Report on the investigation

of the loss of the tug

Flying Phantom

while towing

Red Jasmine

on the River Clyde

on 19 December 2007

resulting in 3 fatalities and 1 injury

Marine Accident Investigation Branch
Carlton House
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Report No 17/2008
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Extract from

The United Kingdom Merchant Shipping

(Accident Reporting and Investigation)

Regulations 2005 – Regulation 5:

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

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GLOSSARY OF ABBREVIATIONS AND ACRONYMS

ABP	-	Allied British Ports
AIS	-	Automatic identification system
ALARP	-	As low as reasonably practicable
ASD	-	Azimuthing Stern Drive (Tug)
BTA	-	British Tugowners Association
CCTV	-	Closed circuit television
CHA	-	Competent Harbour Authority
CPP	-	Controllable pitch propeller
DfT	-	Department for Transport
DWT	-	Deadweight Tonnage
GOT	-	Greenock Ocean Terminal
GPR	-	General Purpose Rating
GRT	-	Gross registered tonnage
GT	-	Gross tonnage
ISM	-	International Safety Management
ISO9001	-	quality management standard
KGV	-	King George V (dock)
km	-	kilometres
Kts	-	knots
LRQA	-	Lloyds Register Quality Assurance
m	-	metres
MGN	-	Marine Guidance Note
nm	-	nautical miles
PEC	-	pilot exemption certificate
PMSC	-	Port Marine Safety Code

RMAS	-	Royal Maritime Auxiliary Service
SHA	-	Statutory Harbour Authority
SMS	-	safety management system
SWIMS	-	Svitzer Integrated Management System
UK	-	United Kingdom
VHF	-	Very High Frequency (radio)
VTS	-	Vessel Traffic Service
WI	-	Work Instruction

All times in this report are UTC unless otherwise stated

Image courtesy of Svitzer Marine Ltd

Figure 1

Flying Phantom

Image courtesy of FotoFlite

Figure 2

Red Jasmine

SYNOPSIS

On 19 December 2007, the tug *Flying Phantom* was girted and sank, while acting as a bow tug. She was assisting the bulk carrier *Red Jasmine* during a transit of the River Clyde in thick fog. Three of the tug's four crew were lost; only the mate managed to escape from the tug's wheelhouse and was subsequently rescued.

After *Flying Phantom*'s tow line had parted during the capsize, the pilot on board *Red Jasmine* completed the transit to the berth safely, in the thick fog, with only a stern tug to assist him.

The investigation has identified a number of factors which contributed to the accident, including:

- The emergency release system for the towing winch on board *Flying Phantom* had operated, but not quickly enough to prevent the tug from capsizing.
- There were no defined operational limits or procedures for the tug operators when assisting/towing in restricted visibility.
- The routine observed by the tug's crew prior to towing or entering fog was ineffective, resulting in the watertight engine room door being left open and the crew not being used in the most effective manner once the fog was encountered.
- The port risk assessment was poor, and the few control measures that had been put in place after a previous similar serious accident in thick fog proved ineffective.
- The port's reliance on their ISO9001 quality management system audits to highlight safety concerns was fatally flawed.
- The lack of an individual to fulfil the role of "designated person" had resulted in major shortcomings in the port's safety management system being overlooked.
- UK ports appear to have been failing to learn lessons from accidents at other ports.
- The lack of an accepted international industry standard for tug tow line emergency release systems.

Recommendations have been made to the port managers, Clydeport, to review and address their safety management system, specifically including the role of designated person. Lloyds Register has been recommended to take forward a proposal to the International Association of Classification Societies (IACS) to develop a standard for tug tow line winch emergency release systems. Svitzer Marine Ltd has been recommended to derive suitable limits and necessary guidelines for operating in restricted visibility. Finally, British Tugowners Association (BTA) has been recommended to highlight to its members the importance of tug crews' emergency preparedness.

SECTION 1 - FACTUAL INFORMATION

1.1 PARTICULARS OF *FLYING PHANTOM* AND ACCIDENT

Vessel details (Figure 1)

Registered owner/ managers	:	Svitzer Marine Ltd
Port of registry	:	Glasgow
Flag	:	UK
Type	:	Fire-fighting tug
Built	:	1981 by Ferguson Bros. (Port Glasgow)
Classification society	:	Lloyds Register of Shipping
Construction	:	Steel
Length overall	:	38.95m
Gross tonnage	:	287
Engine power and type	:	Twin, Ruston 6RK3CM diesel, 1050kW each
Propulsion	:	Single CPP- in Kort Nozzle
Maximum speed	:	14 knots
Other relevant info	:	Aquamaster retractable azimuth thruster fitted at fore end of tug

Accident details

Time and date	:	1800, Wednesday 19 December 2007
Location of incident	:	55°53.6’ N 004°25 W, on the River Clyde
Persons on board	:	4
Injuries/fatalities	:	3 fatalities and 1 injury
Damage	:	Constructive Total Loss

1.2 PARTICULARS OF *RED JASMINE*

Vessel details (Figure 2)

Registered owner	:	Southern Route Maritime S.A.
Time charterers	:	Coeclerici Ceres Bulk Carriers Transport Maritime S.A.M.
Port of registry	:	Panama
Flag	:	Panamanian
Type	:	Bulk Carrier
Built	:	March 2006
Classification society	:	NKK
Construction	:	Steel
Length overall	:	224.94m
Gross tonnage and Deadweight	:	39,738; 76,596
Engine power and type	:	Mitsui Man-B&W 6S60MC Mark VI 10,320 kW at 89.0 rpm.
Service speed	:	14.0 Kts.
Other relevant info	:	4 bladed fixed pitch propeller

1.3 NARRATIVE

1.3.1 Background

The accident occurred on the River Clyde, while the tug *Flying Phantom* was assisting the transit of the bulk carrier *Red Jasmine* from an anchorage at the entrance to the Clyde to Shieldhall Riverside Quay. Shieldhall Riverside Quay is a dry bulk berth situated near King George V (KGV) dock in the city of Glasgow. The river transit, from the outer reaches of the river at Greenock to KGV is 16.5nm, with no turning points and limited lay-by berth options for larger vessels, **(Chart 1)**. Transits of large vessels took place on a rising tide, and it took on average 5 hours from the outer Clyde pilot station to the berth.

The navigable channel in the river is maintained at a depth of between 8.2m and 7.4m up to Shieldhall Riverside Quay. Clydeport requires a 'consultation' meeting prior to a river transit of any vessel with a draught greater than 8.7m or length in excess of 200m. These meetings are held between a Clyde pilot and either the harbourmaster or his deputy. If the ship's draught is expected to be greater than 8.7m, Clydeport's hydrographer also attends the meeting.

1.3.2 Events leading up to the river passage

Red Jasmine was operating worldwide at the time of the accident and had carried, since her maiden voyage in March 2006, a variety of bulk cargoes including wheat, iron ore, coal, maize, soya beans and bauxite. She was crewed entirely by Filipino nationals.

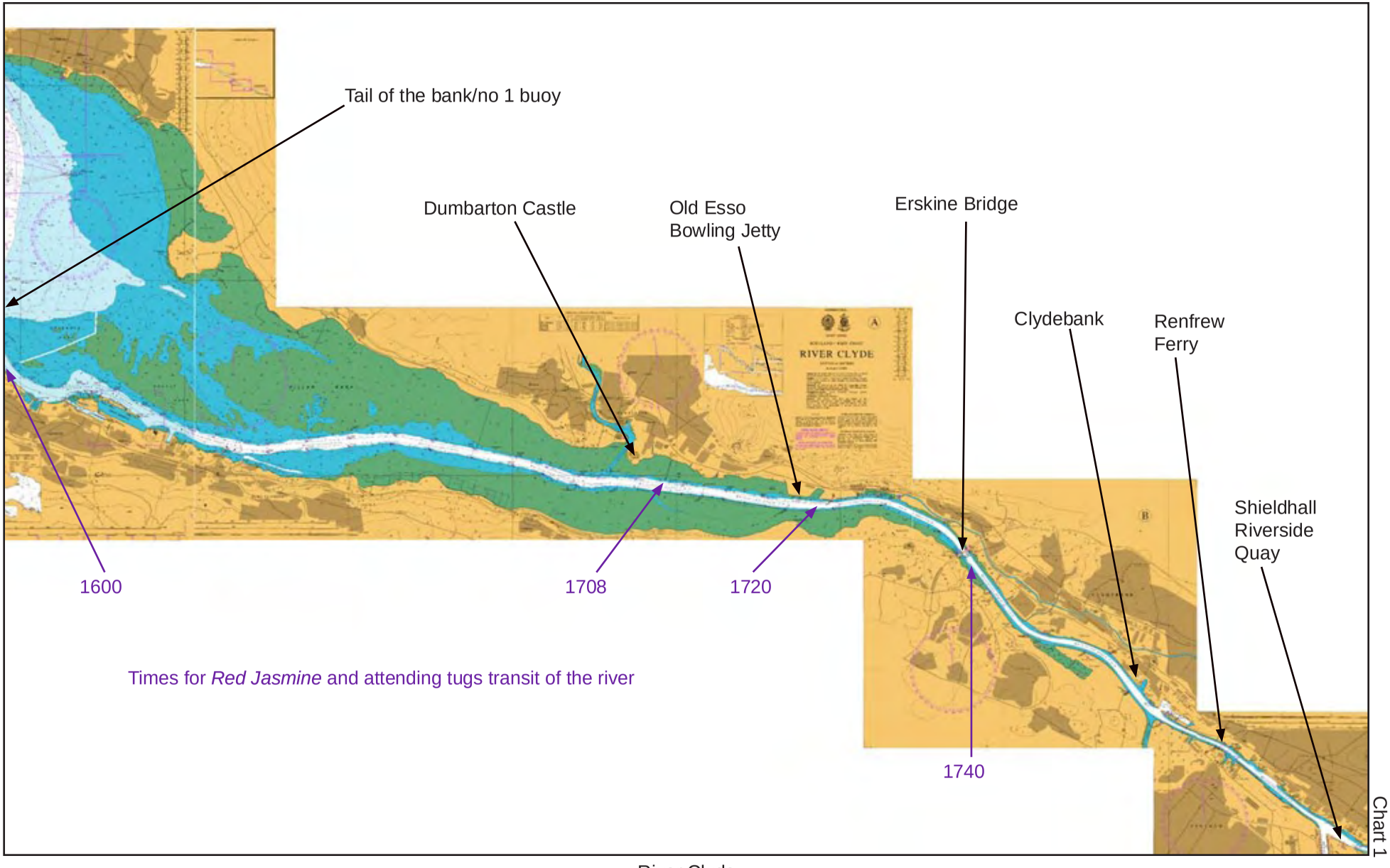
For the voyage to the UK, *Red Jasmine* had loaded maize and hipro in Santos, Brazil, and sailed on 20 November 2007. *Red Jasmine*'s cargo was being transported for Cefetra, an animal foodstuffs importer with UK operations in Belfast, Southampton, Immingham and Glasgow. She arrived in Immingham on 8 December, to discharge approximately half her cargo, and sailed again at 1800 on 12 December for Glasgow.

Red Jasmine had originally been scheduled to arrive at the outer Clyde pilot station at 0500 on 15 December. However, there had been delays to two previous ships with cargoes for Cefetra, requiring the Shieldhall aggregates berth. All three Cefetra cargoes were handled by the same agent, Burke Agencies.

Vechtborg, a 6,130 GRT animal feed carrier, had been due in Glasgow on Tuesday 11 December but, due to bad weather, only arrived at the berth at 0955 on Thursday 13 December. She unloaded and departed the Shieldhall berth at 1248 the following day.

Sergey Lemeshev, a 16,502 GRT animal feed carrier, arrived at 2255 on 13 December and was sent to anchor. She sailed upriver on the next tide after *Vechtborg's* departure, arriving alongside the Shieldhall berth at 2300 on Friday 14 December. The next day, *Red Jasmine*, the largest of the three animal feed carriers, at 39,738 GRT, was directed to anchor at Brodick Bay, doing so at 0648. *Sergey Lemeshev* unloaded and cleared the berth in Glasgow at 1612 on Tuesday 18 December. *Red Jasmine* had now been at anchor for more than 3 days and was already accruing demurrage[1].

[1] Demurrage: penalty for which the charterer is liable if cargo operations exceed an agreed time.



River Clyde

Chart 1

The crew of *Flying Phantom* had started their week's duty on Monday 17 December. They had completed two operations on Monday and Tuesday, but were back alongside in Greenock each night. All of the crew, apart from the mate, went home in the evenings as they lived locally. The mate stayed on board.

On Wednesday morning between 0200 and 0830 the mate acted as crew on board another tug, *Warrior III*, as they were short staffed. He returned to *Flying Phantom* after this and was joined at 0900 by the rest of the crew. The mate then went to bed for 2-3 hours. Prior to leaving the dock to meet *Red Jasmine*, the skipper had told him to get some sleep because he would not be required for sometime, but the mate had declined, saying he did not feel weary.

1.3.3 Consultation meeting

The first opportunity for *Red Jasmine* to make her passage along the River Clyde occurred on the morning tide in the early hours of Wednesday 19 December. The cargo receivers were keen to take delivery of the cargo as the delays were costing them a substantial amount of money; there were heated conversations between the agent and the Clydeport harbourmaster's staff during Tuesday.

Although *Red Jasmine*'s draught of 8.67m was less than the 8.7m cut-off, a consultation meeting for her transit of the River Clyde was still required, as she was over 200m in length. At 1430 on Tuesday, the consultation meeting was held at the Clydeport's offices between an on duty class 1 pilot and the deputy harbourmaster. It was decided that *Red Jasmine* would be brought up the river on Wednesday afternoon's high tide. This was for several reasons:

- The Clydeport document Pilotage Directions and Guidelines specified that for vessels over 200m in length the passage to Glasgow should be conducted in daylight. Acutely aware that a daylight passage would not be available until Friday, the pilot agreed a compromise, that as long as he had completed the first sharp bend in the river Clyde in daylight, he was content to transit the rest of the river in the evening darkness.

- The pilot did not want to navigate the ship up the river on Wednesday between 0230 and 0730 as the whole passage would be in darkness. He was concerned that he, and the ship's crew, would not be at their most alert, something he believed was essential for this passage.

- Lastly, the pilot was concerned that fog had been forecast for the early morning of Wednesday.

The turning of a large ship was regarded as the most hazardous activity of the pilotage and would be very difficult in darkness. It was therefore decided to moor facing east. This removed the need to turn the ship in KGV dock during the hours of darkness.

Both decisions were conveyed to all parties, including *Red Jasmine*'s master and the tug providers Svitzer Marine Ltd. The consultation note and forecast employed on the day of the accident are included at **Annex A**.

The pilot considered he needed only three tugs to handle *Red Jasmine* safely, although the Pilotage Directions and Guidelines specified four.

1.3.4 The passage up the River Clyde

On Wednesday, the pilot who had attended the consultation meeting visited Clydeport's offices at Greenock at around midday and collected the Firth of Clyde inshore forecast that was supplied daily to Clydeport by 'Weather2Sail'. He also asked the deputy harbourmaster if a second pilot would be able to assist him with *Red Jasmine*. On hearing that none was available, the pilot left to board the pilot cutter at Largs Marina.

Red Jasmine weighed anchor at 1234 and made her way towards Greenock. The pilot boarded at 1400 off Cumbrae Island, and proceeded to the bridge. It took 2 hours to transit to the mouth of the River Clyde, during which time the pilot and master exchanged information about the vessel and the forthcoming river transit. The pilot emphasised to the master that the transit was being conducted earlier than would normally be expected because of the need to negotiate the first bend of the river in daylight. He also highlighted the difficulty of the passage and the need for correct helm responses to his orders. On passage up the Clyde estuary the weather was fine, with good visibility and light winds.

At 1600, *Red Jasmine* was met by *Flying Phantom*, *Warrior III* and *Svitzer Mallaig*, the three tugs allocated to assist the vessel. The pilot had already briefed the tugs on VHF channel 8, designating *Flying Phantom* as bow tug, to be made fast first on passing Dumbarton Castle; *Warrior III* as stern tug, to attach at the Erskine Bridge; and *Svitzer Mallaig* to follow the group and to assist in coming alongside at the berth. The skipper of *Svitzer Mallaig* asked to proceed ahead of the group and wait off the berth as was the normal custom, but the pilot asked him to trail behind the group in case the tug was needed during the passage upriver.

The pilot reported by VHF to Clyde Estuary Control, when *Red Jasmine* passed No 1 buoy. At that time he also requested the wind and tidal readings at Greenock. The wind was easterly 8 knots gusting 14 knots, and the tide gauge gave a reading of 1.98m against a prediction of 2.20m. Neither reading gave any due concern to the pilot.

Just after entering the river channel, an outbound vessel, *Apollo Hawk,* passed *Red Jasmine* at the position that had been agreed between the pilots of each vessel. After negotiating the Garvel Bend the group proceeded upriver as planned. A second outbound vessel, *Deo Valente*, with a master on board who held a Pilot Exemption Certificate (PEC), slowed and allowed *Red Jasmine* to pass in the straight section of the river to the east of buoy 21, again as had been arranged between the pilot and PEC holder.

As the group passed Dumbarton Castle, *Flying Phantom's* skipper lowered the Aquamaster azimuth bow thruster and moved into position to make the tow line fast to the bow of *Red Jasmine*. The tow line was secure at 1708. Around this time, the pilot instructed the tugs to switch to VHF channel 6 as channel 8 was busy.

In Clydeport's office, the deputy harbourmaster called Erskine bridge control during the late afternoon and asked the operator if he had noticed any fog, because he was concerned that the weather conditions made fog more likely. The bridge operator said that he had been out on the bridge half an hour previously, and that there had been no fog, but he agreed with the deputy harbourmaster that conditions were right for fog to form.

At 1717, the pilot on *Red Jasmine* reported to Estuary Control that he was at Dunglass Light. He was actually abeam of the disused Esso Bowling Jetty at the time of the call. At 1719, the pilot overheard a report made to Estuary Control by the crew of the Renfrew ferry, *Yoker Swan*, that they had encountered heavy fog in their vicinity, with visibility estimated at 20-30m.

In anticipation of the likely encounter with fog, the pilot discussed the situation with *Red Jasmine*'s master and requested that the range on the ship's radar be reduced. The pilot also instructed the skipper of *Svitzer Mallaig* to position his tug ahead of *Red Jasmine* to provide early warning of any fog banks. However, due to the confines of the river, *Svitzer Mallaig* was unable to pass ahead of *Red Jasmine* until 20 minutes later, after the group had passed under the Erskine Bridge.

Warrior III was made fast to the stern of *Red Jasmine* just as the vessels passed Erskine harbour. At 1750, *Svitzer Mallaig*'s skipper reported thick fog ahead, as *Red Jasmine* rounded the bend in the river at Dalmuir. The pilot asked the skipper of *Svitzer Mallaig* to turn on his deck lights to try and use them as a guide. Three minutes later, *Flying Phantom'*s skipper called *Svitzer Mallaig* to say he had lost sight of the deck lights. *Svitzer Mallaig*'s skipper responded saying the fog was dense, and asked if *Flying Phantom*'s skipper had a good radar picture. *Flying Phantom'*s skipper replied that he did.

Red Jasmine required assistance to safely negotiate the Dalmuir bend. With the engine placed at "slow ahead" the vessel was making about 6.5kts over the ground in a 1kt flood tidal stream. The pilot ordered 'hard to starboard', but the rate of turn was insufficient, and he therefore instructed *Flying Phantom* to take the vessel's bow to starboard more quickly. This increased the rate of turn sufficiently, and less than a minute later the pilot was able to instruct *Flying Phantom* to stop pulling, and he ordered 'hard to port', briefly, to steady the ship's head. At 1756, 'dead slow ahead' was ordered by the pilot and he ordered *Red Jasmine*'s helmsman to steer a course of 145º, followed by 143º. As *Flying Phantom* and *Red Jasmine* entered the fog **(Figure 3)**, their speed over the ground had reduced to 5.5kts, with *Red Jasmine*'s log showing 3.5 - 4.0kts.

Unnoticed by the pilot, *Red Jasmine* continued swinging to port beyond 143º, despite the helmsman applying maximum starboard helm. The pilot became aware of the problem when the vessel's heading was 137º, which, if continued would have taken *Red Jasmine* into the disused concrete groundways of the old John Brown's shipbuilding yard. This danger was marked with a red flashing navigation light **(Figure 4)**.

At 1758, realising that he could do no more with *Red Jasmine*'s rudder, the pilot once again directed *Flying Phantom* to take the vessel's head to starboard **(Figure 5)**. At the same time, he instructed one of *Red Jasmine*'s bridge team to keep a lookout to port for the red light marking the groundways on the port side.

At 17:58.31 **(Figure 6)**, concerned that *Red Jasmine* was not turning sufficiently quickly and was still headed for the groundways, the pilot called *Flying Phantom* to say that the bow needed to move further to starboard. As *Red Jasmine* started to respond, the pilot instructed *Flying Phantom* to ease off at 17:59.02, 1 minute after the initial order to take *Red Jasmine'*s bow to starboard **(Figure 7)**. The instruction was followed a few seconds later, at 17:59.19, by the mate of *Flying Phantom* reporting that *Flying Phantom* was aground **(Figure 8)**. The pilot responded, instructing the crew of *Flying Phantom* to

immediately let go their tow line **(Figures 9, 10, and 11)**. The pilot started to explain to the master what had happened, but stopped himself and directed *Warrior III* to pull astern, followed by ordering full astern on *Red Jasmine*. At 18:00.13, he called *Flying Phantom* to check whether she was all right, but received no reply.

At 18:00.35, there was a report from *Red Jasmine*'s foc'sle, to the master that the tow line had 'been cut'. The pilot informed *Flying Phantom* that he was going to proceed, but again received no response to his call. The pilot was now very concerned that *Red Jasmine* was approaching the starboard side of the river, and would make contact with Blythswood light **(Figure 3)**.

Thereafter, in quick succession, the pilot ordered *Red Jasmine'*s engine to be put slow ahead, the helm to be placed hard to port, and *Warrior III* to take the vessel's stern to starboard to assist the bow round to port. *Red Jasmine* was skillfully manoeuvred back into the centre of the channel without making contact with the bank, and continued upriver in the thick fog. The pilot called to *Svitzer Mallaig* to ask if she could assist, but the tug's skipper declined to come back downstream due to the fog. *Svitzer Mallaig* then continued upriver and waited off the Shieldhall Riverside Quay. *Red Jasmine* made the passage safely along the remainder of the river, in the thick fog, and was met off the berth by *Svitzer Mallaig*, who made fast to the port shoulder. *Red Jasmine* was then berthed starboard side to. The fog was so thick that vehicles with their headlights on were used to highlight the edge of the berth.

1.3.5 *Flying Phantom* capsize

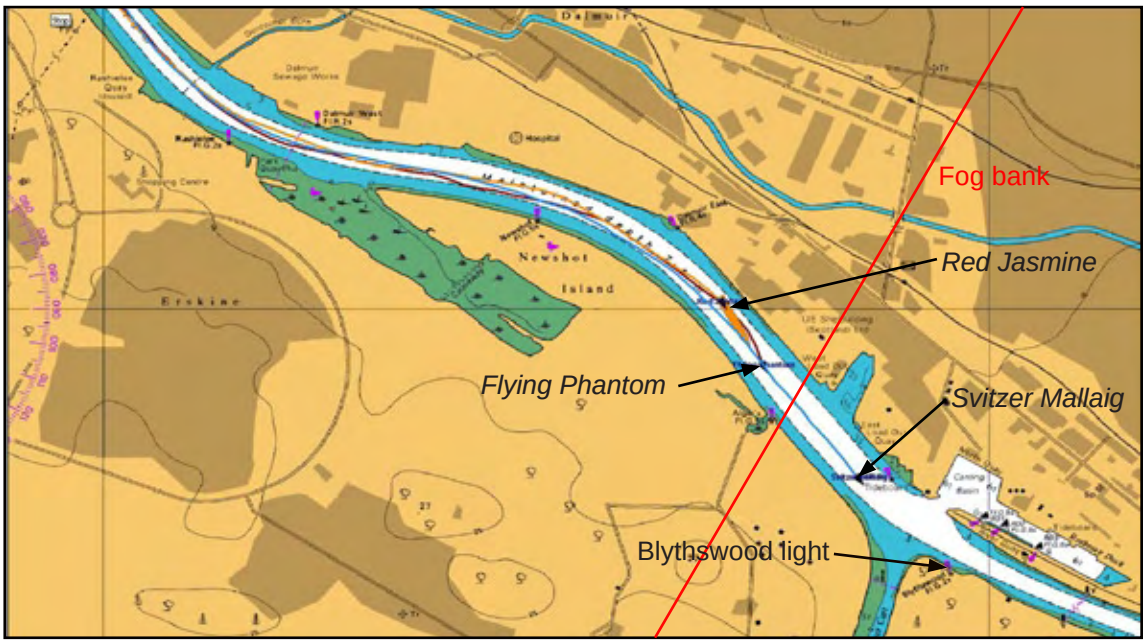
On *Flying Phantom*'s bridge prior to entering the fog, the skipper was at the helm on the port side controls and the mate was on the starboard side. The skipper had the electronic chart display in front of him, while the mate had easy visibility of the radar and was close to the VHF radio. The engineer and the general purpose rating (GPR) were down below. The wheelhouse doors were open so that the skipper and mate could keep a look out for the river banks and monitor the tow.

As *Flying Phantom* entered the fog it was apparent that the towing operation was becoming difficult. The skipper had been keeping the tow rope in line with *Red Jasmine*'s foremast light, but lost sight of this in the fog. The skipper was worried that he was becoming disorientated in the fog, and around this time he discussed with the mate the option of staying in the centre of the channel and towing the ship.

When the pilot requested *Flying Phantom* to pull the bow of *Red Jasmine* to starboard, the skipper used the helm to steer to starboard and he applied some more power to move *Flying Phantom* and her tow across the river. The mate was looking out of the starboard door and glancing at the radar when he noticed the riverbank radar return appeared very close, ahead of the tug's bow. *Flying Phantom* then lurched and heeled over to port. The skipper started to use the Aquamaster thrusters and, at the same time, the mate called the pilot and informed him the tug was aground. On receiving from the pilot the instruction to let go of the tow line, the mate immediately pressed the tow winch emergency release button on the starboard console.

AIS data courtesy of Craig Jump

Figure 3



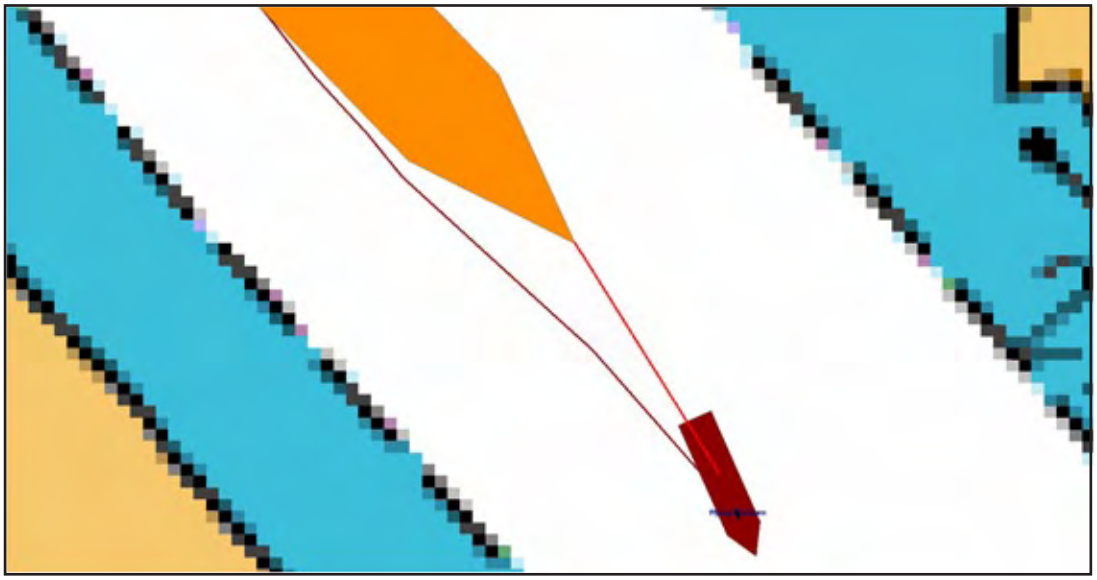
Vessel tracks and estimation of fog bank

Figure 4

Hazard and navigation mark

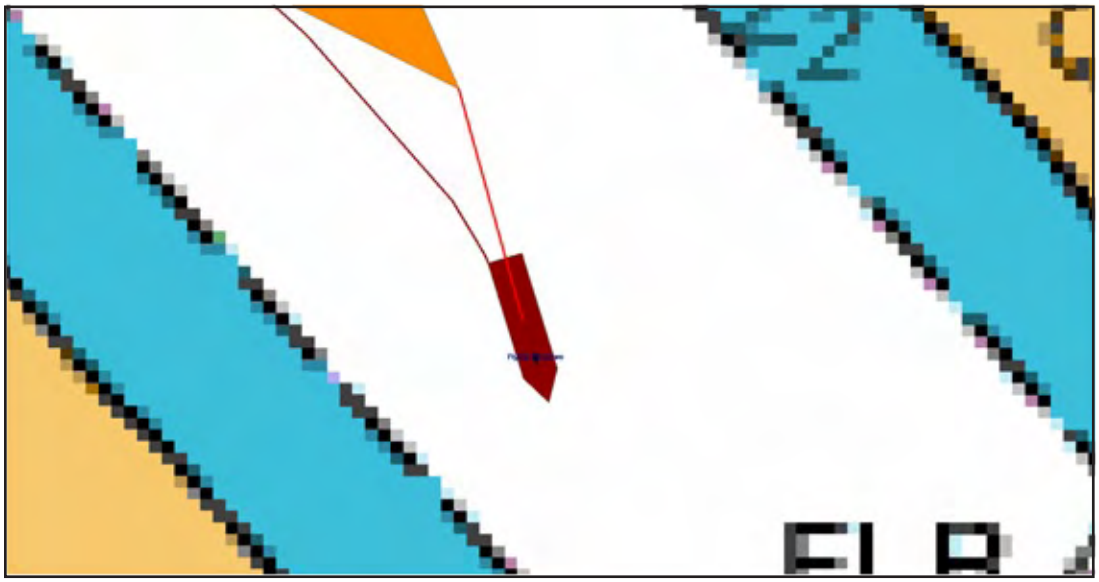
AIS data in Figures 5-11 courtesy of Craig Jump

Figure 5



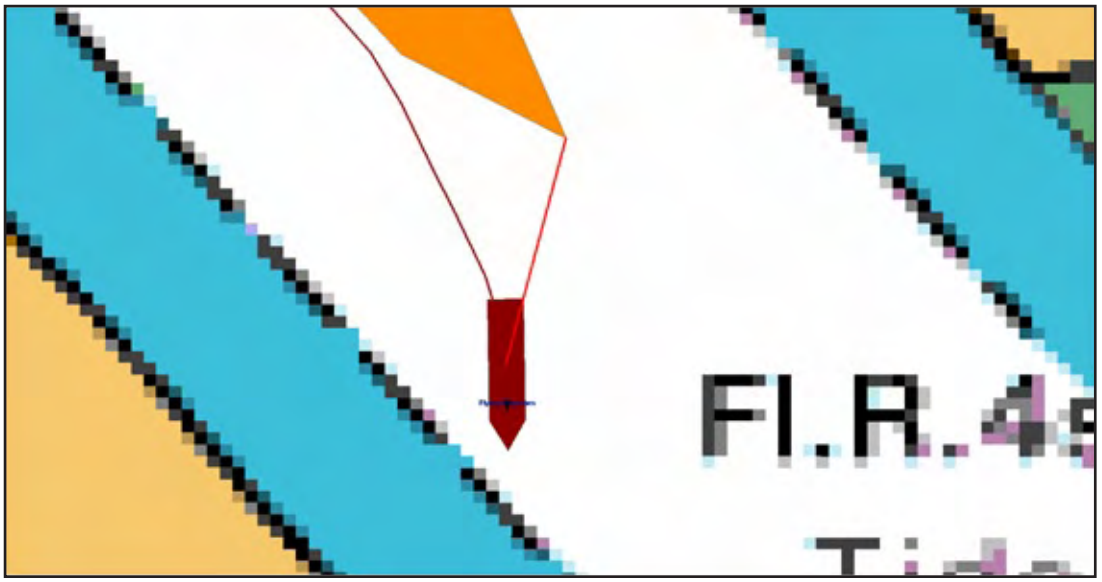
17:58.00 - Pilot instructs *Flying Phantom* to pull to starboard

Figure 6



17:58.31 - Pilot instructs to pull further to starboard

Figure 7



17:59.02 - Pilot instructs *Flying Phantom* to ease off

Figure 8

17:59.20 - *Flying Phantom* informs pilot they are aground

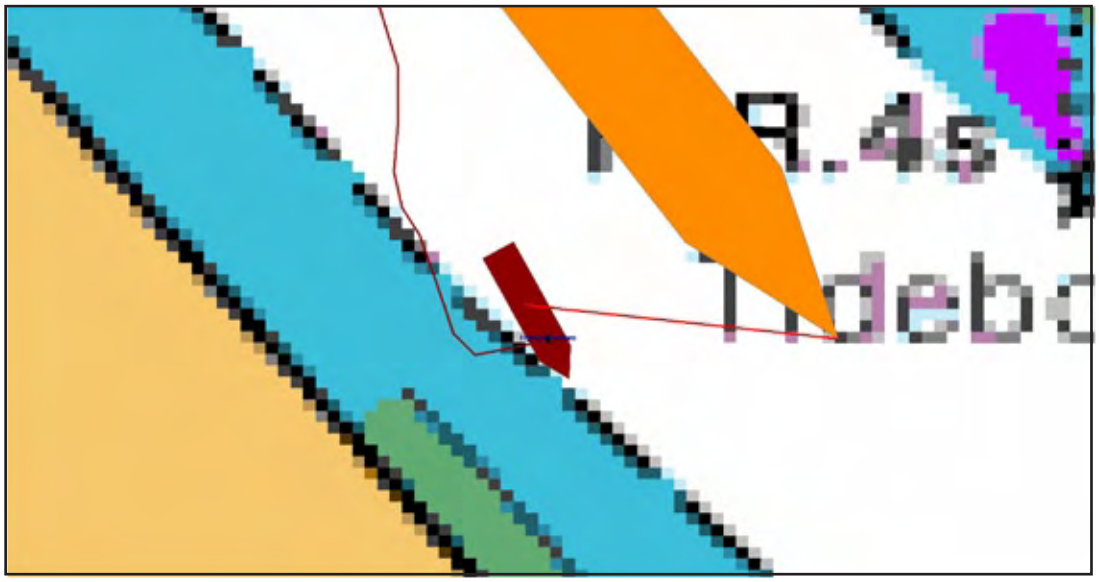
Figure 9

17:59.30 - Girting sequence (estimate of tug heading only)

Figure 10

17:59.40 - Girting sequence (estimate of tug heading only)

Figure 11



17:59.53 - Last recorded AIS position of *Flying Phantom*

As the tug heeled over the two crew members who had been below came up into the wheelhouse. As *Flying Phantom* continued to heel further over to port, the mate clambered out of the wheelhouse and on to the starboard side, expecting the rest of the crew to follow him. As he looked back into the wheelhouse, he saw water bubbling into the wheelhouse through the port door. He was aware the engines were still running at that time and he also heard the pilot's call on the VHF radio asking if *Flying Phantom* was alright, but he was unable to reach the radio to respond. *Flying Phantom* continued to heel over and the mate scrambled on to the side of the hull from where he could see the tug's partially submerged starboard bilge keel. He could also see, on the north side of the river, the red flashing navigation mark on the end of the groundways **(Figure 4)**. He was not aware of *Red Jasmine* or *Warrior III* passing by, but thought he could hear the distinctive engines of *Warrior III*.

1.3.6 Search and rescue

The mate started calling for help as the tug sank under him and the water approached his feet and ankles and then his knees. A community warden who was near Clydebank College heard his call for help and raised the alarm. The mate decided to swim for the red mark, even though it was nearer the further bank, as it gave him a reference to swim for. He managed to reach the remains of a navigation mark close to the red flashing mark and clung on while waiting for rescue. Those on the shore were unable to see the mate in the water due to the thick fog. The mate tried to convey to those on the shore that he was from a tug that had capsized and that three other men were missing.

Earlier in the afternoon, a local boatman had received a call from one of *Warrior III*'s crew, telling him that *Red Jasmine* was proceeding upriver. He was working on the quayside at Rothesay Dock and decided to remain there to watch her go by. Following the accident, the boatman received another call from *Warrior III* informing him that *Flying Phantom* might be in trouble, and he and another crewman boarded his small

workboat, *Trio*, to investigate. He carefully navigated out of the dock and into the river, and was sweeping the area with his searchlight when he saw a flash from a reflective strip on the mate's overalls. He turned *Trio* towards the flash to investigate, and discovered the mate clinging to the remains of the navigation mark. *Trio*'s crew rescued the mate from his perch and landed him ashore at a redundant jetty near the Clydebank College where an ambulance was waiting.

The alarm had now been raised and a search commenced for the tug, co-ordinated by Clyde Coastguard. Unfortunately, the only discoveries were a few items that had floated off the tug as she sank, and some bubbles, which were presumed to be from the wreck. Ministry of Defence divers attended the scene and confirmed that the bubbles did mark *Flying Phantom*'s position. They also searched the wheelhouse for possible survivors trapped inside, but without success.

Over the next 3 days, police divers searched the wreck, locating and recovering the crew from the accommodation areas where they had been swept by the inrush of water.

1.4 EPHEMERAL INFORMATION

1.4.1 Tide & sunset

On the evening of the accident, the predicted high water at Clydebank, Rothesay Dock, was 2011 with a 4.0m height above chart datum. That evening the tide gauge at Rothesay dock recorded a tidal height, on average, 0.2m less than predicted, but the time of high water was coincident with the prediction.

Sunset occurred at 1543 with civil twilight and nautical twilight occurring at 1630 and 1719 respectively.

1.4.2 Weather forecasts used

Clydeport subscribed to a weather service from 'Weather2Sail' which provided a forecast each morning by email. The 60 hour Inshore Forecast for Firth of Clyde issued by 'Weather2Sail' at 0530 19/12/07, gave for the Wednesday:

1200-1800 Long clear periods, visibility good, wind ESE 7-13 kts, air temp 9º
1800-2400 Long clear periods, visibility good, wind ESE 8-14 kts, air temp 9º

This information was based on a spot forecast in the Firth of Clyde Estuary.

1.4.3 Other available forecasts

There had been a routine weather broadcast notice from Clyde coastguard at 1415, but on board *Red Jasmine* neither the bridge team nor the pilot changed channel on the VHF to listen to it. For the Firth of Clyde, the forecast broadcast gave E or SE 3 or 4, mainly fair with risk of mist patches, moderate or good, occasionally poor in mist.

The BBC Scotland national weather forecast had predicted that the evening and night of 19 December 2007 would be dry with clear periods, but also with a risk of freezing fog patches, but did not specify in which particular areas.

One of *Flying Phantom's* crew had seen that fog was forecast on the evening of 19 December as he had checked the BBC weather website on boarding the tug at Greenock to establish if there would be a frost on his car. The website includes a 3 hourly forecast for specific locations, which are updated at 0730 and 1930 each day. The following shows the two relevant forecasts for the Wednesday morning and evening issued for Greenock and Glasgow.

Time	Wind	Temp	Weather	Visibility
1930 Forecast on 18/12/07 - Greenock				
0300 19/12/07	ENE 6mph	4ºC	Low level cloud	Very poor
0600 19/12/07	ENE 7mph	4ºC	Fog	Very poor
1500 19/12/07	ENE 6 mph	4ºC	Low Level cloud	Very poor
1800 19/12/07	ENE 7 mph	4ºC	Fog	Very poor
1930 Forecast on 18/12/07 - Glasgow				
0600 19/12/07	ENE 5mph	-1ºC	Fog	Very poor
0900 19/12/07	ENE 5 mph	0ºC	Fog	Very poor
1800 19/12/07	ENE 5 mph	-1ºC	Fog	Very poor
2100 19/12/07	ENE 5 mph	0ºC	Fog	Very poor
0730 Forecast on 19/12/07 - Greenock				
1500 19/12/07	ENE 7mph	3ºC	Fog	Very poor
1800 19/12/07	ENE 8mph	3ºC	Fog	Very poor
0730 Forecast on 19/12/07 - Glasgow				
1800 19/12/07	ENE 5mph	0ºC	Fog	Very poor
2100 19/12/07	ENE 5mph	-2ºC	Low level cloud	Very poor

1.4.4 Fog

Fog is formed when the air temperature drops to the dewpoint of the air. At this point the air can no longer hold the moisture it contains and it condenses out to form fog.

There are several different mechanisms for forming fog. During the day before the accident, the air temperature had remained low along with the dew point, high pressure had been in place and the sky had been clear with little wind. As the evening approached, radiation fog was likely as the ground cooled causing the air above to also be cooled. There might have also been an element of valley fog coming down off the hills given the topography of the Clyde area.

Fog was not deemed a regular problem for Clydeport. Weather records from Glasgow airport for the last 3 years suggest that fog occurs on average 46 days in each year. However, thickness of the fog and how long it lasted on these occasions were not recorded. The Admiralty Pilot states on average 27 days of fog per year based on records over 20 years up to 1999. December and January were the months when fog was more likely to occur.

Fog is internationally defined as when visibility is less than 1km. For the purposes of this report, thick fog is assumed as less than 100m visibility.

1.5 CREW OF *FLYING PHANTOM* AND THE CLYDE PILOT

1.5.1 Tug crew rota

The crewing rota of the Svitzer Marine Ltd's tugs on the Clyde consisted of the usual crew working for 2 weeks and then having a week off duty. During the usual crew's week off, the relief crew would operate the vessel. After this week, the relief crew would then operate another of the Clyde tugs during that tug's normal crew's week off duty. After completing this week the relief crew would then have their own week off duty.

*Flying Phantom'*s crew on the day of the accident was the relief crew that had just finished their week off duty. At the end of the week they were due to take over *Svitzer Mallaig* as the duty crew.

1.5.2 The skipper

Stephen Humphreys, who was aged 33, served an apprenticeship, becoming an 'efficient deck hand' in 1992. He started work on the River Clyde with the Royal Maritime Auxiliary Service (RMAS), and worked for various companies during his career including Serco Denholm, Caledonian MacBrayne, and Solent and Wightline Cruises. He was very experienced at handling single and twin screw workboat type vessels. At the time of the accident, he held an STCW II/3 master's certificate (tugs less than 500 GRT within 30nm of safe haven from coast of UK & Ireland), a Boatmaster's licence (Clyde area) and a commercial endorsed RYA coastal skipper's certificate of competency.

Stephen Humphreys started work with Svitzer Marine Ltd in August 2006 as tug mate. Soon after joining the company he spent 2 x 2 week periods in Amsterdam as mate on an azimuthing stern drive (ASD) tug. There he gained a substantial amount of experience very quickly, as there were more tug movements in one day in Amsterdam than there were in 2 weeks on the Clyde. Back on the Clyde, he served as mate on most of the tugs operated by Svitzer Marine Ltd. In January 2007, Stephen attended a 5 day course on the ASD simulator at Lyngby in Denmark. The company regarded Stephen as an excellent tug handler, and during the first half of 2007 he acted as mate and occasionally as relief skipper on both *Svitzer Mallaig* and *Flying Spindrift*, both ASD tugs. In June 2007, Stephen was promoted to skipper. During 2007, he had some spells on *Warrior III* and *Flying Phantom*, being signed off on the latter by the senior master in September 2007. When *Flying Spindrift* left the port in September 2007, Stephen and his three crew became the relief crew for *Svitzer Mallaig* and *Flying Phantom*, operating on this rota until the accident.

1.5.3 The mate

The mate, aged 37, who was the sole survivor from *Flying Phantom*, had begun his career at sea on fishing vessels in 1990. He held a Class II Fishing certificate of competency, allowing him to skipper a fishing vessel up to 30m in length in the UK's limited fishing area. During the 12 years that he was a fisherman, he had operated his own boat for a couple of years. Prior to working for Svitzer Marine Ltd, he had worked in the workboat industry for 2 years on the Forth Estuary.

The mate had started working for Svitzer Marine Ltd on the Clyde in January 2005 as a GPR, and had worked on a variety of the Clyde tugs during the 3 years up until the accident, but during the last 2 years, mainly on *Svitzer Mallaig*. In February 2007, he was promoted to mate. He had been acting as Stephen Humphreys' permanent

mate on *Svitzer Mallaig* and *Flying Phantom* since September 2007. At the time of the accident he was still trying to establish how best to obtain a formal tug qualification as, given the limitation of his fishing qualification, he was only permitted to act as mate within the sheltered waters of the Firth of Clyde.

1.5.4 The engineer

Robert Cameron, who was aged 65, held a Chief Engineer (inshore tug) STCW III/2 certificate. He had served at sea for many years and on a variety of ships, and had obtained his Class IV motor certificate in 1981. He had served on various tugs on the Clyde since 2000, and was an experienced tug engineer.

1.5.5 The GPR

Eric Blackley, who was aged 57, had initially trained and worked as a mechanical engineer before joining the Agricultural and Fisheries marine department in 1973. He became a 2nd engineer with Clyde Shipping in 1975 and attained his Engineer Officer Class 4 certificate in 1981. Following a reduction in Cory Towage Tug crews in 1995, he took on the role of GPR with Cory and subsequently Wijsmuller and Svitzer. As a GPR, his key role was to prepare and handle lines while making tow lines fast and during their recovery.

1.5.6 The Clyde pilot

The pilot on board *Red Jasmine* was 52 and had started at sea as a cadet in 1972. During his career he had obtained his STCW II/2 master's certificate (greater than 3000 GRT) and had served as master on North Sea supply, drilling and dive support vessels for 10 years. He became a Clyde pilot in 1996, starting as a Class 4 pilot and progressing through the 4 year training programme to become a Class 1 pilot in 2000. As a Class 1 pilot, he was authorised to pilot all sizes of vessel in the Clydeport Competent Harbour Authority (CHA) area.

1.6 *FLYING PHANTOM* BACKGROUND

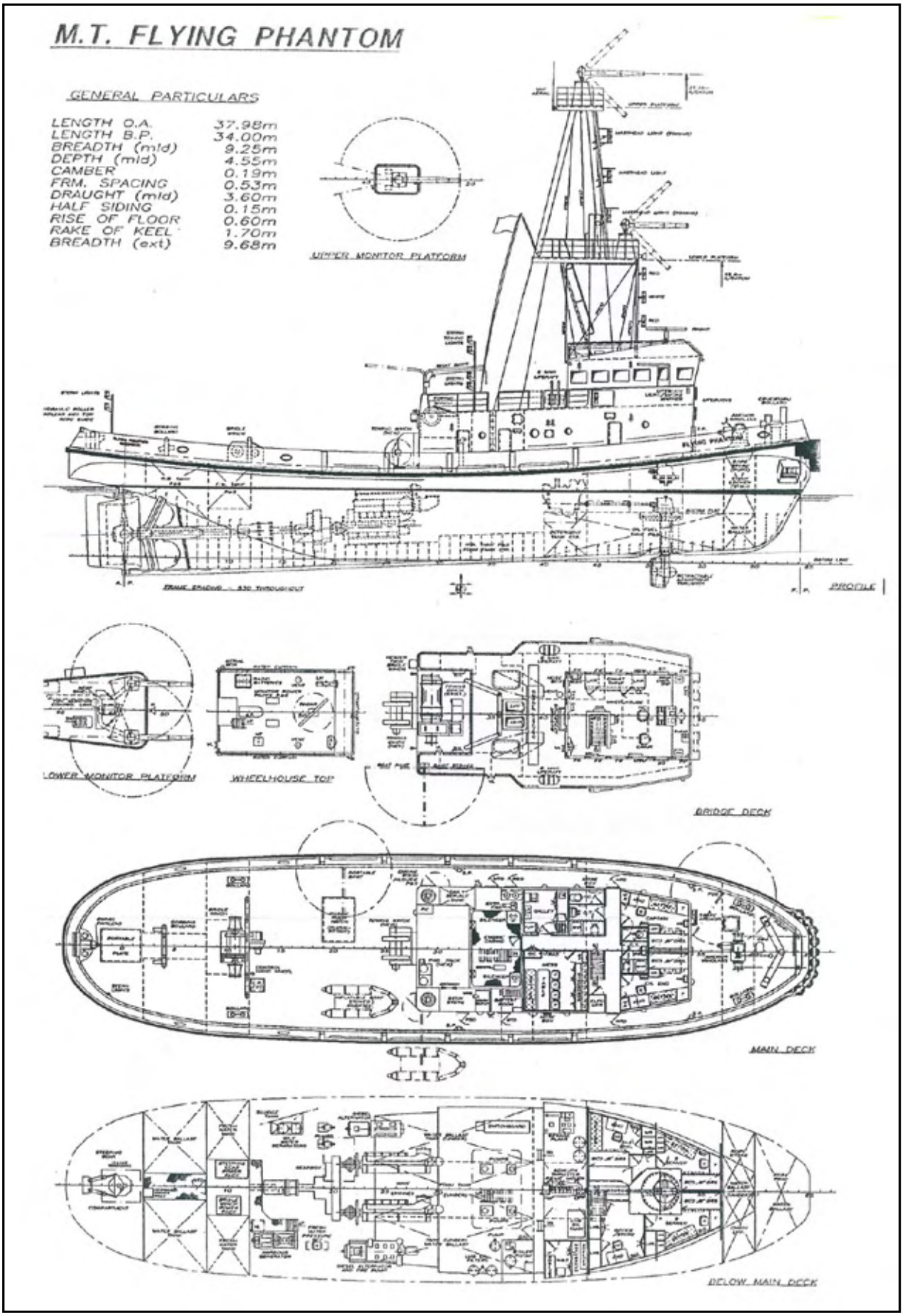
1.6.1 General

Flying Phantom was built on the Clyde and had always operated on the river. She was the last Clyde-built tug still operating on the Clyde. During her working life she had been managed by several different companies, although the personnel had broadly remained the same. A drawing showing the vessel's general arrangement is at **Figure 12**.

Flying Phantom was built as a conventional tug with a fire-fighting capability. She was classed with Lloyds Register as a 100A1 tug, with unmanned machinery space notation. She operated as an MCA class IX vessel and had an MCA approved stability information book, dated July 2000.

1.6.2 Propulsion

Flying Phantom's propulsion system consisted of twin diesel engines driving a single shaft, through a gearbox, fitted with a controllable pitch propeller (CPP), housed within a steerable Kort nozzle **(Figure 13)**. The engine revolutions would be set at standard rate, depending on the operation, and the thrust would be varied by adjusting the propeller pitch.



Flying Phantom General Arrangement

Figure 13

CPP in Kort nozzle

In 1997, *Flying Phantom* underwent a major refit and an Aquamaster retractable azimuth bow thruster was fitted **(Figure 14)**. Once deployed, a mechanical linkage was engaged to the thruster's own dedicated engine sited in the engine room. It took a minute or so to deploy the thruster. The thruster could provide approximately 7 tonnes of thrust in any direction. With the thruster engaged, *Flying Phantom* had a bollard pull of 42 tonnes.

1.6.3 Bridge controls

The bridge layout and main controls are shown at **Figures 15-17**. The central console contained the main engine revolution controls, engine room alarms, steering mode selector, and had a joystick or push buttons for steering. The wing controls had the same controls repeated on each. The CPP pitch could only be adjusted from the wing consoles.

Figure 14

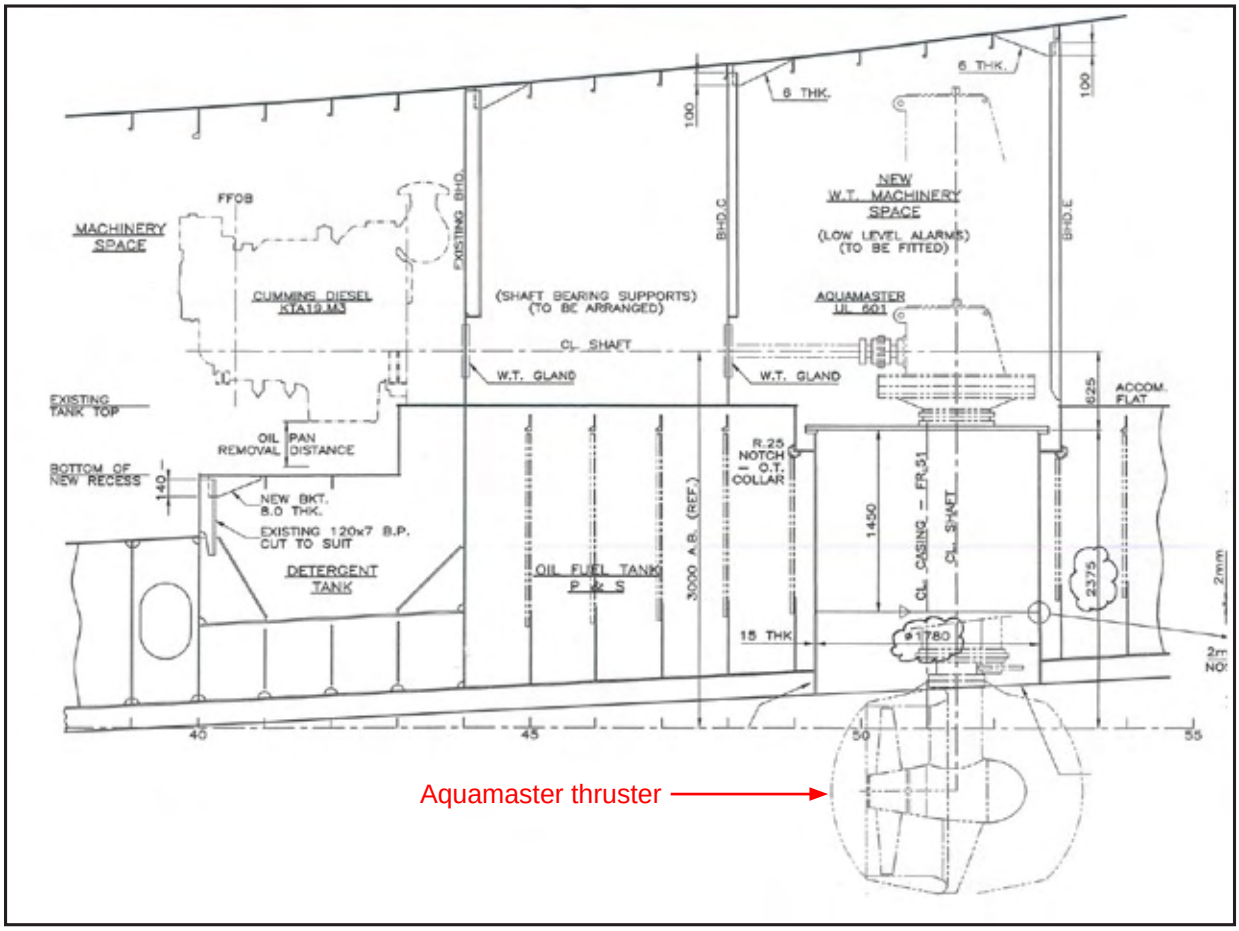
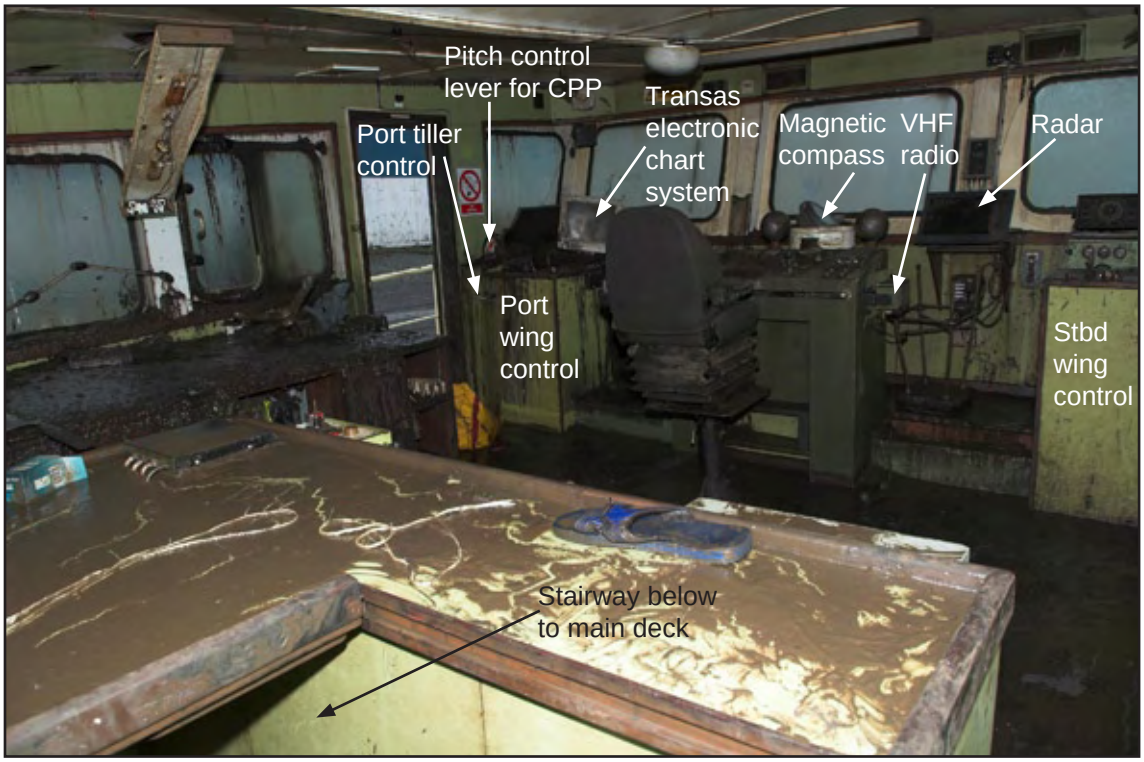


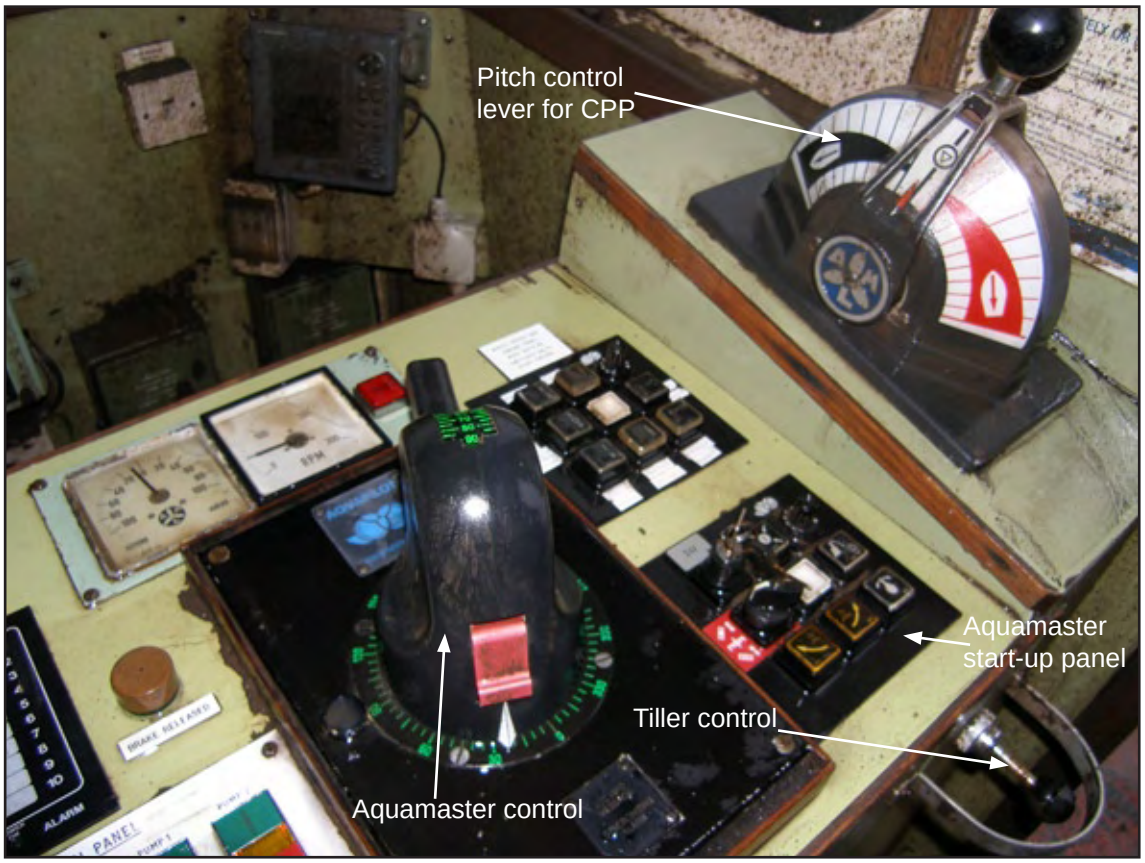
Diagram showing Aquamaster thruster

Figure 15



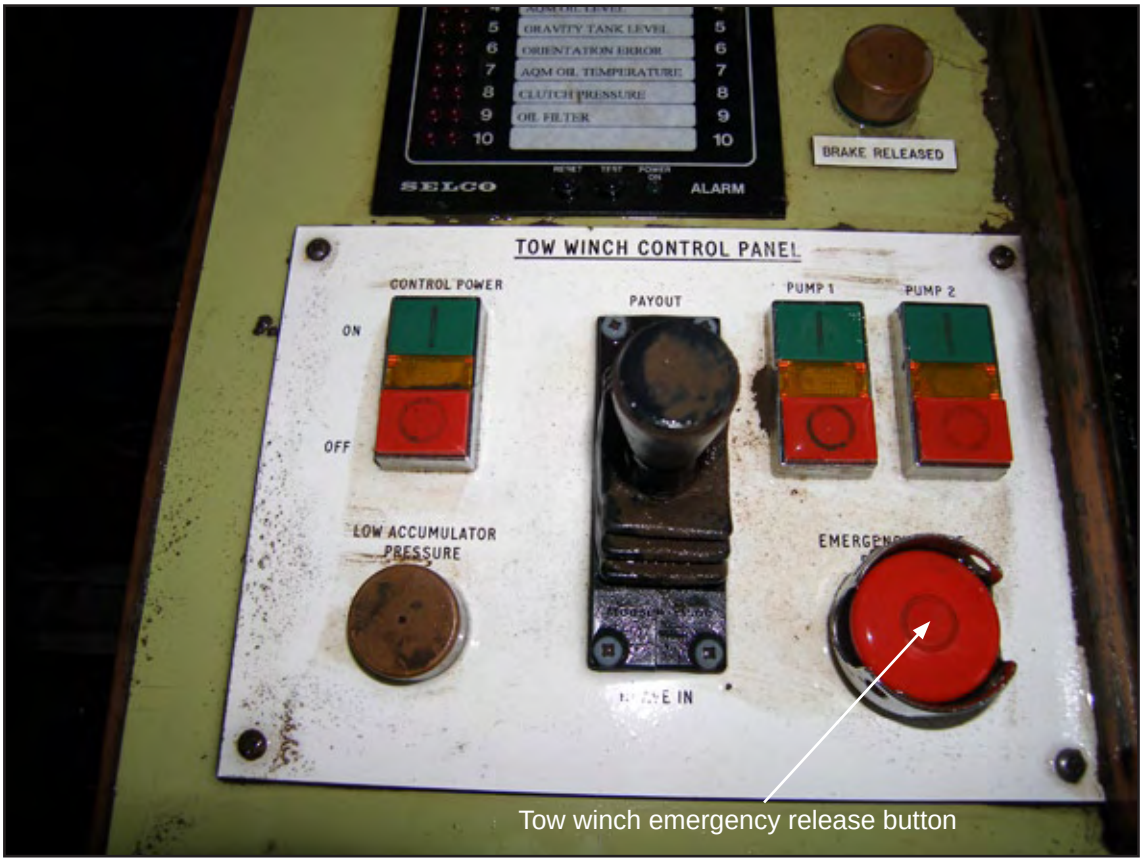
Flying Phantom's bridge

Figure 16



Starboard wing console

Figure 17



Towing winch control panel

1.6.4 Towing winch

The towing winch **(Figure 18)** was fitted during the major refit in 1997. Prior to this, the primary towing attachment was a quick release towing hook, mounted on the aft bulkhead of the wheelhouse. The towing winch was mounted vertically on the bulkhead in place of the towing hook, rather than on the deck, which was more usual for this design of winch. This was because the deck structure had not been designed to take the towing load.

The towing winch could be operated locally on deck, and within the wheelhouse from both the wing consoles and from a console situated towards the rear of the wheelhouse **(Figure 19)**. A camera monitor on the aft bulkhead displayed a view of the towing winch on deck, as it was not visible from the wheelhouse. However, this camera system had not been operational for a while.

The winch was designed so that the towing load was held by the winch band brake, since the motor could only heave 5 tonnes on the bottom layer of the drum. The brake was designed to render at about 80 tonnes. A dedicated hydraulic power pack supplied the tow winch motor and brake system. The winch controls operated on a 24V electrical system.

The towing winch emergency release system was designed so it could still be operated after a power failure. A hydraulic accumulator was used to store the necessary energy to supply hydraulic pressure to release the winch drum brake and allow the drum to rotate in an emergency. The accumulator was pressurised by the hydraulic power pack under normal operating conditions, but there was also a back-up in the form of an air driven pump fed by the ship's compressed air system. At the connection to the ship's compressed air system, there was an isolation valve with a sign adjacent to it stating that the valve must be open when towing, to ensure the emergency release system remained primed.

1.6.5 Bridle arrangement

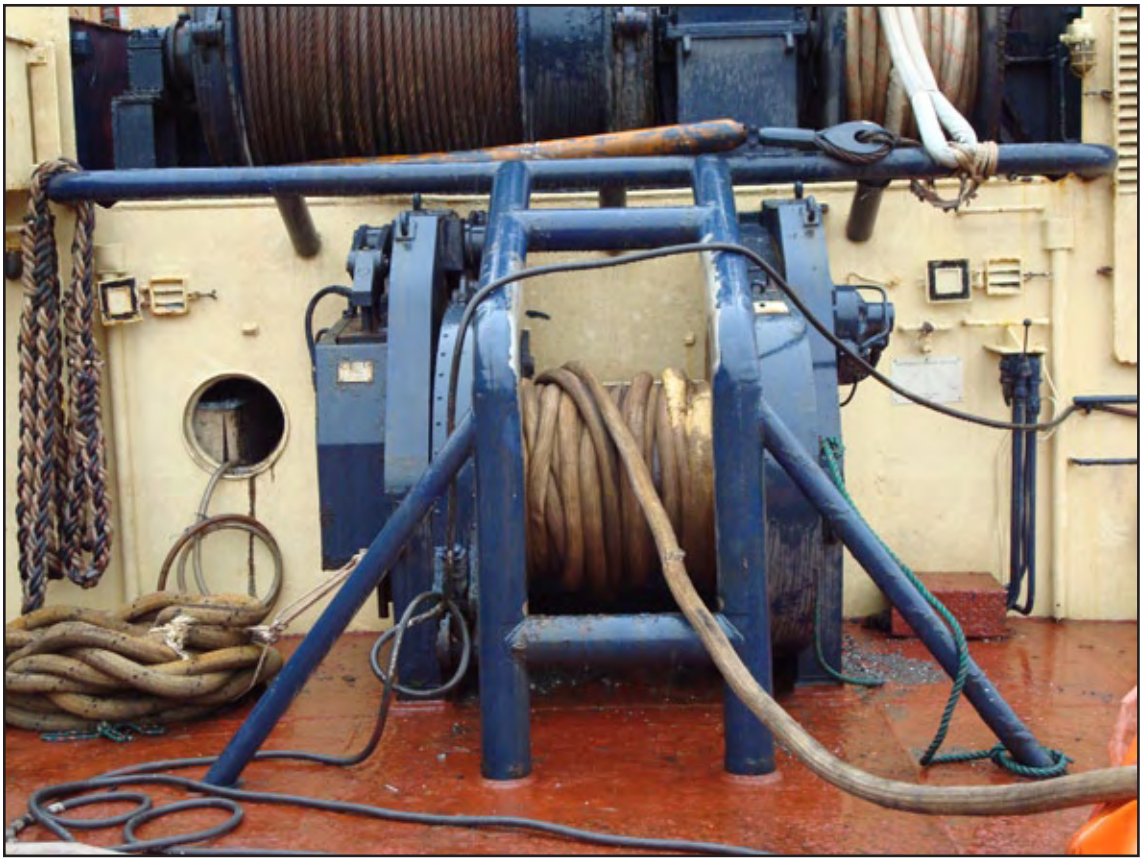
The bridle (also known as the "gob" or "gog") arrangement was used to move the towing point of the tug aft and down **(Figure 20)**. This would prevent the tow line from being taken across the tug's beam and, therefore, would reduce the risk of girting[2]. This was especially important when acting as a stern tug, running astern. However, when operating as a bow tug, running ahead, the bridle arrangement was left slack to enable *Flying Phantom* to manoeuvre as necessary to pull the ship being towed.

On *Flying Phantom*, the bridle winch was situated on the aft deck and the bridle wire from its drum ran through a swivel fairlead mounted inside the bulwark on the stern **(Figure 21)**. The wire had a bow shackle at its end, through which the tow line would pass. The bridle winch was able to heave 9.8 tonnes on the bottom layer, when it was new, and had a specified 24.6 tonne brake holding capacity. Similar to the towing winch, the bridle winch could not be heaved-in under heavy loading.

The bridle winch could be controlled from the aft towing winch control panel in the wheelhouse, and locally on deck.

[2] Girting: when a tug is capsized by being pulled over by its tow line pulling the tug laterally.

Figure 18



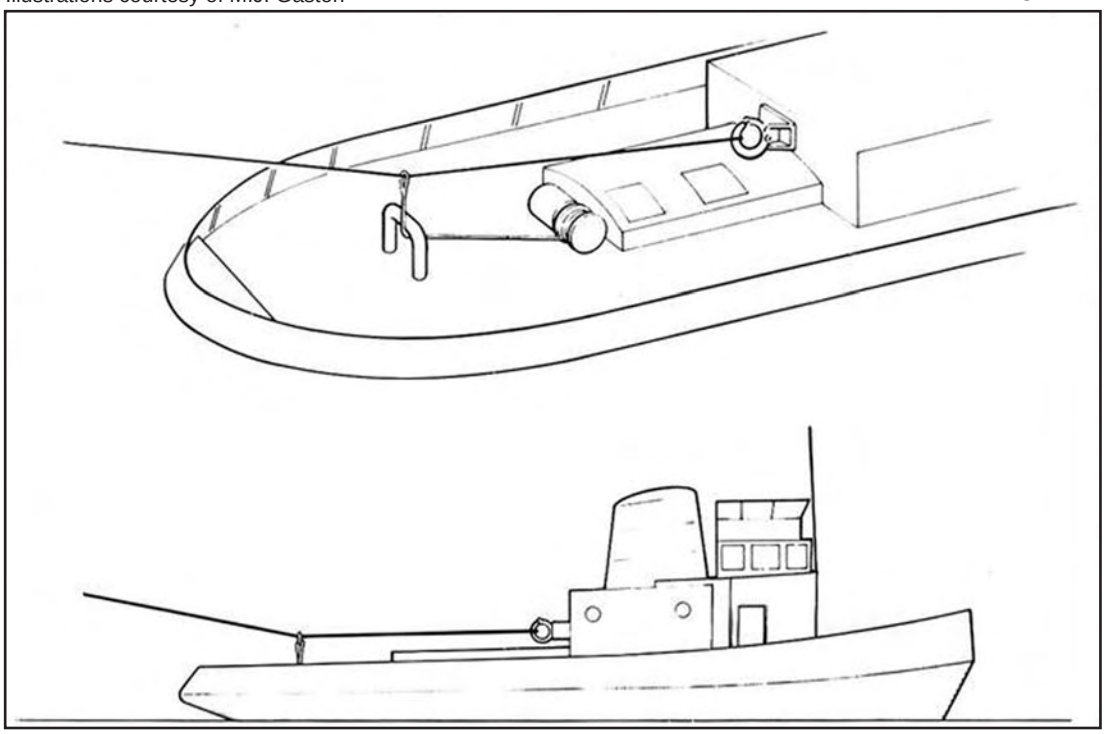
Towing winch

Figure 19

View looking aft in bridge

Illustrations courtesy of M.J. Gaston

Figure 20



Indicative bridle arrangement, also see Figures 21 and 22

Figure 21

Swivel fairlead on transom, bridle wire and bow shackle

1.7 EVIDENCE FROM SALVAGE

1.7.1 Underwater survey

Flying Phantom was found resting on the river bed on her port side, with her bow facing downriver. The Aquamaster was found deployed and pointing forward, slightly to starboard, with no apparent damage except for slight scrape marks on its bottom. The Kort nozzle (rudder) was also to starboard.

The watertight door to the deck store / machinery compartment on the starboard side was found closed. The starboard accommodation door was opened by police divers during their search for the missing crewmen, and they confirmed that during their search they found the port side access door to the accommodation to be closed. However, they were unable to confirm the state of the port side access to the engine room lobby as the tug was lying on her port side.

1.7.2 Salvage damage

To raise the wreck, *Flying Phantom* was parbuckled (rolled upright), using two wire strops attached to the tug's stern tube. During this process the bulwark on the port quarter was bent towards the deck **(Figure 22)**. Once the tug was upright, the top section of the mast was removed and placed ashore to prevent it from fouling the lifting wires Once access to the vessel was possible, it was found that the Aquamaster had been pushed up 0.5-0.6m into the hull and its mechanical linkage was damaged. This damage was caused during the parbuckling operation, as the hull of *Flying Phantom* was rolled on to the Aquamaster.

1.7.3 Watertight closures

During the salvage operation, in addition to the starboard accommodation watertight door which had been opened by police divers, the port accommodation door was found to be open, but not hooked back. It is possible that the clips on this door were opened during the internal search for the missing crew. The salvage divers also found the engine room watertight door on the port side of the superstructure open, and hooked back to the bulkhead.

Along with the other watertight doors on the main deck, this door was closed during salvage, while the tug was still submerged. This was to allow water to be pumped from the hull to reduce the load on the lifting wires, and it accounts for the dirty oily condition of the inside of the door **(Figure 23)**.

1.7.4 Bridge control status

The CPP pitch controls were found set at zero pitch, indicating there was no thrust being generated from the CPP propeller just before the tug capsized **(Figure 16)**. The Aquamaster controls did not yield useful information as each control indicated a different thrust, suggesting the system had probably suffered damage during the capsize. All other alarms and settings required electrical power to indicate their status. This was lost when the tug capsized, and following immersion the indications could not be replicated.

Figure 22

Aft deck showing parbuckle damage and location of bridle winch

Figure 23

Engine room watertight door

1.7.5 Tow line, winch and bridle – visual inspection

The towing winch emergency release button on the starboard wing console was found depressed **(Figure 24)**. The other two emergency release controls had not been operated.

The towing winch appeared in good condition. The winch brake band was found in the 'on' position, but displaced slightly to port.

The tow rope was found to have parted, about 9m from the winch drum. The length of the bridle wire from the swivel fairlead at the stern to the inside of the bow shackle was 6.6m. The parted end of the tow line from the winch drum met with the bridle shackle when both were laid out on deck.

The tow line recovered from *Red Jasmine* consisted of a 20m working length of rope connected to 42m of tow line, and 47m of tow line were recovered from the winch drum on *Flying Phantom*. The tow line certificate, dated 11 April 07, stated the rope was 60mm in diameter, of three stranded polyester with a jacket covering, and had a minimum breaking strength equivalent to 115.3 tonnes.

Forensic examination[3] of the tow line revealed that the rope was generally in good condition and was as described on the test certificate. The rope recovered from the towing winch was found to have a twist about 10m from the parted end. The area of the failure **(Figure 25)** showed indications of localised abrasion and of the rope failing under tension, while loaded over a fixed edge. Three samples of the rope were tested to assess their breaking strength, the lowest breaking load was 72.48t, which occurred in way of the eye splice required to effect the test.

1.7.6 Towing winch technical examination

Following the salvage of *Flying Phantom*, the towing winch was subjected to a detailed examination, full details of which are documented in **Annex K**.

It was possible to re-energise the towing winch system using a portable hydraulic power pack. The winch functioned as was expected, and the brake band re-centred itself once it had been released and re-applied (see section 2.4.1). The emergency release system was tested and worked both without load and with a simulated load of 3.5 tonnes. However, it took 6-8 seconds for the brake band to actually release from the drum. There was no evidence of damage to the brake band or drum to suggest it had been overloaded.

1.7.7 Liferaft

The liferaft, which was still attached to the wreck by its painter, was cut loose after *Flying Phantom* was parbuckled. After salvage, it was found that the hydrostatic release for the liferaft had activated and released the liferaft canister. However, the liferaft had become tangled in the superstructure, had not pulled out the full length of painter, and consequently did not inflate. Although having no bearing on the outcome of this accident, the painter was found to be directly attached to the tug and not to a weak link **(Figure 26)**. Had *Flying Phantom* been lost in deeper water, the liferaft, even if it had inflated, would have been lost with the tug.

[3] By the Health and Safety Laboratory Buxton, report number ES/MM/08/16.

Figure 24

Starboard emergency release button

Figure 25

Tow rope failure

Figure 26

Liferaft painter

1.8 SVITZER MARINE LTD - OPERATION ON THE CLYDE

Svitzer Marine Ltd, the operator of *Flying Phantom*, is a wholly owned subsidiary of Svitzer A/S, an international company providing towage, salvage and offshore services. At the time of the accident Svitzer A/S was operating 600 ships in 35 countries worldwide, while Svitzer Marine Ltd operated over 90 vessels in 18 ports around the UK. Svitzer Marine Ltd had taken over the running of the towage service based at Greenock from Wijsmuller Marine Ltd, in 2001, who themselves had taken over from Cory Towage in 2000. Throughout the various takeovers, the operational personnel on the River Clyde had remained broadly the same, providing some consistency of expertise and knowledge.

Within the UK, Svitzer Marine Ltd's Greenock office was responsible for the company's marine towage business in Scotland and Northern Ireland. The manager nominally had nine tugs available, two on the Forth, three in Belfast and four on the Clyde. However, at the time of the accident there were only three tugs based on the Clyde. The Greenock office had two other members of staff, a tug controller and marine officer who, together with the manager, organised and provided the towage service. An engineering superintendent, who did not report directly to the Greenock manager, normally worked at the office. This post had been vacant for 9 months prior to the accident and was being covered by the engineering superintendent from Svitzer's Liverpool office.

Svitzer Marine Ltd operated a management system based on the ISM Code, referred to as the Svitzer Integrated Management System (SWIMS). This was accessible to its staff, on the internet, and was also installed on computers on the tugs for easy access.

The system contained several key Svitzer Group documents including:

- Health, Safety & Environment Manual, including safety policy, shipboard operations and emergency preparedness.
- Towage Manual, covering all types of tugs and how they can be operated, including acting as head tug and use of bridle ropes.

There was also a Svitzer UK Operations Manual, which duplicated, but also expanded on many of the areas covered in the Svitzer Group documents. This manual contained sections on watchkeeping responsibilities and navigating in restricted visibility, but no guidance on towing in fog. Although containing a comprehensive amount of generic information, SWIMS did not provide any individual tug specific guidance to their operators, and it was Svitzer Marine Ltd's policy to leave such issues to be managed by its local offices.

Most maintenance records and other vessel documentation were kept on board the tugs. Consequently, much of *Flying Phantom*'s documentation was not available as it was destroyed when she capsized.

1.9 CLYDEPORT

1.9.1 Company background

The Clyde Port Authority was formed on 1 January 1966 following the 1964 Harbours Act. The authority was privatised in 1992 and, following privatisation, was acquired by the management and employees. In January 2003, Clydeport Ltd became a wholly owned subsidiary of Peel Holdings plc, part of the Peel Ports group, which also operated the ports of Heysham, Liverpool, Medway and the Manchester Ship Canal.

The port business on the Clyde was run by Clydeport Operations Ltd, a wholly owned subsidiary of Clydeport Ltd. Although the port was the main business interest, Clydeport Ltd also had extensive interests in property investment and development, including many along the banks of the River Clyde. The Department for Transport (DfT) considers the Board of Clydeport Operations Ltd to be the port 'duty holder' as defined within the Port Marine Safety Code (PMSC). In this report the port management company, Clydeport Operations Ltd, is referred to, for simplicity, as Clydeport.

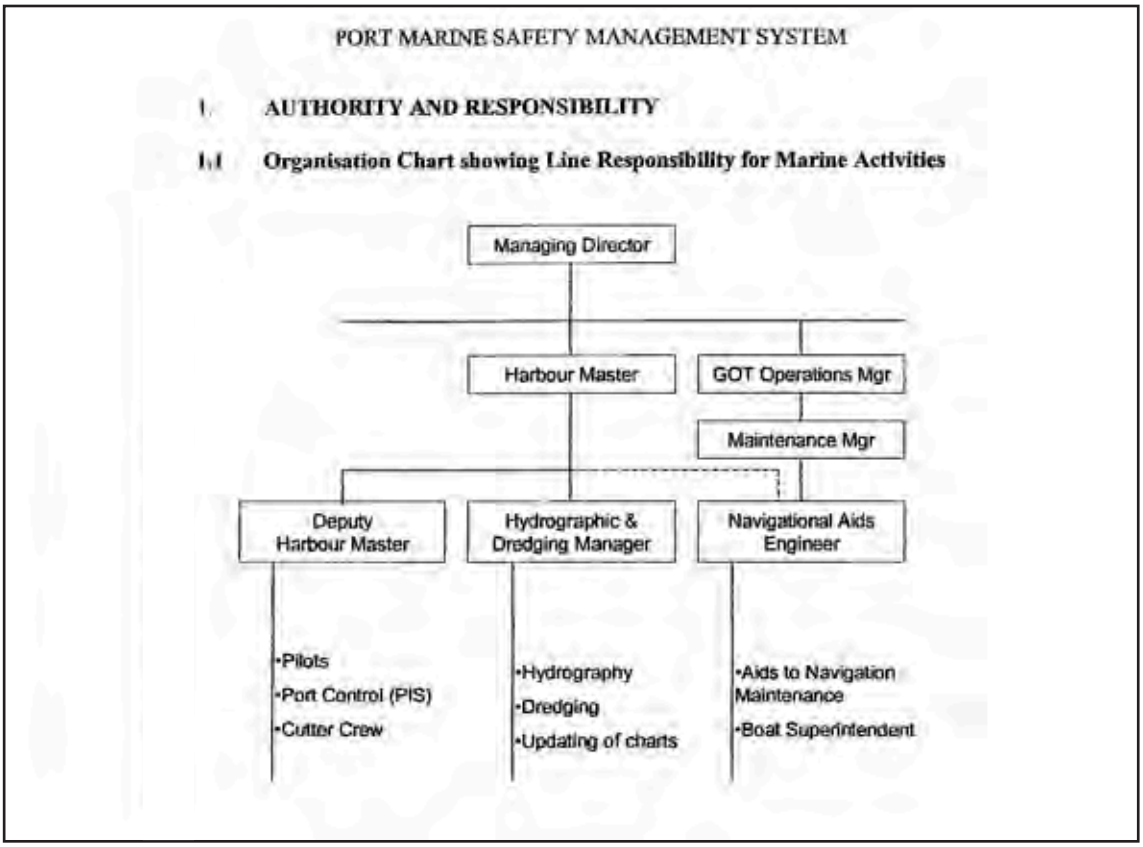
1.9.2 Management structure

The management structure for Clydeport's marine activities is shown in **Figure 27**. The harbourmaster was appointed in 1996. He reported directly to the managing director of Clydeport, and his access to the Clydeport Board was solely via the managing director. The harbourmaster's role was to control and administer all shipping, ensure safety of the river, and to enforce byelaws and statutory regulations.

The deputy harbourmaster had been appointed in April 2006. He had previously been a Clyde pilot, having started with Clydeport in 2000. He was responsible for managing the day-to-day marine operations of the port and was line manager for the pilots, Estuary Control staff and the pilot cutter crews.

The hydrographic and dredging manager was responsible for hydrography, the dredging of the port and the updating of local charts.

Figure 27



Clydeport marine operations management structure

1.9.3 Port facilities

Clydeport's statutory harbour authority (SHA) covered 450 square miles from Albert Bridge in Glasgow city to a line drawn between Isle of Arran's east coast and the mainland. The CHA area for pilotage was slightly smaller than the SHA. Clydeport also acted as the local lighthouse authority.

The main port facilities operated by Clydeport consists of Ardossan (ro-ro facilities), Hunterston (deep water bulk cargoes) and Greenock Ocean Terminal (GOT) (container and other general cargoes). The River Clyde also has several quays including Rothesay dock (fuel and general cargo), Lobnitz basin (scrap) and Shieldhall Riverside Quay (general cargo and bulk cargoes). The River Clyde has a number of other quays and berths including shipyards, but many have become disused as the river traffic and shipbuilding industry has declined. The depth of the river used to be maintained at 9.7m minimum, but this has been reduced to an 'any day draught' in fresh water of 8.7m, with a consultation process required for acceptance of vessels with draughts deeper than this.

The port provided a Port Information service as defined in MGN 238 (M&F). The Port Information service, callsign 'Estuary Control', was situated at GOT and was manned 24 hours a day. The operators were not training to the V-103 standard, as Clydeport did not provide a vessel traffic service (VTS). The operators' roles were to receive, collate and disseminate, on request, information to assist in the running of the port. The operators had three telephones, a fax, three VHF radios, access to email, access to AIS via the internet, and closed circuit television (CCTV) coverage of some port facilities. Wind and tidal information was available from an anemometer and tide gauge at GOT, and a tide gauge at Rothesay dock. There was no radar coverage of the CHA area displayed at Estuary Control.

1.9.4 Pilotage

A pilot service was provided by the port, which, depending on size and type of vessel, required the pilot to board at an outer or inner embarkation point. At the time of this accident there were seven Clyde pilots employed by Clydeport, including the deputy harbourmaster who was not in the pilot rota, although two new pilots had accepted positions with the company.

The pilot rota was based on a complement of eight pilots, in two blocks of four. The pilots were on duty for one week and off for the next. Within their week of duty, there were rules governing time-off after acts of pilotage to ensure the pilots achieved adequate rest.

From starting as a Class IV pilot, the pilots underwent a 4 year training period to attain class 1 status, which entitled them to pilot any size of vessel in Clydeport's CHA. At the time of the accident, there were three class 1 pilots in the rota.

The Clyde pilots were in a long running dispute with their employer, Clydeport, over conditions of service. Working relations between the pilots and Clydeport management were, therefore, far from ideal, but did not materially affect the day-to-day running of the port.

1.10 PORT SAFETY MANAGEMENT

1.10.1 Port Marine Safety Code

The Port Marine Safety Code (PMSC) was created after the grounding of the *Sea Empress* at Milford Haven in February 1996, following the MAIB's investigation report into the accident and the DfT's subsequent review of the Pilotage Act 1987. Produced with the assistance of a wide representation from the ports and shipping industries, the code provided a national standard for ports with the specific aim of improving safety. Although only a voluntary code, the PMSC pulled together the relevant requirements for running a port, most of which were underpinned by existing legislation.

The key principle of the PMSC was for ports to conduct risk assessments of their marine operations, and to ensure adequate control or countermeasures were put in place to mitigate the risks to "as low as reasonably practicable (ALARP)". There was also a requirement for a designated person to be appointed to provide the duty holder (the port board members) with independent assurance that the safety management system was working effectively.

The PMSC was published in March 2000, and it set a timetable for implementation by December 2001. Subsequently, ports were requested to submit a compliance statement once they were satisfied they had met the standard required of the PMSC. Clydeport provided its initial PMSC implementation response in April 2002, and reaffirmed its compliance in September 2005.

1.10.2 Clydeport's quality management system

Prior to introduction of the PMSC, Clydeport had in place an ISO9001 quality management system audited by Lloyds Register Quality Assurance (LRQA). LRQA conducted audits of the port on a 3-yearly renewal cycle. The last audit cycle was completed in August 2008.

Clydeport employed a part-time consultant to manage its quality management system. As an integral part of the system, the consultant scheduled regular internal audits which were conducted by members of Clydeport's staff. These locally trained in-house auditors were tasked to examine areas outside of their own, against the port's derived procedures.

1.10.3 Clydeport's safety management system

Risk assessment-

To comply with the PMSC, in 2001 the harbourmaster conducted a comprehensive risk assessment of marine operations. The harbourmaster is recorded as having reviewed the risk assessments in 2005, and just a week before the accident he had tasked his deputy, assisted by the quality consultant, to review them again. For risk assessment purposes, marine operations were sub-divided into 10 areas, samples of which have been included at **Annex B**.

Staff were encouraged to enter new risks in a hazard log which was maintained at Estuary Control. The log was regularly reviewed by the harbourmaster, and any relevant issues acted upon. An extract of the hazard log is included at **Annex C**.

Procedures and guidelines-

Clydeport's existing ISO9001 procedure was used by Clydeport as the basis for their PMSC safety management system (SMS), with additional documentation being produced as necessary. These included notices, plans and guidelines, and the relevant working instructions for marine operations, including Estuary Control, pilotage and berthing. The following work instructions (WI) have been included at **Annex D** and **Annex E**.

WI/OP19/6 - Instructions for reduced visibility within the river Clyde

WI/OP19/9 - Procedure for river transit of large vessels proceeding east of the Erskine bridge to Glasgow

Also included in the SMS were the Pilotage Directions and Guidelines (January 2005). This document, intended for internal guidelines only, included pilotage directions, pilot working arrangements, berthing guidelines for the various quays and other information. The guidelines were intended to be reviewed annually, and the master copy was kept at Estuary Control. A copy of some sections of the guidelines is included at **Annex F**.

Designated Person-

When the PMSC was first introduced at Clydeport, the role of designated person was undertaken by two members of the port board. They subsequently lost this responsibility and the extant version of the SMS at the time of the accident stated that the role of designated person was fulfilled by the company ISO9001 quality management system. This approach had been adopted after Clydeport became aware of the same practice being used at another port.

External visibility of Clydeport's SMS-

Clydeport was visited by a representative of DfT in December 2002, as part of the department's post-implementation review to establish how application of the PMSC had progressed and determine industry best practice. It was not an audit, and only

an internal departmental report of the visit was produced, which was not shared with Clydeport. Among its conclusions, the report stated:

> "The board does not take more than a formal interest in the operation of the port, … They operate on the basis of trust…their trust is anything but well-founded. There is scope for things to go badly wrong, and to be kept hidden from the Board…They have no independent check on the safety management system … has tried, without success, to engage the Board more actively in the port operations."

In June 2005, the MCA conducted a PMSC verification visit to Clydeport, which was generally positive, but raised one concern, namely the role of the ISO 9001 system fulfilling the role of designated person.

1.11 SIMILAR ACCIDENTS AND INCIDENTS

1.11.1 *Abu Agila*/*Flying Phantom*

In December 2000, *Flying Phantom* was involved in a very similar accident on the River Clyde. She was acting as a bow tug assisting *Abu Agila*, a 10,022 GRT bulk carrier, which was inbound to Shieldhall Riverside Quay. A thick fog bank was encountered at the Erskine Bridge, at roughly 0140. The skipper of *Flying Phantom* expressed to the pilot his concerns about proceeding in the fog, and it was agreed that they would temporarily heave to near the old John Brown's shipyard. However, the group did not make it as far as this berth. As a result of the poor visibility, the tug skipper became disorientated and *Flying Phantom* ran aground on the north bank of the river while trying to regain position ahead of *Abu Agila*. The bow of *Abu Agila* then collided with *Flying Phantom*, holing her below the waterline in the process. *Flying Phantom* was beached and successfully salvaged later the same day. *Abu Agila* proceeded upriver and was berthed without further incident.

Investigations were conducted by Clydeport and Wijsmuller, the owners of *Flying Phantom* at that time. Several recommendations were made as a result of this serious accident, including:

a. Pilots and tug crews to attend blind pilotage training

b. Pilots and tug masters to witness each others' operations

c. Review risk assessments for towing in dense fog.

   Issues to be addressed:

   i. Identifying when appropriate to release the tug.

   ii. Checking for technical aids to help tug skippers orientate themselves to the ship's bow.

   iii. Guidance for pilots on when not to secure a bow tug.

   iv. Identify emergency lay-by berth(s) on the river.

d. Investigate installation of fog detection system.

e. Establish viability of electronic charts.

f. Investigate fitting of VHF recording at Clydeport Estuary Control to assist accident investigation.

g. Conduct tug radar optimal position of aerials review.

h. Commence blind pilotage training for tug deck personnel.

i. Ensure tug watertight integrity established prior to tow.

1.11.2 Other recent incidents on the River Clyde

In October 2007, *Ocean Light*, a 25000 GRT bulk carrier, departed Glasgow and was transiting the River Clyde. Following the normal procedure, the pilot decided to let go the bow and stern tug once past Dumbarton Castle. However, a strong gust of wind caught *Ocean Light* and she grounded on the north bank. She was refloated on the following day's high tide with tug assistance. Clydeport conducted an investigation into the incident, which concluded the cause to be pilot error. As a result, the pilot concerned was demoted from a class 1 pilot to a class 3 to undergo retraining. He previously had been the longest serving pilot on the Clyde. During this incident, while attempting to refloat *Ocean Light*, *Flying Phantom* had grounded briefly on her Aquamaster and heeled over to an alarming angle but then recovered.

Minerva II, a 2000 GRT general cargo vessel, grounded briefly while on passage out of Glasgow with a pilot on board in February 08. This was as a result of losing propulsive power when the chief engineer shut down the main engine after a high temperature alarm on the main engine cooling system. The vessel was towed to safety, where the sea suction was found choked.

Clydeport's hazard log also detailed an incident in 2007, when *Ilse K*, transiting to the scrap berth at Lobnitz basin, had to anchor in the river in the vicinity of Dumbuck light after an engine problem. Fortuitously, the wind was blowing along the river channel, so the ship did not ground while the problem was resolved.

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 FATIGUE

Fatigue is not considered a factor in this accident. The pilot, ship's crew and the majority of the tug's crew were all well rested. The only exception was the mate of *Flying Phantom*, who had not achieved a full night's rest prior to the accident, but there are no fatigue related errors attributable to him that contributed to the accident.

2.3 LOSS MECHANISM OF *FLYING PHANTOM*

After the pilot had instructed *Flying Phantom* to ease off, she started to heel to port and capsized quickly. During this process, she was also pulled round by her stern to face in the opposite way to the intended direction of travel. The tow rope parted when the drag of the tug in the water increased as she capsized.

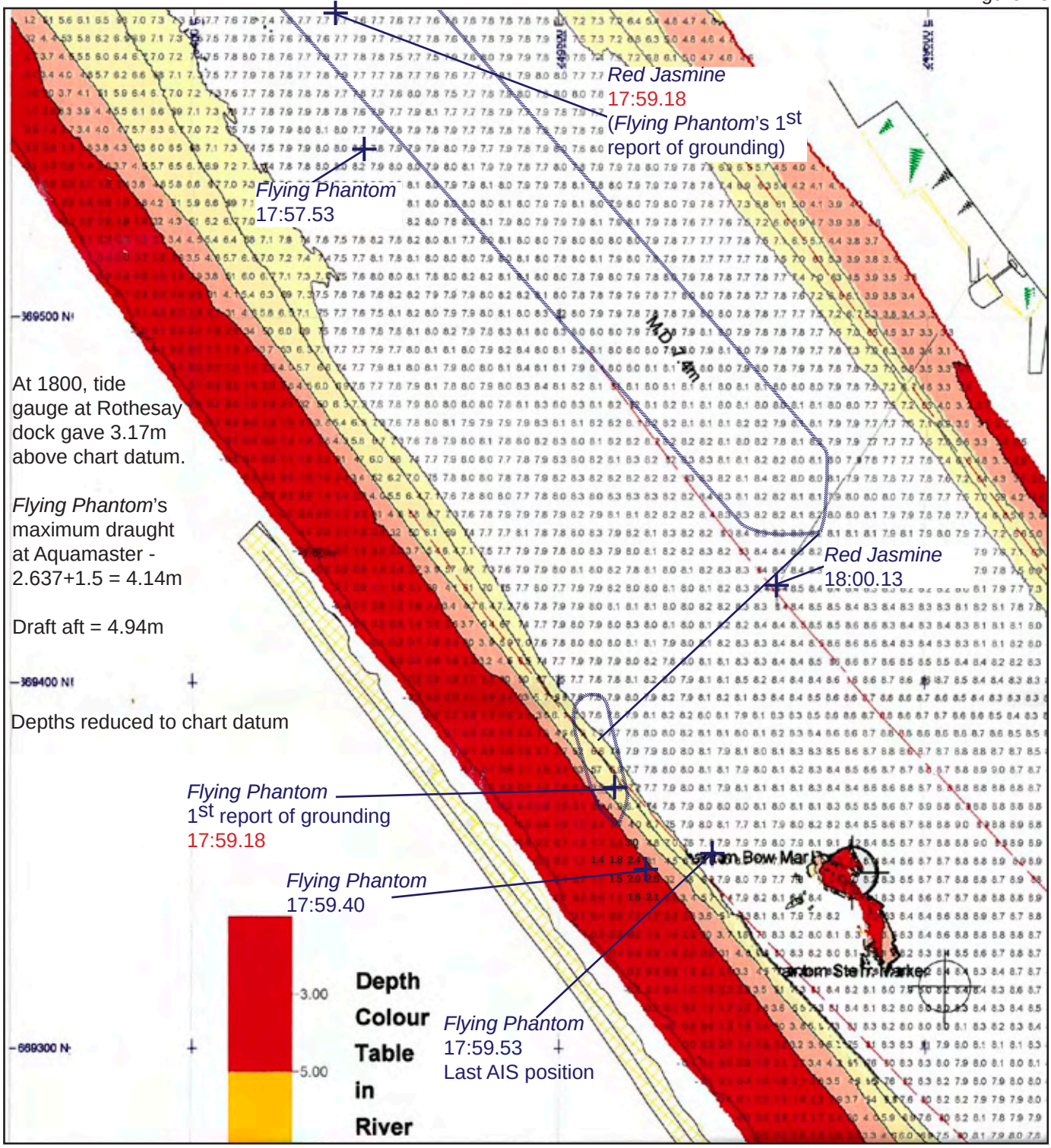
The mate had reported to the pilot they were aground when the tug initially heeled over to port. This was because he could see the riverbank close ahead on the radar, and because the tug had heeled in a similar manner when *Flying Phantom* ran aground while assisting *Ocean Light*, 2 months earlier.

To establish if *Flying Phantom* did run aground, her AIS positional data was plotted on to the hydrographic survey chart produced by Clydeport after the accident. The height of tide was taken from the tide gauge recorded at Rothesay dock. The depth of water at *Flying Phantom*'s position at the time of the accident **(Figure 28)**, supported by AIS showing that she was making way at 3.3 knots over the ground when the mate reported being aground, indicates the tug did not ground.

The other possible cause of *Flying Phantom* capsizing would be for the tug to have been pulled over by her tow rope, known as girting. For this to have occurred, *Red Jasmine* would have had to overtake *Flying Phantom* so that the pull of the tow line was across the tug, instead of astern or nearly astern. Analysis of the data from AIS and *Red Jasmine*'s VDR shows that, as *Flying Phantom* moved wider on *Red Jasmine*'s starboard bow, heading towards the edge of the river, she was overtaken by *Red Jasmine*. At the time of the accident, the line from *Red Jasmine*'s bow was leading aft and to starboard, and from *Flying Phantom* the line was leading across her port side, creating the conditions for girting to occur. It is concluded, therefore, that *Flying Phantom* was lost through girting alone.

A simple analysis was undertaken to establish what magnitude of force acting on the tow rope would have been required to girt *Flying Phantom*, given the geometry of the tow line and bridle wire **(Annex G)**. The result of this calculation estimated that a force equivalent to roughly 31 tonnes in the tow line would be required to capsize the vessel. This is not a significant force when considering the tow rope, when new, had a breaking strength equivalent to 115 tonnes and the tow winch brake was designed to render at about 80 tonnes.

Figure 28



Hydrographic survey with *Flying Phantom* AIS position overlaid.
Charted depths require the addition of 3.17m (height of tide) to obtain the actual depth of water at the time of the accident

The speed of *Flying Phantom*'s capsize would have been affected by the port engine room watertight door being left open. The analysis indicated that the engine room door sill became immersed at 30º of heel. Watertight integrity is an important aspect of tug operational safety as tugs generally have low freeboard and often rely on the first tier of the superstructure to provide additional righting lever. If all watertight doors had been closed, the upper section of the port engine room vent would not have

immersed until *Flying Phantom* had heeled to 42º. The downflooding at 30º would have dramatically reduced *Flying Phantom'*s residual stability and, therefore, the ability of the tug to right herself.

Had the bridle wire been tight down, the point of towing effort would have been aft, and as low as possible, which would have reduced the risk of capsize. However, as is normal when acting as bow tug, the bridle wire was let out some way to allow the tug to manoeuvre, and this effectively raised the point of effort whenever the bridle wire became taught. Once the tug started to heel, the 30 tonne load required to girt the vessel would have been too great for the 9.8 tonne bridle winch to overcome. Therefore, the towing point could not have been lowered as an effective counter to capsizing once the vessel had started to heel.

2.4 TOW LINE EMERGENCY RELEASE

2.4.1 Operation

All tugs must have a means of releasing their tow lines in an emergency to prevent them from being girted or dragged into danger. The emergency release system on *Flying Phantom* relied on releasing the brake of the towing winch so that the tow line would pay out, and run off the drum. The system was activated by the mate at the starboard winch control panel, as *Flying Phantom* heeled heavily to port. However, the emergency release system was ineffective as it did not prevent the vessel from being girted.

It is thought unlikely that the brake was released, paying out tow line, before *Flying Phantom* capsized and the tow rope parted, as the recovered sections of tow rope correspond closely with what was reported to be in use during the tow. Analysis of the AIS data also supports this, since the separation between *Flying Phantom*'s tow winch and *Red Jasmine*'s bow was measured at 59m. However, from the detailed examination of the towing winch it is evident that the brake did release at some stage, since the brake band was found offset to port. This indicates the brake was released after the tow rope parted, and then crept back on as the hydraulic system pressure seeped away following *Flying Phantom*'s foundering. The slight displacement to port of the brake band, found when the tug was recovered, is attributed to gravity acting on it as the tug lay on her port side, as the band returned to the braked position.

The capsize was rapid, as demonstrated by the following timings:

Time	Event
17:59.20	*Flying Phantom* reports she is aground (heeling to port).
17:59.34	Following an instruction to let go the towing line, the emergency release is pressed by mate.
17:59.54	Last position of *Flying Phantom* transmitted by AIS (which shows a jump to the ENE from previous position).
18.00.13	Pilot calls *Flying Phantom* to check if tug is all right, which is heard by the mate who has now climbed outside the wheelhouse.
18:00.35	*Red Jasmine*'s captain reports to the pilot that the tow line has been cut.

It is not possible to determine for certain why the tow line winch brake did not release. It might be possible that by the time the emergency release was operated, the angle of the tow rope passing through the bow shackle on the bridle wire was too acute and the friction generated would not allow the rope to pay out. More likely, is that as a result of the significant load on the winch, the brake did not release quickly enough. This is supported by the post-accident testing carried out on the towing winch **(Annex K)**, when a delay in releasing the brake even under relatively light load, was witnessed.

2.4.2 Testing and general awareness

The need to test tug emergency release systems was stipulated in Svitzer Marine Ltd's safety management system and in the pre-sailing checklist the crews were required to complete. However, the tug specific requirements for the test were established locally, and the procedures would vary between different tugs' crews. It was reported that some crews pressed the release button daily and witnessed the brake lift, while others would load the tow line and then press the release, once a week or once a month. Given the important role performed by the emergency release system, it is vital that tug crews have confidence that it will work, and understand how it will operate.

Following on from this accident it is essential that Svitzer Marine Ltd establishes comprehensive testing regimes for its tugs' towing emergency release systems to ensure they are functioning correctly. Any limitations of release systems must be identified, and steps taken to prevent a tug being operated in a role which could put it at imminent risk of being girted if the release system does not react quickly enough.

There are concerns in the tug industry that some tow winch brakes are intrinsically unsafe. Brake systems can be considered to fit into three categories: self loosening, neutral or self tightening. Band brakes, such as that fitted to *Flying Phantom* and widely used in the tug industry, generally are considered to be self tightening under load, and therefore the brake is likely to take longer to release when heavily loaded. This behaviour unfortunately will not be highlighted by routine testing; tug crews will, therefore, be generally unaware of this danger and still have the expectation the emergency release will function immediately in an emergency. The tug industry needs to be aware of this potential limitation of release systems so that operators' expectations are realistic, and additional precautions can be taken.

2.4.3 Emergency release standard

Although the rules for tugs laid down by several classification societies specify a tow line emergency release system, there are varying requirements, and the towing winch is not generally regarded as equipment that should be the subject of class surveys. Examples of classification society requirements for emergency release systems include: 'able to operate at any angle of heel', or, the emergency release mechanism must be 'reliable'. There is no clear standard which specifies a time within which the emergency brake release must operate, or under what loading conditions, heel angles etc. A recognised standard, in combination with a testing regime, would ensure that the emergency release system should work when needed.

An element of the standard should be that tow winch brakes are intrinsically safe so that brake release systems are able to be rapidly released, under load, at any angle. Ultimately, an emergency release system must work when required.

2.5 TOWING IN FOG

Once the tug skipper found himself in fog, he needed to ensure his tug remained:

- safe from a navigational perspective
- in a safe position with respect to the ship being assisted, and
- on a safe heading with relation to the ship being assisted.

Flying Phantom's skipper was attempting to maintain his position relative to *Red Jasmine* visually, but without the necessary visual clues. Although he could still see his tow line leading away from the tug's stern in the relative direction he expected, he could no longer see *Red Jasmine*'s bow and so could not judge his heading in relation to hers. Without the visual reference, the skipper needed to obtain the same information by other means. This would have required the skipper and the mate to monitor: their position in the river using radar and the electronic chart system; the position, course and speed of *Red Jasmine* by radar/AIS; *Flying Phantom*'s heading by looking at the compass; and then mentally relate all that information. They had received no training, individually or as a team, in blind pilotage operations of this nature. Even if they had been suitably trained, *Flying Phantom*'s bridge equipment was not well positioned to assist them, with pitch controls on the wing consoles, the compass binnacle on the centreline, and poor visibility aft from inside the bridge.

Consideration of the risks of towing in fog, even after the accident to *Flying Phantom* 7 years previously, had not resulted in robust control measures. There was a lack of any procedures, training or limits for towage operations in restricted visibility. Electronic charting was added to the tug fleet after the previous accident, but this was the only significant change that had been made. In this accident, the only practical defence used once fog was encountered was the pilot reassuring himself that the skipper/mate had a good radar picture.

Although navigation in fog was covered in Svitzer Marine Ltd's SMS, there was nothing specific about assisting/towing in fog. Taking all way off the vessel being assisted, so that the load is taken by the tugs, which then navigate down the centre of the channel, had been discussed at a Pilot Liaison Group meeting following the *Abu Agila* accident. *Flying Phantom*'s skipper had also discussed this procedure with the mate shortly before the accident, but did not suggest it to the pilot. Importantly, the minutes of the Pilotage Liaison Group meeting did not accurately reflect the difference in views between the pilots and tug skippers, and no new procedures were subsequently issued. The result was that the tug crews and the pilot were left to make their own instant judgment on how best to handle the situation they found themselves in.

After considering the operational risks fully, another approach might be for Svitzer Marine Ltd to derive clear limits of operation to ensure their tugs and crews do not operate in conditions outside their capabilities. The need for difficult blind pilotage operations while assisting / towing would then be avoided, but this would have implications for port operations, particularly if an operation had to be aborted after it had been started. Such constraints on tug operations would need to be factored into the port authority's risk assessments and associated operational procedures.

2.6 EMERGENCY PREPAREDNESS OF TUG CREW

2.6.1 Preparations for towing

It is widely accepted that the operations carried out by tugs make them more vulnerable to capsize than other merchant vessels. Good clear procedures coupled with the knowledge and experience of the crew is, therefore, essential in ensuring tugs are operated safely.

Svitzer Marine Ltd's SMS was comprehensive and concise. It included a section on watchkeeping procedures and navigating in restricted visibility, and also a pre-sailing checklist which the crews were required to complete daily. However, much of the information was generic, and individual crews were required to apply the requirements of the SMS in an appropriate way, which made allowances for their own tugs. It is unclear how this was achieved on *Flying Phantom*, as all the documentation on board was destroyed when the tug sank. However, there appears to have been no formal system onboard for key processes such as preparing for towing.

Although checklists are not infallible, they are a useful method of ensuring nothing is missed, especially when conducting routine tasks. Many assumptions were made about *Flying Phantom*'s preparedness for towing, because the crew were all experienced, knew their jobs, and had done this task many times before. However, as there was no central collation of completed tasks, neither the skipper nor the mate could be sure the necessary checks and precautions had actually been completed before commencing the tow. Some aspects, such as closing of watertight doors, are safety critical, and for such tasks a formalised procedure for reporting completion is an essential cross-check that they have been done.

Notwithstanding the above, it is not known for certain whether the port engine room watertight door was left open before towing commenced, or whether it was opened and pinned back at some point during the tow. The latter is certainly possible, as *Svitzer Mallaig*'s skipper observed *Flying Phantom* as he overtook *Red Jasmine* at Erskine Harbour, and noted the length of tow being used. Even though it was dark, he was confident that had the port door to the engine room been open (as in Figure 1), he would have noticed this due to the importance the company placed on having all watertight doors closed during towing operations. Nevertheless, it is clear that at some point the door was opened and pinned back before the capsize.

2.6.2 Entering fog

Although Svitzer Marine Ltd's SMS provided instructions on watchkeeping responsibilities and navigating in restricted visibility, it was clear there was no tug-specific 'fog routine' on board *Flying Phantom*. On approaching / entering fog, the crew needs to be informed and additional precautions taken. The crew down below could have been used to act as lookouts, or to man engine controls, but no actions were taken due to the lack of an onboard procedure for towing in fog.

2.6.3 Tow line emergency release

The operation of the emergency release system might also have not been fully appreciated by the crew. Regular testing of the system provides assurance that it should work, but the limitations of the tests need to be fully understood. For example, simply observing that the brake releases when activated does not ensure the system

will react quickly, or the tow winch will pay out under load. Crews need to have confidence in the emergency release system, and understand any delays or limitations that could occur should it be activated in an emergency.

2.6.4 Experience on different tug types

Over recent years, there has been an acknowledgement that some modern tug propulsion systems have significantly different handling and manoeuvring characteristics, and that tug crews changing to new systems need type-specific training, and assessment, before they are allowed to take charge of a new tug type in an operational environment. The MAIB was prompted to issue Safety Bulletin 2/2005 in June 2005 **(Annex H)** because of a spate of such accidents. Although the Safety Bulletin focused on routine operations, implicit was that the action to take in an emergency could also differ between different tug types.

Svitzer Marine Ltd's roster system on the Clyde required the designated relief crew to work on different tug types in successive weeks, such that *Flying Phantom*'s crew moved from her to operate *Svitzer Mallaig*. The control movements and reactions to avert grounding or girting would be very different between a conventional tug, such as *Flying Phantom,* and an Azimuth Stern Drive tug like *Svitzer Mallaig*, and the risk exists that, in an emergency situation, any delayed reaction could be disastrous.

There is no implication that *Flying Phantom*'s skipper was not reacting appropriately; in any case, he believed that he was trying to resolve a grounding situation, not taking actions to avoid girting. Nonetheless, the implications of a crew roster that requires crews to frequently change between tug propulsion types needs careful consideration and, if unavoidable, appropriate measures put in place to minimise the risks involved.

2.7 PORT FOG PROCEDURES

2.7.1 Fog on the Clyde

Fog was not considered a particular problem by Clydeport's management because it caused the port to be closed on very few days each year. It was considered that wind was more a common feature of the weather, and this kept the fog at bay. Certainly, fog as thick as that experienced on the evening of the accident was not anticipated by Clydeport.

Glasgow airport's weather records for the last 3 years show that, on average, fog occurred 46 days a year. The records did not detail the density of the fog, nor how long it lasted. However, given the airport's close proximity to the area of the accident, it would have been likely that fog also affected the Clyde on these days. The area in which the accident occurred has been described as a 'fog sink', and if fog was present it would often be between the Erskine Bridge and the River Cart. Indeed, the primary reason Prestwick airport was constructed was because fog was deemed to be a problem at Glasgow airport. This problem has since been solved by automatic landing equipment. Fog, therefore, would not appear to be unusual in the Clyde area, and WI/OP19/6 Work Instructions: Reduced Visibility within the River Clyde, paragraph 2.2 **(Annex D)** acknowledges this.

2.7.2 Significance of fog

The visibility on the River Clyde is particularly significant in view of the constraints of the narrow river channel. Prior to No 1 buoy near Greenock, ships of any size can turn round or go to anchor if the weather ahead is unsuitable for the river passage. Once past No 1 buoy, large ships are committed to proceeding all the way to KGV, some 16.5 nm, before they have the opportunity to turn round to head back downriver; and there are no anchorages or lay-by berths suitable for large vessels on this stretch of the river. Even if there is no report of fog 'up river' when entering the river channel, it is certainly not unfeasible that fog might descend on the river in the 2-3 hours it would take to transit to KGV. As this accident and the *Abu Agila* accidents have shown, navigating vessels, particularly large vessels, on the River Clyde in thick fog is a highly undesirable and risky operation, which should be avoided if at all possible.

2.7.3 Understanding and forecasting fog

Forecasting fog is not a reliable science, and even the basic indication of air temperature matching the dew point of the air, does not always mean that fog will occur. Predicting the likely density of fog is also very difficult. However, by developing a comprehensive understanding of the fog phenomenon in a specific area, a better assessment can be made of the risks of fog forming unexpectedly, and steps taken to ensure sources of reliable fog forecasting are obtained.

The limitations of the bespoke 'Weather2Sail forecast', with respect to the River Clyde area, had not been fully considered by Clydeport. Had they been, other forecast products, some of which did reliably forecast the fog, could have been obtained.

Having an awareness that fog may be present is one step, but knowing when it has developed is equally important if mitigation measures are to be taken in good time. Fog detection systems exist, which will provide a warning that fog has occurred where the system is sited. The positioning of such systems therefore requires some careful consideration. The purchase of a fog detection system was considered after the *Abu Agila* accident in 2000, but after making inquiries, the cost of £30K was deemed to be outside the ALARP principle. Deciding on a single location for the system was also deemed to have been problematic, despite WI/OP19/6 stating that "*the area particularly prone to fog is Clydebank, and the low-lying land adjacent to the River Cart*".

As way of an example of practices in other ports, ABP Southampton installed a weather sensor station on the Bramble Bank in 2004 for less than the cost quoted by Clydeport for the fog detection system in 2000. This provides live wind, visibility and environmental measurement data, proving not only very useful to the port but also to all the marine users of the Solent, as the information is available on the internet.

Understanding the likelihood of fog occurring, and having a reliable system in place that detects fog as early as possible, are important aspects of managing the safety of a commercial port.

2.7.4 Procedures and options when fog was encountered

WI/OP19/6, Work Instruction for reduced visibility within the river Clyde, **(Annex D)**, highlighted the area around Clydebank and the River Cart as particularly prone to fog. Without a fog detection system, the working instruction relied on operators speaking to local contacts to ascertain the visibility, and Glasgow airport airfield operations tower

was listed as a contact. However, this telephone number listed in the instruction was incorrect and it connected to an office out on the airfield, not the control tower. There was no evidence from those interviewed during the investigation that the number had ever been called. Although not listed as a potential contact, the deputy harbourmaster contacted Erskine Bridge control to obtain a fog report, but was unable to get a positive report on the evening of the accident. In the end, it was the Renfrew ferry crew who provided the first warning of fog when they called Estuary Control on VHF channel 12. The report of the fog was not passed on to the pilot and crew of *Red Jasmine*, as Estuary Control staff assumed, correctly in this instance, that the pilot would overhear the call on the VHF.

Once the pilot had received the report of fog, the only advice to him in WI/OP19/6 was to consider using the disused Esso Bowling Tanker Jetty **(Figures 29 & 30)** as a lay-by berth. *Red Jasmine* had only just passed this berth when the fog was reported, and to halt her and take her astern to the berth would have been possible. The pilot, however, did not consider this a viable option as the berth's condition was unknown, it having been left unused for approximately 12 years. A subsequent hydrographic survey of the berth revealed heavy silting, supporting the pilot's concerns; had *Red Jasmine* moored there, she would have grounded at low water and been at risk of significant hull damage.

In the event, the pilot decided to send the tug *Svitzer Mallaig* to scout ahead. He asked *Red Jasmine*'s captain to reduce the range scale on one of the ship's radars, and explained to him that the passage would be difficult as the fog appeared to be in the most dangerous part of the river, but they had plenty of time and would proceed slowly. The pilot expected the tug skippers to contact him if they were not happy to continue. Later, when the pilot overheard the conversation between the skippers of *Svitzer Mallaig* and *Flying Phantom,* in which the latter said he was happy with his radar picture, it reinforced in his mind that the tugs were content to proceed.

Other options, available to the pilot at the onset of fog, which have subsequently been suggested to the investigators, have included:

Holding *Red Jasmine* in the centre of the river and allowing her to ground at low water. In an absolute emergency, this might be feasible, but it is doubted whether many operators would sanction this as a defined control measure, given the risk of structural damage.

Towing *Red Jasmine* stern-first back to a safe anchorage off Greenock. Given the distance (8-9nm), the lack of effective assistance from ship's propulsion/steering and the configuration of the tugs, it was the pilot's view that this would have been a difficult and hazardous operation.

Releasing the bow tug and continuing upriver. After the accident, the pilot did manage to complete the passage with just a stern tug to assist him. However, the pilot's opinion was that if a bow tug was considered necessary for a ship of *Red Jasmine*'s size, in good visibility, there was no logical reason for not having a bow tug when operating in restricted visibility.

Allowing the ship to be towed up the river with the tugs remaining in the centre of the channel, as was briefly discussed by the skipper of *Flying Phantom* just before the accident. This approach might have been effective in the accident, but was not enacted, as opinions on this method's effectiveness, expressed at the post *Abu Agila* Pilotage Liaison Meeting, had been divided.

The review of the risk posed by fog on the Clyde and the number of control measures introduced following the *Abu Agila* accident in 2000, tragically, have not been effective. Either assisting/towing in fog has to be avoided, hence the need for better fog forecasting and detection systems, or far more robust procedures and contingency plans need to be produced to ensure ships can transit the river safely in fog. In this instance, the pilot had no effective measures to fall back on once he became aware of the presence of fog, and he, not unreasonably, considered the best option available was to proceed with caution to the Shieldhall Riverside Quay.

Figure 29

ESSO Bowling Jetty

Image courtesy of Clydeport Operations Limited

Figure 30

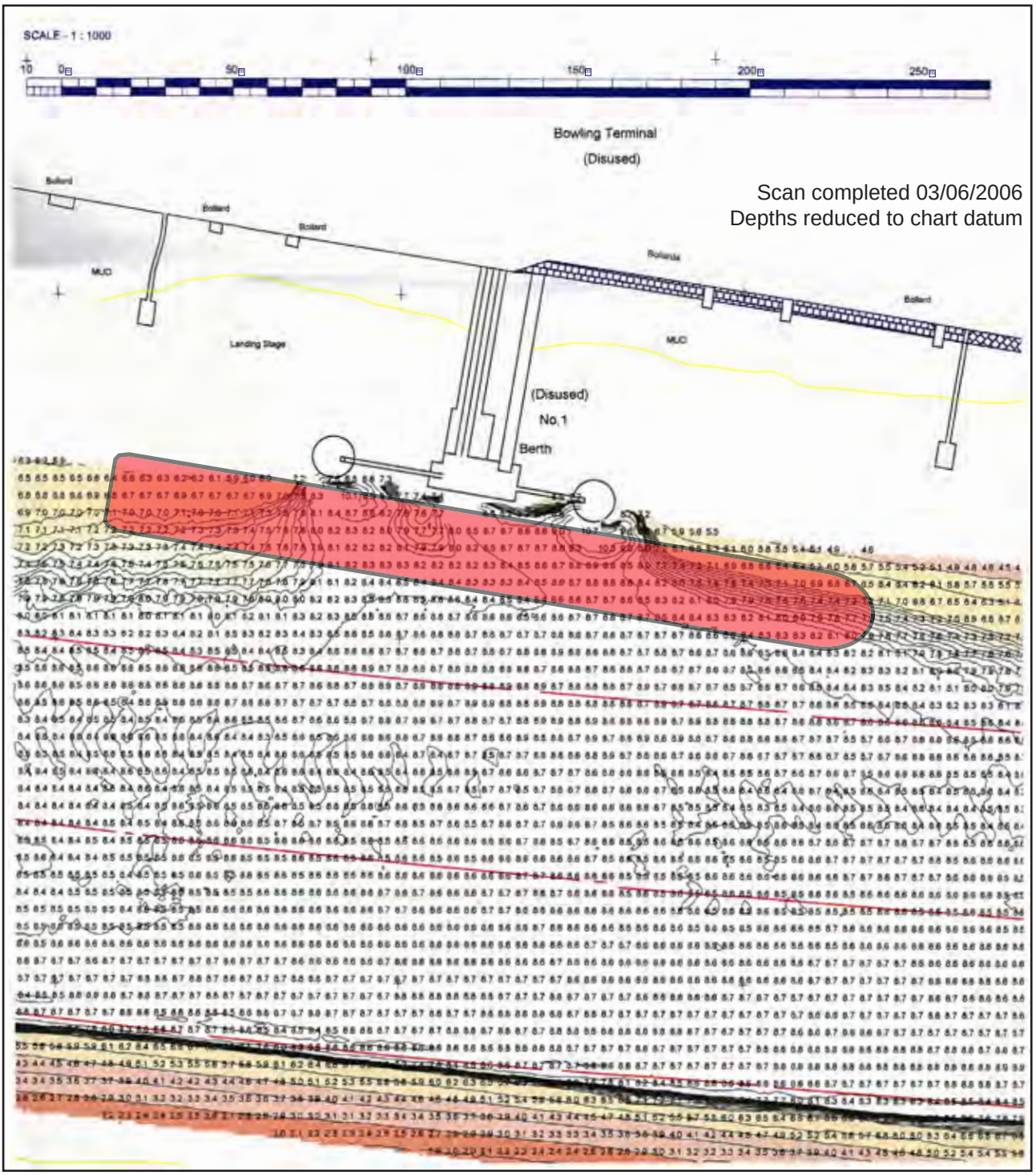


Chart of ESSO Bowling Jetty, showing an indicaion of *Red Jasmine*'s position alongside

2.8 APPLICATION OF THE PMSC AT CLYDEPORT

2.8.1 Risk assessment

The PMSC requires port authorities to base their policies and procedures relating to marine operations on a formal assessment of the hazards and risks. In this manner, risks are identified and mitigated in a logical way to provide confidence in the safety of operations in port waters. It is, however, important that the risk assessment is a live document and is reviewed regularly.

When the PMSC was introduced, Clydeport elected to use its established ISO9001 business processes as the basic structure, and add on whatever additional requirements were needed.

Clydeport's initial risk assessment, carried out with appropriate input from pilots, tug operators and other areas, identified many of the relevant marine risks. However, the risk assessment has matured very little since the original draft, and many of the control or counter measures to mitigate the risks are ineffective. The following, while not comprehensive, gives examples of the document's immaturity **(see Annex B for detail)**:

- Actions still listed as under investigation with no target dates for completion or review (GL5, GL11).
- No counter measures identified, yet the net probability reduced from gross probability (GL21).
- Inappropriate control mechanisms chosen which are outside the port's control and cannot be checked (OPA11).

While few risk assessments will cover every conceivable risk, a major consideration at Clydeport is the risk inherent in operating large ships along the River Clyde, a 16.5nm tube which has no turning places or lay-by berths. OPA 11 considered the risk of a grounding in the outer approaches (but see above), but no risk is listed for a grounding or engine failure in the river, an event which has occurred at least three times in the last twelve months. The lack of an effective lay-by berth is a significant omission given what could happen to a ship making the 16.5nm passage to and from Glasgow, and that it had been identified as a safety issue in the *Abu Agila* investigation.

The original risk assessments have been reviewed once by the harbourmaster, with a further review planned by the deputy harbourmaster. However, given the concerns highlighted by this investigation, it is vital that a comprehensive review of the port's risk assessment is conducted urgently, ideally by an independent marine expert.

2.8.2 Lessons identified

Key to ensuring a risk assessment remains up to date is that robust procedures for ensuring new risks are identified and effective control measures put in place to mitigate the new risks. Clydeport was in the unusual position of having already investigated a very similar accident on the River Clyde: that of *Flying Phantom* being struck by *Abu Agila* in December 2000 while operating in thick fog. Recommendations, which were made following that accident, were progressed during early 2001 and discussed at

Pilotage Liaison Group meetings, whose minutes appear to show an agreed position in February 2001. The following quotes the resultant recommendations, with MAIB's assessment of their subsequent progress and effectiveness appended in italics:

a. Pilots and tug crews to attend blind pilotage training. *A simulator course was run and attended by pilots and tug skippers, but it was deemed ineffective at modelling tug towing ship operations.*

b. Pilots and tug masters witness each others' operations. *This was not taken up by tug skippers, although pilots continued to witness a tug operation as part of their early training on the river.*

c. Review risk assessments for towing in dense fog. *WI/O19/6 issued*.

   Issues to be addressed:

   i. Identifying when appropriate to release the tug. *Decision; never except in an emergency.*

   ii. Checking for technical aids to help tug skippers orientate themselves to the ship's bow. *Researched, but no appropriate equipment in existence.*

   iii. Guidance for pilots on when not to secure a bow tug. *Decision; never, as if a bow tug was needed in good visibility it would be needed in fog.*

   iv. Identify emergency lay-by berth(s) on the river. *Esso Bowling was the only berth highlighted for consideration in WI/OP19/6, however, limited surveying of the berth and no action taken to ensure a maintained depth alongside or that dolphins and jetties remain serviceable.*

d. Investigate installation of fog detection system. *Investigated and decision made not to proceed as the cost of £30K was considered outwith ALARP*.

e. Establish viability of electronic charts. *Completed, and systems fitted to all tugs*.

f. Investigate fitting of VHF recording at Clydeport EC to assist accident investigation. *Completed.*

g. Conduct tug radar optimal position of aerials review. *A new radar was subsequently fitted to Flying Phantom.*

h. Commence blind pilotage training for tug deck personnel. *Not completed.*

i. Ensure tug watertight integrity established prior to tow. *Instructions included in working practices and laid down in Svitzer procedures, but see comments at section 2.6*.

Many of the recommendations were not followed up adequately, and the risks associated with operating in fog (**Annex B** TOW23) were not accurately assessed and mitigated. This indicates that Clydeport's risk assessment process was not employed in a coherent manner, and was not an effective tool for managing the port's risks.

Tragically, as demonstrated by the loss of *Flying Phantom*, the few resulting control measures that were put in place as a result of the previous accident, were ineffective.

2.8.3 Procedure and documentation

During this investigation a number of inconsistencies and conflicts between documents were found. Pilotage Direction and Guidelines **(Annex F)** provided information for vessels over 200m in length transiting east of the Erskine Bridge. The working

instruction describing the consultation process **(Annex E)** and the final consultation note **(Annex A)** appeared to present different information. For example, the guidelines stipulated a maximum wind strength of 15 knots, the consultation note template stated 20 knots. The guidelines also stated 'daylight transit only', but had this been adhered to, *Red Jasmine* would not have made the passage to KGV until Friday 21 December.

The variation between guidance documents and instructions has the potential to lead to confusion, and permits too much flexibility in interpretation. The harbourmaster has responsibility for ensuring his port operates safely and for defining suitable procedures, limits and guidelines within which his staff are to operate. In this accident, the pilot appeared to be the final arbiter on when the passage would take place, but the instructions influencing his decisions were ill-defined and vague. Final accountability in the event of an accident was, therefore, potentially ambiguous.

2.8.4 SMS audits

Clydeport relied on its ISO9001 quality management system to ensure its SMS was operating in accordance with the PMSC. However, ISO9001 is a quality management system, the aim of which is to verify that a company or organisation is following its procedures correctly. In itself, ISO9001 does not necessarily check whether the procedures are correct or appropriate and, in this case, it did not provide a means of checking that the underpinning risk assessments were adequate or that all necessary procedures were in place.

Underpinning the ISO9001 external audits, was a series of internal reviews conducted by auditors who were tasked to audit business areas different to their own. They were not equipped, necessarily, to validate the procedures themselves. Consequently there has been no effective internal or external audit of the marine risk assessments or the resulting procedures and, hence, gaps and inconsistencies in the SMS have not been highlighted. One particular example identified in this investigation is the emergency lay-by berth specified in WI/OP19/6. Had its effectiveness been tested during an audit, the berth's limitations would immediately have become apparent. This information could then have been fed back into the risk assessment process, and an appropriate decision taken about the future use of the berth or provision of an alternative control measure.

Clydeport placed too great a reliance on the ISO9001 system to highlight problems with its SMS, which did not provide any appropriate warning of this accident. The SMS audit process must be proactive in searching for weaknesses and failings in current procedures and systems. Although the process would normally be conducted internally, it should also include periodic external auditing and verification.

2.8.5 Designated person

The position of designated person is a fundamental principle of the PMSC, which states, "*Harbour authorities must have a 'designated person' to provide independent assurance about operations of its marine safety management system, who has direct access to the board*". The supporting guide to good practice on port operations allows that this function can be achieved in different ways, and it is for each authority to determine how best to meet the requirement. Clydeport's SMS states that the ISO9001 system fulfils the role of designated person. The harbourmaster thought that this would be a practical approach, as the ISO9001 audits were providing feedback and assurances about port processes directly to the Board. The harbourmaster himself did not have direct access to the Board.

In this case, the chosen method of fulfilling the role of designated person has been ineffective. Firstly, ISO9001 is a quality management system, not a marine safety management system, and the audit process employed was not probing the marine risk assessments to detect where the shortcomings existed. Secondly, this approach is, by its nature, reactive and not proactive, especially with respect to accident and incident follow-up actions. Given the management structure at Clydeport, it should have been identified that an individual, with direct access to the Board, was needed for the role of designated person, to highlight safety issues and provide an independent view on the harbourmaster's implementation of the port's SMS. Given the SMS shortcomings identified in this investigation, it is considered essential that Clydeport needs to appoint an appropriately qualified individual to the post of designated person under the Port Marine Safety Code.

2.9 THE PMSC AND THE PORTS INDUSTRY

The loss of *Flying Phantom* was the latest in several accidents in port waters investigated by the MAIB. Since the PMSC's introduction, MAIB has conducted 23 investigations into contacts, collisions and groundings in port waters (out of a total of 44 for this type of accident). Notable accident investigations in the last 3 years have included the ports of Newhaven, Mostyn, Liverpool and the Humber. In the cases involving the ports of Liverpool and Humber, both had a contributing factor of inadequate or incomplete procedures for operations in restricted visibility.

Recommendations from these investigations have been aimed at the ports industry, yet it appears that the lessons from an accident at one port are not always being learnt by others.

SECTION 3 - CONCLUSIONS

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

1. Although the tow line emergency release mechanism operated after the mate activated the system, it did not act quickly enough to prevent the girting of *Flying Phantom*. [2.4.1].

2. Towing winches are not generally regarded as equipment that should be the subject of class surveys. Additionally, there is no clear standard defining the time or loading within which the towing winch brake should release. [2.4.3]

3. There were no defined limits for tug towing operations in restricted visibility. If fog was encountered, there was no appropriate procedure or training provided to ensure tug crews could continue to operate safely. [2.5]

4. In the event of encountering fog, the bridge ergonomics of *Flying Phantom* were not suited to conducting blind pilotage operations. [2.5]

5. There were no formal pre-towing checks to ensure the necessary preparations had been completed prior to towing. This resulted in the engine room watertight door being open, which reduced the tug's residual stability and, therefore, her ability to right herself when experiencing a heeling load. [2.6.1]

6. Once *Flying Phantom* had entered the fog bank, her personnel were not used to best advantage to ensure the vessel navigated safely in the narrow confines of the River Clyde. [2.6.2]

7. Clydeport had no effective system for assessing the risk of fog. Although the area in which the accident occurred was known to be susceptible to fog, there was no reliable means of detecting the arrival of fog on the River Clyde, or warning river users of its presence. [2.7.3]

8. While a procedure for operating in restricted visibility was provided in the port's safety management system, it was ineffective. Specifically, although a lay-by berth was detailed for consideration, it was not appropriate for a vessel of *Red Jasmine*'s size, and the pilot had little choice other than to continue to the ship's intended destination, at Shieldhall Riverside Quay [2.7.4]

9. Clydeport's risk assessment was immature, and many of the control and counter measures put in place were ineffective. It is vital that a comprehensive review of the port's risk assessment is conducted urgently by an independent marine expert to rectify this position. [2.8.1]

10. Many of the recommendations from the *Abu Agila* accident, which occurred in thick fog, were not followed up, and the subsequent control measures were not implemented or were ineffective. [2.8.2]

11. There were a number of inconsistencies and conflicts within Clydeport's SMS documentation. These had the potential to cause confusion and permitted too much flexibility in interpretation. [2.8.3]

12. Clydeport's ISO9001 audits were not effective at highlighting any gaps in safety procedures or the adequacy of the safety procedures in place. Furthermore, the audit approach did not provide a means of checking that the underpinning risk assessments were adequate. [2.8.4]

13. Clydeport's board was receiving a false impression of the safety performance of the port by relying on the ISO9001 system acting as the designated person. Given the safety management system shortcomings identified in this investigation, it is considered essential that Clydeport needs to appoint an appropriately qualified individual to the post of designated person under the Port Marine Safety Code. [2.8.5]

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

1. The liferaft painter was attached to the tug directly without a weak link. Although having no bearing on this accident, if *Flying Phantom* had been lost in deeper water, the liferaft, even if it had inflated, would have been lost with the tug. [1.7.7]

2. Lessons from an accident at one port are not always being learnt by other. [2.9]

SECTION 4 - ACTION TAKEN

Svitzer Marine Ltd has undertaken tests on all the towing winch release mechanism of tugs in its fleet to ensure they function correctly.

It has also issued a group safety memorandum and a UK safety memorandum as a result of this accident **(Annex I)**.

Liferaft painters on board the company vessels have also been checked to ensure they are attached correctly.

Lloyds Register has issued a safety alert to its customers **(Annex J)**.

The **United Kingdom Major Ports Group** and **British Ports Association** have undertaken, in consultation with **DfT**, to review the PMSC and its Guide to Good Practice by the end of 2008. Also to be reviewed are the arrangements for the management of the Port Marine Safety Code Steering Group and the mechanism by which MAIB recommendations and other examples of good practice are taken up within the industry. They have confirmed their commitment to the principles of the Code and ensuring that it is an integral part of port operations.

Clydeport has reported that Peel Ports has undertaken a review of procedures to ensure there is uniformity of risk assessment throughout the Peel Ports group. Peel Ports has also set up a Group Health and Safety Committee, which will meet bi annually chaired by the chief executive. Clydeport has created the post of Senior Marine Officer Pilot, which has a remit to oversee pilot training and development, and has appointed another pilot as Tug Liaison Officer, with the remit of auditing tugs within the port and acting as the link between tug crews and pilots.

SECTION 5 - RECOMMENDATIONS

Clydeport Ltd is recommended to:

2008/161 Appoint an appropriately qualified individual to the post of designated person under the Port Marine Safety Code.

2008/162 Conduct an urgent review of its port risk assessment and safety management system to ensure:

- Requirements, conditions, controls and operational limitations for the safe transit of large vessels on the Clyde are clearly defined.
- Ambiguities or conflicts within its SMS documentation are removed.
- The company's SMS is subject to routine audits by an independent and appropriately qualified marine professional.
- Limitations and/or working procedures relating to the operation of tugs in restricted visibility are agreed with the port tug operators and incorporated into standard operating procedures.

Lloyd's Register is recommended to:

2008/163 Take forward a proposal to IACS to develop a standard for tug tow line winch emergency release systems, to ensure tow lines can be released effectively when under significant loads in an emergency.

Svitzer Marine Ltd. in association with the BTA is recommended to:

2008/164 Derive limitations and associated necessary guidelines and training for the operation of tugs in restricted visibility. Ensure that ports and pilots are aware of such limitations and guidelines.

The **British Tugowners Association** is recommended to:

2008/165 Highlight to its members the importance of tug crews' emergency preparedness, including:

- maintaining watertight integrity
- functionality of tow line emergency release systems
- limitations and procedures for operating in restricted visibility.

Marine Accident Investigation Branch
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