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ATSB TRANSPORT SAFETY REPORT
Marine Occurrence Investigation No. 266
MO-2009-005
Final

Serious injury on board *United Treasure* off Port Kembla, New South Wales

7 July 2009

Abstract

On 7 July 2009, while *United Treasure* was anchored off Port Kembla, New South Wales, two seamen fell about 8 m in a cargo hold after the scaffolding on which they were working toppled over. Both men suffered compound fractures and were evacuated from the ship by helicopter and taken to hospital.

The ATSB investigation found that the scaffolding had not been properly assembled or secured to the ship's structure. The investigation also found that an appropriate risk assessment for the work had not been carried out and the relevant ship's procedures were not followed.

To avoid a further occurrence of this type on board their managed ships, *United Treasure*'s managers have taken safety action by revising the relevant shipboard procedures. In addition, the ATSB has issued one safety advisory notice.

FACTUAL INFORMATION

United Treasure

United Treasure (IMO No. 9286607) is a Panamanian registered bulk carrier (Figure 1). At the time of the incident, the ship was owned by Rams Shipping, Panama, managed by United Ocean Ship Management, Singapore (United Ocean) and classed with Nippon Kaiji Kyokai (Class NK).

The ship was built in 2006 by Tsuneishi Corporation, Japan. It has an overall length of 228.99 m, a moulded breadth of 32.26 m and a depth of 19.90 m. At its summer draught of 14.429 m, the ship has a deadweight of 82,926 t.

Propulsive power is provided by a MAN-B&W 7S50MC-C two-stroke, single acting diesel engine that delivers 9,800 kW at 113 rpm. The main engine drives a single, fixed pitch, propeller which gives the ship a service speed of 14.5 knots[1].

United Treasure is a conventional gearless bulk carrier with seven cargo holds fitted with side-opening MacGregor hatch covers. An area for helicopter operations is provided on the hatch covers of number four cargo hold.

The ship's navigation bridge is equipped with navigational and communication equipment consistent with SOLAS[2] requirements.

At the time of the incident, *United Treasure* had an appropriately qualified crew of 21. The crew comprised 18 Indian nationals, Filipino second and third mates and a Sri Lankan deck cadet.

The master had 33 years of seagoing experience, mainly on bulk carriers. He held an Indian master's certificate of competency and had sailed as a master for the past 5 years. He had been employed by United Ocean since 2005 and joined *United Treasure* 5 months before the incident.

Figure 1: *United Treasure* entering Port Kembla

The chief mate also had 33 years of seagoing experience, the last 20 as a chief mate, and had sailed mainly on bulk carriers. He had held an

1 One knot, or 1 nautical mile per = 1.852 km/hour.

2 The International Convention for the Safety of Life at Sea, 1974, as amended.

Australian master's certificate of competency since 2000. He joined *United Treasure*, his first United Ocean ship, 4 months before the incident.

After completing pre-sea training in 1999, the boatswain (bosun) started his career as a seaman with United Ocean. He had sailed almost exclusively on board the company's bulk carriers and joined *United Treasure*, his first ship as a bosun, 9 months before the incident.

The injured able-bodied seaman (AB) completed pre-sea training in 2005 and first went to sea in 2006. He had previously sailed on two ships, initially as a trainee seaman and then as an ordinary seaman (OS). He had joined *United Treasure*, his first ship with United Ocean and his first as an AB, 2 months before the incident.

The injured OS completed pre-sea training in 2006 and started his seagoing career with United Ocean. He sailed for more than 1 year on his first ship as a trainee seaman. He had joined *United Treasure* as an OS 5 months before the incident.

The incident

On 8 June 2009, *United Treasure* sailed from Jingtang, China. The ship was in ballast and bound for Port Kembla, Australia, where it was to load a cargo of coal.

Expecting many days at anchor off Port Kembla waiting for a berth, the master thought it would be a good opportunity to paint the empty cargo holds. Scaffolding to progress hold painting had been recently received on board.

During the voyage, the crew assembled the new scaffolding and the master and chief mate inspected it. Made from aluminium, the scaffolding was similar to other common types of mobile towers designed for use on a stable, level surface. It could provide a 1.6 m x 1.5 m work platform up to a height of 8.5 m. The platform was positioned on top of the tower which is assembled in 1.55 m high tiers (lifts) and had height adjustable, lockable wheels at its base (Figure 2).

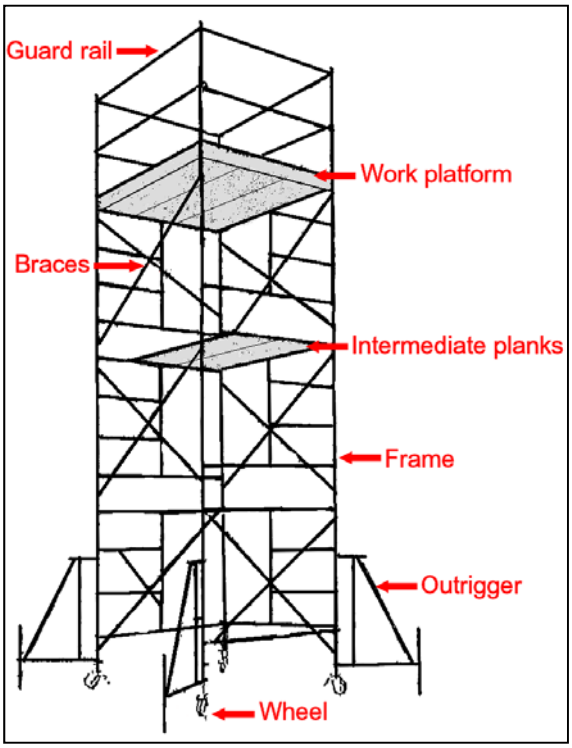
At 1312[3] on 23 June, *United Treasure* anchored about 4 miles[4] east-northeast of Port Kembla's entrance. The ship's arrival draughts were 4.5 m forward and 7.0 m aft.

At anchor, it was usual for only the mates to keep watch so the three ABs were relieved from their bridge watch duties. They joined the bosun and the OS on day work to start cargo hold painting.

The weather at the time was good with a low to moderate swell. At times, *United Treasure* rolled or pitched slightly as it swung on its anchor to the tide or wind. The master decided that the scaffolding could not be used if rolling or pitching was any more than 'light', which he considered as being 2 to 4°.

On 24 June, work started in number four hold. The crew cleaned/scraped and painted areas of the hold's bulkheads that could be reached using long handled equipment while standing on the tanktop[5]. This work continued the following day.

Figure 2: Mobile scaffold tower as designed



On 26 June, the crew began using the scaffolding to paint higher areas in number four hold. The scaffold tower was moved in the hold and its height adjusted as required. The master and the chief mate regularly inspected the work and took photographs to report progress to United Ocean.

3 All times in this report are local times, Coordinated Universal Time (UTC) + 10 hours.

4 A nautical mile of 1852 m.

5 The bottom of the cargo holds are the tanktops of water ballast or fuel oil tanks.

In the following days, the good weather continued and hold painting progressed. Work in number four hold was followed by painting in numbers three and two holds.

On 2 July, the west-southwest wind increased to 30 knots. The swell built up and *United Treasure* began to roll and pitch moderately or heavily at times. Hold painting continued intermittently and some use was made of the scaffolding. By 4 July, the work had progressed to number one hold.

On Sunday 5 July, the crew were given a rest day. On 6 July, they worked inside the accommodation due to moderate to heavy rolling and pitching.

At about 0700 on 7 July, the chief mate and the bosun met on the bridge to discuss the day's work. The wind had decreased to 15 knots but the rolling and pitching persisted due to a 1.5 to 2 m south-westerly swell. The chief mate had decided against hold painting since the ship had been rolling as much as 10° during his watch. Therefore, he assigned the bosun a number of other tasks for the crew to complete.

At 0800, the chief mate completed his watch and went for breakfast. A few minutes later, the master arrived in the mess room and asked if the crew were painting number one hold that day. The chief mate said that he had decided not to because of the rolling. The master told him the rolling was now only a couple of degrees and that he would order the bosun to start the hold painting. The chief mate did not question the master and they did not discuss the matter further.

Shortly after 0815, the master located the bosun on deck and told him to open number one hold hatch covers and start painting. When the bosun said that he had been assigned other tasks, the master told him that he had spoken to the chief mate and ordered him to start the painting.

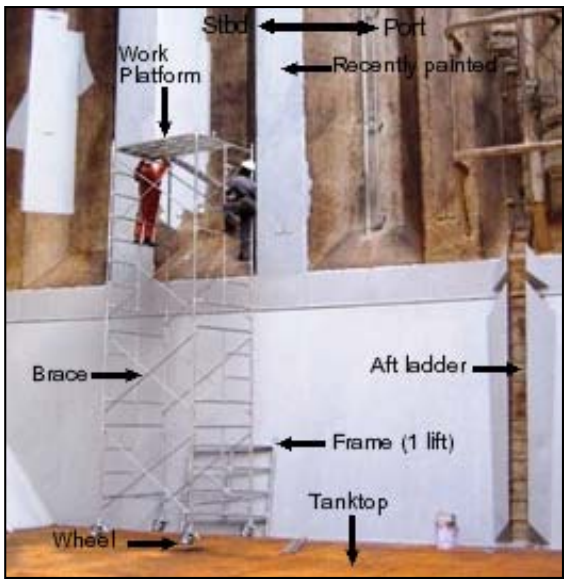
At about 0830, the bosun, one AB and the OS entered number one hold. The other two ABs remained on deck to paint the hold's hatch coaming. Shortly thereafter, the chief mate entered the hold to supervise the crew.

The crew painted areas of the hold accessible from the tanktop. At 1000, they came up for their usual mid-morning break. The master estimated that *United Treasure* was rolling 2 to 3° at the time and ordered that the scaffolding be used when the crew resumed work.

At 1030, the chief mate, bosun, AB and OS re-entered number one hold. The scaffold tower was positioned near the aft hold ladder and lashed to it with a rope (guy rope). The tower's wheels were locked and the AB climbed to its work platform, hooked his safety belt lanyard to the scaffolding and began painting. The bosun and OS painted areas they could reach from the tanktop, and assisted the AB when required. The chief mate observed them and took photographs.

At about 1115, the crew removed the guy rope, moved the tower further to starboard and began increasing its height (Figure 3). One lift was added and the work platform positioned on the tower. The AB and the OS then climbed on to the platform, now 8 m high, to add another lift. They hooked their safety belt lanyards to the tower, which had its wheels locked but was otherwise unsecured. They then lowered a heaving line to pick up frames and braces for the next lift.

Figure 3: Scaffolding in number one cargo hold



At about 1130, both the AB and the OS moved to the platform's inboard (port) side to heave up the equipment that the bosun had tied to the heaving line. As they lifted the equipment off the tanktop, *United Treasure* rolled and the tower swayed. The AB and the OS shouted for help and the bosun and chief mate quickly grabbed the base of the tower to steady it. However, the tower toppled to port and the AB and OS fell with it to the tanktop.

The AB and OS were conscious but in severe pain from arm and leg injuries, some of which were bleeding. The chief mate told the bosun to raise the alarm while he remained with the injured men.

The bosun hurried to the accommodation and used the public address system to raise the alarm. The master was on the bridge and immediately went to number one hold. He saw that the men were seriously injured, ordered that they be given pain relieving tablets and then left the hold to organise medical assistance from ashore.

At 1140, the master reported the incident to United Ocean via satellite telephone and asked for medical assistance. At 1143, he telephoned the ship's Port Kembla agent and requested medical assistance, providing some details of the incident and the injuries. By 1150, the agent had contacted the local emergency services.

At 1240, a rescue helicopter landed on *United Treasure*. The two attending paramedics assessed the AB and OS and determined they had suffered multiple compound fractures and needed to be evacuated. While the paramedics treated them, the helicopter made a trip ashore and, at 1345, it returned with four more paramedics.

At 1412, the AB was winched up from the cargo hold on a stretcher and two paramedics accompanied him ashore in the helicopter. Another helicopter then arrived with two more paramedics and at 1442, it departed with the OS and the remaining paramedics.

Both men were admitted to hospital. The AB had fractured both his heels and ankles and the OS had fractured both his ankles and left elbow.

Over the next couple of weeks, the AB and the OS underwent a number of surgical operations to treat their injuries. Both men remained hospitalised for a further month. On 16 August, they boarded a flight to India accompanied by a doctor from India arranged by United Ocean.

ANALYSIS

The fall

On 7 July 2009, the two seamen were seriously injured after falling about 8 m onto the steel tanktop when the mobile scaffold tower on which they were working toppled over.

The mobile tower was not secured to any part of the ship's structure and the seamen had not secured themselves to a strong point on the ship. Furthermore, the tower was not assembled as designed and except for locking its wheels, no precaution had been taken to prevent it from moving, collapsing or toppling.

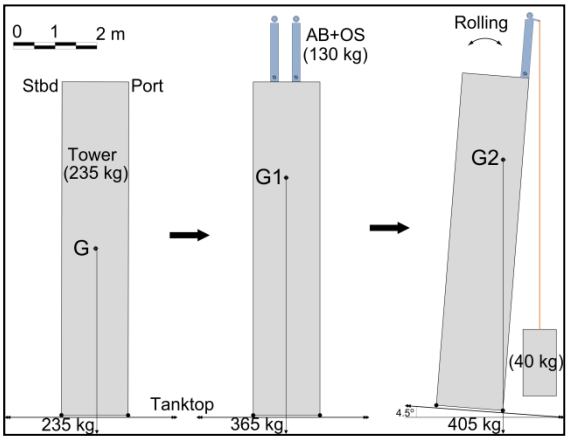
This is not the first incident of this type. In 2003 a shipboard scaffolding incident[6] investigated by the ATSB resulted in one fatality and one serious injury.

Stability of the scaffold tower

An unsecured mobile scaffold tower will remain upright only if its weight acts within the area of its base. Therefore, on board a ship, a mobile tower can be unstable because of the ship's possible list or trim and its potential to roll, pitch and heave.

On 7 July, after its height was increased to 8 m, the tower weighed about 235 kg. This weight acted through its centre of gravity located at its geometrical centre, 4 m above the base (point G in Figure 4). There were no outriggers to improve the tower's stability by increasing its wheel base of 1.7 m x 1.6 m. Hence, if the tower was tilted more than about 11.5°, its weight would act outside the base and the tower would topple.

Figure 4: Progression to the tower toppling



When the AB and the OS climbed onto the tower's work platform, its centre of gravity shifted[7]. Together, the two men weighed approximately 130 kg and the tower's centre of gravity moved 1.7 m upwards (G1). The tower could now topple if tilted more than about 8°.

6 ATSB marine investigation report number 197, Fatality on board *Pacific Wisdom*, 7 September 2003.

7 The centre of gravity of a body shifts directly towards an added weight and parallel to a shifted weight. The shift is proportional to the added/shifted weight and its distance from the original centre of gravity.

When both seamen moved to the port side of the platform, the tower's centre of gravity also moved to port. Then, when they lifted the approximately 40 kg of equipment, the centre of gravity again moved. The combined effect of their movement and the additional weight suspended from their hands shifted the centre of gravity about 0.35 m laterally and 0.3 m upwards (G2). The tower could now topple if tilted more than about 4.5° to port.

At about 1130, *United Treasure* rolled to port sufficiently for the tower to topple over.

The scaffolding

A mobile scaffold tower is designed to be used on a stable and level surface. Therefore, to safely use a mobile tower on board a ship, precautions need to be taken to ensure that it does not collapse, topple, move or otherwise fail under any working conditions. These precautions should include assembling the tower as designed and effectively securing it to provide a safe working platform.

The scaffolding was received on board *United Treasure* in May 2009 when the ship dry-docked in Japan. The equipment had been manufactured in Japan to comply with relevant Japanese regulations and use in that domestic market. The manufacturer's instructions were printed in Japanese but included self explanatory figures, drawings and a parts list to guide correct assembly and use.

However, the master and the chief mate stated that the manufacturer's instructions had not been received and the bosun did not find them when he unpacked the scaffolding. It could not be confirmed whether the instructions had not been supplied or were lost in transit.

Instructions for the scaffolding would have been helpful and should have been used to check if the new equipment was complete. Nevertheless, it was also essential for the crew to assess the equipment to ensure it could be safely used. Cargo hold cleaning on bulk carriers is routine and scaffolding is commonly used. Since the master, chief mate and bosun had all used scaffolding in the past, they should have been able to assess if the new equipment was fit and suitable for its intended use.

When the scaffold tower was first assembled, the bosun pointed out that there should have been more than three planks (only enough for the work platform). However, the master replied that the scaffolding would have to be used as is. The chief mate had similar concerns to the bosun's but did not voice them because the master's response indicated to him that his feedback would not be welcome. Consequently, no attempt was made to confirm if the equipment was complete by obtaining its instructions or a parts list.

In submission, United Ocean advised that scaffolding is a simple, static device for which experienced and trained seamen do not require detailed instructions. The ship's managers stated that, in any case, their safety management system (SMS) adequately addresses the issue of using equipment instructions directly and indirectly through a number of procedures, crew training and familiarisation and personnel on board *United Treasure* had sufficient guidance in this regard.

With only three planks available, the tower was assembled without the two intermediate planks required at every alternate lift. Intermediate planks were necessary to prevent the tower from twisting during use (Figure 5).

Figure 5: Twisted tower after the incident

The outriggers were another important component of the scaffolding that had not been received. Without these, the tower was less stable than it should have been. Furthermore, when it toppled on 7 July 2009, the height was being increased to more than its maximum design height with outriggers fitted.

The tower's work platform guard rails/stanchions had been received but the crew did not think they were useful and, hence, did not to use them.

Significantly though, the incomplete tower was not effectively secured to the hold's structure at any time during the 2 weeks over which hold painting was carried out. A sufficient number (at least two) of guy ropes were needed to prevent the tower

from toppling due to the ship's motion. However, it was secured either with a single guy rope on one side or, when adjusting its height, not at all. This, together with other work practices, indicates an inadequate risk assessment.

Risk assessment

The risk assessment carried out before using the scaffold tower should have included confirming it was complete, correctly assembled and effectively secured. Defining maximum limits for tower height for different circumstances and suitable weather conditions for work were some of the other important considerations.

A combination of factors led to an appropriate risk assessment not being carried out. Before the master joined *United Treasure*, United Ocean had asked him to progress hold painting. After joining, he found there was no scaffolding on board so he ordered it. Once the equipment was received, he made hold painting a priority. His subsequent actions in this regard suggest his focus on completing this task led to some risks being overlooked.

The master, together with the chief mate, was responsible for ensuring that the scaffolding was used safely. However, the chief mate felt the master directed rather than consulted. On the other hand, the chief mate never challenged the master on occasions when his work orders were overruled. Each of them could and should have managed the risks involved in using the scaffolding instead of allowing their less than optimal working relationship to become a possible impediment.

Opportunities to carry out an appropriate risk assessment for hold painting were not taken. Safety meetings were held twice a month. The standard form to record meetings, as per the ship's SMS, included identifying any special precautions, repairs etc. for the voyage. The form completed for meetings held on 13 and 27 June (i.e. before and after the scaffolding was first used) did not refer to hold painting or working aloft (at a height). This work was not included in the forms for the April or May meetings either.

The initial inspection of the scaffolding en route to Port Kembla resulted in the risks being dismissed rather than further assessed. After hold painting started, the master and the chief mate saw, on a number of occasions, the partially secured or unsecured tower being used without adequate safety precautions in place.

Instead of attaching a safety harness to a strong point on the ship using a fall arrestor, as per the SMS, the crew were hooking their safety belts to the ineffectively secured tower. This meant that if the tower toppled, anyone on it would fall.

The reason given for not securing the tower was the lack of accessible strong points for guy ropes. Attaching safety belts to strong points above was considered but found impracticable. While taking those precautions required some effort, they were not impossible. Available strong points could have been used for the guy ropes and harnesses and, if necessary, other strong points could have been fabricated. Inconvenience is not a justification for taking unacceptable risks.

Although the precautions taken (for example using safety belts and hardhats) indicate that some risks were considered, the effectiveness of all the precautions was not evaluated. Relying on *United Treasure* not to roll much and locking the tower's wheels could not ensure that it would not topple. Similarly, a safety belt secured to the tower would not prevent a person falling with it.

Permits to work aloft

United Treasure's SMS had a 'permit to work aloft' system. The main purpose of a permit is to ensure an appropriate risk assessment is undertaken to identify all the precautions necessary to safely carry out the work. Documenting the process can ensure, amongst other things, that all persons involved in the work are fully aware of, and will take, all of those precautions.

The ship's permit to work aloft form defined certain standard precautions. In addition, any other precautions considered necessary by the authorising officer had to be identified. The permit was to be signed by the officer in charge of the work, the senior officer authorising the work and all the crew members carrying out the work.

However, work aloft in the holds at Port Kembla anchorage was not carried out in accordance with the SMS. Permits were not in place before starting work on any of the 9 days that it was undertaken. At interview, the crew carrying out the work stated that they had signed the permits later, in some cases a few days after the work, when asked to do so. Furthermore, the chief mate had signed all of

the permits both as the officer in charge and the authorising officer.

The same officer being the person in charge of the work and its authoriser was consistent with instructions for completing permits. Hence, there was nothing to prevent only one officer completing the risk assessment and any error or oversight going unnoticed. An assessment by more than one person can prevent single-person errors. This may have been a reason why the permits did not identify all the necessary precautions and some of those listed were not implemented. In addition, no tool box meetings or work conferences were held to discuss the risks or the precautions.

At interview, the master stated that he had told the chief mate to complete permits. However, just completing permits as they had been could not ensure the work was safely carried out. More importantly, the master was aware of how the work was being done and, therefore, the effectiveness of the permits. Furthermore, he knew a permit was not in place on 7 July when the work aloft was started on his orders.

When painting the holds, the permit system was not used as a proactive means to ensure safety while working aloft but merely as a compliance exercise. Over a period of 2 weeks, there were multiple violations of the system by personnel at all levels, up to and including the master, indicating that the system had not been effectively implemented on board *United Treasure*.

FINDINGS

Context

On 7 July 2009, two seamen on board the bulk carrier *United Treasure* were seriously injured after falling in a cargo hold when the scaffold tower on which they were working toppled over.

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

Contributing safety factors

- The mobile scaffold tower was not secured to the ship's structure and it toppled over when *United Treasure* rolled and the seamen began lifting equipment up from the tanktop.
- The seamen were secured to the tower instead of a strong point on the ship's structure using a safety harness with a fall arrestor.
- Locking the tower's wheels and using safety belts indicates that some risks were identified but not effectively securing the tower suggests an assumption that it would not topple over. The inadequate and/or ineffective precautions taken indicate that an appropriate risk assessment was not carried out.
- *United Treasure*'s permit to work aloft system had not been effectively implemented on board the ship. In addition, the standard form for the permit did not ensure that the officer in charge of the work and its authoriser were not the same person and that a risk assessment was formally undertaken by at least two responsible officers. *[Significant safety issue]*

Other safety factors

- The tower was not assembled as designed. The outriggers and intermediate planks, both key components, were missing and the work platform guard rails were not used. The manufacturer's instructions were also missing but no attempt was made to obtain them, a parts list or the missing parts. *[Significant safety issue]*
- The less than optimal working relationship between the master and chief mate may have impeded the risk assessment and supervision of the work.

SAFETY ACTION

The safety issues identified during this investigation are listed in the Findings and Safety Action 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.

United Ocean Ship Management, Singapore

Permit system

Significant safety issue

United Treasure's permit to work aloft system had not been effectively implemented on board the ship. In addition, the standard form for the permit did not ensure that the officer in charge of the work and its authoriser were not the same person and that a risk assessment was formally undertaken by at least two responsible officers.

Action taken by United Ocean Ship Management MO-2009-005-NSA-023

United Ocean Ship Management has advised the ATSB that it has implemented the following measures to address the issue.

- The permit to work aloft system has been revised. The amended permit form lists more detailed safety precautions including not working aloft if rolling exceeds 2°, a maximum scaffolding height to width ratio of 2:1, a pre-work inspection to verify that scaffolding cannot topple or collapse and a pre-work job safety meeting. In addition, a risk assessment is to be carried out by the officer in charge and the work permit's authoriser, who must be a senior officer and cannot be the same person as the officer in charge.
- A new 'Risk Management Manual' which provides guidance for the identification of specific hazards when working aloft or outboard and the management of those risks.

ATSB assessment of action

The ATSB is satisfied that the safety action taken by United Ocean Ship Management adequately addresses the safety issue.

Ships' masters and crew

Shipboard use of scaffolding

Significant safety issue

The tower was not assembled as designed. The outriggers and intermediate planks, both key components, were missing and the work platform guard rails were not used. The manufacturer's instructions were also missing but no attempt was made to obtain them, a parts list or the missing parts.

ATSB safety advisory notice MO-2009-005-SAN-024

The Australian Transport Safety Bureau advises that ships' masters and crew should consider the safety implications of this safety issue and take action where considered appropriate.

SOURCES AND SUBMISSIONS

Sources of Information

The master and crew of *United Treasure*

Japan Transport Safety Board

Port Kembla Port Authority

References

Alinco Incorporated, Instructions and parts list for RT type mobile scaffold tower, Alinco Inc. Japan.

Australian Scaffold, web pages related to mobile scaffold tower safety, viewed 30 June 2010, <http://www.australianscaffolds.com.au/technical_safety.html>

Derret, DR 1990, *Ship Stability for Masters and Mates*, Fourth Edition, Newnes, United Kingdom.

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 *United Treasure*'s master, chief mate, boatswain, the injured AB and OS, United Ocean, the Australian Maritime Safety Authority (AMSA) and the Panama Maritime Authority (PMA).

Submissions were received from the chief mate, the bosun, the AB, United Ocean, AMSA and PMA. The submissions were reviewed and where considered appropriate, the text of the report was amended accordingly.