Investigation Report

The Sinking of the Fishing Vessel *Insung I*

by Korean Maritime Safety Tribunal

The investigation that is the subject of this report was conducted in conformity with the Act on the Investigation and Inquiry into Marine Accidents, with the purpose of improving the safety of ships by investigating marine casualties and other incidents.

The sole objective of this investigation is to prevent future accidents and malfunctions by providing requisite information and explanations based on the ascertainment of the causes and circumstances of the shipwreck that is the subject of this report. As such, this investigation did not seek to determine the faults, liabilities or claims that may have been or will be possibly at issue.

Therefore, this report ought not to be be used in any formal proceedings, either in courts of law or before the Maritime Board of Korea.

Issued by:

Marine Casualty Investigation Team of the Korean Maritime Safety Tribunal

9F, 175 Soonhwa-dong, Jung-gu, Seoul 100-773, Republic of Korea

Director General: Capt. Lee Yong

Phone: +82-2-3674-6241 / Fax: +82-2-3674-6239

E-mail: kmst_special@korea. krwww.kmst.go.kr

Table of Contents

1. Summary

On December 9, 2010, the Insung I and a dozen or so other fishing vessels were on their way to Zones H, I, and K, having finished fishing in Zone B of Trench 88-1 that is part of the waters governed by the Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR). Seawater began to flow into the Insung I, through the trawling door as well as the door to the passageway that was used to move the fishing gear along. As the seawater reached the front processing area (i.e.k an area at the bow reserved for processing fish) and inside the passageway, the vessel was overturned on its starboard and eventually sank at 06:25, on December 13, 2010, 1,158 miles away from the Campbell Island off the southern coast of New Zealand, in latitude 63 degrees 19 minutes 52 seconds south, and longitude 160 degrees 15 minutes 25 seconds west.

The sinking of the Insung I resulted in the death of 5 of the 42 crewmembers, and the missing of 16, including the captain and one Korean observer.

1.

2. Facts

2.1 Ship Information

Name	*Insung I*
Ports of Registration	Busan (South Korea) and China.
Owner	Insung Corporation
Total Tonnage	614 tons
Date Keel Laid	August 20, 1979.
Shipbuilder	Miho Shipbuilding (Japan).
Engine Type / Output	1 diesel engine / 1,323 kilowatts.

2.2 General Facts about the Insung I and Its Management

Completed by Miho Shipbuilding of Japan and first launched from Jung-gu, Busan, on August 20, 1979, the Insung I was a pelagic fishing vessel designed for catching fish using anchored reels with hooks and fish traps. 50.45 meters long, 10.00 meters wide, and 4.35 meters deep, the ship weighed 614.00 tons in total, and was equipped with one main diesel engine, with a maximum continuous output of 1,323 kilowatts.

Dongyang Susan Corporation, the first owner of the ship, originally named it the 707 Bonanza. It was Insung Corporation, which acquired the ship on June 15, 2005, that rechristened it with the name, Insung I.

The ship was registered with the Korean Register of Shipping (KRS) on May 15, 1998. In order to render the ship suitable for sailing in the Polar Regions, the ship's owner had the ship's structure reformed during the period from March 13, 1999, through May 4, 1999, with part of the existing superstructure (extending from the stern to the front of the wheelhouse) removed as a result. Although the company submitted a stability report on the

details of the renovation and had them approved by the KRS, the plans submitted did not accurately reflect the actual design and layout of the renovated ship.

Around 12:00 on July 10, 2000, during a fishing voyage when the ship was still owned by Dongyang Susan Corporation, large quantities of seawater flowed into the vessel through the trawling door, significantly threatening the ship's stability. The passageway for moving fishing gear was submerged under water, as was the wheelhouse, when the ship began to heel to starboard.

It was impossible for the crew to steer the ship out of the accident on its own. The ship's crew requested help from another fishing vessel that was engaged in fishing nearby. All the sailors were rescued. The vessel that came to their rescue approached the tilting ship's starboard, fixed the ship's hull, and drained water out of it for three days using a diving pump and other such devices. After the ship had its damaged parts repaired, it went on fishing again. Insung Corporation, at the time of purchasing the vessel on June 15, 2005, did not have knowledge of this prior accident.

Insung obtained the license from the Korean Minister of Food, Agriculture, Forestry, and Fisheries on November 24 to deploy the ship for pelagic fishing, using anchored reels with hooks, from December 1, 2010, through November 30, 2011, in limited zones. These zones included the Atlantic Ocean, the Indian Ocean, and the zones of the Antaractic Ocean subject to the Convention for the CCAMLR, i.e., Trenches 88-1, 88-2, and 58.4.1.

2.3 Ship Structure and Loading Capacity

The Insung I was a center-bridge ship. As the diagram below shows, the lower part of its upper deck consisted of a forepeak tank (FPT) at the bow, followed by fish storage areas 1, 2, and 3, an engine room, and an afterpeak tank (APT) at the stern. Below the fish storage areas and on both sides of the engine room were double bottom tanks storing ballast water.

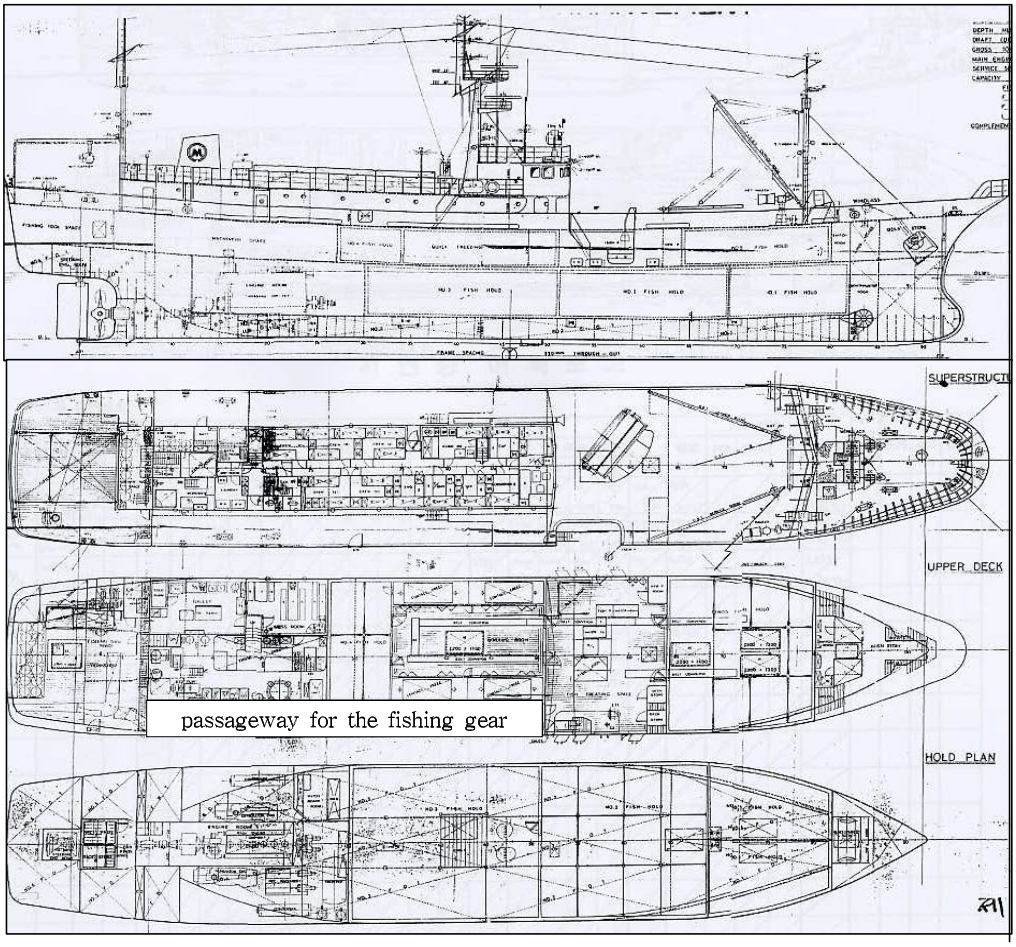
On the upper deck were a bow deck, a front processing area (neighboring the trawling door on the starboard), a processing room, a freezer room, a cafeteria, a storage area for fishing gear at the stern, and a passageway (23.65 meter long, 2.0 meter wide) along the starboard through which the fishing gear was moved.

The superstructure housed a windlass and a derrick at the front. The crewmembers' quarters extended between the middle and the back of the deck. Above the quarters were the wheelhouse as well as a space for storing the fishing gear and sinkers.

The ship's summer load line draft was 4.22 meters. Its freeboard was 41 centimeters long. Its light displacement amounted to 898.3 tons, with a constant of 23.7 tons. The ship's hatch was 1.5 meter wide, while its coaming rose 30 centimeters above the upper deck. The bottom of the hatch extended 71 centimeters along the summer load line draft. Hence, if the ship were to be subjected starboard to tides rising 1.42 meters high or above, the seawater could have easily gotten inside it through the trawling door. Accordingly, Insung sought to prevent the penetration of seawater into the ship by installing a shutter, 1.7 meters in width and 1.0 meter in length, over the trawling door, which had to remain shut whenever the ship was sailing.

The passageway for the fishing gear was located near the trawling door in the middle of the ship body. Because the passageway was slightly tilted to the bow of the ship by 1 to 2 degrees, seawater, once inside the ship, would have accumulated at the bow of the ship. Accordingly, the bow was installed with an electric diving pump, capable of draining 4 tons of water per hour, which was designed to start working automatically if it detected seawater around it. However, the pump at times failed to work properly. The passageway was connected to the processing room, the cafeteria, and the fish storage area at the back of the ship by opening-out doors. These doors, however, were not completely watertight. The doors on the upper deck had doorsills of about 50 centimeters in height.

〔Layouts of the Insung I〕



On either side of the front processing area on the upper deck were three freeing ports, 85 centimeters high and 51 centimeters wide each. Each port was equipped with a non-return valve. The freeing ports were designed to discharge seawater out of the ship, preventing the water from reaching inside the cabin. The bottom of each freeing port extended about 50 centimeters down the summer load line draft.

In terms of the daily marine diesel oil (MDO) consumption, the ship required 6 kiloliters during sailing and 3.7 kiloliters during fishing per day. The ship also daily consumed 53.6 liters and 45.0 liters of the lubricant oil (LO), respectively, during sailing and fishing. Its water purifier generated 4.5 to 5.0 tons of clean water per day. The clean water tank was capable of storing up to 10 tons of water.

2.4 Safety Management

Insung Corporation operated 14 fishing vessels at the time of the accident, including the Insung I. The company distributed copies of “The Regulation for the Safety of Fishing Vessels” (Joeobseon Anjeon Suchik) to all the ships it owned. Written in Korean, the Safety Regulation provided the rules and requirements for the crew to observe before departing, during sailing, during fishing, during bad weather conditions, in emergency situations, in entering and mooring at ports, and so on.

The user’s manual on how to use the expandable rescue boats, the fire escape route guideline, and the sample fire drill layout accompanying each copy of the Safety Regulation were written either in both Korean and English, or in English only. The checklists for safety inspection of each part and device on the ship that were included in the Safety Regulation required each ship’s crew to inspect their ship and devices three times a month (on the 10th,20th,and30thdayseach)andreporttheresultstothecompany.Thecrewwasalsorequiredtoconducttraningonhowtousefireextinguishersandevacuatetheshipthreetimesamonth.ThecrewoftheInsung I, for its part, also reported the completion of the fire extinguishing, escaping, and emergency training on November 30 and December 10, 2010.

2.5 Crew Makeup and Management

The Insung I had 40 sailors, including a captain, two deck officers, three engine officers, and 34 staff members, as well as two observers (one Russian, the other Korean). Seven of the crewmembers, including the captain and the cook, were Korean. The remaining 33 included eight Chinese sailors, eleven Indonesian sailors, eleven Vietnamese sailors, and three Filipino sailors. The ship’s owner, however, believed that it employed ten Indonesians and twelve Vietnamese at the time.

The 33 non-Korean crewmembers for the ship were recruited via the six hiring

agencies of Insung, including Panworld (13), the Korea Overseas Fisheries Association (1), Changman (3), Hwayoung Trading (9), Hanjin (3), and Noah International (4). The Chinese sailors, who were of the Korean descent, were able to speak Korean, but not English. The Filipinos spoke English, but not Korean. The Indonesians spoke a very limited English. The Vietnamese sailors spoke neither of the two languages.

The captain, born in 1965, held a Class 3 license for work on fishing vessels. He had worked as a captain on pelagic fishing vessels for thirteen years. Prior to joining the Insung I, he had worked once on the CCAMLR-governed waters for about three months. He joined the Insung I on August 17, 2010.

Chief officer A was born in 1964, and worked as deckhand and quartermaster from August 1990 through August 1999 on pelagic fishing ships. From December 1999 until October 2010, A worked as first and second officer, with a Class 4 license, on a number of pelagic fishing vessels. He came onboard the Insung I on October 22, 2010, with a Class 4 license for work on merchant ships.

B, the other chief officer, was born in 1977. He held a Class 4 license for work on fishing vessels, and had been working onboard the Insung I since July 20, 2010.

The chief engineer, born in 1957, held a Class 3 engineer license, and started working onboard the Insung I on July 20, 2010.

One of the two first engineers, A, was born in 1962 and held a Class 6 engineer license. He began working onboard the Insung I on October 24, 2007.

B, the other first engineer, was born in 1966 and also held a Class 6 engineer license. He began working onboard the Insung I on December 8, 2007.

C, a Chinese sailor, did not hold any license to work as a marine technician. Nevertheless, he embarked the ship on September 11, 2007, as a deckhand at the time of

the accident. Having worked as a third officer for some time, he became a second officer as of August 2010.

D and E, both Filipinos, began working onboard the Insung I as deckhands on July 1, 2008. At the time of the accident, however, they were also worked as apprentice offier and engineer, respectively.

Chief officers A and B and deckhand C kept the navigational watch on the bridge, for 16 hours on end per shift. Each shift involved two of these men working together.

Sailors on Navigational Watch (Bridge)	Watch Hours
	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Chief Officer A	~06:00 / 14:00~
Chief Officer B	~14:00 / 22:00 ~
Deckhand C	06:00~22:00

Keeping the navigational watch on the engine were first engine officers A (11:30 ~ 17:30 and 23:30 ~ 05:30) and B (05:30 ~ 11:30 and 17:30 ~ 23:30), who switched their shifts every six hours. Deckhand E worked alongside first engine officer B.

2.6 Weather Conditions

The sky was overcast and the visual range was 6 miles or so at the time of the accident. A westerly-southwesterly wind was blowing at 10 to 13 meters per second. The seawater temperature was around 0 to -1 Celsius degree, while the tides rose 3.0 meters in height above the surface of the sea.

3. Details of Accident

3.1 Sailing Conditions

At the time the Insung I departed the Port of Montevideo, Uruguay, at around 18:00 (WST -3 hours) on November 2, 2010, it was carrying 547 kiloliters of MDO, 16.5 kiloliters of LO, Captain Yu Yeong-seob, 39 sailors (7 Koreans, 8 Chinese, 11 Indonesians, 11 Vietnamese, and 3 Filipinos), and 2 observers (1 Russian, 1 Korean). The ship was headed for Zone B of Trench 88-1, in the waters governed by the Convention for the Conservation of Antarctic Marine Living Resources (CCMALR).

On November 5, the ship received an additional 25 kiloliters of fuel, and arrived at Zone B of Trench 88-1 at around 16:00 (WST +11 hours; the following indications of time are all in the World Standard Time) on November 30. The crew began fishing the following day, December 1. Zones B, C, and G of the same trench also had ten or so other fishing vessels working, including three Korean vessels aside from the Insung I; that is, the 707 Hongjin, and the Jeongwooho II and III. The combined quota for all the fishing vessels in the area was 372 tons of tooth fish.

The Insung I caught approximately 39 tons of tooth fish (37.35 tons without heads) until December 9, having relocated to another spot within Zone B on December 4. With the fish stored in the ship's fish storage area no. 2, the ship had to move, along with the dozen other ships, to Zones H, I, and K in Trench 88-1, when they filled the quota.

After finishing the fishing tasks on water at 09:00 on December 9, in latitude 63 degrees 54 minutes south and longitude 175 degrees 21 minutes east, the Insung I set out for Zones H, I, and K of Trench 88-1. Because of ice floes on the way, the ship had to take a circuitous route until arriving at the destination.

While the Insung I sailed to Zones H, I, and K, the ship's trawling door shutter and the bow-side door to the passageway for fishing gear were left open. Fish storage area no. 2 was carrying approximately 39 tons of tooth fish; fish storage area no. 3 was carrying approximately 100 tons of frozen squid (to be used as bait); and fish storage area no. 4 had approximately 10 tons of food. In addition, the ship was also carrying 36 tons of reels with hooks (1,000 baskets on the deck above the front processing area; 700 baskets on the rear deck; 1,500 baskets on the deck above the crewmembers' quarters; at 70m/basket, 80kg/500m), as well as 38 tons of fishing sinkers for sinking the reels (2,000 units on the deck of the front processing area; 5,000 to 6,000 units on the rear deck; at 5kg/unit), and 2,500 to 3,000 meters of the buoy line (18mm in diameter, stored on the rear deck and the deck above the crewmembers' quarters).

The Insung I was sailing in fleet with the 707 Hongjin, leading the latter by about 3 miles. As of 20:06 on November 11, the Insung I was sailing at a speed of 10.5 to 11.0 knots, in latitude 62 degrees 50 minutes south and longitude 172 degrees 53 minutes west, along a course of 090 degrees. First officer A climbed to the bridge at about 14:00 on December 12 to change navigational watch shift with the other first officer, B, and served the duty with deckhand C. A was again on duty from 22:00 onward that day, along with B.

A was told to report to the captain whenever he spotted an ice floe while on his navigational watch. At about 05:00 (WST +12 hours applies to the subsequent indications of time) the next day, December 13, A reported to the captain the ice floe signal he received.

The captain climbed to the bridge at about 05:10 that day, checked the ice floe signal himself, and changed the course from 090 degrees to 135 degrees at about 05:20, with the intent to arrive at the destination spot early.

After changing the course, the ship underwent tides that were 3 meters high and a westerly-southwesterly wind blowing at a velocity of 10 ~ 13 meters per second from the 3 to 4 o'clock direction. Amid these conditions, seawater began to flow into the front processing area and the passageway for fishing gear through the trawling door shutter and the passageway door that had been left open.

First officer A left the bridge at 5:50, after changing shift with first officer B when deckhand C appeared on the bridge. At the time the shift was changed, there were the captain, first officer B, and deckhand C inside the bridge.

At 06:00, deckhand C noticed that the hull was heeling about 10 degrees to starboard, and rolling about 2 degrees along port. He also saw on the closed-circuit TV that seawater had reached inside the passageway for fishing gear. He reported thusly to the captain.

Upon receiving the report, the captain ordered C to contact the engine room immediately and have the fuel moved from the starboard to the port of the ship. The captain also told other crewmembers, who were resting, to move the fishing sinkers that had been stored on the rear deck from the starboard to the port of the ship.

Deckhand C checked the passageway again at 06:05, and noticed that the diving pump was not working, even though the seawater had risen to 30 centimeters above the floor.

An increasing quantity of seawater kept flowing into the passageway for fishing gear, flooding it out by 06:15. A large quantity of seawater then reached the inside of the ship, reaching the fishing gear storage area at the stern as well as the engine room.

Chief officer A, who had been sleeping in his quarters, woke up, sensing something dangerous was afoot, and climbed to the bridge at about 06:20. The captain ordered A to steer rightward so that the bow would face lee side. He contacted, via the VHF radio, the 707 Hongjin that was following behind, requesting emergency rescue by shouting: "The

ship is about to be overturned!" Shortly afterward, all the alarms on the bridge went off and the main engine was stopped.

After stopping the sailors from relocating the fishing sinkers, the captain ordered them to climb to the bridge. Deckhand Choi Gyeong-guk woke up the sailors who were resting in their quarters, and distributed life jackets. The hull was overturned on starboard at 06:25 on December 13, 2010, in latitude 63 degrees 19 minutes 52 seconds south and longitude 160 degrees 15 minutes 25 seconds west, about 1,158 miles away from the Campbell Island, off the southern coast of New Zealand. At the time, the ship was still carrying 350 tons of MDO, 14.4 tons of LO, and 10 tons of clean water.

The two rescue boats that had been attached to the starboard of the ship were automatically released and expanded when the ship was overturned. When these boats appeared above water about 10 meters from the ship, the sailors jumped into the water and swam to the boats. Some of them, however, were swept up by the tides. Others also had difficulty escaping the ship because they were trapped by the reels and buoy lines floating over the sea. About two or three minutes after the ship was overturned, it began to sink at the stern.

The 707 Hongjin that had been following the Insung I about 3 miles behind it arrived at the scene of accident and immediately rescued 9 sailors and the Russian observer from the water. The ship also came to rescue the 11 sailors on the two rescue boats. One of the 21 rescued crewmembers, however, died due to hypothermia.

3.2 Casualties

In addition to the Insung I completely sinking, 5 of the 42 crewmembers died and 16 went missing, including the captain and the Korean observer.

4. Casualty Analysis

4. Casualty Analysis

4.1 The Loss of the Ship's Stability

A) Displacement Tonnage and Drafts

Taking into account the weights of MDO, fishing gear, and fish the vessel was carrying at the time of the accident, its displacement tonnage must have amounted to approximately 1,510 tons. The ship's drafts, calculated on the basis of the available stability data, are estimated to have been 3.00 meters at the bow, 5.60 meters at the stern, and 4.30 meters on average.

B) Seawater's Movement through the Trawling door and the Passageway for Fishing Gear

(1) The Trawling door

The bottom of the trawling door reached 71 centimeters along the summer load line draft. This meant that, if the ship were to be subjected starboard to tides rising 1.42 meters high or above, the seawater could have easily gotten inside it through the trawling door. As a result, a shutter, 1.7 meters in width and 1.0 meter in length, was installed over the trawling door, which had to remain shut whenever the ship was on sail.

The shutter, however, was left open while the ship was sailing to Zones H, I, and K after it finished catching fish in Zone B of Trench 88-1 on December 9, 2010. The sea tides rising 3 meters in height and the westerly-southwesterly wind blowing at 10 ~ 13 meters per second from the 5 to 6 o'clock direction were manageable for the ship when it stayed on the course of 090 degrees. When it changed the course to 135 degrees, however, it was subjected to the wind blowing from the 3 to 4 o'clock direction, which widened the opening of the trawling door shutter and forced the seawater into the ship.

(2) The Bow-side Door to the Passageway for Fishing Gear

The ship had a passageway on its upper deck along the starboard. The passageway was equipped with a conveyor belt, which was used to move the fishing gear (i.e., reels, fishing sinkers, etc.) from the upper deck to the fishing gear storage area near the stern during the fishing periods. The door to the passageway near the bow was thus left open while the sailors were working on fishing. In bad weather conditions, however, the door had to remain shut because, otherwise, the seawater that had reached the upper deck through the trawling door could reach the passageway as well.

The door, however, was left open while the ship was sailing to Zones H, I, and K on December 9, 2010, after it finished catching fish in Zone B of Trench 88-1. Consequently, the seawater that came in through the trawling door flowed into the passageway via the upper deck, with the stern trim.

(3) The Diving Pump in the Passageway for Fishing Gear

The passageway for fishing gear was slightly tilted, 1 ~ 2 degrees, so that seawater that flowed into it would accumulate at the bow. For near the bow in the passageway was an electric diving pump, capable of discharging 4 tons of water per hour. The pump was supposed to turn on automatically and start pumping out water. This pump, however, had a history of not working properly from time to time. At the time of the accident, it again failed to work.

C) The Overturning of the Ship

The Insung I started sailing to another spot of fishing on December 9, 2010, with the trawling door shutter and the bow-side door of its passageway for fishing gear left open, when the draft reached 3.00 meters at the bow, 5.60 meters at the stern, and 4.30 meters on average. The ship managed to stay afloat when it was sailing along the course of 090 degrees, notwithstanding the sea tides rising as high as 3 meters and the

westerly-southwesterly wind blowing from the 5 to 6 o'clock direction at 13 meters per second. After it changed its course to 135 degrees at 05:20 on December 13, 2010, however, it faced the wind blowing from the 3 to 4 o'clock direction, with the seawater forced into the vessel through the trawling door that had been left open. While the seawater could have been discharged via the freeing ports on the upper deck, it instead flowed into the passageway for fishing gear, where the broken diving pump failed to discharge it out of the vessel. Accordingly, the ship began to tilt to starboard. The seawater that had flowed into the passageway finally reached and flooded the fishing gear storage area at the stern as well as the engine room, eventually overturning the ship.

It is important now to examine the factors that affected the tilt and stability of the ship's hull when seawater flowed through its trawling door and passageway for fishing gear.

(1) Freeing Ports on the Upper Deck

The Insung I had three freeing ports (each 0.85 meter long and 0.51 meter high) on either side of its upper deck. The bottom of each freeing port reached 0.50 meter along the summer load line draft (4.22 meters). At the time of the accident, however, given the average draft of 4.30 meters, the bottom of each freeing port was likely to have been dangling 0.42 meter above the sea surface. Assuming that the freeing ports on at least one side work properly when the ship rolls, these ports would discharge 341 tons of water per minute.

Area of freeing ports (A) : 0.85m x 0.51m x 3개 = $1.30m^2$

Displacement tonnage (Q) = $\rho A\sqrt{2gh}$ = 1.30 x $\sqrt{2\times 9.81\times 0.93}$ x 60(초) x 1.025 = 341.4 tons

If the ship's hull were to heel to its starboard in about 10.5 degrees, because of the

seawater that had reached the passageway through the trawling door, the freeing ports on the starboard would be completely submerged under water, and thus unable to work properly in stopping the countercurrents. In the meantime, seawater would continue to flow into the vessel through these freeing ports. This is what happened to the Insung I.

(2) Influx of Seawater through the Trawling Door

The hatch of the Insung I was 1.5 meter wide, with a coaming that arose about 30 centimeters above the upper deck. The bottom of the trawling door extended 65 centimeters down the summer load line draft (4.22 meters). As the average draft for the vessel was 4.30 meters at the time of the accident, and the vessel was subjected to tides that were 3 meters in height along its starboard, the ship's trawling door was likely to have been exposed to seawater as high as 0.93 meter, assuming 50% of the tidal height (i.e., 1.5 meter).

Area of freeing ports (A) : 1.5m x 0.93m = $1.40m^2$

Influx tonnage (Q) = $\rho A\sqrt{2gh}$ = 1.40 x $\sqrt{2\times 9.81\times 0.93}$ x 60 x 1.025 = 367.6 tons

Considering the frequency and shape of the tides, about a quarter of the influx tonnage, i.e., approximately 92 tons, as calculated above, is likely to have flown into the vessel at the beginning of the accident. As more and more seawater flowed into the vessel via the trawling door and the passageway for fishing gear, the ship was increasingly heeling to its starboard, with the amount of seawater present inside it growing at an exponential rate.

(3) Permeation of the Passageway by Seawater

Around 06:00 on the day of the accident, the Insung I was rolling 2 degrees on port and on 10 degrees on starboard. The passageway for fishing gear was about 20 to 30 centimeters deep in seawater by 06:05. In other words, 12 tons of water had already

infiltrated the passageway (23.65 meters long, 2.0 meters wide, 0.25 meter deep) by 06:05, tilting the ship to starboard by 3 ~ 4 degrees as a result.

As 36 tons or so of seawater infiltrated the passageway, the ship tilted to its starboard by 10 degrees or so. With the passageway completely submerged under water, the speed at which seawater flowed into the rest of the ship's cabin increased dramatically, with the water chiefly affecting the fishing gear storage area at the stern (capacity: 174) as well as the engine room (capacity: 378) through their non-watertight doors.

(4) Stowage of the Fishing Gear

On its way to Zones H, I, and K of Trench 88-1 on December 9, 2010, the Insung I was carrying approximately 36 tons of reels with hooks on the upper deck above the front processing area as well as the rear deck and the deck above the crewmembers' quarters. It was also carrying approximately 38 tons of fishing sinkers on the deck above the front processing area and the rear deck, as well as 2,500 to 3,000 meters of buoy line (18mm in diameter) on the rear deck and the deck above the crewmembers' quarters. Although the ship should have, in principle, stored the fishing gear and the fishing sinkers in the fish storage areas, it chose to keep them on the upper deck and above the crewmembers' quarters that were located above the ship's center of gravity. This decision, however, greatly compromised the ship's stability and hence left it that much more vulnerable to the accident.

4.2 Other Factors

A) Surrounding Environment

The CCAMLR-governed region where the accident occurred is found between latitude 60 degrees south and latitude 80 degrees south, amid the Antarctic (Southern) Ocean. The absence of landmass around this ocean makes it rather difficult to determine its precise boundaries. In general, the region is thought to encompass the area of ocean around latitude

60 degrees south, with a distinct ecosystem achieved by the Antarctic circumpolar current. The fisheries in this area are open to exploitation from December to February the next year, during which period of time ice tends to melt. Fishing vessels then engage in fishing in the select waters of this region defined by the CCAMLR, under the strict watch of observers, catching only the amounts of fish within the CCAMLR-assigned quotas.

The Insung I departed from the Port of Montevideo in Uruguay on November 2, 2010, and reached Zone B of Trench 88-1 governed by the CCAMLR on November 30 for fishing. The crew began fishing the next day, December 1. The temperature around Zone B at the time ranged between -3 and -1 Celsius degree. At the time of the accident, the sky was overcast and the visual range extended only 6 miles or so, with a westerly-southwesterly wind blowing at 10 to 13 meters per second and tides around the ship rising 3 meters or so in height. The hull must have been subjected to quite great motions, including rolling and pitching. As the seawater temperature was not higher than -1 or 0 Celsius degree, crewmembers who had fallen into the sea were exposed to great risks of hypothermia.

B) The Ship Itself

Built and launched in 1979, the Insung I was over three decades old at the time of its accident. The older a vessel, the more worn and obsolete its facilities and equipment are likely to be, and the greater the caution and efforts required for inspection and repair. Accordingly, from July 27 through August 30, 2010, the Insung I underwent its periodical repair session as well as class inspection at the Port of Montevideo. The required repair took place from July 29 to August 21 during this period. The repair report completed at the time reports no major damages or changes done, other than the replacement of the deformed exterior of the bulbous bow (16mm thick, 65cm wide, 67cm long). In other words, at the time it set out sailing, the ship was in good condition.

C) Sailing Instructions and Safety Management

The owner of the ship had distributed copies of "The Regulation for the Safety of Fishing Vessels" to all the 14 vessels it owned, including the Insung I. The Safety Regulation instructs the captain of each vessel to take shelter at an appropriate location in situations of bad weather and other bad sailing conditions. If the captain expects the weather to become bad during sailing, he is to prepare the ship and crew members against any foreseeable emergency situations that could be brought on by the weather. In emergency, the Safety Regulation instructs that: (1) all actions be taken for the purpose of saving lives, under the supervision and direction of the captain and the officers, when it becomes necessary to evacuate the ship as it starts sinking; (2) all crewmembers be trained every 10 days in how to use the expandable rescue boat, how to extinguish fires, and how to escape from the ship, with the training results reported periodically to the company; (3) all non-Korean crewmembers be given extra training in how to escape from the ship, and so forth. All the guidelines on expandable rescue boats, fire escape routes, and sample fire drill layouts were made available either in both Korean and English, or in English only.

At the time of its sinking, however, the Insung I had crewmembers from six countries (Korea, China, Indonesia, Vietnam, the Philippines, and Russia). Only some of the Korean crewmembers spoke English. The Chinese sailors, of the Korean descent, spoke Korean, but no English. The Filipinos spoke English, but no Korean. The Indonesians spoke a very limited English, while the Vietnamese spoke neither language. Although the language barrier among these crewmembers was so great as to hinder effective communication, the ship owner had distributed copies of the Safety Regulation written only in Korean, and the guidelines on how to use the expandable rescue boats, the fire escape route, and the sample fire drill layout in Korean and English only, making it almost impossible for some of the crewmembers onboard to adequately understand and master the safety requirements.

D) Crew Management

The Insung I, at the time of its accident, had 42 members onboard, including 40 sailors and 2 observers. The 40 sailors included 7 Koreans, 8 Chinese (of the Korean descent), 11 Indonesians, 11 Vietnamese, and 3 Filipinos. Of the foreign crewmembers, only the Chinese spoke Korean, and only the Filipinos spoke English. The Vietnamese spoke neither of the two languages. The foreign crewmembers had been recruited by the six hiring agencies of Insung Corporation, i.e., Panworld, the Korea Overseas Fisheries Association, Changman, Hwayoung Trading, Noah International, and Hanjin. The implication of this hiring policy was that the ship owner did not even have full knowledge of the names and nationalities of the crewmembers onboard the sunken vessel. While one should not discount the practical difficulties of recruiting and hiring foreign sailors for pelagic fishing vessels, it is also difficult to avoid the conclusion that the ship owner should have made greater efforts and precaution to ensure safety in fishing and emergency situations alike, given the risks implicit in the significant language barrier that existed among the crewmembers.

E) The Captain's Actions

(1) Setting Out to Sail Despite the Bad Weather Conditions

In hindsight, the captain of the Insung I should have ensured that the trawling door shutter and the bow-side door to the passageway for fishing gear were shut before deciding to sail to Zones H, I, and K of Trench 88-1 on December 9, 2010, considering the typical weather conditions of the Antarctic Ocean around that time of the year.

Instead, the captain began sailing without closing these doors. While the ship managed to stay afloat when it was sailing along the course of 090 degrees, despite the high tides rising 3 meters high and the westerly-southwesterly wind blowing at 10 to 13 meters per second, the neglect of the doors led to a fatal situation when the ship changed its course

to 135 degrees around 05:20 on the day of the accident, as it came to face the wind blowing from the 3 to 4 o'clock direction then. The rolling of the hull, and the increasing influx of seawater through the trawling door onto the upper deck as well as into the passageway for fishing gear, eventually sent the ship down to the bottom of the ocean.

(2) Inadequate Preparation for Emergency Situations

The captain received a report at 06:00 on the day of the accident, to the effect that the ship's hull was rolling 10 degrees along starboard and 2 degrees along port, and that seawater had gotten inside the passageway for fishing gear as seen on the closed-circuit TV. The captain immediately ordered the reporting deckhand to contact the engine room to have the fuel moved from the starboard to the port of the ship, and also commanded other crewmembers who were resting to move the fishing sinkers that had been stored on the rear deck from the starboard to the port. When the ship's hull radically heeled to starboard at 06:20, the captain ordered that the ship be steered rightward so that it would face the wind's eye. It was in steering the ship rightward that the ship was finally overturned on its starboard.

Upon receiving the initial report at 06:00 about the ship's tilt and the presence of seawater in the passageway for fishing gear, the captain should instead have checked the sites of seawater influx first. He should have had the officers on the navigational watch in the bridge check the bow-side door of the passageway, the diving pump in the passageway, and any possible damages to the exterior of the hull, and ordered the safety actions called for accordingly. He should also have sounded the depths of the fish storage areas and closed them to see whether the hull was punctured in any part. While the captain failed to carry out this alternative course of action, the deckhand who went down to the passageway upon the captain's order failed to identify the point of seawater influx even after seeing that the passageway was nearly flooded by it. He climbed back to the bridge without shutting

the bow-side door of the passageway. Had he checked whether the diving pump was working properly, he could have seized an opportunity to prevent the ship's sinking and the resulting human toll.

Upon noticing that the ship's hull was radically tilting to starboard, the captain should also have set off the emergency alarms, gathered all crewmembers on the designated evacuation spot, and evacuated the ship accordingly. The captain's failure to command evacuation in a timely manner prevented the crewmembers from floating the rescue boats before the ship was completely overturned.

(3) Inappropriate Conduct of the Ship

When the ship began to tilt radically to starboard, the captain ordered that it be turned hard-a-starboard so that it would face the wind's eye. This decision, however, is interpreted as having accelerated the internal incline of the ship.

4.3 Main Cause of Death

A) Timely and Appropriate Rescue Efforts from the 707 Hongjin

Upon receiving the call for rescue from the Insung I at 06:20, the captain of the 707 Hongjin sailed his ship at full speed to arrive at the scene of accident by 06:40. Seeing that there were sailors onboard the two rescue boats, the captain hurried to save the 10 other crewmembers that were still in water (one of whom died in hypothermia shortly after being rescued). The captain then drew onboard the 11 sailors from the two rescue boats. Given the extremely low temperature of the seawater surrounding them, the sailors who remained long in water could have died in hypothermia, had it not been for the sensible decision on the part of 707 Hongjin's captain to rescue the sailors out of water first.

B) Low Seawater Temperature

The water surrounding the accident was extremely cold, ranging somewhere around 0 and -1 Celsius degree at the time. This was apt to cause death by hypothermia. The

crewmembers of the Insung I who were not rescued in an hour or so after the ship's overturning are very likely to have died, with their body temperatures fallen to 25 ~ 28 Celsius degrees.

4.4 Ship Evacuation

A) Inappropriate Storage of the Fishing Gear

On its way from Zone B to Zones H, I, and K of Trench 88-1 on December 9, 2012, the Insung I was carrying 36 tons of reels with hooks on its upper deck, rear deck, and the deck above its crewmembers' quarters, as well as 2,500 to 3,000 meters of buoy line (18mm in diameter) on its rear deck and the deck above the crewmembers' quarters. This went against the principle that the fishing gear, when not in use, must be kept in the fish storage areas. The fishing gear, placed loosely about the deck areas, was released from the ship when the ship was overturned and stayed afloat around the sinking ship and the crewmembers, hindering the crewmembers' efforts to escape, and becoming obstacles to the rescue boats and the 707 Hongjin when the members on these three vessels sought to draw other crewmembers out of water.

B) Inadequate Training of the Crewmembers against Emergency

The captain of the Insung I reported that he conducted the fire-extinguishing and ship evacuation training of his crewmembers three times a month, as required by the Safety Regulation. The captain also reported that the requisite training took place on November 30, 2010, right after the ship arrived at Zone B of Trench 88-1, and on December 10, shortly after the ship began to sail. Considering that the average temperature in the region dropped to -1 to -3 Celsius degrees at the time, it appears unlikely that the ship's captain actually carried out the training that he reported. Because the ship only had expandable rescue boats that could not be un-expanded, the ship's crewmembers perhaps learned how to use those

boats only by written or spoken explanations, without getting a chance to actually try them afloat the sea.

One could surmise the inadequacy of the crewmembers' training against emergency from the fact that they failed to float the rescue boats in a timely manner when their ship was heeling radically to starboard. Moreover, the 11 crewmembers that were the first to latch onto the two rescue boats that had been automatically released from the ship failed to rescue other crewmembers out of water.

4.5. Follow-up by the KRS

After the accident, the KRS updated its class inspection rules as follows. First, it added new conditions and terms requiring re-approval of stability data and reports that ship owners now have to submit upon modifying or renewing the ship structures. Second, the KRS now requires ship owners to report to the KRS headquarters even the minor changes made to the structures of their ships, whether superstructures or substructures, by submitting the report on the completion of post-renovation inspection and the complete plan reflecting the changes made to each renovated ship.

5. Conclusion

The sinking of the Insung I occurred because the crewmembers failed to keep the trawling door shutter and the bow-side door of the passageway for fishing gear shut while they were sailing amid bad weather conditions. Their failure to check these doors and their decision to proceed with sailing, despite the tides rising 3 meters high and the strong wind blowing at 10 to 13 meters per second, led to the flooding of the passageway by seawater that had flown in through the open trawling door. The crewmembers' failure to take appropriate actions upon first discovering the presence of seawater inside the vessel led to even greater amounts of influx, which then quickly reached the fishing gear storage area at the stern as well as the engine room, undermining the ship's overall stability. However, the sinking also reflects failures of the ship management, as the ship owner failed to provide adequate safety instructions and training in the languages that the crewmembers of five different countries could understand.

The fact that, out of the 42 crewmembers in total, five died and 16 other crewmembers and one observer went missing, indicates the captain's failure to evacuate the ship in a timely manner. This failure led the crewmembers to fall into water, only -1 to 0 Celsius degree at the time, and led many to die in hypothermia as a result.

6. Lessons Learned

1. All vessels sailing across the Antarctic Ocean must be braced for bad weather.

The Antarctic Ocean is a heaving sea given to frequent and dramatic changes in the weather and sailing conditions. Vessels engaged in fishing or sailing across this ocean must therefore anchor themselves securely in all rolling and pitching, and ensure that all the doors and openings remain shut so that seawater would not flow in.

2. The manuals on lifesaving devices and emergency plans must be written in languages that actual crewmembers can understand.

The manuals on major facilities on the vessel must be written in languages that actual crewmembers can understand. This is especially important for the manuals on key lifesaving devices as well as emergency plans.

3. In the Antarctic Ocean, people about to drown must be given priority in rescue operations.

Because the water of the Antarctic Ocean is extremely cold, always below 0 Celsius degree, people that fall into it are likely to die in a short span of time due to hypothermia. Rescue operations in the region must therefore prioritize saving people who are about to drown first.

4. Vessels with multinational crewmembers must thoroughly train all crewmembers against possible emergency situations.

The Insung I had crewmembers recruited from five countries. Even though the captain reported that all the emergency training was conducted three times a month as required by the company's policy, the vessel was not evacuated in a timely manner and the lives were not saved when the vessel was overturned and started sinking. This is most likely because the crewmembers had not been adequately trained and prepared for possible emergency

situations, as a result of which they panicked when the ship was actually overturned. This panic could have been prevented had the captain provided specific, substantial, effective training for all crewmembers speaking different languages. Ensuring that effective communication occur among crewmembers despite the differences in their national and linguistic backgrounds is a key part of preparing against foreseeable emergency situations.

7. Safety Action

A) Insung Corporation

In order to prevent the tragedy of the *Insung I* from recurring, Insung Corporation must immediately improve its policy of crew management and safety control, ensuring that: (a) all crewmembers effectively communicate with one another, above and beyond the cultural and linguistic barriers; (b) all the safety rules and requirements of the company be written not only in English, but also in the languages that actual crewmembers understand.