MA2017-9

MARINE ACCIDENT
INVESTIGATION REPORT

September 28, 2017

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 “CITY”
IMO number: 9281140
Gross tonnage: 4,359 tons

Accident type: Grounding
Date and time: Around 05:09 on January 10, 2016 (local time, UTC + 9 hours)
Location: Near the Port of Sakata, Sakata City, Yamagata Prefecture
(Approximate position: 38°58.0’N, 139°49.2’E)

August 24, 2017
Adopted by the Japan Transport Safety Board
Chairman Kazuhiro Nakahashi
Member Kuniaki Syoji
Member Satoshi Kosuda
Member Toshiyuki Ishikawa
Member Mina Nemoto

SYNOPSIS

< Summary of the Accident >

When a cargo ship CITY, with a master and 17 persons on board, was riding a single-anchor near the Port of Sakata in Sakata City, Yamagata Prefecture, a wind velocity increased and though she hove up anchor and attempted to standing out to sea, she was driven by a pressure, and stranded on a tetrapod at around 05:09 on January 10, 2016 near the Port of Sakata.

Though the CITY swamped to the position of the bridge of her hull and became total loss, there was no fatality.

< Probable Causes >

It is probable that the accident occurred because weather and sea information was not appropriately obtained on the CITY during anchorage in the waters off the Port of Sakata under the condition of anticipated a wind with a maximum speed of 15 m/s and about 2.8-meter-high waves and the master did not have a grasp of the seaworthiness of the CITY, she missed the timing for evacuating to a safe water area, and although she heaved up anchor and tried to head out to sea, the speed necessary to keep the course and the ship became unable to maneuver, and ran on a wave-absorbing blocks.

It is probable that the reason why the master did not appropriately obtain weather and sea information because the master thought there was no sign of worsening weather seeing Asian Pacific surface analysis charts and coastal wave analysis charts.

It is probable that the reason why the master did not have a grasp of the seaworthiness of the ship was because the safety management manual of Trans Ocean Shipping Co., Ltd. did not describe about seaworthiness such as limiting clutch force and limit wind speed in a ballasted

condition and a limit of ship maneuvering for course keeping considering a wind pressure and output power of the main engine in the said condition.

< Safety Recommendations >

It is probable that the accident occurred as a result of the course of events that the CITY had not appropriately obtained weather and sea information during her anchorage and that she missed the timing of evacuating to a safe water area because the master did not have a grasp of seaworthiness of the ship due to lack of descriptions about seaworthiness such limiting clutch force and limit wind speed in a ballasted condition and a limit of ship maneuvering for course keeping considering a wind pressure and output power of the main engine in the said condition in the safety management manual of Trans Ocean Shipping Co., Ltd. and thereby she became unable to maneuver despite an attempt to head out to sea.

It is probable that the reason why the CITY had not appropriately obtained weather and sea information is that the master thought there was no sign of worsening weather seeing weather and sea analysis charts and therefore had not obtained other weather information.

From these, in view of the result of this accident investigation, the Japan Transport Safety Board recommends Trans Ocean Shipping Co., Ltd. which is the vessel management company of the CITY to take the following measures for the purpose of prevention of the recurrence of similar casualties and etc.

(1) Trans Ocean Shipping Co., Ltd. educates masters of the ships under control of the company about obtaining necessary weather information.

(2) Trans Ocean Shipping Co., Ltd. describes information about limiting clutch force and limit wind speed in a ballasted condition and a limit of ship maneuvering for course keeping considering a wind pressure and output power of the main engine in the said condition in the safety management manual.

1 PROCESS AND PROGRESS OF THE INVESTIGATION

1.1 Summary of the Accident

When a cargo ship CITY, with a master and 17 persons on board, was riding a single-anchor near the Port of Sakata in Sakata City, Yamagata Prefecture, a wind velocity increased and though she hove up anchor and attempted to standing out to sea, she was driven by a pressure, and stranded on a tetrapod at around 05:09 on January 10, 2016 near the Port of Sakata.

Though the CITY swamped to the position of the bridge of her hull and became total loss, there was no fatality.

1.2 Outline of the Accident Investigation

1.2.1 Setup of the Investigation

The Japan Transport Safety Board appointed a chief investigator and one other investigator to investigate this accident on January 12, 2016.

1.2.2 Collection of Evidence

January 12, 14, 15, 25-28, 2016: Interview

January 13, August 19, 2016: On-site investigation and interview

February 16, 29, March 17, 22, 30, May 5, 6, 11, 17, 20, July 4, September 9, 21, 2016: Collection of questionnaire

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 Flag State

Comments on the draft report were invited from the flag state of the CITY.

2 FACTUAL INFORMATION

2.1 Events Leading to the Accident

2.1.1 Events leading to the Accident of the CITY according to VDR

According to the record of information of the CITY (hereinafter, referred to as "the ship") by the voyage data recorder (VDR)[*1], the navigational track of the ship between 01:13:00 and 05:10:00 on January 10, 2016 was as shown in Table 2. 1.

Table 2.1 AIS Record of the Ship (excerpt)

Time (HH:MM:SS)	Ship's position		Course Over The Ground (°)	Heading (°)	Speed Over The Ground (kn)
	Latitude (N) (° -′ -")	Longitude (E) (° -′ -")			
01:13:00	38-57-16.7	139-46-47.6	200	180	0.8
01:30:03	38-57-20.1	139-46-42.3	155	167	0.4

[*1] Voyage Data Recorder, or VDR, is a device for recording intercommunications of VHF radiophone, voices in a bridge etc. as well as data about navigation such as a position, course, speed, in a collectable capsule.

01:40:01	38-57-20.0	139-46-42.2	112	159	0.2
01:50:00	38-57-20.5	139-46-42.5	342	166	0.4
02:00:00	38-57-20.4	139-46-42.6	182	162	0.4
02:10:00	38-57-20.6	139-46-42.8	317	167	0.6
02:20:00	38-57-20.2	139-46-43.0	344	169	0.7
02:30:00	38-57-20.6	139-46-42.9	182	167	0.4
02:40:00	38-57-20.5	139-46-42.8	166	164	0.4
02:50:00	38-57-20.8	139-46-43.1	050	148	0.6
03:00:00	38-57-22.0	139-46-46.6	052	162	0.8
03:05:00	38-57-22.0	139-46-50.3	295	214	0.4
03:10:00	38-57-21.7	139-46-50.3	115	180	0.8
03:15:00	38-57-19.6	139-46-54.5	140	208	0.9
03:17:00	38-57-19.5	139-46-55.3	022	236	0.4
03:20:00	38-57-17.9	139-46-56.3	156	224	1.2
03:25:00	38-57-17.5	139-46-56.9	352	237	0.5
03:30:00	38-57-16.3	139-46-57.3	346	261	0.6
03:35:00	38-57-15.5	139-46-57.6	121	256	0.4
03:40:00	38-57-15.6	139-46-57.4	219	248	0.6
03:45:00	38-57-15.9	139-46-57.4	153	246	0.5
03:50:00	38-57-14.9	139-46-57.3	282	259	0.3
03:51:00	38-57-15.2	139-46-57.0	324	268	0.8
04:00:00	38-57-14.5	139-46-53.2	223	255	0.5
04:04:00	38-57-14.7	139-46-55.6	087	218	1.9
04:10:00	38-57-06.0	139-47-02.8	166	251	1.0
04:13:00	38-57-03.7	139-47-04.7	128	282	0.6
04:14:00	38-57-03.7	139-47-05.1	085	301	0.5
04:15:00	38-57-04.7	139-47-05.8	027	347	1.8
04:16:00	38-57-07.3	139-47-08.6	048	000	4.2
04:20:00	38-57-21.0	139-47-18.7	030	340	3.8
04:23:00	38-57-30.6	139-47-24.1	022	321	3.5
04:25:00	38-57-36.3	139-47-26.9	014	316	3.1
04:30:00	38-57-49.4	139-47-30.7	031	314	2.6
04:35:00	38-58-01.4	139-47-47.6	046	339	4.0
04:38:00	38-58-08.2	139-47-55.4	040	330	3.0
04:40:00	38-58-11.9	139-48-00.9	055	350	2.6
04:42:00	38-58-13.1	139-48-07.2	088	021	2.4
04:45:00	38-58-13.9	139-48-17.7	083	346	2.5
04:50:00	38-58-17.4	139-48-29.7	024	277	1.1
04:52:00	38-58-17.4	139-48-30.0	144	256	0.9
04:55:00	38-58-15.6	139-48-34.5	130	205	1.2
05:00:00	38-58-03.1	139-48-52.8	108	118	4.8
05:01:00	38-58-00.7	139-49-02.8	101	134	4.5
05:05:00	38-58-00.3	139-49-11.7	083	184	3.3

05:06:00	38-57-59.7	139-49-13.9	160	241	1.2
05:07:00	38-57-59.2	139-49-14.0	158	238	0.6
05:08:00	38-57-58.2	139-49-13.9	193	243	1.2
05:09:00	38-57-57.2	139-49-13.7	193	257	0.8
05:10:00	38-57-56.7	139-49-12.7	239	274	1.1

2.1.2 Information of Sounds etc. by VDR Record and Others

According to the VDR record of the ship and the recording of communication by VHF radiophone by 2nd Regional Coast Guard Headquarters (hereinafter, referred to as "the 2nd Regional Headquarters"), the intercommunication between the ship and the 2nd regional headquarters by the VHF, an onboard conversation and others of the time period from approximately 01:13 to approximately 05:19 on January 10, 2016 are as shown in Table 2. 1-2.

Note that the communication between the ship and the 2nd regional headquarters was in English and the conversation on the ship was in Russian, and these conversations were translated into Japanese to be described.

Table 2. 1-2 Sound Information (excerpt)

Time	Communication content by VHF	Onboard conversation etc.
Around 01:13		Master: Let the port anchor go. Boatswain: Yes, sir, the port anchor. Master: Into the water by six shackles[*2].
Around 01:22		Boatswain: By 6 shackles into the water.
Around 01:24		Master: By 6.5 shackles into the water.
Around 01:30		Master: Seems that the nail raked the bed.
Around 01:54 – 02:46	Japan Coast Guard(JCG) : CITY, CITY, CITY, CITY, CITY, CITY This is Shiogama coast guard radio.	
Around 03:15	JCG : CITY, what is your intension. C/O(Officer A) : We anchored at 0130, we are going to arrive on 12 th and now anchoring. JCG : Your position is changing. Are you dragging now. Officer A : We are anchoring. JCG : West wind force will be stronger. You should use engine or	

[*2] "Shackle" is a unit for denoting a length of cable chain. With regard to the ship, which sets 1 shackle at 25 m.

	keep as immediate start during anchoring. Where is your position. Officer A： At N３８° ４７.２′ E １３９° ４６.９′ JCG: Please tell me your heading. Officer A：２４５°	
Around 03:29		(Sound of a door) Officer A: There was a calling from the Japan Coast Guard. Was the anchor effective when anchored? Master: It was effective. Officer A: The ship moves and the seawall is close.
Around 03:32		Master: To the engine room、Get the engines ready.
Around 03:51		Engine Room: The engines are ready. Master/Officer A: Let's change the location. Boatswain: The waves became high.
Around 04:04		Boatswain: The anchor became apeak[*3]. Master: Okay. Engine, full speed ahead.
Around 04:12	JCG： CITY Officer A: We are shifting anchor now. JCG： Where is your anchoring position.	
Around 04:16	Capt or officer A： Anchoring position is at N３８° ５７.９′ 、E１３９° ４７.５′ JCG： You should use engine or keep as immediate start during anchoring. Capt.： We will keep on readying for start main engine immediately. We may go offshore for heave-to and we will wait for weather recovery. JCG： Please contact us when you decide to carry out heave-to[4].	
Around 04:21		Master: We must either move forward to the off shore or anchor.
Around 04:23		Master: In either case, we must decide which way to take. It is still 130.

[*3] "Anchor apeak" refers to a state of anchor chain length almost coinciding with water depth during the heave up it.
[*4] "Heave to" refers to a ship maneuvering method in the stormy weather of face the bow toward the direction of the windward.

Around 04:30		Master: Master, though we are proceeding to the off shore, a breakwater is close on the other side. Beware. 130 at 04:30.
Around 04:33		Master: What could I do...
Around 04:38		Master: Stop the engine.
Around 04:40	JCG： How about your course and speed. Capt.： We stopped engine and we are ready for anchoring. JCG：It is getting windy and now wind force is ２０m/s. It is easy to drag anchor, so please use engine. Capt.： Just a moment.	Master: Astern the engine.
Around 04:42		Master: Let the anchor go, the cable three shackles.
Around 04:44		Master: What the hell, where does she go?
Around 04:46		Master: Engine room, we'll heave up the anchor and power up against the wind, so, be prepared.
Around 04:47		Master: The engine, full speed ahead.
Around 04:51		Master: The engine isn't working.
Around 04:53		Master: We're approaching the shore closer to closer. I don't know if the anchor is working or not. We want to get off the shore, but we can't.
Around 04:54	JCG： CITY Capt.： We can not carry out anchorage and can not go offshore. We have problem about main engine. We need your support.	
Around 04:56		Master: How far is it to the shore?
Around 04:59		Master: Stop the engine. Master: Astern the engine.
Around 05;00		Master: The bow, we' re now going toward the shore at 4 kn. Is the anchor Okay? Boatswain: No problem.
Around 05:01	JCG： CITY Capt.： Coast guard, we need	Master: Heave up the anchor to the place we can see.

	tugboat. JCG : How about your course and speed. All crew should be put on lifejacket.	Officer A: The water surface is close. Master: Heave up to the bell mouth[*5].
Around 05:04		Master: (inboard announcement) All hands, get together. (To the bow) Evacuate from that place quickly.
Around 05:05	Capt. : We need tugboat. JCG : How about your course and speed. Please put on lifejacket, will you be a ground.	
Around 05:07	Capt. : We have big problem. We need tugboat and your support. JCG : What kind of trouble.	
Around 05:09		Clink-clank… (impact noise)
Around 05:10		Master: She is still moving. I don't know where she will head for.
Around 05:13		Boatswain: Sounds like she ran on.
Around 05:15		Master: Let's power up the engine. Seems likely to touch the shore.
Around 05:18		Whack, whack, whack… (impact noise) Master: (inboard announcement) All hands, escape to safety.
Around 05:19	Capt. : Mayday mayday mayday This is CITY, we are grounding. JCG : Please tell us your situation. Capt. : We are grounding and already ready for abandon.	

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

According to the statements of the master, the second officer (hereinafter, referred to as "Officer B") the chief engineer, the second engineer (hereinafter, referred to as "Engineer A"), the third engineer (hereinafter, referred to as "Engineer B"), the electric engineer, the boatswain, three able seamen, an ordinary seaman, and five engine crews and the reply to the questionnaire by the 2nd Regional Headquarters and Aquamarine Shipping Co., Ltd. (hereinafter, referred to as "A Company") which is a shipowner of the ship, they were as follows.

(1) Events Leading to the Occurrence of the Accident

On the ship, the master, the Office A, and other 16 members (12 Russian nationals and four Bangladesh national) were aboard and she left the Port of Akita-Funagawa, Akita Prefecture for the Port of Sakata, Akita Prefecture at around 13:40 on January 9, 2016,

[*5] The "bell mouth" is a part where anchors on both sides of the bow are stored.

arrived at an area at about 35 m deep on the northwest side of the quarantine anchorage of the Port of Sakata directed by an agent as an anchorage, got the boatswain into place for the purpose of anchor there, let go the port anchor at around 01:13 on the 10th and began to anchor.

The master usually sets a value which is about one third of the depth of anchorage (by the meter) as a shackle number of a cable to be walked back and while he had planned to have the ship clear land when the weather got worth, he felt that the anchorage off the Port of Sakata was close to the shore, and hence he set 6.5 shackles which was shorter than usual as the volume of the cable to be walked back.

The master confirmed that the anchor scratched the sea bed at about 01:30.

Though the master thought that the weather was calm with no change, since the anchorage was close to the shore, he decided to continue navigation watchkeeping and directed Officer B to give attention to the environment around the ship and to let him know immediately if there was anything suspicious, and the engine room to get ready to start the engine promptly respectively, and he left the bridge.

On the ship, at anchor, Engineer A and two engine crews take up their positions in the engine room and the chief engineer directed a check and clearing on filters of the fuel oil line after the anchorage.

Officer B confirmed the ship's position and also set a distance to the shore as the guard ring*6 on radar and was checking a change of weather conditions and the ship's position such as frequently went out to the wing during anchor watchkeeping.

Officer B had Officer A take over the watchkeeping and left the bridge at about 03:00.

Officer A confirmed that the direction of the wind was between the south and the southwest and that a wind speed was 8 – 10 m/s around the time when he took over the watchkeeping, and thought that the weather was calm.

Officer A confirmed that it sleeted temporarily from around 03:10 to around 3:15, that the direction of the wind changed to the northwest and that the wind was getting to blow harder.

Officer A responded to a calling by the VHF from the 2nd Regional Headquarters at around 03:15 and received information to the effect that the ship was moving, the west wind was getting harder, and the engine should use the engine with being careful to dragging of anchor.

The master entered the bridge upon receiving a request from Office A at sometime between 03:20 and 03:25 and received a report about the conditions of the weather and the information from the 2nd Regional Headquarters, and on seeing the ship being swayed by the shore on radar screen, he thought the ship was in a dangerous situation of dragging the anchor and approaching a breakwater.

The master decided to shift in a location in the direction of the northwest which was more distant from the shore than the place at that time, got the boatswain, the able seamen into place at the bow, and directed the engine room to stand by engine.

The chief engineer and Engineer A immediately entered the engine room upon receiving request from Engineer B and stood by engine with Engineer B.

The ship started to weigh anchor using the engine and around the time when the anchor became a peak, the master directed full speed ahead, but the ship began to be swept out by pressure of wind sea in the direction of the shore.

*6 The "guard ring" is a distance ring set up in order that an alarm is raised when an image of a ship etc. detected by radar approaches to a fixed distance.

In response to the calling from the 2nd Regional Headquarters, around that time, the master said that they were going to either shift anchor or stand out to sea, heave to and wait until better weather came.

In addition, Officer A confirmed that it became a stronger wind and an anemometer in the bridge came to indicate 20 – 25 m/s around that time.

The chief engineer had set an operation lever to full speed ahead upon taking directions from the master, but rotation frequency of the main engine did not run up and he manually regulated the main engine so that the oil level of the fuel injection pump increased.

The ship tried to head for the north, which was offward in this case, in a posture of facing on the wind as the master sensed danger in the state of being swept out towards the shore by pressure, but the helm did not work due to the strong wind, was not able to be manipulated as they wished swept out by pressure generated by wind sea, and she could neither head for offward nor reached the planned anchorage.

The master thought of letting go anchor to thereby compete with the pressure flow, so he gave an instruction to stop the engine and go astern, let go port anchor and dropped the chain cable by three shackles, but the anchor did not work on the ship and the pressured current to the east continued.

The ship was swept out downwind and continued to approach the shore in a posture of facing the shore, and despite the master's instruction of engine astern for the purpose of avoiding collision and striking on, she struck on a wave-absorbing block (hereinafter, referred to as "the wave-absorbing block").

(2) Post-accident Situation

Soon seawater was blended into the lubricating oil line of the main engine of the ship and the engine room began to take the sea, and therefore the master assembled the crews in the dining room over the intercom and instructed to wear a life-saving jacket.

The ship declined to the port side by approximately 10° at around 05:36 and to the starboard side by approximately 30° at around 06:45 and thereafter, submerged in water into the floor surface of the bridge.

The crews were all rescued by helicopters of the Japan Coast Guard and Japan Air Self-Defense Force which came to rescue by around 09:52.

The date and time of occurrence of the accident was January 10, 2016 at around 05:09 and the site of occurrence was at about 2,260 m at 010° true bearing from the Sakata Lighthouse.

(See Attached Figure 1 Navigation Course and Attached Figure 2 Navigation Course (enlarged).)

2.2 Injuries to Persons

According to the statements of the master, there was no causalities.

2.3 Damage to Vessel

According to the statements of the master and the reply to the questionnaire by a salvage company, after the ship submerged in water into the floor surface of the bridge, facilities, interior decorating, etc. in the bridge were flown out by about January 18 and the bridge was destroyed and divided into two and the like by about 26th. Afterward, she was demolished and removed by the salvage company (See Photos 2 and 3.)

Photos 2 and 3 The ship after running-on

2.4 Crew Information

(1) Gender, Age, and Certificate of Competence

① The master Male, 61 years of age Nationality: Russian Federation

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

Grant of certificate: December 17, 2012

(Effective until July 29, 2016)

② Officer A Male, 49 years of age Nationality: Russian Federation

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

(Effective until May 30, 2018)

(2) Major experience in service aboard etc.

① The master

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

The master graduated from school and took a position as a seaman around 1976, and after experiencing the post of a third officer, he took a position as second officer in 1978, and acquired a master's license in 1988 to therewith took a position as a master. He quit the marine job in 1990, but took a position as a master from around 1997 and after having boarded the ship in the period from February to July, 2012, he had been aboard again since September, 2015.

He had experiences of entering a number of ports in Japan and he had entered the Port of Sakata three or four times and his experience of entering into the port in winter time was once.

At the time of the accident, he was in good health condition.

② Officer A

According to the statement of Officer A, it was as follows.

Officer A graduated from school and took a position as a seaman and went aboard a merchant ship around 2004 and became a second officer in 2009.

He went aboard the ship as a second officer in September 2015 and was promoted to a first officer in December.

This was his second time to enter into the Port of Sakata and first time of doing so in winter time.

At the time of the accident, he was in good health condition.

2.5 Vessel Information

2.5.1 Particulars of Vessel

IMO number: 9281140
Port of registry: Panama, the Republic of Panama
Owner: A Company (the Republic of Singapore)
Management company: Trans Ocean Shipping Co., Ltd. (the Russian Federation) (hereinafter, referred to as "B Company" except Chapter 6)
Class: International Register of Shipping (the Republic of Panama)
Gross tonnage: 4,359 tons
L×B×D: 106.62 m × 16.80 m × 9.10 m
Hull material: Steel
Engine: One diesel engine unit
Output: 2,400 kW
Propulsion: Fixed pitch propeller
Date of launch: Year 2002
(See Photo 2.5 – 1.)

Photo2.5 – 1

2.5.2 Vessel Information

(1) Hull structure etc.

According to the general arrangement plan, the ship was a cargo ship of docking-bridge type with a forecastle, which comprised, sequentially from the bow, a deck storage, cargo holds 1 to 3, a deck room and an engine room thereunder, and three cranes on the port side of the upper deck.

In the deck room, sequentially from the top, a bridge deck, a second deck, a first deck, and an upper deck are provided, and in a double bottom under the cargo holds, a ballast tank and a fuel oil tank (A heavy oil and C heavy oil) and in the engine room, a lubricating oil tank etc. were arranged respectively.

(See Figure 2.5 – 1.)

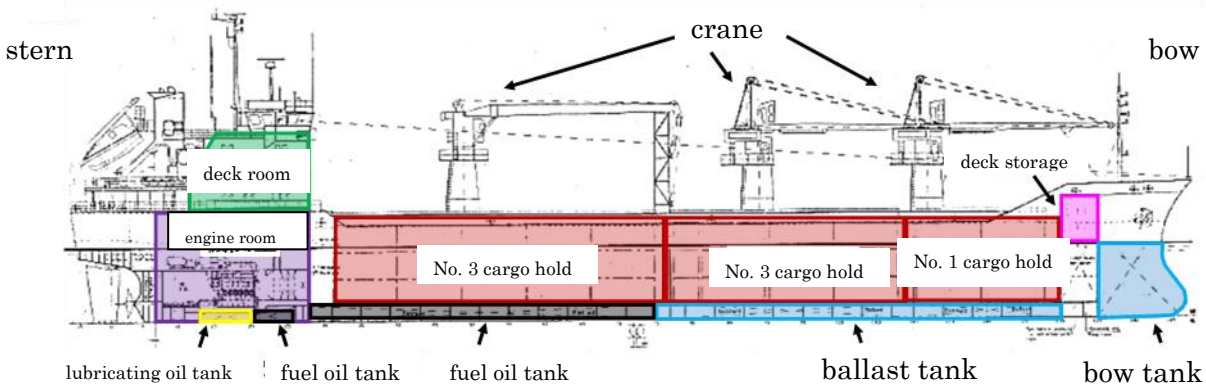


Figure 2.5 – 1 General arrangement plan of the ship

(2) Navigational instrument of the ship etc.

According to the statements of the master and Officer B and the general arrangement plan, it was as follows.

On a console, a steering stand and a gyro repeater were installed on the center and a VHF, an engine telegraph, a radar and an electric chart system*7 (ECS) were installed on the starboard side, and a radar, a NAVITEX receiver*8, an automatic identification system display system (AIS)*9 and a GPS dictator were installed on the port side, and further, an anemometer was installed above the console and a gyro repeater was installed on each wing.

(See Figure 2.5 – 2.)

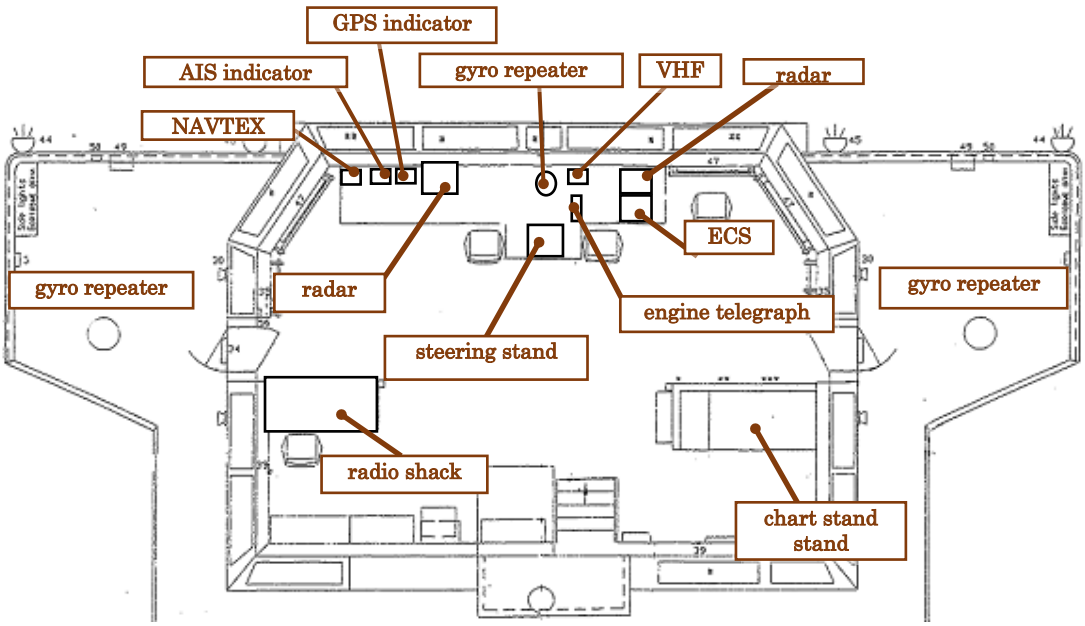


Figure 2.5 – 2 Bridge arrangement of the ship (schematic view)

2.5.3 Mooring and Anchor-handling Facilities Information

According to the statements of the master and the reply to the questionnaire by A Company, it

*7 "Electronic Chart System" is a kind of navigation information system in which chart data and information are displayed on the screen (It does not satisfy all requirements specified by IMO.).

*8 "NAVITEX receiver" is a device capable of receiving marine safety information including marine weather forecasts and alarms necessary for vessel operations.

*9 "AIS" information exchanging device for automatically transmitting/receiving information on the ships' identification signals, types, names, positions, courses, speeds, destinations, and navigation states and exchanging them between vessels and with navigation aid facilities of land stations.

was as follows.

(1) Anchor and chain cable

The anchor is of Hall's type (JIS type) the weigh about 3,000 kg, and each board is provided with one. The chain cable has a diameter of about 50 mm, the one shackle is about 25 m, and each board is provided with 10 shackles. (See Photo 2.5 – 2.)

Photo 2.5 -2 Anchor and chain cable

(2) Windlass

The windlass is a motorized winch and its rating output power was about 104 kN × about 0.15 m/min.

2.5.4 Propulsion Device etc.

(1) According to the Engine International Air Pollution Prevention Certificate, the general arrangement plan, the assembly drawing of propeller, and the statement of the master, it was as follows.

The main device is a low-speed diesel engine with two cycle-six cylinder low-speed diesel engine with a supercharger[*10] by exhaust gas and its maximum output power was 2,400 kW and its revolutions per minute (rpm) at the time of the continuous maximum power was 250.

The number of revolutions corresponding to each speed was as follows.

advance	rpm	astern	rpm
Sea speed	190	—	—
Harbor full speed	180	Full speed	170
Half speed	140 – 150	Half speed	130 – 140
Slow speed	130	Slow speed	110
Dead slow speed	110	Dead slow speed	90

The propeller pitch[*11] was about 1.83 m and in the case of the accident, the upper end of the propeller blades were below water surface.

The ship did not have a side thruster.

The speed at the time of the continuous maximum power at sea trial was 11.5 kn.

[*10] In order that a diesel engine may output high power, it is necessary to supply large quantity of air in the cylinder, and the "supercharger" is an air blower used for this purpose. In the supercharger, there are a main engine direct-drive type and a type driven by input of exhaust gas.

[*11] The "propeller pitch" refers to the distance a ship advances along the blade surface of propeller when the propeller goes into a 360-degree roll.

(2) According to the information from National Maritime Research Institute of National Institute of Maritime, Port and Aviation Technology, an average of the main engine continuous maximum power of general cargo ships of 4,000 tons or more and less than 5,000 tons gross of the IHS Fairplay Towage's fleet statistics at the time of the sea trial was about 3,226 kW.

2.5.5 Hull, Loading Condition etc.

According to the statement of the master, the logbook, and the tank capacity plan, the ship was in ballast carrying no cargo and made the ship in a ballasted condition[*12] condition where all tanks except a bow tank were filled with ballast water (about 1,080 t) and drought was about 2.25 m at the bow and about 3.75 m at the stern.

According to the general arrangement plan and reply to the questionnaire by A Company, as to the ship, a front wind pressure area was about 278.5 m^2, a distance from a water surface to the bell month was about 7.25 m, and an opening angle between the outer panel of the bow and the fore-aft axis at the water surface was about 35°.

According to the statements of the master and the chief engineer, as to the ship, there was no trouble or failure in the hull, the engine and the devices at the time of the accident.

2.6 Weather and Sea Conditions

2.6.1 Observed Values in the Area near the Accident Location

Observed values of average wind speed (WS), most frequent wind direction (both of them were observed values of 20 – 10 minutes before the indicated times) and observed values of every 20 minutes of significant wave height[*13] (average values of 10 minutes before and after the indicated times) by the Port of Sakata Wave Observation Tower of Tohoku Regional Development Bureau situated about 6 km west-northwest of the accident site at the time of the accident were as follows.

Time (HH:MM:SS)	Observed time (MM:SS)	Observed value	
		Average WS (m/s)	Most frequent wind direction
01:20	01:00 – 01:10	10.3	South-southwest
02:00	01:40 – 01:50	8.7	South-southwest
02:40	02:20 – 02:30	8.8	South-southwest
03:00	02:40 – 02:50	8.4	South
03:20	03:00 – 03:10	14.5	West-northwest
03:40	03:20 – 03:30	16.9	West-northwest
04:00	03:40 – 03:50	15.5	Northwest
04:20	04:00 – 04:10	14.0	Northwest
04:40	04:20 – 04:30	17.1	West-northwest
05:00	04:40 – 04:50	15.7	Northwest
05:20	05:00 – 05:10	15.3	Northwest

[*12] The "ballasted condition" refers to navigating in a condition of loading sea water or clear water and maintain adequate draught in order to keep the stability of vessel in the state of no cargo.

[*13] The "significant wave height" refers to an averaged wave height of 1/3 of total number of waves selected sequentially from higher ones when observing continuing waves at a certain spot.

Time (HH:MM:SS)	Observed time (MM:SS)	Observed value Significant wave height (m)
01:20	01:10 – 01:30	1.03
02:00	01:50 – 02:10	1.04
02:40	02:30 – 02:50	0.97
03:00	02:50 – 03:10	1.11
03:20	03:10 – 03:30	1.56
03:40	03:30 – 03:50	1.77
04:00	03:50 – 04:10	1.93
04:20	04:10 – 04:30	1.95
04:40	04:30 – 04:50	1.95
05:00	04:50 – 05:10	2.26
05:20	05:10 – 05:30	2.62
Average for 10 days	―	2.66

2.6.2 Observations by Crews

According to the logbook and the statements of the crews, the observed values at around 03:00 were south wind direction, wind speed 8 m/2, wave direction 290° and wave height 1 m, and it sleeted temporarily at around 03:10 – 03:15, and after around 03:15 – 03:20, the wind direction was northwest and the wind speed was 20 – 25 m/s.

2.6.3 Tide

According to the tidal table published by the Japan Coast Guard, the sea tide in the Port of Sakata at the time of the accident was the middle phase of the rising tide and the wave height was 0.2 m.

2.6.4 Weather Chart for Vessels Released by Japan Meteorological Agency, Alert, etc.

(1) Weather chart for vessels

① Among the weather charts issued by Japan Meteorological Agency (hereinafter, referred to as "metrology FAX"), Asian Pacific surface analysis charts and coastal wave analysis charts at 15:00 and 21:00 on January 9 (Japan Time) were as follows.

② Among the metrology FAX, according to coastal wave 24-hour forecasting charts (FWJP24), anticipated values of the winds and waves from 21:00 on 8th to 09:00 on 10th were as follows.

Date and time	Wind direction	Wind speed	Wind direction	Wave cycle	Significant wave height
8th, 21:00 – 9th, 21:00	South-southeast	2 kn (approx. 1.0 m/s)	Northwest	7 sec	1.4 m
9th, 9:00 – 10th, 9:00	Northwest	19 kn (approx. 9.8 m/s)	Northwest	8 sec	2.8 m

(See Attached Figure 5 coastal wave 24-hour forecasting charts.)

(2) Release of alerts for vessels etc.

① Japan Metrological Agency

According to Japan Metrological Agency, an ocean wind alert was issued at 05:35 on

January 9 (the day before the accident) and it was going on at the time of the accident.

② Marine warning by VHF

According to the 2nd Regional Headquarters, the marine warnings aired on Channel VHF16 between around 17:26 on 9th and around 00:04 on 10th were as follows.

Air date and time	Marine warning	Content
9th, 17:26 – 27 17:33 – 34	Ocean wind warning	Tilt in atmospheric pressure is anticipated to gradually become steeper. A west wind is anticipated to gradually pick up and the max wind speed is anticipated to reach 30 kn (15 m/s) within the next12 hours.
9th, 23:41 – 42 10th, 00:03 - 04	Ditto	Tilt in atmospheric pressure is anticipated to gradually become steeper. A west wind is anticipated to gradually pick up in the waters off Akita and the max wind speed is anticipated to reach 30 kn (15 m/s) within the next 6 hours.

③ NAVTEX

According to the Japan Coast Guard, English marine warning with regard to the waters off Akita aired between around 06:07 on January 9 and around 02:30 on January 10 by NAVITEX Otaru Station were as follows.

Air date and time	Re-air date and time	Marine warning
9th, 06:07 –	9th, 10:30 –	Ocean wind warning
12:02 –	14:30 –	Ditto
18:10 –	22:30 –	Ditto
10th, 00:05 –	10th, 02:30 –	Ditto

2.6.5 Information about the Ship's Access to Meteorological Information

According to the statements of the master, Officer A and Officer B, it was as follows.

The ship habitually obtained meteorological information by FAX, NAVTEX and on VHF.

(1) Meteorology FAX

The master had obtained Asian Pacific surface analysis charts and coastal wave analysis charts at the time of the accident, but he was thinking that there was no sign of worsening weather on these analysis charts.

(2) VHF

On the ship, Channel 16 of VHS had listened in on, but the ocean wind warning information concerning the waters off Akita was not noticed at the time of the accident.

(3) NAVTEX

On the ship, information of Otaru Station had been received on NAVITEX at the time of the accident, but the ocean wind warning concerning the waters off Akita was not noticed.

2.7 Accidental Area Information

2.7.1 Information by Chart

According to the chart W1160 (the Port of Sakata), the marine area where the ship anchored

at around 01:30 was about 35 m deep and the bottom material was mud mixed with sand, and the proximity of the area where the ship let go anchor at around 04:42 was about 23 m deep and the bottom material was mud mixed with sand.

2.7.2 Information by Sailing Directions[*14]

(1) The sailing directions published by Hydrography Department of the Russia Federation describes the Port of Sakata as follows. (Tentative translation of excerpt)

① Fifty – sixty days of high-wind days are observed in a year and 80% of these are concentrated in November – March. When a typhoon in the Sea of Japan moves from east to west[i] throughout the months of March until May, the east-southeast wind changes to the strong west – northwest wind and generates large swells whose height reaches as long as 7 – 8 m. Under such a condition, ships being outside of a refuge harbor have their cables fractured and are sometimes tossed up onto the shoal.

② Vessels entering the Port of Sakata can preferably take refuge in Tobishima when the north – northwest wind is high.

(2) Wind Influence etc.

According to the statement of the master, though the ship was equipped with sailing directions published by Hydrography Department of the Russia Federation, the information of the above (1) ① was not confirmed.

2.8 Information about Watchkeeping of the Ship

According to the statements of the master and the chief engineer, the watchkeeping shift of the ship was as follows.

(1) Navigation watchkeeping shift

The bridge watchkeeping shift of the ship from the departure of the Port of Funagawa, Akita to the anchorage was as follows.

Time	Bridge watchkeeping	Engine watchkeeping
Departure – 15:00	Officer B, one OS	Engineer A, two engine crews
15:00 – 19:00	Officer A, one OS	Engineer B, one engine crew
19:00 – 23:00	The master, one AB	C/E, two engine crews
23:00 - anchorage	Officer B, one OS	Engineer A, two engine crews

(2) Anchor watchkeeping shift

The watchkeeping shift after anchoring at around 01:13 on 10th was as follows.

Time	Bridge watchkeeping	Engine watchkeeping
Anchoring – 03:00	Officer B	Engineer A, two engine crews
03:00 – Anchor weighing	Officer A	Engineer B, one engine crew

2.9 Wind Influence over Ship Maneuvering

According to Literature 1[*15] and Literature 2[*16], it was as follows.

[*14] "Sailing directions" refers to a publication edited on the basis of data collected from measurements, observations and researches sailing organizations of various nations organizations conduct as "marine guidance" necessary for navigation and other organizations.

[*15] Literature 1: Honda, Keinosuke (June 28, 2008) *Sōsen tsūron*, 8th Edition, SEIZANDO-SHOTEN PUBLISHING CO., LTD.

[*16] Literature 2: Inoue, Kinzo (March 8, 2011) *Sōsen no riron to jissai*, SEIZANDO-SHOTEN PUBLISHING CO., LTD.

(1) Wind speed – vessel speed ratio

In the simulation outcome in the case where water depth/draught of automobile carrier carrying 4,500 automobiles was 1.3, when the wind was received crossly or horizontally, as for a marginal condition capable of maintaining a predetermined course against the wind-induced pressurized flow downwind using the maximum rudder angle of 35°, the ship is unable to be maneuvered when the wind speed-vessel speed ratio is eight and over.

(2) Leeway

When a ship runs in the midst of pressured current leeward, the heading and the course over the ground do not match and the ship takes a posture of inclined running. The angle of performing inclined running is referred to as leeway and the size of leeway indicates the degree of drift.

The faster a wind speed is and the slower a vessel speed is, the larger the leeway grows and generally, the 10° of difference indicates being almost impossible to keep a course.

(3) Wind Influence etc.

When a ship catches a head wind, she slowed by the wind pressure and either turning round moment of acts by a wind that is slanted with respect to the fore and aft or a side,

Besides, since a wind pressure area grows large in a ballasted condition, a ship enormously influenced by the wind. In particular, when turning round moment grows large by wind pressure, the helm becomes unworkable and leeway grows large due to drift by the strong wind and will be an obstacle for course-keeping maneuvering.

2.10 Information about Engine Output Power etc.

(1) According to Literature 3[*17], an output power necessary for a ship running at a certain speed of V (kn) while the ship has a resistance R (kg) is shown by the following formula.

$$\text{Output power (kW)} = (R \times V)/145.7 \times 0.735$$

2.11 Information about Anchorage in Heavy Weather

(1) According to Literature 1, a force a ship is subject to is as follows.

① front wind pressure Ra

$Ra\ (kg) = 1/2 \times Pa \times Cao \times A \times Va^2$

Pa: air density 0.125 ($kg \cdot s^2/m^4$)

Cao: front wind pressure drag coefficient

A: front wind pressure area (m^2)

VA: wind speed (m/s)

The front wind pressure drag coefficient of conventional cargo ship is 0.7.

② the maximum tension applied to the chain cable in the state of single anchor unaccompanied by strenuous vertical movement

$R\ (t) = 0.456 \times h^2 \times B \times \sin^2 \alpha$

h: wave height (m)

B: beam

α: opening angle between the outer panel of the bow and the fore-aft axis at the water surface

[*17] Literature 3: Nohara, Takeo (original work) & Shoji, Kuniaki (written) (2010), *Kōkai zōsengaku*, 2nd Revision 3rd Edition, KAIBUNDO

③ whirling movement of the single anchor etc.

When catching a wind, an anchoring ship whirls cyclically and according to experimentation of the water tank in a wind tunnel, the force applied to the chain cable is to be about three times larger in ballast in general.

(2) According to Literature 1, Literature 2, and Literature 4[*18], limiting clutch force of ship is as follows.

① static limiting clutch forceduring anchorage with an anchor and a cable chain

engagement force of vessel is obtained by the following formula.

engagement force $H = \lambda W + \lambda_2 w(S - s)$ (kg)

The length of cable chain's the pendant moiety s is obtained by the following formula.

$s=\sqrt{}(y\text{^}2+2(T\_x/w\_1\ )y)$

Since the limiting clutch force is the state where engagement force and an external force are equal, H is calculated from the above as $T_\chi = H$.

λ: holding power coefficient of anchor

W: weight-in-air of cable chain

λ_2: engagement force coefficient of cable chain

w: weight-in-air of cable chain per meter

S: entire length of veered cable chain

s: length of the veered cable chain's pendant moiety

w_1: weight-in-water of cable chain per meter

y: height from the cable chain opening to the sea bottom

T_χ: horizontal external force exerted on a vessel

The holding power coefficient λ of a JIS-type anchor and the engagement force coefficient of cable chainλ_2 n the case where a bottom sediment is sand are 3.5 and 1 respectively i.

The simplified formula for calculating a weight (W) of cable chain per meter is as follows.

$$w = 0.0219 \times d^2$$

d: Nominal diameter of cable chain

The weight-in-water of cable chain per meter is a value obtained by multiplying the weight-in-air per meter by 0.87.

② Effects when two anchors are used to be anchored

a Other anchor

In the case where other anchor was used, there is an effect of restraing swing of the bow to thereby reduce an acting force over the anchor by 30% - 40%.

b Double anchor

Provided cable chains on both sides have the same length, a ship is in two-anchor mooring where a wind tide is orthogonal to both anchor lines, and their opening angle is 45° - 60°, it has an effect of reducing an acting force on the anchors by 40%.

In two-anchor mooring, engagement forceH_2 is associated with an opening angle of the cable chains θ and provided engagement force of angle is H_1, H_2 is as follows.

$H_2 / H_1 = 2\cos(\theta / 2)$

c Two-anchor mooring

In the case of letting anchors of both sides go simultaneously and stretching them in parallel to the same length, basically twice as much engagement force as obtained.

This anchor method is effective in the case of catching a strong wind and waves and currents from one direction.

[*18] Literature 4: Edited by Kōkai benran henshūiinkai (October 16, 1991) *Kōkai benran, 3rd edition*, KAIBUNDO

2.12 Information about a Speed in the Stormy Weather and Emergency Anchor Dropping

According to Literature 1 and Literature 5[*19], they are roughly as follows.

When travelling on the sea surface which is not so rough, due to an increase in hull resistance by wind waves and corresponding decrease in propulsion efficiency, a speed decreases in spite of a constant main engine power output. This is called natural speed reduction[*20] and a wind power becomes 5 – 6 or more, a speed reduction rate becomes large in the state of opposing wind.

Car carriers have shallow draught and though they are loaded with permanent ballasts besides ballast tanks, their superstructure is large and therefore they are tossed about winds and waves in rough waters and speed reduction is large.

(omitted) *Under most circumstances, in the case where a drift speed of a large vessel when it goes on anchor dropping exceeds 0.5 knots, the anchors of the ship would be incapable of stopping her.* (omitted) *The larger a ship is, the smaller effects of the attempt to stop the movement of the ship by emergency anchor dropping becomes.*

2.13 Safety Management Information of B Company

According to the statement of B Company, it was determined as follows in procedures involved in anchoring and anchor watchkeeping in the safety management manual of B Company.

1 – 10 (omitted)

11. Ensure the continuous monitoring of the weather conditions, the surrounding environment, the relative location of vessels and their maneuvers.
12. Regularly monitor the ship's position for the early detection of vessel drift, excessive approach with the other ships and navigational hazards. If there is ice on the roads carefully monitor its movement.
13. Periodically monitor the anchor chain tension safety stoppers.
14. Upon receipt of the unfavorable weather forecast, weather deterioration, the ship drift immediately report to the captain, to raise readiness SPP, continuously. If necessary slack off the anchor chain. Observe the presence of other vessels in the vicinity of the anchoring area. In good time, if necessary, to weigh anchor and leave for the shelter.

15 – 18 (omitted)

2.14 Oil Spillage Information

(1) Fuel and lubrication oil on board

According to the statement of the master, the ship was loaded with about 25 t of MDO and about 55 t of HFO in the double bottom and about 3 t of MDO and about 4 t of MDO in the engine room respectively.

(2) Spillage range of the oil etc.

According to the reply to the questionnaire by Yamagata Prefecture and the salvage company, the ship had the tanks in the double bottom damaged after running aground and spilt oil spread along the breakwater and flowed into harbor of the Port of Sakata, rivers, and agricultural waterways. The salvage company collected 759 metallic barrels of oily waste by control work.

[*19] Literature 5: Japan Marine Science (supervised by Sekine, Hiroshi) (September 28, 2015) *Jissen kōkaijutsu*, SEIZANDO-SHOTEN PUBLISHING CO., LTD.

[*20] The "natural speed reduction" refers to the state that when a setting of the main engine is maintained, a vessel speed naturally decreases from the effect of waves and winds.

3 ANALYSIS

3.1 Situation of the Accident Occurrence

3.1.1 Course of the Events

As described in 2.1, it is probable as follows.

(1) The ship had the master, Office A and other 16 persons on board and departed from the Port of Funagawa, Akita toward the Port of Sakata at around 13:40 on January 9, 2016.

(2) The ship dropped the port anchor to 35 m deep in a location on the northwest side of the quarantine anchorage of the Port of Sakata and dropped the cable chain by 6.5 shackles and started single anchoring.

(3) The ship began to swing on the coast side centering around the anchored point in accordance with change of the wind direction

(4) The ship began to heave up anchor at around 03:51 and made the engine full speed ahead at around 04:04 when it became a peak.

(5) The ship drifted under pressure in a posture of catching wind waves from the starboard bow with turning round to right until around 04:13 in the state of engine full speed ahead, and she became a posture of catching a wind and waves from the bow on the port side with facing the bow in the northwest – north.

(6) The ship stopped the engine at around 04:38, and although the port-side anchor was urgently dropped and the cable chain was dropped by three shackles, the anchor did not work and hence pressured currents to the east continued.

(7) The ship started up the engine to full speed ahead again at around 04:47, but she was drifted away by pressured currents, and since she became a posture of catching a wind and waves from the starboard bow to thereby kept turning round to the left and came into a state of the bow facing a coast at around 04:52, the engine was started astern at around 04:59.

(8) The ship ran on wave-absorbing blocks.

3.1.2 Date and Time/Site of Occurrence

As described in 2.1 and 3.1.1, it is highly probable as follows.

(1) The date and time of the occurrence of the accident was at around 05:09 on January 10, 2016 when an impact noise recorded in a voice record of VDR.

(2) The site of occurrence of the accident was on the wave-absorbing blocks located at 010°, in the proximity of 2,260 m from the Sakata Lighthouse, a location shown in the ship's VDR record of a time at around 05:09.

3.1.3 Damage to Vessel

As described in 2.1.3, and 2.3, it is probable as follows.

(1) The ship was brought to a state of having swamped to the bridge floor by around 08:28 on January 10 and facilities in the bridge and interior trim flew out by about 18th and the bridge was damaged and the body of the ship was separated into half and was completely destroyed.

(2) The ship was demolished and removed by the salvage company afterward.

3.2 Causal Factors of the Accident

3.2.1 Conditions of Crews and Vessel

(1) Crews

As described in 2.4, they were as follows.

① The master and Officer A had lawful and valid endorsements attesting the recognition of certificate under STCW regulation I/10.

② It is probable that after being aboard the ship as a master for about five months in 2012, the master had been aboard again from September, 2015.

It is probable that the master has experiences of entering a number of Japanese ports and that though he had entered the Port of Sakata three or four times, he had entered there only once in wintertime.

It is probable that the master was in good health condition at the time of the accident.

③ It is probable that Officer A came on board as a second officer of the ship in September, 2015 and that he had been in a chief officer's position from December.

It is probable that it was his second time to enter the Port of Sakata and first time to enter there in wintertime.

It is probable that Officer A was in good health condition at the time of the accident.

(2) Condition of Vessel

As described in 2.1.3, 2.5.4 and 2.5.5, they were as follows.

① The ship was in a ballast passage state at the time of the accident and had all ballast tanks except the bow tank filled with ballast water for the purpose of maintaining stability and maneuverability and the drew about 2.25 m of water at the bow and about 3.75 m at the stern, the front wind pressure area was about 278.5 m^2, a distance from the water surface to the bell mouth was about 7.25 m, and an opening angle between the outer panel of the bow and the fore-aft axis at the water surface was about 35°.

② Output power of the ship's main engine was 2,400 kW and since it was about 74% of the average main engine output power (about 3,226 kW) of general cargo ships of 4,000 tons or more and less than 5,000 tons gross calculated from IHS Fairplay Towage's fleet statistics, it was smaller than the average output power of general cargo ships of the same level of gross tonnage.

③ It is probable that there was no trouble or failure in the hull and the devices at the time of the accident.

3.2.2 Weather and Sea Conditions

As described in 2.1.2, 2.1.3, and 2.6.1 – 2.6.3, they were as follows.

(1) Wind direction and wind speed

① It is probable that since a wind direction changed and a wind grew stronger since a wind direction was south to south-southwest and a wind speed was about 8.4 – 10.3 m/s during the period of about 01:00 to about 02:50 around the site of occurrence and a wind direction was west-northwest and an average wind speed was 14.5 – 17.1 m/s during the period of about 03:00 to about 05:10.

② It is somewhat likely that a northwest wind at 20 – 25 m/s blew after approximately 03:15 – 03:20 in the area around the site of occurrence of the

accident.

(2) Waves

It is probable that since significant wave height in the area around the site of occurrence of the accident was about 0.97 – 1.11 m around 01:10 – 033:10 and about 1.56 – 2.62 m and about 1.56 – 2.62 m around 03:10 – 05:30, it became higher from around 03:10.

(3) Tide

It is probable that tide in the Port of Sakata at the time of the accident was the middle phase of the rising tide and the wave height was 0.2 m.

3.2.3 Analysis on Access to Weather Information etc.

As described in 2.1.3, 2.6.4 and 2.6.5, it is probable to have been as follows.

(1) Though the master had obtained Asian Pacific surface analysis charts and coastal wave analysis charts among weather faxes, he was thinking that there was no sign of worsening weather in these analysis diagrams.

(2) Though it is described in a coastal wave 24-hour forecasting chart in 21:00 on 8th - 21:00 on 9th and 09:00 on 9th – 09:00 on 10th that a wind direction would change from south-southeast to northwest and the wind would be strong and that a wave height would be 2.8 m, the ship had not obtained the coastal wave 24-hour forecasting chart.

(3) At the time of the accident, an ocean wind alert that the maximum wind speed was anticipated to reach 15 m/s was issued for off the coast of Akita including the Port of Sakata, 2nd Regional Headquarters aired an ocean wind alert that a west wind would be stronger and that the maximum wind speed was expected to reach 30 kn four times between 17:26 on 9th and 00:04 on 10th on VHF, and the Japan Coast Guard aired an ocean wind alert eight times between 06:07 on 9th and 02:30 on 10th by NAVTEX, but the ship did not notice the ocean wind alert information.

(4) The master did not know that there was a description to the effect that in the Port of Sakata, high-wind days are concentrated in the period from November to March of the following year and large swells were generated by strong wind blowing from direction between the west and the northwest and the cable chain was broken and a ship might be washed ashore in the sailing directions published by Hydrography Department of the Russia Federation.

(5) From the above, the ship had not obtained weather and sea information during the navigation leaving from the Port of Funagawa and traveling toward the Port of Sakata in the situation that a wind of the maximum speed of about 15 m/s and waves with a wavelength of 2.8 m were anticipated, as the master saw Asian Pacific surface analysis charts and coastal wave analysis charts and thought there was no sign of worsening weather.

3.2.4 Anchoring Condition of the Ship

As described in 2.1, 2.6.1, 2.6.2, 2.11 and 3.2.2 (1) – (3), it was as follows.

(1) It is probable that the ship dropped the starboard anchor at around 01:13 on January 10 and came into a state of the anchor raking the sea bottom.

(2) It is probable that the ship began to swing on the coast side centering around the anchored point in accordance with change in the wind direction as a result of the wind direction changing from south-southwest to west-northwest to northwest.

(3) It is probable that the master received a report about the wind direction changing and the wind blowing harder, as well as the information from the 2nd Regional Headquarters, and that he decided to heave up anchor and to have the ship stand out to sea, thinking that the ship was in a dangerous situation of dragging anchor and approaching a coast.

(4) Engagement force of the ship

① It is probable that the anchorage was 35 m deep and the bottom material was mud mixed with sand.

② It is probable that although the ship comprised a cable chain on each board by 10 shackles, the master felt the anchorage was close to the coast and decided single anchor mooring by setting the cable chain's amount of veering to 6.5 shackles which was shorter than the length usually determined as a standard.

③ It is probable that with regard to the ship, the engagement force of the ship by the anchor and the cable chains in the cases of having veered out 6.5 shackles of the cable chain in the sea and veering out all cable chains (10 shackles) to thereby moor at single anchor should have been approximately 11.3 t and approximately 15.0 t respectively from the formula for calculating static limiting clutch force during anchorage.

④ It is probable that with regard to the ship, the engagement force of the ship in the case of having veered out the cable chains on both sides by 10 shackles to thereby moor at two anchors at an opening angle of 45° – 60° should have been 26.0 – 27.7 t.

⑤ It is probable that with regard to the ship, the engagement forceof the ship in the case of having dropped the anchors on both sides simultaneously to thereby ride at two anchors where the cable chains were veered out in parallel at the same length by 10 shackles should have been about 30.0 t which was approximately twice as much as the case of veering out the cable chain on one side by 10 shackles.

(5) Effect of the external force on a ship

① It is probable that from the formula, the front wind pressure was about 7.6 t when the front wind pressure resistant coefficient was 0.7, the front wind receiving area was 278.5 m^2 and the wind speed was 25 m/s and the size of the impact force applied to the cable chains of the ship while she was swinging was about 22.8 t which was approximately three time as much as the front wind pressure.

② It is probable that the acting force on the anchor of the ship was reduced by 30 – 40% and therefore was about 13.7 – 16.0 t.

③ It is probable that the acting force on the anchors of the ship was reduced by 40% and therefore was about 13.7 t if she moored with two anchors at an opening angle of 45° – 60°.

④ It is probable that the maximum tension applied to the cable chain by waves in the state of single anchor mooring without violent up-and-down movements was about 17.8 t when the wave height was 2.66 m.

(6) Though the ship veered out 6.5 shackles of the cable chain into the water and thereby moored with a single anchor, from the above (4) ③ - ⑤ and (5), it is somewhat likely that the ship at some stage would drag anchor since the limiting clutch forceof the ship was below the sum of the wind pressure force in the case of the maximum wind speed of 25 m/s observed by a crew and the maximum tension by waves in the case of the average significant wave height waves of the average wave height of 2.66 m on 10th.

3.2.5 Analysis on the State the Ship after Weighing Anchor

As described in 2.1, 2.5.4, 2.6.1, 2.9, 2.10, 2.12, 3.1.1, 3.2.1 (2), and 3.2.2, it was as follows.

(1) It is probable that: on the ship, the master ordered engine full speed ahead at around 04:04, turning the bow to sea, started to advance toward the northeast in an attempt to head out to sea at around 04:16, and advanced toward northeast while being drifted by pressure flow, catching a wind from a direction between northwest and west-northwest with a wind speed of 14.0 – 17.1 m/s and waves with a significant wave height of about1.95 meter until about 04:16 when the engine was stopped.

(2) The master uttered "130" at around 04:23 and around 04:30 and it is probable that it indicated the number of revolutions per minute of the main engine, and from this, it is probable that although the chief engineer threw the maneuvering lever to full speed ahead and furthermore, was manually regulating engine governor so as to increase a supply of the fuel, the number of revolution did not reach that of the full speed ahead (190 rpm) during 04:23 – 04:30 and the main engine only rose to about 130 rpm.

(3) It is somewhat likely that concerning the ship, since the number of revolutions of the main engine did not rise, the amount of exhaust gas for driving the supercharger was small, and the amount of air supply was insufficient for supplied fuel, and main engine output that met the supplied fuel was not obtained.

(4) From the course over the ground, the ship's head, and the ground speed in the VDR record of the ship between around 04:16 and around 04:38, it is probable that the speeds in the fore and aft direction of the ship (hereinafter, referred to as "advancing speed") (kn) are as follows and it is probable that they were about 0.6 – 2.8 kn.

time (HH:MM:SS)	Ground speed (kn)	Advanced speed (kn)
04:16:00	4.2	2.8
04:20:00	3.8	2.5
04:23:00	3.5	1.7
04:25:00	3.1	1.6
04:30:00	2.6	0.6
04:35:00	4.0	1.6
04:38:00	3.0	1.0

(5) From the above, it is provable that the ship was in the following condition and that natural deceleration was generated and therefore advanced speeds became about 0.6 – 2.8 kn.

① The output power of the main engine was smaller than an average output power of general cargo ships whose gross tonnage was comparable with the ship.

② The ship was catching wind waves from the port side head in a state of ballast passage at the time of the accident.

③ The (revolution of the) main engine only rose up to 130 rpm at the time of the accident.

④ An output power matching the supplied fuel was not obtained.

(6) Wind speed/vessel speed ratio

It is probable that advanced speeds (m/s), wind speeds, and wind speed/vessel speed ratios within a time range around 04:16 – 04:38 were as follows.

Time (HH:MM:SS)	Advanced speed (m/s)	Wind speed (m/s)	Wind speed/vessel speed ratio
04:16:00	1.4	14.0 – 17.1	10.0 – 12.2
04:20:00	1.3	17.1	13.2
04:23:00	0.9	17.1	19.0
04:25:00	0.8	17.1	21.4
04:30:00	0.3	17.1	57.0
04:35:00	0.8	15.7 – 17.1	19.6 – 21.4
04:38:00	0.5	15.7 – 17.1	31.4 – 34.2

It is somewhat likely that the helm did not work as the wind was strong when the ship advanced toward northwest in an attempt to stand out to sea and that the wind speed/vessel speed ratios were about 10.0 – 57.0 catching a wind from the direction of the port bow at 15.0° – 67.5° within a time range around 04:16 – (04:) 38

(7) Wind pressure difference

It is probable that the wind pressure differences within a time range around 04:16 – 04:38 were as follows.

Time (HH:MM:SS)	Course the ground (°)	Ship's head (°)	Wind pressure difference (°)
04:16:00	048	000	48
04:20:00	030	340	50
04:23:00	022	321	61
04:25:00	014	316	58
04:30:00	031	314	77
04:35:00	046	339	67
04:38:00	040	330	70

(8) It is probable that: the ship heaved up anchor and tried to stand out to sea, but due to the above (6) and (7), both of the wind speed/vessel speed ratio and the wind pressure difference exceeded 8 and 10° respectively in the time period around 04:16 – 04:38 and therefore became unable to maneuver.

(9) When the ship became unable to maneuver, the master was speaking the 2nd Regional Headquarters that ship had trouble with the engine and it is probable that he did not have a grasp of seaworthiness[*21] of the ship described in the above (2) – (7).

[*21] "Seaworthiness" is efficiency to minimize a decline in an average vessel speed to allow for safe and comfortable navigation when a ship navigates with catching external force such as wind or waves

3.2.6 Information about the Ship's Anchor Drop at around 04:42

As described in 2.1.1 and 2.12, it is probable that although the ship let anchor go and veered out the cable chain by three shackles, since the ground speed was about 2.4 kn toward northeast, the anchor did not work and therefore drifted toward east by pressure while turning round to the left.

3.2.7 Safety Management Analysis

As described in 2.1.2, 2.1.3, 2.13, 3.2.3, and 3.2.5, it is probable to have been as follows.

(1) The master did not have a grasp of seaworthiness of the ship at the time of the accident as there was no information about seaworthiness such as limiting clutch force and critical wind speed when in a ballast passage state and the limitation of ship maneuvering with keeping a course considering wind pressure and main engine power output in that navigational state in the safety management manual of B Company.

(2) Though there were descriptions about veering out of a cable chain and evacuation of vessels to a safe water area, the ship missed the timing to evacuate a safe water area due to the following.

① The master thought there was no sign of worsening weather on seeing the Asian Pacific surface analysis charts and coastal wave analysis charts and had not appropriately obtained weather and sea information .

② The master did not have a grasp of seaworthiness of the ship.

③ Though the ship heaved up anchor and tried to stand out to sea, she failed to have a speed to keep the course and became incapable of maneuvering.

3.2.8 Oil Outflow

As described in 2.1.3, 2.5.2, and 2.14, it was as follows.

(1) The ship had oil tanks in the double bottom and the engine room damaged and the oil outflowed due to the impact of the landing-on.

(2) Crews were not able to take measures for preventing oil outflow as the ship was flooded soon after the landing-on.

(3) The spilled oil spread along the breakwater, flowed in harbor of the Port of Sakata, rivers, and agricultural waterways, and a salvage company collected 759 metallic barrels of oily waste.

3.2.9 Analysis on the Occurrence of Accident

As described in 3.1.1, 3.2.1 (2), 3.2.2, 3.2.3, 3.2.4 (1) – (3) and 3.2.5 – 3.2.7, it is probable as follows.

(1) The ship departed from the Port of Funagawa, Akita toward the Port of Sakata at around 13:40 on January 9, 2016, dropped the port anchor to 35 m deep in a location on the northwest side of the quarantine anchorage of the Port of Sakata, and started single anchoring at around 01:13 on January 10.

(2) Concerning the ship, under the condition that a wind with the maximum speed of 15 m/s and waves with the approximate wave height of 2.8 m were anticipated, the master saw Asian Pacific surface analysis charts and coastal wave analysis charts and thought there was no sign of worsening weather, and did not obtain information about the weather and the sea.

(3) The ship came to swing on the coast side centering on the anchored point in accordance with a change in wind direction at around 03:00 due to a change in wind direction from the south to south-southwest to the west-northwest – northwest, the master thought that the ship was in a dangerous situation of dragging anchor and approaching the coast, and he decided to heave up anchor and have the ship stand out to sea.

(4) On the ship, the master ordered full speed ahead at around 04:04 when the anchor became a peak, began to advance toward northeast at around 04:16 to try to head out to sea, and advanced toward northeast while drifted by the pressure, catching a wind from the northwest – west-northwest at an average speed of 14.0 – 17.1 m/s and waves of approximately 1.95-meter high.

(5) Since weather and sea information had not appropriately been obtained on the ship and the master did not have a grasp of the seaworthiness of the ship, she missed the timing to evacuate to a safe area, and although he heaved up anchor and tried to head out to sea, the ship failed to obtain a speed necessary for keeping the course during a period around 04:16 – 04:38 and became unable to maneuver.

(6) Though the port anchor was urgently dropped and the cable chain was veered out by three shackles at around 04:42 on the ship, the anchor did not work and drifted by the pressure toward the east with turning round to the left, and she ran on the breakwater.

(7) The master did not have a grasp of the seaworthiness of the ship at the time of the accident since there was no information about seaworthiness such as limiting clutch force and limit wind speed in a ballasted condition and a limit of ship maneuvering for course keeping considering a wind pressure and output power of the main engine in the said condition in the safety management manual of B Company.

4 PROBABLE CAUSES

It is probable that the accident occurred because weather and sea information was not appropriately obtained on the ship during anchorage in the waters off the Port of Sakata under the condition of anticipated a wind with a maximum speed of 15 m/s and about 2.8-meter-high waves and the master did not have a grasp of the seaworthiness of the ship, she missed the timing for evacuating to a safe water area, and although she heaved up anchor and tried to head out to sea, the speed necessary to keep the course and the ship became unable to maneuver, and ran on the breakwater.

It is probable that the reason why the master did not appropriately obtain weather and sea information because the master thought there was no sign of worsening weather seeing Asian Pacific surface analysis charts and coastal wave analysis charts.

It is probable that the reason why the master did not have a grasp of the seaworthiness of the ship was because the safety management manual of B Company did not describe about seaworthiness such as limiting clutch force and limit wind speed in a ballasted condition and a limit of ship maneuvering for course keeping considering a wind pressure and output power of the main engine in the said condition.

5 SAFETY ACTIONS

It is probable that the accident occurred as a result of the ship missing the timing of evacuating to a safe water area and having become unable to maneuver in spite of the attempt to head out to sea because weather and sea information had not appropriately been obtained on the ship during anchorage and also because the master did not have a grasp of the seaworthiness of the ship due to lack of descriptions about seaworthiness such limiting clutch force and limit wind speed in a ballasted condition and a limit of ship maneuvering for course keeping considering a wind pressure and output power of the main engine in the said condition in the safety management manual of B Company.

It is probable that the reason why the weather and sea information had not appropriately been obtained on the ship is because the master saw Asian Pacific surface analysis charts and coastal wave analysis charts and thought there was no sign of worsening weather and therefore had not obtained other weather information.

Accordingly, in order for preventing a recurrence of accidents of the same kind, it is recommended that B Company should take the following measures.

(1) Educating masters of the ships under control of the company about obtaining necessary weather information

(2) Describing limiting clutch force and limit wind speed in a ballasted condition and a limit of ship maneuvering for course keeping considering a wind pressure and output power of the main engine in the said condition in the safety management manual

5.1 Safety Actions Taken after the Accident

B Company directed masters and crews of all vessels under control of the company to enhance supervision of vessels with regard to performance of a duty, comply with international treaties, laws and regulations, and safety management manuals etc. and perform a duty strictly, and security staff members of the company to irregularly perform an examination with regard to the compliance of the ISM Code, ISPS Codes, etc.

6 SAFETY RECOMMENDATIONS

It is probable that the accident occurred as a result of the course of events that the CITY had not appropriately obtained weather and sea information during her anchorage and that she missed the timing of evacuating to a safe water area because the master did not have a grasp of seaworthiness of the ship due to lack of descriptions about seaworthiness such limiting clutch force and limit wind speed in a ballasted condition and a limit of ship maneuvering for course keeping considering a wind pressure and output power of the main engine in the said condition in the safety management manual of Trans Ocean Shipping Co., Ltd. and thereby she became unable to maneuver despite an attempt to head out to sea.

It is probable that the reason why the CITY had not appropriately obtained weather and sea information is that the master thought there was no sign of worsening weather seeing weather and sea analysis charts and therefore had not obtained other weather information.

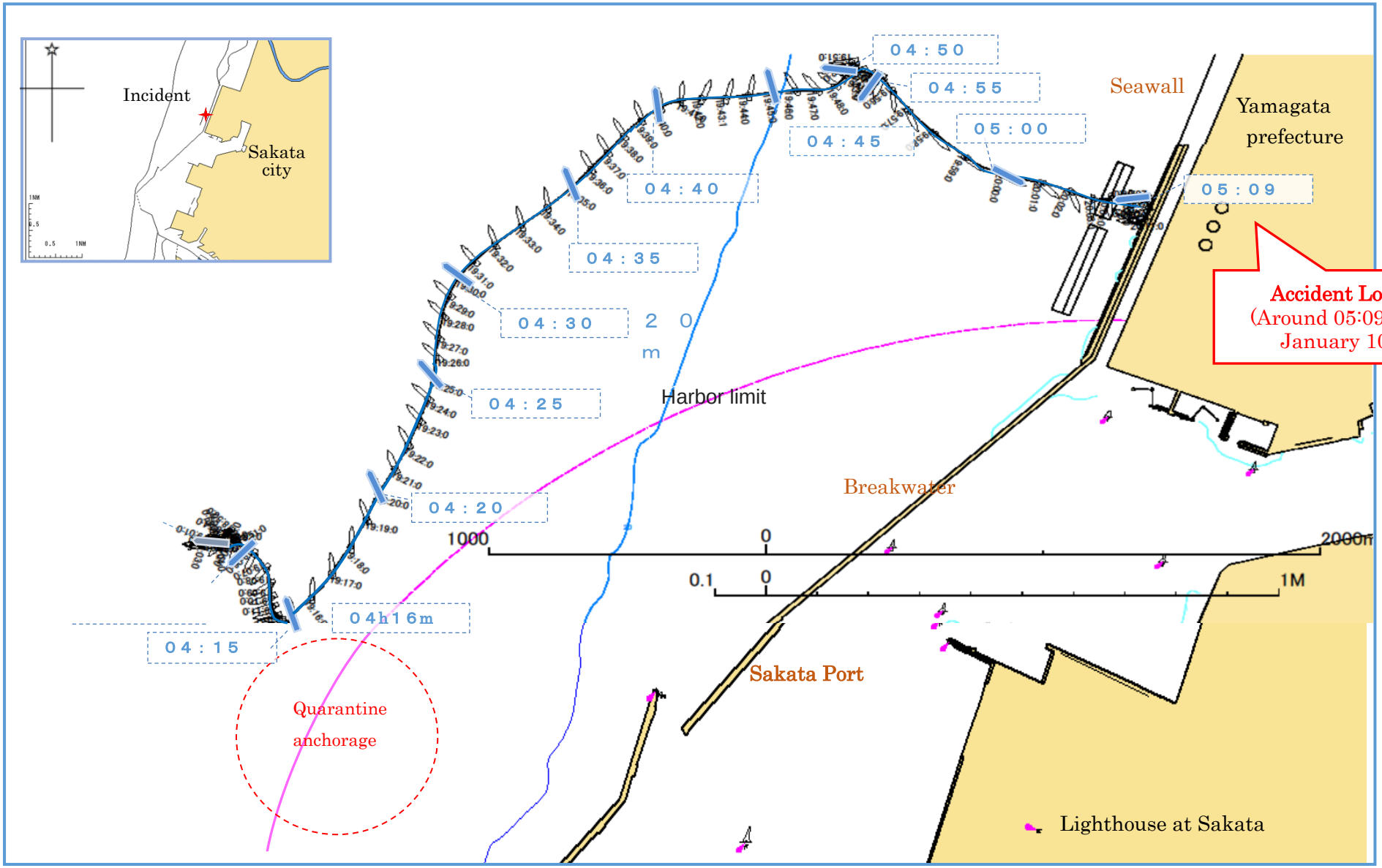
From these, in view of the result of this accident investigation, the Japan Transport Safety Board recommends Trans Ocean Shipping Co., Ltd. which is the vessel management company of the

CITY to take the following measures for the purpose of prevention of the recurrence of similar casualties and etc.

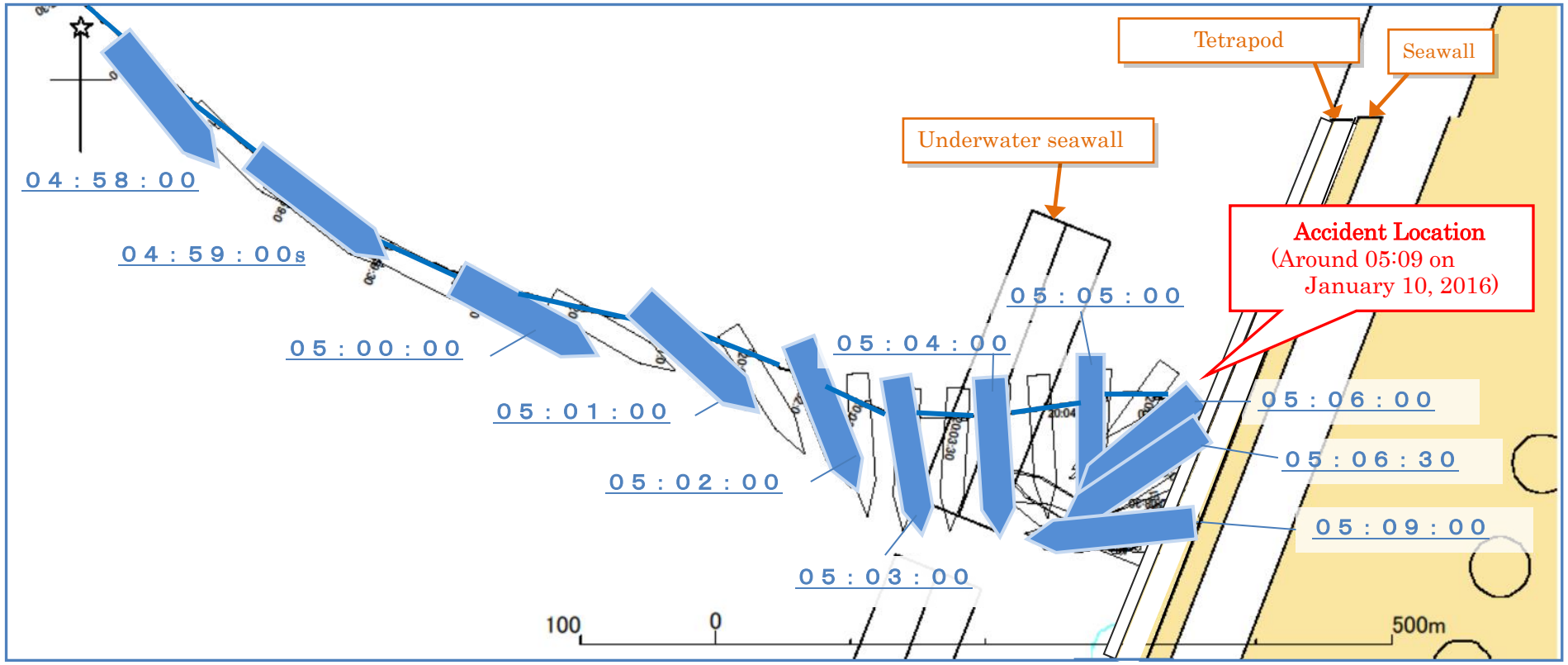
(1) Trans Ocean Shipping Co., Ltd. educates masters of the ships under control of the company about obtaining necessary weather information.

(2) Trans Ocean Shipping Co., Ltd. describes information about limiting clutch force and limit wind speed in a ballasted condition and a limit of ship maneuvering for course keeping considering a wind pressure and output power of the main engine in the said condition in the safety management manual.

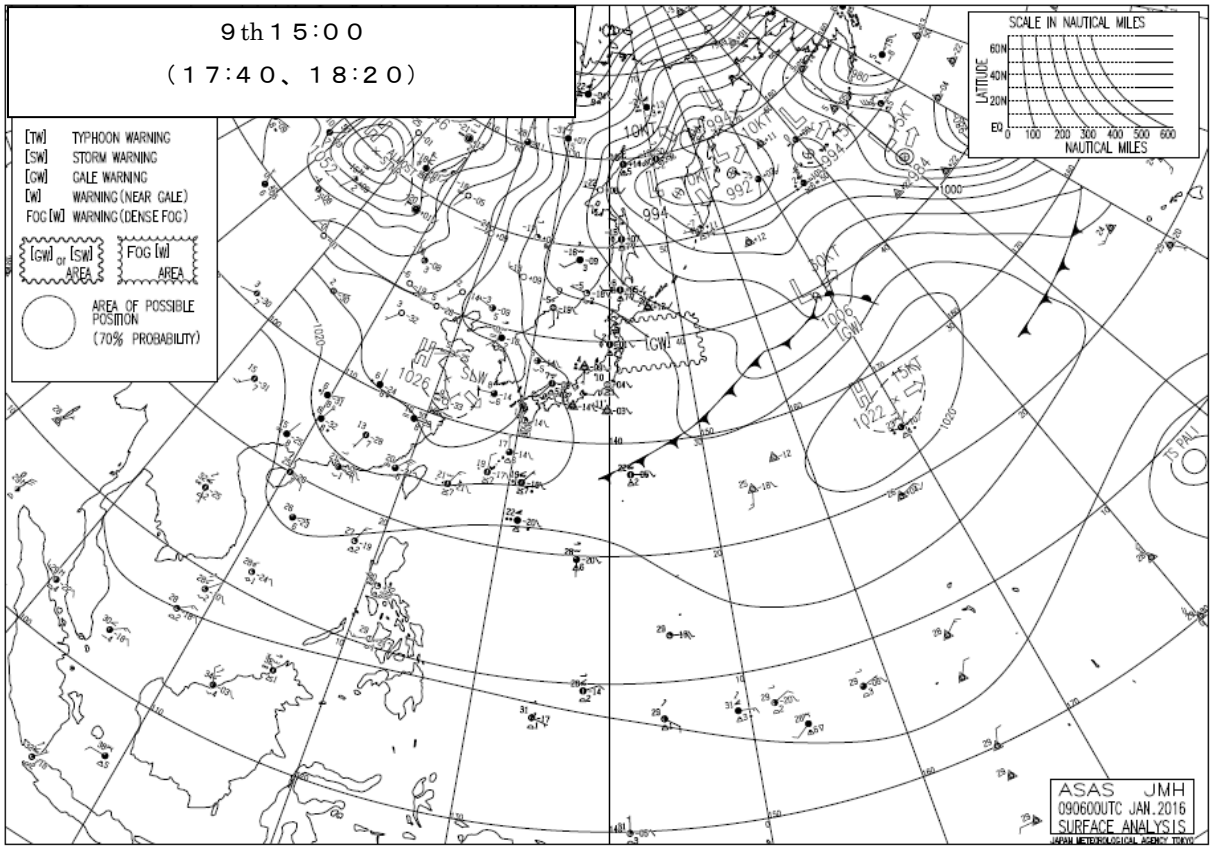
Attached Figure 1　Navigation Course

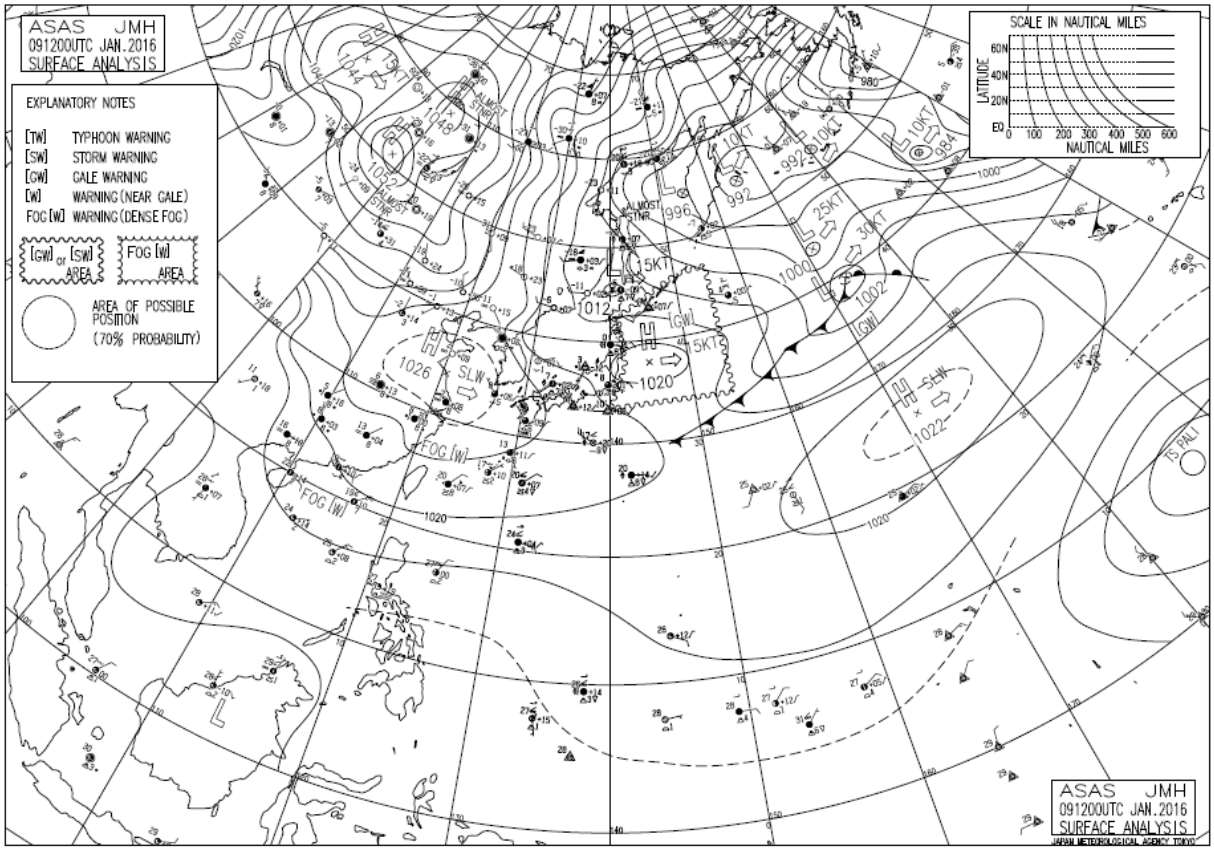


Attached Figure 2　Navigation Course (enlarged)

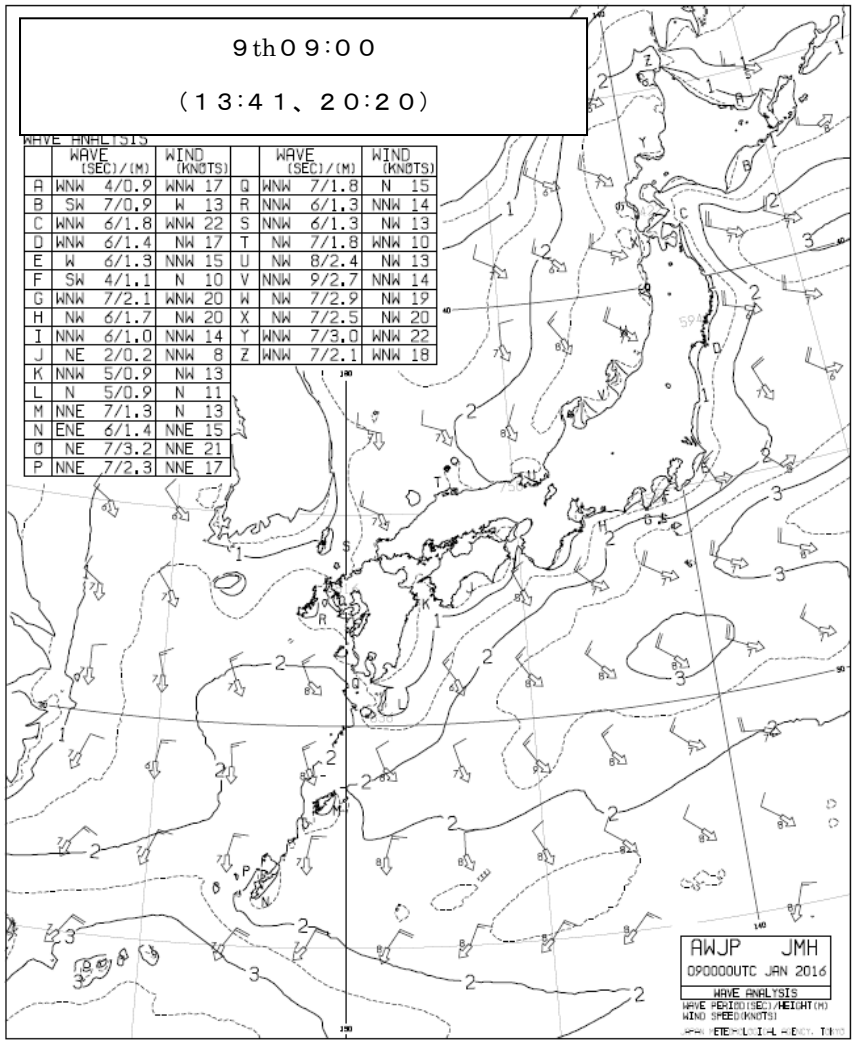


Attached Figure 3　Asian Pacific Surface Analysis Charts

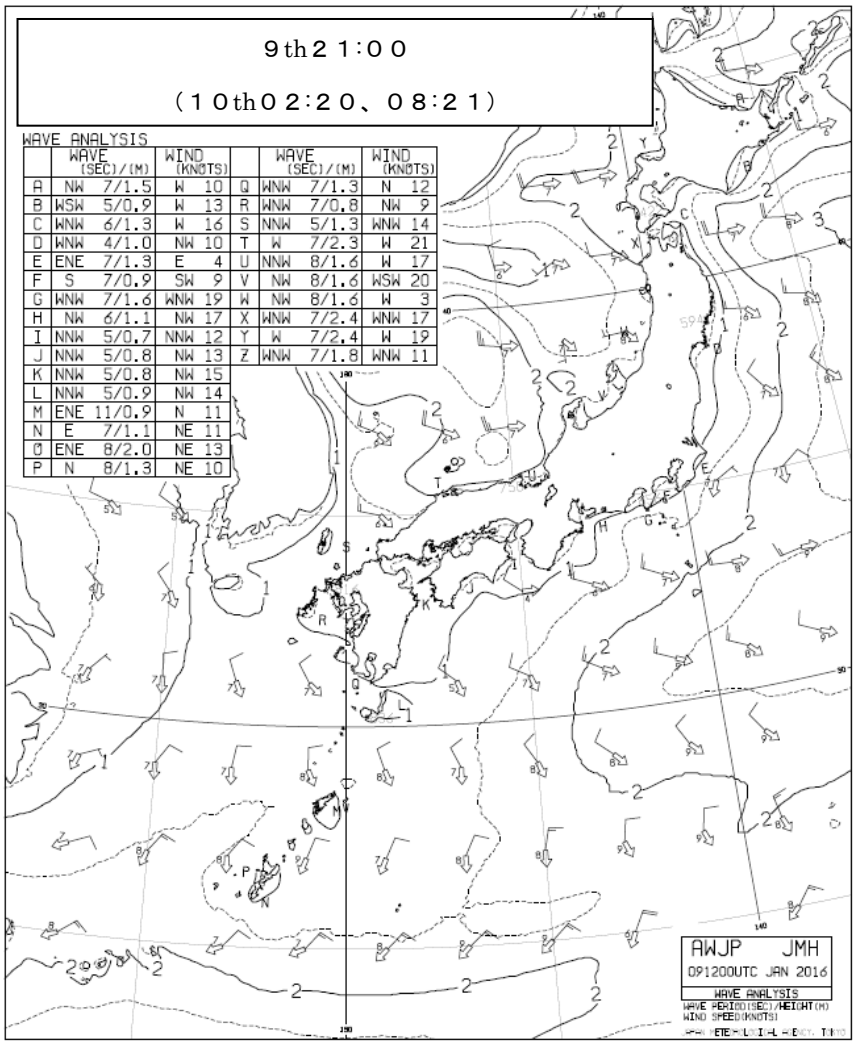




Attached Figure 4　Coastal Wave Analysis Charts



	WAVE (SEC)/(M)	WIND (KNOTS)		WAVE (SEC)/(M)	WIND (KNOTS)
A	WNW 4/0.9	WNW 17	Q	WNW 7/1.8	N 15
B	SW 7/0.9	W 13	R	NNW 6/1.3	NNW 14
C	WNW 6/1.8	WNW 22	S	NNW 6/1.3	NW 13
D	WNW 6/1.4	NW 17	T	NW 7/1.8	WNW 10
E	W 6/1.3	NNW 15	U	NW 8/2.4	NW 13
F	SW 4/1.1	N 10	V	NNW 9/2.7	NNW 14
G	WNW 7/2.1	WNW 20	W	NW 7/2.9	NW 19
H	NW 6/1.7	NW 20	X	NW 7/2.5	NW 20
I	NNW 6/1.0	NNW 14	Y	WNW 7/3.0	WNW 22
J	NE 2/0.2	NNW 8	Z	WNW 7/2.1	WNW 18
K	NNW 5/0.9	NW 13			
L	N 5/0.9	N 11			
M	NNE 7/1.3	N 13			
N	ENE 6/1.4	NNE 15			
O	NE 7/3.2	NNE 21			
P	NNE 7/2.3	NNE 17			



	WAVE (SEC)/(M)	WIND (KNOTS)		WAVE (SEC)/(M)	WIND (KNOTS)
A	NW 7/1.5	W 10	Q	WNW 7/1.3	N 12
B	WSW 5/0.9	W 13	R	WNW 7/0.8	NW 9
C	WNW 6/1.3	W 16	S	NNW 5/1.3	WNW 14
D	WNW 4/1.0	NW 10	T	W 7/2.3	W 21
E	ENE 7/1.3	E 4	U	NNW 8/1.6	W 17
F	S 7/0.9	SW 9	V	NW 8/1.6	WSW 20
G	WNW 7/1.6	WNW 19	W	NW 8/1.6	W 3
H	NW 6/1.1	NW 17	X	WNW 7/2.4	WNW 17
I	NNW 5/0.7	NNW 12	Y	W 7/2.4	W 19
J	NNW 5/0.8	NW 13	Z	WNW 7/1.8	WNW 11
K	NNW 5/0.8	NW 15			
L	NNW 5/0.9	NW 14			
M	ENE 11/0.9	N 11			
N	E 7/1.1	NE 11			
O	ENE 8/2.0	NE 13			
P	N 8/1.3	NE 10			

Attached Figure 5　Coastal Wave 24-hour Forecasting Charts