Marine Safety Investigation Unit

Transport Malta

SAFETY INVESTIGATION REPORT

201804/002 REPORT NO.: 07/2019 March 2019

MV *A NAVIGATION*
Fatality of a stevedore
in the port of Kelang, Malaysia
01 April 2018

SUMMARY

A Navigation was alongside in Port Kelang, Malaysia, discharging a cargo of steamed coal. At approximately 1000 on 01 April 2018, whilst the chief mate and the shore foreman were conducting their routine inspection of the cargo holds, a burning smell was noticed coming from the entrance hatch to cargo hold no. 3.

On investigation, they discovered the body of one of the stevedores, lying on the upper platform of the access ladder to the cargo hold. The stevedore had severe burns to his upper body and without any personal protection equipment (PPE). Although, the exact reason for the accident could not be accurately ascertained by the safety investigation, it was suspected that a pocket of methane gas and coal dust ignited at the top of the ladder for cargo hold no. 3.

Taking into consideration the safety actions adopted by the Company, the MSIU has issued no recommendations following the completion of the safety investigation.

MV *A Navigation*

FACTUAL INFORMATION

Vessel

A Navigation is a 51,265 gt conventional seven hatch, non-geared bulk carrier built by Jiangsu Newyangzi Ship Building Co. Ltd. in China, in 2010. The vessel is owned by Augustea Transhipment Limited and managed by Augustea Tecnoservice Management, in Greece. The vessel is registered in Malta and classed by Bureau Veritas (BV).

A Navigation has a length overall of 229.20 m, a moulded breadth of 38.0 m and a moulded depth of 20.7 m. Her summer draught of 14.90 m corresponded to a summer deadweight of 93,236 tonnes. Propulsive power is provided by a 6-cylinder MAN 6S60MC-C, slow speed, direct drive diesel engine, producing 13,560 kW at 105 RPM. This drives a single, fixed pitch propeller to reach a service speed of 14.5 knots.

The vessel is also fitted with double bottoms and has seven cargo holds, with a combined grain capacity of 11,0330 m^3. All cargo holds are fitted with hydraulically operated, side rolling hatch covers. Each cargo hold has two watertight means of access. One access (vertical ladder) is located forward and the other (Australian ladder) is at the aft end of the cargo hold. Both means are located in way of the cross decks.

Crew

At the time of the accident, the vessel was manned by 20 crew members. All crew members were Filipino nationals. The vessel was manned in excess of the Minimum Safe Manning Certificate. The working language on board was English and the Safety Management System (SMS) was available to the crew in the English language.

The navigational watches were the conventional 4 on – 8 off. However, the engine-room was only manned during the day since it was UMS certified.

Fatally injured person

The deceased stevedore was an employee of RKT Ventures Sdn. Bhd. and was a Malaysian national. Available information suggested that the stevedore had been in employment with this Company for about two months. *A Navigation* was his first ship, engaged in the cleaning of the cargo holds.

Environment

The weather was clear and the visibility was good. A Northwesterly gentle breeze was recorded. Air and sea temperatures were recorded at 32 °C and 18 °C respectively.

Narrative

A Navigation arrived at Port Kelang anchorage, Malaysia at 1600 on 29 March 2018. She had 70,200 tonnes of steamed coal in her cargo holds, which were loaded in Vanino, Russia. The voyage was uneventful.

At 0530 on 30 March, the vessel was all fast, starboard side alongside Jetty no. 1 at Kapar Power Plant Station in Port Kelang. All hatch covers for cargo holds no. 1 through to no. 7 were opened soon after arrival at 0640 and remained opened up to, and including the time of the reported accident.

Discharging commenced at 0815 (30 March) by means of a rotary conveyor. The discharging operation from various cargo holds continued through 30 and 31 March, with intermittent changes between cargo holds for draft and trim purposes. The discharge from cargo hold no. 3 commenced at 0537 on 31 March but was temporarily stopped at 1200 on the same day. Discharging from cargo hold no. 3 resumed at 0453 on 01 April, following the completion of cargo hold no. 2.

On 01 April, four stevedores boarded the vessel at 0230 to carry out the final cleaning of cargo hold no. 2, which they subsequently entered at 0250. Cargo operations in cargo hold no. 2 were completed at 0435. Cleaning of cargo hold no. 2 was completed at about 0446. The gangway log indicated that two of the stevedores departed the vessel at 0450, but the other two remained on board. The whereabouts of the remaining two stevedores was not logged, although the deck watch recalled that he had seen one stevedore resting on the main deck underneath one of the hatch covers, though he was not sure which hatch it was.

Discharging operations continued from cargo hold nos. 3, 5 and 6 up to the time of the reported accident, with operations proceeding as expected and uneventful.

The oxygen and gas readings inside the cargo holds, taken at 0750 on 01 April, showed all readings as normal, with oxygen levels at 20.9% and methane, carbon monoxide and hydrogen sulphide levels at zero. At this juncture, all cargo holds had been open for two days. The gas testing equipment checks also revealed that the equipment was in good working order.

At approximately 1000 on 01 April, whilst the chief mate and the foreman were carrying out inspections of the cargo holds (from main deck level) to determine the balance of the remaining cargo, a burning smell was noticed to be emanating from the entrance hatch of cargo hold no. 3. They also observed a stevedore in the area on the main deck. Concerned, they approached the area and at that point, the foreman noticed the presence of an apparently unconscious person inside the entrance hatch of cargo hold no. 3 (Figure 1).

He immediately brought the matter to the attention of the chief mate. The chief mate reported the situation to the master, who advised the vessel's agent who was on board at the time. The agent soon notified the relevant port authorities. The master also advised the owners of these developments.

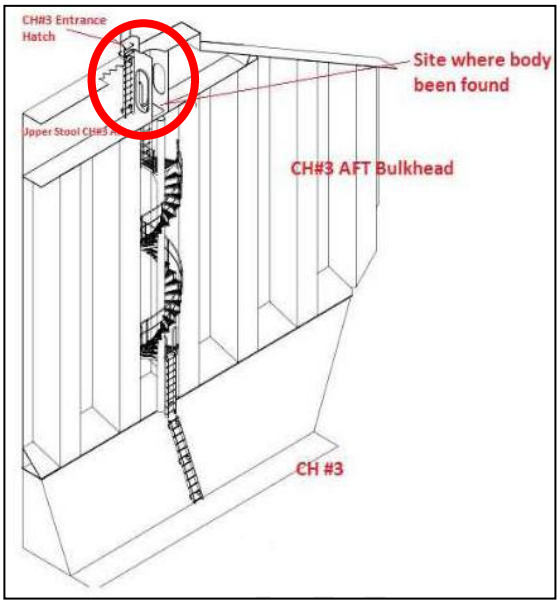

Figure 1: Location of body

While discharge operations were suspended at 1035 at the request of the terminal safety officer for further investigations, the master, concern that foul play may be considered during the ensuing investigation, issued instructions not to initiate any rescue initiatives involving crew intervention. It was therefore decided to leave the recovery efforts to the local rescue teams.

The rescues teams (Figure 2), consisting of the fire and police departments, boarded the vessel at 1445. The body was eventually retrieved from the entrance hatch of cargo hold no. 4 at 1555.

Figure 2: Rescue teams at the accident site

At the request of the terminal safety officer, the electrical circuit breaker for the electric supply to cargo hold no. 3 was isolated during the recovery effort. At 1606, the rescue teams departed the vessel with the deceased.

Post-accident survey

In view of the smell of burning emanating from the access hatch of cargo hold no. 3, the ship board survey focused on determining the possible source of ignition. It was understood that at the time, electrical failure had been identified neither in the 220 V lighting cabling or fittings, nor in the 24 V high-level float cabling located in the vicinity.

A BV surveyor attended the vessel on 02 April to carry out a survey of the electrical system on deck and the area in way of cargo hold no. 3 area. All electrical wires, lightings and receptacles on main deck in way of cargo hold no. 3 and the cross deck were inspected, and all was found to be intact and in a satisfactory condition. The electrical switchboard in the engine-room and electrical panel in the forecastle deck were found without anomalies. Moreover, an insulation test in way of cargo hold no. 3 produced a satisfactory result.

The follow-up inspection in Singapore on 19 May, also indicated that the electrical system in this area was in the same apparent condition.

Location of the body

The body of the stevedore was reported to have been discovered on the upper platform of the cargo hold access. The casualty's face and upper torso were noted to be severely burnt, with only his lower clothing remaining. The burnt safety shoes he was wearing were also found nearby.

Small remnants of charred clothing were found on the bulkheads, grating and frames, though the ship structure was found intact, with no fire damage evident.

Other PPE, other equipment or source of ignition were found neither in the vicinity of the body, nor anywhere else nearby. Photographs taken shortly after the discovery of the casualty supported this information, although the MSIU did not have access to this physical evidence for inspection.

It was initially reported that the casualty was found located on the upper platform in way of the upper stool area. However, it was determined that this was factually incorrect; the body was located on the upper most platform of the Australian ladder (Figure 3).

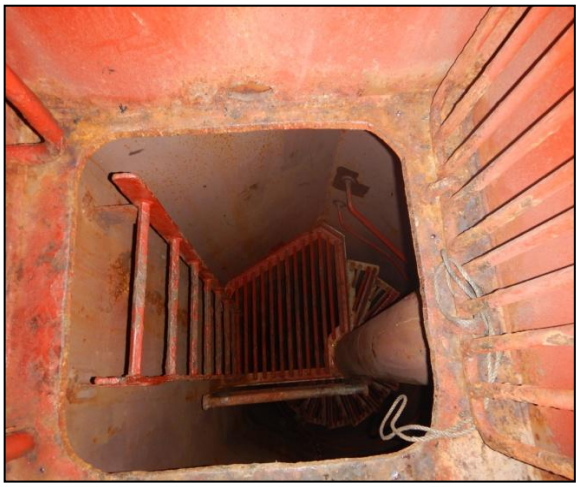

Figure 3: Opening to ladder and first platform where the fatally injured stevedore was found

The Australian ladder on this vessel is enclosed by metal plating from the vertical ladder (close to lower hopper level) up to the upper stool area. The hatch grating at the upper stool deck area was found in the open and unlatched position. To open this, it was common to straddle the frames located on either side, above the grating (Figure 4).

Figure 4: Grating at entrance to Australian ladder

Cause of death

Although the investigation did not have access to the post mortem examination results, it was suspected that the casualty is likely to have died from third degree burns and asphyxiation.

ANALYSIS

Aim

The purpose of a marine safety investigation is to determine the circumstances and safety factors of the accident as a basis for making recommendations, and to prevent further marine casualties or incidents from occurring in the future.

Methane-air mixture

Steamed coal may possess chemical hazards when carried in bulk (MHB). It is usually classed as Group B (and A) under the IMSBC Code. Group A consists of cargoes which may liquefy if shipped at a moisture content in excess of their transportable moisture limit. Group B is defined as a group which contains cargoes that posses a chemical hazard that could give rise to a dangerous situation on a ship.

As per the shipper's declaration[1]:

> "[*t*]*he cargo emits methane, a methane/air mixture containing 5-16% methane may constitute and explosive atmosphere which can be ignited by sparks or naked flame. As methane is lighter than air, it may accumulate in the upper region of the cargo space or other enclosed spaces. Hatch covers and bulkheads should prevent methane from permeating the adjacent spaces.*"

The Australian ladder on this vessel is enclosed in a metal structure down to the level of the vertical access ladder in the lower portion of the cargo hold. As a consequence, when the cargo level is above the level of the vertical ladder, the cargo essentially closes the lower ladder access to become an enclosed space.

This was the situation in this particular instance, as cargo hold no. 3 was half full at the time of the accident and therefore, given that the cargo was liable to emit methane, it was likely that a methane / air mixture may have been present at the upper reaches of the Australian ladder, in way of the after part of cargo hold no. 3, at the time of the stevedore's entry.

Since the cargo hold at the time of the accident was half full, thereby blocking the lower level of the access ladder, it is possible that the unloader that was working in the hold at the time may have agitated pockets of gas. The gas, being lighter than air, is likely to have entered the ladder space.

Coal dust

Combustible dust is defined as a mixture or substance that is in the form of finely divided solid particles that, upon ignition, is liable to catch fire or explode when dispersed in air. Chemical dust, such as coal, is considered to be a combustible dust hazard, which may be created when it is being transported and handled.

[1] Certificate of the Transportation Characteristics of Cargo at the Moment of Loading.

For coal to be flammable / explosive, it has to meet a number of criteria, including the volatile ratio and particle size – the smaller the particle size, the higher is the fire / explosion hazard (coal dust would require less energy and lower temperatures to ignite. Moreover, heat transfer is quicker with smaller particles).

Another requirement is related to the availability of coal dust, *i.e.*, the minimum explosive concentration. This is a measure of the minimum quantity of dust in suspension that will propagate a coal dust fire / explosion and potentially cause damage.

The safety investigation did not exclude the presence of coal dust in view of the ongoing cargo operations in the other cargo holds.

Source of ignition

The safety investigation tried to identify the source of ignition. It was apparent that the stevedore had entered the compartment without prior consent. However, the MSIU could not identify a logical explanation as to why he entered the compartment except, perhaps, to see if he could later gain access to the cargo hold through this access. It is definite, however, that the fire happened after the grating had been opened, since there was adequate time to secure it in the open position (Figure 5) prior to the accident.

Academic literature reviewed by the MSIU during the course of the safety investigation, suggested two ways by which a mixture of coal dust / methane could ignite (subject that the system is within the flammability range).

Auto-ignition can happen if the temperature is high enough to reach the auto-ignition temperature (or the kindling point). That depends on various factors but the lowest value may be in the region of about 530 °C. It was evident to the safety investigation that this temperature could not be reached, unless there was an external ignition source, which is the second means of ignition of a mixture of coal dust / methane.

Figure 5 shows the relation between rate of heating and spatial dimensions of a number of ignition sources.

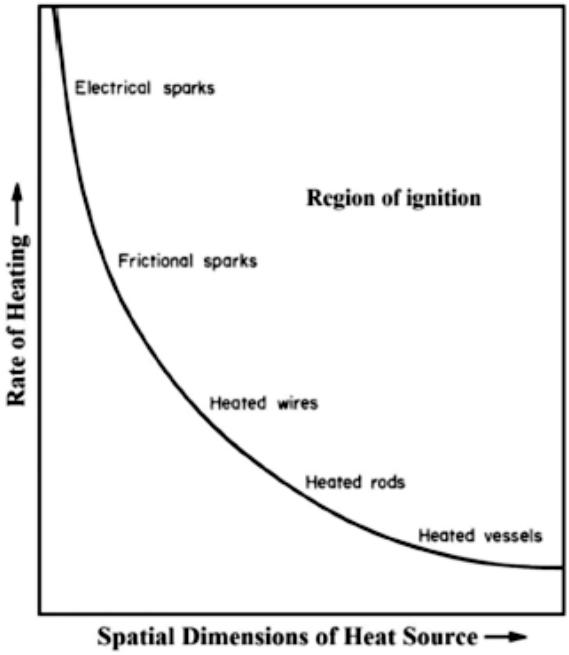

Figure 5: Rate of heating with spatial dimensions

Source: Cheremisinoff, N. P., (2013). Industrial gas flaring practices. Beverly: Scrivener Publishing LLC

It may be noticed from the figure that sources which generate sparks may be very small, but their heating rate and temperature are relatively very high. Moreover, the ignition energy required by methane is very low. However, based on BV's occasional survey report (that all electrical equipment in the vicinity was in order), an electrical failure / spark was ruled out as the source of ignition. Moreover, the safety investigation could not determine whether smoking took place inside the space, although no cigarette butts were found on site.

Whatever the ignition source, it was probable that at this time, a flash fire occurred and engulfed the stevedore. However, the gas was not in sufficient quantities to cause further damage to the vessel or result in a larger fire thus, it was a deflagration rather than a detonation. The condition and

location of the clothing and boots (staining on frames) would support this theory. Small elements of clothing were still evident on the nearby bulkheads during the follow-up inspection on 19 May.

The deflagration may have then caused the stevedore to fall from the position where he lifted the grating to where his body was finally located on the upper platform of the ladder, following the tragic turn of events.

CONCLUSIONS

1. The immediate cause of the accident may have been a deflagration of a mixture of methane and coal dust;
2. The lower ladder access became an enclosed space because of the height of the cargo inside the cargo hold;
3. The cargo was liable to emit methane;
4. The presence of coal dust was not excluded in view of the ongoing cargo operations in the other cargo holds;
5. Although no cigarette butts were found on site, the safety investigation did not rule out smoking taking place inside the space;
6. The deflagration may have caused the stevedore to fall from the position where he lifted the grating to where his body was finally located.

SAFETY ACTIONS TAKEN DURING THE COURSE OF THE SAFETY INVESTIGATION[2]

The Company took the following safety actions:

- published an Information Notice to raise awareness on the hazards related to working alone and on the importance of communication in enclosed spaces;
- reviewed and improved where required the ship's patrolling during port operations and the supervision of activities by shore personnel on board;
- disseminated the findings of the internal investigation carried out in terms of Section 9 of the ISM Code to the fleet; and
- reviewed the ship / shore checklist with the aim of including the requirement for a shore representative in charge of the safety of workers on board, and their safe entry into / exit from enclosed spaces.

[2] **Safety actions shall not create a presumption of blame and / or liability.**

SHIP PARTICULARS

Vessel Name:	*A Navigation*
Flag:	Malta
Classification Society:	Bureau Veritas
IMO Number:	9574420
Type:	Bulk Carrier
Registered Owner:	Augustea Transhipment Limited
Managers:	Augustea Tecnoservice Management
Construction:	Steel
Length Overall:	229.20 m
Registered Length:	222.90 m
Gross Tonnage:	51,265
Minimum Safe Manning:	15
Authorised Cargo:	Solid bulk

VOYAGE PARTICULARS

Port of Departure:	Vanino, Russia
Port of Arrival:	Port Kelang, Malaysia
Type of Voyage:	International
Cargo Information:	78,200 mt of steaming coal
Manning:	20

MARINE OCCURRENCE INFORMATION

Date and Time:	01 April 2018 at 1000 (LT)
Classification of Occurrence:	Very Serious Marine Casualty
Location of Occurrence:	Port area
Place on Board	Cargo hold
Injuries / Fatalities:	One fatality
Damage / Environmental Impact:	None reported
Ship Operation:	Alongside moored / cargo discharge
Voyage Segment:	Arrival
External & Internal Environment:	Weather was clear and the visibility was good. A Northwesterly gentle breeze was recorded. Air and sea temperatures were recorded at 32 °C and 18 °C respectively.
Persons on board:	22