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ATSB TRANSPORT SAFETY REPORT
Marine Occurrence Investigation No. 265
MO-2009-004
Final

Fatality on board *Thor Gitta* at sea off Western Australia
21 May 2009

ABSTRACT

At about 0930[1] on 21 May 2009, a crew member on board the general cargo ship *Thor Gitta* was fatally injured while attempting to secure lashing bins in the cargo hold. At the time, the ship was about 390 miles[2] northwest of Fremantle, Western Australia.

The investigation found that a risk analysis had not been undertaken before the bins were introduced into service and that the bins had been inadequately secured in an area where there were no dedicated lashing points. It also found that the crew member was probably affected by fatigue as a result of the duty roster and the ship's movement in the heavy seas.

As a result of this accident, the ship's manager has implemented a range of measures on all its vessels to improve the security of bin lashing arrangements and manage the risks of carrying out tasks associated with operation of the bins. The company has also introduced a different rostering system to better manage the fatigue of watchkeepers when the ship is at sea.

The ATSB has issued one safety recommendation to the Danish Maritime Authority relating to the use of the 6 hour on/6 hour off work routine and the effect that that work routine has on a crew member's level of fatigue.

Figure 1: *Thor Gitta* in Fremantle

1 All times referred to in this report are ship time, Coordinated Universal Time (UTC) +7 or +8 hours.

2 A nautical mile of 1852 m.

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FACTUAL INFORMATION

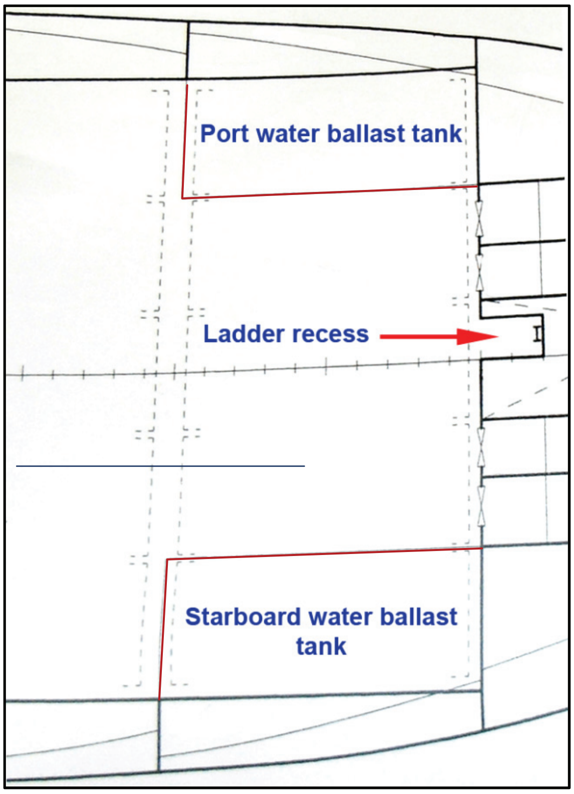
Thor Gitta

Thor Gitta (IMO No. 9137727) is a general cargo ship which was built in Poland in 1996 (Figure 1). It has an overall length of 101.3 m, a breadth of 16.8 m and a deadweight of 4,900 tonnes at its summer draught of 6.4 m.

At the time of the accident, *Thor Gitta* was registered in Denmark and classed with Germanischer Lloyd (GL). It was owned by Thor Ingeborg, Denmark and managed by T-Red, Denmark.

Thor Gitta has a single cargo hold, located forward of the accommodation, which is serviced by two cargo cranes mounted on the ship's port side. Cargo can be stowed in the lower hold, in the tween deck and on the hatch covers.

Figure 2: Forward tween deck arrangement



The tween deck can be positioned on any one of three levels depending, on the height of cargo being carried in the lower hold.

Two water ballast side tanks are located at the forward end of the hold. The tops of these tanks stand about 1.5 m above the tween deck's number one pontoon (Figure 2) and have 20 foot container footings located at the corners. A vertical access ladder is located in a recessed area at the forward end of the hold.

Propulsion is provided by a MAN B&W 9L32/40 diesel engine which drives a single controllable pitch propeller through a reduction gearbox. This gives the ship a service speed of 15 knots[3] at 181 rpm.

At the time of the accident, *Thor Gitta*'s 13 crew consisted of two Danish, three Russian and eight Filipino nationals.

The chief and second mates worked 6 hour watches in port and at sea. Four deck ratings worked a 6 hour watchkeeping routine, on a week on/week off basis, both at sea and in port. During the week when they were not on watchkeeping duties, they were engaged in day work activities along with other crew members.

The master began his seagoing career in 1964. He joined T-Red in 2003 and was appointed *Thor Gitta*'s master when the company acquired the ship in early 2008. He had rejoined it on 30 March 2009 after a period of leave.

The chief mate had 29 years of seagoing experience and had extensive experience on general cargo ships similar to *Thor Gitta*. He was completing his second assignment on the ship.

The deceased crew member was 37 years old. He had been at sea for 14 years and held a Philippines STCW[4] deck certificate. He had been employed by T-Red as an able seaman (AB) since April 2008. He had served one contract on *Thor Gitta*'s sister ship, *Thor Ingeborg,* and had joined *Thor Gitta* for the first time on 4 February 2009.

THE ACCIDENT

At about 2345 on 18 May 2009, *Thor Gitta* commenced loading a cargo of mining equipment in Fremantle, Western Australia. The cargo included a number of trucks which were loaded into the lower hold and secured to the tank top using ratchet webbing straps.

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

4 Seafarer's Training, Certification and Watchkeeping.

At about 1100 on 19 May, all cargo operations were completed. The ship's departure draughts were 3.47 m forward and 5.97 m aft. Its departure GM[5] was 1.75 m.

At 1440, a Fremantle harbour pilot boarded *Thor Gitta* and shortly afterwards, the ship departed its berth. At 1510, the pilot disembarked and *Thor Gitta* began its planned passage, which was to take the ship on a direct rhumb line track across the Indian Ocean, passing to the north of Madagascar and then onto Dar es Salaam, Tanzania.

While *Thor Gitta* was in Fremantle, the master had been monitoring a low pressure weather system (low) in the southern Indian Ocean, to the southwest of Western Australia, which was moving eastwards. At 1900, the Australian Bureau of Meteorology (BoM) issued a forecast, valid for 24 hours, which contained a gale warning for an area within 600 miles of the low. Winds were forecast to be north-westerly to south-westerly at 15 to 25 knots, increasing to about 35 knots. Seas were forecast to be moderate to rough on a moderate to heavy swell. *Thor Gitta*'s passage initially took the ship just within this area, as the low moved eastward.

On the morning of 20 May, in preparation for the expected rough weather, the cargo lashings in the hold were inspected. The cargo was secure but additional lashings were put on the bins containing unused lashing equipment (lashing bins) which had been secured at the forward end of the ship's tween deck.

Water ballast was also discharged from the after peak and numbers 18 and 19 water ballast tanks to reduce the ship's GM to 1.43 m.

As the day progressed, the weather and sea conditions deteriorated. At about 2100, the master reduced the main engine speed to 112 rpm to lessen the pounding[6] being experienced at the time.

By the morning of 21 May, the weather and sea conditions had worsened, with the seas now confused and the waves averaging about 8 m in height. The chief mate wanted to check the lashings in the cargo hold again and the main engine speed was further reduced to 90 rpm, giving *Thor Gitta* a speed through the water of about 3 knots. The ship then took up a slight to moderate pitching motion in the head seas.

The chief mate, an AB and an ordinary seaman (OS) donned their usual personal protective equipment, including hard hats and portable radios. Because there was no access to the lower hold from aft, the crew members made their way to the hold's forward entrance. They then climbed down the 8 m vertical ladder to the lower hold.

At about 0900, the three men started to move from forward to aft through the lower hold, checking the lashings. At 0920, the chief mate reported to the master, who was on the bridge, that all the lashings were secure.

The ship was pitching slightly and when the men were at about midships on their return to the ladder, they heard some movement on the tween deck. The chief mate looked up and, between the gap in the tween deck pontoons, could see that three lashing bins were sliding about 2 m from side to side across the deck.

The men climbed the ladder to the tween deck, confirmed that the lashings on the bins had worked loose and at 0925, began to resecure the bins using ratchet webbing straps. They quickly secured the after two bins against the inboard side of the port water ballast tank. They then began to position the next lashing bin when the ship suddenly rolled to starboard.

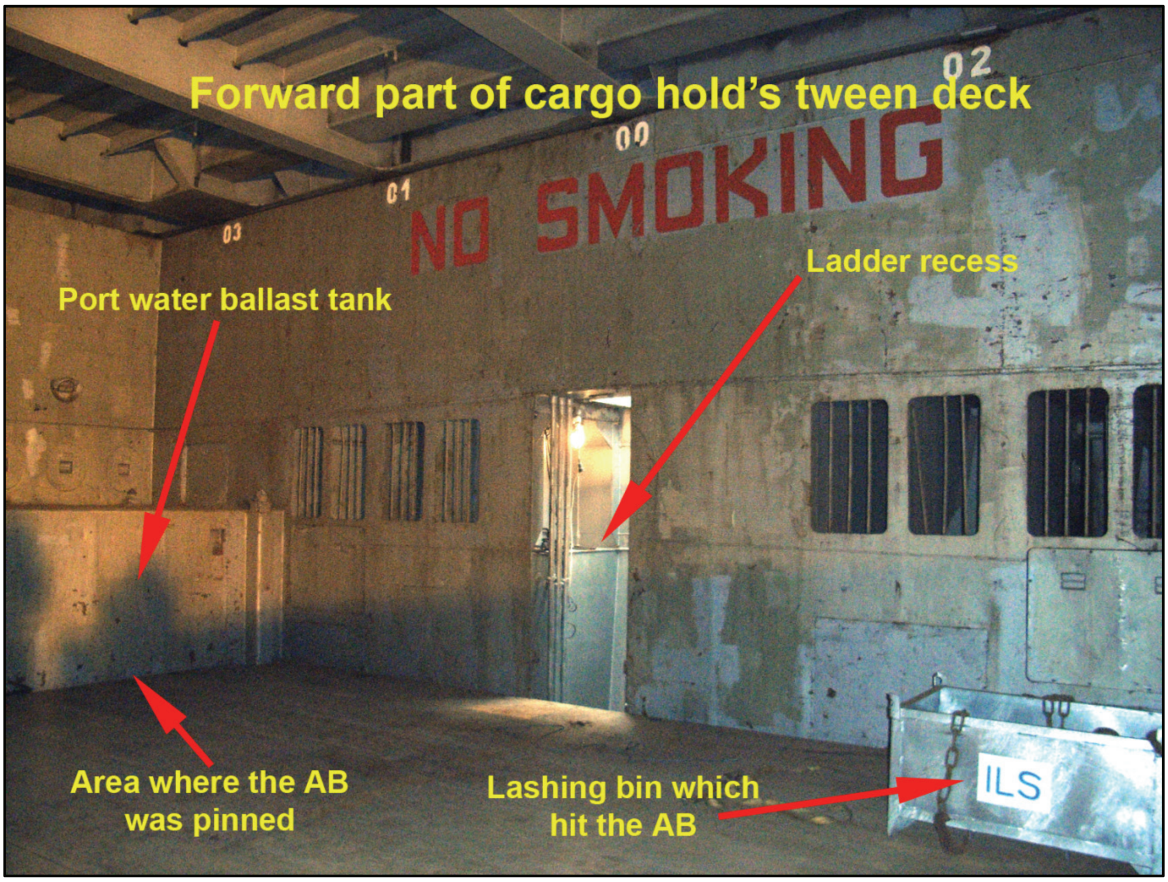
As the ship rolled, the bin began to slide across the tween deck pontoon. The chief mate yelled 'be careful, be careful!' and the OS jumped backward, seeking protection aft of the starboard water ballast tank. The chief mate also jumped clear of the sliding bin, moving to the hold's forward bulkhead, on the starboard side. However, the AB grabbed hold of the port side of the lashing bin and appeared to be trying to stop its slide to starboard.

Shortly afterwards, the ship rolled heavily to port and the lashing bin started to slide back to port. The AB lost his balance and fell onto the pontoon, into the path of the bin. He was unable to get to his feet before the bin slid into him, hitting him

5 Metacentric height – one of the critical measurements of a ship's stability.

6 The heavy falling of a ship's bow into the sea after it has been lifted by wave action.

Figure 3: Accident location on the tween deck level



heavily in the torso and pinning him against the side of the port water ballast tank (Figure 3).

The chief mate tried to pull the bin off the AB but at about 0929, as the ship again rolled heavily to starboard, the bin came away from the AB and the chief mate's left foot was pinned between the bin's leg and the side of the starboard water ballast tank. When he was able, the chief mate jumped onto the top of the starboard ballast tank and clear of the moving bin.

As the lashing bin slid away, the AB jumped to his feet and ran for the relative safety of the ladder recess. The chief mate, concerned that the AB had suffered internal injuries after being hit by the lashing bin, contacted the master using his portable radio and requested urgent medical assistance and that oxygen be brought to the hold.

At about 0930, a few seconds after the AB made his way to the ladder recess, the chief mate and the OS saw him lose his grip on the ladder rung and fall down the recess onto the tank top, about 6 m below.

At about the same time, the ship's rolling stopped and its pitching motion resumed. As a result, the lashing bin's movement stopped and the chief mate and OS were able to run to the ladder and make their way down to the AB, who had blood coming from his mouth, appeared groggy and was trying to sit up. The chief mate told the OS to try to keep the AB conscious while he went to seek assistance.

In the meantime, the master had told the second engineer to get some crew and go forward. He called the second mate to relieve him on the bridge so that he could go forward.

At 0940, when the other crew members arrived at the accident site, the AB's vital signs were checked. His pulse and breathing were both very weak. A resuscitation bag and mask were used to assist his breathing and a neck brace was applied. At about 1000, the AB lapsed into unconsciousness.

The master returned to the bridge and at about 1030, contacted the Danish Medical Advisory Service by satellite telephone. The doctor instructed the master to check the dilation of the pupils of the AB's eyes. The master returned to the hold and both he and the second engineer witnessed that the AB's pupils were non-responsive to light.

The master then returned to the bridge and reported back to the doctor. At 1045, the doctor told him to stop any attempts to revive the AB and pronounced him deceased.

The chief mate's injuries, his swollen left foot and a 10 cm laceration down to the bone on his lower right leg, were treated by the master and second engineer when they returned to the accommodation from the hold.

At 1200, after a discussion between the master and the ship's managers, the decision was made for the ship to return to Fremantle where the AB's body could be landed and further medical attention provided to the chief mate.

At 0510 on 23 May, a Fremantle harbour pilot boarded *Thor Gitta* and by 0606, the ship was all fast alongside its berth.

ANALYSIS

The fall

A post mortem examination revealed that the AB died as a result of multiple head and internal injuries sustained when he was hit by the lashing bin and in the subsequent fall down the ladder recess.

The ladder itself was about 8 m in total length, in one piece, leading vertically from the access hatch on the main deck level to the tank top. It had no intermediate platforms or fall arresting devices fitted.

Thor Gitta was built in 1996 in accordance with the relevant Danish legislation covering vertical ladders in force at the time. There was no requirement in those regulations for vertical ladders to have any form of fall arresting devices attached to them. Therefore, when the AB lost his grip, there was nothing to break his fall or lessen any effects of the fall.

It is probable that the AB, having just been struck in the chest and torso by a heavy lashing bin, was confused, dazed and on the verge of unconsciousness because of internal bleeding. Therefore, his grip on the ladder was probably not as strong as it could have been.

Although he was wearing a hard hat when attempting to secure the lashing bins, the hat did not have a chin strap and it was found some distance from his head after the fall. Consequently, the hard hat did not offer any protection for the AB's head.

The lashing bins

The lashing bins the three crew members were attempting to secure were 1,200 mm long, 800 mm wide and 600 mm in height. They sat on four legs, which were manufactured of 5 mm thick, 50 mm x 50 mm angle iron (Figure 4) with no pads on the bottom. The bin legs offered very little surface area or friction on the metal deck and therefore little sliding resistance. The bins had been delivered to the ship in March 2009 and were a commercially available, readymade product made of galvanised steel, with an empty weight of 90 kg.

The bins had been ordered to replace 200 litre drums which were used on board to store unused lashing equipment. The ship's master had originally ordered replacement drums but the order was changed ashore as it was thought that the drums were 'unsafe and unreliable'.

However, prior to the introduction of the bins, no risk assessment was undertaken on the use of this particular lashing gear storage container. This was despite them being used in a ship where it was necessary for these containers to be moved, depending on the disposition of cargo within the hold. There was also no risk assessment carried out, either ashore or on board, on the difference in weight between a full lashing bin and a full drum, the latter being significantly lighter. The bins were simply introduced into service and were secured in the same way the drums had been on previous occasions, by the use of ratchet webbing straps.

There were lashing points/lifting points on the tops of the bins, and dedicated lashing points were available in the majority of the tween deck space, both on the hold's bulkheads and in the deck itself (flush elephant foot sockets). However, in the section of the tween deck in which the bins were secured; there were no dedicated lashing points on any vertical surface. There were several lashing points in the pontoon itself but none were in the immediate vicinity of the bins. As a result, the straps were secured to the container footings on the top of the port water ballast tank (Figure 4).

Figure 4: Lashing bins secured after the accident

However, the straps led upwards from the body of the bins and did not apply any downward pressure on them to 'hold' them onto the pontoon, thereby increasing the risk of the bins sliding about on the relatively smooth tween deck surface.

There were no shipboard procedures to provide the crew with guidance as to where and how to secure the movable lashing bins. As a result, the bins were secured in an area of the tween deck which did not have suitable lashing points.

Unlike the drums they replaced, the body of the lashing bins did not sit on the deck. Therefore, it was only the bottom of the legs that were in contact with the deck to resist any sliding as the ship rolled. This total surface area was only 20 cm^2.

Two steel surfaces in contact with each other, as the legs of the bins were with the deck, have a low coefficient of friction. Consequentially, the force needed to start one steel surface moving/sliding over the other is low. Despite this fact, no other material, such as rubber matting or dunnage, which would increase the coefficient of friction and therefore the bins' resistance to movement, was placed under the legs when the bins were secured in Fremantle.

In their submission, T-Red stated that:

> The 200 litre drums might have a bigger friction (coefficient) than the delivered lashing bins, but the drums are not designed for storage and lifting of lashing materials. The drums' lifting points are very doubtful.

The lashing bins were specifically designed and manufactured to stow unused lashing equipment. However, the way they were used on board *Thor Gitta* meant that any method of securing them to the ship's structure needed to be sufficient to ensure that they did not move in a seaway.

The method of lashing the bins in Fremantle after cargo operations were completed was not sufficient or adequate. Consequently, the movement of the ship in the heavy seas caused the bins to work the lashings loose and the AB did not appreciate the total weight of the bin when he tried to stop it sliding to starboard as the ship rolled.

Fatigue

The potential for fatigue in seafarers is high. Ships are dynamic work environments which operate on a 24/7 basis and do so with small numbers of crew, on a platform which, unlike similar operations ashore, is subjected to vibrations, noise and movement caused by both mechanical and natural influences. Because they degrade sleep quality, all these factors increase the likelihood of fatigue being a contributory factor in shipboard accidents.

In the context of human performance, fatigue is a physical and psychological condition that is primarily caused by prolonged wakefulness and/or insufficient or disturbed sleep. Fatigue can result from a number of different sources, including time on task, time awake, acute and chronic sleep debt[7] and circadian disruption (i.e. factors which affect the normal 24-hour cycle of body functioning).

Fatigue can have a range of effects on human performance: slowed reaction time, decreased work efficiency and increased errors or omissions. A common symptom of fatigue is a change in the level of risk that a person accepts, or a tendency to accept lower levels of performance and not correct errors which come about in the course of performing tasks while fatigued. All these could have a significant impact on shipboard operations and personal safety.

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7 The difference in the sleep needed over a period of time and the sleep actually obtained.

While many of these symptoms generally only appear after substantial levels of sleep deprivation, even the loss of sleep for one night can have negative effects on several aspects of human performance

An analysis of seafarer survey data dealing with the impact of fatigue on cognitive functioning and safety (errors of attention, memory and action), contained in a Cardiff University seafarer fatigue study[8], shows that:

> ...those who reported high levels of fatigue were at a greater risk of making frequent cognitive failures. Frequent cognitive failures were also more likely to be reported by: those doing shorter tours of duty; those doing 6 or 12 hour shifts; those with poor sleep quality; those exposed to physical or environmental hazards; those with high job demands; those with high levels of stress at work; officers; and older workers.
>
> These findings suggest that, as well as general fatigue risk factors, seafaring is subject to additional specific fatigue risk factors that are particularly linked to poorer cognitive function.

Many of the problems associated with fatigue reflect organisational factors such as manning levels or the use of fatigue-inducing shift systems. It is often the combination of risk factors that lead to impaired performance and reduced well-being.[9]

At the time of the accident on board *Thor Gitta*, the AB was keeping the 0600 – 1200 watch. Prior to working that particular watch, he had worked a combination of watches and day work. He had worked this type of routine since joining the ship, almost 10 weeks before the accident.

Despite an STCW[10] requirement to do so, the records of the deceased AB's actual hours of work in the weeks before the accident could not be provided to the ATSB. Since the AB's recorded working hours could not be used to carry out an accurate analysis of his level of fatigue at the time of the accident, his roster had to be relied upon to give an indication of the minimum level of fatigue.

The Inter*Dynamics* Fatigue Audit InterDyne™ (FAID) program was used to make the assessment on the AB's level of fatigue. FAID does not take into account actual sleep obtained, so it is used to measure expected fatigue based purely on roster information.

The specific formulae for this program were developed and validated by the Centre for Sleep Research at the University of South Australia. The program takes into consideration the following specific determinants of work-related fatigue:

- The time of day of duty and breaks.
- The duration of duty and breaks.
- Duty history in the preceding 7 days.
- Biological limits on recovery sleep.

The FAID program assumes that any period for which an operator is not rostered for duty, provided it is long enough, allows them the opportunity for rest. The actual quantity and quality of sleep that an operator receives is not an input in the FAID model. The program does not make allowance for environmental factors such as noise, light, vibration, or the age and/or the medical condition of the crew member. In addition, no allowance is made for any activity outside work hours such recreation or domestic tasks.

The major output of the FAID program is a numerical score that provides an indication of the level of fatigue likely to be experienced by an individual working a particular roster. A score of 40 would be characteristic of a level of fatigue that a person ashore working 0900 to 1700 Monday to Friday would be likely to experience at the end of a working week.

Validations performed by the University of South Australia indicate that a score below 80 is consistent with a safe system of work from the perspective of hours-of-work contributing to work-related fatigue. Scores above 100 have been shown to be consistently associated with performance impairment comparable to that seen in individuals with a blood alcohol concentration of 0.05% or greater. Such a level of alcohol related impairment would not be acceptable in a workplace.

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8 Smith, A. Allen, P. Wadsworth, E. *Seafarer fatigue: The Cardiff Research programme*. Centre for Occupational and Health Psychology, Cardiff University. November 2006, pg 45.

9 Smith, A. *Adequate crewing and seafarer's fatigue: the international perspective*. Centre for Occupational and Health Psychology, Cardiff University. 2005, pg 5.

10 Seafarer's Training, Certification and Watchkeeping Code.

The FAID analysis of the AB's roster for the 7 days before the accident, in which it is taken that he started watchkeeping duties 4 days before the accident, indicate a score of 111 on the morning prior to the accident. This score is considered to be in the very high range.

In addition to the FAID score, the AB's attempt to grab the lashing bin is indicative that his ability to properly consider the risks associated with trying to stop the bin sliding over the steel deck may have been affected by his level of fatigue.

It is also possible that, given the sea conditions on the night before the accident, if the AB was able to sleep before coming on watch at 0600 on 21 May, the quality of that sleep may have been degraded.

Based on the FAID analysis of the AB's roster, the probable cumulative fatigue effect of the roster and the movement of the ship in the prevailing seas, it is possible that the AB was experiencing a level of fatigue which may have resulted in a reduced level of alertness and impaired his performance.

Fatigue management

The International Labour Organization's Convention 180 (ILO 180) deals with seafarers' hours of work and manning of ships. Article 3 of this conventions states:

> Within the limits set out in Article 5, there shall be fixed either a maximum number of hours of work which shall not be exceeded in a given period of time, or a minimum number of hours of rest which shall be provided in a given period of time.

Under this Article, maritime administrations have the choice to regulate either seafarers' hours of work <u>or</u> their hours of rest, providing those hours are within the limits prescribed in Article 5.

Article 5 of ILO 180 prescribes the maximum hours per day that a crew member, regardless of duties and not including emergency situations, is permitted to work. It states:

> 1. The limits on hours of work or rest shall be as follows:
>
> (a) maximum hours of work shall not exceed:
>
> (i) 14 hours in any 24-hour period; and
>
> (ii) 72 hours in any seven-day period;
>
> or
>
> (b) minimum hours of rest shall not be less than:
>
> (i) ten hours in any 24-hour period; and
>
> (ii) 77 hours in any seven-day period.
>
> 2. Hours of rest may be divided into no more than two periods, one of which shall be at least six hours in length, and the interval between consecutive periods of rest shall not exceed 14 hours.

This convention was ratified by Denmark in 2003 and the Danish Maritime Authority has chosen to use the option provided for in Article 3 to regulate[11] seafarers' hours of rest in a 24 hour period and a 7 day period (1(b) above). In doing so, the Authority permits seafarers to work up to 91 hours in any 7 day period.

Part A, Chapter VIII of the STCW Code deals with watchkeeping standards. Section A-VIII/1 (Fitness for duty) provides guidance for the hours of rest that any person assigned duty as an officer in charge of a watch or as a rating performing part of a watch shall have.

It states that such persons shall be provided a minimum of 10 hours rest in any 24 hour period and that the hours of rest may be divided into no more than two periods, one of which shall be of at least 6 hours duration.

That particular section further states that, notwithstanding the provisions in the above paragraph, the minimum period of 10 hours may be reduced to not less than 6 consecutive hours provided that any such reduction shall not be extended beyond 2 days and not less than 70 hours of rest are provided each 7-day period.

The 6 hours on/6 hours off roster worked by members of *Thor Gitta*'s crew (including the chief and second mates) equated to 84 hours per week, when on watchkeeping duties.

When the deck ratings were not on watchkeeping duties, their hours of work per week equated to 56 hours. Their combined hours of work per fortnight was 140, an average of 70 hours per week, not including when they were needed to work outside those hours, such as for arrival or departure duties.

The deck crew working roster on board *Thor Gitta* was implemented to reduce the number of hours

11 Executive order on seafarers' hours of rest etc (Executive Order No. 515 of 21 June 2002).

worked by the crew over a 2 week period, therefore minimising the effects of fatigue by 'breaking-up' the 6 hours on/6 hours off cycle. By implementing this roster, the managers of *Thor Gitta* recognised the short comings of the crew working 6 hours on/6 hours off for a long period of time.

Therefore, the working routine of the deck crew and the chief and second mates met the hours of rest requirements of STCW and ILO 180.

However, the effect that a 6 hours on/6 hours off roster has on a crew member's level of fatigue has been considered at length in a number of studies undertaken since the STCW and ILO requirements were introduced. These include several conducted by the Cardiff University, the United Kingdom's Marine Accident Investigation Branch, the International Transport Workers Federation and the University of Wellington for Maritime New Zealand.

It is reasonable to say that all these reports comment on the inability of this type of roster to effectively manage the fatigue levels of those working the roster, and that other systems of rosters (such as the 4 hours on/8 hours off) should be considered.

The reasoning behind this is that maintaining a two-person watch keeping system results in a relatively short off-duty period in which the crew member has to get adequate sleep in order to overcome his/her sleep debt. In addition, the quality of sleep crew members do get can sometimes be insufficient due to the environment on board a ship. This is particularly the case when the ship is in heavy seas where sleep may be difficult to get and the quality of the sleep they do get may be reduced.

Consequently, crew members who follow this routine over a period of time are more likely to suffer from the cumulative effects of fatigue.

A 2006 report[12] examined the extent to which STCW and ILO 180 address the criteria of sleep duration, sleep quality, sleep debt, working at nights, circadian rhythms, predictability of shifts, lengths of shifts and rest breaks. The report found that ILO 180 was inadequate in terms of maximum working hours and sleep debt recovery[13].

Both the 6 hours on/6 hours off work routine for watchkeepers and the modified work routine for deck ratings used on board *Thor Gitta,* while complying with the ILO 180 and STCW requirements for rest, probably resulted in a cumulative level of fatigue in the crew.

FINDINGS

Context

At about 0930 on 21 May 2009, a crew member on board the general cargo ship *Thor Gitta* received fatal injuries while attempting to secure lashing bins in the cargo hold.

From the evidence available, the following findings are made with respect to the fatal accident and should not be read as apportioning blame or liability to any particular organisation or individual.

Contributing safety factors

- The lashing bins were not effectively lashed. Consequently, the sea conditions being experienced after the ship left Fremantle resulted in the lashing bins working loose from their securing arrangements.
- The bins were originally secured in an area in the tween deck which did not have any dedicated lashing points on any vertical surface thus reducing the effectiveness of the lashings applied in Fremantle.
- There were no shipboard procedures to provide the crew with guidance as to where and how to secure the movable lashing bins. *[Safety issue]*
- No other material, such as rubber matting or dunnage which would have increased the bins' resistance to movement, was placed under the legs when the bins were secured in Fremantle.
- It is probable that the AB's grip on the ladder was not as strong as it could have been as a

12 Jones, C.B. Dorrian, J. Rajaratnam, S.M.W. Dawson, D. *Working hours regulations and fatigue in transportation: a comparative analysis*. 2005.

13 Smith, A. *Adequate crewing and seafarer's fatigue: the international perspective*. Centre for Occupational and Health Psychology, Cardiff University. 2005.

result of the internal injuries he received from being hit in the chest and torso by the lashing bin.

Other safety factors

- Given the work roster of the AB, the cumulative effect of his hours of duty and the movement of the ship on the night before the accident, it is possible that the AB had a reduced level of alertness and impaired performance on the morning of 21 May because he was affected by fatigue. *[Safety issue]*
- Both the 6 hours on/6 hours off work routine for watchkeepers and the modified work routine for deck ratings used on board *Thor Gitta,* while complying with the ILO 180 and STCW requirements for rest, probably resulted in a cumulative level of fatigue in the crew. *[Safety issue]*

SAFETY ACTION

The safety issues identified during this investigation are listed in the Findings and Safety Actions sections of this report. The Australian Transport Safety Bureau (ATSB) expects that all safety issues identified by the investigation should be addressed by the relevant organisation(s). In addressing those issues, the ATSB prefers to encourage relevant organisation(s) to proactively initiate safety action, rather than to issue formal safety recommendations or safety advisory notices.

All of the responsible organisations for the safety issues identified during this investigation were given a draft report and invited to provide submissions. As part of that process, each organisation was asked to communicate what safety actions, if any, they had carried out or were planning to carry out in relation to each safety issue relevant to their organisation.

T-Red A/S

Lashing bin securing arrangements

Safety Issue

There were no shipboard procedures to provide the crew with guidance as to where and how to secure the movable lashing bins.

Safety action taken by T-Red A/S

The company has directed that the lashing bins be now stored inside open top containers with wooden flooring and the containers can be secured with twistlocks in any 20 foot bay.

Additionally, the involved vessel, and other vessels with similar lashing bins, will be asked to mount wooden planks underneath the bins to increase the friction between the lashing bin and steel decks.

T-Red has also advised the Danish Maritime Authority that:

- Fall arrest systems have been mounted in the access shafts to the holds both fore and aft.
- The safety instructions and workplace risk assessments for entering the holds have been revised.
- To enhance safety, extraordinary safety meetings will be held and work instructions given.
- These preventive measures are also being implemented on *Thor Gitta*'s sister ship, *Thor Ingeborg*.
- The other ships in the fleet have received information (lesson to be learned) about the fatality and injury. Where steel drums are used for storage of lashing gear, they are to be replaced by metal bins.

ATSB assessment of action

The ATSB is satisfied that the action taken by T-Red adequately addresses the safety issue.

Fatigue management

Safety Issue

Given the work roster of the AB, the cumulative effect of his hours of duty and the movement of the ship on the night before the accident, it is possible that the AB had a reduced level of alertness and impaired performance on the morning of 21 May because he was affected by fatigue.

Safety action taken by T-Red A/S

The master of *Thor Gitta* will implement a 3-shift watch routine for the deck department while the vessel is at sea.

ATSB assessment of the response

The ATSB is satisfied that the action proposed by T-Red will adequately address the safety issue.

The Danish Maritime Authority

Fatigue management

Safety Issue

Both the 6 hours on/6 hours off work routine for watchkeepers and the modified work routine for deck ratings used on board *Thor Gitta, while* complying with the ILO 180 and STCW requirements for rest, probably resulted in a cumulative level of fatigue in the crew.

Response from the Danish Maritime Authority

The Danish Maritime Authority recognises the use of programs like FAID to indicate the possibility of fatigue, but regards the indications given by such programs only as normative and not as given proof.

It is the opinion of the Danish Maritime Authority that the 6 hours on/off work routine for watchkeepers and the modified routine for deck ratings on board *Thor Gitta* does not constitute a problem as long as the hours of rest are in compliance with the Order, ILO Convention 180 and part A, Chapter VIII of the STCW code for crewmembers engaged in watchkeeping.

The Danish Maritime Authority disagrees with the statements indicating that the roster of the AB and the work routine for watchkeepers probably results in a cumulative level of fatigue in the crew.

ATSB safety recommendation MO-2009-004-SR-008

The Australian Transport Safety Bureau recommends that the Danish Maritime Authority undertake further work to address this safety issue.

SOURCES AND SUBMISSIONS

Sources of Information

The master, crew and managers of *Thor Gitta*

Office of the State Coroner, Western Australia

The Danish Maritime Authority, Division for Investigation of Maritime Accident

References

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Smith, A. *Adequate crewing and seafarer's fatigue: the international perspective*. Centre for Occupational and Health Psychology, Cardiff University. 2005

Smith, A. Allen, P. Wadsworth, E. *Seafarer fatigue: The Cardiff Research programme*. Centre for Occupational and Health Psychology, Cardiff University. November 2006

The Seafarers' Training, Certification and Watchkeeping Code, Part A, Chapter VIII, Section A-VIII/1

Submissions

Under Part 4, Division 2 (Investigation Reports), Section 26 of the *Transport Safety Investigation Act 2003*, the ATSB may provide a draft report, on a confidential basis, to any person whom the ATSB considers appropriate. Section 26 (1) (a) of the Act allows a person receiving a draft report to make submissions to the ATSB about the draft report.

A draft of this report was provided to the master, chief mate and managers of *Thor Gitta*, the Australian Maritime Safety Authority, the Danish Maritime Authority and the Office of the State Coroner, Western Australia.

Submissions were received from the master and managers of *Thor Gitta*, the Office of the State Coroner, Western Australia and the Danish Maritime Authority. The submissions were reviewed and where considered appropriate, the text of the report was amended accordingly.