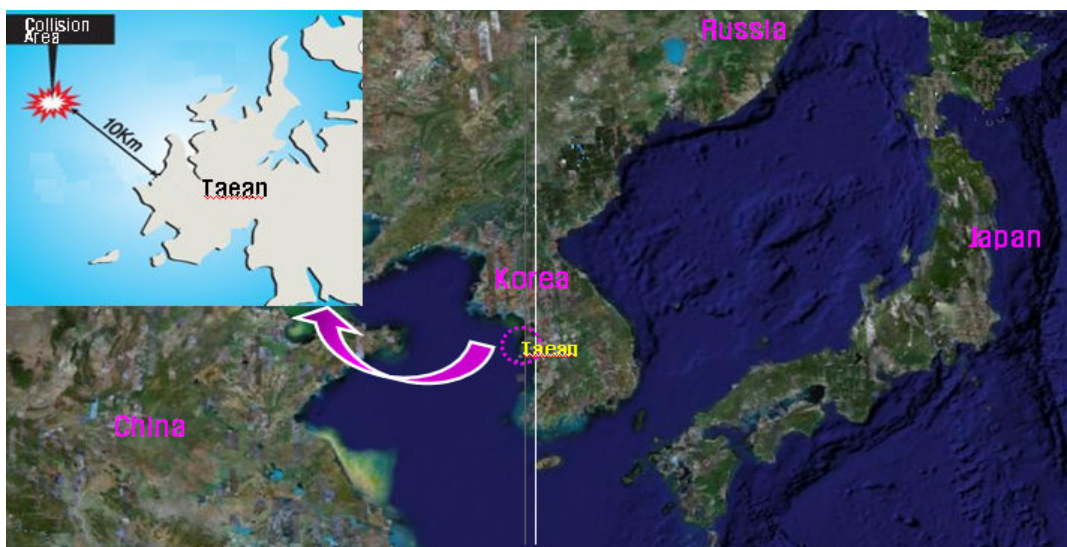


## 'Hebei Spirit' Oil Spill Response and Lesson learnt in Republic of Korea

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### Incident Outline

On 7 December 2007 07:15 VLCC *Hebei Spirit*(146 848 GT)was struck by the floating crane barge *Samsung No.1*(11 800 GT) of Samsung heavy industry, sailing down to the Geoje Kungnam province, while at Daesan A-1 anchorage about 5 miles off Mallipo beach Taeon on the North west coast of the Republic of Korea. About 12,547kl of crude oil escaped into the sea from the tanker as 3 large punctures in No1, 3 and 5 on the port side were made due to the collision. The floating crane barge, 3000tons of lifting capability, was being towed by 2 tug boats, but encountered 14~16m/s of fast wind and 3~4m of wave and was drifting out of control when towing ropes between tugboats slapped. Efforts to adjust the tanker's stability to minimize the amount of spillage were being tried and made just after the crash.



Place of incident

Spilled oil continued to pollute the 6 coastline of counties in Chungchungnam province and 7 in Jullanambuk province and, from the beginning, brought particularly serious damage to, Taeon national park, sensitive natural monument and 15 beaches. Korea's western coastline is saw-toothed as it has many bends and curves, and it has the one of the most

complicated coastal shape in Korea.

### **Initial Response**

On 7 December 2007 07:45 Korea Marine Pollution Response Corporation (the previous name of KOEM), the state-owned response agency, received notice of the incident's occurrence from a local agent of the Tanker and the Korea Coast Guard, and ordered OSRVs of Daesan branch which was located closest the incident spot to sail to the site without delay and also immediately instructed all vessels and personnel to gather at the site but these were unsuccessful. OSRVs of Daesan branch arrived at the site and attempted cleanup operations but these were unsuccessful due to inclement sea conditions as those vessels were comparatively smaller, below GT 200 level.

While the vessels and personnel reached the site, on-scene command post was established and started to perform their emergency duties according to KOEM's response contingency plan. A stockpile for resources storage and distribution was also organized as equipment and materials gradually reached the site. From the second day of the incident, as large amount of spilled oil heavily had reached Mallipo beach, people prioritized to collect such oil through oil skimmers on Mallipo and Chollipo beaches and all staff except from on-board crew on board were involved in removing the crude oil from the beaches.

### **Offshore cleanup operations**

Sea condition and coastline character

The sea condition on 7 December 2008 was very rough with 14~16m/s of wind and 3~4m/s of tide and soon a storm warning was announced. For 3 days from the 3<sup>rd</sup> day the of the incident cleanup operation had been going smoothly but operations had to be temporarily stopped as weather condition deteriorated again with heavy rain from the 13 to 15 December 2007.

Command system

Daily meetings regarding strategy and work planning had been held via VHF devices and a centralized command system was set up to ensure consistent operations and a cohesive work plan. A command structure of 9 teams was used for effective and efficient oil in oil skimming. The teams were offshore operations, protection of sensitive environments, searching, supply, barge fleet, waste disposal etc.

Communication

VHF channel 17, received from the Korea Coast Guard, proved unsuitable for communicating from distance with the vessel fleet as the output was just 1 Watt, so channels selected as alternatives 08, 09 and 69. Mobile phone text messages wre very

useful for transferring status reports and orders between command post and feet as vocal contact via mobile phone was difficult.

#### Vessel mobilizations

For a week from when the incident occurred OSRVs were concentrated and mobilized to protect the sensitive area at the entrance of Garorim bay, utilizing Daesan as a base port. After one week of the spillage spilled oil started to pollute several islands. Cleanup operations were also carried out to protect such oil coming down to the beaches of other islands not in Garorim bay by the protection team mentioned above.

To prevent oil reaching the north and south part of Chosun bay, a very sensitive area with crowded fishing farms, oil booms were deployed. A large volume of floating oil was found, 3m in length and 10cm in depth, near islands like Sanghonso, Hahongseo and Yongdo, and a greater concentration of vessels was needed. Some of the OSRVs fleet continued to recover oil, utilizing Yeondo as a base port.

#### Movement and change in properties of Spilled Oil

Some of the spilled oil from the tanker came to the shoreline of Garorim bay, Chollipo, Mallipo and Mohang as a result of the strong current and northwest wind, but some moved south. As time went by, the spilled oil changed its properties through weathering and emulsification and started to stick to the shorelines of islands.

#### Method of offshore cleanup

On 7 December as the spilled oil was of low-viscosity, and large in volume it was spread to a large area by the current. From the beginning filter belt skimmers were mainly involved to collect this oil. From the beginning on board 14 December as the spilled oil had been changed to high-viscosity and emulsified through weathering it spread widely to the near sea. Weir, disc and drum-type skimmers on board were initially involved to collect oil but none of these were very effective so finally skimmer 'Transrec 100 Hi-Wax' was put in to the water and this was a success. Trash skimmers on Catamaran boats were also very efficient at collecting oil, unaffected by sea conditions.

Some used absorbents were spread to the near sea, so as by current. Wastes collecting devices on board were very useful for collection these absorbents so as to protect them from causing pollutions else where. Emulsified tar ball-type oil was collected via pole with net by staffs on board. On 15 December Oil storage barge 'Bangje1001' was moved to the south of the Gaido area and on 16 December another oil barge 'Bangje 1001' and OSRV 'Hwangkyung3' came to a berth 0.5mile off the northeast of Sohwasan island. As floating oil

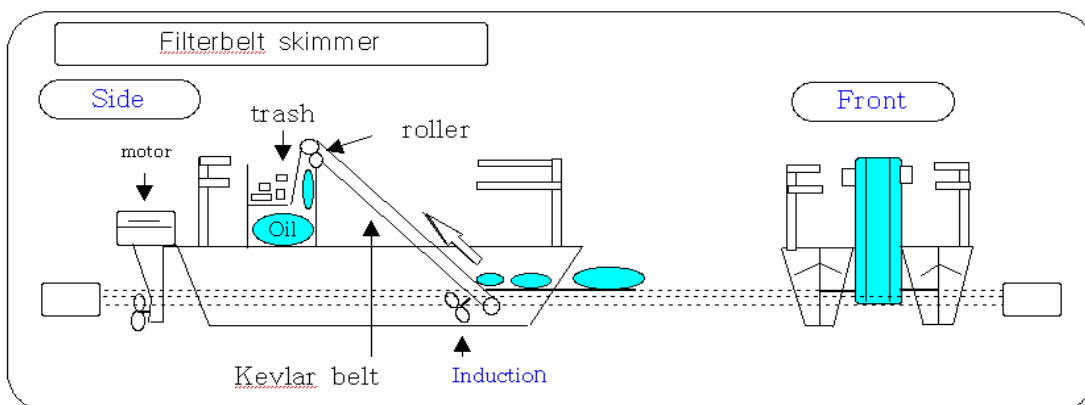
was moving to south, Oil barge 'Bangje1001' changed its position from Sabsido to Yondo so that those 2 oil barges were on standby for oil storage close to the site. They supported and assisted the OSRV fleets with oil collecting and saved us a lot of time. The volume of oily wastes collected from 7 December 2007 to 3 January 2008, for 28 days, was 1,780 ton, of which 1,564kl was oil and 216ton was solid-type wastes.

### Offshore supply duty

One of the OSRVs was appointed as a supply vessel and involved with carrying equipment, materials, appliances and food, and majority of vessels were supplied with fuel and fresh-water at sea to save time.

### Measures needing to be improved

The normal process of cleanup was to deploy oil boom to gather and contain oil and put in skimmers to collect oil. However many barriers such as sea condition far from the coast were faced in the case of this huge oil spill incident. To overcome such obstructions our filter belt skimmers were, in our experience, superior among the many kinds of skimmers because this type could collect oil as it advanced, not affected by circumstances, conditions and oil viscosity. The picture below shows the kind of filter belt skimmers our corporation has at the moment. The Catamaran were very efficient in collecting oil as they utilized the pressure of sailing speed, but, on the other hand, mono-hull ships with sweeping arms were not successful as the spilled oil was passed down the arms due to sea conditions. we therefore believe that the future types of OSRV should be developed as catamarans.



## Protection of environmentally sensitive areas

### Blockage of Garorim Bay

Garorim bay, which is 25km in length and 2.4km wide, shallow with a big tidal gap and great tidal flat in low water, is very famous for crowded fishing farms of oyster and sea weed in the time of warm current which last from spring to summer. Futhermore it has 30

small islands. Its unique characteristics imbued us with a sense of mission to protect this area, especially since we believed that oil inside the bay could lead to irreparable damage. On 8 December 2008, the 2<sup>nd</sup> day, the 0800 strategic meeting for the protection of Garorim bay decided to deploy oil booms even though there was a risk of the booms snapping due to the strong current. Command post was supposed to be installed in the entrance of Garorim bay however facilities for use of office equipment such as computers, fax were not available and even desk space was hard to find. 2 teams were set up; an offshore fleet team, and a land team. The offshore fleet team deployed ocean oil booms to make a 1<sup>st</sup> blockage line with, and the land team set land sea booms to build a 2<sup>nd</sup> blockage in the entrance of the bay with fishing boats and shallow working boats.

On 8 December 2008 1 staff on each of the 5 boats was involved in continuing to deploy oil booms after safety training carried out in the fishing cooperative. 800m of oil booms was installed in zigzags. On 9 December 2007, the 3<sup>rd</sup> day, 3 boats were involved in oil boom operations while the other 2 were involved in removing oil slick as a small amount of oil was found to have come inside the bay. On 10 December 2008, the 4<sup>th</sup> day, 39 working boats were mobilized to remove floating oil slick. Our strategy to connect sorbent boom in the tail of working boat to remove oil slick was put into operation but it was not that fruitful due to a lack of knowledge and cooperation on the part of local villagers. On 11 December 2007, the 4<sup>th</sup> day, some anchor-drag was witnessed and operations to change those small anchors (3~4kg) to heavy ones (40~50kg) were initiated and also an additional 1,000m oil booms were deployed. In total 3,000m of oil booms were deployed and KOEM successfully protected the bay.

On 12 December 2007, the 5<sup>th</sup> day, operations for deployed oil booms adjustment and anchor changes took place and observation lights were installed on the deployed booms. For 4 days from 14 to 17 December 2007 adjustment of oil booms and withdrawal of broken booms continued, and on 18 December 2007 as no further floating oil was found, possibility of oil pollution was regarded as rare and KOEM started to collect all the deployed oil booms step by step.

#### Protection of Chonsu Bay

Chonsu Bay is a shallow area of water bordered by Ammyeon island, Hongsung county and Boryung. The length of its coastline is approx. 120km and the bay itself measures some 161.1 km<sup>2</sup> of water. This area was designated as a National fisheries resources preservation area and had 11,000 hectares of famous fish farms of abalone, seashell, oyster and seaweed but it is also well-known as one of Korea's largest seabird area, with 300 types of approx. 400,000 birds visiting it every year.

KOEM organized a protection team which it sent on 13 December 2007. Initially the team

concentrated its efforts to the northern part of the water route and established an office in the Fisheries Cooperative selling market. As the spilled oil was moving and polluted Gauei Island, KOEM staffs first tried to persuade regional villagers to assist them at night with oil boom protection operations. As a result the 1<sup>st</sup> oil boom deploying operation was completed successfully. Secondly, KOEM tried to place 500m of oil dam into 5 layers, considering oil boom was weak against fast current. Oil snares were also installed between oil booms in case oil came through the booms. On 14 December 2007, the 8<sup>th</sup> day after the incident, spilled oil continued to move toward the area near Deruni port and Ggotgi beach and kept going out to sea. However, fortunately, Chonsu bay was completely protected by the deployed 5 layered oil booms and suffered no damage. The initial response team for the protection of Chonsu bay finished its duty and pulled out on the 29 December 2007 as further pollution was not expected to take place.

The southern entrance of Chonsu Bay was being used as sheltering place for ships, and with sensitive facilities nearby such as Boryung power plant, Daechon pleasure beach, fishing grounds, and so on, tremendous economic problems were expected if pollution took place. The width of the southern entrance is almost 5km so it was impossible to use oil booms to protect it , and ship traffic was also comparatively heavy. On 17 December 2007, making a use of calm water, KOEM tried to induce the floating oil into a southerly direction with 700m of oil booms, and further 800m and 300m of booms were used to guide the oil on 18 and 19 December respectively. Our strategy was to detail OSRV 'Hwangkyung no.1' for 24 hour search, whilst other vessels were involved in collecting oil.

#### Protection of intake of Taeon power plant

On the Second day of the incident the matter of the protection of Taeon power plant was raised discussed and, KOEM received notice that the plant had only oil booms but no boats available to utilize them. 3 OSRV of KOEM's Gunsan vessels were fortunately sailing near the area and, on orders to do so, immediately changed route for the plant.

### **Shoreline assessment and Operational Work Planning**

On the day of the incident took place, 7 December 2007, KOEM received a letter requesting cleanup operations from the Taeon County office. KOEM immediately organized 2 survey teams and sped to the shoreline for assessment at 20:20. At 23:30 KOEM started to survey Mallipo beach which was closest to the incident spot. From 8 December reports of pollution on each beach came in from Taeon County, but KOEM and the County had different view as to what should be done wanted KOEM to survey at once while KOEM felt that survey should proceed once the pollution had spread to the beaches, considering that offshore cleanup operations were not yet completed. Surveys finally

started at 0830 as requested by Taeon County and 2 KOEM survey teams were divided between the polluted areas to investigate the pollution status. A great staff were mobilized to clean up and transfer the oil. Unfortunately places where oil had been removed were repeatedly re-covered with oil. As the Central Response Strategy Headquarters now decided to leave the Korea Coast Guard to coordinate shoreline cleanup operations, the KOEM survey teams accordingly returned to the command post.

Even while shoreline cleanups were proceeding, Taeon county office kept asking KOEM to control shoreline cleanup operations on their behalf but KOEM was of the opinion that KOEM could only provide only response technologies because it lacked the necessary and was already struggling to find the manpower to deal with this huge oil spill. But in authority and response to repeated requests from Taeon county office survey teams were reorganized with 6 groups and each containing 2 KOEM staff, 1 Chungchungnam provincial staff, and 1 County office man. As a consequence of a 2 day survey from 18 to 19 December 2007 22 polluted areas were found and an initial draft response plan was made. The entire job needed to be started great efforts had been made by each body and by volunteers to cleanup polluted shoreline but the polluted islands still remained as a huge problem because strategies for islands cleanup were not yet in place. Then, Korea's Central Response Strategy Headquarter ordered KOME to be responsible for cleanup operations in 46 polluted islands and KOEM had to initiate operations in those islands. Below is one example of a shoreline assessment and response contingency plan.

Islands shoreline assessment table (example)

<b>assessor</b>	Mr. Kim HS, Jung JW	<b>Area name</b>	Myunggeum,Nujeokgeum...
<b>Shoreline nature</b>	Rock, Pebble, Cobble	<b>Pollution range</b> <b>Length</b>	Length : 3.0km Width : 15' 20meter
<b>Shoreline slope</b>	Steep	<b>Vehicle approach</b>	Not available
<b>Car ferry approach</b>	Over GT500 possible Not available to working place	<b>Pollution status</b> <b>Collected wastes</b> <b>stockpiled</b>	Serious pollution in rocks and pebbles
<b>Proposed cleanup method</b> <b>Place for cleanup operations</b>	Between rocks : Oil collection and mechanical cleaning Low-pressure washing Cobble washing possible	<b>Equipment/ materials deliverable and method</b>	1. Vessel to port 2. Vehicle to working place 3. carry materials by hand(30m distance) 4. shallow boat is available in good weather

Sectional shoreline assessment table (example)

Section	Characters of polluted area	Pollution Range	Method (Equipment/material)	Needed mea and working period
Myunggeum	Rock, pebble , cobble	1km x 20m	1 <sup>st</sup> wiping up operation 2 <sup>nd</sup> mechanical cleanup pebbles washing	50men x 60days
<p>Others</p> <ul style="list-style-type: none"> <li>- From 14 December daily 150 to 160 villagers were involved for operations and 150 to 200 tons of wastes collected. (wastes stockpile near the working place)</li> <li>- Removing oil between rocks should be prioritized and low-pressure washing is needed for big pebbles.</li> <li>- 4WD vehicles should be used for carrying materials and wastes and approach access should be made considering the center has marsh.</li> <li>- Available manpower is now 133 families. It is not possible for people from mainland to assist is to be done in full tide.</li> <li>- Over GT500 of car ferry is possible to alongside and wastes transferring is ease as SWL 5ton crane is on the apron.</li> </ul>				

## Shoreline cleanup operations

(Focused from the start on the mechanical collection)

Mallipo beach is located south east from the incident site and could easily be exposed to oil pollution. Mobilized equipment and materials were prioritized to places in Mallipo beach for response operations. On 8 December 2007 difficult combating began against the fast moving oil. As response resources came to the beach step by step plans for arrange equipment and materials delivery kept pace with cleanup operations and operations were in progress without any problem. On the afternoon of 8 December a black oil tide rushed toward the beach and KOEM focused its efforts to move all staff and resources to the beach. 8km of beach length it was too much to expect a quick cleanup, particularly considering our lack of manpower. Whilst from 9 December 2007 huge numbers of volunteers from all over the country came to the beach to help, managing these volunteers was also a problem for KOEM especially where operations with equipment were involved. So from 10 December 2007 KOEM decided to organize teams for operation only at dawn and night, and make tired staff whenever Operations gained pace as the KOEM's unique vacuum equipment 'SMBC-50' landed. Results were very good but staff had to worry about where to store oil collected by the vacuum unit from the beach. 23 vacuum lorries were also very useful in collecting oil floating on the surface of the water. On the 11 December 2007 the president of Korea visited the site and this encouraged people to work harder.



Oil collecting operations via skimmers in Mallipo and Chollipo beach were sustained for 21 days from 8 to 28 December 2007. In total 37 skimmer sets, 130 temporary storage tank sets, 430 vacuum lorries and 2,980m of oil boom and the total collected oil was 1,000kl with 229tonss of solid wastes collected. KOEM suffered from lack of manpower as more than half of on board at sea so we had to deploy our equipment bearing in mind the possible number of workers available.

### **Islands cleanup operations**

Shoreline cleanup had been carried out mainly by private contractors, villagers, army and navy but the islands remained as almost impossible areas for action because access to them was very limited. Suddenly the government ordered KOEM to proceed with islands cleanup as KOEM was the only agency available with specialized response knowledge and technologies. We were initially unsure how to proceed when open the marine chart but at once but set out to make a plan. A total of 46 polluted islands were found including 6 beaches so we had to appoint each staff as a controller for each island and we started the islands cleanup project on 27 December 2007 through assessment of islands and beaches.

It was difficult to land any heavy machines such as excavators on the islands so manual collecting operations had to be carried out by villagers. On some islands the 'flushing' method was applied to collect floating oil via skimmer or absorbent. In the case of small slicks after pouring water through pumps was tried, snares made of oil-friendly material proved most useful in removing oil. In addition 'surf washing', of the rocks and pebbles down near the water provided natural cleaning as the tide went back and. The only aspect here was that the villager were not very cooperative with methods.

### **Collected wastes disposal.**

As the national catastrophe took place KOEM organized a special team for collected wastes disposal according to the response contingency. The government response strategy headquarters decided to consign KOEM to deal with liquid-type wastes disposal with the Environment Ministry in charge of solid-type wastes through wastes disposal contractors. KOME submitted the collected wastes disposal plan to the 6 concerned regional authorities and got approval for the plan. All mobilized vehicles for carrying wastes were issued with certificates for wastes collecting/carrying to be displayed in vehicle windscreens according the Wastes Management ACT of 21 December 2007.

It was also decided with regard to collected wastes disposal to set up an intermediate station for transferring and storing wastes to save costs in case vehicles where delayed

whilst waiting their turn. Accordingly the Hyundai oil refinery near the site was designated as the intermediate store station after long discussion between of the Ministry of Environment, Ministry of Maritime and Fishery Affairs, the Korea Coast Guard, local autonomous entities, and concerned companies.

There were 2 possible choices regarding the collection of accumulated on the beaches. The first one was to collect oily wastes from ready-stored bowls or buckets through vacuum vehicles, and the second was to collect oil wastes directly from the beach via the vacuum vehicles. Initially it proved easy to collect oil directly to the vacuum as the oil was still liquid, but as time went by the oil became solidified and the only way to collect it was to utilize super vacuum trucks as the normal vacuum vehicles were not able to do the job. Materials such as small stones, sand and absorbent clogging up vacuum pipes also hindered working.

Workers moved to Daesan port for wastes disposal operations and 1 OSRVs and 2 Oil barges returned from the cleanup operation at sea. With oily hardening as time passed KOEM made use of on board heating machines to transfer wastes rapidly. Biting cold weather and strong winds made operations very difficult.

KOEM had trouble disposing of wastes collected from islands because wastes disposal contractors were only available on the mainland, and it was finally realized that there was no choice but for KOME to carry and dispose of wastes itself. All collected wastes from the islands could be easily harden and so KOEM needed to know that they had not solidified and had to use the Grab car for transferring wastes as the vacuum vehicles were now useless . Other KOEM vessels were now brought into use to accelerate things and save time.

## **Conclusion**

After the 'Sea Prince' oil spill of 1995, the worst incident in Korean history up to the point, the country's national response command system was centralized to the Korea Coast Guard with 16,900tons of response capability. In addition a contingency plan was set up by regional autonomous entities as well as KOEM for rapid response to oil spills based on the national contingency plan.

The lessons learned from the "Sea Prince" spill were that trial and error can always help us to develop better systems, and every disaster is different in terms of cause, circumstances, ways to combat, preparedness, etc.

As mentioned above more than 1.2million volunteers were involved in Hebei Spirt cleanup

operations making it the largest such operation in Korean history, and an event which clearly moved the Korean nation. In practice however, concerned authorities like to the Korea Coast Guard and KEM were somewhat diverted from and hindered in the performance of their main response duties by the sudden need to manage huge numbers of volunteers-something which used up the majority of KOME's manpower in particular. Another negative aspect to the affair was that agreement made for the purposes of efficient response between KOEM and regional local autonomous entities were in practice not that effective as they had no binding force, and of, as stated above, lack of training for response on the part of the latter was a hug problem.

For the future KOEM wishes to propose 3 things for considerations.

Firstly, programs should be developed for managing volunteers more effectively.

Secondly, if response equipment for emergency situations is to be intensively utilized and new method taken advantage of, continuous training in equipment use should also be made available to would be volunteers in coastal areas.

Finally, the liabilities for local shoreline cleanup should be divided into appropriate parts by amending appropriate legislation or preparing new legislation. For instance we propose that small-sized oil spills should be dealt with by local autonomous entities, middle-sized by province and big-sized by central government.