

MA2017-7

**MARINE ACCIDENT
INVESTIGATION REPORT**

July 27, 2017



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.

Kazuhiro Nakahashi
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: Passenger Ship "BEETLE"

Vessel number: 131358 (IMO number: 8922137)

Gross tonnage: 164 tons

Accident type: Collision

Date and time: Around 09:54 on January 8, 2016 (local time, UTC + 9 hours)

Location: Northwest off Kami Shima, Tsushima City, Nagasaki Prefecture

Around 325° true, 18.2 nautical miles from Mitsushima Lighthouse
(approximately 34°58.6'N, 129°14.0'E)

July 6, 2017

Adopted by the Japan Transport Safety Board

Chairman	Kazuhiro Nakahashi
Member	Kuniaki Shoji
Member	Satoshi Kosuda
Member	Toshiyuki Ishikawa
Member	Mina Nemoto

SYNOPSIS

< Summary of the Accident >

A passenger ship BEETLE, with a captain, a chief officer and five crews on board and carrying 184 passengers, collided with a marine life at around 09:54 on January 8, 2016 when she was proceeding off the west of Kami Shima, Tsushima City, Nagasaki Prefecture toward the Port of Hakata from the Port of Busan at 40 knots, with lifting the hull of the ship above sea level by lift force of hydrofoil wings.

Three of the passengers were seriously injured by a lumbar vertebra compressed fracture etc., and four of the passengers and two of the cabin crews suffered minor injuries. Two shock absorbers on the bow stretched out, and then BEETLE returned to the Port of Busan in hullborne mode.

< Probable Causes >

Concerning the accident, it is probable that BEETLE collided with a marine life in spite of a rudder turn since the marine life was discovered in the proximity during the maneuver at a cruising speed (40 km)

It is somewhat likely that discovering the marine life in the proximity is associated with the captain not directing enhancement of lookout by four persons of a captain, a chief engineer, a chief officer, and a first engineer, suspension of inboard sales by cart, seating of cabin crews, and implementation of airing of seat belt wearing to passengers, in addition to decelerated maneuver at 36 – 38 kn (cetacean-cautious maneuver) as well as navigating without enhancing lookout.

It is probable that the reason why the captain did not direct cetacean-cautious maneuver was that Company A had not established operating guidelines of cetacean-cautious maneuver in the

safety management rules and was not thoroughly disseminating them, had informed the allowable delay time associated with implementation of decelerated maneuver, and did not have a grasp of the implementation status of cetacean-cautious maneuver.

1 PROCESS AND PROGRESS OF THE INVESTIGATION

1.1 Summary of the Accident

A passenger ship BEETLE, with a captain, a chief officer and five crews on board and carrying 184 passengers, collided with a marine life at around 09:54 on January 8, 2016 when she was proceeding off the west of Kami Shima, Tsushima City, Nagasaki Prefecture toward the Port of Hakata from the Port of Busan at 40 knots, with lifting the hull of the ship above sea level by lift force of hydrofoil wings.

Three of the passengers were seriously injured by a lumbar vertebra compressed fracture etc., and four of the passengers and two of the cabin crews suffered minor injuries. Two shock absorbers on the bow stretched out, and then BEETLE returned to the Port of Busan in hullborne mode.

1.2 Outline of the Accident Investigation

1.2.1 Setup of the Investigation

The Japan Transport Safety Board appointed a chief investigator (Moji Office) and one other investigator to investigate this accident on January 8, 2016.

Further, later on, the chief investigator and the investigator-in-charge were taken over by Marine Accident Investigators.

1.2.2 Collection of Evidence

January 9, March 17, May 27, June 13 and 14, 2016: On-site investigation and interview

April 16, June 6 and 30, July 8, November 15, 2016: Collection of questionnaire

June 17 and 23, July 18 and 29, 2016, January 14, 2017: Interview

June 21, 2016: Interview and collection of questionnaire

September 29 and 30, 2016: On-site investigation

1.2.3 Comments from Parties Relevant to the Cause

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

1.2.4 Comments from the Relevant State

Comments on the draft report were invited from the substantially interested state of BEETLE.

2 FACTUAL INFORMATION

2.1 Events Leading to the Accident

2.1.1 Events leading to the Accident of BEETLE according to Automatic Identification System

According to the record of information by the automatic identification system (AIS)*¹ (hereinafter, referred to as “the AIS record”), the process of operation of BEETLE (hereinafter,

*¹ Automatic Identification System (AIS) is a device that each vessel uses to automatically transmit/receive information such as vessel identification code, type, name, position, course, speed, destination and navigating condition, and to exchange information with other vessels or land-based navigation aids.

referred to as “the ship”) between 09:40:01 and 10:00:01 on January 8, 2016 was as follows.

Table 2.1 AIS Record of the Ship (excerpt)

Time (HH:MM:SS)	Ship's position*		Course over the ground* (°)	Ship's head* (°)	Ground speed (knot (kn))
	Latitude (N) (° -' -")	Longitude (E) (° -' -")			
09:40:01	35-05-02.5	129-05-51.7	121.1	119	38.1
09:41:01	35-04-46.5	129-06-36.3	125.4	129	40.6
09:42:07	35-04-14.3	129-07-13.9	137.0	138	40.6
09:43:03	35-03-50.9	129-07-50.6	126.1	126	40.6
09:44:07	35-03-27.0	129-08-34.8	130.2	132	40.9
09:45:09	35-03-00.3	129-09-14.4	128.7	131	41.1
09:46:11	35-02-34.6	129-09-56.4	122.8	123	42.1
09:47:09	35-02-13.3	129-10-38.1	127.0	130	41.5
09:48:01	35-01-49.5	129-11-10.2	132.5	134	40.9
09:49:03	35-01-18.5	129-11-45.1	147.1	148	41.3
09:50:03	35-00-44.3	129-12-12.7	145.1	145	41.1
09:51:03	35-00-10.3	129-12-41.4	145.8	145	41.1
09:52:05	34-59-35.8	129-13-09.6	145.9	146	39.8
09:53:05	34-59-02.5	129-13-37.5	146.8	149	40.6
09:53:35	34-58-45.0	129-13-51.2	147.1	148	41.4
09:53:53	34-58-34.9	129-13-59.4	145.7	146	37.5
09:53:55	34-58-34.1	129-14-00.0	148.6	146	26.3
09:53:57	34-58-33.8	129-14-00.2	146.7	511*	23.0
09:53:59	34-58-33.3	129-14-00.7	140.8	511	19.2
09:54:01	34-58-32.7	129-14-01.4	136.8	511	16.8
09:54:03	34-58-32.4	129-14-01.8	133.1	511	15.0
09:54:07	34-58-32.0	129-14-02.5	129.6	511	14.1
09:54:09	34-58-31.6	129-14-03.1	125.2	511	13.7
09:54:15	34-58-30.9	129-14-04.4	123.7	511	13.2
09:54:23	34-58-30.0	129-14-06.2	122.9	511	13.2
09:54:31	34-58-29.1	129-14-08.0	118.2	511	13.2
09:54:37	34-58-28.5	129-14-09.3	119.1	511	12.7
09:54:41	34-58-28.1	129-14-10.3	120.9	126	13.6
09:54:49	34-58-27.2	129-14-12.1	121.3	127	12.9
09:54:55	34-58-26.6	129-14-13.2	122.7	127	10.5
09:55:01	34-58-26.2	129-14-14.1	122.4	128	8.6
09:55:13	34-58-25.4	129-14-15.6	117.5	130	7.1
09:55:33	34-58-24.2	129-14-17.9	122.2	132	6.7
09:55:55	34-58-22.8	129-14-20.4	123.7	134	6.7
09:56:15	34-58-21.5	129-14-22.6	127.7	135	6.7
09:56:37	34-58-20.1	129-14-25.0	126.0	137	6.7
09:56:57	34-58-19.0	129-14-26.7	127.3	134	3.9
09:57:21	34-58-18.6	129-14-28.3	097.5	107	3.3

09:57:41	34-58-18.6	129-14-30.2	085.1	089	5.3
09:58:01	34-58-18.9	129-14-32.2	075.8	078	4.6
09:58:41	34-58-20.8	129-14-35.9	045.4	039	6.2
09:59:01	34-58-22.5	129-14-37.4	032.4	023	6.0
10:00:01	34-58-27.9	129-14-39.3	005.4	350	5.2

* The ship's position indicates the position of GPS antenna attached to a location above the wheelhouse. The course and the direction indicate those by true bearing (the same applies hereafter).

* The "511" in the ship's head indicates being "not available".

2.1.2 Events Leading to the Accident according to the Statements of Crews

According to the statements of the ship's captain (hereinafter, referred to as "the captain"), the chief engineer (hereinafter, referred to as "the C/E"), the chief officer (hereinafter, referred to as "the C/O"), the first engineer (hereinafter, referred to as "the 1/E") and three cabin crews (hereinafter, referred to as "Cabin Crew A", "Cabin Crew B" and "Cabin crew C") and the reply to the questionnaire by JR KYUSHU JET FERRY INC.(hereinafter, referred to as "Company A", they were as follows.

On the ship, the captain and other six members (five Japanese nationals and one Republic of Korean national) were aboard and the crews began preliminary work for the departure at the Port of Busan at around 07:30 on January 8, 2016, and at around 09:05, when the captain received reports to the effect that the work had been finished from a deck department, an engine department, and a passenger department, he thought of a risk of a delay in departure time since there had already been some delay and some 200 passenger were scheduled to get on board, and he canceled a briefing before departure they usually had (hereinafter, referred to as "the briefing"), ordered the crews to take up their positions at passengers' boarding, and started the boarding.

The cabin crews guided passengers and did things such as urging the passengers to use a seat belt.

Upon receiving a report from the cabin crews that all passengers had embarked and that their seat belt wearing had been confirmed at around 09:20, the captain ordered all crews to take up their positions in respective departments on departure.

Cabin Crew A started inboard broadcasting on departure including dissemination of seat belt wearing and ran a safety instructions video.

The ship left its private dock at the Port of Busan at a scheduled time of 09:30 with 184 passengers (three Japanese nationals, 179 Republic of Korean nationals, one French Republic's national and one Czech Republic's national) on board.

Cabin Crew B and Cabin Crew C started inboard sales by cart in a first-floor cabin and a second-floor cabin respectively.

The ship began to travel in foilborne mode*² after coming into Busan Channel at around 09:35, left the harbor limit of the Port of Busan, and accelerated a speed approximately to 40 kn at around 09:45.

The captain determined that the condition of the sea surface was that of a stormy weather, and moved to "maneuvering of manipulating 'a steering for setting the depth of the hydrofoils to an

*² The "foilborne mode" is a navigation mode of floating a ship's hull above the sea surface by the lifting force of hydrofoil devices capable of remote controlling equipped respectively on the bow and the stern to thereby navigate the ship.

arbitrary position' (hereinafter, referred to as "depth handle") after watching breakers, in order to avoid influence of breakers over the hull and the exposure of a seawater inlet above sea level' during the travel in foilborne mode in stormy weather".

Cabin Crew A finished the inboard broadcasting on departure including disseminating seat belt wearing and started inboard sales by cart.

The C/O left a wheelhouse for on-board patrol and the 1/E and the C/E sat on an engine control seat and a seat provided on the left of the said seat respectively.

The ship entered "the marine area setup on January 4 (hereinafter, referred to as "the decelerating area")" which was one of the 'marine areas set up by Company A for the purpose of instructing implementation of decelerating maneuver etc. as part of the safety actions against collision with a cetacean (hereinafter, referred to as "decelerating area")', set the course at 145° and headed for the Port of Hakata along a standard course line.

The 1/E noticed a marine life with a back-fin-like projection in the proximity of the starboard at around 09:54, raised a shout in fear of a collision, and prepared himself for impact.

Hearing the shout of the 1/E, the captain attempted to avoid a collision considering that the 1/E had noticed a marine life on the course of the ship, and instantly put the helm (hereinafter, referred to as "the helm") to right, but impact was generated on hydrofoil crafts on the bow and the speed decreased, the traveling mode changed from foilborne mode to hullborne mode^{*3} due to speed deterioration, and various alarms provided in the wheelhouse went off.

The captain checked the hour to be around 09:54 on a clock in the wheelhouse and the location by the record of a GPS plotter immediately after feeling the impact, and ordered the crews to determine whether the injured was present and whether the hull was damaged.

The C/O fell down by receiving impact when he was patrolling at a bottom hatch located under the first-floor cabin, considered that the ship collided with a marine life, confirmed that there was neither a hole nor flood in the full, returned to the wheelhouse, and after reporting that to the captain, he performed the determination whether the injured was present upon receiving the captain's instruction.

Cabin Crew A received impact when she was engaged in clerical work accompanying the inboard sales by cart at a bow section closer to the portside of the first-floor cabin, thrown out in a direction toward the bow, and slammed herself against the wall.

Cabin Crew B received impact and fell backward when she was engaged in the inboard sales by cart facing to the stern at the central section closer to the portside of the first-floor cabin.

When the C/O went to the cabin, he saw Cabin Crew B who was confirming the presence or absence of the injured have injuries to her head and other places and the C/O ordered her to stay in bed in a standby room and confirmed the presence or absence of the injured with Cabin Crew A who was less injured and Cabin Crew C who had no damage, found that six persons among the passengers and two persons among the cabin crews were injured and reported that to the captain.

The 1/E checked the hydrofoil device on the bow from the foredeck and found that two shock absorbers (hereinafter, referred to as "the shock absorbers") equipped on the upper part of the fore strut which was a support pillar made of stainless steel constituting the hydrofoil device on the bow operated and had extended in order to absorb impact of the contact with obstacles under the sea and that the hydrofoil device on the bow had greatly been inclined toward the stern, he thought that traveling in foilborne mode is not possible, and reported the condition to the captain.

^{*3} The "hullborne mode" is a mode of navigation of landing the hull on the sea surface.

The captain reported the occurrence of the accident and incapability of traveling in foilborne mode, as well as six injured among the passengers and two injured among the cabin crews to an operation manager of Company A and Busan Branch Office of Company A by mobile phone.

The ship began to return to the Port of Busan in hullborne mode at around 09:58, entered the Port of Busan at around 11:15, eight injured persons were transported to the hospital by ambulance, and the rest of the passengers disembarked.

The date and time of occurrence of the accident was around 09:54 on January 8, 2016 and the location of the accident was at about 18.2 nautical miles (M) at 325° from the Mitsushima Lighthouse.

(See Attached Figure 1 Navigation Path)

2.1.3 Eyewitness Status of the Marine Life

According to the statements of the captain and the 1/E, it was as follows.

The captain and the 1/E had not seen any telltale signs of the existence of cetaceans such as the spouting and the flock of seabirds in the direction of the bow before the 1/E saw the marine life.

After the impact, the 1/E thought that the marine life was moving on from the starboard to the port from the characteristics of the back-fin-like projection of the marine life.

2.1.4 Information about Statuses of Ship Handling and Lookout

According to the statements of the captain and the 1/E, the statuses of ship handling and lookout at the time of the accident were as follows.

The captain was sitting on the captain seat on the starboard side in the center of the wheelhouse with a seat belt fastened and was maneuvering the helm with his right hand and the depth handle with his left hand while looking out in the directions from the bow to the starboard.

The captain and the 1/A were wearing sunglasses since it was hard to see the condition of the sea surface due to sea surface reflection of the sun.

2.2 Injuries to Persons

According to the statements of a safety manager (hereinafter, referred to as “the safety manager”), two injured passengers and two injured cabin crews, and the reply to the questionnaire by Company A, the information about the injured was as follows.

Company A knew that the number of injured passengers was six at first, but at a later date, they heard from another passenger to the effect that she had been injured, and confirmed that seven passengers (hereinafter, referred to as “Passenger A”, “Passenger B”, “Passenger C”, “Passenger D”, “Passenger E”, “Passenger F”, and “Passenger G”) and Cabin Crew A and Cabin Crew B had been injured.

Passenger A went home at first diagnosed as having a chest bruise, but when she had an examination at another hospital on January 12 because of continuing dull pain in the chest and no sign of recovery, she was diagnosed as having a subcutaneous fracture of sternum and needed hospitalization for medical treatment for about three weeks.

Passenger B went home at first diagnosed as having a lumbar bruise, but when he had an examination at another hospital on January 12 because of continuing dull pain in the chest and no sign of recovery, he was diagnosed as having a first lumbar vertebra compressed fracture and needed hospitalization for medical treatment for about seven weeks.

Passenger C returned to her country without informing of her injury at first, but after that, she had an examination at a hospital on January 15 because of continuing dull pain in the chest and no sign of recovery, she was diagnosed as having fractures in left ribs 4, 6, and 7 and needed hospitalization for medical treatment for about six weeks.

Passenger D was diagnosed as having a bruise on the lumbar and other regions, but when he had an examination at another hospital on January 21 because of continuing dull pain in the lumbar and the cervical spine and no sign of recovery, he was diagnosed as having a lumbar strain as well as a cervical sprain.

Passenger E, Passenger F, and Passenger G spilt hot coffee purchased at the inboard sales by cart right before the accident and suffered burns to their hands, but were diagnosed as they were in the mild degree.

Cabin Crew A had an examination on January 9 and was diagnoses as having bruises on the lumber spine and both thighs.

Cabin Crew B had an examination on January 9 and was diagnoses as having a cervical sprain, bruises on the left occipital region and chest.

2.3 Damage to Vessel

According to the statement of the captain and the reply to the questionnaire by Company A, on the ship, shock absorbers on the starboard side and the port side provided on the hydrofoil device on the bow stretched out by 235 mm and 225 mm respectively on impact of the collision with the marine life.

(See Attached Figure 4 Hydrofoil Device on the Bow, Attached Figure 5, Shock Absorber, Photo 1 Shock Absorber)

2.4 Crew Information

(1) Gender, Age, and Certificate of Competence

The captain Male, 41 years of age

3th grade maritime officer (navigation)

Date of issue of certificate: August 6, 1998

Date of grant of certificate: August 6, 2012

Certificate validity expiration date: August 5, 2018

(2) Major experience in service aboard of the captain

According to the statement of the captain, it was as follows.

The captain entered Company A in April, 1998 and after having been aboard as an officer etc. for about eight years, he has served as a captain since April, 2006.

At the time of this accident, his health condition was good and his vision and audibility were normal.

(3) Passenger information

① Passenger A Female, 67 years of age

According to the reply to the questionnaire by Company A, it was as follows.

Passenger A was sitting on the seat of the seat No. 13G located near the center of the stern section in the first-floor cabin with the seat belt fastened, and although it was confirmed that she had a check of the seat belt fastening state by a cabin crew, not enough information was gained about her posture on the seat at the accident, the status of the seat belt fastening, a function of changing the angle of the backrest and the status of use of the

table.

② Passenger B Male, 59 years of age

According to the statement of Passenger B and the reply to the questionnaire by Company A, it was as follows.

Passenger B was sitting on the seat located in the center block closer to the starboard in the second-floor cabin with the seat belt fastened, and although he had had a check of the seat belt fastening state by a cabin crew, at the time of the accident, he had the backrest of his seat fallen down, was sitting on the front of the seat in a posture of leaning against the backrest with the seat belt loosen and was not using the table.

At the time of this accident, his health condition was good.

③ Passenger C Female, 69 years of age

According to the statement of Passenger C and the reply to the questionnaire by Company A, it was as follows.

Passenger C was sitting on the seat of the seat No. G1B (a first-class seat) located in the bow section closer to the port in the first-floor cabin with the seat belt fastened and although she had had a check of the seat belt fastening state by a cabin crew, at the time of the accident, she was sitting back on the seat in a posture of leaning against the backrest with the seat belt fastened and had not the table set back after having a meal at the set-up table designed to be stored in the armrest when not used.

At the time of this accident, her health condition was good.

④ Passenger D Male, 38 years of age

According to the reply to the questionnaire by Company A, it was as follows.

Passenger D was sitting on the seat of the seat No. 31E located near the center of the stern section in the second-floor cabin with the seat belt fastened and although he had had a check of the seat belt fastening state by a cabin crew, at the accident, he had the seat belt removed.

⑤ Passenger E Male, 45 years of age, Passenger F Female, 45 years of age, and Passenger G Female, 44 years of age

According to the reply to the questionnaire by Company A, it was as follows.

Passenger E, Passenger F, and Passenger G were sitting on the seats located in the center block closer to the port in the first-floor cabin with the seat belt fastened, and they had a check of the seat belt fastening state by a cabin crew.

2.5 Vessel Information

2.5.1 Particulars of Vessel

Vessel number: 131358 (IMO number: 8922137)

Port of registry: Fukuoka City, Fukuoka Prefecture

Owner: Company A

Gross tonnage: 164 tons

L×B×D: 27.36 m × 8.53 m × 2.59 m

Hull material: Light alloy

Engine: Two diesel engine units

Output: 2,794.5 kW/unit, 5,589 kW in total

Propulsion: Two jet propulsion engines

Usage: Passenger ship

Date of launch: February 1990

Capacity of persons on board: 200 passengers and 10 crews, 210 persons in total

2.5.2 Hull structure and the like

According to the statements of the captain and a person in charge of the building yard of the ship and the respective replies to the questionnaire by Company A and the building yard of the ship, it was as follows.

Though there was neither breakdown nor defect in the hull and the engines at the time of the accident, an active sonar (hereinafter, referred to as “AS”) for detecting underwater obstructions forward using ultrasound was detached for repair.

(1) Hull structure

The ship is a fully submerged hydrofoil craft called “the JETFOIL”, has two maneuver modes, foilborne mode and hullborne mode, and obtains propulsive force by a water jet propulsion system (hereinafter, referred to as “the WJ propulsion system”) driven by two gas turbine engines.

The hydrofoil device on the bow stretches for approximately 3.1 m from the base line^{*4} to the lower end of the foil in foilborne mode to support the bow part, and consists of a trapezoid foil made of stainless steel (hereinafter, referred to as “the front foil”), a front strut capable of remote controlling while supporting the front foil, and a streamlined member called a pod connected to a lower end of the front strut in the central part, and others.

The hydrofoil device on the stern is situated 4.2 m from the stern end of the hull, stretches for 3.6 m from the base line to the lower end of the foil to support the stern part, and consists of struts on both starboard and port sides slightly protruding from the beam, a central strut comprising a seawater inlet in the lower part, a foil attached transversely between respective struts, pods connected to both starboard and port side struts, and conical members made of aluminum alloy called cones on the front and back parts of the pod.

Furthermore, a lower end of each foil comprises an aileron called a flap capable of remote controlling, and operations such as control of the posture of the hull and increasing/decreasing of lift force are conducted by manipulating the aileron.

(2) Shock absorber information

The shock absorber consists of an external cylinder called a housing, a spindle called a mandrel, hull mounting brackets and others, and has a structure in which: a load is normally borne by a pawl part of the housing, but when a static load over approximately 700 kN which is an operation start load is added by the hydrofoil on the bow coming in contact with undersea obstacle, the pawl part undergoes shear fracture and the mandrel is pulled out from the housing, and in this instance, the mandrel with a diameter longer than an inner diameter of the housing distorts the aluminum alloy housing and thereby the collision energy will be absorbed.

(3) Maneuverability

According to the sea trial report, it was as follows.

① The minimum stopping time and distance (a speed at 45.2 kn)

Stopping time	21.02 sec
Stopping distance	155 m

^{*4} The “base line” is a horizontal line passing through the origination of the rise of floor in the inner surface of the bottom plate.

② Turning performance

	Left turning angle 75°	Right turning angle 75°
Speed	45.3 km	45.5 km
Maximum advance* ⁵	350 m	332 m
Maximum transfer* ⁶	579 m	540 m

According to the statement of the captain and the reply to the questionnaire by Company A, concerning the ship, her turning performance decreased when the speed is less than about 35 km since the flap functions toward increasing lift force, and hence the maneuver mode had been changed from foilborne mode to hullborne mode at about 32 kn,.

(4) Wheelhouse information

The wheelhouse is arranged on the bow side of bridge deck and chair-type seats for a lookout, a captain, an engine officer, and another lookout are provided laterally in a row in a sequential order from the starboard side and there is nothing that hinders the lookouts except a pillar provided on a front glass window of the wheelhouse.

Each seat is provided with a three-point supporting seat belt comprising a winding unit for adjusting the length of the belt in a backrest part, and is designed to fix one's lumbar and upper body.

In addition, the respective seats for a captain and an engineer are about 1.4 m high from the floor and they are higher than the seat for a lookout on the starboard side by about 0.14 m.

(5) Information about view of the sea surface from the seat for a captain and the seat for an engineer in the wheelhouse*⁷

A view of the sea surface from each of the seats for a captain and an engineer in the wheelhouse when travelling in hullborne mode (forward draft: 1.46 m, after draft: 1.65 m) is about 9.9 m.

A view of the sea surface from each of the seats for a captain and an engineer in the wheelhouse when travelling in foilborne mode (foil depth: 2.0 m) is about 18.7 m.

(6) Wheelhouse device information

On a maneuvering console in front of the seat for a captain, a helm, a gyrocompass, a push switch for taking off, a depth handle, a throttle handle, etc. are arranged and below the throttle handle, the AIS, the GPS, a radar, etc. are arranged.

On a front engine console of the chief engineer seat, a main engine revolution indicator, a water-jet system revolution indicator, etc. are arranged so as to be able to keep watch over the operational status of the engines.

(7) Passenger cabin information and information of the seats thereof

Passenger cabins have a capacity to accommodate 200 passengers, consisting the first-floor cabin where first-class seats and economy-class seats are provided and the second-floor cabin where only economy-class seats are provided.

The first-class seats are situated in the front section and chair-type seats for single use are

*⁵ The "maximum advance" is a maximum longitudinal moving distance from the position of the center of gravity of the ship at turning the helm in a locus of the ship's position of the center of gravity by turning the helm (turning circle).

*⁶ The "maximum transfer" is a maximum traverse moving distance from the position of the center of gravity of the ship in the turning circle.

*⁷ The "view of the sea surface from a commanding position in the wheelhouse" is the visibility of the sea surface from the commanding position and a minimum distance from the bow which allows an overall view of the sea surface in the direction of the bow.

arranged two by two on both of the starboard-side and port-side blocks and four by two in the center block, all facing toward the bow.

In each first-class seat, a two-point seat belt comprising a lock-type winding device for emergency use is provided. In the upper part of the armrest of each seat, an about 10-millimeter thickness of wooden panel is installed extending about 5 mm from the side surface of the armrest into the inside of the seat, but no shock-absorbing material is provided.

Each seat is equipped with a wooden table to be stored in the armrest and the distances between the lower surface of the table and the seating face, and the back end of the table and the backrest when using the table are about 20 cm and about 40 cm respectively.

Economy-class seats are situated in the back of the first-class seat section of the first-floor cabin and all of the second-floor cabin, and chair-type seats for single use are arranged three by 12 on both of the starboard-side and port-side blocks and six by four and six by one in the center block in the first-floor cabin, as well as two by 13 on both of the starboard-side and port-side blocks, and four by 2 and five by two in the center block in the first-floor cabin, all facing toward the bow.

In each economy-class seat, a two-point seat belt comprising an emergency lock type winding device is provided.

Each front seat is equipped with a resin table to be stored in the armrest and a wooden table is provided on the back surface of the front seat is available at each of the other seats and the distances between the lower surface of the table and the seating face, and the back end of the table and the backrest when using each table are about 20 cm and about 40 cm respectively.

In addition, for purpose of urging the use of a seatbelt, a board described as “SEAT BELTS REQUESTED” in Japanese, Korean and English is attached to the wall surface of the first-floor cabin and the second-floor cabin, and indicator lights described as “FASTEN SEAT BELT” in Japanese, Korean and English are installed in the front part and the central part of the first-floor cabin and the second-floor cabin respectively.

(8) AS and underwater speaker information

The AS was designed and manufactured in the building yard of the boat, consisting of a telltale, an operation unit, a calculator, a transducer, and a principal device of a nose cone, and has capacity of a 30° detection angle to right and left, a 7° magnetic angle, a 1,000 m detectable range respectively to the maximum.

The underwater speaker (hereinafter, referred to as “UWS”) is a system built into the JETFOIL to radiate sonic waves into the water developed for the purpose of avoiding accidental contacts of the JETFOIL with cetaceans (marine lives such as whales, killer whales and dolphins). It has an erroneous operation preventing function which starts up in the state where the fore strut is lowered as well as at the time of traveling in foilborne mode.

In the case of installing the UWS and the AS, a transmitter or a transmitter/receiver will be installed within the fore pod, but because of the restriction of the capacity of the inside of the pod, it is impossible to co-installing these devices.

Concerning the operation of the AS, besides the necessity of an operator for constantly observing, it has a characteristic that the influence by a sea-surface reflected wave by ultrasonic wave will grow when wave height is over 1m, which makes it difficult to identify objects.

Company A conducted mounting of the UWS onto passenger ships which belonged to the

said company in 2005, but since collision cases with cetaceans occurred more than once in addition to an increase of eyewitness report of cetaceans, it raised doubts if the UWS did not have a cetacean repelling effect but rather was attracting them, and decided the disuse of the equipment on March 30, 2006 and had taken it away.

The boat had been equipped with the AS instead of the UWS, but since the device went wrong when the boat collided with obstacle in October, 2015 and was under repair, the boat was not equipped with the device at the time of the accident.

(See Attached Figure 2: General Arrangements, Attached Figure 3: Wheelhouse Arrangements, Attached Figure 4: Hydrofoil Device on the Bow, Attached Figure 5: Shock Absorber, Attached Figure 6: Seating Arrangements, Photo 3: Economy-class Seat, Photo 4 First-class Seat, Photo 5: Safety Requests, and Photo 6: Captain Lamp)

2.6 Weather and Sea Conditions

2.6.1 Weather Observations

According to the observation values of the Nagasaki Local Meteorological Observatory, Waniura Regional Meteorological Observation Station, which is located approximately 19.4 M southeast from the accident site, they were as follows.

January 8

08:00	Wind direction: West-northwest	Wind speed: 11.9 m/s
09:00	Wind direction: West-northwest	Wind speed: 15.9 m/s
09:30	Wind direction: West-northwest	Wind speed: 15.8 m/s
09:50	Wind direction: West-northwest	Wind speed: 15.1 m/s
10:00	Wind direction: West-northwest	Wind speed: 15.2 m/s

The announced status of warning and advisory in Kami-agata District, Tsushima City was that advisory for gale and advisory for wave were announced at 04:10 on January 8 and 07:51 on January 8 respectively and they were continuing also at the time of the accident.

2.6.2 Observations by Crews

According to the statements of the captain, at the time of the accident, the weather was blue sky, the wind direction was northwest, and the wind speed was about 10 m/s and the wave height was about 1.8 m, and visibility was good.

2.6.3 Attitude and Position of the Sun

According to the information of National Astronomical Observatory of Japan, the attitude of the sun at the time and the place of the occurrence of the accident was about 21.9° and the position was about 141.3°.

2.6.4 Sun Glitter^{*8} Information

According to a literature^{*9}, the brilliance of the sea surface caused by sun glitter, influences on visual functions by sun glitter, and review of sunglasses are as follows.

- (1) The brilliance value becomes largest at a solar attitude of 20° and an average value is 2×10^5 cd/m², a maximum value is 1×10^{10} cd/m².

^{*8} The “sun glitter” means a glittery state of the sun specularly reflecting on the sea surface.

^{*9} The literature: “Influences of sun glitter impeditive for lookout and the evaluation of sunglasses” (The Journal of Japan Institute of Navigation Vol, 91, issued on September 25, 1994)

- (2) Sun glitter significantly deteriorates visual functions.
- (3) Sunglasses have inhibiting effect for the deterioration in visual functions.

2.7 Situation on Cetacean Witness Report (etc.) in the Navigating Marine Area

According to the statements of the safety manager and a cetacean eyewitness report record book that Company A voluntarily keeps, it was as follows.

On January 4, 2016, a 17-meter-long whale (hereinafter, referred to as “the eyewitness information”) had been witnessed in the location at 34°57.6’N, 129°15.4’E.
(See Attached Figure 7 Setting Condition Map of the Decelerating Area)

2.8 Information about Operation Control etc. of Vessels

2.8.1 Safety Management Rules

Company A had set safety management rules based on Article 10 (3) of Marine Transportation Act (Act No. 187 of 1949) and had enforced it since December 1, 2006 (excerpt).

(Streamlining of structure for information collection and communications)

Section 30 An operational manager streamlines information and communications necessary for operation control of a vessel under mutual cooperation with a captain, the Head Office, Busan Branch, and agencies.

(Actions to be taken by an operation controller in collecting information)

Section 31 An operational manager shall grasp the following items and further report on (4) and (5) with no fail, and on other items where necessity, to a captain.

(1) – (7) omitted

(8) Other items necessary for securing safety of maneuver

(Actions to be taken by a captain in collecting information)

Section 32 A captain must collect information necessary for securing safe maneuver under cooperation with an operational manager, Busan Branch, and agencies, and report to the operational manager with no fail in the following cases.

(1) In the case of encountering weather and oceanographic conditions which have relevance to the operating plan or maneuver safety, or the occurrence of events which requires repair or maintenance in the hull, engine, or other facilities

(2) In the case of the occurrence of accidents specified in the accident handling reference

(3) Omitted

(4) In the case of the occurrence of other situations of emergency

2 A captain shall make efforts to grasp the following items and contact an operational manager when necessity.

(1) Omitted

(2) Information about obstructions (floaters) and witnessing of cetaceans

(3) – (4) Omitted

(Items to be disseminated to passengers)

Section 39 An operational manager and a captain make efforts to disseminate the following items by posting, announcing etc. in order to ensure safety of passengers and

safety of the operation of the ship, pursuant to laws and regulations.

(1) – (4) Omitted

(5) *Seat belt use at the time of departure and entry and in foilborne mode*

(6) Omitted

2.8.2 Operating Criteria

Company A had set an operating criteria for clarifying a standard concerning operations based on the safety management rules, but there was no description about measure for preventing collision with cetaceans in the criteria (excerpt).

(Berthing and deberthing work)

Section 4 Omitted

2 – 3 Omitted

4 *In deberthing, a captain shall command crews and leave a port after directly asking passengers for cooperation for seat belt wearing and confirming the wearing.*

5 Omitted

(After-leave work)

Section 5 *Cabin crews shall announce the following items over the intercom.*

(1) Omitted

(2) *Seat belt use at the time of departure and entry and in foilborne mode*

(3) – (6) Omitted

2 *Continuing to the preceding item, broadcasting safety video footage*

(1) – (4) Omitted

(5) *Seat belt wearing guideline*

(On board patrol)

Section 6 *A chief officer shall arbitrarily perform on board patrol and make efforts to prevent fire during a voyage and pay attention to the state of passengers.*

2 *Cabin crews shall perform patrol of passenger cabins between the patrol of the chief officer and pay attention to the state of passengers.*

3 *The chief officer and cabin crews ask for cooperation through the passenger cabins in the case where seat belt wearing is needed*

(Vessel)

Section 8 *With regard to inboard operations, a captain shall clarify assignation of each crew, establish the reporting line, and take counsel with an operation manager about necessary items.*

2.8.3 Transportation Agreement Information

The transportation agreement describes the following as prohibited acts of passengers (excerpt).

(Prohibited acts of passengers)

Section 17

1 *Passengers shall not commit the following acts.*

(1)– (10) Omitted

(11) *Seat belt unworn during the travelling in foilborne mode*

2 – 3 Omitted

2.8.4 Information about Instruction Situation for Safety Actions to a Collision with Cetaceans

According to a record of proceedings of the safety management committee, an administrative circular from an operational manager to each captain, the statements of the captain, the safety manager, and the operational manager, it was as follows.

The operational manager designated the area of the accident as a reduction area in the administrative circular of April 30, 2005 as a safety measure to the flood accident of an engine room of a passenger ship belonging to another company on 29th of the same month, and decided to implement enhancement of lookout, decelerated maneuver at about 40 kn, and a request to passengers for wearing a seat belt, and notified each captain and each C/E of them.

On February 20, 2006, triggered by the collision accident of a passenger ship of Company A on February 6 of the same month, Company A decided to designate the area of the accident as a reduction area, enhance lookout, and decelerated maneuver as a safety measure in the safety management committee with the participation of a safety manager, an operational manager, each captain, and each C/E, and created a record of proceedings.

On March 19, triggered by the collision accident of a passenger ship of Company A on 17 and 19 of the same month, Company A decided to designate the entire marine area as a reduction area, enhance lookout, and decelerate maneuver at 38 kn, asking passengers to wear a seat belt, and stop using UWS as a safety measure in the safety management committee with the participation of the CEO, a safety manager, an operational manager, each captain, and each C/E, and created a record of proceedings.

The operational manager, for the reason that there was no cetacean eyewitness information in the Sea of Genkai and Tsushima East Channel, changed the designation of the reduction area to two types: designating an arbitrary marine area as the reduction area whose ending time period is not yet determined, and designating a range of 5 M round as the reduction area with a cetacean-witnessed point as the center for a week from the day when the cetacean was witnessed.

The operational manager notified each captain and each C/E of designating northward of 34°10.0'N as a reduction area, specifying a speed at 36 – 38 kn, and leaving the ending time period undetermined in the administrative circular on April 25, 2007.

The operational manager notified a change to a reduction area according to the frequency of acquisition of cetacean eyewitness information.

The operational manager had informed that allowable delay time associated with implementation of decelerated maneuver was five minutes when notifying a reduction area.

In addition, the operational manager had given captains oral instruction of enhancement of lookout by four persons of a captain, a C/E, a C/O, and a first engineer, suspension of inboard sales by cart, seating of cabin crews, and implementation of airing of seat belt wearing to passengers, in addition to decelerated maneuver at 36 – 38 kn when passenger ships of Company A navigated the reduction area (hereinafter, referred to as “cetacean-cautious maneuver”).

Company A had not specifically set down about how to share information of new inboard cetacean eyewitness information and of setting status of the reduction area based on the said eyewitness information, and how to issue instructions of cetacean-cautious maneuver implementation, and had left it to each captain.

2.8.5 Operation Statuses of Passenger Ships of Company A in the Reduction Area

According to each AIS record of the ship and the two ships which were the same type as the ship (hereinafter, referred to as “the homotypic ship A₁” and “the homotypic ship A₂”) under operation of Company A received by KANMON KAIKYO Vessel Traffic Service Center, the reduction statuses near the reduction area from January 5 to January 7, 2016 were as follows.

Meanwhile, according to the work designation schedule of Company A, it was from January 6 to January 8 that the captain was aboard the ship.

The ship maneuvered near the reduction area at about 41.5 kn around 09:30, about 40.0 kn around 13:13, and about 41.6 kn around 14:58 on 5th, about 38.8 kn around 16:57 on 6th, and about 39.4 kn around 09:55 and about 41.5 kn around 17:03 on 7th.

The homotypic ship A₁ maneuvered the reduction area at about 37.7 kn around 11:30, about 37.9 kn around 12:51, and about 38.4 kn around 16:47 on 5th, about 37.5 kn around 09:27, about 38.6 kn around 13:12 and about 41.8 kn around 14:53 on 6th, and about 40.0 kn around 11:30, about 40.7 kn around 12:53 and about 38.2 kn around 16:41 on 7th.

The homotypic ship A₂ maneuvered the reduction area at about 41.5 kn around 11:32, about 41.1 kn around 12:56, and about 39.9 kn around 16:44 on 6th and about 40.8 kn around 09:29, about 40.6 kn around 13:13 and about 42.5 kn around 15:01 on 7th.

(See Attached Figure 8 Speed Change Graphs of Passenger Ships of Company A)

2.8.6 Information about Implementation Status of Safety Measure to Collision with Cetaceans

According to the statements of the captain, the safety captain, and the operational manager, it was as follows.

The operational manager created a database of the eyewitness information on January 4, 2016 and had disseminated it to passenger ships of Company A via an information sharing terminal.

The operational manager witnessed a briefing of the ship on departure from the The Port of Hakata on 6th, and confirmed the captain telling the eyewitness information, a setting condition of the reduction area, cetacean-cautious maneuver implementation schedule and others to his crews.

The captain made the C/O confirm the eyewitness information on the information sharing terminal and also he himself made the confirmation to share the information, and told his crews the eyewitness information, a setting condition of the reduction area, cetacean-cautious maneuver implementation schedule and others in a briefing on departure from The Port of Hakata, and issued instructions for cetacean-cautious maneuver implementation before entering the reduction area on 6th.

The captain did not share information with the C/O at on departure from the Port of Busan on 7th since no new cetacean eyewitness information was identified, and told his crews a setting condition of the reduction area, cetacean-cautious maneuver implementation schedule and others in a briefing and issued instructions for cetacean-cautious maneuver implementation before entering the reduction area.

The captain neither shared information with the C/O at on departure from the Port of Busan on 8th since no new cetacean eyewitness information was identified nor had a briefing for fear of delay in the time of departure.

The captain was considering that even five or ten minute delay would disturb passengers.

The captain was considering that even if the speed is decreased only in the reduction area, there was no difference in the safety of maneuver since no one could say for sure that there was not any marine life in other areas.

The captain did not issue instructions for cetacean-cautious maneuver before entering the reduction area due to forgetfulness.

2.9 Actions to Ensure the Safety of Ultrahigh-speed Vessels

2.9.1 Japan's Actions

According to the homepage of the Ministry of Land, Infrastructure, Transport and Tourism (MLIT), "Actions to ensure the safety of ultrahigh-speed vessels (finalized)" announced by "Safety Actions Advisory Committee for Ultrahigh-Speed Vessels" on April 24, 2009 was as follows (excerpt).

Upon a series of accidents of collision of hydrofoil-typed ultrahigh-speed vessels with driftwoods and cetaceans during maneuver in waters near our country around 2006, "Safety Actions Advisory Committee for Ultrahigh-Speed Vessels" was established and study on safety actions to the collision of hydrofoil-typed ultrahigh-speed vessels with obstacles such as driftwood and cetaceans has been conducted.

(Omitted)

In the committee, it was put together about "actions to avoid a collision" and "actions to reduce damage of passengers/crews in the event of a collision" concerning the cases of hydrofoil-typed ultrahigh-speed vessels colliding with obstacles on a sea surface such as driftwood and cetaceans. From now on, it is necessary to take safety actions while attempting cooperation and coordination in administrative agencies, operating companies, and manufacturing business operators, in accordance with this finalization.

1. *Actions to avoid collision*

(1) Grasp of obstacle information such as driftwood and eyewitness information of cetaceans

① Provision of information from the Japan Coast Guard

② Creation of a whale hazard map by operating companies and others

(2) Safe operation utilizing information on obstacles and cetaceans

(3) Utilization of AS

(4) Utilization of the UWS

2. *Actions to reduce damage upon occurrence of collision*

(1) Establishment of technical criteria of seat belt

(2) Seat belt wearing

(3) Installation of shock-absorbing material just in case

(Omitted)

2.9.2 Company A's Actions

According to the statements of the safety manager and the operating manager, they were as follows.

Company A created a cetacean eyewitness information database informed by the Japan Coast Guard as actions to avoid collision in order to grasp obstacle information such as driftwood and eyewitness information of cetaceans, provided latest information to passenger ships of the company via an information sharing terminal, and was instructing cetacean-cautious maneuver based on the said information as safe maneuver.

Though Company A installed the UWS on passenger ships of the company in 2005, since collision with cetaceans occurred more than once in addition to increase in cetacean eyewitness information, after taking it away as there was no cetacean avoiding effect in the device, the AS was

installed as substitute for the UWS, but the AS was not installed on the homotypic ship A₁ and homotypic ship A₂.

Company A equipped passenger ships of the company with seats that met technical criteria of a seat belt in order to reduce damage in instances of collision, had established an obligation to wear a seat belt in its transportation agreement, and had installed a shock-absorbing material inboard just in case.

(See Photo 7 Shock-absorbing material)

2.9.3 Information about the UWS's Developmental Status

According to the statements of a person in charge of the building yard of the ship, it was as follows.

Specification of the target cetacean according to course in service, clarification of the characteristics of cetaceans' auditory sense, specification of an audible frequency band, development of a new UWS audio source from which cetacean avoiding effect can be expected, and investigation of reaction of cetaceans at playback of the audio source have been finished, it has been installed on a plurality of ships of JETFOIL operating company, and cetacean avoiding effect by the new UWS audio source has been investigated.

3 ANALYSIS

3.1 Situation of the Accident/Incident Occurrence

3.1.1 Course of the Events

As described in 2.1.1 and 2.1.2, it is probable as follows.

- (1) The ship left its exclusive pier in the Port of Busan at the schedule time of 09:30 on January 8, 2016 with six crews aboard besides the captain and carrying 184 passengers.
- (2) The ship left the harbor limit of the Port of Busan at around 09:54, accelerated into about 40 kn, moved to the maneuver in rough weather judging that the sea level was the on in the state of rough weather, entered the reduction area at around 09:50, set course at 145°, and went headed off the Port of Hakata along a course line.
- (3) In the ship, the 1/E noticed a marine life comprising a dorsal fin-like projection present very close in the heading on the starboard side, set up a shout sensing the risk of collision, and the captain hearing the 1/E shouting thought that the 1/E identified a marine life on the course of the ship and although the captain instantly put the helm to right to try to avoid collision, the ship collided with the marine life and strong impact was generated on the hydrofoil on the bow, the speed decreased and the traveling mode shifted from foilborne mode to hullborne mode, and various alarms were activated.

3.1.2 Date and Time of Occurrence

As described in 2.1.1, 2.1.2 and 3.1.1, it is probable that the date and time when the accident occurred was around 09:54 on January 8, 2016 and the location where the accident occurred was at 325° from the Mishima Lighthouse near 18.2 M.

3.1.3 Occurrence Situation of the Injured

As described in 2.1.1, 2.2 and 2.4, the situation where seven passengers and two cabin crews were injured was as follows.

(1) Passenger A

It is somewhat likely that Passenger A suffered a subcutaneous fracture of sternum, but the status of use of the seat belt etc. was not able to be clarified.

(2) Passenger B

It is probable that Passenger B had an inclination angle of the backrest changed and was unfastening a seat belt in a posture of being shallowly seated and leaning against the backrest at the time of the accident when he suffered a first lumbar vertebra compressed fracture by receiving a strong impact.

(3) Passenger C

It is probable that Passenger C had the table set up and was fastening a seat belt with an inclination angle of the backrest unchanged, being deeply seated, and leaning against the backrest at the time of the accident when she had fractures in left ribs 4, 6, and 7 by receiving a strong impact.

(4) Passenger D

It is somewhat likely that Passenger D was seated without wearing a seat belt at the time of the accident when he suffered a lumbar strain as well as a cervical sprain by receiving a strong impact.

(5) Passenger E, Passenger F, and Passenger G

It is somewhat likely that Passenger E, Passenger F, and Passenger G suffered mild degree of burns by spilt hot coffee purchased immediately before the accident from the inboard sales by cart when they were seated in the seats with the seat belt worn.

(6) Cabin Crew A

It is probable that Cabin Crew A suffered bruises on the lumbar spine and both thighs by being forced ahead and having her body hit a wall due to a high impact generated when she was performing a clerical routine.

(7) Cabin Crew B

It is probable that Cabin Crew B suffered cervical sprain, bruises on the left occipital region and chest by being forced ahead and fell back due to a high impact generated when she was engaged in inboard sales by cart at the central section closer to the portside of the first-floor cabin.

3.2 Causal Factors of the Accident

3.2.1 Situations of Crews

As described in 2.4, the captain has a lawful and effective seamen's competency certificate and it is probable that his health condition was good at the time of the accident.

3.2.2 Conditions of the Vessel

As described in 2.5, they were as follows.

It is probable that the AS was detached for repair although there was no fault and no failure in the hull and the engines at the time of the accident.

It is probable that the ship was not equipped with the UWS.

3.2.3 Weather and Sea Conditions

As described in 2.6, it is probable that the weather was blue sky, the wind direction was northwest, the wind velocity was about 10 m/s and visibility was good, and that the wave height was about 1.8 m.

3.2.4 Analyses on Conditions of Ship Maneuvering and Lookout

As described in 2.1.2, 2.1.4, 2.5.2, 2.6.3, 2.6.4 and 3.2.3, they were as follows.

- (1) It is probable that the ship was navigating at a speed of about 40 kn under the condition of breakers of about 1.8 m wave high and the sun located at about 5° from the bow on the port side at 22° high.
- (2) The captain was sitting on the operator's seat with a seat belt fastened and wearing sun glasses, and was manually captaining the ship while watching breaker conditions and the bow direction.
- (3) From the following, it is probable that, enhancement of lookout by four persons of the captain, the C/E, the C/O and the 1/E, was not implemented in the ship at the time of the accident.
 - ① The C/E was inputting the engines' operation resource data at the time of the departure.
 - ② The 1/O was performing on board patrol under the operating criteria of the safety management rules.
 - ③ The 1/E was keeping a lookout while performing engine operation and engine operation monitoring.
- (4) It is considered that the captain navigating without directing cetacean-cautious maneuver and strengthening lookout for marine lives by the captain, C/E, the C/O and 1/E may be involved with the discovery of the marine life in a short range.
- (5) It is certain that they had no other choice but to perform the presence confirmation of the marine life relying on direct viewing.

3.2.5 Situation on Marine Life Witness (etc.)

As described in 2.1.2, 2.1.3 and 2.7, it was as follows.

- (1) It is probable that the captain and the 1/E had not seen a sign indicating the existence of cetaceans such as spouting and association of sea birds until the 1/E saw the marine life.
- (2) It is probable that the marine life has a back-fin-like projection and that it was proceeding from the direction of the starboard to the port.
- (3) It is probable that the 1/E discovered the marine life at the position farther than about 18.7 m since the visibility of the sea surface from the command position of the wheelhouse was about 18.7 m in foilborne mode at 2.0 m of the depth of wing.

3.2.6 Analysis on Safety Management

As described in 2.1.2, 2.8 and 3.2.4, it was as follows.

- (1) It is probable that the operation manager collected cetacean eyewitness information, created database, set a reduction area based on the collected cetacean eyewitness information, and disseminated the area to passenger ships of Company A via a information sharing terminal.

- (2) It is probable that the operation manager had informed the allowable delay time associated with implementation of decelerated maneuver.
- (3) It is certain that although the ship, the homotypic ship A₁ and the homotypic ship A₂ needed decelerated maneuver at 36 – 38 kn during the total of 21 maneuvers in the period from January 5 to 7, 2016, 18 times of them were navigated at over 38 kn.
- (4) It is somewhat likely that the captains were not implementing decelerated maneuver.
 - ① Company A had not established operating guidelines of the cetacean-cautious maneuver in the safety management rules and was not thoroughly disseminating them.
 - ② Company A had informed the allowable delay time associated with implementation of decelerated maneuver.
- (5) It is somewhat likely that Company A had not established an administrative structure capable of grasping a referring situation of the cetacean-cautious maneuver and an implementation status of the cetacean-cautious maneuver.
- (6) It is probable that the captain confirmed the cetacean eyewitness information on the information sharing terminal, informing the crews of the cetacean eyewitness information, the setting status of the reduction area based on the information, and the implementation schedule of the cetacean-cautious maneuver in the briefing, and issued specific instructions before entering the area.
- (7) It is probable that the captain canceled the briefing on January 8, 2016 considering a risk of delay in the departure time.
- (8) It is somewhat likely that the captain did not perform the instructions of the cetacean-cautious maneuver due to forgetfulness.
- (9) It is probable that the presence confirmation of the marine life had to be relied on sight since the ship was not equipped with AS for repair during the period from the breakdown of the AS to the occurrence of the accident.

3.2.7 Analysis on the Occurrence of the Accident

As described in 2.1.2, 3.1.1, 3.2.4, 3.2.5 and 3.2.6, it was as follows.

- (1) It is probable that the captain canceled the briefing at around 09:05 considering a risk of delay in the departure time.
- (2) It is probable that the ship left the harbor limit of the Port of Busan and increased speed to about 40 kn at around 09:45, and switched to the maneuvering for rough weather in the judgment of the captain that the sea surface was in the rough weather state.
- (3) It is probable that the ship entered the reduction area at around 09:50, set the course at 145° and headed off to the Port of Hakata along the criterial course line.
- (4) It is somewhat likely that the captain did not instruct the cetacean-cautious maneuver due to forgetfulness.
- (5) Concerning the ship, it is probable that the seat belt wearing was not disseminated and the inboard sales by cart by the cabin crews were continued in the passenger cabins and the C/O left for inboard patrol without going into lookout, and lookout by four persons of the captain, C/E, C/O 1/E was not enhanced, and the ship continued maneuver without conducting decelerated maneuver.
- (6) Concerning the ship, it is probable that the 1/E noticed a marine life having a

back-fin-like projection being in the proximity in the direction of the bow on the starboard side, in spite of the captain put the helm to right, the ship collided with the marine life, a strong impact was generated on the hydrofoil on the bow, the speed decreased from the state of foilborne mode to hullborne mode, and various alarms provided in the wheelhouse went off.

3.2.8 Analysis on Collision Avoidance

As described in 2.1.2, 2.1.3, 2.1.4, 2.5.2, 3.1.1, 3.2.4, and 3.2.5, it was as follows.

- (1) It is probable that the 1/E detected the marine life farther than 18.7 m distance from the ship.
- (2) It is somewhat likely that the captain put the helm to right as he had not seen telltale signs of the presence of cetacean such as the spouting and the flock of seabirds in the direction from the bow to the starboard where he was mainly looking out when he heard the shout of the 1/E and therefore thought it was a safe area.
- (3) It is probable that the ship's ability of maneuver was 332 m in Max. advance and 540 m in Max. transfer when turning to right at a rudder angle of 75° during traveling in foilborne mode at about 45.5 kn.
- (4) From (1) – (3) above, it is somewhat likely that the ship was not able to avoid collision in the distance at which they discovered the marine life.

3.3 Analysis on Reduction of Damage

As described in 2.2, 2.5.2, 2.8, 3.1.1, 3.1.3 and 3.2.7, it was as follows.

- (1) Concerning the ship, it is probable that the acceleration in the horizontal direction and the vertical direction was generated when the hydrofoil on the bow collided with the marine life while traveling in foilborne mode at a speed of about 40 kn.
- (2) It is somewhat likely that the passengers who were seated with their seat belt unfasten fell onto their seats due to acceleration in the vertical direction since their lumbar parts were not fixed and therefore suffered a first lumbar vertebra compressed fracture.
- (3) Concerning passengers who had a fracture of the rib with wearing a seat belt, it is somewhat likely that acceleration in the horizontal direction acted and that their unfastened upper bodies hit onto respective set-up tables or an armrest on which a shock-absorbing material was not provided. For this reason, it is probable that providing a shock-absorbing material on the armrest and storing the table during the cetacean-cautious maneuver are effective for reducing the number of injured and mitigating the degree of injury when an accident occurs.
- (4) It is somewhat likely that the passengers who did not have their seat belt on had a lumbar strain, a cervical sprain and others by acceleration in the horizontal direction and the vertical direction since they had not their body fixed.
- (5) Concerning the three passengers, it is somewhat likely that coffee purchased at the inboard sales by cart spilt on their hands and that they suffered a mild degree of burns to their hands.
- (6) It is probable that the cabin crews were injured when they were continuing the inboard sale by cart without the instruction of the cetacean-cautious maneuver.
- (7) In the accident, it is somewhat likely that from the above descriptions, the crews and

the passengers had a forceful impact on their bodies by acceleration in the horizontal direction and the vertical direction acting and were injured by having their unfixed upper bodies hit onto the respective tables and others since they had the tables set up and no shock-absorbing material was provided on the armrests, though they wore the seat belt.

- (8) For this reason, it is considered effective to thoroughly disseminate appropriate seat belt wearing to passengers, provide a shock-absorbing material on the armrest, store the table during the cetacean-cautious maneuver, suspend inboard sales by cart, and have cabin crews seated are effective for reducing the number of injured and mitigating the degree of injury when an accident occurs.

4 PROBABLE CAUSES

4.1 Probable Causes

Concerning the accident, it is probable that the ship collided with a marine life in spite of a rudder turn since the marine life was discovered in the proximity during the maneuver at a cruising speed (40 km)

It is somewhat likely that discovering the marine life in the proximity is associated with the captain not directing cetacean-cautious maneuver as well as navigating without enhancing lookout.

It is probable that the reason why the captain did not direct cetacean-cautious maneuver was that Company A had not established operating guidelines of cetacean-cautious maneuver in the safety management rules and was not thoroughly disseminating them, had informed the allowable delay time associated with implementation of decelerated maneuver, and did not have a grasp of the implementation status of cetacean-cautious maneuver.

4.2 Causes of Injuries

It is somewhat likely that the reason why the passengers suffered a lumbar vertebra compressed fracture etc. was that they fell onto their seats due to acceleration in the horizontal direction and the vertical direction since they either did not have their seat belt on or do it improperly, and that they hit their unfixed upper bodies against the tables etc. since they had their tables set up and no shock-absorbing material was provided on the armrests though they had their seat belts on.

It is probable that the reason why the passengers suffer burns on their hands with spilt hot coffee and the cabin crews engaged in the inboard sales by cart injured is associated with not having taken actions of cetacean-cautious maneuver.

5 SAFETY ACTIONS

Concerning the accident, it is probable that the ship collided with a marine life while she was navigating in the reduction area at a cruising speed and there were injuries among passengers who had their tables set up in spite of having their seat belt on and also cabin crews who were engaged in the inboard sales by cart.

It is probable that Company A had not established operating guidelines of cetacean-cautious

maneuver such as decelerated maneuver, enhancement of lookout of marine lives, suspension of inboard sales by cart, and implementation of dissemination of seat belt wearing in the safety management rules and was not thoroughly disseminating them, informed allowable delay time associated with implementation of decelerated maneuver, and did not have a grasp of the implementation status of cetacean-cautious maneuver.

Consequently, Company A needs to take the following actions in order to prevent a recurrence of similar accident and reduce damage.

- (1) Setting down about implementation of cetacean-cautious maneuver
- (2) Enforcing cetacean-cautious maneuver in a setup reduction area on each ship
- (3) Establishing an administration system capable of grasping implementation status of cetacean-cautious maneuver
- (4) Accelerating attachment of a shock-absorbing material in passenger cabins and storing of tables at cetacean-cautious maneuver

5.1 Safety Actions Taken after the Accident

5.1.1 Safety Actions Taken by the MLIT

- (1) Actions taken by Safety Policy Division, Maritime Bureau of the MLIT

Maritime Bureau of the MLIT, in view of an increase in an accident of hydrofoil-type of ultrahigh-speed vessels colliding with sea lives such as cetaceans, Safety Policy Division, notified ultrahigh-speed vessel business operators of reviewing security arrangements once again and thorough implementations of the actions below.

- ① Creation/update of a hazard map based on eyewitness information of sea lives such as cetaceans and implementation of decelerated maneuver and route modification utilizing the said information (Make use of eyewitness information of cetaceans through communications among operating companies, besides marine life eyewitness information provided by Maritime Information and Communication System (MICS))
- ② Enforcement of seat belt fastening on passengers by inboard posting, announcing etc.
- ③ Study and captainty of ship maneuvering method for collision avoidance when marine lives such as cetaceans are discovered

- (2) Actions taken by Maritime Safety and Environment Department of Kyushu District Transport Bureau

Maritime Safety and Environment Department of Kyushu District Transport Bureau, in view of continued accidents of hydrofoil-type of ultrahigh-speed vessels colliding with sea lives such as cetaceans within their jurisdiction, made up actions aimed at decrease of the occurrence of accidents of the same sort and reduction of damage at the time of the occurrence of the accident toward the improvement of safety after interviewing business institutions, and gave guidance of implementation with regard to the following items ① to ⑤ and also issued a notice for transmitting necessary information with regard to the following items ⑥ to ⑧.

- ① Implementation of attention reminding before setting out from a terminal (sea life eyewitness information, occurrence of delay)
- ② Decelerated maneuver at 35 kn (65 km/h) in a dangerous sea area
- ③ Deceleration of cruising speed from usual 43 kn (80 km/h) to 40 kn (74 km/h) and under in a time period when it is considered that sea lives are frequently seen on an empirical basis
- ④ Dissemination of safety action by inboard announcement approximately 10 minutes before

entering a dangerous sea area

- a Double check of secure seat belt wearing
 - b Prohibition of on-board transfer in principle
 - c Suspension of inboard service due to the crews' seating
- ⑤ Enhancement of collection of sea life eyewitness information (utilization of multiple sources of information such as information that MICS of Japan Coast Guard provides)
 - ⑥ Maneuver in an emergency
 - ⑦ Utilization of the AS
 - ⑧ Utilization of the UWS

5.1.2 Preventive Actions Taken by Company A

Company A took the following preventive actions

- (1) Creating a written reduction area setting which describes target sea areas and target periods of time as a means for securely transmitting a dissemination method of collected cetacean eyewitness information to passenger ships of Company A, in addition to e-mail distribution through a long-continued information sharing terminal and distributing it to passenger ships of Company A
- (2) Having slowed down a designated speed from 38 – 36 kn to 35 kn
- (3) Having decided to place a priority on lookout for marine lives in the case where on board patrol and by the C/O and reduced area maneuver coincide with each other
- (4) Having decided to introduce BRM philosophy when a training and an instruction course is taken place
- (5) Having decided to remount the UWS and the AS and examine the effects

6 RECOMMENDATIONS PURSUANT TO THE ACT FOR ESTABLISHMENT OF THE JAPAN TRANSPORT SAFETY BOARD

Concerning the accident, it is probable that the passenger ship BEETLE collided with a marine life when she was sailing in a reduction area at a cruising speed, passengers who were not appropriately using a seat belt, passengers who had their tables set up with wearing a seat belt, and cabin crews who were engaged in inboard sales by cart and others.

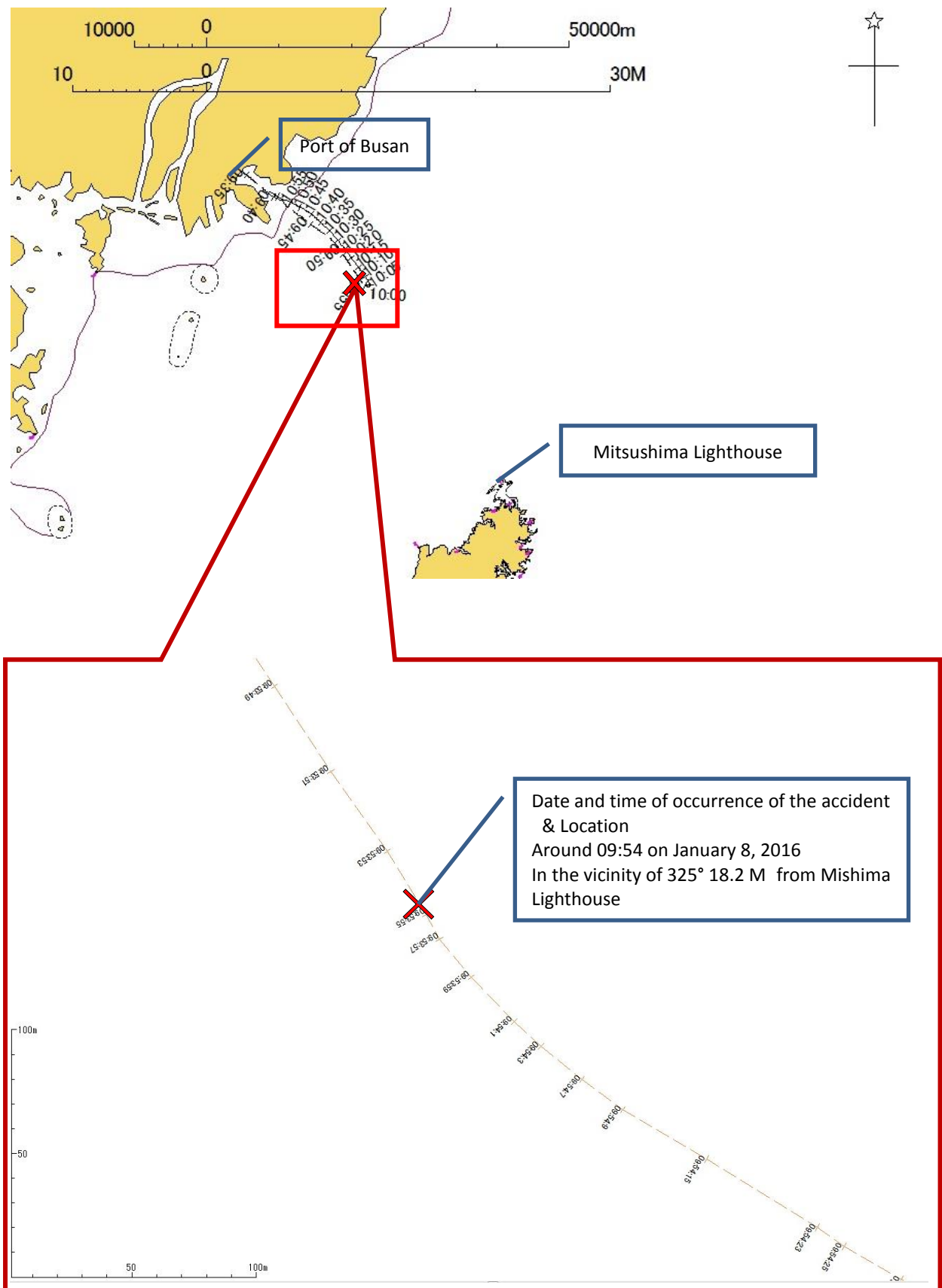
It is probable that JR KYUSHU JET FERRY INC. had not established operating guidelines of cetacean-cautious maneuver such as decelerated maneuver, enhancement of lookout for marine animals, suspension of inboard sales by cart, and implementation of dissemination of seat belt wearing to passengers in safety management rules, and had not thoroughly disseminated them, had informed allowable delay time associated with implementation of decelerated maneuver, and had not grasped an implementation status of cetacean-cautious maneuver.

In view of the result of this accident investigation, the Japan Transport Safety Board recommends JR KYUSHU JET FERRY INC. pursuant to paragraph (1) of Article 27 of the Act for Establishment of the Japan Transport Safety Board as follows:

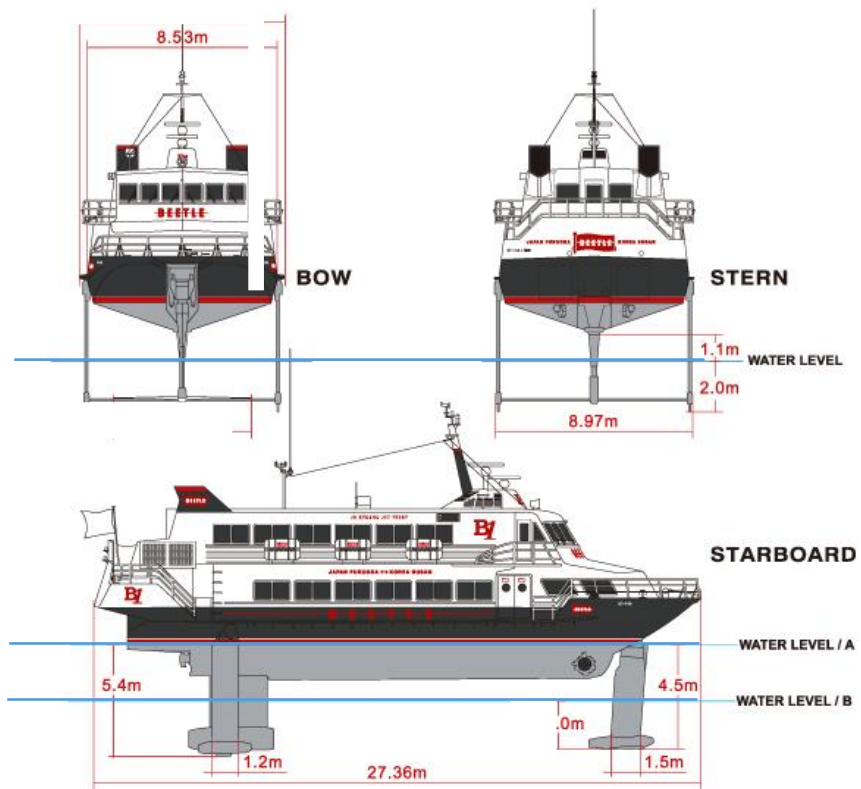
JR KYUSHU JET FERRY INC. must take the following actions in order to ensure safety of passenger transportation.

- (1) Prescribe implementation of cetacean-cautious maneuver in safety management rules.
- (2) Make each ship enforce cetacean-cautious maneuver in setup reduction areas.
- (3) Establish an administration system capable of grasping an implementation status of cetacean-cautious maneuver in each ship.
- (4) Accelerate mounting of shock-absorbing material in passenger cabins and storing of table at cetacean-cautious maneuver.

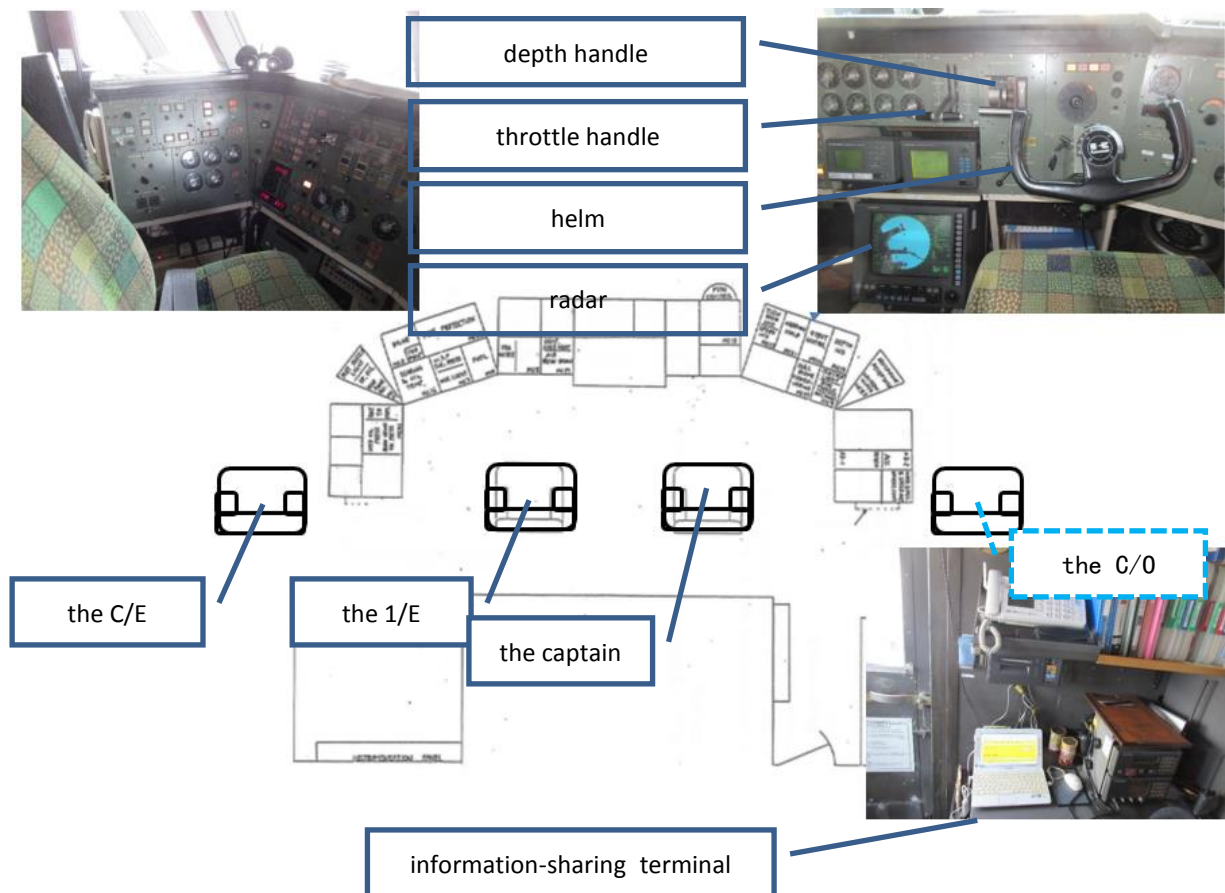
Attached Figure 1 Navigation Path



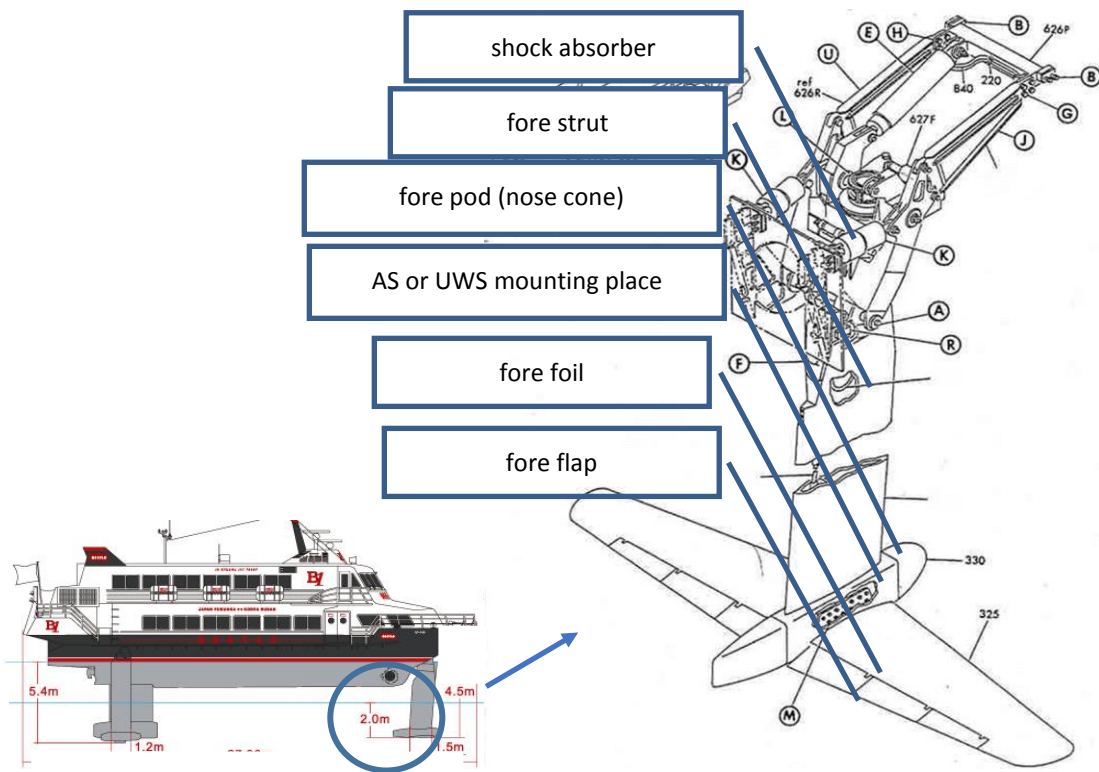
Attached Figure 2 General Arrangements



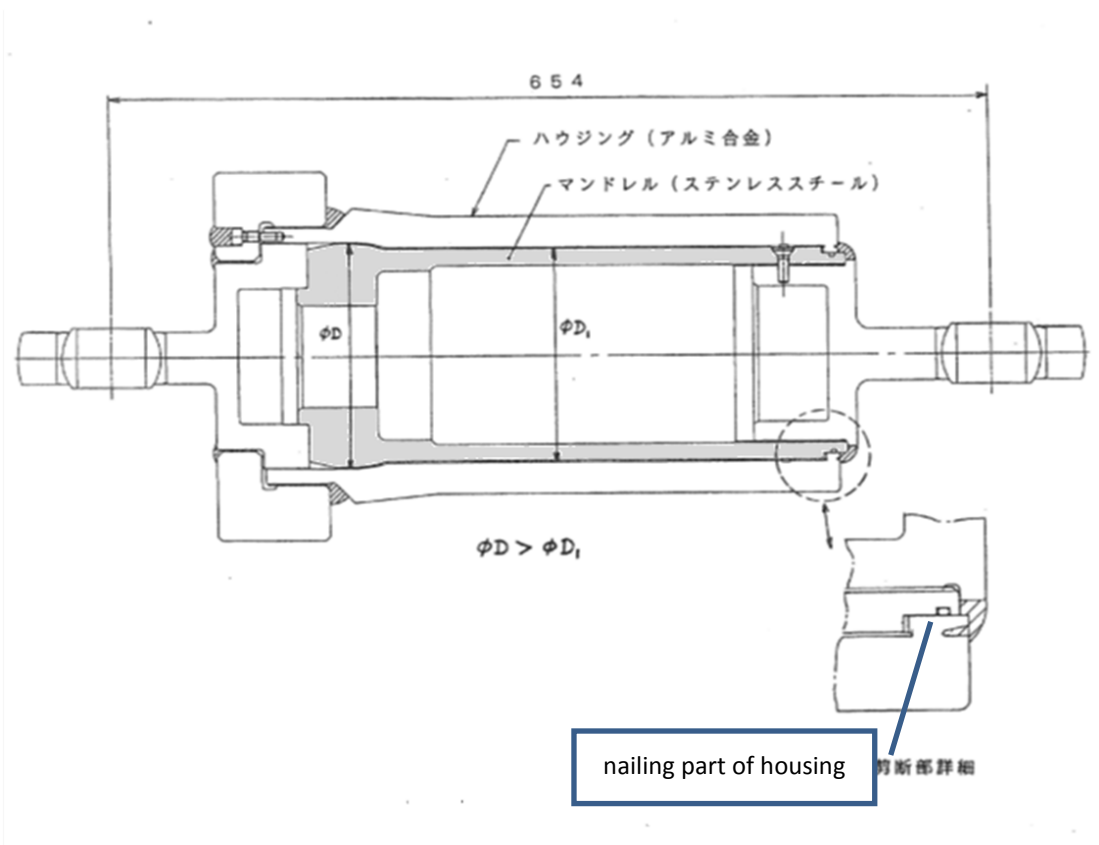
Attached Figure 3 Wheelhouse Arrangements



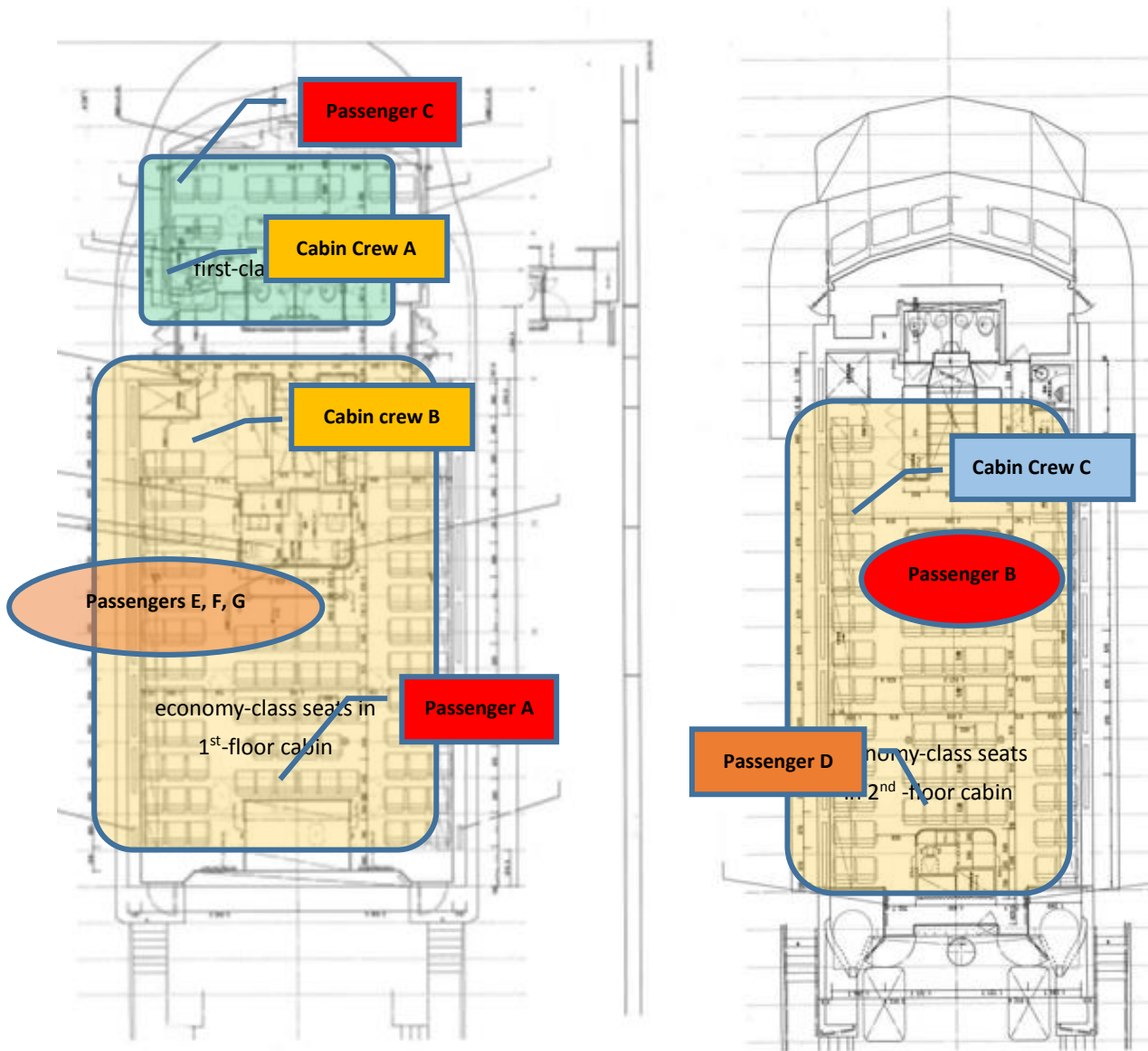
Attached Figure 4 Hydrofoil Device on the Bow



Attached Figure 5 Shock Absorber

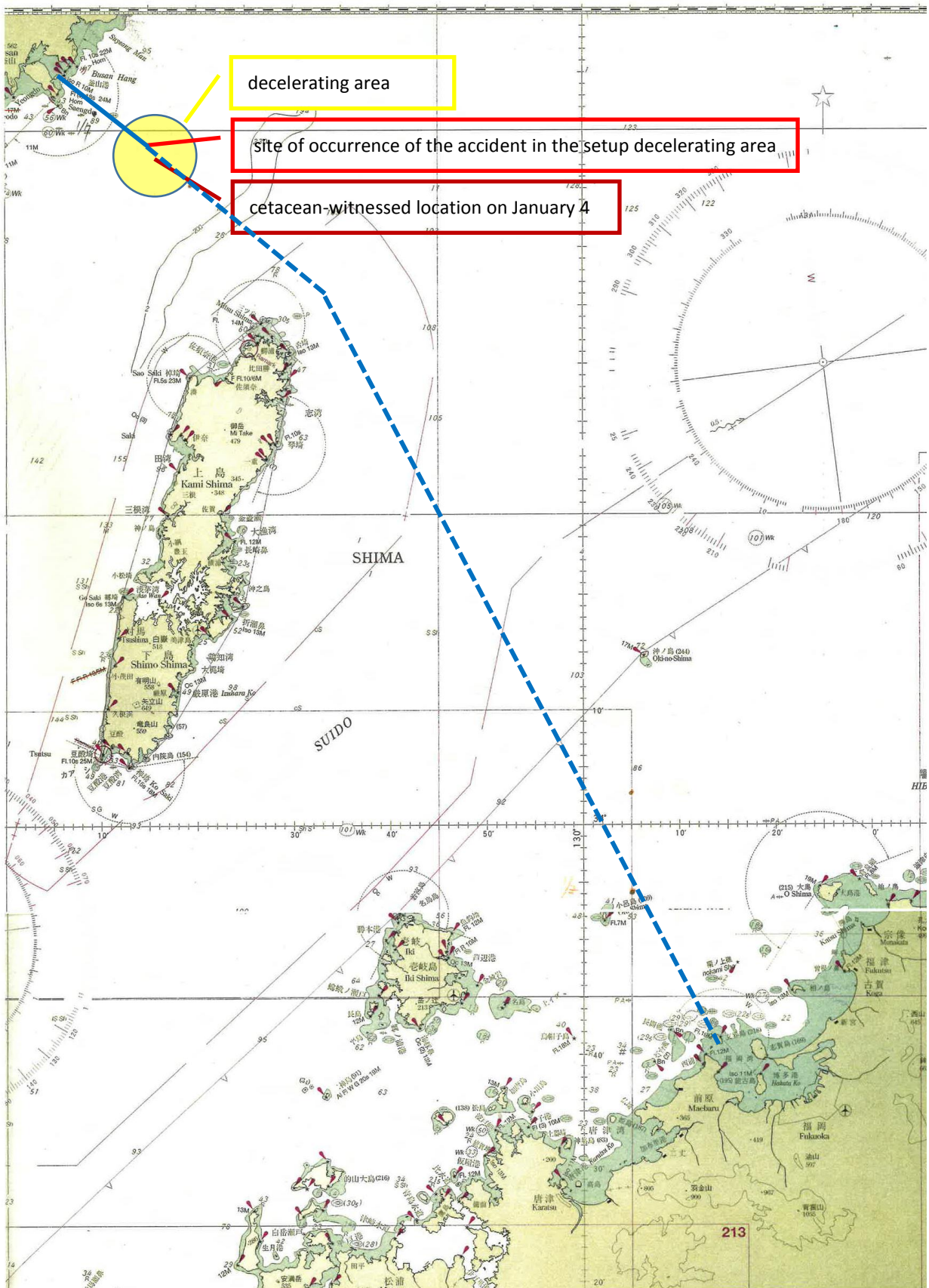


Attached Figure 6 Seating Arrangements

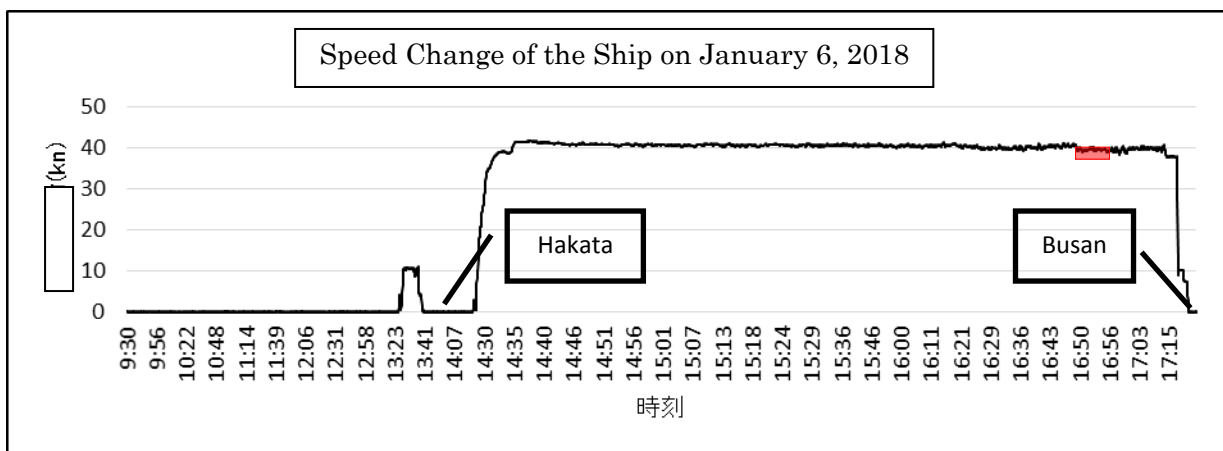
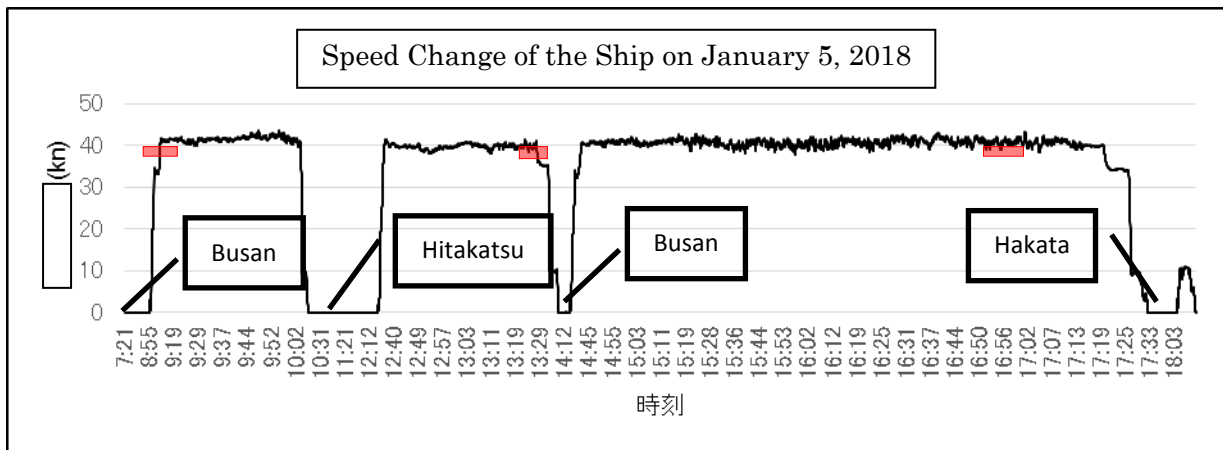


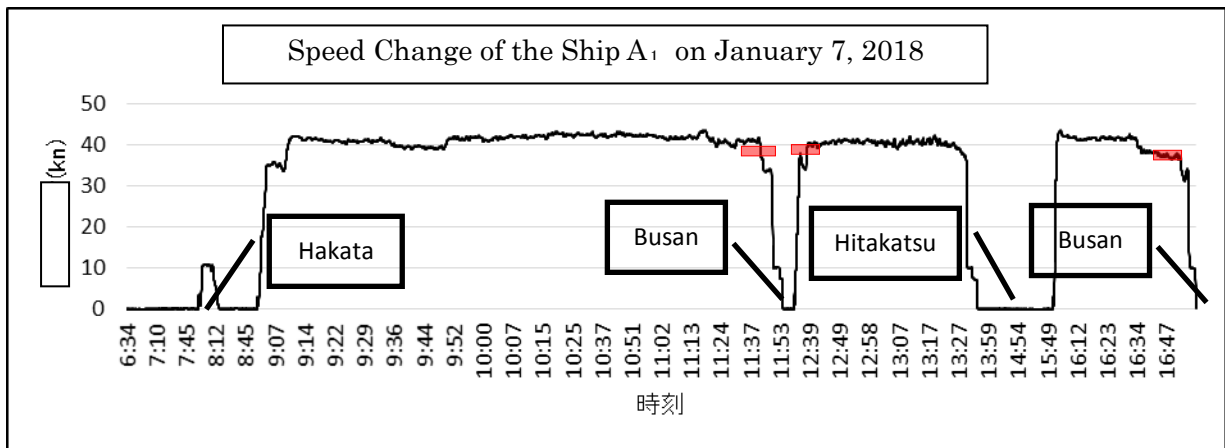
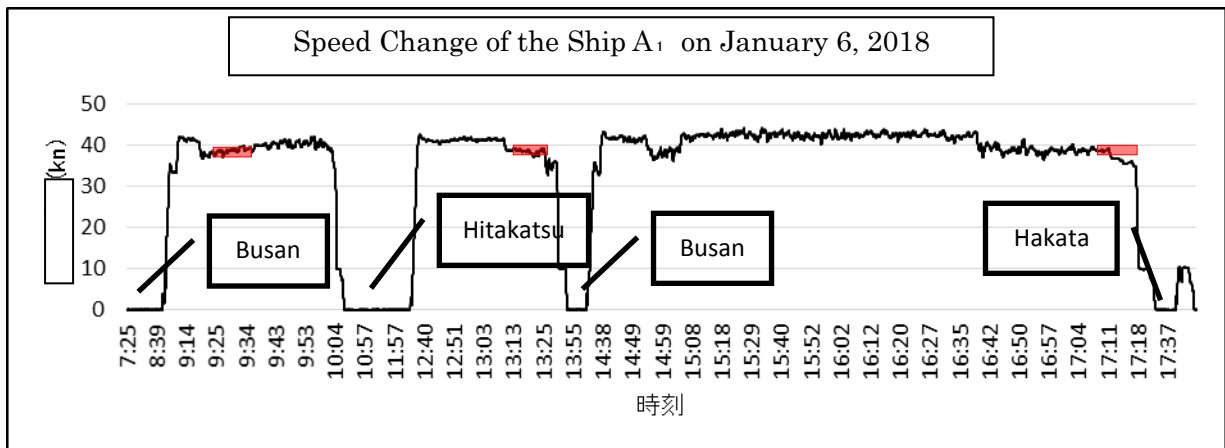
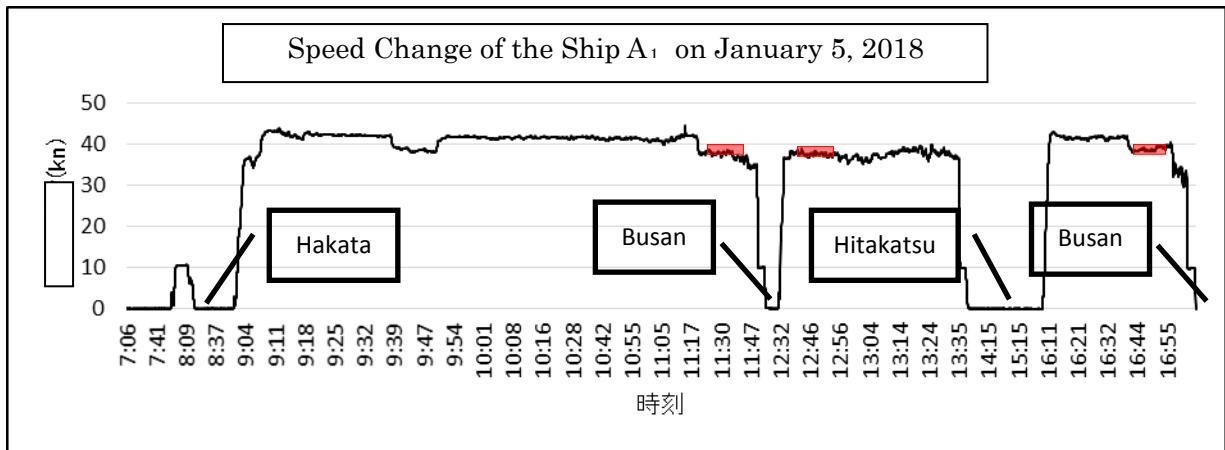
Seating locations of Passenger B, Passenger E, Passenger F, and Passenger G are unknown.

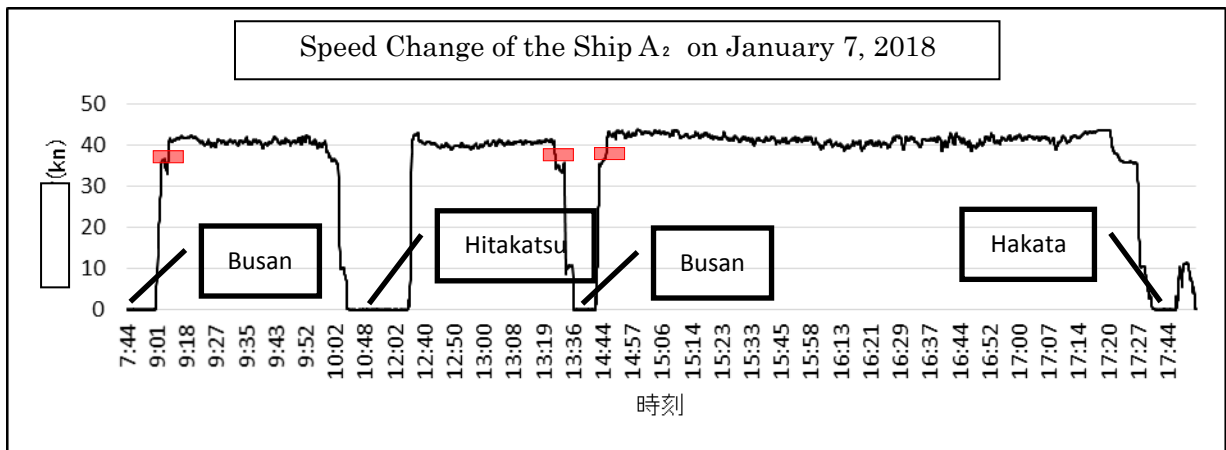
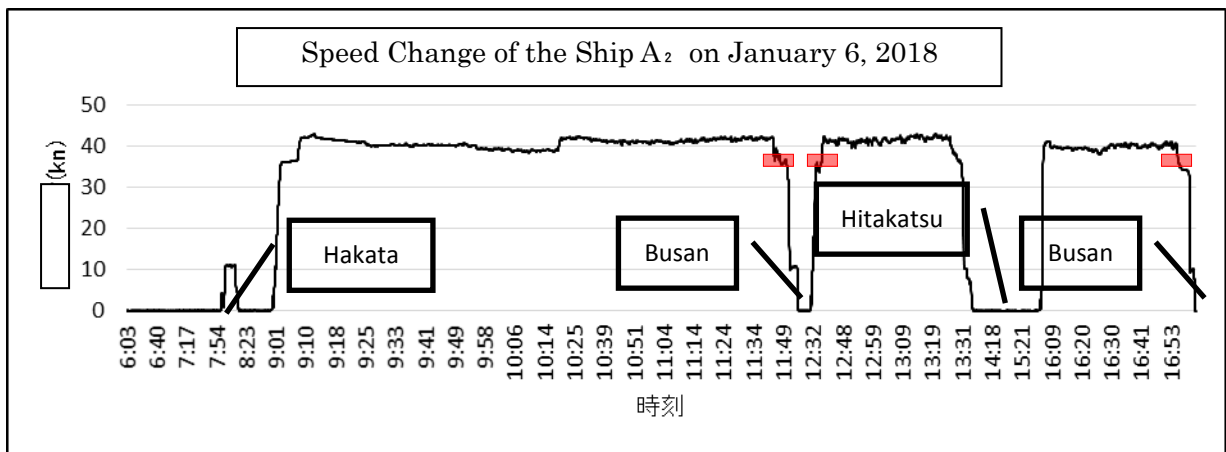
Attached Figure 7 Setting Condition Map of the Decelerating Area



Attached Figure 8 Speed Change Graphs of Passenger Ships of Company A







※ The vertical length and the horizontal length of ■ indicate an estimated passage time of decelerated navigation area and 38 – 36 kn which are designated decelerated speeds respectively.

Photo 1 Shock Absorber



Photo 2 Outlook Condition from the Wheelhouse



Photo 3 Economy-class Seat

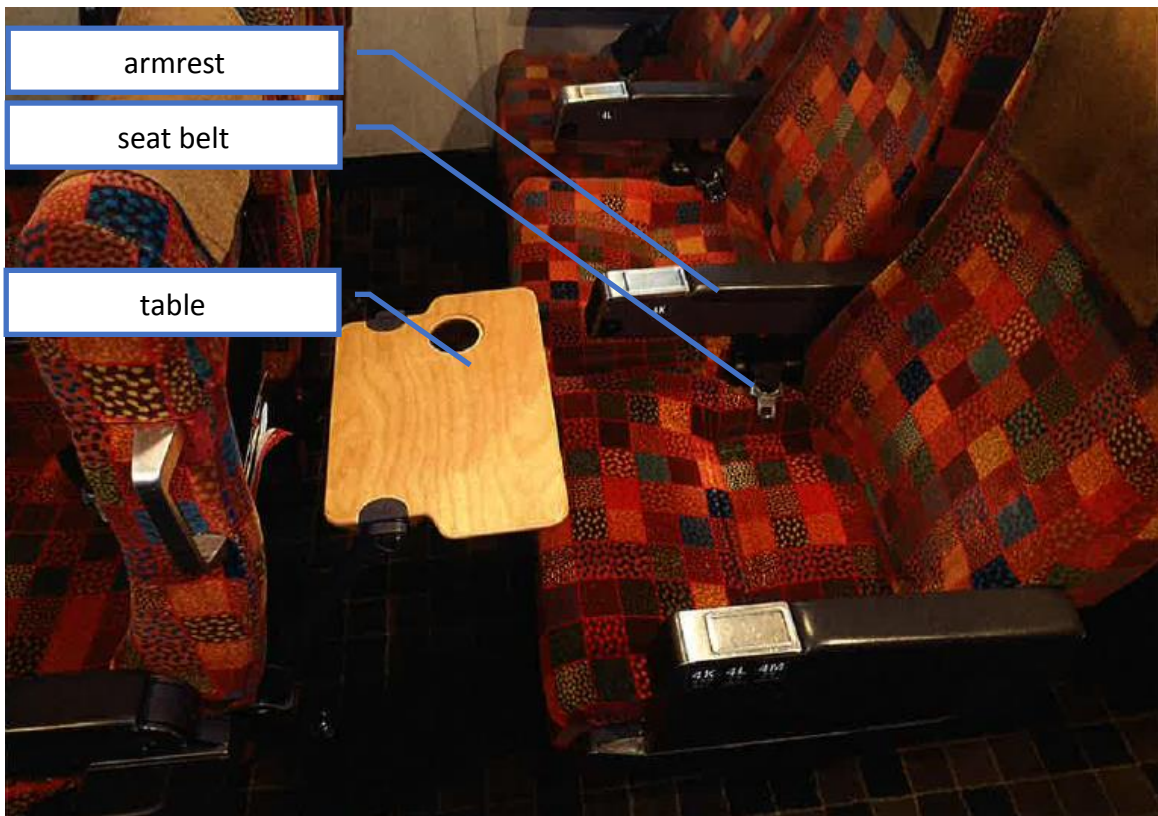


Photo 4 First-class Seat

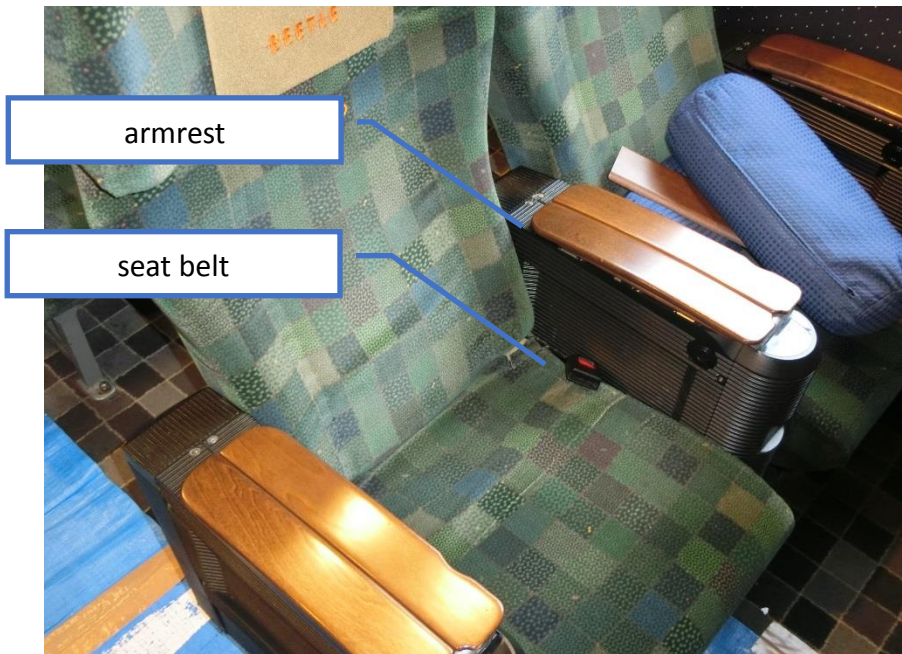


Photo 5 Safety Reminding Board



Photo 6 Pilot Lamp



Photo 7 Shock-absorbing Material

Shock-absorbing material



Shock-absorbing material

