Report of investigation into the Collision between the Hong Kong Registered ship *"Hebei Spirit" and Korean Crane Barge "Samsung No. 1"* on 7 December 2007



The Hong Kong Special Administrative Region
Marine Department
Marine Accident Investigation Section

Purpose of Investigation

This incident is investigated, and published in accordance with the IMO Code for the Investigation of Marine Casualties and Incidents promulgated under IMO Assembly Resolution A.849(20). The purpose of this investigation conducted by the Marine Accident Investigation and Shipping Security Policy Branch (MAISSPB) of Marine Department is to determine the circumstances and the causes of the incident with the aim of improving the safety of life at sea and avoiding similar incidents in future.

The conclusions drawn in this report aim to identify the different factors contributing to the incident. They are not intended to apportion blame or liability towards any particular organization or individual except so far as necessary to achieve the said purpose.

The MAISSPB has no involvement in any prosecution or disciplinary action that may be taken by the Marine Department or others resulting from this accident.

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1. Summary

1.1 On 7 December 2007 at about 0706, a collision incident occurred between a crane barge *"Samsung No 1"* and the Hong Kong registered very large crude oil carrier (VLCC) *"Hebei Spirit"* in the vicinity of Daesan, Korea at position 36° 52.3'N 126° 03.1'E. At time of the incident, the crane barge was towed stern first by the tugs *"Samho T-3"* and *"Samsung T-5"*. A smaller anchor boat *"Samsung A-1"* was escorting at the other end of the barge. Weather conditions were reported as poor.

1.2 "*Hebei Spirit"* was carrying 263,541 tonnes of crude oil. It was anchoring at a position instructed by Daesan vessel traffic information station (VTIS) off Daesan waiting for discharge at time of the incident. Before collision, the tugs lost control of the crane barge in rough weather and somehow drifted toward the "*Hebei Spirit"*. After the crane barge had passed off the bow of the *"Hebei Spirit"*, one of the towing wires parted when the crane barge was in close vicinity of the VLCC. As a result the crane barge made contact with the VLCC at the port side of Nos. 1, 3 and 5 cargo tanks causing severe oil pollution to the sea area.

1.3 Anti-pollution measures were immediately taken on board "*Hebei Spirit"* to reduce the spillage. The crew transferred cargo oil from the ruptured tanks into centre and starboard tanks and rigged collision mats to cover the rupture as an attempt to slow down the spill. Oil boom was also rigged from the vessel trying to contain the spillage of oil. Despite the measures taken, an estimated amount of about 10,900 tonnes of cargo oil had spilled into the sea.

1.4 The investigation revealed that the decision to commence the towing voyage when adverse weather had been forecast is the main contributory factor of this accident. Other causes of accident were loss of control of the towing convoy in rough weather and delaying of notice to the VTIS and other vessels in the area by the tow Master.

2. Description of Vessels

2.1 *"Hebei Spirit"* (fig. 1)

2.1.1	Port of Registry	:	Hong Kong
	IMO No.	:	9034640
	Type	:	Very Large Crude Oil Carrier (VLCC)
	Date of Built	:	1993
	Gross Tonnage	:	146,848
	Deadweight	:	269,605
	Length Overall	:	338.00 m
	Breadth	:	58.360 m
	Summer Draft	:	19.16 m
	Main Engine	:	1 x Oil Engine driving 1 Fix Pitch propeller
	Engine Power	:	20,580 kW @ 68 rpm
	Speed	:	15.5 knots

2.1.2 *"Hebei Spirit"* is a single hull VLCC. The bridge of *"Hebei Spirit"* is equipped with modern navigational aids including gyro and magnetic compasses; 2 radars both of which are fitted with automatic radar plotting aids facilities and 2 global position satellite navigators. The ship is fitted with two bow anchors, each weighing 15 tonnes, and connected to anchor cables with links of 111 millimetres diameter chain and 14 shackles (384 metres) in length**.** *"Hebei Spirit"* was manned in accordance with the requirements of the Minimum Safe Manning (MSM) Certificate issued by the Marine Department of Hong Kong SAR with 27 crew on board.



Fig.1 Hebei Spirit

2.2 *"Samsung No. 1"* (fig. 2)

2.2.1	Type	:	Ocean Crane Barge
	Registered Port	:	Geoje-City, Korea
	Displacement	:	11,828 tonnes
	Length Overall	:	105.63 m
	Breadth	:	45.0 m
	Depth	:	7.0 m
	Built	:	Samsung Heavy Industry
	Date Launched	:	June 1995

2.2.2 The crane barge *"Samsung No. 1"* is a non-propelled vessel equipped with one GPS and one VHF equipment. The barge was also fitted with one windlass with chained anchor, four other pieces of anchor for other special purposes and five lengths of mooring wires (42.5 mm x 400 metres). *"Samsung No. 1"* has a maximum lifting capacity of 3,000 tons. At time of the accident, the barge was under tow and proceeding to its home port of Gohyun in Geoje after completion of the work at the Inchon Grand bridge construction site. The Master of "*Samsung T-5"* was the person in charge for the intended towing voyage.

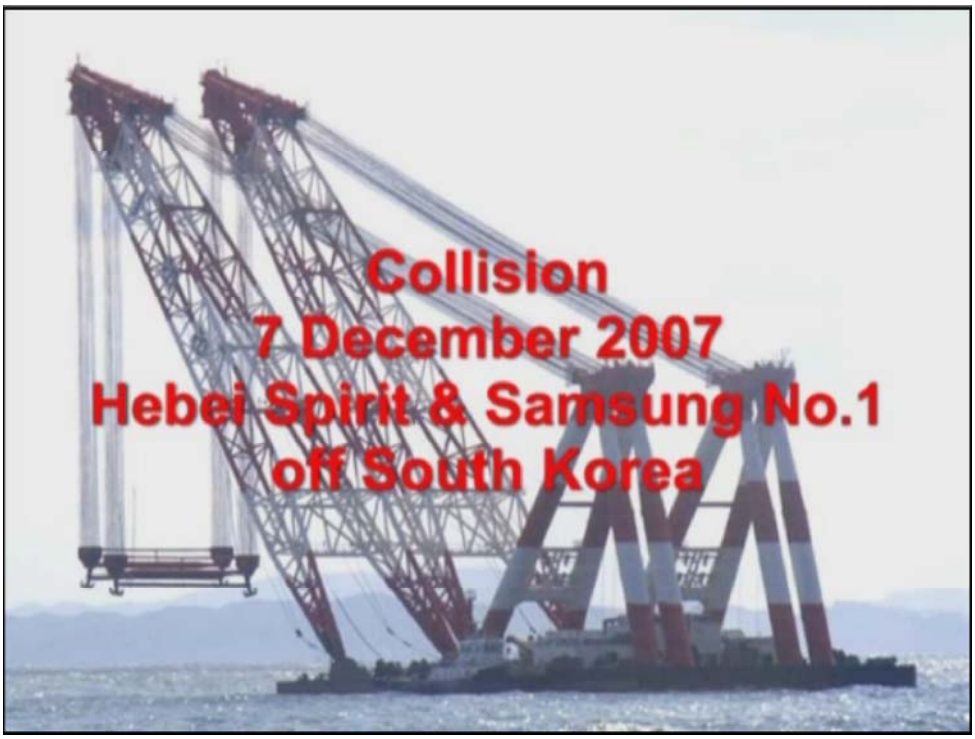


Fig. 2 The crane barge *"Samsung No. 1"*

2.3 *"Samho T-3"*

2.3.1	Type	:	Tug
	Deadweight	:	182 tonnes
	Length Overall	:	33.8 m
	Breadth	:	9.4 m
	Depth	:	4.15 m
	Built	:	2006
	IMO number	:	9413169

2.3.2 At time of the accident tug *"Samho T-3"* was towing the crane barge *"Samsung No.1"* by the stern at its portside. The towing wire was 48 mm diameter at a towing length of 400 metres. *"Samho T-3"* was powered by 2 oil engines driving 2 Z propellers at 220 rpm, total power rating was MCR 2,644 kW (3,594 hp), CSR 2,246 kW (3,052 hp) with a maximum speed of 13 knots.

2.4 *"Samsung T-5"*

2.4.1	Type	:	Tug
	Deadweight	:	311 tonnes
	Length Overall	:	39.6 m
	Breadth	:	10.0 m
	Depth	:	4.6 m
	Built	:	1995
	IMO number	:	9140889

2.4.2 "*Samsung T-5"* was powered by 2 oil engines driving controllable pitch propellers with total power at MCR 3,530 kW (4,800 hp). *"Samsung T-5"* was engaged in towing the crane barge by the stern at its starboard side. The towing wire was 48 mm diameter at a towing length of 420 metres. The Master of tug *"Samsung T-5"* assumed the overall responsibility on navigational safety of the convoy when *"Samsung No. 1"* was under tow.

2.5 *"Samsung A-1"*

2.5.1 "*Samsung A-1"* is a relatively small size anchor boat at about 89 tons. The anchor boat was used for conveyance of personnel and light equipment between the tugs and the crane barge.

3. Sources of Evidence

3.1 *"Hebei Spirit"* - The Master, Chief Officer and the crew

3.2 Lawyer and Operator of *"Hebei Spirit"* – "Ince & Co. International Law Firm" and "V. Ships"

3.3 Korean Maritime Safety Tribunal (KMST)

3.4 Through the assistance of the Korean Maritime Safety Tribunal (KMST) and the lawyer of *"Hebei Spirit"*, information concerning *"Samsung No. 1"* was obtained. At the time of investigation in Daesan, the investigating officer was not able to contact the crew of the *"Samsung No. 1"* as well as from the other 3 tugs involving in the incident, as they had been taken custody by the Korean police.

4. Outline of Events

4.1 Account of *"Hebei Spirit"*

4.1.1 *"Hebei Spirit"* arrived at Daesan late in the afternoon of 6 December with 263,541 tonnes of cargo on board. *"Hebei Spirit"* were carrying a full cargo, with all the cargo oil tanks loaded to 98% capacity, except the Nos. 3 and 5 centre cargo oil tanks, which were 96.5% full. The vessel was on even keel with arrival drafts of 19.98 metres. At 1718 local time, (Greenwich Mean Time +9 hours), Daesan Vessel Traffic Information Service ("VTIS") informed *"Hebei Spirit"* over the VHF radio Channel 12 to proceed to anchor in a position 4.6 nautical miles to the west of the No.1 red flash buoy. *"Hebei Spirit"* had been to Daesan four times previously and on each of these visits she was directed by the VTIS to anchor at or about the same position.

4.1.2 The Master gave the order to let go the starboard anchor at 1918 when in position 36° 52.3'N 126° 03.1'E. About 5 nautical miles west south west from the light beacon (with Racon "G" identification, flash green at 6 seconds intervals, range 13 nautical miles). The position was taken from the Global Position System device and plotted on the chart. The heading on letting go the anchor was 073° Gyro, and the water depth was about 64 metres. The wind was north-easterly force 5 and the tidal current was setting in a south-westerly direction at a rate of 2 knots.

4.1.3 The anchor was brought up with 9 shackles (247 metres) on deck, 8 shackles in the water. The anchor lights and deck floodlights were switched on and navigational lights were turned off. There are two anchor lights on the *"Hebei Spirit"* because of her length, one at forward and one aft. The deck flood lights were also switched on as required under the International Regulations for the Prevention Collisions at Sea, 1972, as amended. In addition, the red signal light indicating carriage of dangerous cargo was also switched on.

4.1.4 At 1924 of 6 December 2007, the Master reported the anchorage position to the VTIS. The VTIS informed that the pilot would be boarding at 1400 on 7 December to take the vessel to the Single Buoy Mooring at Daesan Hang about 20 nautical miles to the North-East, where the vessel would discharge the cargo. The Master informed the Chief Engineer accordingly and the engine was shut down on one hours notice for manoeuvring. One of the steering motors was turned off. The Master kept one steering motor running at this anchorage, because the relatively

strong current could cause the rudder to move around if the power was switched off.

4.1.5 The Master left the bridge leaving the Third Officer and 4-8 duty Able-Bodied Seaman (AB) on anchor watch on the bridge. The Master made several brief visits to the bridge with the last visit at 2115. The Master wrote the Night Orders that the watch-keeping officers should follow the company anchor watch standing orders, and call the Master if they had any concerns or required his attendance. The Master stated that he checked the weather forecast on the Satellite-C system and there were no gales forecast specifically for this area before he left the bridge.

4.1.6 In the morning of 7 December 2007 at about 0605, the Chief Officer called the Master to the bridge telling him that a tow was causing concern because it was shaping up to pass only 0.3 nautical mile ahead of the vessel. There were two other anchored vessels in the vicinity but more than 2 nautical miles away with bearing between 045°Gyro(G) and 090°G. There was therefore, plenty of navigable sea room all around *"Hebei Spirit"*.

4.1.7 The Master arrived the bridge at about 0606. The Master thought it was unnecessarily dangerous for the tug and tow to pass ahead with only 0.3 nautical mile away from *"Hebei Spirit"*, a loaded very large crude carrier (VLCC), when there was plenty of sea room to pass astern and at a greater distance. The Chief Officer was standing by the radars, and the Deck Cadet, who was on 4-8 duty lookout that morning, was standing by the gyro compass repeater at the centre of the wheelhouse.

4.1.8 At that moment the *"Hebei Spirit"* was on a northerly heading. The weather had deteriorated over night. The wind was westerly on the port beam with wind speeds of 30 to 35 knots, Beaufort force 6 to 7. The sea was very rough and there was a short, moderate swell so that the vessel was taking spray over the port bow. The tidal current was setting in a southerly direction at the rate of more than 1 knot. The visibility was fair, more than 3 nautical miles.

4.1.9 A tug towing a large crane barge was visually observed from ahead, there was another tug close to the stern of the barge. There were 3 white masthead lights vertically in a line and a red, port sidelight on the forward tug. The barge was very brightly lit. These lights indicated that the tug and tow unit was more than 200 metres long, and that the forward tug was less than 50 metres in length. The after tug was so close to the barge that it appeared to be pushing the barge. From their

lights, the tugs and barge were on a crossing course, heading in a south-westerly direction.

4.1.10 The Master then sounded more than 5 blasts in quick succession on the forward whistle and checked the radars to see how far away the barge was. The Chief Officer had already acquired the target of the barge on the ARPA on the port radar, and the target of the forward tug on the ARPA on the starboard radar. The barge was making good a course of about 240 degree to 280 degree moving slowly. The closest point of approach was 0.3 nautical mile.

4.1.11 The Master instructed the Deck Cadet at about 0614 to call the tugs and barge on VHF radio Channel 16 and ask them what their intentions were, and to keep clear of *"Hebei Spirit"*, but they did not reply. As they did not reply the Master told the Deck Cadet to inform the VTIS that the tugs and barge were passing very close to *"Hebei Spirit"*. In reply, the VTIS told *"Hebei Spirit"* to stand-by.

4.1.12 At this time there were no other targets close by on the radar. The nearest anchored ship was 1.8 nautical miles away to the east and on the starboard side, bearing just abaft the beam. It was clear that there was a risk of collision with the projected path of the tug and tow. The barge was crossing close ahead and the closest nearest point of approach on the radar was 0.3 nautical mile to port. A passing distance of 0.3 nautical mile ahead would mean that the barge would pass only 0.15 nautical mile i.e. less than 300 metres ahead of the bow of the ship after taking into account the location of radar and the length of the *"Hebei Spirit"*. The Master was also concerned by the fact that the tug was not answering the calls on the VHF radio.

4.1.13 The Master called the Chief Engineer to get the engine ready for manoeuvring as quickly as possible. At this time, the Master also told the Chief Officer and the anchor party to go forward. The Chief Officer and duty AB were both on the forecastle by about 0617. The Chief Officer checked the direction of the anchor cable and reported to the bridge that it was almost in an up and down direction. On acknowledging the direction of anchor cable, the Master decided to give the engine a kick astern to get the ship moving backwards, and at 0617, the Master put the engine to dead slow astern.

4.1.14 Whilst slacking back on the cable at 0622, the VTIS called on the VHF radio on Channel 12 and asked *"Hebei Spirit"* to pick up the anchor to avoid collision with the barge. At this time the barge was bearing about 10° on the starboard bow and was only 0.5 nautical mile away on the radar, 0.35 nautical mile from the bow. If

the anchor cable were heaved, the ship would move ahead, towards the barge thereby increasing the risk of collision. The Master considered the barge was too close and it would be unsafe to heave up the anchor at this time.

4.1.15 The Master informed VTIS that the vessel was paying out the anchor chain and going astern on the engine. He continued to give the engine short kicks astern to 12 shackles (330 metres) in the water. The Chief Officer stopped slacking back and held on to the cable to keep a short length of cable in the chain locker in case it became necessary to slip the anchor cable. At 0632, the barge was now right ahead. Thereafter, her bearing began to open as the barge crossed onto the port bow, the distance between the VLCC and the tug and tow slowly started to increase.

4.1.16 As the Master continued to watch, it was observed that the barge was getting closer to the vessel again. With a steady bearing and decreasing range it was clear there was a risk of collision with the barge moving towards the vessel. The Master put the engine to dead slow astern, followed quickly by slow astern and half astern. At 0658, the Master told the Chief Officer to slip the starboard anchor cable. A short while later the Chief Officer reported to say he was having difficulty hammering out the securing pin.

4.1.17 The barge was now almost upon the port forward of *"Hebei Spirit"* and the crane jibs and hooks were swinging dangerously close above the forecastle deck. The anchor party quickly left the forecastle. With collision imminent, the Master sounded the general alarm and directed the Chief Officer to return aft with the anchor party.

4.1.18 The barge struck the port side in way of the No.1 port cargo oil tank at 0706, and the crane hooks damaged the foremast. Then later the barge made contact again, striking the portside in way of the No.3 port cargo oil tank. With the foremast damaged, fearing some of the electrical wiring forward could be short circuited with spark that might lead to explosion, the Master ordered the anchor lights and deck floodlights to be switched off for safety reasons. Then later the barge made contact again, striking the portside in way of the No.5 port cargo oil tank.

4.1.19 After the first contact scrapped down the port side, at 0721 in an attempt to avoid further contacts, the Master put the engine to dead slow ahead as an effort to swing the stern away from the barge, which was at the engine room position. Shortly thereafter, the barge passed by the bridge, and in doing so the crane hooks struck the main mast at the aft causing further damage, including the satellite

communication antenna dome (fig.5).

4.1.20 As the barge passed clear astern, the Master received reports of oil leaking into the sea from the damaged Nos. 1, 3 & 5 port cargo oil tanks. He contacted the VTIS on VHF Channel 12 and informed them what had happened and reported the pollution. The time was 0728. The Master also broadcast at 0730 on VHF Channel 16 a navigational warning of the pollution.

4.1.21 *"Hebei Spirit"* was not able to report the accident to the shipowners at the time because the crane hooks of *"Samsung No. 1"* had damaged the satellite communications dome on the main mast in the collision. On acknowledging the leakage of oil, the ship's crew implemented the ship's emergency response plan for dealing with an oil pollution incident. They checked the ullages of all the cargo oil tanks, and sounded all the ballast tanks and void spaces to make sure the only leaks were in way of the Nos. 1, 3 & 5 cargo oil tanks. The Chief Engineer reported that there were no leaks in the engine room tanks (fig.3).



Fig. 3 *"Hebei Spirit"* after collision

4.1.22 With the strong wind on the port beam and the rough seas, the vessel was taking spray with the oil leaking out dispersed all over forward part of the deck. The vessel was listing noticeably to starboard. The crew also rigged collision mats at side of the damaged cargo oil tanks in an effort to reduce the amount of escaping

oil went overboard.

4.1.23 At 0938, representatives from the Korean Coast Guard were winched down on to the main deck of the ship by a helicopter for assessing the leakage and damages. It was ascertained that the leaks were confined to Nos.1, 3, & 5 cargo oil tanks (fig. 4). As *"Hebei Spirit"* were carrying a full cargo with almost all the cargo oil tanks were loaded to 98% capacity, with the exception of Nos. 3 and 5 centre of 96.5% full, the vessel had very little tank space available to safely transfer any of the cargo internally between the cargo oil tanks. It was also impossible, owing to the tank and piping configuration, to transfer cargo into the ballast tanks and void spaces. The worst leak at this time was in way of the No.5 port cargo oil tank and in light of the emergency, the Master ordered the Chief Officer to begin transferring the cargo from the breached tanks into Nos. 3 & 5 centre cargo oil tanks.



Fig. 4 Damaged No. 1 port cargo oil tank



Fig. 5 Damaged satellite communication dome at the main mast

4.1.24 Before transferring the cargo, and for safety reasons, inert gas was pumped into the cargo oil tank, and particularly into the leaking cargo oil tank where the inert gas pressure had fallen to reduce the risk of explosion. The crew started transferring the cargo from No. 3 port cargo oil tank to Nos. 3 and 5 centre cargo oil tanks. In order to reduce the quantity of oil ultimately escaping into the sea, the Chief Officer started ballasting into the starboard side ballast tanks. The vessel took in about 3,000 tonnes of ballast, by the time the list was then about 5° to 6° to starboard. The Master could not further increase the list because of the slippery conditions on deck and the dangers to the crew. After 1115 only oil from the No.1 port cargo oil tank was leaking at a rate of about 250 barrels per hour. The oil finally stopped leaking from this tank at 2000 on 8 December.

4.2 Account of the Towing Convoy

4.2.1 At the time of investigation in Daesan, the investigating officer was not able to contact the crew of the crane barge *"Samsung No. 1"* as well as from the other 3 tugs involving in the incident, as they had all been taken custody by the Korean police. Information concerning the towing convoy was obtained through the assistance of the Korean Maritime Safety Tribunal (KMST) and the lawyer of *"Hebei Spirit"*.

4.2.2 The towing convoy departed on its return voyage from Inchon at about 1450 on 6 December 2007 after work and headed south for Geoje (34° 49'N 128° 26'E). The crane barge *"Samsung No. 1"* was towed by the stern by two tugs, namely *"Samho T-3"* and *"Samsung T-5"*. An anchor boat *"Samsung A-1"* was escorting at the other end of the crane barge (fig. 6). The towing wires at tug *"Samho T-3"* was approx. 400 metres and *"Samsung T-5"* was approx 420 metres. Both towing wires were at 48 mm in diameter. The Master of *"Samsung T-5"* had assumed the overall responsibility on navigational safety of the convoy. During the voyage, the communication between the four vessels was through VHF radio Channel 15 and occasionally via mobile phones.

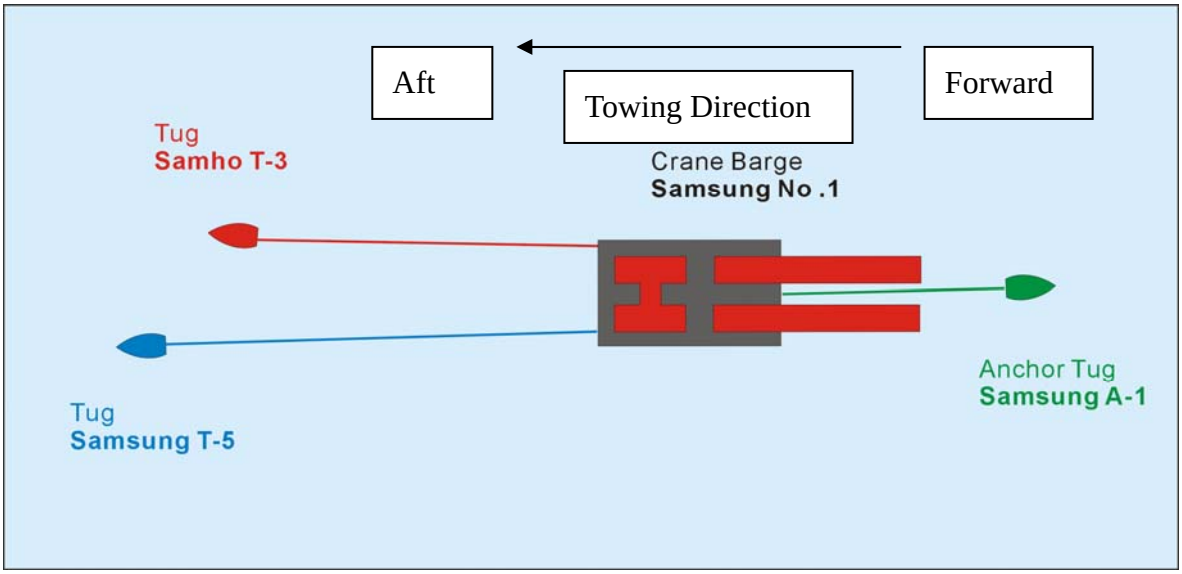


Fig. 6 Towing arrangement of the convoy

4.2.3 A towing capability inspection was carried out on 26 November 2007 in Busan before the voyage to Inchon. Voyage recommendations stipulated that the towing convoy is not to depart if winds in excess of Beaufort scale force 5.

Information on weather forecast

4.2.4 There was a discussion in the morning of 6 December 2007 between the Master of barge *"Samsung No. 1"* and *"Samsung T-5"* regarding the departure of the towing convoy. The Master of the barge *"Samsung No. 1"* received information that the weather was not so good. He also received a text message from the office that the wind would be from southwest to west and the wave height would be about 1.5 - 2.5 metres (Beaufort scale force 4-6). He passed the information to the Master of *"Samsung T-5"* but he played no part in deciding whether the voyage should be commenced in view of the weather condition.

4.2.5 The Master of *"Samho T-3"* also heard the weather information about 1 hour before departure that the weather was not that good on the day of 6 December 2007 and would become even worse the next day. Although he had received the adverse weather information, he did not contact the Master of *"Samsung T-5"* or barge *"Samsung No. 1"*, instead he only discussed with his crew onboard *"Samho T-3"*. He stated that he was not responsible in making the decision whether the towing voyage should go ahead.

4.2.6 The Master of *"Samsung T-5"* considered that the weather forecast would not affect the voyage of the towing convoy because the wind at that time did not reach Beaufort Scale 5. He also considered that the strong wind forecast was for the sea areas of 20 miles from the shore. The voyage of the towing convoy was planned to navigate only 10 miles away from the coast.

The towing voyage

4.2.7 The towing convoy departed at about 1450 on 6 December 2007 from Inchon Grand Bridge construction site and headed south for Samsung Heavy Industry located at Gohyun port in Geoje (34° 49'N 128° 26'E). Anchor boat *"Samsung A-1"* was positioned close to the forward of the crane barge. The average speed of the towing convoy was about 3.5 knots.

4.2.8 At about 0200 on 7 December 2007 the Master of *"Samsung T-5"* went to the steering room and notified the deteriorated weather condition. He changed the course to 250 degree.

Loss of control over the towage

4.2.9 As the weather deteriorated in the morning of 7 December 2007, the crane barge started losing control and the towing convoy was moving in a zigzag direction, deviating from its intended course. At around 0400 hours the towing convoy was virtually out of control as it drifted in a south-easterly direction. The speed dropped down to 1.7 knot, at this slow speed the barge would be further susceptible to drift under the strong wind.

4.2.10 Due to the poor weather situations, the towing capability of the towing convoy could not overcome the weather conditions. The Master changed its course from west to a northern direction at about 0444 trying to seek shelter by returning to Incheon Port but without success. After changing the course, the towing convoy was further drifted to south (fig. 7).

4.2.11 At about 0550 the Master of *"Samho T-3"* observed a huge target on the radar and was getting closer suggesting a risk of collision might exist. This target was later identified to be *"Hebei Spirit"*. At 0630 the towing convoy continued to drift down and passed the bow of *"Hebei Spirit"* uneventfully from a distance of 0.7 nautical mile. After passing, the tugs increased the engine power, probably in an attempt to clear from *"Hebei Spirit"*. However, the towing wire of the *"Samsung T-5"* parted at about 0651 after the towing convoy passed the bow of *"Hebei Spirit"*.

4.2.12 The Master of *"Samsung T-5"* notified *"Samsung No. 1"* through the VHF radio that the tow wire was parted. The Master of the barge *"Samsung No. 1"* ordered his crew to drop the anchor to avoid collision with *"Hebei Spirit"* and he also requested another tug *"Samho T-3"* to pulled them away from the drifting path. Depth of water in the area varied between 30 to 66 metres. *"Samsung No. 1"* dropped the anchor at about 6 minutes before the collision. However even after the anchor was released with about 6 shackles (165 metres) of anchor chain in the water, due to the rough weather, barge *"Samsung No. 1"* continued to drift to the anchored position of *"Hebei Spirit"*.

4.3 Communication between *"Hebei Spirit"* and Vessel Traffic Information Service (VTIS)

4.3.1 At 0609 on 7 December 2007 *"Hebei Spirit"* first called Daesan VTIS informing that a crane barge was fast approaching from a distance of 0.8 nautical mile ahead. After establishing communication the VTIS told *"Hebei Spirit"* that the crane barge would have difficulty to control its maneuver due to rough weather. The VTIS further requested *"Hebei Spirit"* to take some measures to cope with the situation. In reply *"Hebei Spirit"* informed that they were preparing to use the anchor and the engine.

4.3.2 At 0622, the VTIS called *"Hebei Spirit"* to use the engine and raise the anchor. However *"Hebei Spirit"* replied that there was no time to raise the anchor as the distance between them was only 0.3 nautical mile. If the anchor were heaved, *"Hebei Spirit"* would get closer to the crane barge and increase the chance of collision. Instead *"Hebei Spirit"* would go astern to increase the passing distance for the crane barge.

4.3.3 At 0652 the VTIS contacted "*Hebei Spirit*" asking them to pick up the anchor and move immediately to another safe place. "*Hebei Spirit*" reinstated the position that it would be difficult to raise anchor at such moment as the crane barge was still crossing ahead. This could only be safe to do so after the crane barge passed the bow of "*Hebei Spirit*".

4.3.4 The first collision occurred at about 0706. At 0716 VTIS asked "*Hebei Spirit*" if they could extend the anchor chain to the maximum and continued to move backward. "*Hebei Spirit*" replied that they had already done that. At 0719 "*Hebei Spirit*" requested VTIS to send a few tugs to help the situation that had been threatening their vessel. In reply VTIS said it would be difficult for them to do so because the location was too far away from their base. At 0720 "*Hebei Spirit*" reported that oil spills were observed. VTIS inquired about the damages of the vessel over the radio.

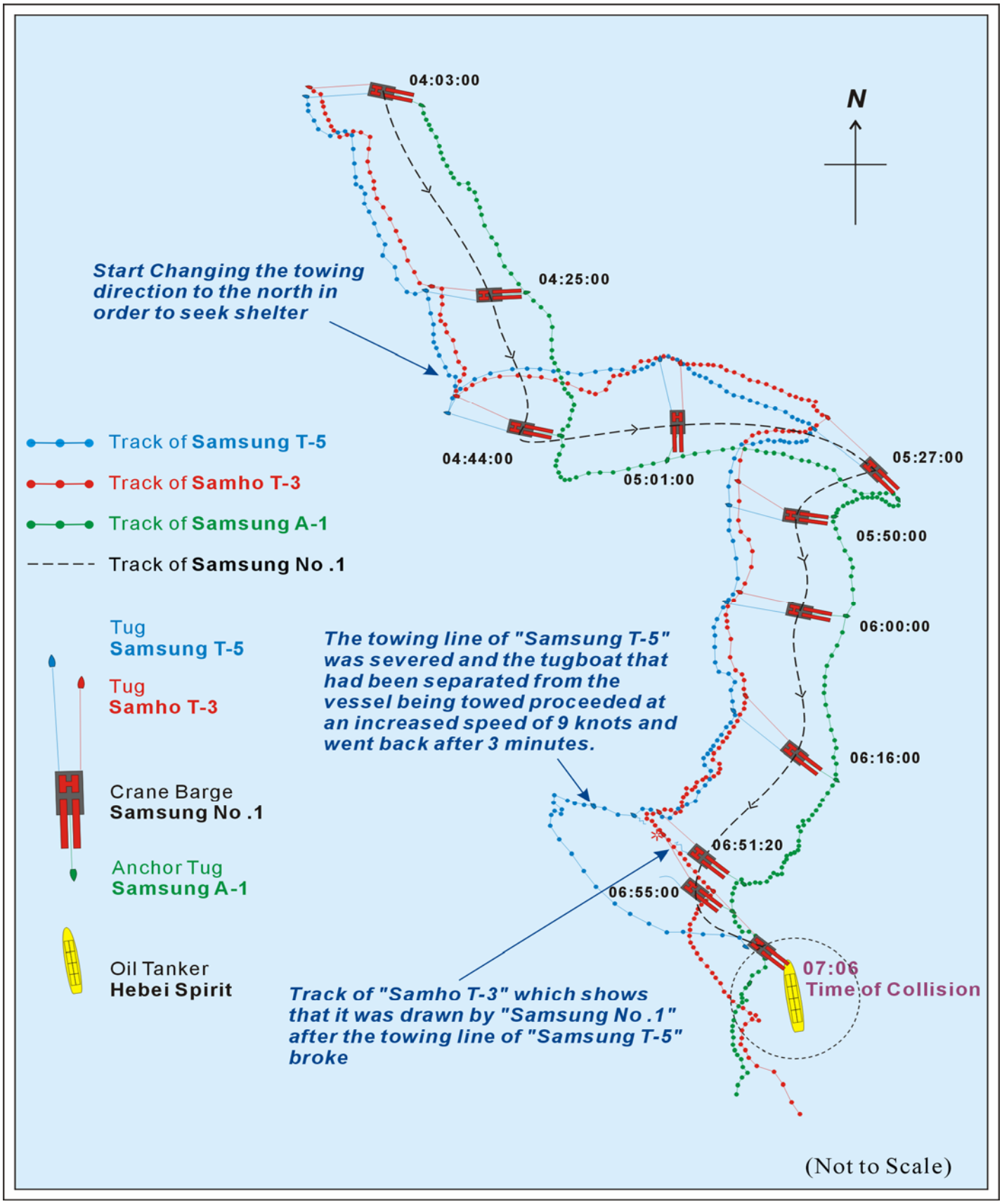


Fig. 7 Probable tracks of the towing convoy before collision

5. Analysis of Evidence

5.1 Weather Considerations

5.1.1 A towing capability inspection had been conducted about 10 days before the towing voyage. Amongst other conditions the inspection recommended that the tow was not to depart if winds were in excess of Beaufort scale force 5.

5.1.2 Before the towing voyage commenced, the Master in charge of the towing convoy had received adverse weather forecast. The forecast weather conditions would amount to Beaufort scale force 6 to 7. Poor weather would be anticipated in the waters around Daesan at around 0300 on 7 December 2007. Rough sea with northwesterly winds of 12 to 16 metre per second and waves at height of 2 to 4 metres would be prevailing in the area.

5.1.3 The Master however thought that the weather forecast of Incheon Port, i.e. the port of departure would not affect the voyage because the wind at departure did not exceed Beaufort Scale 5. Beaufort scale 5 was the limit to allow the towing to proceed set forth by the towing inspection. He also thought that the towing convoy would plan to navigate within 10 nautical miles from the coast. Despite the adverse weather forecast, the voyage however commenced at 1450 on 6 December 2007.

5.1.4 The Master in charge might have underestimated the severity of the rough weather that might affect the towing convoy. He also misinterpreted the effect of strong wind was only for the sea areas of 20 miles from the shore. The Master's decision to commence the voyage appeared to have been based on that the weather conditions at time of the commencement of voyage did not exceed the prescribed limit of Beaufort wind scale 5. He however, failed to take notice of the rough weather might further deteriorate during the voyage and did not make early preparation for rougher weather.

5.1.5 In practice, assessment of weather conditions should be based on a forecast of at least 48 hours period[1]. The Master should be aware that the forecast weather conditions after departure might exceed the prescribed limit as permitted by the towing inspection. He should have considered postponing the towing voyage until more favourable weather was expected.

[1] "General Guidelines for Marine Transportations" by Noble Denton International

5.2 Towing conditions

5.2.1 In general tugs selected for a specific operation should possess suitable power to handle its tow under any condition that may be prevailing in a voyage. The tow should be of suitable draft, stability and freeboard for the intended voyage. Besides, specific attention should also be given to condition and maintenance of towing hawsers and towing gears.

5.2.2 As a general guidance, the following figures reflect the power of tug and related towing line sizes which have proven successful for numerous tows[2]:

Displacement of tows in tons	Tug towing power (hp)	Diameter of steel wire hawser
10,000 – 30,000	3000 to 5000	2 inches

5.2.3 The displacement of crane barge *"Samsung No. 1"* is 11828 tonnes, the power of the tugs *"Samho T-3"* and *"Samsung T-5"* is 2644 kW (3544 hp) and 3530 kW (4731 hp) respectively. The power of anchor boat "*Samsung A-1"* is relatively small. The size of towing ropes were 48 mm (1.89 inches) in diameter. Though appeared to be adequate, it applied only to towing under relative calm sea conditions.

5.2.4 In this incident, it appeared that the towing capability of the towing convoy could not overcome the weather condition during the voyage. The propulsion engine horsepower alone does not necessarily mean a tug would be suitable for a specific towing job, nor does it necessarily reflect bollard pull of the tug. Towage consideration must be taken in relation to maneuvering characteristics of the tow and the prevailing weather, route, towing arrangements, wind surface freeboard area and speed of the tow. In this incident, a big floating crane of 140 m high was mounted on deck of the crane barge. This large deck structure could induce large wind resistance when under strong wind conditions. Besides the relative box shape hull would cause the crane barge to be susceptible to drifting by waves and current. When under poor weather conditions, there is a high possibility that the tugs might lose control of the barge.

[2] Richard A. Cady - Marine Hawser Towing Guide

5.3 Actions Taken by the Towing Convoy

Delay in notifying the VTIS and vessels in vicinity

5.3.1 Despite the fact that the towing convoy had lost control of the crane barge as early as 0400 on 7 December 2007, the Master in charge of the towing convoy did not inform the VTIS or other anchored vessels in the vicinity between 0400 to 0617. The first communication was only established at 0617 when the VTIS called the towing convoy via mobile phone.

5.3.2 Daesan VTIS observed the zigzag track of the towing convoy and called them for clarification on VHF Channel 16 at about 0523. There was no response from the towing convoy. At about 0614 when the towing convoy approached *"Hebei Spirit"* from a distance of 0.5 nautical mile, *"Hebei Spirit"* called via VHF Channel 16 and there was also no response from the towing convoy. The towing convoy appeared to have not maintained a proper VHF watch during this critical period thus unable to reply to these calls.

5.3.3 The first communication between Daesan VTIS and the Master of *"Samsumg No. 5"* was established only at about 0617 when VTIS called him via his mobile phone. After the conversation, at 0622 the VTIS notified *"Hebei Spirit"* to heave up anchor to avoid collision with the crane barge, by such time the crane barge was approaching at only 0.3 nautical mile from the bow of *"Hebei Spirit"*.

5.3.4 As early as 0400 on 7 December 2007 the towing convoy experienced difficulties in maintaining its control. Knowing the vulnerable conditions of the towing convoy, the Master should have immediately informed the VTIS the seriousness of the situation so that other vessels (not just *"Hebei Spirit"*) in the vicinity would be aware of its situation and take the necessary precautionary actions. He should also request assistance from the VTIS at the earliest opportunity.

5.3.5 The delaying in notifying the VTIS and other ships in the vicinity had caused insufficient preparation time for *"Hebei Spirit"* to take action to avoid a collision. At that time, *"Hebei Spirit"* had paid out 9 shackles (247 metres) of anchor chain into the water at its anchorage. For a vessel of about 270,000 deadweight it would take at least 30 to 40 minutes to prepare the engine and heave up the 9 shackles of cable from the water. Had the alert been given earlier, *"Hebei Spirit"* could have heaved up the anchor and avoid the collision.

Possible cause of wire parting

5.3.6 After the accident the main tow wire of tug *"Samsung T-5"* was found to be a used crane runner wire. This tow wire was put to use after it was replaced from the crane and left into a store for some time. Crane wires tend to be of different construction when compare with a towing wire due to their different mode of operation. Use of improper tow wire could be dangerous because of possible shock loading and chafing of the wire while engaging in towing.

5.3.7 After passing the bow of *"Hebei Spirit"* the towing convoy increased the speed. However, in about 10 minutes' time after the increase, the towing wire parted. The Master in charge might have considered an attempt to increase the speed from avoiding further setting towards the *"Hebei Spirit"*. However, an increase of speed in rough sea condition might exert additional strain at the towing wire as a result of increase of force application. This would become critical if the towing wire was already pulled at its limit.

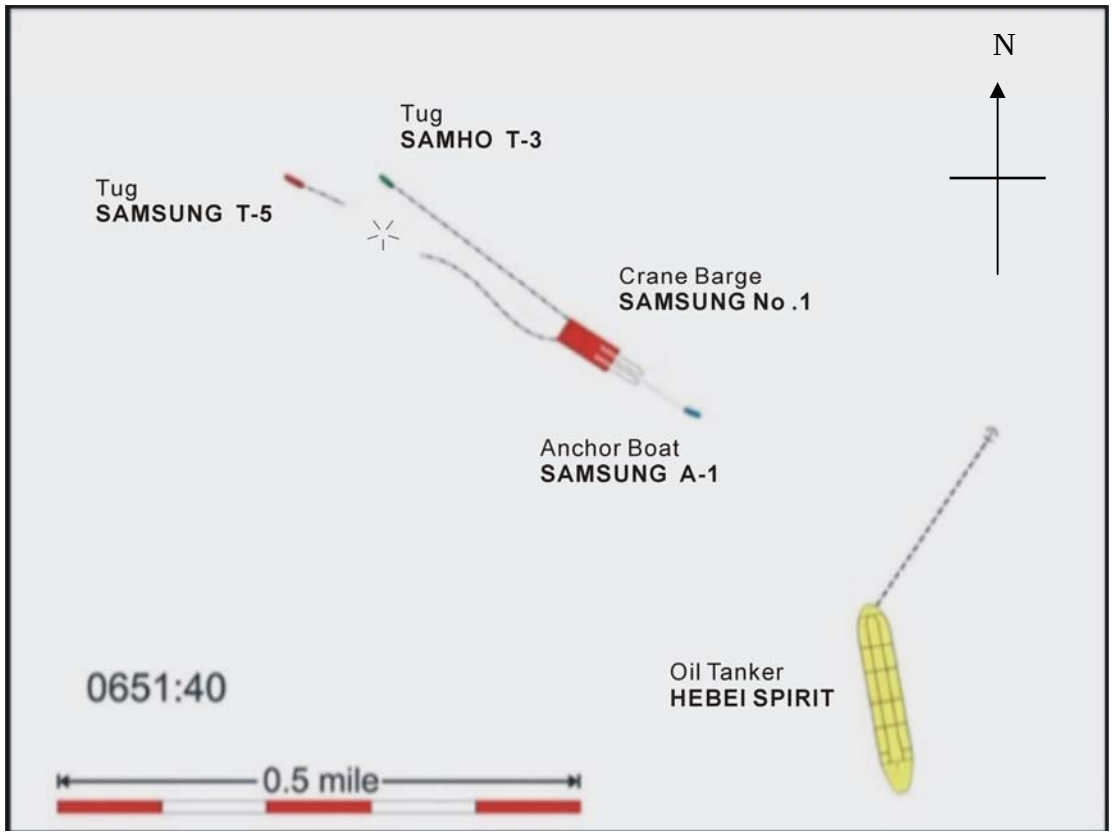


Fig. 8 Sketch of the approximate relative positions of *"Hebei Spirit"* and *"Samsung No. 1"*

5.4 Certification and Experience of Personnel - *"Hebei Spirit"*

5.4.1 The Master of *"Hebei Spirit"* is an Indian national. He is holding a Class 1 Deck Certificate of Competency issued by the United Kingdom Maritime and Coastguard Agency and a Class 1 Deck Officer Licence issued by the Marine Department of Hong Kong Special Administrative Region.

5.4.2 The Master was employed by the management company since 1991, initially as a Deck Cadet and promoted to Master in 2006 onwards. He joined the *"Hebei Spirit"* as Master on 12 October 2007. Since qualifying as a deck officer all of the ships that he had sailed on were oil tankers. He was properly qualified and experienced for the post on *"Hebei Spirit"* at the time of the accident.

5.5 Actions taken by *"Hebei Spirit"*

Decision not to Heave up Anchor

5.5.1 The VTIS advised *"Hebei Spirit"* to heave up anchor at 0622 when the crane barge was approaching to the bow. As the distance between the barge and *"Hebei Spirit"* was reducing, it would be dangerous if the vessel were to heave up its anchor at that moment. Heaving up the anchor would inevitably cause the vessel to move forward and increase the risk of collision.

5.5.2 The Master clarified the situation with the VTIS. Instead of heave up the anchor, he gave astern engine movement and slackened the anchor cable to increase the passing distance. As considerable time would be required to heave up the 9 shackles of anchor cable in water and the possible forward movement with the towing convoy just ahead in close proximity, action to heave up anchor would not be appropriate under the circumstances. It is considered that the Master had taken the right decision not to follow VTIS advice to heaving up anchor at the material time.

Remedial Actions after Collision

5.5.3 After the collision, *"Hebei Spirit"* attempted to reduce the scale of pollution by transferring oil from the damaged tanks and securing the collision mats at side of the damaged cargo oil tanks. As the VLCC was in a fully loaded condition and nearly all cargo oil tanks were at 98% capacity, the transfer of oil could only be done to the Nos. 3 and 5 cargo oil tanks, which were at 96.5% full. The transfer

was taken in a cautious manner to avoid overflow that might aggravate the pollution situation. The Master also pumped ballast to starboard ballast tanks with the intention to list the VLCC to starboard and lower the oil level in the damaged cargo tanks. These remedial actions appeared to have reduced certain amount of oil spillage.

5.5.4 The ship's Shipboard Oil Pollution Emergency Plan (SOPEP) was kept on board the "*Hebei Spirit*" and it provided instructions to the crew in case of emergency situations. Chapter 3 of the SOPEP described "Steps to Control Discharge". Paragraph 3.2 stated: "In responding to a casualty, the Master's priority will be to ensure the safety of personnel, the ship, cargo and the environment and to take action to prevent escalation of the incident".

5.5.5 Paragraph 3.2.5 "Hull Leakage" and paragraph 3.3.3 "Collision with Fixed or Moving Object" of the SOPEP mentioned the emergency duties and actions of the Master, Chief Officer and the Emergency Party in the form of check list. After assessing the remedial actions as described in paragraph 4.1.18 to 4.1.24 of this report, the actions taken by the Master and his crew of the "*Hebei Spirit*" after the collision are considered to have fully complied with the provisions as laid down in the SOPEP.

5.6 VTIS and the Anchor Position of VLCC

5.6.1 The anchored position at 36° 52.3'N 126° 03.1'E was advised by Daesan VTIS. In previous visits, "*Hebei Spirit*" was also instructed to anchor at similar position uneventfully.

5.6.2 To the north of this anchor position there are two traffic separation schemes (TSS) (37° 15'N 126° 15'E); one for inbound (Tong Sudo) and the other for the outbound traffic (Pando Sudo) of Inchon. To the south there is another TSS at west of Ong Do (36° 40'N 126° 00'E) guiding the north and southbound traffic. For traffic proceeds to Inchon from south the course adjoining the TSSs would cause the traffic to pass less than 1 nautical mile from the VLCC anchored position. For traffic from Inchon to south, the traffic would pass at about 2 nautical miles from the anchor position (fig. 9).

5.6.3 In this incident it is believed that the towing convoy might have originally planned to shape a south-westerly route of about 210 degree to join the TSS at

west of Ong Do. With this course the towing convoy would have passed about 2 nautical miles from the anchored position of *"Hebei Spirit"*. However, due to the rough weather and loss of control, the towing convoy drifted towards the VLCC anchorage. As the anchored position was located between the routes of the passing traffic to and from the port of Inchon, it appears that the VLCC anchorage is too close to the passing traffic.

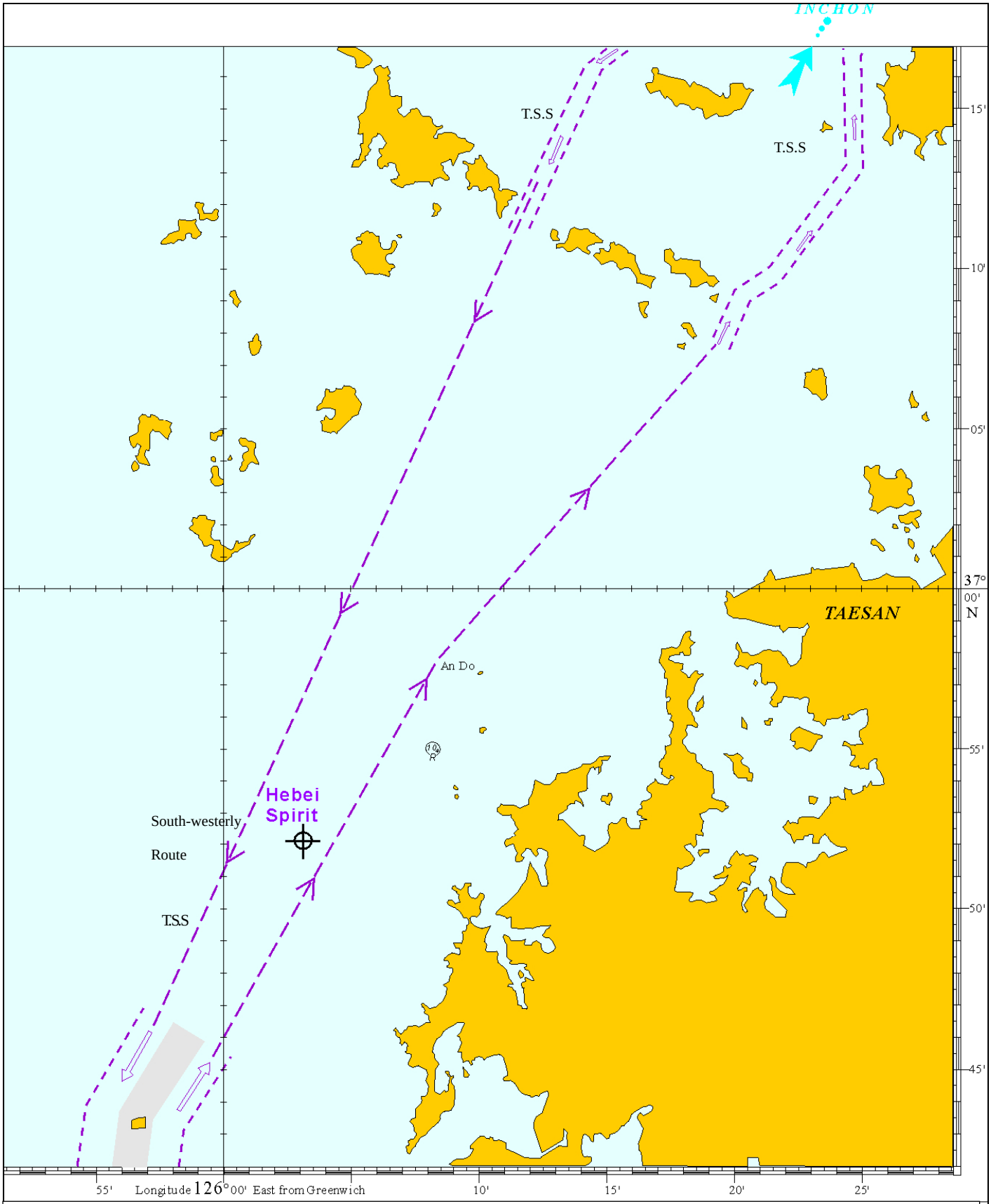


Fig. 9 Approaches to Inchon

6. Conclusions

6.1 On 7 December 2007 at about 0706, a collision incident occurred between a crane barge *"Samsung No 1"* and the Hong Kong registered vessel *"Hebei Spirit"* in the vicinity of Daesan, Korea in position 36° 52.3' N 126° 03.1' E. At time of the incident, the crane barge was towed stern first by the tugs *"Samho T-3"* and *"Samsung No 5"*. Weather conditions were reported as poor.

6.2 *"Hebei Spirit"* was carrying 263,541 tonnes of crude oil. It was anchoring off Daesan waiting for discharge at time of the incident. Shortly before the incident, the tug and tow crossed from starboard to port ahead of *"Hebei Spirit"*. After crossing, the towing wire parted and the crane barge drifted towards to *"Hebei Spirit"*. The crane barge made contact with the tanker in way of the port forward section. As a result of the contact, the port side of Nos. 1, 3 and 5 cargo tanks of *"Hebei Spirit"* were ruptured and caused severe oil pollution in sea area.

6.3 Anti-pollution measures were immediately taken on board *"Hebei Spirit"* to reduce the spillage. As an attempt to slow down the spill, the crew transferred cargo oil from the ruptured tanks into centre tanks and rigged collision mats to cover the ruptured areas. Oil boom was also rigged from the vessel trying to contain the oil. The estimated oil quantities spilled was about 10,900 tonnes.

6.4 The investigation revealed that the decision to commence the towing voyage when adverse weather had been forecast is the main contributory factor of this accident. The towing capability of the towing convoy during the voyage could not overcome the weather conditions. The delay in notifying the VTIS and other ships in the vicinity resulted insufficient time had been given for *"Hebei Spirit"* to take necessary actions to avoid the collision. The loss of control in the towing of crane barge caused direct contact with *"Hebei Spirit"*.

6.5 An increase in speed in rough sea condition generated additional strain which eventually broke the towing wire. It was known that an old crane runner wire was used as the towing wire at the time. The old crane runner wire, if not in good condition, might not be suitable for the purpose of towing and thus led to the accident.

6.6 The VTIS advised *"Hebei Spirit"* to heave up anchor at 0622 on 7 December 2007 when the crane barge was about 0.35 nautical mile from the bow. Given the close proximity of the crane barge, it is considered that the Master had taken the right decision not to heave up anchor at the material time.

6.7 After the collision, *"Hebei Spirit"* attempted to reduce the scale of pollution by transferring oil from the damaged tanks and securing the collision mats at side of the damaged cargo oil tanks. Given the rough weather conditions, the transfer was taken in a cautious manner to avoid overflow that might aggravate the pollution situation.

6.8 The Master also pumped ballast to starboard ballast tanks with the intention to list the *"Hebei Spirit"* to starboard and lower the oil level in the damaged cargo tanks. These remedial actions appeared to have reduced certain amount of oil spillage. The actions taken by the Master and his crew after the collision are considered to have fully complied with the provisions as laid down in the ship's Shipboard Oil Pollution Emergency Plan.

7. Recommendations

7.1 Copies of report should be sent to the Master and management company of *"Hebei Spirit"*. The management company and the Master are to be assured of the proper actions that had been taken before and after the collision.

7.2 Two copies of report should be sent to the Korean Maritime Safety Tribunal and the Samsung Heavy Industries Co. Ltd. as the owner of the crane barge *"Samsung No. 1"* request them to consider the concerned issues in the investigation report.

8. Submissions

8.1 In the event that the conduct any person or organization is criticized in an accident investigation report, it is the policy of the Marine Department that a copy of the draft report is given to that person or organization so that they have an opportunity to rebut the criticism or offer evidence not previously available to the investigating officer.

8.2 Submission on the report was received from the management company of the *"Hebei Spirit"*, Korean Maritime Safety Tribunal and the Samsung Heavy Industries Co. Ltd. The Investigating Officer has taken into account some of the views from the submission and the draft report has been amended where appropriate. Other submissions that have not been incorporated into the report were responded separately to the parties concerned.

10 February 2009

Appendix

Appendix 1

. Chronological Sequence of Brief Events of the Accident

Time	*"Hebei Spirit"*	Towing Convoy	VTIS
6 December 2007			
1450		Towing convoy departed from Inchon for Geoje	
1718			VTIS informed *"Hebei Spirit"* of the assigned anchor position
1918	Let go anchor		
1924	Reported to VTIS of its anchored position		
2115	Master visited bridge last time before rest		
7 December 2007			
0200		Tug "Samsung T-5" received broadcast of adverse weather	
0400		Tugs had lost control over towing of crane barge	
0523			VTIS called the towing convoy on VHF Channel 16 but without response
0550		"Samho T-3" observed target of *"Hebei Spirit"* on radar	
0605	Chief Officer informed Master concerning passing of a tug and tow		
0606	Master arrived bridge		
0609	*"Hebei Spirit"* called VTIS regarding the passing crane barge		

0614	*"Hebei Spirit"* called the towing convoy on VHF Channel 16 but without response		
0617	Chief Officer and AB at forecastle; Engine went dead slow astern		VTIS contacted Tug "Samsung T-5" via mobile phone – First communication established
0622			VTIS asked *"Hebei Spirit"* to heave anchor
0632		The crane barge passed ahead of *"Hebei Spirit"*	
0645.5 - 0654	Engine went dead slow astern		
0651		The towing wire of "Samsung T-5" parted	
0652			VTIS asked *"Hebei Spirit"* to heave anchor
0657	Engine went dead slow astern		
0658	Engine went slow astern Master told Chief Officer to slip anchor cable		
0658.5	Engine went half astern		
0706	Collision occurred		
0716			VTIS asked *"Hebei Spirit"* if they could extend the anchor chain
0719	*"Hebei Spirit"* requested VTIS to send few tugs for assistance		
0720	*"Hebei Spirit"* reported to VTIS that oil spills were observed		
0721	Engine went dead slow ahead and rudder hard to port to swing away from the barge		
0728	Reported the accident and pollution to VTIS		

0730	Master broadcast a radio navigational warning on VHF16		
0938	Korean Coast Guard onboard via helicopter		
0942	Collision mats were secured at the damaged areas		
1000	Started inert gas plant		
1115	Ran ballast into starboard ballast tanks; Oil leaked from No. 1 port cargo oil tank at about 250 barrels per hour		
2000	Oil spillage stopped		