



Isle of Man Ship Registry

Casualty Investigation Report No. CA 119

Nordic Visby

Fatality

on the 19th July 2014

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Summary

On 19th July 2014 Nordic Visby was discharging her cargo at Alexandria Egypt.

At around 21.55hrs, when returning tools to the engine-room workshop upon completion of a job they were doing, the two engineer cadets discovered the Fourth Engineer lying on the workshop bench with a metal rod in his hand which was touching the lamp fitting overhead.

Suspecting electrocution, one cadet isolated the power supply to the lamp unit (which was switched on and working), whilst the other cadet called the Second Engineer to raise the alarm.

Soon afterwards, the Second Engineer arrived in the workshop where he observed the Fourth Engineer “apparently not breathing and having blue skin”.

He immediately called the Master and Chief Engineer.

By 22.00hrs all five individuals had observed the Fourth Engineer without any signs of life.

Alexandria police attended the vessel at 00.40hrs on 20th July 2014 to investigate the circumstances and concluding that no foul play was involved arrangements were made to take the deceased to the local hospital morgue for autopsy.

Cause of death was later confirmed to be cardiac arrest.

Statement of intent

Extract from
Isle of Man Merchant Shipping
(Accident Reporting and Investigation)
Regulations 2001 – Regulation 4:

“The fundamental purpose of investigating a casualty, an accident, or an incident under these Regulations is to determine its circumstances and the causes with the aim of improving the safety of life at sea and the avoidance of accidents in the future.

It is not the purpose to apportion liability, nor, except so far as is necessary to achieve the fundamental purpose, to apportion blame.”

Glossary of abbreviations used

Cluster light – A portable cargo light arranged in a cluster of four or five lamp units contained within a single housing, normally used to provide illumination of a cargo hold during loading or discharge and manually lowered or raised by rope to provide the best possible illumination level.

Company – Nordic Hamburg Shipmanagement GmbH & Co. KG., the managing company responsible for the operation and the implementation of safety on board the vessel.

Double insulated – a type of design where electrical conductors are encapsulated by the primary insulation of the power supply cord and also by a second method (usually the handle or grip of equipment). The two forms of insulation physically separate conductors from any metallic parts of the equipment and fix them in position internally preventing them from flexing and becoming damaged at the unit itself, double insulated designs do not have earth continuity wiring since the shock risk is removed through design.

DPA – The Designated Person Ashore (the shore based person responsible for implementing the Company's safety management system on board vessels).

Earth – the ship's steel hull or anything electrically bonded with it (metalwork or wiring attached/connected without any insulation).

IMS – The Company's Integrated Management System (used for all aspects of safety and operational management).

ISSC – International Ship Stores Catalogue (an internationally available source for ship's sundry equipment purchases).

MAIB – Marine Accident Investigation Branch, an independent body which undertakes investigation into the underlying causes of marine accidents in UK waters with a view to preventing similar occurrences in the future. MAIB also collate the information from other accident reports submitted to them for the same purpose.

Multi-meter – diagnostic test equipment used for measuring values on power circuits and/or consumers and/or electronic control circuits to determine correct operation.

Offsc – "Offscan" – a manually inhibited alarm monitoring system status; an alarm is not raised even if the measured parameters are outside acceptable limits.

PAT – Portable appliance testing.

Phase – reference to one of the vessel's power distribution supplies/cables (Line one, Line two or Line three – sizing and voltage depend on the service required).

PM – planned maintenance - part of the IMS-scheduled maintenance carried out as a preventative measure to ensure maximum possible operational readiness.

PPE – personal protective equipment, supplied to all crew under their employment conditions to protect them from the everyday hazards associated with their work.

STCW – Standard of Training and Certification for Watchkeepers – an internationally agreed progressive standard for training and certifying seafarers for duties on board merchant ships. Based upon examination of knowledge, theory, practical training and seagoing experience, qualifying sea time must be gained in lower ranks before the next higher certificate can be obtained. STCW also governs the work to rest ratio on board a vessel such that if properly implemented and with sufficient numbers of crew on board, fatigue should not occur.

UMS – Unmanned Machinery Space.

Ranks referred to in this report

Master – The vessel's Captain (has overall responsibility for the crew, the vessel and its safe navigation).

C/E – The Chief Engineer Officer (has overall responsibility for the hull, accommodation, machinery and associated engineering systems).

2/E – The Second Engineer Officer (watch-keeper)

3/E – The Third Engineer Officer (watch-keeper).

4/E – The Fourth Engineer Officer (watch-keeper).

E/Cdt(s) – The Engineer Cadet(s) (trainee officers).

ETO – The Electro Technical Officer (conducts the majority of electrical work).

OOW – The Officer of the Watch (Duty Navigating or Engineer Officer taking operational responsibility for a particular period of time).

Fitter and Oiler – Engineroom Crew Ratings (assist the engineroom watch-keepers)

Vessel Particulars



Name : Nordic Visby
Port of Registry : Douglas
IMO Number : 9563380
Official Number : DR 172
Call Sign : 2CYE2
Gross Tonnage : 22409.00
Net Tonnage : 12013.00
Deadweight : 35052.00
Registered Length : 172.81 m
Breadth : 28.40 m
Depth : 15.00 m
Type of Engine : Diesel
Power of Engine : 7600.00 kW
Date of Build : 24th December 2008
Place of Build : Jinghua Shipbuilding Co. Ltd.
Nantong
China

Owner's details :

MS 'Nordic Visby' Schiffahrtsgesellschaft. MBH & Co KG
Cremon 32
Hamburg
20457
Germany

Manager's details :

Nordic Hamburg Shipmanagement GmbH & Co. KG
Cremon 32
20457 Hamburg
Germany

Narrative of events

Times indicated in bold text are approximate only and obtained from witness declarations. Times not indicated in bold text have been verified from log book entries and all are local time in Alexandria Port (GMT +2).

19th July 2014

The Nordic Visby was discharging her cargo at Alexandria inner anchorage using her own cargo cranes.

Weather was calm and sea state smooth so the vessel was not moving excessively.

Ambient air temperature at around 21.00hrs was approximately 25⁰C outside and workshop air temperature approximately 35⁰C.

The engineroom on this vessel normally works under UMS operation - that is the engineroom and auxiliary equipment are arranged with an alarm and monitoring system so that for short periods (usually overnight) nobody has to physically be in the machinery-space. Should a monitored problem occur the duty engineer is alerted and he attends the engineroom to investigate and rectify the problem causing the alarm.

At 18.10hrs cargo operations were suspended at shore request. 3/E stated in his declaration that he was on duty – so 2/E and 4/E took the opportunity to inspect cargo cranes numbers 1 to 4 between **18.30hrs** and **20.30hrs**.

At **20.35hrs** upon completion of the crane inspections 2/E and 4/E took their tools back to the engine-room workshop, following which 2/E proceeded back towards his cabin indicating 4/E should do the same. Despite having no additional planned work, 4/E remained in the workshop, possibly to continue a valve overhaul alone; his demeanour appeared to be normal.

At **20.45hrs**, one of the E/Cdts saw 4/E in the workshop “making a job on a valve” whilst passing opposite the workshop on his way to the middle platform, where they were assisting the Fitter and Oiler do emergency work on the main engine lube oil plate cooler.

At 21.55hrs following lube oil cooler reassembly, the E/Cdts were bringing tools back to the workshop and discovered 4/E on the workshop table with a “metal stick” (subsequently found to be a gas welding filler rod) leading from his left hand to the cargo cluster light fitting (cluster light), which was suspended above the workbench and still illuminated. According to their declarations “his skin was blue”.

One of the E/Cdts switched off the power to the cluster light at the wall socket, the other E/Cdt called 2/E to raise the alarm who immediately came down to the workshop, saw 4/E’s condition and then called the vessel’s Master and C/E.

By 21.58hrs all five persons were present in the workshop and had observed 4/E without any normal signs of life. The Master had checked for a pulse and breathing but there was neither, his skin was visibly blue, his open eyes were dull and whilst checking for a pulse his skin temperature was cool to the touch. These are three indications that a person has been dead for more than twenty minutes, therefore resuscitation was not attempted.

At 22.18hrs the Company were notified by telephone – the deputy DPA took the initial call and then initiated the Company emergency response.

20th July 2014

At 00.40hrs, four police officers and the vessel's port agent arrived by launch to conduct initial investigations and take care of formalities.

After removing the deceased from the immediate vicinity, the police requested the welding rod be tested. The light fitting power was restored and the welding rod which was still attached to the light fitting was subsequently tested with an electrical multi-meter by the vessel's ETO.

It was measured to have a 220v potential between the rod and the metal workbench upon which 4/E was found.

Concluding probable accidental electrocution and no foul play, at 02.10hrs the deceased was transferred to the waiting launch to determine actual cause of death ashore.

At 02.20hrs the police, the agent and the vessel's Master left the vessel.

At 02.45hrs the deceased was transferred to a waiting ambulance for transportation to the hospital morgue where autopsy to determine cause of death was to take place.

At 03.00hrs the Master was taken to the police station to take care of formalities and make necessary arrangements and returned to the vessel by launch at 05.20hrs.

Cause of death was determined by the pathologist to be cardiac arrest.

Actions subsequent to the incident

The Company immediately commenced investigations into the circumstances surrounding this unfortunate event.

One of their key findings was that the cluster light, although comprising of a conductive metal fitting, was not internally wired for an earth continuity safety connection.

Although there was an earth wire connection provided from the socket on the wall through the flexible power cable to the insulated terminal block inside the light fitting - there was no wire connected from the insulated terminal block to the uninsulated metal parts.

This meant that the ship's fault monitoring system would not be able to detect a dangerous condition on the cluster light if one of the power conductors accidentally contacted a metal part of the cluster light, thereby making it "live".

To prevent the risk of a similar occurrence on another vessel, this fact was communicated to Nordic Hamburg Shipmanagement's managed fleet on 22nd July 2014 together with instructions to ship's staff and office staff that :-

Fleet ships' existing cargo lights must be removed from service until they have been comprehensively checked to ensure:-

- they are safe to be used;
- cargo lights are only used for the purpose they are designed for;
- monthly inspections of existing lights are to be made; and
- all newly purchased lights are to be internally inspected prior to first use.

Similarly, for office staff:-

- a monthly inspection routine into the vessels' planned maintenance schedules are to be created; and
- purchasers must verify with prospective suppliers that lights have appropriate earth connection/isolation.

Further to the Company safety circular, the fleet's other cluster lights were checked, revealing that a number of them on different vessels were also badly wired, which were subsequently destroyed.

The vessel placed an order for 20 replacement cluster lights from the ISSC with the agent in Alexandria. However the newly supplied cluster lights, although made of metal, were found not to be provided with earth continuity/safety wiring.

These were immediately rejected by the vessel and other suitable cluster lights requested. However, the agents advised these are the only type supplied, according to ISSC specifications, out of the port of Alexandria so the vessel did not receive any replacements at that time.

Comment and analysis

Operations-working practices

During a normal suspension in the cargo discharge operations, which was at the shore request, the cargo cranes were inspected by 2/E and 4/E. This period was properly recorded in the IMS work/rest programme for both officers although it does not appear to be recorded elsewhere. The inspection was carried out during their normal rest hour's period following day work in the engineroom.

After returning the tools from the crane inspection, 4/E remained in the workshop to carry on repairing a main engine scavenge air box valve, however this was unplanned work.

Although UMS at the time of the incident, the Fitter and Oiler were together with both E/Cdts in the engineroom, performing emergency but pre-considered maintenance work on the main engine lube oil cooler. This period was properly recorded in the IMS work/rest programme for both ratings and both E/Cdts but does not appear to be recorded elsewhere.

The Fitter, the Oiler and both E/Cdts were working together and would be able to assist if something happened to one of them.

It is normal practice when enginerooms are UMS, to log any space entry/exit such that at all times, the OOW (deck or engine) is aware who is where and also when the engineroom is truly vacated.

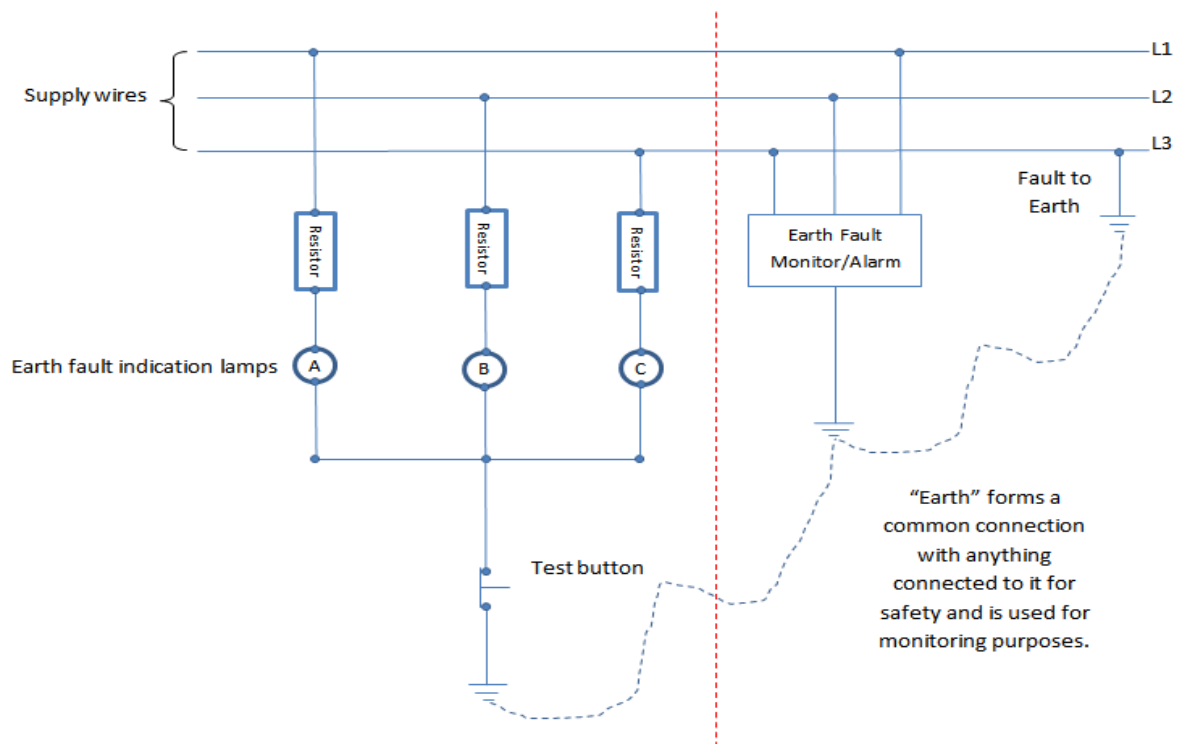
Duty engineer entries for inspection were recorded in the engineroom log book at 20.00hrs and again at 23.00hrs. The duty engineer had completed his first inspection before the accident and his second inspection was after the event. IMS work and rest records indicate the first entry (although the time is accidentally recorded at 21.00hrs rather than 20.00hrs) but not the second. The duty engineer may simply have forgotten to record the second IMS entry due to the circumstances of the night.

Company UMS procedures state "a crewmember must inform the OOW and the duty engineer prior to entering the engineroom during UMS". Whilst this requirement may or may not have been fulfilled verbally that night, neither the deck nor the engineroom log books show a record of persons working in the engineroom whilst it was UMS.

Electrical aspects

Operationally, continuity of power is very important on ships therefore they usually have insulated earth power distribution systems which are subsequently monitored for fault conditions, together with overload protection to protect against more serious faults.

Two simplified diagrams of a ship's earth monitoring system are shown below.



The left side under no fault conditions has all three indicator lamps normally burning with equal brightness. If a fault develops on one supply line, depending on the resistance to current flow to earth, one lamp dims compared to the others. The test button temporarily removes any indicated fault to restore the lamps to their comparison brightness to check the fault has been fully removed (small differences can be perceived by the naked eye). On the right side, continuous comparison monitoring occurs and when a falling insulation resistance threshold is reached (0.5~0.2 MΩ on this vessel) a switchboard alarm is initiated in order that the cause of the fault can be investigated.

The Nordic Visby has continuous monitoring and the alarm printer history shows that no earth faults sufficient to exceed the threshold and initiate an alarm occurred on the night of the incident (or indeed the days leading up to it). Subsequent testing under investigation proved the system to be functioning normally and the alarm sounded soon after a test fault condition occurred. However it was then determined from the alarm history log that the emergency switchboard 220v alarm (ch 673) was set to “offsc” at the time of the incident.

Operationally, it is very important to determine the cause of an earth fault and rectify it as soon as possible, because whilst an “earth alarm” is registered, a subsequent fault on the same alarm channel will not be indicated. If there is an existing fault and a subsequent fault develops elsewhere, circulating currents through the ship’s structure are possible which carries risk to the generating plant, other electrical equipment and as happened in this incident, indirectly the ship’s personnel.

When two simultaneous earth faults occur, it may be difficult to trace them both as the “threshold alarm” remains even if one fault is cleared and unless the change is noticed at the time the fault actually changes or the value of the resistance is noted before and after it changes, the other fault can be easily missed.

The light fitting in use at the time of the accident in the workshop was a “cargo” cluster light normally used for illuminating cargo holds when loading and unloading. When suspended at the end of a rope, physical contact with metal parts of the light unit does not normally occur.

The light in question, suspended in the workshop, had a small diameter “metal rod” connected to it which is normally used for welding but is often (wrongly) used by engineers for a multitude of other purposes as it is a readily available malleable material. In this case it would appear to have been used for directing the cluster light which was suspended just out of reach.

Metal welding rods are good electrical conductors.

Equipment design should never be modified without thinking about possible consequences. If the manufacturer believed any type of rod for directing the unit should be fitted, it would have been provided. Furthermore, it would be made from non-conducting material. Instead of the “cargo” cluster light and welding rod arrangement, an angle poise desk lamp could have been used much more effectively and would stay in the position to which it was pointed.

Following the accident and at the request of Alexandria police, the power was restored to the light fitting and the “metal rod” was tested with a multi-meter by the ship’s ETO.

Under test, 220v were measured between the rod connected to the cluster light and the metal workbench. This indicates the existence of two earth faults on two separate power distribution phases and a phase to phase voltage was being measured.

As a result, whilst touching the rod and sitting upon (or even briefly contacting) the workbench, 4/E would be subject to a severe shock.

The light fitting in question was opened for examination and it was found:-

- to be internally wired with the metal parts of the fitting not having continuity wire to earth making earth fault detection impossible;
- to have brittle insulation breakdown on the internal power supply wires to the lamp holders, probably due to high temperatures generated by the unit itself when in use (240~400Watts depending on the bulbs fitted);
- the conductor connections themselves were corroded - possibly due to the high humidity levels normally existing in a ship's engine room and the age of the cluster light; and
- to have been supplied to the vessel some time prior to embarkation of the 3/E who was the longest serving of the engine room staff. Therefore it is not possible to determine if initial safety testing had been carried out. It could have been assumed, on appearance, that the (ship's equipment) supplied portable lights were fit to use.

Although not readily accessible, through insulation breakdown/ internal contact with conductive metal surfaces and because there was no earth continuity wire to alert the monitoring system, the fitting itself became hazardous.

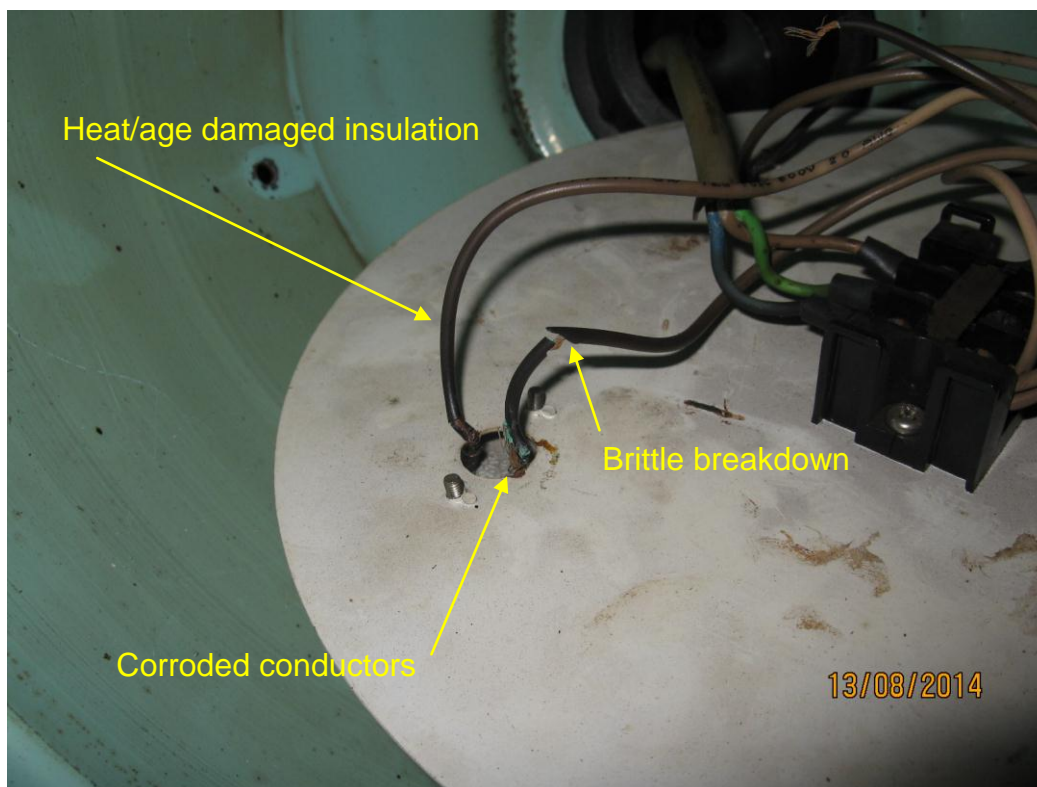
It is vitally important for personnel safety that earth continuity wiring is provided in portable electrical equipment or that it is of a double insulated design, since power supply wiring can be susceptible to damage during normal use making the equipment potentially dangerous.

Somewhere on the emergency switchboard supply, a second fault, by feeding back through the metal workbench which is not electrically insulated from "earth", would give the 220v (phase to phase) reading measured on the night of the accident. Unfortunately this second fault did not raise an alarm since the monitoring channel (ch673) was inhibited at the time.

Investigation determined that individual phase voltages measured to earth were 158v each and between any two phases the voltage measured at 220v confirming the above possibility.



Cluster light in question – note no earth wiring to conductive surfaces (the white plate and fittings secured to it in this picture). Multiple power conductors are highlighted touching metal, but this will undoubtedly be due to disturbance after the accident. Any one of the conductors could have made the fitting “live”.



Heat damaged insulation, brittle breakdown, corroded conductors.



A correctly wired cluster light fitting having earth continuity/safety wire properly attached to a dedicated attachment point.

It is important to understand that the harm to a person is caused by the magnitude of current flow and length of time it acts rather than the actual voltage, although higher voltages do induce higher currents for the same resistance.

Dry skin has quite a high electrical resistance (approx. 100,000 Ω) enabling the body to resist current flow more effectively. However, damp skin substantially reduces this (to as low as 500 Ω). A current of as little as 40mA (forty thousandths of one amp) across the heart can cause cardiac arrest.

Normal PPE worn by engineers consists of a boiler suit, non-conducting (insulating) steel toe-capped shoes or boots and ear defenders for the high noise environment of the engineroom.

With the relatively high ambient temperature outside where 4/E had just been working and even higher temperature in the workshop, he would have been sweating a substantial amount. His boiler suit, in close contact with the skin, would most certainly be damp, if not soaked, with sweat.

Whilst standing up and not touching anything else, just by wearing his PPE, 4/E would have been insulated from the ground by his boots and current could not flow, so he would have been relatively safe.

However, from 4/E's left hand (where the wire was found) to anywhere below the shoulder, is the most dangerous path the current could take, since it passes directly across the heart. Unfortunately, using the "metal rod" to reposition the "live" cluster light created a path for electrical current to flow, most likely to the metal bench upon which 4/E was discovered.

One of the effects of electric shock can be spontaneous loss of muscle control which often means the person cannot "let go" or escape the electric shock.

The welding rod was found looped underneath 4/E's left hand second finger and the back of the rest of his fingers. If his hand clenched under shock, he would not be able to let go (unless the power was removed). Closer inspection of photographs taken by the Master immediately after the accident support that this was the case.

4/E's condition when he was found and after the power supply had been turned off meant resuscitation attempts would not have been successful – nor were they attempted.

Realising the dangers from electrical shock, many Codes and Standards concerning electrical safety exist, although they are enforced on a national basis through legislation (the Health and Safety at Work Act 1974, the Low Voltage Directive 73/23/EEC and IET wiring regulations BS 7671:2008 are three examples of standards which are applied in the United Kingdom).

Whilst many countries apply their own Standards which will mainly include the same information, there does not appear to be an existing internationally agreed requirement such that uniformity in the marine industry for portable electrical equipment can be established.

The International Electrotechnical Commission (IEC) – the body responsible for internationalising electrical standards, currently have 48 standards covering many items aimed specifically at ships and mobile or fixed offshore installations.

IEC 60092-306 ed4.0 part 306 – "Equipment – luminaires and lighting accessories" specifically excludes portable luminaires and even then, it is up to a country's government to decide whether or not to enforce a particular Standard's requirements.

SOLAS II-1 / regulation 45.1.1, does have an earth continuity requirement, but this applies to fixed installations rather than portable equipment.

All alarm monitoring systems have two logical statuses in service – one where something is unfavourable (“alarm”) and needs further attention, the other where the monitored system is within acceptable operating parameters (“normal” or on this system “return”).

- When an alarm sounds, it is accepted and then investigated by the duty engineer. The channel status remains in “alarm” until the parameter being measured is corrected whereupon the status automatically changes back to “return”. The alarm printer logger records the time the alarm occurs and the time it is corrected, so giving the duration of the abnormal condition.
- When in alarm status, due to the logic involved, the same channel cannot record another alarm until the status has changed to “return”.
- On this vessel, a manually inhibited status (“offsc”) can be input to any channel of the monitoring system, so preventing an alarm being raised even if “abnormal” parameters are being measured. Duty engineers have “offsc” level access to the alarm system so can inhibit any channel at any time (the system records any change of state). The C/E undertakes to make himself aware of the current alarm system status each morning.
- This vessel’s alarm monitoring system also records the status of any abnormal channels at each system clock time change (to accommodate the vessel transiting different time zones). However there are no specific controls such as C/E standing orders or an IMS procedure to control who, or the reason why an alarm channel is manually inhibited - which is subsequently acknowledged by the C/E as positive proof he knows about it.
- The monitoring system itself records when the inhibited channel has changed state back to “return” (channel is monitoring again and is operating within acceptable parameters once more).
- The lack of a control procedure for this particular situation is unusual since automation is identified within the IMS as being critical equipment.

Earth faults can be difficult to find as they can be anywhere on the power supply of the vessel and require different circuits to be isolated one by one (from the hundreds comprising the power distribution system) until the circuit causing the alarm is located. The actual fault causing the alarm is easier to find once the circuit has been identified.

From the alarm printer log, in the days and months leading up to the incident, there were numerous “nuisance” earth fault alarms, that is - the system detects an abnormality but clears itself before the circuit can be traced because the “alarm condition” does not persist long enough to physically trace the affected circuit.

Channel 673 (monitoring the emergency switchboard 220v supply) had in excess of twenty alarms, some lasting less than five seconds whilst the engineroom was UMS. This is probably the reason the channel was manually inhibited on more than one occasion, with the intention of checking later when the engineroom was manned again.

On the evening of the accident, ch673 was inhibited which would explain how 220v was measured in the presence of Alexandria police without the system registering an earth fault (the lamp unit did not have the internal wiring to register one and the second path alarm was inhibited).

Historical data collected and collated by MAIB advises that in the period 2002 to 2011, a total of 57 accidents involving electricity have been reported to them. Eight seafarers have died indirectly and 49 have been injured. Of those 49 reported injuries, 15 were direct contact shocks or burns.

ISM related

The Company IMS has a risk management section which covers “safe movement in machinery spaces” (8.700.020.001 #112), and identifies the hazard of working alone stating a risk control measure as “None carried out in UMS mode except by the duty engineer officer”.

It is noted that 4/E was conducting unplanned maintenance and that the duty engineer may not have known about his presence in the engine room.

The risk management “permit to work activities” cover “lone working” (8.700.040.020 #109), the risk control measures of which state “Avoided and monitored closely”. However 4/E was carrying out unplanned work, alone in the workshop, consequently it was not being monitored closely and no-one was there to assist when something happened to him.

If 4/E had advised the duty engineer that he was going to be working in the workshop as required when operating UMS, the duty engineer may have advised him to postpone the work until the next day and the accident may not have occurred.

If it had been clearly pointed out during his safety familiarisation training (which must occur within 24hrs of joining) that there is a Company requirement to notify the duty engineer and Deck OOW of engine room entry when UMS, he should know what was expected of him.

Following the accident, the Master placed a notice on the engine room access door stating that single person entry when UMS, is unauthorised without C/E permission and duty engineer notified. Since it is a Company requirement, the notice should have been in place before the incident but the issue could also be covered in the safety familiarisation given to new joiners.

Risk management in connection with “workshop activities” (8.700.020.020 #105) identifies lack of equipment maintenance to be a hazard and advises “periodic checks and maintenance should be carried out, more frequent checks of emergency stops”.

Whilst the cluster light would not normally be considered part of this workshop equipment, if it had been included as part of a regular inspection/maintenance regime, its lack of safety wiring and/or poor internal condition may have been determined before it became hazardous.

Portable appliance testing (PAT) is commonly practiced in industry ashore and is described in Annex I. PAT usually involves a physical examination and testing immediately before being brought into first use to ensure the appliance is inherently safe for use and then subsequent regular checks/tests to verify it remains so after having been subject to physical “wear and tear” in service.

There are no vessel routine planned maintenance (PM) checks defined for cargo cluster lights although the ETO takes it upon himself, as an example of good working practice, to check each cluster light before use for cargo operations. These lights regularly become damaged and are replaced fairly frequently so deterioration through age is not normally an issue.

However, the workshop cluster light was not used for cargo operations and as a result was not included in these working checks completed by the ETO. The age of the light was unknown as it was already in the workshop prior to any of the current crew joining the vessel. A small manufacturer's label attached to the plug, indicates it may have been originally supplied when the ship was built, making it approximately six years old.

The workshop cluster light was working so would not necessarily be assumed to be faulty and hence not requiring a check. However if it had been included in a regular PAT routine because it was portable, its poor condition with brittle insulation and poor wiring condition may well have been identified, enabling a proper repair or disposal before the light even became dangerous.

4/E had an understanding of the risk of operating machine tools at any time and could consider that the workshop be considered a relatively safe location. With no indicated danger from the monitoring system, coupled with the fact the light was working, the entirely normal reaction would be to believe there was nothing wrong with it.

The Company IMS has a section entitled "Complacency" (6.200.050) which provides very useful information on the "risk of being lulled into a false sense of security". The objective of the section is "to make all staffs aware of complacency and its impact on the safe operation of the vessel"; however this objective does not appear to have been fully achieved.

C/E standing orders require that the Engineer OOW notify him without undue delay "when any event occurs, which in his opinion may cause damage to or breakdown of the propulsion machinery, auxiliary machinery, electrical generation or monitoring and governing system".

Since inhibiting the alarm monitoring system would (by his Standing Orders) require the C/E to be notified of the problem (cause and action followed) and multiple instances of ch673 being inhibited (rather than the underlying cause being fixed) would indicate this had not been fully achieved.

Alarm records are continuously printed out as they occur/rectify and/or when the monitoring system is specifically tested. They are also recorded electronically on this system for a period of approximately one month but then continuously (sequentially) overwritten.

Once printed, the manual printout can be retained indefinitely (subject to ink fade and assuming good printout in the first place). However, there does not appear to be a statutory method, or indeed specified period of retention, to assist casualty investigations (a casualty may be the result of a root cause happening some time before the incident).

Conclusions

The weather conditions at the time of the accident are not considered to be contributory to the accident other than high ambient air temperatures.

IMS work and rest records indicate STCW required rest was being achieved therefore fatigue is not considered to be a contributory factor to the accident.

The Company have a zero alcohol policy therefore alcohol is not considered to be contributory to the accident.

Failure to properly follow Company operational procedures and/or ignorance of identified hazards however gave rise to a dangerous situation.

Insufficient training, enforcement of Company procedures and even work organisation had allowed a casual attitude towards industry accepted safe working practices to develop on board the vessel, coming very close to the outline description of complacency indicated in the text of Company procedure 6.200.050.

- Work was being undertaken in the engineroom when it was UMS on the night of the incident, yet there were no records in either the deck or engineroom log books concerning the five staff working within the machinery space.
- Unplanned, lone working was being undertaken in the workshop by 4/E when the engineroom was UMS, contradicting risk assessments – if he had been accompanied, or undertaking the work when the engineroom was manned, the accident may not have been fatal.
- The Company have a requirement not to work alone if UMS and also a requirement to notify OOW and duty engineer before entry to the engineroom when UMS. These requirements are basic, but they were not followed properly. If these requirements were made known as part of the safety familiarisation training required to be given to seafarers within 24 hours of joining - there should have been no doubt on the procedures to be followed, even for inexperienced crew members.

Since it was not internally wired to do so, the manufacturer's design of the light fitting in question did not provide a low impedance path for current to flow under fault conditions and it was not of a double insulated design. However the manufacturer did not provide the metal welding rod attached to the lamp unit which was touched by 4/E.

Equipment should be used for its designed purpose only.

Through radiated heat in use and general aging, the supply wire insulation condition had deteriorated, exposing the power supply conductors and allowing them to contact the metal (conductive) parts of the fitting, making those "live" as well. Regular inspection may have determined this deterioration allowing rectification or replacement before it became dangerous.

As there was no internal earth connection from the metal parts of the fitting to the terminal block, testing either phase to earth at the power supply plug would not have shown the existence of a fault condition. Also a developing fault on existing equipment would not give an earth fault alarm on the switchboard testing would have to be undertaken between connections at the plug and the metal parts of the fitting itself to show a fault condition.

When touching the metal welding rod, 4/E's muscles contracted under shock to the extent that he was unable to let go of the welding rod. As a consequence he accidentally became the "connection" between the rod and the workbench where he was found and was unfortunately exposed to a lethal electrical current as a result.

Duty engineers have program level access to the alarm monitoring system which is then relatively easy to selectively override. However there are no specific controls in C/E standing instructions or Company procedures, limiting why this might be done, a maximum expected duration of override or indeed who should perform the operation.

Recommendations

Most accidents are the unfortunate result of a sequence of contributory factors. Removing those “factors” before a similar situation occurs again must be the primary focus of any accident report.

As a result of the contributory factors in this incident, widest circulation of this report is recommended so that the industry as a whole may gain awareness. Accordingly, reproduction and re-direction in any form deemed suitable is encouraged.

In this particular scenario and in connection with workplace/operator safety it is recommended that the Company should do the following:-

- by means of fleet circular, draw attention to the Company’s IMS section 6.200.050 on complacency.
- by means of fleet circular, stress the importance of planning that all work carried out on board ships is properly considered and that any last minute changes also require subsequent thought even if it is only to make someone else aware of the revised situation.
- introduce a fleet requirement to visually check and physically test portable electrical equipment to confirm it is inherently safe to be used on board before first use and to record when it was first tested.
- further develop the vessel’s PM system to schedule regular inspection and testing of all portable appliances which are subject to wear and tear during normal use, to help ensure they continue to be inherently safe to use.
- provide and distribute on board reference material, safety posters and notices together with advice by fleet circular letter for use by all employees to raise electrical safety awareness in general.
- introduce some form of a control procedure limiting when an automation control alarm monitoring system may be partially disabled, indicating for how long it may be reasonably be disabled, recording the person taking responsibility for the disablement and indication that C/E has been made fully aware of the disablement.

In view of the foregoing it is recommended that the Company generally develop their IMS and the advice provided to their managed vessels in the following areas:-

- familiarisation training in connection with company requirements;
- record keeping with respect to log book entries;
- operational practices in connection with highlighting company requirements;
- operational control procedures;
- portable appliance testing and maintenance routines; and
- general electrical safety and general work planning advice.

Due to a life being lost which may have been prevented by more effective monitoring and adherence to procedures, it is strongly recommended to industry that:-

- portable appliance testing be included as an inherent part of a vessels' planned maintenance system schedules, such that ongoing safety checks and maintenance are regularly performed on any equipment which is not fixed in position and can therefore be more susceptible to damage occurring through normal use.
- proper consideration is always given to "last minute" or "spur of the moment" jobs.

There is a lot of information regarding general electrical safety, much of it freely available to use as a resource for employers, employees and the self-employed. It is recommended the Company (and industry in general) make use of it where possible, in order to develop guidance and planned maintenance routines for portable equipment on board managed vessels in a more informed manner.

Some hyperlinks have been provided in Annex II to resources available at the UK HSE website and since these are public documents the HSE have granted permission to refer to them from this report.

Appendix I – Portable appliance testing (PAT)

Portable Appliance Testing or PAT is a widely accepted practice to initially assess and subsequently maintain tools, fittings and equipment which through normal use are susceptible to damage and as a result of becoming damaged, have the potential for other, possibly serious, consequences.

Although hand tools are portable they are usually only visually condition checked before use. Portable equipment falls more into a category of “non-fixed tools or equipment, connected to something else by something flexible and usually readily transportable by people”. It is the people aspect that PAT aims to protect.

Not only electrical items are subject to PAT since pneumatic and hydraulic lines have the potential to detach or burst and cause injury and lifting equipment such as chain blocks and lifting strops/connections can fail. Flexible electrical power cables have the potential to make a fitting live (or indeed explode if other circuit protection fails to act quickly enough) if not properly maintained and/or tested.

Test meters and atmosphere testers also connect by something flexible (their test probes or their sample lines) and whilst the latter have a statutory requirement for annual calibration, the former are normally only checked at periods determined by the Company or when their correct function is suspect.

The potential for shocks if power is tested with a broken test lead on an electrical multi-meter (the meter measures no power but the circuit being tested is live) clearly indicates why PAT is good practice.

Ship planned maintenance systems are designed to make regular testing and overhauls at the manufacturers’ or Company’s specified maintenance periods a simple process. They are used to assist with operating a ship efficiently and safely, which makes them ideal for scheduling PAT routines.

The degree of testing, method of checking and what to record can all be specified in the “maintenance routine” such that it occurs regularly, maintains a history of the findings, can determine rate of degradation or even schedule when portable equipment simply needs to be replaced.

Frequency of testing should be based on the degree of use of the portable equipment being considered. For example if something is used only once a month, then there is no need to conduct a weekly check, but if something is used daily it may need to be tested more frequently than once or twice a month.

The ship’s staff are often better placed to advise on the usage of an item of shipboard portable equipment and can provide valuable input should PAT be implemented on board. Whatever is decided, the decision should be circulated throughout the fleet so that uniformity exists on all vessels.

Appendix II – Hyperlinks to reference material

Link to MAIB home page and additional resources

<http://www.gov.uk/maib> - requests for information are treated under the freedom of information act.

Useful links to United Kingdom Health and Safety Executive electrical safety information

<http://www.hse.gov.uk/electricity/faq-portable-appliance-testing.htm> - PAT testing FAQ's

<http://www.hse.gov.uk/electricity/index.htm> - electrical safety at work

<http://www.hse.gov.uk/electricity/precautions.htm> - simple precautions

<http://www.hse.gov.uk/electricity/maintenance/safety.htm> - safety maintenance

<http://www.hse.gov.uk/electricity/injuries.htm> - injuries

<http://www.hse.gov.uk/pubns/tlindex.htm> - talking leaflets - other reference material

<http://www.hse.gov.uk/electricity/information/law.htm> - Law references