Australian Government
Australian Transport Safety Bureau

ATSB TRANSPORT SAFETY INVESTIGATION REPORT
Marine Occurrence Investigation No. 218
Final

Independent investigation into the engine room workshop fire on board the Thailand registered bulk carrier

Opal Naree

at Dampier, Western Australia
15 September 2005

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Abstract

At about 1630 on 15 September 2005, a fire broke out in the engine room workshop on board the bulk carrier *Opal Naree*.

A fitter had been allocated the task of weld repairing the sewage system save-all base, while the duty oiler was assigned to standby in the workshop below and keep a fire watch. The oiler left the workshop to answer the telephone, and then attended to a ballast pump fault that the second mate had alerted him to. During this time the fitter continued to work, and it appears that molten metal from the welding process fell into the workshop, landing on coiled electrical cables, causing them to ignite.

The fire was detected by the fitter and the emergency alarm was raised. The crew mustered and the master contacted the port authority, who, in turn contacted the fire and emergency services.

The crew closed all the engine room doors and fire dampers while the master and chief engineer assessed the situation. They decided to use the fixed fire extinguishing system, and at 1700 carbon dioxide was released into the engine room.

By 1800 two fire fighting tugs were standing by the ship and the fire and emergency services authority (FESA) were on board. At 2153 the ship's crew and FESA commenced the first of two inspections of the engine room. There was no sign of fire and by 2310 the ship's crew had begun ventilating the engine room.

THE AUSTRALIAN TRANSPORT SAFETY BUREAU

The Australian Transport Safety Bureau (ATSB) is an operationally independent multi-modal Bureau within the Australian Government Department of Transport and Regional Services. ATSB investigations are independent of regulatory, operator or other external bodies.

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia that fall within Commonwealth jurisdiction, as well as participating in overseas investigations involving Australian registered aircraft and ships. A primary concern is the safety of commercial transport, with particular regard to fare-paying passenger operations. Accordingly, the ATSB also conducts investigations and studies of the transport system to identify underlying factors and trends that have the potential to adversely affect safety.

The ATSB performs its functions in accordance with the provisions of the *Transport Safety Investigation Act 2003* and, where applicable, relevant international agreements. The object of a safety investigation is to determine the circumstances to prevent other similar events. The results of these determinations form the basis for safety action, including recommendations where necessary. As with equivalent overseas organisations, the ATSB has no power to implement its recommendations.

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The ATSB does not have the resources to carry out a full cost-benefit analysis of each safety recommendation. The cost of a recommendation must be balanced against its benefits to safety, and transport safety involves the whole community. Such analysis is a matter for the body to which the recommendation is addressed (for example, the relevant regulatory authority in aviation, marine or rail in consultation with the industry).

1 SUMMARY

At about 1630 on 15 September 2005, a fire broke out in the engine room workshop on board the bulk carrier *Opal Naree*.

A fitter had been allocated the task of weld repairing the sewage system save-all base, while the duty oiler was assigned to standby in the workshop below and keep a fire watch. The oiler left the workshop to answer the telephone, and then attended to a ballast pump fault that the second mate had alerted him to. During this time the fitter continued to work, and it appears that molten metal from the welding process fell into the workshop, landing on coiled electrical cables, causing them to ignite.

The fitter was the first to detect the smoke from the fire; he alerted the other men in the engine room and they made a vain attempt to extinguish the fire. They also alerted the bridge.

The second mate, on the bridge activated the emergency alarms. The crew, including those from the engine room, mustered at the emergency muster point. The master contacted the port authority, who, in turn contacted the fire and emergency services. The crew closed all the engine room doors and fire dampers while the master and chief engineer assessed the situation. They decided to use the fixed fire extinguishing system, and at 1700 CO_2 was released into the engine room.

By 1800 two fire fighting tugs were standing by the ship and the fire and emergency services authority (FESA) were on board.

At 2153 the ship's crew and FESA commenced the first of two inspections of the engine room. There was no sign of fire and by 2310 the ship's crew had begun ventilating the engine room.

The report concludes that:

- Welding on the base of the sewage system save-all led to molten metal falling on coiled electrical leads in the workshop below, causing the insulation to catch fire.
- The absence of the oiler from the designated fire watch position enabled the fire to start and escalate undetected.
- The hot work permit did not give clear instructions regarding the necessity of a fire watch or the need to clear the surrounding area of all combustible material.
- The crew were prevented from starting the emergency fire pump and fighting the fire with hoses because the space in which the pump was located had filled with smoke from the fire.

It is also considered that:

- The quick action of the master and chief engineer, in deciding to use the fixed CO_2 system to extinguish the fire was instrumental in minimising damage to the ship.

- The fire may have been detected and extinguished earlier, without the use of the fixed CO_2 system, if the ship had been fitted with a fire detection and alarm system.
- By not using the international shore connection to pressurise the ship's fire main from the tug's pump, the ship's crew and the fire and emergency services may have limited their ability to fight the fire in the event of it escalating.

The report recommends that:

- The ship manager should review the work permit system, and ensure that the instructions contained in the permits are clear, and unambiguous.
- Owners and managers of ships that are not fitted with appropriate fire detection and alarm systems in engine rooms should consider fitting such systems.
- The flag state should consider referring the issue of fire protection of high risk areas to the International Maritime Organization for consideration.
- Owners, managers and ships' masters should consider implementing procedures that would ensure that isolating doors between engine rooms and any space containing an emergency fire pump or its source of power are kept closed at all times.
- The flag state should consider referring the issue of the positioning of emergency fire pumps in ships to the International Maritime Organization for consideration.
- The West Australian Fire and Emergency Services should consider reviewing their procedures with regard the use of the international shore connection when fighting fires on board ships.

2 SOURCES OF INFORMATION

The master and crew of *Opal Naree*.

Dampier Port Authority.

Karratha Fire and Emergency Services Authority (FESA).

Nippon Kaiji Kyokai (ClassNK).

References

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

3 NARRATIVE

3.1 *Opal Naree*

Opal Naree is a Thailand registered 'handy-sized' geared bulk carrier. The ship is owned by Precious Opal and managed by Great Circle Shipping Agency. Both companies are based in Bangkok, Thailand. The ship is classed with Nippon Kaiji Kyokai (ClassNK).

Opal Naree was built in 1982 by Kurushima Dockyard Company in Onishi, Japan. The ship has an overall length of 175.5 m, a beam of 27.16 m and a depth of 14.00 m. It has a deadweight of 28 780 tonnes at its summer draft of 10.019 m.

The ship has five cargo holds located forward of the accommodation superstructure, and is fitted with five cargo cranes.

Figure 1: *Opal Naree* berthed in Dampier

Propulsive power is provided by a seven cylinder Sulzer 7 RLB-56, single acting, direct reversing two-stroke diesel engine of 5 694 kW. The main engine drives a single fixed pitch propeller which gives the ship a service speed of 12.5 knots.

Opal Naree's machinery spaces are not fitted with a fixed fire detection and alarm system. The ship was fitted with a fixed carbon dioxide (CO_2) fire extinguishing system that consisted of 101 gas cylinders, each cylinder containing 45 kilograms of CO_2. The cylinders were connected to a common distribution manifold that supplied CO_2 to the engine room or the cargo holds (Figure 2).

At the time of the incident, *Opal Naree*'s crew of 30 consisted of 15 Thai, 13 Indian and two Bangladeshi nationals.

While at sea, the deck and engineering officers maintain a watchkeeping routine of four hours on, eight hours off and generally worked two hours overtime each day.

When in port, the deck officers continued their watchkeeping routine while the engineers worked during the day with one engineer on call at night. The engine room was manned by a duty oiler at all times.

Figure 2: CO_2 system

The master held a class one certificate of competency, issued in Thailand. He had 10 years seagoing experience, and had been master of *Opal Naree* for nine months. He was completing his first contract on the ship.

The chief engineer held a class one certificate of competency, issued in Thailand, and had been sailing in the rank of chief engineer for one year. He joined *Opal Naree* in Dampier on 14 September. When joining, he received no formal handover from the previous chief engineer who had left the ship due to an injury. It was the chief engineer's first contract on the ship.

The third engineer held a class five certificate of competency, issued in Singapore. He had 13 years seagoing experience and had been onboard *Opal Naree* for five months.

The fitter held a technician qualification. He had 10 years seagoing experience, and had been on board *Opal Naree* for six months.

The duty oiler at the time of the fire had completed a four month pre sea training course in Thailand. He had 15 months seagoing experience, and had been on board *Opal Naree* for five months.

3.2 The incident

At 1806 on 14 September 2005, *Opal Naree* arrived along side the Mistaken Island salt berth in Dampier. The plan was to load a cargo 24 000 tonnes of salt, for delivery to Indonesia. Cargo operations commenced on arrival but were suspended at 0600 on 15 September due to a lack of salt in the stockpile. The intention was to start loading again at 1900.

On the morning of 15 September, a surveyor from the Australian Maritime Safety Authority (AMSA) attended the vessel and completed a port state control (PSC) inspection.

Following the PSC inspection the crew attended to the deficiencies found during the inspection and carried out a number of other routine maintenance tasks. One of the maintenance tasks was a weld repair on the base of the sewage tank save-all (Figure 3). The sewage system is located on the compressor deck, one deck above the engine room workshop. Consequently, the save-all base forms part of the workshop deck head.

Figure 3: Sewage system save-all

The welding task was allocated to the fitter, with the duty oiler assisting. The plan was for the fitter to complete the repairs, while the oiler was to watch for sparks and molten metal from the welding process that could fall into the workshop below.

Prior to starting the repair, a hot work permit was completed by the second engineer and signed by the chief engineer.

While the welding was being carried out, only three men were in the engine room. The third engineer, fitter and oiler.

At about 1615, the third engineer answered a boiler flame failure alarm. To rectify the fault he went to the boiler flat, located two decks above the workshop.

Shortly after 1615 the engine control room telephone rang. As the third engineer was busy at the boiler flat, and as there were very few welding sparks falling into the workshop, the oiler went to answer it. The oiler was informed by the second mate that the ballast pump had lost suction. After hanging up he went to the ballast pump, located on the engine room bottom plates, and attempted to rectify the problem. He did not tell the fitter that he had left the workshop.

At about 1623 the second mate rang the engine control room again. He informed the third engineer that the ballast pump had not yet picked up suction. The third engineer joined the oiler on the bottom plates and together they attempted to re-establish the ballast pump suction.

The fitter had continued to work on the save-all, and at about 1628, he noticed smoke coming through the hole he was attempting to weld. He stopped and went to the workshop to investigate. He discovered a large amount of dense black smoke coming from the workshop. The smoke was flowing through the doorway and into the fiddley above.

The fitter immediately shouted to the third engineer and oiler to alert them. All three men made their way to the engine control room to assess the situation.

The third engineer made an attempt to extinguish the fire using the engine control room portable carbon dioxide (CO_2) extinguisher. He could not get close enough to the fire to operate the portable extinguisher, because of the quantity of dense black smoke flowing from the workshop. At the same time, the oiler telephoned the bridge and alerted the second mate to the fire.

At 1635, the second mate sounded the emergency alarm and made an announcement on the public address system. The third engineer returned to the control room, and with the emergency alarms now ringing, the third engineer, fitter and oiler made their way to the emergency muster point, located on the starboard side of the main deck, forward of the accommodation.

When the master heard the emergency alarm he went to the bridge. On the way he noticed some smoke in the accommodation. On reaching the bridge, he could see smoke flowing from the engine room skylight, the funnel casing door and the top of the funnel. He immediately closed the funnel casing door and the engine room skylight. Smoke continued to flow from the open hatch on the funnel top. He then remained on the bridge to co-ordinate the emergency response.

By 1640 all the crew had been accounted for, and under the direction of the chief engineer they started closing the engine room dampers and shutting down machinery, including the diesel generators. No attempt was made to close the open hatch on the top of the funnel.

The ship chief engineer ordered that the diesel powered emergency fire pump should be started. However, there was no remote start for the emergency fire pump and entry to the emergency fire pump space was hampered by smoke from the fire.

At 1645, the master used the VHF radio, on channel 11, to notify the Dampier Port Authority of the situation. Dampier Port Authority notified the Fire and Emergency Services Authority (FESA) and organised two fire fighting tugs to standby *Opal Naree*. It was expected that this assistance would reach the ship at about 1715.

The master then proceeded to the muster station. He consulted with the chief engineer. The two men decided that the best course of action was to use the ship's fixed CO_2 system (Figure 2) to extinguish the fire.

The chief engineer tried to make his way to the CO_2 release station located in the main deck port alleyway. The smoke was too dense for him to get there. He decided to release the CO_2 manually from the CO_2 room, as this room opened directly onto the main deck on the starboard side of the accommodation.

At 1700 the CO_2 was released into the engine room.

The ship's crew then continued to monitor the situation. They checked the temperature of the bulkhead located between the engine room and number five cargo hold. They also watched the discharge of smoke from the one small damper that was still open on the funnel top. There appeared to be no build-up in temperature of the bulkheads surrounding the engine room. The discharge of smoke from the funnel top continued for some time after the release of CO_2.

At 1734, the tugs *Riverside* and *Olivia* were alongside *Opal Naree*. The tug crews started transferring fire hoses to the ship. These hoses were then pressurised from the tugs' fire pumps. One of the tugs had also brought a harbour pilot, in the event that the ship had to be taken off the berth.

By 1755, the FESA units were on board. The harbour master, agent and the manager of the salt loading facility were also on board. At about this time, the majority of the ship's crew made their way onto the wharf. One crew member required medical treatment. He was transported to hospital, where he was treated for minor smoke inhalation. The master, chief officer, chief engineer and accounts officer remained on the ship.

By 1830, only a small amount of smoke could be seen coming from the funnel.

It was the intention of the master and chief engineer to leave the engine room locked down overnight and to begin ventilating in the morning. However, after discussions with FESA, it was decided to carry out an inspection of the engine room while the tugs were on standby, and hence available to supply water to the fire hoses.

Fire hoses were readied for use when entering the engine room, and the chief officer and four fire services personnel donned breathing apparatus sets. At 2153 the five men entered the rope locker through the poop deck hatch. From the rope locker they moved through the steering gear room and into the engine room, where they carried out an inspection of the compressor deck. By 2207 they were back on the poop deck. They had found no sign of fire.

At 2235, the chief officer and a second team of five FESA personnel entered the engine room to inspect the workshop. Again the entry was made through the rope locker hatch, and again there was no sign of fire.

By 2310, the tugs had departed, and the master, chief officer and chief engineer had begun opening the engine room doors and ventilation dampers. The master also requested that seven of the ship's crew return to assist on board. The remainder of the crew spent the night in a hotel ashore.

At 0230 on 16 September, the master and chief engineer checked the oxygen content at the engine room entrance. After determining that it was safe to enter, they then made their way into the engine room and inspected the workshop (Figures 4 and 5).

At 0245, the chief engineer and electrician started checking the generators, main switchboard and auxiliary machinery. They decided that since the number one generator was not running at the time of the fire, it was more likely to be in good condition, and hence would be the first generator started.

Figure 4: Fire damage to engine room workshop

Figure 5: Fire damage to engine room workshop

At 0830, an AMSA surveyor and the harbour master came on board *Opal Naree* to inspect the damage. It was the surveyor's appraisal that the ship was not seaworthy because the BA bottles and CO_2 cylinders were empty. The BA bottles were re-filled, but there was no CO_2 re-filling station in Dampier. AMSA later agreed that the ship could sail to its destination port, providing the ship's flag state or classification society gave approval for the voyage. Approval, conditional on the CO_2 cylinders being re-filled on arrival in Indonesia, was received from ClassNK.

At 1000, the number one generator was on line and the engine room ventilation fans were started. By 1100, the master and chief engineer had declared that the engine room was safe for normal operations.

Throughout the day the engine room staff continued to check engine room machinery and systems to ensure that they were all operational.

At about 1445 it was discovered that a pocket of CO_2 was still present in the emergency fire pump space. This was immediately reported to the chief engineer and the area was cordoned off and ventilated using a portable fan.

Cargo operations commenced again at 1710, and the ship sailed from Dampier at 0150 on 18 September.

4 COMMENT AND ANALYSIS

4.1 Evidence

On 16 September 2005, two investigators from the Australian Transport Safety Bureau (ATSB) attended *Opal Naree* in Dampier. The master and directly involved crew members were interviewed, and provided accounts of the incident. Copies of relevant documents were obtained including log book entries, pilot card, various procedures and statutory certificates.

Information was also gathered from Dampier Port Authority, the ship's agents, AMSA, ClassNK and Karratha FESA.

4.2 The fire

The evidence indicates that the fire started some time after the oiler left the workshop at about 1616, and before it was detected by the fitter at about 1628.

The holes in the save-all base that required repair were only about 2 mm in diameter. However, the plate surrounding the holes was wasted. Inspection of the area after the fire revealed that the hole in the deck plating had increased in size to about 20 mm in diameter.

It is probable that the force of the electric arc blew a hole in the plate during the welding process. This resulted in free molten metal falling into the workshop below. Located in the workshop directly below the area where the welding was taking place were coiled electrical cables. The molten metal probably landed on these cables causing the insulation to ignite (Figure 6).

Figure 6: Burnt coils of electrical cables

4.3 The response

The response of the officers and crew on board *Opal Naree* was prompt and decisive. The alarm was raised quickly and an attempt was made to extinguish the fire using a portable extinguisher. The third engineer, fitter and oiler had attempted to do all they could, and since they could not control the fire and the emergency alarms were ringing they made what appears to be the correct decision, when they evacuated the engine room. The entire crew mustered quickly and all persons were accounted for within five minutes of the emergency alarm being sounded.

The master and chief engineer acted with only limited information about the fire as the third engineer, oiler and fitter could not see into the workshop due to the large amount of dense black smoke. They had no information that would have assisted them in assessing the extent to which the fire may have spread.

After an unsuccessful attempt to reach the emergency fire pump space to start the pump, the master and chief engineer probably had little choice but to use the fixed CO_2 system. The fact that they made that decision early instead of waiting for assistance was probably instrumental in minimising damage to the ship.

While leaving the funnel top hatch open did not hinder the effectiveness of the CO_2 on this occasion, it may have if the fire had been larger or more intense. Ship's crews should attempt to close all means of ventilation before releasing CO_2.

Communications between the ship and Dampier harbour control were effective. Harbour control deployed a pilot and two tugs in good time and they arrived on site in about 40 minutes.

The FESA units arrived on site about 60 minutes after the 000[1] call made by harbour control at 1655. The nearby Dampier FESA unit is operated by volunteers and there appears to have been some delay in deciding if the permanently manned Karratha unit would be turned out. Both units were eventually turned out. Without the initial delay FESA may have been on site about 20 minutes earlier.

When the fire fighting tugs came along side *Opal Naree* their fire hoses were transferred to the ship and lined up for direct use, with the tugs pressurising the fire hoses. This was done so that FESA could use their own hoses and branches.

It is a SOLAS[2] requirement that all ships carry an international shore connection for the express purpose of enabling the ship's fire main to be pressurised from an external means. The fire hoses supplied from the tugs should have been connected to the ship's fire main, using the international shore connection. The tugs could have then pressurised the ship's fire main system. This would have given the ship's crew and FESA access to all the hydrants throughout the ship, providing far more flexibility if it had become necessary to boundary cool the area or to fight the fire.

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1 The telephone number used in Australia for all emergency calls.

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

4.4 Fixed CO_2 fire fighting system

Opal Naree was fitted with a fixed CO_2 fire extinguishing system that consisted of 101 gas cylinders, each containing 45 kilograms of CO_2. The cylinders were connected to a common distribution rail that supplied CO_2 to the engine room and cargo holds (Figure 2).

Discharge of CO_2 into the engine room can be done either remotely from the remote release station located in the accommodation, main deck port alleyway, or locally from the CO_2 room. In either mode of operation the system discharges a dedicated bank of 68 CO_2 cylinders.

On 15 September, access to the remote CO_2 release station was impaired by smoke. Consequently the CO_2 system was operated locally from the CO_2 room. The chief engineer stated that the system was operated as per the instructions posted in the CO_2 room.

When the CO_2 system was inspected after the fire, 96 of the 101 cylinders had been activated. If the system had been operated as per the instructions, only the dedicated bank of 68 CO_2 cylinders should have been discharged. The evidence indicates that some or all of the cylinders had been manually tripped, and that five cylinders did not activate even when manually tripped.

Had the system been operated as per the instructions 33 cylinders should have been left in reserve, in case they were needed at a later time.

4.5 Fire detection

Opal Naree was built in 1982 to SOLAS and ClassNK rules. Under these rules a machinery space fire detection and alarm system was not required for a ship that had a continuously manned engine room. The engine room on board *Opal Naree* was designed to be manned at all times.

The ship was not fitted with a fire detection and alarm system that monitored the ship's machinery spaces. The crew may have been alerted to the fire earlier if the ship had been fitted with such a system. A quicker response may well have led to the fire being extinguished without the use of the fixed CO_2 system.

Since 1982 there have been many changes to the SOLAS rules regarding fire detection and alarm systems for monitoring of ship's machinery spaces. However, there have been no retrospective changes to these rules that would require such a system be fitted to *Opal Naree*.

The engine room staff worked a four hours on, eight hours off watchkeeping routine, and on most days they also completed two hours of overtime work. This system ensured that the engine room was manned at all times.

While having the engine room manned at all times is, in itself, a strategy for detecting fires in the engine room, it is not practical to expect a single watch keeper to monitor the entire engine room space at all times. This is particularly so when the engine room is spread over five decks and the watch keeper is engaged in other work and plant operations for protracted periods.

While a good watchkeeping regime is important, it should not be seen as the equivalent of an adequate fire detection system.

4.6 Hot work permit and fire watch

It is a requirement of *Opal Naree*'s safety management system (SMS) that the crew complete a hot work permit prior to commencing any hot work outside designated areas, such as the workshop.

A permit was completed and signed by the chief engineer for the repairs on the sewage system save-all prior to the incident on 15 September. There was also evidence that the permit system was regularly used on board *Opal Naree*.

Line one of the permit checklist asks the following question.

Is the area clean and clear of oil and other dangerous materials and gases?

Evidence indicates that the aft end of the workshop (the area in which the fire broke out) was clean and clear of oil. It is apparent that the coiled electrical cables were not considered dangerous materials, and as such were left in place. The insulation was however flammable, and the coils were stowed directly below the area where the hot work was being carried out.

While the crew had sensibly decided to post a fire watch in the workshop, the hot work permit did not require a fire watch to be in place. It is common for fires to break out in the spaces adjacent to where hot work is being carried out. Hot work permit systems should ensure that all adjacent spaces are monitored during hot work.

The oiler was given the task of standing-by in the workshop and keeping a lookout. He had carried out this task many times before and was aware that on detecting a fire he should raise the alarm and attempt to extinguish the fire using the workshop portable fire extinguisher.

It is essential that individuals are fully briefed as to their responsibilities when they are assigned a task. The oiler was simply told to standby in the workshop and lookout for fire. He was not told that he must remain in the workshop until the hot work was completed.

When interviewed, the oiler stated that up until the time he left the workshop, there were only a few welding sparks falling into the workshop. He did not consider that by leaving the workshop he was leaving the area in an unsafe condition. It would have been prudent to ignore the telephone, or ask the fitter to stop welding while he went to answer it.

While carrying out a fire watch appears simple, it is a task that requires constant vigilance.

Instructions and work permits need to be clear, and worded in a fashion that cannot be misunderstood. *Opal Naree*'s hot work permit should have ensured the removal of the electrical cables and that a continuous fire watch was maintained.

4.7 Fire pumps

Opal Naree is not fitted with an emergency generator. Consequently, after the diesel generators were shut down the electrically driven main fire and general service pumps could not be operated.

The emergency fire pump was located in a space directly below, and accessed from, the steering gear room. The steering gear room is isolated from the engine room by a watertight door. The watertight door was open when the fire broke out and was not closed in time to stop smoke from filling the steering gear room and emergency fire pump space. Consequently the crew could not gain access to start the emergency fire pump.

Throughout a routine day on board *Opal Naree* there is regular traffic through the access between the engine room and the steering gear room. While it may be considered good practice to keep the interconnecting door closed at all times, in most cases this safeguard would be disregarded by the ship's crew, because it adds inconvenience. It would be a far better solution if the emergency fire pump was located in space that could not be directly accessed from the engine room.

At the time *Opal Naree* was built it was a SOLAS requirement that the fire pump was located in a space other than the engine room.

> No direct access shall be permitted between the machinery space and the space containing the emergency fire pump and its source of power. When this is impracticable an administration may accept an arrangement where the access is by means of an air lock, each of the two doors being self closing or through a watertight door capable of being operated from a space remote from the machinery space and the space containing the emergency fire pump and unlikely to be cut off in the event of fire in those spaces. In such cases a second means of access to the space containing the emergency fire pump and its source of power should be provided.

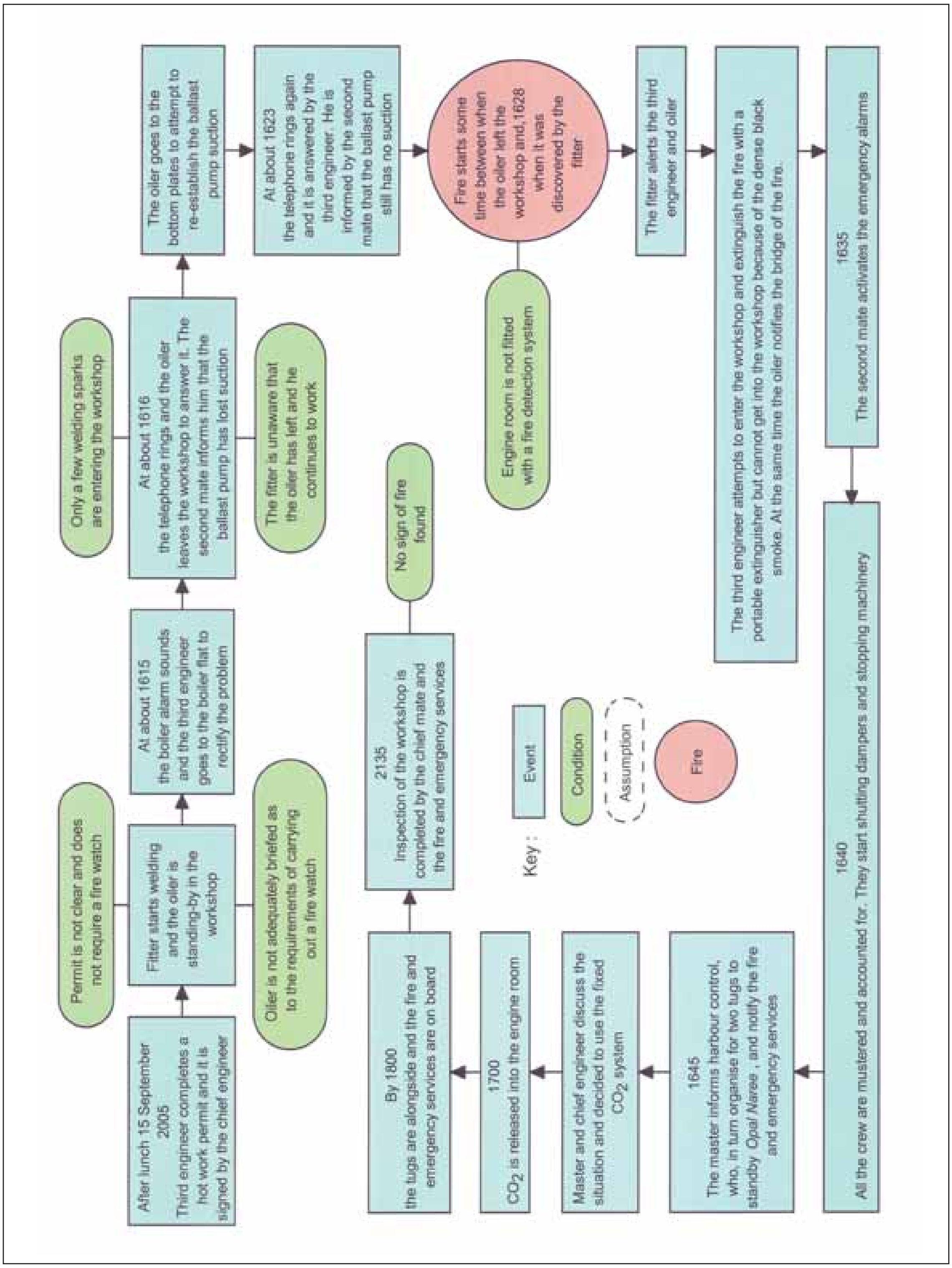
The SOLAS requirements for the isolation of a space containing an emergency fire pump or its source of power from the engine room are unchanged to this day. The watertight door arrangement between the engine room and the steering gear room on board *Opal Naree* complies with the SOLAS requirements.

It may have been possible for the crew to close the watertight door using the remote closing arrangement, and then enter the steering gear room wearing breathing apparatus sets. They could have then started the emergency fire pump. This course of action was not considered by the crew, and the amount of time it would have taken would have probably made it impractical.

It is apparent from the experience on board *Opal Naree* that the watertight door arrangement between these spaces is not adequate, if it is possible for the door to be left in the open position. If the door had been closed when the fire broke out, the space would not have filled with smoke. The crew would have had ready access to the emergency fire pump, and would have had the option of fighting the fire using the ship's fire hoses.

If a similar incident had occurred at sea, the crew would have been without water, either to fight the fire or to use when entering the engine room after the fire.

Figure 7: Events and causal factors chart



5 CONCLUSIONS

These conclusions identify the different factors that contributed to the accident and should not be read as apportioning blame or liability to any particular individual or organization.

Based on the available evidence, the following factors are considered to have contributed to the fire on board *Opal Naree* on 15 September 2005.

1. Welding on the base of the sewage system save-all led to molten metal falling on coiled electrical leads in the workshop below, causing the insulation to catch fire.
2. The absence of the oiler from the designated fire watch position enabled the fire to start and escalate undetected.
3. The hot work permit did not give clear instructions regarding the necessity of a fire watch or the need to clear the surrounding area of all combustible material.
4. The crew were prevented from starting the emergency fire pump and fighting the fire with hoses because the space in which the pump was located had filled with smoke from the fire

It is also considered that:

5. The quick action of the master and chief engineer, in deciding to use the fixed CO_2 system to extinguish the fire was instrumental in minimising damage to the ship.
6. The fire may have been detected and extinguished earlier, without the use of the fixed CO_2 system, if the ship had been fitted with a fire detection and alarm system.
7. By not using the international shore connection to pressurise the ship's fire main from the tug's pump, the ship's crew and the fire and emergency services may have limited their ability to fight the fire in the event of it escalating.

6 RECOMMENDATIONS

MR2006007

The ship manager should review the work permit system, and ensure that the instructions contained in the permits are clear, and unambiguous.

MR2006008

Owners and managers of ships that are not fitted with appropriate fire detection and alarm systems in engine rooms should consider fitting such systems.

MR2006009

The flag state should consider referring the issue of fire protection of high risk areas to the International Maritime Organization for consideration.

MR2006010

Owners, managers and ships' masters should consider implementing procedures that would ensure that isolating doors between engine rooms and any space containing an emergency fire pump or its source of power are kept closed at all times.

MR2006011

The flag state should consider referring the issue of the positioning of emergency fire pumps in ships to the International Maritime Organiszation for consideration.

MR2006012

The West Australian Fire and Emergency Services should consider reviewing their procedures with regard the use of the international shore connection when fighting fires on board ships.

7 SUBMISSIONS

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

The final draft of this report was sent to *Opal Naree*'s master, chief engineer and ship manager, AMSA, Karratha Fire and Emergency Service and the Dampier Port Authority.

Submissions were included and/or the text of the report was amended where appropriate.

8 OPAL NAREE

IMO Number	8210388
Call sign	HSGN
Flag	Thailand
Port of Registry	Bangkok
Classification society	Nippon Kaiji Kyokai (ClassNK)
Ship Type	Geared bulk carrier
Builder	Kurushima Dockyard, Japan
Year built	1982
Owners	Precious Opal
Ship managers	Great Circle Shipping Agency, Bangkok Thailand
Gross tonnage	18 122
Net tonnage	10 167
Deadweight (summer)	28 780 tonnes
Summer draught	10.019 m
Length overall	175.5 m
Length between perpendiculars	165.0 m
Moulded breadth	27.16 m
Moulded depth	14.0 m
Engine	Sulzer 7 RLB-56
Total power	5 694 kw
Service speed	12.5 knots
Crew	30

Independent investigation into the engine room workshop fire
on board the Thailand registered bulk carrier *Opal Naree*
at Dampier, Western Australia 15 September 2005