Report of the investigation into
the accident resulting in one fatality on board the chemical tanker

STOLT SKUA

in the North Sea on 15 April 2012.

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NOTE

The fundamental purpose of investigating an accident under the Cayman Islands Merchant Shipping Law, as amended, is to determine its circumstances and the cause with the aim of improving the safety of life at sea and the avoidance of accidents in the future. It is not the purpose to apportion liability, nor to apportion blame.

This Report is not written with liability in mind and is not intended to be used in court for the purpose of litigation. It endeavours to identify and analyse the relevant safety issues pertaining to the specific accident, and to make recommendations aimed at preventing similar accidents in future.

January 2014.

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GLOSSARY OF ABBREVIATIONS AND ACRONYMS

10S	Designation of one of the cargo tanks on board STOLT SKUA ("cargo tank number ten starboard")
AB	Able Bodied Seafarer, a seafaring rank above that of "Ordinary Seafarer" or "OS"
CCR	Cargo Control Room
CPR	Cardio Pulmonary Resuscitation
EEBD	Emergency Escape Breathing Device. A small portable device intended to provide the user with a supply of fresh air independent of the surrounding atmosphere. EEBDs are designed primarily to aid the user in escaping from a compartment where the atmosphere has become un-breathable.
GCS	Glasgow Coma Scale. An assessment of the level of consciousness in a patient.
ICS	International Chamber of Shipping
ISM Code	The International Management Code for the Safe Operation of Ships and for Pollution Prevention.
LEL	"Lower Explosive Limit". The lowest concentration (percentage) of a gas or vapour in air capable of combustion in the presence of an ignition source.
LT	Local Time (i.e. "Ship's Time" or UTC +2 hrs)
MAIB	The "Marine Accident Investigation Branch", an Executive Agency of the UK Department for Transport.
MARPOL	The International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto.
Nm	Nautical Mile or 1,852m
OCIMF	Oil Companies International Marine Forum
OS	Ordinary Seafarer, a seafaring rank below that of "Able Bodied Seafarer" or "AB".
ppm	Concentration of a substance expressed in "parts per million".
Pumpman	A senior member of the deck crew with duties related to cargo care and cargo operations.

PYGAS	“Pyrolysis Gasoline” – A benzene rich liquid organic chemical with a high aromatic content used as an additive to gasoline or as a feedstock for the production of benzene. PYGAS is both toxic and flammable.
RAF	Royal Air Force (United Kingdom)
SSM	Ship Safety Manual. Part of the documented safety management system required by the ISM Code.
STCW	The International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1995.
TLV/TWA	“Threshold Limit Value / Time Weighted Average”. The level of exposure to a chemical agent to which it is believed a worker can be safely exposed to during a 40 hour working week.
UTC	Coordinated Universal Time
VHF	Very High Frequency
Wilden Pump	A portable pump driven by compressed air. Typically the pump used to remove any remaining tank washings prior to the tank being mopped and dried.

SYNOPSIS

On the morning of 15 April 2012, the chemical tanker STOLT SKUA was on passage from Rotterdam to Antwerp. The ship had finished discharging a cargo of PYGAS in Rotterdam and was completing tank washing and preparation operations prior to loading a new cargo in Antwerp. During the tank cleaning operations one of the Ordinary Seafarers (OS) was discovered inside one of the tanks being prepared for cargo. When discovered, the on board emergency team quickly arrived on the scene and affected a tank rescue. When recovered from the tank, the OS was unresponsive and arrangements were made for him to be evacuated from the ship.

The OS was evacuated by helicopter to the James Paget Hospital in Great Yarmouth. The OS did not regain consciousness and was pronounced dead at 09:20 hours on 15 April 2012 on arrival at the James Paget Hospital. The cause of death was recorded as “Asphyxia in association with inhalation of benzene fumes”.

The investigation found that the direct cause of the accident was the OS making an unauthorised entry into the cargo tank when a toxic and oxygen deficient atmosphere was present. Contributing to the accident was a failure to follow the company’s procedures for tank cleaning.

Fatalities in tanks and other enclosed spaces continue to occur at an alarmingly high rate in the maritime industry. The United Kingdom MAIB issued a Safety Bulletin in July 2008 which made recommendations to regulators, ship managers and other industry bodies aimed at improving the identification of potentially dangerous enclosed spaces and the identification of measures to reduce this unnecessary loss of life. No further recommendations have been made in this report.

Figure 1: STOLT SKUA (© Hannes van Rijn)

SECTION 1 – FACTUAL INFORMATION

1. Particulars of STOLT SKUA

Vessel Details:

Ship Manager	:	Stolt Tankers BV
Port of Registry	:	George Town
Flag	:	Cayman Islands
Ship Type	:	Oil Tanker / Chemical Tanker
Year Built	:	1998
Year of Delivery	:	1999
Classification Society	:	Det Norske Veritas
Length	:	105.31 m
Gross Tonnage	:	5,342

Accident Details:

Date and Time	:	06:58 UTC on 15 April 2012
Location (ship)	:	52º 24.0' North, 002º 14.7' East (In International Waters approximately 17 Nm offshore of the UK Coast)
Location (on board)	:	Cargo Tank 10 Starboard
Fatalities / Injuries	:	One crew fatality
Damage	:	Ship – None, Environment – None

2. Narrative

(all times are UTC or LT as specified)

2.1. Prior to the Accident

Following the discharge of a cargo of PYGAS in Moerdijk, Netherlands, STOLT SKUA conducted a mandatory "pre-wash" of the cargo tanks and discharged the tank washing to reception facilities ashore at Weleplaathaven in Rotterdam. Due to the toxic and flammable nature of PYGAS, each tank had been "inerted[1]" so that the oxygen content in each tank was below 2%.

STOLT SKUA departed Rotterdam at 21:30LT on 14 April 2012 bound for Antwerp in Belgium. When the ship was over 12Nm from the nearest coast preparations began for the washing of cargo tanks in accordance with the requirements of the MARPOL Convention. At 01:15 LT on 15 April 2012, the Chief Officer conducted a pre tank cleaning meeting in the Cargo Control Room (CCR). Present at this meeting were the Chief Officer, the Pumpman, the Bosun, one AB and the Deck Trainee.

During the meeting the tank cleaning plan and procedures were discussed along with the necessary safety measures and precautions. All present at the meeting signed the tank cleaning plan and work commenced. The tank cleaning plan required that each tank be:

Seawater washed for 1.5 hours;

Fresh water rinsed for 10 minutes;

Ventilated to provide a safe atmosphere inside the tank;

Any water remaining in the tank ejected; and finally

The internal surfaces of the tank mopped and dried.

At 01:30LT, seawater washing of the tanks commenced and the Chief Officer went to the Navigation Bridge to relieve an AB who was acting as watchman. After the AB had been briefed by the Chief Officer, the AB joined the deck crew to assist with the tank cleaning operations.

At 06:00LT, the second deck team reported for duty to continue with the tank washing operations. This team consisted of an AB and the OS who was shortly to lose his life. The second team were also briefed on the tank cleaning operations by the Chief Officer and both members of the team signed the tank washing plan.

[1] The atmosphere inside each tank was inerted by purging with nitrogen to reduce the oxygen content below that required to support combustion and to displace any toxic vapours that may be present due to residues of the cargo.

As it would soon be time vent the first of the cargo tanks, the Chief Officer issued two filter masks to the Pumpman for use by the crew when venting the tanks. The Chief Officer then retired to his cabin with the intention of resting until noon when he would be required to confirm that the atmosphere inside the tanks was safe to allow crewmembers to enter the tank to complete the tank cleaning process.

At 07:30LT, while the tanks were still being seawater washed, the deck crew took breakfast and returned to their duties at 08:00LT and made preparations for ventilating the first of the tanks to complete sea and fresh water washing. While making preparations for tank ventilation, both the Pumpman and the AB on duty observed the OS removing a Wilden Pump from the deck store. This pump would be used to remove any remaining tank washings after the tanks had been ventilated and the atmosphere inside confirmed as safe to enter.

While walking from the cargo manifold towards the ship's accommodation, the Pumpman noticed that the main hatch for tank number 10S was open and the hoses for the Wilden Pump were leading into the tank. He also heard the Wilden Pump running inside the tank. As ventilation of this tank had not been completed, it was too early in the tank cleaning process for the Wilden Pump to be used to eject any remaining tank washings. The Pumpman went to investigate and discovered the OS laying apparently unconscious on the first platform inside the tank. When discovered, the OS was wearing one of the filter masks issued earlier in the day by the Chief Officer. The time was 08:58LT.

2.2. Response to the accident

Upon discovery of the unconscious OS inside the tank, the Pumpman immediately contacted the officer on watch on the Navigation Bridge to raise the alarm. All on board were alerted to the situation by the officer on watch activating the ship's General Alarm. After activating the ship's General Alarm the officer on watch made an announcement over the ship's public address system stating "*Emergency, Emergency. Man in tank 10 Starboard. Quickly, Quickly*".

At 09:02LT, the Chief Engineer and the 2nd Officer arrived at the hatch for tank 10S equipped with equipment provided to undertake tank rescues[2]. Both were wearing self-contained breathing apparatus. The Chief Engineer and 2nd Officer entered the tank and placed an EEBD on the OS. An EEBD was used to provide breathing air to the OS as the rescue resuscitator had not yet arrived at the rescue scene. The OS was then removed from the tank using the harness and winch. Once on deck in fresh air, the crew commenced administering CPR to the unconscious OS. The time taken from tank entry to the OS being recovered to fresh air is estimated to be no more than 5 minutes.

[2] The tank rescue equipment provided on board consisted of a harness and hand winch to lift casualties for inside a tank, a rescue resuscitator to provide breathing air to the person being rescued and self-contained breathing apparatus for tank entry.

At 09:09LT, the ship issued a MAYDAY call on VHF radio Channel 16 which was immediately answered by Yarmouth Coastguard. After appraising Yarmouth Coastguard of the situation on board, the master of STOLT SKUA requested an immediate helicopter evacuation of the casualty. A RAF Search and Rescue helicopter (Call sign "RESCUE 125") was despatched to STOLT SKUA with an ETA 07:55 UTC (09:55 LT).

While awaiting the arrival of "RESCUE 125", STOLT SKUA was in radio contact with a doctor ashore, via Yarmouth Coastguard. The OS's condition was described to the doctor as having no detectable pulse or breath and with a yellow / orange substance around his nose and mouth. It was confirmed that CPR was being administered and that the OS had been moved from the open deck to the ship's hospital. The doctor advised that CPR should continue to be administered and that the OS should be transferred to a shore hospital as soon as possible.

Helicopter "RESCUE 125" made initial radio contact with STOLT SKUA at 07:48 UTC. The OS was airlifted from STOLT SKUA at 07:59 UTC and flown to the James Paget Hospital in Great Yarmouth. During the flight to shore, the hospital requested a preliminary assessment of the condition of the OS. "RESCUE 125" reported that the OS was indicating "GCS 2[3]" and that other life signs were "not known at this time". On arrival at the James Paget Hospital, the OS was pronounced dead at 08:20 UTC on 15 April 2012.

3. Tank cleaning procedures and tank entry

Extensive written procedures control the process of tank cleaning and entry into enclosed spaces on board STOLT SKUA. These include a mandatory pre tank cleaning meeting for all involved, discussions of safety precautions and the use of the "permit to work" system before any entry into a tank or other enclosed space.

4. Use of filter masks

The use of filter masks was tightly controlled on all ships managed by Stolt Tankers BV. Section 7.3 of the company's SSM dealt with the use and control of filter masks on board all of their managed ships. The use of filter masks was required to be under the direct control of the chief officer and only persons authorised by him were permitted to use filter masks. As there is no way to determine when a filter cartridge has become saturated (and therefore ineffective at protecting the wearer from toxic vapours) they were only used once and then discarded. A new cartridge was used for each operation.

[3] Indicating a very low level of consciousness and response to stimuli.

The use of filter masks by crew working on deck on board ships carrying benzene is required by IMO Circular MSC/Circ.1095[4] whenever the airborne concentration is expected to exceed 10 ppm. The requirements in this circular for personal protective equipment for cargo operations on deck are given as follows[5]:

> *Whenever direct or representative measurements indicate that the exposure limits are exceeded during normal cargo handling operations, crew required to work in the affected area should wear appropriate respiratory equipment to be used in accordance with the manufacturers' instructions. Such equipment is indicated below, however the crewmember may select a higher level of protection:*
>
> *.1* ***Half face piece:*** *in areas where the airborne concentration of benzene vapours is expected to exceed 1 ppm but not more than 10 ppm;*
>
> *.2* ***Full face (filter) piece with cartridge:*** *in areas where the airborne concentration of benzene vapours is expected to exceed 10 ppm but not more than 50 ppm;*
>
> *.3* ***Air supplied respirators:*** *in areas where the airborne concentration of benzene vapours is expected to exceed 50 ppm, but not more than 100 ppm;*
>
> *.4* ***Pressure demand breathing apparatus and full protective clothing, resistant to chemical attack:*** *in areas where the airborne concentration of benzene is expected to be greater than 100 ppm; and*
>
> *.5* ***Personal protective equipment****: eye protection, impervious gloves and a protective apron should be readily available to crew members while sampling and gauging or when skin contact with the cargo is likely.*

Although the above circular allows the use of "half face masks" for expected concentrations up to 10ppm, Stolt Tankers did not permit the use of "half face masks" and instead mandated the use of "full face filter masks" for all expected concentrations of benzene up to 50 ppm.

At the time of the accident, Section 7.3 of the SSM required:

> ***SSM 7.3 Use And Control Of Filter Masks***
>
> *Under normal circumstances, filter masks are to be stored in a secured locker.*
>
> *Distribution of filter masks is to be done only on the Authorization of the Chief Officer.*
>
> *All filter masks must be returned to the Chief Officer after each operation for cleaning and secure storing.*
>
> *Filter masks are not to be used by any person other than the authorized persons.*
>
> *The Chief Officer will ensure that the correct filter is used for each operation.*
>
> *At regular intervals, the Chief Officer is to remind the crew of the dangers regarding the improper use of filter masks. The filter masks are not a substitute for breathing apparatus and*

[4] MSC/Circ.1095 "Revised minimum standards for ships carrying liquids in bulk containing benzene".
[5] Annex to MCS/Circ.1095; Paragraph 5.2 "Equipment for cargo operations on deck.

should never be used for entry into any confined space. Use of filter masks under any other controlled situation will only be done under the direct supervision of the Chief Officer.

Use of filter masks during cargo operations.

During cargo operations it may not be practical for the Chief Officer to hand out a filter mask on each occasion. Under these circumstances, the Chief Officer may at his discretion, hand a set of numbered masks with filters to the duty officer. These will be placed in a high visibility container marked "Filter Masks", for use during cargo related operations as required. The duty officer will then assure that these masks are used as directed and returned to the container after each use. The Log of use of Filter Masks should be kept by the OOW using RFM Form SR12. At the end of the cargo operation for each port, the Chief Officer will ensure that all the masks are returned to his keeping.

Filter Cartridges

As there is no way to determine when a filter cartridge has become saturated they must only be used once and then discarded in the proper manner. A new cartridge must be used for each new operation.

5. Drills, exercises and on board training.

All crewmembers involved in cargo operations on board chemical tankers are required to have met the mandatory minimum standards for the training and qualification for masters, officers and ratings (as appropriate) as specified in Regulation V/1 of the STCW Convention.

In addition, the OS had completed a company computer based training course covering the additional safety hazards associated with the use of nitrogen on board ships (Course No 1052 "Use of Nitrogen (Chemical Tankers)"). This course was completed by the OS on 13 February 2012.

All crew joining STOLT SKUA are required to undertake a ship specific program of safety and induction training. The OS completed the company's "Familiarisation and Activity Awareness Checklist – Officers and Crew" when he joined STOLT SKUA during August 2011. This familiarisation training makes specific mention of the safe use of filter masks and the dangers of their use in an enclosed space or in an oxygen deficient atmosphere.

As part of the on board program of drills for STOLT SKUA, enclosed space rescue drills are conducted six times a year. The last such drill conducted before the accident was completed on 26 February 2012.

6. Industry Standards for Tank Cleaning and Enclosed Space Entry

The following, non exhaustive, list details a number of recommendations and requirements for both tank cleaning on board tankers and entry into enclosed spaces on board ships.

6.1. Tank Cleaning

Chapter 11.3 of the *International Safety Guide for Oil Tankers and Terminals* (ISGOTT) – ICS and OCIMF;

Chapter 6 of the *Tanker Safety Guide (Chemicals)* – ICS;

6.2. Entry into Enclosed Spaces

The Merchant Shipping (Entry Into Dangerous Spaces) Regulations, 2004 – Cayman Islands Legislation;

Chapter 17 of *Code of Safe Working Practices for Merchant Seamen*. – UK Maritime and Coastguard Agency;

Resolution A.1050(27): *Revised Recommendations for Entering Enclosed Spaces aboard Ships*. – IMO;

Chapter 10 of the *International Safety Guide for Oil Tankers and Terminals* (ISGOTT) – ICS and OCIMF;

Chapter 3 of the *Tanker Safety Guide (Chemicals)* – ICS;

7. The victim

The Ordinary Seafarer who was killed in this accident was a 26 year old male born in the Philippines. He had a total of 37 months and 22 days of sea service at the time of his death. He had worked for Stolt Tanker BV in the position of OS since July 2006 and had sailed on STOLT SKUA since 13 August 2011.

He was well liked by those on board and his crew evaluation reports were never found to be below the level of “meets or exceeds the required standard” in all areas. The crew on board described him as displaying a high level of initiative, very proactive and “smart”. He was reportedly always eager to help colleagues and tried to perform all tasks as carefully and quickly as he could.

Like all seafarers, the OS was required to undergo a Seafarers Medical Examination every two years. The OS’s last such medical examination was completed on 15 May 2011 and the OS was passed fit for service until 15 May 2013. A mild abnormality was noted in his Pulmonary Function Test, but was not considered by the examining

physician to warrant placing any restriction of duties on the OS while working in the deck department.

SECTION 2 – ANALYSIS

1. Aim

The purpose of the analysis is to determine the contributory causes and circumstances of the accident as a basis for making recommendations to prevent similar accidents occurring in the future.

2. Supervision of Tank Cleaning Operations by the Chief Officer

In addition to a general safety policy and procedure controlling entry into cargo tanks and other enclosed spaces, Stolt Tankers BV also operate to a Tank Cleaning Manual to supplement the other policies and procedures. This Tank Cleaning Manual requires that:

> *"Whenever a tank cleaning or gas freeing operation is being carried out the either the Chief Officer or Master must be in attendance throughout the operation."*

On this occasion, the deck crew were all briefed as to the tank cleaning operation, including the safety precautions to be put in place, and had signed the prepared Tank Cleaning Plan. When the OS joined the tank cleaning team at 06:00 LT, he was also briefed by the Chief Officer as to the operations underway and also signed the Tank Cleaning Plan. The briefing by the Chief Officer included a reminder of the absolute prohibition on the entry of any cargo tank until the atmosphere inside the tanks had been tested and an "Entry Permit" issued.

The decision by the Chief Officer to issue the filter masks required for tank venting and then retire to his cabin to rest until he would be needed to test the atmosphere of the tanks after venting would appear not to be in accordance with the Tank Cleaning Manual in use on board. During the investigation it was clarified that the intention of the phrase *"in attendance"* was meant to convey that one of these two most senior officers was to remain available on the ship whenever tank cleaning operations were carried out in port, rather than they had to be in constant attendance throughout the operation.

Having the master or chief officer present, either on deck or in the cargo control room, throughout all tank cleaning operations could also have a detrimental effect on the safe operation of the ship, as they would not be available for other operations that may also be being carried out at the time

3. Adequacy of procedures controlling tank cleaning and enclosed space entry on board STOLT SKUA

Stolt Tankers BV have extensive procedures and polices controlling tank washing and entry into enclosed spaces (including cargo tanks). These procedures meet international safety requirements and recommendations, such as those listed in

Section 6 of the “Factual Information” section of this report. These procedures were representative of industry best practice in these areas.

As the airborne concentration of benzene during stages of the tank cleaning process could be expected to exceed 1 ppm, but were not expected to reach 50 ppm, crew were routinely issued with filter masks for protection when performing cargo operations on deck when carrying cargoes containing benzene.

Amongst other requirements, these procedures required that a tag be permanently attached to the entrance to each tank. These tags were either:

RED:	Unsafe for entry
GREEN:	Tested and safe for entry, all conditions of entry permit met
YELLOW:	Tank inerted and unsafe for entry. (Normally only used when required by shore terminals)

Permits were required for each operation requiring tank entry, and these permits would only be issued after thorough testing of the tanks atmosphere for sufficient oxygen present, the absence of any toxins and the absence of any fire/explosion risk. At the time of the accident a *RED (Unsafe for Entry)* tag was prominently displayed at the entrance to 10S.

Previous records of tank entry were examined and found to be in compliance with the requirements of Stolt Tankers BV’s procedures.

4. Adherence by the deck crew to relevant procedures during the tank cleaning operations

The procedures for tank cleaning on board STOLK SKUA called for the process to be undertaken in a series of sequential steps. Each step was only to be started when the previous step had been completed. The steps involved were:

4.1. Sea Water Washing

Sea water was to be introduced into each tank, circulated and then discharged to the sea for a period of 1.5 hours. This was to dilute any cargo residue left in the tank after cargo discharge and the mandatory prewash of the tanks in the Netherlands.

4.2. Fresh Water Washing

After the sea water washing was complete, fresh water was to be circulated in the tank for a period of ten minutes and the discharged to the sea. This was to dilute and displace any sea water remaining in the tank after the sea water wash.

4.3. **Venting**

Although the water washing would have diluted and removed any cargo residue remaining in the tank, the atmosphere in the tank would have remained largely unchanged from when the cargo was discharged from the tank. This atmosphere would consist of vapour from the PYGAS cargo carried and nitrogen introduced into the tank to provide an inert atmosphere. The purpose of venting the tank was to displace this atmosphere with fresh air so that any PYGAS vapour remaining was removed and sufficient oxygen was introduced into the tank to restore a breathable[6] atmosphere. The tanks were to be initially vented through the ship's vent risers, with the tanks only opened to complete ventilation when the atmosphere in the tanks was expected to be below 30% LEL and the concentration of benzene below the TLV/TWA for benzene of 10ppm. It is then necessary for the tank lid to be opened by the crew to complete the venting. Crew members perform this task wearing filter masks designed to protect against any remaining toxic vapour that may be present in the tank atmosphere.

4.4. **Atmospheric Testing and Permit Issue**

After venting, the atmosphere in each tank was to be tested for the absence of toxic vapour and to confirm the presence of sufficient oxygen. Once the atmosphere in the tank has been confirmed as safe, an "Entry Permit" would be issued allowing crew members to enter the tank.

4.5. **Ejection**

An air driven Wilden Pump was to be lowered into the tank and used to remove any diluted washings remaining after the sea and fresh water washing. This pump was to be lowered from deck on ropes and it was not required for any crew to enter the tank to perform this operation.

4.6. **Mopping and Drying**

The last stage of the tank cleaning process involved crew members entering the tank to manually mop up any moisture that may remain either in the bottom of the tank or clinging to the inside surfaces of the tank. Once the tank was clean and dry, the next cargo could be loaded without contamination from any previous cargo.

Each step in the process was designed to provide the maximum level of safety for those conducting the tank cleaning operations. In particular, although it was not required for a crew member to enter the tank to deploy the Wilden Pump, it would be necessary for them to lean over the open tank hatch and lower the pump to the bottom of the tank. In addition to the crew member wearing a filter mask to protect against toxic vapours, the process was designed to minimise the exposure to any

[6] SSM Section 7.1 gives a breathable atmosphere as one with 20.5% - 21% Oxygen and 0% LEL.

such vapours that may be present. This stage of the process was only to be performed after the atmosphere in the tank had been confirmed as safe.

During this investigation, and the one conducted by Stolt Tankers BV following this accident, it was found that the crew on board STOLT SKUA periodically "modified" the sequence of steps involved to reduce the overall time required for tank cleaning. This type of deviation from the procedures can be seen as an "Optimising Violation[7]" where the violation occurs in the belief that it is "doing things better" than prescribed by the procedure.

Rather than waiting for the atmosphere in the tank to be confirmed as safe, the "Optimising Violation" was to lower the Wilden Pump into the tank before the atmosphere had been checked, with the seafarer remaining on deck and not entering the tank. It was not possible to determine if this practice had become the norm on board STOLT SKUA or if it was employed only in certain circumstances. It was also not possible to determine if it the practice was undertaken with the knowledge and approval of the Chief Officer. However, it is clear that this deviation from the standard tank cleaning procedure was being employed on the day of the accident.

5. Actions of the Ordinary Seafarer

The Post Mortem conducted on the OS showed no evidence of him falling into the tank from the deck onto the first platform on which he was found (a height of 3.31m). It is therefore concluded that he climbed into the tank and down the ladder onto the first platform. The most likely reason for him to take such a course of action is that he was attempting move the Wilden Pump to a new location in the tank after it had become caught in the tank's internal structure.

The OS was wearing a filter mast when he entered the tank. However, respiratory protection with filter masks is dependent on the ambient air containing sufficient oxygen to sustain life. They give no protection whatsoever in an oxygen deficient atmosphere such as was present in Cargo Tank 10 S at the time of the accident.

The OS may have confused "oxygen deficient" and "toxic" and believed protection against one hazard would offer protection against the other. This confusion may have led the OS to believe that a filter mask for toxic vapours would offer protection against an oxygen deficient atmosphere. The OS chose a "solo course of action" when he entered the tank. This decision ultimately cost him his life.

[7] "Non-adherence to Procedures: Distinguishing Errors and Violations"; Patrick Hudson, 11th Human Factors Symposium, Melbourne, July 2000.

A number of factors acting in combination may have led the OS to act in contravention of his training and accepted safe working practice, these factors may have included[8]:

> Risk Taking – Taking an action where the outcome is uncertain, often in contravention of norms, regulations or procedures. "I'll take a chance."
>
> Impulsiveness – Inclined to act on impulse rather than thought. "I know what I am doing."
>
> Invulnerability – Impervious to danger or risk. "It won't happen to me."

The tank cleaning operation was already in violation of standard procedures and the OS may have considered his actions in entering the tank as merely a "stretching" of the "accepted violation" already in progress. Routine violations do not necessarily result in accident themselves. Generally accidents occur when a routine violation occurs in conjunction with an "error". In this case the "error" was the OS's decision to enter the tank.

6. The on board rescue

Once it was realised that the OS had entered the tank the on board emergency response was swift and effective. The response team quickly mustered at the scene with the appropriate equipment to effectively perform a tank rescue. The members of the response team acted on knowledge and training, not on emotion and instinct which has led to many failed rescue attempts in the past.

In training and drill scenarios, the primary means of delivering oxygen to a casualty requiring rescue from an enclosed space would be from a designated rescue resuscitator. Although this rescue resuscitator was being brought to the rescue scene by the support team, the rescue team decided that the fastest way to deliver breathing air to the OS was to use an EEBD that was available at the scene. This decision saved vital seconds in delivering breathable air to the OS and his subsequent removal from the tank to fresh air.

There is no doubt that the prompt actions of the crew gave the OS every chance of survival.

7. The contribution of fatigue, drugs and alcohol

Records of the hours worked by all members of the deck crew on STOLT SKUA were examined for the seven days prior to the accident. All seafarers were found to

[8] From the Nautical Institute's Alert! program :- "Exploring Rogue Behaviour".

be suitably rested, with the hours worked by each being in accordance with the regulation VIII/1 of the STCW Convention.

The Post Mortem examination of the OS showed no evidence that he was under the influence of alcohol or any of the drugs tested for at the time of his death.

The effects of fatigue and the consumption of alcohol or drugs are not considered contributory factors in the causation of this accident.

8. Similar Accidents

In October 2007, the Marine Accident Investigators International Forum (MAIIF) started research into the incidence of accidents in enclosed spaces. By July 2008, and based on responses from 18 Administrations, they had identified 120 fatalities and 123 injuries resulting from entry into enclosed spaces since 1991.

Some common factors have been identified:

Complacency leading to lapses in procedure;

Lack of knowledge;

Potentially dangerous spaces not being identified; and

Would be rescuers acting on instinct and emotion rather than knowledge and training.

The United Kingdom Marine Accident Investigation Branch (MAIB) has also investigated three accidents since September 2007 in which six seafarers have died in enclosed / confined spaces.

In September 2007 three crew members died inside a chain locker on board an offshore safety / stand by vessel. One of the dead entered the chain locker in a failed attempt to rescue the first two. All three men died as a result of lack of oxygen inside the chain locker due to corrosion of the steel structure and anchor chain.

In January 2008 two seamen collapsed in a store on board a general cargo ship carrying a cargo of “steel turnings”. “Steel Turnings” are a self-heating and oxygen depleting cargo. Due to a communication path between the cargo hold and the store room, this cargo had depleted the oxygen in both the cargo hold and the store. When tested, the air in the cargo hold contained only 6% oxygen. The two crew members died of asphyxiation.

In June 2008 a crew member was asphyxiated on a passenger cruise ship after he entered an almost empty ballast tank. The crew member was not intended to enter the tank and no permit to work was issued. The atmosphere

in the tank was severely oxygen depleted due to heavy corrosion and the tank being unventilated for several years.

Common to the above three accidents is that the victims were not expecting to encounter an oxygen deficient atmosphere.

In January 2008, the Maritime Authority of the Cayman Islands investigated a fatal accident on board another chemical tanker managed by Stolt Tankers BV. In this instance, the Third Officer entered a tank with an oxygen deficient atmosphere apparently to retrieve a piece of dropped equipment.

SECTION 4 – CONCLUSIONS, ACTIONS TAKEN AND RECOMMENDATIONS

1. Conclusions

A) The primary cause of this accident was the OS's decision to enter cargo tank 10 S which contained a toxic and oxygen deficient atmosphere incapable of sustaining life.

B) Contributing to this accident was the practice on board of not following the established tank cleaning procedures in the belief that in doing so would improve tank cleaning performance. A so called "Optimising Violation".

C) The level of supervision and control by the chief officer on board was insufficient to prevent this Optimising Violation occurring.

D) Stolt Tankers BV had robust and adequate procedures in place to prevent such an accident occurring. These procedures met all international requirements and represented "best practice"; however they were not always followed by the crew of STOLT SKUA.

E) The members of the on board rescue team acted on knowledge and training, not on emotion and instinct which has led to many failed rescue attempts in the past. The prompt actions of the crew gave the OS every chance of survival.

2. Actions Taken

Following this accident, Stolt Tankers BV have taken the following actions:

Filter masks

Stolt Tankers BV have introduced an immediate and comprehensive ban on the use of filter masks on all company vessels and has obtained written confirmation from each vessel that all such filter masks have been removed from ships.

New Safety Management Procedure

Safety Management Procedures have been amended to reflect the introduction of the ban on the use of filter masks on board and to highlight the strict prohibition on ordering or use of such equipment.

Section 7.3 of the SSM has now been amended as follows:

> ***SSM 7.3 Filter Masks***
>
> *The use of filter masks by company employees is prohibited onboard all ships.*
>
> *In situations where a filter mask may have been used in the past, then an alternative breathing air supply must be used instead. Such alternative breathing air supply (for example, small size air bottles, etc.) is intended only for use on deck and should NOT be used for*

enclosed space entry. In case of enclosed space entry, all relevant procedures described in SSM 7.1 "Cargo Tanks and Enclosed Space" are to be strictly complied with.

There will be occasions when persons not employed by the company (cargo surveyors etc) will wear filter masks for routine tasks such as taking cargo samples and connecting hoses etc.

This practise is acceptable and will be permitted onboard company ships.

Ship's staff are to ensure that persons using filter masks are properly supervised and that filter masks are never worn by any person in an enclosed space.

Replacement equipment

The company has provided each ship with light weight breathing apparatus sets specifically designed for respiratory protection of the crew while handling toxic cargo on deck. This equipment provides a self-contained supply of breathing air so also offers protection in oxygen deficient atmospheres. This action goes beyond the requirements for personal protection contained in IMO Circular MSC/Circ.1095 for the expected levels of benzene in the atmosphere associated with cargo operations on deck.

Where possible, the use of Wilden Pumps has been supplemented by the fitting of an eductor on deck. This eductor is fitted to the ship's fire main and has a suction hose that can be lowered into the tank thereby eliminating the need to lower a Wilden Pump into the tank for water ejection.

Awareness Raising

Additional safety committee meetings have been held on all ships highlighting the circumstances of this accident and the lessons to be learned. These have been followed up by the issue of a "Loss Control Bulleting" to the fleet. In addition, the Managing Director of Stolt Shipowning has written to all ships regarding fatalities caused by the violation of tank entry procedures and the importance of strict adherence to enclosed space procedures.

Stolt Tankers BV have supplied all seafarers with a pocket sized "safety card" detailing key tenets of safe operations on board. First among these is a prohibition on enclosed space entry except when in accordance with procedures.

Training

Stolt Tankers BV use their investigation into this accident as a case study for training purposes at their "Officers and Crew Safety Excellence" conferences and in other company training courses.

3. Recommendations

In view of the actions taken by Stolt Tankers BV, no further recommendations are made as a result of this investigation.

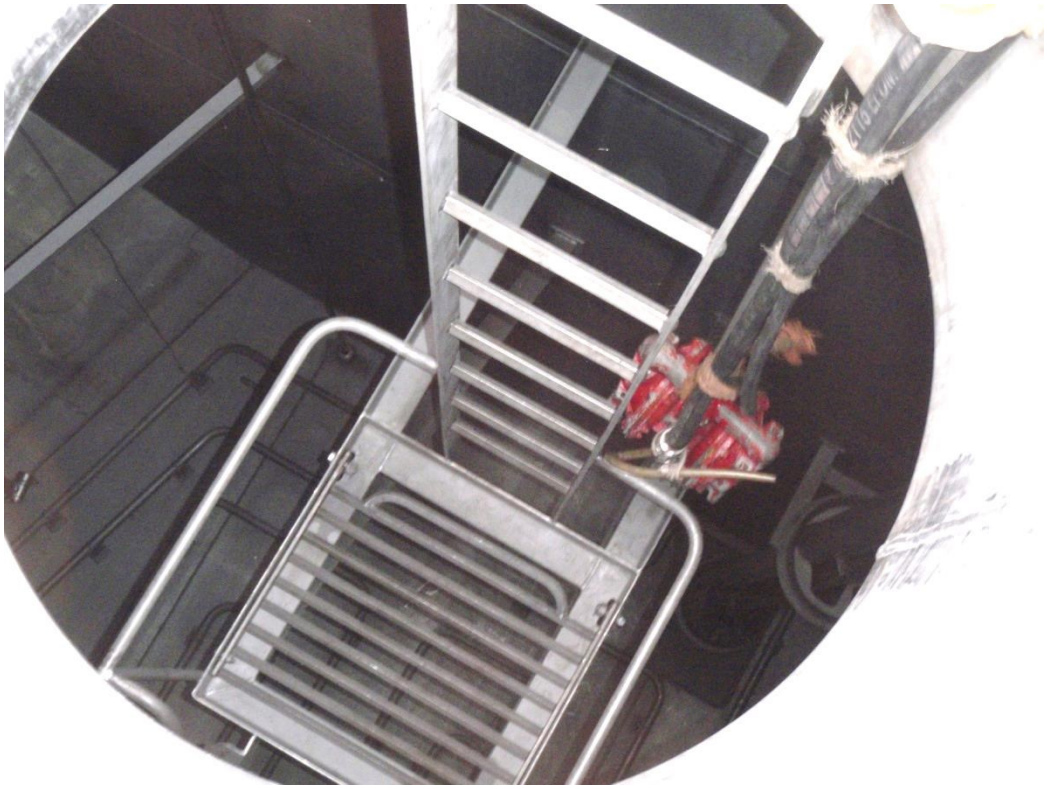
APPENDIX – PHOTOGRAPHS AND ILLUSTRATIONS

Library photo of STOLT SKUA showing location of “10 S” where the accident occurred.

View from the navigation bridge showing the hatch for “10S”

Area around the tank entrance

View inside tank showing the “first platform” where the OS was found unconscious.



Lowering a “Wilden Pump” into the cargo tank to eject any remaining tank washings.

“Safety Card” issued to all seafarers on board ships managed by Stolt Tankers BV.

Water Eductor now used to supplement Wilden Pumps for tank water removal:

WATER EDUCTOR SET-UP DIAGRAM