



Report 01-206

liquefied petroleum gas (LPG) carrier

Boral Gas

grounding

Papakura Channel, Manukau Harbour

15 April 2001

Abstract

On Sunday 15 April 2001, at about 2327, the liquefied petroleum gas carrier *Boral Gas* was outbound from the terminal in Papakura Channel in Manukau Harbour with 14 crew and a licensed harbour pilot on board when it grounded in soft mud on the north side of the channel. After nearly 2 hours the ship was refloated and continued its passage. There were no injuries and the ship suffered no structural damage. The grounding resulted from the pilot losing situational awareness primarily due to 4 consecutive light beacons marking the channel being extinguished.

Safety issues identified included:

- the maintenance and monitoring regime for navigation aids in Manukau Harbour
- the configuration of the navigation aids in Manukau Harbour
- the traffic management system for Manukau Harbour
- the pilotage system for Manukau Harbour
- the adequacy of procedures for controlling liquefied petroleum gas carriers manoeuvring in Manukau Harbour
- the adequacy of current legislation for licensing and monitoring maritime pilots in New Zealand
- the breakdown of effective bridge resource management on the bridge of the *Boral Gas*.

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Boral Gas

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Glossary

aweigh	when an anchor is broken out of the ground and the cable is vertical
bridge	structure from where a vessel is navigated and directed
chart datum	zero height referred to on a marine chart
class	category in classification register
con	direct the course and speed of a ship
double bottom tank	tank at the bottom of a ship formed by the inner and outer bottom plating of hull
draught	depth in water at which a ship floats
even keel	draught forward equals the draught aft
fore peak tank	tank forward of collision bulkhead
gross tonnage	a measure of the internal capacity of a ship; enclosed spaces are measured in cubic metres and the tonnage derived by formula
knot(s)	one nautical mile per hour
port	left-hand side when facing forward
set	allowance applied to the course steered to counteract the effect of tide or current
sounding	measure of the depth of a liquid
starboard	right-hand side when facing forward
track	the path intended or actually travelled by a ship
trim	difference between the forward and aft draughts of a floating vessel

Abbreviations

ARPA	automatic radar plotting aid
AIAL	Auckland International Airport Limited
cm	centimetre
GPS	global positioning system
IALA	International Association of Lighthouse Authorities
ISM	International Safety Management, IMO
IMO	International Maritime Organisation
kW	kilowatt
LINZ	Land Information New Zealand
LPG	liquid petroleum gas
m	metres
m ³	cubic metres
mm	millimetres
MSA	Maritime Safety Authority
nm	nautical mile
POAL	Ports of Auckland Limited
SOLAS	International Convention for Safety of Life At Sea
t	tonnes
UTC	universal time co-ordinated

Data Summary

Vessel particulars:

Name:	<i>Boral Gas</i>
Registry:	Vanuatu
Type:	liquefied petroleum gas (LPG) carrier
Classification:	ABS + AI(E), AMS, ACCU
Class:	VII foreign going cargo vessel (SOLAS)
Length overall:	84.30 m
Breadth:	13.56 m
Summer draught:	5.01 m
Summer displacement:	3909 t
Gross tonnage:	2602 t
Cargo capacity:	2300 m ³
Construction:	steel, double hull
Built:	1990 by Fulton Marine, Belgium
Propulsion plant:	a single 2045 kW Wartsila R32BC medium speed diesel engine, driving a single 4-bladed, controllable pitch propeller
Service speed:	11.5 knots
Manoeuvring aids:	one 250 kW bow thruster one Ulstein high lift rudder
Owner:	Boral Gas NV
Operator:	Origin Energy Contracting Limited, Sydney, Australia
Persons on board:	crew 14 pilot 1
Injuries:	nil
Damage:	patches of anti fouling paint scraped from hull
Location:	Papakura Channel, Manukau Harbour, Auckland
Date and time:	Sunday 15 April 2001, at about 2327 ¹
Investigator-in-charge:	Captain W A Lyons

¹ All times in this report refer to New Zealand Standard Time (UTC + 12 hours) and are expressed in the 24 hour mode.

1. Factual Information

1.1 History of the voyage

- 1.1.1 The LPG carrier *Boral Gas* departed New Plymouth at about 1700 on Saturday 14 April 2001, bound for the Liquigas Limited LPG terminal in Manukau Harbour. On board were 14 crew and a harbour pilot licensed for Manukau Harbour and Bar. While in New Plymouth the ship had loaded 1010 t of LPG for discharge at the terminal.
- 1.1.2 The pilot was contracted by the operator to conduct the pilotage of the *Boral Gas* both in and out of Manukau Harbour. He joined the ship in New Plymouth and completed the round trip to Manukau Harbour.
- 1.1.3 On 10 April 2001, the pilot had sent a facsimile to the ship's agent in New Plymouth advising what he considered to be the optimum times to cross Manukau Bar for the inward and outward passages. The agent forwarded the message to the master of the *Boral Gas*. The times were detailed as follows:

Cross Manukau Bar	1300 hrs Sun 15 April
Arrive Terminal	1500 ~ ~ ~
Depart Terminal	1100 hrs Mon 16 April
Clear Bar	1330 ~ ~ ~

- 1.1.4 Before departing New Plymouth the pilot telephoned both the Onehunga port co-ordinator and the signalman on South Head and advised them of the above times.
- 1.1.5 During the voyage north to Manukau Harbour the master and pilot discussed crossing Manukau Bar and the transit of the harbour. It was the master's first trip into Manukau Harbour. During the discussion the pilot told the master that he had been visiting the harbour for the past 40 years. The pilot explained to the master that it was not unusual to encounter strong tidal flows and currents, especially when crossing the bar, which may require as much as 30 degrees set being applied to the ship's course in order to keep to the track. The master gave the pilot a pilotage information card detailing the relevant ship information.
- 1.1.6 The inward passage went without incident and at 1442 on Easter Sunday, 15 April 2001, the *Boral Gas* berthed starboard side alongside the Liquigas LPG terminal in Papakura Channel. Cargo discharge started at 1520 (see Figure 1).
- 1.1.7 At about 1800 that day the master was informed that the terminal supervisor had requested the ship depart the terminal on completion of cargo operations and proceed to anchor to await crossing the bar. The master was under the impression the agent had told him the ship was to depart the terminal at 1100 on Monday 16 April. The agent later stated that before the ship left New Plymouth he had informed the master verbally that Liquigas may request the ship depart the terminal on completion of cargo operations.
- 1.1.8 The master contacted the terminal supervisor and questioned the decision. He was informed by the terminal supervisor that unless there was a safety issue involved, the ship was to depart the terminal on completion of cargo as there was no labour organised to let the mooring lines go the next day and it was expensive to call staff back. After further discussion the master agreed to depart the terminal and asked for the request to be put in writing and faxed to the agent in New Plymouth, to which the terminal supervisor agreed.

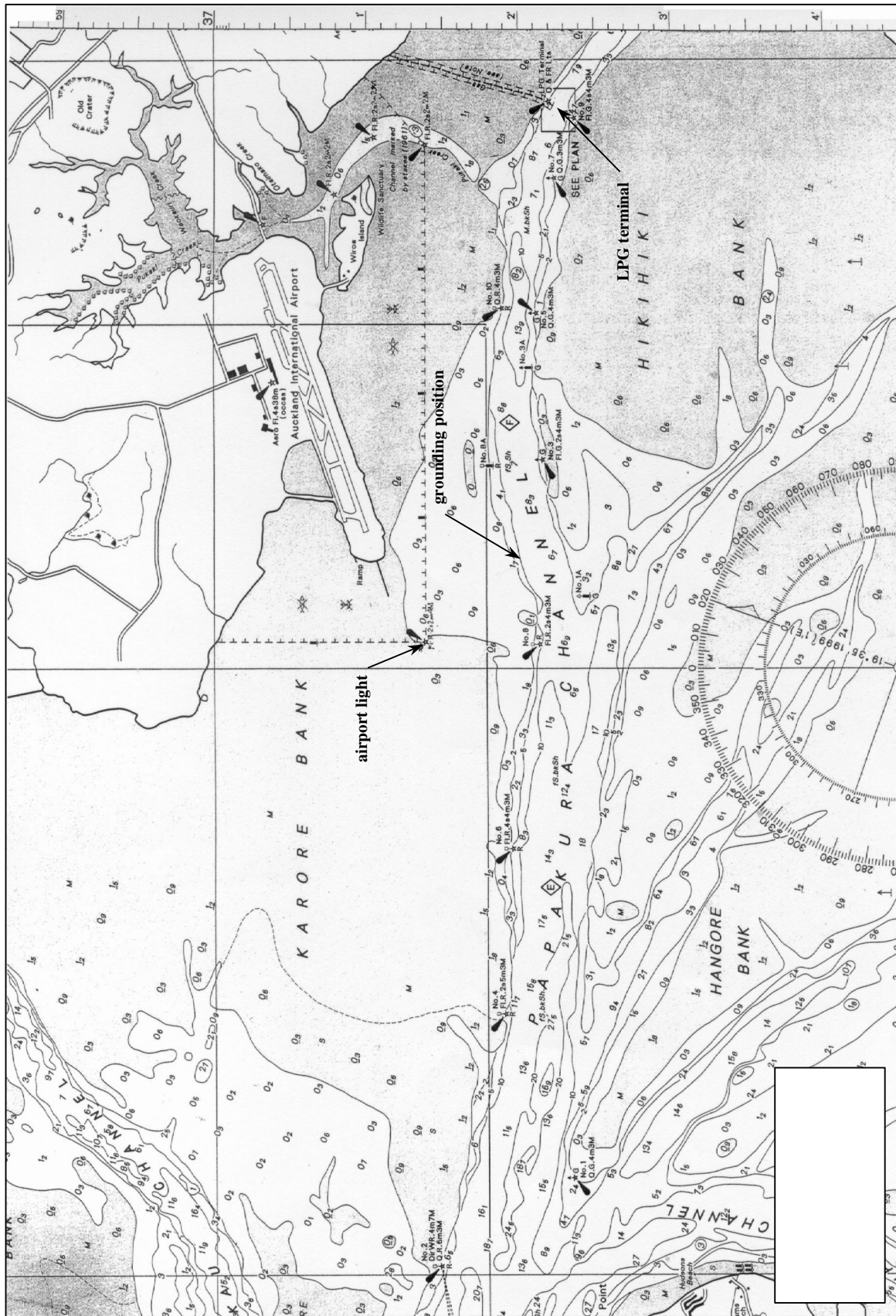


Figure 1
Part of chart NZ 4314 showing Papakura Channel

- 1.1.9 At 2230 the second mate tested the bridge equipment and found everything in order. He started all the usual bridge equipment, including both radar sets. He had superimposed the ship's intended track on the starboard radar screen and set up an electronic parallel indexing² line 0.97 nm off the south-western tip of the airport runway as was stipulated in the passage plan. The port radar was not gyro stabilised and at the pilot's request was set up with a ship's-head-up display.
- 1.1.10 The pilot arrived on the bridge at about 2235 to prepare for departure. He observed through binoculars that the lights on beacons 5, 7, 9 and 10 were operating but could not see any other light beacons from the berth.
- 1.1.11 Cargo discharge was completed at 2247. The departure draught was 2.80 m forward and 4.70 m aft. The engine was put on standby at 2254 and at 2300 the pilot ordered the lines let go and manoeuvred the ship clear of the wharf. The helmsman was hand steering to gyro compass courses ordered by the pilot. The second mate was monitoring the starboard radar and plotting the ship's position periodically on the chart. The master was operating the engine controls and monitoring the overall situation.
- 1.1.12 At 2302 the engine was put to slow ahead, at 2304 half ahead, at 2307 full ahead and at 2310 reduced to half ahead again to maintain a speed of about 6 knots. At 2313 the ship passed between light beacons 5 and 10 and the course was altered to 270 degrees true. At about 2323 the ship passed midway between unlit beacon 8A and light beacon 3 and soon afterwards the pilot altered the course to 260 degrees true. At this time the pilot was on the starboard bridge wing looking through binoculars for the light on beacon 8.
- 1.1.13 The pilot could not find the light on beacon 8 where he expected it to show, so he looked further down the channel for the lights on beacons 6, 4 and 2, but could not see them either. The pilot went to the starboard radar to see if the beacons were showing but could not interpret the display due to the parallel indexing and intended track lines superimposed on the screen. While in the wheelhouse he asked the master if he could see the light on beacon 8, to which the master replied no. The pilot returned to the starboard bridge wing, followed by the master, to look for the light visually. The master returned to the wheelhouse shortly after. The second mate later stated that he could identify the beacons clearly on both radar displays.
- 1.1.14 While on the bridge wing the pilot ordered the course be altered back to 270 degrees. The second mate, who was monitoring the parallel index line on the starboard radar, noticed at that time the ship was north of the track. He could not see the master so he went to the starboard bridge wing and informed the pilot "we are inside the PI" [parallel index]. The pilot later stated he had not understood what the second mate meant by "PI" and as he was intent on looking for the light he took no notice of what the second mate had said.
- 1.1.15 The master, who was also aware the ship was to the north of the intended track, heard the pilot alter the course to 270 degrees true but thought the course alteration had been made to compensate tidal set so did not question the pilot. At about the time the second mate returned to the wheelhouse the pilot noticed a red flashing light broad on the starboard bow and ordered the course be altered to 280 degrees. The master immediately questioned the pilot's order and they had a brief discussion about the ship's position. The pilot pointed out what later turned out to be the light marking the south-west extremity of the restricted area surrounding the airport and told the master that it was number 8 beacon. The master informed him that it was not number 8 beacon and countermanded the pilot's course alteration, ordering the wheel hard to port and the engine stopped.

² A quick and simple method of using a radar to maintain a predetermined distance off a navigational feature.

- 1.1.16 The pilot briefly disputed the master's decision, insisting that the ship was to the south of the track and the helm should be put hard to starboard and the engine to full ahead. At about that time the helmsman reported to the second mate that the ship was not responding to the port helm. The master looked over the starboard side and realised that the ship was aground. He immediately ordered the engine be declutched. Nobody on the bridge felt the ship run aground.
- 1.1.17 The master and second mate plotted the ship's position and found it to be on the north side of the channel with beacon 8 bearing 256 degrees true about 0.6 miles distant. The master then showed the pilot the position and they then agreed that the ship was on the north side of the channel.
- 1.1.18 The master requested that the crew sound the ship's tanks and take water depths around the ship to determine the extent it was aground. As the tide was rising the master decided not to immediately attempt to refloat the ship but to pump out number 7 double bottom tank and fill the fore peak tank in order to bring the ship more to an even keel.
- 1.1.19 At about midnight the master telephoned the operator's designated person, as stipulated in the International Safety Management (ISM) manual, and informed him of the grounding.
- 1.1.20 The internal and external soundings indicated that the ship's tanks were not breached and the ship was aground for almost its entire length. The crew launched the workboat to check the depth of water around the ship further and its draught.
- 1.1.21 At about 0100 on Easter Monday 16 April the draught was 3.00 m forward and 3.70 m aft. The workboat was recovered, the steering gear and bow thruster tested and the engines put on standby at 0118. The master handed the con back to the pilot and the engine was put to half astern. Almost immediately the *Boral Gas* began to move astern into the channel.
- 1.1.22 At 0123 the engine was put ahead and the vessel proceeded down the channel. On the way down the channel it was noted that the lights on beacons 8, 6 and 4 were extinguished and the light on beacon 2 was very weak. The pilot's intention was to anchor in Big Bay to await crossing the bar but when they arrived there was another vessel anchored in Big Bay so the *Boral Gas* continued to Wattle Bay, anchoring at 0306. At 1231 the anchor was aweigh and at 1348 the ship was clear of Manukau Bar and proceeding back to New Plymouth.
- 1.1.23 Shortly after the *Boral Gas* was refloated the master again telephoned the designated person to advise him of the situation. At about 1000 the designated person telephoned the ship's agent in New Plymouth to inform him of the grounding and request he make arrangements for the ship's arrival. The agent then telephoned the New Plymouth Maritime Safety Authority (MSA) inspector to inform him of the grounding. The inspector was on holiday so the agent left a message on his mobile telephone.
- 1.1.24 Later that day the inspector cleared the messages on his mobile phone and contacted the MSA duty accident investigator, who in turn contacted the Commission. The MSA and Commission both contacted different Ports of Auckland Limited (POAL) officials, neither of whom were aware of the grounding. At about 1000 on Tuesday 17 April 2001 the MSA contacted the Onehunga port co-ordinator to enquire about the grounding but he also was unaware of the incident. He contacted the signalman on South Head, who also was unaware of the incident.

1.2 Personnel information

- 1.2.1 The pilot was a 68 year old New Zealander. He went to sea as an apprentice in 1948 and gained a New Zealand master foreign going certificate in 1963. Over the years he had been employed by various New Zealand shipping companies both at sea, mainly as master, and also ashore as marine superintendent.

- 1.2.2 His first trip into Manukau Harbour was in 1955 and he spent numerous years as master of ships trading to Onehunga. At the time of the accident he estimated that he had crossed Manukau Bar and transited the harbour to Onehunga in excess of 2000 times. In May 1999 he applied for pilot licences for both Manukau Harbour and Manukau Bar. He was examined and issued with pilotage licences for Manukau Harbour in May 1999 and Manukau Bar in February 2000.
- 1.2.3 The accident trip was the 29th time he had piloted an LPG carrier to the terminal since his contract with the operator commenced in 1999. In total he had transited Papakura Channel 57 times. He estimated that about 12 transits had been in darkness. He last piloted the channel in darkness on 25 November 2000, about 5 months before the grounding.
- 1.2.4 The master of the *Boral Gas* was 39 years old at the time of the grounding. He was of Indian descent and resided in Australia. He went to sea in 1979 and gained his master foreign going certificate in India in 1990. He also held a Vanuatu master's certificate. In 1997 he completed a bridge resource management course.
- 1.2.5 Apart from a short period working ashore the master had sailed on gas carriers since 1987. He started work with the operator in 1999 and apart from sailing on a sister ship for about 4 months he had sailed as master of the *Boral Gas* since. The accident trip was his first visit to Manukau Harbour.
- 1.2.6 The second mate of the *Boral Gas* was Fijian and 47 years old at the time of the accident. He went to sea in 1973 as a cadet and obtained a Fijian second mate certificate, which he was in the process of upgrading to a New Zealand class 3 certificate. Just prior to the accident he had attended a bridge resource management course as part of the upgrade. He also held a Vanuatu second mate certificate.
- 1.2.7 The helmsman was Fijian and had been at sea since 1988. He had been employed as able seaman on local ships as well as international container ships and had worked for the operator since 1997. He was an experienced helmsman.
- 1.2.8 All personnel stated they were adequately rested and not fatigued at the time of the grounding.

1.3 Vessel information

- 1.3.1 The *Boral Gas* was a 84.3 m long double-hulled LPG carrier. It had a summer displacement of 3909 t. The ship was capable of carrying 2300 m³ of gas in 3 tanks, each constructed of 25 mm thick steel. Since delivery the operator had continuously operated the *Boral Gas* in the South Pacific trade.
- 1.3.2 Propulsion was by a single, bridge-controlled, 2045 kW Wartsila R32BC medium speed diesel engine, driving a single 4-bladed, variable pitch propeller, giving a service speed of about 11.5 knots. Manoeuvring aids included a 250 kW bow thruster and an Ulstein high lift rudder.
- 1.3.3 The bridge provided unobstructed side and forward visibility from the wheelhouse and bridge wings. A centre console housed, amongst other equipment, the steering and engine controls. On the starboard side of the console was a 3 cm Racal Decca Bridge Master series II ARPA radar with GPS capability. On the port side was a 3 cm Anritsu radar which was not gyro stabilised.
- 1.3.4 The operator had a Document of Compliance issued by Det Norske Veritas on 30 May 2000, which was valid until 16 December 2004. The *Boral Gas* had an ISM certificate also issued by Det Norske Veritas on 31 May 2000, valid until 7 March 2005. The *Boral Gas* had undergone an MSA port state inspection on 20 January 2001. There were no deficiencies noted at the time.

1.4 Port information

- 1.4.1 Manukau Harbour provides access to Auckland from the west coast of New Zealand. At the entrance to the harbour is a shifting bar with banks and shoals extending 5 miles seaward. Inside the bar the harbour is almost filled with mud and sandbanks that dry at low water. After crossing the bar there is a natural channel up to Huia Bank which splits at Puponga Point into 4 navigable channels. The 2 main channels are Wairopa Channel, which accesses Onehunga, and Papakura Channel, which accesses the Liquigas terminal (see Figure 2).
- 1.4.2 Manukau Harbour had about 75 coastal size ships visit annually. Most used the main wharf at Onehunga. The Liquigas LPG terminal was visited by 13 gas carriers in the 12 months prior to the accident, the last one being on 28 February 2001. The harbour was also regularly used by about 30 fishing vessels. During the tuna fishing season, between December and May, this number could increase to about 200, the largest vessels being up to 20 m long. There was no requirement for fishing vessels to report their movements when crossing the bar or within the harbour.
- 1.4.3 Manukau Harbour was administered by POAL and managed by a port co-ordinator based at Onehunga. Situated on South Head at the entrance to the harbour was a signal station manned by a signalman who resided on site. His main function was to advise vessels of the bar conditions and monitor their progress when crossing the bar. He kept a fixed radio schedule and was available 24 hours on request. Movements within the harbour were organised and monitored by the port co-ordinator. Both the port co-ordinator and signalman were contactable 24 hours by telephone, facsimile and mobile phone.
- 1.4.4 The New Zealand Pilot 15th edition 2001 stated in part:

Port Authority

2.128

Manukau Harbour is administered by the Ports of Auckland Ltd, represented by a Port Co-ordinator stationed at Onehunga: when unavailable the Auckland Harbour Duty Officer at Harbour Control should be contacted ...

2.136

...In harbour, constant RT [radio telephone] or VHF [very high frequency] watch must be kept with the Port Co-ordinator, Onehunga, for information concerning traffic and conditions in the harbour and for berthing instructions, whether or not a pilot is embarked.

1.5 Terminal, channel and navigation aids

- 1.5.1 The Liquigas LPG terminal was completed in 1988. Underground pipelines linked the terminal to an onshore LPG storage depot in Wiri, about 3 km away. Before the offshore terminal was constructed LPG was trucked to the depot from New Plymouth. From the depot LPG was distributed to the greater Auckland area. The frequency of gas carriers visiting the terminal varied according to seasonal demand. Liquigas employees operated and maintained the terminal.
- 1.5.2 Liquigas in consultation with Auckland Harbour Board installed the navigation marks in Papakura Channel. Both parties recognised that the channel had to be navigable in darkness to better facilitate bar crossings, and in case the ship had to depart the terminal in an emergency. Owing to the relatively high cost of installing navigation marks, and given that the only commercial vessels using the channel would be LPG carriers under pilotage, it was decided to only mark the north side of the channel in the area of the grounding. On completion the ownership of and responsibility for maintenance of the navigation marks were transferred to Auckland Harbour Board, and subsequently in 1989 to POAL.

- 1.5.3 Papakura Channel was naturally deep enough for ships the size of the *Boral Gas* and required no dredging. The width of the usable channel between beacons 2 and 8 was about 0.5 nm. All channel beacons were fitted with radar reflectors. The unlit beacons were also marked with retro-reflective tape. At its closest point the channel passed about 0.85 nm from the Auckland International Airport runway extension. The area immediately adjacent to the terminal and channel was mainly mud flats with industrial and residential areas to the north and south becoming sparser towards the harbour entrance.
- 1.5.4 Contained in the International Association of Lighthouse Authorities (IALA) Aids To Navigation Guide (third edition) is a chapter titled Availability/Reliability of Aids to Navigation which states in part:
- It should be noted that several aids to navigation configurations in a given waterway may provide the same effective coverage. Solution “A” may rely on relatively few, expensive, highly reliable aids, while solution “B” may consist of numerous, less costly, less reliable aids. Both solutions are equally effective in providing the mariner with the information that he requires. Solution “C” may use the same aids as solution “A” but with a lower individual aid reliability due to stringent regulations governing the training and use of pilots. Experienced pilots generally have the capability to rely less on provided aids to navigation than a navigator without local knowledge.
- 1.5.5 POAL visually inspected the channel navigation marks annually. Reporting of extinguished lights was left to the channel users. After the terminal was built the LPG carrier *Tarahiko* was using the terminal about 4 times a month, and until the end of 2000 the workboat for the terminal was moored in Onehunga and used the channel on a regular basis to access the terminal. Between these 2 vessels, the light beacons were subject to regular checks.
- 1.5.6 From the end of 2000 the workboat was based elsewhere and did not use Papakura Channel to access the terminal. The only commercial vessels to use the channel were the LPG carriers, and the frequency of their visits was reduced to about one every 4 weeks. The last gas carrier had visited the terminal about 6 weeks before the grounding and that harbour transit was made in daylight both ways. Recently the only time the operation of the lights was checked was when an LPG carrier transited the channel in darkness.
- 1.5.7 The lights on the navigation marks were battery powered, with the batteries being charged by solar panels. Each light was fitted with a lamp changer that sensed the failure of a lamp and rotated the lamp holder until a new lamp was activated. Beacon 2 was a 2-coloured sector light and the lamp changers could hold a total of 10 lamps; the lamp changers on beacons 4, 6 and 8 could hold 6 lamps each.

POAL maintenance records for beacons 2, 4, 6 and 8 showed:

Beacon number	Date of last maintenance before grounding	Date of repairs after grounding	Action taken
2	19 April 1994 (light reported out)	18 April 2001	4 batteries replaced battery connections replaced 10 lamps replaced lubricated
4	10 March 1993	20 April 2001 23 April 2001	1 battery replaced 6 lamps replaced lamp changer cleaned and tested solar panel cleaned
6	28 October 1997 (light reported out)	18 April 2001 23 April 2001	1 battery replaced 3 lamps replaced solar panel connections re-terminated battery connections replaced solar panel cleaned
8	28 October 1997 (light reported out)	18 April 2001 23 April 2001	1 battery replaced 2 lamps replaced battery connections replaced solar panel cleaned

- 1.5.8 About 0.75 nm north of beacon 8 was a light beacon marking the south-west extremity of the restricted area surrounding the airport. This light was owned and installed by Auckland International Airport Limited (AIAL). At the time of the grounding the flash characteristic for both this light and beacon 8 was flash red every 2 seconds.
- 1.5.9 On 16 May 2000 approval was granted by the MSA for AIAL to upgrade the light. On the application form filled out by AIAL the flash characteristic of the light was detailed as:
- Flash Red every 2 sec – same as before.
- 1.5.10 On 7 August 2000 Notice to Mariners NZ 286 was issued by Land Information New Zealand (LINZ). It informed that the characteristic of the light had changed from quick flash white, as was indicated on chart NZ 4314, to flash red every 2 seconds. This notice was submitted to LINZ by AIAL. The pilot carried his own chart and had not updated the flash characteristic of the light but later stated that he was aware of the change.
- 1.5.11 After the grounding AIAL was contacted to find out the actual characteristic of the light before May 2001. AIAL stated that the light fitting that was removed as a result of the 16 May application was flash red every 2 seconds and as far as it was aware it had been the same since the light had been installed in 1992. The light list published in the 2000 edition of the New Zealand nautical almanac detailed the characteristic of the light as quick flash white.
- 1.5.12 Under the IALA Maritime Buoyage System Region A, which New Zealand had adopted, the airport beacon should have been classed as a special mark and as such should have been yellow in colour with a flashing yellow light. The IALA system was intended to standardise navigation marks worldwide to provide mariners with a system that was simple, clear and concise with the aim of avoiding misidentification of the navigation marks.

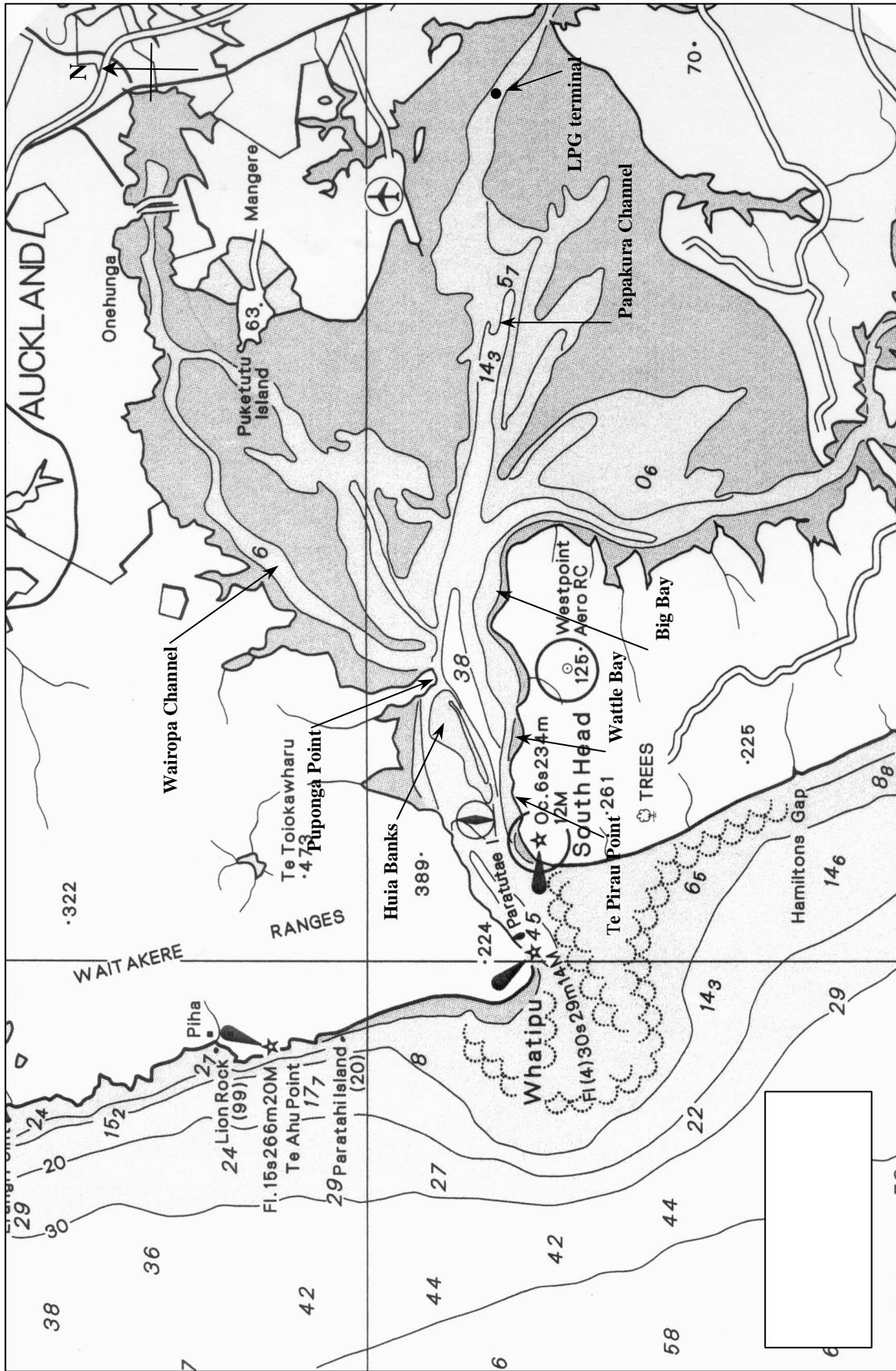


Figure 2
Part of chart NZ 43 showing Manukau Harbour and Bar

- 1.5.13 On 11 September 2000 a temporary notice to mariners, NZ 335(T), had been issued by LINZ advising that light beacons 5 and 10 in Papakura Channel were temporarily unlit or defective. The notice had been submitted to LINZ by POAL. At the time of the grounding both these lights were working, but the temporary notice NZ 335(T) had not been cancelled. It was cancelled on 11 May 2001, soon after the *Boral Gas* grounded.

1.6 Pilotage history

- 1.6.1 From 1984 until late 1998 Liquigas had chartered the New Zealand registered LPG carrier, *Tarahiko*, to distribute LPG around the New Zealand coast. The *Tarahiko* first started servicing the LPG terminal in Manukau Harbour in March 1988. At that time pilotage was not compulsory for ships transiting Manukau Harbour but a pilot was available from the Auckland Harbour Board if required. As pilotage was not compulsory there was no pilotage exemption system in force.
- 1.6.2 For the first few visits to Manukau Harbour the master of the *Tarahiko* navigated the ship across the bar and an Auckland Harbour Board pilot was employed from Te Pirau Point to navigate the ship to the LPG terminal and back.
- 1.6.3 This arrangement was found unsatisfactory to Auckland Harbour Board as it took a pilot away from the busy Waitemata Harbour for about half a day for each transit and it was considered expensive to transfer the pilot to Te Pirau Point and back. Auckland Harbour Board, in conjunction with the Auckland Regional Council, considered that crossing the bar was as hazardous as transiting the harbour and that the *Tarahiko* masters were capable of conducting their own pilotage.
- 1.6.4 The Auckland Harbourmaster at the time, in conjunction with the masters of the *Tarahiko*, made submissions to the Minister of Transport to grant a dispensation to allow the masters to conduct their own pilotage of Manukau Harbour and Bar, which was granted.
- 1.6.5 When the *Tarahiko* was withdrawn from service in 1998 Liquigas began chartering foreign flag LPG carriers to service the terminal and again the problem of pilotage arose. As pilotage was compulsory for the harbour and not the bar, POAL could foresee that foreign masters, possibly with no experience of bar harbours, could be navigating LPG carriers across Manukau Bar.
- 1.6.6 When the foreign LPG carriers first started servicing the terminal, the pilot who was aboard the *Boral Gas* when it grounded was employed to advise the masters while crossing the bar. He joined the ships in New Plymouth and completed the round trip. A POAL pilot was then employed to take the vessel from Te Pirau Point to the terminal and back.
- 1.6.7 This arrangement was also considered unsatisfactory to POAL as it still posed the problem of the expense and inconvenience of removing a pilot from the Waitemata Harbour. The MSA was approached by the Auckland Regional Council and it was decided to create a separate licence for Manukau Harbour and Manukau Bar and to make both compulsory pilotage for LPG carriers.
- 1.6.8 For 2 voyages both the bar pilot and a POAL pilot joined the gas carriers in New Plymouth and completed the round trip. The bar pilot trained the POAL pilot on crossing the bar and the POAL pilot trained the bar pilot on the harbour transit.
- 1.6.9 With the assistance of senior POAL pilots and a shipmaster with many years' experience of trading to Onehunga and crossing the bar, POAL assembled an examining panel approved by the MSA to issue the licences. The bar pilot had some input into the content of the examination for the Manukau Bar licence.

- 1.6.10 The bar pilot and a POAL pilot were the first to be examined by the panel and granted licences, which were issued by the Auckland Regional Council. The bar pilot was granted a Manukau Harbour pilotage licence on 5 May 1999 and a Manukau Bar pilotage licence on 28 February 2000. When he was not available to pilot the LPG carriers, POAL would supply a pilot.
- 1.6.11 At the time of the grounding there was no legislation in place stipulating how many harbour transits a pilot had to make before being eligible to apply for a licence, nor how many he had to complete subsequently for the licence to remain current. This was left to the discretion of the regional councils and port companies. POAL said that as there was no legal requirement for pilots to undergo currency training, it did not require its pilots to undergo any.

1.7 Weather and tidal information

- 1.7.1 The weather at the time of the accident was reported as partly cloudy with a light southerly wind, calm sea and excellent visibility. The moon was at the end of its last quarter phase; consequently it was a dark night.
- 1.7.2 Low tide at the LPG terminal was predicted for 2143 on 15 April at a height of 1.5 m above chart datum and high tide was predicted for 0408 on 16 April. The tabulated tidal stream data provided on Manukau Harbour chart (NZ 4314) for tidal diamond E, off number 6 beacon in Papakura Channel, about 1.5 miles west of the grounding position, predicted the tide to be setting approximately 122 degrees true at 0.6 knots at the time of the grounding.

2. Analysis

- 2.1 This grounding resulted primarily from the pilot losing situational awareness. Because he had not entered an effective bridge resource management relationship with the ship's bridge team, he did not respond to their various challenges, nor was he sufficiently conversant with the ship's navigational aids to utilise them to assist him to regain awareness in time to prevent the grounding.
- 2.2 The *Boral Gas* was being conned by someone who was supposed to be an expert in local knowledge, yet was effectively lost. The bridge team had a good knowledge of their ship's equipment, and knew exactly where the ship was in the channel, yet were unable to convey this knowledge to the pilot in time to prevent the grounding. There was more than sufficient combined expertise on the bridge to make the transit of Papakura Channel without incident, even without the aid of the 4 extinguished light beacons, but that expertise was not working together as a cohesive team, which allowed a knowledge-based error by one person in the team to deviate the ship from its intended track.
- 2.3 The following analysis discusses several factors that contributed to the pilot losing situational awareness:
- the design of the channel navigation aids and the channel's suitability for night transits
 - the maintenance and monitoring of the channel navigational marks
 - the control of navigation aids and adherence to the New Zealand system of buoyage and beaconage
 - the training requirements for pilots
 - the level of experience required for pilots to attain a pilot licence
 - the requirements for pilots to maintain currency in the areas for which they are licensed to pilot.

2.4 The grounding of the *Boral Gas* in soft mud and at relatively slow speed did not create an exceptional risk of fire or explosion, which is a stigma often attached to LPG carriers. However, there were safety issues relating to the movement of LPG carriers and other vessels in Manukau Harbour:

- the poor monitoring of vessel movements in the harbour and the potential risk of collision
- the lack of communication between harbour users and the harbour authority.

The grounding

- 2.5 The master had made comprehensive preparation for his first visit into Manukau Harbour. He had studied the ship's file on the harbour, discussed the pilotage with the previous master, checked and signed off the comprehensive passage plan the second mate had prepared and had ample time to discuss the pilotage with the pilot during the trip north from New Plymouth.
- 2.6 Until about 1800 the master and pilot were under the impression that the ship was to depart the terminal the next morning. After consultation they agreed to sail on completion of cargo, in darkness. The preparation and planning for the harbour passage had already been completed and the change in departure time would have required only minor changes to the plan to facilitate a transit of the channel in darkness.
- 2.7 Given that the channel was designated suitable for night transits and that there were no special harbour regulations preventing LPG carriers from transiting in darkness, the request by Liquigas for the ship to depart the terminal on completion of cargo was reasonable and consistent with normal business practice. The issues of traffic management within the harbour and the maintenance and monitoring of light beacons marking the channel are discussed later in the analysis.
- 2.8 The pilot had last transited the channel in darkness about 5 months before the grounding. Since then no routine inspection of the channel lights had been made and no lights had been reported out by commercial or recreational harbour users. Before leaving the berth the pilot could see that the lights close to the berth were operating. While the pilot may reasonably have expected to find one, or possibly 2 light beacons extinguished, he would not have been prepared for 4 channel lights in succession being extinguished. If any one of the 4 extinguished light beacons had been fully operational it would have given the pilot a reference point to help establish his bearings.
- 2.9 When the *Boral Gas* passed between beacons 8A and 3 at about 2323 the pilot would have been aware of the ship's position. At about the same time he would normally have been searching for the light on number 8 beacon, which he could not see. He would have been expecting the light on number 8 beacon to appear about 5 degrees on the starboard bow but instead could only find the light marking the south-west limit of the airport, which had the same flash characteristic but would have been about 30 degrees on the starboard bow. Judging distance from a single point of reference in darkness is not easy and the airport beacon appearing 30 degrees on the starboard bow would have created a false impression of his relative position in the channel, causing him to think he was to the south, which explains why the pilot altered course to the north. The pilot expected to see beacon 8 flashing red every 2 seconds. Seeing the airport light flashing red every 2 seconds fulfilled his expectations and he probably subconsciously accepted this as the light he was seeking and started to make course alterations to put the light where he was expecting it to be, 5 degrees on the starboard bow.

- 2.10 Only about 4 minutes elapsed from the last known position until the ship grounded. When the pilot ordered the course be altered to 270 degrees the master did not intervene because he thought the pilot was allowing for set. As it was the master's first trip, his reluctance to initially intervene was understandable considering his perception that the pilot was vastly experienced in the channel. When the pilot altered the course to 280 degrees the master quickly realised something was amiss and countermanded the order, but unfortunately too late to prevent the ship grounding.
- 2.11 The master and second mate were tracking the progress of the ship visually and on the radar. They were both aware of the ship's position in the channel and the navigation marks were clearly visible on both radar displays. The pilot was navigating by eye and apart from asking the master if he could see the light on number 8 beacon, and having a brief look at the starboard radar, he requested no other assistance from the bridge team. Had he requested assistance or used either radar correctly the grounding may have been averted.
- 2.12 The end of the airport runway was a good reference point for radar parallel indexing in that part of the channel and would immediately give an indication of the ship's relative position. The second mate, to his credit, tried to advise the pilot that the ship was north of the track but the pilot was intent on looking for the light visually and did not understand the terminology used by the second mate so chose to ignore the warning. It is essential that the language used during shipboard operations is clear and concise. The second mate's terminology was neither; nevertheless, it was a prompt to the pilot that something was amiss.
- 2.13 The bridge team of the *Boral Gas* was made up of people from 3 different nationalities who could all communicate effectively in English. However, cultural differences may have inhibited the second mate's inclination to repeat his warning to the pilot even though the concept of bridge resource management attempts to break down such barriers.
- 2.14 The decision by the master not to immediately try to refloat the *Boral Gas* was wise as the tide was rising and it gave him time to ascertain the ship's condition, alter the trim and assess any damage it may have suffered.

Design of Papakura Channel navigation aids

- 2.15 Papakura Channel was relatively wide and deep for the size of ship that transited. Owing to the expense of installing light beacons and because the channel was originally to be used only by LPG gas carriers under pilotage, which later became masters with ministerial exemption, navigation marks were placed sparingly. However, providing all the lights on the navigation marks were operating, or the pilot was aware of the ones that were extinguished, it was suitable for transiting in darkness, as had happened on many occasions over the preceding years.
- 2.16 If a channel is intended to be used for navigation in darkness it would stand to reason that if it was deemed necessary to place a navigation mark in the channel to aid daylight navigation it should have a light on it for navigation in darkness. If for instance beacon 1A had been lit it would have provided the pilot with another reference point and may have avoided his misidentifying the airport light.
- 2.17 The IALA Aids to Navigation Guide suggested that for a channel, such as Papakura Channel, which was sparsely marked with light beacons, the monitoring repair and maintenance regime should be structured to ensure a high degree of reliability.

Monitoring and maintenance of navigation aids

- 2.18 Up until the end of 2000 the channel was subject to regular use by the Liquigas workboat, which greatly increased the chances of extinguished lights being reported. After the workboat was relocated the only commercial vessels to use the channel were the LPG carriers. All parties involved were aware of the situation but no measures were taken to increase the monitoring and repair of the lights. Other than the annual inspection, POAL made no regular checks that the light beacons were operating and relied on the pilot or recreational harbour users to report extinguished lights. This system was fundamentally flawed in that it did not ensure the high reliability of light beacons, by relying on the ships that required the lights to safely transit the channel to report extinguished ones.
- 2.19 The last time the pilot had transited the channel in darkness was some 5 months before the grounding. Although, for this voyage, he had planned for both transits of the harbour to be conducted in daylight, he was aware that the ship could be requested to depart the terminal in darkness for commercial or safety reasons. He knew the situation regarding inspection of the lights and could have contacted POAL to enquire about their current status.
- 2.20 The temporary notices to mariners current at the time of the grounding had not been updated. The notice in force at the time of the grounding had not been cancelled when beacons 5 and 10 were repaired and as nobody was aware that beacons 2, 4, 6 or 8 were extinguished no new notice had been issued. POAL was responsible for issuing and cancelling the notices. Temporary notices to mariners advise mariners of temporary changes to navigational features, so when devising a passage plan, the planner has the current status of the navigational features within a port. The maintenance and monitoring system for light beacons in Manukau Harbour not only failed to provide reliable short-term information to harbour users but also did not adequately disseminate and follow through longer-term changes such as the status of light beacon information.
- 2.21 After the grounding, the navigation marks with extinguished lights were thoroughly inspected, and from the maintenance records it can be seen that the inspection was long overdue. Of the 4 extinguished lights, 2 still had some operational lamps but had battery and solar power terminal faults. The other 2 had all the lamps replaced and also had electrical faults. Considering the channel was used by LPG carriers and its proximity to residential areas and Auckland International Airport, the inspection and maintenance regime was lacking in both frequency and preventative maintenance.

The Auckland Airport light beacon

- 2.22 The IALA system of buoyage and beaconage is designed to minimise confusion between navigational marks and special marks. Special marks are not primarily used as channel markers but are instead used to indicate a special area or feature, such as the restricted area surrounding the airport. Regardless of the confusion as to when and how the characteristic of the airport light changed, it had never complied with the IALA system as either a flashing red or flashing white light and should have been a special mark since its installation. The airport light beacon should have had a flashing yellow characteristic, a fact that was overlooked by the MSA on 2 occasions. Neither POAL nor the Auckland Regional Council was consulted regarding the change of the light characteristic. This oversight suggests that not only do POAL and the Auckland Regional Council need to review their commitment to providing a reliable system of navigational marks in Manukau Harbour, but also the MSA might need to review the procedures for authorising installation of or changes to navigation aids to ensure that the appropriate authorities are consulted to avoid similar oversights.

Pilot training and currency

- 2.23 Historically pilotage of Manukau Harbour and Bar has been left to the ship's master as most ships that visited the harbour were regular traders with experienced crews. The signal station provided an invaluable service in monitoring and advising the masters on bar conditions and movement. Auckland Harbour Board and later POAL together with the regional council were comfortable with this arrangement as logistically a regular pilot service was difficult to provide owing to the natural features of the port and the distances involved transporting the pilot for the number of ships that would require the service.
- 2.24 As it was compulsory for LPG carriers to take a pilot, when the *Tarahiko* ceased plying the New Zealand coast it was necessary to quickly start a pilot service to cater for foreign LPG carriers trading into Manukau Harbour. Although at that time the pilot had vast experience of Manukau Bar and Wairoa Channel to Onehunga he initially had no experience in Papakura Channel. At the time of the grounding his experience in Papakura Channel was still relatively limited with only about 12 transits completed in darkness. However, he did have more experience in Papakura Channel than the POAL pilots who relieved him. This raises a question over the adequacy of present policy for pilot training and currency for Manukau Harbour.
- 2.25 The present legislation governing pilot training and currency does not specify the amount of training required for a pilot to gain a licence, nor does it require any type of recertification with time. Although this situation is far from ideal there is no reason why an employer of pilots such as POAL cannot introduce its own requirements for training and currency through its own policy and procedures. For independent pilots such as the one conning the *Boral Gas* at the time of the grounding, there were mechanisms by which the Auckland Regional Council could set its own standards for pilots.

Manukau Harbour traffic management and communications

- 2.26 The pilot did not advise the Onehunga port co-ordinator or the signalman that the ship's departure time from the terminal had changed nor did he advise them when it left the terminal or when it grounded. The first POAL knew about the grounding was when the port co-ordinator was contacted by the MSA about 36 hours later. Although the grounding occurred late at night the pilot had options available to advise POAL of the situation but he chose not to do so.
- 2.27 The cargo tanks of the *Boral Gas* were constructed of steel about 25 mm thick and surrounded by a double hull. The bottom of Manukau Harbour was mainly soft mud and sand and presented a minimal threat of breaching the cargo tanks if the ship grounded. Of more concern would be collision with another vessel. As well as recreational boating there could have been many fishing vessels using the harbour at certain times of year. Without a mandatory reporting requirement, relatively large vessels could be transiting the harbour and bar at the same time as an LPG carrier without the vessels being aware of the others movements or whereabouts.
- 2.28 Other than the information available in The New Zealand Pilot, POAL had no special procedures or requirements for LPG carriers in Manukau Harbour. The New Zealand Pilot required that all movements within the harbour be reported, and it goes without saying that groundings should be reported, especially groundings involving LPG carriers. Although the ship was in no immediate danger it was not gas free and was aground close to a residential area and Auckland International Airport.
- 2.29 Although the sailing directions in The New Zealand Pilot for Manukau Harbour required that all shipping movements had to be reported to the port co-ordinator it was apparent that this was not always done by coastal shipping, and almost never done by fishing vessels. Such a communication system is not likely to be effective unless it is rigidly enforced.

3. Findings

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

- 3.1 The *Boral Gas* had valid statutory certificates and was operating under the International Safety Management Code at the time of the grounding.
- 3.2 The master and crew of the *Boral Gas* were adequately experienced and appropriately qualified for their respective positions.
- 3.3 The licensed harbour pilot who had the con of the *Boral Gas* as it was departing the Liquigas LPG terminal in Manukau Harbour lost situational awareness and ordered a series of course alterations that resulted in a controlled departure from the Papakura Channel, and grounding.
- 3.4 The master and second mate both challenged the pilot's orders in the spirit of good bridge resource management, but were unable to prevent the grounding. The pilot's lack of training in bridge resource management probably contributed to the bridge team not functioning as an effective unit.
- 3.5 The principal factors leading to the pilot's loss of situational awareness were the unknown failure of 4 consecutive channel marker light beacons, and his misidentification of an adjacent airport special marker beacon that had the same flash characteristic as one of the failed channel beacons.
- 3.6 The airport special marker light beacon did not comply with the New Zealand system of buoyage and beaconage, which had been established partly to avoid mariners confusing light beacons, such as happened on this night.
- 3.7 The chosen configuration of navigational marks in the Papakura Channel required a high reliability factor for light beacons to make the channel suitable for night transits.
- 3.8 The system for monitoring and maintaining the light beacons at the time of the grounding could not ensure high beacon reliability, which rendered the Papakura Channel unsuitable for night transits by vessels the size of the *Boral Gas*.
- 3.9 Harbour pilots are employed principally for their specialist local knowledge and ship handling skills. While the pilot of the *Boral Gas* was reasonably experienced in transiting the Papakura Channel, his experience, local knowledge and technique were arguably not sufficient to deal with the circumstances that occurred on the night of the grounding.
- 3.10 While not contributing to the grounding, the control of traffic within Manukau Harbour, and current level of communication between harbour authorities and harbour users were not sufficient for the volume and type of vessels using the harbour, which created an unnecessary additional risk to harbour users.
- 3.11 The current legislation governing standards of training and currency for harbour pilots does not ensure pilots are adequately trained and remain sufficiently current to fulfil their function as harbour pilot, and is in need of urgent review.
- 3.12 The inadequacy of the current legislation governing pilot training should not prevent the authorities responsible for licensing pilots from ensuring harbour pilots in their own area of jurisdiction are well trained and remain current.

4. Safety Actions

- 4.1 Origin Energy Contracting Limited ceased transits of Manukau Harbour in darkness by its LPG carriers until all the reports into the grounding of the *Boral Gas* were completed.
- 4.2 POAL inspected and repaired all the extinguished lights in Papakura Channel.
- 4.3 POAL began a programme of overhauling and repairing all navigation marks within Manukau Harbour.
- 4.4 No safety recommendations were made regarding the licensing of maritime pilots or delivery of pilotage services because the MSA were drafting new Maritime Rules to address those issues. The draft rules were expected to be circulated for industry consultation in late 2001.

5. Safety Recommendations

- 5.1 On 29 October 2001 the Commission recommended to the pilot that he:
 - 5.1.1 attend a bridge resource management course. (052/01)
- 5.2 On 19 November 2001 the pilot replied:
 - 5.2.1 I completed the Bridge resource management course at the NZ Maritime School, Auckland on 12 November 2001.
- 5.3 On 29 October 2001 the Commission recommended to the marine manager Ports of Auckland Limited that he:
 - 5.3.1 liaise with the Auckland Regional Council and Maritime Safety Authority and install appropriate lights on all the unlit beacons in Papakura Channel (053/01)
 - 5.3.2 improve the maintenance and repair regime for navigation marks within Manukau Harbour to ensure a high reliability factor is achieved that is consistent with the number and configuration of light beacons. This system should at least result in any ship transiting the harbour knowing what navigation marks are serviceable (054/01)
 - 5.3.3 critically review the existing communication and traffic management system for Manukau Harbour and upgrade it to ensure harbour users are aware of other traffic movements (055/01)
 - 5.3.4 liaise with Auckland International Airport Limited to change the characteristics of the airport light to a special mark under the International Association of Lighthouse Authorities system of buoyage and beaconage (056/01)
 - 5.3.5 conduct a risk assessment for LPG carriers transiting Manukau harbour and form a set of rules and guidelines governing their movement within harbour limits. (057/01)
- 5.4 On 5 November 2001 the marine services manager of Ports of Auckland replied:
 - 5.4.1 053/01

All currently lit beacon in the Papakura Channel have had the new LED lights fitted. The manufacturer claims a 5 year maintenance free period for these lights. POAL believe this will vastly improve light reliability in the Papakura channel. Additional lights have been ordered to light all remaining unlit beacons in the Papakura channel. We expect this to be completed in the next 3 months.

5.4.2 054/01

This has been done. Over 20 new LED lights have been fitted on the Manukau harbour since this incident. A bi monthly inspection regime is in place in addition to users reports. All lighting outages are reported to users by emails, fax and eventually notices to mariners (this has always happened).

5.4.3 055/01

Agree to look at communications in the new year.

5.4.4 056/01

This is not our light but happy to discuss with AIAL.

5.4.5 057/01

Risk assessment is an overkill as the channel is now well lit with new reliable LED lights and the channel is very wide and easily navigated. Agree to recommendation to review and instigate rules for all vessel movement on the Manukau in the new year.

5.5 On 29 October 2001 the Commission recommended to the director of Maritime Safety that he:

5.5.1 include the appropriate Regional Council Harbourmaster in the consultation and approval process when navigational marks are installed, altered or removed in harbours under their jurisdiction. (058/01)

5.6 On 16 November 2001 the director of Maritime Safety replied:

5.6.1 With regard to Recommendation 058/01 to the Director of Maritime Safety, we would advise that Regional Council Harbourmasters are consulted when navigational marks are installed, altered or removed, and hence question the need for this recommendation.

Approved for publication 31 October 2001

Hon. W P Jeffries
Chief Commissioner