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Crew member seriously burned by steam on board *MSC Sonia*

At about 0945[1] on 10 April 2007, *MSC Sonia*'s boatswain and ordinary seaman were on the top platform of the ship's funnel casing, painting the starboard main engine exhaust pipe, when steam unexpectedly exhausted from the nearby boiler safety valve vent pipe. The ordinary seaman was seriously burned by the steam.

MSC Sonia

MSC Sonia (Figure 1) is a 2450 TEU[2] cellular container ship that operates on a liner service between Asia and the Australian east coast ports of Melbourne, Sydney and Brisbane.

The ship was built in 1972 by Mitsubishi Heavy Industries, Japan. It has an overall length of 261 m, a moulded breadth of 32.26 m and a moulded depth of 21.49 m. At its summer draught of 13.0 m, the ship has a deadweight of 42 053 tonnes.

At the time of the incident, *MSC Sonia* was registered in Panama and classed with Germanischer Lloyd (GL). The ship was owned by Oreta Enterprises, Panama and managed by MSC Ship Management, Hong Kong.

The ship's propulsive power is supplied by two Mitsui MAN B&W 7K90GFCA single acting, direct reversing, two-stroke diesel engines, each delivering 20 300 kW at 117 rpm. Each engine drives a fixed pitch propeller and together they give the ship a service speed of 21 knots[3].

At the time of the incident, *MSC Sonia* had a crew of one Myanmar and 30 Indian nationals.

The master held an Indian master's certificate of competency. He had 17 years of seagoing experience and had been sailing as master for six years. At the time of the incident, he was part way through his second, four month, assignment on board *MSC Sonia*.

The chief engineer had 32 years of seagoing experience and held an Indian class one certificate of competency. He had sailed as chief engineer since 1990. He was also part way through his second assignment on board the ship.

The chief mate held an Indian first mate's certificate of competency. He had 18 years of seagoing experience and had been sailing as

Figure 1: *MSC Sonia*

1 All times referred to in this report are local time, Coordinated Universal Time (UTC) + 10 hours.

2 Twenty-foot Equivalent Unit. The nominal size of a ship in TEU refers to the number of standard shipping containers that it can carry.

3 One knot, or one nautical mile per hour, equals 1.852 kilometres per hour.

chief mate for one year. He had been on board *MSC Sonia* for about two weeks.

The second engineer had nine years of seagoing experience and held an Indian class two certificate of competency. He had been on board the ship for about six weeks.

The boatswain had 23 years of seagoing experience. At the time of the incident, he had been on board *MSC Sonia* for about two months.

The ordinary seaman had two years of seagoing experience and had been on board *MSC Sonia* for about two months.

The GL surveyor started his seagoing career in 1968. He reached the rank of chief engineer before taking up a shore based position in 1985. He worked for about ten years in various maritime related industries before becoming a non-exclusive surveyor. After six years as a non-exclusive surveyor, he took up a position as a senior surveyor with GL. At the time of the incident, he had been a surveyor with GL for about five years.

The auxiliary boiler

Steam is used on board *MSC Sonia* by a pair of turbo alternators. It is also used for fuel tank heating, fuel treatment, jacket water heating and domestic heating.

While the ship is at sea, steam is supplied by a pair of waste heat boilers that are fitted in the main engine exhaust uptakes. They use the residual heat in the exhaust gases to produce steam.

Figure 2: Auxiliary boiler

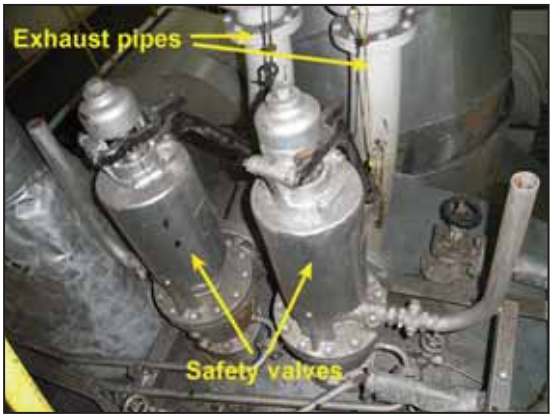
When in port, the ship's steam demand is serviced by a single Osaka Boiler Mfg Company DE 48030-150 cylindrical smoke tube boiler (Figure 2). The boiler is fitted with two automatically controlled Volcano steam jet burners.

At full load, the boiler produces 15 000 kg of steam per hour at a nominal working pressure of 7.5 bar[4].

The boiler is fitted with two safety valves (Figure 3). These valves are designed to limit boiler pressure to a maximum of 13 bar. However, due to the age of the boiler, the safety valve settings had been lowered to 11 bar.

Each boiler safety valve is fitted with an exhaust pipe which connects into a common line that vents at the top of the funnel casing.

Figure 3: Auxiliary boiler safety valves



The incident

MSC Sonia arrived in Kaohsiung, Taiwan on 28 March 2007. The ship carried out its normal cargo exchange and the ship manager's 'port captain' joined the ship. The plan was for the port captain to sail on the ship to Brisbane via Melbourne and Sydney. His task was to carry out an inspection of the ship and to complete an audit of the ship's safety management system, a requirement of the International Safety Management (ISM) Code.

The ship sailed from Kaohsiung on 28 March, en route to Melbourne. The crew carried on with their normal watchkeeping and maintenance duties.

On 31 March, the ship's senior officers held the regular fortnightly management meeting. They discussed the maintenance that they planned to complete in the next two weeks but no upcoming survey items were discussed.

4 1 bar equals 100 KPa or approximately one atmosphere.

About a week later, the port captain informed the master that the due date for the annual class survey of the boilers was imminent. The master then contacted the ship's manager, asking him to arrange for a class surveyor to attend the ship in Australia.

On 8 April, the master telephoned the ship's manager and was told that it was unlikely that a surveyor could attend the ship in Melbourne because of the upcoming Easter holiday period. The master was also notified that the ship would be anchoring for a short time in Melbourne before berthing.

The chief mate and the boatswain decided to use the time at anchor to paint the exhaust pipes at the top of the funnel.

The chief engineer and the second engineer discussed the work that they wished to carry out at the anchorage. They planned to use the time to prepare the boilers for the survey.

The second engineer later met with the chief mate and they discussed the need to allocate as much manpower as possible to prepare for the boiler survey while the ship was at anchor. The chief mate subsequently met with the boatswain and all unnecessary work on deck was postponed.

The ship arrived off Port Phillip on the morning of 8 April and a pilot boarded for the transit to the Melbourne anchorage. The anchor was let go in the anchorage and finished with engines was rung at 1218.

The engineers carried out their checks of the boilers and the crew spent the time at anchor cleaning the boilers and the surrounding areas.

The ship was prepared for the transit from the anchorage to Swanson Dock in the evening of 9 April and, by 1940, it was all fast alongside the berth.

After attending to some ship's business, the master went to his cabin to check his computer for any emails. He had received a message from the ship's manager informing him that a surveyor would attend the vessel at 0900 the next morning to survey the boilers. The master passed this information on to the chief engineer who, in turn, discussed it with the second engineer.

On the morning of 10 April, the chief mate and the boatswain met and discussed painting the funnel exhaust pipes. The chief mate suggested to the boatswain that if the ordinary seaman was not required by the duty mate, he should be able to assist with the work.

The boatswain received the duty mate's permission to use the ordinary seaman and, after getting their equipment, the two men climbed up to the top platform of the funnel casing and started painting the exhaust pipes.

At about 0900, the surveyor arrived on board the ship. He was escorted to the master's cabin where he, the master and the chief engineer discussed the survey. The surveyor wanted to see the boiler burner safety cut-out devices tested. He also wished to see the operation of the boiler safety valves.

The chief engineer and the surveyor went to the engine room and met with the second engineer and the electrical engineer. After an external examination of the boiler they tested the cut-out devices.

When the testing of the cut-out devices had been successfully completed, the surveyor asked for the operation of the safety valves to be tested. The turbo-alternator was shut down to reduce the steam demand and the boiler's two burners were fired manually. The steam pressure started to rise and, at about 0945, when the boiler pressure reached 11 bar, the safety valves lifted.

The boiler burners were then shutdown and the steam pressure began to fall. After about five seconds the safety valves re-seated and the steam pressure continued to fall slowly. When the pressure had returned to normal, the engineers set the boiler burners to fire automatically and the turbo-alternator was placed back in service.

At about 0945, while the boatswain and the ordinary seaman were painting the starboard main engine exhaust pipe, steam unexpectedly vented from the nearby boiler safety valve exhaust pipe, directly onto the ordinary seaman (Figure 4). The force of the venting steam was so strong that it knocked the boatswain off the platform he was standing on and onto the deck.

The boatswain called out to see if the ordinary seaman was alright but he received no reply.

When the steam stopped exhausting, the ordinary seaman appeared through the cloud of steam. He shook off his gloves and said to the boatswain 'look what has happened to me'.

Figure 4: Funnel casing top platform

The boatswain could see that the ordinary seaman was wet all over and the skin he could see was badly scalded. The boatswain told the ordinary seaman to stay where he was while he went for help.

The boatswain went down to the main deck and used a hand held radio to call for help.

He then returned to the funnel casing top platform with the chief mate. The two men explained to the ordinary seaman that he would have to climb down the funnel casing ladder because there was no other way of getting him down. With their assistance, the ordinary seaman climbed down the ladder and walked out of the funnel casing, onto the bridge deck (Figure 5). He then lay on the deck while the chief mate used a nearby hose to shower him with water to cool his burns.

Figure 5: Funnel casing and bridge deck

At about 0950, the chief engineer was called to the engine control room. He was told that one of the ship's crew members had been badly burned. However, he was not told, and was not aware at this time, that the crew member had been burned by the venting of steam from the boiler safety valves. The chief engineer returned to the boiler and he and the surveyor continued with the survey, carrying out an external inspection of the two waste heat boilers.

The master had heard the boatswain's calls for help on the hand held radio. Before going to the bridge deck, he called the second mate and told him to bring up a stretcher. When the master arrived at the bridge deck and saw what had happened, he called the ship's agent on his mobile telephone and requested emergency assistance. He also advised the container terminal staff of the incident.

The master organised the crew's response and they began cutting away the ordinary seaman's overalls to expose his burns to the water.

A first aid officer from the container terminal arrived on board and he determined that the ordinary seaman needed more assistance than he could provide.

At 1015, an ambulance team arrived on board the ship and they took charge of the ordinary seaman's medical treatment.

The container terminal manager also arrived on board the ship, and he and the master discussed how they were going to land the ordinary seaman ashore. It was decided that the terminal staff would connect a personnel basket to the shore side gantry crane and manoeuvre it as close as possible to the ship's bridge deck.

When the ambulance team had completed their initial treatment, the ordinary seaman was placed onto a solid stretcher. He was then carried to the side of the ship and placed into the gantry crane basket.

At about 1100, the ordinary seaman was landed ashore, placed in the waiting ambulance and taken to hospital.

Analysis

Awareness

The chief mate and the boatswain had decided not to paint the funnel exhaust pipes until the ship's main engines were shut down. This indicates that they were aware of, and had considered, some of the hazards involved in working on the funnel casing top platform.

However, the chief mate, the boatswain and the ordinary seaman were not aware that the large

bore pipe on the starboard side of the funnel casing top platform was a steam vent pipe. Furthermore, they were not aware that steam would exhaust from the pipe on every occasion that a boiler safety valve operated. While safety valves do not usually operate very often, they are a safety device that can operate at any time.

The chief engineer, the second engineer and the surveyor were all aware that steam would exhaust from the funnel top vent pipe when the safety valves were operated. However, they were not aware that anyone was working on the funnel casing top platform and they assumed that the area would be clear of all personnel.

Had each work group been aware of the other's activities, it is likely that the incident would not have occurred.

Communication

MSC Sonia's safety management system required the ship's senior staff to meet every two weeks to discuss the maintenance that had been completed in the previous two weeks and the maintenance that they planned to complete in the next two weeks. The record of this meeting was then forwarded to the ship's manager as a maintenance report.

The records of these meetings indicate that they were an overview of the maintenance being carried out and that senior staff were not discussing every task that they planned to complete. Furthermore, because of the ship's age, there was a large amount of unanticipated, or unplanned, work being carried out.

It is common on board many ships for the senior deck and engineering officers to meet on a daily basis to discuss the tasks that they plan to complete that day. The aim of these meetings is to utilise their collective knowledge to increase the group's awareness of everything that is happening on board the ship at any given time.

However, *MSC Sonia*'s safety management system did not require the crew to carry out such daily meetings and the ship's crew had not identified the need to implement such a system.

The second engineer and the chief engineer discussed maintenance issues on a daily basis. However, it was only on occasions when they required extra manpower in the engine room, such as the period when the ship was at anchor off Melbourne, that the second engineer would discuss their needs with the chief mate.

Similarly, the chief mate would discuss maintenance issues on a daily basis with the master but would only talk to the engineers if he felt that their technical input was required.

Had the senior deck and engineering officers met more frequently and discussed all the work that they intended to complete, they probably would have identified the hazards associated with operating the boiler safety valves while crew members were working on the funnel casing top platform.

Risk assessment

The ship's safety management system included a permit to work system. However, it did not include a requirement for the ship's crew to formally assess the risks involved in carrying out hazardous tasks.

Both the chief mate and the chief engineer thought the tasks they were carrying out were routine. However, both tasks included some hazards that had not been identified.

Had the chief engineer and the chief mate taken the time to complete an analysis of the risks associated with the tasks they were undertaking, they would probably have identified the venting of steam at the funnel casing top platform as a hazard.

The surveyor was also aware that steam would exhaust at the top of the funnel casing when the boiler safety valves operated. However, he relied on the ship's crew to ensure that the area was clear of personnel. He did not check that they had implemented strategies that would effectively control the risks.

In submission, the surveyor stated that:

> During normal survey, like external boiler inspection we discuss the inspection but will not check that the ship's management follow company procedures.

Had the surveyor checked the measures the ship's crew had in place to control the hazards associated with operating the boiler safety valves, he may have realised that they had not ensured that the funnel casing top platform was clear of personnel.

The vent pipe

The boiler safety valve vent pipe (Figure 4) is mounted on the starboard side of the funnel casing top platform. It stands about 0.5 m above the deck and is terminated with a right angle bend. Any exhausting steam is directed inboard towards the main working area of the platform.

This arrangement is similar to many such vent pipes. However, the design does not take into account the fact that personnel can, at times, be working on the platform.

Had the pipe been designed so that it directed the exhausting steam away from the working platform or at a height well above the height of a person standing on the platform, it is likely that the ordinary seaman would not have been injured.

Findings

From the evidence available, the following findings are made with respect to the serious crew member injury that occurred on board *MSC Sonia* on 10 April 2007. The findings should not be read as apportioning blame or liability to any particular organisation or individual.

Contributing safety factors

- The chief mate, the boatswain and the ordinary seaman were not aware of all of the hazards associated with working on the top platform of the funnel casing.
- The chief engineer, the second engineer and the surveyor were not aware that the crew were working on the top platform of the funnel casing.
- The senior deck and engineering officers did not discuss their work programs frequently enough to ensure that each department was always aware of the other's activities. *[Safety issue]*
- The ship's crew did not adequately consider the risks associated with either surveying the boiler, or painting the funnel top exhaust pipes. *[Safety issue]*
- The placement of the steam vent pipe, and the direction in which it exhausted, meant that any personnel on the funnel casing top platform were vulnerable when a boiler safety valve operated. *[Safety issue]*
- The surveyor did not check that the ship's crew had implemented strategies that would effectively control the risks associated with operating the boiler safety valves. *[Safety issue]*

Safety actions taken by MSC Ship Management

The ATSB has been advised that the following safety actions have been taken by MSC Ship Management as a result of the incident on board *MSC Sonia* on 10 April 2007.

The company has issued a number of safety circulars to its fleet that have emphasised the need for job planning, analysis and communication.

A new system of job planning has been implemented. This system calls for the completion of a formal risk assessment and toolbox meetings before any job is started.

ATSB safety recommendations

MR20070027

The senior deck and engineering officers did not discuss their work programs frequently enough to ensure that each department was always aware of the other's activities.

The ATSB recommends that MSC Ship Management takes action to address this safety issue.

ATSB safety advisory notices

MS20070009

The placement of the steam vent pipe, and the direction in which it exhausted, meant that any personnel on the funnel casing top platform were vulnerable when a boiler safety valve operated.

The ATSB advises the owners, operators and masters of ships to consider the implications of this safety issue and take action where it is considered appropriate.

MS20070010

The surveyor did not check that the ship's crew had implemented strategies that would effectively control the risks associated with operating the boiler safety valves.

The ATSB advises surveyors to consider the implications of this safety issue and take action where it is considered appropriate.

Media Release

Crew member severely burned by steam

The ATSB has found that a lack of communication, hazard awareness and job safety analysis led to a seaman on board the Panamanian registered container ship *MSC Sonia* being severely burned by steam.

The Australian Transport Safety Bureau investigation also found that the placement of the boiler safety valve vent pipe, and the direction in which it exhausted, meant that any personnel on the funnel casing top platform were vulnerable when a boiler safety valve operated.

At about 0900 on 10 April 2007, a surveyor arrived on board *MSC Sonia* to carry out a scheduled boiler survey while the ship was alongside Swanson Dock, Melbourne.

The ship's chief engineer and the surveyor went to the engine room and, after visually inspecting the outside of the boiler; they tested the safety cut-out devices. The surveyor then asked for the operation of the safety valves to be tested. The turbo-alternator was shut down to reduce the steam demand and the boiler's two burners were fired manually. The steam pressure started to rise and, at about 0945, when the boiler pressure reached 11 bar, the safety valves operated.

The ship's boatswain and the ordinary seaman had spent all morning on the top platform of the funnel casing painting the main engine exhaust pipes. At about 0945, steam unexpectedly exhausted from the nearby boiler safety valve vent pipe, directly onto the ordinary seaman.

The ordinary seaman was severely burned by the steam. He was assisted down the funnel casing ladder and onto the bridge deck. While he lay on the deck, the crew used a hose to shower him with water to cool his burns.

At 1015, an ambulance team arrived on board the ship and, by about 1100, the ordinary seaman had been landed ashore, placed in the waiting ambulance and taken to hospital.

The ATSB is pleased to report safety action already taken and has issued one safety recommendation and two safety advisory notices with the aim of preventing similar incidents.

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