Department of Transport and Regional Services
Australian Transport Safety Bureau

Navigation Act 1912
Navigation (Marine Casualty) Regulations
investigation into the serious injury to a crew member on board the Bahamas flag bulk carrier *CSL Pacific* at sea, south of Portland Victoria on 18 February 2002

Report No 175

January 2003

ISSN 1447-087X
ISBN 1 877071 24 2

Investigations into marine casualties occurring within the Commonwealth's jurisdiction are conducted under the provisions of the Navigation (Marine Casualty) Regulations, made pursuant to subsections 425 (1) (ea) and 425 (1AAA) of the *Navigation Act 1912*. The Regulations provide discretionary powers to the Inspector to investigate incidents as defined by the Regulations. Where an investigation is undertaken, the Inspector must submit a report to the Executive Director of the Australian Transport Safety Bureau (ATSB).

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***CSL Pacific* alongside in Melbourne**

Summary

At 1800 on Sunday 17 February 2002, the bulk carrier *CSL Pacific* sailed from Melbourne after discharging a cargo of furnace slag. The ship was bound for Adelaide to load a cargo of powdered cement.

At 0750 on Monday morning, the chief engineer, deck mechanic and deck fitters met to discuss their major work for the day which was to repair some of the buckets on number one bucket elevator.

Prior to starting work, the deck mechanic went to number one control room and checked that the circuit breaker for the main electric motor on the bucket elevator was open. He did not place a danger tag on the circuit breaker.

The same morning, the boatswain and seamen had started to prepare cargo holds one and two to receive the powdered cement cargo in Adelaide. The seamen were sweeping the residue of the slag cargo from the bottom of the holds into the bucket elevators. This work was being performed under the supervision of the mate who was periodically running number two bucket elevator for short periods to provide the men with empty buckets to fill.

At about 1100, the boatswain, working in the bottom of number two hold, requested that the mate rotate number two bucket elevator. At this time a deck fitter was working inside the top of number one bucket elevator. He was lying with his torso inside the bucket with one foot resting on one of the drive chains as he was welding.

The mate went to number two control room and ran the bucket elevator for a couple of seconds. He then went to number one control room to check on the cleaning in number one hold. While there he decided to run the bucket elevator to provide an empty bucket for the man working there and went to the circuit breaker for the drive motor. Finding no danger tag, he closed the breaker and then ran the motor for 2–3 seconds. Although he had been told about it earlier, he had forgotten about the work being performed at the top of number one bucket elevator.

The fitter welding inside the bucket elevator sustained serious injuries when the bucket elevator moved. His right hip had been dislocated, his pelvis and a vertebrae had been fractured, two ribs were broken and he had some ligament damage in the groin area.

Help was quickly at hand and the injured fitter was lifted out of the bucket elevator and taken on a stretcher to the ship's hospital where he was examined by the second mate. It was evident that the fitter's injuries were serious. The master organised a telephone consultation with a surgeon from the Royal Adelaide Hospital who advised him to land the fitter as soon as possible. After speaking to the ship's manager and the Adelaide agent the decision was made to divert the ship to Portland, Victoria.

CSL Pacific arrived off Portland at 1740. At 1800 the injured fitter was transferred to a pilot launch and then to Portland base hospital. The deck fitter spent the next six weeks in Portland base hospital recovering from his injuries before being repatriated on 2 April 2002.

Sources of Information

The officers and crew of *CSL Pacific*

The Australian Maritime Safety Authority

ASP Ship Management

V.Ships U.K.

Intercontinental Ship Management

Det Norske Veritas, Sydney

References

The International Convention for the Safety of Life at Sea, 1974, and its Protocol of 1988 (SOLAS), the International Maritime Organization (IMO).

The International Management Code for the Safe Operation of Ships and for Pollution Prevention (International Safety Management (ISM) Code) as adopted by IMO resolution A.741(18).

Guidelines on implementation of the International Safety Management (ISM Code) by Administrations as adopted by IMO resolution A.788(19).

The International Convention on Standards of Training, Certification and Watchkeeping for Seafarers 1974/1995 (STCW), IMO.

Narrative

CSL Pacific

CSL Pacific (figure 1), (formerly *River Torrens* - 2000, *Selwyn Range* -1985) is a Bahamas flag, handysized, self unloading bulk carrier of 31 921 deadweight tonnes at its summer draught of 11.021 m. *CSL Pacific* is classed ✠ 100A1, with ✠ LMC[1] and UMS[2] notations, with Lloyd's Register.

CSL Pacific was built at the State Dockyard in Newcastle, Australia in 1977. The ship served as a conventional bulk carrier until it was lengthened in 1985, and fitted with self discharging equipment for the three holds forward of the accommodation superstructure. It has an overall length of 181.8 m, a beam of 24.84 m and a depth of 13.30 m. Propulsive power is provided by a Hitachi B&W 6K74EF slow speed, single acting, direct reversing diesel engine of 8 653 kW which drives a single, fixed pitch, propeller to give the vessel a service speed of 14.5 knots.

At the time of the incident, *CSL Pacific* had a crew of 25. The deck department consisted of the master and three mates, boatswain and five seamen. The engineering department comprised the chief and four engineers (including an electrical engineer), an engine room fitter, a deck mechanic and two deck fitters, an electrician and two engine room ratings. There was also a catering staff of three. The mates maintained a traditional 'four on, eight off' watchkeeping routine at sea. In port, when cargo operations were being performed, the second and third mates worked 'six on, six off' and the mate was on call at all times. The engineers worked a 24 hour duty roster with the engine room unmanned outside normal working hours. All of the crew were Ukrainian nationals.

The master of *CSL Pacific* held an ocean going master's certificate of competency issued in the Ukraine and had 22 years experience at sea, the last six of which were in command. The mate held a deep sea navigator certificate of competency issued in the Ukraine and had been at sea for 19 years. He had previously completed two 4-month contracts on the ship and was two months through his current contract. The deck mechanic had also served on the vessel for two complete contracts and had just started his third.

Ship history

CSL Pacific was built for the Australian National Line (ANL) in 1977 and was owned and managed by the company until 1991 when the management was passed to ASP Ship Management (at the time 50 per cent owned by ANL). In May 1999 the ship was sold to Auscan Self-Unloaders, a wholly-owned subsidiary of CSL International (which together with Canadian Steamship Lines forms the CSL Group Inc). The management of the vessel was taken over by Intercontinental Ship Management of Sydney. Most of the ASP Ship Management crew on the ship at the time of the change of management elected to stay with the ship and accepted employment with the new managers. After this sale, the vessel continued to trade primarily around the Australian coast under the Australian flag.

In July 2000, the vessel was sold again (a sale within CSL) to the current registered owner, CSL Pacific Shipping. The management of the vessel also changed at this time to V.Ships U.K (formerly Acomarit). The ship was re-registered in the Bahamas and the Australian crew were replaced with Ukrainians. After this sale there

1 Notation assigned when machinery is constructed and installed under Lloyd's Special Survey in accordance with Lloyd's rules.

2 Notation denotes ship may be operated with the machinery spaces unattended.

was a period of hand-over when an Australian master and mate remained on the ship for the first two months with the new Ukrainian crew. Their role was to provide technical expertise and advice to the incoming crew, primarily on the operation and maintenance of the cargo self unloading system. Many of the Ukrainian crew on the ship at the time of the incident, including the master and mate, were on the vessel during the hand-over period.

At the time of the incident, *CSL Pacific* was trading primarily around the Australian coast using a continuous voyage permit (CVP) issued by the Commonwealth Department of Transport and Regional Services.

Self unloading system

In 1985 *CSL Pacific* underwent a major conversion in Nagasaki, Japan, to fit a Kvaerner Cargo Scooper system. The system has a maximum discharge capacity of 1800 tonnes per hour using scraper reclaimers to discharge the cargo from the holds. This type of system can discharge bulk cargoes up to 100 mm which makes it suitable for a wide variety of cargoes. *CSL Pacific* has carried bulk cargoes including; grain, powdered cement, fly ash, furnace slag, gypsum and cement clinker.

CSL Pacific's self unloading system is fully automated using programmable logic controllers located in the three cargo control rooms, one adjacent to each hold, on the port side of the main deck (figure 2). Each control room controls the operation of the two longitudinal scraper reclaimers, transverse scraper reclaimer and a bucket elevator in each hold. Distribution boards in each control room supply power to the electric motors which drive the various pieces of equipment.

FIGURE 2:

Inside number 1 cargo control room showing bucket elevator circuit breaker and the control panel

The cargo is discharged from each hold from the top downward with the reclaimers working on the surface of the cargo. Each reclaimer is mounted on support beams, suspended by wires and winches, which allow the reclaimers to be progressively lowered as cargo is discharged. The longitudinal reclaimers also traverse from port to starboard and 'sweep' the cargo to the transverse reclaimer mounted athwartships in the centre of each hold. The cargo is then 'swept' by the transverse reclaimer to a series of gates on each bucket elevator housing located on the starboard side of the hold (figure 3). The gates control the admission of cargo to the elevator depending on the level of the cargo in the hold.

The bucket elevators lift the cargo from the holds and discharge it onto a longitudinal belt conveyor mounted on the starboard side above the main deck. The longitudinal conveyor transports the cargo forward to an auxiliary conveyor, which discharges it onto a boom conveyor which may be slewed outboard to discharge the cargo to shore receiving facilities. The longitudinal belt conveyor, auxiliary conveyor and boom conveyor are controlled from number one control room adjacent to number one hold.

The bucket elevators consist of a steel housing (or trunk) which contains a series of steel buckets bolted onto two parallel continuous Komatsu chain loops. The chains are driven by sprockets mounted on a common shaft at the top of the elevator. An idler shaft and sprockets are located at the bottom of the elevator to provide chain tension. The drive shaft is normally driven by a main electric motor via a reduction gearbox and fluid coupling. An 'inching' motor is also fitted to each bucket elevator to provide slow rotation of the bucket elevator drive shaft for maintenance purposes. Maintenance on the chains and buckets is normally performed at the

FIGURE 3:

Longitudinal and transverse reclaimers in hold

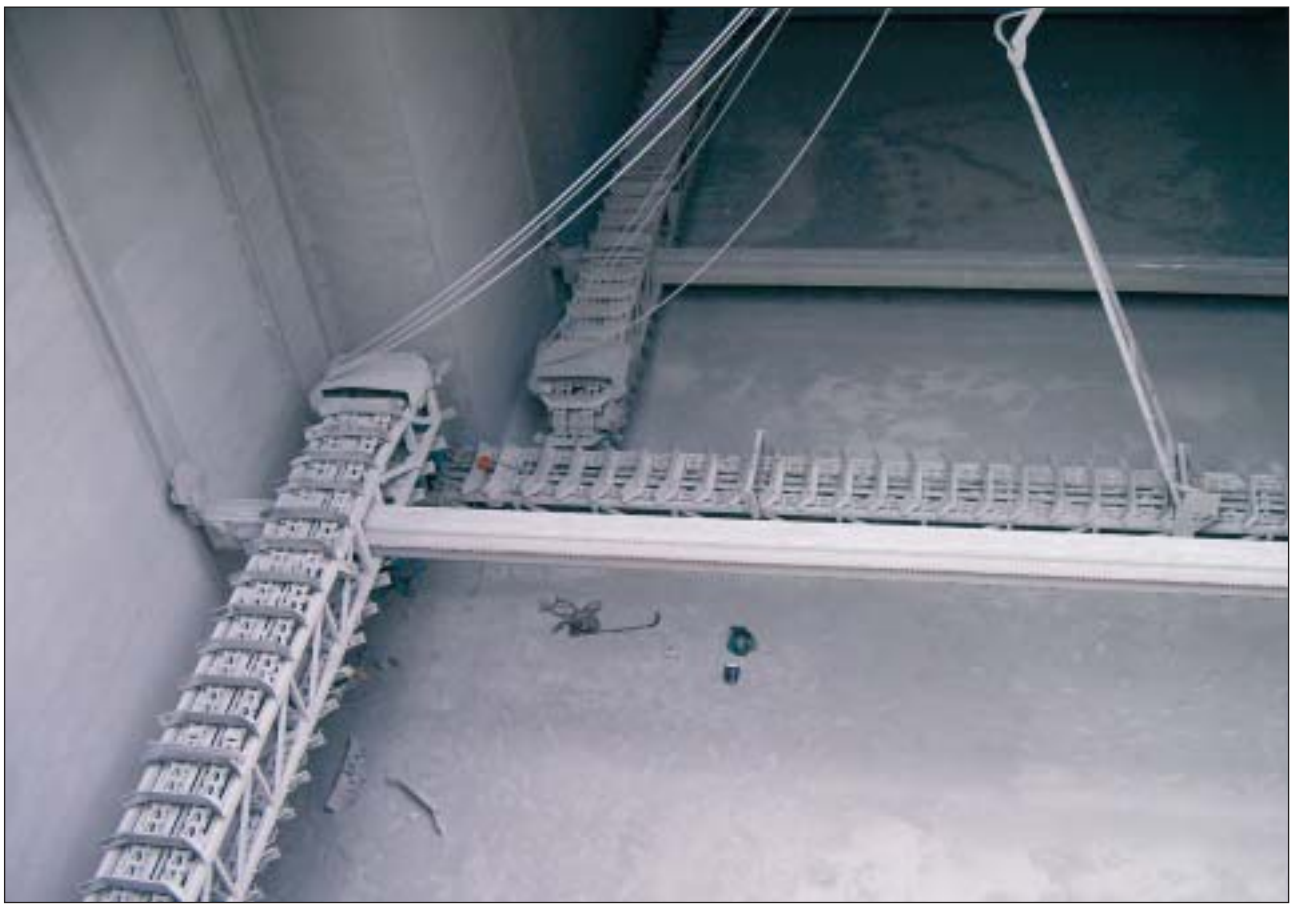


FIGURE 4:
Two views of the top of number one bucket elevator, and one view inside

Top view

Top view

Inside view

top of the bucket elevator, access being provided through two heavy steel doors in the top of the housing (figure 4).

On *CSL Pacific* maintenance of the cargo discharge equipment is the overall responsibility of the chief engineer. The work is normally performed by the deck mechanic and the two deck fitters with the deck mechanic acting as the on-job supervisor. The mate has the responsibility for supervising all day-to-day activities on deck involving cargo operations.

The incident

At 1800 on Sunday 17 February, *CSL Pacific* sailed from Melbourne bound for Adelaide to load a cargo of powdered cement. The ship was in ballast after discharging a cargo of furnace slag in Melbourne. As usual, after the completion of the discharge, the ship's electrical engineer went to each cargo control room and opened the circuit breakers on all of the electric motors for the cargo discharge equipment.

At 0750 on Monday morning, the chief engineer, deck mechanic and deck fitters met to discuss the maintenance work which would be performed that day on the cargo discharge equipment. The major work for the day was the repair, by welding, of some of the buckets on number one bucket elevator, a routine maintenance task which had been performed on numerous occasions in the past.

The weather at the time was fine with a southerly breeze at force four and a southerly swell of about three metres.

Prior to starting work on number one bucket elevator, the deck mechanic went to number one control room to check that the circuit breaker for the main electric motor on number one bucket elevator was open. He found that the circuit breaker was open but he did not place a danger tag on the circuit breaker, nor did he lock the breaker tripping lever in the 'off' position.

During the first part of the morning the deck mechanic and two deck fitters carried out some tasks in preparation for repairing the buckets in the bucket elevator. They were working at the top of number one bucket elevator housing during this time.

The same morning, the boatswain and seamen had started to prepare numbers one and two cargo holds to receive the powdered cement cargo in Adelaide. The hatch covers were open and most of the seamen were clearing the residue of the slag cargo in the bottom of number two hold. The seamen were sweeping the slag tailings into the bucket elevator via the bottom gate in the bucket elevator housing. One seaman was performing the same work in hold number one. The mate was supervising the work in the holds and he was periodically running number two bucket elevator to provide the seamen with empty buckets to fill. During the morning the deck mechanic had spoken to the seaman working in number one hold and told him that the buckets could be filled but the bucket elevator must not be turned as the deck fitters would be working on it.

At 1000 the crew on deck stopped work to take a coffee break. During the coffee break the deck mechanic had a discussion with the mate who asked him if he could repair number nine gate on number two bucket elevator. The deck mechanic answered by saying that he would be working on number one bucket elevator until noon and that they would repair the gate later. The mate later acknowledged this conversation.

Work re-started at 1015 after the morning tea break. One of the deck fitters climbed into the top of number one bucket elevator housing and started the welding repairs on the buckets. The other fitter and the deck mechanic set about fabricating a new flange for the bucket elevator gearbox. The deck mechanic was not carrying his handheld radio at this time, his usual practice when working on deck, as the battery was charging.

At about 1100, the boatswain, working in the bottom of number two hold, requested via his handheld radio, that the mate rotate number two bucket elevator as the bucket in way of the bottom gate had been filled with slag sweepings.

At this time the fitter working inside number one bucket elevator was lying with his torso inside the bucket and was welding with one foot resting on one of the drive chains. The other deck fitter was standing on top of the housing outside the bucket elevator and the deck mechanic was in the engine room workshop.

The mate went to number two control room, closed the breaker on the bucket elevator drive motor and ran the bucket elevator for a couple of seconds. He then went to number one control room, walking forward along the port side of the main deck. He did not notice the men working at the top of number one bucket elevator housing.

When he arrived at number one control room, the mate checked on the progress of work in number one hold from the observation port hole inside the room. While he was in the control room, the mate decided that he would turn the elevator to provide the seaman working in the hold with an empty bucket. He could see that the seaman was clear of the gate at the bottom of the bucket elevator so he went to the circuit breaker for the elevator drive motor, closed the breaker, and then ran the motor for 2–3 seconds moving the buckets approximately five metres.

There was no danger tag on the breaker and he had momentarily forgotten about the work at the top of the bucket elevator.

When number one bucket elevator moved, the deck fitter inside the housing was rotated over the top of the elevator inside the bucket he had been welding, and was then thrown out. He was left hanging by the hands on one of the buckets and the adjacent drive chain crying out in pain. His right hip had been dislocated, his pelvis and a vertebrae had been fractured, two ribs were broken and he sustained some ligament damage in the groin area.

The other deck fitter saw what had happened and immediately called to the seamen on deck for help. He then climbed into the bucket elevator housing and held the injured man's hand until the boatswain arrived. The two men then lifted the injured deck fitter out of the bucket elevator housing. The boatswain then used his radio to summon more help. Shortly afterwards, the deck mechanic and the electrical engineer also arrived at the scene. The four men then moved the injured deck fitter from the top of the bucket elevator to the platform at the top of the bucket elevator housing.

The mate had also heard the boatswain's radio call and came to the bucket elevator. After seeing the condition of the injured man he called for further assistance using his radio. Receiving no immediate response, he went to find the second mate, opened the medical locker and got a stretcher.

The mate and second mate arrived back at the bucket elevator a short time later with a stretcher and some first aid equipment. The master had also arrived by this time and had brought morphine from the safe in his cabin.

After assessing the deck fitter's condition the second mate administered morphine to ease his pain. The deck fitter was then lowered from the platform in the stretcher and moved aft to the ship's hospital where the second mate made a more thorough examination of his injuries.

During this time the master used the ship's satellite telephone to report the incident to the designated person at V.Ships U.K. He also notified CSL's office in Sydney and the ship's Adelaide agent.

After examining the fitter, the second mate conferred with the master. He indicated that he thought the fitter's injuries were serious, particularly in the groin area, and that the morphine was not effectively relieving the man's pain. The master told the second mate to administer a second dose of morphine and then spoke to the agent in Adelaide again to ask him to organise a telephone consultation with a doctor.

A surgeon from the Royal Adelaide hospital contacted the ship a short time later. He discussed the fitter's injuries with the master and advised him to land the man as soon as possible. After speaking again to V.Ships, CSL Australia and the Adelaide agent, the decision was made to divert the ship to Portland, Victoria.

At 1350, *CSL Pacific* altered course for Portland. The ship's Adelaide agent made contact with an agent in Portland who arranged a pilot launch for 1800.

CSL Pacific arrived at Portland at 1740. At 1800 the injured fitter was transferred to a pilot launch and then to Portland base hospital where he spent the next six weeks recovering from his injuries before being repatriated on 2 April 2002.

Comment and analysis

Evidence

On 25 February 2002, two marine investigators from the Australian Transport Safety Bureau attended *CSL Pacific* in Melbourne. The scene of the accident was inspected and the master, mate and deck mechanic were interviewed and provided accounts of the incident. Copies of relevant documents were obtained including logs, written statements, accident reports, timesheets, various procedures and maintenance instructions.

The injured deck fitter was interviewed, using an interpreter, on 26 February at Portland base hospital. He was in a stable condition, lucid, and provided a detailed account of the incident.

ASP Ship Management, V.Ships U.K., Intercontinental Ship Management and Det Norske Veritas in Sydney were contacted and asked to provide further information relevant to the incident. This information included;

- reports of past incidents on the vessel,
- procedural information relating to past maintenance practices on the vessel,
- information relating to the hand over of the management of the vessel in July 2000, and,
- information relating to the International Safety Management Code (ISM Code) certification of the vessel and past audits.

The incident

The deck fitter working inside *CSL Pacific*'s number one bucket elevator, was seriously injured as a result of simple errors on the part of other members of the crew. The deck mechanic supervising the deck fitter did not take adequate steps to prevent the operation of the bucket elevator while the fitter was working on it and the mate started the bucket elevator, forgetting that there was maintenance work being performed on it.

Prior to starting work on the bucket elevator, the deck mechanic had checked that the circuit breaker supplying the drive motor was open, and thus power to the motor was isolated. He did not, however, take any steps to signify it was dangerous to operate the motor nor did he physically or electrically prevent the operation of the motor.

As the immediate supervisor of the work, the deck mechanic had the first responsibility to take the appropriate measures to make the workplace safe. However the chief engineer, as the overall supervisor for the maintenance, was also responsible for ensuring that the men performing the work were taking the appropriate safety measures. In both cases there was a failure of supervisory duty of care to the deck fitter who was injured.

The deck mechanic did speak to the mate and the seaman working inside number one hold and told them of the work being performed on the bucket elevator. He also indicated to the mate that the work on the bucket elevator would not be finished until midday. Providing the mate with this information, albeit at the informal forum of the morning tea break, was an important step in ensuring the safety of the fitters working on the bucket elevator.

The mate ran the bucket elevator despite the knowledge that maintenance was being performed on it. He stated that, at the time he closed the circuit breaker and started the drive motor, he had forgotten about the work at the top of the elevator. In the few seconds it took to close the breaker and start the elevator motor the mate was not cognisant of the risk.

Running the bucket elevators while the cargo holds where being cleaned was an operation the

mate had performed many times before and, indeed, on at least four other occasions that morning. It appears that, at the time he closed the circuit breaker on number one bucket elevator, his actions were automatic. It was the usual practice on the ship to open the circuit breakers on the cargo discharge equipment after the completion of a discharge. Thus when the mate saw the circuit breaker in the 'open' position, with no warning tag, he would have had no reason to pause and reconsider his actions as he expected to find the breaker open and to close it before running the elevator drive motor.

All ships are required to have a safety management system which, amongst other things, safeguards the health and safety of the crew. That an incident of this kind should occur at all means that there had been a significant failure of the safety management system on the vessel.

Shipboard safety management system

The ISM Code requires all ships to 'develop, implement and maintain a safety management system (SMS)…'. The Code states under '1.2 Objectives':

1.2.1 The objectives of the Code are to ensure safety at sea, prevention of human injury or loss of life, and avoidance of damage to the environment, in particular to the marine environment and to property.

1.2.2 Safety-management objectives of the Company should, inter alia:

.1 provide for safe practices in ship operation and a safe working environment;

.2 establish safeguards against all identified risks…

CSL Pacific's safety management system consisted of a set of generic safety management manuals provided by the ship management company with some ship-specific checklists which had been generated by the crew for 'Critical Operations'.

Isolation procedures

The company manuals contained a 'permit to work' system which included an 'Energy Isolation Lockout/Tagout checklist and Permit-WPAC 2' with accompanying instructions stating:

> A completed Energy Isolation Permit is required when performing work on equipment or machinery where an energy-release incident is possible.
>
> All pertinent sections of the Energy Isolation Checklist must be completed and presented to the Chief Engineer or Authorised Delegate for verification and issuance of the Energy Isolation Permit.
>
> Only the Chief Engineer or authorised delegate may approve and issue Energy Isolation Permits.

The instructions contained in the energy isolation checklist were generalised and not specific to any particular activity, system or ship. There was no guidance on specific instances where an energy isolation permit was required.

The ship's generic 'Self Unloading Bulk Carrier Manual' also contained an instruction in section 4 'General Safety' under the heading 'Safe Working Practices and Environment Protection' which states:

> Isolate/lockout power before commencing any maintenance work

There was no reference to the energy isolation permit in this procedure.

There was no specific instruction in any of the procedure manuals as to when circuit breakers are to be opened, tagged and/or locked. The energy isolation permit procedure actually states:

> The Energy Isolation Permit outlines the minimum requirements to work on equipment or

machinery where an energy release incident is possible. Additional written procedures must be compiled when special conditions exist.

The intent of these general instructions had not been translated into practice on board *CSL Pacific* in the form of a working procedure at the time of the incident. The deck mechanic stated that it was his usual practice to open the relevant circuit breaker and place a 'danger tag' on it when working on the cargo discharge equipment. On this occasion, for whatever reason, he did not place a 'danger tag' on the circuit breaker. An energy isolation permit was not issued for the work and the deck mechanic did not indicate knowledge of any requirement to obtain such a permit. Both he and the mate said that it was not usual to padlock the circuit breakers open although they both knew that this had been the practice on the vessel in the past.

The safety management system on *CSL Pacific* at the time of the incident was inadequate in respect of procedures for isolating cargo equipment for maintenance work. There were no prescriptive tagout/lockout procedures relating specifically to the ship and it appears that the generic instructions contained in the SMS manuals were not strictly applied on the vessel. Given the well-known risks associated with maintenance on moving machinery, it would be reasonable to expect that these operations would be identified as 'critical' and an appropriate ship specific procedure formulated.

The proper isolation of equipment before maintenance is a fundamental workplace safeguard which must be ingrained in the working culture on board every ship.

Following the incident, *CSL Pacific*'s crew did formulate a new 'Critical Operation' checklist which contains prescriptive requirements for isolating cargo discharge equipment prior to maintenance work.

Works committee

CSL Pacific is a busy ship in terms of cargo related activities, particularly maintenance. Very often crew from different departments are engaged in different work activities which need to be coordinated. It is the practice on many ships to hold periodic 'works committee' meetings of supervisory personnel from the deck and engineering departments to discuss such work. The meetings are usually held in the evenings or mornings prior to the day's activities and provide a forum where information is passed and the various activities are coordinated as needed.

The mate indicated that it was the practice on board *CSL Pacific* to have a works committee meeting prior to each cargo loading and discharge operation. It was not the practice to meet each day to discuss routine maintenance work. Had there been a more formal exchange of information at such a meeting prior to the day's work on 18 February, the mate may have been more cognisant of the work being conducted on number one bucker elevator.

The hand-over of management

When *CSL Pacific* was first operated as a self-discharging bulk carrier by the Australian National Line, rigorous lock-out procedures were implemented for maintenance work on the cargo equipment. Each person on the ship was issued with a padlock, engraved with their rank. Every person working on a particular piece of equipment was required to place their padlock on the circuit breaker operating handle, to lock it open, before commencing any work. The lock out procedures were designed specifically to prevent the sort of accident which occurred on *CSL Pacific* on 18 February 2002.

Records of past accidents on the vessel show that the lock-out system was effective in as much as there were no accidents on the vessel

involving the inadvertent starting of equipment between 1991 and 1999.

The lock-out procedures were incorporated in the ship's safety management system when the ISM Code was implemented on the vessel by ASP Ship Management in 1998. When Intercontinental Ship Management took over the management of the ship in 1999, the lock-out system was perpetuated with the transfer of the crew and almost all of the ship's safety management system.

When V.Ships took over the management of the vessel in July 2000, they implemented their own safety management system. There was no formal process whereby proven past practices on the vessel were incorporated into the new safety management system. Information from the master and mate from Intercontinental Ship Management, who stayed on the vessel to familiarise the new crew, was passed on in an ad-hoc and informal way.

The new crew did generate several ship-specific critical operation checklists relating to cargo operations, but no checklist for maintenance activities. One checklist requires that circuit breakers must be padlocked when there are personnel in the cargo holds during a cargo operation. Another requires that breakers are tagged out when cleaning a blockage in the conveyor system. These procedures are inconsistent as there is no valid reason why one of these critical operations would rate the lesser protection of tag-out as the risks are the same for both activities. Additionally, neither checklist mentions the 'Energy Isolation Permit' nor do they stipulate 'isolate/lock-out' and as such they do not meet the requirements contained in the generic procedure manuals.

Audits

The guidelines for implementing the ISM Code (International Maritime Organisation (IMO) resolution A.788(19)) establishes basic principles for verifying that the safety management system of a company responsible for the operation of a ship complies with the Code. It states under section 2 'Verifying Compliance with the ISM Code':

> 2.1.1 To comply with the requirements of the ISM Code, Companies should develop, implement and maintain an SMS to ensure that the safety and environmental policy of the Company is implemented. The Company policy should include the objectives defined by the ISM Code.

In practice this means that every ship's safety management system must make adequate provisions to provide a safe working environment for the crew and establish safeguards against all identified risks. To obtain and maintain its ISM Code certification, every ship manager and vessel must demonstrate the adequacy of the safety management system in respect of these things when audited by the accreditation authority.

At the time of the incident, *CSL Pacific*'s managers had a current Document of Compliance. The Document of Compliance certified that the safety management system of the company had been audited and found to comply with the requirements of the ISM Code for bulk carriers. The safety management system in use at the time of the incident on board *CSL Pacific* had also been audited and found to comply with the requirements of the ISM Code, evidenced by a current Safety Management Certificate.

The implementation of the ISM Code on the vessel after the change of management in July 2000 required that the vessel be initially audited by Det Norske Veritas prior to receiving its permanent Safety Management Certificate. This audit was conducted in Japan on 10 January 2001. There was no finding made during this audit that the ship's procedures were in any way deficient with regard to cargo equipment isolation. Nor was there any check to ensure that these fundamental procedures had been perpetuated from the previous manager's safety management system.

The ship management company conducted internal audits of the ship's safety management system in November 2000 and November 2001. Like the DNV audit, these audits did not find that the ship's procedures, regarding maintenance work on the cargo equipment, were deficient or inconsistent with the company's generic procedures regarding energy isolation permits and isolation/lock-out. Additionally, none of the audits revealed that the company's 'Energy Isolation Permit' procedure was not strictly applied on the vessel. Considering the results of these audits of the ship's safety management system, the rigour of the ISM Code implementation process on the vessel must be questioned.

Fatigue

Fatigue may be described as a reduction in physical and/or mental capability as a result of physical or emotional exertion which may impair nearly all physical abilities including, strength, speed, reaction time, coordination and decision making. Fatigue may be described as acute or chronic. Acute fatigue occurs in a matter of hours as the result of excessive mental or physical activity and may be cured by a period of rest or sleep. A state of chronic fatigue is reached when the 'normal' period of rest or sleep is insufficient to restore an individual's working performance to its usual level.

Chronic fatigue is insidious and usually happens over a period of time. Individuals suffering from chronic fatigue always perform below their personal best but are often unaware that their performance has been significantly degraded. Chronic fatigue has been shown to impair individual information processing, particularly in secondary tasks, with increased probability of slips, lapses and mental blocks.

The mate's hours

The mate had been on the ship for the previous two months. His overtime sheets show that he had established a pattern whereby his usual working day while the ship was at sea consisted of the morning watch from 0400 to 0800 followed by four hours of daywork until midday. He then took a short rest in the afternoon after lunch and completed his afternoon watch from 1600 to 2000. His workday at sea averaged 12 hours.

When the ship was in port, the mate's usual day started at 0500 and finished at 2300 or 2400 with an hour for lunch between 1200 and 1300. The mate's work time each day in port was generally 17 or 18 hours.

In the week leading up to the incident the mate had worked 101 hours, 80 hours of which were in the five days before the incident at an average of 16 hours per day. When he closed the circuit breaker and ran number one bucket elevator motor at 1100 on 18 February, he had been working for the previous seven hours.

The IMO's International Convention on Standards of Training, Certification and Watchkeeping for Seafarers 1974/1995 (STCW) has requirements designed to manage watchkeeper fatigue. The Convention states that all watchkeepers must have rest periods of 10 hours in each 24 hour period which may be reduced to six consecutive hours but not for more than two days. The convention also requires that there must be not less than 70 hours of rest in each seven day period. The mate's working hours were excessive, with examination of his overtime sheets revealing that he was regularly below the STCW requirements in respect of daily and weekly minimum rest periods.

The deck mechanic's hours

The deck mechanic had travelled from Odessa in the Ukraine to arrive in Melbourne on 12 February. He had two days in Melbourne before joining the ship four days before the incident. His overtime sheets show that he had averaged 12 hours work per day in the four days on board. During this time the ship was discharging cargo and he had attended several early morning breakdowns of the discharge equipment. On 15

February he was called out at 0400 for seven hours, on 16 February he was called out at 0300 for seven hours and had worked from midnight until 0600 and then from 1300 until 2000 on the day prior to the incident.

Fatigue analysis

The mate's and deck mechanic's hours of work were analysed using Fatigue Audit InterDyne (FAID) software developed in conjunction with the Centre for Sleep Research at the University of South Australia. The FAID program enables the quantitative assessment of an individual's level of fatigue at a point in time based on work hours for the previous seven days. The resultant individual fatigue 'score' may be used as a guide to indicate what effect fatigue may have had on an individual's performance. The FAID program is in wide use throughout Australia as a rostering tool in various transport industries including several pilotage services.

The FAID software indicated that the mate had a maximum fatigue score of 158.6 at 0400 when he started his morning watch on 18 February. At the time of the incident his fatigue score had dropped to 100 (the FAID software allows for 'time of day' or circadian effects which dictate that alertness increases from about 0400 onwards).

Research by the Centre for Sleep Research suggests that a fatigue score of 40–80 is moderate, 80–100 is high with scores 100–120 being very high. High fatigue scores of 80–100 have been shown to produce individual performance impairment equivalent to a blood alcohol concentration over 0.05%. The mate's fatigue score was high at the time of the incident and it suggests that his actions and situational awareness were to some degree affected by chronic fatigue.

The deck mechanic's fatigue score at the time of the incident was 75 having dropped from about 90 at the time when he said he had checked the bucket elevator circuit breaker. His maximum fatigue score for the four days he was on the ship was 168.8. The FAID software does not take into account any effects of circadian dysrhythmia (jet lag) that he may still have been suffering after his long flight from the Ukraine (across nine time zones) before joining the ship. Like the mate, the deck mechanic's fatigue score at the critical time in the morning when he checked the circuit breaker was high. This suggests that his actions may also have been affected by fatigue.

Conclusions

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

Based on the evidence available, the following factors are considered to have contributed to the serious injury sustained by the deck fitter aboard *CSL Pacific* on 18 February 2002:

1. The mate started number one bucket elevator while the deck fitter was working inside it.

2. The deck mechanic supervising the work on the bucket elevator did not place a danger tag on and/or padlock the drive motor circuit breaker in the open position prior to the fitter commencing work.

3. There was a lack of a suitable ship-specific procedure, consistent with the management company's safety policy, detailing steps for isolating cargo equipment prior to maintenance.

4. The lock out procedure, previously used on the vessel, was not perpetuated in the ship's new safety management system after the change of vessel management in July 2000.

5. The ship's management company policies regarding 'Energy Isolation Permits' and isolation/lock out during maintenance activities on cargo equipment were not rigorously applied on the vessel at the time of the incident.

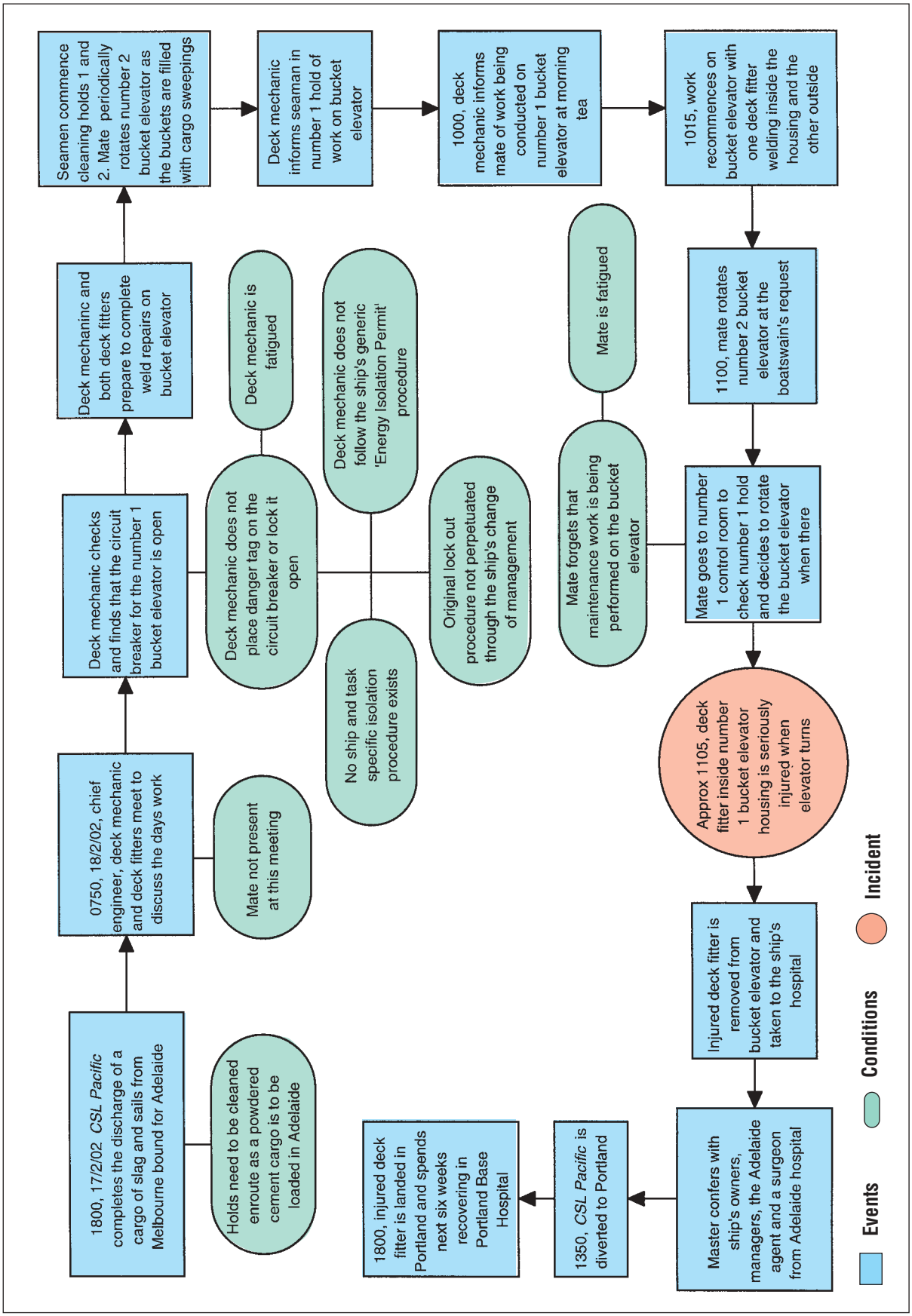
6. Although the mate acknowledged that he had been told of the work by the deck mechanic at the morning coffee break, there was no 'works committee' meeting prior to the incident to formally communicate to the mate the fact that work was being conducted inside number one bucket elevator.

7. Audits of the ship's safety management system prior to the incident failed to ensure that the procedures for isolating equipment prior to maintenance were adequate, consistent, and were being followed.

8. The mate was working excessive hours in the weeks leading up to the incident and it is likely that he was suffering from some effects of chronic fatigue at the time he started the bucket elevator.

9. The deck mechanic may also have been suffering from some effects of chronic fatigue which may have affected his actions on the morning of the incident.

FIGURE 5:
***CSL Pacific*: Events and causal factors chart**



Recommendations

It is recommended that:

1. The ship management company ensures that cargo maintenance activities on board CSL Pacific include equipment isolation procedures which are adequate, consistent and rigorously applied on the vessel.

2. The ship management company monitors working hours on CSL Pacific with a view to ensuring that crew are adequately rested and are complying with the requirements of the STCW convention.

3. That ship management companies, classification societies and maritime administrations ensure that sound safety management practices are perpetuated through and after changes of vessel management.

Submissions

Under sub-regulation 16(3) of the Navigation (Marine Casualty) Regulations, if a report, or part of a report, relates to a person's affairs to a material extent, the Inspector must, if it is reasonable to do so, give that person a copy of the report or the relevant part of the report. Sub-regulation 16(4) provides that such a person may provide written comments or information relating to the report.

Copies of the complete draft report were sent to the master, chief engineer, mate, deck mechanic, deck fitter (who was injured), V.Ships U.K., Intercontinental Ship Management, Det Norske Veritas and the Australian Maritime Safety Authority.

The following was the only submission received and is from the Marine Safety and Quality Manager of V.Ships U.K.:

> We refer to the draft report of the above incident, for which we thank you, and would comment to the Conclusions as follows:-
>
> 1. Accepted
> 2. Accepted
> 3. We do not accept that there were not adequate procedures in place at the time of the incident but these procedures were not being followed.
> 4. Accepted that the previous procedures used on this vessel were not perpetuated but would point out that when taking over Management of a vessel, very often procedures do alter from the previous Management. We believe that procedures provided were adequate but, unfortunately, not followed.
> 5. Similar to Item 4, adequate procedures were on board at the time of the accident but, unfortunately, not followed.
> 6. We believe that in this case, the fact that a 'formal works committee' was not convened prior to commencing the work was not materialistic in causing the accident due to the fact that the Mate was told of the work.
> 7. As you are aware, audits are a 'spot' check onboard as the audit is constrained by time elements and it would be unrealistic to perform a total audit of ALL shipboard systems and procedures. DNV had audited the vessel on 10/01/01 and Internal audits carried out on 10/11/00 and 20/11/01 and we believe that these audits were carried out effectively.
> 8. As pointed out, time sheets were completed for the Mate and we concur that in fact he had been working hours in excess of STCW Convention but would point out that we rely on the on-board Management Team to ensure these hours of work are complied with. Unfortunately in this case, it appears they were not. We would comment that the FAID figures quoted in the report are indeed 'suggested scores/levels of fatigue' and the draft report indicates that the system of indicating these 'scores' is in the research stage. As such we do not believe these figures should be included in an 'Official Report'.
> 9. As per Item 8 above.
>
> We trust that the above is helpful in addressing the 'Conclusions' contained in the draft report but should you require any clarification please do not hesitate to contact us.

CSL Pacific

Name	*CSL Pacific* (formerly *River Torrens*-2000, *Selwyn Range*-1985)
IMO Number	7420716
Flag	Bahamas
Classification Society	Lloyd's Register
Ship Type	Self Discharging Bulk Carrier
Cargo Discharge Equipment	Kvaerner Cargo Scooper System
Builder	NSW Government Engineering and Shipbuilding, Newcastle, Australia
Owners	CSL Pacific Shipping
Ship Managers	V.Ships U.K.
Gross Tonnage	21 047
Net Tonnage	9 980
Deadweight (summer)	31 921 tonnes
Summer draught	11.021 m
Length overall	181.8 m
Breadth	24.84 m
Moulded depth	14.48 m
Engine	Hitachi B&W 6K74EF, 6 cylinder, 2 stroke, single acting, direct reversing
Engine power	8653 kW
Service speed	14.5 knots
Crew	25 Ukrainian nationals