Investigation report

B1/2006M

MS SINGELDIEP, fatal accident in Kotka port on 11.1 2006

Translation of the original Finnish report

SUMMARY

The accident took place in Kotka port on 11 January 2006, when the hatch covers of the vessel sailing under the flag of the Netherlands Antilles were to be opened as loading restarted. The ship had a Polish crew and Polish officers.

The second mate and the AB of the ship had opened the hatch covers together and the mate drove the crane meant to lift and move hatch covers on top of hatch No. 1, closest to the bow. The AB thought that the mate would leave the crane there. The mate, however, started to move the hatch cover alone and he was lifting the cover when it came loose and fell into the cargo hold.

When falling, the hatch cover pulled the crane from its rails and the other end of the crane collapsed over the hatch edge into the cargo hold. The mate, who had been in the cockpit on top of the crane, fell a distance of c. 5 metres on paper rolls and was seriously injured. The victim died from his injuries at the hospital.

The investigation revealed that several corresponding accidents have taken place with the said types of cranes. The victims of the accidents had worked alone, which has been contrary to the instructions. Dutch authorities have been aware of corresponding types of accidents, but no improvements have been required to be made in the lifting appliances and there is no knowledge of other measures required. The shipping company had provided instructions regarding work on the crane and emphasised the dangers of working alone.

THE ABBREVIATIONS USED

MS	Motor Ship
grt	Gross Tonnage
SWL	Safe Working Load
Loa	Length overall
SOLAS	International Convention for the Safety Of Life At Sea
STCW	International Convention on Standard of Training, Certification and Watchkeeping
IMO	International Maritime Organisation
ISM	International Safety Management Code
ILO	International Labour Organisation

INDEX

FOREWORD

The accident took place in Kotka port on a vessel sailing under the flag of the Netherlands Antilles with Polish officers and crew. A Polish mate died when he was moving hatch covers.

One hatch cover fell into the cargo hold in the accident. There were no dock workers in the cargo hold of the vessel at the time of the event, but, on the other hand, there could have been. In that case, the lives of several people would have been at risk.

The event is governed by several different provisions, both Finnish and those governing the Netherlands Antilles. Also the investigation of the event is governed by several different provisions. On the other hand, an accident like this is not very common in Finland, but similar vessels sail to Finland frequently and the working method used is common. Due to the nature of the event, the Accident Investigation Board decided to appoint an investigation commission to investigate the accident. During the investigation it was discovered that cranes of the said type have been involved in many similar accidents.

Harri **Halme**, tech.lic., was appointed chairman of the Board and Kalervo **Mattila**, Technician (Stevedoring), as its member as well as Special Investigator, Captain Risto **Repo** as expert. The commission set the following issues as goals for the investigation.

- To establish the reasons for the accident
- To evaluate the consequences that could, in a normal working situation, have followed from the accident
- To assess the adequacy of the work instructions with regard to dock workers
- To assess the operations of the rescue and other authorities during the accident
- To establish the applicable legislation
- To assess safety on the said crane when lifting and moving hatch covers
- To asses, as an example, the direct and indirect costs arising from the accident
- To establish the basis of international co-operation in accident investigation and assess the adequacy of co-operation

Statements concerning the investigation report. In accordance to the act (79/1996) 24 § concerning accident investigation the final draft of the report was sent for statement to the Dutch Shipping Inspectorate, the Netherlands Antilles' Shipping Inspection, the operator and the master of the vessel, the manufacturer of the crane, Finnish Port Operators Association, Ministry of Social Affairs and Health (Finland) and Saimaa Terminals Ab Kotka.

1 EVENTS AND INVESTIGATION

1.1 The vessel

Figure 1. The ms SINGELDIEP.

1.1.1 General information

Name	SINGELDIEP
Type	General cargo vessel
Owner	Scheepvaartonderneming ms. Europa, the Netherlands
Operator	Feederlines BV, the Netherlands
Flag state	The Netherlands Antilles
Classification society	Germanischer Lloyd (2005)
Gross	3170
Length (Loa)	98.90 metres
Breadth	13.80 metres
IMO No.	9194074
Call sign	PJIW

1.1.2 Manning

The vessel had a Polish crew of nine persons: the master, the chief mate, the mate, the chief engineer, two deckhands, two engineers and the cook. The master had come onboard the vessel in October 2005. He had previously served as master onboard 11 similar sister ships for 7 years. According to the master of the vessel, the mate was an experienced seafarer.

1.1.3 Equipment for handling the hatch covers

The vessel is a general cargo vessel with a single cargo hold and eleven hatch covers. The hatch covers weigh approximately 13 tons a piece. They are lifted and moved with a lifting appliance designed for this purpose. The device is a two-leg gantry crane. The hoisting capacity of the crane is 13 tons (SWL) and the Germanischer Lloyd had run a test thereon with a 16.25 ton load in July 2000. There are rails on both sides of the cargo hold opening, along which the crane runs. The rails are mounted at nearly the height of the hatch edge. On both sides there are two lifting hooks, which are connected to the hooking pockets on the edges of the hatch cover when the hatch cover is lifted. The crane is hydro-electric and common in vessels of this type. Dozens of corresponding vessels sail to Finnish ports every week.

Figure 2. The hatch cover crane onboard a sister ship.

The crane cockpit is located on top of the crane on the starboard side of the vessel. The crane operator has to ensure that the hooks are properly connected to the hooking pockets of the hatch cover. Normally, and also in accordance with the operating instructions, while lifting and moving the hatch cover, there is another person on the one side of the crane to ensure that the lifting hooks are properly connected to the hooking

pockets and the crane operator ensures the other side. This speeds up the work and makes it safer. Also the operating instructions contain this requirement.

The crane was manufactured by Coops & Nieborg, Hoogezand. According to the homepages of the company[1], they have manufactured hundreds of cranes and hatch covers. The representative of the company states in an accident investigation report that they had manufactured over 600 of these cranes (2003). According to the company, the cranes and hatch covers require little maintenance and service. In the instructions provided by the manufacturer, the only thing stated of the maintenance of the crane is that the wheels are easy to detach and that the engine brake is adjusted to the chain length, meaning that if the chain stretches, it must be adjusted. In addition, the thrust bearings must be greased approximately once a month. There are no structural checking instructions. The shipping company sent a company circular to vessels at the beginning of 2005. The circular draws attention to the safe use of the crane with reference to a serious accident that had taken place.

Germanischer Lloyd had checked the structural construction, welding work and materials of the crane in Holland on 16 May 2000. In addition, a test on the cylinders and a hoisting test with a 16.25 ton load were performed on the crane in 2000. According to the regulations of the Netherlands, the lifting appliances of a vessel must be checked thoroughly and re-tested once every five years.

The same manufacturer also makes hatch cover systems where the crane cockpit is located on the side of the crane.

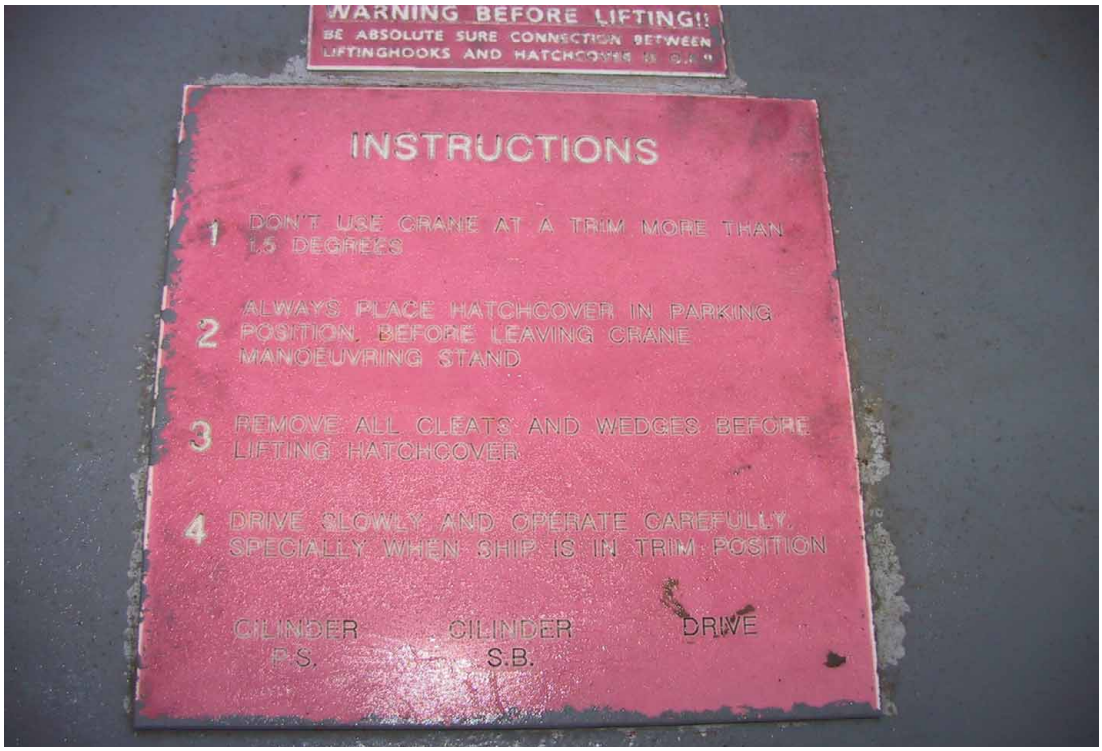

Figure 3. The crane's operating instructions at the site. Picture from a sister ship.

[1] www.coops-nieborg.nl/eng-versie/index-eng.html

The operating instructions of the crane state that all hatch cover wedges must be in backward position and all lockings must be unlocked. Before use, the correct positioning of the wheels on the rails must be checked. No equipment may be attached to the crane, such as wires, E-cables, etc. The alignment of the movement of the power cable with the crane movement must be checked before use. The proper connection of the hooks to the hooking pockets is checked by both work partners; the operator checks the hooks on his side and the partner checks the hooks at the other end. The hatch covers are lifted and moved as low as possible. The crane may not be used if ship trim exceeds 1.5 degrees and the list exceeds 3 degrees.

Also loose bulkheads, used inter alia in the transport of grain and other bulk cargo, may be lifted with the crane.

1.1.4 Cargo

The loading of paper reels in upward position in the cargo hold of the vessel had started. The loading had continued already for some time until dock work was interrupted due to a special action[2] of the dock workers. At that time, the cargo hold contained approximately 1,150 tons of paper reels, about one-third of the cargo to be loaded.

Figure 4. The cargo hold of the vessel.

[2] EU wide strike against Port Directive

1.2 The accident event

1.2.1 Weather conditions

The weather in the port was rainy and the temperature was +5 degrees Centigrade. According to the master and the mate, there was no snow, ice or sand on the deck.

1.2.2 The site

The vessel arrived in Kotka, Finland in the evening of Sunday, the 8th of January. The vessel unloaded its solid bulk cargo in the Port of Mussalo and, on Tuesday, it moved for loading to the quay in the Kantasatama Port, where the accident took place.

1.2.3 Events

The vessel's mate and deckhand were opening the cargo hold to continue the loading. The cargo hold was opened by moving hatch covers with the on-deck crane designed for that purpose.

The dock workers had finished the morning shift two hours earlier than normally and, correspondingly, the night shift had a shorter shift by beginning their shift later than normally. The cranes used to load the vessel were on the quay and their operators were ready in their cockpits.

The dock workers were already coming to work; the first ones were coming onboard when the accident took place. The aim is to open the hatch covers of the vessel so that everything is ready onboard when the dock workers start their work.

Looking from stern to bow, the cockpit, where the vessel's mate worked, is on top of the crane on the SB-side. The vessel's AB worked on the Port side.

They had moved, opened and closed hatches already several times during that day. According to the master, hatch covers had been moved around twenty times. This is a normal work method with regard to vessels and cranes of that type. The aim is to minimise the number of moves during loading, but they easily amount to dozens before the vessel is loaded and ready.

The trim and list of the vessel restrict the moving of the hatch covers as they have to be moved as horizontally as possible.

These work partners had first opened hatch cover No. 2, then hatch covers No. 4 and No. 3. These were stacked on top of hatch cover No. 5. After moving hatch cover No. 3, the AB moved on top of the hatch covers as he thought that the work was done. According to him, they do not usually open hatch covers No. 1 and No. 11. He was moving from the stack of hatch covers to the deck, when he noticed that the mate drove the crane on top of hatch cover No. 1 alone. The AB thought that the mate was going to park the crane on top of hatch cover No. 1.

The mate, however, started to move the hatch cover. There was no one to check the connection of the Port side hooks to the pockets. When the AB was walking towards the stern near hatch cover No. 8, he heard a huge noise. This took place at approximately 14.30 Finnish time (at 13.30 vessel's time).

The master of the vessel said that he had a feeling that something was wrong with the lifting. He was hurrying down from the bridge, when he heard a loud noise. He was on the boat deck at that time

After hearing the noise, the AB rushed to the site and saw that part of the crane had been derailed and collapsed. He saw the mate lying in the cargo hold on top of paper reels on the right side of the crane. He said that he shouted to the people rushing to the site not to touch the mate as he thought that the mate might have damaged his neck.

Figure 5. The collapsed crane. *(© Juha Metso)*

There were two eye witnesses for the event on the quay. They were crane operators, who were sitting in the cockpits of their cranes on the quay aside the vessel. According to the statements of the eye witnesses, the mate had moved the last hatch cover to 2–3 metres from the stack of the hatch covers stacked earlier. When the hatch cover was

lifted, its seaside (starboard side) end became loose from the hooks and the hatch cover fell into the cargo hold. The crane with its operator seemed to derail towards the quay and simultaneously collapse towards the stern of the vessel. The mate had held on to the railings of the crane with both hands and fallen with the crane. When the falling of the crane stopped, the mate flew uncontrollably into the cargo hold.

The foreman of the dock workers group was getting onboard the vessel. The first dock workers and the foreman were on the stern deck near the hatch coaming. They were studying the situation with regard to continuing the loading when the accident took place. The foreman called the Emergency Response Centre and asked for an ambulance, which arrived at the site in 7.5 minutes. First-aid was started. The dock workers fetched an emergency lifting basket, with which the victim was lifted from the cargo hold of the vessel.

The master also rushed to the site and said that he had asked a dock worker he had encountered to call an ambulance. The master said that he had felt that something was wrong although he had not yet seen the site on the port side of the deck.

The master said that he had seen that the wheels of the crane were approximately one metre from their rail on the passageway of the port-side deck. The top of the crane had collapsed towards the stern of the vessel. The upper part was slightly twisted.

The starboard-side wheels of the crane were in the cargo hold against the wall so that the frame of the crane was on paper reels. The leg of the crane had thus been lifted from its rails over the hatch coaming into the cargo hold.

Figure 6. Twisted lifting hooks.

Figure 7. Detail of a lifting hook.

The hatch cover being moved had been detached from the hooks and it fell into the cargo hold. When the crane collapsed, the mate who was operating it fell from the crane into the cargo hold on top of paper rolls and was seriously injured.

The ambulance came to the site at 14.45. When the ambulance came, first-aid was already being administered at the site by a person from the stevedoring company. The mate was alive, but severely injured. No one touched the injured person, he was only spoken to calm him down. An attempt was made to give him an oxygen mask, but it did not succeed. He was moved on a pneumatic stretcher and with it to a lifting basket, with which he was lifted from the vessel to the ambulance and taken to Kymenlaakso Central Hospital.

Figure 8. The fallen hatch cover on the bottom of the cargo hold (a picture taken by the vessel's master).

1.2.4 Measures after the event

The Finnish agent of the shipping company (Feederlines) arrived onboard and lent a mobile phone to the master. The master notified the shipping company of the accident and, at the same time, asked for a replacement. The shipping company notified the Dutch Maritime Authorities of the accident. Also the Finnish Maritime Authorities were notified of the event and the maritime inspector notified the Kymi Occupational Safety District of the accident. The accident victim died on the next day and the Police conducted their own inquest into the cause of death.

The maritime inspector arrived at the site at approximately 18.00 to evaluate the seaworthiness of the vessel. The maritime inspector collected preliminary information on documents for inspection. The master was very shocked by the event. The maritime inspector notified his superior of the event.

An occupational safety inspector from the Uusimaa Occupational Safety District happened to be in the Kotka region and he visited the vessel later on. Also the local representative of the insurance company was there at the time.

In order to find an explanation for the event, the master, together with the chief engineer, examined the crane and hatch covers after the hatch covers had been closed. The master noted that the hooking pockets on the starboard side of the damaged hatch cover were damaged.

On the following day, when examining the crane, they noticed that the hooks on the starboard side were twisted. They concluded that that side had failed during the lifting. Representatives of the Dutch Maritime Authority, two maritime inspectors, arrived in Finland on the next day. They heard the master of the vessel and the AB, who had been the work partner. The special investigator of the Accident Investigation Board was present at these hearings.

1.2.5 Work method

The work method involving the lifting and moving of hatch covers is common with this type of vessel and crane. There are eleven hatches in the vessel and they are stacked on top of each other, where needed, as dock work progresses. The number of moves depends on the cargo. The aim is to get cargo that needs to be covered quicker, such as for example paper reels, below the deck as soon as possible and, on the other hand, the aim is to keep the hatches open for as short a time as possible.

The hatch covers may be handled only in a certain order. Every other hatch cover needs to be lifted first. For example hatch covers Nos. 2 and 4 have to be lifted before No. 3 can be lifted.

Figure 9. Stack of hatch covers, hooking pockets are not marked.

The strength of the vessel also has to be taken into account when moving and stacking the hatches. One hatch cover weighs 13 tons and so, when the hatch covers are stacked on top of each other, considerable stress is directed at the hull of the vessel.

The aim is naturally to load the vessel with as few hatch moves as possible. With regard to their own work, the dock workers find the handling of hatch covers annoying and disturbing. The crew considers that the moving of hatch covers slows down the loading of the vessel especially as the moving should be done so that there are no dock workers in the area affected by the lifting and moving.

During the loading of a vessel, there are usually 20–30 moves of the hatches before the loading is completed. The aim is to organise these taking into account work breaks. The weather, especially rain and snow showers, have an effect on the number of moves.

1.2.6 Technical restrictions on the use of the crane

In Finland, dock workers consider the crane type used here to be light in structure. They think that it needs careful operation.

The manufacturer of the crane has restricted the use of the crane so that the trim (longitudinal heel-over) of the vessel may not exceed 1.5 degrees.[3] For a vessel of 100 metres in length, this means that the draught between the stern and the bow may not exceed 2.5 metres. The trim changes as the hatch covers are moved and as a result of changes in the mass caused by the cargo. On the other hand, the greatest trim mentioned in the construction drawings of the manufacturer is 2 degrees.

The instructions onboard the vessel[4] give the largest allowed threshold value for the vessel list. The maximum list when using the crane is 3 degrees. Also this value has a material effect on safe working conditions. On the other hand, the design drawings give 5 degrees as the maximum list allowed.

The restrictions on the use of the crane presented above require attention to and careful monitoring of the loading from the mate supervising the loading and unloading so that the threshold values given are not exceeded and that the crane can be used all the time.

The rails of the crane are located at approximately the level of the edge of the cargo hatch. The rail wheels of the crane have a flange of approximately 2 centimetres. The flanges are meant to prevent the wheel from derailing. In certain cranes, the safety of the rail wheel is improved by installing a safety catch on the structure of the crane to prevent derailing (see picture 10.).

[3] Instructions plate in the cockpit of the crane, figure 3.
[4] Checklist for manouvre maindeck + grainbulkheads, undated and unsigned instructions in the master's folder

Figure 10. Crane equipped with safety catches. Red arrows point the safety catches.

From the cockpit of the crane, it is not possible to see the connection of the lifting hooks in the hooking pockets at the other end. The operator has to go and ensure this or another person has to be on the other side to check the connection of the hooks. This method is presented in the instruction onboard the vessel, cf. footnote 4.

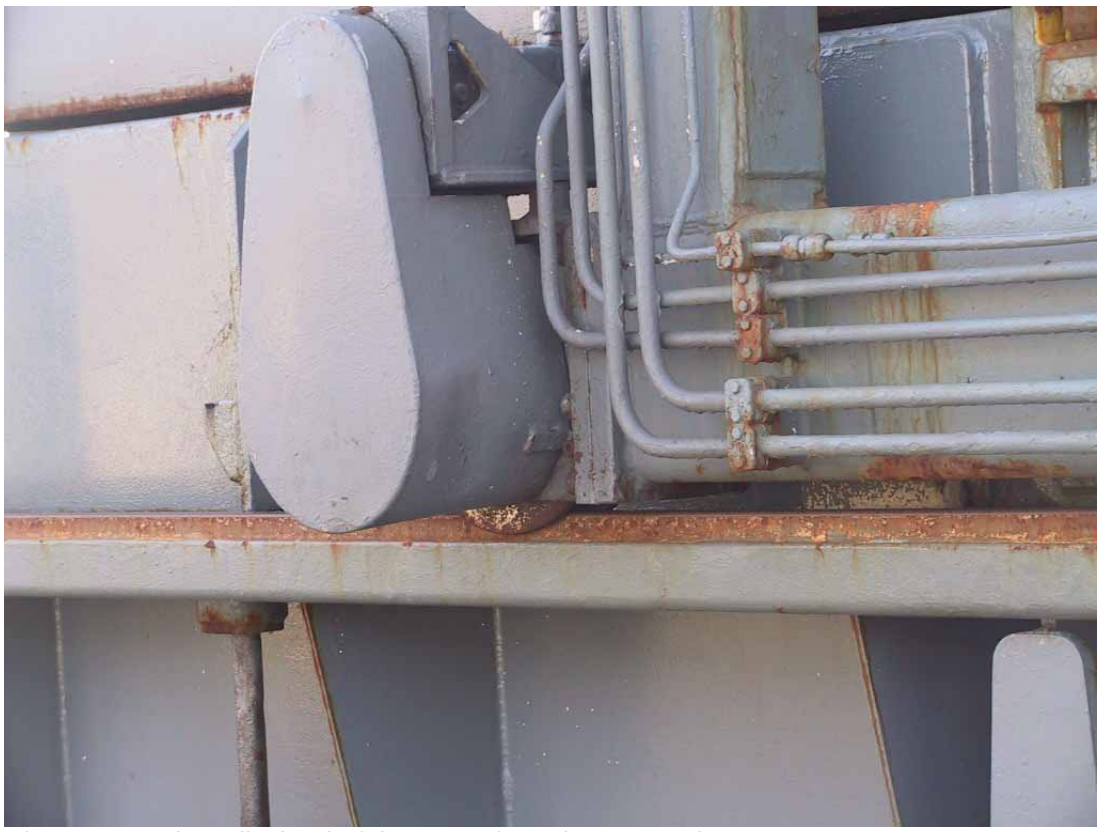

Figure 11. The rail wheel of the crane in a sister vessel.

The driving speed of the crane is approximately 20 metres per minute and the hoisting speed approximately 2 metres per minute. The crane has four motors for driving and it has three positions: forward, reverse and stop. The speed is adjusted by the position of the handle. The crane can lift the port and the starboard sides simultaneously or separately. This makes a correction possible if the load of the crane has to be balanced horizontally due to the trim of the vessel or if the hoisting cylinders have not operated with exactly the same movement. Uneven running or movements with an uneven tempo have a great significance in the creation of swinging. If the engines do not work simultaneously when a move is started or stopped, it causes g-forces directed at the hatch cover and the structures holding it, inter alia the hooks and the hooking pockets.

1.2.7 Safety matters in the handling of hatch covers

The instructions for use issued by the manufacturer and the shipping company have to be complied with at all times. The workers must be carefully familiarised with the use of the crane and the handling of hatch covers. If the working language of the vessel is Polish, all the employees at least understand each other. The success of familiarisation depends on how well the person in charge of the familiarisation can himself use the crane and how well he understands the work-related risks.

The instructions for use in the cockpit and the other instructions were in English. Not everybody onboard knew enough English. This became apparent also in the interview of

the AB, when he stated that he knew what it said in the instructions in English, although he did not understand English.

On the other hand, communication between the crew and a dock worker takes place in English and, with a view to safety, it is important that both parties understand each other's intentions. This especially applies to preventing going under loads so that the crew cannot enter an area where cargo is being loaded into the vessel or, correspondingly, that the dock workers do not work under hatch covers being moved and lifted. Both parties must know each other's intentions so that the work can be scheduled without dangerous incidents.

The condition and operation of the crane are of a great significance with regard to safety. Proper service and regular checks create a foundation for safe work. Since year 2000, no external body has conducted actual periodic checks on the crane. Service and maintenance jobs conducted by the crew themselves have not been entered in the vessel's documents.

According to general safety principles, lifting appliances have to be checked at regular intervals. Finnish legislation requires that a vessel's lifting appliances are checked at three-month intervals and more thoroughly once a year. Corresponding checking principles are included in the ILO Conventions relating to a ship's lifting appliances used in dock work. Lifting appliances used in dock work[5] are thus governed by international provisions, which require thorough and regular testing. The other lifting gear of a vessel is not always checked in accordance with the same principle. As the vessel sails under the flag of the Netherlands Antilles, it does not fall within EU legislation, but many of the corresponding regulations of the Netherlands are complied with onboard. In the Netherlands, lifting appliances are to be tested and thoroughly checked once every five years. This is performed by an external expert, most often a classification society. Other checks may be performed by the master of the ship by or a person appointed by him.

The correct use of the crane is very important, because the dock workers have estimated the structure of the crane to be very light. It may bend and swing during use. Excess list, removal of ice from the rails by driving or other such use may cause changes in the structure of the crane. Likewise, any swinging of the hatch cover when moved or lifted causes dangerous situations.

The condition of the hooking pockets is also of material significance to safety. The hooking pocket has been constructed so that the part carrying the load is welded to the side of the hatch cover. This part goes into the lifting hook and directs the weight of the hatch cover to the hook. The hooking pockets also have a side plate, which ensures that the hook stays in the pocket. In this accident, the side plates of the hooking pockets broke when the hatch cover fell.

The hooking pockets damaged in the accident were repaired so quickly that it was not possible to establish their damage. The damaged pockets were detached from the side

[5] ILO, Occupational Safety and Health (Dock Work) Convention, C 152

of the hatch cover and new pockets were welded in their place. The detached parts were destroyed before the investigator arrived at the site. One reason for the quick actions was that the hatch cover lay on the bottom of the vessel and it had to be removed.

Rails always have to be checked. The rails must be free of any objects or substances. Any loose objects on rails may cause derailing.

It has happened in practice that the power cable of the crane has tangled with the structures of the vessel when the crane has been driven.

Ice that has formed on the rails during passage has been removed on vessels of this type by driving the crane along the rails attempting to clean the rails this way[6]. Ice does not form symmetrically on the rails, which means that, when removed by driving, the loads are not evenly directed at the structure of the crane. Usually the cleaning takes place without a load (a hatch cover). As the structure of the crane yields, this may derail the crane.

A thin layer of snow that has formed on the rails may make the rails so slippery that it is impossible to move a hatch cover upwards. Correspondingly, it may happen that the brakes of the crane do not hold on slippery rails when moving downwards.

According to the instructions of the shipping company, a safety helmet has to be used when working with hatch covers. Both persons had safety helmets. The safety helmets used onboard were of a model that did not have a chin strap or a possibility to tighten the back. The significance of a safety helmet is especially great when one may be hit on the head or when various objects may flow or drop on the head. In this case, the vessel's mate fell from the top of the crane when it collapsed. The helmet had dropped from his head during the fall. The mate fell a distance of approximately 5 metres on paper reels in the cargo hold.

After the accident, the investigators have, on several occasions, noticed deviations from the safety instructions on vessels of different shipping companies. The hatch covers have been moved alone and no safety helmet has been worn while working. However, the Commission is not aware whether all shipping companies have urged their personnel to wear safety helmets.

1.2.8 Working hours

Working hours and one's energy level are important safety factors. The vessel arrived in Finland in the evening of Sunday, the 8th of January. According to the working-hour records, the mate had worked a 10-hour day on Sunday, a 13-hour day on Monday, a 12-hour day on Tuesday and a 4-hour day by the afternoon on Wednesday. Correspondingly, the rest periods had been 11, 12 and 13 hours during the previous days. According to the working-hour records, the victim, who worked as the mate at the

[6] Interviews of dock workers in Finnish ports made by the investigator

time of the accident, had worked from 4.00 to 6.00 on Wednesday and started his next shift at 12.00 noon.

The working hours of the AB, who was his work partner, were correspondingly 4 hours on Sunday, 8 hours on Monday and 12 hours on Tuesday. On Wednesday he had started work at 8 in the morning after a rest period of 10 hours.

According to the working-hour records, no special stress from excess overtime work was noticeable.

1.2.9 Damage to persons

The vessel's mate was seriously injured when he fell from the top of the crane into the cargo load onto paper reels for a distance of approximately 5 metres. On the day following the accident, the mate died at the hospital from an intracranial injury caused by a blow on the head.

1.2.10 Damage to the vessel

Each hatch cover of the vessels weighs 13 tons. One of them fell into the cargo hold from a height of approximately 8 metres with one corner slightly ahead of the others. As usual, there was a layer of paper on the bottom of the cargo hold covered with boards. The purpose is to protect the paper reels from damage. Slightly after the accident it became apparent that the corner of the fallen hatch cover had broken the bottom of the cargo hold and one ballast tank, which is located on the side of the vessel. Water was pumped into the said ballast tank to decrease the trim and the pumping was not stopped immediately after the accident. As a result, ballast water leaked to the bottom of the cargo hold and wet the lowest paper reels. The cargo had to be unloaded. Altogether 115 reels, i.e., 90 tons of paper, became waste.

The crane was damaged in the accident. The lifting hooks of one end were damaged. The crane was lifted on shore and, when the vessel was departing, the same kind of a crane was lifted from a sister vessel to replace it. The SINGELDIEP was leaving for North Africa, where she necessarily needed a hatch cover crane. The damaged crane was lifted on the deck of the sister vessel and taken to a shipyard for repair. The planned route of the sister vessel enabled this trip well.

The hooking pockets of the hatch cover that fell were damaged in the accident. They were replaced in port before the vessel departed.

1.2.11 Other damage

The wet paper reels had to be discarded as waste. They amounted to altogether 90 tons. In addition, the crane and the hatch cover damaged some paper reels when falling. The vessel was laying up for one week. An extraordinary examination by the classification society had to be performed on the ship. Both the hatch covers and the vessel had to be repaired.

The direct costs consisted of compensation paid to the victim's relatives, the damaged cargo and the repair of the crane and the vessel. Altogether 1,150 tons of cargo had to be unloaded in Kotka port, as the lowest reels were wet. After that, the vessel was reloaded from the beginning. This took approximately 60 man hours.

The vessel was laying up for over one week and the income for those days was lost. In addition, this kind of interruptions may have an effect on customer relationships. The end users of paper do not carry much storage, as they assume that the supplement comes right in time. Also this delay causes additional costs.

1.2.12 The port and its equipment

Shore-based cranes may, in compelling cases, be used to lift and move hatch covers. Shore-based cranes are not equipped with the kinds of hooks that could fit into the hooking pockets of the hatch covers, and therefore the lifting work has to be prepared separately by acquiring suitable lifting gear. Therefore the lifting and moving are conducted with the vessel's crane designed for that purpose.

1.3 Rescue operations

1.3.1 Getting the rescue operations started

The Southeast Finland Emergency Response Centre received a notification at 14.37.15. The Kymenlaakso Rescue Service was alarmed at 14.38.36. They sent a lead car, two ambulances and two rescue units. The first ambulance was on site at 14.44.37 and first-aid was started onboard the vessel.

The injured mate was lifted with a pneumatic stretcher on a stretcher, which was lifted ashore with the shore-based crane and therefrom to the ambulance. The ambulance transported the injured person to Kotka Hospital.

1.4 Separate investigations conducted

1.4.1 Work when moving and lifting hatch covers

The Investigation established the practical experiences that dock workers had of opening and closing the hatch covers when loading and unloading vessels in Finnish ports. The investigation was conducted by interviewing representatives and foremen of stevedoring companies and their labour protection experts. The interviews took place in Kotka, Mäntyluoto, Rauma, Pietarsaari, Rahja and Kaskinen ports.

The interviews concerned any close-by incidents, safety defects that had been noticed as well as issues that were considered important with regard to safety.

1.4.2 Other reports

The Investigation sent two lists of questions to the accident investigators in the Netherlands, one of which was meant to be answered by the shipping company and the other by the crane manufacturer. The purpose was to establish the checking and service practices of cranes, to obtain information on previous accidents as well as on the instructions given for working with cranes and hatch covers.

The Investigation familiarised itself with three accident reports from the Netherlands, which dealt with serious accidents that had taken place on vessels when moving and lifting hatch covers with the same kinds of cranes.

The accident report concerning the SINGELDIEP drawn up by the Dutch has been sent to the authorities of the Netherlands Antilles and it has not, as such, been available to the Investigation by the fall of 2006.

1.4.3 Observations regarding the moving and lifting of hatch covers

According to the reports, the dock workers were aware of some close-by incidents. The opening of hatch covers had been started without notifying the dock workers thereof. There had been two incidents where the power cable of the crane had tangled with the structures of the crane when driving the crane. When a stack of hatch covers has been high, i.e., there have already been three or four hatch covers in the stack, the list of the vessel had caused an unstable situation when lifting hatch covers on top of the stack. Sometimes there have been problems in opening the hatch covers as either the list or the trim has shaped the coaming of the hatch so that the structures have not been "straight". Likewise, the uneven location of heavy cargo during loading has caused the hull of the vessel to bend so that it has not been possible to put the hatch covers properly in place.

When many groups work onboard, problems arise due to the fact that the hatch covers may be stacked only in a certain order. Therefore it is not possible to make suitable openings so that the distance between the work groups would be adequate and comply with regulations.

On the other hand, the vessel's trim has sometimes been such that the crane has not been able to drive upwards, which means that the situation is not under control. Frost on the rails has also caused a corresponding uncontrollable situation, as the crane's brakes have not been sufficient downwards. Any foreign objects on rails may cause derailing. A part of a shore-based crane may in certain situations reach and bump into the vessel's crane. In one case, when moving a hatch cover, the list had caused the hatch cover to hit the vessel’s structures, but it did not, however, fall down.

Figure 12. Moving hatch covers during loading. The crane's cockpit is on the side of the crane on this vessel; in the SINGELDIEP it is on top of the crane.

A representative of dock workers suspected that in one case the hatch cover had fallen in the previous port, as it was not possible to open the hatch cover with the vessel's crane, but it had to be moved with a shore-based crane.

All the interviews emphasised the fact that the dock workers must absolutely know when the hatch covers are being moved. No dock workers may be in the area affected by the moving of the hatch covers. After the Kotka accident, also the shipping company gave instructions on this to its vessels. Both parties must be aware and ensure that information on the moving of hatch covers has been received. The representatives of the dock workers also emphasised that the vessel should be as straight as possible. The difference in height between the bow and the stern of the vessel, the trim, as well as the list should be as small as possible.

Both parties, the vessel and the port operator, have their own duties in the loading/unloading of a ship. The duties of the vessel's mate include monitoring of the loading/unloading situation as well as the vessel's trim. The dock worker shall, for his part, comply with the loading plan and notify the mate of any changes. Both parties shall always be aware of the current situation and further plans.

1.5 Provisions and regulations guiding the operations

1.5.1 National legislation

Finnish legislation:

The safe conduct of work is governed by several different provisions and regulations in Finland. The Occupational Safety and Health Act (2002/738) is the basic provision. Inter alia, the Government Decree on the Occupational Safety of Loading and Unloading of Ships (2005/738) has been issued thereunder. This Decree implements, on the national level, inter alia ILO Convention No. 152 concerning dock work.

In accordance with section 62 of the Occupational Safety and Health Act, the ship's master is required, where appropriate, to comply with the provisions of the Occupational Safety and Health Act. When a vessel is moored in Finland or sails in Finnish territorial waters, it falls within the scope of Finnish legislation. On the other hand, the regulations of the flag state shall naturally be complied with onboard.

The general safe working methods, which are to be complied with onboard the vessel when work is performed while the vessel is in Finland, may, in this case, be derived from the Occupational Safety and Health Act. More specific regulations are included in the said Government Decree, which governs the loading and unloading of vessels.

In addition, the party in charge of port management has its own instructions for a vessel, which shall be complied with when the vessel is in port.

The regulations thus aim at ensuring general safe working conditions. They also aim at ensuring safety at work and occupational health, when Finnish employees, dock workers, work onboard a vessel. The equipment used in the work, the passageways, the air, lighting, etc. shall be safe for the Finnish workers onboard.

The crew of the vessel may not, by their own actions, endanger safety at work or the occupational health of the dock workers. This means, for example, that no such cleaning may be performed onboard which will release impurities into the air. Working under loads for example has always been forbidden. The hatches may not be lifted and moved when the dock workers are down in the cargo hold in the said area. After the accident, the stevedoring company gave an instruction where it emphasised that dock workers may not be in the cargo hold while hatch covers are moved and lifted.

The party in charge of port management also requires that for example the safety of the environment or the safety of other vessels in the port is not endangered.

Legislation of the Netherlands:

The vessel sails under the flag of the Netherlands Antilles and it falls within the scope of the legislation of the flag state. Its safety is supervised by the maritime authority of the Netherlands Antilles. In the mother country, the Netherlands, the maritime authorities and the occupational safety and health authorities have mutually agreed that

occupational safety and health issues relating to navigation have been transferred to the Maritime Agency subordinate to the Ministry of Transport. The maritime authority thus supervises occupational safety and health onboard ships, unlike in Finland. Accidents are investigated by the Dutch Safety Investigation Board[7]. Its jurisdiction includes the investigation of all accidents that take place on Dutch vessels or on vessels sailing under the Dutch flag. The accidents may also be investigated by the maritime authority. The Netherlands and the flag state of the ms SINGELDIEP have agreed that accidents on the said vessels are investigated by Dutch authorities.

In the Netherlands, the provisions applicable to cranes onboard vessels are first of all ILO Convention No. 152 concerning dock work and the appliances used therein. A classification society approves the vessel's cranes before they are put into use and supervises their condition in practice by checks and tests carried out at five-year intervals. According to the occupational-safety provision (7.2972), the shipping company is responsible for the execution and implementation of occupational safety onboard.

The Safety Management System, based on the ISM Code (International Safety Management Code) of the IMO, which emphasises compliance with the instructions, shall be complied with onboard. In practice, the shipping company has to give instructions regarding all tasks performed onboard and the crew has to comply therewith. In this case, they include instructions for use of the crane, its service and checking as well as the use of individual protective gear.

In this case, the accident was investigated by two investigators of the Scheepvaartinspectie, Rotterdam Unit (representatives of the maritime authority). After their preliminary investigation, the final decisions on further measures will be made by the authorities of the Netherlands Antilles.

1.5.2 Regulations issued by the shipping company

The shipping company prepares a description of the Safety Management System for the vessel. In addition, the shipping company issues instructions on different equipment and work tasks. Compliance therewith belongs to the supervisory duties of the work supervision.

The ms SINGELDIEP had instructions on the use of the crane and the use of a safety helmet. In addition, the shipping company had sent the vessels a circular regarding the moving and lifting of hatch covers. It emphasised careful compliance with the instructions and safety regulations.

1.5.3 International Conventions and Recommendations

International maritime operations are governed by numerous international conventions. These include inter alia the SOLAS and STCW Conventions, which are conventions

[7] At the beginning of the year 2006, the maritime authority still investigated maritime accidents of international traffic (deep sea).

drawn up by the International Maritime Organisation, IMO, and which the Member States have later ratified.

ILO (International Labour Organisation) Convention No. 152 handles the loading and unloading of vessels in port. Finland has ratified the Convention, but the Netherlands have not.

Due to the nature of the accident, which was clearly an occupational accident, agreements and conventions relating to occupational safety and the safe performance of work are applicable to the accident.

2 ANALYSIS

2.1 Actions of people

The mate acting as the operator of the crane violated the instructions. The instructions required that lifts and moves are done as team work. The Safety Management Code of the ms SINGELDIEP only defines that the instructions issued by the manufacturer shall be complied with when handling hatch covers. The AB, who had been the partner, left his post, because he thought that, after the last move, hatch cover No. 1 would be left in its place as usual. It is not known why the mate still started to move the remaining hatch cover on top of the other hatch covers.

The connection of the hooks to the hooking pockets was not checked. In other words, the AB did not check the connection of the quay-side hooks to the hooking pockets and the mate did not check the hooks on his side. The dock workers were coming in to continue loading and the first ones were already on deck. The mate may have been busy getting the vessel ready for loading and thus under a lot of pressure. Haste and pressure may have been the causes for neglecting to check the hooks.

The fact that the AB left his post indicates that something had been misunderstood regarding the task.

Vessels also have multinational crews, in which case language problems may endanger safety.

The crew of the vessel was Polish. The Safety Management System of the vessel is in English. Likewise, the instructions regarding the crane and its use are in English. In the interview, the AB, who had worked as the partner of the victim, stated that he could not speak English but that he knew what it said in the instructions for the use of the crane. With regard to the victim of the accident, it is not possible to establish his knowledge of English, but we can assume that a mate understands enough English with regard to his tasks. An inadequate knowledge of a language may, however, contribute to a situation where the operation of all equipment is not sufficiently understood and this may cause dangerous situations.

On the basis of the interviews we can state that on vessels of this type, hatch covers have been moved also alone.

The crane has not been subject to annual thorough checks, such as have to be done on lifting appliances used in loading and unloading vessels.

2.2 On the structure of the crane

The crane is of light structure. Its acquisition price is clearly cheaper than for example that of a hydraulic hatch system, where the hatch covers are raised upwards to each end of the cargo hold. Hatch covers lifted with a crane are slower to handle than

hydraulic system, but they are common because of their lower price. Several accidents have taken place in the past few years when operating cranes of this type.

The preliminary minutes of the Maritime Inspection Unit of the Netherlands state of this accident that, with this type of crane, six accidents have taken place, three of which have resulted in death. According to the minutes, the crane manufacturer is aware of the dangers relating to lifting and moving. The greatest dangers mentioned are the falling of a hatch cover if the hooking is not carefully checked, the driving of the crane over obstacles and the derailing of the entire crane.

The maximum load of the crane allowed is the same as the weight of a hatch cover. The crane operates at its maximum. On the other hand, the hatch covers are sometimes very stiff and they cannot be lifted off normally. This may be due for example to the distribution of heavy cargo in the cargo hold so that it has resulted in changes of form, such as the bending of the coaming of the vessel, which, in turn, hampers the opening of the hatch covers. In these cases, the crane is working at its maximum limit.

Overloading of the crane should be impossible. In an electro-hydraulic system, this is usually arranged with a pressure valve. The pressure valve prevents overloading upon lifting.

On the basis of the interviews we can estimate that when a hatch cover is hanging correctly by the hooks, it clearly stiffens the structure of the crane. Those interviewed estimated that a hatch cover cannot fall from the hooking pockets when the hooks are in the correct position in the pockets.

The wheels of the crane have approximately two-centimetre-high flanges. They should prevent the derailing of the crane. The flange did not prevent the wheels from derailing, the rising of one end of the crane first over the coaming and then its falling into the cargo hold. A more developed version of the corresponding structure is one with a safety catch on the structure of the crane to prevent derailing.

2.3 List and trim

The instructions of use of the crane state that the crane may not be used if the list of the vessel exceeds 3 degrees. Simplified, the total mass of the 13 tons of a hatch cover with a 3 degree list causes a sideways force of approximately 700 kilos, which "pulls" the hatch cover towards list. The maximum trim allowed when the stern of the vessel is lower means, correspondingly, in a simplified manner, that the mass of the hatch cover creates a force of approximately 340 kilos, which pulls the hatch towards the stern of the vessel. The accident took place when the crane was moving, which means that there were also dynamic forces involved, which contributed to the accident.

In the construction drawings, the maximum list and trim allowed are bigger than in the instructions of use. The construction values may be different than the guideline values. The manufacturer states that they give guideline values and that the shipping company makes the final decision.

According to an eye-witness, the mate had stopped the crane and he started to lift the hatch cover up so that it could be driven on top of the existing stack of hatch covers. It was not possible to move and lift a hatch simultaneously with the said crane. The investigation has revealed that with certain cranes it is possible to lift and move simultaneously. On the basis of a photograph, we can notice that the lifting cylinders were almost entirely out so that the hatch cover has already been quite high up, when the accident took place.

2.4 Hooking pockets and the position of the hooks

The hooking pockets have been constructed so that they can well bear the load caused by the hatch cover when the hook is in the right position. The side plate of the hooking pockets is meant to ensure that the hook remains connected to the planned spot carrying the load. It is not the purpose of the side plate to carry the load.

The crane manufacturer has instructed that the places of the locking wedges, the hooking pockets, be clearly painted. Likewise, the hooks have been painted. In addition, according to the instructions, the centre line of the hatch cover should be painted on the hatch cover. The hooking pockets had not been painted on the ms SINGELDIEP, but they were of the same colour as the hatch covers. Thus they are not distinguishable from the side of the hatch cover. After the accident, during spring 2006, the investigators have noticed that the hatch cover markings had been painted only in one-third of the corresponding vessels that visited Finnish ports.

Figure 13. Painted hook wedges.

The hooks of the crane on the side of the quay (the port side) were twisted inwards. The side plates of the hooking pockets on the side of the quay of the hatch cover had been

torn off. The cockpit of the crane was at the sea-side (starboard) end. The eye-witness stated that the hatch cover became detached from the side of the sea and fell into the cargo hold.

There is nothing in the hooks of the crane to indicate whether they are correctly in the pockets. It is possible to check only visually that everything is OK and that the hooks are correctly placed.

2.5 On previous accidents

The investigation has revealed that several accidents have taken place when moving and lifting hatch covers with cranes of this type. Both the authorities and the manufacturer have been aware of them and they have also been investigated. The Accident Investigation Board received the investigation reports of three accidents from the Dutch maritime authorities for the investigation. When hatch covers are being handled, there is an accident risk, and therefore occupational safety must be very carefully observed in this work stage. The Dutch accident reports do not recount accidents that have happened to dock workers, which means that apparently no dock workers have been in the cargo hold.

There was an accident in Rönnskär, Sweden, in January 2003, where an AB was run over by the crane and died from his injuries. The cause for the accident was working alone on the crane against instructions.

In 2002 an accident took place in Spain, where a hatch cover fell into the hold when moved. A mate fell into the cargo hold and was injured. The main reason was working alone on the crane against instructions.

A similar accident took place in 1998, where the mate was injured. The main cause was working against instructions.

According to the preliminary investigation report of the SINGELDIEP accident from the Netherlands, six accidents have taken place with these cranes in the last few years, three of which have lead to death.

The investigation proves that work is done on the cranes alone in violation of the instructions. Usually there are only a few persons qualified as crane operators onboard.

2.6 Periodic inspections of lifting appliances

The ILO Convention on dock work requires that lifting appliances used in dock work be tested before put into use for the first time and periodically thereafter. The EU Directive on the use of work equipment also requires that lifting appliances be checked regularly. A general and important safety principle is that lifting appliances used in work are regularly checked. Depending on the nature of the lifting appliance, the contents of the checks and the body performing the check may vary.

The legislation of the Netherlands only requires that an expert performs a check and a test on the lifting appliances of a vessel once every five years. Any other check is decided on by the shipping company and the ship's master. The instructions of the manufacturer of the crane do not state much of periodic checks. They only mention the necessity of greasing.

The investigation shows that the requirements for periodic checks of the Netherlands are modest and do not guarantee the good operating condition of lifting appliances when used.

2.7 Safety at work of dock workers

A basic principle in the safety of lifting work is that no person may remain or go under a load being lifted. The area affected by a load being lifted has to be free of people.

The Investigation Board has found evidence indicating that this basic idea has not been complied with. The reason for this may for example be that the dock workers have not been aware that the vessel's crew was starting to move hatch covers while the dock workers were still in the cargo hold. The dock work group may have considered that it was adequately far from the lifting area and did not leave the cargo hold. Also the supervision of the work may have failed.

In the accident event, the dock workers were returning to the cargo hold. The first ones were already on deck.

A hatch cover is large in size and it weighs 13 tons. It fell to the bottom of the cargo hold for a distance of approximately eight metres. If any person was caught under such a falling hatch cover, he would most likely be killed.

2.8 International co-operation

There are no agreements or recommendation on international co-operation between the authorities of different countries on the investigation of work accidents. The co-operation is based on voluntarism.

In Finland, the police performed an ordinary pre-trial investigation onboard because of the serious work accident. This turned into an inquiry into the death of the victim. Onboard, the Maritime Inspector and the Occupational Safety Inspector visited the site of the accident. On 15 November 2004 the Accident Investigation Board decided to appoint an investigation commission to investigate the accident.

Two inspectors from the Maritime Authority Unit of the Netherlands came to Finland to start their own investigation due to the work accident. The Netherlands and the Netherlands Antilles have a co-operation agreement, under which the maritime authority of the Netherlands gives official assistance to the authorities of the Netherlands Antilles.

The representative of the investigation commission from the Accident Investigation Board was present when the representatives of the maritime authority of the

Netherlands heard the ship's master and mate. The representative was in charge of contacts with the Netherlands and monitored the investigation of its authorities.

The investigation commission prepared a list of questions for the shipping company and the manufacturer of the crane and the Dutch investigators asked these parties their own questions in connection with their investigation and submitted the answers to the commission.

The commission obtained the preliminary minutes of the investigation performed by the Dutch authorities. The preliminary minutes had been sent to the authorities of the Netherlands Antilles, who will make the final decisions in the matter.

During the investigation, the exchange of information between the two countries took place with varying results. Neither party has any obligations towards the authorities of the other country. It was not until towards the end of the investigation that the investigation commission learned about similar problems and events involving this type of crane.

3 CONCLUSIONS

3.1 Events resulting in the accident

It can be determined that the basic reason for the accident was that the mate moved the last hatch cover alone. The mate operating the crane did not carefully check the connection of the hooks to the hooking pockets. Why this happened, remains partly unclear. The instructions required for the work to be performed as a team. According to what the AB working as the partner said, he thought that the last hatch cover closest to the bow would be left as it was as had been customary. This was a clear communication and understanding error.

The technical reason was that the hooks of the crane on the side of the sea were not in the hooking pockets. The crane was driven to the hatch cover so that the hooks held the hatch cover from the lower part of the hooking pocket, not in the hooking pocket. The hatch cover stayed at the tip of the hooks due to friction. The place of the hooking pockets was below the place where the crane was driven. The shipping company had given an instruction to paint the hooking pockets yellow, and also the centre lines of the hatch covers should be painted on the deck. There were no such paintings onboard. During the investigation, visits have been made to over a dozen corresponding ships in Finnish ports with no painted centre line on the deck.

A significant factor has been mental stress to get the ship ready for loading as soon as the dock workers would start their work. At that time the hatch covers should no longer be moved causing a delay in the loading. This means that the mate was in a hurry, because he was responsible for moving the hatches.

According to the master, the vessel had a stern trim at 1.5 degrees. The vessel was also listing towards the quay. The hatch cover was moved downwards and the crane was stopped sufficiently high to lift the hatch cover. Due to the trim and list, there were also sideways forces in the lifting.

As the crane was stopped, the hatch cover first swung towards the stern and then in a counter-swing towards the bow. The hatch cover became detached from the lifting hooks on the side of the sea and fell into the cargo hold. At that point the hooks on the land side, which were in the hooking pockets, held the hatch cover. The hatch cover twisted the hook towards the cargo hold, the side plates of the hooking pockets yielded and became detached as the stress reached the tensile strength.

When the hatch cover became detached from the hooks at one end, the structure of the crane was no longer as stiff as with the hatch cover. At that point the centre of gravity of the crane moved towards the quay. The sea end of the crane was derailed over the side of the hatch and fell into the cargo hold.

The crane driver held on to the railings and tried to remain on his work platform. However, his grip was loosened by the impact and the driver fell into the cargo hold hitting his head either to the side of the hatch or the paper rolls.

The structure of the lifting appliance has to be considered light and it stiffens when the hatch cover is placed correctly on the hooks. The moving speed of the crane is big and there are swings when it stops. Improvements have been planned for cranes, including a safety catch which prevents the wheel from derailing. More detailed instructions have been issued on the use of the crane emphasising its careful use and the fact that one must always check that the lifting hooks are correctly in the lifting pockets. The correct position of the lifting hooks is not ensured mechanically or electronically, but visually. Electronic identification of the correct positioning of hooks in their pockets would prevent a faulty lift.

Also working alone is forbidden in the instructions of the shipping company although it happens against the instructions. There are no instructions regarding the periodic check of the lifting appliance; instead, the instructions mainly point to the need of greasing.

During the years the authorities of the Netherlands have gathered a large amount of information on serious accidents which have taken place with the type of crane in question. The investigation commission has not been informed on any measures taken by the authority due to the accidents.

The occupational safety of dock workers is significantly endangered if there are dock workers in the area affected by the lifting when the hatch covers are moved. The investigation shows that hatch covers have fallen several times in the last few years and that some of these have resulted in deaths. There are hundreds of vessels of this type in Europe and dozens also sail to Finland. Hatch covers are moved in Finnish ports almost daily. It is very important that there are no dock workers in the cargo hold when hatch covers are moved. It is also important that communication between the vessel and the stevedoring company operates flawlessly so that the dock workers know what the crew intends to do and vice versa.

International co-operation, especially the exchange of information, is important both to prevent accidents and to ensure a successful investigation. There was much to be hoped for with regard to the exchange of information.

4 RECOMMENDATIONS

The investigation of the event has shown that work using the hatch cover crane in question requires care and strict compliance with the instructions. There have been cases in which the hatch cover has fallen into the cargo hold and where workers have died or been seriously injured onboard. Also the safety of the dock workers is significantly endangered if there are dock workers in the cargo hold when the hatch covers are moved.

Recommendations

The Investigation commission recommends that

in Finland

1. *the stevedoring companies are informed of the safety risks of moving and lifting hatch covers with the type of crane in question and that they are reminded that no workers may be in the cargo hold when the hatch covers are being moved, and that*

2. *the occupational safety authorities supervise that this is implemented,*

in the Netherlands

3. *the authorities in question evaluate the adequacy of safety when working with the type of crane in question.*

In addition, the Investigation commission recommends that

4. *international recommendations or agreements on the exchange of information and co-operation be developed for the investigation of occupational accidents involving the authorities of two different countries.*

Helsinki November 15, 2006

Harri Halme Kalervo Mattila Risto Repo

LIST OF SOURCES

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