MA2018-8

MARINE ACCIDENT
INVESTIGATION REPORT

August 30, 2018

JTSB Japan Transport Safety Board

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

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:	Cargo ship ASIAN BEAUTY
IMO number:	9598074
Gross tonnage:	17,019 tons
Vessel type and name:	Liquefied gas bulk carrier ZEUS
Vessel number:	135336
Gross tonnage:	2,230 tons
Accident type:	Collision
Date and time:	Around 06:08 on August 7, 2017 (local time, UTC +9 hours)
Location:	Outside of Takuma Port, Mitoyo City, Kagawa Prefecture (the area outside of the port boundary) Around 328° true bearing and 1.4 nautical miles from the Takuma port Sudaichimonji breakwater east lighthouse (approximately 34°15.3'N, 133°38.3' E)

August 1, 2018

Adopted by the Japan Transport Safety Board

Chairman Kazuhiro Nakahashi
Member Yuji Sato
Member Kenkichi Tamura
Member Toshiyuki Ishikawa
Member Makiko Okamoto

SYNOPSIS

< Summary of the Accident>

While anchored with a single anchor, the cargo ship ASIAN BEAUTY, which had a master and 20 crewmembers on board, dragged anchor. Although the anchor was heaved up and let go again, ASIAN BEAUTY could not be helped from becoming un-maneuverable. ASIAN BEAUTY drifted in the current, and at around 06:08 on August 7, 2017, it collided with the liquefied gas bulk carrier ZEUS.

ASIAN BEAUTY suffered a dent, etc. to her front port, and ZEUS suffered a dent, etc. on her starboardside bow.

There were no injuries or fatalities for either ship.

< Probable Causes >

It is probable that, when the storm warning was issued in SETO NAI KAI, including off the north coast of Shikoku, due to incoming Typhoon 5, ASIAN BEAUTY dragged anchor while it was anchored with a single anchor, waiting at Takuma Port for its cargo.

Master of ASIAN BEAUTY, instead of evacuating to a safe area, heaved up the anchor and returned to the anchoring area at 275° of and about 1,500m from the Mitamaiwa light beacon, which was directed by an agency of ASIAN BEAUTY, to reset the anchor, but that didn't work.

While the anchor was lifted, ASIAN BEAUTY became un-maneuverable and drifted; as a result, it collided with the liquefied gas bulk carrier ZEUS.

It was probable that Master of ASIAN BEAUTY returned to the position 275° of and about 1,500m from the Mitamaiwa light beacon, which was directed by an agency of ASIAN BEAUTY, to retry anchoring instead of evacuating to a safe area because he didn't understand anchoring, by itself, would not provide a sufficient escape from the adverse weather.

It was probable that ASIAN BEAUTY dragged anchor because, even though Master of ASIAN BEAUTY received information about the predicted stormy weather due to incoming Typhoon 5, he didn't know the required length of anchor chain extension nor measures against strong wind and continued to be anchored with single anchor.

In the area crowded with many other anchored ships, Master of ASIAN BEAUTY had retried to anchor ASIAN BEAUTY, but he was unsuccessful.

So, he used the engine from dead slow ahead to slow ahead, in a low load operation. It is probable that as a result, ASIAN BEAUTY lost control of its attitude and became un-maneuverable.

1 PROCESS AND PROGRESS OF THE INVESTIGATION

1.1 Summary of the Accident

While anchored with a single anchor, the cargo ship ASIAN BEAUTY, which had a master and 20 crewmembers on board, dragged anchor. Although the anchor was heaved up and let go again, ASIAN BEAUTY could not be helped from becoming un-maneuverable. ASIAN BEAUTY drifted in the current, and at around 06:08 on August 7, 2017, it collided with the liquefied gas bulk carrier ZEUS.

ASIAN BEAUTY suffered a dent, etc. to her front port, and ZEUS suffered a dent, etc. on her starboardside bow.

There were no injuries or fatalities for either ship.

1.2 Outline of the Accident Investigation

1.2.1 Setup of the Investigation

The Japan Transport Safety Board appointed a regional investigator-in-charge (Hiroshima Office) and one other investigator to investigate this accident on August 8, 2017. Later, however, a marine accident investigator replaced the investigator-in-charge.

1.2.2 Collection of Evidence

August 8, 9,14~16, 18, 21, and 22, November 15, 16, 24, and 27, December 8, 12, 14, and 18, 2017, and March 5, April 20, and 27, and May 25, 2018: Collection of questionnaire

August 10, 2017, April 24, 25, and 26, and May 14, 2018: Interview

August 17, 2017: on-site investigation and interview

September 12, and December 5, 2017, and January 24, 2018: Interview

1.2.3 Tests and Research by Other Institutes

To investigate this accident, the JTSB entrusted the calculation of the holding force and the wind force, which ASIAN BEAUTY received while it waited at anchorage, to the National Maritime Research Institute of the National Institute of Maritime, Port and Aviation Technology.

1.2.4 Comments of Parties Relevant to the Cause

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

2. FACTUAL INFORMATION

2.1 Events Leading to the Accident

2.1.1 The Navigation Track According to the AIS data

According to the records of the Automatic Identification System (AIS) data (hereinafter referred to as "the AIS record")[1] received by a data company in Japan, the navigation tracks of the ASIAN BEAUTY (hereinafter referred to as "Vessel A") from around 05:31 to 06:09 on August 7, 2017 and ZEUS (hereinafter referred to as "Vessel B") from around 05:25 to 06:09 were as shown in Table 1 and 2 below.

The positions of Vessel A and Vessel B refer to the positions of GPS antennas attached to the upper side of the respective bridges. The course over the ground and heading are true bearings (hereinafter the same).

Table 1　AIS Record of Vessel A (excerpt)

Time (HH:MM:SS)	Ship's position		Course Over the Ground (°)	Heading (°)	Speed Over the Ground[*2] (knots (kn))
	Latitude (N) (°-′-″)	Longitude (E) (°-′-″)			
05:31:50	34-15-07.0	133-38-40.5	152	072	0.4
05:34:49	34-15-05.2	133-38-39.5	224	075	1.1
05:37:47	34-15-02.1	133-38-35.8	211	084	1.5
05:40:49	34-14-58.8	133-38-38.3	077	057	1.2
05:45:16	34-15-04.2	133-38-43.1	001	044	1.5
05:48:05	34-15-06.5	133-38-41.8	267	057	1.4
05:49:05	34-15-06.1	133-38-40.3	231	071	1.2
05:50:05	34-15-05.1	133-38-39.6	185	076	1.3
05:51:06	34-15-03.6	133-38-40.2	149	073	1.8
05:52:06	34-15-02.3	133-38-42.0	111	064	2.2
05:53:06	34-15-02.1	133-38-45.3	079	048	2.9
05:54:06	34-15-03.7	133-38-48.5	046	036	3.5
05:55:06	34-15-07.1	133-38-51.0	023	030	4.5
05:56:06	34-15-11.3	133-38-52.7	017	027	3.9
05:57:06	34-15-14.3	133-38-53.1	347	022	2.1
05:58:06	34-15-15.2	133-38-51.9	272	012	1.2

Table 2　AIS Record of Vessel A (excerpt)

Time (HH:MM:SS)	Ship's position		Course Over the Ground (°)	Heading (°)	Speed Over the Ground (kn)
	Latitude (N) (°-′-″)	Longitude (E) (°-′-″)			

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

[*2] "Speed over the ground" refers to the speed of a vessel as measured against one point on the earth's surface. The speed of a vessel as measured against the water in which the vessel is traveling is called "speed over water".

05:25:34	34-15-20.5	133-38-16.9	299	053	0.1
05:37:34	34-15-20.5	133-38-16.8	329	057	0.1
05:49:34	34-15-20.3	133-38-17.0	168	053	0.1
05:55:35	34-15-20.4	133-38-16.9	032	055	0.1
06:01:35	34-15-20.3	133-38-17.0	057	053	0.1
06:07:35	34-15-20.4	133-38-16.9	337	058	0.1
06:09:53	34-15-20.3	133-38-14.5	234	040	3.3

2.1.2 The Navigation Tracks Received by VHF Radiotelephone

According to the reply to the questionnaire by the 6th Regional Coast Guard Headquarters, recorded voice communication by the Hiroshima Coast Guard Radio (hereinafter referred to as "the Hiroshima Hoan") with Vessel A and Vessel B between 06:13 and 07:33 on August 7, 2017 using VHF radiotelephone (hereafter referred to as "VHF") were as shown in Table 3.

Table 3 VHF Voice Communication Recorded by Hiroshima Hoan with the Vessel A and Vessel B

Time (HH:MM:SS)	Ch. used	Speaker	Receiver	Content
06:13 ～ 06:16	ch16 ch09	Vessel B	Hiroshima Hoan	We had contact with the foreign vessel A inside Takuma Port.
		Hiroshima Hoan	Vessel B	Is there any injury, submersion, or oil leak?
		Vessel B	Hiroshima Hoan	There is no injury, submersion, or oil leak.
		Hiroshima Hoan	Vessel B	How is the other vessel?
		Vessel B	Hiroshima Hoan	There is no submersion or oil leak.
06:16 ～ 06:22	ch16 ch09	Hiroshima Hoan	Vessel A	Did you collide with the Vessel B?
		Vessel A	Hiroshima Hoan	Yes, we collided with the Vessel B.
		Hiroshima Hoan	Vessel A	Is there any injury, submersion, or oil leak?
		Vessel A	Hiroshima Hoan	We are not in danger.
06:43 ～ 06:45	ch16 ch09	Hiroshima Hoan	Vessel A	The Vessel B reported that it collided with your ship. Did you drag the anchor and collide with the ship?
		Vessel A	Hiroshima Hoan	We heaved up the anchor and are sailing. We will report when we are anchored.
07:01 ～ 07:03	ch16 ch09	Hiroshima Hoan	Vessel B	Report your navigation state at the time of collision.
		Vessel B	Hiroshima Hoan	We are anchored.

		Hiroshima Hoan	Vessel B	How about the Vessel A?
		Vessel B	Hiroshima Hoan	We believe that Vessel A collided with us when it was retrying to let go the anchor.
		Hiroshima Hoan	Vessel B	Do you mean that the Vessel A was anchoring until then?
		Vessel B	Hiroshima Hoan	The Vessel A was anchoring since they came to port the day before yesterday.
07:22 ～ 07:23	ch16 ch09	Vessel A	Hiroshima Hoan	We want to anchor our ship at 34°16.0'N, 133°35.8' E.
		Hiroshima Hoan	Vessel A	I want to confirm the position.
07:32 ～ 07:33	ch16 ch09	Hiroshima Hoan	Vessel A	I confirmed the position. Report the position and the time of anchoring.
		Vessel A	Hiroshima Hoan	Roger.

2.1.3 Events Leading to the Accident According to Statements of Crew Members, etc.

According to the statement of the Master of Vessel A (hereinafter referred to as "Master A"), the Pilot, the Master of Vessel B (hereinafter referred to as "Master B"), and the Officer of Vessel B (hereinafter referred to as "Officer B"), and the reply to the questionnaire by the Officer of Vessel A (hereinafter referred to as "Officer A"), the events leading to the accident were as follows.

(1) Vessel A

Vessel A, which had Master A and 20 others (all were Philippines nationals) on board, left Fukuyama Port after unloading 27,175 t of lime at around 07:06, August5, 2017.

It was heading to 'the anchoring position 275° of and about 1,500m from the Mitamaiwa light beacon, which was directed by an agency of Vessel A' (hereinafter referred to as "anchoring position of Vessel A") to wait until loading slag at Fukuyama Port 2 weeks later.

Master A was giving orders to operate Vessel A, and a pilot was navigating the ship.

While Vessel A was heading to Takuma Port, the pilot and Master A decided on the length of the anchor chain, taking account of the stormy weather which was predicted by the forecast.

At around 09:00, while weather and wave conditions were still calm, the pilot dropped the portside anchor at the anchoring position of Vessel A about 12m deep to the muddy sea bottom, extending 6 shackles of the chain (about 165m).

They began anchoring with a single anchor, keeping enough distance from other ships.

The Pilot got off Vessel A after telling Master A that large ships commonly anchor offshore of Misaki in Mitoyo City. He also advised Master A to extend the chain if the wind picked up the speed.

Master A had always decided on the chain length according to the depth of water, and he thought that 5 shackles would be fine for depth of about 12 m.

But, 6 shackles of the chain were used, since the anchor definitely touched the ground; then, Vessel A continued anchoring with a single anchor.

In the afternoon of the 6th, Master A confirmed that some smaller ships were anchoring within 0.2~0.4 M from Vessel A, in order to escape to safety since the typhoon was predicted.

Although the distance between those ships seemed tight, he didn't take any specific measures.

At around 03:00 on the 7th, Master A went to the navigation bridge because Officer A, who was on duty, reported that the wind direction shifted from east by northeast to northeast with the speed of 11~13m/s.

Since Master A realized the wind speed had picked up to about 11~17m/s, he gave an order to stand by the engine to be able to use it immediately and stayed up with Officer A.

At around 05:35, Officer A reported that, according to the echo trails[3] function, Vessel A was dragging anchor at 0.5kn to the stern direction.

Master A decided to move back to the anchoring position of Vessel A to retry letting go the anchor and positioned Officer A and an ordinary seaman to the vessel's bow.

While keeping an eye out for the third ship waiting anchoring at their stern side, Vessel A began to heave up its anchor in order to move ahead slowly at around 05:37.

At around 06:00, Vessel A arrived at the anchoring position of Vessel A.

It was about 700m east of Vessel B (12m deep to the muddy sea bottom) where Vessel A began to let go the port side anchor, which was the leeward, again, and five shackles were extended into the water. However, such measures could not stop Vessel A from drifting.

Master A used the engines ahead and ordered to heave up the anchor. However, the anchor chain moved under the ship from the portside to starboardside, and as a result, the chain extended fully.

He felt that the drifting speed due to the wind and the current was too high to maneuver the ship.

Vessel A drifted in the west by southwest direction due to the wind and current on its starboardside.

Thus, Master A called Vessel B on VHF Channel to warn Vessel A for the possibility of collision, but at around 06:08, its bow on the port side collided with the Vessel B's bow on the starboardside.

Vessel A, navigating south of Awa-shima in Mitoyo City after leaving Vessel B, was called on VHF Channel by Hiroshima Hoan, which received an accident report from Vessel B at around 06:43. Master A reported the collision with Vessel B and received permission to anchor outside of Takuma port.

At around 08:30, Vessel A anchored with a single anchor with 10 shackles of chain extended at west offshore of Awashima.

(2) Vessel B

Vessel B, which had Master B and 8 others on board, was fuelled outside of Hiroshima port in Hiroshima prefecture.

Then, at west offshore of Awashima, it let go the starboardside anchor, extended 7 shackles, and began anchoring with a single anchor at around 09:30 on August 5th.

At around 05:30 on the 7th, Officer B witnessed Vessel A heaving up the anchor.

After letting go the anchor once more at around 06:00, because Vessel A was moving closer to Vessel B, Officer B blew the whistle to warn Vessel A.

[3] "Echo trail" shows targeted vessel tracks on a radar display.

At Vessel B, Master B, who felt an immediate danger of collision, received a call from Vessel A on VHF Channel.

He finished the call without understanding the call due to a poor connection, then Vessel A collided at around 06:08.

Master B reported the accident to Hiroshima Hoan on VHF Channel.

The date and time of occurrence of the accident were at around 06:08 on August 7, 2017, and the location was at about 1.4 nautical miles at 328° from the Takuma port Sudaichimonji breakwater east lighthouse.
(See Figure 1 Navigation Route, Figure 2 Navigation Route (enlarged))

2.2 Injuries to Persons

There were no deaths or injuries.

2.3 Damage to Vessel

(1) Vessel A suffered a dent on the portside shell plating on her bow, and the stanchion was broken. (See Photo 2)

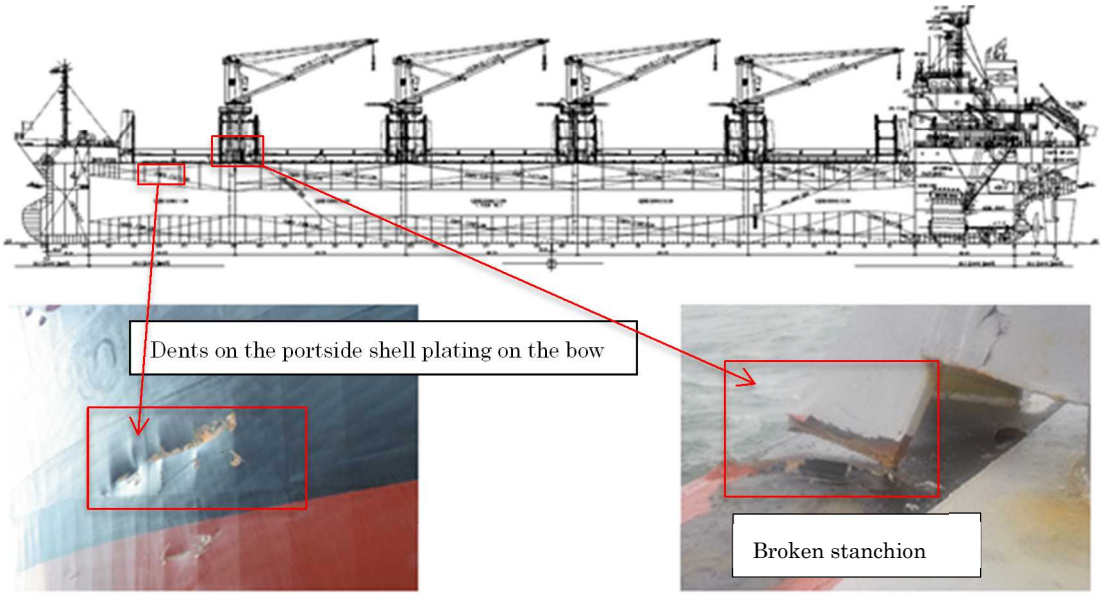

Figure 2 Damage to Vessel A

(2) Vessel B suffered dents on her starboardside of the bow and starboardside center shell plating, and the starboardside bridge was crushed. (See Figure. 3)

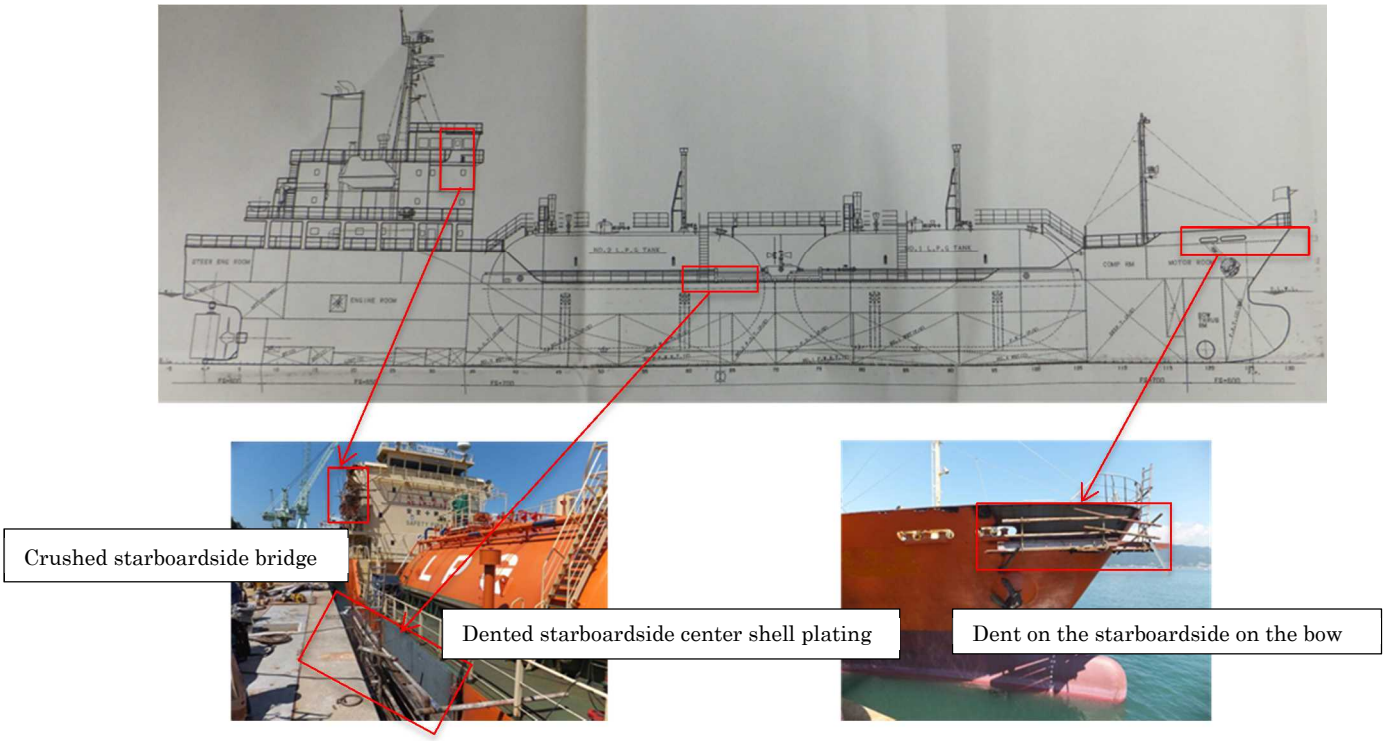

Figure 3　Damage to Vessel B

2.4 Crew Information

(1)　Gender, Age, and Certificate of Competence

Master A: male, 62 years old, national of the Republic of the Philippines

Endorsement attesting the recognition of certificate under STCW regulation I/10 Master (issued by the Republic of Panama)

Date of Issue: July 29, 2016 (Valid until April 12, 2021)

Master B: male, 55 years old

Third grade maritime officer (navigation)

Date of issue: June 29, 1995

Date of revalidation: October 28, 2014

Date of expiry: October 27, 2019

(2)　Major sea-going Experience

According to the reply to the questioner by Master A and the interview with Master B, their sea-going experience was as follows.

(i)　Master A

After serving on cargo ships and lumber carriers as an officer for about 20 years, he became a master in 2001 and had served on Vessel A since July 2017.

Master A was in good health at the time of the accident.

This was his first time entering Takuma port.

(ii)　Master B

He had served on Vessel B since July 2017.

Master B was in good health at the time of the accident.

2.5 Vessel Information

2.5.1 Particulars of Vessel

(1) Vessel A

IMO number:	9598074
Port of registry:	Republic of Panama
Owner:	Southern Cross Marine S.A. (Republic of Panama)
Management company:	Sojitz Marine and Engineering Corporation (hereafter referred to as "Company A")
Class:	Nippon Kaiji Kyokai
Gross tonnage:	17,019 tons
L×B×D:	169.37m x 27.20m x 13.60m
Hull material:	Steel
Engine:	Diesel engine x1
Output:	4,970 kW
Propulsion:	4-blade fixed pitch propeller x 1
Date of launch:	July, 2017

(See Photo 2)

Photo 2

(2) Vessel B

IMO number:	9184146
Vessel number:	135336
Port of registry:	Kobe city, Hyogo prefecture
Owner:	Iino Gas Transport Co. Ltd.
Class:	Nippon Kaiji Kyokai
Gross tonnage:	2,230 tons
L×B×D:	91.30m x 14.50m x 6.40m
Hull material:	Steel
Engine:	Diesel engine x1
Output:	2,574 kW
Propulsion:	4-blade fixed pitch propeller x 1
Date of launch:	October, 1997

(See Photo 3)

Photo 3

2.5.2 Hull and Load Conditions

(1) Vessel A

According to the interview with Master A, reply to the questionnaire by the shipyard, and Vessel A's logbook, Vessel A's hull and load conditions were as follows.

Vessel A's ballast tank was filled with ballast water (about 7,502 tons) (full capacity is 8,042 tons), and her draft was about 3.89m at the bow and about 5.3m at the stern, the frontal projected area was about 532.6m^2, the lateral projected area was about 1,841.7m^2, and the distance from the waterline to the bell-mouth[4] was about 9.7m.

According to the interview with Master A, at the time of the accident, there was no malfunction or failure in hull, engine or machineries of Vessel A.

(2) Vessel B

According to the interview with Master B and the Vessel B's logbook, Vessel B's hull and load conditions were as follows.

At the time of accident, Vessel B was in ballast, and her draft was about 3.20m at the bow and 4.50m at the stern.

2.5.3 Information on the Anchors and the Anchor Chain of Vessel A

According to the finished drawing of Vessel A's anchors and anchor chain, her anchors on both sides were type AC-14 and the weight of anchor was about 4,840kg.

The weight of chain was 84.18kg/m, and the length of a shackle was 27.5m. Also, each side of Vessel A had 11 shackles stored (10 shackles to be extended in the water).

2.5.4 Information on the Engine Operation of Vessel A

According to the engine logbook of Vessel A, engine operation during 05:37~06:08 on September 7, 2017 was as follows.

[4] "Bell-mouth" is the hole in the shell plating on both sides of the bow that houses anchors on the both sides of the bow.

Time (HH : MM : SS)	Engine telegraph operation
05:37:28 ~05:57:31	As appropriate（Stop engines~ Half ahead)
05:59:05	Stop engines
05:59:51	Dead slow astern
06:03:02	Stop engines
06:04:41	Dead slow ahead
06:06:16	Slow ahead
06:07:24	Dead slow ahead
06:08:02	Stop engines
06:08:16	Dead slow astern
06:08:24	Slow astern

2.6 Weather and Sea Conditions

2.6.1 Weather Data

Average wind speed[5] and direction at 00:00~06:00 on August 7, 2017 at Aonoyama Vessel Traffic Signal Station, 9.6 nautical miles east by northeast of the accident site, were as follows

Time (HH : MM)	Average wind speed (m/s)	Wind direction
00:25	10.0	E
00:55	9.0	E
01:25	11.0	E
01:55	9.0	ESE
02:25	11.0	E
02:55	12.0	ENE
03:25	12.0	E
03:55	14.0	ENE
04:25	14.0	ENE
04:55	16.0	ENE
05:25	17.0	ENE
05:55	16.0	ENE
06:25	15.0	ENE

[5] "Average wind speed" refers to the average wind speed observed in 10 minutes period right before the recording time.

2.6.2 Observations by Crew

(1) Vessel A

According to the statement of Master A and the reply to questionnaires by Master A and Officer A, and the logbook, the weather at around 03:00~07:00, August 7, 2017 was: rain, 4~10km visibility, wave height 2.0m, and the current moving from the northeast to the southwest waves.

The wind speed and direction were as follows.

Time (HH : MM)	Wind direction	Wind speed (Beaufort scale)	Wind speed (m/s)
03:00	NE	6~7	10.8~17.1
04:00	NE	6~7	10.8~17.1
05:00	NE	6~7	10.8~17.1
06:00	NE	7~8	13.9~20.7

(2) Vessel B

According to the statement of Master B and Officer B, they had set the anemometer to sound a warning when the wind speed exceeds 15m/s.

At around 00:00 on the 7th, the alarm went off.

Then, they changed the setting of the alarm to sound at higher than 20m/s and continued observation.

At the time of the accident, the alarm was sounding and didn't stop, and the wind was blowing from the northeast at about 21~22m/s.

2.6.3 Tide

According to a tide table published by the Japan Coast Guard, at the time of accident in Marugame port in Marugame city, Kagawa prefecture, the tide was at the beginning of incoming tide and the height was about 1.2m.

2.6.4 Current

According to a tide table published by the Japan Coast Guard, the current at the position of about 0.8 nautical miles north of the west breakwater lighthouse in Tadotsu port was a westerly current at about 1.1kn, and between Awashima-Ushinosu-hana and Kannon-hana was a westerly current at about 1.3kn.

2.6.5 Information on Situation Vessel A's Collection of Typhoon Data

According to the statement of Master A, the situations were as follows.

(1) At about 22:30 on the 6th, Master A used ASAS obtained with meteorological FAX, a weather map used by ships, and learned: the position of Typhoon 5, its predicted path after 12 hours, and the possibility of a wind (about 26m/s) blowing within 50M diameter from the eye of typhoon.

(2) At about 03:05 on the 7th, Master A received a weather alert in English from NAVTEX Moji station and learned that at 03:00 a storm warning[6] was issued in SETO NAI KAI(including north of Shikoku) for the about 55kn wind.

[6] "Storm warning" for typhoon is issued when wind speed over the ocean exceeds 48km but less than 64km (more than 24.5m/s and less than 32.7m/s, wind level of 10~11) or is expected to reach that level within 24 hours.

2.6.6 Typhoon 5

According to the Japan Meteorological Agency's website, on July 21, the Typhoon 5 was formed and moved northward to south Kyushu on August 5. On the 6th, it moved northeastward in south Kyushu and developed into a large typhoon with the highest wind speed of 35m/s at 09:00.

After moving close to Shikoku, it moved slowly in an east by northeastward along the Pacific Ocean coastline of Shikoku.

At 09:00 on the 7th, its central pressure was 975hPa and the highest wind speed was 30m/s.

Before leaving to the Japan Sea, this extremely strong typhoon moved inland to the Kinki region to Hokuriku region (See Figure 4).

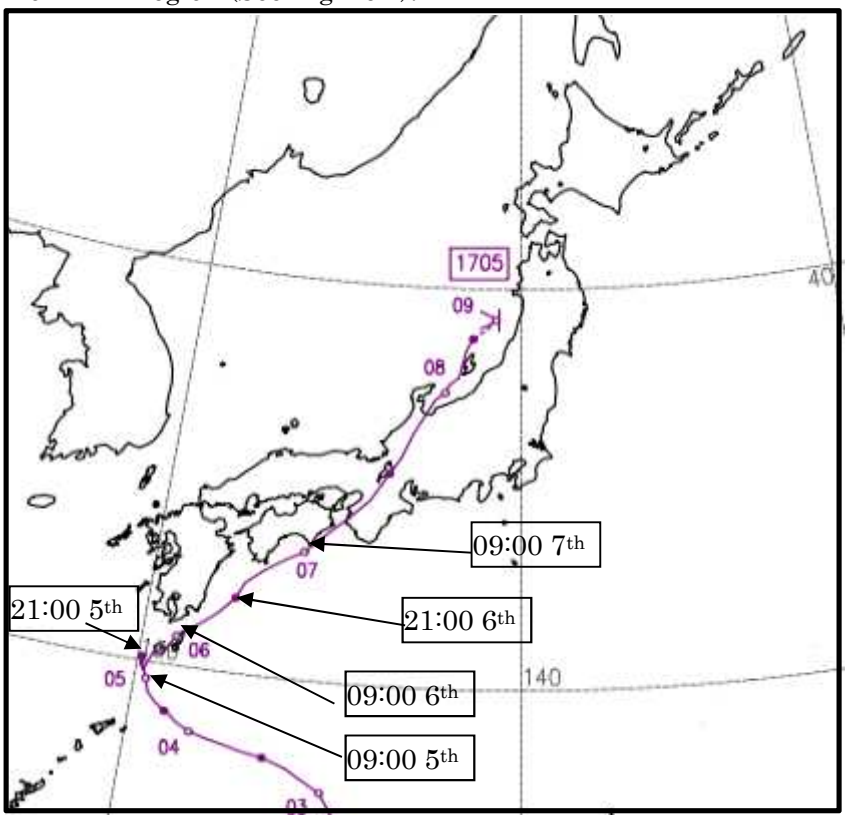

Figure 4. Pathway of Typhoon 5

2.7 Characteristics of the Area

2.7.1 Information According to the Sailing Directions[7].

Seto Naikai Sailing Directions (No. 103, published on March, 2013) published by the Japan Coast Guard, the outline of the information for the area south of Awashima was as follows.

South bay of Awashima widely opens to the south.

The area between this bay and the coast of Shikoku has a water depth of less than 15m, is protected from a wind and waves from all directions, and large ships can stay at anchorage.

2.7.2 Information From the Chart etc.

According to the chart published by the Japan Coast Guard (W137B, west part of Bisan Seto), the area south of South Awashima is located southeast of Awashima, which is about

[7] "Sailing Directions", as Sea Navigation Information required for navigation, is a collection of references which includes surveys, observations, research, etc. data obtained by waterway organizations of the world.

1.5 nautical miles northeast of Takuma Port, and west by southwest of Shishijima in Mitoyo City. The water depth is about 8~15m, and the sea bottom is sand and mud

2.7.3 Situation at around 05:00 August 7

According to the AIS data, on August 5~7, in the area around the anchoring position of Vessel A, an increasing number of ships were anchored in order to take refugee from the typhoon. This led the distance between ships on the leeward side to be around 0.2 nautical miles. (See Figure.5)

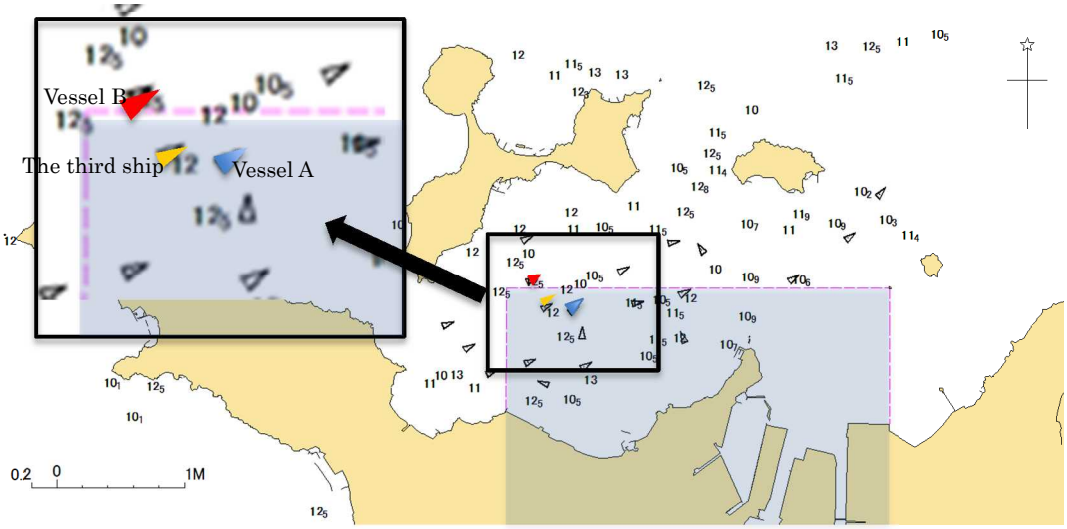

Figure 5　Situation at around 05:00 August 7

2.8 Information Concerning Anchoring and Dragging Anchor

2.8.1 Holding Capability of the Anchor, the Anchor Chain Suspension and the Guideline

Information from the reference literature 1[8] and 2[9] is outlined as follows.

The holding force of an anchor is shown as the maximum value of force from the anchor.

It is stabilized by digging in the sea bottom with its claws and resists forces trying to pull it away.

The amount of chain suspension is calculated according to the external force, and a common empirical approach is used with the following guidelines.

Anchoring under normal conditions: water depth x 3 + 90m

Anchoring under adverse weather: water depth x 4 + 145m

2.8.2 Impact from the External Force While Anchoring with a Single Anchor

Information from the reference literature 2, 3[10], and 4[11] is outlined as follows.

A ship, anchoring with a single anchor, can periodically swing and turn by the wind.

The anchor chain works like a spring and causes a back-and-forth motion (windward and leeward) of the ship.

When the wind picks up, the bow swings, moves windward, and directly faces the wind.

Then, the ship turns to the other side.

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[8] Reference Literature 1 : Ship Handling, by Dr. Keinosuke Honda

[9] Reference Literature 2 : Ship Handling, by Dr. Satoshi Iwai

[10] Reference Literature 3: Theory and Practice of Ship Handling, by Dr. Kinzo Inoue

[11] P&I Loss Prevention Bulletin (July, 2013 Vol.25, Japan P &I Club Loss Prevention and Ship Inspection Department)

Where the anchor chain aligns with the bow and stern, the movement produces a momentary strong force (hereafter referred to as "impact force") to the anchor chain.

The impact force and steady force alternate working on the anchor and the anchor chain while the ship swings and turns.

According to the reference literature 2, for a ship in ballast, the impact force is about 3 times as strong as the frontal wind resistance (hereafter referred to as "frontal wind force"). The reference literature 4 also states that it is 3~4 times of the frontal wind force.

2.8.3 Maneuvering method at the time of anchoring and anchoring precautions under adverse weather

Information from the reference literature 2 is outlined as follows.

A Master should keep in mind the distance between other ships and have enough space on the leeward side of the ship for maneuverability, so that it can quickly move if it dragged anchor.

When letting go an anchor in high wind and tide, a Master should use an anchor on the tide or wind side of the ship.

At an anchorage, if a wind and tide increase a Master should extend the anchor chain as much as possible.

If a Master predicts danger when proceeding, the ship should use a heave to technique[12], so that the leeward force from the current lessens.

2.8.4 Measures to be taken when dragging

Information from the reference literature 2 and 3 is outlined as follows.

If the wind picks up more and a ship drags anchor, the anchor's holding force is reduced due to the claws facing up. Later, the ship drifts away at a steady speed.

Once a ship starts to drag, it is difficult to stop.

Neither lowering a second anchor nor extending the chain will help to stop drifting once it starts to drift at a steady speed.

Once a ship started to drag anchor, to control the ship's attitude, it is necessary to face the bow to the wind turning the rudder fully and using the engine as follows:

For wind speed of 20m/s: dead slow ahead

For wind speed of 25m/s: half ahead

For wind speed of 30m/s: full ahead

2.8.5 Safety Actions for Anchoring

Information from the reference literature 3 is outlined as follows.

As for the distance between other ships, if the ship drifts due to the wind pushing directly on the beam, a master will need time and enough area to move the ship to a maneuverable position by using the engine, the rudder, and the bow thrusters.

For a large ship to move back to its maneuverable position, about 1.0 nautical miles are necessary.

[12] "Heave to" is a maneuvering technique used under adverse weather to lessen the impact from wind, wave, and water splashing on the ship. The ship would use the minimum thrust possible to maneuver while receiving the wind and wave at about 20°~30° of the bow.

In reality, at an anchoring location, small ships move in between large ships, so large ships have difficulty securing enough distance.

Safety support such as giving reports on the conditions of anchoring area would help.

2.9 Information Concerning Situation of Vessel A Dragging

Calculation of the holding force of Vessel A and the wind pressure received by anchored Vessel A, according to the National Maritime Research Institute of the National Institute of Maritime, Port and Aviation Technology, is as follows.

The ship's holding force is a resultant force of the anchor's force holding to the sea bottom and the anchor chain's friction drag.

The maximum holding force made by the anchor and the anchor chain may be said to be "the maximum external force applied to the ship right before it started dragging while an external force is gradually increased.

It is also the limit value of the ship resisting dragging (hereafter referred to as "holding force limit").

When an external force is added to a ship while anchoring with a single anchor, the ship moves toward the stern, opposite side of the anchor chain. As a result, the chain gradually lifts up from the sea bottom and forms a catenary curve[13]. If more force is added the shank lifts up from the sea bottom and a vertical (upward) force works on the anchor, then it loses some holding force.

(See Figure 6)

[13] "Catenary curve" is the curve of a rope being held from both ends.

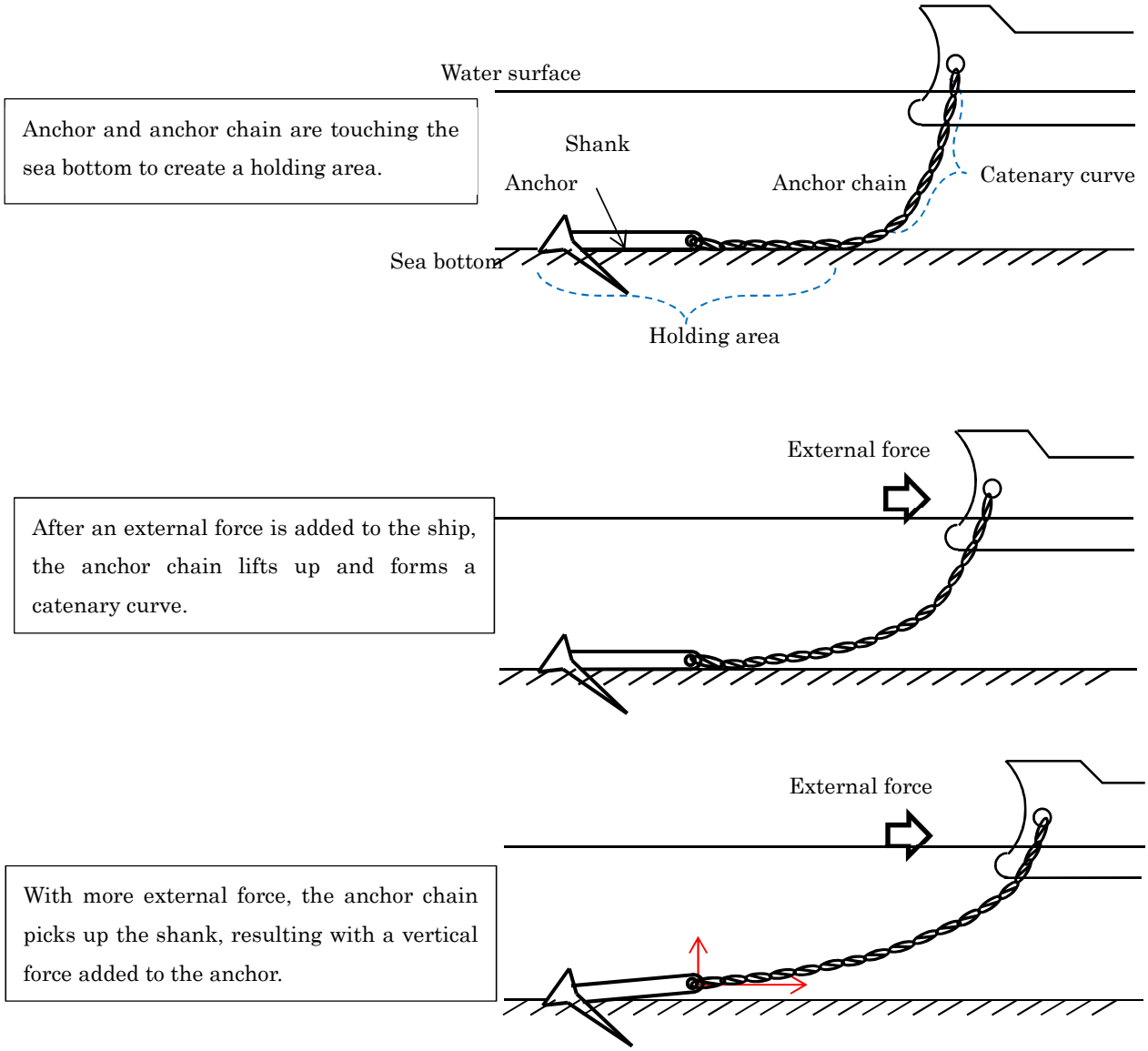

Figure 6　Anchor and anchor chain movement when anchoring with a single anchor

(1)　The next table and the chart shows Vessel A's holding force in a water depth of 12m and mud sea bottom and calculated values of minimum required anchor chain extension.
(See Figure 7)

(i)　Holding Force of Vessel A

Considering the type and the weight of the anchor, and the sea bottom condition, the anchor's holding force was 48.4 tons.

However, while extending 6 shackles (about 165m), because a stationary force was gradually added to Vessel A the entire anchor chain formed a catenary curve.

Moreover, at the time of the accident, the shank was lifted from the sea bottom and its holding force was at the limit, about 43.9 tons.

(ii)　Minimum required anchor chain extension to withstand the horizontal external force

When a horizontal external force is less than 48.4 tons, a minimum required anchor chain extension is the length of a catenary curve right before the anchor chain lifts up

the shank because the anchor chain's holding force exceeds the horizontal external force. Simply, the ship can withstand the horizontal external force.

When the horizontal external force exceeds 48.4 tons, the holding force of Vessel A's anchor alone can not withstand the external force, so a friction drag from the anchor chain should be added to the holding area.

Thus, the anchor chain extension is needed to provide the friction drag.

It is considered probable that if the anchor chain extension is 6.3 shackles (173m), Vessel A can withstand up to 48.4 tons of external force, and if it is 10 shackles (about 275m), Vessel A's holding force is about 55~56 tons.

Horizontal component of cable tension	Minimum required anchorchain extension to touch the sea bottom	Catenary Curve Length	Minimum required anchor chain extension ℓ_min(Tx)+S(Tx)	
Tx (tf)	ℓ _min(Tx) (m)	S(Tx) (m)	Lc_min(Tx) (m)	Lc_min(Tx) (Shackles)
0. 00	0. 00	22. 30	22. 30	0. 80
5. 00	0. 00	59. 50	59. 50	2. 20
10. 00	0. 00	81. 10	81. 10	3. 00
15. 00	0. 00	98. 10	98. 10	3. 60
20. 00	0. 00	112. 60	112. 60	4. 10
25. 00	0. 00	125. 40	125. 40	4. 60
30. 00	0. 00	137. 00	137. 00	5. 00
35. 00	0. 00	147. 70	147. 70	5. 40
40. 00	0. 00	157. 60	157. 60	5. 70
43. 90	0. 00	165. 00	165. 00	6. 00
45. 00	0. 00	167. 00	167. 00	6. 10
48. 40	0. 00	173. 10	173. 10	6. 30
50. 00	19. 00	175. 90	194. 90	7. 10
51. 54	37. 30	178. 50	215. 90	7. 90
55. 00	78. 40	184. 30	262. 70	9. 60
56. 27	93. 50	186. 40	279. 90	10. 20
57. 94	113. 30	189. 10	302. 40	11. 00
60. 00	137. 80	192. 40	330. 20	12. 00
64. 31	188. 90	199. 10	388. 00	14. 10
65. 00	197. 20	200. 20	397. 40	14. 40
70. 00	256. 60	207. 60	464. 20	16. 90

Values plotted on the chart

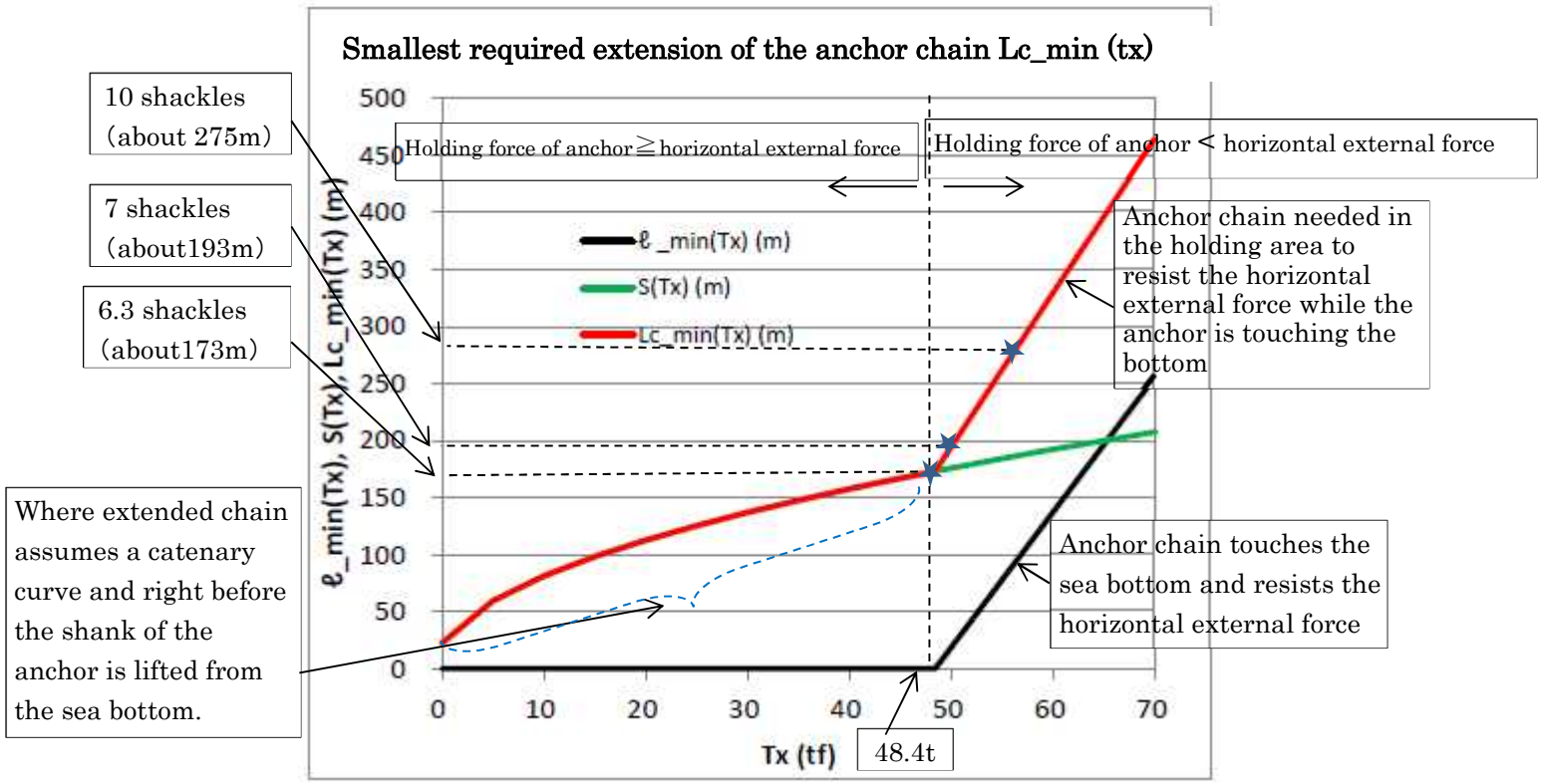

Figure 7　The smallest extension of the anchor chain necessary to resist the horizontal external force Tx　(Lc_min)

(2)　Wind Force Received While Anchored

(i)　From 5:28 to 5:37 on August 7, 2017, the calculated values of the wind force given by the northeast wind of 21~22m/s are shown in the below chart.

Fujiwara's equation (a new component type mathematical model to estimate wind force) was used to calculate the wind force.

Total wind force is a resultant force of frontal wind force　and transverse wind force.

At 05:32, when the angle of relative wind direction was at 028°, the wind force was at maximum strength.

Time (HH：MM)	Relative wind direction（°）	Frontal Wind force（t）		Transverse wind force（t）		Total wind force（t）	
		21m/s	22m/s	21m/s	22m/s	21m/s	22m/s
05:28	Starboard 021	11.14	12.23	23.32	25.59	25.84	28.36
05:29	Starboard 020	11.20	12.29	22.07	24.22	24.75	27.16
05:30	Starboard 008	11.20	12.29	7.825	8.588	13.66	15.00
05:31	Starboard 005	11.02	12.10	4.680	5.136	11.97	13.14
05:32	Starboard 028	10.49	11.51	31.95	35.06	33.63	36.90
05:33	Starboard 008	11.20	12.29	7.825	8.588	13.66	15.00
05:34	Starboard 009	11.25	12.34	8.922	9.792	14.35	15.75
05:35	Starboard 020	11.20	12.29	22.07	24.22	24.75	27.16
05:36	Starboard 020	11.20	12.29	22.07	24.22	24.75	27.16
05:37	Starboard 021	11.14	12.23	23.32	25.59	25.84	28.36

(ii) The following table shows the values of the wind force, multiplied by 3.5 or 4, that the ship received in a wind speed of 21~22m/s.

The impact forces when the frontal wind force were multiplied by 3.5 or 4 were estimated to be about 36.7~45.0 tons at 21m/s, and about 40.3~49.4 tons at 22m/s.

Time	(Frontal Wind force) x3.5 (t)		(Frontal Wind force) x4 (t)	
(HH : MM)	21m/s	22m/s	21m/s	22m/s
05:28	38.99	42.81	44.56	48.92
05:29	39.20	43.02	44.80	49.16
05:30	39.20	43.02	44.80	49.16
05:31	38.57	42.35	44.08	48.40
05:32	36.72	40.29	41.96	46.04
05:33	39.20	43.02	44.80	49.16
05:34	39.36	43.19	45.00	49.36
05:35	39.20	43.02	44.80	49.16
05:36	39.20	43.02	44.80	49.16
05:37	38.99	42.81	44.56	48.92

(iii) As a result of (i) and (ii), when a ship is anchored with a single anchor under adverse weather, stationary forces and impact forces from each relative wind direction work on the ship.

Thus, it is necessary to use multiple anchors to prevent swing and turn motions of the ship.

2.10 Information on Safety Management by Company A

2.10.1 In the Safety Management Manual of Company A, anchoring a ship under severe weather was stipulated as follows .

◯ Preparation Against Stormy Weather in Port / Anchorage

4. Does the Master confirm if special attention is required in connection with weather peculiarities at a specific port?
   (Obtain specific weather information of the port from sailing direction, port information-terminal information, pilot and agent)
6. Does the Master understand the countermeasures to take against strong winds in case of an approaching typhoon or low-pressure system?
   (Confirm that the Master understands the minimum time needed to shift to a safe offshore destination from a berth or an anchorage.)
   (Does the Master understand that anchoring, by itself, does not provide a sufficient escape from stormy weather?)
7. Does the Master have individual criterion, such as a determined wind power, for making decisions about shifting offshore from berth or anchorage?

(Does the Master have the criteria for shifting to offshore from an anchorage and berth? Can you contact the SI and get proper advice when you are in doubt about whether you should shift from an anchorage or a berth or not?)

2.10.2 Operation Management by Company A

According to the statement of the management company personnel, a summary of the information is as follows.

In the case of adverse weather such as a typhoon, in order to prevent confusion to the shipside by the land side sending orders based on the shipside report, the Company A allows the Master A to decide the course of action according to the safety management manual and his experience. So that, generally the landside replies to the shipside when the shipside contacts them.

The management company's personnel was worried about Vessel A because a typhoon was coming close, but he judged the ship was safe by looking at the geography of the anchoring area of vessel A.

The management personnel of Company A looked back after the accident.

Why did Master A lift the anchor after the ship dragged, then let go its anchor?

Master A makes passage in Japan only a few times a year, so he was not familiar with the geography of SETO NAI KAI and typhoon evacuation.

That was why probably he decided to let go the anchor again in the port crowded with other anchoring ships.

Also, in regard to the ship drifting after the anchor was let go again, Master A perhaps decided if he increased the engine output there was a risk of conflict with other ships and ended up unable to control the ship's attitude.

3 ANALYSIS

3.1 Situation of the Accident Occurrence

3.1.1 Course of Events

According to 2.1, it is probable that the following events occurred.

(1) At around 9:00 on August 5, Vessel A let go the portside anchor and extended 6 shackles of anchor chain and began waiting at a single anchorage at the anchoring position of Vessel A.

(2) At around 05:35 on 7, Vessel A began to drag. At around 05:37, it lifted the anchor.

(3) At around 06:00, Vessel A returned to the anchoring position of Vessel A, then it let go the portside anchor and extended 5 shackles of the anchor chain, both on the leeward side of the ship.

However, such measures had no effect. Vessel A drifted.

At around 06:08, its portside front collided with the starboardside bow of Vessel B.

3.1.2 Time, Date and Location of the Accident Occurrence

According to 2.1, it is probable that the time and the date of occurrence was around 06:08 on August 7, 2017, and the accident location was around 1.4 nautical miles at 328° from the Takuma port Sudaichimonji breakwater west lighthouse.

3.1.3 Damage to Ships

From 2.1 and 2.3, it is probable that following damages occurred.

(1) Vessel A's portside front collided with Vessel B's starboardside bow. Vessel A suffered a dent on her portside front shell plating and broken portside front stanchion.

(2) Vessel B suffered dents on its starboardside bow and starboardside center shell plating, and the starboardside bridge was destroyed.

3.2 Causal Factors of the Accident

3.2.1 Situation of Crew Members

(1) Crew

According to 2.4, the situations of the crewmembers were as follows.

(i) Vessel A

At the time of the accident, Master A had over 15 years of experience and possessed a legally valid endorsement attesting the recognition of certificate under STCW regulation I/10.

He was in good health.

(ii) Vessel B

Master B possessed a legally valid certificate of competence. He was in good health.

(2) Condition of the Vessels

From 2.5.2 and 2.5.3, it is probable that the situation was as follows.

(i) Vessel A

Vessel A was in ballast, and her draft was about 3.89m at the bow and 5.34m at the stern.

The projected area front was about 532.6m^2, the projected area side was about 1,841.7m^2, and the distance from the water surface to the bell-mouth was about 9.7m.

Vessel A was anchoring with a single anchor with 6 shackles of portside anchor chain extended.

There was no malfunction or failure with Vessel A's hull, engine, or machineries.

(ii) Vessel B

Vessel B was in ballast, and her draft was about 3.20m at the bow and 4.50m at the stern.

It was waiting at a single anchorage with 7 shackles of starboardside anchor chain extended.

There was no malfunction or failure with Vessel B's hull, engine, or machineries.

3.2.2 Weather and Sea Conditions

From 2.1 and 2.6.1~2.6.4, it is probable that the situation was as follows.

(1) Weather condition and visibility

At the time of the accident, it was raining and the visibility was 4~10km.

(2) Direction and speed of a wind

(i) At the area of the accident, due to Typhoon 5 nearing the area, at 3:00 on the 7th, a storm warning was issued. At the time of the accident, there had been warning issued.

(ii) The wind was blowing from the northeast at about 21~22m/s.

(3) Wind and wave

Wave height was about 2.0m and wave direction was southwest.

(4) Tide

It was at the beginning of incoming tide, and the height was around 1.2m.

(5) Current

At around 0.8 nautical miles north of Tadotsu port breakwater west lighthouse, the tidal current was flowing westerly at about 1.1kn.

The tidal current between Awashima-Ushinosu-hana and Kannon-hana was flowing westerly at 1.3kn.

3.2.3 Anchoring Condition of Vessel A

From 2.1.3, 2.5.3, 2.6.2, 2.6.6, 2.7, 2.8.1~2.8.3, 2.9 and 3.2.2, the situation was as follows.

(1) It is probable that at around 09:00 on August 5, the pilot navigated Vessel A from Fukuyama Port to Takuma Port. Then, under the calm weather and sea conditions, at the anchoring position of Vessel A, it let go the portside anchor and extended 6 shackles of the anchor chain. As the Pilot was getting off Vessel A, he advised that big ships commonly anchor offshore of Misaki in Mitoyo City and that Master A should extend more anchor chain if the wind picked up the speed.

Despite his advice, Vessel A continued to anchor with a single anchor.

(2) It is probable that at around 3:00 on the 7th, because an officer on duty reported to Master A that the wind had picked up, Master A ordered to go up to the highest point of the deck and stand by the engine.

(3) The holding force limit of various anchor chain lengths are shown in the table below. Also, it is probable that the holding force of Vessel A at a single anchorage at the anchoring position of Vessel A with extensions of 6 shackles, 7 shackles, and 10 shackles were respectively about 44 tons, 50 tons, and 55~56 tons.

Anchor chain		Holding force limit (t)
(shackle)	(m)	
6	About 165	About 44
7	About 193	About 50
10	About 275	About 55~56

(4) Effect of external force on Vessel A at 5:28~37 on the 7th

(i) It is probable that the stationary force from the northeast wind at 21~22m/s was about maximum of 33~37 tons at 05:32, when the angle of the relative wind direction was 028° at the starboardside.

(ii) It is probable that the impact force from the northeast wind was about 36.7~45.0 tons at 21m/s and about 40.3~49.4 tons at 22m/s.

This exceeds the holding force limit of Vessel A, about 44 tons.

Thus, Vessel A dragged the anchor.

(5) It is considered probable if Vessel A applied the extension guideline for adverse weather conditions (water depth x 4 + 145m), which they have learned from experience, the chain length would have been about 198m (about 7.3 shackles).

This means that the impact force was very close to the holding force limit, and when the wind speed increased more the external force might have exceeded the holding force limit.

(6) Vessel A has 10 shackles of chain that can be extended.

It is probable that if it extended 2 shackles in addition to 6 shackles while anchoring with a single anchor, at the time of the accident, it could have remained safely.

3.2.4 Dragging Condition of Vessel A

From 2.1, 2.5.4, 2.6.2, 2.7, 2.8.3~2.8.5, and 2.10, the situation was as follows.

At around 05:59 ~ 06:08, maneuvering of Vessel A was as follows.

Time (HH:MM:SS)	Speed over the ground (kn)	Bow direction (°)	Relative wind direction (°)	Course over the ground (°)	Engine telegraph operation
05:59:05	1.8	350	Starboard side 055	246	Stop engines
06:00:05	2.3	331	Starboard side 074	254	Dead slow astern
06:01:05	3.0	327	Starboard side 078	266	
06:02:05	3.5	335	Starboard side 070	272	
06:03:05	3.3	343	Starboard side 062	280	Stop engines
06:04:05	2.8	350	Starboard side 055	275	Dead slow ahead ～ Slow ahead
06:05:05	2.7	354	Starboard side 051	274	
06:06:05	2.8	357	Starboard side 048	284	
06:07:15	3.0	004	Starboard side 041	298	
06:08:05	2.8	005	Starboard side 040	297	Stop engines

(1) It is probable that the anchor didn't help. At around 06:00, Vessel A let go the portside anchor (on the leeward side of the ship) at about 700m east of Vessel B, by operating the engine at dead slow astern, but Vessel A drifted toward the west at about 2~3kn because a northeast wind of about 21~22m/s pushed its starboardside with an angle of about 70°~80°.

(2) It is probable that although Vessel A uses the engine ahead and began lifting the anchor, the anchor chain moved under the ship from the portside to the starboardside , and as a result the chain extended fully.

(3) It is probable that because Vessel A had shifted the engine from dead slow ahead to slow ahead (low load operation) in the area crowded with other anchored ships, it couldn't control the attitude and became un-maneuverable

(4) It is probable that Vessel A drifted at about 3kn leeward due to wind pressing on the beam and collided with Vessel B at around 06:08.

3.2.5 Analysis of Safety Management of Vessel A

From 2.1, 2.4, 2.5.2, 2.6~2.10, and 3.1, the situation was as follows.

(1) It is probable that even though Master A had obtained the weather data, he didn't take adequate measures against the adverse weather, such as extending the anchor chain as much as possible, to control its swing and turn motion.

(2) It is probable that because Vessel A dragged anchor, it lifted the anchor.

Vessel A needed about 1.0 nautical mile on the leeward side to correct its attitude, so it would be maneuverable. However, it was at around 700m from Vessel B, Vessel A retried anchoring by using the portside anchor (leeward side).

(3) The procedures in Company A's Safety Management Manual, and its preparation items against adverse weather included evacuation from anchoring position to safety.

It is probable that the following situation caused Master A to return to the anchoring position of Vessel A and retried anchoring Vessel A after it dragged under adverse weather instead of evacuating to a safe area.

(i) Master A didn't understand that anchoring, by itself, does not provide a sufficient escape from the stormy weather.

(ii) The Safety Management Manual didn't include sufficient information on dragging prevention.

(4) As for ships maneuvering under adverse weather, such as a typhoon, Company A had Master A refer to the procedure in the Safety Management Manual and his experience in order to make decisions.

It is probable that the company didn't have an interactive communication structure, which, for example, would had allowed landside to give an order to avoid adverse weather to the shipside according to a report from the shipside.

(5) It is probable that after Vessel A lifted the anchor due to dragging, if Vessel A left the anchoring area of Vessel A (considering the distance between other ships) and escaped to offshore of Misaki in Mitoyo City and used "heave to" technique it could have avoided the adverse weather and the collision with other ships.

3.2.6 Analysis of the Accident Occurrence

From 2.1, 2.5~2.10, 3.1, and 3.2.1~3.2.5, it is probable that the situation was as follows.

(1) At around 09:00 on August 5, 2017, while Typhoon 5 was moving north toward south Kyushu, Vessel A began anchoring with a single anchor at the anchoring position of Vessel A in Takuma port by letting go its portside anchor and extending 6 shackles of anchor chain.

(2) On the 6th, Typhoon 5 moved in the northwest direction on south Kyushu and came close to Shikoku. At 03:00 on the 7th, at the anchoring area of Vessel A, a storm warning was issued in SETO NAI KAI, including offshore north of Shikoku.

(3) Master A received a report that the wind direction shifted from east by northeast to northeast and the wind speed had changed to 11~13m/s at around 03:00. He went to the highest point of the deck and confirmed the wind had picked up, so he ordered to have the engine stand by while anchoring with a single anchor.

(4) At around 05:35, because Vessel A dragged the anchor, Master A heaved up the anchor.

(5) At around 06:00, instead of evacuating to a safe area, Vessel A returned to the anchoring area of Vessel A and lowered 6 shackles of chain. But, it didn't help, and Vessel A continued to drift.

(6) Vessel A's engine was ahead, and Vessel A began lifting the anchor, but it had no control over the attitude and had trouble maneuvering.

It drifted and collided with Vessel B at about 06:08.

4 CONCLUSIONS

4.1 Probable Causes

It is probable that, when the storm warning was issued in SETO NAI KAI due to incoming Typhoon 5, Vessel A dragged anchor while it was anchored with a single anchor, waiting at Takuma Port for its cargo. Master A, instead of evacuating to a safe area, heaved up the anchor and returned to the anchoring area to reset the anchor, but that didn't work. While the anchor was lifted, Vessel A became un-maneuverable and drifted; as a result, it collided with Vessel B.

It was probable that Master A returned to the anchoring area of Vessel A to retry anchoring instead of evacuating to a safe area because he didn't understand anchoring, by itself, does not provide a sufficient escape from the adverse weather.

It was possible that the area was crowded with many other anchored ships, and Master A had retried to anchor Vessel A, but he was unsuccessful.

So, he uses the engine from dead slow ahead to slow ahead, in a low load operation and tried to lift the anchor.

However, Vessel A became un-maneuverable because its attitude couldn't be controlled since the anchor chain had moved under the ship, shifted from portside to the starboardside, and extended fully.

4.2 Other Discovered Safety-Related Matters

In relation to maneuvering the ship under adverse weather, such as a typhoon, Company A had Master A refer to the procedures included in the Safety Management Manual and his experience in the decision-making process.

It is probable that the company didn't have an interactive communication system for the ship and the land personnel.

Such a system would have allowed shipside to report its condition to the landside in order for the landside to give orders to avoid adverse weather.

5 SAFETY ACTIONS

It is probable that in SETO NAI KAI including offshore north of Shikoku, when the storm warning was issued, Vessel A dragged anchor while it was anchoring with a single anchor to wait for the cargo in Takuma Port.

Master A did not move Vessel A to safety after lifting the anchor. Instead, he returned to the anchoring area of Vessel A and reset the anchor, but it had no effect.

Vessel A became un-maneuverable while Master A was lifting the anchor, and consequently, the ship drifted and collided with Vessel B

Accordingly, implementation of the following measures is necessary for Company A to prevent occurrence of a similar accident.

(1) When adverse weather is expected, such as a typhoon, crews should prepare to anchor securely by understanding the necessary amount of chain extension for adverse weather and measures to take in case of a strong wind.

Moreover, all company ships should be instructed to move the ship to safety in an emergency situation.

(2) Under adverse weather, places of refuge for ships become crowded with many ships. Consequently, large ships have difficulty securing enough distance between other ships.

This is why ships should actively collect information about other safe places to evacuate.

In view of the result of this accident investigation, the Japan Transport Safety Board requests Japan Foreign Steam ship Association and Japan Association of Foreign-trade Ship Agencies to make this report common knowledge to relevant personnel.

It is necessary to advise foreign crews about prevention of dragging and anchoring places under adverse weather for the purpose of prevention of recurrence of similar casualties.

5.1 Safety Actions Taken by Company A After the Accident

As countermeasures for ships dragging anchor, Company A had sent literature in regard to prevention of dragging, which external organizations had published, and equations to derive the holding force of anchor and anchor chain, and wind force to use as reference to all company ships.

The company has revised the Safety Management Manual and conducted safety education in regard to dragging prevention.

Figure 1　Navigation Route

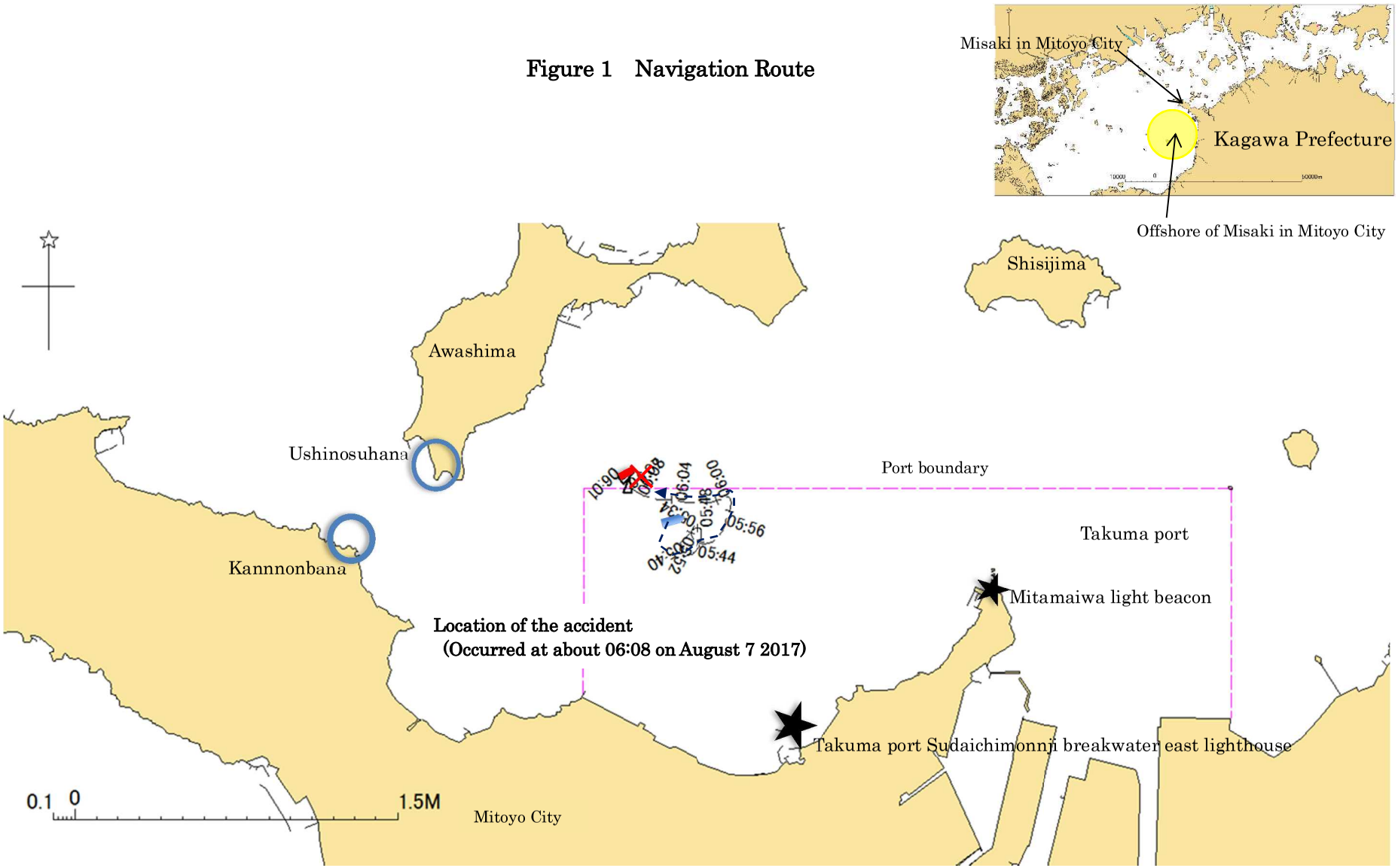

Figure 2 Navigation Route (enlarged)