



Australian Government
Australian Transport Safety Bureau

Crew member burnt on board ship off Carnarvon, Western Australia

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Crew member burnt in explosion while working on hydraulic pipeline on board *Hui Shun Hai*

At about 0840 on 21 April 2005, a crewman on board the bulk carrier *Hui Shun Hai* suffered severe burns after pressurised hydraulic oil ignited while he was working on a deck hydraulic pipe. Immediately following the blast, he ran to the ship's side and jumped into the sea.

He was recovered from the water and evacuated by helicopter to the Western Australian town of Carnarvon. As a result of the explosion, he suffered burns to about 40 per cent of his body. The severity of his injuries resulted in his later transfer to the Royal Perth Hospital.

Hui Shun Hai

Hui Shun Hai is a Hong Kong registered, 'handy-size', geared bulk carrier. The ship was built in 1984 and is 190.0 m in length, has a beam of 28.3 m and has a deadweight of 38 033 tonnes at a summer draught of 10.83 m. The ship is owned by Brightway Shipping, Hong Kong and operated by Tianjin Tianhui Shipping Enterprise, Hong Kong. It is classed with the China Classification Society.

Hui Shun Hai has five cargo holds located forward of the accommodation block. Each

hold has a folding steel hydraulically operated hatch cover. Four deck cranes are located between the hatches (Figure 1).

At the time of the incident, the ship's crew comprised 28 Chinese nationals.

The incident

On the morning of 21 April 2005, *Hui Shun Hai* was on a southerly course off the Western Australian coast on a voyage from Gresik, Indonesia. The ship was in ballast, en route to Albany, on the southern coast of Western Australia, where it was due to load grain. The weather was fine and clear, with a ten knot east-south-east wind and a moderate south-westerly swell.

During the voyage, cargo hold cleaning operations had been undertaken in preparation for the loading of the grain cargo. At 0800 on 21 April, the ship's master and chief mate began an inspection of number four cargo hold to ensure that the hold would pass the pre-loading inspection by Australian quarantine authorities in Albany. In order to provide some natural light in the hold, the hatch covers were half opened.

That morning, the first engineer, welder and a motorman were tasked to replace a section of deck hydraulic pipe which supplied oil to number four hatch cover (forward) operating system. This section of pipe was on the hatch's starboard side just above the ship's main deck. A new section of pipe had been prefabricated the day before in the ship's engine room workshop.

Of the three crew working on the deck that morning, the welder was the only one to have carried out similar replacements on other pipes in the preceding weeks. Prior to starting work, oxygen-acetylene cutting equipment (to be used to cut the corroded bolts joining the

Figure 1: *Hui Shun Hai* arriving in Albany, WA



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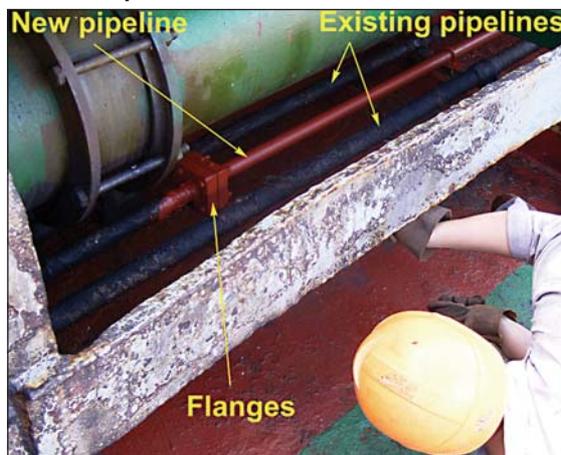
old pipe flanges), a fire hose and extinguisher and various tools were moved to the work site.

In order to access the after flange on the section of pipe which was to be replaced, the welder had to lie on the deck, on his left side, and angle the oxygen-acetylene cutting head up behind another hydraulic pipe (Figure 2).

At 0842, while the welder was in the process of cutting off the third bolt joining the flanges, they separated and hydraulic oil in the pipe, under high pressure, escaped. This oil ignited when it came into contact with the oxygen-acetylene flame.

A fireball about seven metres in diameter enveloped the welder and the oxygen-acetylene bottles nearby.

Figure 2: Welder's position on the deck prior to the explosion



The welder, suffering burns to his face and body, jumped up from his position on the deck, ran to the ship's starboard bulwark, about seven metres away, and jumped into the sea.

The position of the man overboard was 24° 19.7'S 112° 34.7'E, about 66 nautical miles north-west of Carnarvon.

The crew members assisting the welder were standing clear of the area and were not injured. The entire incident caught them by surprise. By the time they realised what had happened, the welder was in the water.

When they heard the explosion, and saw the fire ball above them, the master and chief mate quickly made their way up out of the hold. When they arrived at the location of the incident, the chief mate, being aware of the presence of the oxygen-acetylene bottles, set about extinguishing the fire that was still burning on the deck and the nearby hatch coaming and bulwark. The master went to the bridge.

The third mate, standing watch on *Hui Shun Hai*'s navigation bridge, heard the explosion followed by shouting about a man in the water. Just before 0845, he began to turn the ship to starboard, beginning a Williamson Turn¹ in order to return to the man overboard position.

At 0845, the master made a VHF channel 16 broadcast to all ships in the vicinity advising them of the man overboard. This call was heard by a local volunteer marine rescue unit ashore, who advised the Carnarvon police. Carnarvon police then advised the water police unit in Perth (the State's search and rescue coordination unit).

With the master on the bridge, the third mate sounded the man overboard alarm, alerting all the crew to the incident. The second mate arrived on the bridge and released the man overboard lifebuoy from its cradle on the bridge wing. Prior to its release, he disconnected the man overboard light/smoke float. When the lifebuoy landed in the sea, the welder was able to swim to it and take hold.

The turn was completed by about 0910. All available crew had been told by the master to take up lookout posts high on the ship and to look for the man and lifebuoy in the water.

At 0923, Perth Water Police contacted the Rescue Coordination Centre in Canberra (RCC Australia) and advised that a VHF call regarding a man overboard had been received at Carnarvon. No further details were available at that time. RCC Australia then began to try to contact the ship using INMARSAT-C, without success.

¹ Used to bring a ship onto a reciprocal course, back to the original position where the person went overboard. It is designed to swing a ship's propeller away from the person in the water and to maintain visibility of the person as much as possible.

At 0930, as the ship was approaching the position where the man overboard incident occurred, the welder was sighted. The master stopped the ship and a lifeboat, which had been readied for letting go during the Williamson Turn, was lowered to the water.

At 0946, the master contacted RCC Australia informing them that the man had been located and that, at that time, no further assistance was required. The master stated that he would contact RCC Australia again when the man was back on the vessel.

Between about 0945 and 1100, the recovery operation took place and by 1109, the welder was safely back on board. First aid treatment of his burns was then started. At 1133, when the master became aware of the severity of the man's burns, he requested RCC Australia organise a medical evacuation to get the man to shore as soon as possible.

RCC Australia attempted to get medical advice to *Hui Shun Hai's* master, but language difficulties prevented this from happening. At 1144, RCC Australia set about looking for surface craft or available aviation assets which could effect the medical evacuation.

It was fortunate that a rescue helicopter used by the Royal Australian Air Force (RAAF) was

operating in the Learmonth area (160 nautical miles to the north of Carnarvon) and the RAAF released it to undertake the medical evacuation.

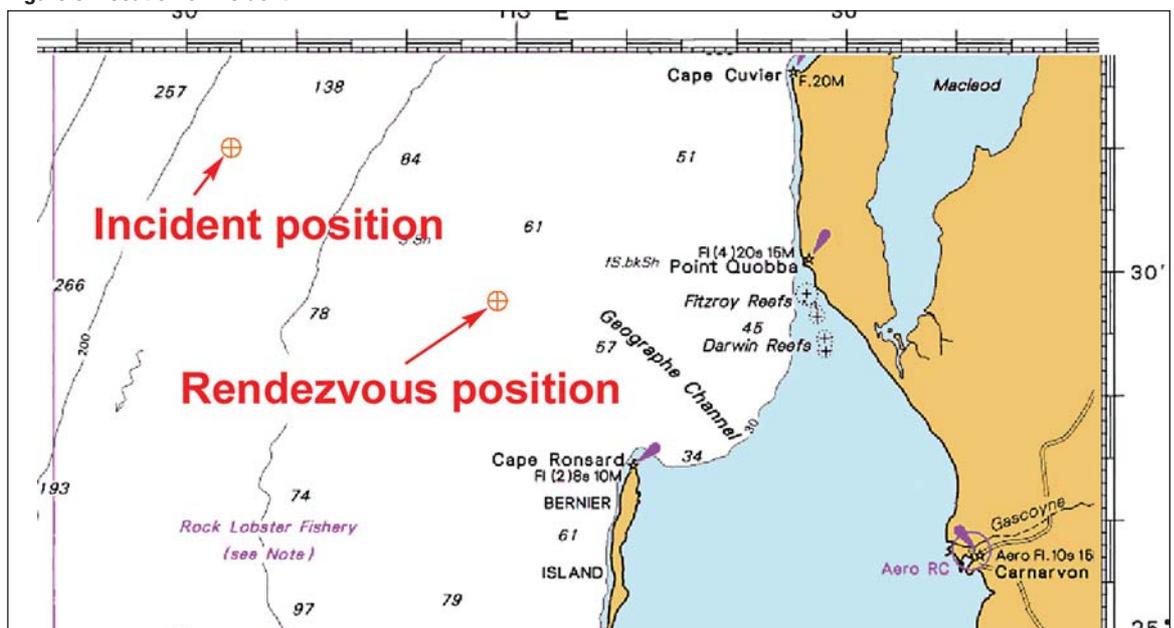
At 1230, RCC Australia informed *Hui Shun Hai's* master that the evacuation would take place by helicopter and to alter his vessel's course and make for an initial rendezvous position of 24° 37'S 113° 13'E, about 28 nautical miles north-west of Carnarvon.

The Sikorsky S76 helicopter, with two RAAF medical personnel on board, departed Learmonth at 1405 and tracked towards the rendezvous position. It was due there at 1540 local time. This time was passed to the master of *Hui Shun Hai* who confirmed the ship would be in position at that time.

At 1455, VHF communications were established between the ship and the helicopter. A revised rendezvous position of 24° 32.2'S 112° 57.5'E (42 nautical miles north-west of Carnarvon) was agreed upon by the pilot of the helicopter and the ship's master.

At 1525, the ship and helicopter rendezvoused and by 1530, the helicopter had winched the medical personnel onto the deck of *Hui Shun Hai*. The welder was assessed and readied for transfer to the helicopter by winch. At 1555, he

Figure 3: Location of incident



was winched off the ship, followed by the medical personnel.

At 1600, the helicopter departed the ship's position for Carnarvon hospital and the ship resumed its voyage to Albany.

The helicopter landed at Carnarvon hospital at 1628. After hospital staff assessed that the welder was suffering burns to 40 per cent of his body, he was transferred to the Royal Perth Hospital by a Royal Flying Doctor aircraft. In Perth, he underwent extensive treatment and spent several months recovering.

Hui Shun Hai arrived in Albany on the morning of 24 April.

Comment and analysis

Hydraulic pipeline replacement

When work in and around number four cargo hold started on the morning of 21 April, both shipboard departments (deck and engineering) were aware of what the other was doing. However, each was concentrating on completing their respective tasks before the ship berthed in Albany.

The master and chief officer wanted to inspect the hold to ensure that it complied with the high cleanliness standards required prior to loading grain in the hold. They had the hatch cover opened before going into the hold in order to allow a good amount of natural light into the cargo space so they could carry out a thorough inspection.

Figure 4: Location of explosion

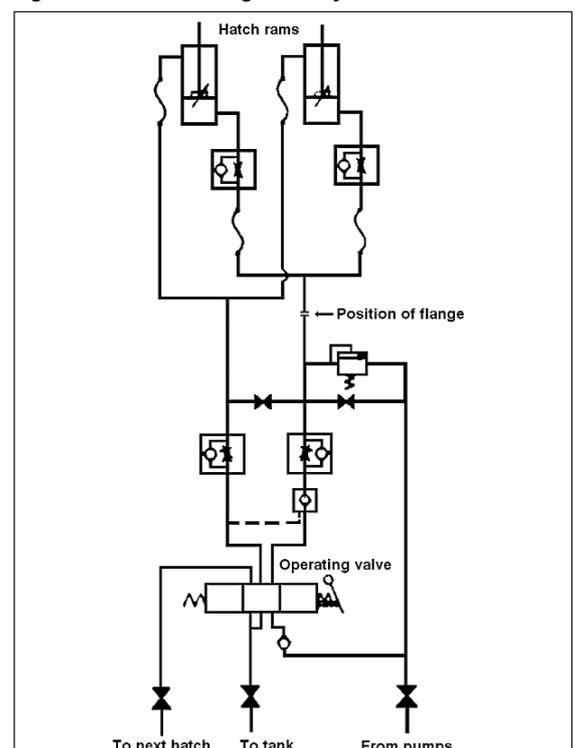


The welder had carried out the replacement of hydraulic pipes on several other holds during the voyage before working on number four hold. During each of these other replacements, the hatch covers had been closed and the choice of which pipe to replace was not an issue, as there was no pressure in the hydraulic lines.

On 21 April, before commencing work on the hydraulic line, the appropriate valves in the system between the pump and the hatch cover controls were closed. This was the same precaution taken before the other replacements and this work had been completed without incident.

However, no-one involved in the work on number four hatch that morning had considered the pressure in the hydraulic circuit. This residual pressure was present due to the loaded state of the hatch cover actuating rams with the covers only partially open. The hydraulic rams were the only thing holding the covers in the half open position and resulted in oil pressure, due to the weight of the hatch covers, still being present in the supply side of the ram's pistons.

Figure 5: Schematic diagram of system



There was no securing device to enable the covers to be locked in the half open position (only in the fully open position), which would have allowed the pressure to be released from the hydraulic system. Had the covers been in either the fully open or closed position, the pressure in the hydraulic circuit could have been relieved, rendering the line safe to work on.

Although the welder had removed two corroded bolts using the oxygen-acetylene cutting gear, the force exerted by the remaining two bolts, and years of corrosion, still held the two flanges together. However, as he proceeded to cut through the third bolt, the evidence indicates that the flanges separated. This allowed the hydraulic oil in the pipe, under pressure, to escape. The oil, probably as a fine mist, then made contact with the oxygen-acetylene flame and ignited. This resulted in the fireball which engulfed the welder and the equipment on the deck near him.

The welder dropped the cutting head as he jumped to his feet. This action removed the source of ignition from the escaping oil and there was no ongoing fire. On inspection, paint work on the deck and hatch surrounds in the area effected by the fire ball showed no signs of excessive blistering, an indication that the fire did not burn for a very long period of time. This was also confirmed by the crew who witnessed the explosion.

The break in the hydraulic pipe, which allowed the oil to escape, also released the pressure in the hydraulic rams supply line and the hatch covers slowly closed.

The fact that the ship's crew did not realise that the half open hatch cover would result in residual oil pressure in the hydraulic system was directly causal in this incident.

Procedures

Before commencing work on the hydraulic pipe on 21 April, the chief mate had completed and signed a hot work checklist, which in effect gave permission for hot work to be carried out adjacent to the starboard side of number four hatch. This checklist named the person in charge of the work and the other crew involved.

It covered the provision of fire fighting equipment, identification of any electrical cabling and flammable liquids which may cause a problem, and if staging was required to access the planning work location.

This checklist, and the other procedures on board, did not ensure that the work to be carried out was not impacted by, or would impact on, any other task/s being carried out at the same time. Had there been such a procedure in place, then it would probably have become apparent that the hatch covers in the half open position could have an effect on the hot work.

Placement of the oxygen-acetylene bottles

The trolley on which the oxygen-acetylene bottles were mounted was located in very close proximity to where the welder was working on the flange nuts (figure 4).

While the oxygen-acetylene bottles did not explode, their proximity to the source of the explosion could have resulted in a significantly worse incident occurring.

Given the lengths of rubber hosing connecting the bottles to the cutting head, it may well have been prudent for the trolley and bottles to have been positioned well away from the area of work being undertaken. Had this been done, the risks associated with using these flammable gases would have been lessened.

Recovery operation

It is probable that, given the extent of the welder's burns, jumping into the sea prevented the heat from progressing further into his skin. However, once in the water, with the ship steaming away, he was now at risk of drowning.

The quick thinking by the crew in getting a lifebuoy to the welder and his ability to grasp it, made it possible for him to at least keep his head above the water while the ship was able to return to his location.

The third mate's prompt initiation of the Williamson Turn meant that the ship did not progress too far from the man overboard position. His actions contributed directly to the successful recovery operation.

Additionally, the fact that the master ordered all available crew to act as lookouts as the ship returned, ensured that the welder was seen quickly and recovered on board in as quick a time as was possible. Had the weather and sea conditions been worse, his survival chances would have been greatly diminished.

The second mate's removal of the man overboard smoke float/light from the lifebuoy could have adversely affected the detectability of the man in the water. The smoke float, activated prior to becoming water-borne, releases bright orange smoke which significantly increases visibility of the lifebuoy in the water during daylight hours.

The welder was also fortunate that the RAAF rescue helicopter was relatively close. Had there not been a suitable evacuation aircraft in that area, RCC Australia may well have had to relocate one from Perth or Karratha. Alternatively, they might have had to organise an evacuation by small surface craft from Carnarvon. Both these options would have increased the time the welder was without expert medical care and had an adverse effect on his chances of recovery.

Conclusions

Based on the evidence available, the following factors are considered to have contributed to the explosion on *Hui Shun Hai* on 21 April 2005:

- Crew carrying out the replacement of the section of hydraulic pipeline did not realise that the half open hatch cover caused the pipe to be pressurised.
- Cutting work, using oxygen-acetylene gas, was being carried out on the pressurised section of hydraulic pipe.
- Removal of the third bolt caused the two flanges to part, enabling pressurised hydraulic oil to escape and come into contact with the oxygen-acetylene flame.
- Procedures failed to provide guidance in identifying the potential hazard of pressurised hydraulic lines.

It is also considered that the trolley carrying the oxygen-acetylene bottles was placed too close to the area of work.

Recommendations

MR20050030

Ship's managers and masters should review their safety management systems and the associated permit to work arrangements, to ensure that hydraulic systems are correctly isolated and relieved of pressure before work on the system has commenced.



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Media Release

Shipboard explosion results in man overboard

A crew member who jumped into the sea after being engulfed in flames probably reduced the severity of his burn injuries according to an Australian Transport Safety Bureau (ATSB) investigation report released today.

The ATSB report into the incident states that, at about 0840 on 21 April 2005, a crew member on board the Hong Kong bulk carrier Hui Shun Hai was working on a hydraulic oil pipeline on the main deck of the ship when the line parted, allowing pressurised hydraulic oil to escape. The oil ignited, and exploded, when it came into contact with the oxygen-acetylene flame the crew member was using.

The ship was proceeding to the Western Australian port of Albany when the incident occurred.

Immediately following the incident, the ship's master turned the vessel around and launched a lifeboat to recover the man from the sea. When he was returned on board the vessel, the extent of his burns were apparent and the master requested a medical evacuation by helicopter. A RAAF helicopter, launched from Learmonth, winched the crew member off the vessel about seven hours after he was burnt. He was flown to Carnarvon and then onto Perth when the full extent of his burns were known.

The report concludes that the crew carrying out the replacement of the section of hydraulic pipeline did not realise that the half open hatch cover caused the pipe to be pressurised. Additionally, the shipboard operating procedures failed to provide guidance in identifying the potential hazard of pressurised hydraulic lines.

The report recommends that ship's managers and masters should review their safety management systems and the associated permit to work arrangements, to ensure that hydraulic systems are correctly isolated and relieved of pressure before work on the system has commenced.

Copies of the report can be downloaded from the ATSB's internet site at www.atsb.gov.au, or obtained from the ATSB by telephoning (02) 6274 6478 or 1800 020 616.

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