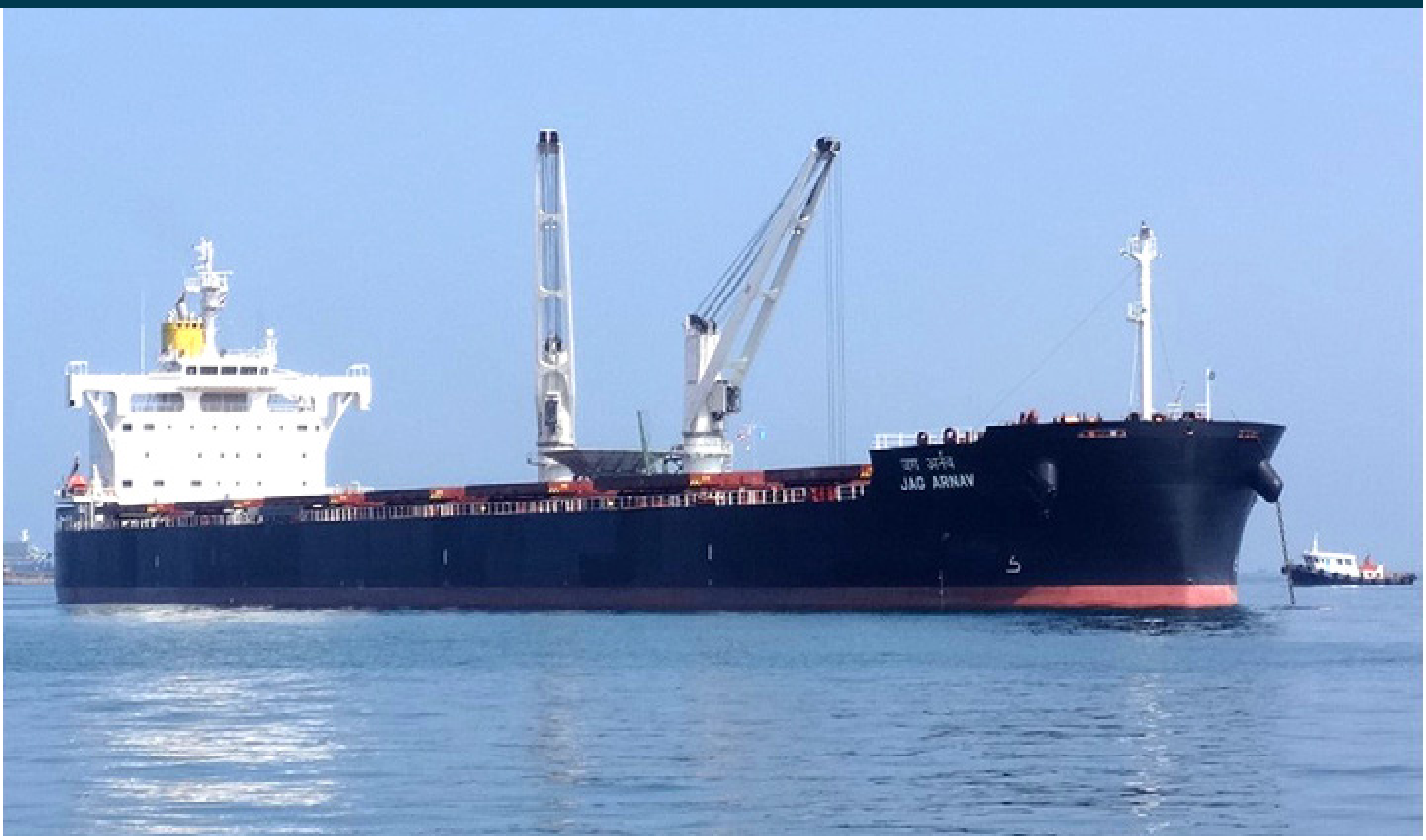
Australian Government
Australian Transport Safety Bureau

# Collision between *Jag Arnav* and *Total Response*

26 NM north-west of Bunbury, Western Australia | 23 June 2015




Investigation

**ATSB Transport Safety Report**
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**Addendum**

| Page | Change | Date |
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# Safety summary

## What happened

On 23 June 2015, in daylight with clear visibility, the bulk carrier *Jag Arnav* and fast utility vessel *Total Response* collided about 26 NM north-west of Bunbury, Western Australia. *Jag Arnav* sustained minor damage and no injuries to the crew. *Total Response* sustained structural damage to its bow and deck, and two crew members received lacerations and abrasions. Both vessels were able to resume their passage.

## What the ATSB found

The ATSB found that a proper and effective lookout by all available means as required by the regulations was not being maintained on either vessel.

The investigation found that *Total Response*'s unqualified deckhand was performing the duties of deck watchkeeper without adequate supervision. *Jag Arnav* was not detected by anyone on board *Total Response* and consequently, no avoiding action was taken. The investigation considered it likely that the chief mate and deckhand on board *Total Response* were at least in a state of reduced alertness attributable to environmental factors including workload prevalent on the day.

The investigation also identified that *Jag Arnav*'s officer of the watch, the third officer, did not maintain an effective lookout despite various electronic aids to navigation detecting *Total Response*. The third officer reported visually detecting *Total Response*, but incorrectly assessed the vessel to be passing clear. No use was made of other available means such as radar or automatic identification system to confirm the assessment and determine risk of collision. Therefore, no action was taken to avoid collision with *Total Response*.

## What's been done as a result

The owner of *Jag Arnav*, the Great Eastern Shipping Company, advised that it has circulated its report into the collision to other ships that they manage and will provide additional training for navigation officers. The company has also emphasised their requirements as laid out in its safety management system with regard to the use of radar for position fixing, acquiring observed targets, use of automatic target acquisition and the use of radar overlay on the electronic chart display and information system.

## Safety message

Over the past 28 years, the ATSB or its predecessors have investigated 38 collisions between trading ships and small vessels on the Australian coast. These investigations have found that failure to keep a proper and effective lookout and to take early and effective avoiding action are recurring contributing factors to these collisions. This was again highlighted by this accident.

The detection of other vessels is the first step in assessing the risk of a collision and taking avoiding action. Systematic visual observations and active use of electronic equipment designed to detect and monitor other vessels can reduce the risk of vessels going undetected or the risk of a collision being incorrectly assessed. Early detection, monitoring and correct assessment of the risk of a collision ensures that timely and appropriate avoiding action can be taken.

# Contents

# The occurrence

On 20 June 2015, at about 1900 Western Standard Time,[1] the 19.9 m long fast utility vessel, [2] *Total Response* (Figure 1), sailed from Albany, Western Australia bound for Fremantle. The vessel's crew comprised the skipper, chief mate and deckhand. The skipper and chief mate were to share the deck watchkeeper duties for the expected 20-hour passage.

During the passage, the vessel encountered adverse weather. The skipper diverted the vessel to Augusta and moored there to wait out the weather.

**Figure 1: The fast utility vessel, *Total Response***

Source: Total AMS (TAMS)

Whilst laid up at Augusta, waiting for the adverse weather to subside, *Total Response*'s crew carried out routine maintenance. On 23 June, at about 0430, *Total Response* departed Augusta. The skipper navigated the ship out of the harbour and remained in the wheelhouse as deck watchkeeper.

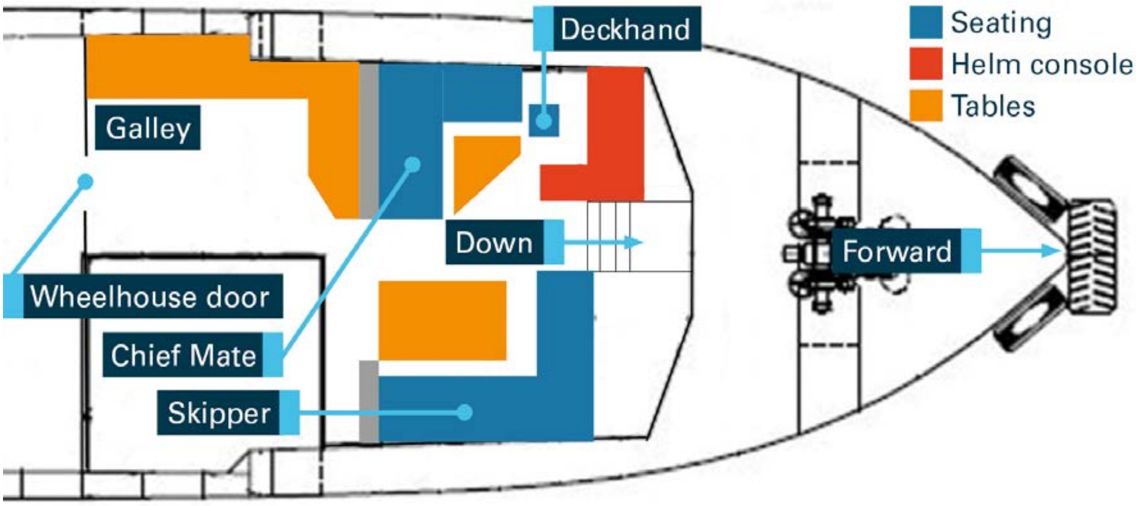
At about 0700, the chief mate took over the duties of deck watchkeeper from the skipper. The deckhand joined them in the wheelhouse and the three men made light conversation. The weather and visibility were good with a light (5 knots) south-easterly wind. By about 0920, *Total Response* had rounded Cape Naturaliste for the final leg of its passage toward Fremantle. The auto-pilot was set on a heading of 027º and the vessel was making good about 16 knots.[3]

At about 1000, the chief mate and skipper decided to give the deckhand the opportunity to act as deck watchkeeper to aid in the deckhand gaining experience towards a deck watchkeeper qualification. The chief mate handed over the watch to the deckhand who took up the seat at the helm console (Figure 2). The chief mate moved to the table behind the deckhand and began using his laptop computer. The skipper was seated at the table on the other side of the wheelhouse.

Meanwhile, *Jag Arnav* was near the coast to the east of *Total Response*. The 229 m long bulk carrier had just sailed from Bunbury (Figure 3) for the United Arab Emirates. The master, third officer and a duty seaman were on the ship's navigation bridge (bridge).

1 All times referred to in this report are local time, Coordinated Universal Time (UTC) + 8 hours.
2 A vessel used for, amongst other things, crew transfers and supplying provisions and stores.
3 All speeds referred to in this report are 'made good/over the ground'.

**Figure 2: Locations of personnel in *Total Response*'s wheelhouse**




Source: TAMS, annotated by the ATSB

At about 1012, *Jag Arnav*'s master ordered a heading of 317° and increased speed to 12 knots for the sea passage. The ship was placed on auto-pilot and the visibility was 'good' (greater than 6 NM). The x-band[4] radar was set to a 6 NM range scale and the s-band[5] radar to a 12 NM range scale. The master handed over navigational responsibilities to the third officer who was the officer of the watch and switched on the bridge navigational watch alarm system.[6]

At about 1030, the master dismissed the duty seaman from the bridge and instructed him to go on deck and help the crew secure the ship for sea.

At about 1042, an alarm on the x-band radar was activated by a spurious radar echo. The alarm was acknowledged, but there were no radar targets on either radar's display at that time.

Shortly after 1044, a faint target echo appeared on the s-band radar display on a true bearing of 251º at a distance of about 12 NM. Over the next 5 minutes, the echo became stronger and its 'target trail'[7] became evident. The target echo was that of *Total Response.* No attempt was made by the third officer to acquire or track the target and neither radar's automatic target acquisition[8] function was turned on at the time.

Meanwhile, in *Total Response*'s wheelhouse, the skipper told the deckhand to keep the vessel on the track displayed on the chart plotter[9] located near the helm console. The skipper also told the deckhand 'not to touch anything, to keep a lookout and call him if he had any problems'. He then retired to his seat to rest. The chief mate had finished using his computer and remained at the table behind the deckhand. Shortly after taking over the watch from the chief mate at 1000, the deckhand observed the automatic identification system[10] (AIS) icon of a vessel near the coast on the chart plotter display. The deckhand did not report this to the chief mate or the skipper as he assumed the chief mate was already aware of it.

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4 An x-band radar operates at a frequency of 10 GHz and its fine resolution makes it useful for collision avoidance.

5 An s-band radar operates at a frequency of 3 GHz and is better at penetrating through weather such as rain or fog.

6 A mandatory system, the bridge navigational watch alarm system (BNWAS) automatically alerts the master or another qualified officer if the officer of the watch becomes incapable of performing the officer of the watch's duties for any reason such as falling asleep or becoming otherwise incapacitated.

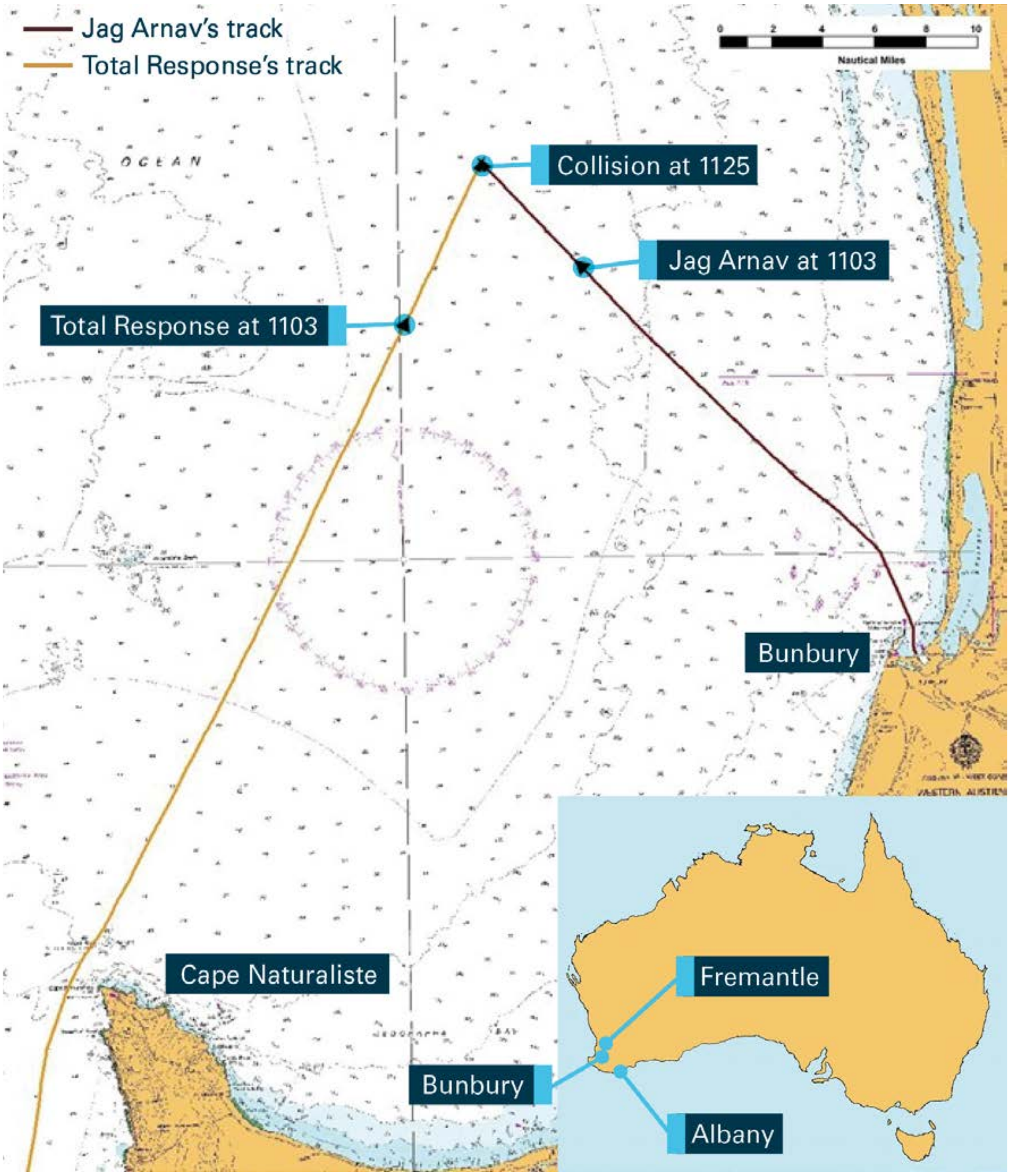
7 The target trail function indicates the historical track of a radar target (settings include true or relative track and the historical time period).

8 Automatic target acquisition is an optional function that allows radar targets to be automatically acquired and plotted based on the user's pre-set parameters.

9 A device used in marine navigation that integrates GPS data with an electronic navigational chart. It displays the electronic chart along with the position, heading and speed of the ship.

10 The automatic identification system (AIS) is a very high frequency (VHF) radio broadcasting system which enables AIS equipped vessels and shore-based stations to send and receive identifying information.

**Figure 3: Section of navigational chart Aus 334 showing the tracks of both vessels**




Source: Australian Hydrographic Service, annotated by the ATSB using electronically recorded data

At about 1100, *Jag Arnav*'s s-band radar indicated *Total Response*'s target echo on a 251º bearing at a distance of 7.4 NM. By this time, *Total Response*'s AIS icon had also appeared on the radar display. The third officer reported he sighted a vessel at about the same time on a bearing of about 4 points[11] on the port bow. Based on his visual observations, the third officer assessed the vessel would pass clear ahead of *Jag Arnav* and therefore maintained *Jag Arnav*'s course and speed. The third officer also fixed the ship's position on the paper navigational chart and continued to do so at 5-minute intervals until the collision.

Shortly after, at about 1103, *Total Response*'s radar echo and AIS icon also appeared on the x-band radar display (Figure 4).

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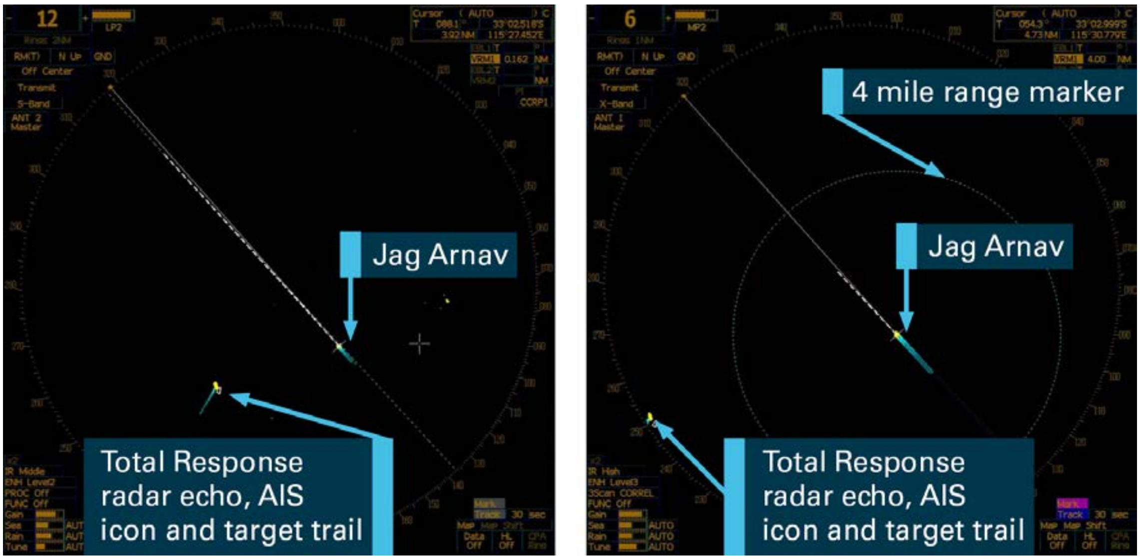
[11] One point of the compass equals 11.25 degrees.

At about 1112, *Total Response* was 4 NM away from *Jag Arnav* and still on a bearing of 251º. The vessel's radar echo, trail and AIS icon were conspicuous on both of the ship's radar displays. Neither radar's automatic radar plotting aid[12] function was used to track *Total Response*.

At 1119, *Total Response* was about 2 NM away on the same steady bearing. The vessel had maintained its course and speed with the deckhand seated at the helm console. The chief mate was still situated behind the deckhand while the skipper rested on the seat on the other side of the wheelhouse.

**Figure 4: Images of *Jag Arnav*'s s-band (L) and x-band (R) radars at 1103**




The images show *Jag Arnav*'s s-band radar set on a 12 NM range scale and the x-band radar set on a 6 NM range scale.
Source: *Jag Arnav*'s voyage data recorder (VDR), annotated by the ATSB

On board *Jag Arnav*, the third officer reported sighting *Total Response* again just before the collision on a bearing of about 2 points on the port bow and again assessed the vessel to be passing clear ahead of *Jag Arnav*. At about 1124, the deck cadet working on the port side of the main deck noticed *Total Response* off the port beam, closing on the ship. He called the bridge using a handheld radio and reported the rapidly approaching vessel to the third officer who was near the chart table.

At about 1125, as the third officer acknowledged the cadet's radio call, *Total Response* collided with *Jag Arnav* near its number two cargo hold on the port side. The master had also heard the radio call and had gone to the port bridge wing where he saw *Total Response* close astern. Realising there had been a collision, he took over from the third officer and began manoeuvring the ship to assist the vessel if required.

The force of the impact was such that the deckhand, chief mate and skipper of *Total Response* were thrown from their positions. Woken suddenly, the skipper quickly took over the vessel's controls and manoeuvred clear of the ship. He then checked on his crew and found both the chief mate and deckhand had suffered abrasions and lacerations, including to their heads.

Shortly afterwards, the master of *Jag Arnav* established VHF radio contact with *Total Response*'s skipper and they exchanged information. After inspecting the vessel, the skipper confirmed that no assistance was required. *Total Response*'s bow had been damaged, but the hull was intact. Water was entering the engine room via the stern tube of the port propeller shaft and a bilge pump was used to pump it out.

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12 A radar with automatic radar plotting aid (ARPA) capability automatically tracks, processes, displays and continuously updates information on manually or automatically acquired radar targets.

At about 1156, *Total Response*'s skipper resumed its passage to Fremantle.

*Jag Arnav*'s crew inspected its hull, including cargo holds and tanks. No structural damage, other than a small indent where the vessel had impacted the hull, was found. At about 1445, after completing the necessary incident reporting, *Jag Arnav*'s master resumed its voyage.

# Context

## *Jag Arnav*

*Jag Arnav* was a 229 m long bulk carrier registered in India and classed with Class NK. The ship was owned and managed by the Great Eastern Shipping Company (GESC), India. Its crew of 24 Indian nationals had joined the ship 1 month before the collision when GESC had taken delivery of the new ship from a shipyard in the Philippines.

The ship's master held a master's certificate of competency. He had 8 years of seagoing experience, the last five with GESC, and had been sailing as a master for 12 months.

The third officer had 18 months of seagoing experience, including his time as a deck cadet, all of it with GESC. *Jag Arnav* was his first ship as a deck officer after obtaining a second mate's certificate of competency. During the 3 weeks at sea after sailing from the Philippines, he had kept navigational watches under the supervision of the master or chief mate as per GESC procedures for new deck officers.

*Jag Arnav* was equipped with all the navigational equipment required by the International Convention for the Safety of Life at Sea (SOLAS)[13] for a new ship of its size. The equipment included an electronic chart display and information system as the primary means of navigation (with paper nautical charts provided as back-up) and two radars. Both radars had automatic radar plotting aid and automatic target acquisition capability as well as data input from the automatic identification system (AIS) and GPS units. *Jag Arnav* was also fitted with a voyage data recorder (VDR)[14] and a bridge navigational watch alarm system.

GESC established a Quality, Safety and Environment Protection System throughout its fleet in accordance with the International Management Code for the Safe Operation of Ships and for Pollution Prevention (ISM Code).[15] This safety management system (SMS) comprised clearly defined policies and procedures that were documented and compiled in the form of manuals. The Fleet Operations Manual provided guidance and instructions concerning the safe navigation of the company's ships based on relevant mandatory international regulations such as The International Regulations for Preventing Collisions at Sea, 1972, as amended (COLREGs) and the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (The STCW Code).[16]

The STCW Code, which prescribes minimum standards relating to training, certification and watchkeeping for seafarers, comprehensively covers the subject of the lookout.[17] Both the shipboard SMS procedures and the Code allowed the officer on watch to be the sole lookout in daylight provided it is safe to do so; taking into account factors such as weather, visibility, traffic density and proximity of navigational dangers. The STCW Code also requires that assistance be readily available to be summoned to the bridge should it be required.

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13 The International Convention for the Safety of Life at Sea, 1974, as amended, International Maritime Organization (IMO), London.

14 A voyage data recorder (VDR) is designed to collect and store data from various shipboard systems in compliance with SOLAS requirements.

15 International Maritime Organization, International Management Code for the Safe Operation of Ships and for Pollution Prevention (ISM Code) as amended, IMO, London.

16 International Maritime Organization, London, 2011, Standards of Training, Certification and Watchkeeping for Seafarers (STCW) Code.

17 ibid. Chapter VIII, Part 4.1 – Principles to be observed in keeping a navigational watch, Lookout, Paragraphs 14 to 17.

## Total Response

*Total Response* was registered in Western Australia as a domestic commercial vessel and was managed by Total AMS (TAMS) in accordance with the National Standard for Commercial Vessels (NSCV).[18]

The vessel was fitted with all the navigation equipment required by the NSCV for a vessel of its class. The equipment fitted included radar, GPS, autopilot, VHF and AIS. It was also fitted with a C-Plot 95 electronic chart plotter with inputs from GPS and AIS. A bridge navigational watch alarm system was not required for a vessel of *Total Response*'s class.

The NSCV required *Total Response*'s core manning to comprise at least an appropriately qualified master (skipper) and an engineer. If the master also held engineer qualifications, the other crew member could be 'uncertificated'. The NSCV also required that voyage duration, area and type of operation, passenger numbers and other factors be taken into account to determine an 'appropriate crew' in addition to the core manning. TAMS had decided that the skipper, chief mate and deckhand was appropriate manning for the voyage from Albany to Fremantle.

The skipper was appropriately qualified for his role[19] with about 9 years at sea, with the last year with TAMS, for the most part as skipper and engineer of *Total Response*.

The chief mate was also qualified for his role[20] and came from a fishing background with about 38 years of seagoing experience, the last five with TAMS, mostly on tugs towing barges.

The deckhand had joined *Total Response* in Albany for the voyage to Fremantle with about 8 years of seagoing experience, the last three with TAMS. His position on *Total Response* was as 'uncertificated crew' with his experience largely limited to being a dredge operator with limited experience in the role of a lookout on a navigation watch.

TAMS, as part of the company's integrated management system, established a vessel SMS that outlined the company's expectations for managing and operating the vessel in a safe and environmentally friendly manner. The vessel SMS contained TAMS policies, procedures, checklists, forms and in addition, vessel specific procedures.

### State of alertness of Total Response's crew

In seeking to determine their state of alertness in the time leading up to the collision, the ATSB interviewed *Total Response*'s crew. The interviews of the skipper, chief mate and deckhand were all consistent in the assertion that they were abruptly roused by the collision.

The skipper had planned on a short rest and was asleep in the time leading up to the collision.

The chief mate's last recollection was of being seated or possibly lying down at the seat behind the helmsman's chair, after using his computer sometime between 1030 and 1100. The deckhand stated that he remembered getting up for a drink, but had no memories until after the collision. Neither the chief mate nor the deckhand could account for the time between their last memories and the collision.

The crew's work/rest schedules including sleep opportunities and time of day of sleep in the days prior to the occurrence, and time-on-task, as well as the time of day and the nature of the work task were used to assess fatigue levels. That assessment indicated that all three crew members had obtained sufficient restful sleep in the days leading up to the accident.

The possibility of oxygen deprivation was also considered as a possible factor leading to sleep. However, the Western Australian Department of Transport's report into the collision stated, that

[18] The NSCV is a standard for the design, construction and operation of Australian commercial vessels regulated by the Australian Maritime Safety Authority (AMSA).

[19] The skipper held a Master Class 5 Trade certificate and a Marine Engine Driver – Grade 2 certificate.

[20] The chief mate held a Master Class 4 Trade certificate and a Fourth Class Engineer certificate.

based on the cubic volume of the internal space on *Total Response*, three adult males would not have been affected by any noticeable lack of oxygen. The report considered it unlikely that there could have been any decrease in oxygen levels to the point where there were any detrimental health effects.

In submission, the chief mate offered carbon dioxide build-up in the wheelhouse as a possible factor. Apart from its asphyxiating effect by displacing oxygen, breathing progressively higher concentrations of carbon dioxide for prolonged periods can cause increasingly severe headaches, fatigue, elevated respiration and pulse rates, and eventually unconsciousness leading to death. While it is possible for carbon dioxide build-up due to respiration in an enclosed space to reach levels at which adverse effects may be felt, ATSB calculations indicated that it was unlikely to be a contributory factor to the collision. There were also no fumes or other unusual smells reported being experienced in the wheelhouse.

In summary, there was no evidence to suggest that sleep-related fatigue, oxygen deprivation or carbon dioxide build-up were contributing factors to the collision.

### *Master's Standing Orders*

*Total Response*'s SMS procedures detailed the master's responsibilities with regard to ensuring continuous and effective watchkeeping. The SMS also required the master of the vessel to develop standing orders to make clear his or her requirements for the safe navigation and operation of the vessel. These orders were required to address the circumstances under which the master was to be called and other vessel specific items such as watchkeeping, reporting and work methods. The master was required to ensure that the orders were read, understood and adhered to by all crew and that they were displayed on the bridge. At the time of the accident, there was no vessel specific master's standing orders evident.

## Collision regulations

The International Regulations for Preventing Collisions at Sea, 1972, as amended (COLREGs) provide internationally agreed rules and measures to prevent collisions. The COLREGs generally apply to all vessels in all waters and include requirements for keeping a lookout, the conduct of vessels and their responsibilities in preventing collisions.

With respect to keeping a lookout, COLREGs Rule 5 – *Look-out*, states:

> 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 5 requires that a lookout be kept not only by sight and hearing, but by all available means. These usually include radar, AIS, electronic chart display and information system, and traffic information from other sources such as radio broadcasts and ship-to-ship calls. Maintaining a proper lookout is the first step in collision prevention so that risk of collision can be assessed in sufficient time for early and appropriate action to be taken.

The COLREGs also advise that, in determining if risk of collision exists:

> Such risk shall be deemed to exist if the compass bearing of an approaching vessel does not appreciably change.

The COLREGs also specify the action each vessel should take to avoid collision depending on the situation. A crossing situation is described in Rule 15 as:

> When two power-driven vessels are crossing so as to involve risk of collision, the vessel which has the other on her own starboard side shall keep out of the way and shall, if the circumstances of the case admit, avoid crossing ahead of the other vessel.

In most situations, one vessel is considered the 'give-way' vessel and the other the 'stand-on' vessel. In general, the 'give-way' vessel is responsible for taking action first, and Rule 16 states:

> Every vessel which is directed to keep out of the way of another vessel shall, so far as possible, take early and substantial action to keep well clear.

Rule 17 details the steps the ‘stand-on’ vessel is required to take. In general, it is required to take action if it becomes necessary to avoid collision as a result of the other vessel not giving way or if action is required due to some other reason. In this case, a crossing situation had developed between *Total Response* (the ‘give-way’ vessel) and *Jag Arnav* (the ‘stand-on’ vessel).

## Voyage Data Recorder

The ATSB found voice recordings from the bridge microphones recorded on *Jag Arnav*’s VDR did not meet the required performance standard,[21] with the recording being at times unintelligible which hindered its use in determining events and the actions of those on the bridge. In addition to the poor quality of the audio recordings, the VDR contained sensor data that could not be interpreted.

[21] International Maritime Organization (IMO), Resolution MSC.333(90), Adoption of revised performance standards for shipborne voyage data recorders (VDRs), 22 May 2012

# Safety analysis

On 23 June 2015, at about 1125, *Total Response* and *Jag Arnav* collided in open waters, with good visibility, about 26 NM north-west of Bunbury, Western Australia. No action was taken by the crew of either vessel to avoid the collision. *Total Response* sustained structural damage and two crew members received minor injuries. *Jag Arnav* sustained minor damage, with no injuries to the crew.

The crew of both *Total Response* and *Jag Arnav* were required to maintain a proper lookout in accordance with Rule 5 of The International Regulations for Preventing Collisions at Sea, 1972, as amended (COLREGs). In addition to keeping a visual lookout (in the prevailing good conditions), a number of other means to help maintain a proper lookout were available on both vessels. This analysis will discuss the lookout onboard both vessels, the availability of electronic aids for supporting an effective lookout, and that state of alertness of *Total Response*'s crew.

## *Total Response's* lookout

On *Total Response*, only the skipper and chief mate were qualified to keep navigational watches as the deck watchkeeper. The deckhand, as 'uncertificated crew', could only undertake watchkeeping duties under the supervision of a qualified deck watchkeeper. When the deckhand was assigned the watchkeeping duties, the skipper believed that the chief mate remained the deck watchkeeper and was supervising the deckhand. However, the chief mate was of the understanding that he no longer held these duties and attended to other tasks. Consequently, this misunderstanding in responsibility resulted in the unqualified deckhand performing watchkeeping duties alone and unsupervised.

In addition, there were no master's standing orders onboard, as required by the operator's safety management system (SMS). While the ATSB could not establish if this would have influenced the outcome, it would have detailed the master's (skipper's) expectations for the operation of the vessel.

Shortly after taking over as deck watchkeeper, the deckhand sighted the automatic identification system (AIS) icon of a vessel (*Jag Arnav)* on the chart plotter. The deckhand assumed the chief mate was aware of the vessel and did not pay it any further attention or alert anyone to its presence. This removed an early opportunity to track and assess the ship for risk of collision.

Furthermore, the deckhand had only a basic understanding and knowledge of the bridge equipment including the radar, chart plotter and AIS. This meant that he could not interrogate the AIS icon himself or acquire a detected vessel on radar in order to be able to make an assessment of the risk of a collision. *Total Response* was equipped with several electronic means of detecting other vessels and assessing their risk of collision. *Total Response*'s chart plotter had a guard zone[22] function to warn of approaching vessels, but this was not in use at the time.

As *Jag Arnav* got closer, the skipper was resting while the chief mate remained at the table behind the deckhand. The large ship would have become increasingly visible to anyone keeping a lookout on *Total Response* and the vessel's chart plotter, AIS and radar could all have been used to enhance the lookout.

The crew of *Total Response* had sufficient opportunity to detect *Jag Arnav* and take action to avoid collision. However, there was no attempt at avoiding action or communication with *Jag Arnav* until after the collision. The lack of supervision of the unqualified deckhand resulted in a failure to detect the inadequate and ineffective lookout being maintained, resulting in *Jag Arnav* not being detected by anyone on *Total Response* until after the collision. Furthermore, had better

[22] A guard zone can be set on the chart plotter at a specified distance around a vessel and will set off an alarm when a radar target or AIS icon of a vessel enters the zone.

use been made of the chart plotter, radar and AIS, it would have likely provided prior warning of *Jag Arnav*'s approach and possibly alerted the crew to the developing situation.

### State of reduced alertness

*Total Response* and *Jag Arnav* collided in open waters during daylight hours under conditions of good visibility and fair weather. However, no one on board *Total Response* saw *Jag Arnav* or was aware of its approach. The ATSB investigation determined that the crew's performance was unlikely to have been affected by sleep-related fatigue, oxygen deprivation or carbon dioxide build-up.

In seeking to determine the likely state of alertness of the chief mate and deckhand on board *Total Response* in the time leading up to the collision, their respective workloads and environment were considered.

Mental and physical workloads both affect human performance and accident reports suggest workload is an important causal factor in many maritime accidents. Mental workload can be defined as 'the mental effort or processing load required to undertake a task or number of tasks'.[23] Workload can be high such as when navigating in congested waters or relatively low such as when navigating a ship in open waters with little or no traffic. The relationship between workload and fatigue can be complex predominantly as both underload and overload can contribute to fatigue.[24] Underload, as with overload, is associated with low attention levels, low motivation, loss of situation awareness and the possible onset of fatigue.[25]

The chief mate, of the belief that he was no longer on watch, was likely in a relatively low workload. The deckhand was on watch, in what was essentially, a monitoring role, a task at which human sustained attention is notoriously poor. It was likely that the deckhand and chief mate were at least in a state of reduced alertness attributable to environmental factors including low social interaction, minimal traffic, a calm sea and warm day, as well as low workload, both physical and mental. It was possible that this could have led to inadvertent sleep despite sufficient prior sleep, however, this could not be established. Despite this, a reduced state of alertness would have adversely affected the deckhand and chief mate's ability to maintain a proper lookout. This would account for their lack of awareness of *Jag Arnav*.

## *Jag Arnav*'s lookout

In the time leading up to the collision, *Jag Arnav*'s third officer, the officer of the watch, was the sole lookout as allowed by the company's SMS and the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (The STCW Code). The third officer reportedly sighted *Total Response* about 25 minutes before and again shortly before the collision. On both occasions, he incorrectly assessed the vessel to be crossing ahead of the ship. The next time the attention of the third officer was directed to the smaller vessel approaching was just before the collision when advised by the cadet.

The third officer had available the ship's radars with automatic radar plotting aid and automatic target acquisition capability, AIS and electronic chard display and information system (ECDIS) to supplement a visual lookout and assist with the early detection of other vessels. The ECDIS also had the ability to display AIS targets and overlay radar images over the electronic chart. However, these electronic aids and/or their functions were either not properly used or not turned on.

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23 Grech, RG, Horbery, TJ & Koester, T 2008, Human factors in the maritime domain, CRC Press, London

24 Grech, Michelle R, Neal, Yeo GB, Humphreys M, Smith S, 2009, An examination of the relationship between workload and fatigue within and across consecutive days of work: is the relationship static or dynamic? *Journal of Occupational Health Psychology*, 14(3). pp. 231-242.

25 Grech, Working onboard: workload, stress and communication, *Human Performance and limitation for mariners*, 2015, London: The Nautical Institute, pp. 53-67.

A review of the voyage data recorder showed that *Total Response* was detected on the s-band and x-band radars about 40 minutes and 20 minutes respectively before the collision. The radar echo and AIS icon were consistently appearing on both radars indicating a rapidly closing vessel on a steady compass bearing. The lack of appreciable change in bearing indicated that there was a risk of a collision and that the vessel would not pass clear or would do so at very close range. As it got closer, *Total Response* would have become increasingly visible to the third officer (almost certainly if aided by binoculars).

Further, as *Jag Arnav* was the 'stand-on' vessel, the third officer was obliged to wait for *Total Response*, the 'give-way' vessel, to take action until such time that it became clear that it was not taking action, or that its action alone could not prevent collision. Once this became apparent, the third officer was obliged to take action to avoid collision. However, the third officer's assessment of the situation was based solely on visual sightings with no use of electronic aids to confirm the assessment. The third officer (incorrectly) assessed that *Total Response* would pass clear, ahead of *Jag Arnav* with no risk of collision and therefore, no need for avoiding action.

After visually identifying the approaching vessel, a more systematic observation using other equipment such as ECDIS, radar or AIS would have allowed a more thorough assessment of the situation. This would have alerted the third officer to the developing close quarters crossing situation and the risk of a collision with *Total Response*. A proper lookout by all available means, as required by the SMS, the master's standing orders and the COLREGs would have ensured that the risk of collision posed by *Total Response* was recognised allowing appropriate action to be taken to avoid a collision.

## Collisions between ships and small vessels

Between 1990 and 2017, 63 collisions between trading ships and small vessels on the Australian coast have been reported to the ATSB or its predecessors. Of these, 38 have been investigated.[26] Failure to keep a proper and effective lookout and take early and effective avoiding action have been identified as recurring contributing factors to these collisions

The keeping of a proper and effective lookout at sea at all times is a critical aspect of collision avoidance. The detection of other vessels is the first step in assessing risk of collision and taking avoiding action. Mariners today have increasing access to navigational aids that enhance the keeping of a lookout. Technology such as ECDIS integrated with radar and AIS are common on ships, and even small vessels are increasingly being fitted with chart plotters and AIS. These aids, when used effectively, give the lookout the ability to detect other vessels well before they are in visual range. Active use of safety features such as guard rings and guard zones, automatic target acquisition functions and ECDIS overlays can reduce the risk of vessels going undetected.

Lessons from past investigations into collisions between trading ships and small vessels on the Australian coast have shown that a proper lookout using all available means and the taking of early avoiding action in accordance with the COLREGs could have prevented most collisions.

The safety lessons from these investigations have been published in ATSB investigation reports. A number of ATSB safety bulletins also highlight these risks to educate seafarers and mariners. These documents and other safety information about marine safety issues are available on the ATSB website.

[26] ATSB investigation MO-2017-007 started on 13 August 2017 was ongoing at the time of finalising the MO-2015-003 report.

# Findings

From the evidence available, the following findings are made with respect to the collision between the fast utility vessel, *Total Response*, and the bulk carrier, *Jag Arnav,* that occurred in daylight in good visibility and in open waters off Bunbury, Western Australia on 23 June 2015. These findings should not be read as apportioning blame or liability to any particular organisation or individual.

## Contributing factors

- A proper lookout, in accordance with The International Regulations for Preventing Collisions at Sea (COLREGs), was not maintained on board *Total Response*. No one, including the deckhand acting as watchkeeper, saw *Jag Arnav* or was aware of its approach.
- Leading up to the collision, the responsibility for the supervision of the unqualified deckhand's watchkeeping activities, by a qualified deck watchkeeper, was not clearly established on board *Total Response*.
- In the time leading up to the collision, it is likely that the chief mate and deckhand on board *Total Response* were at least in a state of reduced alertness attributable to the environmental factors, including the low mental and physical workload prevalent on the day, which may have influenced the effectiveness of the lookout.
- A proper lookout by all available means, in accordance with the company procedures, master's standing orders and COLREGs, was not maintained on board *Jag Arnav*. The third officer incorrectly assessed that *Total Response* would pass clear based on a visual sighting and made no use of electronic aids such as radar or automatic identification system to determine if risk of collision existed.

## Other factors that increased risk

- *Jag Arnav*'s voyage data recorder contained sensor data that could not be interpreted and poor quality audio recordings that did not meet the required International Maritime Organization performance standards.
- At the time of the collision, there were no master's standing orders present on board *Total Response* as required by the company's safety management system.

# Safety issues and actions

## Additional safety action

Whether or not the ATSB identifies safety issues in the course of an investigation, relevant organisations may proactively initiate safety action in order to reduce their safety risk. The ATSB has been advised of the following proactive safety action in response to this occurrence.

### *Great Eastern Shipping Company*

In response to the accident, the Great Eastern Shipping Company advised the ATSB that they have taken the following actions:

- Distributed a circular to company's vessels advising them of the accident and the factors that led to it.
- Distributed a circular to company's vessels re-emphasising the requirement that all company standard operating procedures are always followed when a vessel proceeds to sea. Specifically:
    - Any target once observed needs to be acquired on the radar.
    - The auto target acquisition of both the radars is to be switched on after pilotage and after clearing port limits.
    - Position fixing is to utilise other means such as radar and not rely solely on GPS.
- Instructions have been provided to masters to ensure that the officer on watch is competent and able to keep independent bridge watches during daylight hours with good visibility and low traffic before handing over the 'Con' and dismissing the helmsman from the bridge.
- At the time of the accident, the company's safety management system (SMS) stated that the primary means of navigation were paper charts. The SMS was amended to state that, if fitted, certified and part of a vessel's safety equipment, an electronic chart display and information system (ECDIS) would be the primary means of navigation. Paper charts provided as a back-up for the ECDIS were also to be kept updated as per the company's SMS.
- ECDIS was to be used with the available radar overlay when in use.
- Additional training was to be provided to all navigation officers to prevent such occurrences.

# General details

## Occurrence details

| | | |
|---|---|---|
| Date and time: | 23 June 2015 – 1125 WST (UTC +8 hours) | |
| Occurrence category: | Accident | |
| Primary occurrence type: | Collision | |
| Location: | About 26 NM north-west of Bunbury, Western Australia | |
| | Latitude: 32° 59.2’ S | Longitude: 115° 18.7’ E |

## Ship details - *Jag Arnav*

| | |
|---|---|
| Name: | *Jag Arnav* |
| IMO number: | 9705354 |
| Call sign: | AWJZ |
| Flag: | India |
| Classification society: | Nippon Kaiji Kyokai (Class NK) |
| Ship type: | Bulk carrier |
| Builder: | Tsuneishi Heavy Industries (Cebu) |
| Year built: | 2015 |
| Owner(s): | Great Eastern Shipping Company |
| Manager: | Great Eastern Shipping Company |
| Gross tonnage: | 43,007 |
| Deadweight (summer): | 81,732 t |
| Summer draught: | 14.43 m |
| Length overall: | 229 m |
| Moulded breadth: | 32.26 m |
| Moulded depth: | 20 m |
| Main engine(s): | Mitsui MAN – B&W 6S60ME-C8.2 |
| Total power: | 9,660 kW |
| Speed: | 14.5 knots |
| Damage: | Minor indentations to hull |

## Ship details – *Total Response*

| | |
|---|---|
| Name: | *Total Response* |
| Identification number: | 3168 |
| Call sign: | VNW6226 |
| Flag: | Australia |
| Classification society: | State Survey Western Australia |
| Ship type: | Fast utility vessel |
| Builder: | Unknown |
| Year built: | 1988 |
| Owner(s): | Total AMS |
| Manager: | Total AMS |
| Gross tonnage: | 69 |
| Deadweight (summer): | NA |
| Summer draught: | 1.35 m |
| Length overall: | 19.98 m |
| Moulded breadth: | 4.8 m |
| Moulded depth: | 3.85 m |
| Main engine(s): | 2 x V8 Fiat / 650 hp |
| Total power: | 1300 hp |
| Speed: | 25 knots |
| Damage: | Significant damage to bow structure, deck and superstructure |

# Sources and submissions

## Sources of information

The sources of information during the investigation included the:

- interviews of the crew of *Total Response* and employees of the management company, Total AMS (TAMS).
- documents as supplied by TAMS
- statements, from the crew of *Jag Arnav*, and other information provided by *Jag Arnav*'s management company, Great Eastern Shipping Company
- electronic information taken from the electronic chart plotter of *Total Response*
- electronic information taken from the voyage data recorder of *Jag Arnav*
- documentation supplied by the Western Australian Department of Transport.

## References

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## Submissions

Under Part 4, Division 2 (Investigation Reports), Section 26 of the *Transport Safety Investigation Act 2003* (the Act), the Australian Transport Safety Bureau (ATSB) may provide a draft report, on a confidential basis, to any person whom the ATSB considers appropriate. Section 26 (1) (a) of the Act allows a person receiving a draft report to make submissions to the ATSB about the draft report.

A draft of this report was provided to the Australian Maritime Safety Authority, Western Australian Department of Transport, the master, mate and deck hand of *Total Response*, Total AMS, the master and third officer of *Jag Arnav* and the Great Eastern Shipping Company.

Submissions were received from the Australian Maritime Safety Authority and *Total Response*'s chief mate. The submissions were reviewed and where considered appropriate, the text of the report was amended accordingly.

# Appendices

## Appendix A – Collision Regulations

Rules applicable to this accident as taken from the Convention on the International Regulations for Preventing Collision at Sea, 1972 (COLREGS).

### *Rule 5 - Look-out*

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 15 - Crossing situation*

When two power-driven vessels are crossing so as to involve risk of collision, the vessel which has the other on her own starboard side shall keep out of the way and shall, if the circumstances of the case admit, avoid crossing ahead of the other vessel.

### *Rule 16 - Action by give-way vessel*

Every vessel which is directed to keep out of the way of another vessel shall, so far as possible, take early and substantial action to keep well clear.

### *Rule 17 - Action by stand-on vessel*

(a) (i) Where one of two vessels is to keep out of the way the other shall keep her course and speed.

(ii) The latter vessel may however take action to avoid collision by her manoeuvre alone, as soon as it becomes apparent to her that the vessel required to keep out of the way is not taking appropriate action in compliance with these Rules.

(b) When, from any cause, the vessel required to keep her course and speed finds herself so close that collision cannot be avoided by the action of the give-way vessel alone, she shall take such action as will best aid to avoid collision.

(c) A power-driven vessel which takes action in a crossing situation in accordance with sub-paragraph (a) (ii) of this Rule to avoid collision with another power-driven vessel shall, if the circumstances of the case admit, not alter course to port for a vessel on her own port side.

(d) This Rule does not relieve the give-way vessel of her obligation to keep out of the way.

# Australian Transport Safety Bureau

The Australian Transport Safety Bureau (ATSB) is an independent Commonwealth Government statutory agency. The ATSB is governed by a Commission and is entirely separate from transport regulators, policy makers and service providers. The ATSB's function is to improve safety and public confidence in the aviation, marine and rail modes of transport through excellence in: independent investigation of transport accidents and other safety occurrences; safety data recording, analysis and research; fostering safety awareness, knowledge and action.

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia that fall within Commonwealth jurisdiction, as well as participating in overseas investigations involving Australian registered aircraft and ships. A primary concern is the safety of commercial transport, with particular regard to operations involving the travelling public.

The ATSB performs its functions in accordance with the provisions of the *Transport Safety Investigation Act 2003* and Regulations and, where applicable, relevant international agreements.

## Purpose of safety investigations

The object of a safety investigation is to identify and reduce safety-related risk. ATSB investigations determine and communicate the factors related to the transport safety matter being investigated.

It is not a function of the ATSB to apportion blame or determine liability. At the same time, an investigation report must include factual material of sufficient weight to support the analysis and findings. At all times the ATSB endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner.

## Developing safety action

Central to the ATSB's investigation of transport safety matters is the early identification of safety issues in the transport environment. The ATSB prefers to encourage the relevant organisation(s) to initiate proactive safety action that addresses safety issues. Nevertheless, the ATSB may use its power to make a formal safety recommendation either during or at the end of an investigation, depending on the level of risk associated with a safety issue and the extent of corrective action undertaken by the relevant organisation.

When safety recommendations are issued, they focus on clearly describing the safety issue of concern, rather than providing instructions or opinions on a preferred method of corrective action. As with equivalent overseas organisations, the ATSB has no power to enforce the implementation of its recommendations. It is a matter for the body to which an ATSB recommendation is directed to assess the costs and benefits of any particular means of addressing a safety issue.

When the ATSB issues a safety recommendation to a person, organisation or agency, they must provide a written response within 90 days. That response must indicate whether they accept the recommendation, any reasons for not accepting part or all of the recommendation, and details of any proposed safety action to give effect to the recommendation.

The ATSB can also issue safety advisory notices suggesting that an organisation or an industry sector consider a safety issue and take action where it believes it appropriate. There is no requirement for a formal response to an advisory notice, although the ATSB will publish any response it receives.

**Australian Transport Safety Bureau**

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**REPCON** 1800 020 505
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**Facebook** atsbgovau
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Investigation

**ATSB Transport Safety Report**
Marine Occurrence Investigation
Collision between *Jag Arnav* and *Total Response*
26 NM north-west of Bunbury, Western Australia
on 23 June 2015

MO-2015-003
Final – 8 June 2018