Marine Safety Investigation Report No. 189

Golden Bridge: Engine room fatality, en-route to Newcastle, NSW – 10 December 2002

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Golden Bridge: Engine room fatality

On 10 December 2002, the third engineer aboard the bulk carrier *Golden Bridge* was killed whilst engaged in maintenance work in the engine room. A perspex sightglass exploded into his face when the fresh water generator he was working on was accidentally pressurised. The explosion blew the engineer backwards and he struck his head causing a fatal injury.

Golden Bridge

Golden Bridge is a seven hold, Panama registered, 'panamax' bulk carrier of 69 057 tonnes deadweight at a summer draft of 13.297 m. The ship is owned by Nelson Shipping Corporation, Panama and managed by Sanasia management, Hong Kong. It is classed with Nippon Kaiji Kyokai (Class NK).

The ship was built by Imabari Shipbuilding Company in Marugami, Japan in 1994 and is 224.98 m long overall, with a beam of 32.2 m and a moulded depth of 18.3 m. The ship is equipped with a MHI Sulzer 6RTA62 slow speed diesel engine with a total power output of 13 500 kW.

The crew of 20 consisted of both Filipinos and Koreans. The master and officers all held appropriate qualifications for their positions.

Third assistant engineer

The Filipino third engineer was 39 years old at the time of the incident. He first went to sea as an engine room rating (wiper) in early 1991 and continued his sea service on a variety of ships with this same company, as a rating, until April 2000. He was then promoted to third assistant engineer. He had held a Philippine third engineer's licence since 20 May 1998 and he had joined *Golden Bridge* on 24 November in Japan, 17 days earlier. This was his first contract aboard this ship.

Fresh water generator

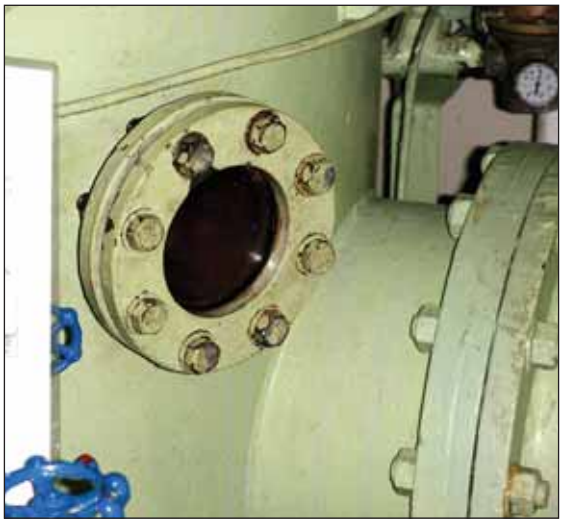
The fresh water generator on board *Golden Bridge* is a type WM-20H manufactured by Miura Company, Japan. It was supplied new when the ship was built.

The manufacturer supplied manuals and instructions for all operations including cleaning.

A fresh water generator of this type makes fresh water using a flash distillation process. This is where seawater is heated in a vacuum until it 'flashes off' into vapour. The ensuing steam is then condensed to produce fresh water. During the process, the heater tubes in the evaporator (boiler) section eventually acquire a coating of calcium carbonate scale, which reduces the efficiency of the unit. This scale must be chemically removed periodically to bring the machine back to reasonable operating efficiency. An opening covered by a perspex sight glass is located on the side of the machine so that the operator can visually observe that the seawater is boiling. The sight glass is held in place by a steel retaining ring which is secured by eight bolts.

FIGURE 1: Photograph of fresh water generator

FIGURE 2: Close up of sight glass



The incident

On 9 December 2002, *Golden Bridge* arrived in Port Kembla from Japan to load a part cargo of coal for export to Japan. On 10 December, after having loaded 24 240 tonnes of coal, the ship sailed for Newcastle to load the remainder of the cargo.

On the morning of 10 December, whilst the ship was still en-route to Newcastle, routine work on board continued in the ship's engine room. The third engineer, who was working the 0800-1200 watch, (the ship is rated UMS[1] but works a watchkeeping system whilst on coastal voyages) and an oiler were working in the engine room.

Whilst on this coastal section of the voyage, one of the routine tasks was to descale the heating tubes in the evaporator section of the fresh water generator as it is normally operated only on the ship's deep sea passages.

The first engineer had allocated this job to the third engineer at the handover of watch at 0800 that day. As he had not performed this task on this ship before, the first engineer gave him verbal instructions on the correct way to do it. The task involved, with the machine shut down, circulating a chemical solution in the evaporator section to aid in the removal of any built-up scale. Firstly, the sight glass (see photo) was removed. The chemical was then poured into the evaporator through the sight glass opening using a hose and funnel. To assist in the mixing and efficiency of the chemical, as prescribed by the chemical's manufacturer, air was bubbled through the descaling mixture. This air was supplied from the ship's service air system, at a pressure of 7.5kg/cm^2, via an air hose connected, using a ship manufactured fitting, to the drain valve on the base of the fresh water generator.

During the early stages of the job the third engineer had had the chief engineer both overseeing and assisting him. After about an hour, when the chief was happy with the progress of the work, he returned to his office to continue with his own work.

At about 1020, the oiler, who was working several decks below the fresh water generator, heard an unusual noise so he came up to investigate. He found the third engineer lying unconscious on the deck adjacent to the fresh water generator with severe facial injuries. Fragments of sight glass were evident on and around the third engineer. The compressed air supply hose was still attached to the drain valve and was still turned on. The oiler immediately went to the engine control room and called the first engineer for assistance.

The first engineer went to the engine room, assessed the situation, and then called the bridge to request further aid and to get the third engineer to the ship's hospital.

The master called Newcastle harbour control to report the incident and to request medivac assistance. The master and second mate provided continuous CPR[2] until a doctor arrived on board and, at 1145, declared the third engineer deceased. At 1740 the body of the third engineer was landed by helicopter.

The ship continued to Newcastle and dropped anchor on arrival to await her cargo.

1 UMS unmanned machinery spaces

2 CPR is cardiopulmonary resuscitation

Contributing factors

The third engineer was killed when he erroneously replaced the sight glass whilst the evaporator was still being supplied with service air. The pressure inside the fresh water generator built up until the sight glass burst. The sight glass was the weakest part of the pressure vessel and hence failed first while the third engineer was still standing in front of it refitting the retaining ring bolts.

The following factors are considered to have contributed to the incident.

Instructions

The equipment manufacturer's instructions are based on using their proprietary chemical as the descaling compound. This chemical did not require the use of compressed air for agitation.

This ship was not using the descaling chemical suggested by the manufacturer due to its lack of availability and relatively high cost. *Golden Bridge* used an equivalent chemical from an alternative manufacturer to perform the task. The manufacturer of this chemical issued their own set of instructions for the use of their product and these were detailed on their Material Data Safety Sheet (MSDS) which the ship held on board, in a file, in the engine control room. These instructions required the chemical to be agitated by bubbling air through the mixture. They also contained the warning:

> The system should be ventilated to the atmosphere at all times during cleaning.

There was no record or indication that the third engineer had read these instructions. If he did so, he did not heed or remember them.

The shipboard instructions

On board this ship, the following procedure was usually used for performing the descaling task. These instructions were repeated consistently by each of the other engineers at interview. They were understood by the rest of the engineers but were not written down.

1. remove bolts to open the sight glass port.
2. fill the evaporator section with a hose through this sight glass port.
3. pour the chemical in through this port to obtain the correct mixing ratio as detailed on the MSDS.
4. connect ship's service compressed air line to the drain valve at the bottom of the evaporator using the on-board manufactured fitting.
5. turn on compressed air supply and then turn on the main engine heating.
6. allow chemical to mix and complete the descaling process.
7. stop heating and then turn off and disconnect the compressed air supply.
9. drain evaporator.
10. fresh water flush the interior of the evaporator.
11. close the drain.
12. close the sight glass port and reapply the holding bolts – machine is ready for use again.

Note that the sight glass opening, when using the shipboard process to descale the unit, provided two functions:

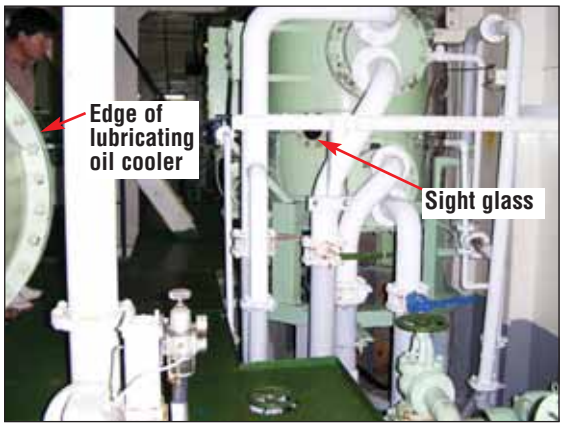
1. access for the chemical and water inputs.
2. an opening to allow the agitation air to escape from the fresh water generator vessel.

Procedures

The ship did not have a written procedure for this task. One is not required, as this is not a 'critical' task under the ISM[3] code, but the ship may have one if it is deemed necessary or desirable by those on board. The third engineer was given verbal instruction by the first engineer and was initially supervised by the chief engineer, but it is apparent that he did

[3] ISM Code is the International Safety Management code

FIGURE 3: Photograph showing lubricating oil cooler



not fully understand the necessity of leaving the sight glass off until the end of the process. A formal, written procedure may have warned the third engineer of the dangers identified when the procedure was compiled.

The job and supervision

The chief engineer had witnessed the removal of the sight glass and the addition of the chemical before leaving the engine room. The third engineer had now only to wait for the chemical to do its job before flushing and reassembling the unit. Though this task is fairly straightforward, the third engineer's lack of experience, as well as lack of time on board, should have meant an enhanced level of supervision. He was supervised for part of the task but this did not extend to an explanation of the continuing dangers or precautions required. He had been in the process of replacing the sight glass (with the service air still being supplied to the vessel) when the glass had exploded due to the build up of pressure within the evaporator. The glass and air blast had hit him in the face causing him to be thrown backward against the lubricating oil cooler behind him (see photo). It was these head injuries which caused his death.

Skill levels

The third engineer was the junior of the engineering officers on board with relatively little experience as a ship's engineer. This job was ship-specific and the dangers involved, and the significance of the job steps, should have been explained in detail to him. As the third engineer was a qualified engineer it would be reasonable for the senior officers to expect a certain level of work skills but this level can vary significantly. Supervisors should make assessments of skill based on practical observation if possible, rather than academic qualification alone.

Conclusions

These conclusions identify the different factors contributing to the incident and should not be read as apportioning blame or liability to any particular individual or organisation.

Based on the evidence available, the following factors are considered to have contributed to the incident:

1. The third engineer had replaced the sight glass whilst the service air was still being supplied to the evaporator causing an internal overpressure and eventual rupture of the sight glass.
2. The change of chemical being used for descaling required a procedure that had not been the subject of an on-board job safety analysis or a written procedure.
3. There were no written instructions and inadequate verbal instruction provided to the third engineer.
4. There was inadequate supervision of a relatively junior engineer.

Recommendations

MR20030035

Senior ship's officers should ensure that any new staff are adequately instructed and supervised during their initial stages on board a ship especially in procedures specific to that vessel where written procedures for ship specific operations are not available.

MR20030036

Ship staff should review their written procedures and job safety analysis to ensure that all 'critical shipboard tasks' have procedures written to detail the correct procedure for safe completion.