DECLARATION

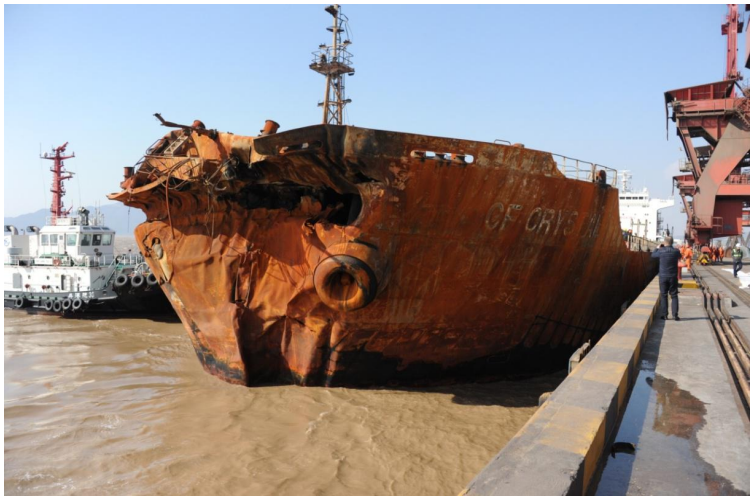
After the collision between MT SANCHI and MV CF CRYSTAL in East China Sea on 6 January 2018, on the basis of equal consultations, the Maritime Safety Administration (MSA) of China, the maritime authorities of Islamic Republic of Iran, Panama, and Hong Kong (China) reached the *Cooperation Agreement on Safety Investigation into the Collision between SANCHI and CF CRYSTAL on 6 January 2018 in East China Sea* (hereinafter referred to as "the Agreement") on 25 January 2018. The Agreement has made it clear that, China MSA, the lead investigating state, will be responsible for the submission of the final version of the marine safety investigation report to the International Maritime Organization and making it available to the public. Without the express consent of the marine safety investigating State or unless such reports or documents have already been published by the marine safety investigating State, other substantially interested States shall not circulate, nor cause to circulate, publish or give access to the report.

The final version of the marine safety investigation report has been unanimously agreed by all substantially interested States and is now being submitted and made available to the public. The content of the factual information, cause analysis and conclusion of the investigation should be based on this report.

We hereby make the above declaration.

Maritime Safety Administration of P.R. China
10 May 2018

Report on the Investigation of the Collision between M.T. SANCHI and M.V. CF CRYSTAL in East China Sea on 6 January 2018



Very Serious Marine Casualty

10 May 2018

NOTE:

Pursuant to the Code of the International Standards and Recommended Practices for a Safety Investigation into a Marine Casualty or Incident (Casualty Investigation Code), the sole objective of the investigation of the accident shall be the prevention of marine casualties and marine incidents in the future through the ascertainment of its causes and circumstances. It shall not be the purpose of the investigation to determine liability or to apportion blame.

CONTENT

1. SYNOPSIS

1.1 Summary

At about 1950LT (1150 UTC) on 6 January 2018, the Panama registered oil tanker SANCHI collided with the Hong Kong (China) registered bulk carrier CF CRYSTAL in East China Sea at approximate position 30°51′.1N / 124°57′.6E. SANCHI, loaded with a cargo of condensate oil, was on her voyage from Assaluyeh, Iran to Daesan, Republic of Korea (ROK). CF CRYSTAL was loaded with sorghum in bulk, bounding from Kalama, USA to Dongguan, China. The collision breached the cargo tanks of SANCHI, resulting in the leakage of condensate oil and consequent fire and explosions and eventual sinking of the vessel. As a result, three crew of SANCHI died and 29 were missing, and resulting pollution occurred. CF CRYSTAL sustained extensive structural damage to her bow and burn damage to other areas. It was a "very serious marine casualty", as defined in the Code of the International Standards and Recommended Practices for a Safety Investigation into a Marine Casualty or Incident (hereinafter referred to as Casualty Investigation Code) (Resolution MSC.255(84)).

1.2 Joint Safety Investigation

Pursuant to the Casualty Investigation Code, after friendly consultations, China Maritime Safety Administration (MSA), the maritime authorities of Islamic Republic of Iran (representing Bangladesh as well), Panama, and Hong Kong (China) jointly conducted the safety investigation of this accident with China as the lead investigating state.

1.2.1 Agreement on Joint Safety Investigation

In accordance with *Casualty Investigation Code* Chapter 7 *Flag state's agreement with another substantially interested state to conduct a marine safety investigation*, China MSA, the maritime authorities of Islamic Republic of Iran (representing Bangladesh as well), Panama, and Hong Kong (China) reached an agreement based on friendly communication on 25 January. (See Annex A for details) The parties undertook to cooperate and provide assistance to one or more parties as far as practicable. The signing of the agreement laid a good foundation for the accident safety investigation and the cooperation between the parties.

1.2.2 Joint Safety Investigation Implementation

On 24 January 2018, under the common witness of the parties, the investigators completed two ships' VDR downloading in Shanghai. Agreed by delegates from all four parties, only 4 hours of CF CRYSTAL's VDR data was downloaded because the incident period data was overwritten. About 58 hours data was downloaded from SANCHI's VDR.

On 25 January, investigators from China, Islamic Republic of Iran (representing Bangladesh as well), Panama, and Hong Kong (China) carried out a joint survey on CF CRYSTAL in Zhoushan and collected copies of relevant certificates (ships' and crew's), documents, and records of ships. The investigators interviewed the duty officers and able seamen (ABs), and conducted on-site inspections of the ship.

On the morning of 2 March, the investigators downloaded all the data (recorded 13-hour data) recorded in CF CRYSTAL's VDR hard disc in Shanghai again.

In the afternoon of 2 March, the four-party investigators made additional interviews to some crew of CF CRYSTAL.

1.2.3 Information Exchange

During the joint investigation, all parties continued to carry out the sharing of accident information and the exchange of evidential materials to promote joint safety investigation. Information exchanged includes:

(1) Ship certificates, crew certificates, company safety management system documents, PSC inspection reports, general arrangement plans and maneuverability information.

(2) Analysis of the AIS dynamic data and voyage-related data of SANCHI, SANCHI's VDR playback information and identity of watchkeepers on SANCHI's bridge at the time of the accident.

(3) The distress alert of SANCHI's INMARSAT C and survey of SANCHI's shipwreck.

(4) SANCHI's Last port departure report, bill of lading, stowage plan and cargo characteristics.

(5) The progress of the technical recovery of CF CRYSTAL's VDR data.

(6) VDR data from MAERSK SHAMS and TRF MONGSTAD.

(7) Pictures and video data of Emergency response and SAR.

(8) Interviews of CF CRYSTAL's crew.

1.2.4 Joint Investigation Meeting

From 28 February to 2 March 2018, the First Meeting on Joint Safety Investigation into the Collision between SANCHI and CF CRYSTAL on 6th January 2018 in East China Sea was held in Shanghai, China. A total of 22 delegates from China, Islamic Republic of Iran (representing Bangladesh as well), Panama and Hong Kong (China) attended the meeting. The Delegates form four States (Region) introduced the accident investigation and evidence collection progress, exchanged evidence, and determined the next step work plan. The meeting minutes were formed.

From 24 to 28 April 2018, the Second Meeting on Joint Safety Investigation into the Collision between SANCHI and CF CRYSTAL on 6th January 2018 in East China Sea was held in Shanghai, China. A total of 24 delegates from China, Islamic Republic of Iran (also representing Bangladesh), Panama and

Hong Kong, China attended the meeting. The meeting reviewed the matters from last meeting and its minutes; each party introduced their activities since last meeting, carried out discussion on the draft investigation report prepared by China and the timeline of the accident by Iran.
(refer to Annex B for details).

1.3 Information Source

(1) VDR of SANCHI and CF CRYSTAL,
(2) VDR data provided by MAERSK SHAMS which was in the vicinity and rendered assistance to the SAR operation,
(3) VDR data provided by TRF MONGSTAD which was in the vicinity and rendered assistance in the SAR operation,
(4) Full set of Safety Management System and records of CF CRYSTAL provided by the management company,
(5) Statements provided by the Master and crew members of CF RYSTAL,
(6) Part of the Safety Management System and records of SANCHI provided by the management company,
(7) SAR operation information provided by China MRCC,
(8) Firefighting operation information provided by Shanghai MSA, and

(9) Salvage information provided by China East Salvage Administration.

1.4 Abbreviations and Acronyms

AB: Able Seaman

ABS: American Bureau of Shipping

AFS: International Anti-Fouling System Certificate

AIS: Automatic Identification System

ARPA: Automatic Radar Plotting Aid

BCR：Bow Crossing Range

BWMC: Ballast Water Management Certificate

CCC: Cargo Ship Safety Construction Certificate

CEC: Cargo Ship Safety Equipment Certificate

CLCE: Classification Certificate

COG: Course Over Ground

C/O: Chief Officer

CoC: Certificate of Competency

COLREGS: International Regulations for Preventing Collisions at Sea 1972 (as amended)

CPA: Closest Point of Approach

CRC: Cargo Ship Safety Radio Certificate

DNV GL: Det Norske Veritas and Germanischer Lloyd

DOC: Document of Compliance

ECDIS: Electronic Chart Display and Information System

GPS: Global Positioning System

HFO: Heavy Fuel Oil

IAPP: International Air Pollution Prevention Certificate

ILLC: International Load Line Certificate

IOPP: International Oil Pollution Prevention Certificate

ISPP: International Sewage Pollution Prevention Certificate

ISSC: International Ship Security Certificate

ITC: International Tonnage Certificate

kt: knot

m: metre

MLC: Maritime Labour Certificate

MRCC: Maritime Rescue Coordination Center

nm: nautical mile

OOW: Officer of the Watch

P & I: Protection and Indemnity

ROB: Remaining On Board

RPM：Revolutions Per Minutes

SAR: Search and Rescue

SMC：Safety Management Certificate

SOG: Speed Over Ground

SOLAS: International Convention for the Safety of Life at Sea 1974, as amended

STCW: International Convention on Standards of Training, Certification and Watchkeeping for Seafarers 1978, as amended

TCPA：Time to Closest Point of Approach

UAV: Unmanned Aerial Vehicle

UTC: Universal Time Coordinated

VDR: Voyage Data Recorder

VHF: Very High Frequency (Radio)

3/O: Third Officer

TIMES: All times in this report are local (UTC+8) unless otherwise stated.

2. FACTUAL INFORMATION

2.1Vessel Information

2.1.1Particulars

Table 1 Particulars of SANCHI and CF CRYSTAL

Vessel Details	SANCHI	CF CRYSTAL
Flag	Panama	Hong Kong (China)
Call Sign	3FJU8	VRIC2

IMO Number	9356608	9497050
Vessel Type	Oil Tanker	Bulk Carrier
Material of Hull	Steel	Steel
Gross Tonnage	85462	41073
Net Tonnage	53441	25634
Length Overall	274.18m	225m
Beam	50.04m	32.26m
Depth	23.1m	19.60m
Summer Deadweight	164160t	75725.19t
Engine Power	16794kW	8833kW
Date Keel Laid	29 October 2007	19 October 2010
Date of Build	24 April 2008	17 March 2011
Builder	Hyundai Samho Heavy Industries Co., Ltd.	Chengxi Shipyard Co., Ltd.
Owner	Bright Shipping Ltd.	Changhong Group (HK) Ltd.
Operator	National Iranian Tanker Company	Changhong Group (HK) Ltd.
Manager	National Iranian Tanker Company	Shanghai CP International Ship

		Management & Broker Co., Ltd.

2.1.2 Statutory Certificates

（1） SANCHI : All certificates are valid.

Table 2 Statutory Certificates of SANCHI

Certificates	Issuing Authority	Issuing Date	Expiration
Certificate of Registry	Panama Maritime Authority	2017-3-16	2022-3-15
Minimum Safe Manning Certificate	Panama Maritime Authority	2016-6-23	/
International Ballast Water Management Certificate	Panama Maritime Authority	2017-9-8	2018-8-2
Certificate of Insurance or Other Financial Security in Respect of Civil Liability for Bunker Oil Pollution Damage	Panama Maritime Authority	2017-1-12	2018-2-20

Certificate of Insurance or Other Financial Security in Respect of Civil Liability for the Removal of Wrecks	Panama Maritime Authority	2017-2-20	2018-2-20
International Ship Security Certificate	Panama Maritime Authority	2016-11-11	2021-10-31
Radio Station Statutory License	Panama Maritime Authority	2017-3-24	2022-2-7
Document of Compliance	DNV GL	2016-11-29	2021-9-7
Safety Management Certificate	DNV GL	2016-11-29	2021-10-14
Class Certificate	DNV GL	2016-11-21	2018-4-24
IAPP	DNV GL	2016-7-6	2018-4-24
ILLC	DNV GL	2016-7-6	2018-4-24
ITC	DNV GL	2016-10-4	/
CCC	DNV GL	2017-3-26	2018-4-24
CRC	DNV GL	2016-7-6	2018-4-24
IOPP	DNV GL	2017-8-31	2018-4-24
ISPP	DNV GL	2016-7-6	2018-4-24

MLC	DNV GL	2016-11-29	2021-10-14
Class Status Report	DNV GL	2017-12-24	/
AFS	DNV GL	2016-7-6	/
Energy Efficiency Certificate	DNV GL	2016-7-6	/
P&I Certificate of Entry	STEAMSHIP MUTUAL	2017-2-20	2018-2-20

（2） CF CRYSTAL: All certificates are valid.

Table 3 Statutory Certificates of CF CRYSTAL

Certificates	Issuing Authority	Issuing Date	Expiration
Certificate of Registry	Marine Department Hong Kong (China)	2011-3-14	/
Minimum Safe Manning Certificate	Marine Department Hong Kong (China)	2016-9-27	/
Certificate of Insurance or Other Financial	Marine Department	2017-2-13	2018-2-20

Security in Respect of Civil Liability for Bunker Oil Pollution Damage	Hong Kong (China)		
ITC (to be verified by HK delegates)	Marine Department Hong Kong (China)	2011-3-7	/
Radio Station Statutory License (to be verified by HK delegates)	Marine Department Hong Kong (China)	2017-2-1	2018-2-1
DOC	Shanghai, MSA	2016-11-30	2021-11-29
Certificate of Insurance or Other Financial Security in Respect of Civil Liability for the Removal of Wrecks	Maritime Affairs of the Marshall Island	2017-2-20	2018-2-20
SMC	ABS	2016-8-27	2021-10-18
Certificate of Compliance for BWM	ABS	2016-1-1	2021-3-16

Class Certificate	ABS	2016-1-1	2021-3-16
IAPP	ABS	2016-1-1	2021-3-16
ILLC	ABS	2016-1-1	2021-3-16
CRC	ABS	2016-1-1	2021-3-16
CEC	ABS	2016-1-1	2021-3-16
CCC	ABS	2016-1-1	2021-3-16
IOPP	ABS	2017-4-13	2021-3-16
ISPP	ABS	2016-8-27	2021-10-18
Statement of Compliance MLC 2006	ABS	2013-9-3	2018-9-2
ISPP	ABS	2016-1-1	2021-3-16
Certificate for Carriage of Grain	ABS	2011-3-4	/
P&I Certificate of Entry	Assurancefore ningenSkuld (Gjensidig)	2017-2-20	2018-2-20

2.1.3 Maneuverability

Under the full loaded condition, the SANCHI's advance is about 0.47 nm at a speed of 10.8 kts and hard starboard. CF

CRYSTAL's advance is about 0.375 nm at a speed of 10.06 kts and hard starboard. (See Annex C for details)

2.1.4 PSC/FSC Inspection

（1） SANCHI

The table below shows the status of PSC inspections of SANCHI since 1 January 2016.

Table 4 Status of PSC Inspections of SANCHI

Regional PSC Organization	Place	Port	Type	Date	Detention
Tokyo MOU	ROK	Taesan	Follow-up Inspection	05/09/2016	No
Tokyo MOU	ROK	Taesan	Initial Inspection	05/09/2016	No

On 27 July 2017, SANCHI underwent FSC inspection in Mundra, India by Panama Maritime Authority. No deficiency was found.

According to the regulation of Panama Maritime Authority, the Flag State has to inspect vessels under its flag annually.

Last PSC report is attached in Annex D.

（2）CF CRYSTAL

The table below shows the status of PSC inspections of CF CRYSTAL since 1 January 2016.

Table 5 Status of PSC Inspections of CF CRYSTAL

Regional PSC Organizations	Place	Port	Type	Date	Detention
US Coast Guard	USA	Portland	Standard Inspection	14/12/2017	No
Tokyo MOU	ROK	Kwangyang	Follow-up Inspection	17/11/2017	No
Tokyo MOU	ROK	Kwangyang	Initial Inspection	17/11/2017	No
Tokyo MOU	China	Humen	Initial Inspection	16/08/2017	No
	Ukraine	Nikolayev		07/07/2017	No
	Saudi Arabia	Jeddah		06/06/2017	No
Paris MOU	Germany	Hamburg	Detailed Inspection	11/04/2017	No
Indian Ocean MOU	Australia	Other West	Follow-up Inspection	28/02/2017	No

Tokyo MOU	Australia	Fremantle	Initial Inspection	27/02/2017	No
Tokyo MOU	Vietnam	Ton Duc	Initial Inspection	26/08/2016	No
US Coast Guard	USA	New Orleans	Standard Inspection	17/06/2016	No
Mediterranean MOU	Egypt	Alexandria	Initial Inspection	24/05/2016	No

Based on the result of PSC inspection, Marine Department of Hong Kong (China) did not conduct FSC inspection for CF CRYSTAL in recent years.

2.2 Manning and Watchkeeping

2.2.1 SANCHI

There were 32 persons on board including 30 from Iran and 2 from Bangladesh. The crew certificates were valid. The ship's manning complied with the minimum safe manning requirements, and persons on board vessel did not exceed the capacity of the vessel life-saving equipment. Bridge team

members' information is as follows:

Captain, Iranian, CoC issued by the Iranian Administration, No. 1/11/03/701529, valid until 11 January 2022, Service report No. 0427693. He signed on board SANCHI on 28 September 2017. He first served as the captain of DIAMOND II on 10 June 2013. He had served seven ships as master before SANCHI.

3/O, Iranian, CoC issued by the Iranian Administration, No. 1/11/01/701643, valid until 6 October 2019, Service report No 0360262. He signed on board SANCHI on 2 November 2017. He was the OOW on bridge when the accident happened. On 3 December 2014, he began to serve as 3/O on HAPPINESS I for the first time. He had served for five ships and he had a total of 534 days experience as 3/O.

AB (0800-1200, 2000-2400 shift), Bangladeshi, signed on board SANCHI on 20 November 2017, service report number CTC450670, was the lookout on the bridge when the accident happened.

2.2.2 CF CRYSTAL

There were 21 Chinese crew members. The crew certificates were all valid. The ship's manning complied with the minimum safe manning requirement, and persons on board vessel did not exceed the capacity of the vessel life-saving equipment. At the time of the accident, 3/O and an AB were on the bridge. C/O and another AB were just relieved several minutes before the accident. Some bridge team members' information is as follows:

Captain, Chinese, CoC issued by Shanghai MSA, certificate number AGA111201305151. He started working on board as captain since 25 September 2010. He signed on CF CRYSTAL in Nantong, China on 26 August 2017.

C/O, Chinese, CoC issued by Shanghai MSA, certificate number AGA112201413972. He started working on board as C/O on 6 December 2014. He signed on CF CRYSTAL in Nantong, China on 26 August 2017. He had a total of 728 days' experience as C/O. No signs of drinking were found.

3/O, Chinese, CoC issued by Shanghai MSA, certificate number AGA114201604040. He obtained the certificate on 21 April 2011. From 30 December 2015 to 25 August 2016, he served on

board as 3/O for the first time. He signed on CF CRYSTAL on 18 May 2017 in YEOSU, ROK. He had a total of 501 days as 3/O. No signs of drinking were found.

AB1, Chinese, obtained watchkeeping certificate issued by Changjiang MSA. Certificate number was APC145201603836. On 14 September 2013, he began to serve on board as an AB on BAOYING. He signed on CF CRYSTAL on 26 August 2017 in Nantong, China. His duty time was 0000-0400, 1200-1600. No signs of drinking were found.

AB2, Chinese, obtained watchkeeping certificate on 29 May 2005 issued by Shandong MSA. Certificate number was AED146201600520. He began to serve onboard as AB on 19 September 2005. He signed on CF CRYSTAL on 18 May 2017 in YEOSU, ROK. His duty time was 0800-1200, 2000-2400. No signs of drinking were found.

2.3 Company Information

2.3.1 SANCHI

The owner of SANCHI was BRIGHT SHIPPING. Ltd., IMO No.

5931356. It was managed and operated in care of NITC, East Shahid Atefi Street 35, Africa Boulevard, PO Box 19395-4833, Tehran, Iran. SANCHI was the only vessel registered under its name.

The operator and management company of SANCHI was National Iranian Tanker Company, IMO No. 0101754, located in East Shahid Atefi Street 35, Africa Boulevard, PO Box 19395-4833, Tehran. The DOC of the management company, No. D193582/161129F/PAN, was valid until 7 September 2021 and the annual verification was conducted on 18 October 2017. There were 62 vessels managed by National Iranian Tanker Company.

2.3.2 CF CRYSTAL

The owner and operator of CF CRYSTAL was Changhong Group (Hong Kong) Co., Ltd., registered in Hong Kong (China) on 18 March 2010. Changfeng Shipping Group Holdings Co., Ltd. is responsible for the operation of the vessel according to the agreement signed with Changhong Group (Hong Kong) Co., Ltd.

The management company of CF CRYSTAL was Shanghai CP International Ship Management & Broker Co., Ltd. It obtained the DOC (No. 05A027) issued by Shanghai MSA, with bulk carriers and other cargo ships within management scope. The DOC was valid until 29 November 2021. The management company managed 14 vessels and had been responsible for managing CF CRYSTAL since 20 January 2011.

2.4 Voyage Information

On 16 December 2017, SANCHI sailed from Assaluyeh, Iran, to Daesan, ROK, carrying 111,510 tons of condensate oil with fore and aft draught of 13.4 m. There was 2,974 tons of heavy oil, 119 tons of diesel oil, 42 tons of lubricating oil on board on departure. No consumption of diesel and lubricating oil was expected. The estimated figure of HFO at the time of the accident was about 1,941 tons based on the noon report figure (HFO ROB 1,956 tons) and daily consumption (41 tons). The consignor was National Iranian Oil Company and the consignee was Hanwha Total Petrochemical Co., Ltd.

On 15 December 2017, CF CRYSTAL sailed from Kalama,

USA, to Dongguan, China, carrying 63,997.817 tons of sorghum in bulk with fore and aft draught of 13.02 m. On 5 January 2018, CF CRYSTAL was replenished with 1,050 tons of heavy fuel oil, 90 tons of diesel oil and 17.43 tons of lubricating oil in outer anchorage of Busan, ROK. At 1430LT 5 January 2018, CF CRYSTAL resumed her voyage. When the accident happened, there were about 1,477.8 tons of HFO, 144.6 tons of diesel oil and 29.628 tons of lubricating oil on board.

2.5 Characteristics of Condensate Oil

The oil tanker SANCHI was carrying South Pars condensate oil. It is generated from natural gas reserves, consisting of hydrocarbons separated from methane and ethane (as the principal and lightest parts of natural gas). It is composed of hydrocarbons such as propane, butane, pentane, hexane, etc. Additionally, condensate oil may contain additional impurities such as hydrogen sulfide, mercaptans, CO2, Straight-chain alkanes from 2 to 12 carbon atoms, Cyclohexane and perhaps other naphthenes. Condensates are highly flammable (at temperature -40 degrees), and will explode if ignited or pressure is exerted to the tank. Once spilled, condensate evaporates

mixes with air and forms an explosive mixture, which can move towards the source of fire and backflash. Fire and explosion will break out when the explosive gas comes into contact with fire. Toxic substances such as CO, NOx, SOx, etc will be produced when burnt.

Table 6：Chemical Specifications

Appearance	Colorless, shiny reddish blue	Special weight	AP 0.62-0.76
Like oil	Smell	High	Evaporation rate
Liquid	Physical conditions	-	VOCs
-	pH	100 %	Volatility
1 <	Vapor density	-	Octanol/water ratio
39 to 200 C	Boiling point	AP -40 C	Flash point
-	Melting point	- 60 C	Freezing point
Negligible	Solubility in water	250 C	Spontaneous sparkling

Yes	Flammability	Ordinary conditions	Flammability

2.6 Drills and Training

According to SANCHI's safety committe meeting minutes of December 2017, the drills were carried out as shown in Table 7.

Table 7 Drills carried out on SANCHI in December 2017

DATE	DRILL
10.12.2017	FIRE DRILL(PORT MIDSHIP STORE)
10.12.2017	CARGO VAPOUR LEAKAGE DRILL
10.12.2017	ABANDON
21.12.2017	ABANDON
21.12.2017	FIRE DRILL (FAMILIRIZATION)
21.12.2017	ACUTE PERSON INJURY DRILL

A number of drills and trainings were carried out on CF CRYSTAL in November and December (see Table 8). Last boat drill and fire drill were carried out on 26 December 2017.

Table 8 Drills/training record on CF CRYSTAL in November and December 2017

No.	Item	Date
1	Free-fall Lifeboat Launching Drill	2017.11.2
2	Rescue Boat Launching Drill	2017.11.2

3	Abandon Ship Drill	2017.12.5
4	Emergency Steering Drill	2017.12.5
5	Fire Drill	2017.12.5
6	Oil Pollution Prevention Drill	2017.12.5
7	Entry into Enclosed Space Drill	2017.12.6
8	Emergency Towing Drill	2017.12.6
10	Cargo shifting Drill	2017.12.19
11	Hull Damage Drill	2017.12.19
12	Recovery of Persons from the Water Drill	2017.12.26
13	Comprehensive Drill	2017.12.26
14	Communication Loss Drill	2017.12.26

2.7 Environmental Conditions

2.7.1 Weather and Sea Conditions

At the time of the accident, the weather was cloudy with good visibility, the northeast wind Beaufort force was 4 to 5, and the sea state was slight.

2.7.2 Navigational Environment

The location of the accident was in the East China Sea (Figure 1). Charted water depth was 55 m. At the time of the accident, the following vessels were in the vicinity: CCL NINGBO, MAERSK SHAMS, TRF MONGSTAD, MANTUCKET, ZHEDAIYU 03187, ZHEDAIYU 01272, ZHEDAIYU 01215, ZHEDAIYU 02151. (Figure 2)

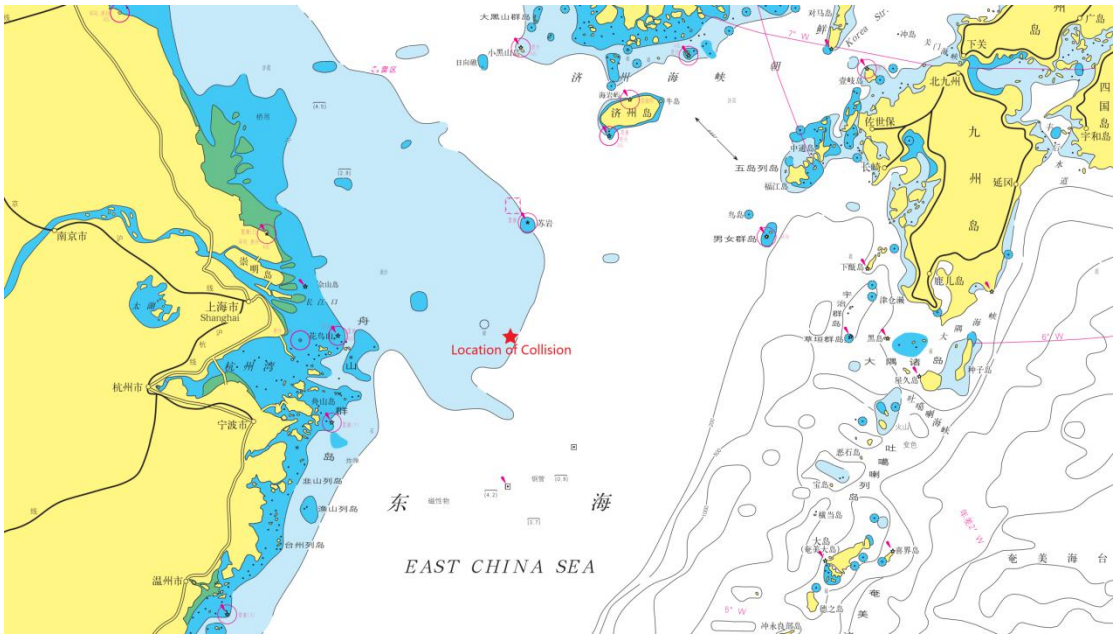


Figure 1- Location of the accident

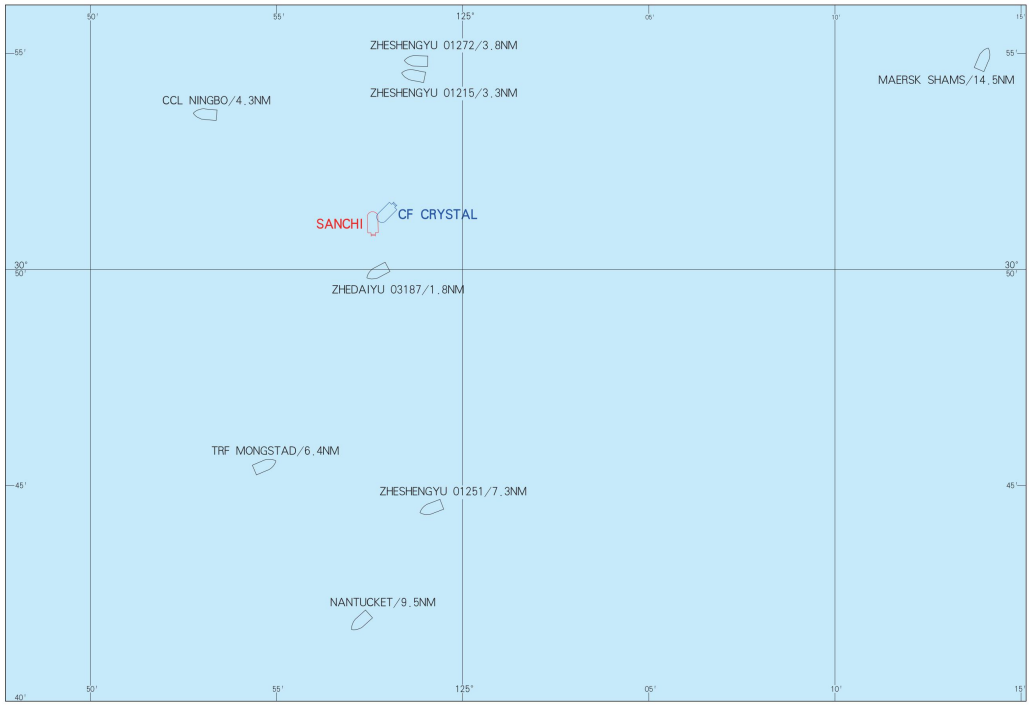


Figure 2- Traffic conditions at the time of the accident

2.8 Damage Survey

2.8.1 SANCHI

From 0835LT to 0905LT on 13 January 2018, 4 rescuers were sent on board SANCHI in a basket from SHENQIAN. At that time, the spilled oil on the sea surface was still burning on the starboard side of the SANCHI and the smoke was rather heavy with high temperature. (Figure3/4)

Figure 3- Photos taken on the spot

Figure 4 -Photos taken on the spot

2.8.2 CF CRYSTAL

(1) The on-site survey

The whole bulbous bow had plunged backward into the hull, and the impacting surface was slightly to the right; the anchor chain storage in the front end of the bow presented a "V" shape, the sag on the starboard side bow was slightly larger than the port side, both of two bow anchors were lost; the bulwark of forecastle deck concaved towards the starboard, the sag was slightly curved and the depression was located above the forecastle deck. The forecastle deck was severely distorted and deformed; ship’s storeroom and forepeak were struck through; heavy deformation had occurred on main deck from the bow to NO.3 cargo hold. (Figure 5)

The main deck between the bow and No.3 cargo hold sustained fire causing damage to the windlasses, mooring winches, the front mast and the firefighting box; the whole ship's port side sustained fire damage, and the lifeboat on the port side was damaged. For the starboard side, the parts from the bow to the front of No.3 cargo hold were also burnt. (See Annex F - CF CRYSTAL Survey Report)

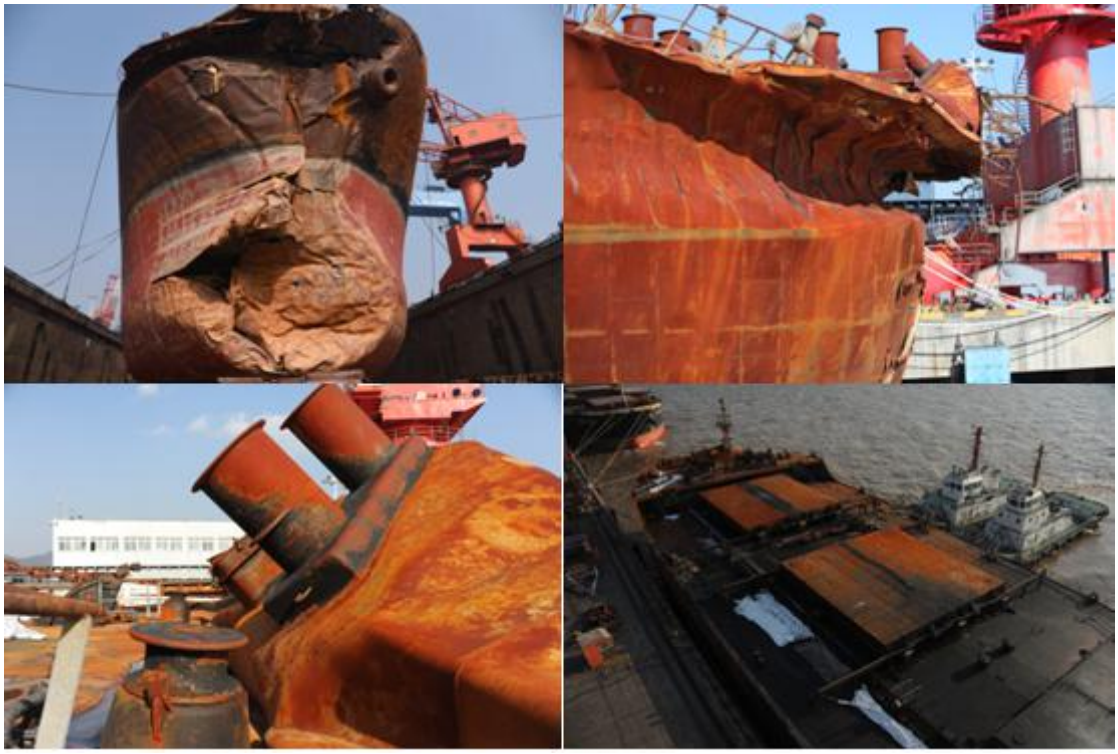


Figure 5-Damage Inspection of CF CRYSTAL

(2) The ship's power, manoeuvring and navigational Equipment

Main Engine, steering gear and electrical equipment: M/E: HHM B&W 5S60MC, 12012HP; Auxiliary Engine: 5DK-20, 700KW; Emergency Generator: 634DSBG SISU DISEL INC; Steering Gear: FE21-102, the main steering gear was of electrohydraulic type.

Figure 6-The Bridge of CF CRYSTAL

Navigational equipement: 2 sets of radar with types of FURUNO FAR-2827 and FURUNO FAR-2837S; 1 set of AIS with the type of FURUNO FA-150; 1 set of GPS with the type of FURUNO GP-150; 1 set of Meteorological Fax Receiver with the type of FURUNO FAX-408; 1 set of Navtex Receiver with the type of FURUNO NX-700; Voyage Data Recorder, FURUNOVR-3000; 3 sets of VHF, FURUNO FM-8800S. The ECDIS was not equipped on board.(Figure 6)

According to on-site inspection, the main and auxiliary engine, steering gear, radio equipment and navigational devices of the vessel worked in a normal condition.

(3) Main Engine RPM

The RPM of main engine were as follows:

The engine speed was 97 RPM at 12:09:43LT on 6 January 2018.

At 19:50:19LT on 6 January, after the collision, the RPM of main engine was reduced to 76 RPM.

At 19:50:38 LT, the RPM of main engine was 0;

At 19:51:53 LT, the RPM of main engine was 58 astern;

At 19:52:14 LT, the RPM of main engine was 65 astern;

At 19:52:35 LT, the RPM of main engine was 71 astern.

2.9 Time and Location of Collision

2.9.1 Time of Collision

The CF CRYSTAL collided with the SANCHI at 1950 LT on 6 January 2018.

The VDR of SANCHI recorded the sound of collision and deflagration, as well as the voice of duty crew in bridge at 1950 LT, which reflected the dramatic emotional changes. The image of X-Band Radar extracted from the VDR (one capture every 15 seconds) showed that the heading changed from 358° at 1949 LT to 338° at 1951LT(Figure 7), meanwhile, the vessel speed

dropped from 10.4 to 6.5 knot. The time was verified by the engine telegraph record of CF CRYSTAL, the VDR data of MAERSK SHAMS and TRF MONGSTAD, and the statement of the duty crew of CF CRYSTAL.

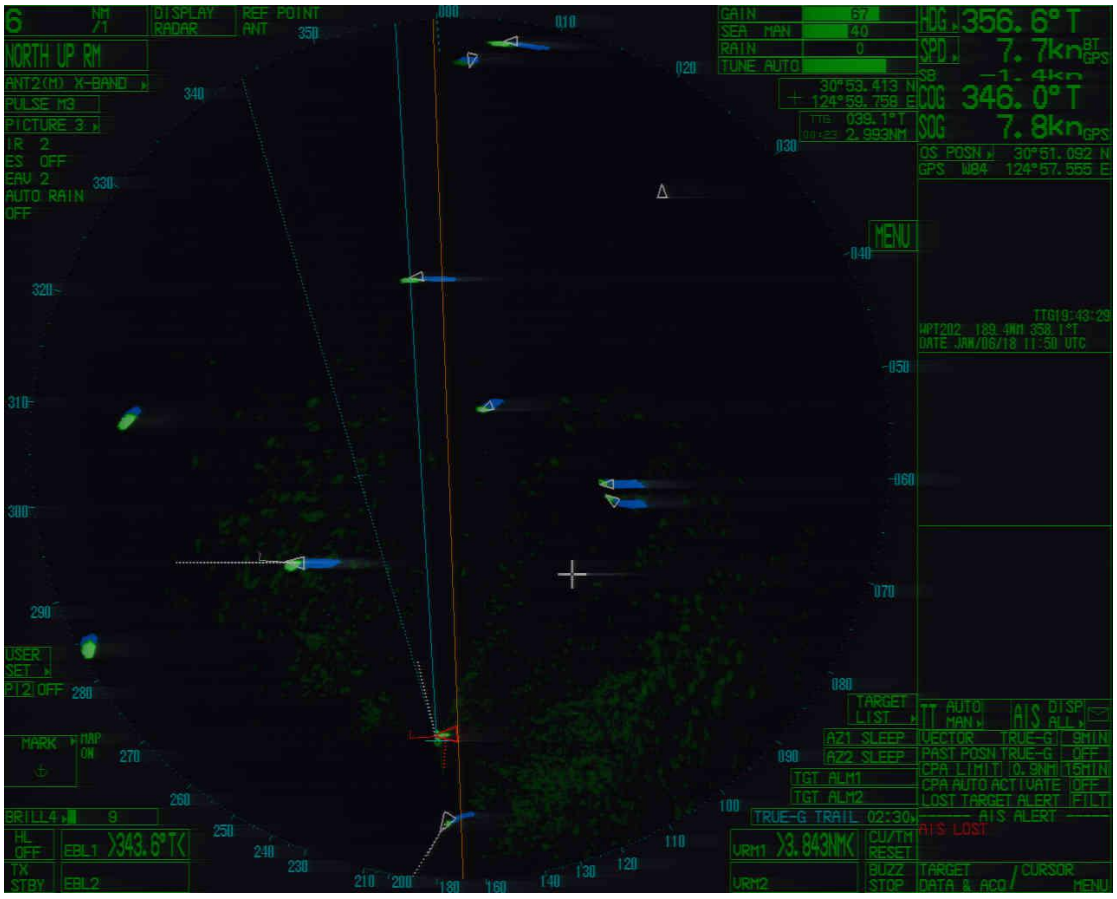


Figure 7- SANCHI's X Band Radar Display at 1951LT (right after collision)

2.9.2 Location of Collision

At 1950LT, the position of SANCHI was 30°51′.02N/124°57′.59E, which reflected the position of the ship's GPS antenna. The vessel was heading 358° at the time. The distance from the bridge of SANCHI to its bow was 230.9

m. Considering the parts of damage to SANCHI, the corrected location of the accident was approximately 30°51′.1N/124°57′.6E.

2.9.3 The Parts and Angle of Blow

The bow of CF CRYSTAL collided with the starboard side hull between No.2 and No.3 ballast tanks, breaching the boundary of the No.2 and No. 3 starboard cargo tanks of SANCHI. When the collision occured, CF CRYSTAL was heading 226°, and SANCHI 358°. So the angle of blow between the two ships was about 48°. This was consistent with the damage inspection of both vessels. (Figure 8)

Figure 8-Arial Picture taken on 10 January

2.10 VDR Data Revovery

2.10.1 VDR Data from Accident Vessels

1. CF CRYSTAL

The model of CF CRYSTAL's VDR is FURUNO VR-3000S. At least 12 hours' data is required to be stored. About 13 hours' data was actually recorded covering the period from 2201 LT 6 January 2018 to 1106 LT 7 January 2018. Unfortunately, the data at the time of the incident was overwritten.

2. SANCHI

On 13 January 2018 SANCHI's VDR capsule was retrieved by search and rescue crew after boarding the vessel. On 14 January 2018, the Swedish engineer from manufacturer downloaded all data from the VDR storage capsule.

The manufacturer of SANCHI's VDR is CONSILIUM. At least 12 hours' data is required to be stored. The data stored in VDR is intact and about 58 hours' data was actually recorded covering the period from 1002 LT on 4 January 2008 to 1951 LT on 6 January 2018. The sensor inputs include X-band radar display (one image every 15 seconds), audio data (bridge, chart room and VHF), GPS data (position, SOG, COG), Gyro compass data

(heading), speed log (longitudinal and transversive speed), echo sounder (depth under keel), anemometer.

2.10.2 VDR from Passby Vessels

1. MAERSK SHAMS

In the afternoon of 10 January 2018, the MSA investigators boarded and downloaded VDR data from the passby vessel MAERSK SHAMS in Shanghai. The model of the VDR was JRC JY-1900. It was installed after 1 July 2014. The VDR equipment complied with the REVISED PERFORMANCE STANDARDS FOR SHIPBORNE VOYAGE DATA RECORDERS (VDRs) adopted at the IMO 90th Maritime Safety Committee meeting in May 2012 by resolution MSC333(90). That is, at least 30 days (720 hours) data shall be recorded in the long-term recording medium, and at least 48 hours data shall be recorded in the fixed recording medium and float-free recording medium.

The investigators downloaded VDR data covering 0400UTC to 1600UTC 6 January 2018 from MAERSK SHAMS's VDR and obtained the AIS data of SANCHI and CF CRYSTAL at the time of the incident.

2. TRF MONGSTAD

On 16 January 2018, the investigators downloaded VDR data from another passby vessel named MONGSTAD in Guangzhou. The device was a FURUNO VR-7017, installed after 1 July 2014.

The investigators downloaded VDR data covering 0000UTC to 1200UTC 6 January 2018 and obtained the AIS data of SANCHI and CF CRYSTAL at the time of the incident.

2.10.3 Comparison of VDR Data

It was found that partial dynamic data of SANCHI and CF CRYSTAL such as heading, position obtained from SANCHI's VDR and two passby vessels' VDR was consistent. However, there were 20 to 25 degrees differences of COG and 2 to 3 kts differences of SOG between the SANCHI's AIS information received by other vessels and the readout of SANCHI's VDR. (Table 9/10, Figure 9)

Table 9 SANCHI's AIS Information Received by Other Vessels

Time（UTC）	Heading (°)	COG (°)	SOG(kts)
11:40:16	358	24.6	8.5
11:41:06	358	24.3	8.4

11:42:06	358	23.2	8.2
11:43:06	358	24.2	8.2
11:44:16	358	23.5	8.5
11:45:16	358	24.3	8.4
11:46:06	358	17.4	7.4
11:47:06	358	18.3	7.2
11:48:06	358	20.0	7.2
11:49:06	358	22.6	7.0

Table 10 Readout of SANCHI's VDR Data

Time（UTC）	**Heading (°)**	**COG(°)**	**SOG(kts)**
11:40:16	358.1	358	10.4
11:41:06	358.1	358	10.4
11:42:06	357.9	358	10.4
11:43:06	358.3	357	10.4
11:44:16	357.9	358	10.5
11:45:16	358.1	358	10.5
11:46:06	357.8	358	10.4
11:47:06	358.2	357	10.5
11:48:06	358.1	358	10.5
11:49:06	358.3	358	10.5

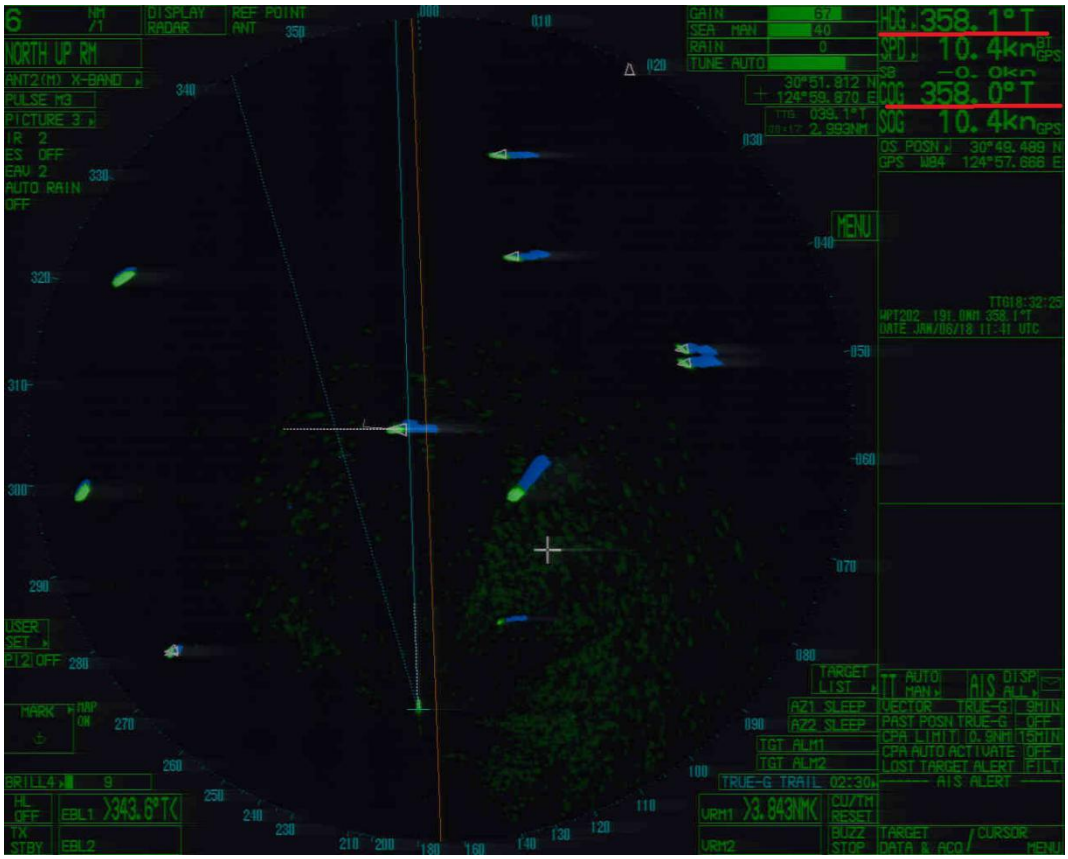


Figure 9 SANCHI's X Band Radar Display at 1941LT

To find out the cause of the deviation, the investigators analyzed the sensor inputs of SANCHI's VDR and the installation manual of the Swedish SAAB R4 AIS.(Figure 10)

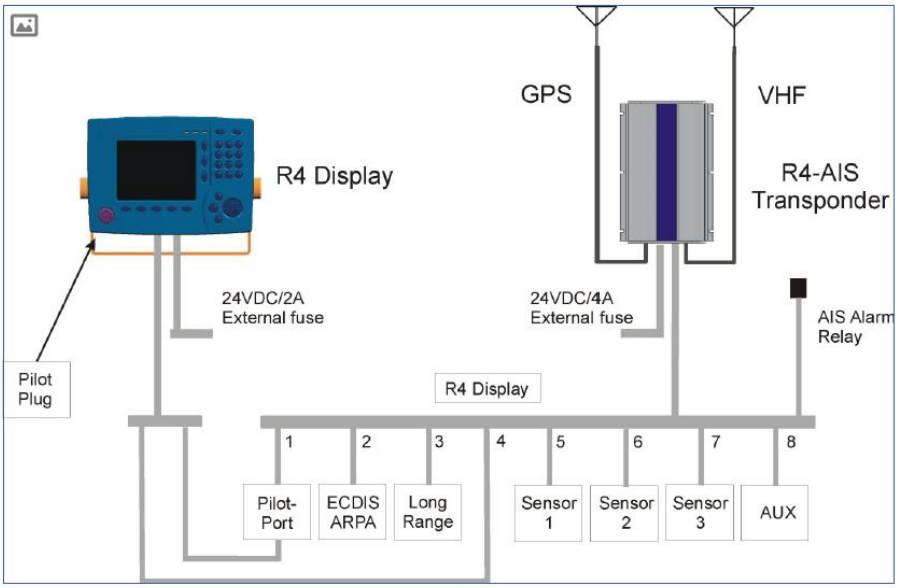


Figure 1: R4-AIS Transponder System overview

Figure 10-SAAB R4 AIS Transponder System Overview

According to the instructions in section 2.16.3.5 of the equipment installation manual, the COG and SOG data are based on Speed Log sensor input data in format VBW (IEC 61162-1 sentences).

2.16.3.5 Log (VBW)

If a Bottom Track (BT) Log (hereafter referred to as Speed Log) for Speed Over Ground (SOG) is available, it shall be connected to the R4 Transponder.

The R4 Transponder will derive Course Over Ground (COG) from this information.

Note that the R4 Transponder needs heading information to be able to derive SOG and COG from Speed Log data. The R4 Transponder will use the Speed Log as source for SOG and COG as long as heading information is available.

If heading information is not available, Speed Log data will not be used. In this case the R4 Transponder will use the position sensor as source for SOG and COG.

Figure 11-Extract from Installation Manual of R4 AIS

According to the equipment installation manual, there are two data input sources for COG and SOG transmitted by AIS. The first is the calculation output of the longitudinal and transverse speed from the Speed Log and the gyro heading. The second is the direct COG and SOG information obtained from shipboard position sensor such as GPS. The AIS normally uses the first data source as long as heading information is available. The second data source is used only when the gyro heading is not available.

According to the investigation, the gyro compass of SANCHI was working properly before the incident and the ship's heading was available. So, the COG and SOG transmitted by the shipboard AIS were derived from Speed Log data. The COG and SOG transmitted by SANCHI’s AIS did not conform to what were derived from GPS.

2.11 Diagrams of Navigational Tracks

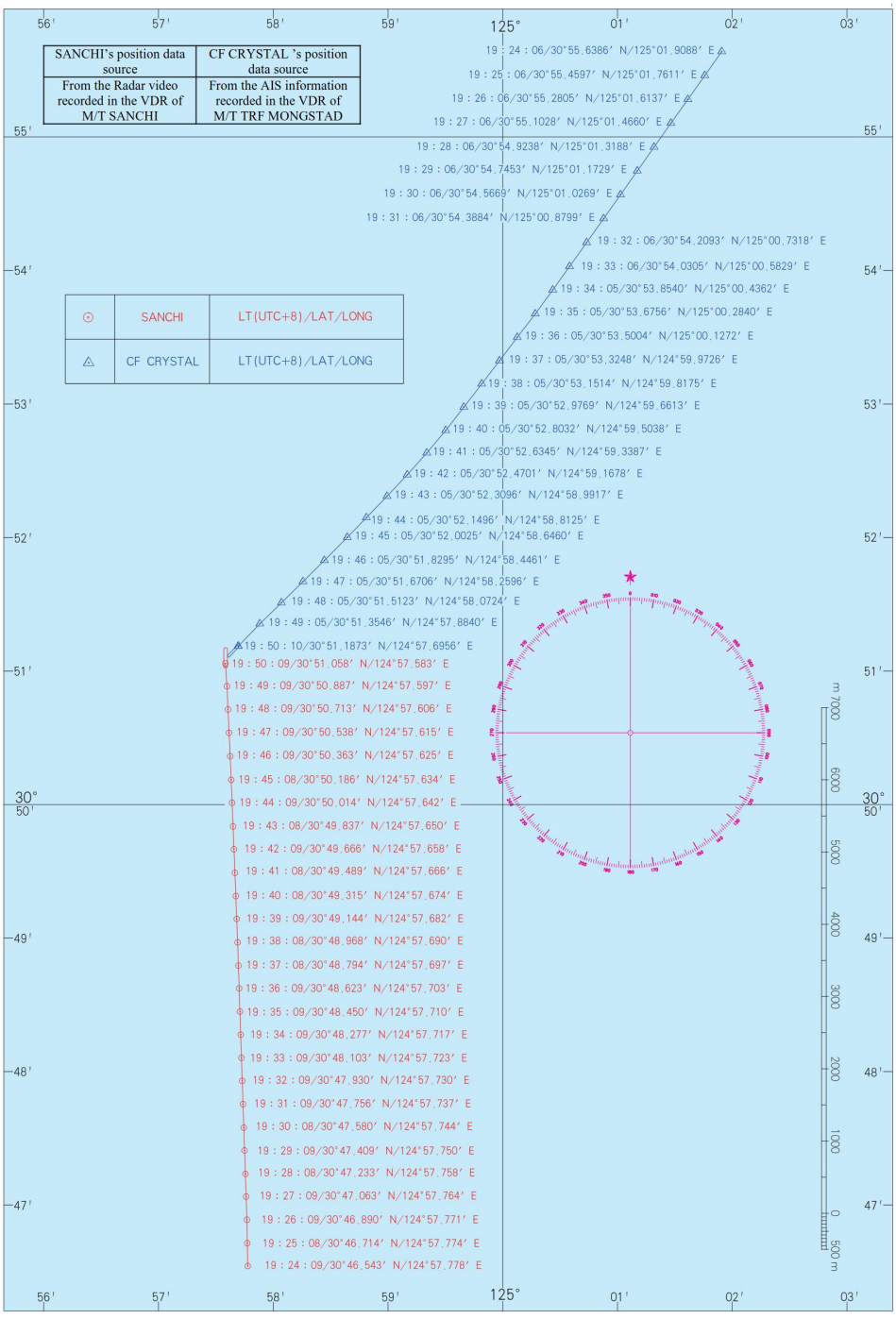


Figure 11 Diagram I of navigational track of SANCHI and CF CRYSTAL

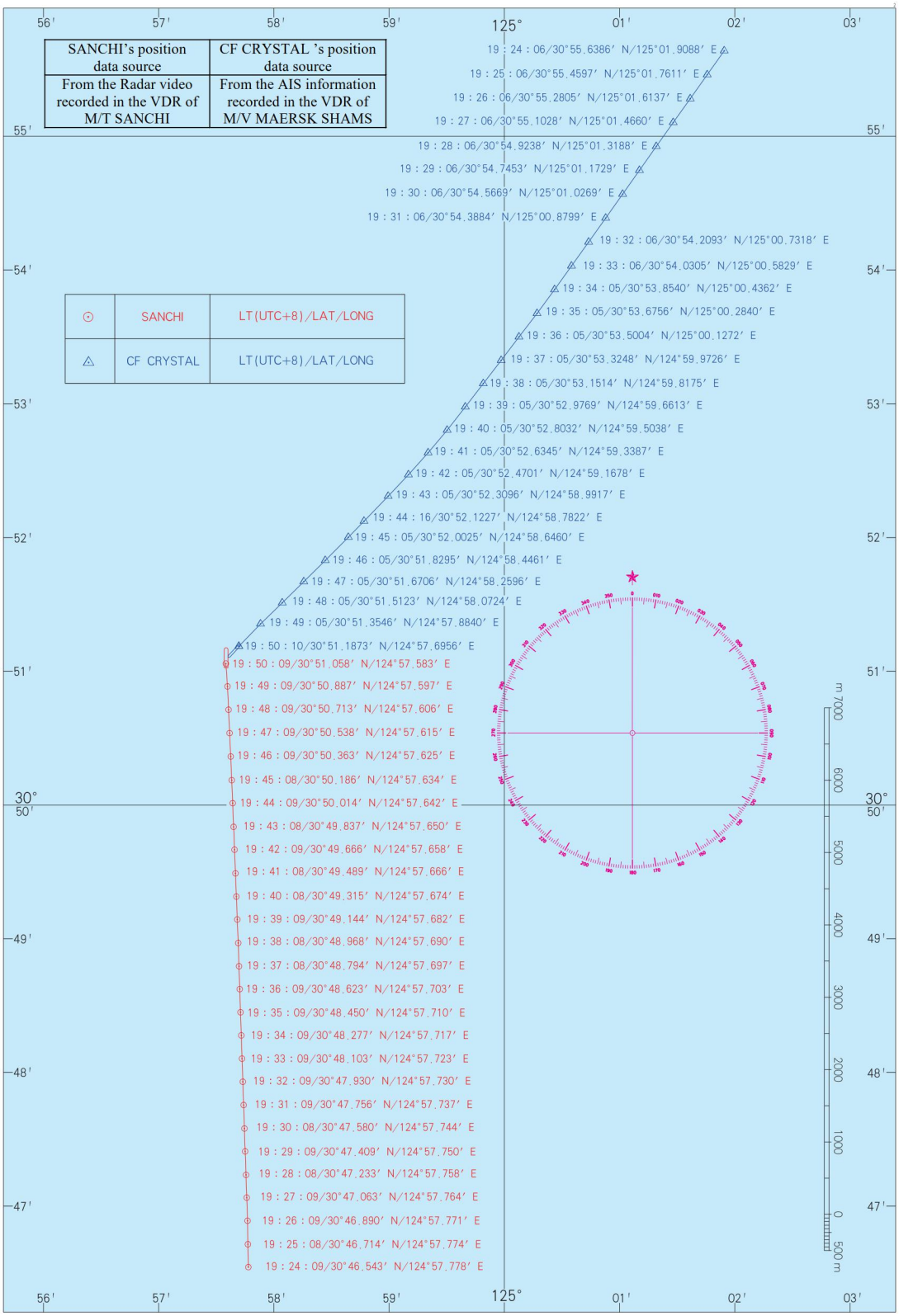


Figure 12 Diagram II of navigational track of SANCHI and CF CRYSTAL

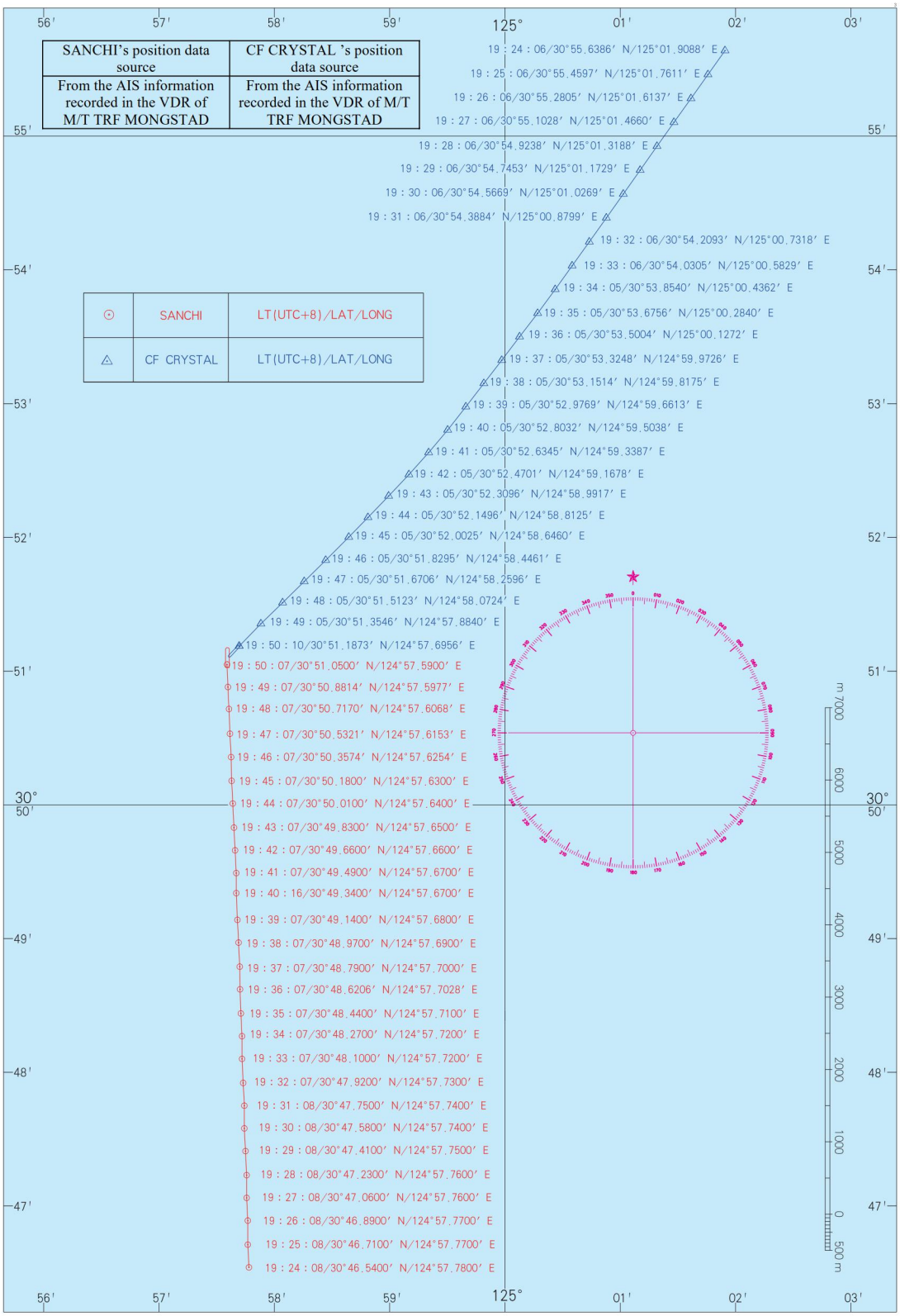


Figure 13 Diagram III of navigational track of SANCHI and CF CRYSTAL

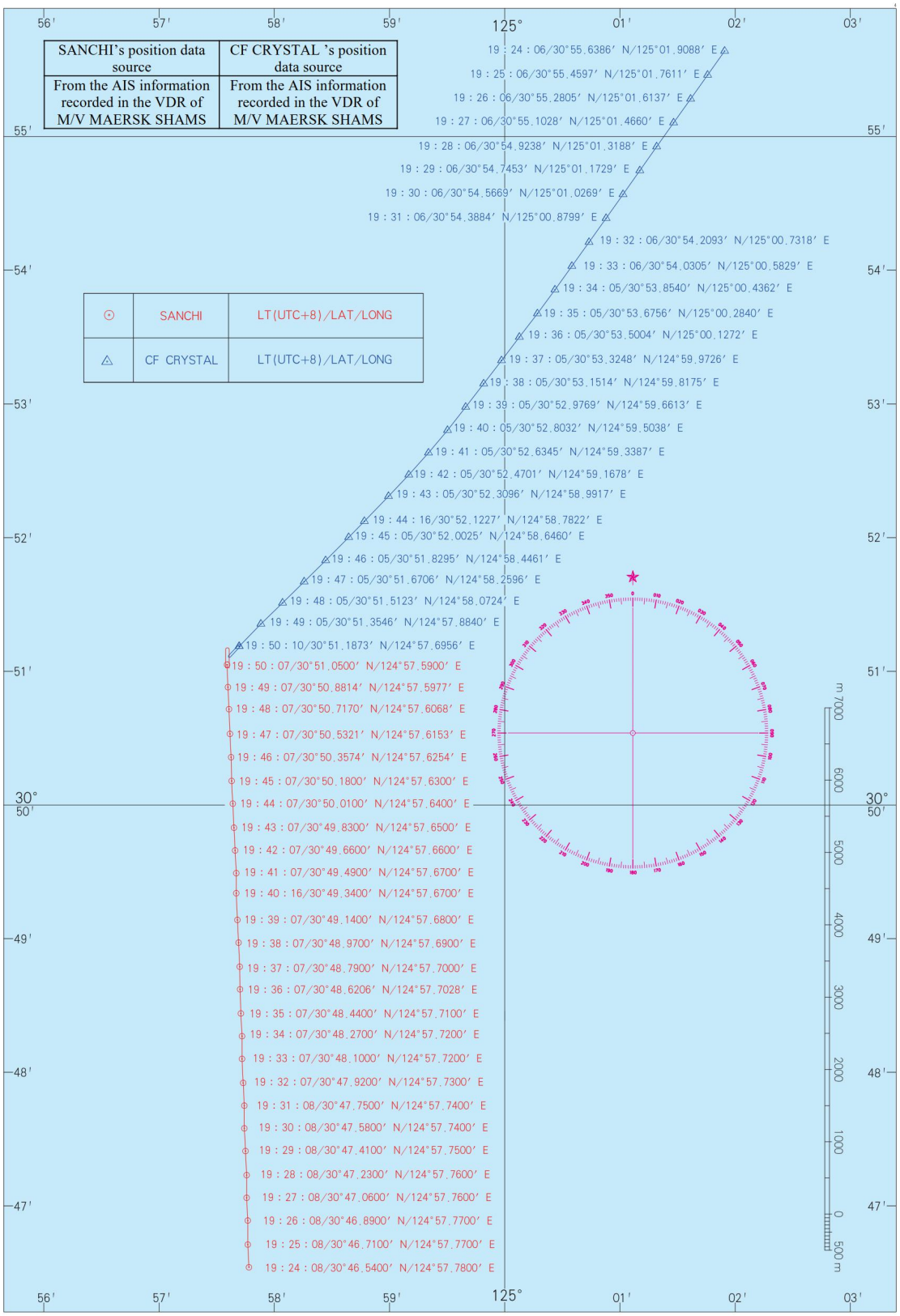


Figure 14 Diagram IV of navigational track of SANCHI and CF CRYSTAL

2.12 Narrative

a. Data source:

(i) SANCHI GPS position and heading were from the ship's X-band radar display recorded in SANCHI's VDR which were consistent with the readout from SANCHI's AIS information received by MAERSK SHAMS and TRF MONGSTAD after comparison with the data interpreted by third party ships.

(ii) SANCHI's COG and SOG were from the ship's X-band radar display recorded in SANCHI's VDR and there were 20 to 25 degrees differences of COG and 2 to 3 kts differences of SOG between such data and the SANCHI's AIS information received by other vessels.

(iii) CF CRYSTAL's position, heading, COG and SOG were from the VDR of MAERSK SHAMS and TRF MONGSTAD.

b. Calculation:

(i) The range and bearing were calculated by the GPS position of the two ships;

(ii) The CPA and TCPA were calculated by GPS position, COG and SOG of two ships. (See Annex H)

2.12.1 SANCHI

On 16 December 2017, SANCHI departed the loading port - Assaluyeh, Iran - with a cargo of 111,510 tons of condensate oil and bounded for Daesan, ROK. The draughts on departure were 13.4 m fore and aft. There were 2,974 tons of HFO, 119 tons of diesel oil and 42 tons of lubricating oil on board. During the passage no consumption of diesel oil and lubricating oil was expected. According to the noon report and daily consumption, there was about 1,941 tons of HFO at the time of accident.

On 6 January 2018, SANCHI was proceeding in East China Sea. At about 1900LT, SANCHI's GPS position was 30°42′.5N/124°58′.3E, COG was 340° and SOG 10.3 kts. The Iranian 3/O and the Bangladesh AB took over their bridge watch. The VHF radio was set on channel 16. Two ARPA radars were in operation with the X-band radar set on 6-nm-range scale, off-center, north-up, relative motion display mode. The CPA and TCPA limits were set on 0.9 nm and 15 mins respectively. (Figure 15)

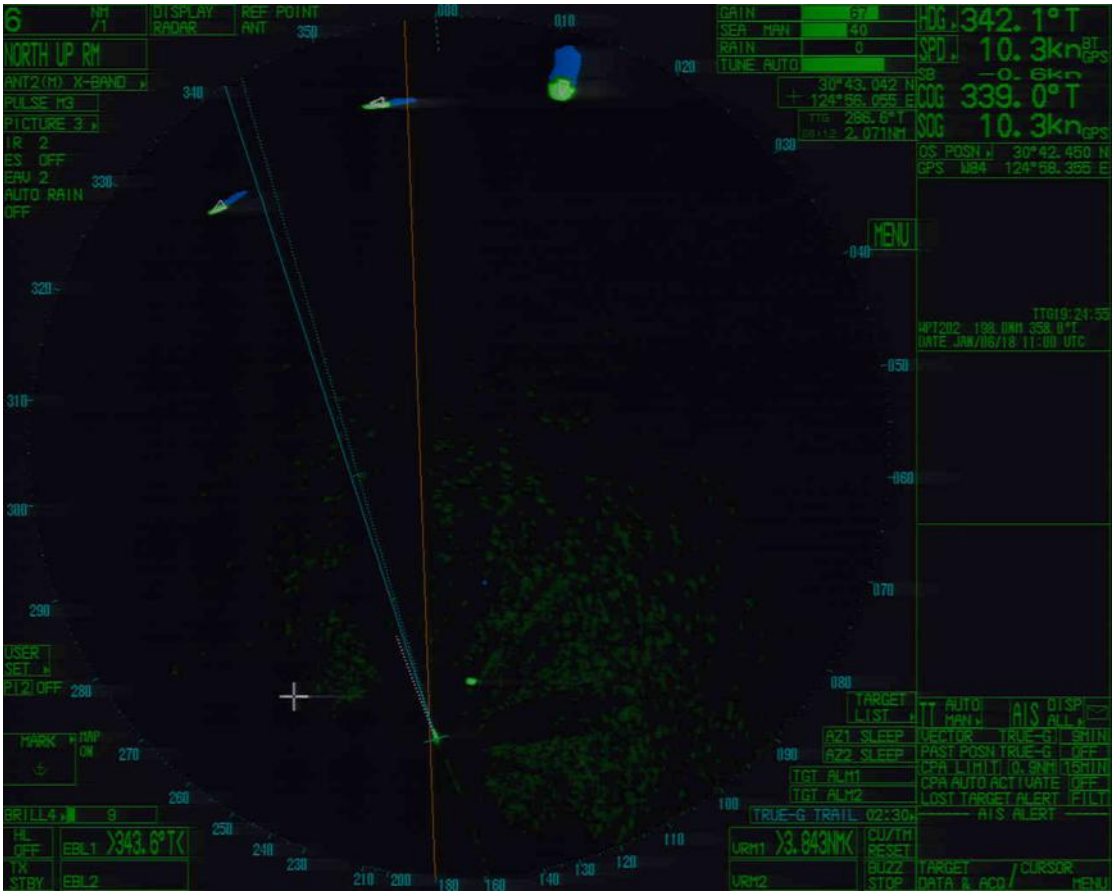


Figure 15-SANCHI's X band radar display at 1900LT (shift change)

At about 1930LT, SANCHI's GPS position was 30°47′.6N/124°57′.7E, COG was 358° and SOG 10.4 kts. The OOW assessed all targets would pass astern of own vessel. (Figure 16)

At about 1932LT, the OOW again started assessing the situation of CF Crystal, and Said: *BCR (Bow Crossing Range) (of target A and B) are minus.*

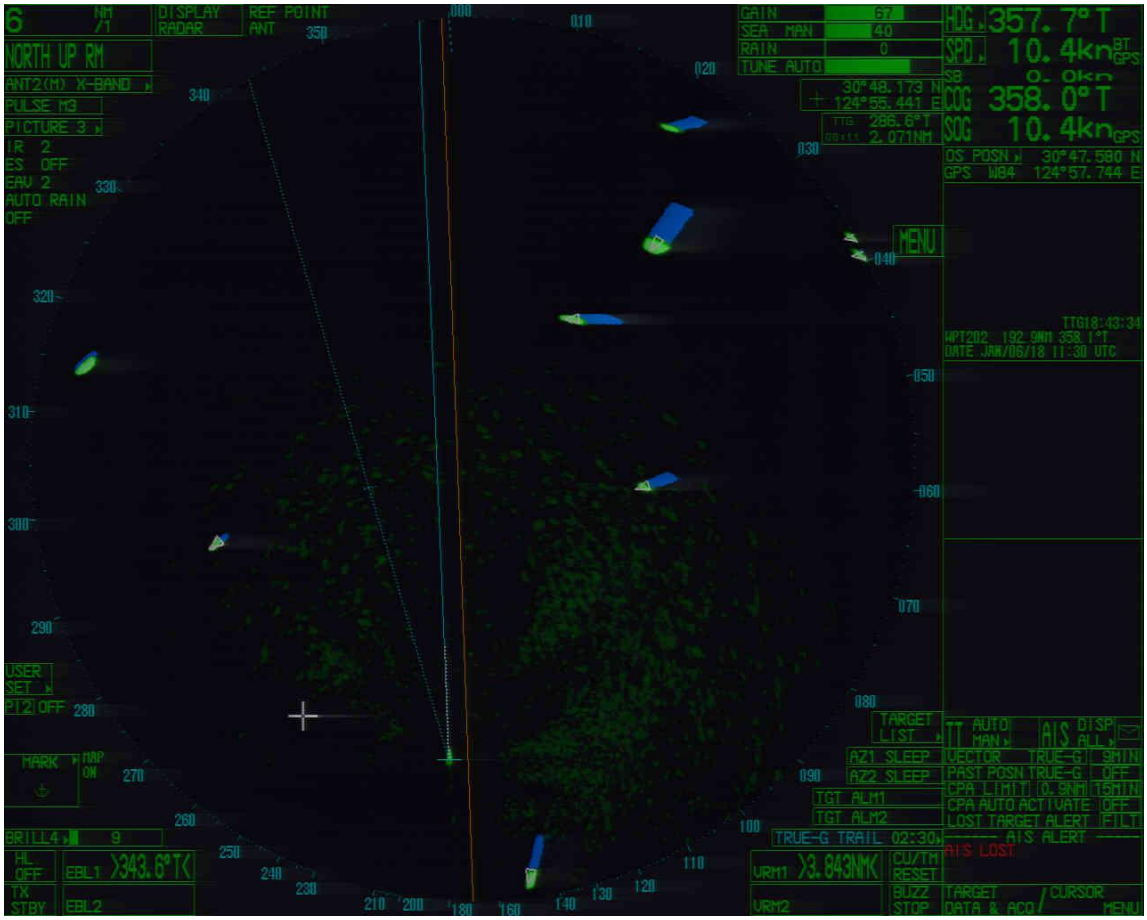


Figure 16-SANCHI's X band radar display at 1930LT

At about 1934LT, SANCHI's GPS position was 30°48′.3N/124°57′.7E, COG was 358° and SOG 10.4 kts. In their conversation, the OOW and lookout mentioned the approaching target, whose bearing was 022°.

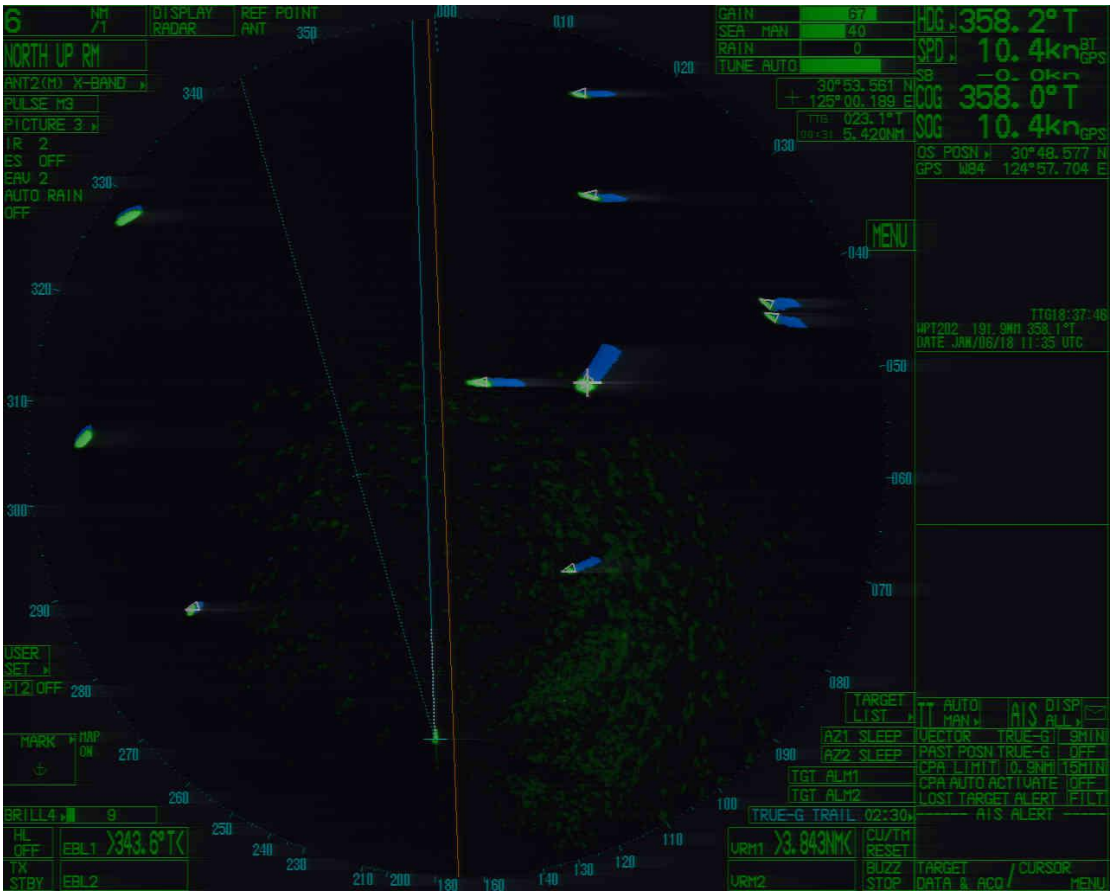


Figure17-SANCHI's X Band Radar Display at 1935：45LT（cursor on CF CRYSTAL）

At about 1935LT, SANCHI's GPS position was 30°48′.4N/124°57′.7E, COG 358° and SOG 10.4 kts. The cursor of X-band radar was shifted to CF CRYSTAL. On the X-band radar, the echo of CF CRYSTAL was not acquired and the AIS target was not activated either. Lookout mentioned a vessel at a bearing of 013° on radar screen and showing red & green. (Figure 17)

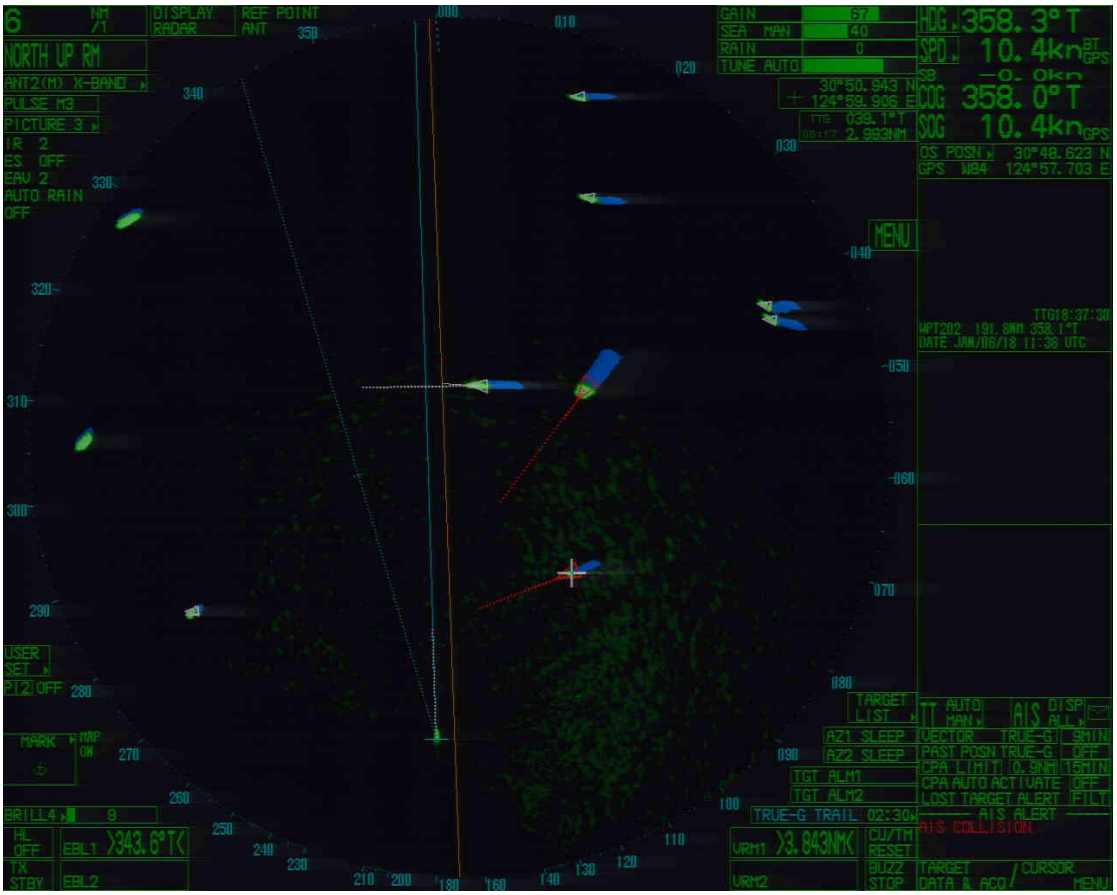


Figure18：SANCHI's X Band Radar Display at 1936LT（cursor on ZHEDAIYU03187）

At about 1936LT, SANCHI's GPS position was 30°48′.6N/124°57′.7E, COG 358° and SOG 10.4 kts. CF CRYSTAL at a range of 5.3 nm. The watchkeeper of ZHEDAIYU 03187 started calling SANCHI on VHF channel 16. At this time, the cursor of X-band radar was shifted to ZHEDAIYU 03187 and shortly afterwards visual AIS warning signals of CF CRYSTAL and ZHEDAIYU 03187 were displayed on SANCHI's X band radar. The triangle symbols of both targets turned red and the message "AIS COLLISION" appeared in the right lower corner of radar display. (Figure 18)

At about 1939LT, SANCHI's GPS position was 30°49′.1N/124°57′.7E, COG 358° and SOG 10.4 kts. ZHEDAIYU 03187 kept calling SANCHI on VHF radio. (Figure 19)

3/O said: *Oh, he's talking to another one. You know, never answer these calls. Because if you don't answer, it is not ok to action. But if you answer, he seems ... he confirms with you about his action. So he takes action, whatever he said in the radio and you don't understand. But if you don't answer, he shall be forced to take action to make himself clear, understand?*

AB: *And this is not complying to the rules that I must oblige…… Because we don't understand their language.*

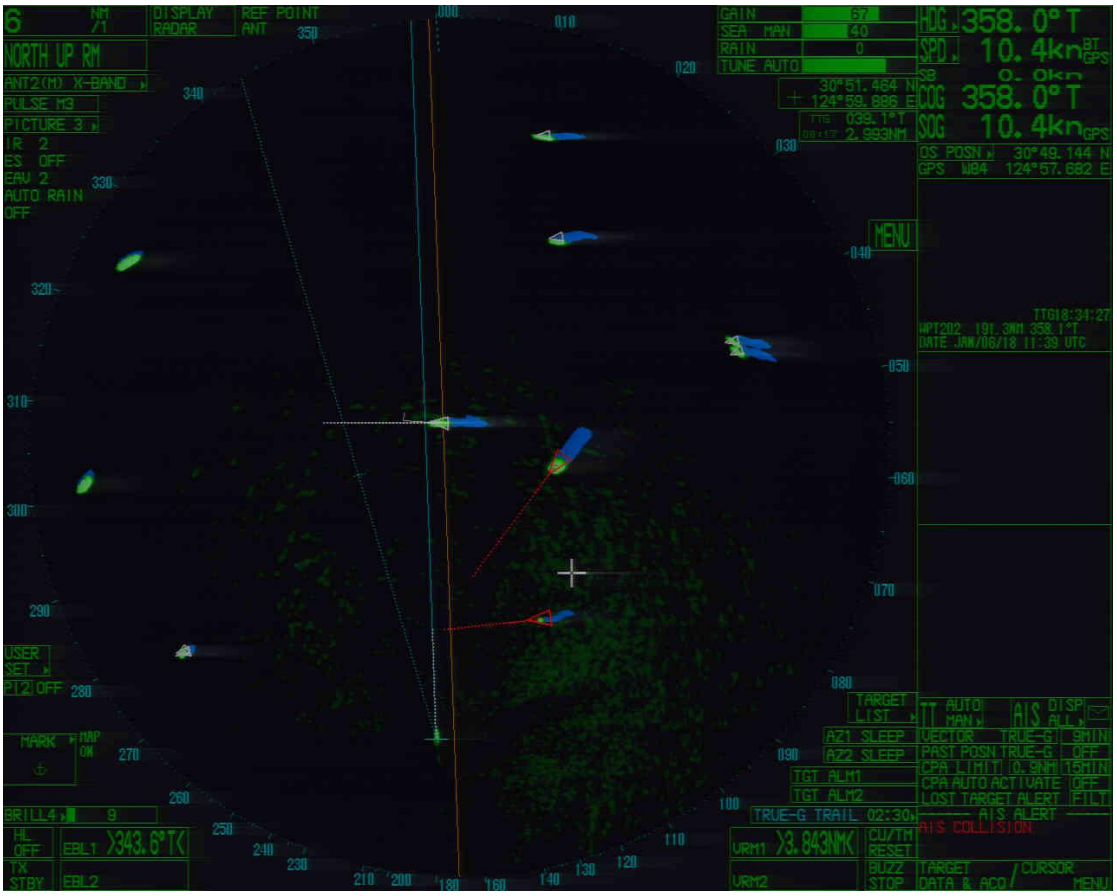


Figure 19 SANCHI's X band radar display at 1939LT

At about 1941LT, SANCHI's GPS position was 30°49′.4N/124°57′.7E, COG 358° and SOG 10.4 kts. ZHEDAIYU 03187 was around 1.8 nm away. The 3/O asked lookout to give ALDIS signal to ZHEDAIYU 03187. The OOW noticed that the fishing boat started altering its course to port side.

At about 1944LT, SANCHI's GPS position was 30°50′.0N/124°57′.6 E, COG 358° and SOG 10.5 kts. The 3/O commented that it was a hard situation.

SANCHI's X-band radar displayed AIS collision alert. (Figure 20)

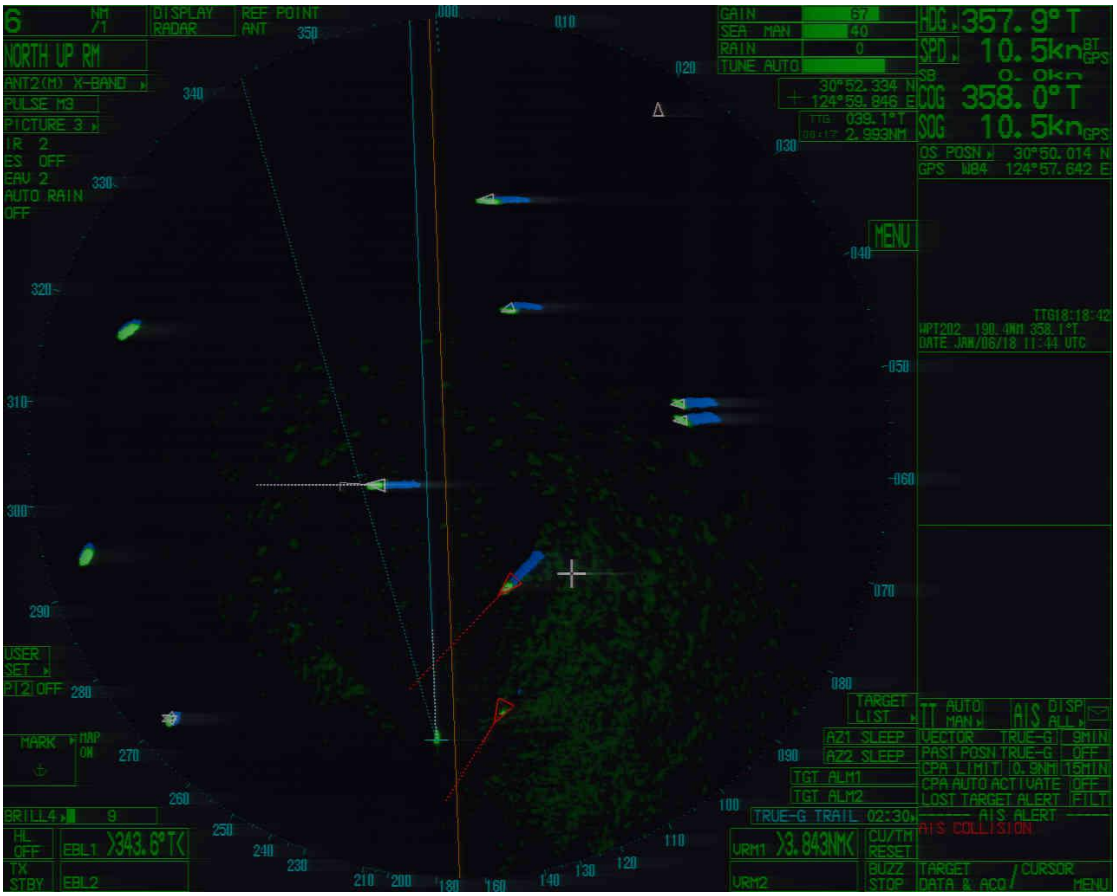


Figure 20 SANCHI's X band radar display at 1944LT

At about 1945LT, SANCHI's GPS position was 30°50′.1N /124°57′.6E, COG was 358° and SOG 10.5 kts. ZHEDAIYU 03187 was almost abeam SANCHI's starboard. The OOW of SANCHI asked AB to give ALDIS signal to CF CRYSTAL.(Figure 21) He spoke to the lookout: ...*we have this one on our starboard side. We should take action. But what action can I take in this situation? Starboard side is full.*

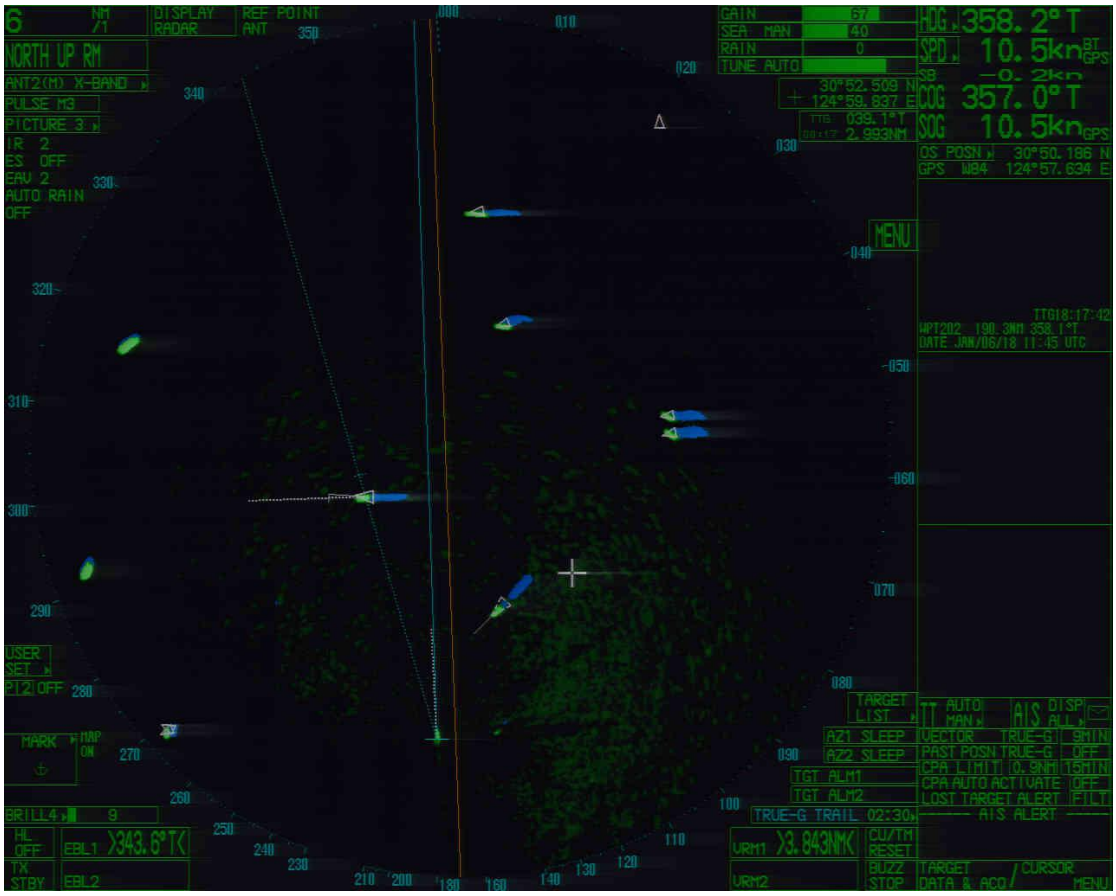


Figure 21 SANCHI's X band radar display at 1945LT

At about 1946LT, SANCHI's GPS position was 30°50′.3N/124°57′.6E, COG was 358° and SOG 10.4 kts. Fishing vessel cleared from SANCHI's stern. Signals to CF Crystal (5 short flashes by ALDIS Lamp) to attract attention. (Figure 22)

AB:*Charlie is passed, right? A little to starboard?*

3/O:*Starboard? Why?*

AB:*What's the CPA? CPA is … zero, zero.*

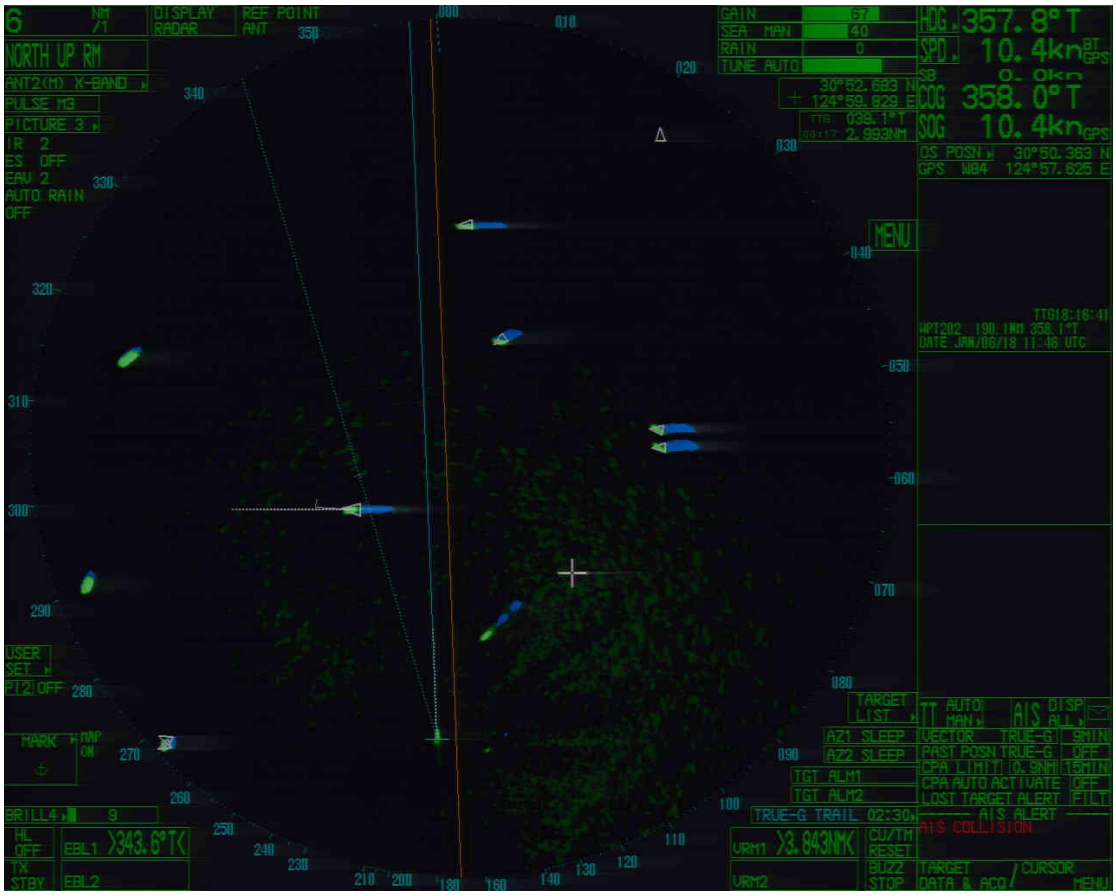


Figure 22 SANCHI's X band radar display at 1946LT

At about 1947LT, SANCHI's GPS position was 30°50′.5N / 124°57′.6E, COG was 358° and SOG 10.4 kts.

3/O: *...It's a small vessel, right?*

Lookout: *No, big vessel.*

3/O: *So why is she intending to take action like this?*

At about 1948LT, SANCHI's GPS position was 30°50′.7N / 124°57′.6E, COG was 358° and SOG 10.5 kts. (Figure 23) The 3/O called the Master and said: ... *We get a target on starboard side and CPA is zero. Distance is very short. It's a big vessel.*

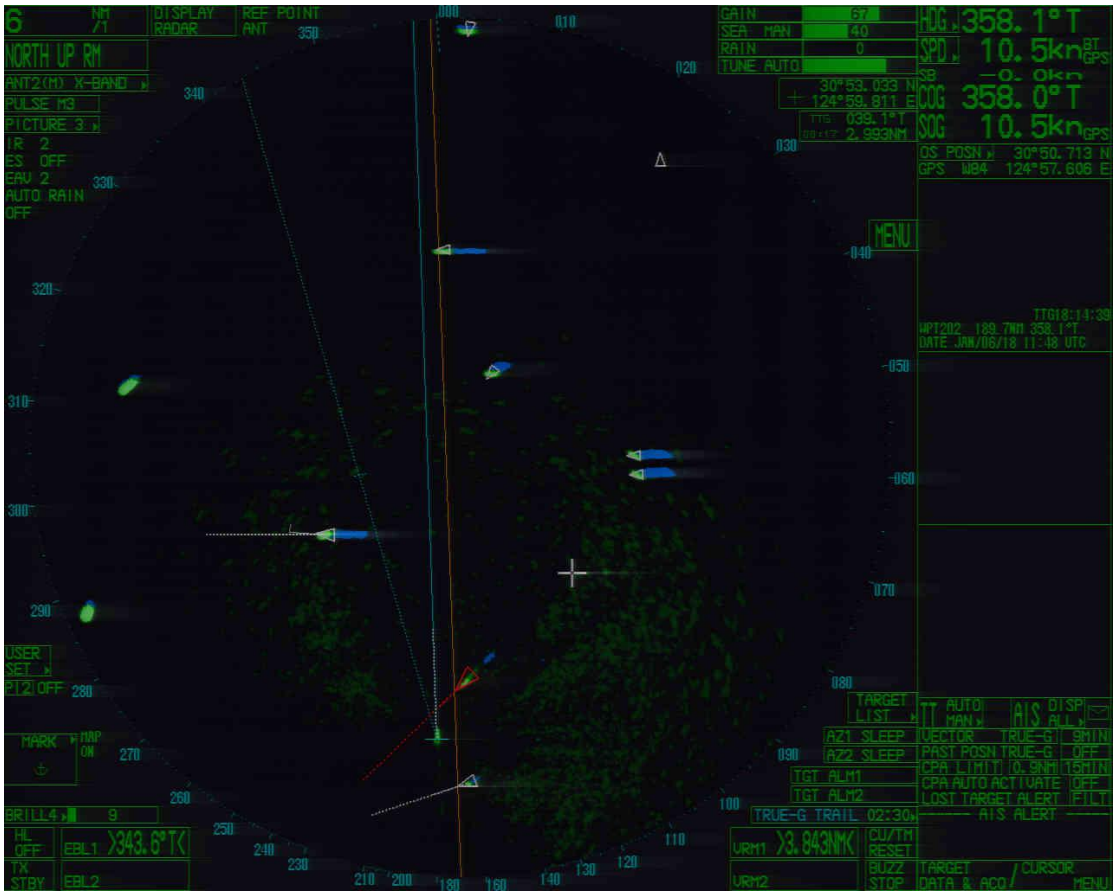


Figure 23 SANCHI's X band radar display at 1948LT

At about 1949LT, SANCHI's GPS position was 30°50′.8N / 124°57′.6E, COG was 358° and SOG 10.5 kts. (Figure 24)

3/O: *Oh, why is she not doing anything? Oh man, he's touching*

3/O: *Go to port side, full port side. Oh, man! Full starboard side, full starboard side. Full, full, please.*

Captain comes to bridge at 19:49:28LT

3/O: *Captain, she did not take any action.*

Cap: *Hard to starboard, hard to starboard.*

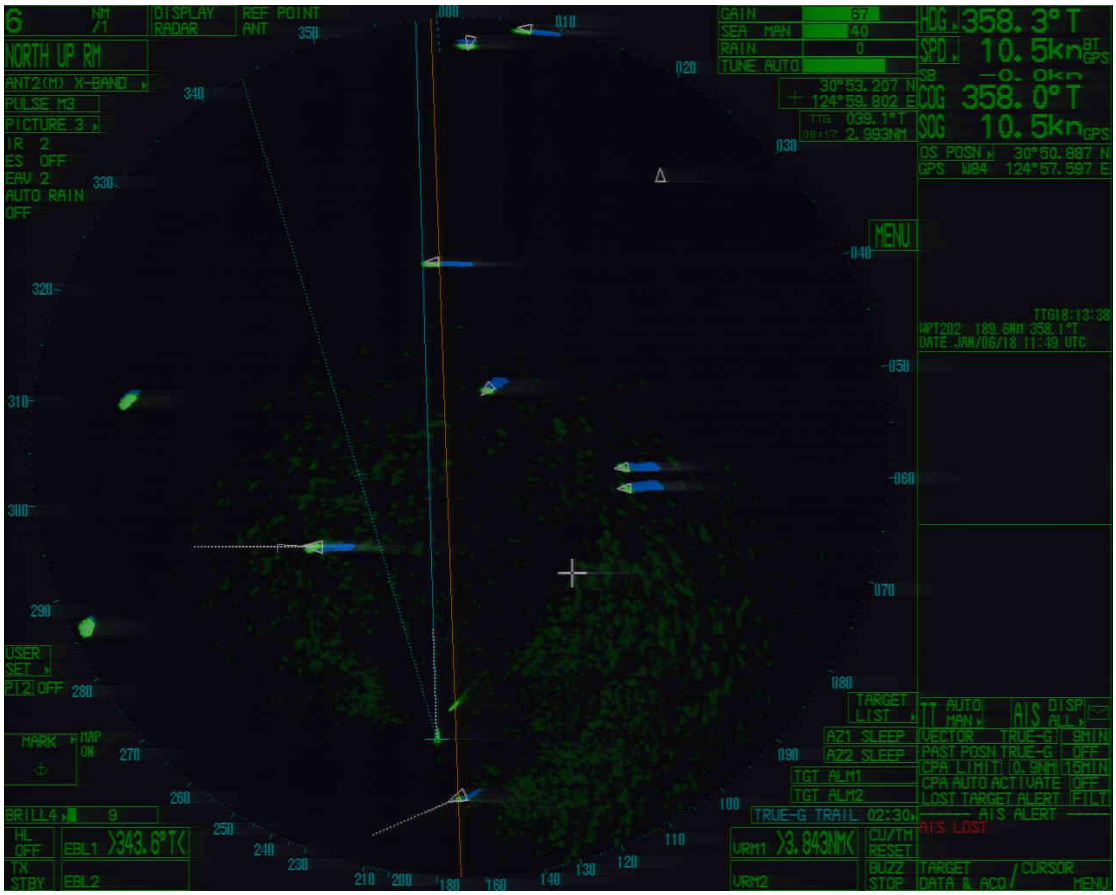


Figure 24 SANCHI's X band radar display at 1949LT

At about 1950LT, CF CRYSTAL's bow hit SANCHI's starboard side between No.2 and No.3 starboard ballast tanks and breached her cargo tanks, resulting in the leakage of condensate oil and a consequent fire and explosion. The captain requested to switch on all deck lights and ordered helmsman to steer "hard to port". Then he asked to send distress message.

At about 1951LT, Captain instructed fire pumps to be started and GMDSS activated.

At about 1952LT, explosion and fire engulfed bridge &

accommodation, followed by suffocation sounds.

At about 1953LT, GMDSS signaling stopped.

2.12.2 CF CRYSTAL

On 15 December 2017, loaded with 63,997.817 tons of sorghum in bulk, CF CRYSTAL left the loading port - Kalama, USA - and bounded for Dongguan, China. The forward and aft draughts on departure were both 13.02 m. At around 0106LT on 5 January 2018, she arrived at the outer anchorage of Busan, ROK for the replenishment of fuel oil. After the completion of bunkering, at 1430LT on 5 January 2018, she resumed her voyage toward the discharge port. The navigational lights were switched on when the vessel was underway and the RPM of main engine was 87.

At about 1200LT on 6 January, the Captain instructed to increase the main engine RPM to 100.

At about 1550LT on 6 January, the C/O and his lookout took over their bridge watch. The following navigational aids were in operation: 2 GPS, 1 AIS, 3 VHF (all on channel 16), 2 radars.

Port side X-band radar's range scale was set on 6 nm, while starboard S-band radar on 12 nm. Both radars were set head-up, relative motion, off-center display and had ARPA functions and access to AIS data and GPS planned route. The limit of deviation alarm was 1 nm.

At about 1924LT (1124UTC): Speed 13.2 kts, Heading 217°, COG 214° (as per MAERSK SHAMS VDR), radar range scale in use: 6 -nm off-center relative motion (Interview).

At about 1931LT, CF CRYSTAL's C/O saw SANCHI about 7 nm on her port side (Interview), and said*: I checked again and found that the CPA did not change, then I did not pay any more attention to that vessel.*

At about 1932LT, CF CRYSTAL's GPS position was 30°47′.9N / 124°57.7′E, COG 216° and SOG 13.2 kts. SANCHI was about 6.8 nm bearing 202°. Chief Officer found 2 CPA on radar 0.9 and 0.4 nm, he confirmed that 0.9 nm was SANCHI passing her bow (in his 2nd interview).

At about 1934LT, CF CRYSTAL's GPS position was 30°53′.9N

/ 125°00′.4E, COG 216° and SOG 13.2 kts. SANCHI was about 6.0 nm bearing 203°. The C/O said that he started to adjust the course from 217 to 225 with the intention to go back the planned passage. CF CRYSTAL deviated to port of the planned passage at that time (2nd interview).

At about 1942LT, CF CRYSTAL's GPS position was 30°52′.4N/124°59′.2E, COG 225° and SOG 13.2 kts. The OOW completed the course adjustment to 225°. SANCHI was about 3.1 nm bearing 205°. The OOW found the CPA of SANCHI's AIS target became 0.4 nm. He thought that it was a small vessel without risk of collision. The C/O did not see the radar echo of SANCHI, only by the AIS signal displayed on port radar determined the CPA with SANCHI.

At about 1943LT, CF CRYSTAL's GPS position was 30°52′.3N / 124°59′.0E, COG 223° and SOG 13.3 kts. The 3/O came up to take over his watch from the C/O. The 3/O firstly checked on the paper chart of vessel's position and surrounding situation in the chart room. Then he used port side radar to check the traffic condition and found two port side AIS targets on the X-band radar.

At about 1944LT, CF CRYSTAL's GPS position was 30°52′.1N / 124°58′.8E, COG 225° and SOG 13.3 kts. The 3/O thought SANCHI was a fishing vessel by the AIS symbol (there was no radar echo) and there was no risk of collision.
At about 1945LT, CF CRYSTAL's GPS position was 30°52′.0N / 124°58′.7E, COG 223° and SOG 13.4 kts. SANCHI was about 2.0 nm bearing 205°. The C/O took a call from the Master.

At about 1946LT, CF CRYSTAL's GPS position was 30°51′.8N / 124°58′.4E, COG 225° and SOG 13.4 kts. The C/O handed over the watch to the 3/O and he said the traffic was clear and did not tell the situation of other vessel. The 3/O did not see the signal of SANCHI. Then with the consent of the 3/O, the C/O left the bridge. Shortly after the departure of the C/O, the 3/O's lookout came to the bridge to take over his watch from previous lookout who advised him of the steady course 226° and autopilot condition before leaving the bridge.

At about 1947LT, CF CRYSTAL's GPS position was 30°51′.6N / 124°58′.2E, COG 226° and SOG 13.5 kts. The lookout reminded the 3/O that the CPA of SANCHI’s AIS target on radar was around 0.2 nm. The OOW also observed the target by radar

and thought it was a small vessel.

At about 1948LT, CF CRYSTAL's GPS position was 30 ° 51 ′ .5N / 124°58 ′ .1E, COG 226° and SOG 13.5 kts. The AB reminded the OOW the CPA of one target was 0.1 nm.

At about 1949LT, CF CRYSTAL's GPS position was 30°51′.4N/124°57′.9E, COG 226° and SOG 13.6 kts. The lookout reminded the OOW again that the CPA of the AIS target was 0.1 nm, but not aware that the target was SANCHI. Then the OOW asked his lookout to change the autopilot to hand steering and ordered to steer starboard rudder without giving a specific rudder order. The lookout reported to the OOW when the rudder angle was starboard 20.

At about 1950LT, CF CRYSTAL's GPS position was 30°51′.1N / 124°57′.6E, CF CRYSTAL's bow struck the starboard side of SANCHI between her No.2 and No.3 starboard ballast tanks and breached her cargo tanks with the angle of blow at about 48° degrees. The collision caused severe damage to CF CRYSTAL's bow and deformation of her main deck and hatch covers forward of No. 3 cargo holds. The subsequent fire caused damage to CF

CRYSTAL's port side bulwark and partial deck facilities. After the collision, the captain immediately rushed to the bridge. The telegraph was pulled to "Stop" position.

At about 1951LT, the Captain of CF CRYSTAL made a "Mayday" call on VHF channel 16 and pulled the telegraph to "Full Astern" position, mentioning that he found the situation too emergency to realize about backing up the VDR. Then he gave abandon ship order. Later the crew were evacuated through the free fall lifeboat on the stern of the vessel and rescued by the fishing boat ZHEDAIYU 03187.

3. EMERGENCY RESPONSE and SAR OPERATION

According to the information from China MRCC and Shanghai MRCC, since the receiving of alert at 1958LT on 6 January 2018 to the end of mass rescue operation at 1200LT on 15 January the total dispatched forces included professional search and rescue vessels from MSA, rescue and salvage bureaus as well as coast guard. In addition, merchant vessels, Japanese search and rescue vessels, ROK search and rescue vessels and fishing boats were coordinated in the operation. Maritime fixed wing aircrafts,

patrol aircrafts, and military UAVs were coordinated to carry out maritime and aerial search and rescue operations. One body and other wrecked objects from SANCHI such as life jackets were found at sea. (See annex E) At 1958LT on 6 January 2018, China MRCC received a call from JRCC claiming to have received an alarm from INMARSAT-C station of SANCHI and immediately notified Shanghai MRCC. Shanghai MRCC was responsible for checking the basic information and SANCHI's position, organizing and coordinating rescue vessel DONGHAIJIU 101, patrol vessel HAIXUN 01, rescue vessel DONGHAIJIU 117 to the scene where the accident happened, coordinating the East China Sea Bureau of China Coast Guard, the Coast Guard Corps of Shanghai, the Shanghai Fire Emergency Bureau for Rescue, coordinating fisheries departments of Jiangsu, Zhejiang, Shandong and Fujian provinces to contact the fishing boats nearby to offer assistance, promulgating navigational warnings in both Chinese and English and notifying the cleansing forces to be prepared.

On 7 January 2018, Shanghai MRCC coordinated and informed nearby fishing boats to expand the search area and coordinated nearby ships through MAERSK SHAMS to conduct the search

and rescue operation. At 0555LT 7 January 2018, professional rescue vessels arrived at the scene in succession. Patrol vessel HAIXUN 01 was the on-scene-commander, organizing and coordinating rescue vessels DONGHAIJIU 101, DONHAIJIU 117, ZHOUHAIGONG 5 and ROK Coast Guard 3006 to search and rescue. SANCHI listed to starboard about 21°, the fire was relatively fierce and it was impossible to approach. CF CRYSTAL crew were transferred from fishing boat ZHEDAIYU 03187 to DONGHAIJIU 101. Later, CF CRYSTAL's crew returned to their vessel and controlled the vessel.

At 0030LT on 8 January 2018, the fire on CF CRYSTAL was put out. After inspection, CF CRYSTAL sailed to Zhoushan escorted by rescue vessel DONGHAIJIU 118.

At 1044LT, the rescue vessel DONGHAIJIU 117 found one body at about 3 nm northwest to SANCHI (30°49.25'N, 124°54.92'E). At 1400LT, the Iranian bulk carrier DELNAVAZ arrived at the scene to assist the search and rescue operation.

At 0940LT on 9 January 2018, the body was transferred to the civil affairs department.

On 10 January 2018, ROK Coast Guard 5002 arrived at the scene nearby at 0800LT to assist the search and rescue. Rescue vessels DINGHAIJIU 101, SHENQIAN and DESHEN began to spray water to SANCHI. At 1300LTCF CRYSTAL safely berthed at the Laotangshan wharf in Zhoushan.

At 0800LT on 11 January 2018, military UAVs arrived at the scene to assist the search and rescue. At 1040LT rescue vessels SHENQIAN and DONGHAIJIU 117 carried out firefighting by foam. At 1143LT the Iranian ambassador in China, Iranian state television reporters and other officials arrived at Shanghai MRCC. At 1703LT fire in SANCHI reignited and expanded rapidly. At 1920LT the Japanese fire-fighting boat KOYO MARU arrived at the scene.

At 0750LT on 12 January 2018, KOYO MARU started firefighting using foam. At 0817LT, firefighting operation ended. At 0825LT, U.S. fixed-wing aircraft arrived at the scene.

At 0837LT on 13 January 2018, 4 search and rescue members from the Shanghai Salvage Bureau carried the equipment and

went to SANCHI’s stern deck via a basket of rescue vessel SHENQIAN to search the living spaces and found two bodies on the lifeboat deck. At 1100LT a 14-person delegation led by the Iranian President's special envoy, Labour Minister Mr. RABIEE visited Shanghai MRCC to acquire information on progress of the search and rescue. Iran's ambassador to China and Shanghai MRCC signed the “Communication with the Iranian Squad” on the 13th and it was determined to send Iranian squad to SANCHI on the afternoon of 13th. SHENQIAN, DONGHAIJIU 101 and DONGHAIJIU 117 continued firefighting using foam. SANCHI continued drifting to southwest at a speed about 1.1 kts.

On 14 January 2018, SHENQIAN and DONGHAIJIU 101 continued firefighting using foam. Japanese fire-fighting boat KOYO MARU sprayed water at the stern for cooling, rescue vessels HAIXUN 11 and HAIXUN 22 were at the alert near the waters where the accident happened. Navy UAV, maritime air patrol fixed-wing aircraft flew to the site to carry out search and rescue operation. 14 Iranians onboard patrol vessel HAIXUN 01 arrived at the scene. The measurement indicated that the temperature of vessel bow is about 280 ℃, amidship about

780 ℃, stern about 418 ℃ and it was impossible to get onboard SANCHI. At 0924LT SANCHI exploded. At 1230LT, SANCHI was in full fire that was raging, and half of the vessel's mast was in water. SANCHI's starboard light loadline emerged from the water. At 1300LT Shanghai MRCC promulgated another navigational warning and notified Wusong VTS and Yangshan VTS to strengthen safety information broadcast and alerts. At 1430LT the rescue vessel DONGHAIJIU 117 transported and transferred VDR and bodies of two crew members to Shanghai. At 1520LT with the joint participation of Iranian, Shanghai MSA and Shanghai Salvage Bureau, the VDR of SANCHI was sealed and kept by the Shanghai Salvage Bureau. At 1645LT on-site rescue vessel confirmed that no sight of wrecked vessel outline was visible, and the radar echo disappeared; the last known position was 28°22′N, 125 ° 55' E.

At 0855LT on 15 January 2018, the navy UAV and maritime fixed-wing aircraft took off and went to the site to continue the search. Oil spill response vessels HAIXUN 169, DONGLEI 6 and the survey ship HAIXUN 166 sailed to the site to sweep the location of the sunken vessel. The Iranian personnel returned to Shanghai with the vessel DEYI. At 0927LT the surface sustained

combustion on the site turned into a periodic combustion of oil and gas. At 0958LT the flame on the sea surface went out. After consultation with experts, the mass rescue operation ended at 1200LT on the 15th and was turned into a routine search.

4. ANALYSIS and CONCLUSION

4.1 Both vessels failed to comply with the requirements of Rule 5 of the COLREGS to maintain a proper look-out by sight and hearing as well as by all available means appropriate in the prevailing circumstances and conditions, and failed to make a full appraisal of the situation and of the risk of collision.

4.2 Both vessels failed to comply with the requirements of Rule 7 of the COLREGS to use all available means appropriate to the prevailing circumstances and conditions to determine if risk of collision exists.

4.3 Different statements were given regarding the causal factors of the accident as follows:

4.3.1 China

This accident happened in open waters with good visibility (about 10 nm). Both SANCHI and CF CRYSTAL were power-driven vessels underway. According to COLREGS, the

two vessels were in a crossing situation, in which SANCHI was the give-way vessel and CF CRYSTAL was the stand-on vessel. (Figure 25)

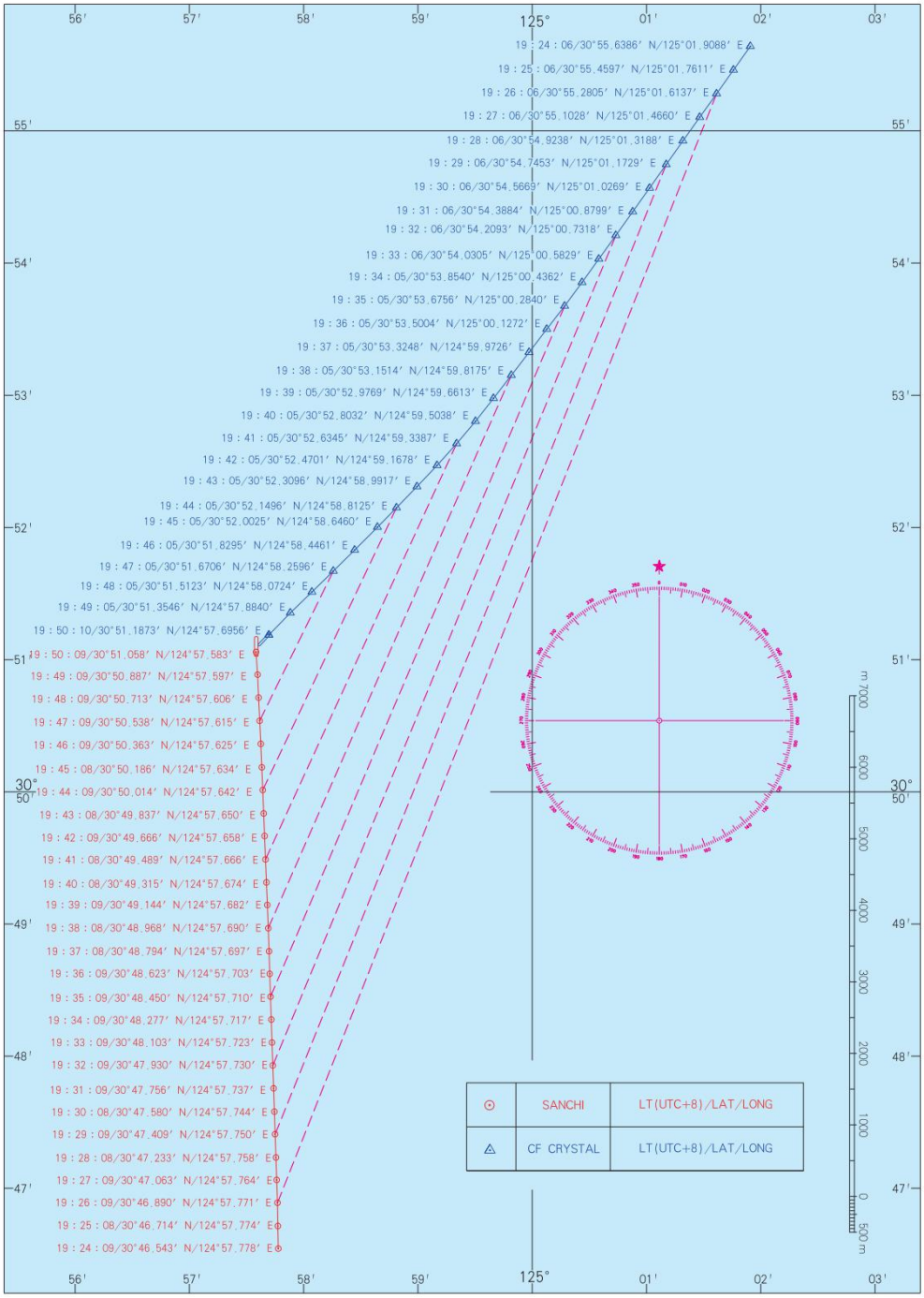


Figure 25 Navigational Tracks of SANCHI and CF CRYSTAL 1924-1950LT

1. At about 1924LT on 6 January, SANCHI's course was

357° (heading 359°) and speed 10.4 kts, CF CRYSTAL's course 216° (heading 216°) and speed 13.1 kts. CF CRYSTAL was 9.8 nm away bearing 021° with a CPA of 0.4 nm and TCPA 26.5 mins. The two vessels were approaching each other at a relatively steady bearing.

2. At about 1932LT, SANCHI's course was 358° (heading 358°) and speed 10.4 kts, CF CRYSTAL's course 216° (heading 217°) and speed 13.2 kts. CF CRYSTAL was 6.8 nm away bearing 022° with a CPA of 0.4 nm and TCPA 18.2 mins. A crossing situation was developing between these two vessels.

3. At about 1934LT, SANCHI's course was 358° (heading 358°) and speed 10.4 kts, CF CRYSTAL's course 217° (heading 217°) and speed 13.2 kts. CF CRYSTAL was 6.0 nm away bearing 022° with a CPA of 0.3 nm and TCPA 16.5 mins.

4. At about 1942LT, SANCHI's course was 358° (heading 358°) and speed 10.4 kts, CF CRYSTAL's course 223° (heading 225°) and speed 13.2 kts. CF CRYSTAL was 3.1 nm away bearing 025° with a CPA of 0 nm and TCPA 8.5 mins.

5. As the give-way vessel in the crossing situation, SANCHI

did not take actions to keep well clear of CF CRYSTAL according to Rule 15 and 16 of the COLREGS. This was the main causal factor of the collision.

6. As the stand-on vessel in the crossing situation, CF CRYSTAL failed to take actions to avoid collision according to the requirements of Rule 17 of the COLREGS. This was also a causal factor of the collision.

4.3.2 Hong Kong (China)

According to Rule 7 of COLREGS, *Risk of Collision*,

(d) In determining if risk of collision exists, the following considerations shall be among those taken into account:

(i) Such risk shall be deemed to exist if the compass bearing of an approaching vessel does not appreciably change.

(ii) Such risk may sometimes exist even when an appreciable bearing change is evident, particularly when approaching a very large vessel or a tow or when approaching a vessel at close range.

According to the timeline agreed by all parties:

At 1924LT, CF CRYSTAL was first observed by SANCHI at a distance of about 9.8 nm and bearing about 021°

At 1935LT, CF CRYSTAL's distance was about 5.4 nm and bearing was about 023°

At 1945LT, CF CRYSTAL range was about 2nm and bearing about 025°

Based on the fact above, the bearing of the approaching vessel not changing appreciably, it was concluded that the Risk of Collision existed since the first time CF CRYSTAL was observed by SANCHI according to COLREG Rule 7 (d) (i) and (ii).

According to Rule 15 of COLREGS, *Crossing Situation*,

When two power-driven vessels are crossing so as to involve risk of collision, the vessel which has the other on her own starboard side shall keep out of the way and shall, if the circumstances of the case admit, avoid crossing ahead of the other vessel.

Since SANCHI had CF CRYSTAL on her own starboard side and risk of collision existed in a crossing course since 1924 LT, she should have kept out of the way and should have, if the circumstances of the case admitted, avoided crossing ahead of the other vessel. But, SANCHI did not take actions as required. This was the main factor contributing to the collision.

According to Rule 16 of COLREGS, *Action by Give-way Vessel,*

Every vessel which is directed to keep out of the way of another vessel shall, so far as possible, take early and substantial action to keep well clear.

As the give-way vessel in this crossing situation of Rule 15, SANCHI did not take actions as required. This was the main factor contributing to the collision.

According to Rule 17 of COLREGS, *Action by Stand-on Vessel,*

(a) (i) Where one of two vessels is to keep out of the way the other shall keep her course and speed.

(ii) The latter vessel may however take action to avoid collision by her manoeuvre alone, as soon as it becomes apparent to her that the vessel required to keep out of the way is not taking appropriate action in compliance with these Rules.

(d) This Rule does not relieve the give-way vessel of her obligation to keep out of the way.

As the stand-on vessel in this crossing situation of Rule 15, CF CRYSTAL did not take action as requirement of (a) (ii) of Rule 17 while SANCHI did not take avoiding action. Anyway, this

did not relieve the give-way vessel - SANCHI - of her obligation to keep out of the way.

Other findings:

(1) During avoiding collision with small vessels, the 3/O attitude was negative. He expected the small vessels to take action even SANCHI was a give way vessel.

(2) Before the accident, the AB on duty repeatedly reminded the 3/O to take action, but the latter was too confident and did not take action.

(3) The 3/O stayed in the chart room for too long, leaving only the AB as the sole lookout in the bridge.

(4) 3/O talked with the AB about things that had nothing to do with navigation.

(5) There were 20 to 25 degrees differences of COG and 2 to 3 knots differences of SOG between the SANCHI's AIS information received by other vessels and the readout of SANCHI's VDR.

4.3.3 The Islamic Republic of Iran (representing Bangladesh as well) and Panama

4.3.3.1 Main causal factor

1. Alteration of CF CRYSTAL's course to starboard starting 15 minutes prior to the collision developed the situation into a collision, which would have otherwise been clear.

4.3.3.2 Contributory Factors

1. CF CRYSTAL's watchkeeping personnel had not noticed the SANCHI's presence up to the time of collision.
2. Both of the vessels had not noticed the change in navigational status of the other.
3. AIS had been used on board CF CRYSTAL as the sole means of collision avoidance.
4. CF CRYSTAL had not noticed the flashing signals given by the SANCHI.
5. No proper hand-over/take-over had occurred between the CF CRYSTAL's whatchkeeping personnel.
6. Improper use of the AIS was observed as a navigational aid in not identifying the surrounding vessels.

5. ACTION TAKEN

5.1 Action by Flag States

5.1.1 Panama

Panama Maritime Authority evaluated the ISM procedure of NITC, as operating company of M/T SANCHI. The evaluation was done with the purpose of verifying the compliance with the ISM Code and also to seek whether they have a room to improve their manual and procedures, to assure the safety onboard their operated vessel, considering that recent collision and later sinking of the vessel. The evaluation included all the ISM Manual paying much attention on key areas that may have relevant information related to the accident. Marine Operation Manual (MOM), Owner Manual (OM), Quality Management Manual (QMM) and Safety Management Manual (SMM) were evaluated. After a deep and detailed evaluation of the NITC ISM Manual, a conclusion was made that the ISM Manual was in compliance with ISM code and international regulations. Panama Maritime Authority will do further evaluation after finalized outcome of the join safety investigation and, in case, Panama Maritime Authority will provide recommendations to NITC to improve the ISM procedure of the company.

5.1.2 Hong Kong (China)

The officer of Marine Department of Hong Kong (China) visited the management company of CF CRYSTAL on 27 March 2018, he conducted a presentation for PSC results & measures of Hong Kong registered ships, discussing on manning issues and the company agreed to enhance their officers / crew management including watchkeeping arrangement.

The immediate follow-up action of circulating the accident to their fleet for alerting their crew members was received by Marine Department of Hong Kong and the joint investigation team.

5.2 Action by Substantially Interested States

5.2.1 China

a. Issuing navigation warnings to set restricted areas and monitoring closely to prevent secondary accidents.

(i) After the accident, an area to be avoided was set around SANCHI with a radius of 10 nm. Navigation warnings were continuously broadcast in Chinese and English, in order to remind passing ships to avoid entering the area and prevent

secondary accidents.

(ii) A comprehensive and close monitoring was available on the floating and drifting state of SANCHI, as well as the state of fire and oil pollution by various scientific and technological means including a real-time live broadcast.

b. Proper coordination of foreign parties to stabilize the situation.

The accident involved Iran, Bangladesh, Panama and other interest-related countries as well as Japan, South Korea and other neighboring countries. The Chinese government properly coordinated all parties involved to deal with related affairs and actively conducted external publicity to ensure the overall situation was smooth and steady.

5.2.2 Islamic Republic of Iran (representing Bangladesh as well)

The Islamic Republic of Iran took the following actions after the accident:

1. Establishing an emergency response team, immediately after being notified about the accident, supervised by the highest governmental level (Cabinet members), and composed of all related entities.

2. Taking its maximum efforts to support SANCHI’s seafarers' families.
3. Establishing a casualty investigation committee, including independent technical experts to support Iranian investigators in the joint safety investigation.
4. Requesting NITC (as a management company of Iranian flagged vessels) to conduct additional ISM Audits to ensure preventive actions.
5. Reviewing seafarers training policies and procedures (by PMO) in order to improve training standards for Iranian seafarers.

5.3 Action by Shipping Companies

5.3.1 The Management Company of SANCHI

1. Reaching an agreement with Shanghai MSA on the night of the accident through their Shanghai office, and providing all required information about ship particulars, cargo and crew.
2. Sending adequate notice to all fleet vessels under management to take preventive actions.

3. Reviewing the Company's SMS to improve management system for preventive actions.

4. Amending the bridge team management procedure for the vessels transiting the area by changing the manning level.

5.3.2 The Management Company of CF CRYSTAL

After the accident, Shanghai CP International Ship Management Co., Ltd. took the following safety measures:

a. Immediately notifying all ships under management to strictly abide by the COLREGS.

After the accident, the company immediately notified the fleet to ensure all ships strictly obeyed the COLREGS at all times, maintained a proper lookout and took timely and effective collision avoiding actions.

b. Strengthening the training and assessment on crew's professional skills.

(i). Comprehensively evaluating the employed seafarers, including their professional abilities and qualifications. Only those meeting the evaluation conditions can be included in the list to be assigned.

(ii). Carrying out a pre-job training on the crews to be dispatched before their boarding, especially the officers. The

captain and officers must take an examination of the COLREGS. If failed, they will not be assigned.

(iii). Strengthening the training and assessment of crew members on board a ship.

(iv). Ensuring assessments and training on crew members are carried out by captains and engineers in charge during the onboard inspections.

c. Strengthening the monitoring and guidance on ships.

Strengthening the safe navigation monitoring on ships, and closely maintaining follow-up and guidance for ships sailing through special water areas, complex water areas and strange ports.

d. Further improving the company's safety management system.

Further specifying details of the operational requirements and procedures related to navigation safety and duty rules.

e. Further carrying out case analysis and lessons to learn.

Collecting various information of accidents related to navigation safety in the first time, including video and text, so as to remind the fleet of safty issues.

5.4 Action by Classification Societies

5.4.1ABS:

The ABS surveyor attended on board CF CRYSTAL on 13 January 2018:

1) No deficiencies were observed by the attending ABS surveyor during this survey relating to possible Safety Management System failures.

2) Damage survey was carried out on 13 January 2018 and damage survey report was issued;

3) The attending ABS surveyor recommended that the vessel be placed in a repair facility for further examination upon completion of unloading and be repaired to the satisfaction of attending surveyor, and

4) The attending ABS surveyor also recommended that repairs be effected and re-examined to the satisfaction of attending surveyor prior to the vessel leaving the repair port.

6. RECOMMENDATIONS

Based on the investigations and facts provided above, this Joint Safety Investigation Team recommends that

1. An IMO Model Course on Bridge Resource Management be developed and implemented by Member States, with regular revisions.
2. For vessels carrying special types of cargoes, lights and

day signals be defined in Part C of COLREGS, and special conditions and privileges be stipulated for such vessels in Rule 18 of the mentioned convention.

3. Cargo handling requirements of condensate oil be further discussed by IMO, in order to promote related practices, including AIS warning messages ("Keep away over one mile"), etc.

4. Means be provided to contain inert gas pressure for tanks which are not breached.

5. Effectiveness of training, drills and exercises be verified through reviewing the ISM system for further enhancement in particular of the areas of Bridge watch handover procedures.

The safety management system shall include the clear instructions regarding the operation of bridge equipment and especially establish rules when the visual and/or audio alarm can be switched off.

6. Shipping companies develop and implement procedures for backing up VDR information at the time of near misses and accidents.

7. Choke points and navigational congested areas be identified, and regional cooperation be maintained by the

littoral States at the time of maritime search and rescue and salvage operations.

8. Crew, watchkeeping officers and ratings be required not to rely on only one source of navigation information, and to use all the navigational aids available on board.

9. Further research be conducted by IMO on the performance standards of AIS access, with full consideration of technical developments of GNSS, whose accuracy and stability can satisfy aids to navigation requirements. It is also recommended that research be conducted on the feasibility of considering GNSS as major data sources for vessel's AIS speed and course.

ANNEX

Annex A Cooperation Agreement on Safety Investigation

Cooperation Agreement on Safety Investigation into the Collision between SANCHI and CF CRYSTAL on 6th January 2018 in East China Sea

At about 1950 on 6th January 2018 Beijing time, a collision happened between Panama-flagged tanker SANCHI and Hong Kong-flagged bulk carrier CF CRYSTAL in East China Sea. Immediately after the accident, fire and explosions broke out on board SANCHI and kept burning until 14th January when she sank; as a result, oil pollution occurred, 29 crew members went missing and 3 dead (30 Iranian and 2 Bangladeshi nationalities). CF CRYSTAL sustained extensive structural damages to her bow, extensive burn damages to other areas, and got alongside in terminal Laotangshan of Zhou Shan Port on 10th January.

In accordance with IMO's 《Code of the International Standards and Recommended Practices for a Safety Investigation into a Marine Casualty or Marine Incident》 (hereinafter referred to as the Code), based on friendly communication, a cooperation agreement on safety investigation into the collision between SANCHI and CF CRYSTAL on 6th January 2018 in East China Sea (hereinafter referred to as the Safety

Investigation), is mutually agreed between China, Islamic Republic of Iran, Panama and Hong Kong (China). The agreement is as follows:

1. Investigating States (Region)

In accordance with paragraph 7.2 of the Code, China, Islamic Republic of Iran, Panama and Hong Kong (China) are the investigating states （Region） of the subjected accident.

Considering the factors mentioned in chapter 18 of the Code, and considering the fact that China MRCC has been coordinating the emergency response to the accident, that survival ship and her crew are in China, and that China has plenty of investigating resource for the case, China Maritime Safety administration will leadthe safety investigation into the collision between SANCHI and CF CRYSTAL on 6th January 2018 in East China Sea, while Iran, Panama and Hong Kong (China) will participate in the Safety Investigation.

Meanwhile, the conduct the Safety Investigation referred to in this agreement will not prejudice the right of the above investigating states to conduct their own parallel investigations in the nature of civil, administrative etc.

2. Investigation Cooperation

Each investigating state shall co-operate with other investigating states to

the extent practicable, and shall provide for the participation of other investigating states to the extent practicable.

3. Confidentiality of Information

After the signing of this agreement, each investigating state shall ensure that any marine safety record in its possession during this safety investigation is not disclosed in criminal, civil, disciplinary or administrative proceedings, unless under the situation listed in paragraph 23.2 of the Code. During the process of the Safety Investigation, each investigating state shall guarantee not to disclose information related to the investigation.

4. Safety Investigation Report

China Maritime Safety Administration, the leading investigating state, will be responsible for writing theSafety Investigation Report, and will send the draft report to other investigating states for comments in accordance with chapter 13 of the Code, and will submit the final report to IMO after agreed by investigating states in accordance with chapter 14 of the Code.

5. Re-opening of Investigation

If after completion of the Safety Investigation, any states find new

significant evidence, which may materially alter the analysis and conclusions reached by the Safety Investigation, such evidence should be sent to other investigating states, and fully assessed by all investigating states. Safety investigation may be re-opened upon the agreement of all investigating states.

6. Other Issues

Should issues that are not covered in this agreement arise, the investigating states shall communicate and act in compliance with the Code.

7. Authorized Investigators

A list of all authorized investigators nominated by the investigating states, and their contact information are provided in the appendix to this agreement.

China Maritime Safety Administration：

Iran Ports and Maritime Organization：

Panama Maritime Authority：

Marine Department of Hong Kong, China:

January 2018

Annex B Minutes of the Meetings on Joint Safety Investigation

Minutes of the First Meeting on Joint Safety Investigation into the Collision between SANCHI and CF CRYSTAL on 6th January 2018 in East China Sea

From 28th February to 2nd March 2018, the First Meeting on Joint Safety Investigation into the Collision between SANCHI and CF CRYSTAL on 6th January 2018 in East China Sea was held in Shanghai, China. A total of 22 delegates from China, Islamic Republic of Iran, Panama and Hong Kong, China attended the meeting. The Delegates form four States (Region) introduced the accident investigation and evidence collection progress, exchanged evidence, and determined the next step work plan. Chinese delegates also introduced search and rescue and emergency response measures after the accident. IMO Assistant Secretary-General Mr. Lawrence Barchue attended the first day of the meeting and delivered a speech. All delegates highly appreciated China's efforts in search and rescue and emergency response and expressed gratitude to Chinese government. The minutes of the meeting are as follows:

1. Meeting Content

1.1 The delegates from four States (Region) introduced the investigation progress of the accident so far, exchanged relevant evidence collected and discussed the issues of concern. Iranian delegate stated that Bangladesh, as a substantially interested State, had authorized Iran to conduct the safety investigation on her behalf. Iran will provide the official authorization letter after the meeting.

1.2 The delegates from four States (Region) introduced and discussed the readout of SANCHI’s VDR data respectively. They also discussed the recovery feasibility of CF CRYSTAL’s VDR data during accident period.

1.3 Chinese delegates introduced the readout of VDR data obtained from third-party vessels. The delegates from four States (Region) discussed 20 to 25 degrees

differences of COG and 2 to 3 knots differences of SOG between the SANCHI's AIS information received by other vessels and the readout of SANCHI's VDR. This matter will be dealt with in the future.

1.4 At the request of Iran, the technician from Shanghai Seven Seas Electronics Co., Ltd., in the witness of four parties and ship owner, carried out the unsealing, data downloading covering the period from 1401 UTC 6th January 2018 to 0301 UTC 7th January 2018 (all data in the hard disc) and re-sealing of the VDR hard disc of CF CRYSTAL.

1.5 At the meeting, China provided the following investigation evidence to the other three parties:

a) The readout of Audio data from SANCHI's VDR from 1855 to 1950 on 6th January 2018,

b) DVD containing VDR data of MAERSK SHAMS and TRF MONGSTAD and the readout AIS data of two vessels in the accident,

c) Comprehensive data list and collision diagram of two vessels in the accident,

d) DVD containing emergency response pictures and video data, and

e) A list of relevant evidence to be provided by Iran.

1.6 Iran provided their own findings. The other three parties considered that such findings shall be discussed in the next meeting.

a) 1137 UTC, the CPA is 0.3 crossing stern of SANCHI,

b) 1137 UTC, the course of CF CRYSTAL changed from 217 to 225,

c) 1145 UTC, the new course of CF CRYSTAL is 225,

d) 1147 UTC, the ALDIS alarm signal containing five flashes were given to CF CRYSTAL,

e) 1148 UTC, SANCHI's Third Officer called Master,

f) 1150 UTC, collision happened,

g) 1143 UTC, CF CRYSTAL's Third Officer went to bridge,

h) 1145 UTC, CF CRYSTAL's Chief Officer left bridge,

i) Collision happened when CF CRYSTAL's speed was 13.2 knots, and 10.5 knots of SANCHI,

j) After the collision, Master of CF CRYSTAL came to bridge, he stopped engine

and full astern,

k) On CF CRYSTAL they didn't stopped VDR, neither did they take VDR and abandoned vessel,

l) The source of information for analyzing the situation includes SANCHI's VDR, the other vessels' VDR and crew's interviews.

1.7 All parties have decided that the next cooperation meeting will be held in Shanghai. A preliminary agreement on the timing and content has been reached.

2. Consensus Achieved on the Following Issues:

2.1 The certificates of two vessels in the accident and their crew are valid.

2.2 This accident occurred in open waters with good visibility. SANCHI and CF CRYSTAL were involved in a crossing situation as defined in the International Regulations for Preventing Collisions at Sea, 1972. The time when crossing situation existed will be discussed at next meeting.

2.3 The accident occurred at 1950 on 6th January 2018 and the accident location was 30 ° 51'.1N / 124 ° 57'.6E.

2.4 The hard disc of CF CRYSTAL's VDR data was sealed for future use. Currently the overwritten data on the hard disc would not be destructively recovered.

3. Next Step Work Plan

3.1 Supplementary interviews are to be given to the relevant crew of CF CRYSTAL including Captain, Chief Officer, Third Officer and two Able Seamen.

3.2 China will analyze the emergency response and search and rescue work carried out, and put forward corresponding recommendations for improvement.

3.3 Iran is to provide detailed information on the characteristics and transport management of condensate oil cargo, and to propose corresponding safety recommendations in respect of the structure and safety facilities for ships carrying cargoes of this kind.

3.4 Proposals for improvements are to be made by Panama and Hong Kong, China on bridge watchkeeping, crew competency requirements and bridge resource management.

3.5 Panama is responsible for the evaluation of the operation of SANCHI's ISM system and shall propose precautionary measures for the transport of dangerous goods

such as condensate oil.

3.6 Hong Kong, China is responsible for the evaluation of the operation of CF CRYSTAL's ISM system and shall propose corresponding measures for improvements.

3.7 All parties should also actively participate in the investigation matters that were not covered in this meeting.

3.8 All parties shall start in-depth analysis of the causal factors of the accident and send the results of analysis to the designated liaisons by the end of March.

3.9 All parties should notify Mr. Xu Xiewei, the meeting liaison, of matters requiring discussion at the next meeting before the end of March.

3.10 After the meeting, Iran is responsible for reporting relevant information about this meeting to Bangladesh.

Participants:

China:

Islamic Republic of Iran:

Panama:

Hong Kong, China:

Minutes of the Second Meeting on Joint Safety Investigation into the Collision between SANCHI and CF CRYSTAL on 6th January 2018 in East China Sea

From 24th to 28th April 2018, the Second Meeting on Joint Safety Investigation into the Collision between SANCHI and CF CRYSTAL on 6th January 2018 in East China Sea was held in Shanghai, China. A total of 24 delegates from China, Islamic Republic of Iran (also representing Bangladesh), Panama and Hong Kong, China attended the meeting. The meeting reviewed the matters from last meeting and its minutes; each party introduced their activities since last meeting, carried out discussion on the draft investigation report prepared by China and timeline of the accident by Iran. The minutes of the meeting are as follows:

1. Meeting Content

1.1 China presented the draft report on investigation into collision between SANCHI and CF CRYSTAL, then the 4 parties carried out in-depth discussion paragraph by paragraph, agreed on the modification and revision about the draft report.

1.2 A workgroup joined by delegate(s) from each party was established, and carried out in-depth discussion on the Timeline of the collision prepared by Iran, agreed on the modification and revision about the

Timeline.

1.3 Iran introduced the characteristics of cargo condensate oil, then the meeting discussed about the difficulties of effectively responding to large scale fire and explosion on board tankers carrying this type of cargo in large quantity.

1.4 China introduced about the error of ship's AIS data transmitted from SANCHI.

1.5 Panama presented its evaluation of ISM procedure of National Iranian Tanker Company; Iran and Panama presented safety recommendations and actions taken after the accident; Hong Kong China presented its safety recommendations and action taken by the class and manager of CF CRYSTAL after the accident; Iran presented delegation letter from Bangladesh.

1.6 Additional documents about the two accident ships were presented between each other.

2. Consensus Achieved on the Following Issues:

2.1 After discussion and modification, the 4 parties agreed on the back ground information in the draft report prepared by China, such as accident summary, ships' manning, information of companies,

environmental conditions and etc; terminology and times were unified in the report.

2.2 In accordance with IMO Casualty Investigation Code, the safety investigation report of the accident is based on the determined accident facts, analyzes the causes, and develops safety recommendations to prevent similar accidents from happening again; the report does not apportion liabilities, cannot be used in any civil proceedings. Any one participated the investigation and cooperation meetings as investigator or government consultant shall not get involved in any civil proceedings of the accident in any way, such as expert witness, legal counselor and etc; shall not provide accident information to any person or entity.

2.3 Regarding the causal factors of the accident, following 3 points were raised and discussed:

(1) Both ships failed to keep proper lookout as required by rule 5 of the COLREG 1972; this is agreed by all parties.

(2) Both ships failed to determine if risk of collision existed as required by rule 7 of the COLREG 1972; this is agreed by all parties.

(3) Regarding other causal factors, all parties fully expressed their opinions.

2.4 Based on the draft report prepared by China, after revision and modification, the safety investigation report of the collision between SANCHI and CF CRYSTAL happened on 6th January 2018 in East China Sea was agreed on； during the meeting, each party fully expressed their opinions under a fair, just, equal and transparent environment.

2.5 All parties agreed to consider submitting a joint proposal to MSC100 as a possible way to share the experience of this joint safety investigation.

Participants:

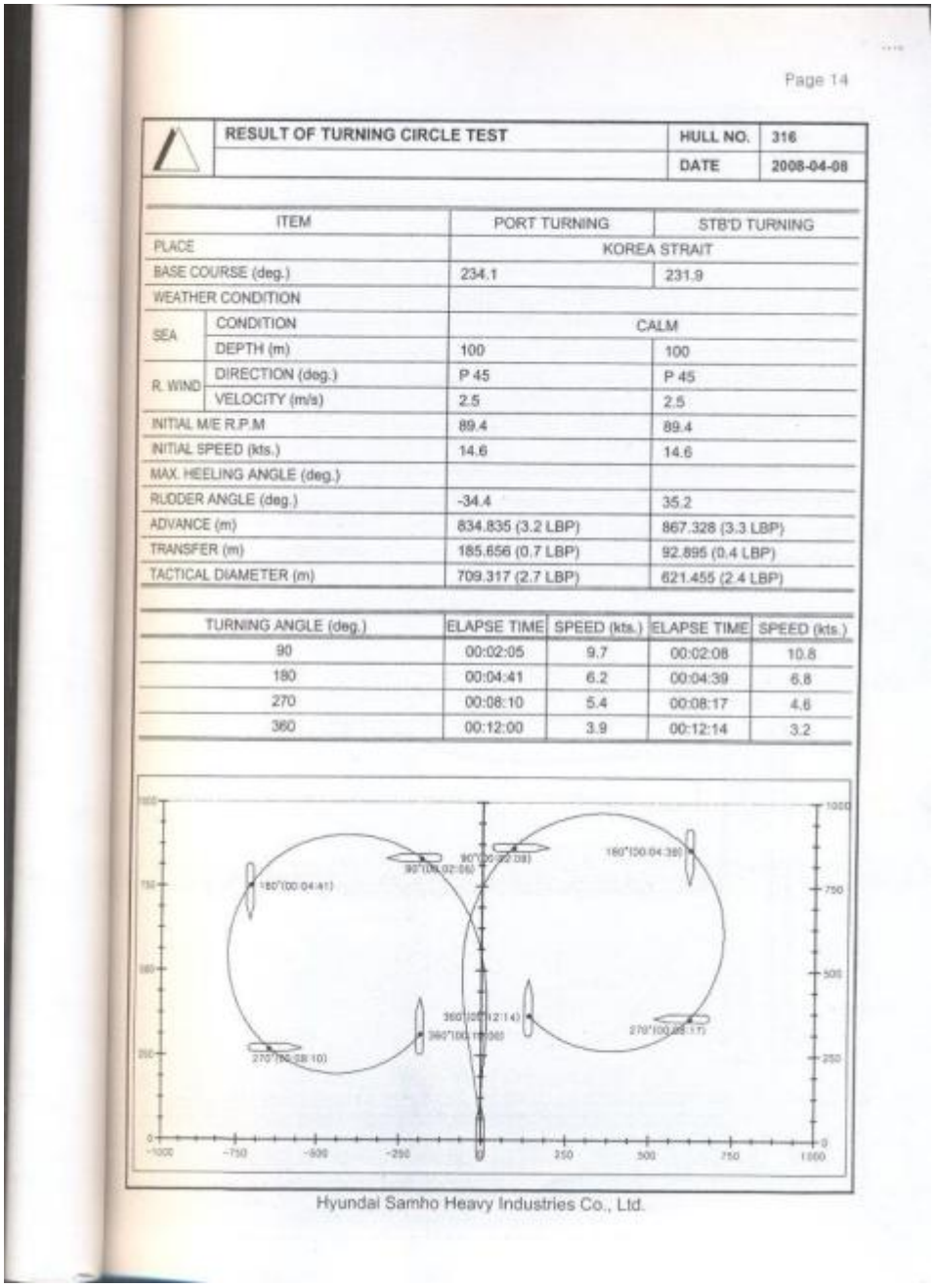
China:

Islamic Republic of Iran
(also representing Bangladesh):

Panama:

Hong Kong, China:

Annex C Maneuverability of SANCHI and CF CRYSTAL



Page 14

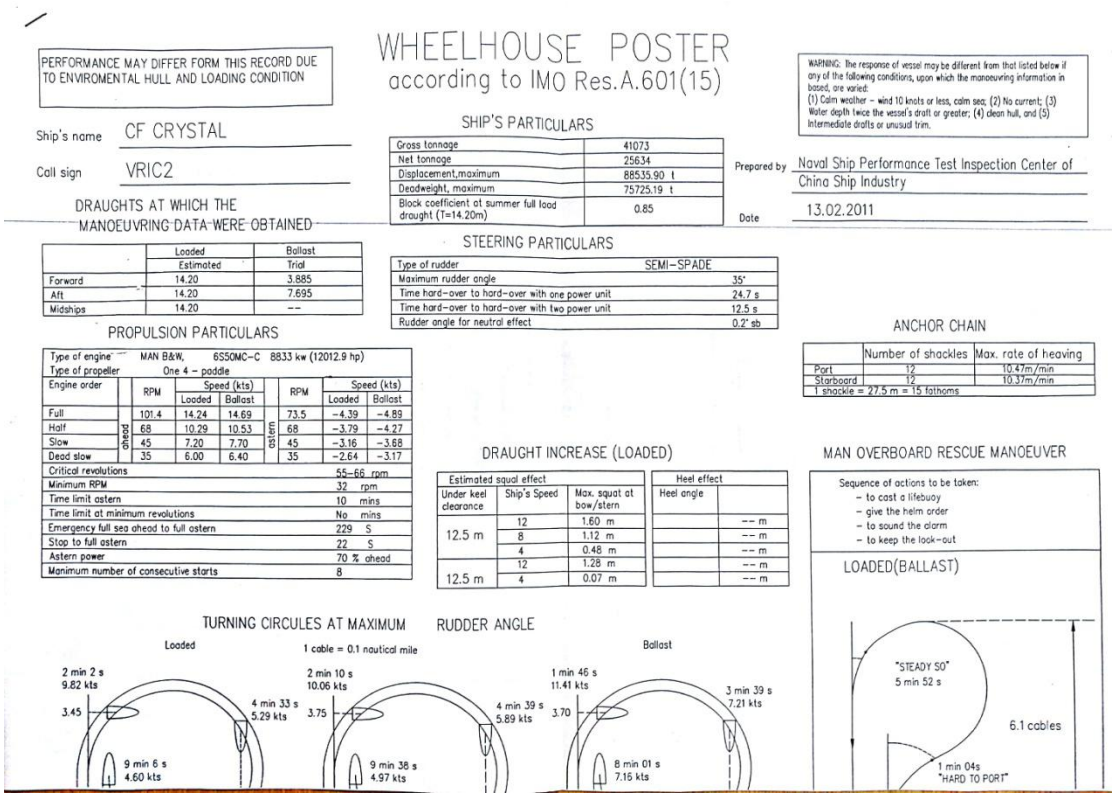
RESULT OF TURNING CIRCLE TEST	HULL NO.	316
	DATE	2008-04-08

ITEM		PORT TURNING	STB'D TURNING
PLACE		KOREA STRAIT	
BASE COURSE (deg.)		234.1	231.9
WEATHER CONDITION			
SEA	CONDITION	CALM	
	DEPTH (m)	100	100
R. WIND	DIRECTION (deg.)	P 45	P 45
	VELOCITY (m/s)	2.5	2.5
INITIAL M/E R.P.M		89.4	89.4
INITIAL SPEED (kts.)		14.6	14.6
MAX. HEELING ANGLE (deg.)			
RUDDER ANGLE (deg.)		-34.4	35.2
ADVANCE (m)		834.835 (3.2 LBP)	867.328 (3.3 LBP)
TRANSFER (m)		185.656 (0.7 LBP)	92.895 (0.4 LBP)
TACTICAL DIAMETER (m)		709.317 (2.7 LBP)	621.455 (2.4 LBP)

TURNING ANGLE (deg.)	ELAPSE TIME	SPEED (kts.)	ELAPSE TIME	SPEED (kts.)
90	00:02:05	9.7	00:02:08	10.8
180	00:04:41	6.2	00:04:39	6.8
270	00:08:10	5.4	00:08:17	4.6
360	00:12:00	3.9	00:12:14	3.2

Hyundai Samho Heavy Industries Co., Ltd.

SANCHI



WHEELHOUSE POSTER
according to IMO Res.A.601(15)

PERFORMANCE MAY DIFFER FORM THIS RECORD DUE TO ENVIROMENTAL HULL AND LOADING CONDITION

WARNING: The response of vessel may be different from that listed below if any of the following conditions, upon which the manoeuvring information in based, are varied:
(1) Calm weather – wind 10 knots or less, calm sea; (2) No current; (3) Water depth twice the vessel's draft or greater; (4) clean hull, and (5) Intermediate drafts or unusual trim.

Ship's name CF CRYSTAL

Call sign VRIC2

Prepared by Naval Ship Performance Test Inspection Center of China Ship Industry

Date 13.02.2011

SHIP'S PARTICULARS

Gross tonnage	41073
Net tonnage	25634
Displacement,maximum	88535.90 t
Deadweight, maximum	75725.19 t
Block coefficient at summer full load draught (T=14.20m)	0.85

DRAUGHTS AT WHICH THE MANOEUVRING DATA WERE OBTAINED

	Loaded Estimated	Ballast Trial
Forward	14.20	3.885
Aft	14.20	7.695
Midships	14.20	--

STEERING PARTICULARS

Type of rudder	SEMI-SPADE
Maximum rudder angle	35°
Time hard-over to hard-over with one power unit	24.7 s
Time hard-over to hard-over with two power unit	12.5 s
Rudder angle for neutral effect	0.2° sb

PROPULSION PARTICULARS

Type of engine MAN B&W, 6S50MC-C 8833 kw (12012.9 hp)
Type of propeller One 4 – paddle

Engine order		RPM	Speed (kts) Loaded	Speed (kts) Ballast		RPM	Speed (kts) Loaded	Speed (kts) Ballast
Full	ahead	101.4	14.24	14.69	astern	73.5	-4.39	-4.89
Half	ahead	68	10.29	10.53	astern	68	-3.79	-4.27
Slow	ahead	45	7.20	7.70	astern	45	-3.16	-3.68
Dead slow	ahead	35	6.00	6.40	astern	35	-2.64	-3.17

Critical revolutions	55–66 rpm
Minimum RPM	32 rpm
Time limit astern	10 mins
Time limit at minimum revolutions	No mins
Emergency full sea ahead to full astern	229 S
Stop to full astern	22 S
Astern power	70 % ahead
Manimum number of consecutive starts	8

ANCHOR CHAIN

	Number of shackles	Max. rate of heaving
Port	12	10.47m/min
Starboard	12	10.37m/min

1 shackle = 27.5 m = 15 fathoms

DRAUGHT INCREASE (LOADED)

Estimated squal effect Under keel clearance	Ship's Speed	Max. squat at bow/stern
12.5 m	12	1.60 m
	8	1.12 m
	4	0.48 m
12.5 m	12	1.28 m
	4	0.07 m

Heel effect Heel angle	
	-- m
	-- m
	-- m
	-- m
	-- m

MAN OVERBOARD RESCUE MANOEUVER

Sequence of actions to be taken:
- to cast a lifebuoy
- give the helm order
- to sound the alarm
- to keep the lock-out

LOADED(BALLAST)

"STEADY SO"
5 min 52 s
6.1 cables
1 min 04s
"HARD TO PORT"

TURNING CIRCULES AT MAXIMUM RUDDER ANGLE

1 cable = 0.1 nautical mile

Loaded

2 min 2 s
9.82 kts
3.45
4 min 33 s
5.29 kts
9 min 6 s
4.60 kts

2 min 10 s
10.06 kts
3.75
4 min 39 s
5.89 kts
9 min 38 s
4.97 kts

Ballast

1 min 46 s
11.41 kts
3.70
3 min 39 s
7.21 kts
8 min 01 s
7.16 kts

CF CRYSTAL

Annex D Last PSC Report of SANCHI

FORM A

REPORT OF INSPECTION IN ACCORDANCE WITH THE MEMORANDUM OF UNDERSTANDING ON PORT STATE CONTROL IN THE ASIA-PACIFIC REGION[1)]

(reporting authority) MINISTRY OF OCEANS AND FISHERIES, REPUBLIC OF KOREA
(address) 94, Dasom 2-ro, Sejong-si, Republic of Korea
(telephone) + 82 - 44 - 200 - 5815
(telefax) + 82 - 44 - 200 - 5848

Copy to: master
head office
PSCO
If ship is detained, copy to:
flag State
IMO
recognized organization, if applicable

1 name of reporting authority	REPUBLIC OF KOREA		2 name of ship	SANCHI	
3 flag of ship	PANAMA	4 type of ship	OIL TANKER	5a call sign	3FJU8
5b MMSI	356137000				
6 IMO number	9356608	7 gross tonnage	85462	8 deadweight(where applicable)	
9 year of build	29-10-2007	10 date of inspection	05-09-2016	11 place of inspection	DAESAN, KOREA
12 classification society	DNV·GL	13 date of release from detention[2)]			
14a IMO Company Number	0101754	14b particulars of company	NATIONAL IRANIAN TANKER COMPANY		

15 name and signature of master to certify that the information under 14b is correct:
name [redacted] signature [redacted]

16 details of ship certificates

a title	b issuing authority	c date of issue and expiry
1 CARGO SHIP SAFETY CONSTRUCTION	DNV·GL	06-07-2016 / 06-10-2016
2 CARGO SHIP SAFETY EQUIPMENT	DNV·GL	06-07-2016 / 24-04-2018
3 CARGO SHIP SAFETY RADIO	DNV·GL	06-07-2016 / 24-04-2018
4 IOPP	DNV·GL	06-07-2016 / 24-04-2018
5 IAPP	DNV·GL	06-07-2016 / 24-04-2018
6 ISPP	DNV·GL	06-07-2016 / 24-04-2018
7 LOAD LINE	DNV·GL	06-07-2016 / 24-04-2018
8 DOC	DNV·GL	30-03-2016 / 02-03-2017
9 SMC	DNV·GL	06-07-2016 / 06-01-2017
10 ISSC	DNV·GL	06-07-2016 / 06-01-2017
11 MINIMUM SAFE MANNING	F.S	23-06-2016 /
12 INTERNATIONAL TONNAGE	DNV·GL	06-07-2016 / 06-10-2016
13		/
14		/

d information on last intermediate or annual survey

date	surveying authority	place
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		

17 deficiencies ☐ no ☑ yes (see attached FORM B)
18 ship detained ☑ no ☐ yes [3)]
19 supporting documentation ☐ no ☐ yes (see annex)

issuing office: DAESAN REGIONAL OFFICE OF OCEANS AND FISHERIES
telephone: + 82 - 41 - 660 - 7635
telefax: + 82 - 41 - 663 - 0347
E-mail address: daesanpsc@korea.kr

name [redacted]
(duly authorized PSCO of reporting authority)
signature [redacted]

This report must be retained on board for period of two years and must be available for consultation by Port State Control Officers at all times.

1) This inspection report has been issued solely for the purpose of informing the master and other port State that an inspection by the Port State, mentioned in the heading, has taken place. This inspection report cannot be construed as a seaworthiness certificate in excess of the certificates the ship is required to carry.

2) To be completed in the event of a detention.

3) Masters and companies are advised that detailed information on a detention may be subject to future publication.

REPORT OF INSPECTION IN ACCORDANCE WITH THE MEMORANDUM OF
UNDERSTANDING ON PORT STATE CONTROL IN THE ASIA-PACIFIC REGION

(reporting authority) MINISTRY OF OCEANS AND FISHERIES, REPUBLIC OF KOREA
(address) 94, Dasom 2-ro, Sejong-si, Republic of Korea
(telephone) + 82 - 44 - 200 - 5815
(telefax) + 82 - 44 - 200 - 5848

Copy to: master
head office
PSCO
If ship is detained, copy to:
flag State
IMO
recognized organization, if applicable

2 name of ship: SANCHI
6 IMO number: 9356608
10 date of inspection: 05 - 09 - 2016
11 place of inspection: DAESAN, KOREA

20 number	21 code	nature of deficiency [4]	convention reference [5]	22 action taken [6]	23 responsible RO [5]
1)		CARGO TANK LEVELING DEVICE			
				99/	
		INAPPRO PRIATE		WITHIN	
		- LEVELING GAUGE SHOWS ERROR		3 MONTHS	
		(ALL CARGO TANKS)			

Page No. 1 of 1

name [redacted] (duly authorized PSCO of reporting authority)
signature [redacted]

4) This inspection was not a full survey and deficiencies listed may not be exhaustive. In the event of a detention, it is recommended that full survey is carried out and all deficiencies are rectified before an application for re-inspection is made.
5) To be completed in the event of a detention.
6) Applicable Deficiency Action Codes(see below) to be entered.

※ If the owner of a ship objects to the detention of a vessel, he will have a right of appeal against a detention within 90 days from date of detention.

Codes for action taken

	Deficiency Action Code
10	deficiency rectified
15	rectify deficiency at next port
16	rectify deficiency within 14 days
17	rectify deficiency before departure
18	rectify deficiency within 3 months
30	detainable deficiency
99	other (specify in clear text)

	PSC Inspection Action Code	
26	competent security authority informed	☐
27	ship expelled on security grounds	☐
40	next port informed	☐
45	rectify detainable deficiencies at next port	☐
50	flag State/consul informed	☐
55	flag state consulted	☐
70	recognized organization informed	☐
85	investigation of contravention of discharge provisions(MARPOL)	☐

Annex E SANCHI –CF CRYSTAL Timeline

Time (UTC)	MT Sanchi	MV CF Crystal
15.12.2017		Departure from Kalama Port, US **Cargo:** Sorghum, 63,997.817 tons **Destination:** Dongguan, China **ETA:** 10.01.2018
16.12.2017	Departure from Assaluyeh Port, Iran **Cargo:** Natural gas condensate (highly flammable, toxic, and of lesser pollution ability, due to aromatic nature), 111,510 tons **Destination:** Daesan Port, South Korea **ETA:** 08.01.2018	
06.01.2018		
09:00 C 1700	Only 2 distant vessels visible on radar screen.	No Data

10:00 C 1800	Numerous vessels visible on radar screen (4 on starboard side, 6 ahead, and 5 on port side).	No Data
1043 C1843	Start to alter course from 007 ° to 340 °.	
10:45 C 1845	Shift Change (2nd Officer to 3rd Officer). Korea: 1945	No Data
C1855	course was steady on 340 ° .	
11:00 C 1900	2nd Officer handed shift over to 3rd Officer and left the bridge. Extra 2nd officer still stay in chart room.	No Data
1900	3/O talked with extra 2/O from 1902 to 1912 and from 1922 to1926 in the chart room.	No Data
11:24 C 1924	Several vessels and boats crossing from starboard bow. CF Crystal first appears on radar screen (distance ≈ 9.8 NM). Sanchi Speed: 10.4 knots Range scale RADAR in use 6 NM off center relative motion.	Speed: 13.2 knots Course: 217 HDG 214 COG (as per Maersk Shams VDR) Range scale RADAR in use 6 NM off center relative motion(Interview).
11:28 C 1929	Extra 2nd Officer left the bridge. Sanchi duty officer start assessing the situation .	

11:29 C 1929	3/O ordered AB make ready signaling light and told him “just relax”.	
11:30 C 1930	3/O talked about target A and B,lighting signals then assessed All of them passing astern	-
1931		- CF Crystal watchman (CoC Holder) seen Sanchi about 7 NM on her portside (Interview) Said: I checked again and found that the CPA did not change, then I did not pay any more attention to that vessel -
11:32 C 1932	Sanchi duty officer again start assessing the situation , Said: BCR (Bow Crossing Range) (of target A and B)are minus. 3/0 talked about 3 targets . The bearing/range of CF Crystal was 022° /6.8nm from VDR radar data.	Chief officer found 2 AIS targets CPA on radar 0.9 and 0.4, [first interview on 25 Jan 2018] he confirmed that 0.9 NM was MT Sanchi passing my bow[2nd interview on 2 Mar 2018].
1934	3/O said that one was clear,The next one 022° .	C/O said that he started to adjust the course from 217 to 225 with the intention to go back our planned passage .My vessel was deviated to port of the planned passage at that time (2nd interview).
11:35 C 1935	Lookout said a vessel at bearing 013 on radar screen and showing red & green. The cursor of X band radar was moved to CF CRYSTAL with bearing 023° range 5.4NM.	COG: 218 (as per Maersk Shams VDR)
11:36 C 1936	Fishing vessel call Sanchi and asking to pass port to port The triangle symbols of both targets turned red and the message "AIS COLLISION" appeared in the right lower corner of radar display. Sound alarm turned off.	

1939	3/O said: Oh, he's talking to another one. You know, never answer these calls. Because if you don't answer, it is not ok to action. But if you answer, he seems … he confirms with you about his action. So he takes action, whatever he said in the radio and you don't understand. But if you don't answer, he shall be forced to take action to make himself clear, understand? AB: And this is not complying to the rules that I must oblige…… Because we don't understand their language	
11:40 C 1940	Duty officer ordered to signal to small vessel (ALDIS Lamp signals) with five short flashes to attract attention.	Continue with course adjusting.
11:41 C 1941	Signals to fishing vessel (5 short flashes by ALDIS Lamp). - Fishing vessel turns toport side (distance with CF Crystal ≈ 3.5，bearing about 025°)	Continue with course adjusting.
1942	3/O:Yes, if I take any action, I make everything worse. You know, they shall take action. They are the smaller vessels.	End of adjusting course to 225° SANCHI was about 3.1 nm bearing 205° Question:Did you notice the CPA with SANCHI change after you changed course C/O:After I changed course,I noticed the CPA with SANCHI was 0.4nm. Question:how you did determin the CPA with SANCHI，by radar echo or AIS? C/O: I did not see radar,only by AIS siginal on my port radar. [interview on 25 Jan 2018]
1944		Question:After you checked your radar,did you realize there's a risk of collsion. 3/O:I thought it was a fishing vessel.There was no radar echo only AIS symbol.[interview on 25 Jan 2018]

11:45 C 1945	Sanchi duty officer start assessing the situation of CF Crystal. CF CRYSTAL was about 2 nm away bearing 025°. 3/O: Ok, give a signal to this one. We had this one on our starboard side, we should take action. But what actually can I say, in this situation? My starboard side is full. It was five?	1- course steady on 226° 2- Watch keeping Shift Change (Chief Officer to 3rd Officer).
11:46 C 1946	Lookout identifies CPA zero with CF Crystal (distance about 1.6 NM). - Fishing vessel cleared from Sanchi astern. - Signals to CF Crystal (5 short flashes by ALDIS Lamp) to attract attention. AB:Charlie is passed, right? A little to starboard? 3/O:Starboard? Why? AB:What's the CPA? CPA is … zero, zero.	Chief Officer left the bridge. 3rd officer on watch. Question:When chief officer hand over the watch,did he mention the situation? 3/O answered:No,he only said " the traffic was clear".[interview on 25 Jan 2018] Question:How much time passed after you took over your watch when the collision happened? 3/O: At 1943LT on 6 Jan I came out of my cabin and went up to bridge .At about 1945LT.I took over my watch .Chief mate did not tell me the situation of the other vessel.When the accident happened,I didn't check the time. [interview on 25 Jan 2018] Question: Did you see any signals from other ship? 3/O: No.[2nd interview on 2 Mar 2018]
11:47 C 1947	- 3/O:It's a small vessel, right? - AB: No, It's a big vessel. - 3/O: So why is she intending to take action like this?	Duty officer and look out haven't seen Sanchi. (as per interviews)
11:48 C 1948	OOW: calls Captain 3/O: hello captain ,we have a target at Starboard Side. The CPA is zero .the distance is very short……..distance is short. Captain ,it is very big ship.	Duty officer and look out haven't seen Sanchi. (as per interviews) Question:Have you give any reminder or notification to 3/O? AB:I reminded 3/O that one of CPA was already 0.1.[2nd interview on 2 Mar 2018]
11:49 C 1949	3/O: Oh, why is she not doing anything? Oh man, he's judging 3/O: Go to port side, full port side. Oh, man! Full starboard side, full starboard	Duty officer and look notice a ship but still not aware that she was Sanchi. - Turn to Starboard ordered by 3rd (11:49:30 – C 19:49:30)

	side. Full, full, please. Captain comes to bridge at 11:49:28 3/O:captain she did not take any action. Cap: Hard to starboard, hard to starboard	
11:50 C 1950	Captain: we are being hit. Captain: Hard to port. Hard to port	Hard to Starboard.
11:50 C 1950	Collision (LT19:50:03) Captain instruct to activate GMDSS	
11:51 C 1951	Fire on board. Captain instructs fire pumps starting.	Fire on Bow Captain to the bridge and order for full stern.
11:51:40 C 1951	GMDSS activated	
11:52 C 1952	Explosion and fire engulfing bridge & accommodation, followed by suffocation sounds.	
11:53:42 C 1953	Big fire and GMDSS signaling stopped	All the crew moved toward the astern free fall lifeboat. Abandon ship.

Annex F On-Site Survey Report of CF CRYSTAL

On-Site Survey Report of CF CRYSTAL

Surveyor/Investigator：

Vessel:

Date：10-16 January 2018

From 10 to 16 January 2018, the MSA investigators carried out on-site survey of CF CRYSTAL （Flag：Hong Kong, China；TYPE： bulk carrier） in Zhoushan, China. The survey records were as follows:

Vessel Information：

Name：CF CRYSTAL

IMO No:9497050 Flag：Hong Kong, China

Register of shipping：ABS Call Sign：VRIC2

MMSI ：477550800 GT：41073

DWT ：75725 TYPE：bulk carrier

Date of construction：2010.10.19

Owner/Operator：CHANGHONG GROUP (HK) LTD;

Manager：Shanghai CP International Ship Management & Broker Co Ltd

CF CRYSTAL Alongside Laotangshan Berth, Zhoushan, China

Overview：

Bow View

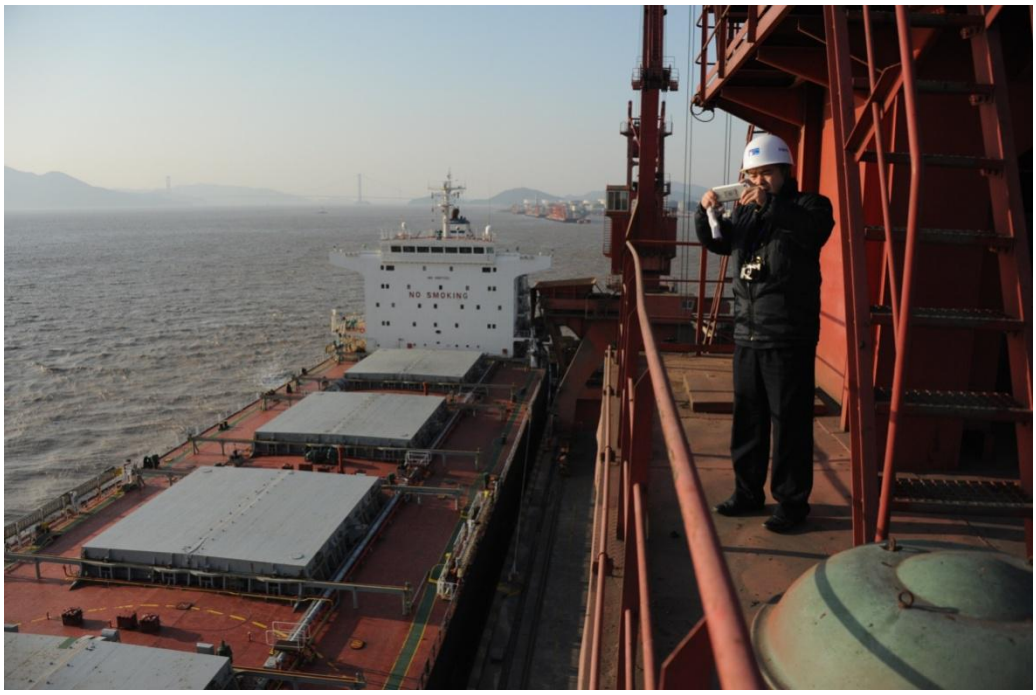
Stern View

Starboard Side View

Port Side View

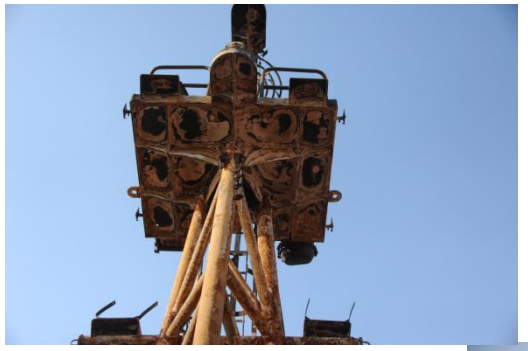
Top View：

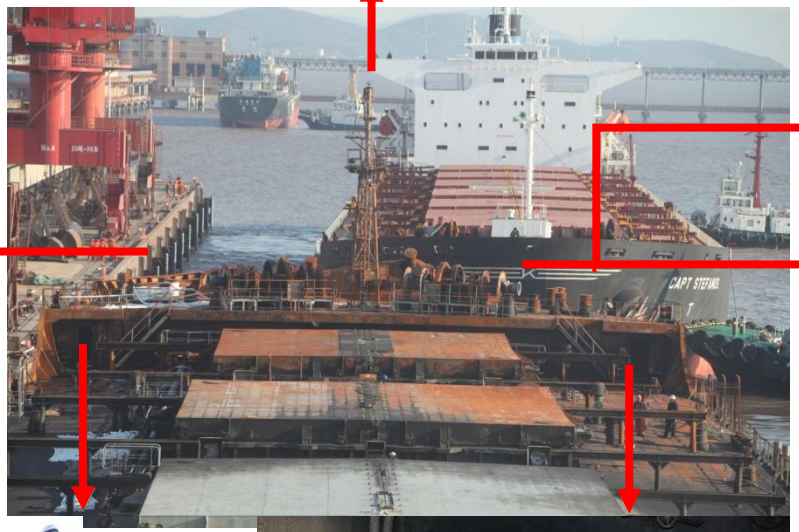
Top View from Midship Forward (forward No.3 cargo holds sustained fire)



Top View from Midship to Stern

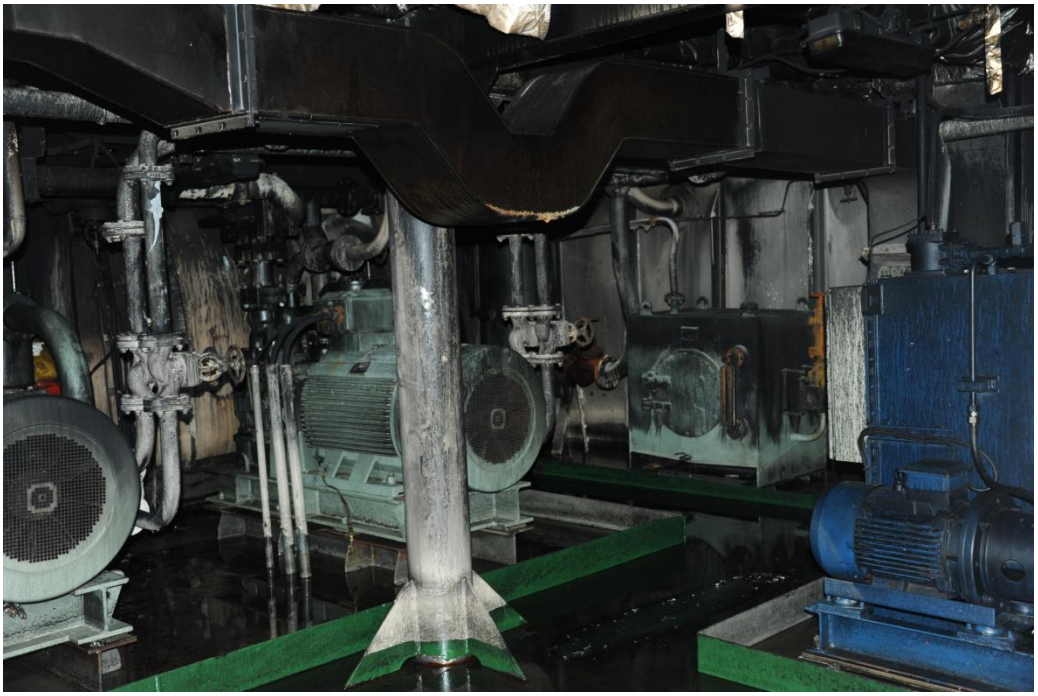
On board Inspection：





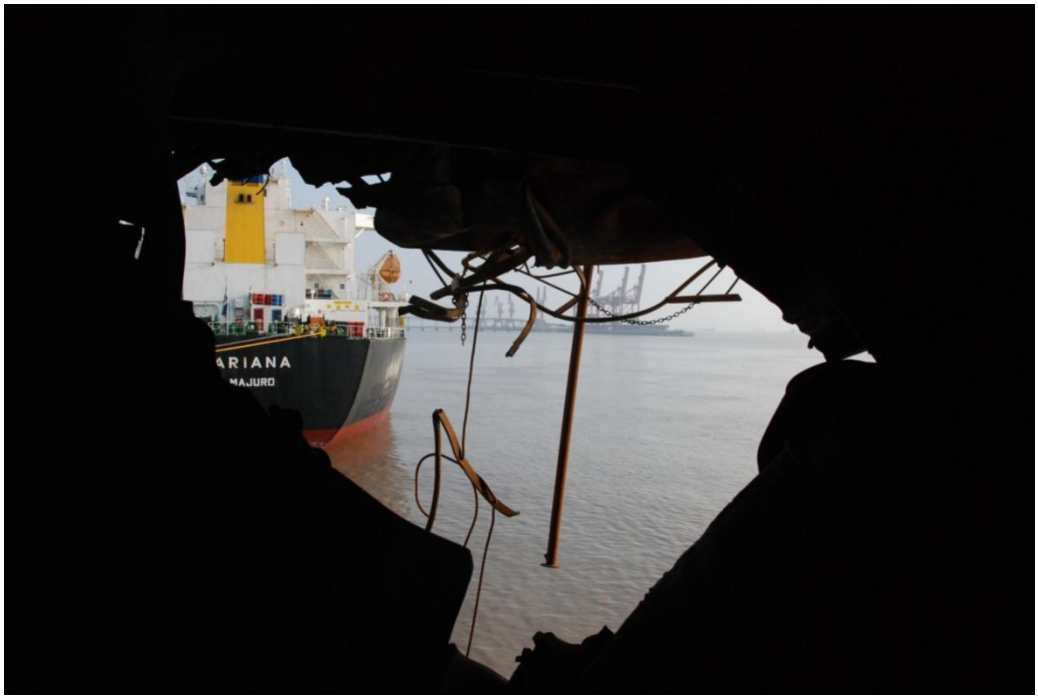
Forecastle Store：

Port side Store：

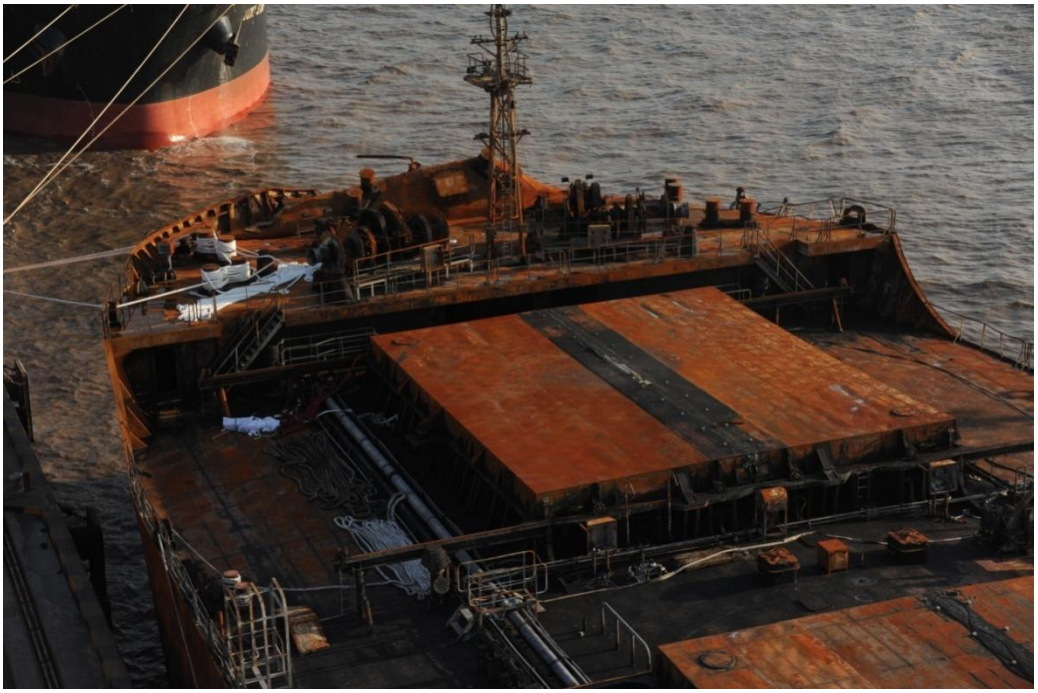


Inside Port Side Store

Starboard Forecastle Store：



Starboard Forecastle Store

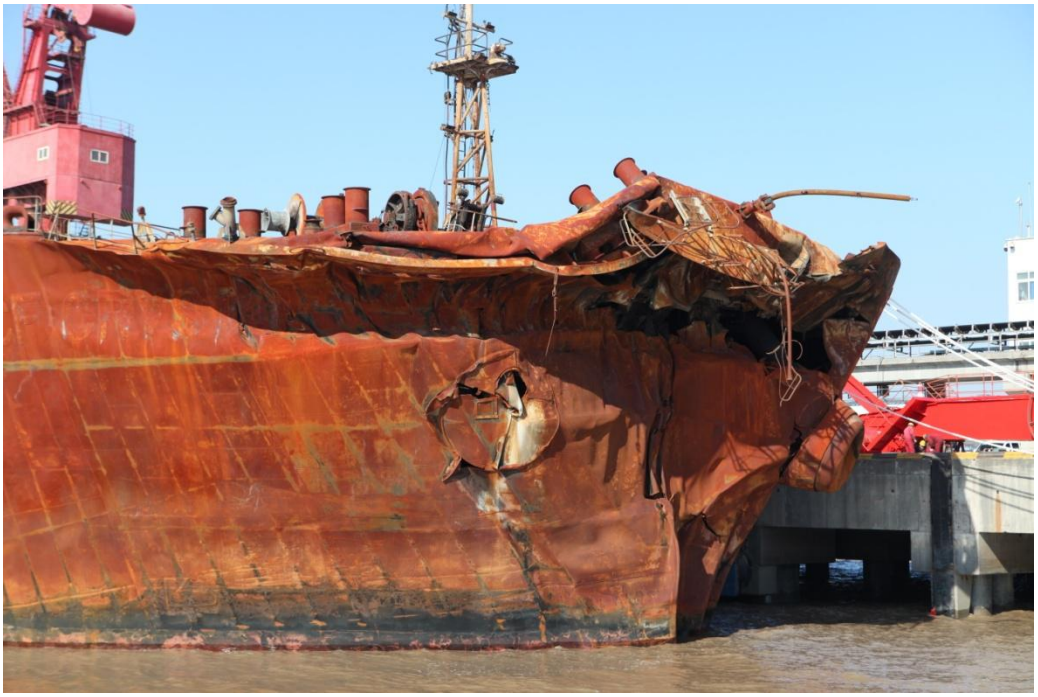


Dent of Bow from Starboard to Portside

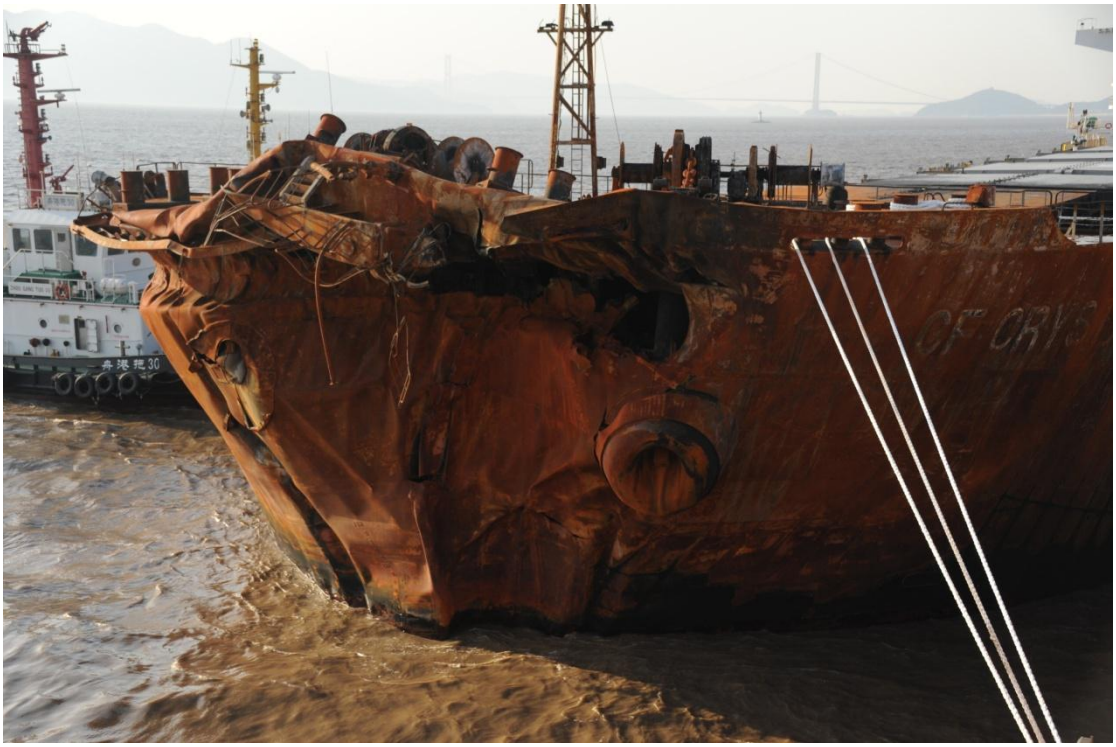
Forecastle deck bending backwards

Forecastle deck bending backwards

Bow



Starboard Bow

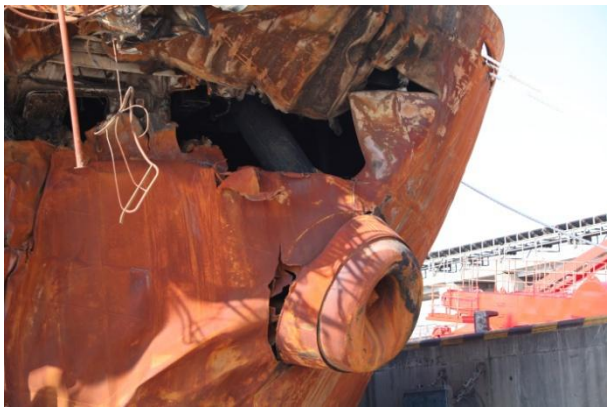


Port Bow

Starboard Bow

Bow damage：

Anchor and Hawsehole：



Starboard Bow (outside)

Starboard Bow (inside)

Draught Mark：

Foreward Starboard Draught 13.6 meters

Cargo Holds：

Hatch cover of No.1 Cargo hold

No. 1 Cargo Hold (sustained fire)

No. 2 Cargo Hold (sustained fire)

Fire Box Debris

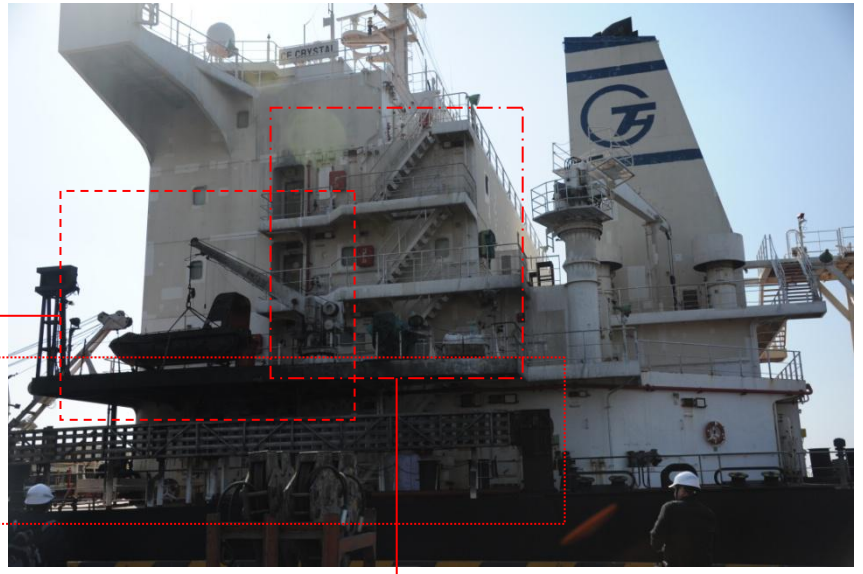
Life raft debris

Accommodation：

Starboard side

Port Side

Port side of living quarters：



Aft Draught Marks：

Aft draught 13.2 meters

Bridge：

Navigational Aids / Equipment：

Autopilot

Telegraph Console

Telegraph Printer

Alarm button of Sat C

Control panel of Navigational Lights

Public Adress System

Port side Radar (X Band)

Starboard Radar (S Band)

ECDIS（without software）

GPS (chart table)

GPS (on the starboard of operation console)

Sat C

VHF (bridge front)

VHF (on console)

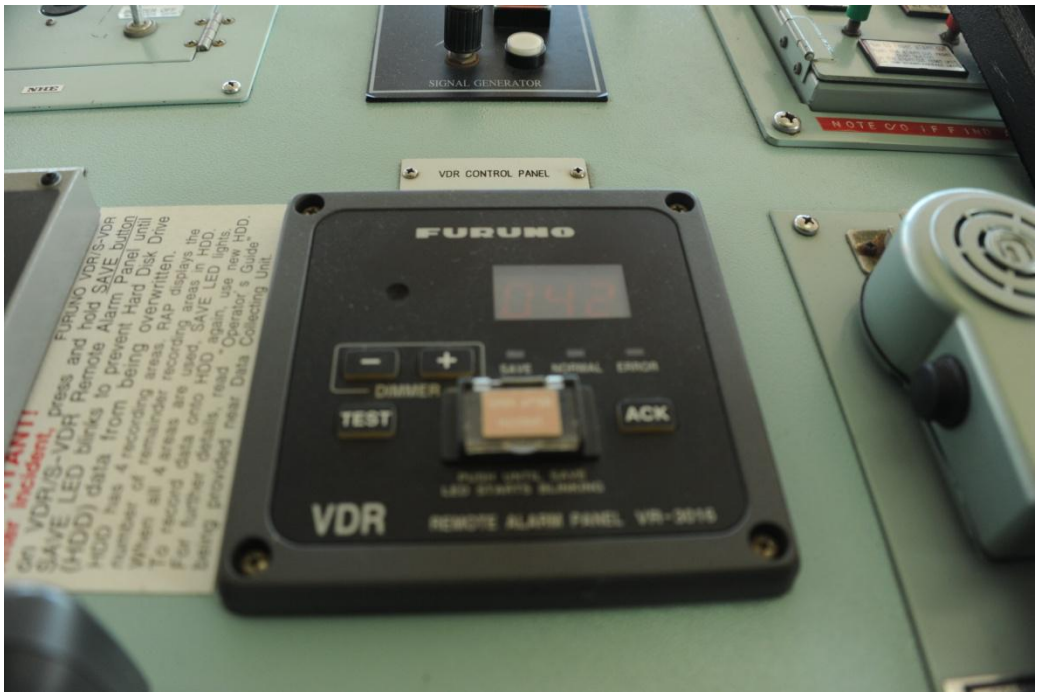
VHF and Sat Phone (Radio Room)

NAVTEX receiver

Weather facsimile and Clock

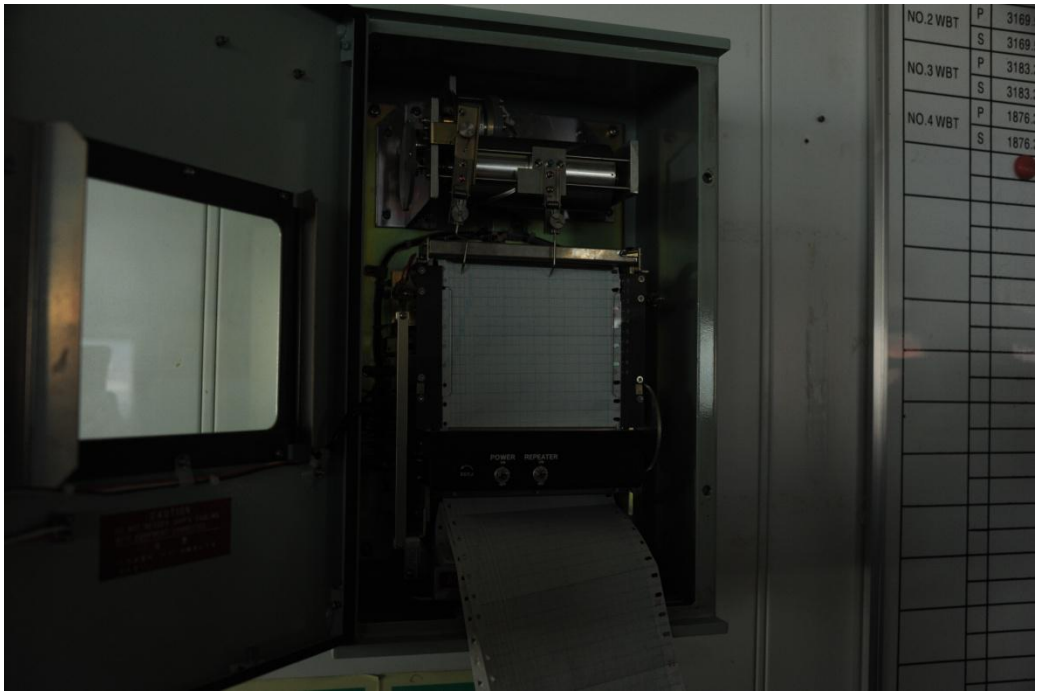
MF/HF Transceiver（SSB）

Speed Log



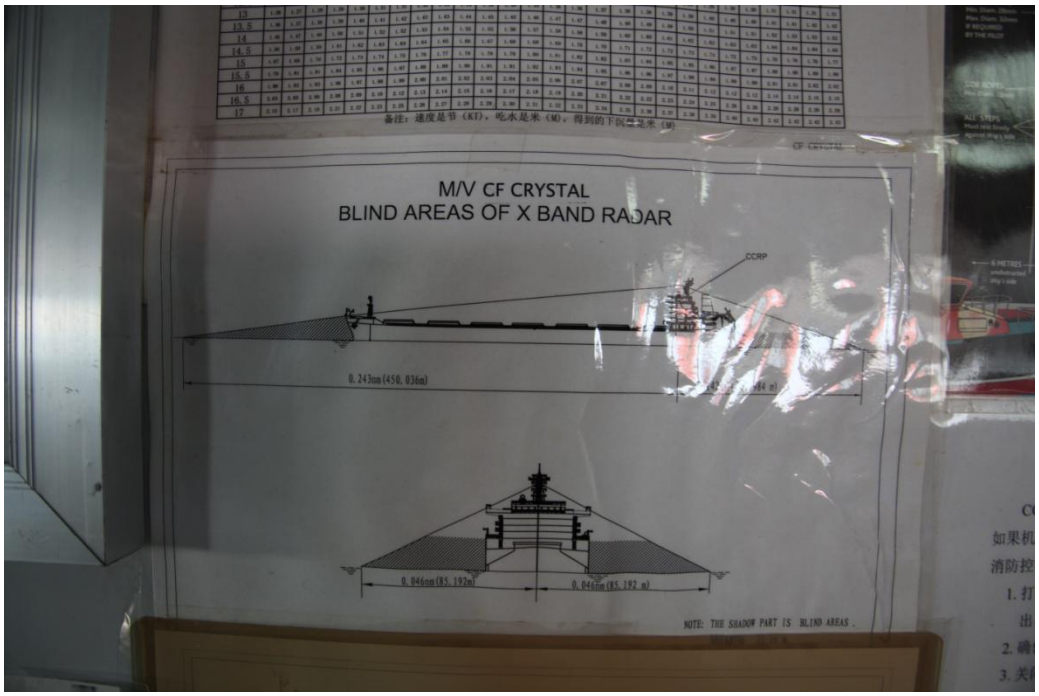
VDR Backup Button

VDR Control Panel and Model



Course Recorder

Navigational Chart



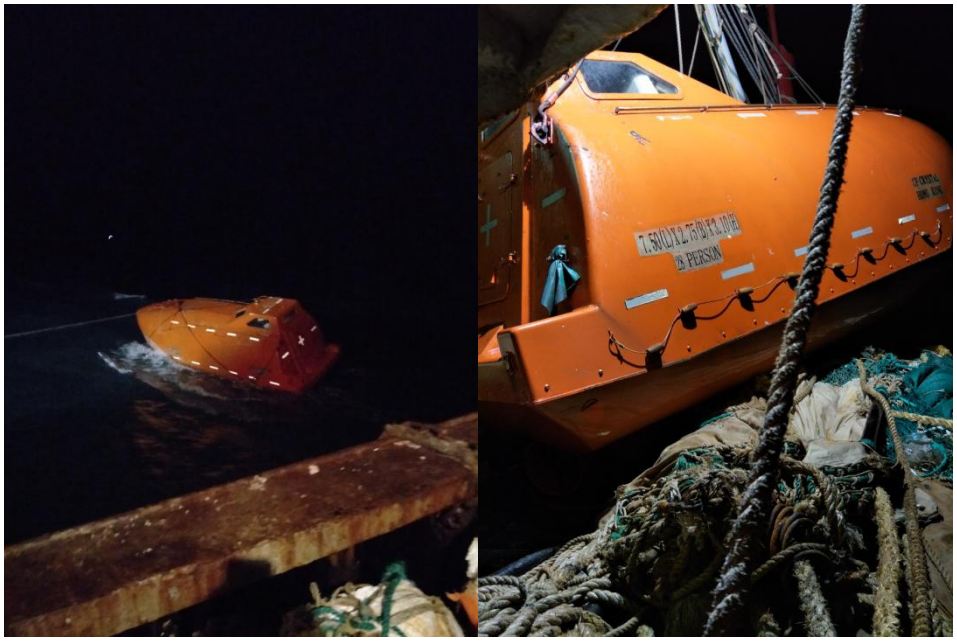
Blind Areas of X Band Radar

Annex G Emergency Response and SAR Record

Emergency Response and SAR Record

At about 1950 (All time used in this report is Beijing Time (UTC+8) unless otherwise stated) on 6 January 2018, the Panama registered oil tanker SANCHI collided with the Hong Kong registered bulk carrier CF CRYSTAL in East China Sea at approximate position 30° 51′ .1N / 124° 57′ .6E. SANCHI, loaded with a cargo of condensate oil, was on her voyage from Asalueh, Iran to Daesan, South Korea. CF CRYSTAL was loaded with sorghum in bulk, bounding from Kalama, USA to Dongguan, China. The collision breached the cargo tanks of SANCHI, resulting in the leakage of condensate oil and consequent fire and explosions and eventual sinking of the vessel. As a result, three crew of SANCHI died and 29 were missing, and resulting pollution occurred. CF CRYSTAL sustained extensive structural damage to her bow and burn damage to other areas.

Fire and Explosion after Collision



The main engine of CF CRYSTAL was running when ship was abandoned and the crew evacuated. All crew were rescued by ZHEDAIYU 03187.

CF CRYSTAL’s Crew members were transferred to DONGHAIJIU 101

7 January 2018





SANCHI on Fire and Vessel listing to Starboard

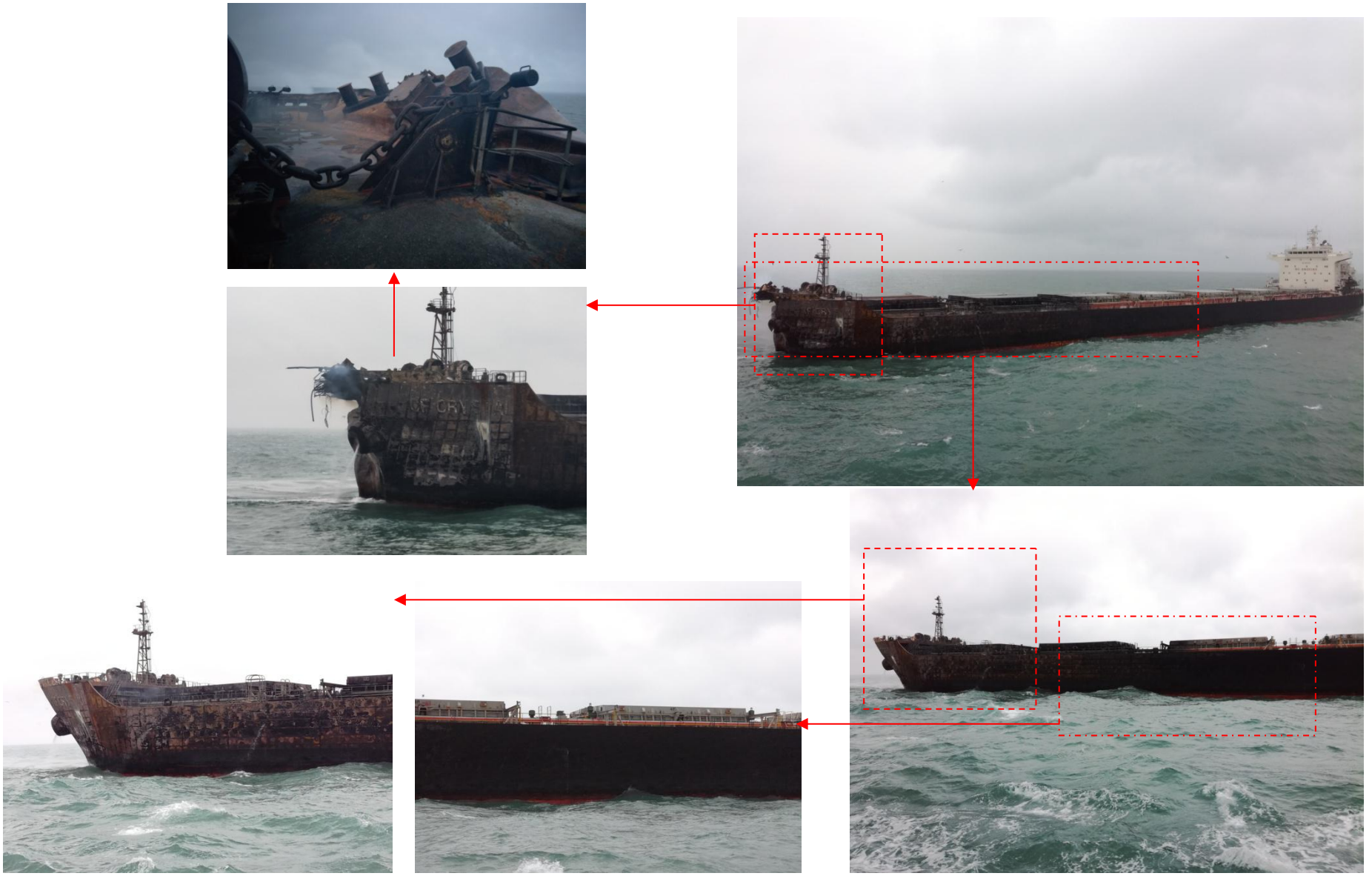
CF CRYSTAL's condition after abandoned

Front View

Starboard View

Port Side View

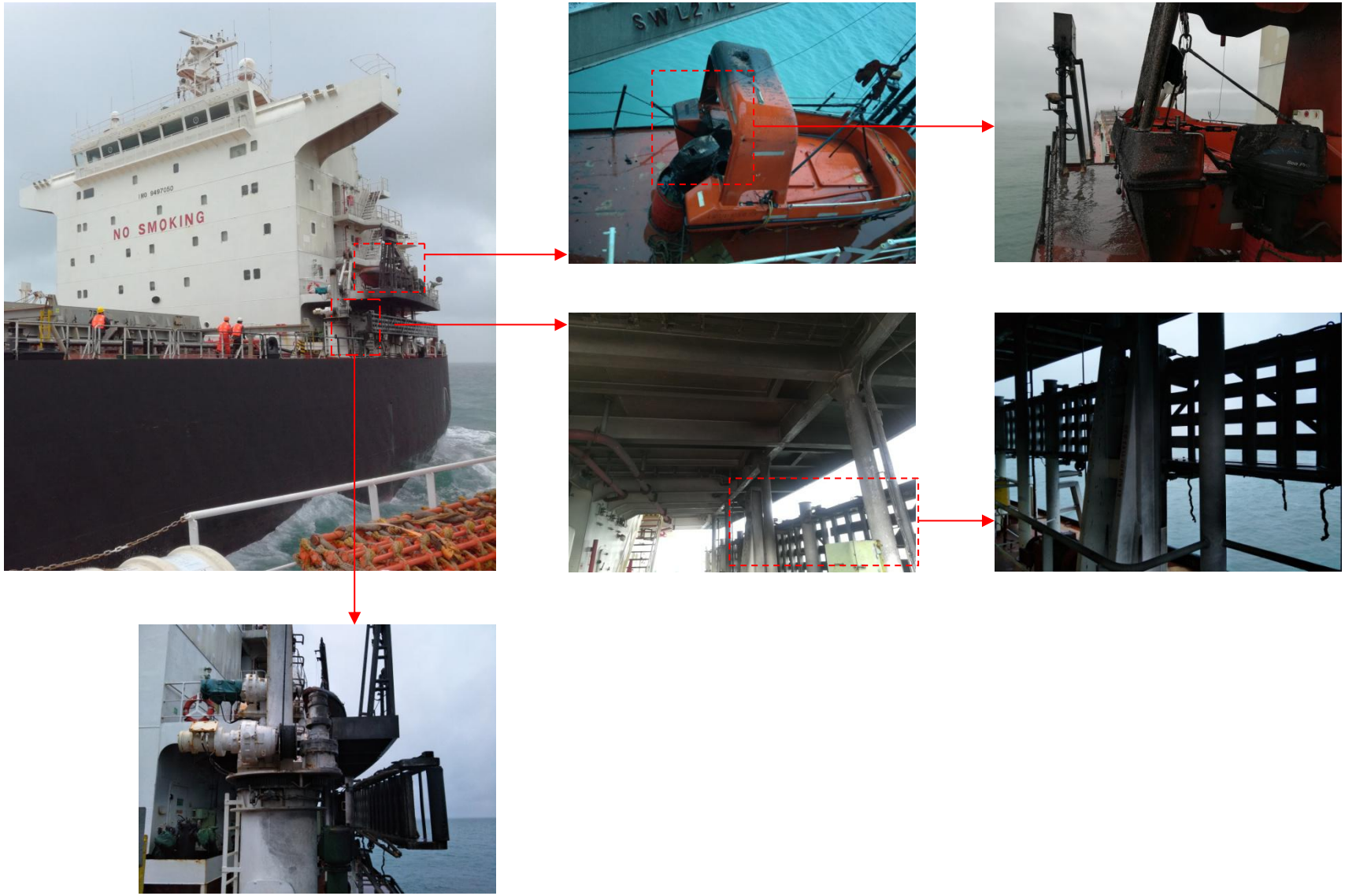
Starboard Quarter View



The damage to the bow of CF CRYSTAL and color difference between bow and midship

The CF CRYSTAL’s crew were sent back by DONGHAIJIU 101.

The port side of the accomodation


NO SMOKING

Firefighting by CF CRYSTAL's crew after returning to ship.

CF CRYSTAL was escorted to Zhoushan by DONGHAIJIU 118.

8 January 2018

SANCHI on Fire

Fire continued and spread to stern. One body of SANCHI's crew was found and recovered from water by DONGHAIJIU 117.

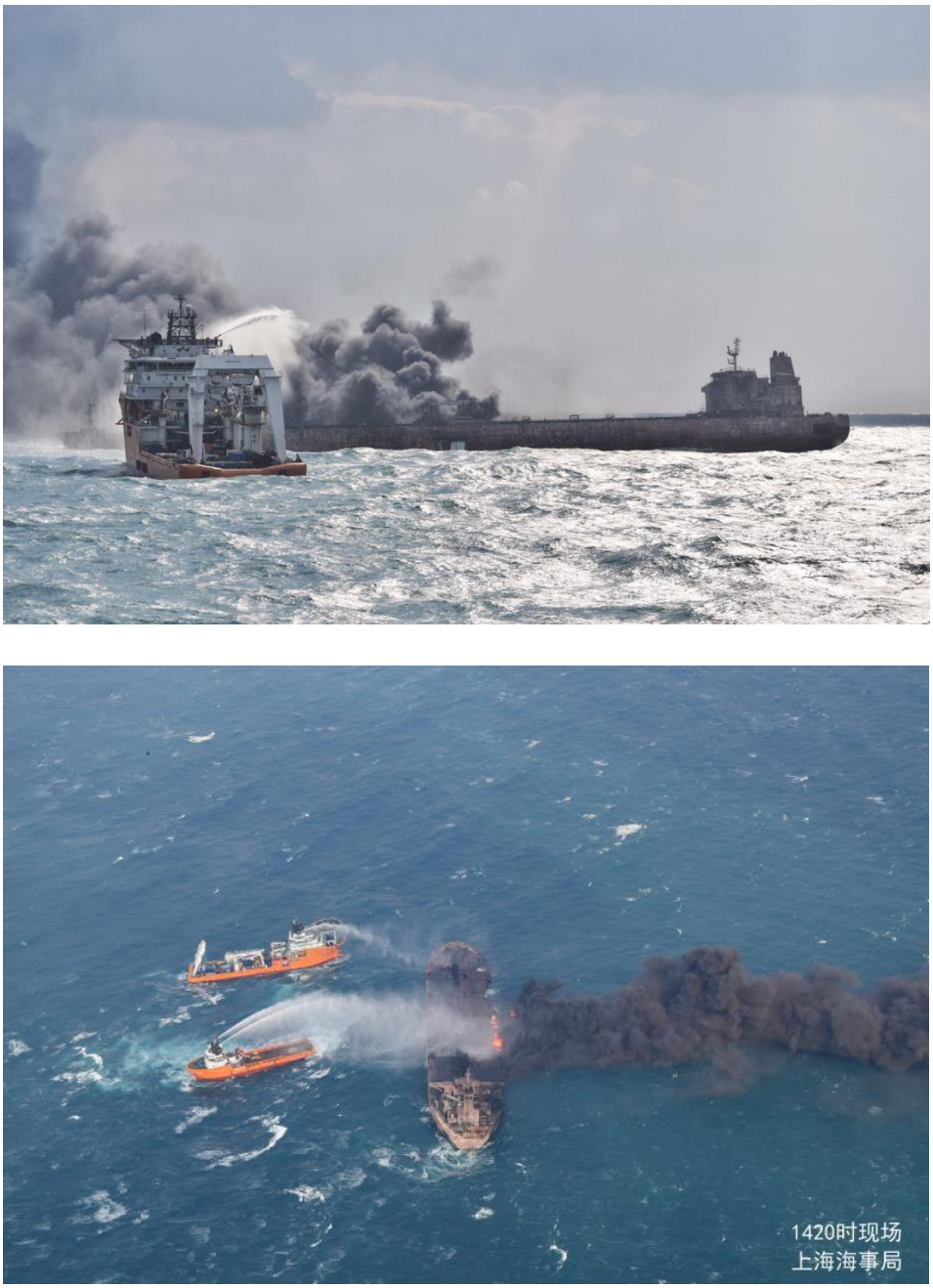
9 January 2018

SANCHI on Fire

DONG HAI JIU 117 berthed at Rescue and Salvage Port, Waigaoqiao, and the body was properly transferred to the civil affairs department.

10 January 2018

Fire mainly in rear of starboard midship, and the ship listed to starboard and trimmed by head.



Rescue vessels on site went on firefighting.

CF CRYSTAL got alongside Laotangshan berth, Zhoushan. MSA investigators started on-site survey and investigation.

11 January 2018

Firefighting by SHENQIAN and DONGHAIJIU 117

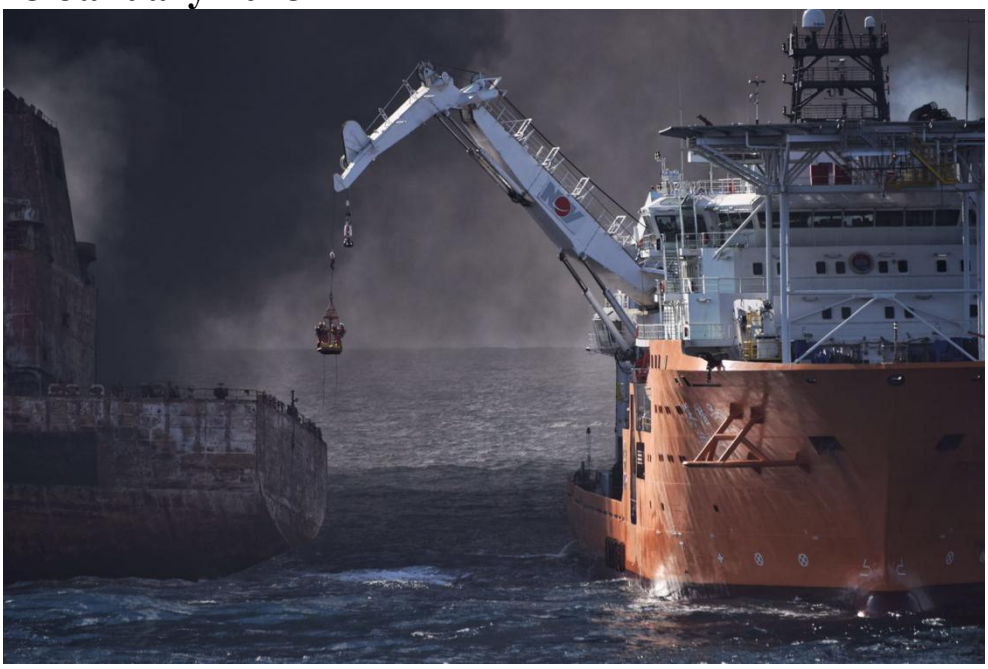
Explosive fire broke out again

12 January 2018

Rescue vessels on site went on firefighting.

SANCHI still listed to the starboard with intensive fire

13 January 2018



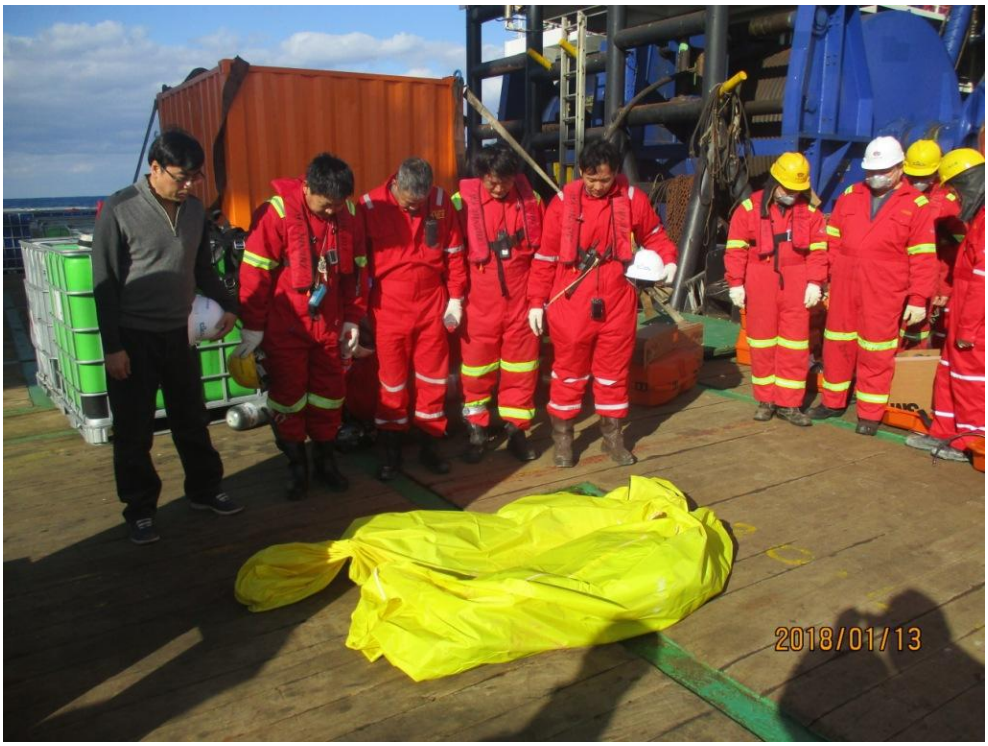
4 SAR personnel were transferred to poopdeck of SANCHI from SHEN QIAN HAO.


2018/01/13


2018/01/13


2018/01/13


2018/01/13



SAR personnel found the bodies of two crew members on boat deck，retrieved VDR capsule from the bridge.

14 January 2018

SANCHI on fire

The bow of SANCHI submerged into water.

Vessel listed to starboard by about 90 degrees with a small part of the hull out of the water.

At 1645, SAR vessels on site confirmed radar echo disappeared in approximate position of 28° 22′ N，125° 55′ E.

Annex H CPA and TCPA Calculations

N.B.: The following calculation was provided by China and agreed by Hong Kong (China). But it was not agreed by Islamic Republic of Iran (representing Bangladesh as well) and Panama.

		SANCHI					CF CRYSTAL								
	UTC	HDT	COG	SOG	VDR-Lat (DDMM.MMMM)	VDR-Long (DDMM.MMMM)	HDT	COG	SOG	AIS-Lat (DDMM.MMMM)	AIS-Long (DDMM.MMMM)	Distance	Bearing	CPA	TCPA
1	11:10:15.38	356	354	10.3	3044.1484	12457.9465	216	216	13.4	3058.1763	12503.9681	14.95	20.2	0.61	40.5
2	11:10:26.12	356	355	10.3	3044.1798	12457.9436	216	214	13.4	3058.142	12503.9414	14.88	20.2	0.78	40.0
3	11:10:35.19	356	355	10.3	3044.2056	12457.9410	217	213	13.4	3058.1138	12503.9197	14.83	20.3	0.89	39.7
4	11:10:46.90	356	355	10.3	3044.2398	12457.9377	217	215	13.4	3058.0797	12503.8925	14.75	20.3	0.68	39.7
5	11:10:56.02	356	355	10.3	3044.2654	12457.9352	217	216	13.4	3058.0522	12503.8698	14.70	20.3	0.53	39.7
6	11:11:05.51	356	355	10.3	3044.2940	12457.9326	216	216	13.4	3058.0218	12503.8445	14.64	20.3	0.56	39.5
7	11:11:15.40	356	355	10.3	3044.3197	12457.9305	216	215	13.4	3057.9912	12503.8192	14.58	20.3	0.63	39.3
8	11:11:26.14	356	355	10.3	3044.3511	12457.9280	216	214	13.4	3057.9567	12503.7921	14.51	20.3	0.75	39.0
9	11:11:35.19	356	356	10.3	3044.3768	12457.9261	217	214	13.4	3057.9286	12503.7704	14.45	20.3	0.69	38.7
10	11:11:56.02	356	356	10.3	3044.4368	12457.9214	217	216	13.4	3057.8672	12503.7202	14.32	20.3	0.41	38.6
11	11:12:05.51	356	356	10.3	3044.4654	12457.9190	216	216	13.4	3057.8367	12503.6947	14.26	20.3	0.46	38.4
12	11:12:15.38	356	356	10.3	3044.4911	12457.9168	216	215	13.4	3057.8058	12503.6702	14.20	20.4	0.61	38.1
13	11:12:25.20	356	356	10.3	3044.5196	12457.9145	217	214	13.4	3057.7746	12503.6459	14.14	20.4	0.73	37.8
14	11:12:35.19	356	356	10.3	3044.5482	12457.9119	217	214	13.5	3057.7435	12503.6213	14.08	20.4	0.62	37.6
15	11:12:46.15	356	356	10.3	3044.5796	12457.9090	217	216	13.4	3057.7099	12503.5935	14.01	20.4	0.46	37.7
16	11:13:05.51	356	356	10.3	3044.6367	12457.9040	216	215	13.4	3057.6521	12503.5457	13.89	20.4	0.50	37.3
17	11:13:15.38	356	356	10.3	3044.6625	12457.9020	216	214	13.5	3057.6209	12503.5215	13.83	20.4	0.68	36.8
18	11:13:35.19	356	356	10.3	3044.7197	12457.8977	217	215	13.4	3057.5589	12503.4721	13.70	20.4	0.52	36.8
19	11:13:46.15	356	356	10.3	3044.7512	12457.8955	217	216	13.4	3057.5255	12503.4440	13.63	20.4	0.41	36.7

20	11:13:56.02	356	356	10.3	3044.7798	12457.8933	216	215	13.4	3057.498	12503.4213	13.57	20.5	0.49	36.5
21	11:14:06.56	356	356	10.3	3044.8113	12457.8908	216	214	13.4	3057.4637	12503.3942	13.51	20.5	0.64	36.2
22	11:14:15.38	356	356	10.3	3044.8342	12457.8890	217	214	13.5	3057.4355	12503.3724	13.45	20.5	0.69	35.8
23	11:14:25.19	356	356	10.3	3044.8630	12457.8866	217	214	13.5	3057.404	12503.3481	13.39	20.5	0.63	35.7
24	11:14:35.19	356	356	10.3	3044.8917	12457.8842	217	215	13.4	3057.3734	12503.3228	13.33	20.5	0.54	35.8
25	11:14:56.03	356	356	10.3	3044.9518	12457.8790	216	216	13.5	3057.3125	12503.2717	13.20	20.5	0.46	35.4
26	11:15:06.55	356	356	10.3	3044.9834	12457.8763	216	214	13.5	3057.2779	12503.2452	13.13	20.6	0.69	35.0
27	11:15:15.38	356	356	10.3	3045.0063	12457.8744	217	214	13.6	3057.2494	12503.2235	13.08	20.6	0.70	34.7
28	11:15:25.19	356	356	10.3	3045.0349	12457.8720	217	215	13.5	3057.2188	12503.1986	13.01	20.6	0.53	34.8
29	11:15:35.46	356	356	10.3	3045.0636	12457.8698	217	216	13.4	3057.1886	12503.1729	12.95	20.6	0.39	34.9
30	11:15:46.76	356	356	10.3	3045.0981	12457.8671	216	216	13.4	3057.1551	12503.1448	12.88	20.6	0.43	34.7
31	11:15:56.39	356	356	10.3	3045.1239	12457.8652	216	215	13.4	3057.124	12503.1203	12.82	20.6	0.61	34.4
32	11:16:06.55	356	356	10.3	3045.1526	12457.8629	217	213	13.5	3057.0925	12503.0963	12.76	20.6	0.73	33.9
33	11:16:25.19	356	356	10.3	3045.2071	12457.8585	217	216	13.4	3057.0338	12503.0490	12.64	20.6	0.47	34.0
34	11:16:35.47	356	356	10.3	3045.2359	12457.8557	216	217	13.4	3057.004	12503.0229	12.58	20.7	0.34	34.0
35	11:16:46.76	357	356	10.3	3045.2704	12457.8524	216	215	13.4	3056.9704	12502.9953	12.51	20.7	0.50	33.6
36	11:16:56.39	357	356	10.3	3045.2963	12457.8503	216	213	13.4	3056.9387	12502.9716	12.44	20.7	0.75	33.2
37	11:17:06.55	358	356	10.35	3045.3279	12457.8482	217	213	13.5	3056.9072	12502.9478	12.38	20.7	0.78	32.8
38	11:17:25.20	357	356	10.3	3045.3796	12457.8458	217	216	13.4	3056.8497	12502.8994	12.26	20.7	0.39	33.1
39	11:17:35.46	357	357	10.3	3045.4083	12457.8444	216	216	13.4	3056.8197	12502.8739	12.20	20.7	0.34	32.8
40	11:17:46.76	357	357	10.3	3045.4428	12457.8424	216	215	13.4	3056.7858	12502.8466	12.13	20.7	0.49	32.4
41	11:17:56.39	357	357	10.4	3045.4686	12457.8407	217	214	13.4	3056.7545	12502.8234	12.07	20.8	0.64	32.0
42	11:18:06.55	357	357	10.4	3045.5002	12457.8386	218	213	13.4	3056.7234	12502.7999	12.00	20.8	0.67	31.8
43	11:18:15.80	357	357	10.4	3045.5261	12457.8369	217	215	13.4	3056.6963	12502.7773	11.95	20.8	0.45	31.9
44	11:18:25.19	357	357	10.4	3045.5520	12457.8352	216	217	13.4	3056.6667	12502.7509	11.89	20.8	0.23	31.9

45	11:18:35.46	357	357	10.35	3045.5807	12457.8334	216	216	13.3	3056.6364	12502.7255	11.83	20.8	0.34	31.9
46	11:18:46.76	357	357	10.3	3045.6153	12457.8315	216	214	13.4	3056.6019	12502.6996	11.75	20.8	0.62	31.3
47	11:18:56.39	357	357	10.3	3045.6412	12457.8301	217	213	13.4	3056.5703	12502.6761	11.69	20.8	0.73	31.1
48	11:19:06.55	357	357	10.3	3045.6729	12457.8285	218	215	13.4	3056.5396	12502.6514	11.63	20.9	0.51	31.1
49	11:19:15.80	357	357	10.3	3045.6988	12457.8272	217	217	13.3	3056.5132	12502.6279	11.57	20.9	0.23	31.3
50	11:19:25.19	357	357	10.4	3045.7247	12457.8257	216	217	13.3	3056.4834	12502.6021	11.51	20.9	0.27	31.0
51	11:19:35.46	357	357	10.4	3045.7535	12457.8241	216	214	13.3	3056.4524	12502.5780	11.45	20.9	0.59	30.6
52	11:19:46.76	357	357	10.4	3045.7881	12457.8220	217	212	13.4	3056.418	12502.5524	11.38	20.9	0.77	30.1
53	11:19:56.39	357	357	10.4	3045.8140	12457.8203	218	214	13.3	3056.387	12502.5282	11.32	20.9	0.64	30.2
54	11:20:06.55	357	357	10.4	3045.8457	12457.8182	217	216	13.3	3056.3574	12502.5027	11.25	20.9	0.34	30.3
55	11:20:25.19	357	357	10.4	3045.8976	12457.8149	215	215	13.2	3056.3007	12502.4543	11.14	20.9	0.46	30.0
56	11:20:35.46	357	357	10.4	3045.9265	12457.8133	216	213	13.3	3056.2697	12502.4305	11.08	21.0	0.67	29.5
57	11:20:46.79	357	357	10.4	3045.9611	12457.8115	218	214	13.3	3056.2355	12502.4046	11.01	21.0	0.66	29.3
58	11:21:06.55	357	357	10.4	3046.0159	12457.8087	217	217	13.2	3056.1764	12502.3547	10.88	21.0	0.30	29.5
59	11:21:15.99	357	357	10.4	3046.0447	12457.8073	216	216	13.2	3056.15	12502.3318	10.83	21.0	0.37	29.2
60	11:21:26.15	357	357	10.4	3046.0736	12457.8057	216	215	13.2	3056.1169	12502.3051	10.76	21.0	0.50	28.9
61	11:21:35.48	357	357	10.4	3046.0995	12457.8043	217	214	13.2	3056.0891	12502.2841	10.70	21.1	0.64	28.7
62	11:22:06.10	357	357	10.4	3046.1890	12457.7988	216	218	13.1	3055.9967	12502.2061	10.51	21.1	0.26	28.6
63	11:22:15.99	357	357	10.4	3046.2178	12457.7971	216	217	13.1	3055.9704	12502.1831	10.45	21.1	0.32	28.4
64	11:22:26.15	357	357	10.4	3046.2467	12457.7952	216	214	13.2	3055.9362	12502.1572	10.39	21.1	0.63	27.8
65	11:22:36.34	357	357	10.4	3046.2756	12457.7935	218	213	13.2	3055.9053	12502.1340	10.33	21.2	0.75	27.5
66	11:22:46.76	357	357	10.4	3046.3075	12457.7918	218	215	13.2	3055.8755	12502.1093	10.26	21.2	0.51	27.6
67	11:22:56.43	357	357	10.4	3046.3335	12457.7904	217	218	13.1	3055.8467	12502.0829	10.20	21.2	0.21	27.8
68	11:23:06.10	357	357	10.4	3046.3625	12457.7889	216	218	13.1	3055.8176	12502.0573	10.14	21.2	0.26	27.6
69	11:23:15.99	357	357	10.4	3046.3913	12457.7875	216	215	13.1	3055.7903	12502.0356	10.08	21.2	0.54	27.2

70	11:23:26.16	357	357	10.4	3046.4203	12457.7861	217	214	13.2	3055.7565	12502.0096	10.02	21.2	0.63	26.8
71	11:23:36.34	357	357	10.4	3046.4492	12457.7846	218	215	13.2	3055.7262	12501.9855	9.95	21.2	0.54	26.7
72	11:23:45.06	358	357	10.4	3046.4753	12457.7828	218	216	13.1	3055.6998	12501.9628	9.90	21.3	0.38	26.8
73	11:23:56.39	358	357	10.4	3046.5071	12457.7803	216	217	13.1	3055.668	12501.9343	9.83	21.3	0.31	26.7
74	11:24:06.10	359	357	10.4	3046.5361	12457.7784	216	216	13.1	3055.6386	12501.9088	9.77	21.3	0.38	26.5
75	11:24:15.99	359	357	10.4	3046.5650	12457.7772	216	215	13.1	3055.6114	12501.8872	9.71	21.3	0.52	26.2
76	11:24:26.16	359	357	10.4	3046.5939	12457.7765	217	214	13.2	3055.5777	12501.8616	9.64	21.3	0.61	25.8
77	11:24:45.06	359	358	10.4	3046.6488	12457.7757	217	217	13.1	3055.5215	12501.8143	9.53	21.3	0.27	25.8
78	11:25:06.09	359	358	10.4	3046.7095	12457.7741	216	216	13.1	3055.4597	12501.7611	9.40	21.4	0.33	25.4
79	11:25:16.01	359	359	10.4	3046.7385	12457.7730	217	214	13.1	3055.4319	12501.7401	9.34	21.4	0.48	25.0
80	11:25:26.15	359	359	10.4	3046.7674	12457.7721	218	214	13.2	3055.3982	12501.7141	9.27	21.4	0.46	24.7
81	11:25:36.35	359	359	10.4	3046.7963	12457.7717	218	216	13.1	3055.3686	12501.6890	9.21	21.4	0.27	24.8
82	11:25:45.06	359	359	10.4	3046.8223	12457.7718	217	218	13.1	3055.3428	12501.6655	9.15	21.4	0.11	24.8
83	11:25:56.39	358	359	10.4	3046.8541	12457.7719	216	217	13.1	3055.3107	12501.6375	9.08	21.4	0.16	24.6
84	11:26:06.10	358	359	10.4	3046.8830	12457.7714	216	215	13.1	3055.2805	12501.6137	9.02	21.4	0.40	24.2
85	11:26:26.15	358	359	10.4	3046.9407	12457.7689	218	215	13.1	3055.2202	12501.5659	8.90	21.5	0.35	23.9
86	11:26:36.34	358	359	10.4	3046.9695	12457.7674	217	218	13.1	3055.1915	12501.5400	8.84	21.5	0.14	23.9
87	11:26:45.06	358	358	10.4	3046.9954	12457.7661	216	217	13.1	3055.1655	12501.5172	8.78	21.5	0.22	23.8
88	11:26:56.39	358	358	10.3	3047.0272	12457.7650	216	216	13.1	3055.133	12501.4899	8.71	21.5	0.37	23.6
89	11:27:06.10	358	358	10.3	3047.0560	12457.7642	217	214	13.1	3055.1028	12501.4660	8.65	21.6	0.47	23.3
90	11:27:15.99	358	358	10.3	3047.0849	12457.7635	218	215	13.1	3055.0757	12501.4444	8.59	21.6	0.42	23.2
91	11:27:36.90	358	358	10.4	3047.1455	12457.7617	216	217	13.1	3055.0142	12501.3916	8.46	21.6	0.25	22.9
92	11:27:45.06	358	358	10.4	3047.1686	12457.7608	216	218	13.1	3054.9882	12501.3682	8.41	21.6	0.22	22.8
93	11:27:56.26	358	358	10.4	3047.2003	12457.7596	216	215	13.1	3054.9548	12501.3417	8.34	21.6	0.42	22.5
94	11:28:06.10	358	358	10.4	3047.2292	12457.7582	217	213	13.2	3054.9238	12501.3188	8.28	21.7	0.60	22.0

95	11:28:25.51	358	358	10.4	3047.2869	12457.7555	217	217	13.1	3054.8678	12501.2717	8.16	21.7	0.27	22.1
96	11:28:36.92	358	358	10.4	3047.3186	12457.7541	216	218	13	3054.836	12501.2439	8.09	21.7	0.24	22.1
97	11:28:45.06	358	358	10.4	3047.3417	12457.7531	215	215	13	3054.8092	12501.2221	8.04	21.7	0.42	21.7
98	11:28:56.26	358	358	10.4	3047.3734	12457.7518	216	214	13.1	3054.7758	12501.1964	7.97	21.8	0.54	21.3
99	11:29:06.10	358	358	10.4	3047.4023	12457.7507	217	214	13.1	3054.7453	12501.1729	7.91	21.8	0.52	21.2
100	11:29:16.02	358	358	10.4	3047.4311	12457.7496	217	215	13.1	3054.7157	12501.1483	7.85	21.8	0.40	21.1
101	11:29:25.51	358	358	10.4	3047.4600	12457.7486	217	217	13	3054.6895	12501.1254	7.79	21.9	0.31	21.2
102	11:29:36.90	358	358	10.4	3047.4918	12457.7476	215	217	13	3054.6577	12501.0975	7.72	21.9	0.30	21.0
103	11:29:45.93	358	358	10.4	3047.5177	12457.7468	216	215	13.1	3054.6308	12501.0760	7.67	21.9	0.43	20.6
104	11:29:56.26	358	358	10.4	3047.5467	12457.7458	217	214	13.1	3054.5973	12501.0506	7.60	21.9	0.53	20.4
105	11:30:06.26	358	358	10.4	3047.5756	12457.7446	217	214	13.1	3054.5669	12501.0269	7.54	22.0	0.51	20.2
106	11:30:16.03	358	358	10.4	3047.6045	12457.7432	217	216	13.1	3054.5376	12501.0020	7.48	22.0	0.36	20.2
107	11:30:25.51	358	358	10.4	3047.6334	12457.7418	216	217	13	3054.5117	12500.9790	7.42	22.0	0.29	20.2
108	11:30:36.92	358	358	10.4	3047.6652	12457.7404	216	216	13.1	3054.4791	12500.9518	7.35	22.0	0.38	19.8
109	11:30:45.94	358	358	10.4	3047.6911	12457.7392	216	214	13.1	3054.452	12500.9302	7.29	22.1	0.47	19.6
110	11:31:06.26	358	358	10.4	3047.7489	12457.7369	217	215	13.1	3054.3884	12500.8799	7.17	22.1	0.41	19.3
111	11:31:16.01	358	358	10.4	3047.7778	12457.7358	217	216	13.1	3054.3592	12500.8546	7.11	22.1	0.33	19.2
112	11:31:25.51	358	358	10.4	3047.8067	12457.7348	216	217	13.1	3054.3329	12500.8315	7.05	22.2	0.31	19.1
113	11:31:45.94	358	358	10.4	3047.8646	12457.7330	217	214	13.2	3054.2725	12500.7832	6.92	22.2	0.46	18.5
114	11:32:06.26	358	358	10.4	3047.9224	12457.7309	217	216	13.2	3054.2093	12500.7318	6.79	22.3	0.38	18.2
115	11:32:16.01	358	358	10.4	3047.9514	12457.7296	216	217	13.1	3054.1803	12500.7059	6.73	22.3	0.28	18.2
116	11:32:25.70	358	358	10.4	3047.9803	12457.7283	216	217	13.1	3054.1536	12500.6833	6.67	22.3	0.30	18.1
117	11:32:45.94	358	358	10.4	3048.0381	12457.7258	217	214	13.2	3054.0927	12500.6357	6.55	22.4	0.50	17.5
118	11:32:56.26	358	358	10.4	3048.0671	12457.7247	217	215	13.2	3054.0598	12500.6086	6.48	22.4	0.40	17.4
119	11:33:06.26	358	358	10.4	3048.0960	12457.7237	217	217	13.2	3054.0305	12500.5829	6.42	22.5	0.29	17.3

120	11:33:16.02	358	358	10.4	3048.1249	12457.7228	216	217	13.2	3054.0011	12500.5574	6.36	22.5	0.30	17.1
121	11:33:25.69	358	358	10.4	3048.1539	12457.7219	216	215	13.2	3053.9741	12500.5351	6.30	22.5	0.39	16.9
122	11:33:36.90	358	358	10.4	3048.1857	12457.7209	217	215	13.3	3053.9377	12500.5063	6.23	22.6	0.44	16.6
123	11:33:46.66	358	358	10.4	3048.2146	12457.7199	217	215	13.2	3053.9105	12500.4843	6.17	22.6	0.43	16.5
124	11:33:56.25	358	358	10.4	3048.2406	12457.7188	217	216	13.2	3053.8808	12500.4594	6.11	22.6	0.35	16.4
125	11:34:05.30	358	358	10.4	3048.2666	12457.7175	217	217	13.2	3053.854	12500.4362	6.06	22.7	0.32	16.3
126	11:34:16.03	358	358	10.4	3048.2984	12457.7161	217	216	13.2	3053.8213	12500.4091	5.99	22.7	0.38	16.1
127	11:34:25.71	358	358	10.4	3048.3273	12457.7148	218	214	13.2	3053.7938	12500.3875	5.93	22.8	0.46	15.8
128	11:34:36.90	358	358	10.4	3048.3591	12457.7135	219	216	13.3	3053.7576	12500.3576	5.86	22.8	0.38	15.6
129	11:34:46.66	358	358	10.4	3048.3880	12457.7123	219	218	13.2	3053.7313	12500.3340	5.80	22.8	0.27	15.7
130	11:34:55.11	358	358	10.4	3048.4111	12457.7115	218	218	13.3	3053.705	12500.3102	5.74	22.9	0.25	15.5
131	11:35:05.31	358	358	10.4	3048.4400	12457.7104	218	217	13.3	3053.6756	12500.2840	5.68	22.9	0.27	15.3
132	11:35:16.02	358	358	10.4	3048.4718	12457.7092	219	217	13.3	3053.6428	12500.2562	5.61	22.9	0.30	15.1
133	11:35:25.70	358	358	10.4	3048.5007	12457.7080	219	216	13.3	3053.6157	12500.2339	5.56	23.0	0.37	14.8
134	11:35:36.42	358	358	10.4	3048.5296	12457.7067	220	217	13.2	3053.5833	12500.2055	5.49	23.0	0.32	14.8
135	11:35:46.67	358	358	10.4	3048.5614	12457.7053	219	220	13.2	3053.5551	12500.1779	5.43	23.0	0.16	14.8
136	11:35:55.11	358	358	10.4	3048.5845	12457.7043	217	221	13.2	3053.53	12500.1528	5.37	23.0	0.10	14.7
137	11:36:05.30	358	358	10.4	3048.6134	12457.7031	217	217	13.2	3053.5004	12500.1272	5.31	23.1	0.28	14.3
138	11:36:16.55	358	358	10.4	3048.6481	12457.7017	218	215	13.3	3053.4668	12500.1003	5.24	23.1	0.42	13.9
139	11:36:25.70	358	358	10.4	3048.6741	12457.7008	220	216	13.2	3053.4397	12500.0779	5.18	23.2	0.36	13.9
140	11:36:46.66	358	358	10.4	3048.7348	12457.6989	218	220	13.1	3053.3798	12500.0220	5.06	23.2	0.18	13.8
141	11:36:55.11	358	358	10.4	3048.7580	12457.6982	217	218	13.1	3053.3542	12459.9984	5.00	23.3	0.23	13.6
142	11:37:05.30	358	358	10.4	3048.7869	12457.6973	218	217	13.2	3053.3248	12459.9726	4.94	23.3	0.29	13.3
143	11:37:16.55	358	358	10.4	3048.8217	12457.6961	219	216	13.2	3053.2919	12459.9451	4.87	23.4	0.33	13.1
144	11:37:25.70	358	358	10.4	3048.8477	12457.6951	220	216	13.2	3053.2652	12459.9225	4.81	23.4	0.33	12.9

145	11:37:36.42	358	358	10.4	3048.8767	12457.6939	219	218	13.1	3053.2341	12459.8931	4.75	23.4	0.24	12.9
146	11:37:46.23	358	358	10.4	3048.9056	12457.6927	218	220	13	3053.2064	12459.8659	4.69	23.5	0.18	12.9
147	11:37:55.12	358	358	10.4	3048.9316	12457.6916	218	219	13.1	3053.1808	12459.8423	4.63	23.5	0.20	12.6
148	11:38:05.30	358	358	10.4	3048.9606	12457.6903	218	217	13.1	3053.1514	12459.8175	4.57	23.5	0.32	12.3
149	11:38:16.55	358	358	10.4	3048.9953	12457.6885	220	216	13.2	3053.1182	12459.7900	4.50	23.6	0.34	12.1
150	11:38:25.69	358	358	10.4	3049.0213	12457.6873	220	217	13.2	3053.0919	12459.7664	4.44	23.7	0.27	12.0
151	11:38:36.42	358	358	10.4	3049.0503	12457.6860	219	220	13.1	3053.0611	12459.7366	4.38	23.7	0.17	12.0
152	11:38:56.55	358	358	10.4	3049.1111	12457.6837	218	217	13.2	3053.0033	12459.6843	4.25	23.8	0.29	11.5
153	11:39:05.30	358	358	10.4	3049.1342	12457.6829	219	217	13.2	3052.9769	12459.6613	4.20	23.8	0.30	11.3
154	11:39:16.55	358	358	10.4	3049.1690	12457.6815	220	218	13.2	3052.9451	12459.6328	4.13	23.9	0.24	11.2
155	11:39:36.42	358	358	10.4	3049.2240	12457.6791	219	218	13.2	3052.8878	12459.5797	4.01	24.0	0.24	10.8
156	11:39:46.23	358	358	10.4	3049.2530	12457.6777	220	217	13.2	3052.8585	12459.5538	3.95	24.1	0.29	10.6
157	11:39:56.57	358	358	10.4	3049.2849	12457.6761	221	218	13.2	3052.8292	12459.5275	3.88	24.2	0.25	10.5
158	11:40:05.30	358	358	10.4	3049.3080	12457.6750	222	219	13.2	3052.8032	12459.5038	3.83	24.2	0.23	10.4
159	11:40:16.55	358	358	10.4	3049.3428	12457.6731	221	220	13.2	3052.7726	12459.4732	3.76	24.3	0.18	10.2
160	11:40:26.55	358	358	10.4	3049.3689	12457.6718	221	220	13.1	3052.7449	12459.4453	3.70	24.3	0.16	10.1
161	11:40:36.42	358	358	10.4	3049.3978	12457.6705	221	220	13.2	3052.7169	12459.4178	3.64	24.3	0.16	9.9
162	11:40:46.23	358	358	10.4	3049.4268	12457.6691	222	219	13.2	3052.688	12459.3912	3.58	24.4	0.21	9.7
163	11:40:56.55	358	358	10.4	3049.4586	12457.6676	223	219	13.2	3052.6594	12459.3643	3.52	24.5	0.21	9.5
164	11:41:05.30	358	358	10.4	3049.4818	12457.6667	223	221	13.2	3052.6345	12459.3387	3.46	24.5	0.14	9.5
165	11:41:16.55	358	358	10.4	3049.5166	12457.6652	223	223	13.2	3052.6049	12459.3070	3.39	24.5	0.08	9.3
166	11:41:26.55	358	358	10.4	3049.5456	12457.6640	222	223	13.2	3052.5777	12459.2784	3.33	24.6	0.09	9.2
167	11:41:36.42	358	358	10.45	3049.5717	12457.6628	223	221	13.2	3052.5499	12459.2507	3.28	24.6	0.14	8.9
168	11:41:46.23	358	358	10.5	3049.6006	12457.6616	224	220	13.2	3052.5217	12459.2231	3.21	24.7	0.17	8.7
169	11:42:05.30	358	358	10.4	3049.6557	12457.6590	225	223	13.2	3052.4701	12459.1678	3.10	24.7	0.07	8.5

170	11:42:16.55	358	358	10.4	3049.6905	12457.6573	225	224	13.2	3052.4415	12459.1348	3.03	24.8	0.04	8.4
171	11:42:26.55	358	358	10.4	3049.7195	12457.6558	224	224	13.2	3052.4151	12459.1047	2.97	24.8	0.04	8.2
172	11:42:35.22	358	358	10.4	3049.7427	12457.6545	224	224	13.2	3052.3909	12459.0782	2.92	24.8	0.05	8.0
173	11:42:56.55	358	357	10.4	3049.8066	12457.6514	225	223	13.3	3052.3342	12459.0177	2.79	24.9	0.10	7.7
174	11:43:05.31	358	357	10.4	3049.8298	12457.6504	225	223	13.3	3052.3096	12458.9917	2.73	24.9	0.11	7.5
175	11:43:16.55	358	358	10.4	3049.8646	12457.6490	225	224	13.2	3052.2807	12458.9590	2.67	25.0	0.05	7.4
176	11:43:26.55	358	358	10.4	3049.8936	12457.6478	225	225	13.3	3052.2547	12458.9287	2.60	25.0	0.02	7.2
177	11:43:35.22	358	358	10.4	3049.9169	12457.6470	224	224	13.3	3052.2301	12458.9017	2.55	25.0	0.04	7.0
178	11:43:46.55	358	358	10.4	3049.9517	12457.6455	225	223	13.3	3052.2001	12458.8694	2.48	25.0	0.07	6.8
179	11:44:15.62	358	358	10.5	3050.0361	12457.6413	225	225	13.3	3052.1227	12458.7822	2.31	25.1	0.04	6.3
180	11:44:26.55	358	358	10.5	3050.0680	12457.6396	225	224	13.4	3052.0938	12458.7486	2.24	25.2	0.04	6.1
181	11:44:35.22	358	358	10.5	3050.0913	12457.6383	225	225	13.3	3052.0702	12458.7214	2.19	25.2	0.03	6.0
182	11:44:46.55	358	357	10.5	3050.1262	12457.6365	225	224	13.4	3052.0405	12458.6884	2.12	25.3	0.06	5.8
183	11:44:55.67	358	357	10.5	3050.1524	12457.6353	226	223	13.4	3052.0157	12458.6615	2.06	25.3	0.08	5.6
184	11:45:15.61	358	358	10.5	3050.2106	12457.6326	226	226	13.4	3051.9629	12458.5997	1.94	25.4	0.01	5.3
185	11:45:26.55	358	358	10.5	3050.2426	12457.6311	226	225	13.4	3051.9334	12458.5657	1.87	25.4	0.02	5.1
186	11:45:46.55	358	358	10.4	3050.3008	12457.6284	225	226	13.4	3051.8797	12458.5047	1.75	25.5	0.03	4.8
187	11:45:55.68	358	358	10.4	3050.3269	12457.6270	226	225	13.4	3051.856	12458.4768	1.69	25.5	0.02	4.7
188	11:46:05.30	358	358	10.4	3050.3531	12457.6257	226	225	13.4	3051.8295	12458.4461	1.64	25.5	0.02	4.5
189	11:46:35.06	358	357	10.4	3050.4404	12457.6205	226	225	13.5	3051.7502	12458.3528	1.45	25.6	0.03	4.0
190	11:46:46.55	358	357	10.5	3050.4754	12457.6185	226	226	13.5	3051.7205	12458.3190	1.38	25.8	0.04	3.8
191	11:47:05.30	358	357	10.5	3050.5278	12457.6156	226	226	13.5	3051.6706	12458.2596	1.27	25.8	0.02	3.5
192	11:47:15.62	358	357	10.5	3050.5599	12457.6140	226	225	13.5	3051.6445	12458.2282	1.21	25.9	0.02	3.3
193	11:47:26.55	358	357	10.5	3050.5919	12457.6124	226	225	13.6	3051.6153	12458.1942	1.14	26.0	0.03	3.1
194	11:47:35.06	358	357	10.5	3050.6152	12457.6113	226	225	13.5	3051.5912	12458.1664	1.09	26.0	0.04	3.0

195	11:47:46.55	358	357	10.5	3050.6502	12457.6096	226	226	13.6	3051.5621	12458.1322	1.02	26.2	0.03	2.8
196	11:47:55.67	358	358	10.5	3050.6764	12457.6083	226	226	13.6	3051.5385	12458.1039	0.96	26.3	0.02	2.6
197	11:48:05.19	358	358	10.5	3050.7027	12457.6070	226	226	13.5	3051.5123	12458.0724	0.90	26.3	0.02	2.5
198	11:48:16.39	358	358	10.5	3050.7346	12457.6053	226	226	13.6	3051.4835	12458.0379	0.84	26.4	0.02	2.3
199	11:48:35.06	358	358	10.5	3050.7899	12457.6024	226	225	13.6	3051.4333	12457.9790	0.72	26.7	0.02	2.0
200	11:48:46.55	358	358	10.5	3050.8218	12457.6008	226	226	13.6	3051.4039	12457.9447	0.65	26.9	0.02	1.8
201	11:48:55.67	358	358	10.5	3050.8509	12457.5993	226	227	13.6	3051.3804	12457.9162	0.60	27.2	0.02	1.6
202	11:49:05.19	358	358	10.5	3050.8771	12457.5980	226	227	13.6	3051.3546	12457.8840	0.54	27.2	0.01	1.5
203	11:49:16.39	358	358	10.5	3050.9092	12457.5963	226	226	13.6	3051.3259	12457.8492	0.47	27.5	0.02	1.3
204	11:49:27.04	358	358	10.5	3050.9413	12457.5948	226	225	13.6	3051.2966	12457.8149	0.40	28.0	0.02	1.1
205	11:49:35.06	358	358	10.5	3050.9646	12457.5942	226	226	13.6	3051.2747	12457.7904	0.35	28.5	0.03	1.0
206	11:49:46.55	358	358	10.5	3050.9995	12457.5924	226	225	13.6	3051.2457	12457.7556	0.28	29.6	0.02	0.8
207	11:49:55.67	359	358	10.5	3051.0256	12457.5900	226	217	13.6	3051.2217	12457.7275	0.23	31.0	0.02	0.6