AUSTRALIAN TRANSPORT SAFETY BUREAU

MARINE SAFETY INVESTIGATION
REPORT 155

Independent investigation into the collision involving the Chinese bulk carrier

Hai Teng

and the Australian recreational vessel

Chester

east of Mooloolaba, Queensland
on 19 March 2000

COMMONWEALTH DEPARTMENT OF TRANSPORT AND REGIONAL SERVICES

Report No 155

Departmental investigation into the collision involving the Chinese bulk carrier *Hai Teng* and the Australian recreational vessel *Chester* east of Mooloolaba, Queensland on 19 March 2000

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Hai Teng

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Chester

Summary

At about midnight on 18 March 2000, the recreational craft *Chester*, a half cabin cruiser with the owner and a deckhand on board, was at anchor about 28 miles east of Mooloolaba. No lookout was being maintained on the craft.

Shortly after midnight, when both crew members were asleep, *Chester* was struck by a ship. After the collision, the skipper found that there was minor damage to the bow and a handrail. The anchor had been lost, but the hull was intact and he anchored once more, using a spare anchor. About an hour later, he weighed anchor and returned to Mooloolaba, then to Brisbane by road with the craft on a trailer, where the deckhand reported the incident to the water police.

The Australian Transport Safety Bureau (ATSB) interviewed the crew of *Chester* at Brisbane and obtained samples of paint, deposited as a result of the collision, from the starboard rail of the vessel.

The ATSB obtained a surface plot of ships in the area of the collision from AusSAR, the Australian search and rescue organisation. A number of ships on the plot were asked for their positions at the time of the collision and the bulk carrier *Hai Teng* provided a position close to that of the collision.

Hai Teng had been on a voyage from Newcastle to China at that time. When the vessel returned to Newcastle on 21 April 2000, interviews were conducted by the ATSB with the master, the 2nd and 3rd mates and the able-bodied seaman (AB) who had been on watch with the 2nd mate. The 2nd mate and AB denied any knowledge of the incident stating that they had not seen any craft near the ship at the time reported for the collision.

The ATSB also obtained paint samples from *Hai Teng*. The Criminalistics Team, Forensic Services, of the Australian Federal Police at Canberra analysed the paint samples from both vessels concluding, in their report, that there was strong evidence to support the proposition that the *Hai Teng* and *Chester* had come into contact.

Sources of Information

Owner and deckhand of C*hester*

Master, 2nd and 3rd mates and lookout, *Hai Teng*

AusSAR (Australian Search and Rescue)

AMSA (Australian Maritime Safety Authority)

Acknowledgement

Portion of chart Aus 365 reproduced by permission of the Hydrographic Office, RAN

The Criminalisitics Team, Forensic Services, Australian Federal Police

Narrative

The ship

Hai Teng is a Chinese flag bulk carrier of 37 871 tonnes deadweight at a summer draught of 10.763 m. The vessel has an overall length of 187.73 m, a moulded breadth of 28.4 m, and a moulded depth of 15.3 m.

The vessel was built in April 1977 by Ishikawajima Harima Heavy Industries at Aioi in Japan. It was named *Adrianople* and then *Radiant Venture* before it was purchased by its present owners, Guangdong Ocean Shipping Co of Guangzhou, China, who re-named it *Hai Teng*. *Hai Teng* is classed with the China Classification Society.

Hai Teng has five cargo holds and is equipped with four deck cranes. The bridge, engine room and accommodation are located aft.

The vessel is powered by a single, 6-cylinder Sulzer diesel engine of 7 282 kW and has a service speed of 12 knots. The engine room is manned whilst the vessel is at sea.

Hai Teng had the normal range of navigation equipment, including three radars, of which two were in use. One radar, 3 cm, was manufactured by Tokyo Keiki in 1977 and was fitted with a JRC, JAS — 800 M II, ARPA. A second Japanese radar was not in use. The third radar, fitted in 1998, was a Kelvin Hughes, Nucleus 6000A, 10cm radar with ARPA.

All officers and crew were from China and the officers held appropriate certificates of competency issued by the Chinese Maritime Authority.

The master held a master's certificate as well as radar and ARPA licences. He had been at sea since 1980, as ordinary seaman (OS) and able-bodied seaman (AB) before sailing as 3rd mate from 1985 until 1989. He was 2nd mate on bulk carriers, general cargo and container ships from 1989 until 1993 and was chief officer on similar ships from 1993 until 1997. In 1998 he was promoted to master of a bulk carrier and he joined *Hai Teng* as master on 12 October 1999.

The 2nd mate had a 2nd mate's certificate and licences for radar and ARPA. He had been at sea since 1992 as a cadet, then AB and assistant officer, before sailing as 3rd mate in 1995. He had been a 2nd mate since 1998 and this was his second trip on *Hai Teng*. He had earlier sailed on *Hai Teng* from December 1997 until November 1998 and re-joined the ship in May 1999.

The 3rd mate had a 3rd mate's certificate and licences for radar and ARPA. He had been at sea since 1996 as a cadet, OS and AB before he was promoted to 3rd mate in March 2000.

The AB on watch with the 2nd mate had been at sea since 1985 as a cadet and OS. He had been sailing as AB for the last ten years.

The three mates maintained 4 on, 8 off sea watches, with an AB assigned to each watch for lookout duties.

The recreational craft

The recreational craft *Chester*, a half cabin cruiser built in 1986 and registered with Queensland Transport is operated out of Mooloolaba, Queensland.

The vessel has a registered length of 7.4 m, a beam of 2.5 m and a depth of 1 m. The hull and upperworks are of aluminium, painted white.

Chester is fitted with a 175 hp outboard engine driving a single screw. The vessel has a raked stem and a transom stern. There is a wheelhouse and the sleeping quarters are forward of, and below, the wheelhouse. The fishing deck is aft, illuminated at night by two strip lights just above the well-deck level. A white all round light is fitted above the forward end of the cabin.

Navigation equipment included a magnetic compass, GPS, a fish finder/echo sounder and two marine radios. The craft was equipped with an EPIRB.

The owner of *Chester* has a power boat licence and a licence to operate 27 MHz radio. He was a recreational fisherman and had been fishing for about 20 years, from his father's boat initially, then from his own boat which he bought in 1988. He had not had any previous accidents before this collision.

The deckhand, a recreational fisherman, had no licences. He had worked on charter craft for a few years and had fished with the owner of *Chester* for about 4 years.

The Incident

Hai Teng

Hai Teng had berthed at Newcastle at 1030 on 16 March 2000 to load a cargo of coal for China. After loading 36 912 tonnes of coal, the vessel sailed at 1144 on 17 March 2000. The draft at sailing was 10.55 m forward, 11.00 m aft.

After departing from Newcastle and disembarking the pilot, normal sea watches were maintained with the autopilot in use. The course recorder, which the master normally used when entering or leaving a port, was switched off after the pilot's departure.

The voyage proceeded without incident.

The 3rd mate took over the watch at 2000 on 18 March and he and the AB on duty maintained a lookout. The 10 cm radar was in use. At 2020 the 3rd mate retarded clocks 20 minutes to UTC (Universal Coordinated Time) + 10h 40m.

The ship recorded the following GPS positions,

- at 2200: 27° 02.9' S, 153° 37.1' E.
- at 2300: 26° 51.2' S, 153° 36.8' E and,
- at midnight: 26° 39.5' S, 153° 36.4' E.

The watch was uneventful. When the 3rd mate handed over to the 2nd mate, there were no ships or other craft visible at the time. The visibility was in excess of 11 miles and the wind was from the southeast at force 4. There was a slight southeast sea running. There was no rain although the skies were partly cloudy.

The 2nd mate went to the bridge at 2345 on 18 March, fifteen minutes before the start of his watch as was normal. He and the AB were rested and, when they took the watch, the AB kept a lookout, moving from side to side of the bridge so that there would be no interference with the view ahead. The 2nd mate used the 10 cm radar to assist with keeping a lookout.

The AB did not see any other vessel ahead of Hai Teng throughout the watch. The 2nd mate, who was also keeping a lookout, did not recall seeing any other vessel ahead of *Hai Teng* at the time of the collision as reported by *Chester*.

At 0047, the 2nd mate retarded clocks by 20 minutes to UTC +10h 20m. At 0200 he logged a position by GPS, 26° 08.5' S, 153° 34.9' E and he logged two other GPS positions at 0300 and 0400. Nothing untoward was reported to have occurred during the 2nd mate's watch.

Chester

Chester sailed from Mooloolaba at about 0700 on 18 March 2000 with the owner and a deckhand on board. When the vessel arrived at the fishing ground at about 0900, the owner used the fish finder to find the best spot to fish. He anchored *Chester* at about 0930 about 28 nautical miles north east of Mooloolaba Harbour.

While *Chester* lay at anchor, heading towards the east, in about 78 metres of water, the owner and deckhand fished using rods and lines.

The weather forecast was for showers. There was some rain at about 1600, otherwise the

weather was good with about 3/8 cloud cover and good visibility. The wind was mostly from the east, though the owner thought that it might have backed to the northeast during the afternoon.

The anchor light was switched on about an hour after sunset. One of the two low-wattage strip lights on the port side in the well-deck aft was also switched on. At about 2100, the owner went to sleep in the cabin forward of, and below, the wheelhouse.

At that time, the vessel was lying to an easterly wind. There were four other craft in the vicinity that night, one of them a commercial fishing vessel about 3 miles south. There was a boat due north, on the horizon, displaying a white light. There were two other craft, to the southwest and west of *Chester*.

When the deckhand went to sleep at about 2300, the forward hatch to the cabin was left open for ventilation.

The owner and the deckhand were both asleep when the craft was struck by a ship at about midnight. The sound of the impact was so loud that the owner thought that the fuel tanks might have exploded. He first looked towards the stern but saw nothing, then looked out of the forward hatch and saw the hull of a large ship less than a metre away from the bow of *Chester*. The ship's hull appeared to be dark grey or black and he thought that he could see draught marks on the side of the ship as it went past, heading north. Contact seemed to have taken place at the ship's port quarter.

The owner was concerned that the anchor rope would be caught in the ship's propeller, pulling his craft into the side of the ship, but the ship passed clear. He checked to see if they were taking on water, lifting hatches set into the deck forward and at the stern, but there were no apparent leaks.

He checked the craft for damage and saw that the fairlead for the moorings and anchor rope was bent though it was still serviceable. There was also a smear of black paint on the starboard rail of the craft.

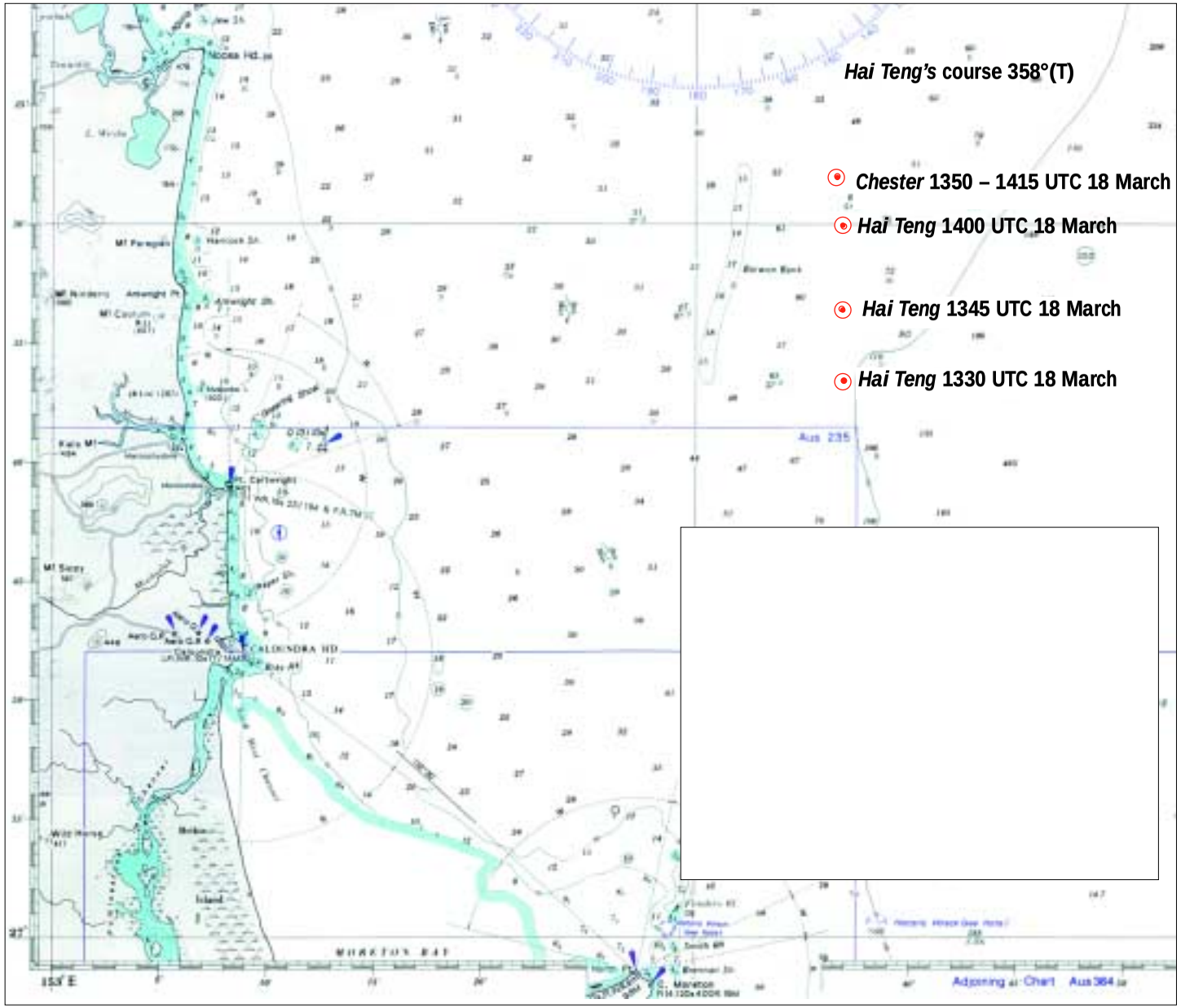
The deckhand, awakened by the collision and thinking that *Chester* might have been sinking, went to the wheelhouse where he picked up the handset for the 27 MHz radio. However, he noticed that the owner seemed calm as he checked the craft for damage, so he turned the radio on but did not use it.

When the deckhand learned that there was not much damage to the craft, he went forward to have a look at the ship, but all he could see was its sternlight.

Chester's anchor rope had parted and the craft was drifting. The skipper, after manoeuvring Chester back to the original anchor position, anchored again using a spare anchor.

After a while the owner weighed anchor having decided to return to Mooloolaba. He did not make radio contact with any state authority or attempt to contact any vessels that might have been in the area. At Mooloolaba, the deckhand and he loaded the boat onto a trailer and returned to Brisbane where the deckhand reported the incident to the water police.

FIGURE 3:
Portion of chart Aus 365 showing positions of *Hai Teng* and *Chester*



Comment and analysis

Evidence

In a statement to the water police, the deckhand said that he had been asleep on the boat, which was anchored at 26° 28.02' S, 153° 35.63' E, when the collision occurred at 2350 local time, 1350 UTC on 18 March. He also said that the owner and he had seen a large ship with a black hull close to their boat, heading north.

The water police informed the Australian Maritime Safety Authority (AMSA) at Brisbane of the incident. AMSA obtained details of the incident from the skipper and the deckhand and informed the Australian Transport Safety Bureau (ATSB) of the collision.

The owner and the deckhand of *Chester* were interviewed at Brisbane by the ATSB. As a result of the collision, paint had been deposited on the starboard rail of the boat. Samples of the paint were taken by the ATSB for analysis by the Australian Federal Police at Canberra.

An AusSAR surface picture for 0030 UTC 18 March 2000 listed ships that might have been within 50 miles of the position of the collision. Certain ships on the plot were requested to provide their positions around the time reported for the collision.

All ships except the Chinese bulk carrier *Hai Teng* were eliminated. The vessel was on a voyage from Newcastle to China at the time of the incident and one of the positions, at 1400 UTC, reported by the master was about two miles south of the position of the collision involving *Chester*.

The master of *Hai Teng* was informed that the ATSB would investigate the collision when the vessel returned to Australia.

When the vessel returned to Newcastle on 21 April 2000, paint samples from its hull were obtained by the ATSB from a position where marks indicated a possible area of contact. The master, 2nd and 3rd mates and the AB who had been on duty with the 2nd mate were interviewed.

Copies of the ship's deck log, radar maintenance log and other relevant documentation were obtained.

The time of the collision

After the water police had informed AMSA about the incident, an AMSA surveyor obtained details of the collision from the skipper and the deckhand of *Chester*. The surveyor was informed that the collision had occurred between 2350 and midnight, Eastern Standard Time (1350 and 1400 UTC).*

Later, the skipper of *Chester* informed the ATSB that he thought the collision had occurred about ten or fifteen minutes after midnight, at about 1410 or 1415 UTC.

Positions of both vessels

The position reported by *Chester* for the collision was 26° 28.02' S, 153° 35.635' E.

The positions for *Hai Teng* were:

- 1330 UTC, 26° 36.3' S, 153° 36.0' E
- 1345 UTC, 26° 33.3' S, 153° 35.9' E
- 1400 UTC, 26° 30.0' S, 153° 35.8' E.

The ship's speed, from GPS positions at 2200 and midnight, was 11.7 knots. The course was

* *Chester* was keeping Eastern Standard Time. *Hai Teng* was keeping Australian Eastern Daylight Saving Time while in Newcastle and, on the night of the collision, was retarding clocks one hour to Eastern Standard Time. As *Chester* and *Hai Teng* were keeping different times, UTC is used in this report.

358° (T). Using this course and speed and the position at 1400 UTC, at 1410 UTC the ship's position would have been 26° 28.05' S, 153° 35.73' E. This position was within 200 metres of the position given by the skipper of *Chester*.

Analysis of paint samples

Paint samples from *Chester* and *Hai Teng* were analysed by the Criminalistics Team, Forensic Services, of the Australian Federal Police. As well as paint samples, the ATSB also submitted photographs of both vessels to the Criminalistics Team.

The report on the analysis stated:

> The ship paint was multilayered with the outer most layer sequence being black: pink: silver: black: lime green: and brick red. The photographs confirmed the outermost layer to be black.
>
> The fishing vessel paint was also multilayered, being various shades of white.
>
> The microscopic examination of paint from the ship did not reveal any smears which appeared to be transferred from the impact.
>
> The microscopic examination of paint from the bowsprit of the fishing vessel revealed black smears with some pink inclusions. These appear to be transferred from the impact.
>
> Samples of these paints were analysed using infra-red spectroscopy. A very close correlation was observed in the spectra of the pink inclusions and black smears from the fishing vessel bowsprit and the paint from the ship.
>
> The evidence amounts to a two layer one way transfer from the ship to the fishing vessel and strongly supports the proposition that the *"Hai Teng"* came into collision with the *"Chester"*.

Hai Teng was the only ship close enough to the recreational vessel to have been involved in the collision.

Based on the analysis and other evidence, the Inspector is satisfied that the paint samples taken from *Chester*'s starboard rail had come from *Hai Teng* and that the ship had collided with the fishing vessel.

Responsibilities of both vessels

Under Rule 5 of the International Regulations for Preventing Collisions at Sea, 1972, as amended (the Colregs), (reference Appendix to this report), both vessels were obliged to keep a proper lookout at all times (by sight, hearing and by all available appropriate means).

According to *Hai Teng's* 2nd mate and the AB on watch, they were keeping a lookout during the watch from midnight to 0400 on 19 March 2000. The radar was in use. The visibility was good and neither man had seen any craft at the time of the collision. Prior to the collision, *Chester* would have been virtually right ahead of the ship.

Neither of the two men aboard *Chester* was keeping a lookout. Both the skipper and the deckhand were asleep when the collision occurred.

Under Rule 7 of the Colregs (ref Appendix), every vessel is obliged to use all available means to determine if risk of collision exists including the proper use of radar. However, Rule 6 of the Colregs advises that there is a possibility that small vessels may not be detected by radar at an adequate range.

Chester is only 7.5 metres in length overall and has a small beam. The craft was not fitted with a radar reflector. Its aspect could determine whether or not a ship's radar would detect it. Additionally, the echo of the craft might well have been lost in sea clutter on the radar screen.

Weather

The crew of *Chester* reported that the wind at the time of the incident was from the east or east – northeast at 15–20 knots. According to the skipper and the deckhand, there was a 1.5 m sea on a 1 or 1.2 m swell and the weather was fine and clear.

According to the ship's logbook, the wind was from the southeast at force 4, (11–16 knots) and there was a slight sea running. The wind speed was reasonably consistent with that being reported by *Chester*.

According to the Mariner's Handbook, winds of force 4–5 would cause small to moderate waves with maximum heights between 1.5 – 2.5 metres. Such waves would be detected as clutter on the ship's radar screen and could have obscured the echo of *Chester*.

Radar detectability

The ATSB has published two safety bulletins relating to collisions between ships and fishing vessels. Both bulletins, reproduced as attachments to this report, contain advice on the limitations of radar.

A supplement to the January 1994 edition of Seaways, the journal of The Nautical Institute, entitled 'Radar Detectability and Collision Risk[1]' advised its readers that the characteristics of propagation and reflection determine what can be seen on radar. The foreword to the article states that it is essential to understand these principles and not place too much reliance on what is seen and, more importantly, not seen on the screen.

The foreword goes on to say that the paper focuses on the limitations implicit in detecting small craft, which are that:

- Weak echoes can only be detected at limited range and are likely to be lost close in due to clutter.
- Due to properties of propagation, 'phase out' may occur and weak echoes might be lost for a significant period of time.
- Radar reflectors do not enhance radar, but do assist in the detection of a small target.
- Radar reflectors must be properly designed to ensure detection in present operating conditions at sea.
- Echoes displayed on S-band (10 cm wavelength) radar are misleading. Small targets will not be detected more efficiently. Where small targets are being searched for, X-band (3 cm wavelength) must be used.

On the topic of intermittent response and multipath propagation, the paper states:

> Even when small vessels are carrying an effective radar reflector, they are sometimes lost on the radar screen. There are many reasons why this may be so. Prominent among them is a phenomenon affecting radar rather than the reflector, known generally as 'multipath propagation'. Regrettably, many seafarers operating radar are unaware of it.
>
> Equations of radar height, range, target height and the state of the sea or other surface between the radar and the target result in zones where the target will not be seen on the radar screen.
>
> Transmissions from the radar to a target arrive direct or via the region called the bounce point on the intervening surface. If the difference in path length between the two transmissions is exactly half a wavelength or multiples, 1½, 2 ½, 3½ etc., wavelengths, the signals cancel and no return transmission is possible.
>
> The zones in which the target may not be seen are named Fresnel Zones…. Their width is largely dependent on the overall signal strength (a factor of range) and the power and sensitivity of the radar equipment being used. Their existence depends on the sea or other surface conditions at the bounce point being 'electromagnetically smooth', a condition that is not confined to calm seas but even where wave heights are over 10 feet, providing breaking crests are not present.
>
> …specimen tables covering First Fresnel Zones (that is at 1½ wavelength differences) for radars at 20, 40, 80, 120 ft height, ranges from 0.5 to 8 nautical miles, and targets at 1 to 30 ft height have been published.
>
> In this table…, the maximum value of the sum of zone widths is around 1 nautical mile.
>
> …The tables can be used to determine the range at which a small yacht (say) carrying a

[1] Radar Detectability and Collision Risk, by S W Bell, Consultant, GEC-Marconi Defence Systems Ltd and Captain A P Starling, Chairman, Sea Safety Group.

perfect omni-directional radar reflector can be effectively guaranteed by the laws of physics to disappear from the radar screen of an approaching ship.

Radar maintenance

Aboard *Hai Teng*, the radio officer was responsible for maintenance of the ship's communications and radar equipment, but contractors were called in to assist when required.

While the vessel was at Newcastle on 17 March, radar technicians were employed to correct some faults on the 10 cm radar. Water in the cable feed from the scanner was drained and sealant applied to a crack in the original sealant. Gaskets were fitted where required. The left side of the display was missing 3 cm of picture, but, according to the technician's report, horizontal blanking was adjusted to restore the picture.

The performance monitor had been fitted, but not installed. Installation was carried out by the technician, the service report noting that the performance monitor 'rising sun' was operating satisfactorily, but the cavity performance monitor required connection and tuning.

The radar picture was checked and confirmed to be very good with targets out to 53 nautical miles.

The evidence is that, both before and after the collision, this radar was working effectively.

Signals for anchored vessels

Chester was not seen by either of the two men on the bridge of *Hai Teng*.

According to Rule 30 of the Colregs, vessels of less than 50 metres in length at anchor must exhibit an a white all-round light.

According to Rule 22 (c), *Chester* was required to display a white all-round light as an anchor light, visible at a distance of at least 2 miles. At the time of the collision, *Chester* was reported to have had an anchor light on and a low wattage light in the well-deck aft.

While *Chester* was at anchor by day, it should have been exhibiting an anchor ball forward. The craft was not equipped with an anchor ball and there was no such signal being exhibited by day.

The anchor light on *Chester*

The bulb used for the anchor light on *Chester* was labelled Narva, 21/5 w 12 v. This dual filament bulb (with 5 watt and 21 watt filaments, for use with a 12 volt supply) is designed for use as a road vehicle's stop and tail light.

The skipper of *Chester* confirmed that, when he used the light, only the 5 watt filament was illuminated. When the vessel was anchored, this would have been the only source of light on the craft, apart from the glow of the fluorescent light just above the after-well deck.

The lens for the anchor light fitted aboard *Chester* was marked with a part number 1317, the letters GI-ARW, 12 V 10 W. The bulb that should have been used for this lens was a 10 watt bulb.

In *Chester*'s case, the skipper was using a bulb with half the power of a 10 watt bulb. Use of an incorrect bulb would affect the distance at which a light becomes visible. The condition of the battery and wiring could also affect the output from the light. Additionally, the position and orientation of the filament is critical for the lens elements to function effectively.

On board *Chester*, the use of an automotive bulb with the navigation lamp would have led to the following conditions affecting the visibility of the anchor light;

- a wattage only half that required by the manufacturer of the fitting and
- a location for the centre of the filament that was, almost certainly, incorrectly positioned for the lens in use.

FIGURE 4:
Narva bulb used in anchor light aboard *Chester*

The existing socket was not designed for the Narva bulb, which had to be jammed into the socket using insulating tape around the cap (see photograph, page 11). This would have caused the bulb to be seated at an angle to the vertical, instead of it being upright, in order to illuminate the filament.

In addition, the 5 watt filament is positioned off centre in the bulb. This could result in a varied intensity in azimuth.

Advice was received from the Safety Programs and Support Branch of the ATSB that, given that the filament in use was off-centred, that it was only 5 watts and that the bulb was not upright in the socket, there was the possibility that the anchor light would only be visible at a mile, or less, over certain sectors. This is considerably less than the requirement in the Colregs for the light to be visible at 2 miles.

Chester had apparently been bought by its present owner with the jury-rigged all-round light already fitted.

Watchkeeping on board the ship

If the anchor light on *Chester* had been visible at the correct distance of 2 nautical miles, the 2nd mate and the lookout on board *Hai Teng* should have seen the light about ten minutes before the two vessels came into contact.

The watchkeepers' height of eye on the bridge of *Hai Teng* was about 20 metres and the anchor light on *Chester* was only about 2 metres above the water. Given this difference in heights and the fact that the visibility was good, as the distance between the vessels reduced, *Chester*'s light would have dipped inside the horizon for an observer on the ship's bridge.

The moon was almost full that night and, at the time of the collision, it was bearing 326° at an altitude of 45°. The sky was cloudy with moonlight breaking through in patches. If *Chester* had been in moonlight as *Hai Teng* approached, its weak anchor light could easily have been lost in the reflection of the moonlight off the water.

Fatigue

To check whether fatigue was a factor in this incident, the hours of work of the crew on duty on the bulk carrier were analysed using fatigue analysis software developed at the University of South Australia's Centre for Sleep Research.

No evidence was found that either the 2nd mate or the lookout was suffering from the effects of fatigue at the time of the incident.

Collisions and causal factors

Since 1 July 1999, the ATSB has investigated 6 collisions involving ships and fishing vessels or small craft and reports of the incidents have been widely circulated within the industry.

All those at sea, responsible for any vessel, must understand the vital importance of maintaining an effective lookout at all times on all vessels, whether large or small. However, such lookouts are not being kept.

All masters, skippers and watchkeepers should also understand the limitations of radar and that small targets can be difficult to detect, as well as being likely to be lost in sea or rain clutter.

Equipment such as radar reflectors, that enhance the probability of detection of small vessels should be used.

Conclusions

These conclusions identify the different factors contributing to the incident and should not be read as apportioning blame or liability to any particular organisation or individual.

- There was no lookout being maintained on the recreational vessel. Both crew members on *Chester* were asleep and the lookout on *Hai Teng* was not sufficiently effective to detect the small craft and prevent the collision.
- The bulb for the anchor light aboard the recreational vessel was inappropriate for the use to which it was put.
- The bulb for the anchor light had been jammed into position. It was not upright in the socket as it should have been and the filament in use was off-centre in the bulb. The visibility of the light would have been adversely affected, so that it might only have been visible at a mile or less over some sectors.
- It is probable that visual detection of the light on *Chester* was affected by the reflection of moonlight from the water.
- *Chester*, a small craft with limited visual and radar conspicuousness, was anchored about 28 miles off the coast in shipping lanes.
- The size and, possibly, the aspect of *Chester* as well as existing sea conditions led to the craft not being observed on the ship's radar.

Recommendations

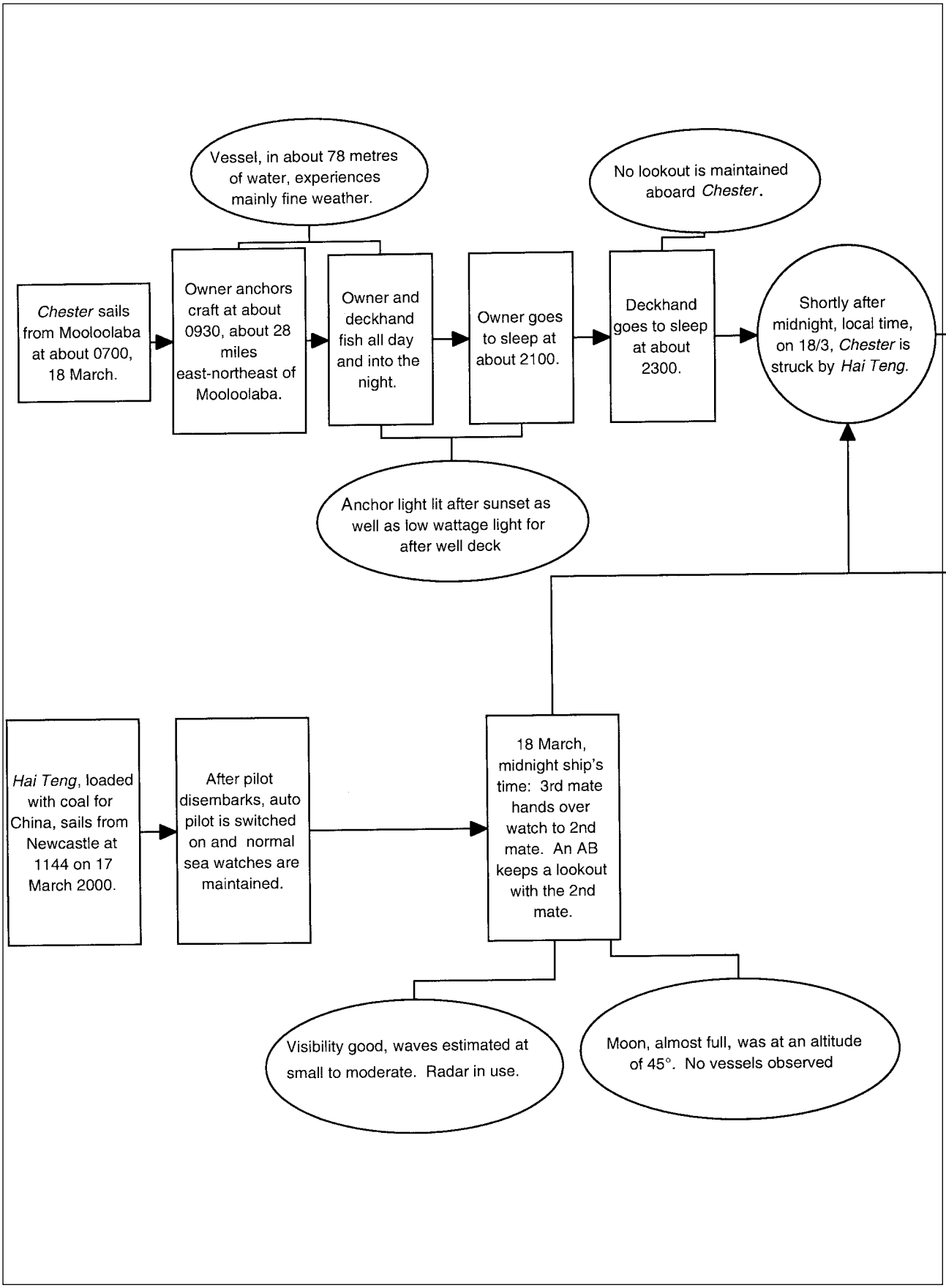
The ATSB notes that the number of collisions involving small craft and ships continues to be a major safety issue. A contributory cause is often the fact that a proper lookout is not being maintained, either by the small craft, the ship, or both vessels.

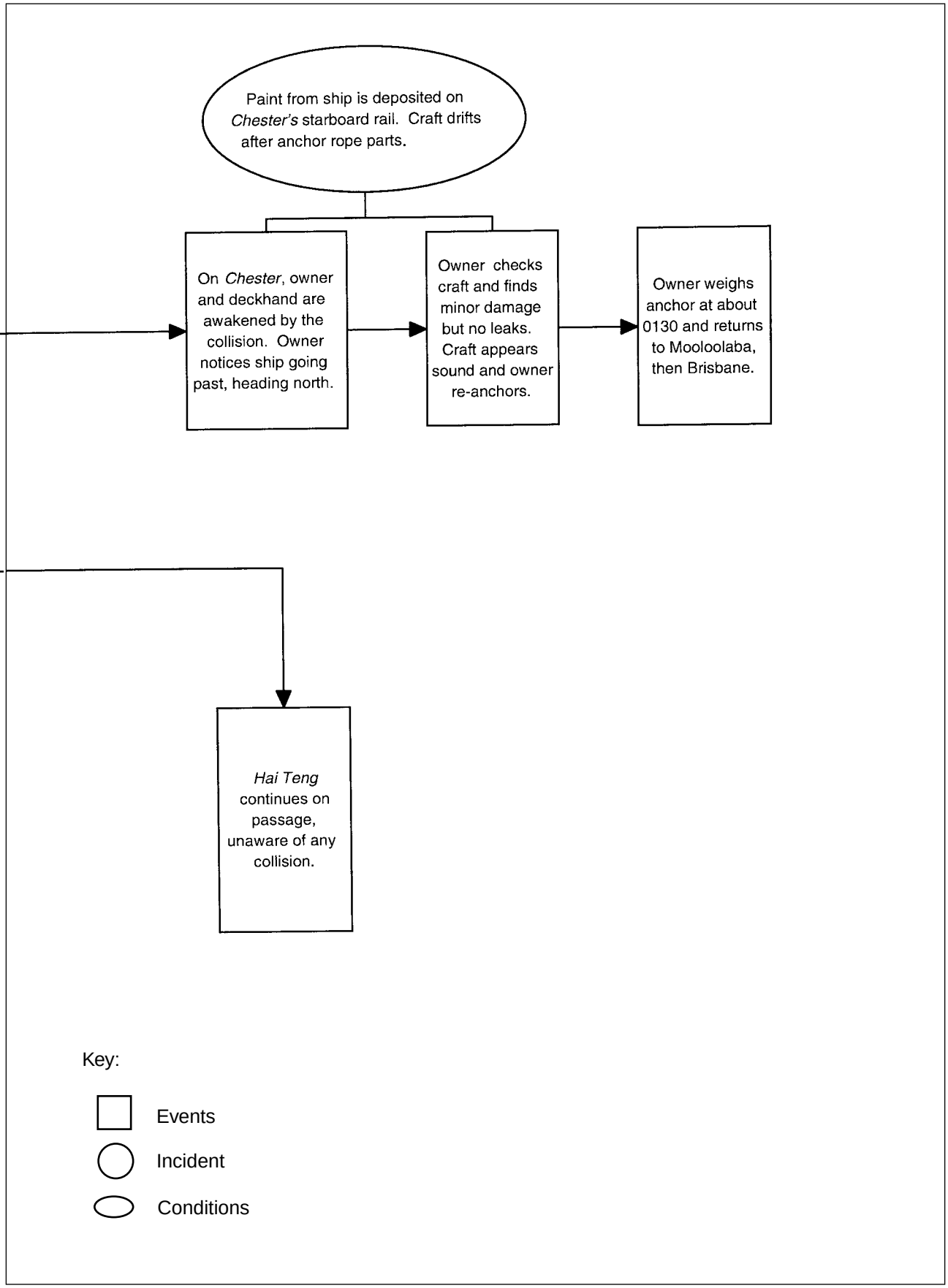
The ATSB recommends that training establishments and authorities issuing certificates of competency, or boating or similar licences, place greater emphasis on training and examining candidates for full knowledge and proper understanding of the International Regulations for Preventing Collisions at Sea, 1972, as amended and in force for Australia.

Examinees should be aware of the requirement to maintain the proper lookout on all vessels at all times. In addition, they should be aware that the Collision Regulations do not exonerate any vessel, the owner, master or crew from the consequences of any neglect to comply with the Rules.

The ATSB also recommends that Australian shipowners, managers, pilots and agents take note of Safety Bulletin 02 attached to this report and avaliable on the ATSB website, bringing it to the attention of as many vessels as possible. The bulletin points out that the only explanations for most collisions are the lack of a proper visual lookout, or an over-reliance on radar detection when the radar set has not been correctly set-up, or has not been maintained properly.

FIGURE 5:
Collision: *Hai Teng* and *Chester*, Events and causal factors chart




Paint from ship is deposited on *Chester's* starboard rail. Craft drifts after anchor rope parts.
On *Chester*, owner and deckhand are awakened by the collision. Owner notices ship going past, heading north.
Owner checks craft and finds minor damage but no leaks. Craft appears sound and owner re-anchors.
Owner weighs anchor at about 0130 and returns to Mooloolaba, then Brisbane.
Hai Teng continues on passage, unaware of any collision.
Key:
Events
Incident
Conditions

Submissions

Under sub-regulation 16(3) of the Navigation (Marine Casualty) Regulations, if a report, or part of a report, relates to a person's affairs to a material extent, the Inspector must, if it is reasonable to do so, give that person a copy of the report or the relevant part of the report. Sub-regulation 16(4) provides that such a person may provide written comments or information relating to the report.

The final draft of the report, or parts of the report, was sent to the following:

- The skipper and deckhand of *Chester*
- The master, 2nd mate and lookout of *Hai Teng*
- The owners of *Hai Teng*

No comments were received from any party in respect of the draft report.

Appendix

Rule 5 of the International Regulations for Preventing Collisions at Sea, 1972, as amended (the Colregs), states that:

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

Rule 7(a) states that:

> Every vessel shall use all available means appropriate to the prevailing circumstances and conditions to determine if risk of collision exists.

Rule 7(b) states that:

> Proper use shall be made of radar equipment if fitted and operational to obtain early warning of risk of collision.

Rule 30 (a) states:

> A vessel at anchor shall exhibit where it can best be seen:
>
> (i) in the fore part, an all-round white light or one ball
>
> (ii) at or near the stern and at a lower level than the light prescribed in sub-paragraph (i), an all-round white light."

Rule 30 (b) states:

> A vessel of less than 50 metres in length may exhibit an all-round white light where it can best be seen instead of the lights prescribed in paragraph (a) of this Rule.

Hai Teng

IMO No.	7616327
Flag	China
Classification Society	China Classification Society
Ship type	Bulk Carrier
Owner	Guangdong Ocean Shipping Co
Year of build	1977
Builder	IHI Industries, Aioi, Japan
Gross tonnage	22 112
Net tonnage	12 096
Summer Deadweight	37 871
Length overall	187.73 m
Beam	28.4 m
Summer draught	10.763 m
Main engine	6-cylinder Sulzer diesel 6RND68
Engine power	7 282 kW
Crew	30 (Chinese)

Chester

Flag	Australian
Owner	Michael E Bickle
Registered length	7.4 m
Beam	2.5 m
Construction	Aluminium hull and upperworks
Engines	175 hp outboard engine
Crew	2 Australian

Safety Bulletin 01

Ships and Fishing Vessels

Ships and Fishing Vessels

At about 0110 on 21 June 2000 a fisherman from Iluka, New South Wales, was killed when his 14 m trawler was run down and sunk by a 181 m long, 42 717 tonne deadweight bulk carrier.

The collision highlights:

1. the risks faced by fishermen from large ships;
2. the limitations of radar; and
3. the mutual obligation of all people at sea to observe the International Regulation for Preventing Collisions at Sea, 1972 (Colregs).

The Risks

Since June 1995, the Australian Transport Safety Bureau has investigated fourteen collisions between trading ships and Australian fishing vessels. In all these cases, the fact that a collision occurred indicates that the lookout aboard the trading ship, both visual and by radar for whatever reason, was ineffective. In a few cases it is probable that the lookout was non-existent. Regardless of any failure on the part of the trading ship to keep a proper lookout:

- Only three involved fishing vessels engaged in fishing.
- Seven involved fishing vessels not engaged in fishing, but en route between fishing grounds.
- Four involved fishing vessels anchored in open water.
  - On three of the four vessels at anchor no lookout was maintained and the crewmembers went to bed despite being anchored in open waters in recognised shipping lanes,
- In twelve incidents, the fishing vessel failed to maintain a proper lookout
  - In four of the incidents, a contributory factor was that the person keeping watch on the fishing vessel had no training, did not understand the obligations placed on a fishing vessel by the Colregs and did not understand how to use the radar.
  - The number of crew typically employed on fishing boats was two or three, which for a sustained 24-hour operation is insufficient to fish and maintain a proper lookout required by the Colregs.

Until 21 June, Australian fishing vessels had been lucky as no fatalities had occurred.

Figures from the UK show that since 1991, at least 19 fishermen are known to have died as a direct result of collisions. In 1998, five fishermen were killed in four collisions involving merchant vessels and British registered fishing vessels.

The Limitations of Radar

RADAR operates by transmitting electro-magnetic signals in the form of pulses from an antenna. Radar reflective objects, which lie in the path of this transmission reflect the signal, which is received by the same antenna in the form of a return signal (echo).

Radar technology has developed to the extent where radars are reliable aids to both navigation and collision avoidance. They do, however, have limitations. Radars are not 'all seeing eyes'.

It is important for fishermen to understand what these limitations are.

The weakest detectable echo, which a radar can display, is one which is just stronger than the radar receiver noise level.

The display of this echo is dependent on the following four factors.

1. The correct setting up of the radar display.
2. The siting of the vessel's radar antenna.
3. The target.
4. The weather conditions at the time of using the radar.

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All these factors are very important, but the target and weather conditions are crucial to fishermen.

The target
The echo response received from a target depends upon the following four factors:
(a) size,
(b) shape,
(c) composition and
(d) aspect

(a) size
Targets presenting a large surface area to the radar signal will be detected easily and at long range. Small targets of limited surface area, which are not very high, may not be detected, if at all, until much closer to the source radar.

(b) shape
A smooth shaped object (hull of a fishing vessel) gives a poor radar detection response as compared to a rough shaped object (rocky coastal out crop).

(c) composition
Metal objects give a better radar response than wood.

Fibreglass objects are transparent to radar signals and will not be displayed on a radar screen.

Small vessels, particularly of wooden or other non-metallic construction, can have a large number of separate reflectors (metal masts, booms, engine and other metallic reflectors). None of these are large enough to provide a constant echo. The close proximity of masts rigging, engine etc., acting as reflectors, can also make the vessel a 'multiple' reflector target. This characteristic can result in either an enhanced echo or the return echoes cancelling each other out. A very small change in relative distance from the radar antenna can make the difference between being seen – 'in phase' – and not being seen –'out of phase'.

Similarly, the phase of the radar signal and echo can be affected by skipping or bouncing off the sea surface resulting in signals that may subtract from each other as described above.

(d) aspect
A target beam on to the radar transmission is more likely to give a radar return than a target lying at an angle of 45° to the transmission.

Weather conditions at the time of using the radar
Waves themselves form targets, which when reflected and picked up by the radar, form 'sea clutter'. 'Sea clutter' varies widely with the sea state. Return echoes from rain showers (rain clutter) can have the same effect. Small vessels are more likely to be consistently lost in clutter than are large vessels.

Rain, fog, high humidity and an air temperature lower than the sea temperature will also reduce the radar detection range.

The Regulations

The Colregs apply to all vessels at sea.

The requirement to keep a proper look-out is a mutual obligation for all vessels at sea.

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

In short every vessel must keep a lookout, whether fishing or not.

Although power-driven vessels and sailing vessels must keep out of the way of vessels 'engaged in fishing', fishing vessels must, so far as possible keep out of the way of a vessel not under command or a vessel restricted in her ability to manoeuvre.

A vessel carrying certificates as a fishing vessel is only a 'restricted' vessel when actually engaged in fishing. It is not restricted when its nets are on the surface or when it is on passage to or from fishing grounds.

Vessels are only considered to be engaged in fishing when fishing with nets, lines, or trawls or other fishing apparatus which restrict manoeuvrability, but does not include a vessel fishing with trolling lines or other fishing apparatus which does not restrict manoeuvrability.

Please remember

If you cannot see a long way visually then the radar cannot generally detect targets at a long range either.

To improve the radar detection of small vessels you should fit as a minimum:

- **a metal corner radar reflector mounted 'in the catch water position'; or**
- **an octahedral cluster of corner reflectors;**

as high as possible above the water line.

Proper understanding and observation of the Colregs and a listening watch on channel 16 VHF can protect your life and your boat.

Safety at sea is like safety on the road. You should assume everybody else is a potential danger – an idiot – and act accordingly.

End note

The vulnerability of fishing vessels has been highlighted in a number of Incidents at Sea reports. The problems created by working lights were highlighted in Report 35 (September 1991) and Report 49 (December 1992). Since June 1995, the issue of fishing boats maintaining a lookout or the limitations in radar in detecting small vessels has been highlighted in the following reports:

81 (June 1995)
94 (July 1996)
98 (September 1996)
103 (November 1996)
104 (November 1996)
106 (December 1996)
116 (April 1997)
125 (September 1997)
131 (April 1998)
144 (February 1999)

Acknowledgements

ATSB is grateful to Mr Ian Smith, Manager Ship Simulator at the Australian Maritime College and Mr John Pothen, Teacher (Ship Simulator) at the Sydney Institute of Technology for advice on radar.

Safety Bulletin 02

Ships and Fishing Vessels

An open letter to all Masters, and bridge watch-keepers

Collisions with fishing vessels

The safety of fishermen and people in small boats is a continuing concern in terms of safety at sea. In the course of your voyages you encounter many types of fishing operations from dug out canoes, with sometimes a candle or oil lantern, to large fishing/factory ships. In and around the Australian coast fishing vessels tend to be less than 20 m in length with a crew of two or three. They often exhibit very bright working lights, though these should be shielded in order to ensure that the fishing lights required by the Colregs can be seen clearly.

Since January 1991, the Australian Transport Safety Bureau has reported on, or is in the process of investigating, 21 incidents of collision between trading ships and small fishing or pleasure craft. Fishermen claim that 'near-miss' situations are common and from time to time, incidents are reported to the ATSB.

That these incidents occur is evidence that fishing vessels and other small craft are not being detected visually or by radar by the watch keeping personnel on board trading vessels. There is an obligation on the part of all vessels at sea to maintain a proper lookout. The fact that in some cases the crews of fishing vessels do not maintain a lookout and do not carry radar reflectors, even though their boats may provide a very poor echo, does not excuse trading ships in any failure to keep a proper lookout.

The following summary underscores the main issues and demonstrates that there are normally no mitigating factors to explain the vast majority of collisions. The only explanations are the lack of a proper visual lookout, or an over reliance on radar detection in circumstances where the radar set has either not been set-up properly, maintained properly or monitored with sufficient diligence.

- Eighteen collisions occurred in clear weather.
- Three collisions occurred in conditions of heavy rain and poor radar detection conditions.
- Fourteen occurred in darkness, five in full daylight and two occurred in the half-light of twilight.
- Eleven collisions occurred between midnight and 0400 in the morning.
- Seventeen collisions involved commercial fishing vessels and four involved yachts or pleasure craft.
- Five of the seventeen fishing vessels were actually engaged in fishing, four were at anchor and eight were in transit.
- Seven small vessels on steady courses were being overtaken by the trading vessel and had been in sight for some time.
- Six vessels were not making way (five were at anchor and one drifting).

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The Australian coast generally enjoys good visibility and has relatively light traffic. It seems probable that watch-keeping officers:

- may be lulled into a sense of false security;
- attentiveness (arousal) is reduced in the clear conditions and they may easily become bored;
- lose track of time in open sea conditions;
- rely too much on radar to the detriment of a proper systematic visual look out.

Radar

As professional mariners, certificated officers hold qualifications as radar observers. However, I must stress the importance of having the radar properly tuned to its optimum performance with both gain and clutter controls correctly set.

In investigating the 21 incidents two critical issues of radar observing seem to emerge.

When using ARPA, assessments of a target's course and speed are made too quickly. Also, it must be realised that where there is a proportionately small amount of relative movement, such as in an overtaking situation, ARPA readings may be inconsistent.

Small vessels, particularly of wooden or other non-metallic construction, can have a large number of separate reflectors (metal masts, booms, engine and other metallic reflectors). None of these is large enough to provide a constant echo. The close proximity of masts rigging, engine etc, acting as reflectors on a small vessel moving in the swell causes multiple reflections. This characteristic can result in either an enhanced echo or in the return echoes cancelling each other out. A very small change in relative distance from the radar antenna can make the difference between a fishing vessel returning a strong signal 'in phase' – or returning a weak or nil signal –'out of phase'.

Similarly, the phase of the radar signal can be affected by multi-path signals due to reflection off the sea surface, resulting in signals that are 'out of phase'.

Conclusion

You may think that a collision cannot happen to you. Experience suggests that accidents of all types can happen to anyone. The best people have the worst accidents.

Australian authorities have taken action against fishermen for the failure to observe the Colregs. They have also prosecuted a ship's master and watch-keeping officer for failure to observe the Rules.

A few minutes failure to keep a proper watch can result in the death of a fisherman and tragedy for the family. For you it can mean lengthy police interviews, delay to the ship, arrest and possible criminal charges which could result in a heavy fine or jail.

Please keep this letter in mind wherever you may be. Under normal conditions of visibility around Australia, there is no substitute for a proper visual lookout supplemented by sensible use of a well set up radar.

Kym Bills
Executive Director

3 August 2000

PS For further information on ATSB's marine casualty and incident reports visit our web site at www.atsb.gov.au

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