# Departmental investigation into a fire in the engine room aboard the Netherlands Dredger Leonardo Da Vinci off the port of Dampier, WA on the 11 June 1998

MIIU

ATSB
Australian Transport Safety Bureau

# Contents



**Navigation Act 1912**

**Navigation (Marine Casualty) Regulations**

**investigation into a fire in the engine room aboard**

**the Netherlands dredger**

**LEONARDO DA VINCI**

**off the port of Dampier, W.A. on 11 June 1998**


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# Summary

On 11 June 1998, the Netherlands flag dredger *Leonardo da Vinci* was engaged in widening the approach channel to the Parker Point Terminal at Dampier, Western Australia.

At approximately 1750, the fire alarm sounded and crew members in the engine control room saw a fire on No. 1 diesel engine. The engines were stopped, the fuel supply shut off and the engine room battened down. A fire party attacked the seat of the fire with portable dry powder extinguishers, but as the party could not be certain the fire was fully extinguished, the Halon system was activated.

Two harbour tugs provided assistance in boundary cooling until a shore fire brigade party arrived on board. Members of the shore fire brigade party entered the engine room and, after a careful inspection, declared the fire to be fully extinguished.

The fire was caused by diesel fuel oil spraying onto the hot exhaust trunking of the engine. The source of the diesel fuel oil leak was traced to the shut-off cock to the pressure differential indicator on the No. 1 engine fuel oil filter. The bonnet of the cock had become dislodged, permitting diesel oil, under 8 bar pressure, to be sprayed upwards onto the exhaust trunking.

The fire caused extensive damage to electrical wiring and fittings, resulting in *Leonardo da Vinci* being out of commission for three weeks. One person was injured in the incident, receiving burns to the face and left forearm.

# Sources of Information

Master, officers and crew, *Leonardo da Vinci*

Technical representative of Jeaumont Industrie, France

Dampier Port Control Tower

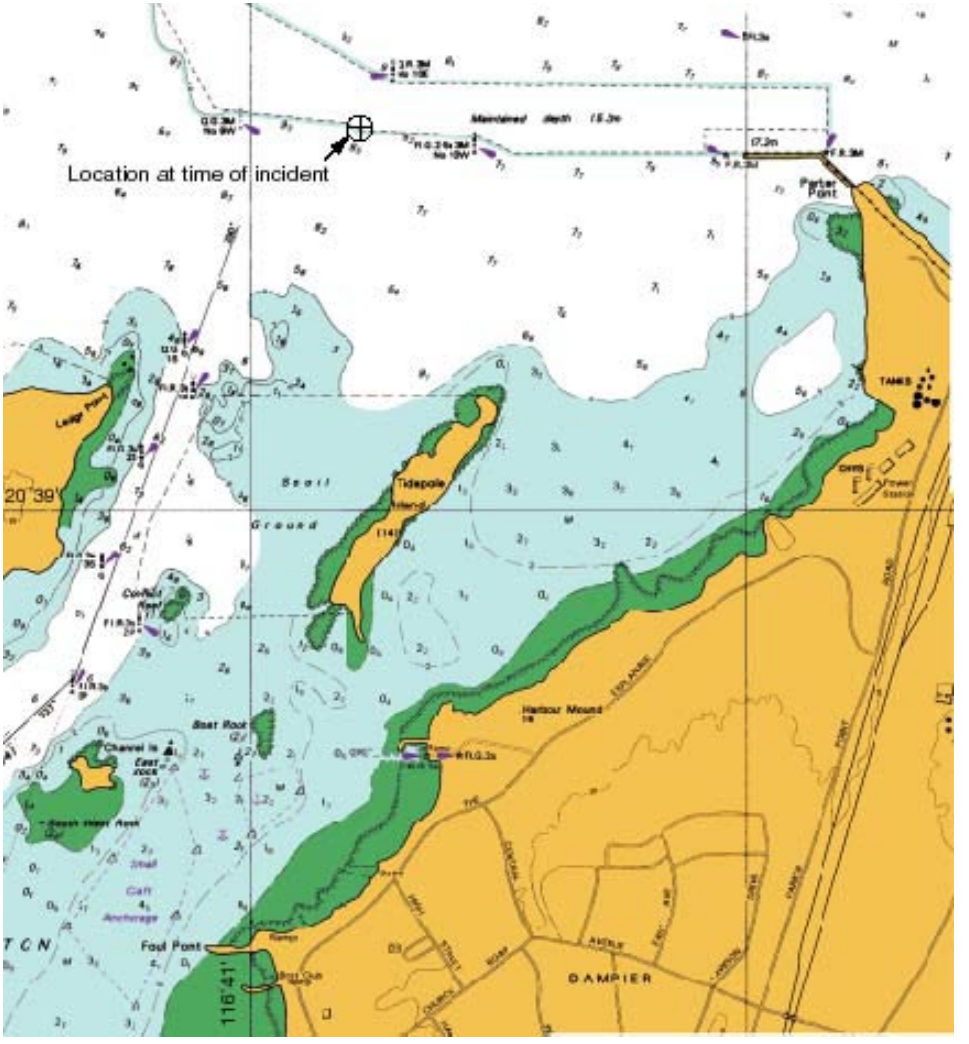
Fire & Rescue Service of Western Australia

Western Australia Police Service, Karratha


## Acknowledgement

The Inspector is grateful to the AMSA management for making available their two surveyors in Karratha to be appointed as Investigators to conduct the field investigation.

Portion of chart Aus 59 reproduced with permission of the Hydrographic Office, RAN.




**Portion of chart Aus 59 showing location of incident**

# Narrative

## Leonardo da Vinci

*Leonardo da Vinci* is owned by Dredging and Contracting Rotterdam, BV, a wholly owned subsidiary of Jan de Nul NV of Belgium. The vessel has an overall length of 129.2 m, a beam of 22.4 m and a depth of 8.15 m and a maximum dredging depth of 30 m. At the time it was built at the Kinderdijk yard of IHC Holland in 1985, it was the world's most powerful self-propelled cutter suction dredger.

Main propulsion is by diesel electric, with power provided by three Deutz BV8M 3295 kW diesel engines, each coupled to its own Jeumone-Schneider type SAT 100.100.6 generator (located in the separate generator room) in turn linked to two 2736 kW electric propulsion motors. The vessel is also equipped with two Deutz SBV12M 4900 kW diesel engines, each driving a 4485 kW dredge pump.

*Leonardo da Vinci* is equipped with two (main and auxiliary) spud bars (vertical pillars) situated at the bow, for holding the vessel in position. The main spud bar is housed in a slot, which allows the vessel to move ahead about 6 m, while the auxiliary spud bar is housed in a pipe collar. The cutter boom is located in the after part, where the hull is divided in two (twin hulls).

After the vessel has been manoeuvred into the correct dredging position, the main spud bar is dropped and acts as a single point mooring. The cutter boom is lowered and two anchors are run out by support vessels, one on each bow, the cable wires of the anchors passing through sheaves at the cutter head. This allows the vessel to be pivoted about the main spud bar, providing a dredging width of about 150 m. As dredging is in progress, the vessel is worked slowly ahead to the extent of the main spud bar slot. The auxiliary spud bar is then dropped, to secure the vessel while the main spud is lifted and repositioned. In this fashion, the vessel is walked along the required dredge path.

The two large dredge pumps draw the dredged material (spoil), as a slurry, from the dredge head and discharge it either side, through "T" shaped pipes, into self propelled hopper barges, which tie up alongside the vessel.

During a dredging operation, *Leonardo da Vinci* is supported by two hopper barges (*Magellano* and *Verrazzano*), a tug/work boat, a work barge and a transport/survey launch (*Sentinel*).

*Leonardo da Vinci* arrived off Dampier from Batam, Indonesia, in April 1998 and commenced work, under contract to Hamersley Iron, to deepen the Parker Point berth, to dredge for a new berth at the East Intercourse Terminal and to straighten a section of the Parker Point approach channel.

## Manning

*Leonardo da Vinci* is normally manned by a Dutch crew, but while operating in Australian waters the vessel was operated by an Australian crew, working to the Dutch Master and two 1st Operators, or Dredgemasters. However, the Dutch Chief Engineer, two 1st Engineers, a third 1st Operator, plus the Electrician (who was British) all remained on board as supernumeraries, working in an advisory capacity. An Australian crew had joined the vessel before its departure from Indonesia, for familiarisation purposes during the delivery voyage.

During dredging operations, the crew work a two, 12-hour shift system, the shifts changing at 0600 and 1800. While working off Dampier, the bridge/deck watch comprised a Dutch dredgemaster, an Australian assistant dredgemaster, an Australian mate and two Australian seamen. The engine room watch comprised Australian 1st and 2nd engineers, two Australian greasers and a Dutch (supernumerary) 1st engineer.

The watch routine for the engineers included formal rounds of the engine room half an hour into the shift and halfway through the shift, during which each engine was inspected. The greasers wiped down all engines shortly before the end of each shift. The Dutch Chief Engineer and/or the Australian Chief Engineer would also conduct an inspection of the engine room every morning and afternoon.

## Operational issue

The vessel had been experiencing problems with the automatic voltage regulator on No.1 generator for some considerable time. On 10 June 1998, a manufacturer’s technician arrived on board to help solve the

problem. The Technician worked with the ship's Electrician, who showed him around the engine room before they set to work on the generator. The Technician worked on the generator until 1800, then returned ashore to spend the night in an hotel, returning on board the following morning.

## The incident

On Thursday 11 June 1998, *Leonardo da Vinci* was dredging in a position midway between beacons 9W and 10W, on the south side of the Parker Point approach channel. Towards late afternoon, both hopper barges were alongside and the vessel's discharge pipes were in the lowered position, discharging spoil into the barges.

At 1745, the Master was on the bridge, talking to the day shift Dredgemaster and the Supernumerary Dredgemaster. The Chief Engineer was in the engine control room (ECR) with the day shift 2nd Engineer, who was preparing for the evening shift change and, at about that time, one of the day shift greasers returned to the ECR, having completed the routine wiping down of the main engines. The Electrician and the Technician had finished their task on No. 1 generator and the Technician was packing up his equipment.

At 1750, the No.1 engine filter differential pressure alarm and the fire panel alarm both annunciated in the ECR, indicating a fire in the area of No. 1 engine. The Chief Engineer, turning from the alarm panel to the fire alarm panel, looking through the window into the engine room saw flames. He immediately telephoned the bridge and informed the Master. He then stopped the engines, which caused a brief blackout until the emergency generator cut in. He then instructed the Greaser to close the engine room flaps.

The Master, as soon as he received the information from the Chief Engineer, sounded the general alarm. He then called Dampier Port Control on VHF, informed the Duty Officer of the fire and requested the assistance of two tugs with fire fighting capabilities.

The Supernumerary Dredgemaster donned the self contained breathing apparatus (SCBA) stowed on the bridge and, accompanied by the Dredgemaster in support, made his way to the engine room entrance adjacent to the ECR. He entered the engine room at 1753 and reported that the fire was on No. 1 diesel engine.

On hearing the general alarm, the Mate went immediately to the bridge, where the Master informed him that there was a fire in the engine room. As he did not receive any detailed information or instructions, the Mate left the bridge and checked off the mustered deck crew. He then organised the crew into hose parties to carry out boundary cooling and closing the engine room fire flaps.

The Supernumerary 1st Engineer had boarded the support vessel *Sentinel* and was on his way ashore. Seeing heavy smoke rising from *Leonardo da Vinci*, he requested the skipper to turn back. He reboarded the dredger, donned the SCBA stowed in the bosun's locker and made his way to the door to the engine room where the Dredgemaster was in support of the Supernumerary Dredgemaster.

The Electrician had left the Technician packing his equipment in the generator room and had ascended the ladder to the workshop above. Opening the door to the engine room, he saw that No. 1 engine was on fire. He quickly retraced his steps, told the Technician that there was a fire and that he should follow him. The two men ascended the ladder to the workshop, then moved towards the door to the engine room. At about this time the blackout occurred.

Moving out into the engine room, the Electrician turned left and passed through a door into the starboard side alleyway. He then discovered that the Technician was not with him. He tried to re-enter the engine room, but the smoke was too dense, forcing him back.

The Technician, losing contact with the Electrician in the dark and smoke, followed the only route out that he knew, which was a right turn after leaving the workshop. This took him across the forward end of the engine room, above the forward ends of the diesel engines, to the port side. He then moved aft, down the port side, to exit the engine room by way of a door adjacent to the ECR. He had progressed a little less than halfway along the port side, when there was an explosion and fireball. Although struck by the blast, he was able to continue and make his exit from the engine room. He was found by a member of the crew, who took him to the galley, where other crew members administered first aid to his burnt face and left arm. He was then put aboard *Sentinel*, to be taken ashore.

Working together and using portable dry powder fire extinguishers, the Supernumerary Dredgemaster and Supernumerary 1st Engineer extinguished the flames at the base of the fire but, because of the smoke,

could not be certain that the fire was fully extinguished. They reported this fact to the Chief Engineer, at a time logged as 1802.

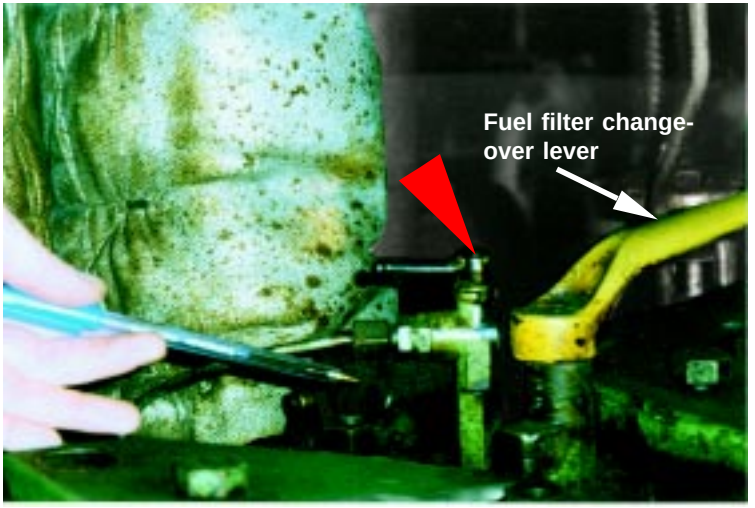
The Chief Engineer discussed the situation with the Master and recommended that the Halon system be activated. The Master agreed and, after checking that everyone was accounted for, the Chief Engineer released the Halon into the engine room at 1805.

*King Bay* was the first tug to arrive on the scene, at 1830, closely followed by *Withnell Bay,* at 1840. Both tugs were deployed boundary cooling, directing their fire monitors at the funnel and surrounding deck areas. The Master had anticipated that there would be fire fighting teams aboard the tugs, but learning that this was not the case, he contacted the Port Authority and requested that the fire brigade attend the vessel.

Members of the Dampier fire brigade arrived on board at 1930. They entered the engine room, wearing SCBA's and accompanied by the Dutch Chief Engineer. A search of the engine room revealed that the fire was extinguished, which information was passed to the Port Authority and the tugs were released. The engine room was then ventilated, to allow safe entry in order to investigate the cause of the fire and to assess the damage.

*Leonardo da Vinci* was found to have sustained considerable damage to electrical wiring and fittings, which resulted in the vessel being out of commission for three weeks.

The Technician was taken first to Karratha hospital, then airlifted by the Royal Flying Doctor Service to the Royal Perth Hospital's burn unit. He remained in the Royal Perth Hospital until 26 June 1998, when he was repatriated to France.




**No 3 shut-off cock handle in place**

**No 2 shutt-off cock handle missing**

**No 1 shut-off cock spindle bonnet missing**

# Comment and Analysis

## Cause of the fire

Each diesel engine is fitted with a ‘duplex’ type fuel filter, located on the starboard side of the engine, which is fitted with a swing cock assembly, allowing the filters to be changed over whilst the engine is running. Each filter is also fitted with a differential pressure indicator, connected by piping to the top and bottom of the filter and fitted with a shut-off cock.

On investigation, the handle and spindle bonnet of the shut-off cock to No. 1 diesel filter differential pressure indicator were found to be missing. This had allowed diesel fuel, under 8 bar pressure, to spray upwards, on to the hot exhaust trunking of the engine, the heat of which had ignited the oil.

The spindle was found in the bilge, beneath the engine, clean and undamaged. The body of the shut-off cock was also undamaged.

The handle, which is attached by a screw to the top of the spindle, also serves as a keep, or locking device, securing the spindle bonnet. During the course of the investigation it transpired that the handle had been missing for some considerable time. It is apparent that with the handle (the locking device) removed, the threaded bonnet had vibrated loose.

The shut-off cocks are normally left in the open position, only being changed to the closed position when maintenance work, such as changing the diaphragm, is necessary on the differential pressure indicator. The shut-off cock had not been operated, and had therefore been undisturbed, for some months. It was not possible for the investigation to determine how long it had taken for the spindle bonnet to vibrate loose and to become unscrewed.

## Maintenance and house keeping

The handle was also found to be missing from No. 2 diesel filter differential pressure indicator shut-off cock, however in that instance the spindle bonnet was seated tightly. According to those interviewed, the handle

had been missing from both Nos. 1 and 2 diesel filter differential pressure indicator shut-off cocks for some considerable time. The only likely reason for the handle to be unscrewed and removed is if the lever has been broken off and the boss is removed to leave the square head of the spindle free for manipulation with the engineers' indispensable "shifter".

The officers conducting the field investigation ascertained that there were five spare shut-off cock assemblies held in the storerooms and it would have been a simple operation to fit replacement handles from the spares. The fact that this was not done raises doubt about the attention to detail in the maintenance of machinery in the engine room space and indicates a certain amount of complacency about such matters.

During the investigation it also became apparent that, although it had not contributed to the fire, there had been a slight fuel oil leak from the spindle of the No. 1 diesel engine fuel filter change-over lever. This had first been recorded in the Chief Engineer's workbook seven days before the fire, with subsequent daily entries indicating new "O" rings were required. The time required to change the "O" rings is about one hour, but the Chief Engineer did not consider the leak of sufficient significance to stop the dredging operation in order to effect the change.

All fuel oil leaks are potential hazards and should be dealt with as soon as practicable. However, it was reported that when the Chief Engineer had stopped dredging operations on an earlier occasion, but for different reasons, afterwards the dredging company reminded him that stoppages cost $10,000 an hour. Such apparent admonishments from management place pressures on ships' personnel which can be detrimental to safety.

It is perhaps fortunate that the fire occurred immediately after the greasers had completed wiping down the engines, otherwise any accumulated oil may have ignited, extending the fire.

## Fire fighting

To the credit of those on board, the fire was dealt with quickly and effectively. The engines were stopped and the fuel valve remote closing systems operated; the engine room was sealed by closing the fire flaps;

**Spindle from No1 bonnet**

boundary cooling was arranged; a fire party entered the engine room and extinguished the fire at its seat and then the Halon system was used to ensure the fire was fully extinguished.

Nevertheless, a number of short-comings came to light during the investigation.

*Leonardo da Vinci* is a vessel to which the SOLAS Convention applies and, therefore, the crew should be exercised in a fire drill at least once every month. Although some of the Australian crew members had been on board for three months, they had undergone no fire drills in that time, only musters. Also, at the time of the incident, the Emergency Muster lists posted about the vessel were out of date.

According to the Emergency Muster list, members of the Australian crew made up the fire fighting party. However, when the Mate reported to the bridge he found the Dutch Supernumerary Dredgemaster donning the SCBA. Apart from being informed by the Master that the fire was in the engine room, the Mate received no further direction.

As a result of all this, there was no co-ordinated team attack on the fire and the successful outcome was due to a number of individual officers responding automatically to the situation.

Under the circumstances that existed on board, the use of the Dutch supernumerary officers as the fire fighting team was the sensible approach. However, had the Supernumerary 1st Engineer not been able to get back aboard to assist the Supernumerary Dredgemaster, it is not clear who would have donned the second SCBA, the Supernumerary Dredgemaster may have ended up fighting the fire single-handed. Had this been the case, the risk to the individual would have been unacceptable and the chance of a more serious outcome for the vessel itself would have been significantly greater.

## Outside assistance

On being informed of the fire in the engine room, the Master immediately informed the Port Authority and requested the assistance of fire fighting tugs. The tugs responded promptly, but were unable to arrive at the dredger until 1830.

With the loss of main electrical power, the dredger was unable to raise the spoil discharge pipes, thus the

two hopper barges were held captive alongside.

When it was discovered that there was a fire aboard *Leonardo Da Vinci* both barges were captive alongside by the dredges loading booms. The crews of the hopper barges mustered as directed in response to the fire.

The barge masters were asked to provide boundary cooling and they did so until the arrival of the first tug, which was equipped for firefighting. Although not requested to supply any other equipment such as SCBA, that was avaliable if required.

## Sealing spaces - heat retention

When members of the Dampier fire brigade entered the engine room, 85 minutes after the release of the Halon, the engine room was still very hot. This was despite the crew having started boundary cooling over 90 minutes earlier and the tugs having provided boundary cooling for 50 minutes.

The temperature reached was sufficiently high to warp aluminium fittings and to melt fluorescent polycarbonate light covers, electrical wiring and insulation. Whereas it is essential to seal compartments so as to exclude the entry of air (oxygen), leaving an opening at the top, in this case leaving the funnel flaps open, allows the escape of hot fumes and heat, assisting the cooling process.

When releasing the fixed smothering system, it is important to seal the space to prevent escape of the fire extinguishing medium. Where personnel are committed to the space to fight the fire with hoses or extinguishers, to the maximum extent possible, all possible sources of air that might feed the fire should be closed off. However, the heat should be allowed to vent through the natural chimney, the funnel, to prevent a build up of heat, which makes entry into the space more hazardous.

## Injury to the Technician

The Technician had boarded the day before the incident and, although he had been shown briefly around the engine room, he had not been put through a safety induction program, nor had he been shown the

various escape routes from the areas in which he would be working. In the two days that he was aboard, he always entered and left the engine room by way of a door adjacent to the electrical workshop, at mid length of the port side. The route to the generator room was then forward, to the forward casing bulkhead, then across to the starboard side, to the door into the workshop. The generator room was situated beneath the workshop area and accessed by a ladder in an enclosed well within the workshop space.

When the Electrician saw the fire in the engine room, he went back to warn the Technician and to lead him to safety. However, instead of avoiding the engine room and leading the way through either the engine room store or through the emergency generator room, both accessible from the workshops, he went back into the space where the fire was. Although it was dark, because of the brief blackout and because of the smoke, the two men did not maintain physical contact and, as a result, they became separated.

When the two men became separated, the Technician followed the only route he knew, a route that took him above the fire on No. 1 engine.

During the course of the investigation, the investigating officers noted that the exits and emergency exits in the engine room, particularly in the workshop area, were not clearly marked.

The two members of the fire fighting team used only one compressed air bottle each, they did not have to change over to the spare bottles. However, a point noted by members of the fire brigade was that members of the crew were unsuccessful in their attempts to recharge the two depleted air bottles.

The compressor for recharging the BA bottles is linked to the main electrical switchboard, rather than to the emergency switchboard. In the event of a prolonged fire fighting operation, in which the main engines and thus the main generators are shut down, the physical attack on the fire would be limited to the duration of the two air bottles on each SCBA.

# Conclusions

These conclusions identify the factors contributing to the incident and should not be taken as apportioning either blame or liability.

- The fire occurred when diesel oil sprayed from a shut-off cock on No. 1 engine fuel filter on to the hot exhaust trunking of No. 1 diesel engine.
- Over an undetermined period, the spindle bonnet of the shut-off cock had vibrated loose, had unscrewed and had been blown off, permitting the escape of diesel oil under 8 bar pressure.
- At some undetermined time, the handle of the shut-off cock had been removed, to allow access to the square head of the spindle, and had not been replaced. This action removed the locking, or keep-safe, portion of the valve.
- Although five spare shut-off cock assemblies were held on board, missing handles had not been replaced on two shut-off cocks, indicating a laxity towards maintenance.

The following factors are considered to have contributed to the Technician sustaining burn injuries:

- When leading the way out, the Electrician chose a route that took them into the engine room, the compartment in which the fire was burning, and he did not maintain physical contact with the Technician, so that they became separated in the dark/smoke.
- On first boarding, the Technician had not been give a formal induction session, to ensure he understood the emergency signals and was familiar with the escape routes from the areas in which he was to be working.
- The exits and emergency exits from the engine room and workshop areas were not clearly marked.

# 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.

The final draft of the report, or parts of the report, was sent to the following:

The Master, Mate, Dredgemaster, Supernumerary Dredgemaster, Chief Engineer, Supernumerary 1st Engineer, Electrician and Technician.

A submission was received from the Chief Engineer, who submitted:

"1. Passage headed: Maintenance and house keeping" page 9. Although in the immediately preceding passage on the same page headed "Cause of the fire" a distinction is made between the swing cock assembly and the differential pressure indicator shut off cock assembly, the distinction is not made clearly enough. These are entirely separate assemblies with no direct physical connection between them, they serve different functions.

This lack of clarity in distinguishing between these two assemblies becomes very evident in the passage headed "Maintenance and house keeping". In particular the reference in the third paragraph of this passage to the entry in the chief Engineer's workbook is confusing in that it is not made clear that this reference deals with a separate assembly to the one from which the fire was caused. At the time that the entry in the workbook was initiated there was no indication that a problem might be developing in relation to the separate differential pressure indicator shut off cock assembly.

The implication in this paragraph is that if the 'O' rings referred to had been changed, the fire would not have occurred. But, (as has been pointed out immediately above), these 'O' rings were part of a different assembly which was not the cause of the fire. It was not known that a problem was about to develop with the differential pressure indicator shut off cock assembly. To infer that the replacement of the 'O' rings, referred to above, in the separate assembly may have led to work on the differential pressure indicator shut

off cock assembly is purely speculative. It was not known that a problem was about to develop in this assembly.

2. In the second paragraph of the passage headed “Maintenance and housekeeping” there is reference to the standard of maintenance in the engine room and speculation that “complacency” existed with respect to maintenance. This viewpoint is put forward on the basis of spare parts held for the assembly that caused the fire. But, as has already been pointed out in 1 above, it was not known that a problem existed or was developing with this assembly. Consequently the connection between the number of available spare parts for this assembly and alleged complacency in relation to maintenance has not been established. There is no connection.

In the passage marked “Conclusions”, fourth dot point, page 14, the word “complacency’ is replaced by the word “laxity”, once again without any attempt to distinguish between the two separate assemblies. In effect, since the work of replacing an ‘O’ ring on a separate assembly had not been carried out at the time of the fire it is alleged that maintenance is lax. But this assembly had nothing to do with the cause of the fire.

3. The insinuation in the report that the fire was only put out by “chance” does not accord with the extensive experience and certification of those members on board with respect to fire fighting, advanced fire fighting and the fact that the fire did not spread and was put out in a professional manner. As the report says, people did the “right thing” (page 1). This demonstrates that they were properly trained and did what they had trained to do.

4. With respect to the conclusion that the technician who experienced a personal injury as a result of the fire was not given a “formal induction session”, the only comment I can make is that I am aware that this individual was shown around the machinery spaces. He was given a “familiarisation” session. Also, I would point out that the “exits and emergency exits from the engine room and work shop area that were not clearly marked” could and should have been picked up when the vessel was initially inspected by AMSA.

*5. A possible contribution to the fire was the potential design fault that has now been rectified as a bonnet has been placed over the “duplex fuel filtration area” to eliminate the potential of diesel fuel being sprayed upwards onto a hot exhaust.”*

# Details of Leonardo da Vinci

| | |
|---|---|
| **IMO No.** | 8411592 |
| **Flag** | Netherlands |
| **Classification Society** | Bureau Veritas |
| **Ship type** | Self-propelled cutter suction Dredger |
| **Owner** | Dredging and Contracting Rotterdam, BV (Jan de Nul NV) |
| **Year of build** | 1985 |
| **Builder** | IHC Smit BV, Kinderdijk |
| **Gross tonnage** | 7560 |
| **Net tonnage** | 1728 |
| **Deadweight** | 1490 |
| **Length overall** | 129.2 m |
| **Beam** | 22.4 m |
| **Draught** | 5.13 m |
| **Main engines** | 3 x 8 cylinder Deutz diesel engines, total 9886 kW, driving 3 generators connected to 2 x2736 kW electric motors |
| **Crew** | 33 (Dutch & Australian) |