

MA2011-6

**MARINE ACCIDENT  
INVESTIGATION REPORT**

**June 24, 2011**

**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: Container ship CARINA STAR

IMO number: 9172612

Gross tonnage: 7,401 tons

Vessel type and name: Destroyer KURAMA

Standard displacement: 5,200 tons

Accident type: Collision

Date and time: 19:56:09/12 hrs, October 27, 2009 (local time, UTC+ 9 hours)

Location: Vicinity of Moji Saki, Kanmon Passage, Kanmon Port  
Around 294° true, 330m from Moji Saki Light House in Kitakyusyu-City,  
Fukuoka-Prefecture  
(approximately 33°57'48.2" N, 130°57' 35.1" E)

June 2, 2011

Adopted by the Japan Transport Safety Board

Chairman Norihiro Goto

Member Tetsuo Yokoyama

Member Tetsuya Yamamoto

Member Toshiyuki Ishikawa

Member Mina Nemoto

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Figure 1: Plots of Estimated Ship Positions (Overview)

Figure 2: Plots of Estimated Ship Positions (Close-up 1)

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Figure 4: Tidal Current Charts in Kanmon Strait

Figure 5: Variations in the Heading and at a speed of Ship A

Figure 6: Plots of Tactical Diameter of Ship A

Figure 7: General Arrangement Plan of Ship A

Figure 8: General Arrangement Plan of Ship B

Figure 9: Summarized Cause Flow Diagram

Table 1: AIS Records of Ship A

Table 2: Radar Tracking Records of Ship B

Table 3: AIS Records of Ship C

Table 4: Distance, etc. from Ship A

Table 5: VDR Voice Records of Ship A

Table 6: Records of the Bridge Voice Recorder of Ship B

Table 7: VDR Voice Records of Ship C

Table 8: VHF Communication Records

Photo 1: Situation of Ship A

Photo 2: Situation of Ship B

Photo 3: VDR Radar Image Recorded by Ship C

# 1 PROCESS AND PROGRESS OF THE INVESTIGATION

## 1.1 Summary of the Accident

Containership CARINA STAR, boarded by a master with 15 crew members, was proceeding eastward toward Hanshin Port through the Kanmon Passage in Kanmon Port. Destroyer of Japan Maritime Self-Defense Force (JMSDF) KURAMA, boarded by a master with 295 crew members, was proceeding westward through Kanmon Passage toward Sasebo Port, Sasebo City, Nagasaki Prefecture. At 1956.09-12 hrs, October 27, 2009, the ships collided with each other in the vicinity of Moji Saki, Kita-Kyusyu City, Fukuoka-Prefecture.

CARINA STAR sustained a fracture opening on the starboard bow outer-plate, and KURAMA sustained substantial damage on the bow, which caused both ships to catch a fire at the damaged part. Six crew members of KURAMA suffered injuries during the fire-fighting operations, however, there were no injuries among the crew of CARINA STAR.

## 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, as well as one regional investigator from Moji regional office, to investigate this accident on October 27 and 28, 2009. In addition, four regional investigators from Moji and Hiroshima regional offices joined the investigation of the accident.

### 1.2.2 Collection of Evidence

October 29–31, November 3, 2009 and February 19, 2010: On-site investigations and interviews

February 17 and 18, 2010: Interviews

May 10, 2010: Collection of written reply to questionnaire

### 1.2.3 Factual Information made in Public

Plots of estimated ship positions from AIS data and other evidence were publicized on January 27, 2010.

### 1.2.4 Opinions of Parties Relevant to the Cause

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

### 1.2.5 Comments from CARINA STAR's Owner

Comments on the draft report were invited from CARINA STAR's owner.

## 2 FACTUAL INFORMATION

### 2.1 Events Leading to the Accident

#### 2.1.1 Events Leading to the Accident According to AIS and Other Information

According to the VDR<sup>1</sup> of CARINA STAR (hereinafter referred to as “Ship A”), the records on the bridge voice recorder<sup>2</sup> of KURAMA (hereinafter referred to as “Ship B”), the VDR of a cargo ship named QUEEN ORCHID (hereinafter referred to as “Ship C”), which was proceeding ahead of Ship A, the records of AIS<sup>3</sup> information (hereinafter referred to as “AIS records”) of Ship A and Ship C received by the Kanmon-Kaikyo Vessel Traffic Service Center (hereinafter referred to as “Kanmon MARTIS”), the radar tracking records of Ship B, and VHF radio-telephone communication (hereinafter referred to as “VHF”) recorded by Kanmon MARTIS, the events leading to the accident were as follows:

#### (1) Movements of Ship A

{1} At 1908.06-48 hrs, Ship A reported to Kanmon MARTIS by VHF that, “We have just passed the AS line<sup>4</sup>,” and received the following messages from Kanmon MARTIS: “We have confirmed your position. A timber carrier of about 40,000 tons is heading south from the east side of Mutsure-Sima. You will likely encounter the carrier in the vicinity of Buoy 10, so please keep out of her way. The tidal stream is flowing west-going at 3 knots (kn), (speed over the ground, the same shall apply hereinafter unless denoted as speed through the water), which is decreasing.”

{2} At 1935.00 hrs, Ship A was proceeding on a heading of 065° (true bearing, the same shall apply hereinafter, for Course Over the Ground as well), COG of 064.6°, and at a speed of 11.8 kn.

{3} At 1940.00 hrs, Ship A was proceeding on a heading of 023°, COG of 023.8°, and at a speed of 11.9 kn.

{4} At 1948.26 hrs, Ship A was proceeding on a heading of 033°, COG of 036°, and at a speed of 13.4 kn.

{5} At 1953.06 hrs, Ship A was proceeding on a heading of 033°, COG of 035.9°, and at a speed of 13.8 kn.

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<sup>1</sup> A “Voyage Data Recorder (VDR)” is an apparatus that records navigation data such as position, course, and speed, as well as voices from VHF radio-telephone communications and conversations on the bridge in a retrievable capsule.

<sup>2</sup> A “bridge voice recorder” is an apparatus that records conversations and other sound on the bridge automatically.

<sup>3</sup> An “Automatic Identification System (AIS)” is a system that enables ships to automatically exchange navigation information, such as call sign, ship’s type, name, position, and course, with other ships or with shore facilities for the navigational aid. Note that the recorded ship position is the position of the GPS antenna on board.

<sup>4</sup> The “AS Line,” as well as the “HS Line” and “MN Line”, is set by the 7<sup>th</sup> Regional Coast Guard Head Quarters for a specified vessel to report her passing to the Kanmon MARTIS. The “AS Line” is a line connecting the southernmost point of Aino-Shima Island and the northernmost point of Kata-Shima Island.



- {6} At 1953.08-26 hrs, Ship A received a VHF message from Kanmon MARTIS, “CARINA STAR, vessel ahead of you, QUEEN ORCHID is moving to starboard side, so please overtake on her port side. Over,” and replied, “Ok, roger, I will overtake.”
- {7} At 1953.31-49 hrs, Ship A received a VHF message from Kanmon MARTIS, “Overtake on her port side, QUEEN ORCHID is moving to starboard side, but 1 mile (M) ahead of you, Japanese navy ship is coming. Pay attention. Over,” and replied “Ok, thank you, I will overtake on my port side<sup>5</sup>.”
- {8} At 1954.09-12 hrs, a voice in Korean said, “Do we have to overtake on her port side? A head-on vessel is getting closer to us.”
- {9} At 1954.14 hrs, there was the order “Slow Ahead”, and at 1954.18 hrs, Ship A was proceeding on a heading of 032°, COG of 031.5° and at a speed of 12.1 kn.
- {10} At 1954.22 hrs, there was the order “Port 10”, and at 1954.24 hrs, Ship A was proceeding on a heading of 033°, COG of 031.3°, and at a speed of 11.9 kn.
- {11} At 1954.40 hrs, there was the order “Port 20”, and at 1954.42 hrs, Ship A was proceeding on a heading of 034°, COG of 033.3° and at a speed of 11.0 kn.
- {12} At 1955.03 hrs, there was the order “Hard Port”, and at 1955.06 hrs, Ship A was proceeding with heading of 027°, COG of 031.4°, and at a speed of 10.7 kn.
- {13} At 1955.12 hrs, there was the order “Midship”, and at 1955.13 hrs, Ship A was proceeding on a heading of 023°, COG of 028.7° and at a speed of 9.8 kn.
- {14} At 1955.14 hrs, there was the order “Hard Starboard”, and at 1955.20 hrs, Ship A was proceeding on a heading of 016°, COG of 023.4°, and at a speed of 9.6 kn.
- {15} At 1955.30 hrs, a whistle was sounded (one short blast), while Ship A was proceeding on a heading of 005°, COG of 008.2°, and at a speed of 9.4 kn.
- {16} At 1955.34 hrs, there was the order “Hard Starboard, Sir”, while Ship A was proceeding on a heading of 002°, COG of 003°, and at a speed of 9.1 kn.
- {17} At 1955.55 hrs to 1956.04 hrs, Ship A received a VHF message from Kanmon MARTIS, “CARINA STAR, CARINA STAR, opposite course vessel, pay attention. CARINA STAR, pay attention,” but Ship A made no reply.
- {18} At 1956.06 hrs, Ship A was proceeding on a heading of 352°, COG of 338.8°, and at a speed of 8.0 kn. At 1956 09 hrs, there were a crash sound of a collision and an alarm.

## (2) Movements of Ship B

- {1} At 1918.22-50 hrs, Ship B reported to Kanmon MARTIS by VHF that “We have just passed the HS line.<sup>6</sup> We will proceed westward through the Kanmon Strait and cross

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<sup>5</sup> The phrase “on my port side” was possibly, as stated later in 3.2.5 (1) {4}, mistakenly used for “on her port side.”

<sup>6</sup> “HS line” refers to a line connecting a point 090° and 2,150m from the Shin-Moji Light House to a point 215° and 3,950 m from the Ryuosan trigonometric point.

the MN line,”<sup>7</sup> and Ship B received information from Kanmon MARTIS that, “About two miles ahead of and head-on to you, KAISHO-MARU, which is performing dredge work near Buoy No.2. The tidal stream is 3 kn west-going, which is decreasing.”

{2} At 1952.00 hrs, Ship B was proceeding on a COG of 239.4° and at a speed of 16.3 kn.

{3} At 1953.00 hrs, Ship B was proceeding on a COG of 240.6° and at a speed of 16.3 kn.

{4} At 1953.23-56 hrs, there were voices, “Now, under the bridge, under the bridge, just passing under the bridge,” “Next one worries me,” and “Steady, 600 to the bridge. Mine is 1,500 to the bridge.”

{5} At 1954.10-32 hrs, there were voices, “Port 10°,” “Blue light<sup>8</sup> visible. Roger,” “A cargo vessel,” and “leading lights came into view now. In view now.”

{6} At 1955.00 hrs, Ship B was proceeding on a COG of 239.7° and at a speed of 17.1 kn.

{7} At 1955.12-18 hrs, Ship B was proceeding on a COG of 239.0–239.3° and at a speed of 17.5 kn. At 1955.14-21 hrs, there were voices, “There’s something strange about the blue light on the second ship. Is she putting the helm to port? What?”

{8} At 1955.30-34 hrs, a whistle was sounded (two short blasts), and there were the orders, “Stop both engines” and “Full astern”. At 1955.30-36 hrs, Ship B was proceeding on a COG of 239.9–240.0° and at a speed of 17.1–17.5 kn.

{9} At 1955.42-46 hrs, there were the orders “Hard-a-port” and “Hard-a-starboard”. At 1955.42-48 hrs, Ship B was proceeding on a COG of 240.0° and at a speed of 17.1 kn.

{10} At 1956.00 hrs, Ship B was proceeding on a COG of 243.8° and at a speed of 15.5 kn.

{11} At 1956.09-11 hrs, there was a crash sound accompanied by flares, and, at 1956.12 hrs, Ship B’s COG and speed was 240.2° and 9.6 kn respectively.

{12} At 1956.32–35 hrs, Ship B reported to Kanmon MARTIS by VHF: “Kanmon MARTIS, Kanmon MARTIS, this is Maritime Self-Defense Force KURAMA, Maritime Self-Defense Force KURAMA, vessel number 144, over.”

{13} At 1956.38-41 hrs, Ship B received a VHF message from Kanmon MARTIS: “CARINA STAR is likely to get extremely close to you. Please take evasive action.”

{14} At 1956.42-48 hrs, Ship B reported to Kanmon MARTIS by VHS: “We collided with a tanker at Hayatomo Seto. Fire broke out on the tanker, over.”

### (3) Movements of Ship C

{1} At 1935.05 hrs, Ship C was proceeding on a heading of 018°, COG of 020.2° and at a speed of 7.4 kn.

{2} At 1940.06 hrs, Ship C was proceeding on a heading of 024°, COG of 023.6° and at a

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<sup>7</sup> “MN line” refers to a line connecting the Mutsure-Shima Light House, a point 000° and 6,930 m from the Mutsure-Shima Light House and the Kurumise Light Beacon.

<sup>8</sup> The conversations in the bridge are reproduced as they were. The “blue light” here means a green light.

speed of 7.4 kn.

{3} At 1952.15 hrs, Ship C was proceeding on a heading of 038°, COG of 036° and at a speed of 7.1 kn.

{4} At 1952.18-38 hrs, Ship C received a VHF message from Kanmon MARTIS: “Vessel behind you, vessel behind you, CARINA STAR is approaching you. Her speed is 14kn. Pay attention.” Ship C replied: “Ok, Ok. It’s surpassing. Overtake me on my port side, on my port side.”

{5} At 1952.38-55 hrs, Ship C received a VHF message from Kanmon MARTIS, “Ok. Then you should keep starboard side. You are now middle of the fairway. Move to starboard side right now. Over,” and Ship C replied: “Ok, Ok. I will be a little course to starboard side.” At 1952.45 hrs, Ship C was proceeding on a heading of 037°, COG of 037.4° and at a speed of 6.8 kn.

{6} At 1953.30-42 hrs, a voice in Chinese said, “We are in a narrow channel where ships have to be on alert. Proceed with care.”

{7} At 1954.10-17 hrs, there was the order “Starboard 6°” in Chinese, and at 1954.15 hrs, Ship C was proceeding on a heading of 050°, COG of 045.9° and at a speed of 6.2 kn.

{8} At 1955.13 hrs, there was the order “6°” in Chinese, and at 1955.15 hrs, Ship C was proceeding on a heading of 054°, COG of 050.6° and at a speed of 6.2 kn.

{9} At 1955.30 hrs, a whistle was sounded (two short blasts). At 1955.36 hrs, Ship C was proceeding on a heading of 058°, COG of 052.7°, and at a speed of 6.3 kn.

{10} At 1956.11-12 hrs, there was a crash sound, and at 1956.15 hrs, Ship C was proceeding on a heading of 063°, COG of 063.4° and at a speed of 6.3 kn.

#### 2.1.2 VDR Radar Image Recorded by Ship C

The every 15-second radar images recorded by the VDR on board Ship C showed that:

- (1) At 1954.02 hrs, Ship A was proceeding eastward at the west of Kanmon Bridge, Ship B was proceeding westward at the east of Kanmon Bridge, and Ship C was proceeding eastward in the vicinity of Kanmon Bridge.
- (2) At 1954.47 hrs, Ship A was proceeding eastward in the vicinity of Kanmon Bridge, Ship B was proceeding westward at the east of Kanmon Bridge, and Ship C passed under Kanmon Bridge eastward.
- (3) At 1955.32 hrs, Ship A after passing under Kanmon Bridge, was proceeding eastward behind Ship C; Ship B was proceeding westward at the east of Kanmon Bridge; and Ship C was proceeding eastward at the east of Kanmon Bridge.
- (4) At 1956.02 hrs, the images of Ship A and Ship B came very close to each other at the east of Kanmon Bridge, and Ship C was proceeding eastward at the east of Kanmon Bridge.

- (5) At 1956.17 hrs, the images of Ship A and Ship B overlapped at the east of Kanmon Bridge, and Ship C was proceeding eastward at the east of Kanmon Bridge.

### 2.1.3 Events Leading to the Accident According to the Statements from the Crew

According to the statements from the crew of Ship A, master (hereinafter referred to as “Master A”), the chief officer (hereinafter referred to as “Officer A1”), the third officer (hereinafter referred to as “Officer A2”), and the ordinary seaman (hereinafter referred to as “Ordinary Seaman A”), as well as those from Ship B (the master and chief navigator are hereinafter referred to as “Master B” and “Officer B,” respectively) and those from Ship C (the master, chief officer, and third officer are hereinafter referred to as “Master C,” “Officer C1,” and “Officer C2,” respectively), the events leading to the accident were as follows.

#### (1) Ship A

Ship A, boarded by Master A with 15 crew members, left Busan Port, Republic of Korea, bound for Hanshin Port, at about 1145 hrs, October 27, 2009.

Master A, at about 3 to 4 M from the AS Line, took the con of the vessel with Officer A1, Officer A2, an apprentice officer, and Ordinary Seaman A manned on the bridge. Ship A headed to Kanmon Port at a speed of about 14 kn with the main engine running at 150 revolutions per minute (rpm).

At about 1935-1940 hrs when Ship A was proceeding through Kanmon Passage in Kanmon Port (hereinafter referred to as “Kanmon Passage”), Master A saw the light of Ship C, and then confirmed her radar image and Kanmon Bridge ahead of Ship C at the same time.

Master A, when Ship A came to approximately 2.5 M ahead of Kanmon Bridge, thought that Ship A could overtake Ship C on her starboard side by keeping the speed of 14 kn before reaching Kanmon Bridge, because Ship C was proceeding near the center of Kanmon Passage at a speed of about 8 kn.

Ship A, after passing Kanmon Passage Light Buoy No. 30 (hereinafter “Kanmon Passage” is omitted for the light buoys whose names begin with “Kanmon Passage”), turned to starboard and proceeded on the right side of Kanmon Passage with heading of about 035°. On the other hand, Ship C kept proceeding near the center of Kanmon Passage.

At about 1952 hrs, Master A heard that Kanmon MARTIS called Ship C by VHF. However, Master A did not change the channel to the one which was designated by Kanmon MARTIS and could not catch the content of the conversation between Ship C and Kanmon MARTIS.

At about 1953 hrs, Ship A approached to Ship C at a distance of about 0.3 to 0.4 M in an overtaking situation where Ship A would pass Ship C about 150 to 200 m abeam on the

port side of Ship A, while maintaining the course and the speed. At that time, because Ship A received a VHF message from Kanmon MARTIS that Ship A should overtake Ship C on the port side of Ship C, then Ship A replied that she would overtake Ship C on the port side of Ship C. At the same time, Master A saw the red light (portside navigation light) of Ship B approximately 1.5M ahead, and confirmed by radar that Ship B was proceeding at a speed of about 18kn. On the other hand, Ship B was not displayed on the AIS when Officer A2 looked at it.

Master A took the message from Kanmon MARTIS, “overtake the foregoing vessel on her port side,” as an order rather than an advice, and thought that if Ship A overtook Ship C on the starboard side neglecting the message from Kanmon MARTIS, Master A would be in troubles of undergoing investigation or being forced to submit a report.

Master A decided to overtake Ship C on her port side and reduced the revolutions of her main engine from 150 rpm to 100rpm (half) because Master A thought that Ship A might not be able to overtake Ship C on her port side without reducing speed as Ship C’s speed would decrease from 8 kn to about 5 to 6 kn due to the effect of the 3kn west-going tidal stream while Ship A’s speed was 13 kn. However, Ship A did not immediately slow down.

Master A put the helm to port in a step by step manner: first 10° and then 20°. As Ship A came close to Ship C, Master A put the main engine to slow ahead and then dead slow ahead, and put the helm hard to port.

Ship A cleared Ship C’s stern at a distance of about 70m, and Master A felt that that was a close one.

Master A thought that Ship A would have been able to overtake Ship C on her starboard side if he had not received the message from Kanmon MARTIS since, although the speed of Ship A would have been reduced to about 12.5kn due to the tidal stream, the speed of Ship C also would have been reduced to about 6kn.

Master A received a message from Kanmon MARTIS to pay attention to the movements of a destroyer (Ship B), which was proceeding in the opposite direction about 1M ahead of Ship A, but Master A did not pay attention to Ship B as Ship C was getting closer.

Master A, while swinging to port behind Ship C, realized a risk of collision with Ship B just about one minute before the collision because the distance to Ship B was about 0.4 to 0.5 M. He ordered the helm hard to port and then hard to starboard immediately after Ship A cleared Ship C’s stern, but Ship A collided with Ship B.

Ship A did not swing to starboard promptly because the main engine was set to dead slow ahead and there was the effect of the tidal stream, while Master A was wanting Ship A’s immediate swing to starboard. At the time of the collision, Ship A’s rudder was put hard to starboard and the main engine was at dead slow ahead.

Master A did not blow a whistle while he was overtaking Ship C.

Master A thought that Ship A could have overtaken Ship C safely if “the order” from Kanmon MARTIS had been received 3 to 5 minutes earlier.

(2) Ship B

Ship B, boarded by Master B with 295 crewmembers, left Yokosuka Port at about 1221 hrs October 26, 2009, and was scheduled to sail the ocean off Shikoku, to pass through Bungo Channel and the Kanmon Strait, and to enter her base, Sasebo Port, at about 0900 hrs, October 28.

Ship B was proceeding at a speed through the water of about 15 kn, with the main engine set to the full of 135 rpm. Ship B reported her position to Kanmon MARTIS when Ship B had crossed the HS Line.

Ship B activated the Navigation Safety Arrangement to prepare for passing the Kanmon Strait just before 1930 hrs, October 27. Under the arrangement, Master B, with 15 crew members, was positioned on the bridge, Officer B was assigned to the command of Ship B under the supervision of Master B, and about 20 crewmembers at the bow were preparing to let go the starboard anchor.

At about 1951 hrs, Officer B steered the ship to a heading of 240°, toward the Shimonoseki Leading Lights<sup>9</sup> (the true bearing of the line connecting the front and rear light is 240.1°).

Although the planned speed through the water while navigating through the Kanmon Strait was about 12kn according to the navigation plan of Ship B, Officer B did not consider the speed through the water of 15kn as a dangerous speed because there was no ship around Ship B but a small ship ahead of her, which was proceeding in the same direction at a fair distance away without any sign of getting closer.

Master B had approved the full speed through the water of about 15kn because there was only one small ship proceeding in the same direction ahead of Ship B, he wanted to pass the Kanmon Strait quickly, and he also wanted to have sufficient time for hull-cleaning and onboard training before entering her base. In addition, Master B thought that it would be appropriate to navigate the ship through the Kanmon Strait with a speed through the water from 12 to 15kn, temporarily 18 kn for overtaking, because the speed through the water could not be reduced to less than 9 kn while passing the Kanmon Strait in order to have a sufficient rudder effect, which could not be attained at a speed through the water of 6 kn.

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<sup>9</sup> “Leading Lights” refers to a pair of light emitting structures on the shore installed on the extended line of the fairway to indicate a safe passage of a narrow entrance of a bay or a water way which is difficult to navigate.

Although Master B had initially wanted to pass the Kanmon Strait before it got dark and while the tidal stream was slower than 3kn, Master B decided to navigate at a speed of about 17kn as he understood that the expected time of passing the Kanmon Strait was after sun set with the following tidal stream at about 2kn.

Officer B thought that it would be better to enter the strait a little before the tidal stream turned in order to pass the narrowest part of channel while the tidal stream was turning from favorable to adverse because, although passing the narrowest part of channel just as the tidal stream turned was a good way to avoid the tidal stream effect, the ship would have to navigate through congested traffic. Officer B had heard that backwash caused by the ship proceeding through the Kanmon Strait at a high speed of about 21 kn had affected fishing boats, but he had not been given any specific guidance on her speed.

Master B, while Ship B was proceeding on a heading of 240° toward the Shimonoseki Leading Lights and when Ship B was just before Light Buoy No.31, saw the two masthead lights (white color) and the starboard navigation light (green color) of Ship C about 3,000 yards (approximately 2,743 m) ahead. Master B recognized Ship C as a large ship on the opposite course.

Officer B, at first, took the masthead lights of Ship C, which was seen at 10° on the port bow, as the Hikoshima Leading Lights, which were placed next to the Shimonoseki Leading Lights, but then soon recognized them as the lights of a large cargo ship. In addition, Officer B saw containers loaded on Ship A, which was behind Ship C, at 20° on the port bow.

Master B received a report from the lookout monitoring the radar that Ship C was a mid-sized ship on the opposite course and proceeding on a heading of 50° and at a speed of 12kn.

Officer B thought that Ship C was dangerously close to Ship B because Ship C was proceeding near the center of Kanmon Passage, and wanted Ship C to turn to starboard immediately. On the other hand, Officer B thought that Ship A would turn to starboard to pass by Ship B as a matter of course. Officer B did not think that Ship A was going to overtake Ship C, believing that any ship would not overtake another in the vicinity of Kanmon Bridge.

Master B used binoculars to observe Ship C and saw the masthead lights nearly in a line and both of the side navigation lights, and then, the masthead lights and the port navigation light (red color). Therefore, Master B judged that Ship C was turning to starboard to navigate along Kanmon Passage.

Officer B saw the hull of Ship A when the side navigation light Ship C showed changed from the starboard navigation light to the port navigation light. In addition, Officer B saw

the starboard navigation light of Ship A about 1,000 m ahead when Ship C passed Ship B 200 to 300 yd (approximately 183 to 274 m) abeam to port.

Master B saw the two masthead lights and the starboard navigation light of Ship A about 2,800yd (approximately 2,560m) ahead shortly after Ship B passed Light Buoy No. 31. Master B thought that Ship A was almost the same size as Ship C and would navigate in a similar manner.

Master B received a report from the lookout monitoring the radar at about 1.5 minutes before the collision that the minimum distance to Ship C would be 200yd (approximately 183m) at 140°, and thought that Ship C would pass by Ship B at a short distance and Ship A, following Ship C, would do so too turning to starboard as Ship C did.

Master B, at about one minute before the collision, felt something strange about the starboard navigation light of Ship A as Ship A seemed to be turning to port because the distance between the masthead lights of Ship A seen from Ship B was widening rather than narrowing. Although Master B concluded that Ship A was making a minor course alteration to port and then would soon turn to starboard, he felt uneasy and wondered why Ship A was putting the helm to port in such a situation where other ships were so close, when the distance between the masthead lights seen from Ship B became wider.

Master B heard a whistle blast before Officer B ordered the engine stopped and to full astern. Master B although he was about to blast Ship B's whistle at that moment, instructed the crewmembers on the bow to evacuate by microphone because he thought his instruction could not reach to them if he sounded the whistle.

Officer B wondered if Ship A would turn to starboard because Ship A did not change her attitude and the starboard navigation light of Ship A was still in view. Officer B was cautioned by Master B that Ship A might be turning to port and he ordered, when the distance to Ship A became about 500 m, the main engine to full astern and the helm hard to port because there was clearance of only about 100 yd (approximately 91 m) on the right side of Kanmon Passage. Officer B heard three short blasts of Ship A, while ordering the main engine stopped and then to full astern.

Master B ordered the helm hard to starboard himself when the rudder angle indicator showed about 7° to port after the orders of stop-engine, full astern and hard-a-port by Officer B. However, the bow of Ship B collided with the starboard side of Ship A at approximately a right angle.

Master B did not confirm the movements of Ship A and Ship C by using AIS nor did he blast the whistle.

Officer B, after the accident, felt that the effort to gather information of ships going through the narrowest part of the strait was insufficient.



### (3) Ship C

Ship C left Incheon Port, Republic of Korea, for Fukuyama Port, Hiroshima-Prefecture, and was navigating through the Kanmon Strait at a speed of about 8.6 to 8.7 kn putting the main engine to full ahead at 160rpm. On the bridge, Master C, Officer C1, Officer C2 and a helmsman, four people in total, were on watch duty.

At about 10 minutes before the collision, Master C was thinking of altering the course to starboard at 200 to 300 m before Kanmon Bridge, when Officer C2 received a VHF message from Kanmon MARTIS that Ship A was approaching to her from behind.

Master C instructed Officer C2 to reply to Kanmon MARTIS that Ship C wanted Ship A to overtake on Ship C's port side or to follow Ship C because Ship A should not overtake Ship C on the starboard side as Ship C was very close to Kanmon Bridge and intended to alter her course to starboard after passing under Kanmon Bridge.

Officer C2 thought that Ship A was probably going to overtake Ship C because it would be difficult for Ship A, which was faster than Ship C, to follow Ship C, so he replied to Kanmon MARTIS by VHF that Ship C wanted to be overtaken on the port side.

Master C saw Ship A getting closer to Ship C at a speed of about 14 kn, proceeding on the starboard side of Ship C until Ship A reached Kanmon Bridge, and then gradually altering her course to port astern of Ship C.

Master C thought that Ship A would overtake Ship C after passing under Kanmon Bridge not when passing under Kanmon Bridge. In addition, Master C never thought that Ship A and Ship B would collide with each other because Master C did not find any irregularity in the movement of Ship B.

Master C heard a prolonged blast from Ship A directed at Ship B. On the other hand, Ship C did not blast a whistle.

Ship C altered her course to starboard along Kanmon Passage while maintaining the same speed. The speed indicated by the GPS of Ship C was 7.8 kn when Ship C passed under Kanmon Bridge.

#### 2.1.4 Events Leading to the Accident According to the Statements from Kanmon MARTIS Operators

The events leading to the accident, according to the statements from operators of Kanmon MARTIS: the operator serving at the Daiba Console<sup>10</sup> (the console for the surveillance of the Daiba area of the Kanmon Strait) who had moved from the O Seto Console (the console for the surveillance of the O Seto area of the Kanmon Strait, hereinafter referred to as "Operator D1"); the operator serving at the O Seto Console who had moved from the Hesaki Console (the console

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<sup>10</sup> A "console" refers to a table for an operator to serve, equipped with radar displays and VHF, etc.

for the surveillance of the Hesaki area of the Kanmon Strait, hereinafter referred to as “Operator D2”); the operator serving at the AIS Console (the console for monitoring the AIS System) who had moved from the Daiba Console (hereinafter referred to as “Operator D3”); and the operator who was off duty, having finished the service at the AIS Console (hereinafter referred to as “Operator D4”), were as follows:

(1) Operator D1

Operator D1 took a seat at the O Seto Console at about 1852 hrs because the scheduled service duty was from 1900 to 2000 hrs on October 27, then started work and set the prediction vector<sup>11</sup> to 9-minutes. The responsibility range of the O Seto Console included Kanmon Bridge and the vicinity of Hayatomo Seto.

Operator D1 became concerned about the movement of Ship A, which was about 1 M behind Ship C when Ship A took a straight course after having passed Light Buoy No.30 but was catching up to Ship C due to the difference in speed between the two ships. Operator D1 estimated the time when Ship A and Ship C would pass under Kanmon Bridge judging from the 9-minute prediction vector to know that the half-length of the vectors reached the bridge, and therefore he thought that they would pass under Kanmon Bridge in about 5 minutes and Ship A would overtake Ship C in the vicinity of the Hayatomo Seto exit.

Operator D1, at 1952.00 hrs, called Ship C by VHF and changed the VHF channel from Channel 16 to Channel 14, and at 1952.30 hrs he informed Ship C that she should pay attention to Ship A approaching from behind at a speed of 14 kn. Ship C replied, “OK. Overtake me on my portside.”

Operator D1 thought that it was a matter of course that Ship C had that idea because Ship C was going to turn to starboard along the passage after passing under Kanmon Bridge and it should be dangerous if Ship A overtook Ship C on her starboard side, and he informed Ship C that she was navigating near the center of the passage, and that she should move to the starboard side. Ship C replied to the message with “OK.”

Operator D1, at 1952.50 hrs, called Ship A via VHF intending to inform Ship A that the overtaking should be done on the port side, and said that she should overtake Ship C on the port side because ship C would move to the starboard side. After Operator D1 received a reply, “OK, I will overtake,” in order to confirm that Ship A understood the overtaking should be done on the port side, he informed Ship A again that overtaking should be done on port side, that Ship C was moving to the starboard side, and that Ship B was about 1 M

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<sup>11</sup> “Prediction vector” refers to a function to display a line indicating a predicted course and speed of a ship for a specified time ahead.

ahead on the opposite course. Ship A replied to the message with “OK.”

As Ship A and Ship C were approaching Kanmon Bridge, Operator D1 noticed that Ship A was likely to catch up with Ship C after passing the east side exit of Hayatomo Seto waterway<sup>12</sup> by judging from the 9-minute prediction vector.

Operator D1 thought that the effect of the west-going tidal stream would decrease the speed of Ship C, which was near the center of Kanmon Passage, where the current was strongest, and on the contrary would not affect the speed of Ship A that much, which was on the right side of Kanmon Passage. On the other hand, Operator D1 also thought that the speed of Ship C would be increased when she altered her course to starboard after passing Kanmon Bridge and the speed of Ship A would be decreased due to the effect of the tidal stream because it was a general practice for ships of the size of Ship A to move toward the center of Kanmon Passage to avoid approaching Moji Saki as they were approaching Kanmon Bridge at night, and then confirmed that Ship A should come up with Ship C after passing the east side exit of Hayatomo Seto waterway.

Operator D1 judged from what is described above that the situation was not dangerous because Ship A would overtake Ship C after passing the east side exit of Hayatomo Seto waterway and Ship B would pass both ships before the overtaking. In addition, Operator D1 thought that Ship A should pay necessary attention to Ship B, which was navigating along Kanmon Passage on the opposite course, and that Ship A would not take improper actions as long as she confirmed safe overtaking. Operator D1 did not provide Ship B with the information of such situation because information of head-on passing vessels was generally provided according to situations and Ship B was not navigating near the center of Kanmon Passage, and the course of Ship A was not giving indication of overtaking Ship C.

Operator D1, at about 1953 hrs, when the duty time would be soon finished, left the VHF transceiver on the console and began to handover the service to Operator D2 because Operator D1 had finished the communication with Ship A and Operator D2 had already been standing by Operator D1.

Operator D1 explained Operator D2 that Ship A was overtaking Ship C on her port side showing him the echo of Ship A on the radar display on the O Seto Console, that Ship C had already been informed that she should shift to the starboard side showing him the echo of Ship C, and that information about Ship B had also been provided. Operator D1 finished handing over the service at the O Seto Console to Operator D2 and then moved to the Daiba Console.

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<sup>12</sup> “Hayatomo-Seto Waterway” refers to the part of Kanmon Passage between the extended line of the west side of Kanmon Bridge and the line running along 130° from Hino-Yama-Shita Stream Signal Station.

Operator D1, just after taking a seat at the Daiba Console at about 1955 hrs, heard Operator D2 communicating by VHF with Ship A. Operator D1 switched the radar display to see the vicinity of Kanmon Bridge and saw that Ship A was in a transversal attitude to Kanmon Passage and parallel to Kanmon Bridge.

Operator D1, at about 1956 hrs, also heard Operator D2 communicating with Ship B. Operator D1 understood that the collision between Ship A and Ship B occurred by the situation displayed on the radar.

## (2) Operator D2

Operator D2 was on service on the Hesaki Console in the slot scheduled for 1930 to 2000 hrs, October 27, and moved to the O Seto Console at about 1954 hrs after finishing a handover, which took about one minute, to the next Operator who had come close to the Hesaki Console.

Operator D2 was monitoring the movements of Ship A, Ship B and Ship C because the Hesaki Console was the first contact point of VHF calls from ships when other Consoles cannot respond to them and therefore he had to pay attention to ships in other areas than the designated area as well.

Operator D2 confirmed that Ship A was possibly overtaking Ship C after passing the east side exit of Hayatomo Seto waterway by pointing a mechanical pencil to the echoes on the radar screen at the handover of the O Seto Console from Operator D1.

Operator D2, at the O Seto Console, switched the radar to 5-minute prediction vector, recognized ships over 10,000 tons proceeding eastward through O Seto, and then monitored the Hesaki area and Tachinoura area.

Operator D2, when paying attention to the vicinity of Hayatomo Seto, noticed that Ship A and Ship C were rapidly approaching each other and that the prediction vector of Ship A began to swing to port in a situation where Ship A was just behind Ship C. Operator D2 communicated by VHF Channel 16 with Ship A twice to inform Ship A that she should pay attention to Ship B, on the opposite course. However Ship A did not reply.

When Ship A and Ship C were rapidly approaching each other, Operator D2 had the idea that the distance between the ships would probably widen after passing Moji Saki because the speed of Ship C would be increased and the speed of Ship A would be decreased due to the west-going tidal stream. On the other hand, he also thought that Ship A would be pushed by the current to port and would collide with Ship B.

Operator D2 told Ship B on VHF Channel 16 that Ship B should take evasive actions because Ship A was extraordinarily close to Ship B. However, Ship B did not reply. Operator D2, on seeing the radar screen on which the echoes of Ship A and Ship B had been

overlapped, thought that both the ships had collided with each other.

Operator D2, when trying to communicate with Ship B since she had made no reply, received a report from Ship B that she collided with a tanker ahead.

The time and date of the occurrence of the accident was about 1956.09-12 hrs, Oct.27, 2009, and the location was around 294°, 330 m from Moji Saki Light House.

(Refer to Attached Figure 1 to 3, Plots of Estimated Ship Positions; Attached Table 1, AIS Records of Ship A; Attached Table 2, Radar Tracking Records of Ship B; Attached Table 3, AIS Records of Ship C; Attached Table 4, Distance, etc. from Ship A; Attached Table 5, VDR Voice Records of Ship A; Attached Table 6, Records of the Bridge Voice Recorder of Ship B; Attached Table 7, VDR Voice Records of Ship C; Attached Table 8, VHF Communication Records; and Photo 3, VDR Radar Images Recorded by Ship C)

## 2.2 Death, missing and Injuries to Persons

Six crewmembers of Ship B suffered minor injuries during fire-fighting operations.

## 2.3 Damage to Vessel

### (1) Ship A

Ship A suffered damage on the starboard bow outer-plate in the form of an open crack.

### (2) Ship B

Ship B suffered damage on the bow in the form of crushing.

(Refer to Photo 1, Situation of Ship A; Photo 2, Situation of Ship B)

## 2.4 Events following the Accident

### 2.4.1 Ship A, Ship B and Kanmon MARTIS

#### (1) Ship A

According to the statement from Master A, the events following the collision were as follows:

{1} Electric power was lost after the collision with Ship B, and Ship A drifted, entangled with Ship B. The electric power was recovered 4 to 5 minutes later.

{2} Several containers on board were broken, and the wooden dunnage in the broken containers caught fire due to the flames on Ship B. The fire of Ship A was extinguished by the crewmembers of Ship A.

#### (2) Ship B

According to the statement from Master B, the events following the collision were as follows:

{1} Master B, at first thought that the contents stored in the containers of Ship A caught fire. Master B, later on, received a report that the paint stored in the bow storage room had been ignited and that the fire had spread to ropes and other materials. The fire was extinguished by the crewmembers of Ship B and the fireboats which had arrived at the collision site.

{2} Because the ships had collided with each other at almost a right angle and it was difficult to separate the ships immediately, Master B maneuvered the ship to separate from the other paying attention to preventing the ships from drifting to the Shimonoseki side and running aground. It took about 6 to 7 minutes for the ships to be separated.

{3} Master B received a request from Kanmon MARTIS to set the AIS so as to transmit information, but he replied that the AIS of Ship B was unable to transmit information due to a “functional” limitation.

### (3) Kanmon MARTIS

According to the statements from Operators D1, D2, D3 and D4, the events following the collision were as follows:

{1} Operator D2 made contacts by VHF with Ship A and Ship B to confirm the situations.

{2} Operator D2 informed the vessels sailing the strait by VHF Channel 16 to pay attention to the ships which had collided about 5 cables east of Kanmon Bridge.

#### 2.4.2 Fire Fighting and Other Activities

##### (1) Fire fighting activities

According to the information from Japan Coast Guard and the Kita-Kyushu City Fire and Disaster Management Bureau, the fire fighting activities were as follows:

It was confirmed at 0630 hrs October 28 that the fire on Ship B had been extinguished by the fire fighting activities of the fireboats and the crew members of Ship B.

##### (2) Cause of the fire

According to the information from the Kita-Kyushu City Fire and Disaster Management Bureau, the cause of the fire was as follows:

It was considered highly probable that the fire was caused by ignition, due to sparks generated by the hard contact of the steel hulls, of the flammable mixture of gas generated from the petroleum No.1 thinner cans in the bow storage room of Ship B, which were broken by the collision between Ship A and Ship B.

## 2.5 Crew and Other Information

### 2.5.1 Crew Information

#### (1) Gender, Age, and Certificate of Competence

Master A: male, 44 years old

First Class License issued by Republic of Korea

Date of Issue: January 26, 1996

Date of Revalidation: February 27, 2008

Date of expiry: February 25, 2013

Master B: male, 47 years old

First Class Certificate, Navigation (the Ministry of Defense of Japan Classification)

Officer B: male, 39 years old

First Class Certificate, Navigation (the Ministry of Defense of Japan Classification)

#### (2) Sea-going Experience

According to the statements from Master A, Master B, Officer B and Master C, they had the following experience:

##### {1} Master A

The Master A served as an apprentice officer for six months in 1984, and after he joined the Navy for two years, he became a third officer in 1987 and served as a master since 1998. In 1990, Master A joined NAM SUNG SHIPPING CO., LTD (hereinafter referred to as "Company A"), served in semi-container ships around 1990, and served in container ships since 1994.

The on-board experience of Master A included four 4,500ton-class ships, six ships similar to Ship A in size and four 10,000ton-class ships. Master A began to serve as a master on Ship A before the departure on the day of the accident.

Master A had navigated in the Kanmon Strait over 900 times during a period of seven to eight years.

Master A did not drink alcohol during navigation, and his health condition was good.

##### {2} Master B

Master B had served as a captain of the ships of 2,100 displacement tons. Master B had about thirteen years of on-board experience, and had served as a captain of Ship B since October 1, 2008.

Master B had navigated in the Kanmon Strait twenty to thirty times.

Master B did not drink alcohol during navigation, and his health condition was good.

{3} Officer B

Officer B had six years of onboard experience in total. Officer B had boarded five destroyers.

Officer B had navigated in the Kanmon Strait four or five times.

Officer B did not drink alcohol during navigation, and his health condition was good.

{4} Master C

Master C navigated once a month in the Kanmon Strait.

(2) Pilot

No pilots were on board Ship A, Ship B or Ship C.

## 2.5.2 Information regarding Operators of Kanmon MARTIS

### (1) Gender, Age and Certificate

Operator D1: male, 36 years old

No certificate of maritime officer. First Class Technical Radio Operator for On-The-Ground Services

Operator D2: male, 52 years old

No certificate of maritime officer. First Class Radio Operator for Specific On-The-Ground Services

### (2) Operators' Careers

Operator D1 and Operator D2

According to the statements from Operator D1 and Operator D2, their careers were as follows:

Operator D1 and Operator D2 had about one year and seven months of service experience at Kanmon MARTIS before the day of the accident. Operator D1 and Operator D2 had undertaken about two weeks of training before they began to serve as Operators in April, 2008. Their health conditions were good. Operator D1 and Operator D2 had boarded lighthouse patrol boats when maintaining lighthouses.

## 2.6 Vessel Information

### 2.6.1 Particulars of Vessel

#### (1) Ship A

IMO number: 9172612



Port of registry: Jeju, Republic of Korea  
 Owner: Company A (Also the management company)  
 Gross tonnage: 7,401 tons  
 L × B × D: 127.00 m × 20.00 m × 10.70 m  
 Hull material: Steel  
 Engine: One diesel  
 Output: 5,589 kw (Maximum and Continuous)  
 Propulsion: One fixed-pitch propeller  
 Date of launch: July 25, 1998  
 Number of persons on board: 16 (12 Republic of Korea nationals, 4 Union of Myanmar nationals)

(2) Ship B

Owner: Ministry of Defense of Japan  
 Standard displacement: 5,200 tons  
 L × B × D: 159 m × 17.5 m × 11.0 m  
 Hull material: Steel  
 Engine: Two steam turbines  
 Output: 51,485 kW (Maximum and Continuous)  
 Propulsion: Two fixed-pitch propellers  
 Date of launch: September 20, 1979  
 Number of persons on board: 296

(3) Ship C

IMO number: 7721744  
 Port of registry: Panama (Republic of Panama)  
 Gross tonnage: 9,046 tons  
 L × B × D: 138.55 m × 21.00 m × 12.40 m  
 Hull material: Steel  
 Engine: One diesel  
 Output: 5,252 kW (Maximum and Continuous)  
 Number of persons on board: 22 (People's Republic of China nationals)

(Refer to Attached Figure 7: General Arrangement Plan of Ship A and Attached Figure 8: General Arrangement Plan of Ship B)

## 2.6.2 Loading Conditions

### (1) Ship A

Ship A was loaded with 305 containers. The draught was about 6.60 m at the bow and about 7.60 m at the stern.

### (2) Ship B

The draught was about 8.30 m at the bow and about 5.80 m at the stern.

### (3) Ship C

According to the statement from Officer C1, Ship C was loaded with about 14,000 tons of granulated slag. The draught was about 2.1 m at the bow and about 5.5 m at the stern.

## 2.6.3 Navigational Equipment

### (1) Ship A

Ship A's bridge was equipped with two radars, GPS, VDR, VHF and AIS.

The time stamps of the records in the VDR were about 50 seconds ahead.

According to the statement of Master A, at the time of the occurrence of the accident, the navigation lights were on, and there were no problems or malfunctions in the hull, the equipment, the main engine or the rudder.

### (2) Ship B

Ship B's bridge was equipped with one radar, a Bridge Voice Recorder, VHF and AIS. The AIS was receive-only.

The time stamps of records in the Bridge Voice Recorder were about 2 minutes and 47 seconds behind.

According to the statement from Master B, at the time of the occurrence of the accident, the navigation lights were on, and there were no problems or malfunctions in the hull, the equipment, the main engine or the rudder.

### (3) Ship C

Ship C's bridge was equipped with a radar able to display AIS information overlapped on the screen, and also VDR, VHF and AIS.

According to the statement from Master C, at the time of the occurrence of the accident, the navigation lights were on, and there were no problems or malfunctions in the hull, the equipment, the main engine or the rudder.

## 2.6.4 Maneuverability

### (1) Ship A

According to the speed panel of Ship A, the results of the speed test data and the

statement from Master A, the maneuvering characteristics of Ship A were as follows:

{1} Speed through the water of Ship A

a. The speed panel

Level	Revolutions per minute (rpm)	Speed through the water (kn)
Full	100	10.62
Half	75	7.96
Slow	60	6.37
Dead Slow	45	4.78

b. Statement from Master A

The maximum speed was about 16 kn at 162 rpm. Usually, the ship sailed at the economic speed of about 14 kn at 150 rpm.

{2} The turning characteristics of Ship A

a. At a left turn (hard-a-port), the transfer<sup>13</sup> was 205 m, and the advance<sup>14</sup> was 399 m. The tactical diameter<sup>15</sup> was 473 m.

Read from the tactical diameter chart, the transversal distance and the advance when the head accomplished 40° and 60° turns from the original course were about 50 m and 261 m, and about 100 m and 344 m, respectively.

b. At a right turn (hard-a-starboard), the transfer, the advance and the tactical diameter were 208 m, 395 m and 486 m, respectively. The transversal distance and the advance, read from the tactical diameter chart, were the same as in the case of a left turn.

c. The reach<sup>16</sup> of Ship A was about 191 to 254 m.

d. At hard-a-port (35°) or hard-a-starboard(35°), it took about 13 seconds after the helm was actually set to the ordered angle for the rudder angle indicator to show the ordered value. In the case where the rudder was changed from hard-a-port to hard-a-starboard, it took about 25 seconds.

{3} The variation of the speed through the water of Ship A in the case where the engine was

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<sup>13</sup> “Transfer” refers to the traversal distance of the center of gravity measured from the original course when the head accomplished a 90° turn away from the original course.

<sup>14</sup> “Advance” refers to the forward distance of the center of gravity from the original position measured along the original course when the head accomplished a 90° turn away from the original course.

<sup>15</sup> “Tactical diameter” refers to the traversal distance of center of gravity measured from the original course when the head accomplished a 180° turn away from the original course.

<sup>16</sup> “Reach” refers to the advance measured on the original course between the time of the turn of the rudder and the time when the gravity center reaches the center of the steady turn. The typical reach in case of hard-a-port or hard-a-starboard at the navigation speed is 1.5 to 2.0 times the hull length.(by Kokaibinran)

set to stop and then to full astern while Ship A was navigating at a speed of 18.15 kn were shown in the table below with the advances of Ship A.

Advance (m)	Speed through the water (kn)
900	10
1,000	8
1,100	6
1,200	4

(2) Ship B

According to the speed plate of Ship B and the statement from Master B, the maneuvering characteristics of Ship B were as follows:

{1} Speed standard of Ship B

Level	Revolutions per minute (rpm)	Speed through the water (kn)
Full	135	15
Navigation	105	12
Half	80	9
Slow	55	6

{2} The advance and time to stop from the time when the engine was put to full astern during proceeding was as follows:

In the case of proceeding at a speed through the water of 12 kn, the time to stop was 3 minutes and 10 seconds, and the advance was 680 yd (approximately 622 m).

In the case of proceeding at a speed through the water of 15 kn, the advance was 1,000 yd (approximately 914 m).

## 2.7 Situations at Kanmon MARTIS

According to the statements from the officer in charge of Kanmon MARTIS, and from Operator D3 and Operator D4, the situations at Kanmon MARTIS were as follows:

(1) Services of Kanmon MARTIS

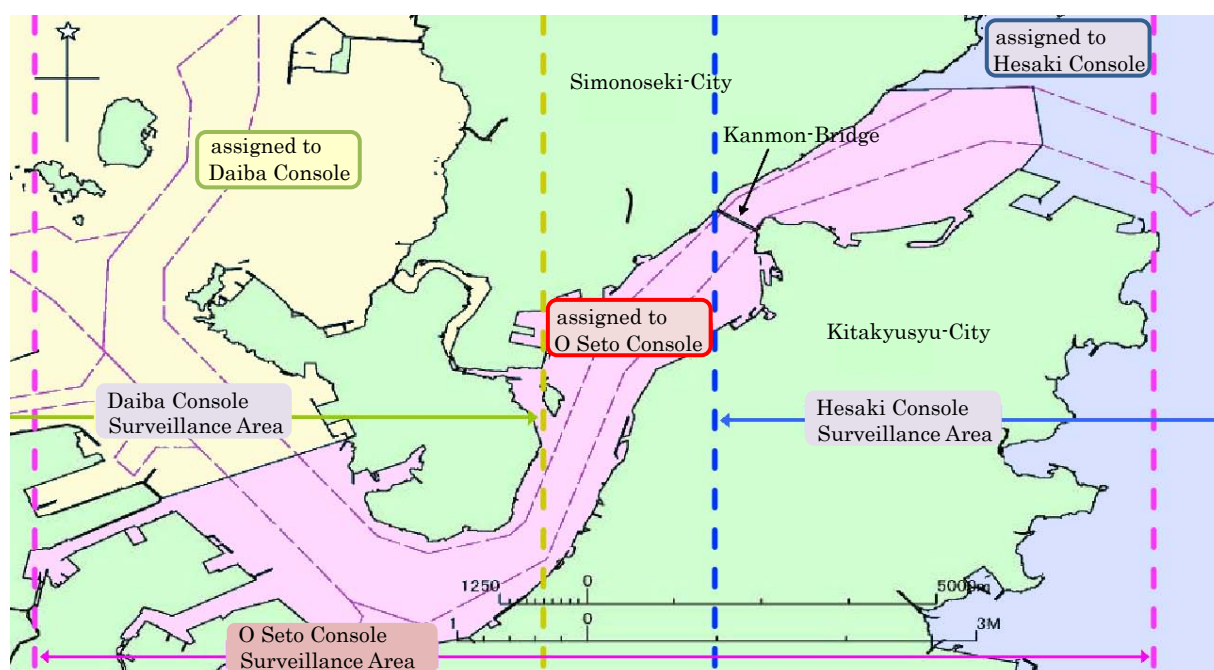
Kanmon MARTIS, in Moji ward, Kitakyushu City, located around the middle point of Kanmon Passage, has views over O Seto and serves on a 24-hour basis for the safe navigation on the sea in coordination with Coast Guard patrol boats, on the basis of traffic information in the Kanmon Strait shown on the radar displays with a 15-25 second lag of collecting and processing necessary information of vessels by using the AIS equipment and

high-performance radars installed at four points around the strait.

(2) Surveillance and services by the operators

{1} The area of the Kanmon Strait are divided into three parts and assigned to the Daiba Console, the O Seto Console and the Hesaki Console. To each console, one Operator is assigned to monitor the surveillance area through the radar displays. The surveillance area assigned to a certain console can be monitored by the adjacent consoles to enable multiple surveillance. In addition, there is another Operator assigned to the AIS console to monitor the AIS information service area of 7th Regional Coast Guard Headquarters. The Operators cover the areas and exchange necessary information aiming at preventing groundings and other accidents. However, there is no officer assigned to supervise the whole surveillance area.

Surveillance Areas assigned to Consoles



{2} The services are conducted using a four-shift arrangement of 7 to 8 Operators for each shift, of which the day time service starts at 0900 hrs and ends at 1700 hrs, and the night time service starts at 1600 hrs and ends at 0930 hrs. If operators continue service for a long time at a certain console, their concentration levels may fall, therefore they move cyclically from one console to another at certain intervals, which are usually one hour each for the Hesaki, O Seto, Daiba and AIS Consoles. Each shift has a shift leader who arranges the shift, makes the shift time table, and serves at a console along with the other shift members.

Time Table for Consoles

	16	18	19	20	21	22
Hesaki Console		Another operator	D2	Another operator		
O Seto Console		D3	D1	D2	Another operator	
Daiba Console		D4	D3	D1	D2	
AIS Console		Another operator	D4	D3	D1	

{3} The Operators judge the risk of vessel collision using prediction vectors of vessels, which are adjustable between one minute and 99 minutes in one-minute steps. The Operators adjust the length of vectors according to the situations.

Generally, long prediction vectors are suitable for predicting the future positions of vessels but do not always show the actual positions due to changes in vessel speed and water conditions, including tidal streams, while short prediction vectors are suitable for predicting positions more accurately in the near future. The Operators ordinarily change the length of prediction vectors depending on the situations.

According to the statements from Operator D3 and Operator D4, Operator D3 generally uses 2- to 3-minute vectors, and Operator D4 uses 5-minute vectors. Both Operators use longer vectors when necessary.

{4} In day time, live video cameras are used for monitoring the movements of vessels. However, no equipment for night-surveillance is installed.

(3) Service volume

The number of vessels passing through Hayatomo Seto in the Kanmon Strait is about 600 per day. Among the 600 vessels, 19 in average are vessels over 10,000 tons or tankers over 3,000 tons, and about 200 are vessels over 3,000 tons and less than 10,000 tons. Kanmon MARTIS monitors the movement of that volume of vessels plus other ships which have reported their positions and provides them with information for safe navigation.

#### (4) Training of Operators

{1} The newly appointed Operators attend a training course for about two weeks before they start to serve as an Operator. For one to two months after finishing the training course, they serve with an experienced Operator as a single unit.

{2} Operators, in order to maintain English competence, attend 90-minute English training courses ten times per year, which are led by instructors invited from outside using the IMO Phrases (described in 2.12.4) as a reference to learn the communication phrases except the message markers (described in 2.12.3(2)). The Operators did not have difficulties in English conversation for providing information.

#### (5) Particulars of service

{1} Kanmon MARTIS provide services in compliance with the Kanmon-Kaikyo Vessel Traffic Service Center Service Operation Regulations (hereinafter referred to as “Operation Regulation”), the Kanmon-Kaikyo Vessel Traffic Service Center Service Operation Procedures (hereinafter referred to as “Operation Procedure”), and Guidance for Operators, which has been edited as manuals for the Operators (hereinafter referred to as “Operation Manual”), along with the Service Procedure, which describes particulars of the common understanding for the Operators during their duties (herein after referred to as “Service Procedure”). Those regulations, procedures and manuals are hereinafter collectively referred to as “Kanmon MARTIS Operation Manuals.”

{2} Kanmon MARTIS, in order to prevent frequent accidents due to overtaking around Kanmon Bridge, laid out the Service Procedure in 2005, and since then, had been guiding vessels by informing them to refrain from overtaking in Hayatomo Seto because it is dangerous, especially when there is a vessel on the opposite course.

Kanmon MARTIS, at the time of the accident, had conducted activities to let the vessels passing through the Kanmon Strait know about Kanmon MARTIS’s service of providing information to the vessels on the movements of other vessels or information necessary for safe navigation, such as meteorological conditions, by providing a leaflet in both Japanese and English titled “For Safety Navigation in Kanmon-Kaikyo Sea Area.” The Information Service is introduced, in the leaflet, as providing traffic information, individual information, special information and information on anchoring vessels. In addition, the Traffic Control Service is introduced as providing traffic control by traffic control signals.

{3} Kanmon MARTIS revised the Operation Manual in 2008, according to which Kanmon

MARTIS had guided such large ships as ships or passenger ferries of 10,000 gross tonnage or over to maintain their speed at around 15 kn because there were cases where waves generated by large ships caused troubles to ships moored at the berths, such as interference with the cargo handling or breakages of mooring lines.

{4} Kanmon MARTIS was categorized as a radio navigation ground station by the Radio Act at the time of the occurrence of the accident, and had provided information on vessel movements via VHF but was not authorized to give navigational instructions to vessels. Therefore, Operation Regulation prescribed that if there were vessels navigating against the traffic regulations, Kanmon MARTIS should inform them that they were doing so and the patrol boats should make them correct the action.

In the case described above, oral notifications, not in written form, were given to the violating vessel. If VHF communication was not established, the representative agent of the vessel was contacted or a report was made to the coast guard offices in the destination port of the vessel.

{5} Kanmon MARTIS, at the time of the occurrence of the accident, did not use the message marker of the IMO Standard Marine Communication Phrases because they were not adopted by Kanmon MARTIS.

#### (6) Operators' Career

{1} Operator D3, according to the statement, had served for about six years at Kanmon MARTIS, had served on patrol boats, and had a third grade maritime officer (navigation) certificate.

{2} Operator D4, according to the statement, had served for about seven months at Kanmon MARTIS, had served on patrol boats, and had a third grade maritime officer (navigation) certificate, a first class special maritime radio officer certificate and a second class special ground radio operator certificate.

## 2.8 Weather and Sea Conditions

### (1) Weather and Sea Observation Data

{1} The observation data by the Shimonoseki Local Meteorological Observatory located about WSW 2 M from the site of the accident, at the time of the accident were as follows:

1800 hrs, weather clear, wind NNW 1.5 m/s, visibility 6.0 km.

1900 hrs, wind NE 1.7 m/s,

2000 hrs, wind NNE 2.1 m/s,



2100 hrs, weather fine, wind ESE 1.3 m/s, visibility 6.0 km.

{2} The observation data by the Hesaki Tidal Stream Signal Station located about Eastly 3 M from the site of the accident, at the time of the accident were as follows:

1915 hrs, wind NNE 3 m/s,

1930 hrs, wind N 3 m/s,

1945 hrs, wind NNE 2 m/s,

2000 hrs, wind N 3 m/s.

{3} The tidal stream speeds displayed on the electric signal board at the tidal stream signal station were as follows:

Between 1757 hrs and 1924 hrs 3 kn West-going, decreasing,

Between 1924 hrs and 2036 hrs 2kn West-going, decreasing,

Between 2036 hrs and 2118 hrs 1 kn West-going, decreasing.

(2) Observation by crew

{1} According to the statement from Master A, the weather was fine, the visibility was 5 to 6 M and the tidal stream was 3 kn West-ward.

{2} According to the statement from Master B, the weather was fine, the visibility was 15 to 20 km, the wind was SW to SE 2 to 3 kn, the waves were calm, and the tidal stream was West-ward at 2 kn

{3} According to the statement of Officer C1, the weather was fine, there was almost no wind, and the tidal stream was 1 kn.

(3) Time of sunset

According the celestial observation calendar published by the Japan Coast Guard, the time of sunset in Kanmon Port on October 27, 2009 was 1729 hrs.

## 2.9 Characteristics of the Accident Area

### 2.9.1 Kanmon Strait

Sailing Directions for Seto Naikai by the Japan Coast Guard (March 2009), of which the English edition is available, introduces the characteristics of the area as follows:

#### *Particulars of the Kanmon Kaikyo*

*The strait is mostly within the port limits of Kanmon Ko, where Kanmon Passage is prescribed by the Act on Port Regulations. The strait is narrow and there are bends in it. The navigable width of the fairway is about 1 M at its widest and only about 500 m wide in*

*the narrowest part. The tidal streams are strong and the traffic is very heavy. There are ten port areas and seven passages with more than 200 berths in total. There are branch passages on both sides of the main passage through the central part of the strait. The strait is generally congested with the numerous vessels that pass through it, vessels that approach and leave the berths, and fishing vessels. Kanmon Kaikyo is one of the most difficult areas in the Seto Naikai and sufficient care must be exercised when navigating through it. Collisions and other marine accidents are frequent. Vessels that navigate through Kanmon Kaikyo must comply with the traffic rules prescribed by the Port Regulations Law and other laws.*

Vicinity of Hayatomo Seto Waterway



## 2.9.2 Tidal Stream

### (1) General characteristics of the tidal stream in Kanmon Strait

According to Tidal Current Charts in Kanmon Kaikyo published by the Japan Coast Guard, February 2006, the situations of the stream are as follows:

#### *2 East of the Hayatomo-Seto*

*The tide turns in the area between Hesaki and Kanju-Shima 0.5 to 1.5 hours earlier than that in Hayatomo-Seto. At the start of the East-going stream, a small circular-flowing current develops on the E side of Moji Saki. It gradually increases in area and lasts until the initial stage of the West-going stream. In consequence, the stream always sets W in the area S of Kakinotsuji, from off Tanoura Wharf and Tachinoura Wharf to the vicinity of Moji Saki. A branch stream, running along the coast, reaches the front of Moji Saki (Part 3, Ports).*

#### *3 Moji-district*

*When tide (from West-going to East-going) turns in Hayatomo-Seto, weak currents moving South-West run along the coast. Although it only takes about 30 minutes for all the currents to turn West-going, the flowing speed is very low. After about 1 hour, a return current appears around anchorage point No. 1 of Moji District and grows as the at a speed of the main stream increases to a anticlockwise circular-flowing current covering almost the whole area of Moji District about two hours after the tide turns. The center, coverage and speed are different according to situations. The circular-flowing current stays until the end of the West-going stream, flowing North-East in the whole area of the district after the tide turns (West-going to East-going) until the East-going stream reaches full strength (Part 4, Ports).*

(2) Tidal stream at the time of the occurrence of the accident

According to the Tidal Tables and Tidal Current Charts in Kanmon Kaikyo published by the Japan Coast Guard, the time that the tide turned from West-going to East-going in Hayatomo Seto on the day of the accident was 2049 hrs. The tidal stream in Hayatomo Seto, according to the tidal current chart one hour before the start of the East-going stream, was faster in the center than in the sides and moving SW (about 225°) at 2.2 to 4.5 kn around Kanmon Bridge, which would have been about 225° at about 1.3 to 2.7 kn at the time of the accident.

(Refer to Attached Figure 4: Tidal Current Charts in Kanmon Kaikyo (1 Hour before Turn of Tidal Current to East at Hayatom Seto))

## 2.10 Safety Guidance to Crew

### 2.10.1 Ship A

(1) Company A had prepared a checklist on bridge watchkeeping in accordance with the ISM Code.<sup>17</sup> The items on the checklist on the day of the accident had been checked and signed by Master A.

The items of the check list included “navigation equipment, function of rudder, to keep sufficient distance from fishing vessels,” “not to stay too long in the chart room,” “to call for the master when the visibility is under 3 M,” and so on.

(2) Company A had prepared a check list for passing narrow channels in accordance with the ISM Code. The items on the check list on the day of the accident had been checked and signed by Master A.

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<sup>17</sup> “ISM Code (International Safety Management Code)” refers to the international safety management codes for the safe operation of ships and for pollution prevention.

The items of the check list included:

“Has the latest situational information of the channel been collected?”

“Have the proper route and course been selected?”

“Is the fairway selected in compliance with regulations?”

“Is it proper to pass the channel under the current situations of our ship?”

“Has the position where the master is called for been set?”

“Are the engines on stand-by?”

“Are the position where a position report should be made to shore facilities and the radio frequency to be used confirmed?”

“Are the rudder and the navigational equipments in good condition?”

“Is the lookout arrangement and the assignment of crew proper?”

“Is the safe navigation speed proper?”

“Is the procedure of communication with approaching vessels and the actions to avoid collision proper?”

“Has the master confirmed the points mentioned above as the commander of navigation?” and “Are the power generators in parallel operation mode?” In the bottom column, “1758 (hrs), W-stream highest of 5.8 kn,” and “2124 (hrs), turn of tide” were written by hand.

## 2.10.2 Ship B

### (1) Master and Navigation Command

According to the statement from Master B, the master was supposed to navigate the ship while the ship is entering or leaving ports or navigating by the Navigation Safety Arrangement, however, in actual practice, the navigation was performed under the command of the master while entering or leaving ports and under the command of the first officer while navigating by the Navigation Safety Arrangement. Even under the Navigation Safety Arrangement, the master has the responsibility for the navigation command, and only his authority to give ship maneuvering orders was delegated to the chief navigator. If a dangerous situation was expected, the navigation was performed under the command of the master.

### (2) Speed in Kanmon Strait

{1} According to the statements from Master B and Officer B, although the original speed plan in the Kanmon Strait had been about 12 kn through the water, judging from the traffic situations, the plan was changed to about 15 kn through the water. The actual speed of Ship B was about 17 kn due to the effect of the tidal stream.

No specific speed of passing narrow channels was prescribed in the manuals for navigation stipulated by the JMSDF Fleet Training Group (hereinafter referred to as “Navigation Manual”) and used internally in the JMSDF.

{2} According to the statement from the officer in charge in the JMSDF Escort Division Two which directly supervised Ship B with regard to navigation and other matters, the situations were as follows:

As for passing through the narrow channels, the Escort Division Two had made guidance for the ships in the Fleet according to the Navigation Manual, which included a detailed explanation of navigation routes to take and regulations to comply with, a stipulation to navigate at a safe speed, not a high speed, and pointed out that VHF monitoring and reporting should be strictly carried out.

As for the speed of navigation in the Kanmon Strait, the Escort Division Two had made no guidance regarding the specific speed, however, made guidance for the ships to ensure such a safety speed that the ship can take evasive actions in a dangerous situation, or at least can stop within a distance sufficient to avoid collisions. In addition, the guidance required to navigate bearing in mind that waves caused by the ship at a high speed could reach the coast and cause damage.

The navigation plan of Ship B in the Kanmon Strait was made out based on the reasonable speed of 12 kn through the water. The navigation plan had been submitted to the higher commands and sent to the relating sections of the JMSDF.

### (3) Use of AIS

{1} According to the statement from Master B, the AIS was operated in receive-only and was not able to transmit because it had not been assigned a MMSI Code.<sup>18</sup> The AIS was used to identify the names of other vessels and to confirm their destinations. The Navigation Manual prescribed nothing about the use of AIS. The AIS was not used at the time of the accident.

{2} According to the statement from the officer in charge in the JMSDF the Escort Division Two, the AIS was equipped as a supplemental equipment, and basically operated in receive-only mode. The movements of other vessels were confirmed by VHF after identifying the names by the AIS. After the accident, because the AIS has the function of transmitting if

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<sup>18</sup> “MMSI,” an abbreviation for Maritime Mobile Service Identity, refers to an identification number assigned to an individual AIS instrument. In transmission, by specifying a MMSI, it is possible to send a message to the specified vessel. In reception, by confirming the MMSI, it is possible to know the sender. MMSI is used in a similar manner as an email address.

necessary, the Escort Division Two decided to consider the use of a transmitting function during navigations in narrow channels in view of collision avoidance.

#### (4) Information of Other Vessels

According to the statement from the officer in charge in the JMSDF the Escort Division Two, the information gathering of other vessels was as follows:

The ships belonging to the Escort Division Two, when they were passing through the Kanmon Strait, obtained information of other vessels through communication with Kanmon MARTIS and by using their own radars. It was necessary to use AIS information, but that was not prescribed as mandatory because AIS was categorized as a supplemental equipment.

The Escort Division Two had made guidance for the ships to always report to Kanmon MARTIS when crossing the report lines. However, a call such as, “We are approaching Hesaki. Are there vessels on the opposite course?” was not required as mandatory. On the contrary, the Escort Division Two had thought that Kanmon MARTIS would send a message such as, “Do you recognize a vessel on the opposite course?” In addition, as for VHF monitoring, the Escort Division Two had made guidance to monitor on selected channels when the information was related to their vessels. However, the guidance did not require to monitor all VHF communications.

The Navigation Manual prescribed nothing on gathering information of the movements of other vessels by monitoring VHF or by using Kanmon MARTIS.

## 2.11 Regulations relating to Kanmon MARTIS

What are described below in 2.11.1 to 2.11.5 are situations at the time of the accident. The present situations are different, as a result of modifications taken on July 1, 2010, following the enforcement of the amended Act on Port Regulations and the amended Maritime Traffic Safety Act, which is described later in chapter 7 as Actions Taken.

### 2.11.1 Services Responsibility

#### (1) The Japan Coast Guard Organization Ordinance

According to appended table 15 stipulated in Article 121 of the Japan Coast Guard Organization Ordinance (MLIT ministry ordinance), the service responsibility of Kanmon MARTIS is as follows:

*1 (omitted)*

*2 The guidance services of navigation based on the information on traffic collected by the operation of the vessel traffic signal stations stipulated in the previous sentence for the sea*

*areas specified by the Chief of the Headquarters.*

*3 to 7(omitted)*

*8 The services to communicate information necessary for the safe navigation.*

*9 and 10(omitted)*

(2) Ordinance for enforcement, the Japan Coast Guard Organization Ordinance

According to Article 308, Paragraph 10 of the Ordinance for enforcement of the Japan Coast Guard Organization Ordinance, the responsibilities of the Operator are as follows:

*(1) Collection and analysis of traffic information obtained through the operation of radars, and the provision thereof to individual vessels,*

*(2) Collection and analysis of traffic information obtained through the operation of the automatic identification system, and the provision thereof to the individual vessels,*

*(3) Guidance on navigation rules and traffic control signals*

*(4) to (7)(omitted)*

#### 2.11.2 Operation Regulation

According to the Operation Regulation (of the 7th Regional Coast Guard Headquarters), the regulations for the control operation are as follows:

*Article 2 (definition)*

*(1) to (4)(omitted),*

*(5) Object vessel of control: a vessel of 10,000 gross tonnage and over (as for a tanker, 3,000 gross tonnage and over) which will navigate through Hayatomo-Seto Waterway.*

*(6) Object vessel of guidance: a vessel of 3,000 gross tonnage and over except for the object vessels of control,*

*(7) Object vessel: an object vessel of control or an object vessel of guidance,*

*(8) Sub-object vessel: a vessel equipped with AIS, except for object vessels,*

*(9) Object vessel in general: a vessel categorized as an object vessel or sub-object vessel,*

*(10) to (15)(omitted),*

*(16) Special Information: the information provided for supporting independent judgment of a master on a vessel whose movement can be monitored by radar or AIS,*

*(17) to (19)(omitted).*

*Article 3 (collection of information)*

*1 and 2(omitted)*

*3 Chief Operator or Operator (hereinafter referred to as "Operator in general" does, (the rest is omitted).*

4 and 5 (omitted).

*Article 13 (special information)*

*Operator in general provide to object vessels in general within the surveillance area of the radars, by VHF or subscribed telephone, the following information as special information:*

- (1) Information for collision avoidance in cases where a close quarter situation is predicted,*
- (2) (omitted),*
- (3) Information of navigation rules to be followed in cases where an object vessel in general navigates in an improper way on a traffic route or its surrounding area,*
- (4) and (5) (omitted),*
- (6) Other information necessary to avoid any danger in navigation.*

2 (omitted)

*3 Information described in this Article, Paragraph 1, Item 1 is primarily related to the sea areas described in the following sentence:*

- (1) Hayatomo-Seto and its vicinity*
  - (2) to (7) (omitted),*
- 4 and 5 (omitted)

*Article 14 (intermediation of communications between bridges)*

*Operator in general shall, after having provided the information stipulated in Paragraph 1, Item 1, 4, 5, and 6 of the previous article, in the situations described in Paragraphs 1, 4 and 5 of the previous article, if necessary, provide intermediation of the communications between the bridges, where Operators shall report to the vessel concerned the necessary items among those listed in the following sentences:*

- (1) The other vessel's name, type, gross-tonnage, approximate position, destination and speed.*
- (2) Other necessary information*

*Article 25 (correction of navigation against the navigation rules)*

*Operator in general, besides the cases stipulated in Article 13, Paragraph 1, in the sea areas under radar surveillance, upon recognizing a vessel that is behaving against the navigation rules or apparently interfering with the navigation of other ships, or that may cause a marine accident, shall inform the vessel how the vessel is against the rules, interfering other ships or may cause accidents, and in addition, by using the Coast Guard boats assigned to the patrol in Kanmon Passage, correct such behaviors.*



2 (omitted)

### 2.11.3 Operation Procedure

According to the Operation Procedure prescribed by Kanmon MARTIS, the operation procedure was as follows:

#### *Chapter 4 Provision of Information*

1 to 5 (omitted)

#### *6 Provision of Special Information by Operator in general*

*Operator in general, mainly based on the radar information obtained through surveillance by “GD (Graphic Display)” or “PPI (Plan Position Indicator),” or the AIS information obtained through “AIS” surveillance, for the purpose of helping the independent judgment of a ship master, shall provide, by VHF, subscribed telephone or AIS, to the vessels within the radar surveillance area, the critical and emergent information for the navigation of the vessels as described in the following (1) to (6); and in addition to the provision of Special Information, take the best actions, such as sending the K patrol<sup>19</sup> boats promptly to the site, in order to prevent danger according to the situations:*

##### *(1) Collision Prevention*

###### *a. Criteria for provision*

*When vessels, in the areas listed below, are in a close quarter situation, information shall be provided. In addition, even when there are no replies to the call-ups by VHF, Operator in general shall make the best efforts to provide information for collision prevention using simple and appropriate messages.*

*(a) to (d) (omitted),*

*(e) Hayatomo-Seto and its vicinity*

*(f) to (i) (omitted)*

###### *b. Information to be delivered*

*Operator in general shall provide information on the type, gross-tonnage, approximate position, destination, whether there are pilots on board or not, TCPA, and CPA and the position of the other vessel.*

###### *c. Procedure of provision*

*Operator in general shall take into consideration the size, maneuvering characteristics, course, speed, destination and the sea area of navigation of the recipient vessel, and provide information early enough for the recipient to take actions.*

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<sup>19</sup> “K patrol” refers to a patrol in Kanmon Strait.

(2) (omitted)

(3) *Correction of Navigation*

*When a vessel is, or appears to be, against the navigation rules on a traffic route or in waters in the vicinity, or is navigating in an improper manner, information shall be provided in a way described as follows:*

a to d (omitted)

e. *Overtaking*

(a) *Criteria for provision*

*When a vessel of 10,000 gross tonnage and over is going to overtake or is overtaking unreasonably another vessel of 10,000 gross tonnage and over, the vessel in question shall be alerted, except in cases where there is room for safe overtaking, for example, overtaking will be completed before meeting a vessel on the opposite course.*

(b) *Information to be delivered*

*The vessel in question shall be informed of the existence of head-on vessels or crossing vessels, and the fact that there is little room for safe overtaking. At the same time, the vessel shall be informed that she should not make unreasonable overtaking in a traffic route.*

(c) *Procedure of provision*

*When overtaking is predicted, the vessel in question shall be informed, with sufficient attention paid to how the vessel is navigating, while continuing to monitor the vessel in question and calculate the course and speed on the "GD" display. In addition, guidance not to overtake in the fairway shall be provided after the vessel completes the overtaking, with consideration given to the behavior of the vessel.*

(4) and (5) (omitted)

(6) *Intermediation of communications between bridges*

a. *Criteria for provision*

*When the information provided by the MARTIS for collision prevention or traffic control is considered to be insufficient for the evasive and cooperative actions by both vessels, or when it is necessary for both vessels in a close quarter situation to directly communicate with each other, the intermediation service shall be provided.*

b. *intermediation Items*

*Type, name, gross-tonnage, approximate position, destination and speed of the other vessel and other necessary information shall be relayed.*

c. *Procedure of intermediation*

*Both vessels shall be called up, requested to report items such as their name, position or speed and then guided to communicate between bridges about evasive action, cooperative movement, speed adjustment, etc., and report the results of such communications to the MARTIS.*

*(7) Points in providing special information*

*a. It shall be considered that special information is provided to support the independent decision of the ship master to ensure safe navigation, and that they, therefore, have no enforcement power. Accordingly, phrases implying enforcement power, such as “I instruct you,” shall not be used.*

*b. In the event of an emergency, proactive support to the distressed vessels and information for preventing the occurrence of a further accident that could be caused by the consequences of the first accident shall be provided. While providing information, it is essential to use as simple phrases as possible because communication channels will be congested.*

7 to 9 (omitted)

#### 2.11.4 Operation Manual

According to the Operation Manual prescribed by Kanmon MARTIS, the Operation Manual was as follows:

*Chapter 2 Laws and Regulations applied to Kanmon Strait and its vicinity*

*Section 1 Laws*

1 (omitted)

*2 Act on Port Regulations*

*{1} and {2} (omitted)*

*{3} Detail*

*① to ⑨ (omitted)*

*⑩ Navigation Rules in the Fairway*

*a to c (omitted)*

*d. Prohibition of Overtaking in the Fairway*

*Generally, the fairways in the passage are narrow with structural objects such as breakwaters installed along their sides, and waters off the fairways are shallow. Besides such geographical constraints, traffic is always heavy. Therefore, because overtaking in such fairways is highly likely to lead to accidents such as collisions or groundings,*

*overtaking in the fairways is prohibited. However, in Kanmon Passage, overtaking is permitted in the following situations:*

- When a vessel being overtaken does not need to make any cooperative movement in order for an overtaking vessel to pass safely.*

- When an overtaking vessel can keep out of the way of any other vessels safely*

*The overtaking vessel shall whistle a prolonged blast followed by a short blast (– •) when overtaking on the starboard side, or a prolonged blast followed by two short blasts (– • •) when overtaking on the port side, (the rest is omitted).*

① to ② (omitted)

3 (omitted)

## *Section 2 Administrative Guidance*

1 (omitted)

### *2 In- MARTIS Guidance*

(1) (omitted)

(2) *Guidance of actions required to prevent collisions*

*Operators shall guide vessels by VHF, AIS or other means, while monitoring with radars and AIS as follows:*

*{1} In cases where vessels of 10,000 tons or over (as for oil tankers, 3,000 tons or over) are predicted to meet each other at Hayatomo Seto waterway, Operators shall provide the vessels with information to alert them and let them adjust the time to pass the waterway, and if necessary provide them with guidance to avoid meeting each other at the waterway by intermediating communications between bridges.*

*{2} In addition to the situations prescribed in the previous item, in cases where two vessels of 3,000 tons and over (hereinafter referred to as “object vessel”) are predicted to be in a close quarter situation, Operators shall alert the vessels and provide, if necessary, intermediation of communications between bridges.*

*{3} In cases where an object vessel is predicted to proceed to or approach accident sites, shallow waters or near there, the vessel shall be alerted and provided with guidance on actions necessary to avoid danger.*

*{4} In cases where two or more vessels of 10,000 tons or over should come too close to each other, Operators shall alert them and if necessary make intermediation of communications between bridges.*

*{5} Guidance for the correction of navigation shall be provided to an object vessel navigating in an improper manner against navigation rules.*

*{6} If possible, {2}, {3} and {5} shall be provided to other vessels in addition to the object*

vessel.

3 (omitted)

#### *Chapter 4 Provision of Information*

*Section 1 to 3 (omitted)*

#### *Section 4 Special information*

*Special information refers to information, described below, provided by Operator by VHF, maritime telephone or AIS. When object vessel of a position report are predicted to be in a dangerous situation in relation to other vessels or to proceed into or approach dangerous areas, such as accident sites, or when object vessel is navigating in an improper manner, the adjustments upon encountering another vessel in Hayatomo-Seto Waterway will be required.*

#### *1 Information for Collision Prevention*

*Collision prevention information refers to information provided when, in the sea areas shown below, object vessel of a position report are predicted to be in a dangerous situation with other vessels leading to a collision.*

*a to d (omitted)*

*e. Hayatomo-Seto and its vicinity*

*f and g (omitted)*

*When a dangerous situation in relation to another vessel is predicted to arise through such prediction means as displays of the course and speed, the following information shall be provided to the object vessel of a position report: course and speed and the future positions on GD, items such as the type, name, gross-tonnage, course, speed, position (relative), TCPA, CPA, communication means such as VHF, whether pilots are on board the other vessel or not, and the name and course of the watcher boat. In addition, depending on the situation, intermediation of communications between bridges shall be provided.*

*(1) to (7) (omitted)*

*2 (omitted)*

#### *3 Information relating to Correction of Navigation*

*When, by the GD or visual surveillance of the Kanmon Strait and the vicinities, vessels in the traffic are found to violate the Act on Port Regulations or the Act on Preventing Collision at Sea, or not to be in compliance with the Administrative Guidance, such vessels shall be informed, with the explanation of the laws and regulations, that they are violating laws and regulations and should immediately correct and take the proper navigation.*

*(1) to (3) (omitted)*

*4 to 6 (omitted)*

## *7 Information relating to Speed*

*To large ships or large ferries, the speed guidance shall be provided in such a way that a ground speed less than 15 kn will be maintained while navigating in the offing of the Sunatsu Route or the waters between Nishi-Kaigan to Tanoura offing in Kanmon passage. Around the area mentioned above, vessels moored at berths have frequently suffered damage.*

### 2.11.5 Service Procedure

According to The Service Procedure prescribed by Kanmon MARTIS, the Service Procedure was as follows:

*1 to 5 (omitted)*

#### *6 Provision of Information of the individual consoles*

##### *(1) Fairway information and special (for collision prevention) information*

*The Daiba Console: (omitted)*

*The O-Seto Console:*

- (omitted)
- *Because in the O-Seto area it is difficult to confirm the movements of vessels on the opposite course and because collisions have actually occurred, it shall be informed that overtaking is prohibited in the area in the case where an encounter with a vessel on the opposite course in the vicinity of the way points of changing course is predicted as a result of the overtaking in or before the O-Seto area.*
- (omitted)
- *Surveillance of the area in the vicinity of the waypoints of changing course of Hayatomo-Seto, O-Seto and Tachinoura-Corner, and provision of information about the area.*
- (omitted)

*The points are as follows:*

*\* Information on passing situations at Hayatomo-Seto*

*\* Guidance not to overtake in O-Seto, Hayatomo-Seto and the vicinities especially when there are vessels on the opposite course.*

*\* (omitted)*

*The Hesaki Console (omitted)*

*The AIS Console (omitted)*

(2) and (3) (omitted)

7 to 13 (omitted)

### Situation of the operation room of Kanmon MARTIS



## 2.12 Conventions relating to Marine Traffic Services

The parts related to the use of the message marker in 2.12.1 to 2.12.4 below have been enforced since July 1, 2010, by the amendments of the Japan Coast Guard Organization Ordinance in accordance with the amendments of the parts of the Act on Port Regulations and the parts of the Maritime Traffic Safety Act. Those are also described later in the Chapter 7 as Actions Taken.

### 2.12.1 Traffic Safety according to SOLAS convention<sup>20</sup> Chapter V

Chapter V, Regulation 12 of the SOLAS convention describes the traffic service as follows:

#### *Regulation 12 Vessel Traffic Services*

- 1. Vessel traffic services (VTS) contribute to safety of life at sea, safety and efficiency of navigation and protection of the marine environment, adjacent shore areas, work sites and offshore installations from possible adverse effects of maritime traffic.*
- 2. Contracting Governments undertake to arrange for the establishment of VTS where, in their opinion, the volume of traffic or the degree of risk justifies such services.*
- 3. Contracting Governments planning and implementing VTS shall, wherever possible, follow the guidelines developed by the Organization. The use of VTS may only be made mandatory in sea areas within the territorial seas of a coastal State.*

4 and 5 (omitted)

*Note: Refer to the Guidelines on VTS adopted by the organization (IMO) by Resolution A. 857 (20)*

### 2.12.2 Guidelines prepared by IMO

#### (1) VTS Guidelines Annex 1

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<sup>20</sup> "SOLAS Convention" is the abbreviation for "The International Convention for the Safety of Life at Sea." The convention was adopted on November 1, 1974, and enforced on May 5, 1980.

Guidelines for Vessel Traffic Services adopted by the organization (IMO) in resolution A. 857 (20) (hereinafter referred to as “VTS Guidelines”) Annex 1 describes the following guidelines:

- {1} A VTS authority should take into account the legal implications in the event of a shipping accident where VTS operators may have failed to carry out their duty competently.
- {2} When the VTS is authorized to issue instructions to vessels, these instructions should be result-oriented only,<sup>21</sup> leaving the details of execution to the master on board the vessel.
- {3} Decisions concerning the actual navigation and the maneuvering of the vessel remain with the master.
- {4} In conjunction with the IALA/VTS Manual,<sup>22</sup> IMO Standard Marine Communication Phrases<sup>23</sup> (hereinafter referred to as “IMO Phrases”) should be used where practicable.
- {5} Details of VTS service should be published in “World VTS Guide.”<sup>24</sup>

#### (2) VTS Guidelines Annex 2

VTS Guidelines, Annex 2 describes that the VTS authority should be provided with sufficient staff, appropriately qualified, suitably trained and capable of performing the tasks required, and provides guidelines on how the VTS authorities can recruit, select and train personnel in order to carry out their tasks.

#### 2.12.3 IALA / VTS Manual

The IALA / VTS Manual, in order to provide particular information on the VTS Guidelines, describes the equipment required by the VTS, the operations of the VTS and the measures for effectiveness of the VTS, as follows:

- (1) A fundamental principle of VTS communications should be result-oriented only; leaving the execution the vessel, and the execution, such as courses to be steered or engine maneuvers to be ordered, remain the responsibility of the person on board accountable for navigational decision making at that time.
- (2) When transmitting a message, in order to increase the probability that the intention of the message will be correctly understood, a message marker should be attached to the head, chosen from among “Instruction,” “Advice,” “Warning,” and “Information,” and in addition from among “Question,” “Answer,” “Request” and “Intention”. It is at the discretion of the shore personnel or the ship’s officer whether to use one of the message markers and if so, which marker is applicable to the situation. The transmitted message should be clear and in compliance with the IMO Phrases.
- (3) The World VTS Guide is published as the material for the latest information because VTS services are used for the navigation of vessels. The latest version of the VTS Guide Book at the time of the occurrence described the services of Kanmon MARTIS as information service.

#### 2.12.4 IMO Phrases.

The IMO Phrases prescribe the message marker as the VTS standard phrases, as described

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<sup>21</sup> “Result-oriented” as used in the annex should be interpreted as “Instructions only specify the results, and do not include operational suggestions, such as what course should be taken or how the main engine should be operated.”

<sup>22</sup> “IALA/VTS Manual” refers to the VTS manual published by the International Association of Marine Aids to Navigation and Lighthouse Authorities.

<sup>23</sup> The IMO Standard Marine Communication Phrases were adopted as IMO resolution A. 918 (22), based on the concept that the standardized words and terms in communication are tools for safe navigation and contribute to safety.

<sup>24</sup> “World VTS Guide” is material that introduces VTS services and operations around the world, publicized by IALA.



below, and recommend that the proper marker, chosen from among INSTRUCTION, ADVICE, WARNING, or INFORMATION, should be used in order to clarify the intention of the message. In addition, the STCW Convention<sup>25</sup> stipulates that navigational watch personnel should have the ability to understand and use IMO Phrases as the minimal common English ability.

*(a) INSTRUCTION*

*This indicates that the following message implies the intention of the sender to influence others by a Regulation.*

*Comment: This means that the sender, e.g. a VTS Station or a naval vessel, must have full authority to send such a message. The recipient has to follow this legally binding message unless he/she has contradictory safety reasons which then have to be reported to the sender.*

*Example: "INSTRUCTION. Do not cross the fairway."*

*(b) ADVICE*

*This indicates that the following message implies the intention of the sender to influence others by a Recommendation.*

*Comment: The decision whether to follow the ADVICE still stays with the recipient. ADVICE does not necessarily have to be followed but should be considered very carefully.*

*Example: "ADVICE. (Advise you) stand by on VHF Channel six nine."*

*(c) WARNING*

*This indicates that the following message implies the intention of the sender to inform others about danger.*

*Comment: This means that any recipient of a WARNING should pay immediate attention to the danger mentioned. Consequences of a WARNING will be up to the recipient.*

*Example: "WARNING. Obstruction in the fairway."*

*(d) INFORMATION*

*This indicates that the following message is restricted to observed facts, situations, etc..*

*Comment: This marker is preferably used for navigational and traffic information, etc.. Consequences of INFORMATION will be up to the recipient.*

*Example: "INFORMATION. MV No name will overtake to the west of you."*

*(e) QUESTION*

*This indicates that the following message is of an interrogative character.*

*Comment: The use of this marker removes any doubt as to whether a question is being asked or a statement is being made, especially when interrogatives such as what, where, why, who, how are additionally used at the beginning of the question. The recipient is expected to return an answer.*

*Example: "QUESTION. (What is) your present maximum draught?"*

*(f) ANSWER*

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<sup>25</sup> "STCW Convention" refers to the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, concluded in 1978.

*This indicates that the following message is the reply to a previous question.*

*Comment: Note that an answer should not contain another question.*

*Example: "ANSWER. My present maximum draught is zero seven metres."*

#### *(g) REQUEST*

*This indicates that the following message is asking for action from others with respect to the vessel.*

*Comment: The use of this marker is to signal: I want something to be arranged or provided, e.g. ship's stores requirements, tugs, permission, etc..*

*Note: REQUEST must not be used involving navigation, or to modify COLREGS.*

*Example: "REQUEST. I require two tugs."*

#### *(h) INTENTION*

*This indicates that the following message informs others about immediate navigational action intended to be taken.*

*Comment: The use of this message marker is logically restricted to messages announcing navigational actions by the vessel sending this message.*

*Example: "INTENTION. I will reduce my speed."*

### 2.12.5 Other Regulations

Regarding air traffic control, the "Air Traffic Controller Certification Regulations" (MLIT instruction No. 97, 2001) stipulates procedures for training and testing the skill of persons who wish to serve in the air traffic control services, and certification is issued to the people who has passed the test. Annex 1 to the Convention on International Civil Aviation (Personnel Licensing) requests the air traffic controllers to obtain the license issued by the contracting state where the air traffic controllers serve, and prescribes the necessary qualifications. However, a qualification standard has not been prescribed for vessel traffic service operators.

## 2.13 Other Relevant Matters

### 2.13.1 Effects of Tidal Stream on Vessel Movements

(1) Descriptions in the KOKAIBINRAN (published by Kaibun-Do in 2004), 12.4 Wind or Stream Effect on Navigation, 12.4.1 Wind Pressure and Fluid Pressure, (2) Fluid Pressure and Fluid Pressure Moment" are approximately as follows:

{1} The pressure applied by a stream, such as a tidal stream, to the under-water hull of a vessel moving in the stream is principally a similar physical phenomenon as in the case of wind pressure, and is calculated by using the equation below:

$$R_w = 1/2 \sigma_w C_{Rw} V_w^2 L d$$

( $R_w$ : resultant force caused by stream pressure (kg),  $\sigma_w$ : water density,  $C_{Rw}$ : fluid pressure (force) coefficient,  $V_w$ : fluid velocity (relative) (m/s),  $L$ : hull length (m), and  $d$ : average draught (m))

According to the table showing the measurements of  $C_{Rw}$  value and the relative direction of

fluid stream, the fluid pressure (force) coefficient ( $\sigma_w$ ) is maximum when the relative direction of fluid stream is around 90°.

{2} The rotational moment around the center of gravity generated when the center of fluid pressure is not at the center of gravity is a similar physical phenomenon as in the case of wind pressure, and is calculated by using the equation below:

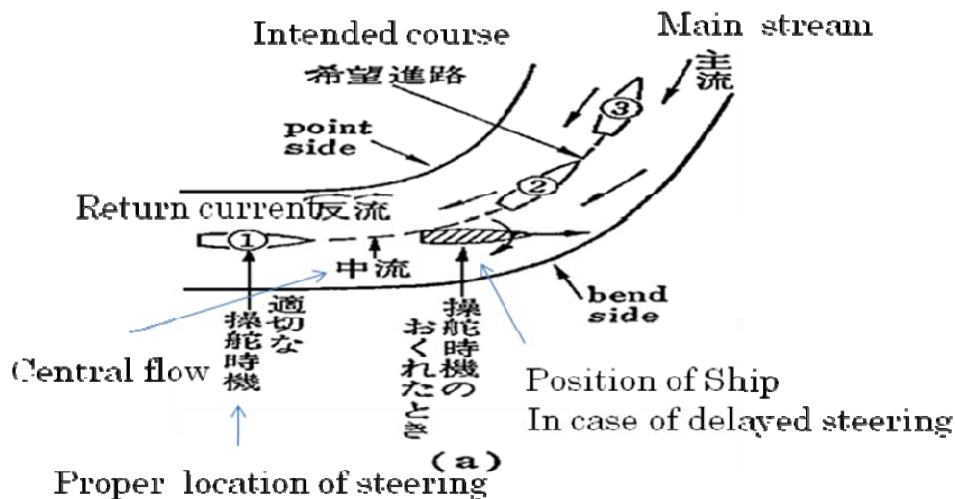
$$M_w = 1/2 \sigma_w C_{Mw} V_w^2 L^2 d$$

( $M_w$ : rotational moment around the center of gravity caused by fluid pressure (kg-m), and  $C_{Mw}$ : fluid pressure coefficient)

According to the table showing the measurements of  $C_{Mw}$  value and the relative direction of fluid stream, the fluid moment coefficient ( $C_{Mw}$ ) is at the local maximum when the relative direction of fluid stream is about 30 to 60° and also when it is around 130°.

(2) Descriptions in the KOKAIBINRAN, 12.4.2 Ship Behavior under Wind Pressure, (2) Ship Behavior in Locally Fluctuating Wind or Fluctuating Fluid Stream, ③Effects of Streams in Narrow Wimple Channel are as follows:

*The flow at a bend in a narrow channel such as a river or canal, as shown in the diagram below, generates a strong stream at the bend side, a weak stream at the point side and return streams locally in various places. In such waters, there is the possibility, as illustrated graphically in the diagram below, that a ship would be likely in danger depending on the course which is selected by the ship.*



(3) Descriptions in KOKAIBINRAN, 12.7 Navigation Safety and Navigations in the occasion of Marine Accident, 12.7.1 Navigation Safety in Special Waters and (3) Navigations in Restricted Waters are as follows.

*Points to keep in mind when navigating in water of restricted width or depth, such as a narrow channel, river, or port are as follows:*

### *{3} Navigation and Steering*

- *Avoidance of excessive steering,*
- *Keeping a proper speed in accordance with the situation of the water,*
- *Avoidance of over-running or rotation of heading due to branch, return or loop currents, while navigating in a bend in a channel with a stream, by properly making decisions about the course or steering timing.*

#### 2.13.2 Description of Act on Port Regulations

“Description of the Act on Port Regulations” (published in March 2008, by Kaibun-Do, supervised by the Japan Coast Guard) describes Article 16, Paragraph 1 of the Act on Port Regulations as follows:

*The article is stipulated for the prevention of accidents occurring on a vessel or with other vessels in the congested traffic inside ports or in the vicinities. Paragraph 1 requires vessels in such waters to navigate with a proper speed that enables other ships to easily take actions to avoid collision and causes no hazards to other vessels by ship waves. (The rest is omitted)*

## 3 ANALYSIS

### 3.1 Situation of the Accident Occurrence

#### 3.1.1 Course of the Events

According to 2.1, it is considered probable as follows:

##### (1) Ship A

- {1} At 1935.00 hrs, October 27, 2009, Ship A was proceeding on a heading of 065°, a COG of 064.6° and at a speed of 11.8 kn.
- {2} At 1940.00 hrs, Ship A altered her course to port in the vicinity of O Seto, and was proceeding on a heading of 023°, a COG of 023.8° and at a speed of 11.9 kn.
- {3} At 1948.26 hrs, Ship A passed Light Buoy No. 30, altered her course to starboard toward Kanmon Bridge, and was proceeding on a heading of 033°, a COG of 036° and at a speed of 13.4 kn.
- {4} At 1954.14 hrs, Ship A reduced the speed to slow ahead, and at 1954.18 hrs, was proceeding on a heading of 032°, a COG of 031.5° and at a speed of 12.1 kn.
- {5} At 1954.22 hrs, Ship A put the helm 10° to port, and at 1954.24 hrs, was proceeding on a heading of 033°, a COG of 031.3° and at a speed of 11.9 kn.
- {6} At 1954.40 hrs, Ship A put the helm 20° to port, and at 1954.48 hrs, was proceeding on a heading of 034°, a COG of 033.8° and at a speed of 10.9 kn.
- {7} At 1955.03 hrs, Ship A put the helm hard to port, and at 1955.06 hrs, was proceeding on a heading of 027°, a COG of 031.4° and at a speed of 10.7 kn.
- {8} At 1955.12 hrs, Ship A put the helm to amidships, and at 1955.13 hrs, was proceeding on 023°, a COG of 028.7°, and at a speed of 9.8 kn.
- {9} At 1955.14 hrs, Ship A put the helm hard to starboard, and at 1955.30 hrs, was proceeding

on a heading of 005°, a COG of 008.2° and at a speed of 9.4 kn.

{10} At 1955.34 hrs, Ship A attained the helm hard-a-starboard, and Ship A was proceeding on a heading of 002°, a COG of 003° and at a speed of 9.1 kn.

{11} At 1956.06 hrs, Ship A, while proceeding on a heading of 352°, a COG of 338.8° and at a speed of 8.0 kn, and at 1956.09 hrs, collided with Ship B.

(2) Ship B

{1} At 1952.00 hrs, October 27, 2009, Ship B, just before Light Buoy No. 31, was proceeding on a COG of 239.4° and at a speed of 16.3 kn.

{2} At 1953.00, Ship B passed Light Buoy No. 31 and was proceeding on a COG of 240.6° toward the Shimonoseki Leading Light, and at a speed of 16.3 kn.

{3} At 1955.00 hrs, Ship B was proceeding on a COG of 239.7°, and at a speed of 17.1 kn.

{4} At 1955.12 to 18 hrs, Ship B was proceeding on a COG of 239.0° to 239.3° and at a speed of 17.5 kn.

{5} At 1955.33 to 34 hrs, Ship B stopped both engines and put them to full astern, and , at 1955.30 to 36 hrs, was proceeding on a COG of 239.9° to 240.0° and at a speed of 17.1 to 17.5 kn.

{6} At 1955.42 to 46 hrs, Ship B put the helm hard to port and then hard to starboard, and at 1955.42 to 48 hrs, was proceeding on a COG of 240.0° and at a speed of 17.1 kn.

{7} At 1956.00 hrs, Ship B was proceeding on a COG of 243.8° and at a speed of 15.5 kn.

{8} At 1956.09 to 11 hrs, Ship B collided with Ship A at 1956.12 hrs, the COG was 240.2° and the speed was 9.6 kn.

(3) Ship C

{1} At 1935.05 hrs, October 27, 2009, Ship C was proceeding on a heading of 018°, a COG of 020.2° and at a speed of 7.4 kn.

{2} At 1940.06 hrs, Ship C was proceeding on a heading of 024°, a COG of 023.6° and at a speed of 7.4 kn.

{3} At 1952.15 hrs, Ship C was proceeding on a heading of 038°, a COG of 036° and at a speed of 7.1 kn.

{4} At 1952.45 hrs, Ship C was proceeding on a heading of 037°, a COG of 037.4° and at a speed of 6.8 kn.

{5} At 1954.13 hrs, Ship C altered her course 6° to starboard, and at 1954.15 hrs, was proceeding on a heading of 050°, a COG of 045.9° and at a speed of 6.2 kn.

{6} At 1955.13 hrs, Ship C altered her course 6° to starboard, and at 1955.15 hrs, was proceeding on a heading of 054°, a COG of 050.6° and at a speed of 6.2 kn.

{7} At 1956.11 to 12 hrs, Ship C heard collision sounds, and at 1956.15 hrs, was proceeding on a heading of 063°, a COG of 063.4° and at a speed of 6.3 kn.

### 3.1.2 Time, Date and Location of the Occurrence of the Accident

According to 2.1 and 3.1.1, it is considered probable, because the time stamps recovered by Ship A, B and C did not coincide but varied within some range, that the time and date of the accident was 1956.09 to 12 hrs, October 27, 2009. It is considered probable that the location was the vicinity of 294° and 330 m from the Moji Saki Light House (approximate position of 33°57'48.2"N 130°57'35.1"E).

### 3.1.3 Situation of Collision

Judging from the crossing angle of the heading of Ship A of 352° with the COG of Ship B of 240.2° at the time of the accident, the statements, the radar images of VDR recorded in Ship C and the situations of the damage described in 2.1, 2.3 and 3.1.1, it is considered probable that the starboard bow of Ship A and the bow of Ship B collided at an angle of about 110° measured from the stern of Ship A.

## 3.2 Causal Factors of the Accident

### 3.2.1 Crew

According to 2.5.1, Master A had a legal and valid Seaman's Competency Certificate, and Master B and Officer B had a Ship Officer's Certificate issued by the Ministry of Defense of Japan.

### 3.2.2 Vessel

According to 2.6.3, it is considered probable that Ship A and Ship B had no problems or malfunctions in the hulls, the engines or the equipments. It is considered probable that the VDR on Ship A and the Bridge Voice Recorder on Ship B had not been time-adjusted.

### 3.2.3 Weather and Sea Conditions

According to 2.8 and 2.9.2, it is considered probable that it was nighttime, the weather was fine, the wind was N to NE about 2 to 3 m/s, the tidal stream was SW-going about 1.3 to 2.7 kn, and the visibility was about 6 M.

### 3.2.4 Communications among Crew Members

According to 2.1 and 2.5.1 (2), it is considered probable as follows:

#### (1) Ship A

{1} Master A boarded as master before the departure from Busan Port and took the navigation command of Ship A. Master A had no difficulties in navigation.

{2} The navigation orders in Ship A were made in English. There were no difficulties in communication among the crew members.

{3} Officer A2 of Ship A communicated in English with the Operator in Kanmon MARTIS, and reported the contents of the communications to Master A. There were no difficulties in communications.

#### (2) Ship B

The Bridge was stationed by Master B with the fifteen crew members. Officer B was at the command of Ship B under the supervision of Master B. About twenty crew members were stationed at the bow and preparing to let go the starboard anchor. There were no difficulties in communications.

#### (3) Ship C

Although Master C instructed Officer C2 to contact Kanmon MARTIS to inform it that he wanted Ship C to be overtaken on the port side or to be followed by Ship A, Officer C2 thought that Ship C would eventually be overtaken because Ship A would find it difficult to follow her, so he requested that Ship C be overtaken on the port side. Therefore, the

intention of Master C was not fully delivered to Kanmon MARTIS.

### 3.2.5 Communications between Ship A and Kanmon MARTIS

According to 2.1, 2.7 (5) {5}, 2.12.3 (2) and 2.12.4, it is as follows:

#### (1) Communications

{1} It is considered probable that Operator D1 thought that Ship A would overtake Ship C, made communications with Ship C, received a reply that Ship C had accepted to be overtaken on the port side and would move to the starboard side of Kanmon Passage, and then sent by VHF to Ship A the following message:

“CARINA STAR, vessel ahead of you, QUEEN ORCHID is moving to starboard side, so please overtake on her port side. Over.”

{2} It is considered probable that Ship A, upon receiving the message in {1}, sent back by VHF to Kanmon MARTIS the following message:

“Ok, roger, I will overtake.”

{3} It is considered probable that Operator D1, upon receiving the message in {2}, sent by VHF to Ship A the following message:

“Overtake on her port side, QUEEN ORCHID is moving to starboard side, but 1 mile ahead of you, Japanese navy ship is coming. Pay attention. Over.”

{4} It is considered probable that Ship A, upon receiving the message in {3}, sent back by VHF to Kanmon MARTIS the following message:

“OK, thank you. I will overtake on my port side.”

Note that it is considered somewhat likely that the phrase “on my port side” was mistakenly used for the phrase “on her port side.”

#### (2) Analysis of the Content of Communications

{1} It is considered somewhat likely that Master A, by taking the messages from Kanmon MARTIS as an order instead of an advice, thought that if Ship A neglected such order and overtook on the starboard side, Master A would later be in troubles of undergoing investigation or being forced to submit a report. In addition, it is considered probable that both of the messages shown in (1) {1} and {3} were in the imperative form in English and any message marker was not attached because they were not adopted by the Kanmon MARTIS. Furthermore, taking into account that the voice recorded in Korean said, “Do we have to overtake on her port side? A head-on vessel is getting closer to us,” it is considered somewhat likely that Ship A, although having replied that she accepted the advice to overtake Ship C, was skeptical about overtaking Ship C on the port side. It is considered probable that Ship A overtook Ship C on the port side in such a situation.

It is considered somewhat likely, taking into consideration the whole situation described

above, that Master A did not understand properly the relationship between a VTS and a ship master and the meaning of the message markers mentioned in 2.12.2 (1), 2.12.3 and 2.12.4. It is also considered somewhat likely, judging from the statement from Master A that he took the message from Kanmon MARTIS as an order, that Master A thought that the message had some enforcement power rather than being made just for the provision of information.

{2} It is considered probable that, judging from the prescriptions in the Kanmon MARTIS Operation Manual of and in 2.7 (5) {2}, Operator D1 made the communications mentioned in (1) with Ship A as a provision of information.

It is considered probable that Operator D1, although having been aware on the radar display after completing the communications that both ships were in a situation where Ship A would catch up with Ship C after passing the east side exit of Hayatomo Seto, thought that the situation would be safe because it would be in a wide sea area where Ship A would complete overtaking Ship C due to the effects of the tidal stream after Ship B would have passed both Ship A and Ship C.

It is furthermore considered probable that Operator D1 thought that Ship A, which was about to overtake Ship C, would naturally navigate paying attention to Ship B on the opposite course, which was navigating along Kanmon Passage, and would not take an improper action as long as she confirmed safe overtaking.

It is considered somewhat likely, judging from what is described above, that if Master A had properly understood the relationship between a VTS and a ship master and the message markers described in 2.12.2 (1), 2.12.3 and 2.12.4, he would have been skeptical about the messages from Operator D1, confirmed the intention of the messages, and as a result, not overtaken Ship C. Therefore, a proper understanding of the relationship between a VTS and a ship master and the message markers, as well as putting them into practice, is desirable.

### 3.2.6 Lookout and Navigation

According to 2.1, 3.1.1, 3.2.4, and 3.2.5, it is as follows:

#### (1) Ship A

{1} It is considered probable that at 1935.00 to 40.00 hrs, Master A altered the course to port in the vicinity of O Seto, and then, while navigating at a speed of about 12 kn, saw Ship C, which was proceeding NNE at a speed of about 8 kn.

{2} It is considered probable that at 1948.26 hrs, Master A, while proceeding at a speed of 13.4 kn after having passed Light Buoy No. 30, thought that, because Ship C was navigating close to the center of Kanmon Passage at a speed of about 8 kn, it would be possible to overtake on the starboard side at the west of Kanmon Bridge, and then continued to navigate in such a way that Ship A would approach the starboard side of Ship C.

{3} It is considered probable that at 1953.08 to 53.49 hrs, Ship A exchanged messages with Kanmon MARTIS about the overtaking of Ship C on her port side and the necessity of paying attention to Ship B on the opposite course, and then Master A saw Ship B on the opposite course about 1.5 M ahead and confirmed by radar that Ship B was proceeding at a speed of about 18 kn. It is considered probable that, at that time, Ship C was navigating



about 500 to 600 m ahead on the port side of Ship A.

It is considered probable that Officer A2, although having looked at the AIS display, did not see the symbol for Ship B.

Although it is considered somewhat likely that at 1954.09 to 54.12 hrs, the crew on Ship A's bridge, after the communications with Kanmon MARTIS, was skeptical about overtaking Ship C on the port side, it is also considered somewhat likely that Master A took the message from Kanmon MARTIS to have enforcement power instead of just a provision of information.

It is considered probable that Master A, as a result of the situations described above, decided to overtake Ship C on the port side.

{4} It is considered probable that at 1954.14 hrs, when Ship A was close to the starboard side of Ship C, Master A reduced the speed to slow ahead in Hayatomo Seto, west of Kanmon Bridge, in order to overtake Ship C on the port side, taking into consideration the decrease in the speed of Ship C to about 5 to 6 kn caused by the effects of the tidal stream.

It is considered probable that Master A, although trying to overtake Ship C on the port side, was anxious when the speed of Ship A, which was about 13 kn, had not decreased promptly. It is considered probable that, at that time, Ship A was about 350 m behind Ship C.

{5} It is considered probable that at 1954.22 hrs, Master A, in order to overtake Ship C on the port side, ordered the helm 10° to port. It is considered probable that, at that time, Ship A was about 300 to 350 m behind on the starboard of Ship C.

It is considered probable that Master A, because he was concentrating on clearing Ship C, which was close to Ship A, paid little attention to the movement of Ship B. It is considered probable that, Master A, furthermore, sent no Overtaking Signal to Ship C.

{6} It is considered probable, judging from {4} and {5}, that Ship A had not collected, by using the radar or the AIS, sufficient information on the situations and movements of Ships B and C.

{7} It is considered probable that, at 1954.40 hrs, Master A ordered the helm 20° to port. It is considered somewhat likely that, at that moment, Master A intended to have a large rudder effect by having a wide rudder angle because Ship A had been close to Ship C.

{8} It is considered probable that, at 1955.03, Master A ordered the helm hard to port. It is considered somewhat likely that, at the moment, Master A intended to have a greater rudder effect by having the rudder angle wider, judging from the situation of approaching Ship C.

{9} It is considered probable that at 1955.12 hrs, when Ship A reached about 70 m from the stern of Ship C, which Ship A had seen on the port side, Master A ordered the helm amidships; however, Ship A advanced to the center of Kanmon Passage, partly due to the effect of the tidal stream. It is considered probable that, at that moment, Ship B had come to about 850 m ahead of Ship A.

{10} It is considered probable that, at 1955.14 hrs, Master A, being aware of a possible collision with Ship B, ordered the helm hard to starboard, and then, at 1955.30 hrs, made whistle blasts (one to two short blasts).

(2) Ship B

{1} It is considered probable that, just before 1930 hrs, when Ship B passed the HS line, the Ship B's bridge was stationed, under the navigation safety arrangement, by Officer B, who was taking the command under the supervision of Master B, and the preparations for letting go the starboard anchor were working.

It is considered probable that, after having confirmed that it would be after sunset when Ship B would pass the Kanmon Strait and that the tidal stream was following at about 2 kn, under the situation where there were no vessels ahead of Ship B except a small ship on the same course, Master B intended to pass through the Kanmon Strait as fast as possible in order to have sufficient time for the scheduled works and was having Ship B proceed at a speed of about 15 kn, and 17 kn in the vicinity of Tanoura Offing, by having put the main engines to the full at a speed of 135 rpm before entering Kanmon Passage.

{2} It is considered probable that, at 1952.00 hrs, just before Light Buoy No. 31, when Ship B was navigating toward the Shimonoseki Leading Lights, Master B saw the two masthead lights and the starboard navigation light of Ship C about 2,743 m ahead, and thought that it was a large vessel on the opposite course. It is considered probable that Master B, on the receipt of the report from the radar look-out crew that the heading and the speed of Ship C was 050° and about 12 kn, judged that Ship C was navigating along Kanmon Passage because he found the distance between the two masthead lights of Ship C was narrowing, watching the both side navigation lights, and then the port navigation light came into view.

{3} It is considered probable that, at 1953.00 hrs, when Ship B passed Light Buoy No. 31, Master B saw the two masthead lights and the starboard navigation light of Ship A about 2,560 m ahead, and thought that it was a vessel about the same size as Ship C and that it would navigate in a similar way of Ship C.

{4} It is considered probable that, at 1953.23 to 54.52 hrs, Master B heard a voice announcement made in the bridge of Ship B that Ship A and Ship C were approaching Kanmon Bridge, and thought that Ship B was in a situation where she would come across Ship A and Ship C in the vicinity of Hayatomo Seto. It is considered probable that, after that, Master B, upon receiving a report from the radar look-out crew that the CPA to Ship C was 140° and about 183 m, concluded that Ship C would pass Ship B at a close distance, and in addition, because Ship A was navigating just behind Ship C, Master B thought that Ship A would pass with the helm to starboard. It is considered probable that Ship B, keeping the full at a speed of about 15 kn through the water, proceeded at a speed of about 17 kn due to the effects of the tidal stream.

{5} It is considered probable that, at 1955.14 to 21 hrs, Master B, judging from the fact that Ship A was showing the starboard navigation light and that the distance between the masthead lights on the bow and stern was widening, suspected that Ship A was putting the

helm to port, and, although expressing anxiety by saying, “There is something strange about the blue navigation light on the second ship. Is she putting the helm to port? What?,” continued to proceed at a speed of about 17 kn. It is considered probable that Master B made no warning signals.

{6} It is considered probable that, at 1955.30 to 34 hrs, Master B and Officer B heard the sounds of whistle blasts, and Officer B, when the distance to Ship A became about 500 m, stopped both engines and put them to full astern.

{7} It is considered probable that, at 1955.42 to 46 hrs, Officer B put the helm hard to port, then Master B put the helm hard to starboard while the rudder angle was changing to port.

### (3) Ship C

{1} It is considered probable that, at 1952.18 to 38 hrs, Officer C2 received the message by VHF from Kanmon MARTIS, “Vessel behind you, vessel behind you, is approaching you. Her speed is 14 kn. Pay attention.”

It is considered probable that Master C, upon receiving the report that there was a vessel overtaking on the starboard side, instructed Officer C2 to inform that Ship C did not want to be overtaken on the starboard side because Ship C intended to alter her course to starboard after passing under Kanmon Bridge, and wanted to be overtaken on the port side or to be followed.

It is considered probable that Officer C2, thinking that it was difficult for Ship A, which was faster, to follow Ship C, said by VHF to Kanmon MARTIS, “OK. It’s surpassing. Over take me on my port side.”

{2} It is considered probable that, at 1952.38 to 55 hrs, Ship C received the message by VHF from Kanmon MARTIS, “OK. Then you should keep starboard side. You are now the center of the Kanmon passage. Move to starboard side right now. Over,” sent back the message, “OK. I will be a little course to starboard side,” and then, at 1954.13 hrs, ordered the helm 6° to starboard.

### 3.2.7 Use of AIS

According to 2.1 and 3.2.6, it is as follows:

#### (1) Ship A

It is considered probable that, at about 1935 to 40 hrs, Ship A saw Ship C and was thinking that it would be possible to overtake Ship C on the starboard side before passing Kanmon Bridge, and at 1953.08 to 49 hrs, received a message by VHF from Kanmon MARTIS that Ship A should pay attention because Ship B was coming 1 M ahead. It is considered probable that, at that time, Officer A2, although having looked into the AIS display, did not find a symbol indicating Ship B.

It is considered somewhat likely that if the AIS information for Ship B had been available, Ship A would have been able to know the situations of the approaching Ship B and Ship C, notice that the overtaking would occur in narrow waters, and conclude earlier that the overtaking was inappropriate.

## (2) Ship B

It is considered somewhat likely that Ship B saw Ship C and Ship A at about 1952 hrs and 1953 hrs respectively, and was navigating with an idea that Ship A would put the helm to starboard in a similar way to Ship C, and if she had used the AIS, she could have noticed earlier than stated in 3.2.6 (2) {5}, by the information that would have been obtained on the speed, course and rate-of-turn of Ship A and Ship C, that Ship A was navigating with an intention of overtaking Ship C.

Judging from what was stated above, it is desirable to use AIS because, by using AIS effectively, it is possible to notice the name and size of the vessel in question as well as any questionable navigation behavior at an earlier stage.

### 3.2.8 Situations in Kanmon MARTIS

According to 2.1.4 and 2.7, it is considered probable as follows:

#### (1) Operator D1

{1} At about 1852 hrs, Operator D1 took a seat at the O Seto Console to conduct surveillance by using 9-minute prediction vectors. The radar display of Console had a lag of 15 to 25 seconds.

{2} At about 1948 hrs, Operator D1 visually measured the time it would take Ship A and Ship C to pass Kanmon Bridge as half of the length of the 9-minute prediction vectors and predicted that both ships would pass Kanmon Bridge in about five minutes and that Ship A would then overtake Ship C in the vicinity of the exit of Hayatomo Seto.

{3} At 1952.18 to 38 hrs, Operator D1 sent to Ship C by VHF the message, "Vessel behind you, vessel behind you, is approaching you. Her speed is 14 kn. Pay attention," received from Ship C the reply, "OK. It's surpassing. Overtake on my port side" and confirmed the acceptance of Ship C of being overtaken on the port side.

{4} At 1952.38 to 55 hrs, Operator D1 sent to Ship C by VHF the message, "OK. Then you should keep starboard side. You are now middle of the fairway. Move to starboard side right now," and received the reply, "OK, OK. I will be a little course to starboard side."

{5} At 1953.08 to 49 hrs, Operator D1, sent to Ship A by VHF the message, "CARINA STAR, vessel ahead of you, QUEEN ORCHID is moving to the starboard side, so please overtake on her port side. Over," and received the reply, "OK, roger, I will overtake."

In order to confirm that Ship A understood the overtaking should be done on the port side. Operator D1 also sent to Ship A the message, "Overtake on her port side. QUEEN ORCHID is moving to starboard side, but one mile ahead of you, a Japanese navy vessel is coming. Pay attention. Over." and received the reply, "OK, thank you, I will overtake on my port side."

According to Operator D1's statement, he had continued the surveillance by 9-minute vectors and noticed that Ship A would catch up with Ship C after passing the east side exit of Hayatomo Seto waterway, but according to the record of both ships' positions, Ship A was

going to catch up with Ship C in Hayatomo Seto Waterway or its vicinity(hereinafter referred to as the “Hayatomo Seto and its vicinity”).

Judging from the statement that Operator D1 thought that Ship A, due to the effects of the tidal stream, would complete the overtaking of Ship C after passing the east side exit of Hayatomo Seto waterway and Ship B would pass both ships before the overtaking, he did not fully grasp the situation of where Ship A would overtake Ship C and how Ship B would pass that place.

(2) Operator D2

{1} At about 1953 to 54 hrs, Operator D2, during the hand-over to Operator D1, pointed at the echoes of Ship A, B and C on the radar display, and was given by Operator D1 the explanation of the situation where Ship A would overtake Ship C just beyond Moji Saki, and also was informed that Ship A and Ship C had been provided with information on the situation. After the handover, Operator D2 took a seat at the O Seto Console to conduct surveillance changing to 5-minute prediction vectors.

Operator D2, after checking vessels going eastward in O Seto and then conducting surveillance of Hesaki and Tachinoura, paid attention to Hayatomo Seto and its vicinity, just before the occurrence of the accident.

{2} At 1955.55 to 56.04 hrs, Operator D2 judged that Ship A, shifted left by the current, was involved in a risk of collision with Ship B because the prediction vector of Ship A began to swing to the left. Operator D2 called Ship A twice by VHF, “CARINA STAR, CARINA STAR, opposite course vessel, pay attention. CARINA STAR, pay attention.” However, Operator D2 did not receive any reply from Ship A.

{3} At 1956.38 to 41 hrs, Operator D2, after the collision of Ship A and Ship B, called Ship B by VHF, “CARINA STAR is getting extraordinarily close to you. Clear.” However, Operator D2 did not receive any reply from Ship B.

3.2.9 Tidal Stream Effects on Navigation

According to 2.9.2 and 2.13.1, it is considered probable that the effects on the navigation of the SW-going stream of about 1.3 to 2.7 kn were as follows:

(1) Speed Increasing or Decreasing

As the Ships approached Kanmon Bridge, the speed of Ship A and Ship C decreased, and the speed of Ship B increased.

(2) Movement of Ship A

{1} Ship A, while proceeding on a heading of 033° (within this section, referred to as “Original Course”) at 1948.26 hrs, put the helm 10° to port at 1954.22 hrs, the helm 20° to port at 1954.40 hrs, and began to swing to port at 1954.54 hrs. At 1955.03 hrs, Ship A put the helm hard to port, and at 1955.06 hrs, the swing of the heading of Ship A attained about 6° to port from the Original Course.

{2} At 1955.12 hrs, Ship A put the helm amidships, and at 1955.13 hrs, the swing of the heading of Ship A attained about 10° to port from the Original Course.

{3} At 1955.14 hrs, Ship A put the helm hard to starboard, and at 1955.30 hrs, the swing of the heading of Ship A attained about 28° to port from the Original Course.

{4} At 1955.34 hrs, with the helm put hard to starboard, the swing of the heading of Ship A attained about 31° to port from the Original Course.

{5} At 1956.09 to 12 hrs, the swing of the heading of Ship A attained about 41° to port from the Original Course.

{6} Due to the port swing inertia caused by previously putting the helm hard to port and also the rotational moment caused by the tidal stream, Ship A swung widely to port and advanced to the center of Kanmon Passage.

(Refer to Attached Figure 5: Variations in the Heading of Ship A, and Attached Figure 6: Plots of the Tactical Diameter of Ship A)

### 3.2.10 Navigation Rules and Guidance

According to 2.1, 2.13.2, 3.1.1 and 3.2.4 to 3.2.9, Ship A and Ship B were navigating in sight of one another in Kanmon Passage, and were in a situation where the Act on Port Regulations and the Ordinance for Enforcement of the said Law, and the Act of Preventing Collision at Sea apply, as described below:

#### (1) Ship A

{1} It is considered probable that, because Ship A tried to overtake Ship C in Kanmon Passage, Article 38, Paragraph 2 of the Ordinance for Enforcement of the Act on Port Regulations apply to Ship A as follows:

In Kanmon Passage, a vessel is permitted to overtake other vessels when, according to the situations, the other vessels do not have to take necessary actions in order to let the vessel safely overtake, or when the vessel is able to avoid the courses of other vessels (hereinafter referred to as the "Overtaking Rule"), and the overtaking vessel shall, by whistle or siren, blow one prolonged blast followed by one short blast when the vessel is overtaking on the starboard side, or one prolonged blast followed by two short blasts when the vessel is overtaking on the port side (hereinafter referred to as "Overtaking Signals") in accordance with the Overtaking Rule.

{2} It is considered probable that, contrary to Master A's judgment that Ship A, which was proceeding at a speed of about 14 kn on the right side of Kanmon Passage, would be able to overtake Ship C, which was proceeding at a speed of about 8 kn near the center of Kanmon Passage, on the starboard side at the west of Kanmon Bridge, it was difficult for Ship A to overtake Ship C on the starboard side because it was predicted that Ship C, proceeding by Kanmon Passage, would alter her course to starboard in the vicinity of Moji Saki and the room for overtaking on the starboard side would narrowed.

{3} It is considered probable that Master A, upon receiving and accepting the message from Kanmon MARTIS, "Overtake on her [Ship C's] port side," took possibly the message to

have enforcement power instead of just a provision of information, and decided to overtake Ship C on the port side.

{4} When Ship A was overtaking Ship C on the port side, Ship B was proceeding on the opposite course about 1 M ahead, and Ship A was likely to come across Ship B in the midst of overtaking in the vicinity of the narrowest part of Kanmon Passage.

It is considered probable that it was difficult for Ship A to overtake Ship C on the port side because it was not certain whether Ship A, which was obligated to keep a sufficiently safe distance from both Ship C and Ship B in the situation where Ship A was overtaking Ship C and then soon coming across Ship B, could safely avoid the course of Ship B in the narrow part of the fairway of Kanmon Passage, in which the width on the port side of Ship C was about 300 m and hence Ship A was unable to have sufficient room to pass Ship B.

Therefore, it is considered probable that, according to Article 38, Paragraph 2 of the Ordinance for Enforcement of the Act on Port Regulations, Ship A was not allowed to overtake Ship C but Ship A did.

{5} It is considered probable that, because Master A did not make Overtaking Signals, Ship B could not know the intention of Ship A, and also that Ship C could not know when she would be overtaken. It is considered somewhat likely that Ship A, during her swinging to port, whistled a blast when the risk of collision with Ship B arose.

## (2) Ship B

{1} It is considered probable that, while Ship B was proceeding westward, Master B thought that Ship A, which Master B had seen and realized was as large as Ship C after seeing Ship C, would proceed along the Kanmon Passage and pass Ship B by following just behind Ship C with putting the helm to starboard in a similar manner to Ship C, which Master B thought would pass Ship B in a short distance upon receiving a report of the CPA to Ship C. In addition, it is considered probable that Officer B had thought that no vessel would overtake in the vicinity of Kanmon Bridge.

{2} It is considered probable that Master B maintained the full speed through the water at about 15 kn, and Ship B was proceeding at about 17 kn due to the effects of the tidal stream.

It is considered probable that if Ship B had used the AIS and radars or monitored the communications exchanged between Kanmon MARTIS and Ship A or Ship C, or if Ship A had made Overtaking Signals, Ship B, which was proceeding toward Kanmon Bridge in a situation where Ship B would meet Ship A and Ship C, would have been able to know exactly that Ship A would overtake Ship C on the port side in the vicinity of Kanmon Bridge, where Ship B would meet Ship A and Ship C.

It is considered somewhat likely that, if Ship B had known the situation as stated above she would have reduced the speed earlier in order to avoid the meeting in the vicinity of Kanmon Bridge in Hayatomo Seto, where the fairway was too narrow and there was no room off the fairway in which to navigate, because Article 16, Paragraph 1 of the Act on Port Regulations requires a vessel navigating in a port area to navigate at such a speed that will produce no hazards for other vessels.

It is considered somewhat likely that the accident would have been avoided if Ship B had been proceeding at a speed of through the water about 12 kn as stated in the navigation plan, or had obtained the information that Ship A was overtaking Ship C and reduced the speed earlier to a safer speed.

{3} It is considered probable that Master B maintained the full speed and made no warning signal although, while expecting Ship A to pass with the helm to starboard, he had a suspicion that Ship A was putting the helm to port judging from the starboard navigation light that became visible and the situation of the masthead lights.

(3) Kanmon MARTIS

{1} It is considered probable that Operator D1, contacting with Ship C, which was ahead of Ship A, and Ship A, which was overtaking Ship C, finally told Ship A as a provision of information to overtake Ship C on the port side and pay attention to Ship B coming 1 M ahead in addition to Ship C shifting to the starboard side, and received the reply from Ship A that Ship A would overtake Ship C on the port side. It is considered probable that, in addition, Operator D1 told Ship A to overtake Ship C on the port side in imperative English, and furthermore, with no message marker because they were not adopted by the Kanmon MARTIS.

{2} It is considered probable that Operator D1, in the situation where Ship A was catching up with Ship C in the vicinity of Hayatomo Seto and Ship B was navigating on the opposite course in the vicinity of Hayatomo Seto as both Ships approached Kanmon Bridge in addition to the situation stated above in {1}, was required to guide Ship A not to overtake according to the Kanmon MARTIS Operation Manual.

{3} It is considered probable that Operator D1 did not provide such required guidance not to overtake because he predicted that Ship A would overtake Ship C after passing the east side exit of Hayatomo Seto waterway due to the effects of the tidal stream and Ship B would pass both Ship A and Ship C before the overtaking, and furthermore, thought that Ship A would never take improper actions as long as she confirmed safe overtaking.

{4} It is considered probable that Operator D1 did not fully grasp the situation of where Ship A would overtake Ship C and how Ship B would pass that position.

{5} It is considered probable that although Ship B navigated at a speed 17 kn, Kanmon MARTIS did not provide the guidance required in Kanmon MARTIS Operation Manual that vessels should navigate at a speed under 15 kn in Kanmon Passage between Nishi-Kaigan and the Tanoura Offing, because Ship B was not such a vessel to which the guidance should be given as a ship or a passenger ferry of 10,000 tons or over.

{6} It is considered probable that Kanmon MARTIS did not inform Ship B that Ship A would overtake Ship C on the port side because Ship A would catch up with and overtake Ship C after passing the east side exit of Hayatomo Seto waterway, Ship B would pass both ships before the overtaking, the course of Ship A was not giving indication of overtaking



Ship C and Ship B was not proceeding near the center of Kanmon Passage. It is considered probable that Operator D2 was handed over the situations on the O Seto Console by Operator D1, checked vessels proceeding eastward in O Seto, conducted surveillance of the vicinities of Hesaki and Tachinoura, and then paid attention to Hayatomo Seto and its vicinity just before the occurrence of the accident.

According to what is stated above, the following is desirable:

For Master A,

{1} To reconfirm the contents of the communications if Master A, in view of the Overtaking Rule, doubts the message received from Kanmon MARTIS, and in addition, to reduce the speed and follow behind the vessel ahead if he is not confident about the overtaking.

{2} To make safety confirmations based on knowledge of the situations surrounding his own ship, and make Overtaking Signals in cases of overtaking in Kanmon Passage.

For Master B,

{1} To confirm the movements of passing vessels by using the AIS, monitoring ship VHF communication on 16 ch as well as other channels(described in “monitoring ship VHF communication”)and using the services of Kanmon MARTIS, take into account the effects of the tidal stream in Hayatomo Seto, and proceed at a safe speed that enables other vessels to freely take actions to avoid collision or produces no hazards for other vessels by the ship waves while navigating in Kanmon Passage.

{2} To send warning signals in cases where the intentions or movements of other vessels are not understandable.

For Operator D1,

{1} To gather accurate information on overtaking or passing situations by operating radars, and when a vessel is found overtaking in Hayatomo Seto and its vicinity in a situation where the vessel will meet a vessel on the opposite course during the overtaking, inform the vessel in question in an early phase of the overtaking that the overtaking is dangerous and guide the vessel in question to hold back from overtaking while informing the vessel on the opposite course that there is an overtaking vessel.

{2} To give information aiming at preventing a collision, such as urging to slow down the speed, if a close quarter situation is predicted.

{3} To add a message marker to the head of a message to be transmitted in order for the ships to understand the intention of the message.

{4} To reconsider the timing of hand-over in such a way that, in a situation where an overtaking is taking place, the hand-over should be done after the overtaking is completed and safe navigation is ensured.

### 3.2.11 Safety Management

#### (1) Ship A

According to 2.5.1 (3) and 2.10.1, the situations of safety management are as follows:

{1} It is considered probable that the safety management of Company A was not sufficient because, although Company A had prepared a check list for passing narrow channels in

accordance with the ISM Code to prepare for navigations in the Kanmon Strait and although Master A had confirmed the item “Judging from the situations around you, are you conducting appropriate navigation?,” in the check list, there were no specific descriptions on what to be noted while passing through a narrow channel, such as observance of the Overtaking Rule or close communications with Kanmon MARTIS.

{2} It is considered probable that Ship A made a position report to Kanmon MARTIS when passing the AS Line to enter the Kanmon Strait.

{3} It is considered probable that Ship A had not obtained sufficient information on the situation of Ship B or Ship C by using the radar or AIS.

{4} It is considered somewhat likely that Ship A, although not being obligated to have a pilot onboard, would have followed the Overtaking Rule properly if a pilot had been onboard.

## (2) Ship B

According to 2.4.1 and 2.10.2, it is considered probable as follows:

{1} Ship B made a position report to Kanmon MARTIS when passing the HS Line to enter the Kanmon Strait.

{2} Although the higher commander of the JMSDF had accepted the navigation plan from Ship B stating that the speed through the water on passing through the Kanmon Strait was about 12 kn, Ship B navigated at a speed through the water of about 15 kn.

{3} Although Ship B had been using the Navigation Manual, there were no descriptions in the manual on obtaining information about the movements of passing vessels by using AIS, monitoring ship VHF communication and using the services provided by Kanmon MARTIS, or about the setting of a safe speed in accordance with the situations.

{4} Although some of the ships of the JMSDF, including Ship B, were equipped with AIS, Master B or Officer B did not use the AIS for the confirmation of the movements of other vessels if necessary. Furthermore, neither Master B nor Officer B collected information on the movements of other vessels which might come across in Hayatomo Seto and its vicinity by any measure of monitoring ship VHF communication or using the services of Kanmon MARTIS.

{5} The higher commander of the JMSDF had not provided sufficient guidance on the collection of information on passing vessels by using AIS, monitoring ship VHF communication and using the services provided by Kanmon MARTIS or on the setting of a safe speed in accordance with situations.

{6} Although Kanmon MARTIS requested Ship B to transmit AIS information after the collision, she was not able to send information because, according to the codes of the JMSDF, the AIS had been set to receive-only.

According to what is stated above, the following is desired:

Company A should add to the check list in Ship A specific measures to follow the Overtaking Rule and to ensure close communication with Kanmon MARTIS, and should obligate the ship to collect information of the movements of the passing vessels by using radar and AIS.

The JMSDF, in order to ensure safe navigation in passing through the Kanmon Strait, should add to the Navigation Manual the collection of information on the movements of passing vessels by monitoring ship VHF communication and using the services provided by Kanmon

MARTIS, and setting a safe speed for passing through the strait. In addition, the transmission of AIS information while passing through narrow strait such as the Kanmon Strait should be considered by the JMSDF because the recipient vessels are able to use such AIS information for navigation.

### 3.2.12 Situations of Practice of Kanmon MARTIS Operation Manuals

According to 2.5.2, 2.7, 2.11 and 2.12, it is considered probable as follows:

#### (1) Kanmon MARTIS Operation Manuals

{1} According to the Operation Regulation, Kanmon MARTIS had been serving to provide special information and information for intermediation of communications between bridges, and in addition, when a vessel against navigation regulations is found, to inform the vessel of the fact and then to correct the navigation (hereinafter referred to as “navigation-violation correction”) using patrol boats.

{2} According to the Operation Procedure, Kanmon MARTIS, regarding collision prevention, evasive actions in an emergency situation, intermediation of communications between bridges and navigation-violation correction, had been providing special information with no enforcement power in order to assist independent decisions of ship-masters. As for the Overtaking Rule, information was provided as special information in relation to correction of navigation.

{3} According to the Operation Manual, Kanmon MARTIS, in addition to special information for collision prevention, correction of navigation and speed, had been providing guidance for correction of navigation to vessels navigating improperly in order to prevent collisions. As for speed guidance, Kanmon MARTIS, in accordance with the Operation Manual which requests Operator to guide vessels to navigate below 15 kn while navigating between Nishi-Kaigan and the Tanoura Offing in Kanmon Passage, had been requesting such large vessels passing by as ships or passenger ferries of 10,000 tons or over to cooperate and control the speed below 15 kn.

{4} The Service Procedure requests the Operator at the O Seto Console to guide vessels, by providing route information and special information, not to overtake in Hayatomo Seto and its vicinity, especially when there is a vessel on the opposite course.

However, what the Operator could do through VHF communications was to provide information according to the way of 2.7 (5) {4} that the vessel in question was informed that the overtaking is dangerous and was requested to give up the overtaking. In addition, the timing of the information provision, the criteria of when the guidance or navigation-violation correction should be carried out and the specific contents of such messages to be delivered had been left to the judgment of the Operator according to the actual situations.

Furthermore, as stated in 2.7 (5) {5}, any message marker was not used.

#### (2) Surveillance

{1} Each console was assigned a surveillance area of the Kanmon Strait, and one Operator

for surveillance.

{2} No night-vision video cameras were installed.

### (3) Orientation and Training

Kanmon MARTIS had provided the Operator with orientation and training necessary for serving as an Operator. However, Operator D1 and D2 had little on-site experience related to vessel navigation such as experience on board a ship navigating the Kanmon Strait. In addition, no certificate was required to serve as an Operator.

According to what is stated above, it is desired that Kanmon MARTIS should revise Kanmon MARTIS Operation Manual in such a way that the specific contents of messages using a message marker to be delivered for information on overtaking in a situation where there is a vessel on the opposite course and the decision criteria along with the timing of the guidance or navigation-violation correction are included in the manuals, and in addition, should provide the Operator with more sufficient training. As for the Operator, it is especially desired that their operational competence should be enhanced by such means as actual experience of navigating in the Kanmon Strait on board large ships, and in addition, a competence certification system should be established in accordance with international trends. Furthermore, it is desired to install night-vision video cameras for better surveillance at night time.

#### 3.2.13 Occurrence of Accident

According to 2.1, 3.1 and 3.2.1 to 3.2.12, it is as follows:

##### (1) Ship A

{1} It is considered probable that Ship A, while navigating eastward in Kanmon Passage under the navigation command of Master A, was approaching the starboard side of Ship C thinking that it would be possible to overtake Ship C at the west of Kanmon Bridge due to the speed difference between both ships.

{2} It is considered probable that Ship A, on the receipt of the message from Kanmon MARTIS, "Overtake on her port side, QUEEN ORCHID is moving to starboard side, but 1 mile ahead of you, a Japanese Navy ship is coming. Pay attention," replied that Ship A would overtake on the port side.

It is considered somewhat likely that the crew on Ship A's bridge doubted the message about overtaking Ship C on the port side from Kanmon MARTIS as there was a voice in the bridge saying, "Do we have to overtake on her port side? A head-on vessel is getting closer to us."

{3} It is considered somewhat likely that Master A took the message to have enforcement power instead of just provision of information. It is considered probable that Ship A decided to overtake Ship C on the port side in the situation where Ship A had approached the starboard side of Ship C; reduced the speed to slow ahead in the vicinity of Hayatomo Seto, west of Kanmon Bridge; put the helm 10° to port and eventually put the helm hard to port because Ship A came close to Ship C; and passed about 70 m astern of Ship C.

{4} It is considered probable that Master A, although having cleared the stern of Ship C

and having put the helm amidships, Ship A advanced to the center of Kanmon Passage, and she also put the helm hard to starboard being aware of a risk of collision with Ship B but collided with Ship B before Ship A obtained a rudder effect.

{5} It is considered probable that Master A did not pay attention to the movement of Ship B because Ship A was too close to Ship C, and furthermore, he made no Overtaking Signals either.

{6} It is considered probable that Ship A, due to the port swinging inertia of the helm hard-a-port and the port side rotational moment caused by the tidal stream, swung widely to port, advanced to the center of Kanmon Passage, and proceeded ahead of Ship B.

{7} It is considered probable that Ship A, which had tried to overtake in Kanmon Passage, should not have overtaken, in accordance with Article 38, Paragraph 2 of the Ordinance for Enforcement of Act on Port Regulations, because the overtaking position was near Kanmon Bridge; the starboard side clearance of Ship C would decrease as Ship C put the helm to starboard along Kanmon Passage; the port side clearance would decrease as Ship B was coming on the opposite course; and as a conclusion it was difficult to overtake Ship C on either of the starboard side or the port side.

{8} It is considered somewhat likely that, although Ship A possibly had doubted the message from Kanmon MARTIS, if Ship A had confirmed the intention of Kanmon MARTIS, Ship A would not have attempted the overtaking around Kanmon Bridge and as a result would have been able to prevent the accident.

{9} It is considered probable that the safety management of Company A was improper because the check list for navigation through narrow channels included no specific descriptions of what to be noted, such as measures to follow the Overtaking Rule or to keep close communications with Kanmon MARTIS, which should have been applied to Ship A in navigating the Kanmon Strait.

## (2) Ship B

{1} It is considered probable that although Ship B's navigation plan for the Kanmon Strait had prescribed the speed through the water at about 12 kn, Ship B, while navigating westward by Kanmon Passage under the command of Officer B, who was supervised by Master B, was navigating at a speed of about 17 kn at the Tanoura Offing due to the effects of the tidal stream, faster than the full speed though the water at about 15 kn, which had been set before entering Kanmon Passage based on the judgment on the situations where there were no vessels on the same course ahead except for a small vessel and also due to the intention to pass through the Kanmon Strait quickly so as to have sufficient time for scheduled work.

{2} It is considered probable that Master B saw Ship C and judged that it was a large vessel on the opposite course navigating along Kanmon Passage with putting the helm to starboard because Ship C, which had shown the starboard navigation light, changed to

show the port navigation light.

{3} It is considered probable that after seeing Ship C, Master B saw Ship A and thought that it was as large a vessel as Ship C and would navigate along the fairway like Ship C. In addition, it is considered probable that Officer B had no idea that a vessel would overtake another near Kanmon Bridge.

{4} It is considered somewhat likely that the fact that Master B maintained the full speed through the water at about 15 kn, which meant that Ship B was navigating at a speed of about 17 kn due to the effects of the tidal stream, was related to the occurrence of the accident. Master B's decision to maintain such speed was based on his judgment that Ship C would come close to Ship B but pass by her upon receiving the report that the CPA to Ship C would be about 183 m and Ship A, which was following close behind Ship C, also would pass Ship B by putting the helm to starboard in a similar manner to Ship C.

{5} It is considered probable that Master B, although suspecting that Ship A, which he had previously thought was putting the helm to starboard, put the helm to port because Ship A was showing the starboard navigation light, kept Ship B navigating at a speed of about 17 kn, and furthermore, made no warning signals.

{6} It is considered probable that Officer B, because the attitude of Ship A had not shown changes, wondered why Ship A was not putting the helm to starboard, and upon being warned by Master B that Ship A might have put the helm to port, set both engines to stop and then to full astern.

{7} It is considered probable that, although Master B put the helm hard to starboard while the rudder angle was changing to port due to the helm hard-a-port operation of Officer B, Ship B collided with Ship A.

{8} It is considered somewhat likely that, because Ship B was proceeding in Hayatomo Seto toward Kanmon Bridge and was in a situation where Ship B would come across Ship A and Ship C, if Master B had used AIS to confirm the sizes and movements of Ship A and Ship C, monitored the communications to and from Kanmon MARTIS with Ship A and Ship C, and confirmed the movements by using radars properly or using the services by Kanmon MARTIS, he could have grasped the following situations: that Ship A and Ship C were large vessels; that both ships would come across Ship B near Kanmon Bridge in Hayatomo Seto; and that Ship A would overtake Ship C on the port side near Kanmon Bridge.

{9} It is considered somewhat likely that the accident could have been prevented if Master B had had accurate knowledge of the movements of Ship A and Ship C and the position in which Ship A and Ship C would meet, or if Ship A had made Overtaking Signals while overtaking Ship C, because Ship B would have reduced her speed and navigated at a safe speed as the fairway width was narrow around Kanmon Bridge in Hayatomo Seto and, furthermore, there were no room in which to navigate off the fairway.

{10} It is considered probable that, although Master B had made the navigation plan for passing through the Kanmon Strait and submitted it to the higher commander, the Navigation Manual did not include descriptions for obtaining movements of passing vessels by using AIS, monitoring ship VHF communication and using the service provided by Kanmon MARTIS, or applying a safe speed depending on situations. It is considered probable that the higher commander had not provided proper safety management for passing through the Kanmon Strait because the higher commander had not provided Ship B with sufficient guidance including obtaining movements of passing vessels through using AIS, monitoring ship VHF communication and using the service provided by Kanmon MARTIS or applying a safe speed depending on situations.

(3) Kanmon MARTIS

{1} It is considered probable that Kanmon MARTIS had assigned Operators and had been providing navigation guidance in accordance with the Kanmon MARTIS Operation Manual, based on traffic information in the Kanmon Strait collected through the high-performance radars and the AIS equipment and shown on the radar displays with a 15 to 20 second lag, and that Operator D1 had been conducting surveillance of the waters between O Seto and Kanmon Bridge in the Kanmon Strait until two minutes before the occurrence of the accident.

{2} It is considered probable that, at about 1948 hrs, Operator D1, according to the information obtained through the radar, thought that Ship A proceeding eastward in Kanmon Passage would overtake Ship C in the vicinity of the Hayatomo Seto.

{3} It is considered probable that, at about 1952 hrs, Operator D1 told Ship C by VHF as a provision of information, "Vessel behind you, vessel behind you, CARINA STAR is approaching you. Her speed is 14 kn. Pay attention."

It is considered probable that, at that time, Operator D1 received from Ship C the reply, "OK, OK. It's surpassing. Overtake me on my port side," answered "OK. Then you should keep starboard side. You are now middle of the fairway. Move to starboard side right now. Over," and received from Ship C the reply, "OK, OK. I will be a little course to starboard side."

{4} It is considered probable that, at about 1953 hrs, Operator D1 told Ship A as a provision of information, "Vessel ahead of you, QUEEN ORCHID is moving to the starboard side, so please overtake on her port side. Over" and received from Ship A the message, "OK, roger. I will overtake."

It is considered probable that Operator D1, for confirmation, informed Ship A again, "Overtake on her port side. QUEEN ORCHID is moving to starboard side, but 1 mile ahead of you, a Japanese navy vessel is coming. Pay attention. Over," and received the reply, "Ok, thank you, I will overtake on my port side."

{5} It is considered probable that Kanmon MARTIS gave the messages described in {3} and {4} as a provision of information. However, it is considered somewhat likely that Ship A took those messages to have enforcement power instead of just a provision of information

because they were in the imperative form in English and those messages did not have a message marker, which was not adopted by Kanmon MARTIS.

{6} It is considered probable that Operator D1 was required to guide Ship A in accordance with the Kanmon MARTIS Operation Manual in such a way that Ship A should not overtake because Ship A would catch up with Ship C in the vicinity of Hayatomo Seto, where Ship B was proceeding on the opposite course, and because of the situations described above in {4}.

{7} It is considered probable that Operator D1 did not give such guidance because he thought that Ship A would overtake Ship C after passing the east side exit of Hayatomo Seto waterway due to the effects of the tidal streams and Ship B would pass Ship A and Ship C before the overtaking, and because Operator D1 thought that Ship A would take no improper actions as long as she confirmed safe overtaking.

{8} It is considered somewhat likely that the fact that Operator D1 had no accurate knowledge of the position where Ship A would overtake Ship C or how Ship B would pass there was related to the occurrence of the accident.

It is considered probable that Operator D2 was handed over the situations on the O Seto Console from Operator D1, checked vessels proceeding eastward in O Seto, conducted surveillance of the Hesaki area and Tachinoura area, and then paid attention to Hayatomo Seto and its vicinity just before the occurrence of the accident.

{9} It is considered probable that Kanmon MARTIS provided no guidance to Ship B because Ship B was less than 10,000 tons and was not such a large ship as to navigate at a speed below 15 kn in order to ensure the safety of vessels moored at berths.

It is considered probable that Kanmon MARTIS, although having judged that Ship A would catch up with Ship C Hayatomo Seto and its vicinity, did not inform Ship B of such situations which Ship A would overtake Ship C to the starboard side, because Ship A would overtake Ship C after passing the east side exit of Hayatomo Seto waterway, Ship B would pass both ships before the overtaking, the course of Ship A was not giving indication of overtaking Ship C and Ship B had been proceeding off the center of Kanmon Passage.

{10} It is considered somewhat likely that Kanmon MARTIS would have prevented the occurrence of the accident if it had provided guidance not to overtake in accordance with the knowledge obtained through the surveillance described above in {8} and had properly provided the information described above in {9}.

(Refer to Attached Figure 9: Summarized Cause Flow Diagram)

#### 3.2.14 Post-Accident Activities

According to 2.4, it is considered probable as follows:

##### (1) Cause of fire

Due to the shock caused by the collision between Ship A and Ship B, the cans stored in the bow storage room of Ship B, which contained paint thinner categorized as petroleum



category No. 1, were broken, the flammable mixture of gas including thinner was ignited by sparks generated by the hard contact of steel plates upon the collision of the hulls, and fire broke out.

(2) Fire fighting

The crew members of Ship A and Ship B, the Japan Coast Guard and the Kita-Kyushu City Fire and Disaster Management Bureau fought the fire to prevent the spread of the fire on Ship A and Ship B.

(3) Actions to Avoid Grounding

{1} Master B prevented a second accident by appropriate ship handling to separate both ships and prevent them from grounding since they were in contact with each other and drifting toward Shimonoseki due to the pressure of the west-going tidal stream.

{2} Kanmon MARTIS properly provided necessary information to the vessels on traffic in order to prevent a second accident.

## 4 CONCLUSIONS

### 4.1 Findings

(1) Events leading to the Accident

It is considered probable that Ship A, proceeding eastward along Kanmon Passage commanded by Master A, and Ship B, proceeding westward along Kanmon Passage commanded by Officer B under the supervision of Master B, collided with each other at around 294°, 330 m from the Moji Saki Light House in Hayatomo Seto at 1956.09–12 hrs October 27, 2009, after Ship A, which was overtaking Ship C ahead of her near Hayatomo Seto, proceeded ahead of Ship B crossing over the center of Kanmon Passage, and after Ship B proceeded on the right side of Kanmon Passage, in a situation where Ship B would meet Ship A and Ship C in Hayatomo Seto, at a speed of about 17 kn until just before the collision.

(2) Ship A's Movements of Proceeding ahead of Ship B to overtake Ship C

{1} It is considered probable that Ship A, expecting that her speed advantage over Ship C, which was proceeding ahead of Ship A, would enable Ship A to overtake Ship C around the west of Kanmon Bridge, continued to proceed in a situation where Ship A was approaching the starboard side of Ship C.

{2} It is considered somewhat likely, judging from the voices in Ship A's bridge saying, "Do we have to overtake on her port side? A head-on vessel is getting closer to us," that although Ship A had responded, saying that she would overtake Ship C on her port side, to the message from Kanmon MARTIS; "Overtake Ship C on her port side. Ship C is moving to the starboard side, but one mile ahead of you, a Japanese Navy Ship is coming. Pay attention," Ship A doubted the contents of the message to overtake Ship C on the port side from Kanmon MARTIS.

{3} It is considered somewhat likely that Master A took the message to have enforcement power instead of just provision of information. It is considered probable that Ship A decided to

overtake Ship C on her port side although Ship A had approached the starboard side of Ship C, reduced the speed in the vicinity of Hayatomo Seto, west of Kanmon Bridge and put the helm to port, then put the helm hard to port because Ship A came close to Ship C, and then passed about 70 m astern of Ship C.

{4} It is considered probable that Ship A, due to the port swinging inertia of the helm hard-a-port and the port side rotational moment caused by the tidal stream, swung widely to port, advanced to the center of Kanmon Passage, and proceeded ahead of Ship B.

{5} It is considered probable that Master A did not pay attention to the movement of Ship B, because Ship A was too close to Ship C, and he made no Overtaking Signals either.

{6} It is considered probable that Ship A, which had tried to overtake in Kanmon Passage, should not have overtaken, in accordance with Article 38, Paragraph 2 of the Ordinance for Enforcement of Act on Port Regulations, because the overtaking position was near Kanmon Bridge; the starboard side clearance of Ship C would decrease as Ship C put the helm to starboard along Kanmon Passage; the port side clearance would decrease as Ship B was coming on the opposite course; and as a conclusion it was difficult to overtake Ship C on either of the starboard side or the port side.

{7} It is considered probable, judging from the fact that the check list for navigation through narrow channels prepared by Company A did not include specific descriptions on what to be noted, such as measures to follow the Overtaking Rule or to keep close communications with Kanmon MARTIS, that Company A had not properly practiced the safety management for Ship A with regard to navigation in narrow channels.

(3) Situations of Ship B having continued to proceed at a Speed of about 17 kn until the last minute before the Collision

{1} It is considered probable that although Ship B's navigation plan for the Kanmon Strait had prescribed the speed through the water at about 12 kn, Ship B was navigating at a speed of about 17 kn at the Tanoura Offing due to the effect of the tidal stream, faster than the full speed through the water at about 15 kn, which had been set before entering Kanmon Passage based on the judgment on the situation where there were no vessels on the same course ahead except for a small vessel and also due to the intention to pass through the Kanmon Strait quickly so as to have sufficient time for scheduled work.

{2} It is considered probable that after seeing Ship C, Master B saw Ship A and thought that it was as large vessel as Ship C and would navigate along the fairway like Ship C. In addition, it is considered probable that Officer B had no idea that a vessel would overtake another near Kanmon Bridge.

{3} It is considered probable that Master B thought that Ship C would approach and pass Ship B, and expected that Ship A would turn to starboard and pass in the same way as that taken by Ship C because Ship A was proceeding just behind Ship C, and that Master B maintained the full speed through the water at about 15 kn and, as a result, let Ship B proceed at a speed of about 17 kn.

{4} It is considered probable, judging from the fact that the Navigation Manual had no prescriptions on the use of AIS, no prescriptions on monitoring ship VHF communication, no prescriptions on the collection of information on the movements of passing vessels by the use of the service provided by Kanmon MARTIS, and no prescriptions on applying a safe speed depending on situations, and also the fact that no sufficient guidance on those matters had

been provided to Ship B, that the higher commander of Ship B had not properly practiced the safety management for passing through the Kanmon Strait.

(4) Collision Avoidance Actions by Ship A and Ship B

{1} It is considered probable that Master A, although having cleared the stern of Ship C and having put the helm amidships, Ship A advanced to the center of Kanmon Passage, and she also put the helm hard to starboard being aware of a risk of collision with Ship B but collided with Ship B before Ship A obtained a rudder effect.

{2} It is considered probable that Master A made no Overtaking Signals when Ship A overtook Ship C on her port side.

{3} It is considered probable that Master B, although suspecting that Ship A, which he had thought was putting the helm to starboard, put the helm to port because Ship A was showing the starboard navigation light and her masthead lights, he continued to let Ship B navigate at a speed of about 17 kn, and made no warning signals.

{4} It is considered probable that Officer B, because the attitude of Ship A had not shown changes, wondered why Ship A was not putting the helm to starboard, and upon being warned by Master B that Ship A might have put the helm to port, set both engines to stop and then to full astern.

{5} It is considered probable that, although Master B put the helm hard to starboard while the rudder angle was changing to port due to the helm hard-a-port operation of Officer B, Ship B collided with Ship A.

(5) Guidance provided by Kanmon MARTIS

{1} It is probable that Operator D1, according to the information obtained through the radar, thought that Ship A proceeding eastward in Kanmon Passage would overtake Ship C after passing the east side exit of Hayatomo Seto waterway.

{2} It is considered probable that Operator D1 made communications by VHF with Ship C proceeding ahead of Ship A, and with Ship A overtaking Ship C, and finally sent a message to Ship A, as information provision, saying that Ship A should overtake Ship C on her port side and, although Ship C had moved to the starboard side, Ship A should pay attention to Ship B sailing one M ahead, and received a reply from Ship A that she would overtake Ship C on her port side.

It is considered somewhat likely that Master A took those messages to have enforcement power instead of just a provision of information because they were in the imperative form in English and those messages did not have a message marker, which was not adopted by Kanmon MARTIS.

{3} It is considered probable, judging from the situations where it became more likely that Ship A would catch up with Ship C in the vicinity of Hayatomo Seto as the vessels approached the Kanmon Bridge, that, because Ship B on the opposite course approached Hayatomo Seto and Operator D1 had received a message from Ship A showing her intention to overtake Ship C, Operator D1 should have provided guidance, according to the “Kanmon MARTIS Operation Manual,” to Ship A by informing that overtaking was prohibited.

It is considered probable that Operator D1 did not give such guidance because he thought that, due to the tidal stream effect on Ship A and Ship B, Ship A would overtake Ship C after passing the east side exit of Hayatomo Seto waterway and Ship B would pass both ships

before the overtaking, and moreover, that Ship A would take no improper actions as long as she confirmed safe overtaking.

{4} It is considered probable that Operator D1 did not have accurate knowledge of the position where Ship A would overtake Ship C and how Ship B would pass there.

{5} It is considered probable that Kanmon MARTIS provided no guidance to Ship B to navigate at a speed of below 15 kn in order to ensure the safety of vessels moored at berths, because Ship B was not such a large vessel as a ship or a passenger ferry of 10,000 tons or over.

{6} It is considered probable that Kanmon MARTIS, having judged that Ship A would catch up with Ship C in the vicinity of Hayatomo Seto and overtake Ship C after passing the east side exit of Hayatomo Seto waterway, Ship B would pass both ships before the overtaking, the course of Ship A was not giving indication of overtaking Ship C, and Ship B had been proceeding off the center of Kanmon Passage, did not inform Ship B of such situation which Ship A would overtake Ship C to the starboard side.

#### (6) Causal Factors of Accident

{1} It is considered probable that Ship A, while navigating eastward in the vicinity of Hayatomo Seto in Kanmon Passage, as a result of her action of trying to overtake Ship C proceeding ahead in a situation where Ship A was approaching Ship C on her starboard side, advanced ahead of Ship B, which was proceeding westward along the right side of Kanmon Passage, and collided with Ship B.

{2} It is considered somewhat likely that Master A took the message by Kanmon MARTIS to overtake Ship C on her port side as having enforcement power instead of just a provision of information. It is considered probable that Master A consequently decided to overtake Ship C on her port side.

{3} It is considered probable that Ship A advanced to the center of Kanmon Passage and proceeded ahead of Ship B, because when Master A tried to overtake Ship C on her port side in the situation where Ship A had been approaching the starboard side of Ship C, Ship A had swung widely to port due to the port swinging inertia of the helm hard-a-port and the port side rotational moments caused by the tidal stream after reducing speed, when she came close to Ship C.

{4} It is considered somewhat likely that, while Master B had seen Ship C on the opposite course and Ship A behind Ship C, the action taken by Master B of keeping Ship B proceeding at a speed of about 17 kn based on the expectation that Ship A would turn to starboard and pass Ship B was related to the occurrence of the accident.

{5} It is considered somewhat likely that Operator D1 did not have accurate knowledge of the position where Ship A would overtake Ship C and how Ship B would pass there was related to the occurrence of the accident.

## 4.2 Probable Causes

It is considered probable that the accident occurred at night in Hayatomo Seto and its vicinity of Kanmon Passage with a tidal stream of about 1.3–2.7 kn SW, while Ship A was proceeding eastward and Ship B was proceeding westward, and that the vessels collided with each other in the situation where Ship A had approached Ship C's starboard side and then tried to overtake Ship C on her port side, which, as a result, made Ship A proceed ahead of Ship B, which was proceeding on the

right side of Kanmon Passage.

It is considered somewhat likely that the reason for Ship A's action of trying to overtake Ship C on her port side in the situation where Ship A had approached the starboard side of Ship C was that Master A had taken the message sent by Kanmon MARTIS for just a provision of information as an enforcement power.

It is considered probable that Ship A's movements of proceeding ahead of Ship B when Ship A tried to overtake Ship C on her port side was due to the wide swinging of Ship A to port caused by the port-swinging inertia of the helm hard-a-port and the port side rotational moment by the tidal stream after having reduced the speed in the situation where Ship A had approached the starboard side of Ship C while overtaking Ship C.

It is considered somewhat likely that the Operator of Kanmon MARTIS did not have accurate knowledge of the position where Ship A would overtake Ship C and how Ship B would pass there was related to the occurrence of the accident.

It is considered somewhat likely that the movements of Ship B of proceeding at a speed of about 17 kn was related to the occurrence of the accident.

## 5 OPINIONS

### 5.1 Opinions to the Commandant of the Japan Coast Guard

It is considered probable that the accident occurred at night in the vicinity of Hayatomo Seto in Kanmon Passage with a tidal stream of about 1.3–2.7 kn SW, while Ship A was proceeding eastward and Ship B was proceeding westward, and that the vessels collided with each other in a situation where Ship A had approached Ship C's starboard side and then tried to overtake Ship C on her port side, which, as a result, made Ship A proceed ahead of Ship B, which was proceeding on the right side of Kanmon Passage.

It is considered somewhat likely that the reason for Ship A's action of trying to overtake Ship C on her port side in the situation where Ship A had approached the starboard side of Ship C was that Master A had taken the message sent by Kanmon MARTIS for just a provision of information as an enforcement power because they were in the imperative form in English without message markers on the message, which were not adopted by Kanmon MARTIS.

In addition, it is considered somewhat likely that the Operator of Kanmon MARTIS did not have accurate knowledge of the position where Ship A would overtake Ship C and how Ship B would pass there was related to the occurrence of the accident.

Furthermore, it is considered somewhat likely that the movements of Ship B of proceeding at a speed of about 17 kn were related to the occurrence of the accident.

Therefore, in view of the result of this accident investigation, the Japan Transport Safety Board expresses its opinions as follows to the Commandant of the Japan Coast Guard pursuant to Article 28 of the Act for Establishment of the Japan Transport Safety Board in order to assure the safe navigation of vessels passing Kanmon Port:

(1) Revising the Kanmon MARTIS Operation Manual and others

It is desirable that the Kanmon MARTIS Operation Manuals should be revised according to the following items, and at the same time, that they should be practiced properly:

{1} Revising the Kanmon MARTIS Operation Manual

In order to ensure proper implementation of the Overtaking Rule in the Kanmon Strait in accordance with the Act on Port Regulations, criteria to decide which action should be taken,

information provision, guidance or correction of navigation-rule violation, and messages to be delivered should be prescribed for Hayatomo Seto and its vicinity.

{2} Implementation of the Overtaking Rule

In order to ensure proper implementation of the Overtaking Rule in Kanmon Passage in accordance with the Act on Port Regulations, information should be provided to vessels in advance to inform that overtaking in Hayatomo Seto and its vicinity should be avoided because it is dangerous when there is a vessel on the opposite course.

{3} Public announcement of the use of the international standard communication procedures

The Kanmon MARTIS should inform vessels passing the Kanmon Strait that Kanmon MARTIS use message markers when giving information, advice or instruction based on the international standards.

(2) Notification of the Overtaking Rule and Navigation Speed

It is desirable that Kanmon MARTIS should make public notifications on specific situations in which overtaking in the Kanmon Strait should be avoided, as well as the area where a speed of 15 kn or less is recommended in order to ensure the safety of ships moored at berths.

(3) Reinforcement of Surveillance Arrangement

It is desirable that, in order to reinforce the surveillance arrangement, Kanmon MARTIS should consider the following:

{1} Establishment of qualification system for Operators

Kanmon MARTIS should establish a qualification system for Operators in order to ensure the supply of competent Operators, in addition to the training sessions for Operators that have been held.

{2} Monitoring by Operators

a. Reinforcement of monitoring

Monitoring should be reinforced, for example, by more than one Operator, when overtaking is going to take place while there is a vessel on the opposite course. In addition, handover operation should take place after the overtaking is completed and safety is secured.

b. Night vision systems

Night vision systems which enable the Operators to monitor vessels passing by at night time should be installed in addition to the cameras which have been installed for monitoring in day time.

## 5.2 Opinions to the Minister of Defense

It is considered probable that the accident occurred at night in the vicinity of Hayatomo Seto in Kanmon Passage with a tidal stream of about 1.3–2.7 kn SW, while Ship A was proceeding eastward and Ship B was proceeding westward, and that the vessels collided with each other in the situation where Ship A had approached Ship C's starboard side and then tried to overtake Ship C on her port side, which, as a result, made Ship A proceed ahead of Ship B, which was proceeding on the right side of Kanmon Passage.

It is considered somewhat likely that the movements of Ship B of proceeding at a speed of about 17 kn were related to the occurrence of the accident. Moreover, it is considered probable that such navigation taken by Ship B was due to the safety management for passing through the Kanmon Strait which was not appropriate with the lack of sufficient guidance to Ship B to collect information on the movements of other vessels through the AIS, monitoring ship VHF

communication and use of the services provided by Kanmon MARTIS as well as sufficient guidance on setting a safe speed depending on the situations.

Therefore, in view of the result of the accident investigation, the Japan Transport Safety Board expresses its opinions as follows to the Minister of Defense pursuant to Article 28 of the Act for Establishment of the Japan Transport Safety Board in order to ensure the safe navigation of vessels passing Kanmon Port:

(1) Revising the Navigation Manual for passing through the Kanmon Strait

It is desirable that the related items in the Navigation Manual should be revised so as to include the following:

{1} Collection of information on the movements of other vessels through the AIS, monitoring ship VHF communication and use of the services provided by Kanmon MARTIS

{2} Safe speed for navigation in the Kanmon Strait

(2) The application of the AIS

It is desirable that the JMSDF ships should make sure to transmit AIS information when navigating narrow channels, including the Kanmon Strait, because such information helps reception vessels.

## 6 SAFETY RECOMMENDATIONS

It is considered probable that the accident occurred at night in the vicinity of Hayatomo Seto in Kanmon Passage with a tidal stream of about 1.3–2.7 kn SW, while Ship A was proceeding eastward and Ship B was proceeding westward, and that the vessels collided with each other in the situation where Ship A had approached Ship C's starboard side and then tried to overtake Ship C on her port side, which, as a result, made Ship A proceed ahead of Ship B, which was proceeding on the right side of Kanmon Passage.

It is considered somewhat likely that the reason for Ship A's action of trying to overtake Ship C on her port side in the situation where Ship A had approached the starboard side of Ship C was that Master A had taken the message sent by Kanmon MARTIS for just a provision of information as an enforcement power because they were in the imperative form in English without message markers on the message, which were not adopted by Kanmon MARTIS.

In view of the result of this accident investigation, the Japan Transport Safety Board recommends Company A to take the following into consideration and take necessary actions.

Company A should establish directions for practicing the overtaking navigation rule in the Kanmon Strait, keeping close communication with Kanmon MARTIS, and using AIS information appropriately, and then should train the crewmembers to be familiarized with them. Company A also should train the crewmembers in order for them to have accurate knowledge of message markers and the master's relationship with the VTS, taking into account the amendments of the Act on Port Regulation on July 1, 2010.

## 7 ACTIONS TAKEN

### 7.1 Application of Message Markers

On July 1, 2010, Kanmon MARTIS started using message markers in communications in accordance with the amendments of the relevant laws and regulations described as follows:

(1) Amendments of the Act on Port Regulations, etc

The Act on Port Regulations was amended to have new provisions: Article 14-2 on giving instruction; Paragraph 4 of Article 37 on making advice; Paragraph 1 of Article 37-3 on providing information; and Paragraph 1 of Article 37-4 on making advice. The amended Japan Coast Guard Organization Ordinance prescribes that Kanmon MARTIS implements the new provisions in Kanmon Port.

(2) Amendments of the Ordinance for Enforcement of the Radio Act

The communications between Coast Guard radio stations and ship stations pursuant to the provisions of the Act on Port Regulations are defined as communications not restricted by the purpose of the stations stated in their licenses.

### 7.2 Actions taken by Kanmon MARTIS

(1) Kanmon MARTIS revised Kanmon MARTIS Operation Manual to start using message markers as described in the above, 7.1 Application of Message Markers.

(2) Kanmon MARTIS has been deployed with five supervising Operators in charge of the supervision and coordination of services related to advice, etc.

(3) Kanmon MARTIS secured its budget to install night-vision apparatus.

### 7.3 Action taken by Japan Maritime Self-Defense Force

JMSDF revised its policy on AIS operation on January 27, 2010 as follows:

*If deemed necessary for safe navigation, such as when passing an area which is congested or anticipated to be congested, JMSDF's ship may receive and transmit AIS information when needed subject to paying attention to its security.*



Figure 1: Plots of Estimated Ship Positions (Overview)

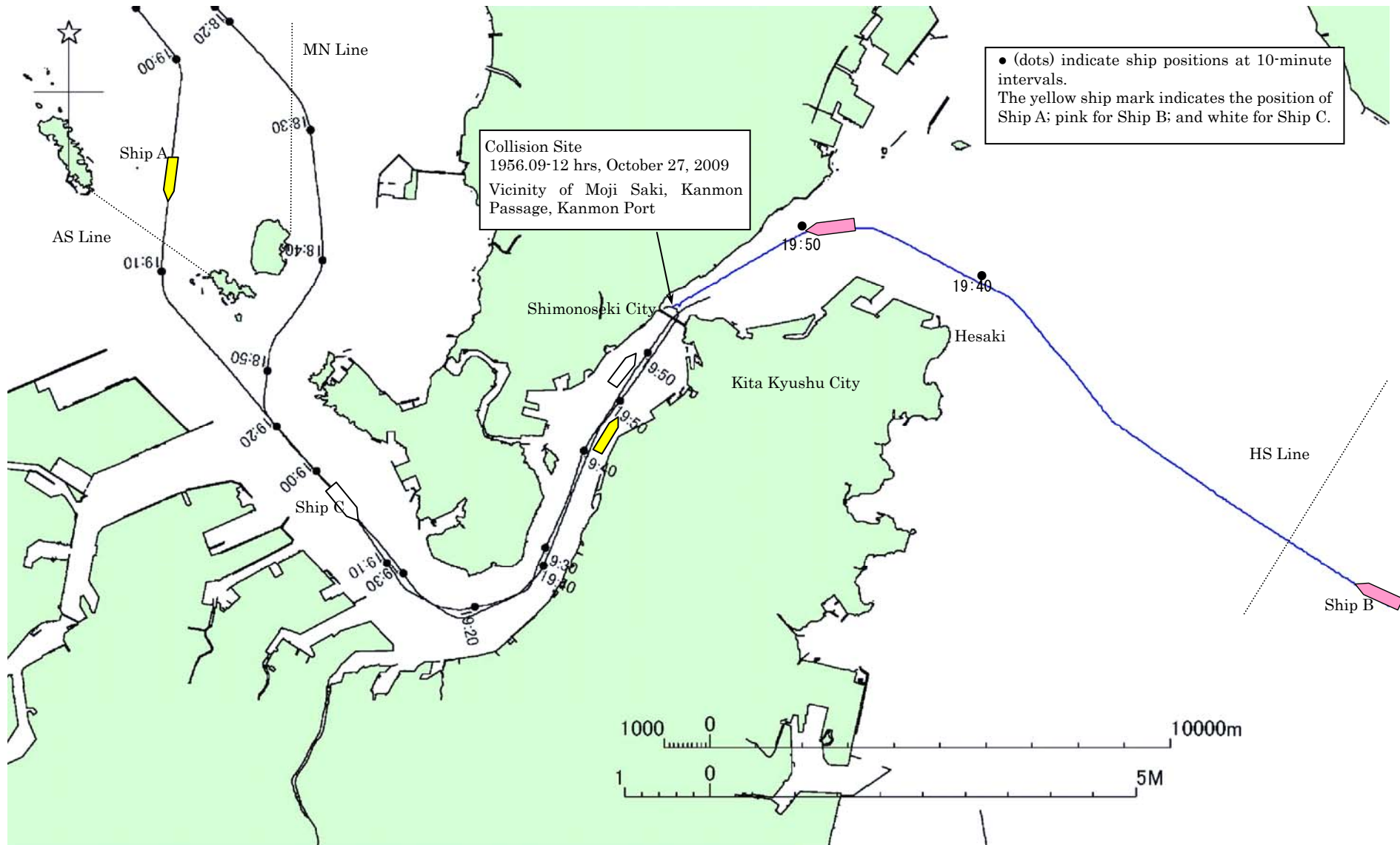


Figure 2: Plots of Estimated Ship Positions (Close-up 1)

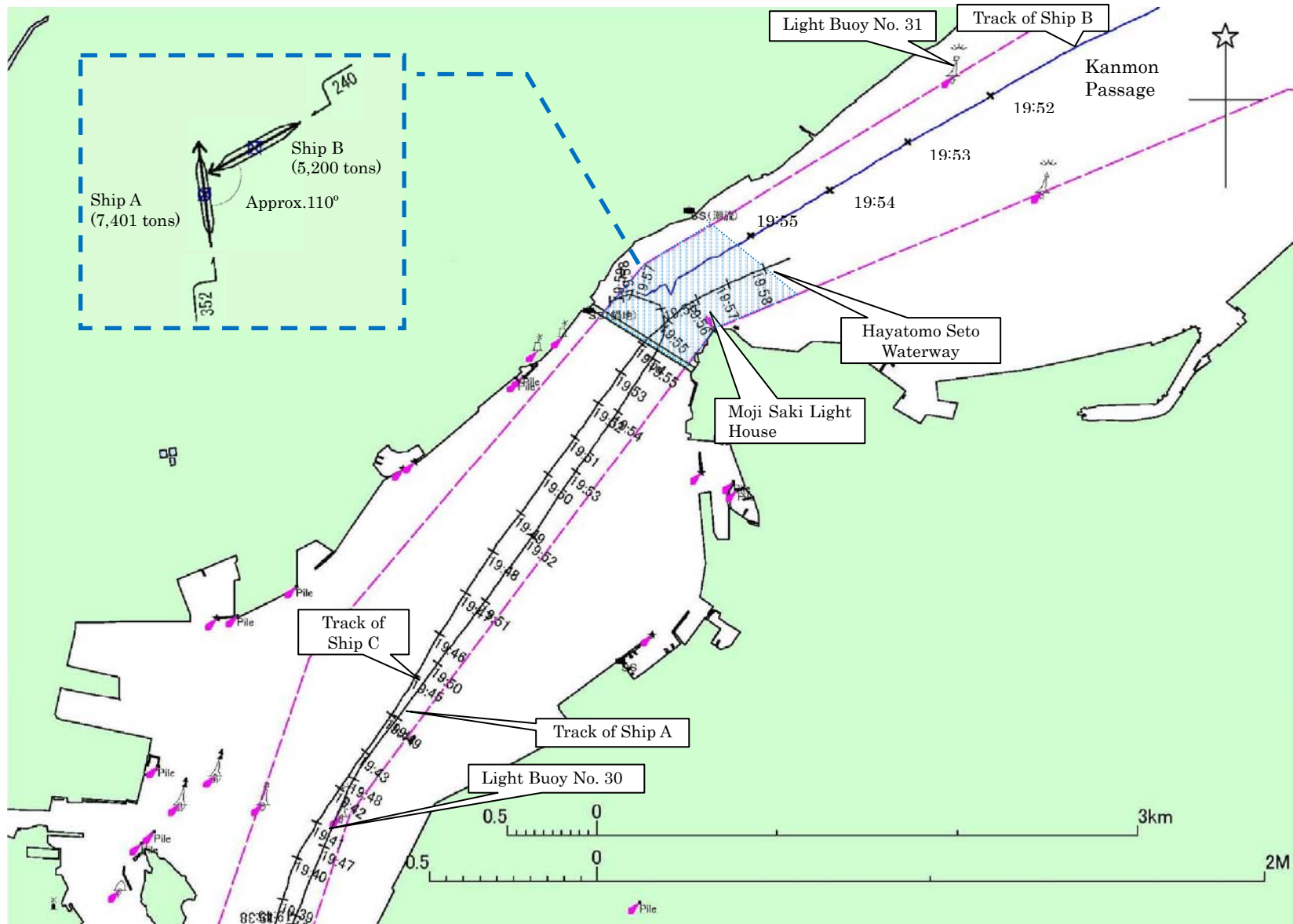


Figure 3: Plots of Estimated Ship Positions (Close-up 2)

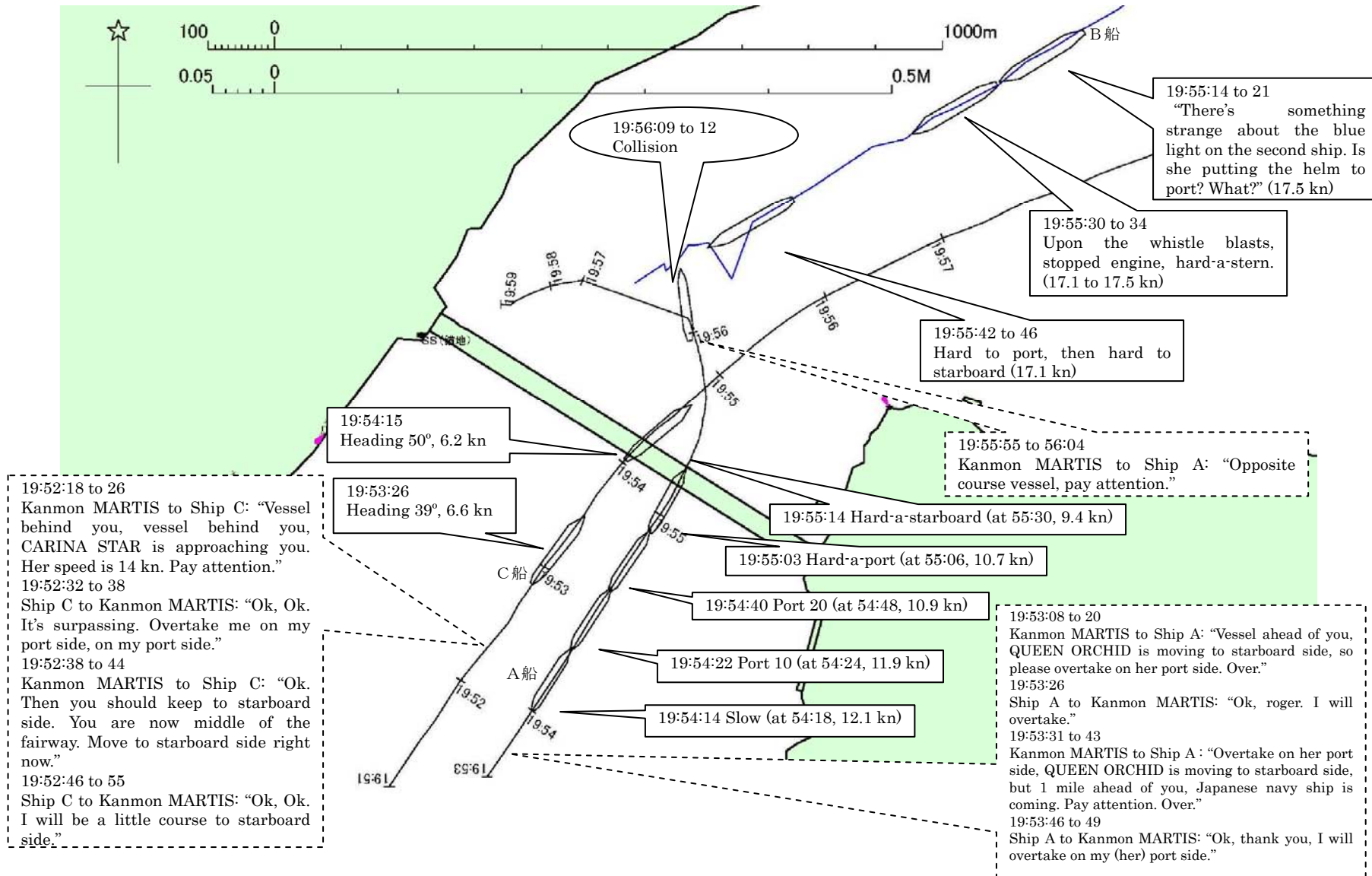


Figure 4: Tidal Current Charts in Kanmon Strait

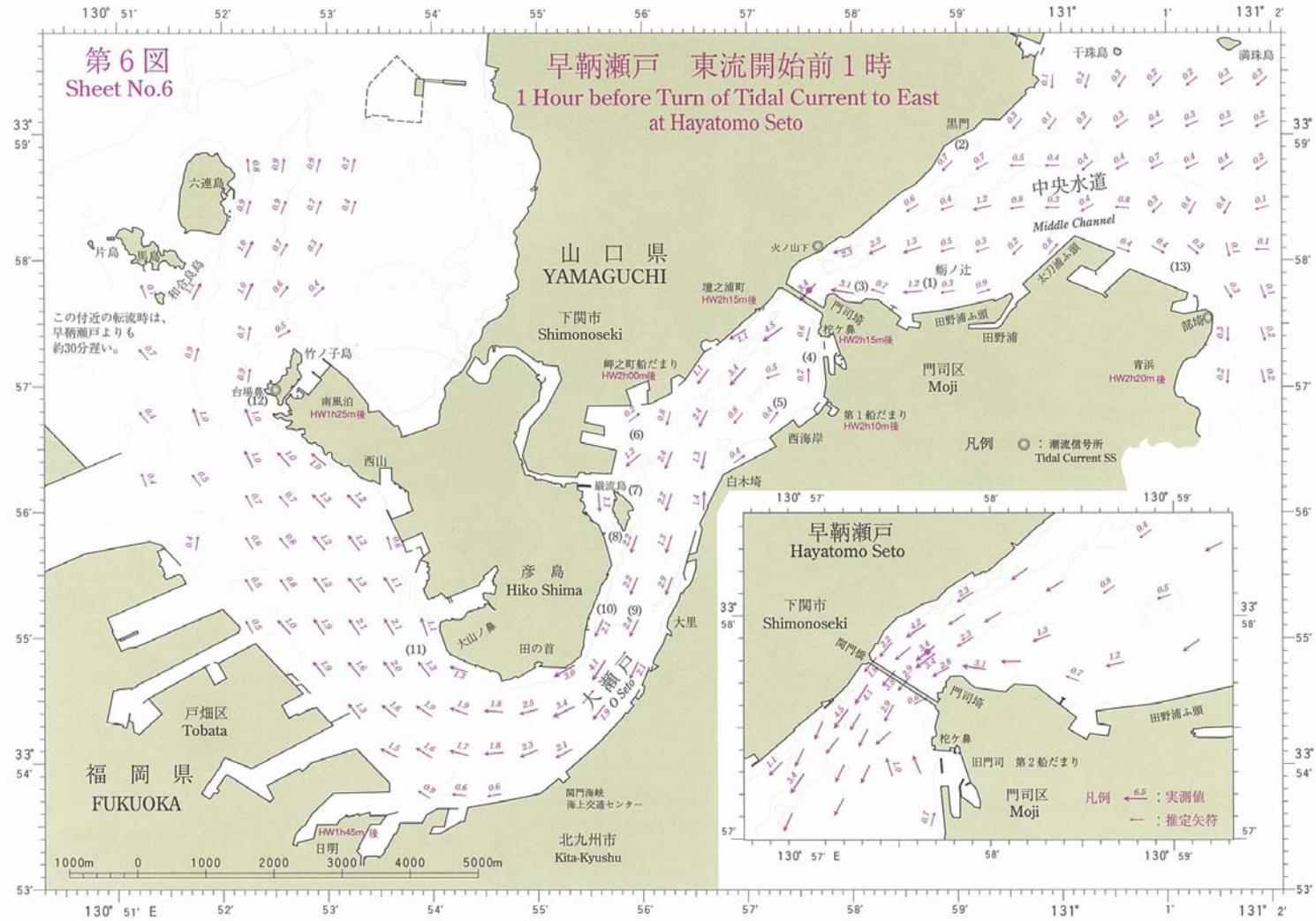


Figure 5: Variations in the Heading and at a speed of Ship A

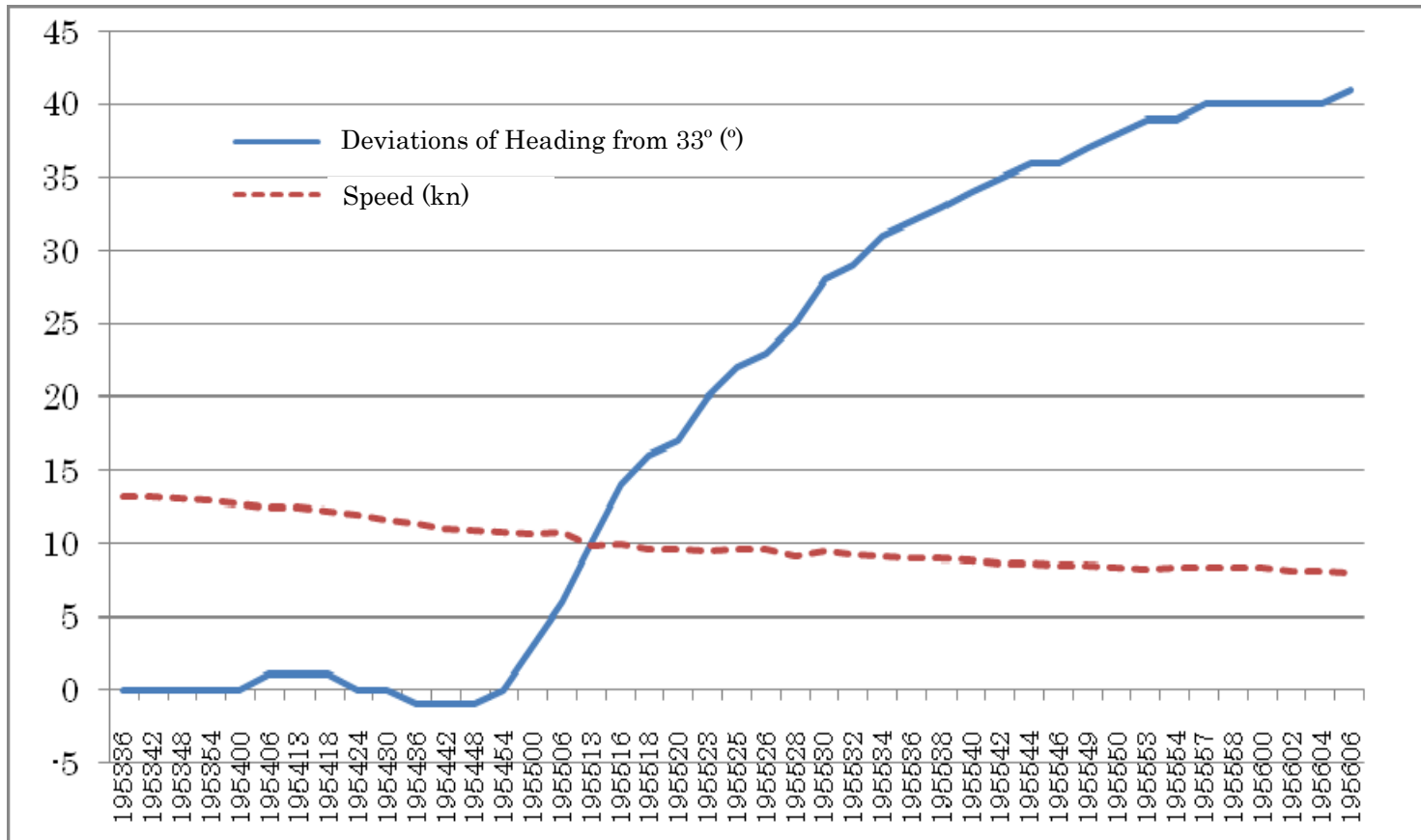




Figure 6: Plots of Tactical Diameter of Ship A

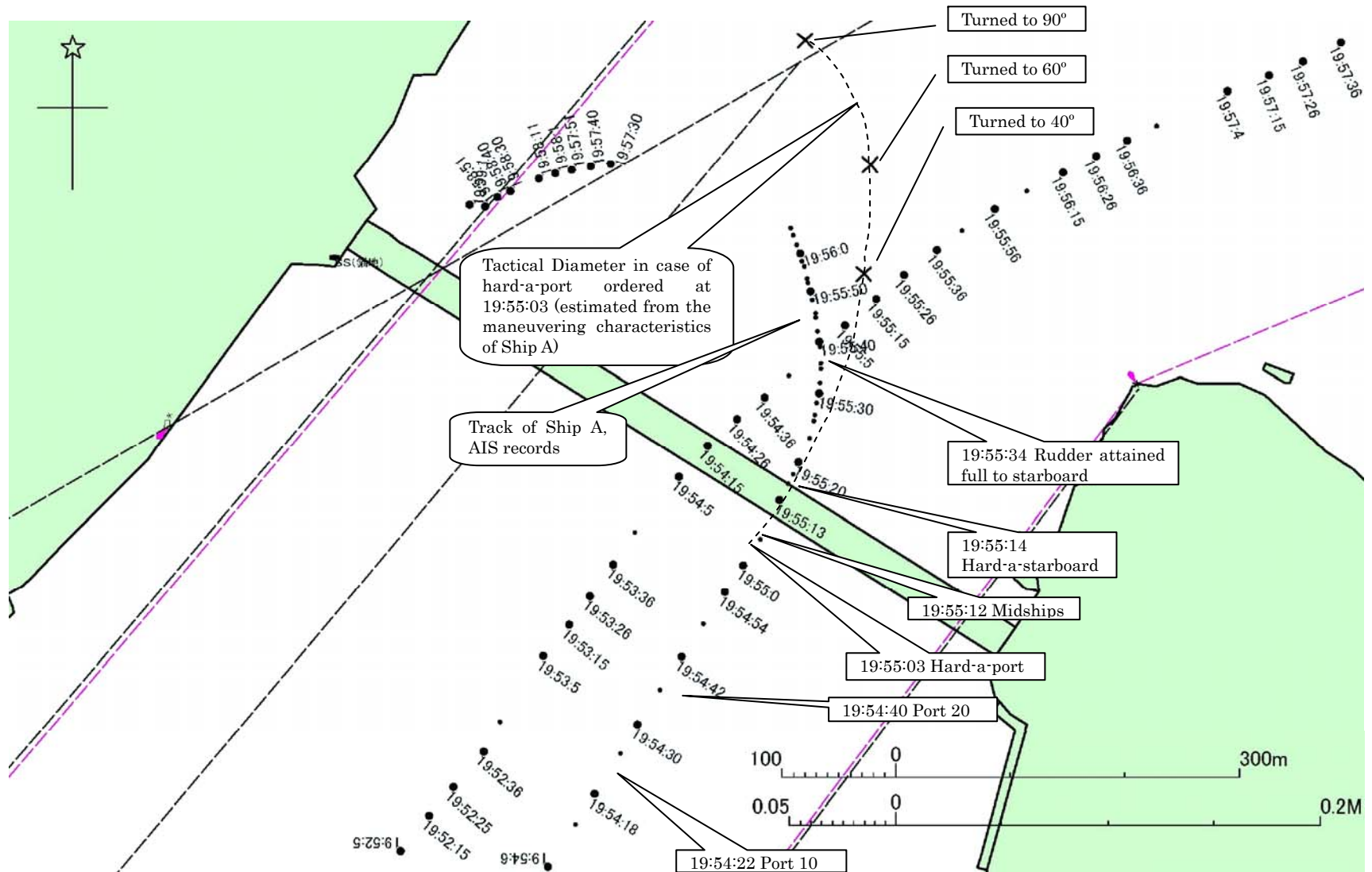


Figure 7: General Arrangement Plan of Ship A

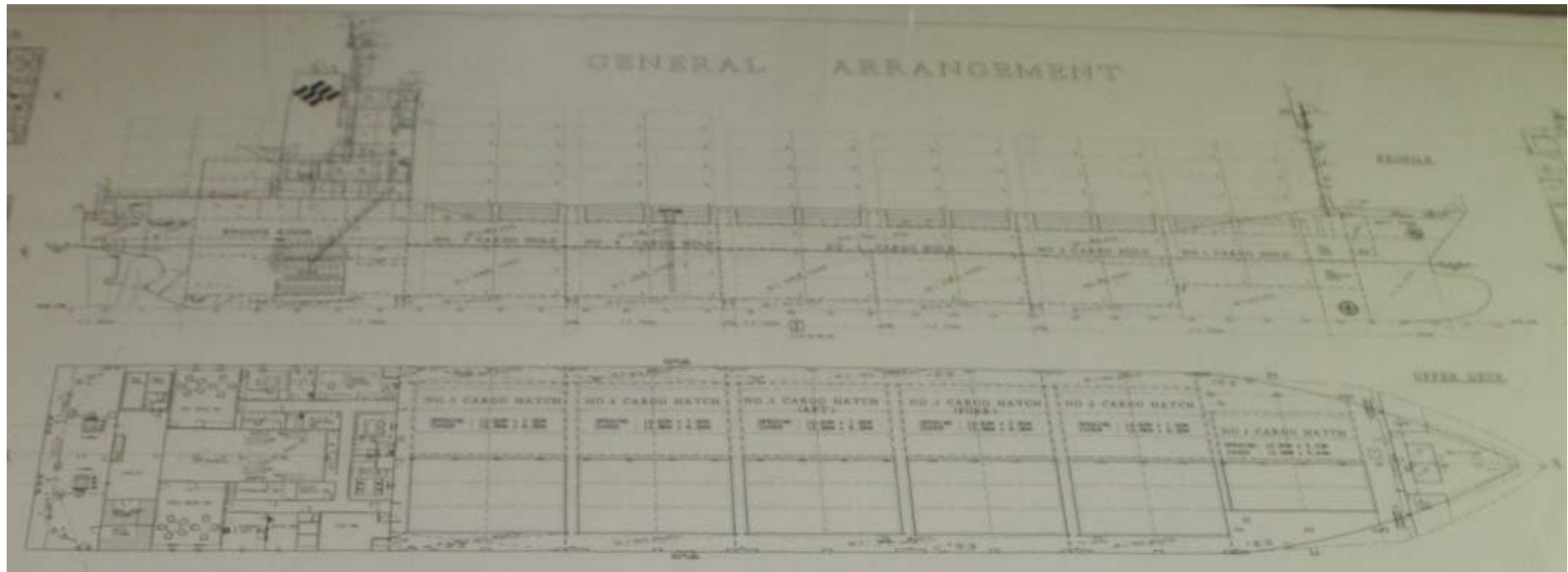


Figure 8: General Arrangement Plan of Ship B

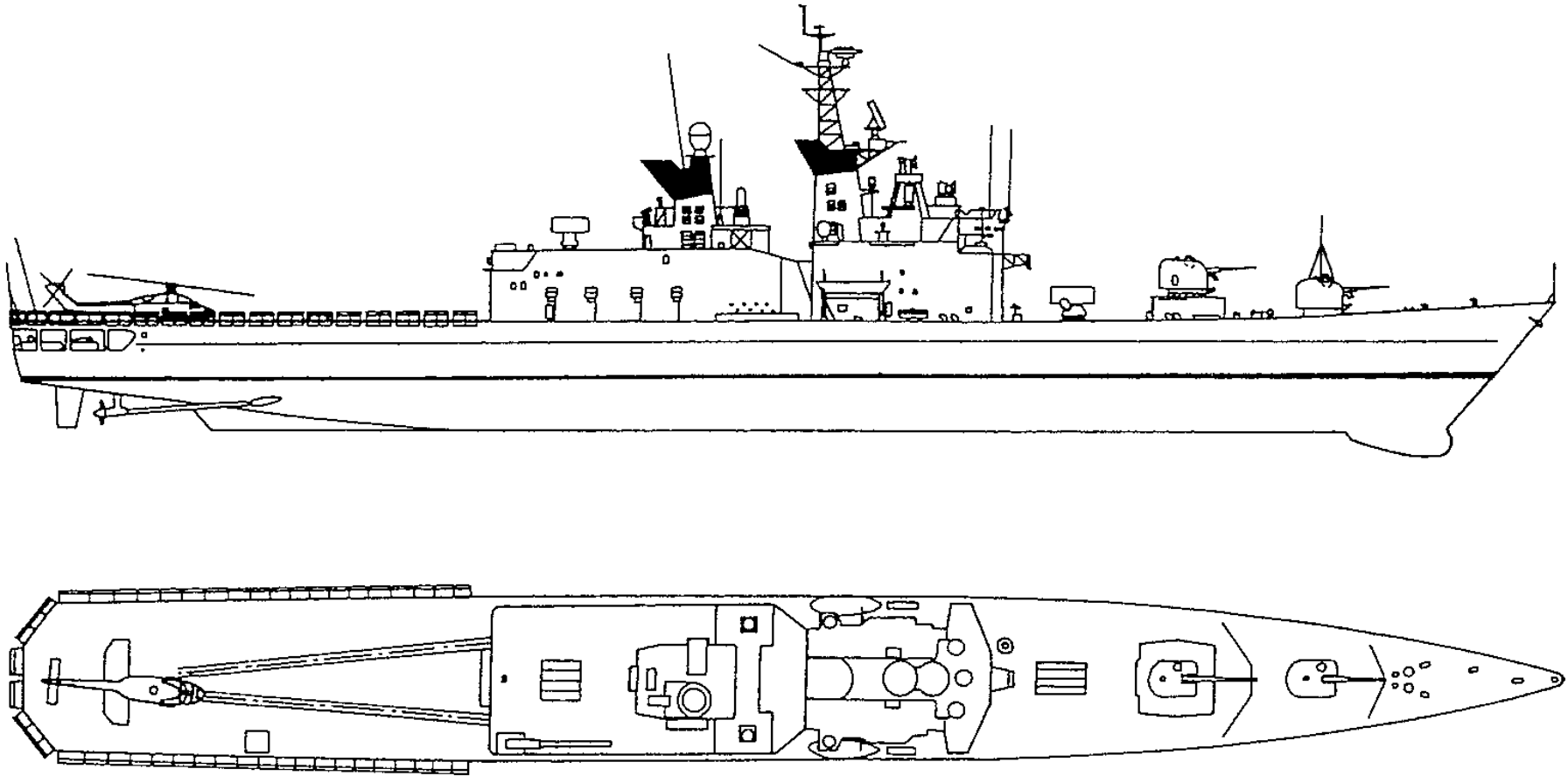




Figure 9: Summarized Cause Flow Diagram

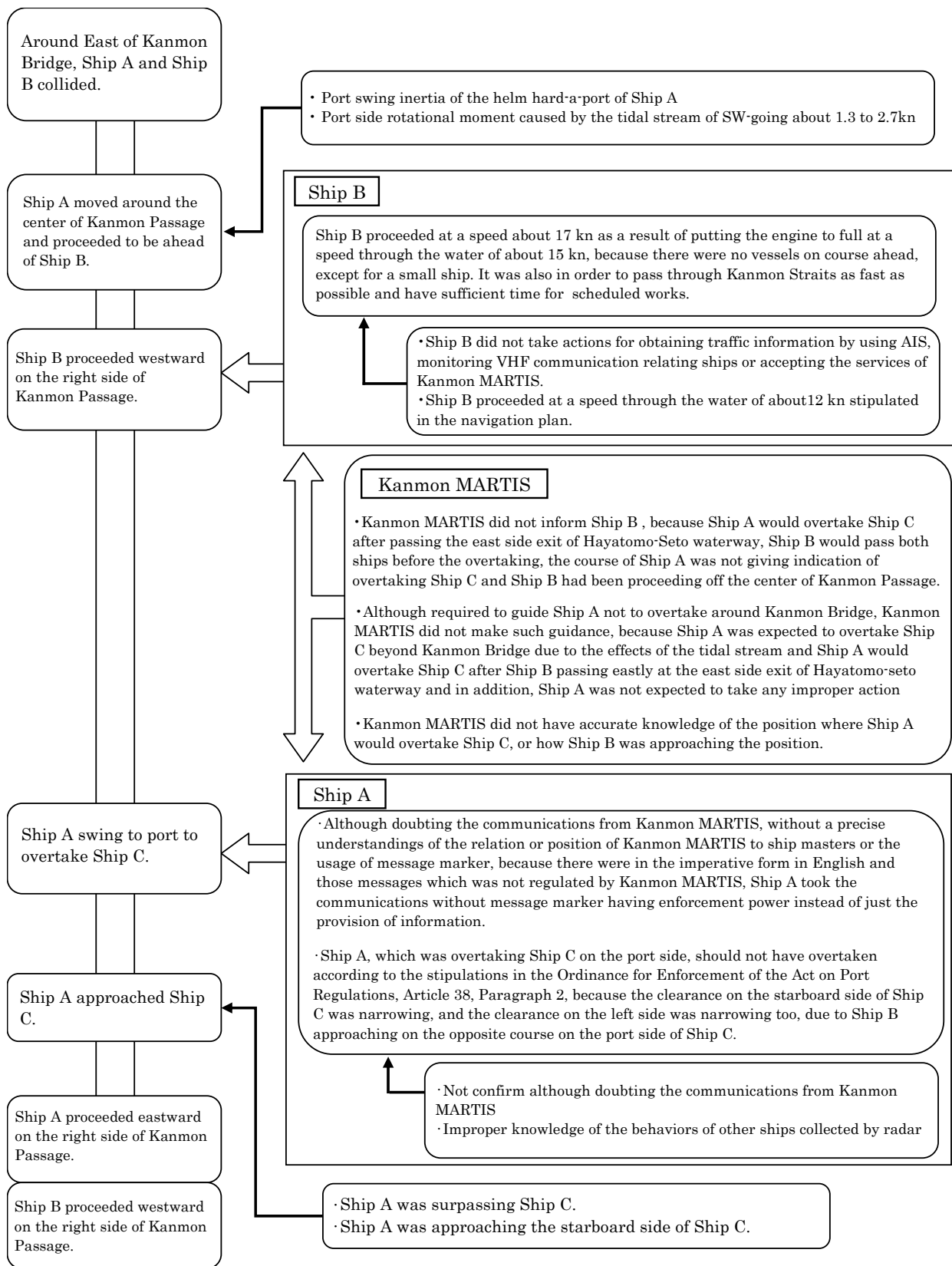


Table 1: AIS Records of Ship A

Time	Speed	Latitude	Longitude	COG	Heading
19:35:00	11.8	33-54-12.1	130-54-43.8	064.6	065
19:40:00	11.9	33-54-46.8	130-55-42.4	023.8	023
19:48:26	13.4	33-56-26.3	130-56-31.7	036	033
19:53:06	13.8	33-57-19.2	130-57-17.8	035.9	033
19:53:18	13.6	33-57-21.4	130-57-19.7	034.2	033
19:53:24	13.5	33-57-22.8	130-57-20.8	033.5	033
19:54:13	12.4	33-57-31.3	130-57-27.8	032.2	032
19:54:18	12.1	33-57-32.1	130-57-28.4	031.5	032
19:54:24	11.9	33-57-33.3	130-57-29.3	031.3	033
19:54:30	11.5	33-57-34.1	130-57-29.9	032.4	033
19:54:36	11.3	33-57-35.1	130-57-30.6	033.0	034
19:54:42	11.0	33-57-36.0	130-57-31.4	033.3	034
19:54:48	10.9	33-57-36.9	130-57-32.1	033.8	034
19:54:54	10.7	33-57-37.8	130-57-32.8	035.1	033
19:55:00	10.6	33-57-38.6	130-57-33.5	032.7	030
19:55:06	10.7	33-57-39.4	130-57-34.1	031.4	027
19:55:13	9.8	33-57-40.5	130-57-34.7	028.7	023
19:55:20	9.6	33-57-41.5	130-57-35.4	023.4	016
19:55:30	9.4	33-57-43.5	130-57-36.0	008.2	005
19:55:34	9.1	33-57-44.2	130-57-36.1	003.0	002
19:55:54	8.3	33-57-46.7	130-57-35.7	345.2	354
19:56:06	8.0	33-57-48.2	130-57-35.1	338.8	352
19:57:30	3.4	33-57-50.0	130-57-28.9	262.7	511

Table 2: Radar Tracking Records of Ship B

Time	Speed	Latitude	Longitude	COG
19:30:00	15.3	33-56-09.177	131-04-17.441	303.7
19:40:00	14.9	33-57-58.905	131-02-11.557	306.1
19:50:00	14.2	33-58-40.810	130-59-20.436	245.8
19:52:00	16.3	33-58-26.025	130-58-46.604	239.4
19:53:00	16.3	33-58-17.593	130-58-28.519	240.6
19:54:00	16.7	33-58-09.160	130-58-12.150	238.3
19:55:00	17.1	33-58-00.661	130-57-54.846	239.7
19:55:12	17.5	33-57-58.390	130-57-50.559	239.0
19:55:18	17.5	33-57-57.936	130-57-49.390	239.3
19:55:30	17.5	33-57-56.574	130-57-45.883	239.9
19:55:36	17.1	33-57-54.628	130-57-42.454	240.0
19:55:42	17.1	33-57-53.719	130-57-40.583	240.0
19:55:48	17.1	33-57-52.876	130-57-38.869	240.0
19:56:00	15.5	33-57-51.838	130-57-36.297	243.8
19:56:06	14.2	33-57-51.708	130-57-35.518	245.6
19:56:12	9.6	33-57-51.708	130-57-35.128	240.2

Note: The measurement data, although obtained every 6 seconds beginning on the hour, is recorded with a lag of about 15 to 25 seconds due to the radar characteristics. In the table above, to compensate for the lag, the time stamps are time adjusted by shifting 18 seconds; for example, the data at 00 in the table is the data time-stamped with 18, and the data at 12 is the data time-stamped with 30.

Table 3: AIS Records of Ship C

Time	Speed	Latitude	Longitude	COG	Heading
19:35:05	7.4	33-55-32.5	130-56-02.1	020.2	018
19:40:06	7.4	33-56-08.3	130-56-16.5	023.6	024
19:52:15	7.1	33-57-31.5	130-57-22.8	036	038
19:52:25	7.0	33-57-32.3	130-57-23.6	036.8	038
19:52:45	6.8	33-57-34.2	130-57-25.2	037.4	037
19:53:26	6.6	33-57-37.7	130-57-28.3	033.7	039
19:54:15	6.2	33-57-42.0	130-57-32.3	045.9	050
19:55:15	6.2	33-57-46.2	130-57-38.0	050.6	054
19:55:36	6.3	33-57-47.6	130-57-40.0	052.7	058
19:56:15	6.3	33-57-49.8	130-57-44.4	063.4	063

Table 4: Distance, etc. from Ship A

Time on Ship A	Distance to Ship C (m)	Heading of Ship A	Bearing to Ship C	Distance to Ship B (m)	Bearing to Ship B
19:52:06	789.2	032	25.8	3494	46.1
19:52:13	777.6	032	25.9		
19:52:25	721	032	25.7		
19:52:36	682.4	033	25.7		
19:52:48	627.4	033	24.8		
19:53:06	568.8	033	23.5	2563.4	45.2
19:53:13	551.6	033	23.4		
19:53:24	499.9	033	22.5		
19:53:36	461.7	033	21.5		
19:53:42	452.8	033	21.3		
19:54:06	360.6	032	18.6	1664.8	43.9
19:54:13	351.2	032	19.1		
19:54:24	308.9	033	19.1		
19:54:36	272.1	034	19.6		
19:54:48	227.8	034	19.1		
19:55:06	200.5	027	21.6	848.2	38.9
19:55:13	196.4	023	25.3		
19:55:16	178.8	019	25		
19:55:26	146.1	010	32.4		
19:55:36	142.5	001	45.4		
19:55:46	147.1	357	60		
19:55:57	174.9	353	73		

Note: This table came from Attached Table 1-3.

Table 5: VDR Voice Records of Ship A

Time	Recorded Voice
19:08:06-48	In Japanese, Ship A to Kanmon MARTIS: “We have just passed the AS line.” Kanmon MARTIS to Ship A: “We have confirmed your position. A timber carrier weighing about 40,000 tons is heading south from east of Mutsure-Shima. You will likely encounter the carrier in the vicinity of Buoy 10, so please take evasive action. The tidal stream is flowing west-going at 3 kn, falling.” Ship A to Kanmon MARTIS: “Roger.”
19:54:09- 19:54:12	In Korean, voice inside the ship: “Do we have to overtake on her port side? A head-on vessel is getting closer to us.”
19:54:14	In English, voice inside the ship: “Slow Ahead.”
19:54:22	In English, voice inside the ship: “Port 10.”
19:54:40	In English, voice inside the ship: “Port 20.”
19:55:03	In English, voice inside the ship: “Hard Port.”
19:55:12	In English, voice inside the ship: “Midships”
19:55:14	In English, voice inside the ship: “Hard Starboard”
19:55:30	Blast of whistle (short single)
19:55:34	In English, voice inside the ship: “Hard Starboard. Sir”
19:56:04-09	In Korean, voice inside the ship: “Oh, Oh, Oh!”
19:56:09	Sound of collision, alert in Ship A
19:56:53	In English, voice inside the ship: “Slow Astern,”
19:57:18-27	In Japanese, broadcast from Kanmon MARTIS: “Collision occurred.”
19:57:30	In English, voice inside the ship: “Engine Stop.”
19:59:19-50	7 short blasts and 1 long blast
20:04:01-12	3 short blasts
20:04:20	In English: “Stand-by engine.”

Note: As the time-stamps of the recorded voice were about 50 seconds ahead against Attached Table 7-8, the times in the table have been adjusted by subtracting the difference.

Table 6: Records of the Bridge Voice Recorder of Ship B

Time	Recorded Voice
19:53:23-26	Now under the bridge, under the bridge, just crossing the Bridge.
19:53:31	Next one is touching.
19:53:49-56	If she stays on course, 600 to the bridge. Mine is 1,500 to the bridge.
19:54:10	Port 10.
19:54:14	Blue light visible. Roger.
19:54:21	Cargo vessel
19:54:26-32	Leading lights came into view. In view.
19:54:33-44	That's it. Uh, yes. That's it, isn't it?
19:54:50	CPA 140°.
19:54:52	Port 20.
19:55:14-21	There's something strange about the blue light on the second ship. Is she putting the helm to port? What?
19:55:23	What?
19:55:28	Oh!
19:55:30	Whistle sounds (short single two blasts)
19:55:33	Stop both engines.
19:55:34	Hard astern.
19:55:34-40	Blue Light! Watch out! Watch out!
19:55:42	Hard-a-port
19:55:46	Hard-a-starboard
19:56:09-11	(Sounds of collision)
19:56:11	(Sparks)
19:56:27	Report to the Coast Guard.
19:56:30	(Alert in the ship)
19:56:31	Stop both. Backup.
19:56:43-49	(Chaotic situation. Conversations incomprehensible for a while)
19:56:59	Full-astern.
19:57:00	Half, both.
19:57:41	Hard-a-starboard.
20:01:56	Going astern, dragging them.
20:02:17	160 m to berth.
20:02:23	Passed Kanmon Bridge.
20:02:51	Hard-a-port.
20:03:13	Stop both.
20:03:18	Half ahead.
20:04:01-11	Three short blasts.
20:04:12	They are apart.
20:05:52	Stop both.
20:06:29	Half astern.

Note: The time stamps on the records were about 2 minutes 47 seconds behind, against Attached Table 7-8. The times in the table were adjusted by adding the delay.

Table 7: VDR Voice Records of Ship C

Time	Voices
19:53:30	In Chinese, on-ship announcement: "We are in a narrow channel where ships have to be on alert. Proceed with care." (Seems to be an announcement to crew members)
19:53:37	In Chinese, on-ship announcement: "Proceed with caution."
19:53:42	In Chinese, on-ship announcement: "Must be an idiot. They are (incomprehensible) under the bridge."
19:54:10	In Chinese, on-ship announcement: "Move to starboard."
19:54:13	In Chinese, on-ship announcement: "6 degrees, 6 degrees."
19:54:17	In Chinese, on-ship announcement: "Putting to 6 degrees, sir"
19:54:19	In Chinese, on-ship announcement: "Get away from the Ship above."
19:54:30	In Chinese, on-ship announcement: "Unbelievable. Idiot!"
19:54:34	In Chinese, on-ship announcement: "Will hold more space behind."
19:54:57	In Chinese, on-ship announcement: "Will get further away from the ship to the north."
19:55:13	In Chinese, on-ship announcement: "Mr. Chen (ship master), sir, 6 degrees."
19:55:17	In Chinese, on-ship announcement: "Straight, go straight."
19:55:30	Whistle (two short blasts)
19:56:11- 12	Sounds of collision



Table 8: VHF Communication Records

Time	Party	Communications
19:18:22-50	Kanmon MARTIS, Ship B (CH16) Note: CH of VHF	In Japanese, Ship B to Kanmon MARTIS: “We have just passed the HS line. We will proceed westward through Kanmon Strait and cross the MN line.” Kanmon MARTIS to Ship B: “About two miles ahead of you, KAISHO-MARU, a vessel navigating in the opposite direction, is performing dredge work near Buoy No.2. The current there is 3 kn westward, falling.” Ship B to Kanmon MARTIS: “OK, roger. We will proceed with full attention.
19:52:18-26	Kanmon MARTIS to Ship C (CH14)	“Vessel behind you, vessel behind you, CARINA STAR is approaching you. Her speed is 14kn. Pay attention.”
19:52:32-38	Ship C to Kanmon MARTIS(CH14)	“Ok, Ok. It’s surpassing. Overtake me on my port side, on my port side.”
19:52:38-44	Kanmon MARTIS to Ship C (CH14)	“Ok. Then you should keep starboard side. You are now middle of the fairway. Move to starboard side right now. Over.”
19:52:46-55	Ship C to Kanmon MARTIS(CH14)	“Ok, Ok. I will be a little course to starboard side.”
19:53:08-20	Kanmon MARTIS to Ship A(CH14)	“CARINA STAR, vessel ahead of you, QUEEN ORCHID is moving to starboard side, so please overtake on her port side. Over.”
19:53:26	Ship A to Kanmon MARTIS	“Ok, roger, I will overtake.”
19:53:31-43	Kanmon MARTIS to Ship A(CH14)	“Overtake on her port side, QUEEN ORCHID is moving to starboard side, but one M ahead of you, Japanese navy ship is coming. Pay attention. Over.”
19:53:46-49	Ship A to Kanmon MARTIS(CH14)	“Ok, thank you, I will overtake on my port side. <sup>27</sup> ”
19:55:55-56:04	Kanmon MARTIS to Ship A(CH16)	“CARINA STAR, CARINA STAR, opposite course vessel, pay attention. CARINA STAR, pay attention.”
19:56:32-35	Ship B to Kanmon MARTIS(CH16)	“Kanmon MARTIS, Kanmon MARTIS, this is JDS KURAMA, Ship No. 144. Over.”
19:56:38-41	Kanmon MARTIS to Ship B(CH16)	“CARINA STAR is getting extremely close to you. Pay attention. Take evasive action.”
19:56:42-48	Ship B to Kanmon MARTIS(CH16)	“We collided with a tanker, in Hayatomo Seto. The tanker is on fire. Over.”
19:56:52-57	Kanmon MARTIS to Ship B(CH16)	“Roger. Fix your condition of ship. Open this CH 16.”
19:57:18-27	Kanmon KARTIS to every vessel (CH16)	Kanmon MARTIS to every station: “All stations, All stations, this is Kanmon MARTIS. 5 cables east of Kanmon Bridge, a JDS and foreign vessel CARINA STAR collided and are stuck together. Vessels around there pay attention. This is Kanmon MARTIS.”

<sup>27</sup> It is considered possible, as stated before in 3.2.5 (1) {4}, that the phrase “on my port side” was mistakenly used for the phrase “on her port side.”

Photo 1: Situation of Ship A

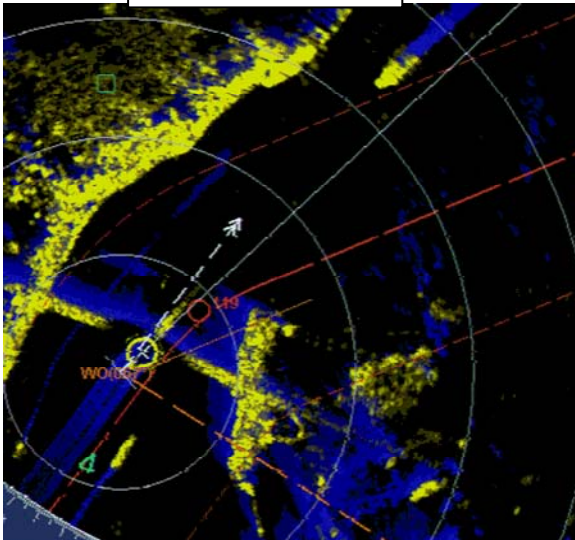


Photo 2: Situation of Ship B

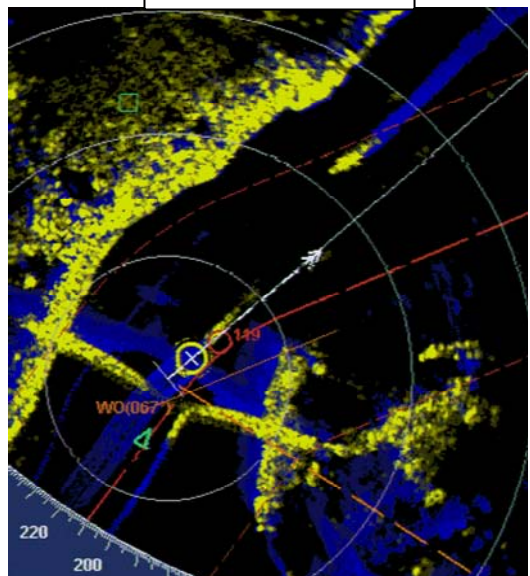


Photo 3: VDR Radar Images Recorded by Ship C

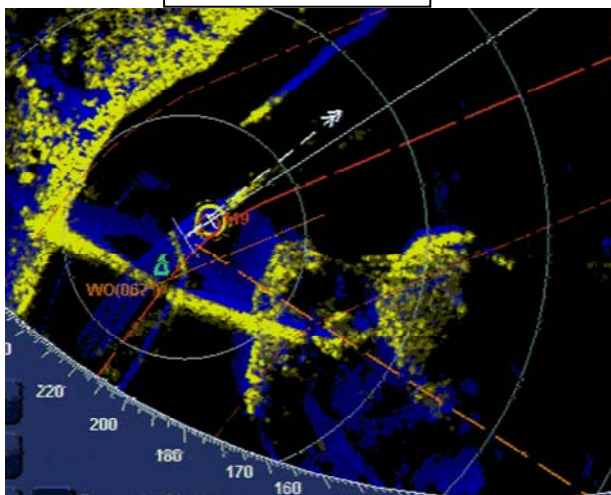
At 19:54:02



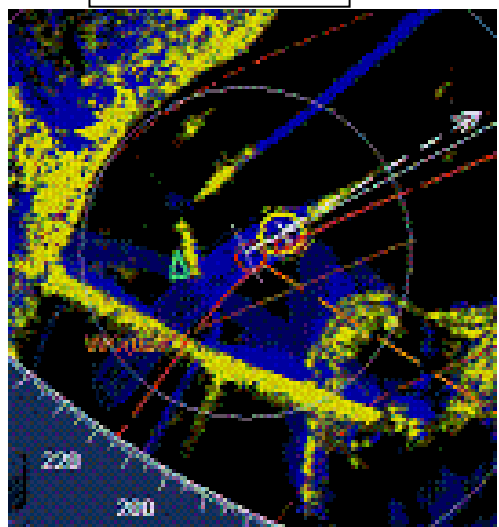
At 19:54:47



At 19:55:32



At 19:56:02



At 19:56:17

