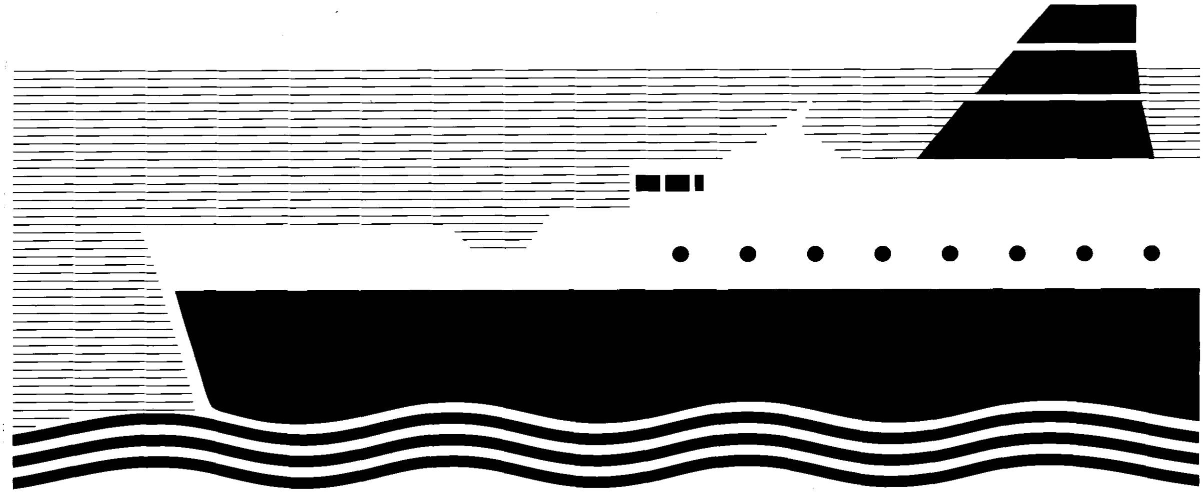
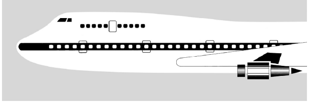
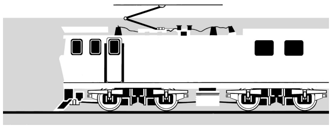
TRANSPORT ACCIDENT INVESTIGATION COMMISSION
TE KOMIHANA TIROTIRO AITUA WAKA



MARINE OCCURRENCE REPORT

02-206 bulk carrier *Tai Ping*, grounding, Bluff Harbour 8 October 2002


TRANSPORT ACCIDENT INVESTIGATION COMMISSION
NEW ZEALAND

Report 02-206

bulk carrier
Tai Ping

grounding

Bluff harbour

8 October 2002

Abstract

On Tuesday 8 October 2002 at 0356, the bulk carrier *Tai Ping,* with a pilot, a master and 22 crew on board, became engulfed by thick fog, left the Bluff approach channel and grounded. The ship remained aground until 17 October 2002 and suffered extensive damage to the bottom plating.

Safety issues identified included:

- adequacy of pilot training, including simulation
- adequacy and interpretation of weather forecasts for port areas
- adequacy of bridge resource management
- adequacy of resource management within the port service personnel
- adequacy of the operational procedures in the port.

Safety recommendations were made to the Chief Executive of South Port Limited to address these issues.

***Tai Ping* aground in Bluff Harbour**

Contents

Figures

Abbreviations

ARPA	automatic radar plotting aid
ESP	enhanced survey programme
GPS	global positioning system
hPa	hecto Pascal(s)
kW	kilo Watt(s)
m	metre(s)
m/s	metres per second
nm	nautical mile
NZDT	New Zealand daylight saving time (UTC +13 hours)
rev(s)	revolution(s)
SOLAS	International Convention for the Safety of Life at Sea
South Port	South Port New Zealand Limited
t	tonne(s)
UTC	universal co-ordinated time
VHF	very high frequency

Glossary

ARPA	automated system to plot and monitor targets on a radar. Used by a watchkeeper to assist in collision prevention
astern	towards the rear of the ship, or proceeding stern first
ballast	weight, usually seawater, put into a ship to improve stability
beacon	a lighted or unlighted fixed (non-floating) aid to navigation
bilge keel	thin plates attached to the exterior of the hull to deaden any rolling
bollard pull	measure of the static pull a ship can exert
bow	the front of the ship
bulk carrier	a ship designed to carry cargoes in bulk form
bulkhead	the term given to a wall on a ship
bunkers	term referring to fuel used aboard the ship
chart datum	zero height referred to on a marine chart
con (conduct)	directing the course and speed of a ship
course	direction steered by a vessel
dew point	the temperature to which air has to be cooled for water vapour to condense out as water droplets
displacement	the amount of fluid, measured in tonnes, displaced by a solid floating or immersed in it
doppler log	a device that uses the doppler effect to measure a ship's speed
draught	depth in water at which a ship floats
echo sounder	a device for measuring the depth of water below a ship's bottom
forecastle	raised structure on the bow of a ship
frame(s)	the ribs of a ship much like a skeleton
gross tonnage	a measure of the internal capacity of a ship; enclosed spaces are measured in cubic metres and the tonnage derived by formula
helm	the amount of angle that the rudder is turned to port or starboard to steer the ship
heading	direction in which a ship is pointing at any moment
in way of	connecting to or in the vicinity of
knot	one nautical mile per hour
leading lights	light(s) that identify the safest track in a channel. Used by the mariner to monitor and maintain a ship's position within a channel
made fast	tied up, attached
port	left hand side when facing forward
reach	straight stretch of water between 2 bends in a river or channel
relative humidity	the ratio between the amount of water vapour in the air and the amount that it can contain at that temperature
starboard	right hand side when facing forward
steerage	the slowest speed at which a ship steers
stern	the rear of a ship

tidal stream	the horizontal movement of the water due to tide
tidal window	the time range during which there is enough water or the tidal stream is at a slow enough rate for a ship to enter or leave a port
under keel clearance	the clearance between the bottom of a ship and the seabed

Data Summary

Ship Particulars:

Name:	*Tai Ping*
Type:	bulk carrier
Class:	100 A1 Bulk Carrier, ESP LMC SPS
Classification:	Lloyds Register of Shipping
Length (overall):	168.60 m
Breadth (extreme):	26.0 m
Gross tonnage:	16 041 t
Built:	1996
Propulsion:	a single 6076 kW MAN-B&W 5L50MC diesel engine driving a single 4-bladed propeller
Service speed:	14.0 knots
Owner:	Right Link Shipping Ltd, Hong Kong
Operator:	Fenwick Shipping Services Ltd, Hong Kong
Port of Registry:	Hong Kong
Minimum Safe Manning:	20
Date and time:	8 October 2002 at 0356[1]
Location:	Bluff harbour
Persons on board:	crew: 23 others: 1 pilot
Injuries:	crew: nil others: nil
Damage:	bottom plating severely indented and ruptured in way of some ballast tanks
Investigator-in-charge:	Captain D Monks

[1] All times in this report are New Zealand Daylight Time (UTC +13 hours) and are expressed in the 24-hour mode.

1 Factual Information

1.1 Narrative

1.1.1 In the early morning of 8 October 2002, after discharging part of its cargo of urea, the geared bulk carrier *Tai Ping* departed Bluff. As it proceeded towards the approach channel fog formed ahead of it and it was subsequently engulfed in thick fog, severely restricting visibility. The *Tai Ping* left the channel and grounded on the north-eastern side of the channel, coming to rest on shoal ground west of Tiwai point (refer Figure 1).

1.1.2 The *Tai Ping* had arrived at Bluff on 6 October 2002 and at 2136 it berthed at No. 8 Wharf, Island Harbour. Cargo work, using the ship's cranes, commenced at 0745 on 7 October 2002 and completed at 0300 on 8 October 2002.

1.1.3 The *Tai Ping* was scheduled to depart at 0315 on 8 October 2002. Two harbour tugs, the *Monowai* and the *Hauroko* left their berths at 0305 and proceeded to assist the unberthing. A harbour pilot boarded the ship at 0310 and was advised by the master that the crew were securing the hatches and cranes so the ship's departure would be slightly delayed.

1.1.4 At 0326, with the *Monowai* fast aft and the *Hauroko* fast forward, the ship's lines were let go. The pilot conned the ship stern-first along the wharf, before swinging the ship in the basin formed by the entrance to Island Harbour berths 3 to 6. The tugs were let go as the ship came round onto the heading required to intersect No. 3 Reach.

1.1.5 As the pilot conned the ship onto No. 3 Reach he noticed that visibility was reducing in the channel and was obscuring the Davey leading lights ahead. Being concerned about losing sight of his visual cues the pilot devised strategies to assist him. He requested that the skipper of the pilot vessel, *Awarua,* take up a position at the seaward end of the channel, in line with and near the Davey leading lights. He also asked the master of the *Hauroko* to precede the ship down the channel, and the master of the *Monowai* to align his tug on the No. 3 leading lights, astern of the ship, and to follow it out. To reduce the ship's speed, the pilot ordered the main engine stopped but as the ship's speed dropped, steerage was lost and the ship started to pay off to port. The pilot estimated the ship's heading had fallen off to 128°(T) instead of 133°(T), the direction of the leading line, during the loss of steerage. To regain steerage the pilot ordered the engine to dead slow ahead and starboard helm.

1.1.6 As the *Hauroko* entered the channel it was engulfed by fog, the tug master posted lookouts, one to keep watch ahead and one to lookout for the ship astern. He had no opportunity to switch the radar on and soon became disorientated. He was surprised when he sighted No. 2 beacon close on his port side sooner than expected. As the tug continued down the channel its master became further disorientated and completely lost, so, he asked the skipper of the *Awarua* what the tug's position was and was told that the tug had left the northern side of the channel and was in danger. So the skipper of the pilot vessel was asked to guide the tug down the channel towards the pilot vessel.

1.1.7 As the *Tai Ping* approached No. 3 beacon, it too was engulfed in fog. Horizontal visibility was severely reduced with all visual references being obscured, including the leading and channel beacons, and the port service vessels.

1.1.8 Shortly after this, the chief officer stationed on the forecastle of the *Tai Ping* reported a beacon with a green light very close to port. The bridge team sighted the beacon when it was approximately abeam No. 4 hatch, about 50 m ahead of the bridge. To the master and pilot, the ship appeared to be setting onto the beacon and so the pilot ordered port helm. The pilot recalled the helm order as port 20°, while the helmsman remembered it as hard to port, before easing to port 20°. The engine speed was increased, first to slow ahead and then to half ahead, to increase the effect of the rudder and swing the stern clear of the beacon.

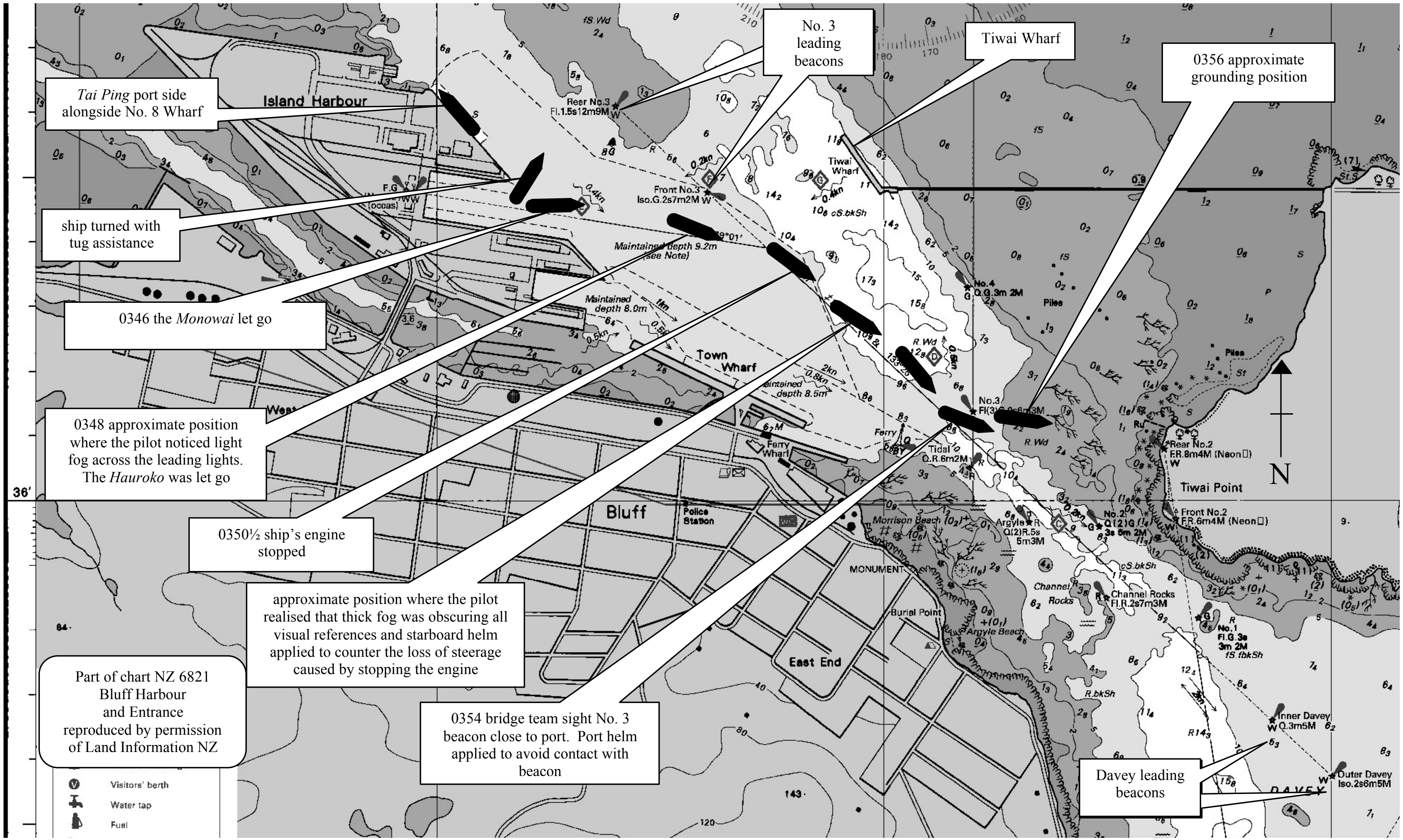


Figure 1
The approximate track of the *Tai Ping*

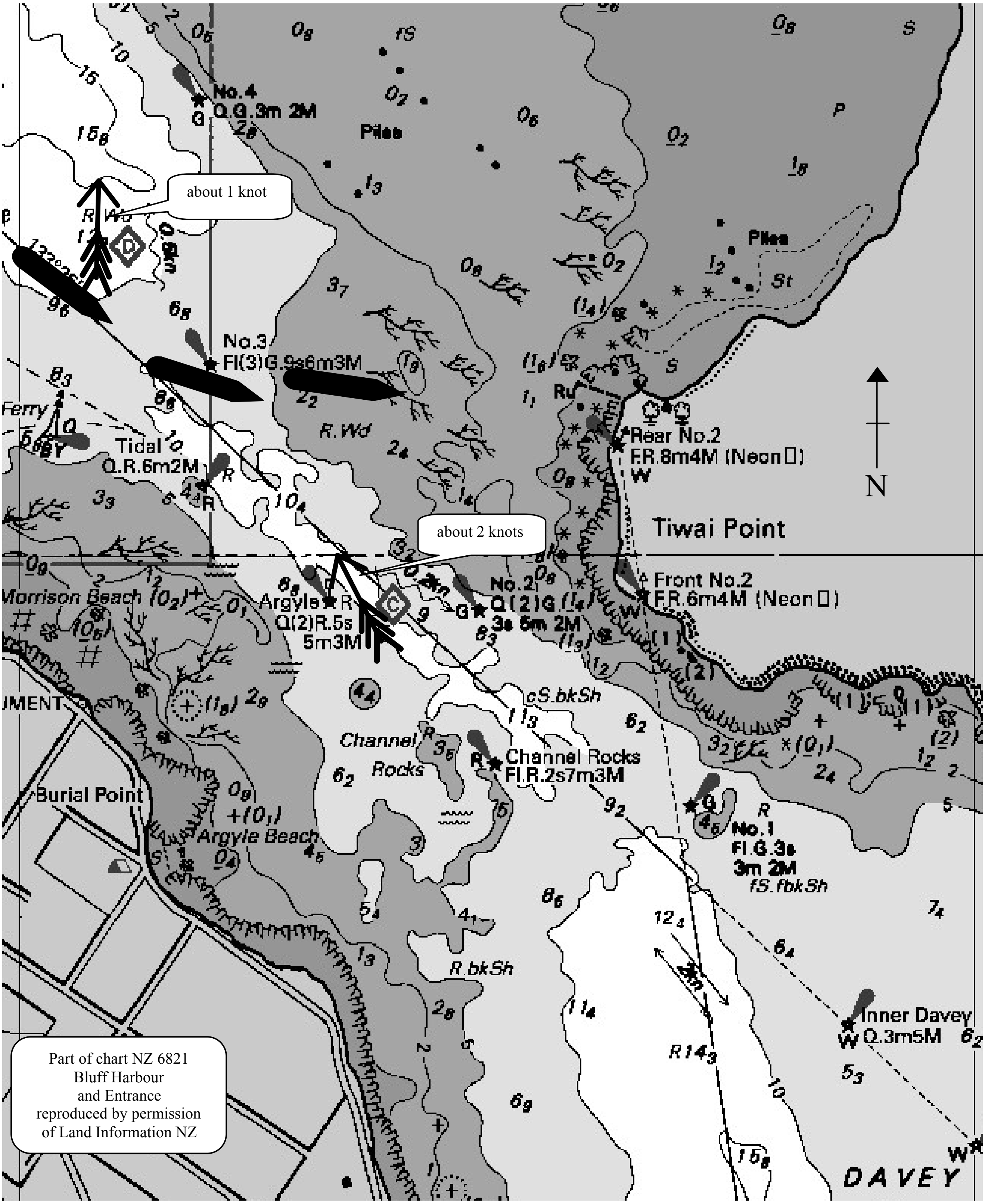


Figure 2
Entrance channel and the position of the *Tai Ping* after grounding.
Approximate direction and strength of tidal streams indicated

1.1.9 The ship's stern cleared the beacon by about 2 or 3 m. Immediately, the pilot ordered amidships and reduced the engine speed to dead slow ahead but before corrective helm could be applied to bring the ship back on track, the ship grounded on the north-eastern edge of the channel at 0356. The pilot ordered the engine be stopped and then subsequently ordered it to dead slow ahead to maintain the ship's position against the current that was setting to the north.

1.1.10 The pilot requested that the tugs return to assist the ship. The *Monowai*, which was following the ship down the channel, soon arrived at the stern of the ship where its line was made fast. The skipper of the *Awarua* guided the master of the *Hauroko* back up the channel, where he initially attempted to make his way towards the ship's starboard bow, but the tug's skeg grounded, so the master decided to secure the tug at the stern of the ship, alongside the *Monowai*. When both tugs were fast an unsuccessful attempt was made to refloat the ship.

1.1.11 The *Tai Ping* remained aground for 10 days during which time an extensive salvage and anti-pollution operation was carried out. When the ship was refloated on 17 October 2002, temporary repairs were carried out in Bluff before it sailed to Lyttelton on 9 November 2002. There it discharged the remainder of its cargo and took bunkers before it proceeded to Dalian, China, for permanent repairs, which were completed on 21 December 2002.

1.2 Ships and equipment information

1.2.1 The *Tai Ping* was a standard design geared bulk carrier, built in China in 1996. It was owned by Right Link Shipping Limited of Hong Kong and operated by Fenwick Shipping Services Limited, also of Hong Kong. The ship was registered in the Peoples Republic of China Special Administrative Region of Hong Kong and had valid certificates issued by, or on behalf of that government and Lloyds Register of Shipping.

1.2.2 The *Tai Ping* had an overall length of 168.60 m and a breadth of 26.0 m, with a gross tonnage of 16 041. It had a mean summer draught of 9.536 m giving a displacement of 32 783 t. The draughts, when the ship left Bluff prior to the grounding, were 5.0 m forward and 6.5 m aft.

1.2.3 The ship was powered by a MAN-B&W 5L50MC reversing diesel engine, developing 6076 kW driving a single fixed pitch 4-bladed propeller. It had a single rudder located directly behind the propeller. The *Tai Ping* was not fitted with a bow thruster.

1.2.4 The manoeuvring speeds for the *Tai Ping* were as follows:

Speed	Revs	Condition	
		Loaded	Ballast
Full ahead	112	12.74 knots	13.78 knots
Half ahead	90	10.80 knots	11.85 knots
Slow ahead	64	8.37 knots	9.18 knots
Dead slow ahead	50	6.96 knots	7.63 knots

The master indicated that the ship lost steerage at about 5 knots.

1.2.5 The ship was fitted with 2 Racal Decca radars, one fitted with ARPA and the other conventional, which were positioned on the port and starboard sides of the wheelhouse respectively. Other navigation aids included a Doppler log, echo sounder, GPS receiver, magnetic and gyro compasses. All the navigation equipment was reported to have been functioning correctly at the time of the grounding.

1.2.6 Gyro compass repeaters were positioned at the steering position, on the centreline at the fore part of the bridge (refer Figure 3), and one on each bridge wing. The bridge wing compass repeaters were of the conventional bowl type that required the observer to look down into the compass to determine the heading. Both bridge wing repeaters were pedestal mounted on a raised platform. A flat brass cover was fitted over them for protection; this needed to be removed before the heading could be read. In addition to the compass repeaters, the radars had heading readouts on them (refer Figure 5). There was no centralised easily read gyro compass repeater.

1.2.7 A rudder indicator was centrally mounted on the wheelhouse deckhead. This was clearly visible from all parts of the wheelhouse. There were also rudder indicators on each of the bridge wings.

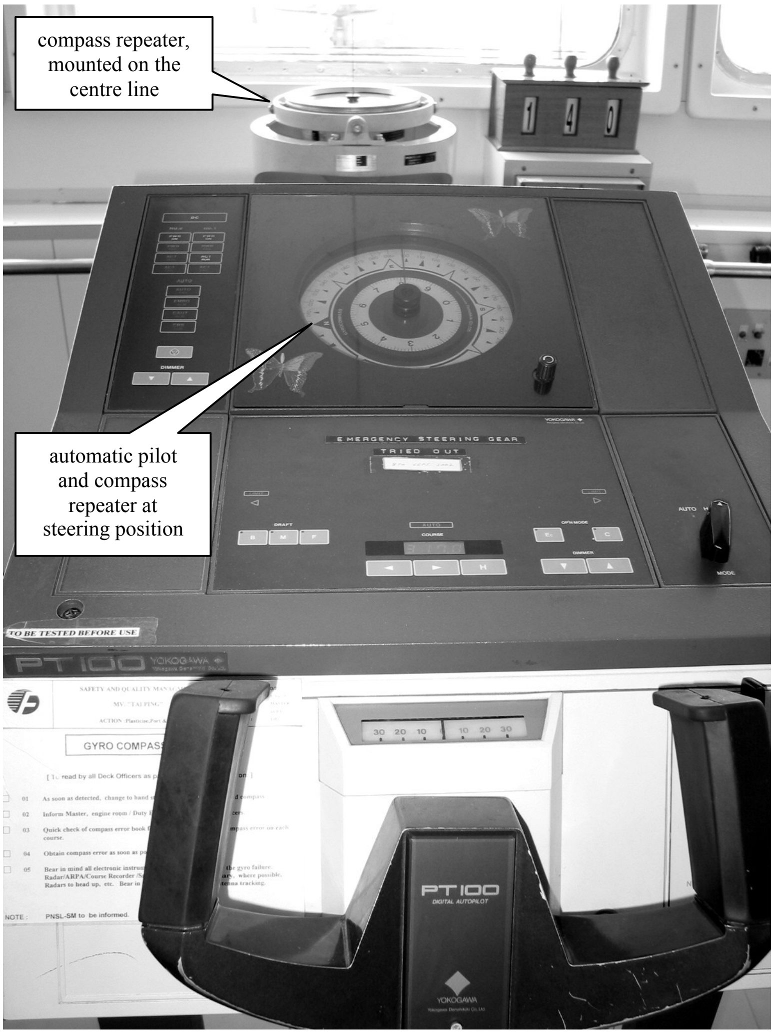


Figure 3
Steering console

1.2.8 The pilot was conning the ship visually with occasional reference to the port radar. The master was also occasionally observing the port radar. During pilotage, the officer of the watch usually used the starboard radar for navigational purposes, but on this occasion the third officer, who was the officer of the watch, said that he had not referred to the radar prior to the grounding.

1.2.9 Following the grounding, the personnel on the bridge of the *Tai Ping* recalled the ship having been on a different heading when No. 3 beacon was sighted. The third officer remembered 155°, the helmsman remembered 130°, and the master was unsure whether it was 135° or 140°. The pilot also recalled a heading of 155° but was unsure why he recalled it, whether he had heard it from the third officer or master, or whether he had read it, or possibly misread 135°, from the radar.

1.2.10 When queried later, the third officer indicated that he had read a heading of 155° and a speed of 3.5 knots from the GPS (see Figure 4) and these figures were entered into the movement book. The same figures were used in the master's draft statement of facts. Later, the third officer indicated that he had read the speed and what he thought was the heading, vertically, rather than horizontally from the GPS display, as shown by the outlines in Figure 4. When asked to show which figure he had used he pointed to the lower left one, which was the bearing to the next waypoint rather than the heading.

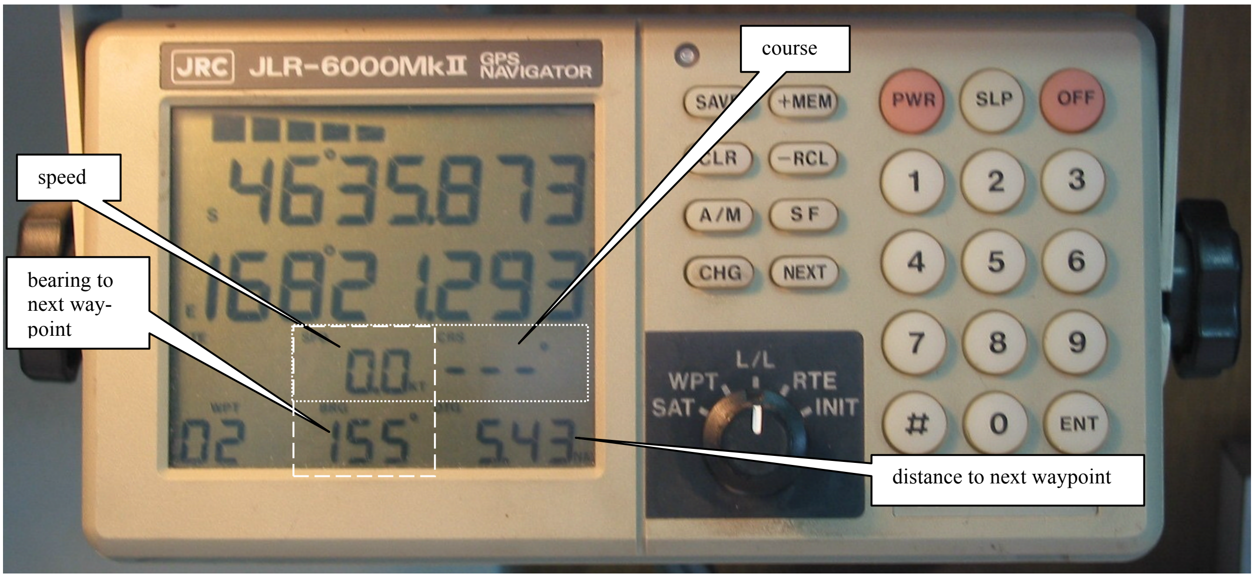


Figure 4
GPS receiver display showing ship's course and speed, and bearing and distance to next waypoint. (Photo taken on 9 October while *Tai Ping* was aground)

1.2.11 The pilot had set the port radar to ship's head up display and 0.75-mile range. As the visibility deteriorated he reduced the range to 0.50 miles, the same as that shown in Figure 5, in the hope of identifying the channel beacons more easily.

1.2.12 A ship's head up, or un-stabilised, radar display has the ship's heading marker fixed at 000°, at the top of the screen. All targets, fixed or moving, then move relative to the ship's position in the centre of the screen and the heading marker. As the ship moves through the water, fixed targets appear to track down the screen on a reciprocal heading at the speed the ship is moving and when the ship alters course targets appear to rotate in the opposite direction to that of the ship, so targets appear to move on the radar screen while the ship's heading remains fixed. The coating on a radar display is designed to allow a certain amount of afterglow of targets, which in the ship's head up mode causes smearing and may make the identification of smaller targets difficult. In addition, when targets, particularly large landmasses, are in close proximity interference occurs, which can further inhibit the detection of small targets. Notwithstanding the above limitations, the pilot stated that he was able to identify the beacons on the radar (refer Figure 5).

1.2.13 After the grounding, it was reported by another ship's master that the light beacons marking the channel were not radar conspicuous and could become lost in the general sea clutter on a ship's radar, particularly if a radar was not correctly set up.

1.2.14 Prior to departure, the third officer had switched the course recorder on. He did not however check that the unit was operating correctly. During the investigation it was identified that the main power switch had an intermittent fault and did not always make when turned on. The trace from the course recorder did not correlate with the courses the ship would have steered after departure from the berth. Consequently, it was impossible to confirm the courses steered immediately before the grounding.

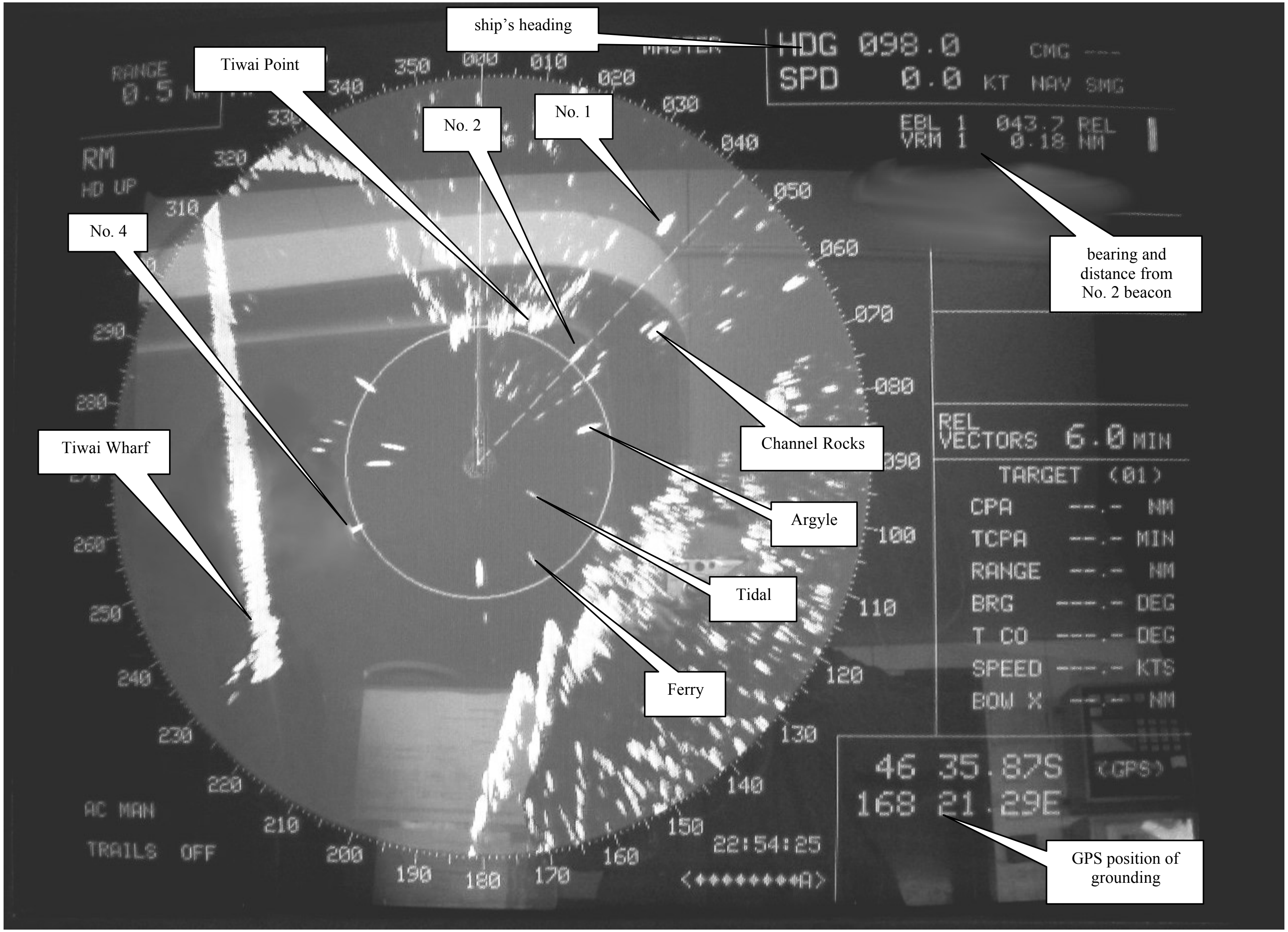


Figure 5
Photograph of the *Tai Ping*'s port radar, taken on 9 October 2002, beacons and landmasses can be clearly distinguished

1.2.15 The tug *Monowai* was built in 1973 at Whangarei and had a length overall of 32 m, a beam of 9.56 m, and a draught of 4.75 m. It was propelled by 2 Voith Schneider units and had a bollard pull of 30 t. It was crewed by a master, engineer and 3 deckhands. The *Monowai* had a line recovery winch and not a towing winch. So to recover the tow line, the crew hauled in the line while the tug slowly steamed away from the line to prevent it being caught in the tug's units. The tug master estimated that it took about 3 minutes to recover the line.

1.2.16 The master of the *Monowai* set the tug's radar to standby prior to departure from its berth. When the pilot requested that the tug standby on No. 3 leads, astern of the *Tai Ping,* the tug master left the flying bridge, the usual conning position when assisting a ship, and went down to the wheelhouse to switch the radar on. He remained in the wheelhouse conning the tug from there while using the radar to find and maintain his position on No. 3 leads, even when the fog obscured the rear leading light.

1.2.17 The tug *Hauroko* was built in 1988 at Whangarei and had a length overall of 30.52 m, a beam of 11.00 m and a draught of 3.48 m. It was propelled by 2 Voith Schneider units and had a bollard pull of 35 t. It was crewed by a master, engineer and 2 deckhands. It was fitted with a towing winch so recovery of the line was quicker and easier than the *Monowai*.

1.2.18 The master of the *Hauroko* did not switch his radar on before he departed the berth. Once the tug was engulfed in fog, he was too busy handling the tug and trying to determine his whereabouts in the channel to switch on the radar himself. The master said that he asked the crew members, who had gone to the bridge after stowing the tow line, if they knew how to switch on the radar. They didn't, and the master was not prepared to turn on the wheelhouse lights for them to identify the correct switches, for fear of losing his night vision.

1.2.19 The pilot vessel *Awarua* was a 14 m steel hulled boat crewed by a skipper and one deckhand.

1.2.20 The *Awarua* had its radar operating. This enabled the skipper to maintain his position on the Davey leading line even when he could not see the beacons. He also used the radar to guide the *Hauroko* down the channel and lead it back up the channel to assist the grounded ship.

1.3 Personnel and port company systems

1.3.1 South Port employed 4 pilots, one of whom was the marine manager. All the pilots were trained tug masters and regularly formed part of the tug master roster when not required for pilotage duties.

1.3.2 The *Tai Ping* had a compliment of 23, comprising of an Indian master, a Bangladeshi chief officer, with the remainder from the Peoples Republic of China. At the time of the accident the master, third officer and a helmsman were on the bridge, the chief officer was stationed forward and the second officer was stationed aft.

1.3.3 The pilot had gone to sea as a deck officer apprentice at age 16 and had gained his master's certificate in 1989. In 2001, he was appointed tug master at Bluff and commenced training as a pilot in May 2001. He gained his pilot's licence in September 2001, allowing him to handle vessels up to 140 m. He continued training and in January 2002, was upgraded to a class 'B' pilot allowing him to handle ships up to 180 m. At the time of the accident he was training to handle ships up to 200 m. He had attended a bridge resource management course prior to joining South Port and had also attended simulator training for the port of Bluff at the Australian Maritime College, Launceston, Australia.

1.3.4 The master of the *Tai Ping* first went to sea in 1969, he gained his master's certificate in 1992 and had served on several ships in that capacity. He had served on the *Tai Ping* previously from July 2001 until January 2002 and had rejoined the ship on 6 September 2002.

1.3.5 The master of the *Monowai* had been part time tug master for the previous 3 years. He had spent most of his life at sea, mainly on fishing boats out of Bluff. He had gained his commercial launch master's certificate in 1985.

1.3.6 The master of the *Hauroko* was also the marine manager for South Port and one of the senior pilots. He had gained his master's certificate in 1971 and had been employed by South Port for the previous 20 years, initially as tug master and then as pilot. He had attended simulator training for the port of Bluff in Launceston on a number of occasions and had completed bridge resource management and advanced marine pilot training.

1.3.7 The skipper of the pilot vessel *Awarua* had fished in the waters around Bluff, Stewart Island and Fiordland for a considerable time and gained his commercial launch master's certificate in 1993. He had worked for South Port on a part time basis since then.

1.3.8 South Port had commissioned the Australian Maritime College in Launceston to construct a computer model of the port of Bluff to be used with the college's ship simulator. Bluff pilots had attended the simulator on a number of occasions, the last time being in July and August 2002 when the 4 pilots employed by South Port at the time of the accident were divided into pairs. Each pair attended the simulator for one and a half days, during which a number of scenarios were run. The focus of these courses was to increase the tidal window for all ships and to possibly increase the ship size able to negotiate the approach channel, rather than improving the pilots' ability to handle ships under unusual and unexpected conditions, such as fog. To that end, the simulator was configured for different types of ship, rates of tidal streams and weather conditions but all the runs were conducted in good visibility giving the pilots full access to visual cues.

1.3.9 The South Port pilot/tug master training manual, which had been introduced in January 2001, identified that "blind pilotage" should be tried on the simulator before being used on a ship. It also called for such techniques to be part of the annual peer review process. At the time of the grounding, South Port had not instituted the simulator training, which was the necessary precursor for instrument only navigation. Consequently, none of the pilots had practised this type of navigation.

1.3.10 The pilot's formal training did not include piloting ships under conditions of restricted visibility. His only training in this area had been observing the actions of the other pilots when the visibility had become reduced during his training transits. There was no standard operating procedure covering the movement of ships in reduced visibility. The usual practice was that if fog was present, shipping operations were suspended. There were no contingency plans for the situation faced in this accident where fog engulfed the harbour during a shipping movement.

1.3.11 South Port operated a multidisciplined workforce environment, where the majority of the employees were trained to carry out a number of tasks and were used as required within the port. For example, the crew on the tugs and pilot vessel were usually employed as general hands on the wharves. The tug masters were solely employed in that position but pilots were used to supplement the tug roster when required and available.

1.3.12 The marine manager, in his capacity as one of the pilot/tug masters, was rostered to assist in the un-berthing of the *Tai Ping*. In view of the fact that he had worked a full day in the office the previous day, the marine manager arranged that he would command the *Hauroko,* allotting the pilotage of the *Tai Ping* to the junior pilot.

1.3.13 In the week prior to the accident, the pilot had carried out 11.5 hours of operational duties, either as pilot or tug master. In addition, he had spent 2 days in the office as duty pilot. On the day prior to the accident the pilot's only duty had been to berth a ship as pilot, a job that had lasted about one and a half hours. On the evening prior to the accident he had gone to bed at 2200 and slept for about 4 hours.

1.4 Damage

1.4.1 The *Tai Ping* was re-floated on 17 October 2002, and an in-water survey was carried out by divers approved by Lloyds Register of Shipping. They identified the following areas of damage:

- No. 5 water ballast tank had a small rupture in the hull close to the inboard longitudinal bulkhead and a 300 mm diameter hole that had been cut in the hull to allow water to be forced out by air pressure during the salvage operation.

- The shell plating in way of Nos. 3 and 4 port water ballast tanks was heavily indented and ruptured. The bulkhead between the 2 tanks was breached, causing them to be common.

- The forepeak tank shell plating had several small ruptures.

- The port bilge keel was buckled and deformed over its entire length. Some of this damage was pre-existing.

- The starboard bilge keel had been ruptured for approximately 4 m at the forward end.

- In addition to the above, the flat bottom had numerous indentations to the plating and probable damage to the internal structure in some areas.

1.4.2 There was no pollution as a result of the grounding.

1.5 Climatic conditions and tidal information

1.5.1 The weather forecast issued at 0017 on 8 October 2002, by the New Zealand Meteorological Office for the sea area Foveaux, which included the port of Bluff, was:

> *GALE WARNING IN FORCE*
> Northerly 15 knots rising to 25 knots this afternoon and to 35 knots offshore in the evening. Sea becoming very rough. Southwest swell 2 metres easing.
> OUTLOOK FOLLOWING 12 HOURS: Northerly 25 knots but 35 knots offshore.

1.5.2 The metrological notes in the New Zealand Almanac for 2002/2003 stated that coastal weather forecasts are a general indication of average conditions expected in a particular coastal area. The forecasts are for open waters to within 60 nm of the coast and do not apply to enclosed areas such as small bays and harbours. There was no weather forecast specifically for the port of Bluff.

1.5.3 The isobaric chart for midnight 7 October 2002, showed that there was a large high-pressure system covering the country. A weak warm front was in the Tasman Sea some 200 miles south-west of Stewart Island.

1.5.4 At 0356 on 8 October 2002, a tide and wind gauge situated at the pilot vessel jetty gave the following readings:

Tide height	2.886 m
Wind direction	349° (T)
Wind speed	2 m/s (4 knots)

1.5.5 At 0400, the automatic weather station situated at Tiwai Point recorded the following:

Wind speed:	1.43 m/s (2.8 knots)
Wind direction:	006° (T)
Barometric pressure:	1028.2 hPa

Air temperature: 05.4°C
Relative humidity: 94.7%

Using the observed air temperature and relative humidity, the dew point temperature was 4.7°C. The trend of the recorded weather data over the period immediately before and after the accident was a falling air temperature and an increasing relative humidity. Witnesses reported that the sky was cloudless, indicative of the high-pressure system over the area.

1.5.6 A private automatic weather station situated about 100 m from the town wharf, Bluff, also recorded the conditions at the time of the grounding. That data was used to produce a graph (refer Figure 6). It can be seen from the graph that the temperature was falling towards the dew point and the humidity was high. The weather recorded that it was calm and there was no rainfall.

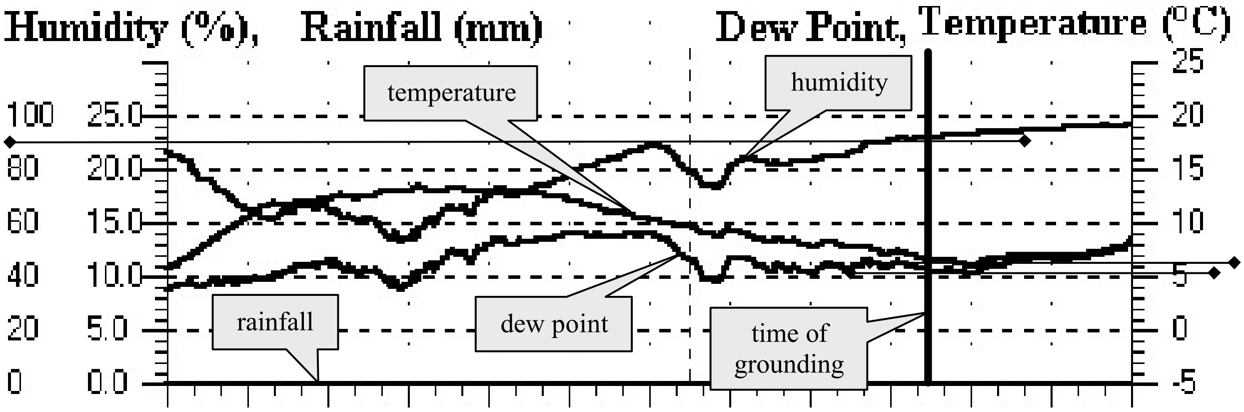


Figure 6
Weather conditions in Bluff for the 24 hours up to 0900 on 8 October 2002
(graph courtesy of Mr T Hardwick)

1.5.7 The general manager of a paua (abalone) growing facility on the southern side of the harbour, regularly recorded the temperature of seawater drawn from the harbour adjacent to the Town Wharf. At 0830 on 8 October 2002, the seawater temperature was 11.2°C. The manager indicated that the seawater temperature fluctuated about 1°C with the ebb and flood tides but was otherwise constant throughout the day.

1.5.8 Fog is a surface based cloud composed of water droplets suspended in the atmosphere. Fog forms when the atmosphere is cooled to, or below, its dew point causing water vapour to condense and produce suspended water droplets.

1.5.9 The method by which the air is cooled to its dew point determines the type of fog. Two of the main forms of fog found in coastal areas are radiation fog and advection or sea fog. Radiation fog forms when heat from the ground is lost through radiation, usually at night when there is a clear sky. The heat loss causes the static or near static layer of atmosphere in contact with the ground to be cooled below its dew point. Advection fog develops when a warm moist air mass moves over a cold surface and is cooled to below its dew point.

1.5.10 The New Zealand Pilot (Admiralty Sailing Directions NP 51), states that fog is not frequent [in Bluff] but may be expected in spring and autumn. The operators of the port service vessels indicated that any fog encountered in Bluff was usually either patchy or was stratified to such an extent that either the pilot vessel or tugs could see under it or the pilot conning a ship could see over it. This was not the case on 8 October 2002.

1.5.11 The weather conditions at the time the ship sailed from its berth were clear and calm. It was only after the ship had swung in the basin and let go the tugs that the pilot noticed any decrease in visibility. The master of the *Monowai* said he noticed “a haze in the air” when his tug was being let go from the ship at 0446. After the tug’s line was recovered, approximately 3 minutes later, the master of the *Monowai* looked up and saw the fog. When the pilot requested that the *Monowai* lay in line with No. 3 leads, the tug master had to leave the flying bridge so he could use the radar, situated at the tug’s lower manoeuvring position, to locate No. 3 leading beacons.

1.5.12 The pilot and the crews of the port service vessels noticed haze and light fog patches soon after the ship has completed its swing off Island Harbour and it was another 4 or 5 minutes later before the port service vessels and the ship were rapidly engulfed in thick fog that had rolled onto the harbour from the marshes to the north; almost instantly reducing the visibility to zero.

1.5.13 The skipper of the *Awarua* was the first to become aware of the presence of fog. The pilot vessel left its berth shortly after 0330. Soon after clearing the Town Wharf, the skipper noticed that there were patches of fog around the lights near Tiwai Point but otherwise the visibility was good. At about 0345, as the *Awarua* proceeded down the channel, in the vicinity of Argyle beacon, the fog became thicker, rolling in from the marshes and land to the north or north-east of the harbour. The skipper did not inform the pilot of the developing fog. At about this time, the ship had completed its turn in the basin and was coming onto No. 3 Reach; the pilot asked the pilot vessel skipper to position the *Awarua* in line with the Davey leading lights. When the pilot vessel was about 200 m from the front leading light, the fog had become so thick that the skipper lost sight of the Davey leading lights and needed to use his radar to maintain his position.

1.5.14 The marine manager, who lived in Invercargill, noticed fog at the north end of the city at about 0230, when he left home to drive to Bluff to join the *Hauroko*. However, he did not see any fog on the marshes between Invercargill and Bluff, the normal indicator that fog could be expected in the harbour and so thought the fog was restricted to Invercargill city and that he was unlikely to see fog in the harbour.

1.5.15 There is no fully slack water in the port of Bluff. The tidal streams swirl around the inner harbour. Around the time of high water, the flood continues to run in the northern part of the harbour, in way of Tiwai wharf, while the ebb tide starts to flow on the Island Harbour or southern side of the harbour. The narrow entrance causes strong tidal streams in the vicinity of the approach channel. The tide generally runs in the direction of the channel except that the flood tide tends to flow more to the north, towards Tiwai Wharf at the inner end of the channel.

1.5.16 The maximum spring range of tides in Bluff was 2.7 m and the minimum neap range was 1.2 m. The range at the time of the accident was 2.6 m, and therefore a spring tide.

1.5.17 The predicted tidal data for Bluff as detailed in the New Zealand Nautical Almanac for 7/8 October 2002, was:

Low Water		High Water		Low Water	
07/10/02 2133	0.4 m	08/10/02 0342	3.0 m	08/10/02 1000	0.4 m

1.5.18 South Port produced and used their own tidal information, which predicted the high and low water slack at the Bluff tide beacon, and was:

Low water		High water		Low water	
07/10/02 2200	0.4 m	08/10/02 0415	3.0 m	08/10/02 1030	0.4 m

1.5.19 The tidal data printed on chart NZ 6821, Bluff Harbour and Entrance, showed that the tide at position "C", midway along the approach channel could be expected to flow in a direction of 310°(T) at 1.2 knots during spring tides at high water. An hour before high water it was predicted to flow in a direction of 319°(T) at 3.2 knots. At position "D", between No. 3 beacon and Tiwai Wharf, the tide could be expected to flow in a direction of 038°(T) at 0.5 knots during spring tides at high water. An hour before high water it was predicted to flow in a direction of 333°(T) at 1.6 knots.

1.6 Description of the port

1.6.1 The port of Bluff was located on the southern side of Bluff Harbour. An aluminium smelter with its own wharf was situated on the northern side of the harbour at Tiwai. The harbour was accessed through a narrow entrance comprising of 3 reaches. From seaward, a ship steered 031°(T) on No. 1 leading line. On this track there was a large sandbank to the east and Bluff Hill to the west. As a ship approached Stirling Point on its port side, No. 2 leading line came to bear and the ship was brought onto No. 2 Reach on a course of 351°(T). On this track the ship was heading towards Tiwai Point, still with sand and mud to starboard but with a rocky shore ahead and to port. No. 3 Reach, 313°(T), had leading markers at each end and 3 light beacons on either side of the narrow approach channel, which had a maximum navigable width of approximately 100 m. To the outer end of the reach were the Davey leading light beacons and at the inner end were No. 3 leading light beacons. On the north-eastern side of this channel were Nos. 1, 2 and 3 beacons (numbered from seaward), which marked the edge of gnarly shoal ground off Tiwai Point. On the south-western side were Channel Rocks, Argyle and Tidal beacons, which marked the edge of rocky shoal water. The controlling depth of the port was in No. 3 Reach with a minimum of 8.5 m of water above chart datum. The inner harbour had a maintained depth of 9.2 m.

1.6.2 Bluff Harbour was a natural harbour with an area of approximately 5500 hectares. The entire water movement for the harbour passed through the narrow approach channel, causing strong tidal streams of up to 7 knots to run at mid tide on both the flood and the ebb. In 1998, in preparation for the use of the ship simulator in Launceston, an Acoustic Doppler Current Profiler survey of the tidal currents in Bluff harbour was carried out. This survey indicated that at high water and high water minus 30 minutes the flood tide continued to flow at about 2 knots through the channel and towards Tiwai wharf. On the southern side of the harbour the ebb tide started to flow about one hour before high water, resulting in tidal eddies forming between the inner end of the channel and Island Harbour.

1.6.3 The distance from the basin where the ship was swung to the beginning of the channel was 0.65 nm.

1.6.4 For the conditions at Bluff, and for a ship of the size of the *Tai Ping* the Permanent International Association of Navigation Congresses recommends that a straight channel should be a minimum of 3.3 times the beam of the ship, which equates to 86 m. The Bluff approach channel exceeded this minimum.

1.6.5 The strength of the tidal stream necessitated that the movement of ships be confined to a tidal window of one hour either side of slack water.

1.7 Pilotage, passage planning and bridge resource management

1.7.1 Owing to the nature of the port, the pilotage in Bluff was work intensive for the pilots. It was necessary for them to constantly adjust courses, monitor the results and then adjust them again to ensure a ship remained in the centre of the channel. The pilot, in common with the other South Port pilots, gave helm orders rather than course requirements to the helmsman.

1.7.2 When the pilot boarded the ship at 0310 the pilot/master interchange took place. The master gave the pilot the ship's pilot card containing the ship's details. The pilot and master signed the card to acknowledge its receipt. The pilot presented his 2-page passage plan to the master. The first page contained the time of high water slack, the height of tide and the calculated under keel clearance and a description of how the ship would be swung after leaving the berth. The second page contained a chartlet with details of the courses to be steered, the positions of lights and minimum depths in the channels. The pilot's intentions were discussed and agreed with the master. As the weather was clear at the time, the pilot did not consider the possibility of reduced visibility and consequently no contingency plans were discussed.

1.7.3 The ship's navigating officer had prepared a passage plan for the pilotage. This consisted of a basic course card with waypoints, and the courses and distances between the waypoints. The positions used were to the nearest 0.1' (0.1 nm), which was insufficiently accurate for navigating in the tight confines of the harbour. A list of relevant publications that might be referred to was included. There was no provision either in the plan or on the chart of clearing distances or parallel index lines for monitoring the progress of the ship through the pilotage. No contingency plans were contained in the passage plan.

1.7.4 The courses and distances shown on both the pilot's and the ship's passage plans were identical.

1.7.5 The South Port procedures manual contained flow diagrams for the actions that should be taken before and during the unberthing of a departing ship. In that flow diagram there was a query box "Weather conditions acceptable", with a yes/no response to determine the next action. No guiding notes were provided for the pilots defining acceptable weather conditions nor were there any contingency plans for unexpected events during the pilotage. The marine manager indicated that while there were no documented procedures for operating in restricted visibility, the normal operating practice was for shipping movements to be postponed until the conditions improved.

1.7.6 The third officer was monitoring the ship's progress by plotting positions from the GPS receiver on the chart. The starboard radar was available for his use but he had not set it up to monitor the ship's progress, and stated that he did not use it prior to the grounding.

1.8 Previous incident

1.8.1 On 19 August 1985, a deeply laden vessel, the *Trinta*, outward bound from Tiwai Wharf, grounded on the northern side of the approach channel between No. 3 and No. 2 beacon. High water was predicted at 0328, with slack water at 0358. As the ship approached No. 3 beacon, it was set down onto the beacon, so the pilot adjusted the course to starboard to 140°(T). The pilot was unable to apply further starboard course alterations as the stern would have made contact with the beacon. The ship cleared No. 3 beacon but continued to be set to the northern side of the channel. Almost immediately, at 0336, the ship grounded on the northern side of the channel. The edge of the channel was steep-to and resulted in the ship being pinned onto it rather than running hard aground. The ship was re-floated, with the assistance of tugs in less than an hour. In their reports, the pilot and the harbourmaster indicated that there was an unusual sudden surge of tidal stream, which caused the ship to be pushed to the northern side of the channel and ground.

1.9 Human factors

1.9.1 The pilot's style of conning a ship relied heavily on visual references. The ship's course made good was monitored using the leading lights, and its position in the channel was referenced to the channel markers. When the pilot realised that the visibility was becoming restricted he put in place a number of strategies to assist him to negotiate the channel. He requested that the pilot vessel station itself on the leading line and asked the *Hauroko* to precede him down the channel so that the pilot could use the tug lights as a guide and asked the *Monowai* to position itself on No. 3 leading line to give him a reference astern. In addition, he continued conning the ship, adjusting its speed and observing the radar.

1.9.2 Stress, attention and workload are 3 related factors that affect human performance. Stress is the body's response to stressors. Attention is the ability to focus one's mind on information providers or senses. The mind does have a limitation on the amount of information that can be absorbed and processed at any one time, consequently we may channel our attention to what we perceive as important or relevant to the exclusion of other information. Workload is the amount of work that an individual is required to do at any one time.

1.9.3 When the demands of certain tasks approach or exceed the capability of an operator, stress develops; this is termed task or acute stress. One of the primary outcomes of this type of stress is that the person starts to load-shed and focuses on one or more tasks to the exclusion of others. An extreme form of load-shedding results in channelled attention where an individual gives all their attention to one aspect of the situation. Load-shedding and channelled attention are primary symptoms of poor situational awareness, preventing an operator from forming an accurate overall mental model and enabling them to take the correct action to recover from an unexpected situation.

1.9.4 When an unexpected event occurs, an individual's workload suddenly increases as they react to the situation. The effect of this sudden increase in workload can be minimised by having practised contingency plans in place, thus saving the individual the need to go through the involved cognitive process of forming a plan, evaluating whether it would be successful and then implementing it. Contingency planning reduces an individual's workload and reduces the likelihood of load-shedding.

1.9.5 Humans can suffer from hazardous attitudes from which hazardous thoughts develop and affect the standard of their decision-making. These attitudes depend upon an individual's characteristic and the type of environment they are operating in. Factors that influence decision-making are commercial pressure, peer pressure and the corporate environment in which the decisions are made.

1.9.6 The pilot had had extensive training as a pilot but had never been trained to operate in reduced visibility or to practise techniques that could be of assistance in such conditions. Consequently, when he lost visual references he tried to initiate strategies that would assist him to navigate the channel; this increased his workload dramatically.

1.9.7 From laboratory studies, workplace studies and incidents and accidents in a variety of industries, there is clear evidence that due to the body's circadian rhythm, people are more prone to making errors and are less alert during the early hours of the morning[2].

2 Analysis

2.1 At an average speed of 5 knots it would have taken the ship about 7½ minutes to cover the distance from the turning position to No. 3 beacon. The ship's movement book confirms this showing a difference of 8 minutes between the time of letting go the forward tug, at the completion of the swing, and the ship grounding.

2.2 The short distance between the position where the ship was swung and the start of the channel meant that the pilot was committed to negotiating the channel almost as soon as the ship was aligned on No. 3 Reach. When the pilot realised that the fog was so dense and was going to impede visibility in the channel, it would have been imprudent for him to attempt to stop or turn the ship in that position.

2.3 Although fog was not common in Bluff it was known to occur occasionally in spring and autumn. The general weather conditions prevailing at the time were conducive to the formation of radiation fog and should have alerted those at the port to the possibility. Having seen fog in

[2] Professor Philippa Gander, 15 March 2001, TAIC 01-205 *Spirit of Resolution* grounding, from numerous references.

Invercargill, the marine manager should have been even more aware of the possibility of reduced visibility.

2.4 When the fog engulfed the channel it did so rapidly, becoming very dense and severely reducing visibility almost instantly. This was consistent with radiation fog being blown from the marshes to the north by the light northerly wind.

2.5 Observation of the trend of the dew point and air temperature lines on the graph in Figure 6 would have enabled an observer to predict the likelihood of fog in the early hours of the morning. This facility was not available to South Port staff.

2.6 The master of the *Hauroko*, who was also the marine manager of the port and one of the senior pilots, did not see the need to have an operational radar, or even one in standby mode, for what appeared to be a normal manoeuvre on a night with good weather. He had not identified that fog might affect the visibility in the port. However, the lack of an operational radar on the *Hauroko* resulted in the tug deviating from the leading line of the channel and its master becoming disorientated.

2.7 One of the strategies that the pilot devised to help overcome the effect of the fog was for the *Hauroko* to precede the ship down the channel to give the pilot an additional reference point. However, the pilot had not taken into account the possibility that the tug master may also be unable to see the leading lights and have difficulty staying in the centre of the channel. The pilot indicated that he was following the *Hauroko* visually and by radar, and so the tug being off course to the north of the channel might have initiated the ship's movement towards the northern side of the channel.

2.8 There is always commercial pressure to expedite a ship's departure from a port, particularly one that has a restrictive tidal window, such as Bluff. However, South Port pilots had postponed the departure of other ships in adverse weather conditions when considered prudent. On this occasion, it would not have been commercially expedient for the pilot to postpone the ship's departure on the chance that fog may possibly form, but once the reduction of visibility of the Davey leading lights had been noted, it would have been prudent to hold the ship in the harbour until the extent of the fog could be ascertained.

2.9 The ship's draught was such that it could have sailed at either high or low tide. Consequently, had the pilot aborted the sailing because of reduced visibility the ship would have only been delayed by a maximum of 6 hours.

2.10 The port company procedure of postponing ship movements when fog was present prevented the pilots becoming practised in the techniques that would assist them. Pilotage in the port was almost exclusively carried out using visual references. There was no evidence that the pilots practised position-monitoring techniques on the radar during pilotages in good visibility.

2.11 The master of another ship that regularly used Bluff questioned the radar identification of the approach channel beacons. It is possible that targets, such as the beacons, could be lost in clutter or be suppressed by sea or rain anti-clutter controls in a poorly adjusted radar. However, the radar image in figure 5, which was taken on 9 October 2002 and was the same range and display as at the time of the grounding, clearly identified the channel beacons, particularly to someone who had extensive experience in the port. The pilot confirmed that he was able to clearly identify the beacons on the radar.

2.12 The reduction of speed when the pilot realised the loss of visibility had 2 effects. Firstly, the ship's speed fell below that at which steerage was lost and secondly, the tidal stream would have had more influence on the slow moving ship, setting it to the north, towards Tiwai Wharf.

2.13 The confusion between the bridge personnel over the heading of the ship when they sighted No. 3 beacon was possibly indicative of the stress they found themselves under when the visibility closed in. The heading of 155° was remembered vividly whereas the alternatives of 135° or

140° were less positively remembered. It is possible that at the time of encountering the fog either the master or the pilot asked the common question of "how's your head". Because of the helmsman's lack of English, the third mate would probably have answered such a query and would have called out the heading from the GPS receiver that was on the chart table right in front of him. As he later indicated, the 155° figure he thought was the heading was actually the bearing of the next waypoint.

2.14 Had the ship been heading 155° when the pilot saw No. 3 beacon, to ground in the position it did, the ship would have had to turn through an impossibly large angle, at least 80° to port, in a very short distance, about 250 m.

2.15 When the pilot sighted No. 3 beacon close to port, he ordered port helm be applied. Had there been open water to port this may have been a reasonable action to avoid contact with the beacon. However, with the pilot's knowledge and experience of the port and the configuration of the approach channel he must have realised that such an action would, in addition to swinging the stern away from the beacon, turn the bow of the ship to port, out of the channel and onto the rocky shoal ground. Once No. 3 beacon had been sighted close on the port side of the ship, the only action that would have prevented the ship running aground would have been, to keep the helm amidships until the beacon had passed, even if the stern of the ship hit it, and then apply starboard helm in an attempt to regain the centre of the channel.

2.16 If the pilot thought that the ship was heading 155° at the time of sighting No. 3 beacon, a bold alteration of course to port would have been reasonable to avoid contact with the beacon and bring the ship back into line with the channel.

2.17 The flood tidal stream set generally along the line of the approach channel but tended slightly towards the north. Inside the harbour, tidal eddies occurred but on the northern side of the harbour, in the vicinity of Tiwai Wharf, they tended towards the north in the hour before high water. Consequently, the *Tai Ping* would have been consistently set towards the north as it proceeded down No. 3 Reach. Poor visibility, lack of visual cues and his preoccupation with putting alternative strategies in place might have prevented the pilot being aware of this and so prevented him from steering the courses necessary for the ship to gain the centre of the approach channel.

2.18 South Port had contracted the Australian Maritime College to make a computer model of Bluff and to run simulator-training courses for its pilots. The course the pilot and his colleague attended in July 2002 was designed to assist them increase the tidal window parameters for all ships and to possibly increase the size of ships able to negotiate the approach channel. All the simulator-training runs were carried out assuming good visibility, so visual cues, such as leading line and channel beacons were available. Simulation is an ideal medium for practising handling ships in unusual conditions. The opportunity to practise instrument only navigation using radar alone, as required by the South Port pilot/tug master training manual, was missed. Had such training been part of the course, the pilot would have been better prepared to handle the situation he faced on the morning of 8 October 2002.

2.19 Coastal weather forecasts cover large parts of the coastline and extend up to 60 nm seawards and specifically exclude harbours and small bays. Forecasters tended to predict the worst weather patterns that were likely to occur during the period of validity of a forecast. On the day of the grounding, the Foveaux area forecast included a gale warning, something not usually associated with fog. This may have led the South Port personnel to discount the possibility of fog occurring despite the actual prevailing weather conditions being conducive to it forming.

2.20 The grounding of *Trinta* in 1985 and this occurrence had similarities. Each event happened on a spring high tide early in the morning, the ships were large and relatively low powered and the ships grounded on the north-eastern side of the channel. However, there were also significant differences between the 2 accidents. When the *Trinta* grounded there was no reduction of visibility, the ship was heavily laden, there was evidence of an unusual and unpredicted sudden increase in tidal flow, and the pilot applied starboard helm rather than port, which caused the ship to lie along the north-eastern side of the channel rather than running hard aground.

2.21 The *Tai Ping* did not have a clearly visible compass repeater that the pilot could use to con the ship from the port side of the wheelhouse. Once he had moved to the port side, adjacent to the radar his only means of determining the heading was from the radar display. The absence of clearly visible compass repeaters may partially explain why the bridge personnel had different recollections of the heading of the ship in the period leading up to the grounding.

2.22 Once No. 3 beacon had been sighted from the bridge of the *Tai Ping*, the natural reaction would have been for the pilot and master to go to the port bridge wing to check that the ship had missed it. Such action would have also distracted them from monitoring the course of the ship.

Human factors

2.23 The strategies that the pilot put in place when he became aware of the reduced visibility took time to organise and he had to communicate his requirements to the master of each of the other vessels. This was in addition to the other tasks associated with conducting the safe navigation of the ship, so causing his workload to peak suddenly.

2.24 The pilot vessel skipper first noticed the fog while the *Tai Ping* was swinging off Island Harbour. Soon after, as the pilot vessel proceeded down the channel, the skipper noted that the fog had become dense, severely restricting visibility. When the pilot noticed haze around the Davey leading lights and requested the skipper to align the pilot vessel with those leads, the skipper did not inform the pilot of the intensity of the fog. Had the skipper done so at that time, it might have alerted the pilot to the risk of losing all visual references and have been sufficiently early for him to have aborted the sailing and re-secured the ship safely.

2.25 Bridge Resource Management training emphasises the need to recognise "hazardous thoughts" and replace them with opposite "safe thoughts". Three hazardous thoughts and their opposite safe thoughts, as used in Bridge Resource Management concepts, were relevant to the master of *Hauroko* when he decided that it was unnecessary to switch his radar to standby before leaving the berth.

Hazardous Thought	Safe Thought
It won't happen to me	It could happen to me
I can do it	Why take chances
We've always done it this way	It's about time we changed

The master of the *Hauroko* had been operating in the port, both as a pilot and tug master for 20 years and didn't consider the possibility of becoming lost in the channel. When he became lost he thought about using the radar but was preoccupied handling the tug so was unable to turn the radar on; he asked his crew if they knew how to turn the radar on, but they were unable to operate it. Consequently, the one piece of navigational equipment specifically designed to assist a ship in reduced visibility was not used.

2.26 The skipper of *Awarua* considered that it wasn't his duty to inform the pilot about the fog or that it was rapidly thickening and obscuring the navigation aids. Bridge Resource Management concepts consider this to be a hazardous thought and shows that the skipper was not acting as part of a cohesive team.

2.27 When he became aware of the fog, the pilot should have changed from visual pilotage to instrument only pilotage. He focussed on arranging the port service vessels to assist him continue visual pilotage, rather than preparing to navigate by radar alone. Restricted visibility was outside his normal routine and a situation for which he had not practised nor been trained, in other words he was acting instinctively and not operating to any well thought out plan. Task or acute stress would have resulted and was likely to cause task shedding and, in its extreme form, channelled attention and loss of situational awareness.

2.28 To steer a ship under normal conditions in Bluff took concentration but to monitor the ship's progress and con the ship required uninterrupted concentration. The restricted visibility was a severe distraction and it is probable that it partially diverted the pilot's concentration from his principle task of conning the ship while he arranged alternative strategies. The pilot conned the ship using helm orders, as was normal among the South Port pilots. Should a pilot become distracted while conning the ship, the helm would remain in the position that he last ordered and the ship would continue to respond to that helm until the pilot gave another helm order, leaving the helmsman without a course to steer.

2.29 It was unclear why the pilot recalled the ship's heading to be 155° immediately before sighting No. 3 beacon. It was possible that the master or third officer called out that figure at a time when the pilot was under a very high workload and that figure registered above the other information he was receiving at that time. It was also probable that following the accident the pilot referred to the ship's movement book, which would have reinforced his memory of 155°.

2.30 There were sufficient, clearly visible, rudder indicators in the wheelhouse and on each of the bridge wings, so the pilot, master and third officer should have been aware of the position of the helm at any time.

2.31 The standard of resource management on the bridge of the *Tai Ping* was less than optimum. No guidelines had been set for challenge and response to the pilot's actions. There was uncertainty recalling the courses steered and the helm orders given by the pilot prior to the grounding. The third officer was writing up the movement book and plotting the occasional position on the chart from the GPS and the helmsman was repeating the helm orders back the pilot and applying the ordered helm. The master was on the port side of the bridge and not in a position to closely monitor the courses steered. With no challenges made to his actions, the pilot was left in virtual isolation and was susceptible to one-man error and task overload.

2.32 A cultural difference existed between the pilot and the bridge team that would have made a challenge to his orders unlikely, particularly from the third officer and helmsman, where there was a large authority gradient. The master was on his first visit to Bluff and had little knowledge of the port and therefore deferred to the pilot's advice throughout, considering the pilot's extensive local knowledge made him best qualified to navigate the ship.

2.33 Bridge Resource Management is specific to the way personnel relate to each other on a ship's bridge. On this occasion, there were management deficiencies on the ship but they also extended to the interaction between the personnel on the port service vessels.

2.34 During the week leading up to the accident, the pilot carried out approximately one operational act of between one and one and a half hours duration each day. In addition to operational duties, he was in the office for 2 days during the period to carry out administrative duties. The duties and workload of the pilot did not indicate that fatigue was a contributory factor in the accident. Notwithstanding the above, owing to the circadian cycle, all the personnel involved in the grounding would have found it more difficult to concentrate and maintain alertness at that time of the day.

3 Findings

Findings and safety recommendations are listed in order of development and not in order of priority.

3.1 On its departure from Bluff, the *Tai Ping* encountered dense fog before leaving the approach channel and grounding.

3.2 Soon after the ship had left its berth, there were indications that fog was forming over the marshes to the north. However, when the fog moved onto the harbour, the pilot and the personnel on the port service vessels were surprised by the speed that it engulfed them and almost immediately obliterated all visual references.

3.3 Once in the fog, all the harbour navigation aids were obscured causing the pilot to lose situational awareness.

3.4 The tidal stream set the ship to the north and without visual cues the pilot was unable to monitor the effect the tidal stream had on the ship.

3.5 When confronted by the fog, the pilot's workload increased dramatically and he took time to devise strategies to enable him to continue visual pilotage rather than immediately instigate instrument only navigation techniques.

3.6 The increased workload on the pilot would have heightened his stress, making him vulnerable to load-shedding and channelled attention.

3.7 The pilot used the *Hauroko as* both a visual and radar reference point. The *Hauroko's* master became lost and the tug was displaced to the north-eastern side of the channel, possibly causing the pilot to con the ship to the north of the channel.

3.8 The loss of steerage resulting from the pilot stopping the engine, to reduce his speed, probably resulted in the ship steering more to the north than the pilot intended.

3.9 The ship grounded shortly after the pilot had ordered port helm to prevent the stern of the ship colliding with a beacon that was unexpectedly sighted close to port and before corrective starboard helm could be applied.

3.10 The absence of reliable course recorder data and the confusion among the bridge personnel made it impossible to confirm the courses the ship steered prior to the grounding. The pilot may have made the alteration of course to port based on his perception that the ship was heading 155° when No. 3 beacon was sighted.

3.11 The skipper of the pilot vessel was well placed to alert the pilot to the deteriorating visibility in the channel but did not do so and thus denied the pilot the opportunity to abort the departure.

3.12 The pilot did not consider aborting the ship's departure when he first noticed the decreasing visibility.

3.13 By the time the *Tai Ping* entered the dense fog, its position was such that the pilot was unable to either stop or turn the ship around with any degree of safety.

3.14 The Bluff approach channel was sufficiently wide for the *Tai Ping* to transit, but the severe tidal streams that could be experienced made it a difficult pilotage. When those tidal streams were combined with reduced visibility the channel became exceptionally difficult to negotiate.

3.15 There were no written operating procedures covering the movement of ships in restricted visibility nor were there contingency plans for the sudden loss of visual cues.

3.16 The South Port pilot/tug master training manual required staff to receive training with peer reviews for instrument only navigation but this had not occurred for any of the pilots. Had the pilot been trained in instrument only techniques on the simulator he would have been better equipped to properly manage the situation.

3.17 The port practice of suspending shipping movements in reduced visibility precluded any of the pilots gaining experience in managing ships under those conditions.

3.18 The Foveaux weather forecast area covered a large coastal area and was not necessarily accurate for Bluff Harbour but there were no weather forecasts specifically for the port of Bluff.

3.19 Despite the prevailing meteorological conditions and the knowledge that fog could be expected in spring and autumn, none of the personnel at South Port had anticipated that fog was likely and consequently no precautions were taken against that likelihood.

3.20 Resource management and communications both on the ship and between the port service vessel operators was less than optimum.

3.21 Fatigue does not appear to have contributed to this accident, but as it occurred at a time when the body's circadian rhythm was at its lowest point, all the personnel may have been less alert than they might otherwise have been during other parts of the circadian cycle.

4 Safety Recommendations

4.1 On 20 May 2003, the Commission recommended to the General Manager of South Port Limited that he:

4.1.1 evaluate South Port's pilot/tug master training programme including the use of the simulator to determine the most efficient method of ensuring that all staff are suitably equipped to respond to any operational eventuality. Emphasis should be given to instituting a training programme in instrument only navigation techniques for all South Port pilots, in line with that prescribed in the pilot/tug master training manual (001/03).

4.1.2 determine the availability of weather forecasts specifically for Bluff and the port environs (002/03).

4.1.3 promote the bridge resource management concepts by requiring pilots to use them at every opportunity (003/03).

4.1.4 promote resource management concepts throughout the operational staff of the port (004/03).

4.1.5 review the company's procedure manuals with the purpose of ensuring that there is sufficient information available for personnel responsible for making critical decisions to make informed judgements. Wherever possible, foreseeable risks should be addressed and contingency plans put in place and practised (005/03).

4.2 On 11 June 203, the Chief Executive of South Port Limited responded, in part, as follows:

> South Port continues to attach high importance to maintaining a safe and effective maritime operation, and to changing its procedures when that appears appropriate.
>
> The Company has commissioned a comprehensive risk assessment for its marine operation, which is scheduled to be completed in late June 2003. When the report on that assessment is received, South Port will review all current information which has a bearing on the safety of its marine operation, including the Commission's findings, with a view to making any appropriate changes.

Approved for publication 26 May 2003

Hon W P Jeffries
Chief Commissioner

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