Australian Government
Australian Transport Safety Bureau

Stevedore fatality on board the general cargo ship *Weaver Arrow*

at Newcastle, New South Wales | 23 September 2012

Investigation

ATSB Transport Safety Report
Marine Occurrence Investigation
296-MO-2012-010
Final – 4 June 2013

Released in accordance with section 25 of the *Transport Safety Investigation Act 2003*

Publishing information

Published by: Australian Transport Safety Bureau
Postal address: PO Box 967, Civic Square ACT 2608
Office: 62 Northbourne Avenue Canberra, Australian Capital Territory 2601
Telephone: 1800 020 616, from overseas +61 2 6257 4150 (24 hours)
Accident and incident notification: 1800 011 034 (24 hours)
Facsimile: 02 6247 3117, from overseas +61 2 6247 3117
Email: atsbinfo@atsb.gov.au
Internet: www.atsb.gov.au

Addendum

Page	Change	Date

Safety summary

What happened

On 23 September 2012, a stevedore working on board the general cargo ship *Weaver Arrow* while it was berthed in Newcastle NSW, died after being crushed under packs of aluminium ingots which toppled over during loading. Other stevedores raised the alarm and tried to help the crushed man but he showed no signs of life. Paramedics and police officers arrived on the scene shortly afterwards and confirmed that the stevedore was deceased.

What the ATSB found

The ATSB found that the stevedore was climbing down aluminium ingot packs to work on a lower tier of the cargo when the packs toppled over. It was usual for some stevedores to climb up or down ingot packs to work on different cargo tiers instead of using the ladders provided.

The investigation identified that the ingot cargo units or lifts (multiple packs of ingots strapped together) were inherently unstable and prone to toppling over. The stevedoring company's procedure for loading aluminium products did not adequately address the risk of the cargo toppling over and the implementation of basic precautions, such as using ladders to climb between cargo tiers, was not effectively monitored or enforced.

The ATSB also found that stevedores often worked extended hours, exposing the company's operations to a level of fatigue-related risk that had not been assessed and treated.

What's been done as a result

Immediately after the accident, Newcastle Stevedores, the stevedoring company, re-assessed the risks involved in loading aluminium ingots and revised its procedures for managing the risk of an ingot lift toppling. The primary measure was establishing an exclusion zone adjacent to a lift. This was included in a revised procedure for ingot loading with other measures such as the use of ladders. Steps to implement the procedure and ensure compliance included increased monitoring of loading operations. Other safety action taken includes an independent review of procedures, retraining of senior grade stevedores in hazard management, developing a process to reject hazardous lifts and suggestions to improve ingot lift configurations.

Patrick Ports and Stevedoring, the company responsible for preparing ingot packs for loading, has taken steps to enhance the stability of ingot lifts and a review is ongoing to identify other ways to address the issue. The main action taken is the addition of vertical straps to hold ingot stacks in a lift together (one strap for each pair of adjacent stacks).

Gearbulk Norway, *Weaver Arrow*'s manager, has made toppling of cargo a specific agenda item at the daily meetings between senior staff on board its ships and stevedores in all ports. Gearbulk has also introduced a policy of rejecting ingot lifts with broken pack, lifting or unitising straps for loading on any of its ships.

The ATSB has recommended that Newcastle Stevedores address the issue of stevedore fatigue. The ATSB has also issued two safety advisory notices to all stevedoring companies with regard to the issues concerning ingot loading and fatigue risk to promulgate a broad safety message.

Safety message

Individual stacks of aluminium ingots and other similar break-bulk cargoes (whether or not strapped together for carriage on ships) should always be considered unstable and prone to toppling over. No work should be undertaken in the vicinity of ingot stacks unless they have been secured to prevent toppling.

Contents

The occurrence

At 1800[1] on 22 September 2012, the 200 m long general cargo ship *Weaver Arrow* (Figure 1) berthed at number one berth, Eastern Basin in the port of Newcastle. The ship was to load a cargo of aluminium products, predominantly ingots for discharge in Japan and South Korea.

Figure 1: *Weaver Arrow* berthed in Newcastle

Source: ATSB

At 2200 that evening, stevedores from Newcastle Stevedores began loading aluminium ingots using the ship's two gantry cranes. Trucks positioned pre-slung lifts of 880 or 1,056 ingots (each ingot weighing about 23 kg) on the wharf under the cranes (Figure 2). The two cranes allowed simultaneous loading of the 20 or 24 tonne lifts into two cargo holds.

Figure 2: Ingot handling on same class of ship

Source: Gearbulk Holding

Loading started in cargo hold numbers two and ten, two of the three holds to be loaded (Figure 2 inset). Six stevedores were deployed to load each hold. Two stevedores attended the cargo lifts on the wharf, two were assigned to drive the crane and another two to work in the hold. One of those assigned to the hold was a senior grade stevedore, the team leader responsible for loading cargo in accordance with the stowage plan. The crane drivers alternated between driving the crane and other work (usually in the hold) every 2 hours during a shift and, hence, there were usually three stevedores in the hold.

Cargo loading continued throughout the night of 22-23 September. Ingots were stowed in the cargo holds in three athwartships rows of 15 lifts each (Figure 3). Once a full tier of ingots had been stowed, the stevedores arranged timber planks (dunnage) before stowing the next tier (Figure 4). To prevent the cargo from shifting during the sea passage, the spaces between rows were filled with inflatable rubber bags (airbags) by the ship's crew.

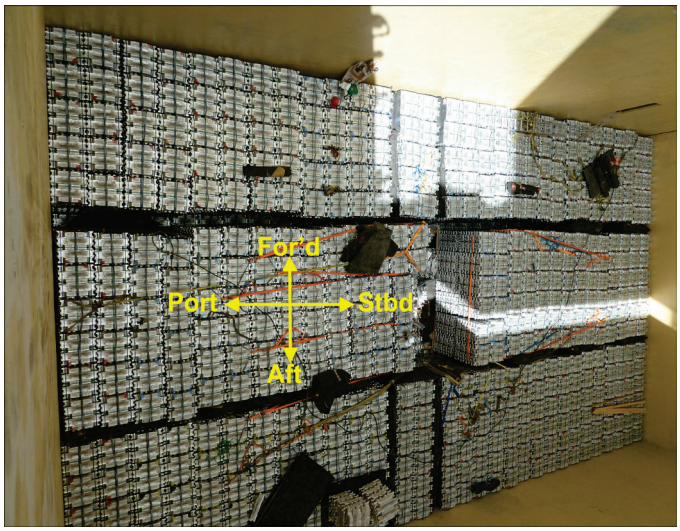
On 23 September, the stevedores worked a morning shift from 0700 to 1500. Some of the stevedores were also rostered to work the next shift (the evening shift) after a 1 hour break.

At 1600, the evening shift continued loading in both cargo holds. In number two hold, the team leader and both assigned crane drivers had earlier worked the morning shift. A trainee stevedore

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

(trainee) assigned to work in the hold was on his first shift of the day. Two of *Weaver Arrow*'s crew members were also working in the hold, air-bagging between rows of ingots.

Figure 3: Ingots stowed in number two cargo hold



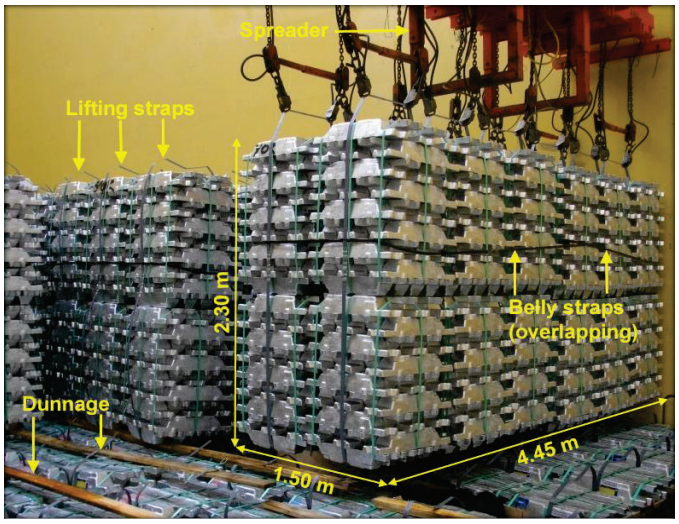
Source: ATSB

At 2010, after a rest break of about 45 minutes, cargo loading resumed. Loading of the third and last tier of ingots was well underway in number two hold, and the stevedores were loading the middle row, the last to be loaded. The ship's boatswain and an able seaman (AB) were air-bagging on the port side of the hold.

From time to time during loading, the stevedores 'hit-up'[2] a stowed ingot lift to make a tighter stow. When 'hitting-up', the team leader communicated with the crane driver above using a hand-held radio and hand signals.

Shortly after 2105, the second last lift of ingots to be loaded in number two hold was used to 'hit-up' and push the lift previously loaded. While doing so, ingot packs[3] in the lift that was 'hit-up' became slightly disturbed. The dunnage in the gap where the last two lifts were to be stowed was also disturbed. This was not unusual and the team leader decided to go down into the gap or 'hole', as it is known, to re-arrange the dunnage. He called the crane driver above on his radio and indicated his intentions to ensure that the suspended lift remained stationary while he was in the 'hole'. He then advised the stevedore (the standby crane driver) assisting him in the hold of his intentions and handed over the radio.

Figure 4: Ingot lifts stowed in cargo hold



Source: Newcastle Stevedores

At about 2110, the team leader began climbing down the ingot packs in the aftermost of the six inboard stacks of the lift that had just been 'hit-up'. The stevedore assisting him was standing aft of the 'hole' and the trainee forward of it. When the team leader was half way down the ingot stack, the stevedore saw the stack move. He yelled a warning, urging the team leader to jump. As the stack he was climbing down toppled, the team leader tried to avoid it by moving to the forward end of the 'hole' and either jumped or tripped and fell. He lay in a foetal position and both of the falling stack's ingot packs fell clear of him. However, the second, third and fourth stacks (from aft) then toppled over in quick succession. Ingot packs from the second stack fell on

---

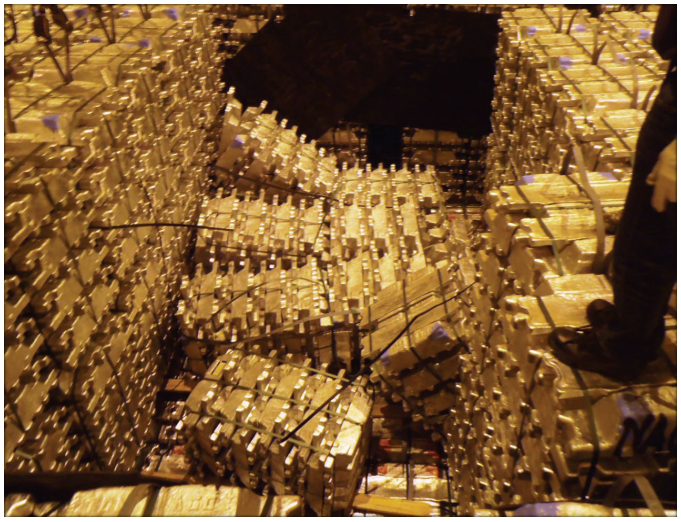
2 'Hitting-up' involved manoeuvring the next lift, suspended from the cargo spreader, to bump and push the stowed lift against the one on its opposite side.

3 Each 1 tonne pack comprised 44 ingots strapped together (described in the 'Context' section of the report).

the team leader's legs and packs from the third on his torso. The two forward inboard stacks and all of the outboard stacks in the lift remained upright.

The four aft inboard ingot stacks had collapsed in less than 5 seconds (Figure 5). The stevedore could partially see the head and an arm of the team leader, who appeared to be unconscious. Using the radio, he called the foreman ashore, reported the accident and asked for emergency services to be called. He then told the trainee to go and call the other stevedores while he remained in the hold to see how best to help the team leader. The crane driver, who had seen what had happened from above, also called the foreman and further explained the situation.

Figure 5: Collapsed ingot stacks (view looking aft)



Source: *Weaver Arrow*'s master

The crew in the hold had been air-bagging on the port side when they heard a loud bang followed by alarmed shouting. Seeing only two of the three stevedores, they walked over to the 'hole' and saw the team leader, who appeared to be buried under fallen packs of ingots. The AB called the chief mate on his hand-held radio and reported that there had been an accident. The master overheard the radio conversation. He immediately called the ship's agent in Newcastle to report the accident and then began notifying other parties.

In the cargo hold, the stevedore checked that the eight remaining stacks in the collapsed ingot lift appeared sufficiently stable before climbing into the 'hole' to help the team leader. He found that the crushed man was unresponsive, his face was discoloured, there was no pulse and he showed no sign of life.

Cargo loading was suspended and, shortly afterwards, other stevedores began entering the cargo hold. By about 2120, up to 15 stevedores had entered the hold and joined an attempt to remove ingots from the packs that had fallen on the team leader. A number of the ship's crew had also arrived in the hold with a stretcher, and first aid and resuscitation equipment.

At 2130, paramedics and police officers responding to the emergency boarded *Weaver Arrow*. They entered the cargo hold and assessed the accident site and the team leader's condition.

At 2147, the paramedics confirmed that the team leader was deceased. Shortly afterwards, everyone except for two police officers collecting evidence, left the cargo hold.

Over the next few hours, a number of persons (police, stevedores, surveyors and others) attended the ship to gather evidence, obtain information and make arrangements to remove the team leader's body from the ship.

At 0430 on 24 September, the team leader's body was taken out of the cargo hold. At 0522, police officers removed his body from the ship.

At 1200 on 28 September, stevedores resumed loading in accordance with revised procedures aimed at preventing a similar incident. At 2100 on 29 September, loading was completed without further incident and, at 2353, *Weaver Arrow* sailed from Newcastle.

Context

Weaver Arrow

Weaver Arrow is an open hatch ship designed to carry general cargo or containers. The ship has two gantry cranes that can travel the length of the main deck to service its 10 cargo holds. The ship's cargo gear includes purpose-made spreaders for handling aluminium ingot cargoes.

At the time of the accident, the ship had a crew of 28 Chinese nationals, including the master, all of whom were appropriately qualified for their positions.

Weaver Arrow was managed by Gearbulk Norway (Gearbulk), which is the largest carrier of aluminium products by sea and has provided logistics and transport solutions for aluminium cargoes for several decades. Gearbulk has a fleet of open hatch ships similar to *Weaver Arrow* and a number of these ships regularly load aluminium products (mainly ingots) in Newcastle, New South Wales (NSW).[4]

Aluminium ingot cargo

The aluminium ingots loaded in the port of Newcastle are manufactured by Tomago Aluminium at its plant near Newcastle.[5] Cast in moulds, the ingots are similar but not identical and weigh about 23 kg. At the plant, robots stack the ingots into packs of 44 that each weigh about 1 tonne (usually between 1,020 and 1,035 kg). There are five ingots in each of the eight tiers above a pack's base, which has four ingots. The approximately 0.75 m x 0.75 m x 1.15 m high packs are held together by strong, polyester plastic straps,[6] three straps over one side and one over the other (Figure 6).

The ingot packs are trucked from the plant to the Eastern Basin wharf in the port of Newcastle. The packs are then prepared for loading by the terminal operating company, Patrick Ports and Stevedoring (Patrick).

A forklift fitted with a purpose-made steel frame stacks ingot packs two high and a steel lifting strap[7] is placed vertically around the two-pack stack. The lifting strap is secured to the middle plastic strap of the stack's lower pack with a cable tie. The forklifts place either 10 or 12 stacks together to form one ingot lift of about 20 or 24 tonnes, respectively. Each lift is about 2.30 m high and 1.50 m wide (Figure 6), and is either 3.70 m or 4.45 m long (10 or 12 stacks, respectively). Two horizontal steel straps (belly straps) that overlap in the middle of the lift are secured around its upper packs (Figures 4 and 6). According to Patrick, the belly straps prevent the lift's stacks from splaying while being handled by the crane.

Rows of pre-slung ingot lifts are lined up on the wharf in preparation for loading. When a ship is ready to load, the forklifts place the cargo lifts onto trucks that move them under the ship's cranes.

On average, about 500 aluminium ingot lifts each month are exported through Newcastle to Far East Asia, exclusively on Gearbulk ships.

---

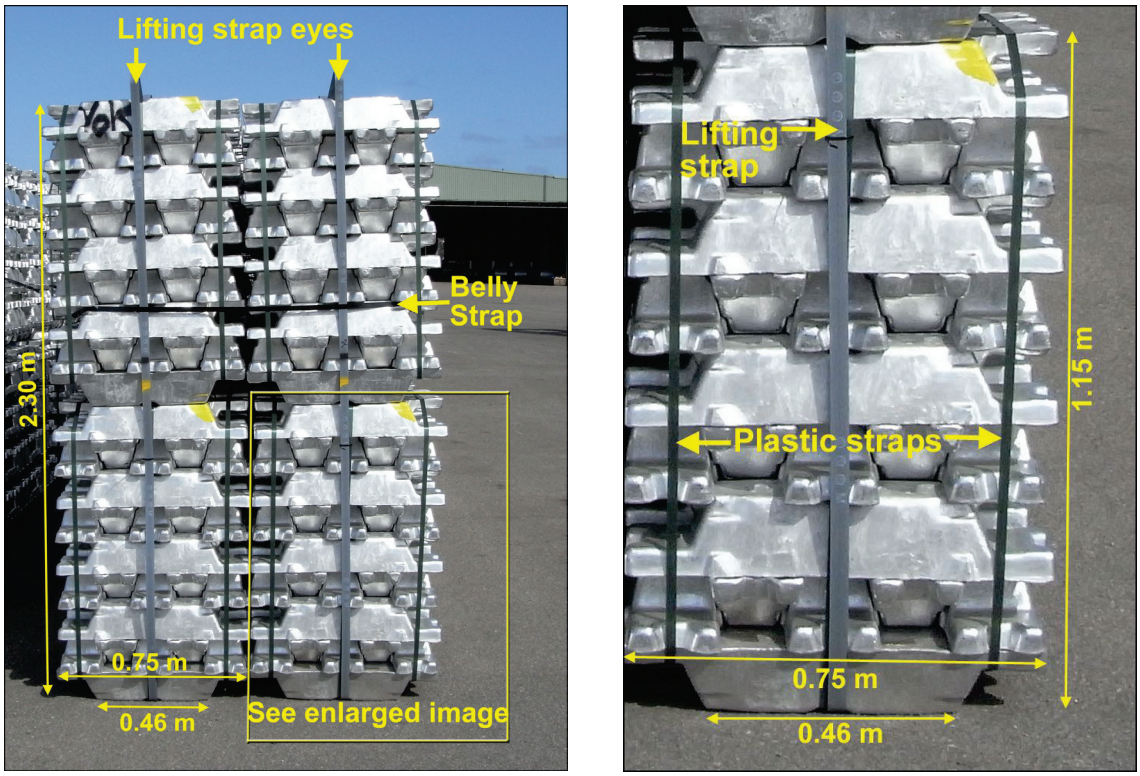
4 The ships also regularly load aluminium products in Portland, Victoria, and Gladstone, Queensland.

5 Somewhat similar aluminium ingots, produced by different manufacturers, are exported through Portland and Gladstone.

6 Tomago Aluminium has used polyester straps since 2001, after conducting assessments and trials in their use. Similar straps are widely used (internationally) for aluminium ingot packs.

7 The lifting straps are purpose-made and certified to lift more than 2 tonnes up to four times.

Figure 6: Aluminium ingot lift (view from one end) and a single pack (enlarged image)



Source: ATSB

Newcastle Stevedores

Newcastle Stevedores provides stevedoring services for container, bulk and general cargoes in the port of Newcastle. The company has been operating since 1997 and primarily handles containers and break-bulk cargo at the four Eastern Basin berths under a contract with Patrick. At the time of the accident, the company employed about 100 permanent and casual stevedores.

The stevedore team leader who died had been a stevedore for 26 of his 56 years. He had joined Newcastle Stevedores in 2001 as a casual employee, becoming permanent in 2011. He was a grade 5 stevedore (one level below the company's senior most stevedores). At that level, he could be assigned shifts as a team leader, which he regularly was.

The stevedore assisting in number two cargo hold had been a stevedore since 1996 and joined Newcastle Stevedores in 2005. He was employed as a grade 4 machinery operator on a permanent basis and usually worked as a crane driver.

The crane driver at the time of the accident had been a stevedore since 1992. He was employed by Newcastle Stevedores as a grade 4 machinery operator on a permanent basis and usually worked as a crane driver.

The trainee stevedore had started training with Newcastle Stevedores about 3 months before the accident. He was employed as a grade 2 stevedore on a casual basis.

Previous occurrences

Newcastle Stevedores had previously not had a stevedore fatality. While this accident was the first as a result of aluminium ingots toppling or falling, there had been instances of ingot cargo toppling or falling. In the 27 month period before the accident, at least five separate incidents had occurred whilst loading sister ships of *Weaver Arrow*. No one was injured as a result of those incidents. However, each of the incidents could have resulted in serious injury.

On 26 April 2012, during the loading of *Penguin Arrow*, a crane hoisting problem led to an ingot lift on a truck toppling over (the lift had to be re-packed). During subsequent testing of the crane with another ingot lift in the ship's cargo hold, the lift became unstable and had to be re-stowed.

On 21 May 2012, during the loading of *Kite Arrow*, an ingot lift on a truck toppled over as a result of a crane operation/signalling error.

On 21 September 2011, during the loading of *Merlin Arrow*, an ingot pack fell out of a lift while it was being 'hit-up' against the cargo hold side.

On 17 May 2011, during the loading of *Toucan Arrow*, an ingot pack slipped out of its lifting strap while the lift was being stowed in the cargo hold.

On 22 June 2010, during the loading of *Kite Arrow*, about 1 minute after an ingot lift was stowed in the cargo hold, it toppled over. No one was near the lift, which had appeared stable before toppling.

During the same period, concerns related to the chaining down of ingot lifts on trucks and the failure of ingot lifting straps had been documented, indicating that events prompting those concerns had occurred from time to time.

After this accident on 23 September 2012, stevedores indicated that while they were not aware of an occurrence resulting in injury, ingot packs in lifts did occasionally topple. One of the stevedores estimated the frequency of lifts being unstable or toppling as one or two events per year.

The previous incidents or near miss events with ingots toppling or falling provided valuable lessons that could have been used to better manage the risks involved. While the circumstances of each incident might well be different, the potential for ingot lifts to topple over and cause serious injury was the same in each case.

Post mortem autopsy report

A post mortem autopsy carried out following the accident established that the direct cause of the stevedore team leader's death was chest injuries resulting from blunt force trauma. A post mortem blood sample showed no evidence of alcohol.

Safety analysis

Stability of aluminium ingot lifts

Metal ingots are among the numerous types of break-bulk cargo carried at sea. However, there are no specific international or domestic standards applicable to their carriage. While some general guidance for the stowage of ingots has been documented,[8] accepted ingot handling practices are based on experience. As a result, efficient cargo handling and safety considerations, such as cargo hold loading limits and securing to prevent cargo shifting at sea, have been influential in the development of stowage practices employed on board Gearbulk ships.

The strapping of many aluminium ingot packs into a single lift means that they can be loaded onto a ship much quicker than loading individual packs. Similar reductions in unloading time can also be achieved. The ingot strapping and unitising process is, therefore, aimed at efficient handling. However, this accident and previous occurrences in Newcastle where ingot lifts have toppled indicate that lifts can be unstable, increasing safety risk.

While the shape, size and weight of aluminium ingots manufactured at different plants vary, they are often strapped together in packs of about 1 tonne each. In sea transport, the norm for handling ingots is to stack the packs two high. This is also the case at the ports of Newcastle, Portland and Gladstone. Lifts of between 20 and 32 tonnes, sometimes referred to as 'super lifts', are routinely handled.

Ingot lifts are more likely to topple over when being moved by trucks on the wharf or during the loading or unloading of a ship's hold. Once loaded and secured for the voyage, lifts are quite stable because little movement is possible. However, unless secured or within a completed stow, a lift should be considered no more stable than one of its individual two-pack stacks.

In Newcastle, a two-pack stack is 2.30 m high and has a maximum width of 0.75 m (Figure 6). However, as ingots at the bottom rest on their shorter length, the width at the base of the stack is reduced by about 40 per cent to 0.46 m. Therefore, a stack is effectively only 0.46 m wide making its height to width ratio 5:1. If tilted about 11 degrees, a stack will become unstable and, if not restrained, topple over.[9]

A number of factors can reduce the angle at which a stack will topple over, making it even more unstable. For example, if ingot packs in a stack are not tightly strapped together it is possible for the upper pack to slide or move sideways (see enlarged image in Figure 6). This shifts the centre of gravity of the stack sideways, effectively reducing the stability of the stack.

In submission, Newcastle Stevedores advised that the variation in the shape and size of ingots also contributed to the instability of a lift. The company noted that such variations can lead to a 'leaning tower' effect on lifts and considers that this was a factor at the time of the accident.

A reduction in a stack's stability also accompanies instances of climbing up or down its side. The reduction in stability is greater at the top of the climb when the person's weight acts at hand and footholds on the stack's upper pack.

Since the lifts are stowed in cargo holds with their length aligned in a fore and aft direction, their stability is susceptible to the ship's list or its heeling. Furthermore, lifts in higher tiers are subject to being stowed on surfaces which are not necessarily even or level.

Essentially, strapping and unitising for efficient ingot handling has inadvertently resulted in inherently unstable ingot lifts. Belly straps are fitted with the intention of keeping the stacks in a lift

---

[8] Thomas R, Thomas O, Pepper G, *Thomas's Stowage-The properties and Stowage of Cargoes*, Fifth Edition, 2008.

[9] An individual ingot pack (not in a stack or a lift) would topple over if tilted about 23 degrees.

from splaying when being lifted. However, they are not designed to restrain the stacks from moving or toppling and the straps often break during 'hitting-up'.

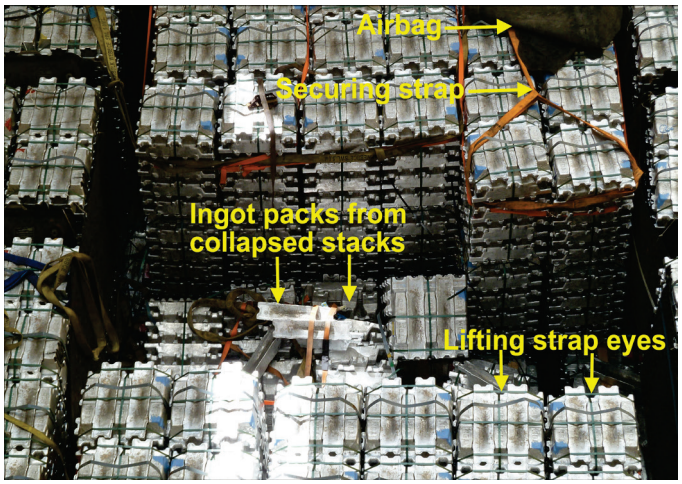
While the risks associated with the stability of lifts should be managed through loading and unloading procedures, these risks could be reduced, or eliminated, through a review of the unitising stage of ingot handling. It is worth noting here that if ingot packs at Newcastle rested on the 0.75 m length of the ingots at the base (Figure 6), the two-pack stack would not topple over until it was tilted more than 19 degrees, a comparatively significant improvement in its stability.[10]

Weaver Arrow's cargo loading

On 22 and 23 September, *Weaver Arrow*'s aluminium ingot cargo was loaded in the same way as it usually had been in Newcastle. The stevedores regularly loaded this cargo on the same class of ships, were familiar with the tasks involved and followed their usual practices.

These practices included taking precautions associated with lifting straps, suspended loads, slips, trips and falls, use of personal protective equipment, communication and signalling. Before each shift, tool box meetings were held to highlight the risks that were considered significant.

Figure 7: Ingots lifts adjacent to accident site



Source: ATSB

There is a significant risk of slips, trips and falls when stowing ingots in cargo holds. The working area formed by ingot lifts is not flat and there are many gaps and trip hazards (Figure 7). Lifting strap eyes, which project more than 10 cm above the ingots, are major trip hazards. As each strap has two eyes, there are three or four of these trip hazards per square metre of the working area. Gaps between ingots and between lifts are additional hazards. Hence, the likelihood of a trip or fall is high.

The other significant risks are related to the ingot cargo falling or toppling. A lift is made up of 880 to 1,056 ingots held together by many securing and lifting straps. The failure of one or more straps can result in part or the whole of the lift falling, collapsing or toppling. The size and weight of the ingots means that if one or more were to fall on a person, serious or fatal injury is almost certain.

Handling ingots is quite different to handling cargo units such as shipping containers which are standard, purpose-made, robust units and stowed in defined slots. The inherently unstable ingot lifts are more likely to topple over than other box shaped cargo units with smaller height to width ratios.

Dunnage between ingot tiers and airbags between rows (all provided by Gearbulk) are used to make the cargo stow more stable and less prone to shifting or toppling. The dunnage also provides some protection for lifting straps. However, the manual intervention necessary to place dunnage, 'hit-up' lifts and place airbags in gaps increases the risks involved when loading. At the same time, manual intervention increases as the loading of ingots progresses. 'Hitting-up' is carried out more often on the higher tiers and dunnage may need to be adjusted. Stevedores sometimes had to move between tiers, including accessing the confined and dangerous gap or 'hole' where the final lifts of a tier are to be stowed.

[10] The plastic straps, however, would be more exposed to contact and damage (see enlarged image in Figure 6).

It was usual for some stevedores to climb up or down a stowed ingot lift in the belief that their weight was too little to make the heavy, stacked cargo topple over. The lift's securing and lifting straps made convenient handholds while the ingots provided good footholds. Although available, portable ladders provided by Newcastle Stevedores or the ship were not regularly used.

On 23 September, the stevedore team leader was climbing down the side of an ingot lift when stacks in it toppled. The stacks had become extremely unstable when the lift was 'hit-up' minutes before the accident. The aft belly strap and possibly the forward one had broken, and some stacks appeared slightly askew. The stevedores, including the crane driver, had seen those signs but did not think that this was unusual for a lift that had been 'hit-up' or consider that it might be unstable.

In submission, the Maritime Union of Australia (MUA)[11] advised that a hatchman overseeing work in the hold may have prevented the accident through an early alert to the team leader.[12] The MUA considers that a hatchman was required and the lack of one was a critical weakness because the focus of the hatchman is the wellbeing of the workers in the hold.

The six person team loading number two hold at the time of the accident was standard for loading Gearbulk ships in Newcastle. While the two assigned crane drivers alternated between driving the crane and working below, no hatchman was specifically assigned. The gantry crane driver had an overhead view of the load and a stevedore in the hold (designated signaller) communicated with the driver using a radio and hand signals. Given that neither the crane driver above nor the two experienced stevedores in the hold considered that the slightly askew lift was unstable, it is unlikely that another stevedore (hatchman) would have come to a different conclusion.

Essentially, the practice of climbing down the side of an ingot lift had become acceptable because it was convenient and it was considered that an unstable lift would be readily apparent. However, the risk of an accident, similar to the one that occurred on board *Weaver Arrow* on 23 September 2012, had not been properly identified.

Ingot loading procedures

Newcastle Stevedores had a documented safety management system for its operations.[13] The system included a procedure titled *Loading Aluminium Products onto Gearbulk Vessels* dated 22 June 2012. The procedure was based on a formal risk assessment in the company's *Hazard ID & Risk Assessment Form-Gearbulk Cargoes-Loading of Aluminium Ingots* dated 29 May 2012. Implementation of the procedure was regularly audited by the company through completion of a *Task Inspection Checklist-Loading Aluminium-signalling/control of work area* form.

The documented procedures were supplemented by tool box meetings and a process whereby stevedores identified task specific hazards before starting work (the company's "'take 5' and stay alive" safety initiative).

The risk of an ingot lift 'unexpectedly' toppling and causing a crush injury had been identified in the risk assessment form. The form identified the main risk control measure as stabilising the lift before unhooking it from the crane. However, neither the risk nor the control measures were included in the *Loading Aluminium Products onto Gearbulk Vessels* procedure.

The risk of a person falling while climbing from one tier to the next had also been identified in the risk assessment form. Correctly using a ladder, with another person bracing it, was identified as the risk control measure. However, the procedure did not refer to the risk of falling or the use of ladders. More importantly, some stevedores routinely did not use ladders to climb between tiers.

---

[11] The Maritime Union of Australia or MUA represents about 10,000 Australian seafarers and stevedores (including those employed by Newcastle Stevedores) and is affiliated to the International Transport Workers' Federation.

[12] The relevant regulation (Marine Orders 32) states that a hatchman must be employed during loading or unloading if the crane driver does not have an unrestricted view of the load at all times during loading or unloading.

[13] Newcastle Stevedores, *Occupational Health Safety & Environment Management System*, as of 23 September 2012.

In submission, Newcastle Stevedores advised that using ladders was an informal requirement that was encouraged. The company noted that the acquisition of 15 new ladders in the previous 12 months suggested that ladders were commonly used. The company further stated that senior stevedores and cargo superintendents also encouraged and monitored the use of ladders.

However, Newcastle Stevedores' own investigation report immediately after the accident noted that some stevedores regularly climbed ingot lifts as they felt that ingots provided good footholds and were more secure than using a ladder. The report identified the effect of the team leader's weight while climbing down as contributing to the accident but did not document the point that a ladder was not used. In fact, the report stated that there was no deviation from the normal loading practice leading up to the accident.

A ladder was not in use at the time of the accident nor did the four stevedores loading the hold suggest or insist that one be used, indicating that they felt that nothing unusual, unsafe or non-compliant was being done. However, the use of ladders should have been identified in the procedure and full compliance should have been monitored and enforced. This was not the case at the time of accident and simply encouraging the use of a ladder was not an effective risk management strategy. Nevertheless, the ongoing monitoring of the use of ladders and the acquisition of more ladders by the company is a positive move.

While the company's *Working safely on the waterfront* booklet identified the risk posed by unstable ingot lifts, this general guidance for stevedores was not reflected in their usual work practices. The statements of stevedores interviewed by the ATSB after the accident indicate that the ingot loading procedure could have benefitted from their collective knowledge and experience. For example, it was not unusual for 'hitting-up' to sometimes result in dunnage shifting or belly straps breaking, potentially making lifts more unstable. It was also common to enter the 'hole' sometimes to re-position or place additional dunnage so that stowed lifts could be more stable. The likelihood of belly straps breaking and matters related to safely entering a 'hole' were not covered by the procedure or properly identified in the associated risk assessment.

At the same time, company audits and inspections had not identified any issues with the ingot loading procedures or practices. The task inspection checklist form completed during the loading of *Mandarin Arrow* on 13 July 2012, the last such checklist completed before the accident, did not identify any non-conformance or concern, including any relating to the use, or non-use, of ladders.

It is possible that the inspections and usual practices of stevedores were focused mainly on slips or trips and standing clear of suspended loads, risks that were present all or most of the time when loading ingots. The chance of ingots toppling over was less likely and, hence, the associated risks may have been overlooked.

In the 2 years before the accident, the company's occupational health and safety committee (which met every 2 months) had discussed concerns with the securing of ingot lifts on trucks and their lifting straps. However, despite some relevant incidents of note, the committee had not recorded any concerns with regard to ingot cargo falling or toppling in a cargo hold.

Similarly, the past incidents (described in the Context section of this report) did not lead to a change in the procedure for loading aluminium products. However, following the *Kite Arrow* incident on 22 June 2010, Newcastle Stevedores issued safety alert number 63 (titled *Ingots Topple in Hold*) on 2 July 2010, which stated:

> On 22/6 during the loading of aluminium ingots into Hold 2 of the Kite Arrow a pack rolled over after being landed on the second tier.
>
> Personnel advise that the pack looked stable when landed, the crane had detached & left the hold when approx. a minute afterwards the pack slowly started to lean before slowly toppling over.
>
> Fortunately no one was in the way.
>
> The pack underneath was next to an air bag but hold personnel are sure that the pack was sitting squarely on the pack below and not partly on the air bag. The pack had been 'kicked back' [refers to the placing of dunnage so that the ingot lift to be placed on it will lean into the ingot stow, not away from it].

> Hold personnel believe that there was a slight listing of the vessel possibly because both cranes travelled out at the same time & that this may have been enough to start the pack tipping.
>
> Things we must do:
> - Always be aware of the potential for a pack to topple even if initially it looks secure.
> - Do not stand in a position where you could be crushed by a toppling pack especially with your back to it.
> - Do not unhook the pack until you are confident that the lift is stable.

The company's safety alert initiative is aimed at bringing safety issues or matters of concern to the attention of its employees. However, safety alert number 63 did not lead to a change in the procedure or the usual practices of stevedores that could definitely have prevented the accident. It is likely that both the stevedores and the company's management believed that stevedores could determine whether or not a lift was unstable, based on a visual assessment and their experience, and that there was no need to modify the procedures.

Immediately after the accident on 23 September 2012, the risks involved in loading ingots were re-assessed and control measures to address the risk of a lift toppling were identified and, on 26 September, were documented in the company's formal risk assessment form. The control measures primarily comprised establishing a 3 m exclusion zone adjacent to a lift. Entering the exclusion zone was permitted only after securing the lift with synthetic strap slings, ratcheted back to prevent toppling (Figure 7). The procedure was revised to describe the risk and control measures, including the use of a ladder when climbing between tiers.

The MUA submitted that mechanically aligning cargo by smashing cargo units against one another ('hitting-up') was a dangerous and incorrect practice, particularly for handling ingots given issues with their stability and strapping. It also noted that 'hitting-up' had clearly been omitted from Newcastle Stevedores' procedures and accepted as standard practice.

Although the high risk involved in mechanically aligning cargo units is highlighted above, some alternative methods could introduce other risks. For example, handling individual ingot packs or smaller lifts to eliminate 'hitting-up' would increase the time that stevedores were exposed to risks like slips and trips. On the other hand, control measures to manage the risk of injury due to an ingot lift toppling (such as Newcastle Stevedores' revised procedures) could be a practical alternative.

While the risks of an ingot lift toppling have been taken into account by Newcastle Stevedores' revised procedure, its implementation will still need to address the disparity that existed between the procedure and actual practices at the time of the accident. In this regard, the company's audit and inspection process and initiatives such as its occupational health and safety committee and safety alert bulletins should be useful.

Fatigue management

In the context of human performance, fatigue is a physical and psychological condition primarily caused by prolonged wakefulness and/or insufficient or disturbed sleep.[14] Fatigue can have a range of influences on performance, such as decreased short-term memory, slowed reaction time, decreased work efficiency, reduced motivational drive, increased variability in work performance, and increased errors of omission.[15] Therefore, fatigue poses a risk to both productivity and safety.

At the time of the accident, the stevedores loading number two cargo hold had been on shift for more than 14 hours of a 15 hour shift that was due to end at 2200. The stevedore team leader, stevedore assisting and crane driver had all started work at 0700. All three had been rostered to

---

[14] National Transport Commission, 2008. *National Rail Safety Guideline. Management of Fatigue in Rail Safety Workers.*

[15] Battelle Memorial Institute 1998, *An Overview of the scientific literature concerning fatigue, sleep, and the circadian cycle*, Report prepared for the Office of the Chief Scientific and Technical Advisor for Human Factors, US Federal Aviation Administration.

work two consecutive 7 hour shifts with a 1 hour break between the shifts (a normal shift was usually 8 hours). The stevedores called such shifts 'double-headers', while the company referred to them as 'shift extensions'.

It was not unusual for stevedores at Newcastle Stevedores to work 'double-headers'. In fact, when a number of ships were being serviced, the stevedores would routinely work a number of 'double-headers' in succession. For example, at the time of the accident, the stevedore team leader was working his fourth 15 hour 'double-header' in a 7 day period.

While stevedores were rostered for extended shifts with their agreement, no limits for daily or weekly working hours applied. However, stevedores were generally not rostered to work more than 15 hours a day. In addition, the extended shifts were usually arranged so that they did not extend past midnight.

These informal rostering practices of the company indicate an attempt to limit fatigue by making extended working hours less onerous. However, they were not part of any plan, procedure or system, nor based on any current scientific understanding of fatigue management.

Research indicates that the risk of accidents or injuries occurring increases over successive shifts,[16] and with increasing shift length. On average, the safety risk during the fourth successive shift is 17 per cent higher than during the first shift. It has also been shown that the risk during the final hour of a 12 hour shift is almost double that during the eighth hour.[17] Furthermore, it has been found that people who routinely work longer (12 hour) shifts generally achieve only 5 to 6.5 hours of sleep per 24 hours,[18] compounding the fatigue risk associated with shift length alone.

At the time of the accident, there were no specific rules or regulations for managing fatigue in the stevedoring industry. However, under state and national work health and safety legislation, overall responsibility for workplace safety and safe working practices rests with the employer. Guidance for preventing and managing fatigue in the workplace was also available, for example codes of practice.

Newcastle Stevedores had identified that its stevedores could, at times, be exposed to fatigue-related risk. Consequently, the company's *Working safely on the waterfront* booklet provided general guidance on how stevedores could identify fatigue and what they could do to manage their own fatigue. The subject of fatigue was covered in a similar manner in the company's safety induction questionnaire for stevedores. Essentially, stevedores were responsible for managing their own fatigue.

However, Newcastle Stevedores had not identified stevedore fatigue as a risk to the company or its operations. As a result, the company had not developed a fatigue management plan or other method that systematically managed fatigue risk. Therefore, its operations were exposed to a level of fatigue-related risk that had not been assessed and treated.

The company's rostering of stevedores was based on work demand rather than defined criteria and limits to regulate stevedore working hours. Therefore, in the absence of a fatigue risk management plan, there was a greater likelihood of unregulated working hours, at times, becoming excessive and resulting in high levels of fatigue.

On the day before the accident, the stevedore team leader was rostered off and, therefore, had adequate sleep opportunity before commencing work on 23 September. However, at the time of the accident, he had probably been awake for about 15 hours, most of it working.[19] Including those 15 hours, he had been rostered on for 75 hours (with breaks in and between shifts) during the 7 day period. Based on an analysis of his shifts in that period, it is likely that the team leader

---

16 In this context, shifts undertaken on consecutive days, unbroken by a rostered day off.

17 Folkard S & Tucker P 2003, Shift work, safety and productivity. *Occupational Medicine, 53,* 95-101.

18 Ferguson S & Dawson D 2012, 12-h or 8-h shifts? It depends. *Sleep Medicine Reviews, 16,* 519-528.

19 In addition to the 1 hour break between the shifts, there was a break of about 1 hour during each shift.

had been experiencing elevated levels of fatigue, peaking during the 15 hour 'double-header' on 20 September, his third such extended shift on consecutive days. Similarly, the stevedore in the hold at the time of the accident and the crane driver had been rostered for shifts totalling 63 and 53 hours with breaks, respectively, over those 7 days. The stevedore in the hold was on his third 15 hour shift that week (the previous two had been on consecutive days) and the crane driver on his first such shift.

In submission, Newcastle Stevedores advised that four extended shifts in a 7 day period was not a normal roster pattern. The company also noted that, depending on the location of a shift, type of operation and other factors, stevedores may not be performing physical tasks for a number of the rostered hours. It claimed that in that 7 day period, the stevedore team leader would actually have carried out tasks for periods ranging from 2.5 to 7.5 hours during each 15 hour shift. The company further pointed out that when not performing a task, stevedores were permitted to leave the site, sleep, watch television or relax in any other way.

However, fatigue risk is based on hours of sleep and wakefulness. Therefore, unless sleep has been planned for and can be effectively achieved during a shift, fatigue must be assessed on the hours on shift and the subsequent reduction in sleep opportunity. While the nature of the task is an important factor (for example, an arduous task performed in extreme temperatures or high humidity), long shifts reduce the person's opportunity to obtain sufficient sleep.

Newcastle Stevedores' rostering practices, which incorporated long shifts, often in succession, has, at times, resulted in stevedores experiencing high levels of fatigue and, therefore, increased safety risk.

It was expected that, based on their experience and a visual assessment, stevedores could determine whether or not an ingot lift was unstable. This reliance on an individual's decision-making ability and judgment rather than compliance with standard procedures (that is, following the rules) meant that decision-making errors, including any attributable to fatigue, unnecessarily increased risk.

Given that the accident resulted from a decision-making error by the stevedore team leader and, to some extent, by the stevedore assisting him, the possibility of their judgment being impaired (in the absence of a plan to manage their fatigue) cannot be ignored. While it cannot be stated with certainty that their judgement was impaired by fatigue, it can definitely be said that the extended hours being worked by stevedores in the absence of a fatigue risk management plan increased fatigue-related risk with regard to this occurrence and more broadly in the company's operations.

In submission, the MUA advised that it has serious concerns about the lack of effective fatigue management in the stevedoring industry.

Findings

On 23 September 2012, a stevedore working on board the general cargo ship *Weaver Arrow* while it was berthed in Newcastle NSW, died after being crushed under packs of aluminium ingots which toppled over during loading. Other stevedores raised the alarm and tried to help the crushed man but he showed no signs of life. Paramedics and police officers arrived on the scene shortly afterwards and confirmed that the stevedore was deceased.

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

Contributing safety factors

- The aluminium ingot lifts in Newcastle, comprising multiple stacks of ingot packs strapped together, with an effective height to width ratio of 5:1 were inherently unstable. Furthermore, handling and stowage of ingot lifts involved the risk of a lift being disturbed and one or more of its packs falling or toppling because the lifting and other straps were not designed to restrain the packs as a single homogenous cargo unit and were prone to failure. *[Minor safety issue]*
- When the stevedore started climbing down the side of an aluminium ingot lift, stacks toppled over and crushed him.
- While the risk of aluminium ingot stacks toppling over had been identified by the stevedoring company as a result of past incidents, its procedure for loading aluminium products had not evolved to adequately address this risk. Furthermore, the implementation of basic precautions such as using ladders to climb between ingot tiers was not effectively monitored or enforced. *[Significant safety issue]*

Other safety factors

- The stevedoring company had not identified stevedore fatigue as a risk to the company or its operations and, as a result, had not implemented a system to manage fatigue. Consequently, its operations were exposed to a level of fatigue-related risk that had not been assessed and treated. *[Significant safety issue]*

Safety issues and actions

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 directly involved parties were provided with 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.

Stability of aluminium ingot lifts

Number:	MO-2012-010-SI-01
Issue owner:	Patrick Ports and Stevedoring (Patrick) and Gearbulk Norway (Gearbulk)
Operation type:	Cargo packaging, handling and stevedoring
Who it affects:	Cargo handling companies and their employees
Risk at time of occurrence:	Minor

Safety issue description:

The aluminium ingot lifts in Newcastle, comprising multiple stacks of ingot packs strapped together, with an effective height to width ratio of 5:1 were inherently unstable. Furthermore, handling and stowage of ingot lifts involved the risk of a lift being disturbed and one or more of its packs falling or toppling because the lifting and other straps were not designed to restrain the packs as a single homogenous cargo unit and were prone to failure.

Proactive safety action taken by: Patrick Ports and Stevedoring

Patrick Ports and Stevedoring (Patrick) advised the ATSB that additional strapping is now being used to restrain each column of two adjacent ingot stacks. This is done by putting an additional strap around each two stack column (that is, one strap holds four 1 tonne ingot packs). Therefore, a 20 tonne lift has five additional straps and a 24 tonne lift has six additional straps.

According to Patrick, the additional straps stop the internal spread in each column by binding two stacks together, and reduce both the internal spread of each ingot pack and the risk of the top packs toppling out of the lift. The overall stability of the lift also improves (since the two stack columns are wider and, as a result, have a smaller height to width ratio).

Patrick also advised that it is continuing to look at the stability of unitised aluminium ingot packs and other ways to enhance their stability. The company will continue to consult key stakeholders, including Patrick employees, in this ongoing review of the stability of the ingot lifts.

Action number: MO-2012-010-NSA-005
Action status: Closed

Proactive safety action taken by: Gearbulk Norway

Gearbulk Norway (Gearbulk) advised the ATSB that it recognises this investigation report as an important document to improve safety during loading operations. Gearbulk noted that it has a committed safety first culture both on ships and ashore but considers that there should be no boundaries in developing an even safer working environment. The company advised that it will continue to enforce best safe practice in all operations and will focus on cargo operations with particular reference to safety in the hold.

Gearbulk advised that the safety of personnel, ship and environment, and cargo are among the subjects discussed at the daily meetings between senior ship staff and stevedores in all ports. The company will include toppling of cargo as a specific item during these meetings and will reinforce the concept of safe areas in the hold. It has also decided to reject any ingot lifts with broken bundle, lifting or unitising straps.

Action number: MO-2012-010-NSA-006

Action status: Closed

Aluminium ingot loading procedures

Number:	MO-2012-010-SI-02
Issue owner:	Newcastle Stevedores
Operation type:	Stevedoring
Who it affects:	Stevedoring companies and their employees
Risk at time of occurrence:	Significant

Safety issue description:

While the risk of aluminium ingot stacks toppling over had been identified by the stevedoring company as a result of past incidents, its procedure for loading aluminium products had not evolved to adequately address this risk. Furthermore, the implementation of basic precautions such as using ladders to climb between ingot tiers was not effectively monitored or enforced.

Proactive safety action taken by: Newcastle Stevedores

Newcastle Stevedores advised the ATSB of a number of actions that it has taken to address the safety issue, which in summary are:

- Immediately after the accident, the risks involved in loading ingots were re-assessed and control measures to address the risk of an ingot lift toppling were identified and documented. The measures primarily comprised establishing a 3 m exclusion zone adjacent to a lift.
- The procedure for loading ingots was revised to describe the risk and control measures, including exclusion zones and the use of a ladder when climbing between tiers.
- Enforcement of exclusion zones and the pre-requisites for zone entry (permitted only after securing the ingot lift with strap slings, ratcheted back to prevent toppling, in accordance with a specific, new procedure).
- Increased monitoring of loading operations by the company staff and a number of updates to the revised loading procedure.
- An independent review of company procedures and committing to an ongoing review of its policies and procedures in consulatation with the Maritime Union of Australia and the company's occupational health and safety representatives.
- Retraining of senior grade stevedores in hazard identification and assessment.
- Audits and independent testing of ingot strapping and developing a process for rejecting substandard lifts.
- Recommending improved lift configurations to Patrick Ports and Stevedoring (Patrick).

As of 1 March 2013, Patrick took over the stevedoring for Gearbulk ships in Newcastle. The company advised the ATSB that it has implemented risk control measures to address the risk of ingot stacks toppling over through a job safety analysis, and provided its stevedores with training in applying these measures. The measures are equivalent to those implemented by Newcastle Stevedores after the accident and include establishing exclusion zones and enforcing zone entry conditions.

Action number: MO-2012-010-NSA-007
Action status: Closed
ATSB response: The ATSB is satisfied the action taken adequately addresses the safety issue.

Current status:

Residual safety risk: Minor
Issue status: Adequately addressed
Justification: Proactive safety action taken

ATSB safety advisory notice to: All stevedoring companies

Action number: MO-2012-010-SAN-010

The Australian Transport Safety Bureau advises that all stevedoring companies should consider the risk of aluminium ingot stacks and similar break-bulk cargoes toppling over during handling.

Stevedore working hours and fatigue

Number:	MO-2012-010-SI-03
Issue owner:	Newcastle Stevedores
Operation type:	Stevedoring
Who it affects:	Stevedoring companies and their employees
Risk at time of occurrence:	Significant

Safety issue description:

The stevedoring company had not identified stevedore fatigue as a risk to the company or its operations and, as a result, had not implemented a system to manage fatigue. Consequently, its operations were exposed to a level of fatigue-related risk that had not been assessed and treated.

Response to safety issue from: Newcastle Stevedores

Newcastle Stevedores advised the ATSB that the risk should be classified as minor as it had informal fatigue management systems in place at the time of the accident. The company further advised that it has developed draft policies for stevedore fatigue and working hours, and has entered into discussions with the Maritime Union of Australia to finalise these policies.

ATSB safety recommendation to: Newcastle Stevedores

Action number: MO-2012-010-SR-009
Action status: Released

The Australian Transport Safety Bureau recommends that Newcastle Stevedores takes further action to address the issue concerning stevedore fatigue in its operations.

Current status:

Residual safety risk: Significant
Issue status: Monitor
Justification: Insufficient action taken by Newcastle Stevedores.

ATSB safety advisory notice to: All stevedoring companies

Action number: MO-2012-010-SAN-008

The Australian Transport Safety Bureau advises that all stevedoring companies should consider having a system to effectively manage stevedore fatigue to reduce safety risk in their operations.

General details

Occurrence details

Date and time:	23 September 2012 - 2110 (UTC + 10 hours)	
Occurrence category:	Accident	
Primary occurrence type:	Fatality (stevedore crushed in cargo hold)	
Type of operation:	Deck operation (loading aluminium ingot cargo)	
Location:	Berth number one, Eastern Basin, Newcastle, New South Wales	
	Latitude: 32° 55.01’ South	Longitude: 151° 46.23’ East

Ship details

Name	*Weaver Arrow*
IMO number	9151826
Call sign	C6PG5
Flag	Bahamas
Classification society	Det Norske Veritas
Ship type	Open hatch general cargo ship
Builder	Dalian New Shipbuilding Heavy Industries, China
Year built	1998
Owner(s)	Gearbulk Shipowning, Norway
Operator	Gearbulk Pool, Bermuda
Manager	Gearbulk Norway
Gross tonnage	36,008
Deadweight (summer)	55,402 tonnes
Summer draught	13.518 m
Length overall	199.70 m
Moulded breadth	32.20 m
Moulded depth	19.30 m
Main engine(s)	B&W 6L60MC, two stroke single acting diesel engine
Total power	11,520 kW
Speed	14.2 knots

Sources and submissions

Sources of information

On 24 September 2012, two investigators from the Australian Transport Safety Bureau (ATSB) attended *Weaver Arrow* while the ship was berthed in Newcastle. The master and crew members present at the accident site were interviewed. Photographs and copies of relevant documents and records were obtained.

On 24 and 25 September, the investigators interviewed stevedores who witnessed the accident. Staff from Newcastle Stevedores' management were interviewed and relevant documents were obtained. Patrick Ports and Stevedoring (Patrick) staff provided information in relation to the aluminium ingot cargo.

During the course of the investigation, further information was provided by Newcastle Stevedores, Gearbulk, Patrick, the New South Wales Police and the New South Wales Coroner's office.

References

Alcoa, <http://www.alcoa.com/australia/en/info_page/home.asp> web pages related to aluminium ingots viewed 11 December 2012.

Australian Maritime Safety Authority, *Marine Orders 32, Cargo handling equipment*, Issue 3, 2011.

Battelle Memorial Institute 1998, *An Overview of the scientific literature concerning fatigue, sleep, and the circadian cycle*, Report prepared for the Office of the Chief Scientific and Technical Advisor for Human Factors, US Federal Aviation Administration.

Ferguson S & Dawson D 2012, 12-h or 8-h shifts? It depends. *Sleep Medicine Reviews, 16,* 519-528.

Folkard S & Tucker P 2003, Shift work, safety and productivity. *Occupational Medicine, 53,* 95-101.

Gearbulk, <http://www.gearbulk.com/> web pages related to aluminium ingots and handling viewed 11 December 2012.

National Transport Commission 2008, *National Rail Safety Guideline. Management of Fatigue in Rail Safety Workers.*

Newcastle Stevedores, *Occupational Health Safety & Environment Management System*, as of 23 September 2012.

Safe Work Australia, <http://www.safeworkaustralia.gov.au/sites/swa/whs-information/stevedoring/pages/stevedoring> web pages related to stevedoring viewed 10 April 2013.

Safe Work Australia, *Draft Code of Practice, Preventing and managing fatigue in the workplace*, September 2011.

Sumitomo Australia, <http://www.sumitomocorp.com.au/non-ferrous_metals_products.html> web pages related to aluminium ingots viewed 29 January 2013.

Thomas R, Thomas O, Pepper G, *Thomas's Stowage-The properties and Stowage of Cargoes*, Fifth Edition, 2008.

Tomago Aluminium <http://www.tomago.com.au/> web pages related to aluminium ingots viewed 11 December 2012.

WorkCover Authority of NSW <http://www.workcover.nsw.gov.au/newlegislation2012/health-and-safety-topics/human-behaviour/Pages/fatigue.aspx> web pages related to fatigue viewed 7 February 2013.

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 deceased stevedore's next of kin, *Weaver Arrow*'s master, the ship's managers, Gearbulk Norway (Gearbulk), Patrick Ports and Stevedoring (Patrick), Newcastle Stevedores, three stevedore witnesses, the Maritime Union of Australia, the Bahamas Maritime Authority, the Australian Maritime Safety Authority, the New South Wales Police and the New South Wales Coroner's office.

Submissions were received from *Weaver Arrow*'s master, Gearbulk, Patrick, Newcastle Stevedores, two stevedore witnesses, the Maritime Union of Australia, the Bahamas Maritime Authority and the Australian Maritime Safety Authority. The submissions were reviewed and where considered appropriate, the text of the report was amended accordingly.

Australian Transport Safety Bureau

The Australian Transport Safety Bureau (ATSB) is an independent Commonwealth Government statutory agency. The Bureau is governed by a Commission and is entirely separate from transport regulators, policy makers and service providers. The ATSB's function is to improve safety and public confidence in the aviation, marine and rail modes of transport through excellence in: independent investigation of transport accidents and other safety occurrences; safety data recording, analysis and research; fostering safety awareness, knowledge and action.

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia that fall within Commonwealth jurisdiction, as well as participating in overseas investigations involving Australian registered aircraft and ships. A primary concern is the safety of commercial transport, with particular regard to fare-paying passenger operations.

The ATSB performs its functions in accordance with the provisions of the *Transport Safety Investigation Act 2003* and Regulations and, where applicable, relevant international agreements.

Purpose of safety investigations

The object of a safety investigation is to identify and reduce safety-related risk. ATSB investigations determine and communicate the safety factors related to the transport safety matter being investigated. The terms the ATSB uses to refer to key safety and risk concepts are set out in the next section: Terminology Used in this Report.

It is not a function of the ATSB to apportion blame or determine liability. At the same time, an investigation report must include factual material of sufficient weight to support the analysis and findings. At all times the ATSB endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner.

Developing safety action

Central to the ATSB's investigation of transport safety matters is the early identification of safety issues in the transport environment. The ATSB prefers to encourage the relevant organisation(s) to initiate proactive safety action that addresses safety issues. Nevertheless, the ATSB may use its power to make a formal safety recommendation either during or at the end of an investigation, depending on the level of risk associated with a safety issue and the extent of corrective action undertaken by the relevant organisation.

When safety recommendations are issued, they focus on clearly describing the safety issue of concern, rather than providing instructions or opinions on a preferred method of corrective action. As with equivalent overseas organisations, the ATSB has no power to enforce the implementation of its recommendations. It is a matter for the body to which an ATSB recommendation is directed to assess the costs and benefits of any particular means of addressing a safety issue.

When the ATSB issues a safety recommendation to a person, organisation or agency, they must provide a written response within 90 days. That response must indicate whether they accept the recommendation, any reasons for not accepting part or all of the recommendation, and details of any proposed safety action to give effect to the recommendation.

The ATSB can also issue safety advisory notices suggesting that an organisation or an industry sector consider a safety issue and take action where it believes it appropriate. There is no requirement for a formal response to an advisory notice, although the ATSB will publish any response it receives.

Terminology used in this report

***Occurrence*:** accident or incident.

***Safety factor*:** an event or condition that increases safety risk. In other words, it is something that, if it occurred in the future, would increase the likelihood of an occurrence, and/or the severity of the adverse consequences associated with an occurrence. Safety factors include the occurrence events (for example, engine failure, signal passed at danger, grounding), individual actions (for example, errors and violations), local conditions, current risk controls and organisational influences.

***Contributing safety factor*:** a safety factor that, had it not occurred or existed at the time of an occurrence, then either: (a) the occurrence would probably not have occurred; or (b) the adverse consequences associated with the occurrence would probably not have occurred or have been as serious, or (c) another contributing safety factor would probably not have occurred or existed.

***Other safety factor*:** a safety factor identified during an occurrence investigation which did not meet the definition of contributing safety factor but was still considered to be important to communicate in an investigation report in the interests of improved transport safety.

***Other key finding*:** any finding, other than that associated with safety factors, considered important to include in an investigation report. Such findings may resolve ambiguity or controversy, describe possible scenarios or safety factors when firm safety factor findings were not able to be made, or note events or conditions which 'saved the day' or played an important role in reducing the risk associated with an occurrence.

***Safety issue*:** a safety factor that (a) can reasonably be regarded as having the potential to adversely affect the safety of future operations, and (b) is a characteristic of an organisation or a system, rather than a characteristic of a specific individual, or characteristic of an operational environment at a specific point in time.

***Risk level*:** The ATSB's assessment of the risk level associated with a safety issue is noted in the Findings section of the investigation report. It reflects the risk level as it existed at the time of the occurrence. That risk level may subsequently have been reduced as a result of safety actions taken by individuals or organisations during the course of an investigation.

Safety issues are broadly classified in terms of their level of risk as follows:

- **Critical safety issue:** associated with an intolerable level of risk and generally leading to the immediate issue of a safety recommendation unless corrective safety action has already been taken.
- **Significant safety issue:** associated with a risk level regarded as acceptable only if it is kept as low as reasonably practicable. The ATSB may issue a safety recommendation or a safety advisory notice if it assesses that further safety action may be practicable.
- **Minor safety issue:** associated with a broadly acceptable level of risk, although the ATSB may sometimes issue a safety advisory notice.

***Safety action*:** the steps taken or proposed to be taken by a person, organisation or agency in response to a safety issue.

Australian Transport Safety Bureau

24 Hours 1800 020 616
Web www.atsb.gov.au
Twitter @ATSBinfo
Email atsbinfo@atsb.gov.au

Investigation

ATSB Transport Safety Report
Marine Occurrence Investigation

Stevedore fatality on board the general cargo ship *Weaver Arrow*, at Newcastle, New South Wales, 23 September 2012

296-MO-2012-010
Final – 4 June 2013