



**The Bahamas
Maritime Authority**

THE COMMONWEALTH OF THE BAHAMAS

TAI SHAN

IMO Number 8513560

Official Number 7000612



**Report of the investigation into
Fire damage to
Tai Shan
on
2nd July, 2014**

The Bahamas Maritime Authority investigates incidents at sea for the sole purpose of discovering any lessons which may be learned with a view to preventing any repetition. It is not the purpose of the investigation to establish liability or to apportion blame, except in so far as emerges as part of the process of investigating that incident.

It should be noted that the Bahamas Merchant Shipping Act, Para 170 (2) requires officers of a ship involved in an accident to answer an Inspector's questions fully and truly. If the contents of a report were subsequently submitted as evidence in court proceedings relating to an accident this could offend the principle that a person cannot be required to give evidence against himself. The Bahamas Maritime Authority makes this report available to any interested parties on the strict understanding that it will not be used as evidence in any court proceedings anywhere in the world

Date of Issue: 11th August 2015
Bahamas Maritime Authority
120 Old Broad Street
LONDON
EC2N 1AR
United Kingdom

CONTENTS

| | | |
|-----------|---|-----------|
| 1. | Summary | 1 |
| 2. | Particulars of Vessel | 2 |
| | Registration, Class and Port State | 2 |
| | Voyage | 3 |
| | Crewing and Competence | 3 |
| | Drills and Fire Fighting Teams | 3 |
| 3. | Narrative of events | 6 |
| | Prior to the Fire | 6 |
| | Incinerator Specification and Maintenance | 8 |
| | Incinerator Alarm Activation | 8 |
| | Incinerator Operation | 9 |
| | Waste Oil Tank | 12 |
| | Source of Fire | 13 |
| | Officer in Charge of Engineering Watch | 14 |
| | Fire Alarm Activation | 15 |
| | Spread of the Fire | 16 |
| | Fire Fighting Team | 18 |
| | Fire Fighting | 20 |
| | Fire Extinguished | 22 |
| | Vessel under tow | 22 |
| 4. | Analysis | 24 |
| 5. | Conclusions | 26 |
| 6. | Recommendations | 28 |
| | List of Appendices: | 29 |
| I | Oil Record Book Extract | |
| II | Minimum Safe Manning Document | |
| III | Ship Management Manual | |
| | - Engine Room Procedures | |
| | - Fire Muster List | |
| | - Emergency Plan 1 | |
| | - Emergency Plan 2 | |
| IV | Shipboard Contingency Plan – Fire Muster List | |
| V | Shipboard Contingency Plan – Emergency Plan | |
| VI | Shipboard Contingency Plan – Emergency Plan 2 | |
| VII | Kidde Fire Detection Plan | |
| VIII | Location of Fire | |
| IX | Incinerator Plan Maintenance Schedule | |
| X | Overview of Incident | |
| XI | Fire main isolation valves | |
| XII | Fire damage | |

MV Tai Shan – Marine Safety Investigation Report

Abbreviations:

| | |
|----------------|------------------------------------|
| AB | Able Seaman |
| BA Set | Self-Contained Breathing Apparatus |
| Bos'n | Boatswain |
| C/E | Chief Engineer |
| C/O | Chief Officer |
| ECR | Engine Control Room |
| kW | kilowatts |
| m ³ | cubic metres |
| 2/E | Second Engineer |
| 3/E | Third Engineer |
| 4/E | Fourth Engineer |

1 SUMMARY

- 1.1 On the 02nd July 2014, the *Tai Shan* was underway from Cotonou, Benin, to Tianjin, China, partly laden with a cargo of vehicles loaded in the United States of America.
- 1.2 After passing the coast of South Africa and South of Madagascar, a fire broke out in the upper parts of the engine room.
- 1.3 Initially, some confusion was caused by the appearance of the fire, 5 decks down the engine casing, at the exhaust gas boiler (economiser). However, it was later established that the fire was primarily in the incinerator room on the 2nd deck down from the upper deck and that burning debris had dropped through gratings, to the 5th deck.
- 1.4 The first fire fighting action was to provide boundary cooling on the funnel and engine room access stairway and elevator trunking. The fire at the economiser deck (Car deck No. 7) was extinguished and various attempts were made to access the centre of the fire at the incinerator deck, from the engine room and also from the car decks via the entrances to the stairway on the 2nd and 3rd decks.
- 1.5 The vessel blacked out approximately 20 minutes after the fire detection system alarm was triggered, due to short circuiting of electrical cables located in the access stairway trunking between the engine room and the upper deck.
- 1.6 The fire fighting continued, using the emergency fire pump, driven from the emergency generator and was eventually extinguished approximately 3 hours after it started.
- 1.7 The damage to the electrical cabling resulted in the main engine only being controllable from the local manoeuvring position and communications from the bridge to the engine room being disabled.
- 1.8 Consideration was given to arranging the cabling to permit communications between the bridge, engine control room, engine local control and the steering gear. However, the main engine monitoring and alarm system was also disabled due to the cabling damage and it was decided to arrange for a tug to tow the vessel to Durban for repairs.

2 GENERAL INFORMATION

2.1 *Tai Shan* is a vehicles carrier registered at Nassau, Bahamas, of welded steel construction. The accommodation was situated forward and machinery spaces were situated aft. She had the following principal particulars:

| | | |
|-------------------|---|------------------------------|
| • Official Number | : | 7000612 |
| • IMO Number | : | 8513560 |
| • Year of Build | : | 1986 |
| • Length overall | : | 190.05 metres |
| • Length BP | : | 180.00 metres |
| • Breadth | : | 32.26 metres |
| • Depth | : | 31.05 metres (to upper deck) |
| • Gross Tonnage | : | 48676 tonnes |
| • Net Tonnage | : | 14603 tonnes |
| • Call Sign | : | C6AZ2 |

2.2 The vessel was powered by one Sulzer 7 RTA58 main engine that developed 8840 kW (11850 bhp) driving a fixed bladed propeller. She had 3 main generators that developed a total of 2925 kW.

2.3 The cargo was carried in car decks that were arranged in 13 decks, with decks 4, 6, 8 and 10 capable of being lifted.

2.4 The *Tai Shan* was built in Japan at Sumitomo Heavy Industries and was formerly named *Nosac Tai Shan*. At the time of the incident she was owned by Caiano Shipping AS, managed by Green Management and chartered to Hoegh Autoliners Shipping AS.

Registration, Class and Port State

2.5 The vessel was first registered under the Bahamas Flag in February 2014 and at the same time, the Classification Class was changed from Nippon Kaiji Kyokai¹ (ClassNK) to Det Norske Veritas (DNV). Her last Special Survey was completed on the 11th November 2011. At the time of the incident, she complied with the all statutory and international requirements and certification.

2.6 The *Tai Shan* was last subjected to a Bahamas Maritime Authority Annual Inspection at the Port of Callao, Peru, on the 9th May 2014, where no deficiencies or observations were issued.

2.7 The vessel was also subject to Port State Control Inspections by the United States Coast Guard at the Norfolk, Virginia, USA on the 27th May 2014. Again, no deficiencies were noted.

¹ Classification Societies, sometimes referred to as Recognised Organisations (RO).

MV Tai Shan – Marine Safety Investigation Report

Voyage

- 2.8 After sailing from Cotonou, Benin the vessel arrived in Lomé, Togo anchorage to take bunkers by barge on the afternoon of 20th June 2014. *Tai Shan* sailed bound for Tianjin, Peoples Republic of China at 0155 on the 21st June 2014, with a part cargo of 1204 vehicles, previously loaded in Portsmouth, USA. The passage to China was about 10,500nm² with a passage time of 29 days.

Crewing and Competence

- 2.9 The Safe Manning Document was issued by the Bahamas Maritime Authority on the 3rd February 2014 for 13 crew members, while the vessel operated with a crew of 21 crew members.
- 2.10 On the 19th June 2014 at Cotonou, Benin, a planned crew change took place, involving the Third Officer, Second Engineer, Fourth Engineer and Bos'n.
- 2.11 All Senior and Junior Officers were certified as per the Safe Manning Document in accordance with the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers.
- | | |
|---------|---|
| Captain | Holder of a Master certificate (II/2 ³) which included Advanced Fire Fighting requirement. |
| C/O | Holder of a Chief Mate certificate (II/2) which included Advanced Fire Fighting requirement. Although at the time of the incident was in bed, sick. |
| 2/O | Holder of Officer in Charge of Navigation Watch certificate (II/1) which included Extended Fire Fighting. |
| 3/O | Holder of Officer in Charge of Navigation Watch certificate (II/1) which included Extended Fire Fighting. |
| C/E | Holder of a Chief Engineer certificate (III/2) which included Advanced Fire Fighting requirement. |
| 2/E | Holder of a Second Engineer certificate (III/2) which included Advanced Fire Fighting requirement. |
| 3/E | Holder of Officer in Charge of Engineer Watch certificate (III/1) which included Extended Fire Fighting. |
| 4/E | Holder of Officer in Charge of Engineer Watch certificate (III/1) which included Extended Fire Fighting. |

Drills

- 2.12 The Bridge Logbook indicated that on the 24th June 2014, the following Drills were carried out on board the vessel:
- | | |
|-------------|--------------|
| 1630 – 1722 | Abandon Ship |
| 1722 – 1835 | Fire Drill |
- 2.13 Fire drills were also carried out in accordance with the vessel's Safety Management System Safety Procedures.

² Nautical Miles

³ Relating to the "International Convention on Standards of Training, Certification and Watchkeeping for Seafarers.

MV Tai Shan – Marine Safety Investigation Report

| Drills | Schedule | Drill shall include | |
|----------------------------|---------------------------------|---------------------|---------------------------------|
| | Descriptions | Interval | |
| Fire muster drill** | SOLAS Chapt III Reg 19 - 3.2 | M | SOLAS Chapt III Reg 19 – 3.4 |

Fire Drills are to be conducted on monthly intervals:

SOLAS⁴ Chapter III Reg. 19 – 3.2

3.2 Every crew member shall participate in at least one abandon ship drill and one fire drill every month. The drills of the crew shall take place within 24 h of the ship leaving a port if more than 25% of the crew have not participated in abandon ship and fire drills on board that particular ship in the previous month. When a ship enters service for the first time, after modification of a major character or when a new crew is engaged, these drills shall be held before sailing. The Administration may accept other arrangements that are at least equivalent for those classes of ships for which this is impracticable

SOLAS Chapter III Reg. 19 – 3.4

3.4 Fire drills

3.4.1 Fire drills should be planned in such a way that due consideration is given to regular practice in the various emergencies that may occur depending on the type of ships and the cargo.

3.4.2 Each fire drill shall include:

- .1 reporting to stations and preparing for the duties described in the muster list required by regulation 8;*
- .2 starting of a fire pump, using at least the two required jets of water to show that the system is in proper working order;*
- .3 checking of fireman’s outfit and other personal rescue equipment;*
- .4 checking of relevant communication equipment;*
- .5 checking the operation of watertight doors, fire doors, fire dampers and main inlets and outlets of ventilation systems in the drill area; and*
- .6 checking the necessary arrangements for subsequent abandoning of the ship.*

3.4.3 The equipment used during drills shall immediately be brought back to its fully operational condition and any faults and defects discovered during the drills shall be remedied as soon as possible.

- 2.14 In accordance with the Safety Management Manual, fire drills had previously been held and recorded on the 22nd March, 23rd April and 24th May 2014.

Fire Fighting Teams

- 2.15 As the Chief Officer was indisposed through illness, the manning of the Fire Fighting Teams was revised with the Chief Mate leading Team 1.

Team 1 Fire Team
2/0 (leader): assisted by 3/0 and AB

Team 2 Engine Room
2/E (leader): assisted by 3/E and Oiler

⁴ International Convention for the Safety of Life at Sea, 1974 as amended

3 NARRATIVE OF EVENTS

- 3.1 All times noted in this narrative are given in the style of the standard 24 hour clock without additional annotation and as local time in the incident area, which was UTC +3.
- 3.2 Although the Flag State requested the VDR data be preserved, it was not, therefore could not be used to verify any times, or review bridge audio information.
- 3.3 The weather at the time of the incident on the 2nd July 2014 south of Madagascar was fair with wind from the NNW – Force 4⁵, cloudy with good visibility.

Prior to the Fire

- 3.4 The Waste Oil Incinerator⁶ was used at the commencement of day work by the Fourth Engineer (4/E) on the 2nd July 2014. Entries obtained from the Oil Record Book⁷ (ORB) indicated that the incinerator was in used from 08:00 hours until 08:45 hours, by which time about 50 litres (0.05m³) of sludge had been incinerated. This left a remaining 400 litres (0.4m³) in the waste oil tank for future incineration.

The entry in the Oil Record Book classified the incinerated sludge as code C, item number 12.3 in Fig. 01 below.

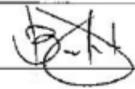
| Date | Code (letter) | Item (number) | Record of operations/signature of officer in charge |
|--------------|---------------|---------------|---|
| 02 JULY 2014 | C | 12.3 | 0.05 m ³ SLUDGE INCINERATED |
| | | | START 0800 / STOP 0845 |
| | | | RETAINED 0.40 m ³ |
| | | | 02 / JULY / 2014 4E  |

Fig. 01 Oil Record Book - incinerator entry

Code letter C: Collection, transfer and disposal of oil residues (sludge)
 Item: 12.3: Refers to the method of disposal - Incinerated

⁵ Beaufort Force 4 = 11 – 16 knots wind strength.

⁶ Used to burn off and dispose of Oily Sludge collected in the Engine Room bilges.

⁷ Required in accordance with the International Convention for the Prevention of Pollution from Ships, Annex 1 regulation 17.

MV Tai Shan – Marine Safety Investigation Report

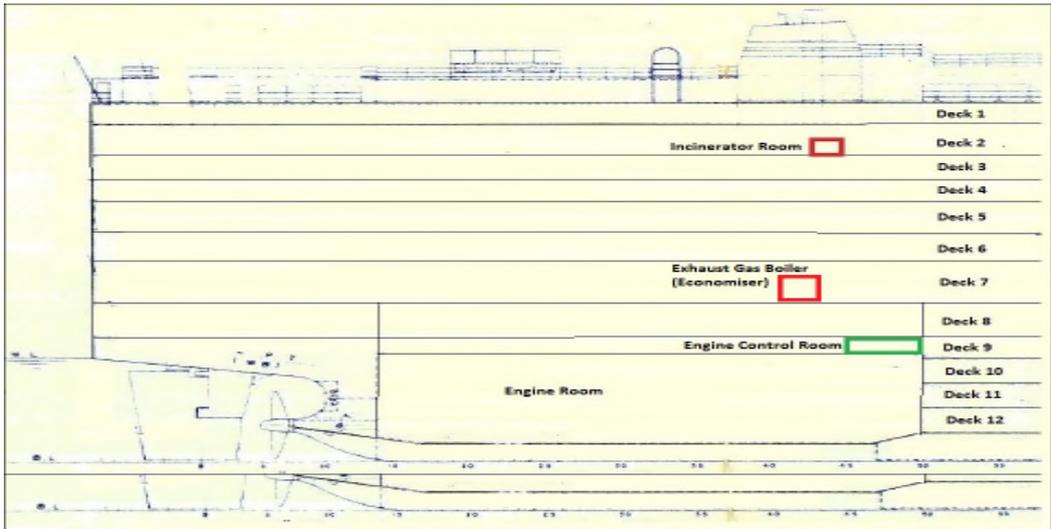


Fig. 02 Location of incinerator room – starboard side layout at Car Deck No:2

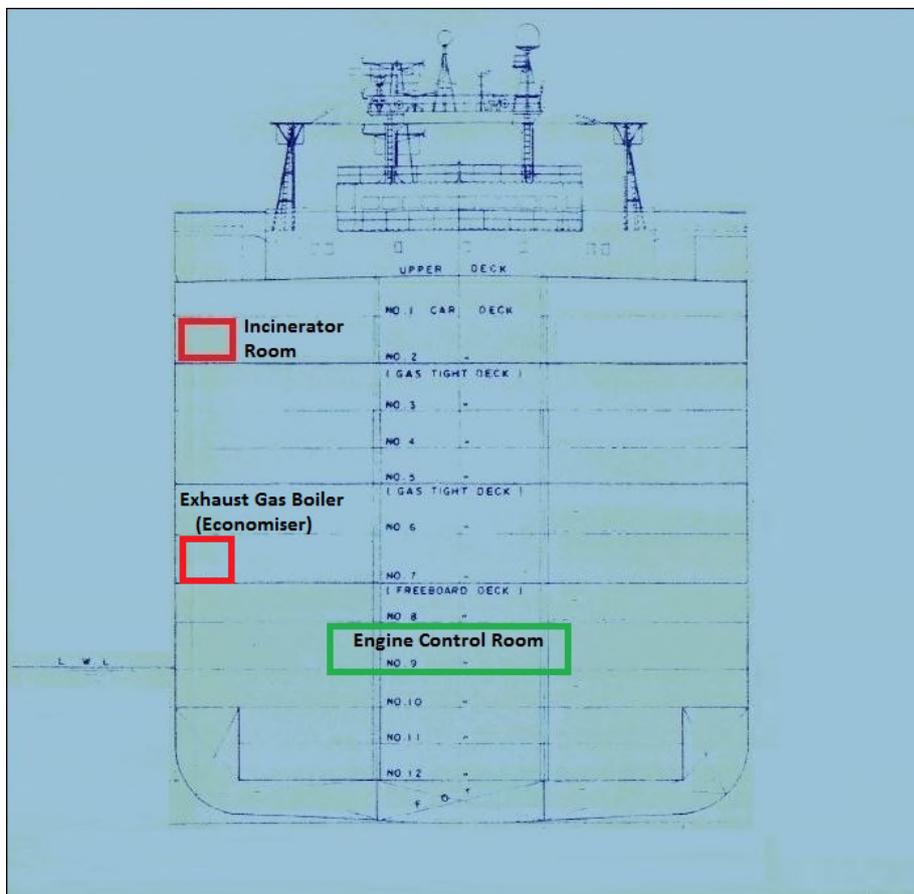


Fig. 03 Location of Incinerator room and Economiser – starboard side layout at Car Deck No:2

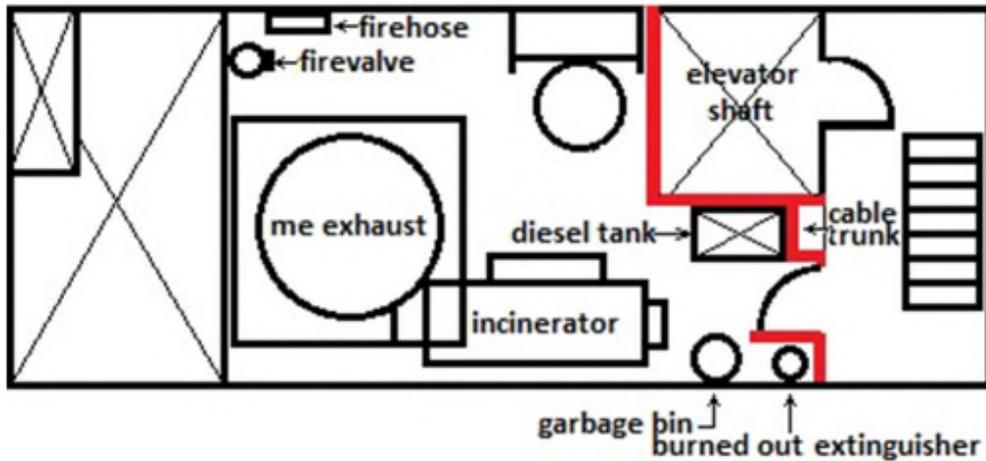


Fig. 04 Incinerator room layout at Car Deck No 2

Incinerator Specification and Maintenance

3.5 The *Tai Shan* was fitted with Waste Oil Incinerator, Model VTH – 30 SN, manufacturer Volcano Ltd. and is located on the starboard side of the 2nd Deck above the engine room at frame 45. The purpose of the incinerator is to safely burn off waste oil produced on board, such as bilge, sludge, lantern oil, cleaning oil and inflammable solids. The burning quantity of this model of incinerator is 30 – 50 litres per hour.

3.6 The incinerator was included within the TM Master ^v2 planned maintenance system; a scheduled monthly check of the incinerator was carried out on the 14th June 2014.

In accordance with the manual the following checks were carried out:

1. Check Refractory Condition
2. Check Diesel Oil Burner
3. Check Sludge Oil Burner
4. Lubricate all moving parts
5. Check and clean spark arrester
6. Check auto stop function of sludge pump

Additionally, four monthly scheduled checks were carried out of the incinerators temperature switches and alarm circuit.

Incinerator Alarm Activated

3.7 At 08:40 hours, the incinerator alarm activated. The 4/E went to the Engine control room to check which alarms had been activated. As the alarm concerned related to the incinerator room, the 4/E returned to the incinerator room, via the stairwell to shut down the incinerator. The alarm was activated due to low level of the waste oil tank. He subsequently carried on with his duties in the Engine Room, which included pumping out the engine room bilges and would investigate the alarm abnormalities later. This can be verified by the Oil Record Book which indicates the fact that 1.2m³ of bilge water was transferred from the engine room bilges to the bilge tank. The bilge tank now contained 5.8m³ and the operation was completed by 08:57 hours.

| | | | |
|-----------------|---|------|--|
| 02 JULY 2014 | D | 13 | 1.2 m ³ BILGE WATER FROM E/R BILGES |
| | | 14 | START 0850 / 0857 |
| | | 15.3 | TO BILGE TK RETAINED 5.90 m ³ |
| | | | 02 / JULY / 2014 AB |

Fig. 05 Oil Record Book – Bilge water transfer.

MV Tai Shan – Marine Safety Investigation Report

- 3.8 The unit had the capability to burn waste oil collected in residue tanks and transferred to the waste oil tank in the incinerator compartment. It also had the capability to burn solids in limited quantities. Records indicated that the last solid waste burning was on the 21st April 2014, when 0.5 m³ of Category C garbage was incinerated. Category C waste was described in the Garbage Record Book⁸ as domestic wastes (e.g. paper products, rags, glass, metal, bottles, and crockery).
- 3.9 The waste oil tank capacity was 0.5 m³ (500 litres). It was filled using a sludge pump located in the Engine Room on the bottom plates. The pump which was started manually and automatically stopped at a level equating to approximately 450 litres.
- 3.10 When the incinerator was used to burn the sludge, the level would drop until it reached a low level of approximately 50 litres at which time, the incinerator would stop.
- 3.11 After the fire, and with no further entries regarding the incinerator tank, the retained quantity in the Incinerator tank was recorded as empty (0 m³).

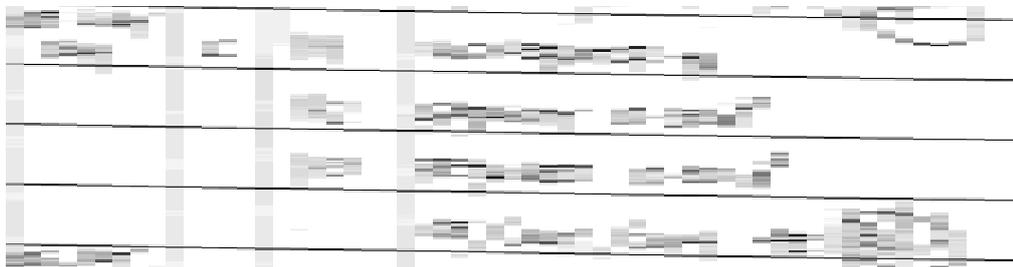


Fig. 06 Oil Record Book – 5th July 2014

Incinerator Operation

- 3.12 The incinerator forced draft fan duct, between the fan and the casing, was split into two paths. The upper path was for providing cooling air to the exhaust and outside of the furnace on the exhaust side of the incinerator. The lower path was for combustion air, ducted to the burner section. The manual on board provided default settings for the 5-step flap control. The advised setting was 100 % open for the exhaust flap and 50 - 80% open for the combustion flap. The exhaust cooling flap was found completely out of the graduated plate provided for setting, but the flap position would have been approximately 50% open. The combustion air flap was 80% open.

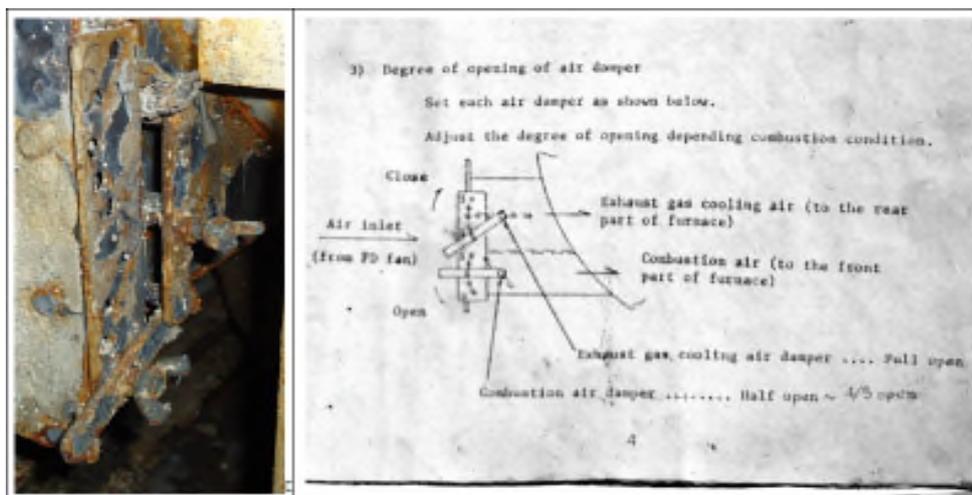


Fig. 07 Air Damper Control & Fire damaged damper

⁸ Required in accordance with the International Convention for the Prevention of Pollution from Ships, Annex V regulation 10.

MV Tai Shan – Marine Safety Investigation Report

- 3.13 The 4/E, finding the incinerator had stopped, due to the low Waste Oil tank level alarm having activated, went straight from the engine control room to the incinerator room, which would have taken approximately a minute. He then shut down the incinerator and continued with his duties and to investigate the incinerator abnormality later.
- 3.14 He reported that he had switched the control selector from the “Waste Oil Self” mode, to “*post purge*” for 20 seconds” and then switched it off. The manual indicates that the post purge should be operated for 20 minutes. The 4/E noted at the time the exhaust temperature was approximately 200° Celsius.

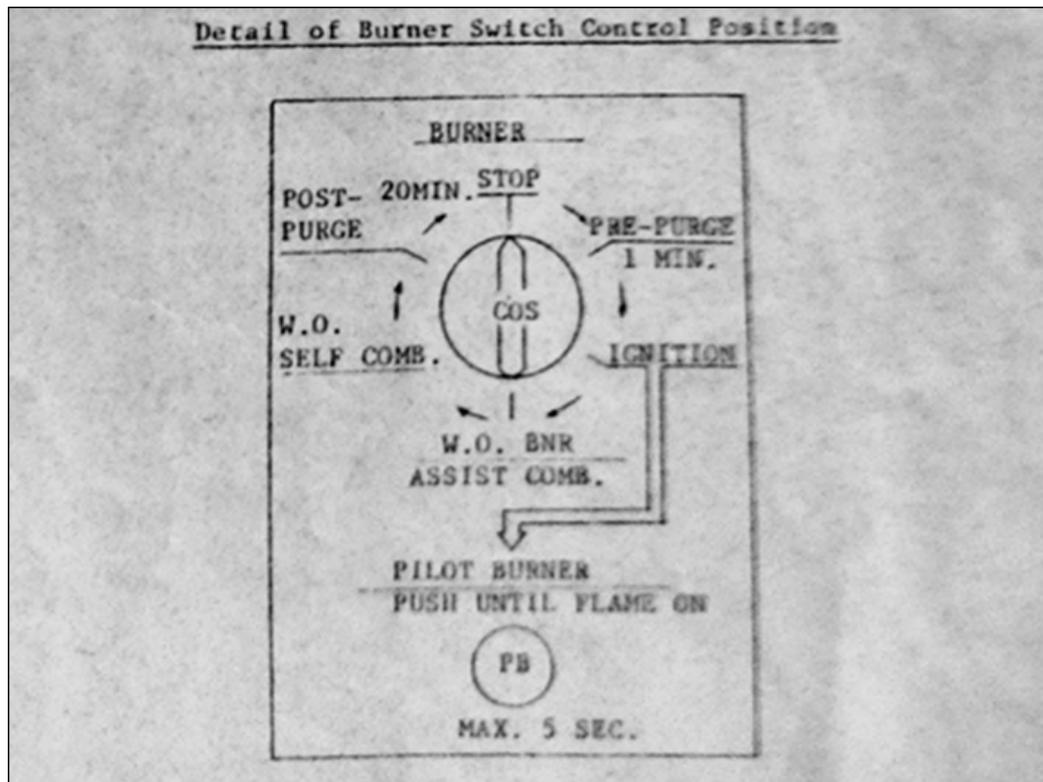


Fig. 08 Burner Switch Control Position

- 6 Upon completion of waste oil incineration (namely, when the level float switch of waste oil tank operates), the waste oil valve will close, thus stopping waste oil combustion.
- 7 Put the burner switch in "POST-PURGE" position.
Conduct furnace purging and cooling for about 20 minutes and put the burner switch in "STOP" position to stop the incineration.
- 8 Close main valves such as atomizing air main valve, waste oil agitating air main valve, etc.

Fig. 09 Instruction – Burner Switch Control

- 3.15 Thereafter the 4/E closed the following valves, as per drawing (Fig 10) Waste oil filter valve, atomising air inlet valve (14), Waste oil circulation valve / Return to tank (17), diesel to pilot burner (23) and diesel to waste oil burner (16). Notably, the diesel valve on the diesel tank and the main diesel valve before the filter and pump were not closed.

MV Tai Shan – Marine Safety Investigation Report

3.16 It is estimated that the incinerator may have been switched off, less than a minute after it stopped burning sludge, far less than the recommended 20 minutes.

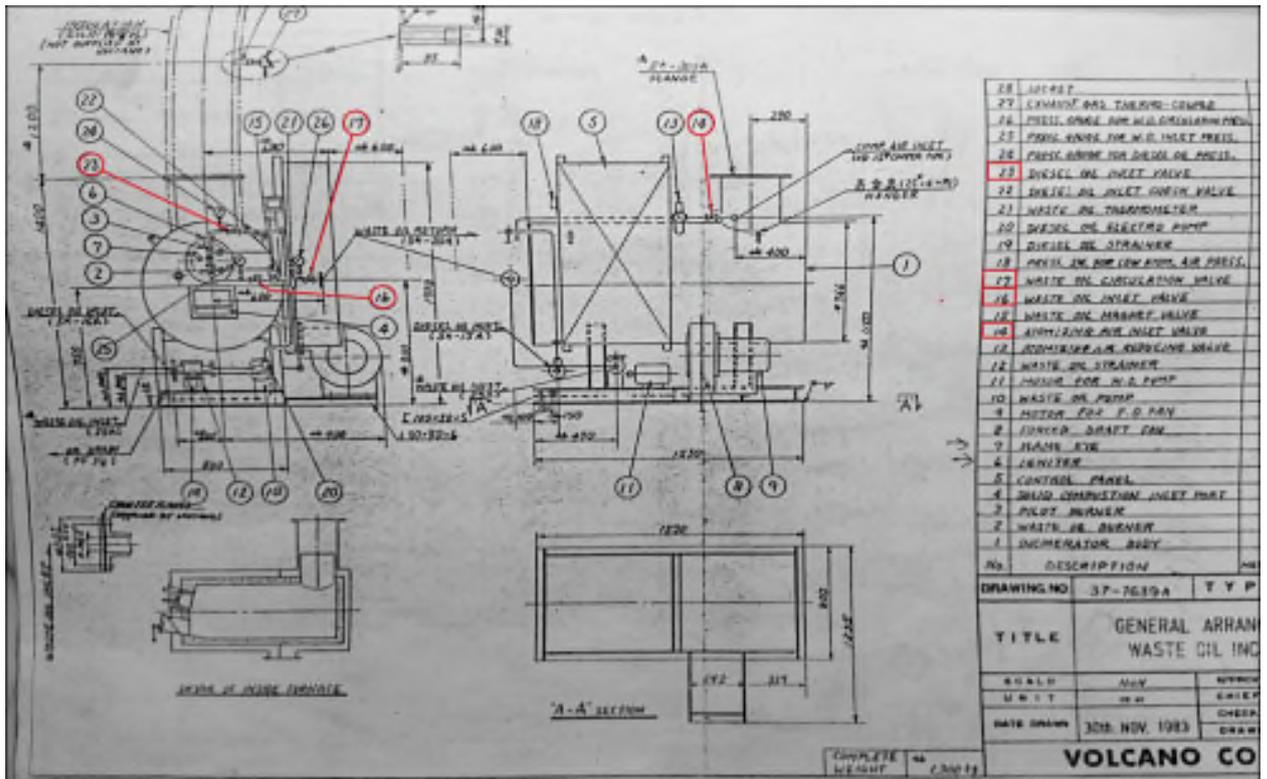


Fig. 10 General Arrangement – Waste Oil Incinerator

Waste Oil Tank

3.17 The waste oil tank sounding rod was used to check the remaining contents in the tank. The result was a level approximately equivalent to 10% of the depth, which would be roughly 50 litres.



Fig. 11 Waste Oil Tank sounding rod

Source of the Fire

- 3.18 The 4/E reported that around 08:40 hours, he went back to check the incinerator. He noticed that the incinerator was already shut off because the level of waste oil tank was low. So as always done, he proceeded to secure all lines and shut off some of the valves. According to the Master, the Fire Alarm sounded at 09:12 hours, although the 4/E stated, at about 09:00 hours he was in the Engine Control Room when the fire alarm sounded. It was subsequently identified that the Fire Detector unit fitted above the incinerator had activated. The position of the detector was approximately 3.5 metres above the incinerator, as the space was a double volume compartment, covering 2 decks.
- 3.19 A small fire was reported by the Engine Room team in the Economiser room on car deck No.7 at 09:30 hours, although it was quickly brought under control and extinguished with a fire extinguisher.

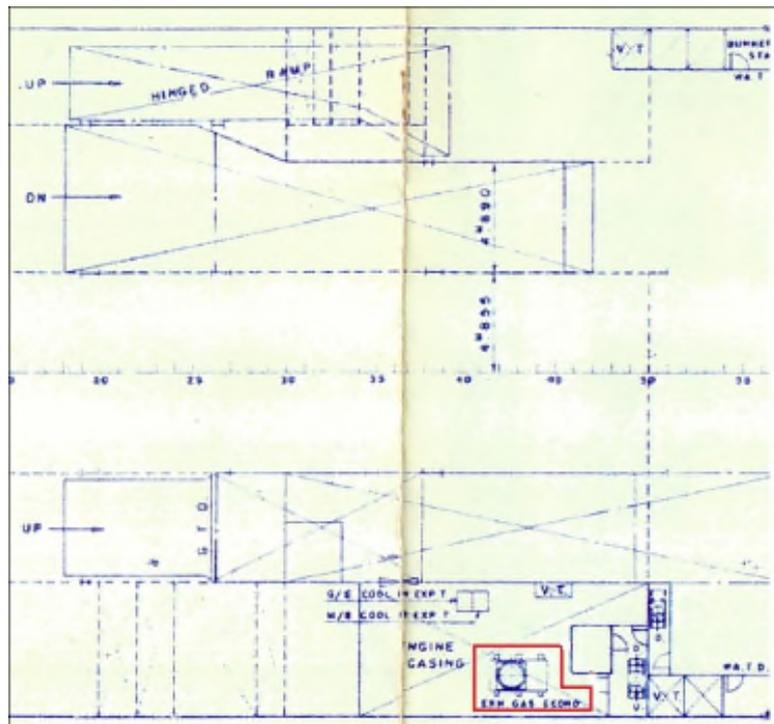


Fig: 12 Location of Economiser - Deck 7

- 3.20 The primary source of the fire was found to be centred in the incinerator room, which was fed by the pilot burner and diesel fuel tank, the content leaking fuel from the burnt pipes and melted alloy fuel filters under the incinerator. The diesel tank and the waste oil tank were both found empty.
- 3.21 Prior to the fire the diesel tank was stated to have been “*about half full*”, which would indicate that it had contained approximately 300 litres of diesel.
- 3.22 A large amount of insulation in the stairwell had allowed a secondary fire to develop, which spread to No. 2 Car Deck. The spread of the fire was caused by the opened Incinerator room door. The insulation had been removed in places, down to the bare metal. Where insulation did remain, it was evident that the cladding had been coated with paint.

MV Tai Shan – Marine Safety Investigation Report

Officer in Charge of Engineering Watch – 4/E

3.23 The following additional information was established by the 4/E:

- He had been at sea for 7 years and had sailed as 4/E since 2013, having joined the vessel one month prior to the incident.
- He had been informed by the off signing 4/E that there was leakage on the diesel filter for the diesel pilot burner for the incinerator. This leakage had been reported to off signing 2/E. The filter was positioned under the incinerator, within the save all area.
- The 4/E had carried out some repairs, on the filter, including use of thread tape on fittings, replacement of an “O” ring on the filter cleaning shaft, and changed to top cover gasket, using standard rubber insertion packing, 2 weeks prior to the incident. Following the repairs to the Incinerator, the leakage had reduced; however, this was not completely satisfactory.
- Subsequently on each occasion prior to using the incinerator, the operator would wipe up any diesel collected under the incinerator and the used rags would be placed in a steel drum in the incinerator room.
- This drum would only be emptied when instructed by the 4/E, which was usually when it was approximately half full.
- On the day of the incident, he had used the abovementioned drum to hold open the door, from the incinerator room to the stairway from the engine room to the upper deck.
- The usual procedure was for oil to be transferred from the Sludge tank to the Incinerator waste oil tank each evening, and for the steam heating of the waste oil tank to be applied through the night to allow the evaporation of any water.
- On the morning of the incident, he had started the incinerator to burn waste oil, at approximately 08:00 hours on his way down to the engine room.
- Approximately 40 minutes later, the incinerator alarm activated and on checking, he found that a flame fault and low waste oil tank alarm had activated. This was thought to be unusual, as he thought the waste oil tank contained approximately 450 litres, which would have taken 8 to 9 hours to empty.
- The 4/E decided to shut down the incinerator, continue with his duties and come back later in the day to investigate further.

Fire Alarms Activated

3.24 At 09:12 hours, the fire alarm sounded, being identified within zone – Engine Casing (Car Deck No: 1 L6). The Master, who was on the bridge within a minute of the fire alarm sounding, announced over the intercom that there was a fire in the funnel and that it was not a drill. On looking aft, the Master sighted from the starboard wings, “*clouds of thick black smoke from and around the funnel*”. The Engine Log Book recorded the events, one hour earlier than the bridge log book. The statements issued by engine staff all stated the same times as the bridge log book, indicating incorrect times in the engine log book.

3.25 A second fire alarm activated in less than 2 minutes - Engine Casing (Car Deck No. 6 - Alarm L7). At 09:14 hours, the C/E, who was in the Engine Control Room, advised the Bridge officer of the watch, that there was a fire in the Auxiliary Boiler area and requested that the main engine was stopped from the bridge control. The vessel altered course to keep the wind from the port side.



Fig.13 ECR – Fire Alarm Panel

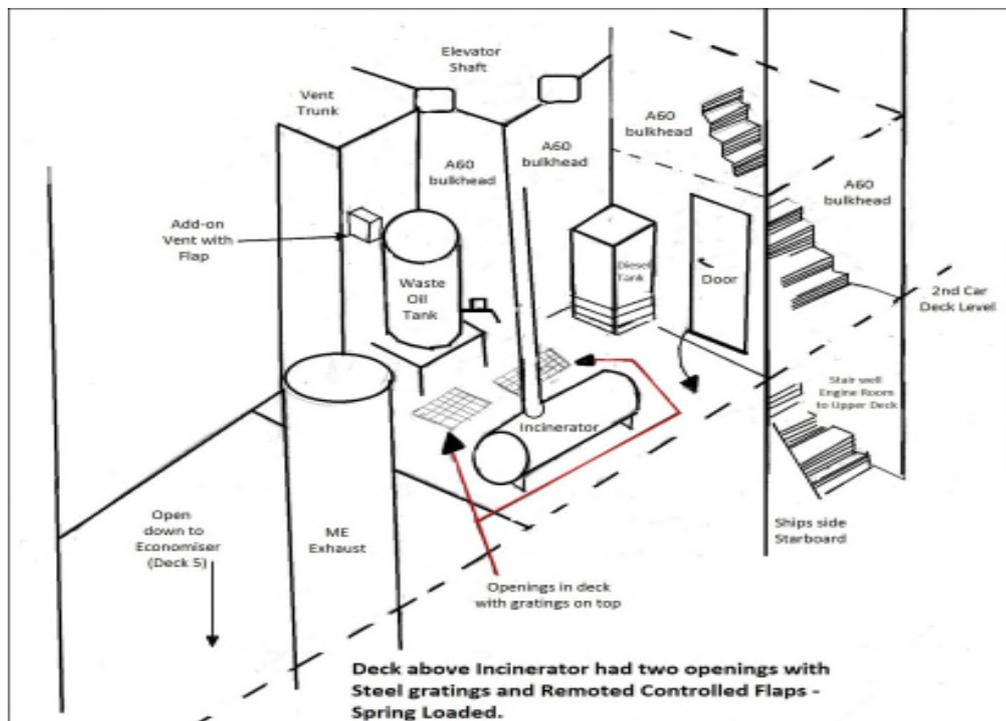


Fig. 14 Incinerator Room

Spread of the Fire

- 3.26 The incinerator was positioned on a platform (not enclosed), level with the 2nd car deck within the engine casing and adjacent to the stairwell leading from the engine room level to the upper deck. No drawings, which could adequately illustrate the actual situation, were found and the sketch above was drawn up to assist (Fig. 14).
- 3.27 The 4/E and firefighters arriving at the scene of the fire, concurred that the door from the incinerator room was propped open with a drum, used to hold rags and other garbage. The rags were those used to wipe up diesel which had leaked under the incinerator. The empty drum shown was the one used to prop open the door. Following the incident unburned garbage was placed in the drum.



Fig. 15 Drum propping open door

- 3.28 The flaps in the deckhead above the incinerator were open, which would allow pressurised air from the engine room into the upper funnel casing and out of the louvered vents.
- 3.29 It could not be confirmed if the flap had been closed at any stage during the fire. The flaps had a manual release facility as well as a remote (pneumatic) facility. The Electrician stated that he had closed the flaps by pulling the trip wire outside the engine room casing. However (Fig.16) shows flaps in the funnel casing deck still open, following the fire.



Fig. 16 Flaps in the funnel casing deck at upper deck level

- 3.30 With the flaps open the updraft, caused by air flow from the engine room air supply fans exhausted out of the funnel casing louvres and the open stairwell door on the upper deck.
- 3.31 The relative sizes of the openings (partially open incinerator room door and open funnel casing flaps), were estimated to be slightly larger through the funnel casing louvres.

MV Tai Shan – Marine Safety Investigation Report

- 3.32 The fire, starting in the incinerator room, would be propelled into the stairwell and also upward into the upper part of the funnel casing into the cargo space. If the flaps in the division deck were closed, the fire would all be pushed through into the stairwell and out through the open door to the upper deck, until the upper deck door was closed.
- 3.33 The heat generated by the fire, fuelled by diesel leaking via fittings on the incinerator, resulted in temperatures in excess of the melting point of Brass (approximately 900°C). The alloy filter, originally fitted under the incinerator, had melted completely.



Fig. 17 Melted alloy under the Incinerator

Fire Fighting Team

- 3.34 At 09:16 hours, the 2/O reported that all the crew were present, with the C/O being in bed with a high fever. The Master placed the 2/O in charge of the fire fighting. The fire dampers on the funnel were closed. The 2/O's normal duty in an emergency was to be on the bridge assisting the Master, with communication.
- 3.35 The 2/O acted as Fire Team 1 team leader with the 3/O and an AB while the 2/E was designated as the engine room - Team 2 team leader in charge of the 3/E and oiler.
- 3.36 Fire Team 1 initially attacked the fire from the top of the staircase on the upper-deck; however, this was not successful. The staircase door to deck was then closed and the team went down to deck 7, to attempt to fight from below, from the boiler area.

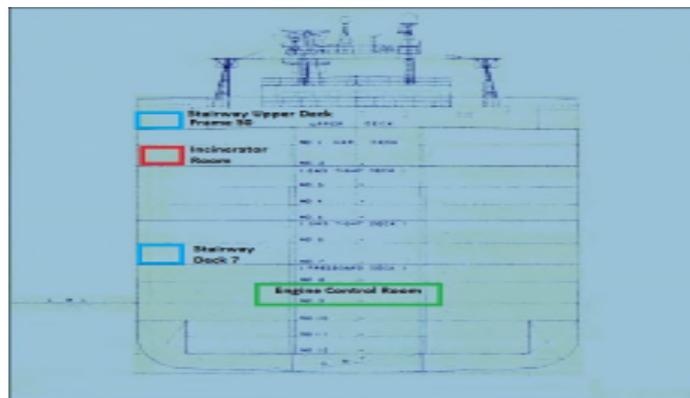


Fig.18 Team 1 Fire Party –  Stairway Upper Deck

- 3.37 At 09:28 hours, electrical power was lost and the emergency generator started. A mains clock on board stopped at 0928 confirmed this outage.

MV Tai Shan – Marine Safety Investigation Report

- 3.38 The source of the fire had not yet been identified and a report from the Electrical Engineer that dense smoke was found at car deck 7, resulted in Fire Team 1 being sent down to attack the fire from the economiser level.
- 3.39 The 3/O reported that he and the AB were waiting for some time for water pressure on their hoses. The Master instructed the C/E to ensure that the emergency fire pump (car deck 9 aft) was running and upon confirmation, instructed the C/E to check all valves as to why there was no water coming from the fire hydrants on the car deck and those used in the lower parts of the engine room.
- 3.40 By 09:49 hours the water pressure to the fire main was restored. The AB's BA set pressure was low, with less than 10 minutes of air remaining and he had to retreat. A few minutes later, the 3/O was asked to retreat, by the 2/E.
- 3.41 The 3/O then approached the fire via the staircase. He was able to direct water up the stairs towards the door of the incinerator room, which was slightly open.
- 3.42 The fire was subsequently found to have been fed by the pilot burner diesel fuel tank contents, leaking from burnt pipes onto a hot surface and melted alloy fuel filters under the incinerator.
- 3.43 During investigations, the diesel tank and the waste oil tank were both found empty. Prior to the diesel tank was stated to have been "about half full", which would indicate that it had contained approximately 300 litres of diesel.
- 3.44 The position of the detector which first detected the fire was approximately 3.5 metres above the incinerator, as the space was a double volume compartment, covering 2 decks.
- 3.45 The water pressure again dropped at 1022 and the 3/O and AB had to retreat into car deck 2, where the 3/O had to change his BA cylinder. The Master instructed the C/E to ensure that the emergency fire pump was running and once confirmed, he was instructed to check all valves to establish why there was no water on the hydrants in the car deck and those used in the lower parts of the engine room.
- 3.46 It was established that the fire was located in the Incinerator Room on car deck level 2. The water pressure was obtained from all fire hydrants after opening the isolation valves on upper deck level.

Fire Fighting

- 3.47 Fire fighting was initially attempted from the top of the stairway from the engine room to the upper deck. This was not successful, as the open door acted as an updraft, bringing the fire up the stairway, at the same time feeding the fire from below.
- 3.48 Fire fighting from the engine room was attempted, however, there was no / low water pressure on the hydrants and effectively no significant amount of water could reach the fire which was 3 decks up from the top level which could be reached from the engine room.
- 3.49 Consideration was given to the use of the bulk CO2 system but as the fire was at the extreme upper level of the engine room, it was decided that the effectiveness would be limited. Only one CO2 nozzle was provided at the Incinerator flat and even if it was directed at the fire near the beginning of the flooding, the gas would disperse down the open engine room casing until the engine room was completely filled with CO2 from the other nozzles. The engine room fans would have been switched off prior to flooding.
- 3.50 The operation of the quick closing valves for the outlet valves for the diesel and incinerator waste oil tanks had not been activated. It was noted that the valves were included in the "one shot" system for all quick closing valves. If operated, all other fuel supply quick closing valves, which may have been needed, would have had to be manually reset. After the vessel

MV Tai Shan – Marine Safety Investigation Report

blackened out, this would have not been of significance, and only the emergency diesel generator supply valve would have required manual re-opening. The quick closing valve on the diesel tank for the incinerator was found stuck in the open position.



Fig. 19 Quick closing valve – diesel tank

- 3.51 Fighting the fire from the car decks access to the stairway was the most effective route. It was established that access to the stairway was delayed due to lack of effective water pressure, which later found to be due to fire main isolation valves for the car decks (and engine room) being shut.



Fig. 20 Isolation valve for car decks 1 to 7

- 3.52 The boundary cooling on deck was rigged and applied within a few minutes but the first effective use of water at the seat of the fire, appeared to have been at 10:00 hours, which was 48 minutes after the fire alarm sounded.

MV Tai Shan – Marine Safety Investigation Report

- 3.53 The fire in the incinerator room was reportedly extinguished by approximately 10:35 hours. During assembling and debriefing the crew on the upper deck, at 11:08 hours it was found that there was still fire in the elevator motor room which is accessed from the funnel casing on the upper deck level. This fire was attacked and reported extinguished by 11:20 hours. These times differed up to 10 minutes, in the crew statements, however, the Masters log has been taken as a guidance as he would have been more capable of recording actual times than persons fighting fires.

Fire Extinguished

- 3.54 The fire in the incinerator room (car deck level 2), was reportedly extinguished by attacking from the No. 3 car deck level, via the door to the incinerator room which had been propped open with a drum. Logged records reported that the fire in the incinerator room was extinguished by 10:34 hours.
- 3.55 All crew were mustered on the upper deck, near to the stairwell entrance door, with all persons accounted for by 10:40 hours.
- 3.56 Post fire rounds were carried out and at 11:08 hours it was found that a fire was still burning in the elevator motor room, which was a separate compartment within the engine/exhaust casing, at the upper section of the stairwell casing, immediately above and forward of the incinerator room.
- 3.57 The fire team, including the 3/O entered the exhaust casing and attacked the elevator room fire, reportedly extinguishing this by 11:30 hours.
- 3.58 An examination of the car decks, revealed that some cars had been damaged on car deck level 2 from heat radiated from the bulkhead shared with the engine room casing.
- 3.59 The Master then reported the incident to the operators via satellite phone.
- 3.60 Fire rounds were maintained, gradually extending the period between rounds, to 1 hour, after 6 hours.
- 3.61 Due to the burnt cabling leading from the engine room to deck and between the emergency generator and the main switchboard, selected circuits were powered from the Emergency Diesel Generator (EDG) by fitting of temporary cabling in order to maintain essential services.
- 3.62 In consultation with the Managers, the Master contacted salvors to tow for repairs and investigation at Durban, The Republic of South Africa.

Vessel under Tow

- 3.63 On the 04th July 2014, the tug “Pacific Peacock” designated to tow the stricken vessel to Durban approached the *Tai Shan* in preparation for the tow at 16:15 hours. Once in position, preparations for the tow began. The operation was completed at 18:20 hours, with the length of tow being 810 metres.
- 3.64 The position at the commencement of the tow was latitude 35° 10' .3S longitude 048° 27' .2E, some 935 nautical miles on a course of 284° from Durban. Her expected speed was 4 knots.

Throughout the tow the bridge was fully manned and the *Tai Shan* kept a radio watch on VHF channel 06, arriving off Durban on the 15th July at 07:10 hours.

MV Tai Shan – Marine Safety Investigation Report

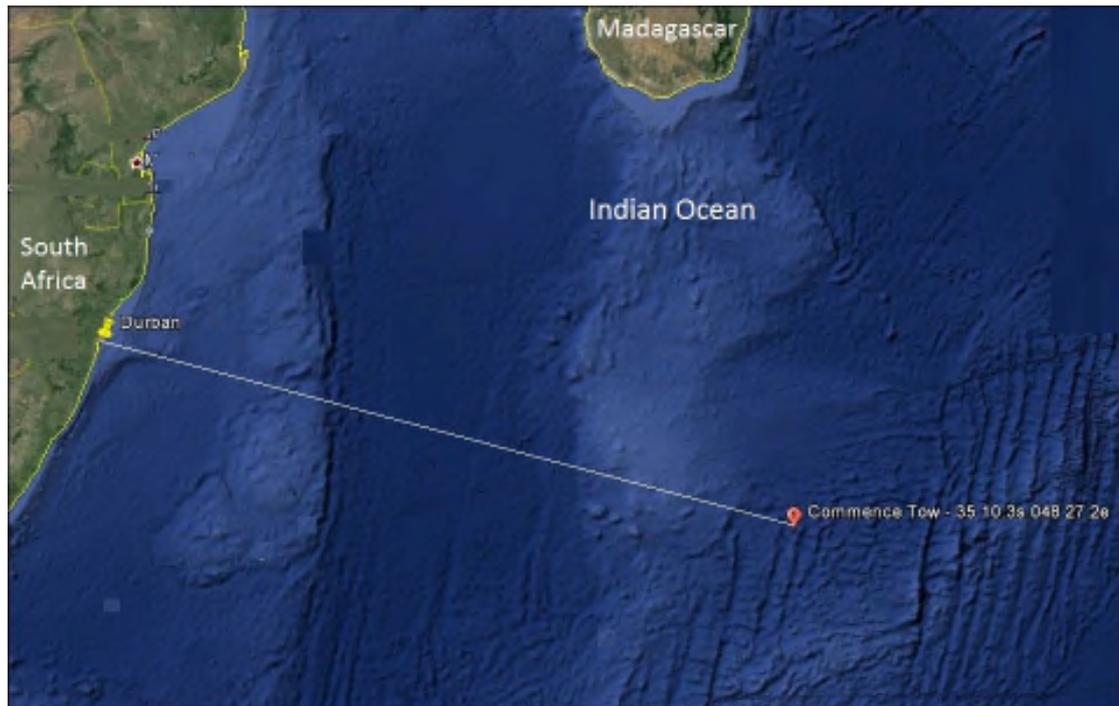


Fig. 21 Tow under with “Pacific Peacock”

- 3.65 The tow by tug *Pacific Peacock* of the *Tai Shan* was completed at 09:42 hours on the 15th July with the arrival at Durban pilot station, having averaged 3.6 knots for the passage.

4 ANALYSIS

- 4.1 The Voyage Data Recorder data was not preserved therefore an accurate timeline was not able to be produced and findings relied solely on statements from the crew and logbooks.
- 4.2 The C/O remained ill in bed throughout the incident, resulting in the need for the 2/O to take charge of the Fire Teams. This resulted in the Master being alone on the wheelhouse, having to coordinate the firefighting and maintaining log book entries during the incident.
- 4.3 In the absence of the C/O, the 2/O was appointed as team leader for Fire Team 1, although only having an Extended Fire Fighting course proved to managed the task well.
- 4.4 The Oil Record Book had been completed in accordance with MARPOL 73/78 and on each occasion was signed off by the relevant person in charge throughout the operation.
- 4.5 The actual source of ignition was not able to be precisely determined. The reports of fuel leakage under the incinerator, requiring wiping up before each operation would indicate the likely source of fuel for the fire.
- 4.6 The off signer 4/E who left the vessel at Cotonou, Benin on the 19th June, reported to his relief, of the diesel leakage beneath the Incinerator. The on signing 4/E had carried out repairs to the diesel leaks, however this was not successful, as wiping up the diesel was still necessary.
- 4.7 Having joined the *Tai Shan* the 4/E had operated the Incinerator on four previous occasions. So the 4/E was familiar with the Incinerator operating procedures, yet the operation of the incinerator was not carried out in accordance with the manual. Purging the system for only 20 seconds may have resulted with residual sludge remaining and the cooling effect would have been marginal. The air flaps for determining the ratio of air which would be delivered to the casing cooling and the burner area were incorrectly set.
- 4.8 The incorrect post operation purging of 20 seconds, as stated by the 4/E, although the manual post operation purging recommended a time of 20 minutes. This failure may have resulted in “hot spots” and the potential for a hot embers or carbon to drop and emit sparks.
- 4.9 A small fire in the Economiser room on car deck No.7 was the result of fire debris falling through the gratings from the incinerator room to deck 5.
- 4.10 The fire under the incinerator melted the fuel filter which was positioned within the save-all. According to the 4/E, he had not shut any valves between the diesel tank and the filter when he shut down the incinerator. The waste oil tank temperature was kept at a temperature of about 85° Celsius, with the steam on. The 4/E was also involved in other tasks in the Engine Room which may had distracted him from the management of the Waste Oil Incinerator.
- 4.11 The automatic stop on the incinerator activated between 08:00 hours and 08:40 hours on the 2nd July 2014, indicating that there was either a fault with the incinerator, or the waste oil tank had only been partly filled on the 1st July 2014.
- 4.12 During the investigation, the Waste Oil tank was found empty, or at least as far as the dipstick sounding arrangement could reach, which appeared to be at about 10 % level.
- 4.13 It had become a regular practice on board for the incinerator door to the stairwell to be kept opened with the drum, used to collect the oily rags used to wipe up the oil leaking from the incinerator, .
- 4.14 The positioning of the incinerator in conjunction with the staircase door and flaps being open, provided an extreme draught through the incinerator room, fed by the engine room ventilation fans. Once a fire started, the rising heat would create its own updraught, even if the fans were

MV Tai Shan – Marine Safety Investigation Report

stopped. This would continue until the door at the top of the stairway and the flaps in the deckhead above the incinerator to the upper deck level of the funnel casing were closed.

- 4.15 The heat generated, by the fire in the incinerator room, was in excess of 900° Celsius, which is the approximate melting temperature of brass, (Brass fittings were found melted). The heat had resulted in ignition of the cabling on the other side of the A60 bulkhead shared with the stairwell, which appeared to have been probable, even if the incinerator room door was closed.
- 4.16 SOLAS Specification for an A60 bulkhead, is that it shall be insulated with approved non-combustible materials, such that the average temperature of the exposed side, will not rise more than 140° Celsius above the original temperature, nor will the temperature, at any one point, including any joint, rise more than 180° Celsius above the original temperature, within 60 minutes.
- 4.17 Although consideration was given to activating the CO² system, it was discounted from being initiated owing to the number of CO² discharge nozzle in the Incinerator Room.
- 4.18 It appeared that the ship staff believed that the fire isolation valves to car decks (and apparently the engine room), should be closed and only opened as required. This is a dangerous practice and undoubtedly caused delays in actively fighting the fire.
- 4.19 It was reported that the cabling in the stairwell was burning less than an hour after the fire was detected. The door from the incinerator room, to the stairwell had been held open by a drum would have resulted in breaching of the A60 division. This would have caused a secondary fire to develop, which spread to cargo space.

5 CONCLUSIONS

- 5.1 Although the precise seat of the fire was not able to be determined, however the resultant damage indicated that the fire was probably initiated in the incinerator room. The fire detector only detected the fire approximately 32 minutes after the incinerator was stopped, however it is possible that the fire started some time before detection as the detector was installed approximately 3.5 m above the incinerator and was a “rate of rise heat detector” type.
- 5.2 Insufficient care was taken by the crew, to ensure that any fuel leakage in way of the Incinerator was addressed in a timely manner. The responsibility was given to the 4/E to maintain the incinerator. It had previously been reported of the leakage to the previous 2/E. The C/E and 2/E at the time of the incident were unaware that there was any leakage requiring wiping up prior to each operation.
- 5.3 The fire started under the incinerator, resulting in more leakage from rubber gaskets and subsequently melting the alloy fuel filter. Due to open valves, this provided a constant source of diesel to fuel the fire until the diesel tank, (reportedly containing approximately 300 litres of diesel) was empty.
- 5.4 A possible source of ignition may have been hot ember dropping out of the incinerator. Although there was no evidence that this could have come from the solid waste loading chute, which was fitted with a flap, a tight fitting gauze and a door, albeit that the door was warped after the fire. Records also indicated that solid waste had not been burned for some time, although the inspection of the furnace indicated that it had not been cleaned properly after the last solid waste incineration.
- 5.5 The dampers fitted for the incinerator forced draft fan were found in the wrong position. It was possible that this had resulted in a “hot spot” compounded by the lack of post purging. Although, as stated by the 4/E, there was no obvious means noted for a hot spot to cause ignition of any free oil or diesel.
- 5.6 Spontaneous combustion of oily rags in the drum placed in the doorway of the incinerator room is unlikely; there was no evidence to confirm this as a possible cause.
- 5.7 The statement that the incinerator had tripped due to “*low waste oil tank level*” and “*flame fault*”, especially in view of the belief that the tank was in fact full, does indicate the possibility of an electrical fault. However there was a possibility that the tank had not been full, and that the flame fault and low waste oil tank level alarms were the result of the lack of oil supply to the burner.
- 5.8 Fire fighting was delayed, due to initially attempting to fight from above, down the staircase, and later, due to no water pressure, caused by closed isolation valves to car decks and also the engine room hydrants. Due to the door from the incinerator room to the stairwell having been held open by a drum, this made attacking the fire from the stairwell virtually impossible.
- 5.9 The significance of whether or not the flaps in the separation between the incinerator compartment and the funnel space above were closed during the initial fire-fighting attempts, does not appear to be quantifiable. If they were closed, all of the fire would have been forced through the open incinerator room door to the staircase. If they had not been closed, the fire would all have been forced through into the funnel casing and out of the funnel louvers.
- 5.10 In conclusion, the cause of the fire, appeared to be lack of effective maintenance regarding diesel leakages on the incinerator, the incorrect operation of the incinerator and the oily rags adding to the fuel source once the fire had been established. The spread of the fire was exacerbated due to lack of water pressure on the hydrants, resulting from closed isolation valves, compounded by the door from the incinerator room to the stairwell and the door at the top of the stairwell being opened.

6 RECOMMENDATIONS

Recommendations for the Managers

- 6.1 To review the management and procedures for fire main isolation valves.
- 6.2 To develop procedures to ensure incinerator rooms are frequently attended when in use and any issues are raised promptly with senior officers.
- 6.3 To ensure that any leaks occurring in the fuel supply lines should be address promptly in accordance with good engineering practice.
- 6.4 Safety management procedures need to be adhered to ensure all fire doors are never left open.

Appendix I: Oil Record Book extract 2 July 2014

Name of ship M/V TAI SHAN
 IMO Number 2513560

MACHINERY SPACE OPERATIONS

| Date | Code (letter) | Item (number) | Record of operations/signature of officer in charge |
|---------------------------|---------------|---------------|---|
| 02 JULY 2014 | C | 12.3 | 0.05 m ³ SLUDGE INCINERATED |
| | | | START 0800 / STOP 0845 |
| | | | RETAINED 0.40 m ³ |
| | | | 02 / JULY / 2014 4E [REDACTED] |
| 02 JULY 2014 | D | 13 | 1.2 m ³ BILGE WATER FROM E/R BILGES |
| | | 14 | START 0850 / 0857 |
| | | 15.3 | TO BILGE TK RETAINED 5.80 m ³ |
| | | | 02 / JULY / 2014 4E [REDACTED] |
| 04 JULY 2014 | D | 13 | 20 m ³ BILGE WATER FROM E/R BILGES |
| | | 14 | START 1300 / STOP 1450 |
| | | 15.3 | TO BILGE TK RETAINED 25.80 m ³ |
| | | | 04 / JULY / 2014 4E [REDACTED] |
| 04 JULY 2014 | D | 13 | 18 m ³ BILGE WATER FROM BILGE TK |
| | | 14 | START 1800 / STOP 2200 |
| | | 15.1 | LAT. 35° 10.097' S, LONG 048° 27.926' E |
| | | 15.1 | LAT. 35° 08.539' S, LONG 048° 15.763' E |
| | | 15.1 | TROUGH 15 FPM EQUIPMENT |
| | | 15.1 | RETAINED 7.50 m ³ |
| | | | 04 / JULY / 2014 4E [REDACTED] |
| Signature of master | | | [REDACTED] |

REV. 03 November 2010

THE COMMONWEALTH OF THE BAHAMAS MINIMUM SAFE MANNING DOCUMENT

Issued by The Bahamas Maritime Authority

under the provisions of regulation V/14 of the International Convention on the Safety of Life at Sea, 1974, as amended and pursuant to regulation 24 of The Bahamas Merchant Shipping (Training, Certification, Manning and Watchkeeping) Regulations 2011

Particulars of the ship: Certificate Number: C6AZ2/SM/001

| | | | |
|-----------------|----------------------------------|----------------|-----------------|
| Name of Ship | Port of Registry | IMO Number | Official Number |
| TAI SHAN | Nassau | 8513560 | 7000612 |
| Gross Tonnage | Main Propulsion Power - (KW/BHP) | Type of Ship | Call Sign |
| 48676 | | | C6AZ2 |

| |
|---|
| Trading Area: World Wide |
| Operating Company: Green Management Sp. z.o.o. |

The ship named in this document is to be considered to be safely manned if, when it proceeds to sea, it carries not less than the number and grades/capacities of personnel specified in the table below, subject to any attached conditions. The certificate and training are in reference to the STCW 1978, as amended.

| Grade / Capacity | Certificate / Training | Number of Persons Condition 1 | Number of Persons Condition 2 | Grade / Capacity | Certificate / Training | Number of Persons Condition 1 | Number of Persons Condition 2 |
|---|------------------------|-------------------------------|-------------------------------|--|------------------------|-------------------------------|-------------------------------|
| Master | II/2 | 1 | - | Chief Engineer | III/2 | 1 | - |
| Offshore Installation Manager | - | - | - | Maintenance Supervisor | - | - | - |
| Chief Mate | II/2 | 1 | - | Second Engineer | III/2 | 1 | - |
| Officer in Charge of Navigational Watch | II/1 | 2 | - | Barge Supervisor | - | - | - |
| Ballast Control Operator | - | - | - | Officer in Charge of Engineering Watch | III/1 | 1 | - |
| Able Seafarer Deck | II/5* | 3 | - | Electro-Technical Officer | - | - | - |
| Rating (Navigational Watch) | II/4 | 1 | - | Able Seafarer Engine | - | - | - |
| Ship Cook | - | 1 | - | Electro-Technical Rating | - | - | - |
| Doctor | - | - | - | Rating (Engine-room Watch) | III/4 | 1 | - |
| Other | - | - | - | Other | - | - | - |
| Periodically Unattended Machinery Space | | | | | | Yes | |
| Special requirements or conditions if any | | | | | | | |
| See Conditions Overleaf. | | | | | | | |
| *See conditions 2, 12, and 14 overleaf | | | | | | | |

Issued at London on ~~31 January 2014~~ 03 31 January 2014

Date of Expiry: 30 January 2019



Name: [REDACTED]
Duly Authorized Official
For and on behalf of The Bahamas Maritime Authority

Appendix III: Shipboard Management Manual – Engine Room Procedures Rev.00

| | | |
|---|---|---|
|  | Shipboard Management Manual Engine-room procedures | Revision No.: 00 Rev. date: 01/01/1999 Appr. by: Oyvind Johannessen Prep. by: Sverre A Kristoffersen |
| | Doc.no: 52.01.010 Chapt.: 09-04 | Page: 1 of 1 |

9.4 FIRE IN ENGINE ROOM.

1. Engine-room fire instructions. During E0. Ref. Posted Muster List.

In the event of fire, sound the alarm immediately.

- (a) Inform the Officer on Watch.
- (b) Inform the Chief Engineer.
- (c) If possible, bring the situation under control. Wait for assistance.
- (d) When assistance has arrived act according to posted alarm instructions.

2. Engine-room fire instructions. During manned engine- room. Ref. Posted Muster List.

On discovery, or on receiving message or suspicion of fire in the engine room or surrounding area, the Engineer on Watch shall immediately:

- (a) Release fire alarm.
- (b) Inform the Officer on Watch.
- (c) Inform the Chief Engineer.

The Engineer on Watch shall try to fight any incipient fire using of all available fire fighting equipment in engine room when waiting for assistance.

If he does not succeed, and the fire seems be getting out of control, he shall:

- (a) Order evacuating of the engine room.
- (b) Close down all ventilation.

He shall then place himself at engine room fire station and wait for assistance.

When Chief Engineer arrives, Engineer on Watch shall pass on all available information about the situation to him.

After this, act in accordance with posted alarm instruction.

3. Instructions for Engineer on Duty. Fire outside engine-room . Ref. Posted Muster List.

- (a) When the fire alarm sounds, start the fire pump immediately and pressurise deck fire line.
- (b) Start necessary auxiliary engines and prepare for possible reduction of speed and manoeuvres if ship is at sea.
- (c) Remain in engine room until reliever arrives. Inform him about the steps already taken after this, act accordance with posted alarm instruction.

Appendix IV: Shipboard Contingency Plan Fire Muster List Rev.00

| | | | |
|---|--|--|--|
|  | Shipboard Contingency Plan | | Revision No.: 00 Rev. date: 27/12/2013 Appr. by: Wlodek Wencel Prep. by: Dariusz Terech |
| | Emergency Plans for this vessel | | Doc.no: 52.01.014 Chapt.: 01-200-01 Page: 4 of 4 |

| FIRE MUSTER LIST | | |
|------------------|------------|--|
| Rank | Emcy No. | Rank |
| Master | Master | Overall in charge of operation, |
| C/O | C/O | Team 1 - Squad leader. On-scene commander in case of fire in deck. |
| 2/O | 01 | Prepare radio equipment, Distress comm. on Master order. First Aid |
| 3/O | 02 | Team 1 - Fireman. Wear smoke diving equipment. |
| C/E | C/E | In charge of firefighting |
| 2/E | 21 | Team 2 - Squad leader. On-scene commander in case of fire in engine. |
| 3/E | 22 | Team 2 - Fireman. Wear smoke diving equipment. |
| 4/E | 23 | Tech Squad – Close vents and door as required. General support |
| ETO | 24 | Tech Squad – Circuit breaking. Vent Fan control. |
| Bsn | 10 | Backup Squad – Boundary cooling. Boat preparation. Assists as required |
| AB | 11 | Helmsman – If not required – Backup Squad |
| AB | 12 | Team 1 - Fireman. Wear smoke diving equipment. |
| AB | 13 | Team 1 - Linesman for smoke divers |
| OS | 14 | Backup Squad – Boundary cooling. Boat preparation. Assists as required |
| OS | 15 | Backup Squad – Boundary cooling. Boat preparation. Assists as required |
| FTR/E | 30 | Team 1 - Bring fire hoses, nozzles and fire extinguisher |
| FTR/D | 31 | Team 2 - Bring fire hoses, nozzles and fire extinguisher |
| MTM | 32 | Team 2 - Fireman. Wear smoke diving equipment. |
| MTM | 33 | Team 2 - Linesman for smoke divers |
| Cook | 40 | Med Squad - Brings First Aid Kit. Assists as required |
| MSM | 41 | Med Squad - Brings stretcher. Assists as required |
| extra | 50, 51, 52 | Other personnel assists as required |

| ENCLOSED SPACE MUSTER LIST | OIL POLLUTION MUSTER LIST |
|--|---|
| <p>Master overall in charge of operation</p> <p>If engine room - Chief Engineer operation leader (Chief Officer act as substitute)</p> <p>If ballast tank or cargo holds - Chief Officer operation leader (Chief Engineer act as substitute)</p> <p>Emrg no:</p> <p>01 Prepare radio equipment, await orders</p> <p>02 / 22 Wear smoke diver equipment</p> <p>13 Linesman for smoke divers</p> <p>10 / 12 / 24 Assist as required</p> <p>32 Bring light if necessary</p> <p>11 / 32 Assist linesman</p> <p>30 Bring other equipment as required</p> <p>40/41 Bring stretcher and first aid kit</p> <p>Other personnel stand by awaiting orders.</p> <p><i>(See also Shipboard Contingency Plan, chapter 5)</i></p> | <p>Master</p> <p>Overall in charge. Inform terminal authority of incident. Inform local agent and request local P&I club representative Advise the company's head office of the situation, keep everyone updated. Request assistance as deemed necessary.</p> <p>Chief Officer</p> <p>In charge of deck operations.</p> <p>Keep Master informed of the situation and results of steps taken to limit the outflow.</p> <p>Chief Engineer</p> <p>In charge of engine / bunker operation. Organise distribution of oil spill detergent. Start fire/foam pump if required.</p> <p>01 / 02 Deck Officer on duty</p> <p>Stop bunker operation in an emergency. Alert and inform Ch.Off / Ch. Eng. Alert shore / barge staff and close all valves on bunker manifold.</p> <p>21 / 22 / 23 Engineer on duty</p> <p>Prepare to fight oil pollution. Assist Ch.Eng. Open an empty tank for transfer if necessary.</p> <p>Rating on duty.</p> <p>If oil leakage is detected, alert the duty officer immediately. Commence cleaning up procedure as required.</p> <p><i>(See also Shipboard Oil Pollution Emergency Plan)</i></p> |

This is an uncontrolled paper copy of Green Managements TQM system. Whenever this document is electronically revised, a printed copy of the new revision shall replace the old. It is the responsibility of the reader of this document to ensure that this paper copy is valid.

| | | |
|--|---|--|
|  Green Reefs | Shipboard Contingency Plan Emergency Plans for this vessel | Revision No.: 00 Rev. date: 27/12/2013 Appr. by: Wlodek Wencel Prep. by: Dariusz Terech |
| | Doc.no: 52.01.014 Chapt.: 01-200-01 | Page: 2 of 4 |

PLAN

FIRE ALARM

Fire Alarm - Automatically Activated by Fire detection System + Continuous sounding of Alarm bells, And additionally verbally announced on ship's PA system or by two way radio.

STRATEGIC FIRE FIGHTING LOCATION

Chief Engineer is in charge of Fire Fighting, supervision and overview of firefighting operations, technical and backup control. Reports to the Master

FIRE FIGHTING PARTIES

| | |
|--|---|
| Team 1 – Chief Officer – Team Leader In case of fire on deck, in cargo holds, pump room, in accommodation. Team 1 will stay in the front line of fire fighting operations. Team 2 will back up | Team 2 – 2nd Engineer – Team Leader In case of fire in Engine Room, or any machinery spaces topside. Team 2 will stay in the front line of fire fighting operations. Team 1 will back up |
|--|---|

General Support Team El. Officer Team Leader

| | | |
|---|---|--|
| Technical Squad – Circuit breaking, Vent Fan control. Close vents and door as required. General support | Back-up Squad – Boundary cooling. General support. Lifeboat preparation if ordered. | Medical Squad – Stand by to assist in first aid/evacuation. General support. |
|---|---|--|

SUPPLEMENTARY PERSONNEL

Additional crew members, tidying squad, visitors with required training
 Act as ordered – may handle hoses, ready boats, perform general support

Supernumeraries, passengers, visitors without required training:
 Stand by as ordered

| | |
|---|--|
| EMERGENCY CONTROL CENTRE (E.C.C.) – BRIDGE 1. Following to meet directly at (ECC) Captain and Emergency no. 01 and 11. 2. If bridge inaccessible the ECC changes to forecabin deck 3. Emergency no. 01 (Radio Operator) prepare all radio equipment for immediate use. 4. Distribute Emergency VHF and establish communications with VHF or other Com. equipment, with leaders | ENGINE CONTROL ROOM (E.C.R.)- Engine control room 1. Following to meet directly in (E.C.R.) Chief Engineer Emergency no. 22, 24 and 31. 2. Report to E.C.C. confirm if all are present and awaiting in the a. 3. If fire alarm, start fire pumps after instructions from E.C.C. NB: If Engine control room is inaccessible proceed to E.C.C and report. |
|---|--|

GENERAL FIRE INSTRUCTIONS

Any person spotting the fire should:

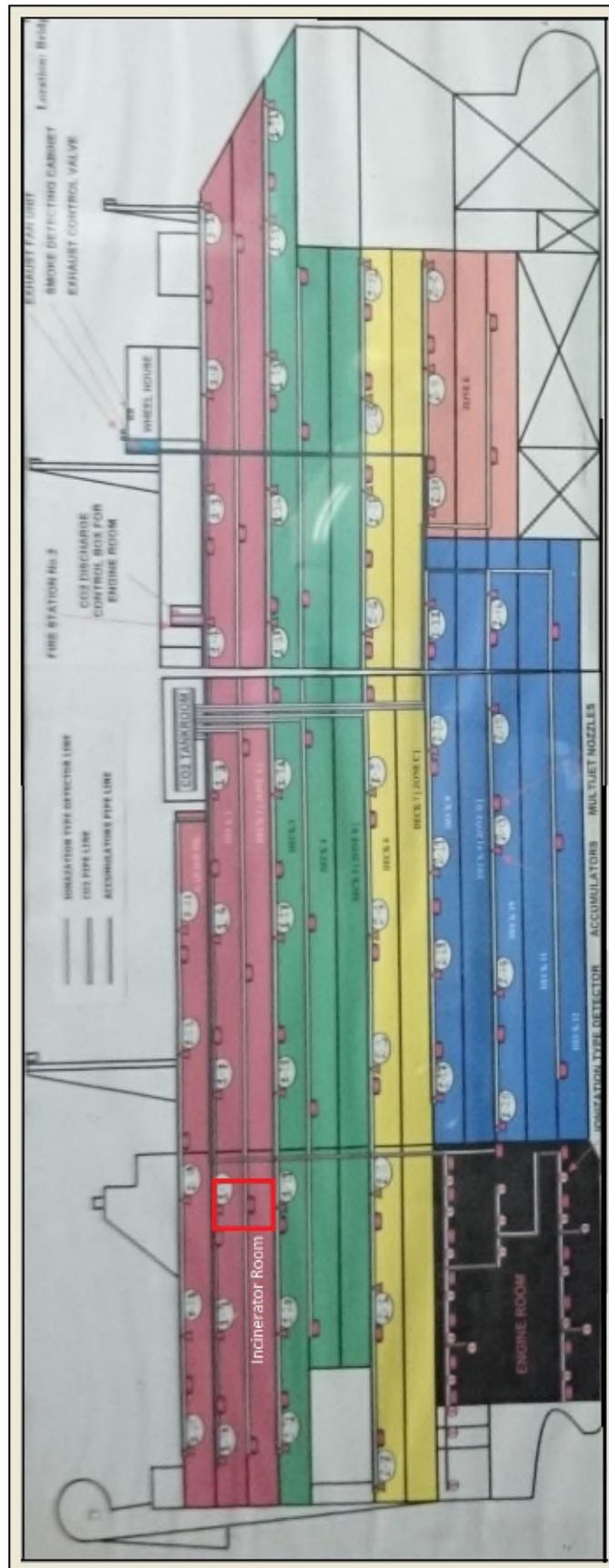
- Raise the alarm,
- Attempt to extinguish the fire,
- If not possible to extinguish the fire – close all openings if possible and report to muster station

CO2 will only be released by Chief Engineer by verbal order by the Master.
 Before releasing CO2 into Engine compartment or car deck – ensure that all persons are evacuated from there.
 If CO2 alarm is raised all crew to meet at meeting points.

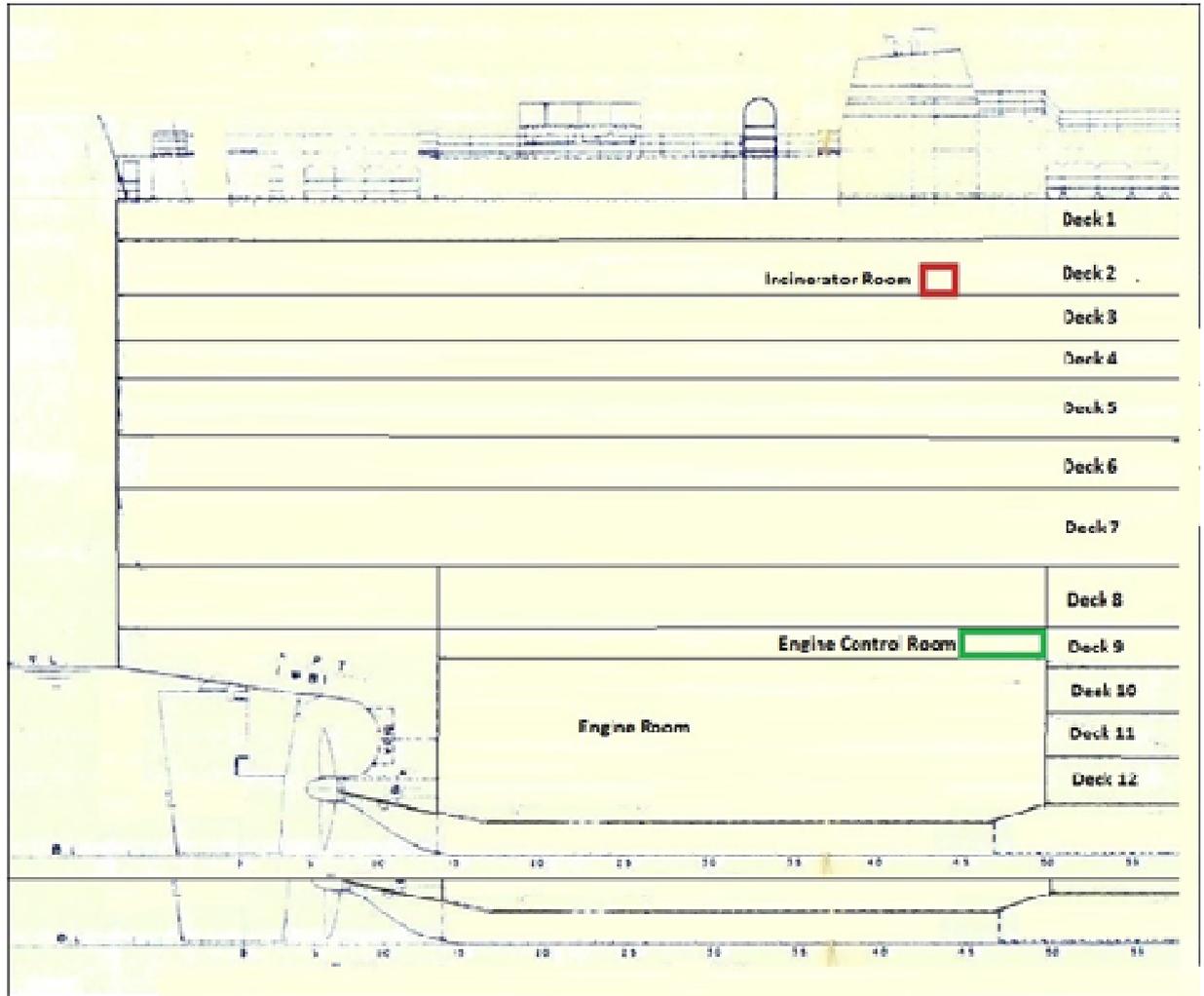
This is an uncontrolled paper copy of Green Managements TQM system. Whenever this document is electronically revised, a printed copy of the new revision shall replace the old. It is the responsibility of the reader of this document to ensure that this paper copy is valid.

Appendix VII:

Kidde Fire Detection Plan



Appendix VIII: Location of Fire – Incinerator Room No.2 Car Deck



Area where initial fire was reported - debris had fallen from incinerator above.



MV Tai Shan – Marine Safety Investigation Report

Appendix IX: Incinerator Planned Maintenance Schedule



Job history for M/V Tai Shan

Between 17/07/2013 and 17/07/2014 17-Jul-2014
2 Pages

445.01 - INCINERATOR 50 - 90 Kg/h

| | | | | |
|--|------------|------------------|-----------------|------------|
| Job Type and Job name | | Due Date | Date | Next Due |
| CHK132 - NEW INCINERATOR- MONTHLY CHECK | | 15/06/2014 | 14/06/2014 | 14/07/2014 |
| Done by | Signed by | Due Hrs | Hrs done | Next Due |
| [REDACTED] | [REDACTED] | | | |
| Reason | Symptom | Job Interval | CMS Code | |
| Planned | | (1M) | | |
| Remark | | Condition before | Condition after | |
| Checking | | Good | Good | |
| Service report | | Job origin | SERE | |
| Job done. | | | | |
| <input type="checkbox"/> Job was postponed <input type="checkbox"/> Files are attached to this history record <input type="checkbox"/> SRF available for this history record | | | | |

| | | | | |
|--|------------|------------------|-----------------|------------|
| Job Type and Job name | | Due Date | Date | Next Due |
| PRE49 - TEMPERATURE SWITCHES :- INCINERATOR | | 29/04/2014 | 22/05/2014 | 22/06/2014 |
| Done by | Signed by | Due Hrs | Hrs done | Next Due |
| [REDACTED] | [REDACTED] | | | |
| Reason | Symptom | Job Interval | CMS Code | |
| Routine Maintenance | | (3M) | | |
| Remark | | Condition before | Condition after | |
| Maintenance | | Good | Good | |
| Service report | | Job origin | SERE | |
| TEMPERATURE SWITCHES :- INCINERATOR | | | | |
| Job done | | | | |
| <input type="checkbox"/> Job was postponed <input type="checkbox"/> Files are attached to this history record <input type="checkbox"/> SRF available for this history record | | | | |

| | | | | |
|--|------------|------------------|-----------------|------------|
| Job Type and Job name | | Due Date | Date | Next Due |
| CHK132 - NEW INCINERATOR- MONTHLY CHECK | | 09/05/2014 | 15/05/2014 | 15/06/2014 |
| Done by | Signed by | Due Hrs | Hrs done | Next Due |
| [REDACTED] | [REDACTED] | | | |
| Reason | Symptom | Job Interval | CMS Code | |
| Routine Maintenance | | (1M) | | |
| Remark | | Condition before | Condition after | |
| Maintenance | | Good | Good | |
| Service report | | Job origin | SERE | |
| 1. CHECK REFRACTORY CONDITION. 2. CHECK D.O.BURNER. 3. CHECK SLUDGE OIL BURNER. 4. LUBRICATE ALL MOVING PARTS 5. CHECK AND CLEAN SPARK ARRESTER. 6. CHECK AUTO STOP FUNCTION OF SLUDGE PUMP | | | | |
| <input type="checkbox"/> Job was postponed <input type="checkbox"/> Files are attached to this history record <input type="checkbox"/> SRF available for this history record | | | | |

| | | | | |
|--|------------|------------------|-----------------|------------|
| Job Type and Job name | | Due Date | Date | Next Due |
| PRE50 - ALARM CIRCUIT "INCINERATOR ABNORMAL" :- INCINERATOR | | 29/04/2014 | 04/05/2014 | 04/08/2014 |
| Done by | Signed by | Due Hrs | Hrs done | Next Due |
| [REDACTED] | [REDACTED] | | | |
| Reason | Symptom | Job Interval | CMS Code | |
| Planned | | (3M) | | |
| Remark | | Condition before | Condition after | |
| Checking | | Good | Good | |
| Service report | | Job origin | SERE | |
| Checked Incinerator abnormal alarm. Found in good condition. | | | | |
| <input type="checkbox"/> Job was postponed <input type="checkbox"/> Files are attached to this history record <input type="checkbox"/> SRF available for this history record | | | | |

TmMv2 JobHistory01.rpx
Page 1 of 2 Jul-2014-17

TMMaster v2 2.640.4211.18555

MV Tai Shan – Marine Safety Investigation Report

Job history for M/V Tai Shan

TM Master^{v2}

Between 17/07/2013 and 17/07/2014

Page 2 of 2

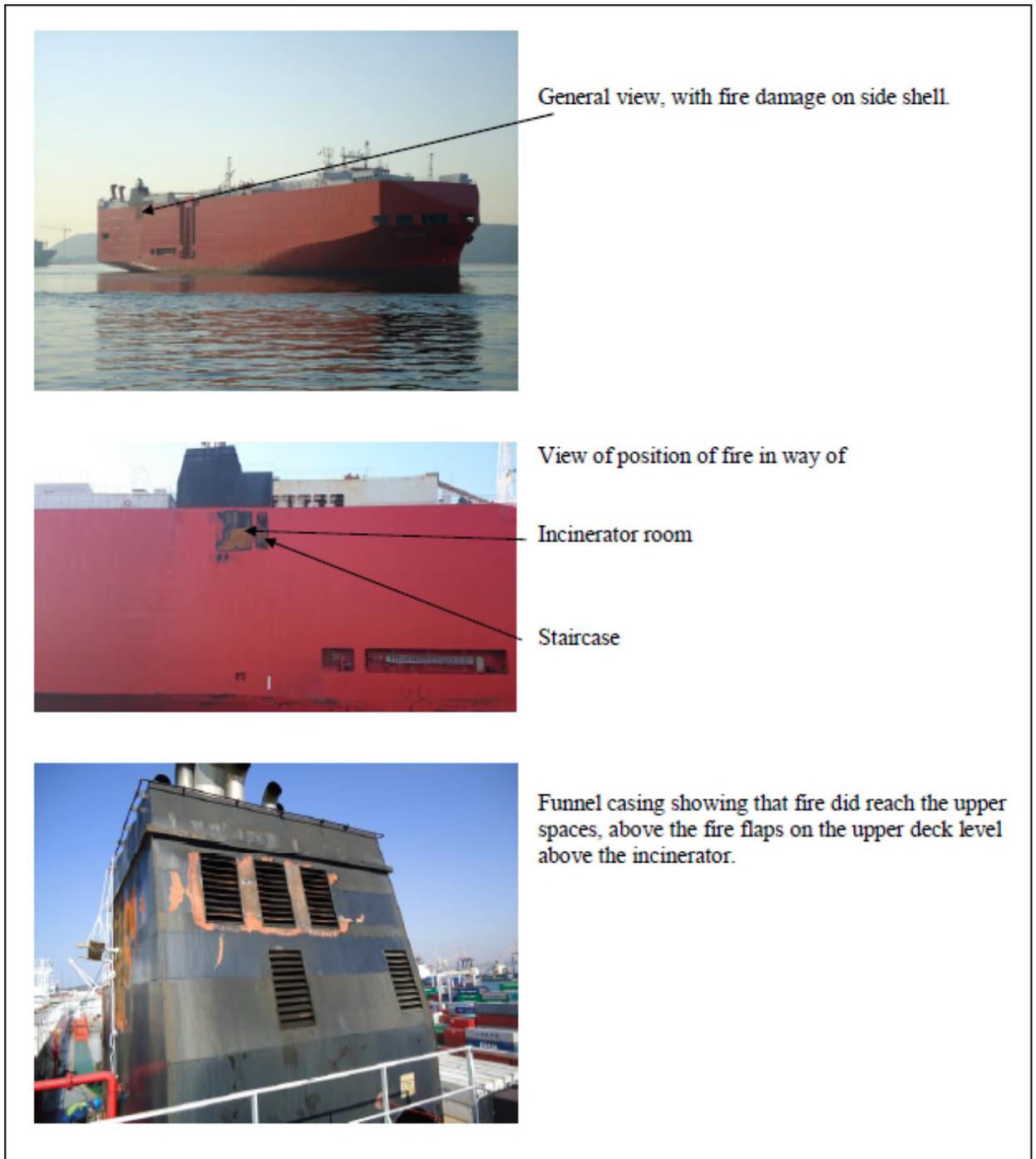
445.01 - INCINERATOR 50 - 90 Kg/h

| | | | | |
|--|---------------------------|--|--|--|
| Job Type and Job name AUT5 - EMERG.STOP :- INCINERATOR | | Due Date 26/04/2014 | Date 26/04/2014 | Next Due 26/07/2014 |
| Done by [REDACTED] | Signed by [REDACTED] | Job Interval (3M) | Due Hrs | Hrs done |
| Reason Routine Maintenance | Symptom | CMS Code | Condition before Good | Condition after Good |
| Remark Test | Job origin SERE | | Service report PRESS MANUAL EMERG. STOP PUSH BUTTON OR POWER OFF, CHECKED ALARM. | |
| <input type="checkbox"/> Job was postponed | | <input type="checkbox"/> Files are attached to this history record | | <input type="checkbox"/> SRF available for this history record |

| | | | | |
|---|-------------------------|-----------------------------|--|--------------------------------|
| Job Type and Job name CHK132 - NEW INCINERATOR- MONTHLY CHECK | | Due Date 07/04/2014 | Date 09/04/2014 | Next Due 09/05/2014 |
| Done by [REDACTED] | Signed by [REDACTED] | Job Interval (1M) | Due Hrs | Hrs done |
| Reason Routine Maintenance | Symptom | CMS Code INCINC | Condition before Acceptable | Condition after Good |
| Remark Inspection | Job origin | | Service report <ol style="list-style-type: none"> 1. INSPECT FAN BELTS AND TENSIONS. N/A 2. CHECK REFRACTORY CONDITION. 3. CHECK D.O.BURNER. 4. CHECK SLUDGE OIL BURNER. 5. LUBRICATE ALL MOVING PARTS 6. CHECK AND CLEAN SPARK ARRESTER. 7. CHECK AUTO STOP FUNCTION OF SLUDGE PUMP ON WASTE OIL TK (DK.#2) | |

| | | | | |
|---|--|--|---|--|
| Job Type and Job name CHK132 - NEW INCINERATOR- MONTHLY CHECK | | Due Date 28/02/2014 | Date 07/03/2014 | Next Due 07/04/2014 |
| Done by Wladyslaw Makowski | Signed by Wladyslaw Makowski | Job Interval (1M) | Due Hrs | Hrs done |
| Reason Routine Maintenance | Symptom | CMS Code INCINC | Condition before Good | Condition after Good |
| Remark Checking | Job origin | | Service report inspection carried out | |
| <input type="checkbox"/> Job was postponed | | <input type="checkbox"/> Files are attached to this history record | | <input type="checkbox"/> SRF available for this history record |

Appendix X: Overview of Incident





Fire flap (one of two) in the funnel space, above the incinerator room. The deck shown, was the same level as the upper deck outside.



Mechanism for releasing the fire flaps in the deck above the incinerator. The shackle at the top, was connected to the cable pull fitting on the outside of the funnel. The unit below, was a pneumatic operated cylinder, which was also designed to release the spring loaded flap, by withdrawing the pin from the link.

It was apparent that the pneumatic system was not considered operational and that manual operation was the means used.



The two pull wires to release the funnel flaps mentioned above. These were positioned on the inboard side of the funnel casing (which was situated on the stbd side).



Stairway access from upper deck level.

Elevator door inside.



Staircase at car deck 2, looking in a port direction, with the car deck entrance door in the background and the incinerator room door on the left.



The drum viewed, was reportedly used to hold open the door at the time prior to the fire starting. It was stated that it was approximately half full with oily rags at the time and was placed in the door opening, keeping the door approximately 1/3 open.

The plastic and other debris in the drum at the time of the first attendance, had been deposited, during cleaning up operations, after the area had cooled down and before the operator informed the ship staff to preserve the scene, which had subsequently been cordoned off until arrival at Durban.



Diesel tank in the incinerator room, for the incinerator pilot burner and for burner assistance when incinerating poor quality waste oil.



Quick closing valve for diesel tank, noted to be in the open position. (Closing spring still compressed).



Gratings in the incinerator room deck, covering the openings to the engine room below.



The deckhead above the incinerator with the opening (one of two) fitted with a spring loaded, (to close), flap, operable from open deck.

The photo is taken, viewing upwards from immediately to the port of the incinerator unit.

The incinerator room was two decks high. (No plate deck, level with cargo deck No. 1)



Incinerator room, looking upwards and slightly forward. As per the previous photograph, the space was two decks high, with car deck No. 1 level, only with a small thwartships stringer plate at the forward part.

The fire flap in the deckhead, to the funnel space, mentioned in the previous photograph, can be seen at the top of this photograph.



At the aft end of the No. 2 Deck platform on which the incinerator was fitted, the deck was open, down to Deck 5, where the exhaust gas economiser was fitted.

This photograph is taken from the aft of the platform, level with the incinerator, and with the main engine exhaust pipe on the bottom left.



Valve from the waste oil tank to the waste oil filter. The valve was partially melted and appeared to be open.

Valve from the diesel tank, prior to the diesel filter. This valve was confirmed to have been left open.



The diesel filter and pump were completely melted / disintegrated. In conjunction with the open diesel valve mentioned above and also viewed on the left, all of the diesel in the tank, was able to run into the saveall under the incinerator and feed the fire



Molten alloy, found under the incinerator, which was presumed to be from the diesel filter.



Motor for the diesel supply pump. The pump casing was completely melted / disintegrated.



Evidence of non-ferrous piping, including fuel and waste oil piping, having melted.



Dipstick level measurement of waste oil tank, indicating less than 50 litres.

Although it is possible that the contents of the tank could have boiled, it is considered more likely that the tank was at approximately this level at the time of the fire commencement, than at the 450 litre level, that was presumed by the 4/E.



The waste oil tank was fitted with a steam temperature control system, which was reportedly not used. Steam valves were controlled manually, to maintain the temperature at approximately 85 Deg C. Noted that if the tank was at 50 litres overnight, and not the presumed 450 litres, then the temperature may have been higher. However, the absolute maximum temperature achievable by the steam, would be approximately 175 Deg C and the combustion temperature of sludge would be well over 250 Deg C



The incinerator was opened initially in the inspectors presence and the state of the locking devices, indicated that it had not been opened since the fire.

The outer door was slightly buckled, however, a flame gauze was in place and the inner flap was effectively closing the opening.

It was determined that it was improbable that any spark or ember could have dropped out of the door during or shortly after the last operation.

MV Tai Shan – Marine Safety Investigation Report

Ships funnel.



Starboard side of *Tai Shan*.



Appendix XI: Fire main isolation valves.

Engine room fire main isolation valve.



Car deck fire main isolation valves.



Appendix XII: Fire Damage

Fire damage electrical cable – adjacent elevator motor.



Solid waste loading port.

