MA2014-6

MARINE ACCIDENT
INVESTIGATION REPORT

June 27, 2014

JTSB Japan Transport Safety Board

The objective of the investigation conducted by the Japan Transport Safety Board in accordance with the Act for Establishment of the Japan Transport Safety Board is to determine the causes of an accident and damage incidental to such an accident, thereby preventing future accidents and reducing damage. It is not the purpose of the investigation to apportion blame or liability.

Norihiro Goto
Chairman,
Japan Transport Safety Board

Note:

This report is a translation of the Japanese original investigation report. The text in Japanese shall prevail in the interpretation of the report.

MARINE ACCIDENT INVESTIGATION REPORT

Vessel type and name: Bulk Carrier NIKKEI TIGER
IMO number: 9159438
Gross tonnage: 25,074 tons

Vessel type and name: Fishing Vessel HORIEI-MARU
Fishing vessel registration number: ME1-937
Gross tonnage: 119 tons

Accident type: Collision
Date and time: Around 01:56, September 24, 2012 (local time, UTC+9 hours)
Location: Around 930 km, Off the East of Kinkazan, Ishinomaki City, Miyagi Prefecture (approximately 39°37.5' N 152° 12.1'E)

June 12, 2014
Adopted by the Japan Transport Safety Board
Chairman Norihiro Goto
Member Tetsuo Yokoyama
Member Kuniaki Shoji
Member Toshiyuki Ishikawa
Member Mina Nemoto

SYNOPSIS

< Summary of the Accident >

The bulk carrier NIKKEI TIGER, with a master and 20 crew members, departing Shibushi Port, Shibushi City, Kagoshima Prefecture, was proceeding northeast on the North Pacific toward Vancouver, Canada. The fishing vessel HORIEI-MARU, with a master and 21 crew members, was proceeding south-southwest, for the purpose of avoiding a low pressure system, on the North Pacific. At around 01:56, September 24, 2012 (local time UTC+9), at around 930 km east of Kinkazan, Ishinomaki City, Miyagi Prefecture, NIKKEI TIGER's bow and HORIEI-MARU's port side collided with each other.

Nine crew members onboard HORIEI-MARU were rescued by HORIEI-MARU's consort, but the others went missing, and the vessel sank.

NIKKEI TIGER had no casualties and received no significant damage to its hull.

< Probable Causes >

It is probable that the accident of collision between NIKKEI TIGER and HORIEI-MARU occurred at around 930 km east of Kinkazan at night while NIKKEI TIGER was proceeding northeast and HORIEI-MARU was proceeding south-southwest, because NIKKEI TIGER altered its course to port and HORIEI-MARU altered its course to starboard in a situation where the vessels came close to each other sailing on intersecting courses.

It is probable that NIKKEI TIGER altered its course to port for the purpose of widening the passing distance to HORIEI-MARU, which was crossing ahead.

1 PROCESS AND PROGRESS OF THE INVESTIGATION

1.1 Summary of the Accident

The bulk carrier NIKKEI TIGER, with a master and 20 crew members, departing Shibushi Port, Shibushi City, Kagoshima Prefecture, was proceeding northeast on the North Pacific toward Vancouver, Canada. The fishing vessel HORIEI-MARU, with a master and 21 crew members, was proceeding south-southwest, for the purpose of avoiding a low pressure system, on the North Pacific. At around 01:56, September 24, 2012 (Japan local time UTC+9, the same shall apply hereinafter), at around 930 km east of Kinkazan, Ishinomaki City, Miyagi Prefecture, NIKKEI TIGER's bow and HORIEI-MARU's port side collided with each other.

Nine crew members onboard HORIEI-MARU were rescued by HORIEI-MARU's consort, but the others went missing, and the vessel sank.

NIKKEI TIGER had no casualties and received no significant damage to its hull.

1.2 Outline of the Accident Investigation

1.2.1 Setup of the Investigation

The Japan Transport Safety Board appointed an investigator-in-charge and two other investigators to investigate this accident, on September 24, 2012.

1.2.2 Collection of Evidence

October 2, 7 to 9, 15, 16, and 18, 2012; January 20, March 1, November 28, and December 3, 2013: Interviews

October 3, 2012; January 27, 2013: On-site investigation and interviews

1.2.3 Tests and Research by Other Institutes

The Japan Traffic Safety Board entrusted the investigation and research about the following matters to the National Maritime Research Institute; the sound records (containing collision sounds) related to the collision between the bulk carrier NIKKEI TIGER and the fishing vessel HORIEI-MARU; the tracks of the bulk carrier and the fishing vessel; the hull behavior of the fishing vessel after the collision; evaluations of the functions of navigational equipment for the avoidance of collision accidents; and others.

1.2.4 Interim Report and Comments pursuant to Article 28 of the Act for Establishment of the Japan Transport Safety Board

On October 25, 2013, based on the factual information gained until then, the Transport Safety Board published an interim report, and expressed its opinion on the measures to be taken for preventing similar accidents to the Minister of Land, Infrastructure, Transport and Tourism and the Director General of Fisheries Agency.

1.2.5 Comments from the Parties Relevant to the Cause

Comments on the draft report were invited from parties relevant to the cause of the accident.

1.2.6 Comments from Flag State

Comments on the draft report were invited from the flag State of NIKKEI TIGER.

2 FACTUAL INFORMATION

2.1 Events Leading to the Accident

2.1.1 Progress of NIKKEI TIGER leading to the Accident According to data of Simplified Voyage Data Recorder

According to the data of the simplified voyage data recorder[1] (hereinafter referred to as "SVDR") installed in NIKKEI TIGER (hereinafter referred to as "Vessel A"), the progress of Vessel A was as follows:

(1) Records of position and speed of Vessel A

The position and speed (speed over ground, the same shall apply hereinafter) of Vessel A between around 01:51 and around 01:57, September 24, 2012, were as shown in Appendix Table 1.

(2) Records of the voices and conversations of watchkeeping personnel of Vessel A just before the occurrence of collision

Records of the voices of the second officer of Vessel A (hereinafter referred to as "Officer A") and helmsman (hereinafter referred to as "Helmsman A") are shown in Table 2.1.1 (1). Note that voices in Tagalog are translated and shown in English.

Table 2.1.1 (1): Voices recorded in Vessel A's SVDR

hh:mm:ss	Speaker	Content
01:51:02	Helmsman A	Ship lights.
01:51:04	Officer A	Is it near?
01:51:05	Helmsman A	Yes, near.
01:51:13	Helmsman A	A fishing vessel too.
01:51:17	Helmsman A	Yes
01:51:49	Officer A	Can be seen here? (According to the statement of Officer A, he asked if the image of the vessel was seen on the radar screen)
01:51:51	Helmsman A	Cannot be seen
01:52:00	Helmsman A	Crossing
01:52:10	Helmsman A	Green. (According to the statement of Helmsman

[1] "Simplified Voyage Data Recorder (SVDR)" refers to a device which can record voyage data of a ship such as location, speed, as well as VHF radio communication and sound from the bridge, into retrievable capsules when an accident occurs. The SVDR installed in Vessel A had no functions for recording radar images.

		A, he meant “Green light”)
01:52:12	Officer A	Green
01:52:19	Helmsman A	Green (Tagalog)
01:53:42	Officer A	Is she crossing? (Tagalog)
01:53:44	Helmsman A	Yes, crossing (Tagalog)
01:53:46	Officer A	Let’s alter course. (Tagalog)
01:53:51	Officer A	Green light can be seen.(Tagalog)
01:53:54	Helmsman A	Yes (Tagalog)
01:53:54	Officer A	Port ten.
01:54:01	Officer A	Port twenty.
01:54:13	Helmsman A	Ah, the light turned red (Tagalog)
01:54:16	Helmsman A	Crazy.
01:54:33	Officer A	Starboard, Starboard. (Put the rudder to the starboard)
01:54:34	Officer A	Midship
01:54:48	Officer A	Hard port
01:55:11	Helmsman A	Oh, my God (Tagalog)
Between around 01:55:27 and around 01:55:47 Mechanical clicking sounds were recorded: Officer A was flashing a daylight signaling light.		
01:55:31	Helmsman A	Ah ah
01:55:45	Helmsman A	Aha, ah (Tagalog)
01:55:47	Helmsman A	Oh, my God (Tagalog)
01:55:50	Officer A	Call Master (hereinafter referred to as “Master A”) (Tagalog)
01:55:57	Helmsman A	Enter (Tagalog)
01:56:07	Officer A	What? (Tagalog)
01:56:07	Helmsman A	Hit(Tagalog)
01:56:08	Officer A	What? (Tagalog)
01:56:09	Helmsman A	Already hit. (Tagalog)
01:56:15	Helmsman A	We are still hard port. (Tagalog)
01:56:16	Officer A	Understood (Tagalog)
01:56:27	Helmsman A	Thirty. (According to the statement of Helmsman, it is the master’s quarters extension number)
01:56:29	Helmsman A	Thirty, Three Zero.
01:56:31	Helmsman A	Cannot see anymore (Tagalog)
01:56:36	Helmsman A	We are still on hard port. (Tagalog)
01:56:38	Officer A	Midship. Hello, Sir. (hereinafter, phone conversations; to the master’s quarters) Good morning, Sir. There is a vessel, now hit by the fishing vessel,

		Sir. Already hit by the fishing vessel. It's lost, Sir, lost. Yes, Sir. Maybe fishing vessel lost, Sir.
01:57:01	Officer A	Because, suddenly, the fishing vessel was coming into our course to cross. (Tagalog)
01:57:25	Helmsman A	Yes, the fishing vessel altered their course suddenly. (Tagalog)
01:57:29	Helmsman A	No more light (Tagalog)
01:57:44	Officer A	It did not even shake? (Tagalog)
01:57:46	Helmsman	Shook (Tagalog)
01:57:48	Officer A	A little? (Tagalog)
01:57:49	Helmsman A	Shook (Tagalog)

(3) Records of the voices of the persons on the bridge watch after the collision

Officer A's voice records related to the accident situation are shown in Table 2.1.1 (2). Note that as for the voices in Tagalog, their English translations are shown.

Table 2.1.1 (2): Records of the Voices of Officer A and Others

Time	Speaker	Contents
From around 03:35	Officer A	The Fishing vessel passed on our starboard side. I made hard to port. The fishing vessel passed. They should have kept the course. They followed us.
		(According to the statements, Officer A explained the bearing of Vessel B's light and others to Master A as follows.) About 11 thirty, 11 past. No side light
From past 03:37	Master A	Green light.
	Officer A	Yes, Sir. When I saw the green light, I made a port 20, Sir.
	Master A	How many miles.
	Officer A	Maybe less than 1 mile.
From past 03:39	Officer A	Because of very near, if I saw go in starboard side, dangerous, I turn to port side. Cannot see in the radar. When 12 o'clock, 12 o'clock with at the fishing vessel, we saw the red light. I continue hard port, I made hard port continue.

2.1.2 Operations of HORIEI-MARU

The progress of HORIEI-MARU (hereinafter referred to as "Vessel B") was as follows:

(1) Records of Vessel B's position

According to the vessel position monitoring system using a satellite, which is managed by the Fisheries Agency (hereinafter referred to as "VMS"), the position of Vessel B was recorded every 6 hours, the nearest two position records before the accident were as follows:

(i) 18:14, September 23, 2012: 41° 05' 14" N, 153° 04' 43" E
(ii) 00:14, September 24, 2012: 39° 56' 46" N, 152° 23' 24" E

(2) Records of Vessel B's distress signals

According to the person in charge of the Japan Coast Guard, the situation of receiving distress signals from the Emergency Position Indication Radio Beacons[2] (hereinafter referred to as "EPIRB") of Vessel B was as follows:

(i) At 02:02 on September 24, 2012, a satellite received Vessel B's distress signal.
(ii) After that, multiple satellites received Vessel B's distress signal leading to the identification of Vessel B's distress signal transmission point (39° 37' 34" N, 152° 13' 09" E) at 02:31 on September 24, 2012.

2.1.3 Events Leading to the Occurrence of Accident according to Statements of Crew Members

Events leading to the occurrence of accident according to the statements of Master A, chief officer, Officer A, Helmsman A, Vessel B's chief fisherman (hereinafter referred to as "Chief Fisherman B"), Vessel B's chief engineer (hereinafter referred to as "Chief Engineer B"), Vessel B's seven crew members (hereinafter referred to as "Crew Member B_1, B_2, B_3, B_4, B_5, B_6, and B_7"), the chief fisherman of Vessel B's consort ship (hereinafter referred to as "Vessel C" and "Chief Fisherman C"), and Vessel A's logbook, were as follows:

(1) Events leading to the occurrence of accident regarding Vessel A

Vessel A, with Master A and Officer A and 18 crew members, departing Shibushi Port at around 07:30 on September 15, 2012, drifting off the south coast of Japan, started its voyage toward Vancouver, Canada, just after 18:00 on September 21.

Vessel A, at around 23:00 on September 23, was proceeding using autopilot at a speed of about 13.7 knots (kn) on a course of 072° (true bearing, the same shall apply hereinafter), with Officer A and Helmsman A on the watch on bridge.

Officer A, when starting the watch on bridge, confirmed the visibility being more than

2 An Emergency Position Identification Radio Beacon (EPIRB) is equipment for sending a distress signal and location information of a distress vessel using 406 MHz band to land stations of search and rescue organizations via satellite.

4 M, the radar display, and the data of the Automatic Identification System [3] (hereinafter referred to as "AIS"); and then, kept on lookout using one of two radars[4] installed on Vessel A.

Helmsman A, while intermittently making a radar lookout, noticed an on-and-off radar image of a vessel on the port abeam, then found that the vessel was passing astern of Vessel A, and believed that the vessel was a fishing vessel because its light was small although had no clear sight of the vessel,. In addition, in about ten minutes, the weather worsened and the sea surface became rough, so Helmsman A thought that the visibility had become about 2 M.

Then, Helmsman A, while on lookout standing in front of the steering stand, noticed the sight of a whitish light of Vessel B at about 15° port bow within a distance of less than 2 M, and reported it to Officer A who was working at the chart table. Helmsman A, at the time of his report to Officer A, stated that the vessel at port bow ahead was a fishing vessel, because he had seen a light appearing to be that of a fishing vessel about 30 minutes ago.

Officer A, upon receiving Helmsman A's report, after seeing the whitish light of Vessel B, tried to locate Vessel B on the radar by changing the radar range to 6 or 3 M and to obtain Vessel B's information on AIS. However, he could not locate Vessel B on the radar or obtain Vessel B's AIS information. Moreover, he asked Helmsman A about the presence or absence of a radar image of Vessel B, and received an answer of absence.

After that, Officer A and Helmsman A saw Vessel B's green light (starboard light) on the port bow, and knew that Vessel B's course had changed to Vessel A's bow.

Officer A, judging from the fact that Vessel B's light had shown changes in its bearing, believed that there would be no risk of collision. However, intending to widen the passing distance between the two vessels, he ordered port 10, followed by port 20, to Helmsman A when Vessel B closed at about 5° and less than 1 M on Vessel A' port bow. Helmsman A, on the receipt of those orders, took the wheel in manual steering, and steered according to Officer A's orders.

Helmsman A, just after reporting port 20, found that Vessel B began to show its red light at less than 5° and 0.5 M on the starboard bow, and reported the fact to Officer A.

Officer A recognized Vessel B's red light on the starboard bow, and made steering orders of starboard and then midship in order to avoid Vessel B, which was coming close from the starboard side by turning to starboard. However, Officer A, thinking that there was no time to turn to starboard, made an order of hard to port; and then flashed a daylight signaling light[5] on-and-off toward Vessel B.

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[3] An Automatic Identification System (AIS) refers to a device that enables vessels to automatically send and receive information regarding vessels' identification codes, types, names, positions, courses, etc. in order to exchange information between vessels and navigation aid facilities of land stations.

[4] While two radars are identical regarding performance, the radar used for lookout was equipped with an automatic radar plotting aid (equipment that is able to display a calculated collision position, etc.by tracking objects on radar screen).

[5] A "daylight signalling light" is a highly-directional and high intensity signalling light used for sending signals under daylight.

Officer A and Helmsman A, judging from the changes in the positions and colors of Vessel B's lights, thought that Vessel B made a turn, but did not see an actual sign of Vessel B's turning, such as it showing both green and red lights at the same time.

Helmsman A, after Vessel B hid in the starboard bow blind zone of Vessel A (in a situation of limited range of view) and became invisible from the bridge, felt slight hull vibrations before 01:56:07 on September 24. (See Figure 2.1.3 (1))

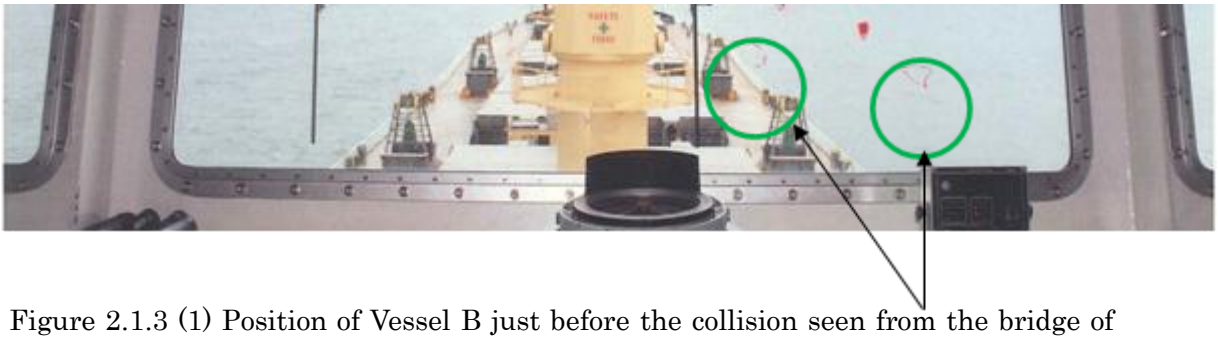

Figure 2.1.3 (1) Position of Vessel B just before the collision seen from the bridge of Vessel A

Helmsman A, after standing at the steering position, did not leave the position until the collision, and was able to continuously see Vessel B's lights through the window in front of the steering position (a glass window at the front).

Officer A made a report of the occurrence of collision to Master A in the master's quarters by the telephone. Master A immediately left his quarters, got on the bridge, and had been conning the vessel since then.

(See Appendix Figure 1 – 1: General Arrangement of Vessel A)

(2) Events leading to the occurrence of accident regarding Vessel B

(i) Events leading to the occurrence of accident of Vessel B

Vessel B, with a master (hereinafter referred to as "Master B") and Chief Fisherman B and 20 crew members (15 members of Japanese nationality and 5 members of Indonesian nationality), in order to avoid a closing low pressure system, started voyage southward with Vessel C from the location of around 41° N 153° E using autopilot at a speed of 12.5 kn on a course of 200 to 205° at around 18:00 on September 23.

During the voyage, Vessel C proceeded by 0.3 to 0.5 kn faster than Vessel B.

Each of Vessel B's power generators was installed on the either side of the engine room, and at the time of the accident, only the generator on the port side was in operation. At around 22:00, Chief Engineer B, who was in the steering room, in the situation where the ability to use the radar that had been used so far to locate vessels on the radar was lost due to images of rain, etc. in line with the worsening weather, switched on another radar that had been idle, and then located Vessel C on the radar, ahead of Vessel B proceeding on approximately the same course as Vessel B.

Crew Member B_1, who was waiting in the dining room adjacent to the stern side of the engine room on a request from another crew member to help him, thought of bringing a cool canned coffee to a crew member on the bridge watch (hereinafter referred

to as "Watchkeeper B"), got on bridge about 15 to 20 minutes before the collision, handed the canned coffee to Watchkeeper B and had a brief conversation, and then returned to the dining room to keep waiting.

Chief Fisherman B, a little after starting radio conversations in a bedroom with Vessel C, felt a shock from the port side, and immediately requested rescue from Vessel C.

Neither Chief Fisherman B, who was in a bedroom adjacent to the stern side of the steering room, nor Crew Member B_1, who was waiting in the dining room, felt Vessel B's hull motions as if Vessel B was turning.

(See Appendix Figure 1 -2: General Arrangement of Vessel B)

(ii) Events regarding Vessel C leading to the occurrence of the collision

Vessel C, after finishing fishing work in September 23, for the purpose of avoiding a low pressure system, proceeded southward using autopilot on approximately the same course as Vessel B.

Chief Fisherman C, after receiving a report from a person on the bridge watch that a large vessel had passed near Vessel C, felt a change in wind direction just before around 02:00 on September 24. Therefore, he thought that it would be better to alter the course to south further, began to make radio conversations with Chief Fisherman B. Just after that, Chief Fisherman C, upon request for rescue from Chief Fisherman B, decided to proceed to the area where Vessel B was expected to be.

The date and time of the occurrence of accident was around 01:56 on September 24, 2012, and the location was around 930 km east of Kinkazan, Ishinomaki City, Miyagi Prefecture.

(iii) Situation at the time of the occurrence of accident of Vessel B

Chief Fisherman B, when leaving the bedroom after requesting rescue from Vessel C, saw Vessel B lose its lighting and the steering room's sidewall deforming with noises as if being pushed by something, and sensed water vapor rising from the engine room.

Chief Fisherman B entered the steering room immediately after leaving the bedroom in the dark, and asked Watchkeeper B to report the situation, but received no clear explanations. Then water fiercely flowed into the steering room from starboard side, and the room was soon filled with water. Therefore, he felt for the doorknob of the portside door and tried to open the portside door. Since he could open the portside door, he could go out of the room and he fell into water.

Chief Engineer B, while sleeping in a bedroom adjacent to the stern side of the chief fisherman's room, woke up with a shock and got out of the bed room, seeing a crack appearing in a longitudinal direction on the bed room's side wall. Moreover, he heard abnormal sounds coming from the engine room, so tried to find out the situation in the engine room using a flashlight, however, could not find out the situation, being disturbed by the water vapor full of the engine room,.

Chief Engineer B, when exiting onto the stern deck, saw that Vessel A's bow had

made contact with Vessel B's port midship in the light of his flashlight, while he fell in water, hit by a wave from the starboard side just after feeling that Vessel B had a slight listing to starboard.

Crew Member B_1, while waiting in the dining room, felt a shock from the port side and knew the dining room had flooded after the vessel listed to starboard and lost lighting.

Crew Member B_2, B_3, and B_4, while sleeping in a bedroom placed under the dining room, were awoken by collision sounds, moved into the dining room and got out of the dining room through the dining room's stern-side door on to the stern deck, accompanying Crew Member B_1. Then they saw the stern deck's starboard end was as low as the sea surface, and sensed that Vessel B, pushed by Vessel A, was listing further. While some of the crew members were trying to prepare lifebuoys, Crew Members B_1, B_2, B_3, and B_4 fell into water as Vessel B sank below the sea surface from its stern.

Crew Member B_5 and B_6, sleeping in a bedroom adjacent to the port side of the dining room, and Crew Member B_7, sleeping in a bedroom placed on the port side of the bridge deck, were awoken by collision sounds, and after retreating onto the weather deck, fell into water.

According to some of the rescued Vessel B's crew members, the time from the moment of the shock they felt to the moment they fell into water was about 40 to 60 seconds and the distance from Vessel A seemed to be 5 to 8 meters at the time of coming up on the sea surface after falling into water.

Vessel B's crew members who had exited onto the stern deck saw Vessel A's bow had collided with Vessel B around the port astern from the steering room (next to the engine room) with an angle between the center lines of both vessels of a little wider than 90°, and in addition saw Vessel A kept contacting Vessel B as if Vessel A was pushing Vessel B to make Vessel B list to starboard. However, they did not see Vessel B's hull get bent or broken.

2.1.4 Situation between Collision and Rescue

(1) Events between drift and rescue of crew members of Vessel B

According to the statements of Chief Fisherman B, Chief Engineer B, Crew Members B_1, B_2, B_3, B_4, B_5, B_6, and B_7, and Chief Fisherman C, the events were as follows.

Crew Members B_1, B_2, B_5, and B_7 (hereinafter referred to as "Group 1"), and Chief Engineer B, Crew Members B_3, B_4, and B_6 (hereinafter referred to as "Group 2") came up on the water surface on Vessel A's starboard side. After that, Group 1 and 2 kept drifting on the water surface, holding a fender, and an object of combined three-beaded-fenders, respectively. These fenders, which had been tied on Vessel B's forecastle, were drifting after being knocked off Vessel B' hull.

Chief Fisherman B, after falling into water and coming up on Vessel A's port side, began to drift by himself holding a FRP box. Then, he met and joined Group 1.

Some of the persons in the water, just after the start of drifting, called to Vessel A, while others saw Vessel B floating to drift on the water surface with its stem up in the

air.

Members of Group 1 and Group 2, during their drifting encouraged each other and saw the lights of Vessel C, which was searching the surface and waved their hands so as to be discovered, but they were not discovered until after sunrise, when they were rescued by Vessel C in the order of Group 2, followed by Group 1.

Although some of the crew members rescued by Vessel C had suffered abrasions, their injuries were not so severe to need immediate treatment in hospital, so they received treatment in Vessel C and joined search activities for Vessel B and its crew members in the water.

(2) Search and rescue activities by Vessel C and Vessel A

(i) Situation of search and rescue activities by Vessel C

According to the statements of Chief Fisherman C, search and rescue activities by Vessel C were as follows.

Chief Fisherman C, for the purpose of conducting rescue activities, based on his memory of Vessel B's location on the previous day, turned Vessel C's heading to the area where Vessel B was expected to be. In addition, he reported the accident to the Japan Coast Guard and other related parties within 30 minutes from the receipt of Vessel B's request for assistance. The Japan Coast Guard informed Vessel C of receiving Vessel B's distress signals and the name of Vessel A.

Vessel C, on the way to the expected area, located Vessel A and an object which was suspected to be vessel B's bow on the radar.

Vessel C, before the sunrise, arrived at around the occurrence site of the accident, where the smell of fuel oil was sensed, and under Chief Fisherman C's command, started its search activities. Several crew members conducted their search activities of persons in the water standing on the deck or bridge before the sunrise using search lights or binoculars. They were also waving lights to encourage persons in the water.

Vessel C, during its search activity, discovered Vessel B's inflatable liferaft with its tent expanded, but no crew members were found on it.

Vessel C, when it became bright enough to see the surroundings, saw Vessel B's bow drifting, and rescued four members of Group 2 just after 07:00, and then five members of Group 1, reporting that effect to the Japan Coast Guard.

Vessel C, coming around the windward of persons in the water, recovered persons in the water onto the vessel by throwing lifebuoys, etc.

(ii) Situation of search activities by Vessel A

According to the statements of Master A, search activities by Vessel A were as follows.

Officer A reported the collision with a fishing vessel to Master A by ship phone.

Master A, got on the bridge and entered the port wing immediately, then had

sight of the bow of Vessel B floating on the sea surface, as well as hearing voices believed to be of persons in the water. However, he could not confirm the existence of persons in the water because it was dark surrounding Vessel A.

Master A, on the receipt of Officer A's report on the situation, decided to halt the voyage and conduct search activities, and issued an emergency call. However, he did not let lifeboats go due to bad weather conditions. Moreover, he ordered Chief Officer and others to investigate Vessel A for damage.

Master A, on the receipt of the report that no damage was found on Vessel A, reported the occurrence of the accident to the general safety manager of Tamai Steamship Co., Ltd, the management company of Vessel A (hereinafter referred to as "Company A") and the Japan Coast Guard from around 02:39.

Master A stationed crew members equipped with binoculars and daylight signal lights on the bridge wings on both sides of the bridge, and ordered them to make searches after shutting down the lights on the deck for fear of those lights disturbing search activities.

Vessel A, without information on locations of Vessel B's liferaft or persons in the water, conducted its search activity in an expected area centered at the possible location of the collision occurrence in consideration of wind and tidal current with a risk of rotating propellers catching persons in the water, but could not discover persons in the water.

Note that there are no internationally accepted standard procedures for recovery operations of persons in the water, but the International Maritime Organization amended Chapter 3 of Annex of The International Convention of Safety of Life at Sea, cargo ships and other vessels engaging in international voyages have been obligated since July 2014 to promote the installment of manuals for recovery procedures of persons in the water in compliance with guidelines[6] prepared by the organization.

(iii) Situation of the search activities by the Japan Coast Guard

The Japan Coast Guard, receiving Vessel B's distress signals at around 02:31 on September 24, established a maritime accident headquarters in the 2nd Regional Cost Guard Headquarters at 03:00, and dispatched patrol vessels and aircrafts.

According to the information released by the 2nd Regional Coast Guard Headquarters, the search and rescue activities were as follows: the search activities were conducted for 18 days since the occurrence of the accident; a total of 47 ships were engaged, including 27 patrol vessels from the Japan Coast Guard, 5 ships belonging to the Fisheries Agency, and Vessel C; a total of 24 aircraft from the Japan Cost Guard and 12 aircraft in total from the Japan Maritime Self-Defense Force were engaged; the total area of the search was

6 MSC.1/Cir.1447 "Guidelines for the Development of Plans and Procedures for Recovery of Persons from the Water"

about 97,322 km²: four persons from Group 2 were rescued by Vessel C at the point of 39° 39.93' N 152° 12.42' E at past 07:00 on September 24, and five persons from Group 1 were rescued by Vessel C at the sea of 39° 39.79' N 152° 13.50' E at around 07:22; no persons in the water other than the nine rescued by Vessel C were discovered.

Vessel B's liferaft, EPIRB, lifebuoys, and the fender that Group 1 held were recovered by the Japan Coast Guard and others.

(See Photo 2.1.4 (2) – 1 and Photo 2.1.4 (2) – 2)

Liferaft

Lifebuoy

Photo 2.1.4 (2)-1: Recovered Vessel B's Liferaft and Others (courtesy of the Japan Coast Guard)

Photo 2.1.4 (2)-2: Recovered Vessel B's EPIRB and Fender Held by Group 1 during Their Drift

2.2 Injuries to Persons

(1) Vessel A

There were no injuries on Vessel A.

(2) Vessel B

Thirteen persons out of the members (including Watchkeeper B, Master B, and the crew member who asked Crew Member B_1 to work in the engine room with him and wait in the dining room) went missing after the occurrence of the accident, and at a later date, they were declared dead. In addition, some of the nine rescued members had abrasions, and were treated on Vessel C.

2.3 Damage to Vessel

(1) Vessel A

Vessel A suffered abrasive damage to the bow, but received no significant damage that affected its seaworthiness.

(2) Vessel B

Vessel B's hull went missing, therefore, detailed information of Vessel B's damage were not available.

2.4 Crew Information

(1) Gender, Age, and Certificate of Competence

Master A Male, 55 years old
Nationality: Japan
Endorsement attesting the recognition of certificate under STCW regulation 1/10:
Master (issued by Republic of Panama)
Date of issue: February 10, 2011 (valid until December 6, 2015)

Officer A Male, 50 years old
Nationality: Republic of the Philippines
Endorsement attesting the recognition of certificate under STCW regulation 1/10:
Second Officer (issued by Republic of Panama)
Date of issue: January 29, 2009 (valid until November 4, 2013)

Master B Male, 54 years old
Certificate of competence: Fifth grade maritime officer (navigation)
Date of issue: December 3, 1979
Certificate of competence expired on January 12, 2010.

Watchkeeper B Male, 58 years old
Certificate of competence: First class boat's operator
Date of issue: March 23, 2005
Date of revalidation: October 13, 2009 (valid until March 22, 2015)

(2) Seagoing experiences

According to the statements of Master A, Officer A, Helmsman A, and Chief Fisherman B, their seagoing experiences were as follows:

(i) Master A

Master A had been serving on Vessel A since 2002, and he gained voyage experience on similar courses to the course taken for this voyage more than ten times, including experience on other ships than Vessel A. His health condition at the time of the accident was good.

(ii) Officer A

Officer A had experience as a seaman of more than 20 years, as well as experience as a second officer of more than five years. Although this was his first time to serve on

Vessel A, he had experienced the North Pacific Route seven times on other ships than Vessel A. He had completed a radar operation training course in a sea competence training facility in the Philippines. His health condition at the time of the accident was good.

(iii) Helmsman A

Helmsman A had experience as a seaman of nine years. This was his second serving on Vessel A. His health condition at the time of the accident was good.

(iv) Master B and Watchkeeper B

Master B and Watchkeeper B had been serving on Vessel B for about seven years since 2006. They had been serving on other fishing vessels before serving on Vessel B. Their health conditions did not appear to be bad.

2.5 Vessel Information

2.5.1 Particulars of Vessel

(1) Vessel A

IMO number:	9159438
Port of registry:	Panama (Republic of Panama)
Owner:	T. S. Central Shipping Co., Ltd. (Republic of Panama)
Management company:	Company A
Gross tonnage:	25,074 tons
L × B × D:	189.6 m × 30.5 m × 15.8 m
Hull material:	Steel
Engine:	One diesel
Output:	7.450 kW
Date of launch:	April, 1997

Photo 2.5.1 (1): Photo of Vessel A

(2) Vessel B

Fishing vessel registration number: ME1 – 937
Base port: Kihoku Town, Mie Prefecture
Owner: Privately owned
Hull material: FRP
Engine: One diesel
Output: 743 kW
Date of launch: February, 1999

Photo 2.5.1 (2): Photo of Vessel B (courtesy of Chief Fisherman B)

2.5.2 Maneuvering characteristics

According to the test data, Vessel A's maneuvering characteristics are as follows:

Tactical Diameter (Port): 467 m
Tactical Diameter (Starboard): 528 m

Turning Angle (degree)	Port		Starboard	
	Speed (kn)	Time	Speed (kn)	Time
0	16.0	0	16.0	0
90	8.0	1 min 33 sec	8.5	1 min 39 sec
180	5.0	3 min 06 sec	5.7	3 min16 sec
270	3.9	4 min 48 sec	5.0	5 min 01 sec
360	3.7	6 min 38 sec	5.0	6 min 54 sec

2.5.3 Equipment

(1) Vessel A

Vessel A was equipped with two radars, AIS, and SVDR.

The location of the GPS antenna of Vessel A (the location recorded in SVDR as

vessel position) was about 162 m from the bow, and about 12 m from the port side.

Vessel A was not equipped with search lights.

According to the statements of Master A, there were no problems or troubles with Vessel A's hull, engine, or equipment.

(2) Vessel B

Vessel B was equipped with three radars, and an autopilot system.

EPIRB was specified to function as follows: activated by water pressure of 1.5 to 4 meter's depth, then automatically isolated from hull to come up to the water surface, then transmit distress signals at an interval of about 50 seconds to be received by satellites.

According to the statements of Chief Fisherman B, there were no problems or troubles with Vessel B's hull, engine, or equipment.

2.6 Weather and Sea Conditions

2.6.1 Weather Information

(i) According to the Japan Meteorological Agency, the predicted wind speed and direction at the location of 39° 37.6' N 152° 12.0' E at 03:00 on September 24 were as follows:

Wind direction (16 points of compass): East-northeast to East-southeast
Wind speed (kn): 25 to 35

(ii) According to the Japan Meteorological Agency, the predicted current direction in the area where the accident occurred was east on September 24.

(iii) According to the daily sea surface temperature report by the Japan Meteorological Agency, the water temperature around the location where the accident occurred was 25°C at 11:00 on September 24.

(iv) According to the AWPN by the Japan Meteorological Agency, the wave height in around the area where the accident occurred was approximately 2 to 3 meters at 21:00 on September 23 and approximately 3 to 4 meters at 09:00 on September 24.

2.6.2 Observations by Crew

(i) According to the statements of Officer A and Helmsman A, at the time of the accident, it was raining with the wind direction of east-southeast and the wind force of 7 (28 to 33 kn of wind speed).

(ii) According to the statements of Vessel B's crew members who fell into the water, it was raining when they fell into the water and the wave height was about 3 meters.

2.7 Vessel Operation System and Operation Management

2.7.1 Vessel A

(1) Systems and others for Vessel operation

According to the statements of Master A and Vessel A's watch schedule table, Vessel A employed a two-man bridge operation (four-hour shifts) and at the time of the accident, Officer A and Helmsman A were on duty from 23:00 on September 23 to

03:00 on September 24.

(2) Vessel operation management

According to Company A, Vessel A's operation management was conducted as follows.

(i) Company A, following Chapter 9 of the Annex of the International Convention for the Safety of Life at Sea, had established a safety management system for securing vessel safety operations, in compliance with the International Safety Management Code.[7] In addition, Company A had prepared the procedures for conducting watch on the bridge with regard to the above mentioned safety management system and had the procedures in use on the vessel.

The procedures regarding the watch duty on the bridge required to obtain the information of the other vessel using navigational equipment in a normal voyage, for the purpose of assessing the risk of collision with other vessels approximately in a range of 10 M.

(ii) Vessel A had conducted exercises on a scheduled basis for emergency situations including abandoning ship, firefighting, rescue, and engine trouble.

(iii) Company A's manuals for safety management stipulated that, on the receipt of a report of the occurrence of a significant maritime accident from a vessel under their management, a emergency headquarters for maritime accident should be established, headed by Company A's representative director to handle the situation. After the occurrence of the accident, Company A established such a headquarters and kept it active until the middle of October, when the Japan Coast Guard completed its search activities.

2.7.2 Vessel B

According to the statements of Chief Fisherman B, Vessel B employed a one-man bridge operation (two-hour shifts). It was stipulated that Vessel B must have a captain on board with a valid certificate of competence in accordance with laws and regulations.[8]

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7 "The international Management Code for the Safe Operation of Ships and for Pollution Prevention (International Safety Management (ISM) Code)," for the purpose of securing safe ship operations and protection of marine environments, adopted as a resolution of the IMO Assembly at November 4 1993, employed in the annex of the SOLAS Convention 1974, after the SOLAS amendment of 1994, came into force on July 1, 1998. The code is applied to all passenger vessels engaging in international voyages and ships with tonnage of more than 500 tons.

8 Article 18, Paragraph 1 of the Act on Ships' Officers and Boats' Operators (excerpt):
A ship owner, considering the type, voyage area, size, output of the propulsion system of the ship, and other matters related to the safety of the ship, following the regulations stipulated by government ordinances on ship officers on board (hereinafter referred to as 'manning regulations") shall have a master and officers who hold a proper certificate of competence.

2.8 Researches on the Situation of the Occurrence of the Accident

The National Maritime Research Institute was entrusted to conduct research and studies on the following: analysis of the collision sounds, the navigation tracks of Vessel A and B just before the collision, and the hull behaviors of Vessel B after the collision, using Vessel B's positions recorded in VMS; Vessel A's information recorded in SVDR including positions, speed and voices, the statements of the persons concerned, information on Vessel C's track, and related documents including the general arrangement charts of Vessel A and B.

The results of the research by the National Maritime Research Institute are summarized as follows.

2.8.1 Collision Sound

The results of the research on the voice data recorded in Vessel A's SVDR are shown as follows.

Because the sound-collection microphones installed out of the bridge (on the both wings) were suspected to have collected noises such as wind sounds, the researches were conducted as follows: the changes in sounds around the time of the occurrence of the accident were analyzed regarding the sounds related to the collision; under such research strategy, a sound spectrum was calculated for every one second to extract characteristic sound frequency components; and then, time variations of such sound frequency patterns were analyzed.

According to the results of the analysis on the voice data recorded on Vessel A's SVDR between around 23:00 on September 23 and around 05 o'clock September 24, stationary sounds (having frequency of around 400 to 500 Hz) were continuously recorded; for about 20 seconds from 01:55:50 on September 24, the sound peak around 400 to 500 Hz decreased, and after that, the sounds of a frequency of around 750 Hz were recorded.

The characteristic sounds after 01:55: 50, were not identifiable as the sounds induced by the collision, but except for such time interval, only stationary sounds were recorded throughout the approximately three-hour VDR sound record, and the sounds that could suggest the relation to the collision were difficult to find except for such time interval, at least.

2.8.2 Research on Tracks of Vessel A and B

Regarding the time interval of about five minutes since Vessel A's watchkeeping personnel on the watch on the bridge saw for the first time, according to Vessel B's position information recorded in VMS, Vessel A's position information recorded in SVDR, and the statements of the persons concerned, the relative positions of Vessel A to Vessel B was estimated as follows:

(i) Vessel B, at around 01:52:02, was 13.5° 1.92 M on Vessel A's port bow.
(ii) Officer A ordered port 10 when Vessel B came close to Vessel A at 4.2° 0.66 M on Vessel A's port bow.
(iii) Vessel B, at around 01:54:13, turned to starboard at right on Vessel A's heading (less

than 5° off the heading) at 0.53 M.

(iv) Vessel B, at a speed of about 12.5 kn, proceeded toward the collision site.

(v) Vessel B's starboard turn was a mild turn by a relatively small rudder angle.

(vi) Tracks of Vessel A and Vessel B are shown in Appendix Figure 2.

2.9 Situation of Occurrence of Similar Accidents and Evaluation of Navigational Equipment (AIS) Functions

2.9.1 Situation of Occurrence of Collision of Commercial Vessel with Fishing Vessel

In June 2013, on the Pacific, an accident caused by a collision of a commercial vessel with a fishing vessel occurred[9]; the hull of the fishing vessel was bent/broken, and the chief fisherman went missing.

Although the investigation on this accident is ongoing, in both cases of the accident and the above mentioned accident, the commercial vessel was equipped with AIS. On the other hand, the fishing vessel, not obligated by laws and regulations, did not have an AIS installed, and the fishing vessel was ocean going and operating (designated by the Ship Safety Act[10] as a second-class fishing vessel).

Furthermore, according to the maritime accident investigation reports released between January 2009 and January 2013 by the Japan Transport Safety Board, more than ten accidents occurred in a situation where a commercial vessel was unable to locate its counterpart fishing vessel on the radar.

2.9.2 Evaluation of AIS Functions regarding Collision Avoidance

The National Maritime Research Institute to which the Board entrusted the researches on the effectiveness of AIS functions on collision avoidance replied in their report as follows:

(i) AISs, less susceptive to rain drops or waves than radars, are able to more easily provide other vessels' information, including vessel positions.

(ii) Unlike radars using radio waves reflected from objects for detection, of which detection performance depends on the size or hull material[11] of object vessels, AISs' functions are

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9 At around 10:00 on June 23, 2013, at around about 300 km off the south-east of Kinkazan, Miyagi Prefecture, a collision of a car carrier NOCC OCEANIC (58,250 tons) registered in Republic of Marshall Islands and a fishing vessel No. 7 YUJIN-MARU (19 tons) occurred; the hull of the fishing vessel broke into two (the stern of the vessel sank, and the bow was towed to Japan and scrapped later); one out of the nine persons on board of the fishing vessel went missing. It is probable that, at the time of the occurrence of the accident, it was raining heavily.

10 A second-class fishing vessel, etc. based on the Ship Safety Act is a ship designated by the Act (special regulations for fishing vessels) as a second-class fishing ship (gross tonnage of more than 20 tons) or a second-class small fishing boats (gross tonnage of less than 20 tons), engaging on bonito-rod-fishing or tuna-long-line fishing; those vessels, supposed to operate in remote areas away from land, are required to satisfy higher standards for installation of life-saving appliances and navigational equipment than required in fishing boats operating in coastal sea areas.

11 "Hull material" is a material composing the hull of a ship; ships whose hulls are composed by fiber-reinforced plastic (hereinafter referred to as "FRP") are less likely to be undetected by radars than steel ships.

independent of the size or hull material of target vessels if such vessels are equipped with an AIS because it actively transmits signals.

(iii) Simplified types of AISs[12] (hereinafter referred to as "Simplified AISs"), in addition to the advantages described in (i) and (ii), are able to stably exchange vessel information including vessel positions in a distance of more than about 4.5 M, which is approximately equivalent to the required detection range of small-ship radars (specified by a technical standard[13]).

In addition, AISs or Simplified AISs are able to exchange vessel information including names and types, which are not obtained by radars; furthermore, no certificates of competence are required to operate a Simplified AIS.

12 A "Simplified AIS" is equipment which has a lower operating power than an AIS, which the International Convention obligates the vessels of certain specifications to install, and exchanges limited information of vessel's name, position, speed, course, and type.

13 The technical standard to be applied to the radar installed on Vessel A (9 GHz band) requires the radar to have a performance of detecting a small vessel of 2 meters higher than the sea surface and ten meters long at a distance of 3.4 M in a condition where no there is no influence of rain or waves.

3 ANALYSIS

3.1 Situation of the Accident Occurrence

3.1.1 Course of the Events

Judging from 2.1 and 2.8.2, the course of the events was as follows.

(1) Vessel A

(i) It is probable that Vessel A left Shibushi Port at around 07:30 on September 15, 2012, and after drifting, began its voyage toward Vancouver, Canada, using autopilot.

(ii) It is highly probable that at 01:51:01 on September 24, Vessel A was proceeding at around 39° 37.06' N 152° 10.83' E with a heading of 071.9°and at a speed of 12.68 kn. It is highly probable that Vessel A's trace after that until around 01:56 was as shown in Appendix Figure 2.

(iii) It is probable that in Vessel A, while Officer A and Helmsman A were on the watch on the bridge, Helmsman A, seeing Vessel B's masthead light on the port bow, reported to Officer A.

(iv) It is probable that Officer A and Helmsman A, seeing Vessel B's green light (starboard light), believed that Vessel B was crossing ahead of Vessel A, therefore, Officer A, when Vessel B came close to port bow, ordered port 10 at 01:53:54' and then port 20.

(v) It is probable as follows: Helmsman A, seeing Vessel B's red light (port light) at less than 5° on the starboard bow at 01:54:13', reported to Officer A; Officer A, for the purpose of avoiding Vessel B, issued an order of putting the rudder to starboard and others; in addition, Officer A flashed a daylight signalling light.

(vi) It is probable that Vessel A had weak hull vibrations before around 01:56:07.

(2) Vessel B

(i) It is probable as follows: Vessel B, at around 18:00 on September 23, started proceeding for the purpose of avoiding a low pressure system. Vessel B proceeded at the speed of about 12.5 kn, heading of 200-205° at port stern of vessel C using autopilot, and was located at 39° 56' 46" N 152° 23' 24" E at 00:14 on September 24.

(ii) It is somewhat likely as follows: Vessel B, as shown in Appendix Chart 2, was at 13.5° 1.92 M on Vessel A's port bow at around 01:51:02, and at 4.2° 0.66 M on Vessel A's port bow at around 01:53 :54; Vessel B, at around 01:54:13, made a starboard turn at right on the bow (0 to less than 5° on the starboard bow) 0.53 M on the bow of Vessel A, which was in the middle of its port turn, coming close to Vessel A's bow.

(iii) It is probable that Chief Fisherman B sensed collision shocks right after beginning his radio conversations with Chief Fisherman C.

3.1.2 Situation of Collision

Judging from 2.1 , the hull behaviors of Vessel A and Vessel B were as follows:

(i) It is probable that Vessel A's bow and Vessel B's port stern quarter behind the steering room collided with each other.

It is probable as follows: Vessel A, after the collision, pushed Vessel B to list to starboard; Vessel B, having an open break on its port side, had water flooding into its engine room; the flooding water made contact with the hot objects in the engine room, generating vapor; as water continued flooding into the hull, Vessel B began to sink from the stern, where heavy objects such as an engine were installed.

It is probable that the collision angle between Vessel A and Vessel B, when Vessel B's crew members retreated onto the deck, was more than 90° between the ship line of either vessel to the ship line of the other vessel.

(ii) It is somewhat likely that Vessel B, although not having been broken or bent, was ridden over by Vessel A as if forced downward under water.

(iii) It is somewhat likely that some of the fender members which had been tied on Vessel B's forecastle, were knocked off when Vessel A rode over Vessel B due to the contact with Vessel A's hull to come in reach of Vessel B's crew members in water.

3.1.3 Date, Time and Location of Occurrence of Accident

Judging from 2.1, 2.8.1, and 3.1.1, the course of rescue is probable that the time and date of occurrence of the accident was around 01:56 on September 24, 2012, and the occurrence site was around 930 km off the east of Kinkazan (approximate location: 39° 37.5' N 152° 12.1' E).

3.1.4 Course of Rescue

Judging from 2.1, 2.3.2(2), and 3.2.2, it is probable as follows.

(1) Vessel C and the Japan Coast Guard

(i) It is probable that Chief Fisherman B, sensing the collision shocks, requested assistance from Chief Fisherman C, who was on radio communication with Chief Fisherman B; Chief Fisherman C estimated Vessel B's location and proceeded to try to rescue Vessel B.

(ii) It is somewhat likely that Vessel B's crew members, while sleeping or doing some other things, sensing shocks or some other abnormality, exited to the deck and other places.

(iii) It is probable that Chief Fisherman B and eight crew members fell down into water because of the list of Vessel B's hull.

In addition, it is probable that the EPIRB installed on Vessel B, sensing the water depth when a portion of Vessel B's hull including the steering room where the EPIRB had been installed sank to a certain depth, was knocked off the hull, came up to the surface, and began to transmit distress signals; the distress signal was received by a satellite at 02:02.

(iv) The Japan Coast Guard, receiving Vessel B's distress signals at around 02:31 on September 24, 2012, identifying the location of distress signal transmission origin, started its search and rescue activities.

(v) It is probable that Vessel B's crew members, holding the fenders knocked off from Vessel B, kept drifting.

(vi) It is probable that Vessel C, on its way to around the location of the occurrence of the accident, located Vessel A and Vessel B's bow on the radar; after that, Vessel C conducted search activities with their crew members stationed on its decks and other positions.

(vii) It is probable that Vessel C, although having discovered Vessel B's inflatable liferaft, found no crew members there.

(viii) It is probable as follows: Vessel C rescued Group 2 just after 07:00 on September 24, and Group 1 at around 07:22; the rescued crew members, after having medical treatments, joined the search activities.

(2) Vessel A

(i) It is probable that Master A, on the receipt of a report from Officer A, got on the bridge, recognized, standing on the port wing, that Vessel B's bow was floating on the surface, and knew the existence of persons in the water; however, Master A did not identify the locations of the persons in the water because it was dark at the night and the weather conditions including rainfall disturbed visibility.

(ii) It is probable that Master A, judging that the weather was bad because the wave height was about 3 meters, decided that the conditions would not allow their lifeboats to go.

(iii) It is probable that Master A, stationing his crew members on the wings to conduct search activities for persons in the water, after confirming the damage situation on Vessel A's hull, reported the occurrence of the accident to the Japan Coast Guard and Company A.

(iv) It is probable as follows: Master A, while not identifying the location of the inflatable liferaft of Vessel B or persons in the water, continued search activities in the surrounding area while giving consideration to the effects of wind and sea current because there was a risk of damaging persons in the water by Vessel A's propeller; however, Master A did not discover any persons in the water.

3.1.5 Damage to Vessels

Judging from 2.1 and 2.3, the damage was as follows.

(1) It is probable that Vessel A, although having abrasions at the bow, received no severe damage affecting its seaworthiness.

(2) It is probable as follows: regarding Vessel B, Vessel B's crew members, who were drifting, and Chief Fisherman C saw the bow floating on the surface with its stem up in the air; however, Vessel C had no sight of Vessel B during or after their search activities; Vessel B's hull is still missing, so Vessel B is considered to have sunk in the water. Therefore, the detailed damage situation at the time of collision is unknown.

3.1.6 Casualties

Judging from 2.2, the casualties are as follows:

(1) Vessel A had no casualties.

(2) Regarding Vessel B, thirteen of its crew members went missing after the occurrence of

accident, and were declared dead later; some of the nine crew members of Vessel B who were rescued, having abrasions, had medical treatment in Vessel C.

3.2 Causal Factors of Accident

3.2.1 Crew and Vessel

(1) Crew

Judging from 2.4, it is as follows:

(i) Vessel A

It is probable that Master A and Officer A had a proper and valid endorsement attesting the recognition of certification under STCW regulation 1 / 10. The health conditions of Master A and Officer A were good.

(ii) Vessel B

It is somewhat likely that Master B and Watchkeeper B have been serving on Vessel B since 2006, and their health conditions were good, and that Master B, because his certificate of competence had expired, should not have been allowed to be on board.

(2) Vessel

Judging from 2.5.3, it is probable that neither Vessel A nor Vessel B had problems or troubles with their hull, engine, equipment, or others.

3.2.2 Weather and Sea Condition

Judging from 2.1 and 2.6, it is probable that at the time of the accident, the weather was rain, the visibility was about 2 M, the wind direction was east-southeast, the wind force was 7 the tidal current was toward east, the wave height was about 3 meters, and the water temperature was about 25˚C.

3.2.3 Effectiveness of AIS

Judging from 2.9.2, it is probable that AIS (including Simplified AIS) has the following features for collision avoidance:

(i) AIS is able to obtain other vessel's information, including ship positions, easier than radar as it is less susceptible to rain drops or waves.

(ii) Compared to radar, which uses radio waves reflected by objects, of which detection performance depends on the size and other conditions of other vessel, AIS is not significantly susceptible to conditions including the size of AIS-equipped vessels because AIS actively transmits radio waves.

(iii) Even a Simplified AIS is able to stably exchange information at a distance comparable to the radar detection range of a small vessel (approximately 4.5 M).

(iv) AIS is able to obtain other vessel's information such as name or type, which is unavailable with radar.

(v) Furthermore, because an operator of Simplified AIS is not required to have a radio operator license, shipping business operators will have no additional burdens by equipping their ships with Simplified AIS systems.

3.2.4 Lookout and Navigation

Judging from 2.1, 2.8, 2.9.2,, 3.1.1 and 3.2.3, it is as follows.

(1) Vessel A

(i) It is probable that Officer A and Helmsman A, having been on the watch since around 23:00 on September 23, were conducting their lookouts by radar and sight.

(ii) It is probable that the visibility, although more than 4 M at around 23:00, was about 2 M at the time of the accident due to rainfall.

(iii) It is probable that Helmsman A, seeing Vessel B's masthead lights on the port bow at 01:51:02 on September 24, reported to Officer A, who had been working at the chart table. It is somewhat likely that, at that time, Vessel B was located at 13.5° 1.92 M on Vessel A' port bow.

(iv) It is probable that Officer A, although trying to locate Vessel B on the radar display and Vessel B's information on AIS, could not confirm either of them.

(v) It is probable that Officer A and Helmsman A, seeing Vessel B's green light at 01:52:12, recognizing at 01:53:44 that Vessel B was going to cross Vessel A's course, and Officer A, judging from the change in Vessel B's bearing to Vessel A's bow, believed that Vessel B was crossing ahead of Vessel A.

(vi) It is probable that Officer A, intending to widen the passing distance to Vessel B, ordered port 10 at 01:53:54, and then port 20. At this time, it is somewhat likely that Vessel B was approaching to 4.2° 0.66 M on Vessel A's port bow.

(vii) It is highly probable that Officer A, at 01:54:43 when Vessel A was part way through its port turn, received Helmsman A's report that Vessel B had been showing its red light. It is somewhat probable that Vessel B, at that time, was at right and 0.53 M on Vessel A's bow (between right on the bow and less than 5° on the starboard bow).

It is highly probable that the change in Vessel A's heading during about 20 seconds from the time when Officer A ordered port 10 and the time when Helmsman A saw Vessel B's red light, remained at about 2.5°.

(viii) It is probable that Officer A, intending to avoid Vessel B by turning to starboard when seeing Vessel B's red light, ordered starboard and then midship, but thinking that Vessel A did not have sufficient time to complete a starboard turn, ordered hard port, and after that, flashed a daylight signal light.

(ix) It is probable that Helmsman A, judging from that he saw Vessel B enter Vessel A's blind zone and then sensed vibrations, thought that Vessel A collided with Vessel B. It is highly probable that Officer A, since around 01:56:38, made a report to Master A that Vessel A had collided with a fishing vessel.

(x) It is somewhat possible that Officer A did not locate Vessel B on the radar as previously described in (iv) because of the influence of rainfall or waves and the size of Vessel B. Therefore, it is somewhat likely that Vessel B came to around 0.66 M on Vessel A's port bow because Officer A, trying to visually obtain the information on Vessel B's movement, took three minutes to recognize Vessel B was crossing ahead of Vessel A.

(2) Vessel B

(i) It is probable that Vessel B, for the purpose of avoiding a low pressure system which was coming close, proceeded southward, accompanying a consort Vessel C, which was proceeding ahead of Vessel B.

(ii) It is somewhat likely as follows: Watchkeeper B, at around 01:40 on September 24 when Crew Member B_1 met him and handed him a cold can of coffee, was standing and serving on the watch duty; Vessel B, after Watchkeeper B and Crew Member B_1 had a conversation with each other, at 01:54:13 when Vessel B came into a situation where Vessel B was at Vessel A's bow (right on bow to less than 5° of starboard bow) 0.53 M on Vessel A's bow, turned to starboard, approaching Vessel A's bow, showing its red right to Vessel A.

(iii) It is somewhat likely that Watchkeeper B, in a situation where due to rainfall or waves he was finding it difficult to keep an exact monitoring of other vessel's movements, while Vessel A was approaching Vessel B with its rudder to port while changing its heading by about 2.5°, believing that Vessel A was coming close from the starboard to cross Vessel B's course, made a starboard turn for the purpose of keeping out of the way of the other vessel according to the navigation rule in a crossing situation, which require a vessel that sees another vessel on its starboard to give way to the other vessel; however, it could not be determined in detail what he was intended to do, because he went missing in the accident.

(iv) It is somewhat likely that Vessel B, although its radar was in operation, because of rainfall and waves about three meters high, was required to make radar adjustments for locating Vessel A on the radar. It is somewhat likely, however, that if Vessel B had been equipped with AIS, thanks to its ability to provide information on Vessel A including its course and speed with less interference by rainfall or waves than a radar, the load of the person on the bridge watch could have been reduced.

3.2.5 Operation Management

Judging from 2.7 and 2.9.2, it is as follows.

(1) It is somewhat likely that, while Company A, having prepared bridge watch procedures regarding the safety management system in compliance with the International Safety Management Code, had installed in Vessel A the procedures which require a person on watch duty to, for the purpose of assessing the risk of collision, obtain the information of other vessels in a 10 M range as a target, because Officer A did not obtain Vessel B's information by radar and Vessel B was not equipped with AIS (including Simplified AIS), Vessel B reached around 0.66 M on Vessel A's port bow at about the time when, as described above in 3.2.4 (2) (x), Officer A saw Vessel B's side lights and recognized Vessel B was crossing ahead of Vessel A.

Therefore, it is somewhat likely that, if Vessel B had been equipped with AIS (including Simplified AIS), Officer A could have been able to know the existence and information on Vessel B including its course and speed before seeing its lights, and

assess the risk of collision earlier, and furthermore have sufficient time for considering actions to avoid collision and the timing of such actions.

(2) It is somewhat likely that Helmsman A, when he saw white lights, believed that the lights belonged to a fishing vessel which he had seen before, but if Vessel A had been provided with the information from Company A on fishing vessels operating around the area where Vessel A was proceeding, he could have taken into consideration the possibility of a decrease in the radar detection range of FRP vessels as opposed to a large bulk carrier, and could have been able to have made, at an earlier stage, judgments on evasive navigation.

It is somewhat likely, in addition, that if Vessel B was provided with the information of commercial vessels proceeding in the area of its navigation, it could have helped Vessel B consider its watch arrangement including the focus points during lookout.

(3) It is probable that at the time of the accident, Master B's certificate of competence had been expired, but the ship owner should have had a master who had a valid certificate of competence on board.

3.2.6 Occurrence of Accident

Judging from 2.1, 2.8, 3.1.1, 3.1.2 and 3.2.4, it is as follows.

(1) Vessel A

(i) It is probable that Officer A and Helmsman A, having been on the bridge watch since around 23:00 on September 23, were conducting lookout visually or by radar, with the visibility at the time of the occurrence of accident being about 2 M due to rainfall.

(ii) It is probable that Helmsman A, at 01:51:02 seeing Vessel B's mast lights on the port bow, reported to Officer A, while Officer A, although trying to locate Vessel B on the radar and obtain Vessel B's information on AIS, but he could not locate Vessel B on the radar or obtain Vessel B's AIS information.

(iii) It is probable that Officer A and Helmsman A, at 01:52:12 seeing Vessel B's green light, at 01:53:44, knew that Vessel B was going to cross Vessel A's course. It is probable that Officer A, judging from the change in Vessel B's bearing, believing that Vessel B was crossing ahead of Vessel A, at 01:53:54 ordered rudder to port for the purpose of widening the passing distance to Vessel B. It is somewhat likely that at that time, Vessel B came close to 4.2° 0.66M on Vessel A's port bow.

(iv) It is probable that Officer A, at 01:54:13 receiving the Helmsman's report that Vessel B began to show its red light, seeing Vessel B's red light, and trying to avoid Vessel B by turning to starboard, issued a number of orders to make starboard turn, but, thinking that Vessel A had no sufficient time to complete the starboard turn, ordered hard port, and then intermittently flashed a daylight signalling light.

(v) It is probable that Helmsman A, after seeing Vessel B coming into Vessel A's bow blind zone, sensed hull vibrations, and at that time Vessel A and Vessel B collided with each other.

(2) Vessel B

(i) It is probable that Vessel B proceeded southward with a consort Vessel C which was proceeding ahead of Vessel B, for the purpose of avoiding a low pressure system which was coming close.

(ii) It is somewhat likely that Watchkeeper B, standing on the bridge watch at around 01:40 when Crew Member B_1 brought a cold can of coffee to him, made a starboard turn at 01:54: 13 when Vessel B got in a situation where Vessel B was at 0.53 M on Vessel A's bow (0° to less than 5° on the starboard bow), and Vessel B came close to Vessel A's bow.

(iii) It is somewhat likely that Watchkeeper B, believing that Vessel A was proceeding straight from Vessel B's starboard to cross Vessel B's course, made a starboard turn for the purpose of keeping out of the way of Vessel A following the navigation rule in a crossing situation which requires the vessel that sees another vessel on starboard to give way. However, because Watchkeeper B went missing in the accident, it was not possible to determine what he intended to do.

(iv) It is probable that, when Chief Fisherman B during his radio conversations with Chief Fisherman C sensed shocks of collision, Vessel B collided with Vessel A.

(See Appendix Figure 3: "Why Tree" (Fault Tree Analysis) and Appendix Figure 4: VTA Analysis (Vessel A))

3.3 Analysis of Measures to Mitigate Consequences

Judging from 2.1, 3.1.4, and 3.1.6, it was as follows:

3.3.1 Vessel B

It is probable that Chief Fisherman B's prompt request for assistance from Vessel C when he sensed shocks during his radio conversations with Chief Fisherman C contributed to the rescue of persons in the water.

In addition, it is somewhat likely that, regarding the nine persons that were rescued, although they could not use life-saving devices, the following contributed to their life-saving; they were able to drift holding buoyant material including fenders since the start of drifting in the water; they were drifting in a group of persons encouraging each other; and the water temperature was around 25°C.[14]

In addition, it is probable that most of the crew members, at the time of the accident, were sleeping, while the crew members who came out on the stern deck for the first time recognized Vessel B's collision with Vessel A, and because they fell into the water within a minute since they felt the collision shocks, they had no sufficient time to prepare inflatable liferafts or lifebuoys.

3.3.2 Vessel A

It is probable that Vessel A, after the occurrence of the accident, although

[14] According to the International Aeronautical and Maritime Search and Rescue Manual, in a case of water temperature of more than 20°C, the survival time of a person in water is "Indeterminate (depends on the fatigue-severity)."

conducting search activities for persons in the water, did not come to discover persons in the water because of the weather conditions and other factors.

It is probable that, if Vessel A had dropped self-igniting lights or other such devices into the water when seeing Vessel B's bow floating on the water, it would have contributed to the search and rescue of persons in the water, so it is desirable that Company A should enhance their rescue procedures by adding such measures as dropping self-igniting lights in water and through training inform its crews of such measures.

4 CONCLUSIONS

4.1 Findings

(1) Vessel A

(i) It is probable that Vessel A, leaving Shibushi Port at around 07:30 on September 15, after drifting, started proceeding toward Vancouver, Canada, using autopilot. (3.1.1 (1) (i))[15]

(ii) It is probable that, while Officer A and Helmsman A, who took over the navigational watch at around 23:00 on September 23, were conducting their lookout visually or on radar, the visibility at around the time of the accident became about 2 M due to rainfall.

It is somewhat likely that Helmsman A, seeing Vessel B's masthead lights on the port bow at 01:51:02 on September 24, reported to Officer A, and Vessel B, at that time, was at 13.5° 1.92 M on Vessel A's port bow. It is probable that Officer A, although trying to locate Vessel B on the radar and obtain Vessel B's information on AIS, could not confirm either of them.

It is somewhat likely that, if Vessel B had been equipped with AIS (including Simplified AIS), Officer A could have recognized Vessel B's existence and course before seeing its lights, having sufficient time for considering actions to avoid collision and the timing of such actions. (3.2.4 (1) (i), (ii), (iii), and (iv), and 3.2.5 (1))

(iii) It is probable that Officer A and Helmsman A saw Vessel B's green light at 01:52:12 and recognized that Vessel B was going to cross Vessel A's course at 01:53:44, while Officer A, recognizing the changes in Vessel B's bearing to Vessel A's bow, believing that Vessel B was crossing ahead of Vessel A, for the purpose of widening the passing distance to Vessel B, ordered rudder to port. It is somewhat likely that, at that time, Vessel B came close to 4.2° 0.66 M on Vessel A's port bow. (3.2.4 (1) (v) and (vi))

(iv) It is probable that Officer A, on his receipt of Helmsman A's report at 01:54:13 during Vessel A's port turn that Vessel B began to show its red light, ordering rudder to starboard for the purpose of avoiding Vessel B by turning to starboard, but judging that Vessel A had no sufficient time to complete its starboard turn, ordered hard to

[15] The numbers attached to the ends of sentences in this section refer to the items in paragraph "3 ANALYSIS".

port. (3.2.6 (1) (iv))

(v) It is probable that, after Helmsman A saw Vessel B come into Vessel A's bow blind zone and sensed hull vibrations, Vessel A and Vessel B collided with each other. (3.2.6 (1) (v))

(2) Vessel B

(i) It is probable that Vessel B, starting its voyage for the purpose of avoiding a low pressure system at around 18:00 on September 23, proceeding at a speed of about 12.5 kn and on a course of 200 to 205° following Vessel C on its port using autopilot, was, at 00:14 on September 24, at 39° 56' 46" N 152° 23' 24" E. (3.1.1 (2) (i))

(ii) It is somewhat likely that Watchkeeper B was standing and serving on the watch when Crew Member B_1 brought a cold can of coffee at around 01:40, and turned to the starboard for the purpose of giving way at 01:54:13 when Vessel B was at 0.53 M on Vessel A's bow (0° to less than 5° on the starboard bow). It was however not possible to determine what he intended to do because he went missing due to the accident. (3.2.6 (2) (ii) and (iii))

(iii) It is probable that Chief Fisherman B sensed collision shocks during his radio conversations with Chief Fisherman C, and at that time, Vessel B collided with Vessel A. (3.2.6 (2) (iv))

4.2 Probable Causes

It is probable that the accident of collision between Vessel A and Vessel B occurred at night at around 930 km east of Kinkazan while Vessel A was proceeding northeast and Vessel B was proceeding south-southwest, because Vessel A altered its course to port and Vessel B altered its course to starboard in a situation where the vessels came close to each other sailing on intersecting courses.

It is probable that Vessel A altered its course to port for the purpose of widening the passing distance to Vessel B which was crossing ahead of Vessel A.

5 SAFETY ACTIONS

It is probable that the accident of collision between Vessel A and Vessel B occurred at night at around 930 km east of Kinkazan while Vessel A was proceeding northeast and Vessel B was proceeding south-southwest, because Vessel A altered its course to port and Vessel B altered its course to starboard in a situation where the vessels came close to each other sailing on intersecting courses.

It is probable that Officer A, although seeing in the rainfall Vessel B's lights when Vessel A came close to Vessel B at less than 2 M, was not able to locate Vessel B on the radar display, and while he was trying to confirm the situation of Vessel B's approaching, it came closer, and he altered Vessel A's course, resulting in the collision.

According to the maritime accident investigation reports released by the Japan Transport Safety Board between January 2009 and January 2013, more than 10 accidents occurred in a situation where a commercial vessel's watchkeeping personnel, although conducting radar lookout, were unable to have the other vessel's radar image, which led to a collision between a commercial vessel and a fishing vessel. Furthermore, similar collision cases occurred after the collision accident of this time.

The watchkeeping personnel are required, when seeing another vessel, to assess the situation of approaching and determine the necessity of actions to avoid collision. Furthermore, after having decided to take avoiding actions, they are required to determine how and when, as well as to keep a safe distance so as not to create uncertainty on the other vessel regarding the avoiding actions.

Hence, it is important, in a case where there is sufficient leeway in terms of time and distance, for a vessel to have knowledge of other vessel's situations and take necessary actions to avoid collision. Shipping companies, from the standpoints described above, develop guidelines in their bridge watchkeeping procedure manuals, for early detection of other vessels, avoiding actions in ample time, and CPAs[16] to other vessels.

Radars, although being able to detect other vessels a long distance away and are therefore effective to lookout for detecting other vessel's information in early stages, in some cases as previously described, due to the disturbances by rainfall or waves, do not detect images of small vessels including fishing vessels if proper adjustments are not made. Therefore, it is probable, judging from what described above, that taking the following measures for vessels should be effective to prevent collision cases.

(1) Promotion of the deployment of AISs on fishing vessels

AISs (including Simplified AISs) are less susceptible to the influence of rainfall or other factors, and have features for exchanging information including vessel positions at a distance comparable to the radar detection range of small vessels (around 4.5 M or longer). It is probable therefore that AISs significantly contribute to avoiding collisions, because, if fishing vessels are equipped with AISs (including Simplified AISs), commercial vessels are able to obtain useful information for ship maneuvering

[16] For the requirements described in Company A's procedures of watch keeping, refer to 2.7.1 (2). Note that some companies require in their procedures to keep CPAs to other vessels more than around 2 M.

including positions of fishing vessels early and stably, and to have sufficient time and distance for observing fishing vessel's movement and obtain information on fishing vessels including vessel name and type not available by radar, which help watchkeepers to think of the possibility of the existence of other fishing vessels in the surrounding area or ongoing operations (such as towing fishing nets) specific to fishing vessels.

On the other hand, regarding fishing vessels, it is expected that AISs (including Simplified AISs) make it easier to obtain information including positions of other vessels (commercial vessels, etc.), and alleviate watchkeeping personnel's load, effectively contributing as a result, to the prevention of collision accidents, because generally fishing vessels are in a situation where a succession of fishing operation and watch duty or one-man bridge operation is inevitable, and in addition, a limited number of officers on board.

It is furthermore probable that, regarding Simplified AISs, they have advantages for prompt deployment, because their operations require no radio operator licenses.

Furthermore, it is desirable, judging from the fact that a fishing vessel intensively suffers damage in a collision with a commercial vessel, that AISs (including Simplified AISs) should be deployed promptly, particularly on the fishing vessels operating or navigating in the open sea in the areas overlapping with the voyage routes for commercial vessels which are equipped with AISs.

(2) Pre-departure information gathering on the navigational situations of other vessels

It is probable that, regarding a commercial vessel, information gathering before its departure for estimating chances of encountering fishing vessels during its voyage, on fishing vessel's operational situations (number of vessels, fishing methods, etc.) in its planned navigation areas, helps it make prompt judgments on the necessity of actions to avoid collision or proper ship maneuvering when encountering fishing vessels, and contributes to the prevention of collision accidents.

It is probable, on the other hand regarding a fishing vessel, that obtaining information on the occurrence situation of accidents or commercial vessel's routes in its operation area contributes to the prevention of collision accidents as well as in the case of a commercial vessel, because such information helps a fishing vessel make adjustments on its watchkeeping arrangement in advance.

5.1 Safety Actions Taken

5.1.1 Opinions to the Minister of Land, Infrastructure, Transport and Tourism, and the Director General of the Fisheries Agency

In view of the results of this accident investigation, the Japan Transport Safety Board expressed its opinions as follows on October 25, 2013, to the Minister of Land, Infrastructure, Transport and Tourism and the Director General of the Fisheries Agency, pursuant to Article 28 of the Act for Establishment of the Japan Transport Safety Board in order to prevent collision accidents at sea between a commercial vessel and a fishing vessel.

(1) Opinions to the Minister of Land, Infrastructure, Transport and Tourism

(i) The Minister of Land, Infrastructure, Transport and Tourism should consider the necessary measures for further informing ship owners and others of the effectiveness of AISs for the prevention of collision accidents, and the necessary measures for promptly promoting the deployment of AISs on fishing vessels that, at present, are not equipped with AISs (including Simplified AISs, the same shall apply hereinafter), for example, the fishing vessels operating or navigating in the open sea (the second class fishing vessels designated by the Ship Safety Act).

(ii) It is necessary that, for the purpose of preventing collision accidents, the Minister of Land, Infrastructure, Transport and Tourism should guide shipping business operators to collect and utilize the information on the situations of fishing vessel operations in their ship's navigation areas, using public information including information provided by the industry associations related to fisheries or the Japan-Marine Accident Risk and Safety Information System by the Japan Transport Safety Board.

(2) Opinions to the Director General of the Fisheries Agency

(i) The Director General of the Fisheries Agency, with regard to the fishing vessels that, at present, are not equipped with AISs, for example the fishing vessel engaged in operations or navigation in the open sea (the second-class fishing vessels designated by the Ship Safety Act), should inform the shipowners and others of the effectiveness of AIS for the prevention of collision accidents, and consider the necessary measures for promptly promoting the deployment of AISs.

(ii) It is necessary that the Director General of the Fisheries Agency should guide fishing vessel owners to collect and utilize the information on the situations of accident occurrences and the information on commercial vessel's voyage routes using public information, including the Japan-Marine Accident Risk and Safety Information System by the Japan Transport Safety Board.

5.1.2 Safety Actions Taken by the Ministry of Land, Infrastructure, Transport and Tourism and the Fisheries Agency.

(1) Establishment of the liaison committee of the four ministries and agencies for the promotion of the deployment of AIS on fishing vessels

The Ministry of Land, Infrastructure, Transport and Tourism, upon receiving the opinions of the Japan Transport Safety Board, immediately called upon the Fisheries Agency, the Ministry of Internal Affairs and Communications, and the Japan Coast Guard, and established "The Liaison Committee of the Related Ministries and Agencies on the Promotion of the Deployment of AISs on Fishing Vessels" (administered by the Maritime Bureau of the Ministry of Land, Infrastructure, Transport and Tourism). At present, the committee has been discussing the specific measures for the promotion of AISs.

(2) Guidance to the related parties

(i) The Maritime Bureau of the Ministry of Land, Infrastructure, Transport and Tourism issued its notice, dated October 25, 2013, to the maritime industry associations (Japanese Shipowners' Association and Japan Federation of Coastal Shipping Associations), requiring shipping business operators to collect and utilize the

information on the situations of fishing vessel's operations in the navigation areas of their vessels using the Japan-Marine Accident Risk and Safety Information System by the Japan Transport Safety Board. The Maritime Bureau directed each of the District Transport Bureaus to inform such shipping business operators of the notice and its points using the seminars and other means related to safety.

In addition, the Maritime Bureau directed the District Transport Bureaus to conduct safety enlightenment campaigns for installation of AISs on board.

(ii) The Fisheries Agency issued its notice, dated October 25, 2013, to the fisheries industry associations (JF Zengyoren (the nationwide federation of Japan Fisheries Cooperatives), Japan Fisheries Association, and Center for Employment Promotion and Training of Fishermen) and Prefectural Governors, requiring the recipients of the notice to promote the deployment of AISs to fishing vessels and guide fishing business operators to collect the situation of accident occurrences using the Japan-Marine Accident Risk and Safety Information System by the Japan Transport Safety Board.

In addition, the Fisheries Agency established the financing support system for the costs of installation of the AISs, which is virtually interest-free loan in April 2014.

5.1.3 Actions Taken by Company A

(1) Company A made the following notifications to all the vessels under Company A's management

(i) To keep conducting sufficient lookout during the watch on bridge;

(ii) Not to hesitate, for the purpose of securing safety, to use whistles or engines (to reduce the ship speeds);

(iii) To read the boards posted in vessels to confirm the vessel characteristics including maneuvering characteristics;

(iv) To take into consideration the situations specific to Japanese fishing vessels (their hull material is FRP; they are not equipped with AISs; generally, they are operating in a group, not by a single vessel).

(v) To have necessary expertise for the operation of navigational equipment including radar and AISs.

(2) Company A, for the measure of rescuing persons overboard off other vessels in case of a collision, revised their manuals under the ISM Code so that those drill procedures include the throwing of lifebuoys and self-igniting lights onto the sea surface from the vessel. In addition, Company A decided, for all their crew members (including new crew members scheduled to be on board), to conduct drills for rescuing persons overboard and training for expertise on navigational equipment including radars, and informed the whole company of their decisions described above.

Furthermore, Company A, following the opinions of the Japan Transport Safety Board provided to the Minister of Land, Infrastructure, Transport and Tourism, has started collecting information of the situations of fishing vessel operations provided by the associations related to the fishery industry and

delivering it to the vessels under its management.

Company A is revising its manuals describing the procedures for recovering persons overboard, which have been required by the amended International Convention for the Safety of Life at Sea.

Appendix Table 1: Data of SVDR of Vessel A

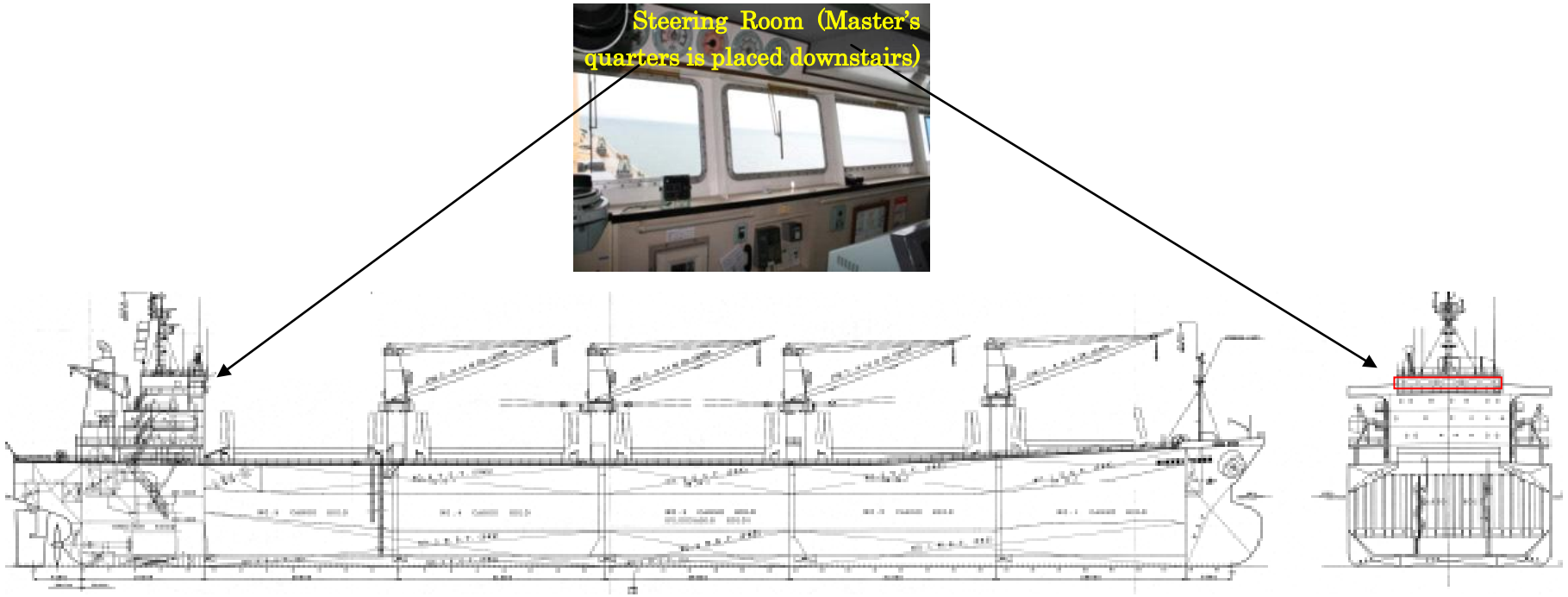
Time	Latitude (North)	Longitude (East)	Heading (True Bearing)	Speed (kn)
01:51:01	39°37.06′	152°10.83′	71.9	12.68
01:51:05	39°37.06′	152°10.85′	72.2	12.66
01:51:09	39°37.07′	152°10.87′	72.2	12.77
01:51:13	39°37.07′	152°10.88′	72.1	12.62
01:51:17	39°37.08′	152°10.9′	72.1	12.68
01:51:21	39°37.08′	152°10.92′	72.1	12.74
01:51:25	39°37.09′	152°10.93′	72	12.73
01:51:29	39°37.09′	152°10.95′	72	12.79
01:51:33	39°37.1′	152°10.97′	72.1	12.85
01:51:37	39°37.1′	152°10.99′	72	12.69
01:51:41	39°37.11′	152°11.01′	72.1	12.61
01:51:45	39°37.11′	152°11.03′	72.1	12.58
01:51:49	39°37.12′	152°11.04′	72	12.56
01:51:53	39°37.13′	152°11.07′	72.2	12.59
01:51:57	39°37.13′	152°11.08′	72.1	12.69
01:52:01	39°37.14′	152°11.1′	72.1	12.73
01:52:05	39°37.14′	152°11.12′	72.1	12.73
01:52:09	39°37.15′	152°11.13′	71.8	12.64
01:52:13	39°37.15′	152°11.15′	71.6	12.49
01:52:17	39°37.16′	152°11.17′	71.7	12.53
01:52:21	39°37.16′	152°11.19′	71.6	12.56
01:52:25	39°37.17′	152°11.2′	71.7	12.7
01:52:29	39°37.17′	152°11.22′	71.8	12.69
01:52:33	39°37.18′	152°11.24′	71.9	12.6
01:52:37	39°37.18′	152°11.26′	72	12.68

01:52:41	39°37.19′	152°11.28′	71.9	12.77
01:52:45	39°37.2′	152°11.3′	72.2	12.62
01:52:49	39°37.2′	152°11.32′	72.2	12.78
01:52:53	39°37.21′	152°11.33′	72.2	12.94
01:52:57	39°37.21′	152°11.35′	72.2	12.75
01:53:01	39°37.22′	152°11.37′	72.2	12.75
01:53:05	39°37.22′	152°11.38′	72.2	12.81
01:53:09	39°37.23′	152°11.4′	72.2	12.75
01:53:13	39°37.23′	152°11.42′	72.3	12.66
01:53:17	39°37.24′	152°11.44′	72.3	12.6
01:53:21	39°37.24′	152°11.46′	72	12.68
01:53:25	39°37.25′	152°11.47′	72.2	12.69
01:53:29	39°37.25′	152°11.49′	72.1	12.65
01:53:33	39°37.26′	152°11.51′	71.8	12.59
01:53:37	39°37.27′	152°11.53′	71.8	12.53
01:53:41	39°37.27′	152°11.55′	71.6	12.66
01:53:45	39°37.28′	152°11.57′	71.5	12.7
01:53:49	39°37.28′	152°11.58′	71.4	12.64
01:53:53	39°37.29′	152°11.60′	71.3	12.51
01:53:57	39°37.29′	152°11.62′	71.2	12.57
01:54:01	39°37.3′	152°11.64′	71.2	12.41
01:54:05	39°37.3′	152°11.65′	70.8	12.41
01:54:09	39°37.31′	152°11.67′	69.9	12.47
01:54:13	39°37.31′	152°11.69′	68.8	12.55
01:54:17	39°37.32′	152°11.71′	67.1	12.58
01:54:21	39°37.33′	152°11.73′	65.2	12.58
01:54:25	39°37.33′	152°11.75′	63	12.7
01:54:29	39°37.33′	152°11.77′	60.6	12.69

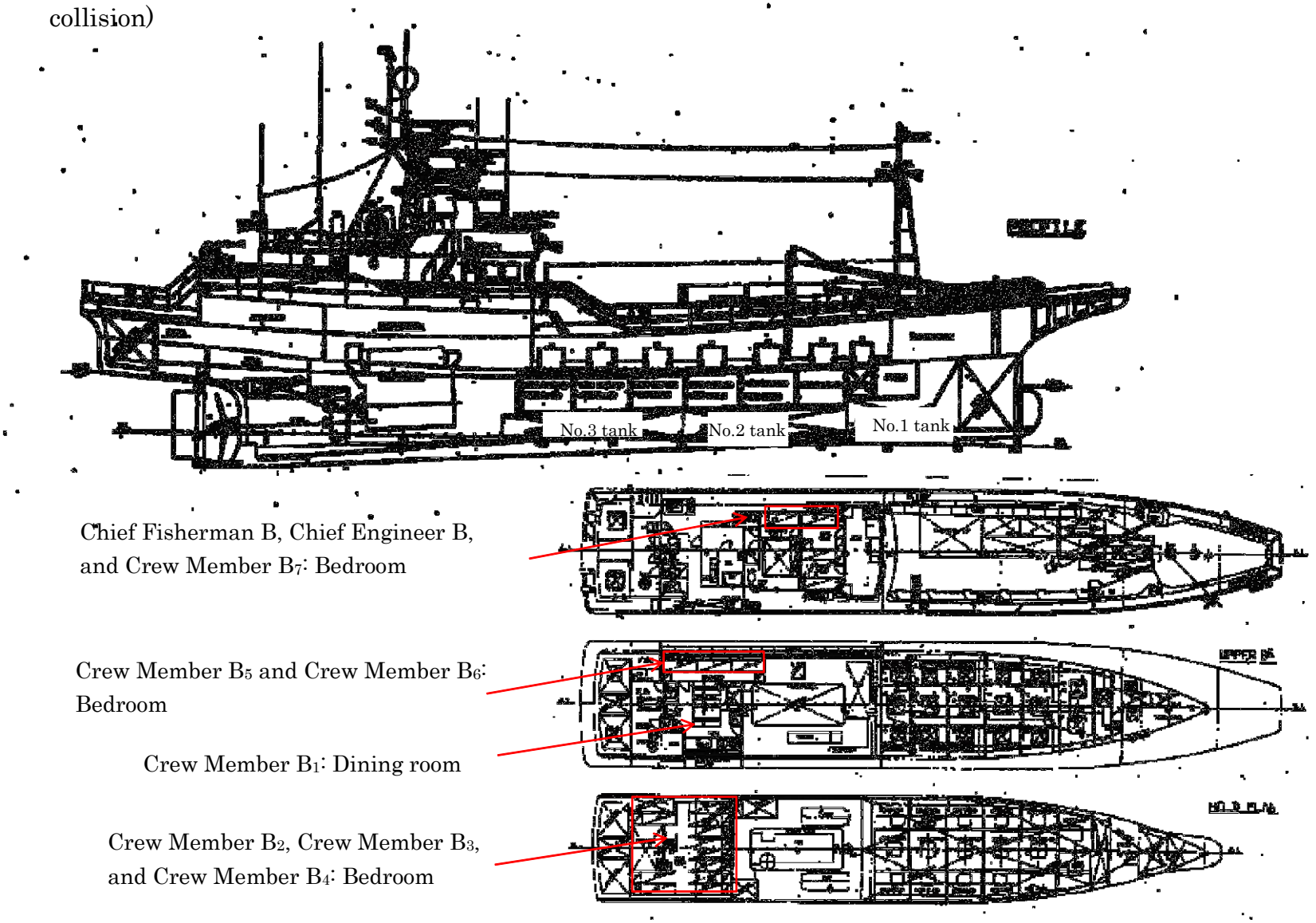
01:54:33	39°37.34′	152°11.78′	57.9	12.62
01:54:37	39°37.34′	152°11.8′	55.3	12.35
01:54:41	39°37.35′	152°11.81′	52.6	12.29
01:54:45	39°37.35′	152°11.83′	50.5	12.33
01:54:49	39°37.36′	152°11.85′	48.6	12.31
01:54:53	39°37.37′	152°11.86′	47.1	12.26
01:54:57	39°37.38′	152°11.88′	45.3	12.21
01:55:01	39°37.38′	152°11.89′	43.6	12.2
01:55:05	39°37.39′	152°11.91′	41.5	12.12
01:55:09	39°37.4′	152°11.92′	39.1	11.94
01:55:13	39°37.41′	152°11.94′	36.2	11.94
01:55:17	39°37.42′	152°11.95′	32.7	11.98
01:55:21	39°37.43′	152°11.97′	29	11.85
01:55:25	39°37.44′	152°11.98′	24.9	11.89
01:55:29	39°37.45′	152°11.99′	20.8	12.07
01:55:33	39°37.46′	152°12′	16.4	12.31
01:55:37	39°37.47′	152°12.01′	12	12.59
01:55:41	39°37.48′	152°12.02′	8.1	12.31
01:55:45	39°37.49′	152°12.03′	3.5	12
01:55:49	39°37.5′	152°12.04′	358.9	11.77
01:55:53	39°37.51′	152°12.05′	354.8	11.42
01:55:57	39°37.52′	152°12.05′	350.5	11.05
01:56:01	39°37.53′	152°12.06′	346.2	10.85
01:56:05	39°37.55′	152°12.06′	3401	10.39
01:56:09	39°37.56′	152°12.07′	336.4	10
01:56:13	39°37.57′	152°12.07′	331.8	9.47
01:56:17	39°37.58′	152°12.07′	327.5	9.04
01:56:21	39°37.58′	152°12.07′	323.9	8.57

01:56:25:	39°37.59′	152°12.07′	320.6	8.29
01:56:29	39°37.6′	152°12.07′	317.1	8.02
01:56:33	39°37.61′	152°12.07′	314.2	7.74
01:56:37	39°37.62′	152°12.07′	311.2	7.51
01:56:41	39°37.63′	152°12.07′	308.5	7.25
01:56:45	39°37.63′	152°12.06′	306.2	7.19
01:56:49	39°37.64′	152°12.06′	303.9	6.95
01:56:53	39°37.65′	152°12.06′	302	6.73
01:56:57	39°37.66′	152°12.05′	300.2	6.58
01:57:01	39°37.66′	152°12.05′	298.9	6.59

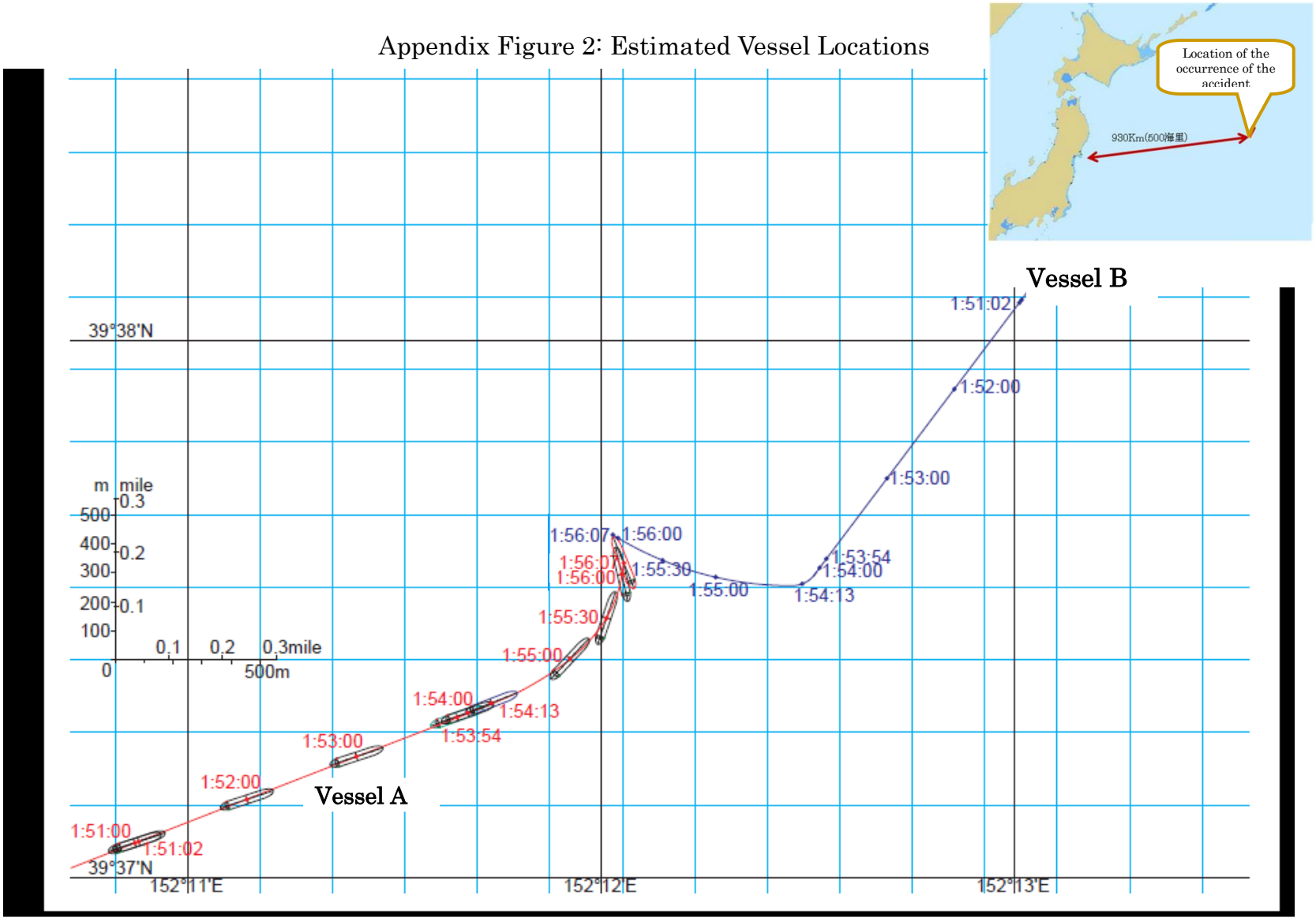
Appendix Figure 1-1: General Arrangement of Vessel A



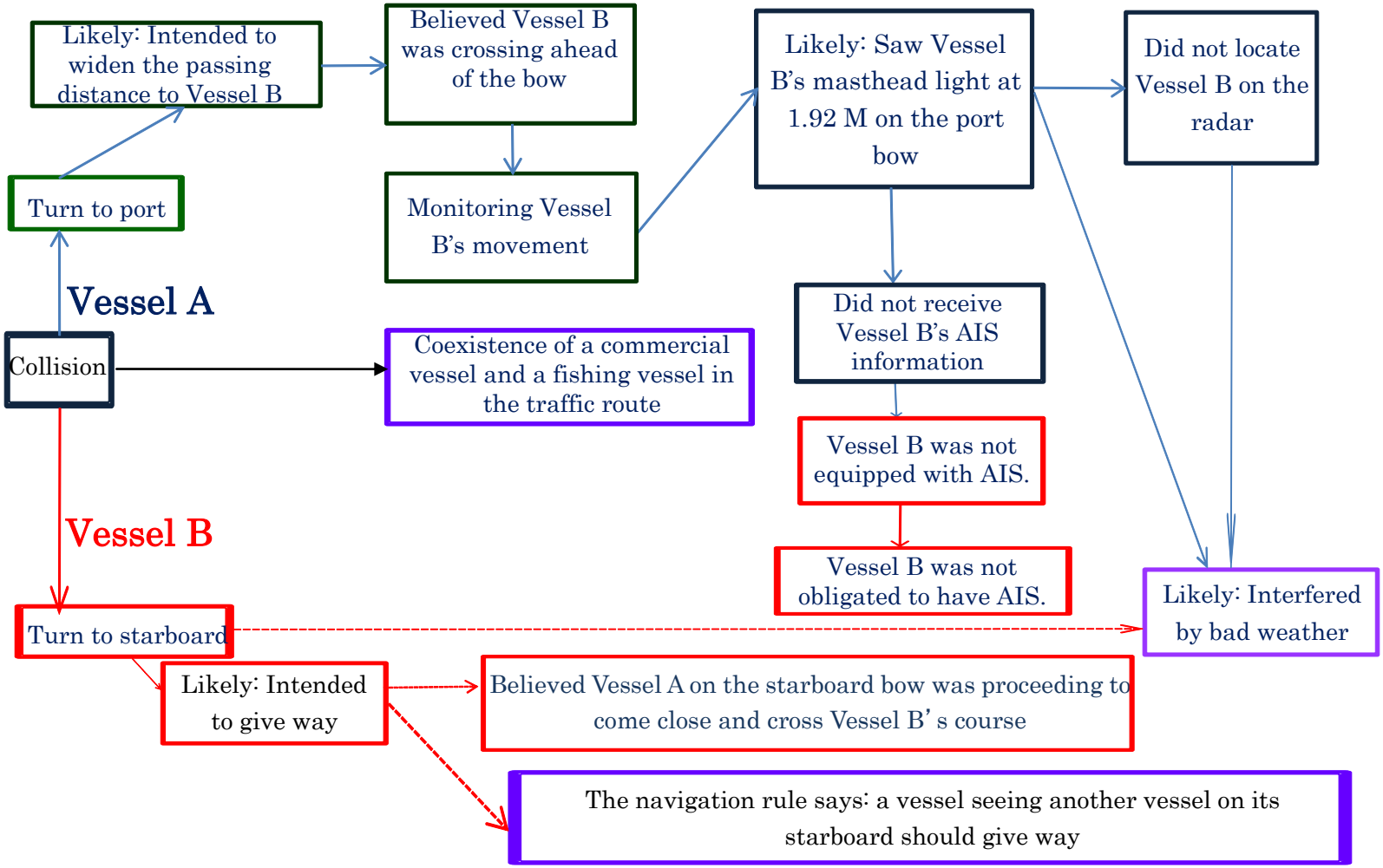
Appendix Figure 1-2: General Arrangement of Vessel B (including location of crew members at the time of collision)



Appendix Figure 2: Estimated Vessel Locations



Appendix Figure 3: "Why Tree" (Fault Tree Analysis)



Appendix Figure 4: VTA Analysis (Vessel A)