



REPUBLIC OF TURKEY
MINISTRY OF TRANSPORT AND INFRASTRUCTURE
Accident Investigation Board

Accident Investigation Report On
The Explosion Onboard TIBIL

Sea of Marmara / Tuzla Anchorage Area
20th of January 2014

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This report is prepared by the Accident Investigation Board.

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PURPOSE

This marine accident was investigated in accordance with the Bylaw on the Investigation of Marine Accidents and Incidents which came into force after being published at the Official Gazette No.29056 on 10th of July 2014.

Investigation procedures and principles are further applied by considering Resolutions of International Maritime Organization concerning International Standards and Recommended Applications for Safety Investigations Directed to MSC 255(84) (Accident Investigation Code) and Resolution A.1075(28) Sea Accidents or Incidents, and European Union Directive 2009/18/EC.

Purpose of the Marine Accident Investigation is to provide the improvement of the legislation and applications directed to the safety of life, goods and environment by achieving the real reasons which cause the occurrence of marine accidents, and thereby, to avoid a repeat in occurrence and to provide the mitigation of negative impacts and consequences following the accident.

Marine accident investigation shall be inadmissible in any judicial and administrative proceedings whose purpose or one of whose purposes is to attribute or apportion liability or blame.

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SUMMARY

On 20th of January 2014, while anchored at Tuzla Anchorage Area, on Turkish flagged chemical tanker TIBIL, a big explosion happened around 13:25 while hot work being carried out on the deck and one crew lost his life.

The ship, after unloading the chemical cargo of Acrylonitrile Monomer (ACN) at Yalova Aksa Port on 19th of January 2014, bounded for Tuzla with the purpose of maintenance-repair at anchor and anchored at Tuzla on 15:50 the same day. Between Yalova-Tuzla while navigating and also at anchor, washing operation was carried out with the aim of cleaning the gas that the cargo emitted and the residue of the cargo inside the cargo tanks.

On 20th of January 2014, around 13:25 a big explosion happened with the effect of sparkles while cutting the air duct which belonged to the cofferdam¹ of No.2 starboard side tank and where the pump's lines are placed, with a spiral motor with a team of 4 deck crew. One deck crew died because a hard object hit his head and one crew became ill from his ear. After the explosion, a big rupture on the side wall and very big ruptures on the bulkheads of cargo tanks occurred. After the accident, the ship first heeled on the port side, afterwards port upper-side tanks were discharged to sea, and this time the ship heeled between 30 – 35 degrees to starboard side. A couple of crew including the master, who left the ship after the explosion returned to the ship and the ship was righted near stable position with the ballast operation and then towed to shipyard with the help of tugs.

SECTION 1 – FINDINGS

1.1 Factual Information

Information on TIBIL

Name of the Ship : TIBIL

Flag : Turkish

Port of Registry : Istanbul

¹ *Cofferdam: A void space especially on tankers to prevent water propagation to other compartments in the event of an accident.*

Type of Ship : A1A Chemical Tanker
Owner : Beykim Petroleum and Ship Managing Ind.Ltd.Co.
Classification Society : Turkish Lloyd
Place and Year of Build : 1981 / Norway
Gross and Net Tonnage : 3642 / 1575
DWT : 6275
IMO Number : 8012138
Call Sign : TCSN8
Length Over All and Breadth: 101,26 / 15,7 meters
Draft : 7,46 meters
Main Engine Maker&Power : MAK – 2570 Kw (3494 Bhp)
Speed : 10,5 Knots (On Ballast)
Number of Crew : 17
Last Port of Call : Yalova / TURKEY
Next Port of Call : Tuzla / TURKEY

Information Regarding the Accident

Date and Time of Accident : 20th of January 2014 / 13:25
Type of Accident : Very serious marine casualty
Place of the Accident : Sea of Marmara Tuzla Anchorage Area
Injured/Dead/Missing : 1 dead, 1 slightly injured
Damage : Tear of 1,5 meters in length on the starboard side wall and tears in the cargo tanks
Pollution : None



Figure 1: Location of the Accident

1.1.1 Other Information Regarding the Ship

There are 7 center cargo tanks and 12 port-starboard side cargo tanks, totalling 19 cargo tanks on the ship. No.2 center cargo tank is divided as No.2 center port and No.2 center starboard cargo tanks. The ship is not loaded with cargo on side tanks in line with double hull practice. Accordingly, 7 center tanks are loaded with cargo. Center tanks are made of chrome stainless steel alloy. Side tanks are coated with paint and are not chrome stainless steel. The ship has been managed by Beykim Petroleum since 2007. Ships' allowed navigation region is near coastal voyage and generally it navigates on cabotage line and from time to time it navigates to countries which has shore to Meditarrenean and Black Sea.

1.2 Environmental Conditions

It was learned that on the day accident happened; the wind was blowing from north-northeast with a beaufort scale of 3, the sea was calm, sky was partly cloudy, visibility was good and temperature was around 16 °C.

1.3 Sequence of Events

On 20th of January 2014, while anchored at Tuzla Anchorage Area, on Turkish flagged chemical tanker TIBIL, a big explosion happened around 13:25 while an air duct on the deck was being cut with a spiral motor and one crew lost his life.

The ship, after unloading 2650 tons of chemical cargo of Acrylonitrile Monomer (ACN) at Yalova Aksa Port which it loaded from Aliaga (Izmir/Turkey) Petkim Port, on 19th of January 2014, around noon hours bounded for Tuzla and anchored at Tuzla Anchorage Area on 15:50 the same day. The ship arrived to Tuzla with the aim of carrying out 10 items of work including changing a line of 50 meters that has leakage on the cargo lines located at tweendeck² and changing some of the structural members that were corroded on the deck. It was planned to carry out these work items by staying for around 3 days anchored at Tuzla.

Washing operation was carried out for around 6 hours on total 7 tanks of which were loaded after anchoring at Tuzla with the time while navigation between Yalova-Tuzla and this operation was finished by the end of the shift. On 20th of January 2014 around 08:00 boatswain and 2 able seaman, started eject³ operation of residue tank washing water of No.1 center tank, after finishing the operation they shifted to eject operation of No.2 center starboard side tank. While eject operation was being carried out on No.2 center starboard side tank, the operation was finished by the master with the reason that the process would be continued at night and boatswain and able seaman (deceased) were sent to rest, and it was requested that one ordinary seaman (watchkeeping seaman) to stay on the deck to keep watch. Designated Person Ashore (DPA), who came to ship around 10:30, with the master and chief officer walked around the deck and talked about the maintenance work that would be carried out and marked the deck structural members that would be changed. At noon hours, the order of wakening the boatswain and the deceased able seaman while they were resting at that time, was given by the chief officer to the watchkeeping seaman. Boatswain, who was woken up by the watchkeeping seaman went to chief officer and received the order to cut the 2 air ducts which were corroded on deck by himself and 4 air ducts which were at fore castle deck to be cut by the fitter. Boatswain first cut the air duct

² Tweendeck: Section where the lines pass inside and placed over cargo tanks.

³ Eject: Air and water suction process at low pressure.

above the pump room with the spiral motor, after completing the work, with 2 ordinary seaman went to fore and started cutting the marked air duct of cofferdam where the No.2 starboard side tank pump lines located. Boatswain firstly cut the clamp of the air duct and then left the cutting of the air duct to fitter by fitters' request who came by. Fitter started to cut the pipe with the spiral motor and when he completed cutting approximately half of the pipe, a big explosion occurred at 13:25 with the effect of sparkles that spiral motor emitted, and one of the able seaman died because a leaping up hard object hit his head with the effect of explosion and one crew became ill from his ear. After the explosion a big rupture on the side wall and very large tears on the bulkheads of the cargo tanks occurred.

As soon as after the explosion, the ship started to heel towards port side, following this, after discharging the ballast inside port upper side tanks by the master and the chief officer, this time the ship sharply heeled to starboard side. The master gave the abandon ship order upon heeling of the ship approximately between 30-35 degrees, thereupon the crew abandoned the ship by embarking to agent boat which approached the ship. Later on the master embarked the ship with the help of agent boat and took the deceased able seaman's body and transferred it to the Coast Guard Boat, and Coast Guard Boat delivered to ambulance which was ashore and they transferred the corpse to the hospital. Within this few hours, taking into account that the ship kept its' state as heeled to 30-35 degrees to starboard and not heeled more to starboard, in line with the Harbour Master's initiative, a voluntary team consisting of the master, chief officer, chief engineer and oiler, again embarked the ship with the help of a service boat of the company and succeeded in righting the ship near stable position by the ballast operation they carried out and they berthed the ship to shipyard with the help of a tug under the supervision of the pilot.

1.4 Pre Survey – Non-scheduled Survey – Port State Control

On 28th of August 2013, pre survey inspection was carried out at Samsun Port. On the inspection report that was prepared after the result of pre survey, it was stated that markings were missing on deck and the engine room and there were excessive corrosions on the structure of the ship in general. On the following inspection, it was stated that the missing markings were completed with the works carried out until the departure of the ship and the master was informed regarding the excessive corrosion and it was allowed for the ships' departure. Again on the inspection report prepared as a result of pre survey which

was carried out at Bandirma/Balikesir on 24th of December 2013, code number 18 was written on the report stating that problems with regard to excessive corrosion was still continuing and it was required to rectify the deficiency within 3 months, additionally it was stated that there were holes on the ventilation of the tweendeck.

1.5 Acrylonitrile Monomer (ACN Monomer)

Acrylonitrile Monomer (ACN Monomer) cargo, which was carried in the last 3 voyages of the ship, is one of the commercial names used for alternative of Acrylonitrile. It is called more than 10 names similar to this. Acrylonitrile is located in IMDG Code with 1093 UN number. Acrylonitrile is placed at class 3 on the main table where dangerous goods are classified and where the flammable liquids take place and with regard to secondary risk it is one of the poisonous substances taking place in the class of 6.1. It is a colorless liquid and has a strong and sharp odor. Its' flash point is 0°C at the outdoor and - 5°C in the closed vessel and explosion limits are 3% and 17% in volume, liquid specific gravity is 0,8075 (20°C), gas specific gravity is 1,8. In different sources it was stated that the gas that ACN emitted was heavier than the air, it could reach to distant locations and it could explode even from very distant locations with the smallest sparkle or flame.

1.6 Cofferdam Where the No.2 Starboard Side Tank Pumps and Lines Located and Gas Accumulation

It was observed at the inspection of cofferdam where the No.2 starboard side tank pumps and lines located that cargo pipe line which was coming from tweendeck was closed but tubulure which was going inside the tank was left open. Additionally, it is observed that there is a 30 cm gap in the section where the structure consisting subject lines passing inside from and other lines are placed normally required to be bond with a bolt in order to ensure tightness. It could not be decided definitely whether this gap was formed during the explosion or it was like that previously. During the inspection carried out after the explosion, it could not be observed that there was a physical change in these lines and this strengthens the possibility that this gap was present before the explosion.

It was also observed that inside the cofferdam connections of hydrolic pipes of the pump coming from tweendeck and entering the subject cofferdam were cancelled with the thought of them being out of use. Taking into account that there were leakages at some

parts of cargo lines placed at tweendeck, it is considered that, air/gas transfer at these pipes between tweendeck and cofferdam was likely possible.

Additionally it was stated by some of the deck crew that, there were cargo transfers from the center tanks to the side tanks that were not filled with cargo. However, evidences for justifying this situation could not be reached because of the reasons such as tears on the tank bulkhead as a result of explosion etc.



Figure 3: Cofferdam of No.2 Starboard Side Tank

In the light of the observations mentioned above, it is thought that the subject cofferdam and the tank below became as integral, therefore gas transfer was ensured easily and contacting of the sparkle formed by cutting the air duct with the possible accumulated gas inside the tank resulted in the explosion.

1.7 Washing and Gas Free Operation of Tanks

In the interview with the lower level deck personnel, it was stated that, they carried ACN and similar dangerous cargoes before, while carrying out tank washing operation after the discharge of cargo; firstly each of the tanks was washed with sea water in 3 phases at least approximately for 1 hour, then it was ventilated approximately for at least 3 hours with portable fan, again cargo pipe lines were flushed with fresh water, subsequently liquid cargo which remained at the bottom that the pump could not suck was ejected with

portable pump. Afterwards, it was stated that drying operation was carried out with fabrics inside the tank.

Deck personnel stated that, before the accident firstly a washing operation was carried out for 6 hours for a total of 7 tanks, during the night only the tanks that were loaded with cargo were ventilated (natural ventilation was carried out, ventilation with portable fan was not done), on the following day morning firstly eject operation was carried out inside No.1 center tank, while eject operation was being carried out inside No.2 center starboard tank the operation was cancelled by the chief mate, thereby, the ship was not gas freed completely.



Figure 4: Entrance Manhole of the No.2 Starboard Side Tank Cofferdam

The chief mate stated that; washing was carried out firstly inside the tanks that were filled with cargo with the aim of gas free, natural ventilation was done after the discharge of cargo by opening all the tank's manhole and washing covers, meanwhile forced ventilation was continued with mobile fan, explosive gas measurement was performed inside all tanks that were filled with cargo in the morning that explosion happened but there was no explosive gas, but admitted that gas measurement was not carried out inside the tanks that were not filled with cargo and the ship was not gas free fully before the explosion, and gas measurement log book, which could be regarded as an evidence for the gas free operations,

was not recorded since he joined the ship. Therefore an inspection could not be carried out on the gas measurement log book by the safety investigation team.

On the other hand the master stated that, he ordered the chief mate to start gas free operation after the discharge of cargo, in this direction, operations such as washing and ventilation of tanks were continued under the supervision of the chief mate and gas measurement was carried out in the morning hours of the explosion.

Additionally, it was also stated in the interview that, in the last three voyages the ship carried just ACN, for this reason tank washing or gas free operation was not carried out after the first two voyages.

1.8 Manhole and Tank Washing Covers

It was stated by the lower level deck crew that, side tanks and cofferdams' manhole and tank washing covers were closed excluding center cargo tanks before the explosion, and it was observed in the inspection onboard that, the bolt which was holding manhole cover of the No.1 center cargo tank was buckled but the manhole cover was in its' place, No.1 starboard, No.2 starboard and No.3 starboard cargo tank's manhole covers were not in their place, No.2 starboard cargo tank's tank washing covers were not also in their place.

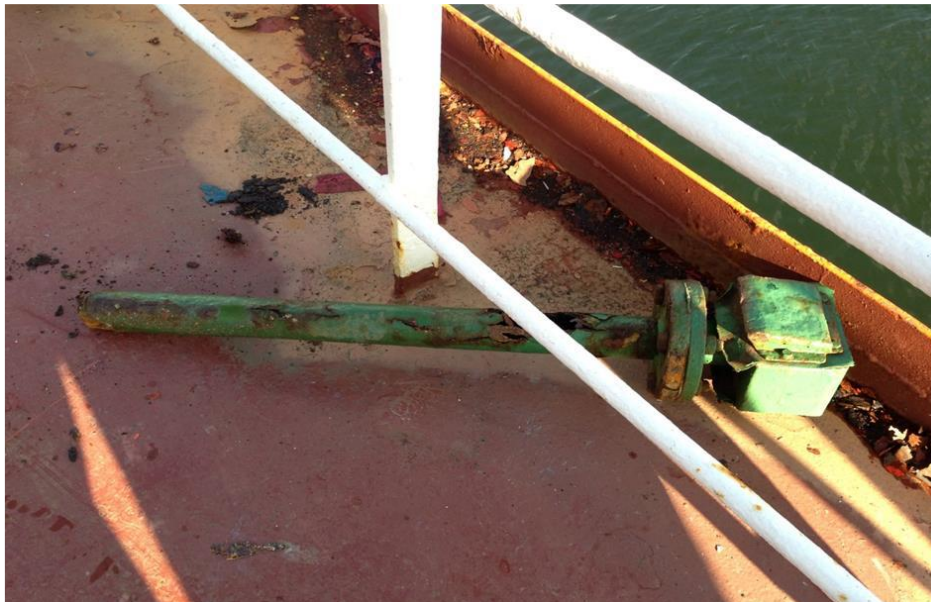


Figure 5: Air Duct of No.2 Starboard Side Tank Cofferdam

1.9 Marking

In the audit report, prepared as a result of pre survey that was carried out at Samsun in 2013 August, it was stated that markings were missing on deck and in the engine room, but it was also stated that this deficiency was rectified in the time period until the ship left the

port. In the interview that was done with low level deck crew after the accident, one of the crew stated that he had not known that the air duct pipe they were cutting with the spiral motor was belonging to cofferdam where No.2 starboard side tank pump lines were located and he added that he learned this issue after the accident. Within this context, during the general inspection onboard it was detected that mostly markings were inadequate and there was no marking on the air duct and neighbouring manhole where the explosion happened.

1.10 Carrying Out Hot Work

As it was mentioned in ISGOTT (International Safety Guide for Oil Tankers and Terminals) and ISM⁴ Manual of the ship; it was required to conduct a meeting tackling the planned work and safety precautions carefully prior to start of hot work under the presidency of the master of the ship and it must be ensured that all the personnel who have responsibility regarding the work attend this meeting. Dutied personnel must be informed regarding their own roles during and preparations of the operation at the meeting and a plan must be agreed upon as a result of the meeting. Additionally, it is stated in ISM Manual that hot work permission form had to be filled prior to start of hot work.

Within the safety measures context mentioned above, during the interview carried out with the lower level deck crew it was stated that; no meeting was conducted regarding the hot work before the accident, the personnel were not informed regarding their own roles, hot work permission form was not filled and they were instructed to carry out hot work with spiral motor on the deck several times without taking any safety measure even the ship was carrying dangerous cargo before the days accident happened onboard the ship. On the other hand, any evidence showing that a safety meeting was carried out and hot work permission form issued by the master or the chief mate before the accident could not be presented to the safety investigation team.

Additionally, again it is stated in ISM Manual that; it is required to control continuously and observing that explosive gas amount is not more than 1% in the space that hot work will be carried out and neighbouring other enclosed spaces and in order to supply this condition to ventilate by cleaning prior to start hot work and connection lines to be purged from explosive gas. It is stated that, it is required that the content of the hydrocarbon vapor to be decreased to 1% and at least a diameter of 30 metres including cargo and slop tanks surrounding the work area to be cleaned if the hot work will be carried out on the open

⁴ ISM: *International Safety Management System*

deck. It was stated by the lower level deck personnel that gas measurement were not carried out in the tanks that cargo loaded and in the neighbouring tanks that cargo was not loaded before the accident.

Chief mate stated that; on the day that accident happened, after lunch firstly he would make gas measurement inside the tanks, he ordered the deck personnel that he would show the air duct that would be cut by himself and afterwards the cutting operation would start, but the deck personnel who would carry out hot work started the cutting operation in accordance with their own initiative at out of business hours (12:00-13:00) and without any responsible mate accompanying them.



Figure 6: Damage of No.2 Starboard Side Tank

1.11 Key Crew and Fatigue

The master is 41 years old and holds a certificate of competency as oceangoing master and has been a master since 2011. He has worked for 6 years onboard chemical tanker intermittently before the accident and he has been the master of TIBIL for 4 months. It was stated by himself and also by the deck crew that the master and deck crew experienced various problems between them.

Chief mate is 31 years old and holds a certificate of competency as oceangoing chief mate. He has been the chief mate for 4,5 months onboard the mentioned ship. He has 5 years sea life experience and he worked for long periods onboard this ship previously.

The boatswain is 42 years old, he has 21 years sea life experience and 3 years chemical tanker experience. He has been working as a boatswain for 14 years and has been working onboard the mentioned ship for 8 months.

The deceased personnel was 35 years old, had a certificate as able seaman and had 8 years of sea life experience. He had been working onboard the mentioned ship for 4 months.

There were no finding that the crew was fatigued on the day that accident happened.

1.12 By-law on Ports

Within the By-law on Ports which was published on the Official Gazzette of 31st of October 2012 and numbered as 28453, berthing permission was defined as: “The permission certificate defining berthing and anchoring area, issued by the harbor master with the aim of accepting the ships and sea crafts to shore facilities and anchoring areas.” It is stipulated with the article 10 of the same by-law that; “Turkish and foreign flagged vessels and sea crafts approaching the port area shall not carry out berthing, mooring or anchoring without receiving berthing permission.” In accordance with this provision, ships’ agency requested berthing permission in order to anchor to Tuzla Anchorage Area by consulting Harbor Master of Tuzla on 18th of April 2014, and Harbor Master of Tuzla gave the anchoring permission to the agency on the same day. Agency did not refer to any maintenance-repair issue in their berthing permission request and did not make any declaration within this context.

It is stipulated in article 22-9 of the mentioned By-law that: “Ships and sea crafts, which are present at the port region, shall not carry out repair, blasting and painting, welding and other hot work, launching lifeboat and/or boat to the sea or other maintenance works unless getting the permission from the harbor master. If the ships and sea crafts that will make these works done, are inside a shore facility, they have to ensure coordination with the shore facility management.”

In article 33 of the By-law on Ports it is stipulated that “Ships and sea crafts, which will carry out gas free operations with the aim of maintenance or repair with hot or cold operation, shall comply with the provisions of By-law on the Gas Freeing of Ships and Sea Crafts in Construction, Modification, Maintenance, Repair and Scrapping Operations, which was published in the Official Gazette on 21st of December 2004 and numbered as 25677. “ In the interview with the Harbor Master of Tuzla, it was stated that from the

tankers that would carry out hot work at the Tuzla Anchorage Area it was required to submit firstly a time schedule covering the details and time period of the works that would be carried out and in the attachment of the time schedule, a certificate of permission for gas freeing and hot work, issued by an authorized expert from the Administration in accordance with the provisions of the By-law on the Gas Freeing of Ships and Sea Crafts in Construction, Modification, Maintenance, Repair and Scrapping Operations to the Harbor Masters. It was also stated that the plan that was presented to be assessed by the Harbour Master and decided whether to give permission or not. It was identified that the authorities of the ship did not request a permission towards this direction before the accident.

1.13 Search and Rescue Operation

2 tugs and 1 boat of Directorate General of Coastal Safety, 2 boats of Coast Guard Command, 1 tug of a company carrying out pilotage and tug services within the region of responsibility of Harbour Master of Tuzla and a special passenger boat either took part in the search and rescue operation or was present at the accident scene after the explosion. Casualty personnel abandoned the ship by embarking the agent boat, which was berthing the ship, in accordance with the master's order after the explosion, afterwards they embarked the Coast Guard Boat. Moreover, the operation of righting the ship to stable position from the position of heeled to starboard side and towing to shipyard via tugs was started and continued by the volunteer crew in accordance with the initiative of the Harbour Master.

1.14 Safety Management System (SMS) Practices

1.14.1 Safety Management Certificate (SMC), Document of Compliance (DOC) and Internal Audit

Safety Management Certificate (SMC) for the ship was issued by Turkish Lloyd on 10th of January 2012 and Document of Compliance (DOC) for the company was issued again by Turkish Lloyd on 17th of May 2013.

On 3rd of August 2013, an internal audit was carried out onboard in order to inspect the competency of "Quality and Safety System". 3 non conformities were found as a result of the audit.

1.14.2 Repair Procedure

In the ISM Manual of the ship under the repair procedure's "Responsibility" title, it is stipulated that "Master shall decide whether the operations are carried out in a safe manner and to the level of required safety measures" and this provision gives the responsibility in

the repair operations onboard to the masters. Again in the same section it is stated that: “Chief mate must personally be sure that measurements carried out with explosimeter and oxygen meter is in compliance with the safety rules.”

Under the section titled hot work it is stated that; hot work covers combustion, works including boiling and drilling operations, electrical works and works consisting regarded as not very safe and using the electrical equipments that can produce spark, and it is required that permission form of hot work must be filled prior to starting work and hot work might be transferred outside the main engine place only in the case that there are no other suitable repair method.

Under the section titled consideration of hot work it is stated that; “Master shall decide the appropriateness and safeness for hot work and the level of measures required. The operations must not be started inside the main engine room and at the places outside the areas that were indicated by the welder unless the master informs the shore office of the ship manager regarding the details of the work and the procedure that was discussed and decided. A meeting where planned work and safety measures are considered carefully must be conducted before the start of hot work under the presidency of the master. At least everyone who has a responsibility with regard to work must attend the meeting. With regard to work, an agreement on a plan must be sustained and necessary safety precautions must be taken. Plan must give authorization to one worker on the side of audit of the work and to another worker on the side of safety measures comprising the communication between all participating groups clearly and fully. On the preparation of hot work operation and also during operation, all the personnel must be informed and trained with regard to their roles. All the personnel must know openly who is responsible from the audit and who is responsible from the safety measures. Hot work permission in written form must be issued for all the planned works.”

The section, which the hot-work will be performed, should be cleaned and ventilated until the atmospheric test shows 21% oxygen by volume and the amount of explosive gas is not more than 1%. The ventilation should continue during hot-work. Adjacent cargo tanks, including cross-settled cargo tanks, should either be cleaned or gas evacuated or cleaned in accordance with the hot-work standard and the content of the hydrocarbon steam should be reduced or deactivated in such a way that the amount of explosive gas is not more than 1%, or completely filled with water. In non-gas free tanks, hydrocarbon steam should be

reduced to less than 2% and be made inert and secured. It should be ensured that the adjacent ballast tanks and cargo tanks are free of gas free and suitable for hot work. If there is pollution due to hydrocarbon liquid or steam, the cause of contamination should be determined and the tanks should be cleaned and made gas free. Substances which can subtract sludge, residue or any other flammable material should be kept at least 10 meters away from the area where hot-work is performed. The remaining areas on the other side of the hot working area should be fully cleaned. If the hot-work is to be performed on the open deck, the cargo and slop tanks should be cleaned at least 30 meters around the working area and the content of the hydrocarbon steam should be reduced to 1% and gotten inert. In other cargo areas, open spaces should be closed and gotten inert. It should be controlled that there is no gas in the sections other than adjacent ballast tanks and cargo tanks and that are suitable for hot-work. If there is contamination due to hydrocarbon liquid or steam, it should be cleaned and the gas should be emptied.



Figure 7: Location Where the Explosion Occurred onboard

The controls of officer in charge of safety take place this statement : “Officer in charge of safety measures should inspect the location where the hot-work will be performed and ensure that the oxygen is 21% and the rate of explosives is not more than 1%. The working area should be adequately and continuously ventilated. The atmosphere should be frequently controlled for explosive and flammable gas. After the work is paused and while re-starting to the work, the atmosphere should be re-controlled, that the side-tanks and the connection circuits has been free of explosive gas should be continuously controlled”, if these controls include in the titled section.

SECTION 2 - ANALYSIS

2.1 Discipline of Tank Washing and Gas Free Operation

Tank washing and gas free operation is defined as washing of cargo tanks in a tanker and collecting&seperating the remainings and explosive/poisonous gases of the cargo inside the tank. Generally gas free operation is carried out when it is needed to enter into cargo tanks by any reason or with the aim of carrying out hot work. In order to regard a medium as gas free, it is required that flammable or explosive gas concentration lower explosion limit must be decreased under 1% and oxygen concentration must be over 20,8% inside the atmosphere. Generally the chief mate is responsible for the management of gas free operations onboard ships.

During the gas free operation; removing of the poisonous, flammable or explosive gases from the tank atmosphere shall only be carried out from the approved exits of the tanks and be done with a proper speed. Throughout the operation continuous measurements shall be done from the tank atmosphere via portable gas measurement equipments, log book shall be recorded with regard to these measurements, measurement shall be done via gas meters and dedector tubes at the end of operation. It must not be forgotten that, cargo vapours tend to stay on deck as it is heavier than the air and flammable or poisonous mixtures may not scatter and stay at a close distance where they were transported at wind conditions below 5 knots. Within this context, gas measurement must definitely be carried out inside all tanks and enclosed spaces neighbouring the cargo tanks that are filled with cargo. In case any explosive gas is detected, gas free operation must be carried out in these compartments. Gas free operation must be carried out with an utmost care within the framework of ISGOTT standards and taking into account the properties of the cargo inside the enclosed space where the gas free operation will take place.

Deck crew stated that; before the accident, approximately 6 hours of washing was carried out for a total of 7 tanks, during the night natural ventilation was done only inside the tanks that were loaded with cargo, portable fan, which is indispensable of gas freeing operation was not ever used in this operation, on the day that explosion happened; firstly eject operation was carried out inside No.1 center tank in the morning, while eject operation was being done inside No.2 center starboard tank, operation was finished by the chief mate,

flammable or explosive gas measurement was not done in any moment of the operation, accordingly, the ship was not fully gas freed.

However, the chief mate stated that; washing was carried out in all tanks that were filled with cargo, tanks were ventilated not only with natural ventilation but also with portable fan, explosive gas measurement was done inside all tanks that were filled with cargo in the morning that explosion happened and explosive gas was not witnessed inside the tanks, **but, he admitted that; gas measurement was not carried out inside the tanks that were not filled with cargo and gas freeing operation was lacked, accordingly the ship was not gas free fully before the explosion. Besides, he stated that gas measurement log book, which shall be recorded in gas free operations, was not recorded since he joined the ship,** accordingly he could not present the oxygen and explosive gas measurement values inside the tanks that cargo was filled and that he declared as he measured before the accident, to the safety investigation team.

It was stated by the lower level deck crew that, side tanks and cofferdams' manhole and tank washing holes covers were closed excluding center cargo tanks before the explosion, and it was observed in the inspection after the explosion that, the bolt which was holding manhole cover of the No.1 center cargo tank was buckled but the manhole cover was in its' place, No.1 starboard, No.2 starboard and No.3 starboard cargo tank's manhole covers were not in their place, No.2 starboard cargo tank's tank washing holes covers were not also in their place. It was considered that, the pressure generated by the explosion removed the manhole covers of No.1 starboard, No.2 starboard and No.3 starboard cargo tanks, which were closed and had the least strength inside the tank and threw them away. On the other hand, it is considered that as the manhole cover of No.1 center cargo tank was open before the explosion, the pressure effect of the explosion decreased to minimum due to the open cover and consequently only the bolt of it buckled. **In the light of the facts mentioned above, it is considered that before the accident with the aim of gas free, enough ventilation was not carried out onboard the ship.**

In general, it is required that hot work that will be carried out on a tanker, must not be started unless the procedures mentioned in ISGOTT are met. Possibly one of the most important procedure of these is the ship to be gas freed properly. It is considered that, it is an incorrect order from the beginning that the chief mate ordered the personnel to carry the

equipments to the deck for the hot work although he admitted that gas measurement was not carried out inside the tanks that were not filled with cargo and gas freeing operation was lacked thereby, the ship was not gas freed completely before the explosion. It is considered that planning a hot work on a ship which is not fully gas free, means asking for an accident.

As stated in section 1.6, the cofferdam where the explosion happened became integral with the bottom neighbouring tank and the situation became as the gas transfer could easily be provided between these compartments. However, it is considered that as the master and the chief mate were not so familiar with the ship, they were not aware of this situation. It is considered that, the chief mate should have thought the possibility that the gas that ACN emitted could leak to all neighbouring tank and compartments which were not filled with cargo by passing from all the possible holes and cracks and maybe accumulate there, therefore he should have provided that gas freeing operation was carried out in all neighbouring tanks and compartments in accordance with the procedure mentioned in ISGOTT and ISM Manual and he should have done the oxygen and explosive gas measurements but he acted as imprudent and caused the possibility for the accident. Additionally it is considered that, as it is understood from the statements of the crew that chief mate and deck crew were affected from some of the attitude and behaviours of the master and this situation might likely caused the chief mate to apply the rules regarding safety hesitantly.

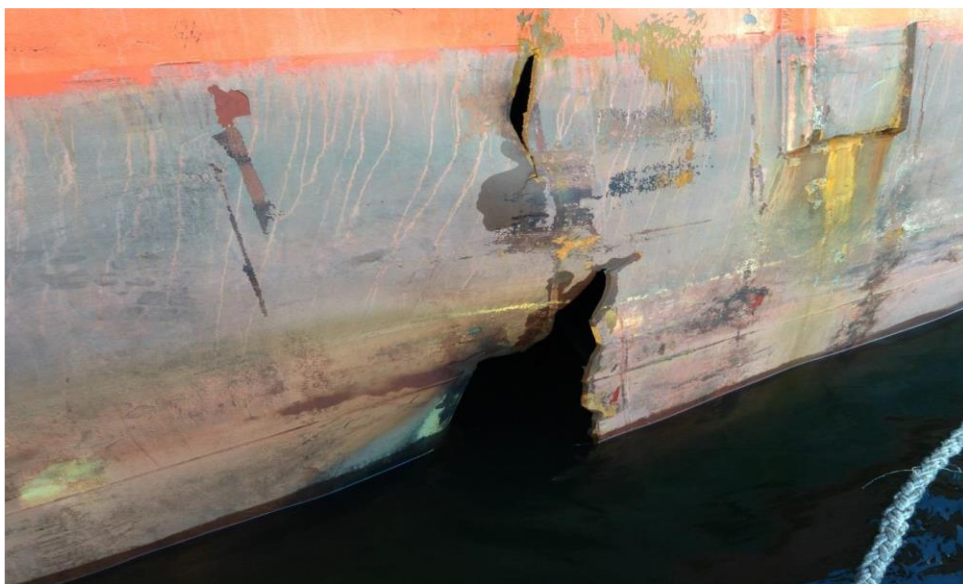


Figure 8: Fracture Which Was Formed on the Starboard Side Wall After the Explosion

2.2 Hot Work Discipline

Within the context of considerations made on the days before the accident by the master and company authorities, it was decided to cut the sections that had holes on the cargo lines on the tweendeck and various structural members on the deck and to change them with the new ones and accordingly after the discharge of cargo the ship navigated to Tuzla and was anchored. In this direction, it is required that official procedures are met before the maintenance&repair and to make the ship ready for maintenance&repair. The most basic preparation that will be done is to make the chemical dangerous good carrying ship a suitable environment for the hot work, in other words to be gas freed. With this, it was already mentioned in Section 1.7 that a gas freeing operation was not carried out onboard within the context of repair procedure inside ISM Manual and ISGOTT standards.

Within the inspection carried out in the light of mentioned above; first steps were taken for the explosion by carrying out a hot work in a chemical tanker and after carrying a very dangerous chemical cargo such as ACN and disregarding the most basic safety rule regarding carrying out the hot work outside the engine room while there was no alternative repair possibility for an emergency operation or regarding the safety of the ship.

Chief mate stated that gas measurement was not carried out inside the enclosed spaces that were neighbour to section that the hot work would be done before the explosion, and any documentation stating the making a safety meeting and issuing a hot work permission certificate before the explosion could not be presented to the safety investigation team. Within this context, it is considered that generally rules regarding safety in ISGOTT and ISM Manual are not met.

Additionally, in accordance with the statement of “Master shall decide the appropriateness and safeness for hot work and the level of measures required.” that was stated in ISM Manual, the responsibility of the hot work onboard was given to the masters. Accordingly, as the duty for inspecting in every moment of whether the measures taken regarding safety for gas free operation and hot work are applied is upon master, it is considered that he could not hand over this responsibility to another one.

Although in accordance with the statement “Hot work outside the main engine room can only be permitted provided that related national or international regulations and/or port/terminal provisions are complied with...” that is under hot work heading inside the

ISM Manual onboard and related provisions of the By-law on Ports, prior to starting hot work ship authorities had to inform the Harbour Master of Tuzla and request for permission, but there was no request for permission. Besides, it was detected that permission certificate for gas free and hot work, necessary prior to hot work in accordance with the provisions of By-law on Gas Freeing in Construction, Retrofit, Maintenance Repair and Scrapping Operations of Ships and Sea Crafts were not taken. Within this context, it is considered that it seems not so possible that ship and company authorities complied with the duty and operations regarding the safety required while hot work within the framework of ISGOTT and ISM Manual procedures as they already did not comply with the official procedures for hot work.

2.3 Safety Management System (SMS) Practices

Under the upper heading of hot work, in “General” sub heading section inside ISM Manual of the ship, it is stipulated that “prior to starting a duty requiring a permission for hot work, permission must be received from the company orally or in written form.”. While requesting definitely a **written** form of permission from the company before all the works requiring hot work in accordance with the international standards, forms the opportunity for mutual inspection, it must absolutely be refrained from the oral permission.

Inside ISM Manual there was an assessment procedure for the personnel but an assessment procedure for the master and the chief engineer could not be detected. Evaluation of these managerial positioned people is more important and required from all other personnel. As the situation is like that, it attracts attention that it is an important deficiency that the way how these mentioned personnel will be evaluated is not placed inside ISM Manual.

Internal audit was carried on 3rd of August 2013 onboard the ship. Nonconformities detected as a result of audit were with regard to cleanliness and repair and maintenance issues. This situation made an impression of an audit was not carried out within the context of deck operations comprising hot work, gas freeing etc., in brief the core was not touched upon. Within this context, it is considered that carrying out internal audits helping the following of whether the safety management system is applied or not from time to time within the context of capabilities while navigation and adding operations such as hot work and gas free to the context of internal audit will increase the contribution gained by applying the system.

2.4 Possible Effects of Acrylonitrile Monomer in the Explosion

As it is stated in paragraph 1.5, the flashpoint of ACN is 0°C at the outdoors, 1°C in the closed vessel, explosion limits are 3% - 17% and gas specific gravity is 1,8. It is stated that the gas that ACN emitted is heavier than the air, it can transfer to far distances and it can explode from far distances even with a smallest sparkle or flame.

It was observed that there were deformations, ruptures and bulgings in various sizes in No.2 center port and starboard cargo tanks, No.3 center cargo tank and No.2&No.3 side cargo tanks' bulkheads onboard. Although it was stated by lower level deck personnel that there were leakages from center tanks to side tanks, during the inspection carried out onboard mentioned situation could not be detected because of the damage occurred inside the tanks. Taking into account the effect of the explosion, it comes to mind that, the explosive gas that ACN emitted was not only present in No.2 starboard side tank and had the possibility of being leaked to another damaged tanks and thus damaged other tanks by increased effect. This situation justifies the determination of the possibility of the gas that ACN emitted can transfer to far distances by leaking.

SECTION 3 - CONCLUSIONS

3.1 It is considered that the mentioned cofferdam and the tank below became as integral thereby, transfer of the gas was obtained easily and it is thought that the sparkle that was formed while the air duct was being cut resulted in the explosion by contacting the possible accumulated gas inside the tank.

3.2 It was detected that the ship did not request permission for hot work by consulting the Harbour Master of Tuzla, accordingly, it did not present the permission certificate for gas free and hot work in accordance with the provisions of By-law on Gas Freeing in Construction, Retrofit, Maintenance Repair and Scrapping Operations of Ships and Sea Crafts to the Harbour Master.

3.3 It was admitted by the chief mate that gas measurement was not carried out inside the tanks that were not filled with cargo and gas freeing operation lacked, accordingly the ship was not fully gas free before the explosion.

3.4 It was assessed that, working conditions required for hot work mentioned in ISGOTT and ISM Manual were not prepared fully, most of the safety measures were not applied, safety meeting were not carried out, permission certificate for hot work were not issued and the work was started without defining the duties and responsibilities of the personnel that would take duty in the hot work.

3.5 It is considered that enough ventilation was not carried out onboard the ship with the intent of gas free before the accident.

3.6 It is considered that the master was not so familiar with the ship and that's why ignored the possibility of gas transfer to cofferdam, besides, the chief mate and the deck crew were affected by various attitude and behaviours of the master, and this situation possibly led to hesitation of the chief mate to apply the rules with regard to safety.

3.7 It was detected that gas measurement record book, which is required to be logged during gas free operations, was not logged since the chief mate joined the ship until the day the accident happened.

3.8 During the general inspection carried out onboard the ship, it was observed that markings were inadequate, there was no marking on the air duct that explosion happened and on the neighbouring manhole, deck crew had no knowledge regarding the deck structure that they were carrying out cutting operation before the accident.

SECTION 4 - RECOMMENDATIONS

BEYKIM SHIPPING is recommended to:

4.1 Provide training to the personnel working at the company and onboard the ships under its' management towards increasing safety culture,

4.2 Carry out internal audits onboard the ships under its' management from time to time within the capabilities also during navigation and add operations such as hot work and gas free to the context of internal audit,

4.3 Ensure that onboard the ships under its' management, a written permission to be provided from the company before the "hot work" and revise ISM Manual accordingly,

4.4 Carry out inspection and follow-up towards logging the required records inside the log book of explosive gas measurement of enclosed spaces onboard the ships under its' management,

4.5 Establish and apply an ISM procedure towards assessment of masters, chief engineers and officers prior to accepting for the job, during onboard and after leaving the ship,

DIRECTORATE GENERAL FOR REGULATION OF MARITIME AND INLAND WATERS is recommended to,

4.6 Make implementation audits towards ISM more effective.