REDUCING THE RISK OF PROPULSION LOSS

Operational guidance for preventing blackouts and main engine failures

The London P&I Club

TMC MARINE
A BUREAU VERITAS GROUP COMPANY

BUREAU VERITAS

TABLE OF CONTENTS

REDUCING THE RISK OF PROPULSION LOSS

INTRODUCTION

Modern engine room with two medium speed main engines

The purpose of this booklet is to provide general guidance and practical advice to marine engineers and ship owners on blackout and main engine failures, the risks associated with propulsion loss and the precautions to manage these risks.

It is not intended to replace official IMO regulations and guidance notes or any document that forms part of a vessel's safety management system.

Blackouts, propulsion limitations, total loss of propulsion and loss of steering capability are all serious incidents.

When they occur during navigation in non-congested waters, incidents such as these increase the risk to the vessel and personnel but rarely result in dangerous or life-threatening outcomes.

However, when they occur during manoeuvring in restricted areas such as traffic lanes, when entering or leaving port, or when a vessel is navigating close to a coast during heavy weather, these risks become critical and may result in a major casualty.

GLOSSARY

AVR	Automatic Voltage Regulator
LSMGO	Low Sulphur MGO
MGO	Marine Gas Oil
SECA	Sulphur Emission Control Area
STCW	Standards of Training, Certification and Watchkeeping for seafarers
ULSMGO	Ultra LSMGO
UPS	Uninterruptible Power System

BLACKOUT

According to MSC.1/Circ.1464/Rev.1 paragraph 6 (Interpretation of SOLAS Chapter II-1 Regulations 42 & 43 paragraph 3.4), it means a "dead ship" condition initiating event. According to the BV Rules Part C Chapter 2 Section 1 paragraph 3.29.1, a "blackout situation" means that the main and auxiliary machinery installations, including the main power supply, are out of operation but the services for bringing them into operation (e.g. compressed air, starting current from batteries, etc.) are available.

DEAD SHIP CONDITION

According to SOLAS Chapter II-1 Regulations 3 paragraph 8 and to MSC.1/Circ.1464/Rev.1 paragraph 3.1 (Interpretation of SOLAS Chapter II-1 Regulations 26 paragraph 4), it is the condition under which the main propulsion plant, boilers and auxiliaries are not in operation due to the absence of power. In addition, no stored energy for starting and operating the propulsion plant, the main source of electrical power and other essential auxiliaries is assumed to be available.

POSSIBLE CONSEQUENCES OF PROPULSION LOSS

The main serious consequences for the ship that might occur as the result of a blackout or propulsion loss are contact, collision and / or grounding.

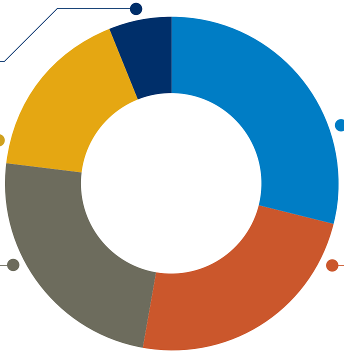
The consequences of third party claims may be substantial – in time, expense and reputation. The implications of propulsion loss may be significant either affecting or stopping navigation altogether in ports and their approaches, in canal systems, in waterways for days, weeks and months. Claims as a result of collisions, groundings, consequential pollution and 'off-hire', transhipment costs – all in addition to any repair costs - as well as claims from shore based facilities operators of loading and discharge equipment and facilities are all likelihoods in the event of damage. Media and stakeholder interests will all need to be addressed.

Bottom damages as a consequence of machinery failures[1]

[1] *On the top photo, the glass jar is here to highlight the degree to which the shell plating is set in.*

POSSIBLE CAUSES OF PROPULSION LOSS

The main causes of propulsion loss by the London P&I club members' ships and for which P&I investigation was required during the last five full P&I years are as follows:



Main engine failures and blackouts which result in large claims tend to occur when a ship is at its most vulnerable. The stable electrical consumption which is a characteristic of a ship during deep sea passage is replaced by more volatile or variable consumption requirements due to additional load placed on the electrical generation equipment when the ship begins manoeuvring in more confined waters (e.g. by starting supplementary machinery such as additional steering motors, starting and stopping bow thrusters, starting general service pumps, powering up hydraulic equipment and running deck machinery). Compliance with the low sulphur fuel regulations and changes from one grade of fuel to another has added to incidents of propulsion failures and power interruptions.

POSSIBLE CAUSES OF MAIN ENGINE FAILURE

- Blackout
- Fuel oil poor quality or contamination (e.g. fines, water or bacteria inside the tank)
- Insufficient attention to proper fuel changeover procedure when entering or exiting SECA
- Failure of starting air (insufficient pressure in the bottle). High or excessive numbers of engine starts and stops while manoeuvring will deplete pressure in the main engine start bottles. This may lead to the engine failing to start with a consequent loss of navigational control at critical times, such as when docking. It is important that the start air pressure is monitored while the ship is being manoeuvred and also vital that the pilot and bridge team are made aware of the maximum number of consecutive engine starts they can demand.
- Insufficient or ineffective maintenance of electronic and pneumatic control systems (for example, filters in pneumatic control systems are often neglected)
- Loss of control air pressure
- Loss of lubrication
- Engine automated shut down or even slow down at a critical time
- Shaft intermediate bearing failure
- Stern tube bearing failure

POSSIBLE CAUSES OF ALTERNATOR FAILURE

- Load share issues
- Loss of exciter voltage due to failure of diodes
- Failure of AVR

POSSIBLE CAUSES OF EMERGENCY GENERATOR FAILURE

- Batteries in poor condition
- Failure of starting system
- Switchboard selector switch not in "auto" start position
- Fuel oil poor quality or contamination
- Fuel oil starvation

POSSIBLE CAUSES OF **BLACKOUTS**

- Human error
- Control equipment failures (e.g. governor failures, defective trips for high temperature cooling or low lube oil pressures)
- Main engine failure whilst using shaft generator (e.g. shaft generator tripping whilst auto start and load share of auxiliary generators inoperative)
- Automation failure (e.g. AVR defect or auxiliary load control / sharing failures)
- Electrical failure (e.g. overload, reverse power trip or preferential trip device failure)
- Fuel issue, e.g.:
  - blocked filters
  - poor changeover procedures
  - failure to bleed the stand by filter before putting it back in use
  - Poor quality (for instance, water in fuel)
  - fuel supply piping and pump failures (fuel starvation)
  - loss of air control supply to fuel tank valves
- Mechanical failure, e.g.:
  - lack of compression
  - engine seizure
  - loss of lubrication
  - overheating
  - scavenge fires
- Other causes (e.g. fire in electrical panel / main

A significant number of blackouts are caused by electrical failures when starting bow thrusters and deck machinery - such as mooring winches or cranes - when insufficient electrical power is available. Awareness is required that the starting current of electrical motors may be several times the full 'on load' current. Starting large motors may trip breakers and lead to blackouts. Despite built-in safety features in modern ships to prevent such an occurrence, it is a sensible precaution to establish routines to ensure the availability of adequate generating power before starting large electrical motors. Many modern ships have automation to ensure that before items such as the bow thruster can be started there must be sufficient electrical capacity available; however it is not unknown for the automation to fail.

RECOMMENDATIONS

The following guidance is drawn from our experience and may be the difference between an occurrence of a problem being a minor problem and a major casualty.

PREVENTIVE ACTIONS

(considered to be good practice)

- Ensure correct maintenance of all equipment: engines (including their control and automation systems), purifiers, filters, fuel systems and sealing arrangements.
- Ensure that no maintenance is carried out on filters and fuel systems when on standby or approaching restricted navigational areas.
- Ensure fuel oil viscosity and temperature control equipment is accurate and fully operational.
- Ensure that all engineers are aware of how to isolate one cylinder on the main engine in the event of failure, so that this does not have to be stopped until convenient.
- Wait for the results of tests on newly supplied fuel oil to ensure that the fuel is 'on spec' before changing-over to the new one.
- It is recommended not to mix bunkers from two different suppliers in the same tanks.
- Ensure water is regularly drained from fuel oil tanks, in order to prevent water build up and carryover in the fuel and to lessen the risk of bacterial contamination / microbial infestation. Removal of water or reducing its presence to a minimum is the best method to prevent microbial infestation.
- Ensure that system temperature and pressure alarms, fuel filter differential pressure transmitters, etc. are accurate, tested and operational.
- Ensure that engineers are fully familiar with all engine room systems and their pipelines, including the changeover procedures from heavy fuel oil to MGO / LSMGO / ULSMGO and vice versa. Engineers should also be familiar with the method of changing from remote control to local control of valves and equipment.
- Establish **'failure to start' / blackout procedures / checklist** as well as emergency response manual / procedures / checklist / instructions. These should include familiarisation with operation locally and from the engine control room, as well as information to ensure control of the vessel's propulsion when operating on emergency power.

RECOMMENDATIONS

Blackout / engine failure / emergency propulsion control drills should be carried out at least every quarter[2] and it should realistically simulate an emergency, in order for the crew to be ready to respond to the situation. To be well prepared, trained and practiced avoids panic. Such procedures should be part of the ship's Safety Management Manual (SMM) / System (SMS).

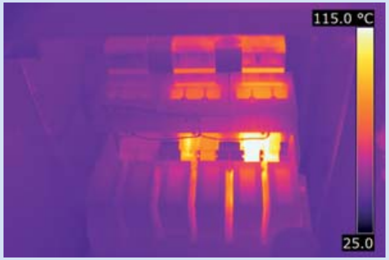
- Ensure the manning level / team composition in the engine (control) room is compliant with the international (e.g. STCW convention), national and local regulations when entering and leaving ports, manoeuvring or in hazardous situations.
- Ensure that any loss of power and/or propulsion incident is investigated and a root cause determined, by properly trained personnel.
- Ensure the corrective actions of a possible previous loss of propulsion / electrical power have been duly implemented in order to prevent reoccurrence.
- Ensure that weekly tests of the emergency generator are carried out with the battery charger disconnected from the mains. It is important to check the condition of the batteries as there may be no local indicator that informs the crew that the batteries are discharged. Electrically driven starter motors take power from the batteries, however if the batteries remain connected to the battery charger during test starts of the engine this may be masking the fact that the batteries are unable to hold a charge. Batteries should be checked as part of the weekly routine.
- Ensure that all means of starting the emergency generator are tested and that all crew members are familiar with them. It is recommended that the starting instructions for all means of starting of the emergency generator are posted in the emergency generator room so that these can be referred to by crew members.
- Ensure that the emergency generator is operated on load as close to the maximum capacity as possible, for at least one hour, every month[3].
- Ensure the starting air pressure is monitored by the watchkeeping engineers when manoeuvring and ensure that the deck department is aware of the limitations of starting air availability.

[2] Due to the more frequent change-over of crew (many who spend no more than four months on board), it is essential to carry out drills with each cohort of crew so that all are familiar with the procedures.
[3] The UK Marine Safety Agency in the Marine Guidance Note (MGN) 52 recommends that this is done weekly.

Typical air compressors on a vessel

- During manoeuvring operations or when on standby, run two (or more) generators in parallel whilst ensuring sufficient power availability should one either stop or trip. Monitor and balance switchboard power loads equally. All watchkeeping engineers should be trained in manually operating load share, putting generators on the board and taking generators off the board. It is self-evident; however, practicing these techniques should be done regularly so that these are second nature.
- Test the astern operation of the main engine prior to arriving at the pilot station and, if practical, before approaching the berth. This test should be carried out on the fuel which the vessel will use for manoeuvring (i.e. after any changeover has been carried out) and suitable entries made in both the deck and engine room logbooks.
- Establish procedures to ensure that there is adequate electrical capacity available before starting up lateral thrusters, mooring equipment or other heavy equipment, bearing in mind that simultaneous starting of large electric motors will lead to a large power surge and possible overload. A protective interlock prevents the bow thruster from starting or operating on one generator (but this can fail).
- Tests of the lateral thrusters and mooring equipment should be carried out well before entering restricted waters and undertaking critical manoeuvres.

- Ships fitted with shaft generators should, where appropriate, switch to auxiliary generator power well before entering restricted waters and well before undertaking critical manoeuvres. Manufacturer's guidelines should be followed and ship's staff guided accordingly.
- Engineers should change over to manoeuvring mode and be standing by in the Engine Control Room (ECR) prior to the vessel entering the port's seaward approaches. A nominated point at which the machinery status is to be changed from sea mode to manoeuvring mode or an end of sea passage position should be included in the passage plan.
- Over-current tests for the vessel's main generator breakers have to be carried out to the satisfaction of the classification society during periodic surveys.
- A regular thermographic survey of the switchboard should be carried out to monitor for loose connections or overheating equipment.
- The alarm printer, where fitted, should be maintained correctly, such that the printout is legible, as this is often a valuable source of information regarding the cause of the blackout.



Digital and thermal images of a switchboard breaker fault

RECOMMENDATIONS

CORRECTIVE ACTIONS

- Master to follow the company SMS procedures for loss of propulsion, often described in a stand-alone document called the "Emergency Procedures Manual".
- Position of the vessel and time need to be recorded accurately in the deck log book and in the engine log book.
- Anchors may have to be dropped in order to reduce the ship's speed. When manoeuvring in confined waters the anchors should be 'cleared' for immediate use.
- Good and efficient communication between the engine room and the bridge. The bridge and engine room should exchange critical information so that key personnel have a full understanding of the situation and can make informed decisions. Each department must quickly inform the other department of what they require, what is happening at their station, what problems they are experiencing, and what risks are present. If bridge and engine room personnel do not exchange critical information during an emergency, there is a risk that key personnel will not be fully aware of the situation and may make ineffective decisions.
- Crew member(s) may have to be sent to the emergency generator room in case this generator did not automatically start and in order to try to start it.
- Crew member(s) may have to be sent to the steering room in order to use the emergency steering but the master and deck officers should be aware that this is less effective with the engine stopped and the vessel's forward movement through the water is reduced below steerage speed.
- In order to restore power to the main switchboard during a blackout, the power from the emergency switchboard can be fed back to the main switchboard (refer to the relevant section below).
- In case of an overload of current, the reset button may have to be used to reset the electrical breaker after it has been tripped due to an overload of current.
- It will probably be necessary to bring the engine to STOP in order to enable the restart. Control should be taken by the engine room until the power has been fully restored.

AREAS OF SPECIFIC FOCUS

EMERGENCY GENERATOR

Regulatory framework

According to SOLAS Chapter II-1 regulations 42 & 43 paragraph 3.1.2, where the emergency source of electrical power is a generator, it shall be started automatically upon failure of the electrical supply from the main source of electrical power and shall be automatically connected to the emergency switchboard. The automatic starting system and the characteristic of the prime mover shall be such as to permit the emergency generator to carry its full rated load as quickly as is safe and practicable, subject to a maximum of 45 seconds. Unless a second independent means of starting the emergency generating set is provided, the single source of stored energy shall be protected to preclude its complete depletion by the automatic starting system.

SOLAS Chapter II-1 regulations 42 & 43 paragraph 3.4 requires that for ships constructed on or after 1 July 1998, where electrical power is necessary to restore propulsion, the capacity [of the emergency source] shall be sufficient to restore propulsion to the ship in conjunction with other machinery, as appropriate, from a dead ship condition within 30 minutes after blackout.

MSC.1/Circ.1464/Rev.1 paragraph 6 (interpretation of SOLAS Chapter II-1 regulations 42 & 43) states that emergency generator stored starting energy is not to be directly used for starting the propulsion plant, the main source of electrical power and/or other essential auxiliaries (emergency generator excluded).

General

An emergency generator is fitted in case none of the vessel's normal generator capacity is available for the supply of electrical power. As per the rules and regulations it should be able to run for 18 hours continuously.

The emergency generator will not supply power to all the equipment. Power will only be supplied to machinery and equipment that are necessary and of critical importance.

Examples of machinery fed through the emergency generator include[4]:

- Emergency transformer
- Local firefighting main panel
- Fire detection system control cabinet
- Navigational light indicator panel
- E/R control console
- Smoke detection system
- Emergency D/G room lighting
- UPS for C02 release alarm system
- Public address main unit
- Bridge control console
- Battery charger & distribution board
- M/E control system power supply unit
- Battery charger for rescue boat
- One steering gear motor
- Emergency fire pump
- Emergency fire pump room fan
- Local fire fighting
- Main air compressor
- Breathing air compressor
- Elevator

[4] It may differ from vessel to vessel and the crew should be fully aware of what is supplied from the emergency generator on their own vessel.

AREAS OF SPECIFIC FOCUS

LOAD SHEDDING OR OTHER EQUIVALENT ARRANGEMENTS

Definitions

(MSC.1/Circ.1464/Rev.1 paragraph 4 > interpretation of SOLAS Chapter II-1 Regulation 41 paragraph 5.1.2):

- **Primary essential services** are those services which need to be in continuous operation to maintain propulsion and steering.
- **Secondary essential services** are those services which need not necessarily be in continuous operation to maintain propulsion and steering but which are necessary for maintaining the vessel's safety.
- **Services for habitability** are those services which need to be in operation for maintaining the ship's minimum comfort conditions for the crew and passengers.

Regulatory framework

According to SOLAS Chapter II-1 Regulation 54 paragraph 2, the main source of electrical power shall comply with the following:

- Where the electrical power can normally be supplied by one generator, suitable load-shedding arrangements shall be provided to ensure the integrity of supplies to services required for propulsion and steering as well as the safety of the ship. In the case of loss of the generator in operation, adequate provision shall be made for automatic starting and connecting to the main switchboard of a stand-by generator of sufficient capacity to permit propulsion and steering and to ensure the safety of the ship with automatic restarting of the essential auxiliaries including, where necessary, sequential operations.
- If the electrical power is normally supplied by more than one generator running in parallel operation, provision shall be made (for instance by load shedding) to ensure that, in case of loss of one of these generating sets, the remaining sets are kept in operation, without overload, to permit uninterrupted operation of propulsion and steering, and to ensure the safety of the ship.

According to SOLAS Chapter II-1 Regulation 41 paragraph 5.1.2:

- The load shedding or other equivalent arrangements shall be provided to protect the generators required by this regulation against sustained overload.

According to the interpretation in MSC.1/Circ.1464/Rev.1 paragraph 4.9:

- Primary essential services should not be included in any automatic load shedding or other equivalent arrangements;
- Secondary essential services may be included in the automatic load shedding or other equivalent arrangement provided disconnection will not prevent services required for safety being immediately available when the power supply is restored to normal operating conditions
- Services for habitability may be included in the load shedding or other equivalent arrangement.

According to the interpretations in MSC.1/Circ.1464/Rev.1 paragraph 5.4.3 and IACS UI SC157 paragraph 2.3:

- The load shedding should be automatic.
- The non-essential services, services for habitable conditions may be shed and where necessary, additionally the secondary essential services, sufficient to ensure the connected generator set(s) is/are not overloaded.

According to BV Rules Part C Chapter 2 Section 3 paragraph 2.2.18 (f):

- On ships having remote control of the ship's propulsion machinery from the navigating bridge, means are provided, or procedures are in place, so as to ensure that supplies to essential services are maintained during manoeuvring conditions in order to avoid a blackout situation.

Preferential tripping system

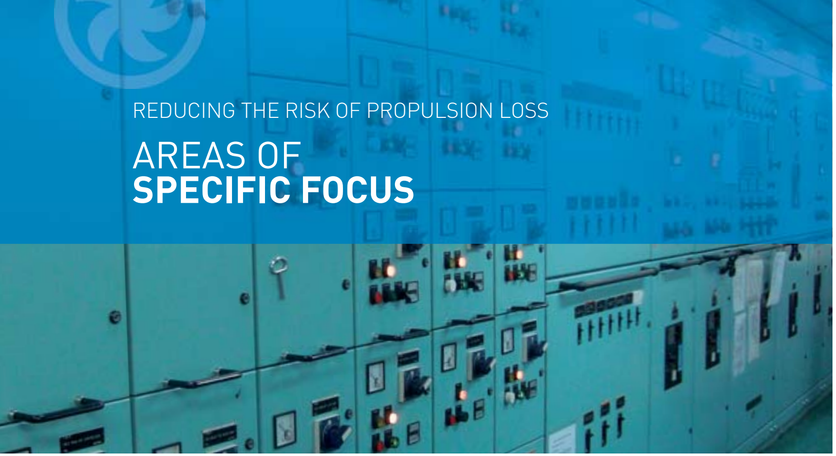
The preferential trip is a part of the ship's generator protection system. It is the electrical arrangement on ships which is designed to disconnect the non-essential circuits (i.e. supplying non-essential load) from the main bus bar in case of partial failure or overload of the main supply.

The non-essential circuits or loads on ships are air conditioning, exhaust and ventilation fans, and galley equipment which can be disconnected momentarily and can be connected again after fault finding. The main advantage of preferential trip is that it helps in preventing the operation of main circuit breaker trip and loss of power on essential services and thus prevents blackout and overloading of generator.

The preferential trip operates at timed intervals and the load is removed accordingly. If the overload still persists, then an audible and visual alarm is sounded. The preferential trip is an important electrical circuit which helps remove excessive load from the main bus bar, thus preventing a blackout.

The crew should be familiar with the equipment which is shed on the operation of the preferential trip. This is often a multi stage process with first and second stage tripping arranged to shed load. The items are usually indicated on the switchboard to show

AREAS OF SPECIFIC FOCUS



Typical switchboard on a modern vessel

FEEDING BACK POWER FROM THE EMERGENCY SWITCHBOARD TO THE MAIN SWITCHBOARD

In order to restore power to the main switchboard after a blackout, the power from the emergency switchboard can be fed back to the main switchboard.

According to the IMO circular MSC.1/ Circ.1464/Rev.1 paragraph 3.1.2 (interpretation of SOLAS Chapter II-1 regulation 26 paragraph 4), where the emergency source of power is an emergency generator which complies with regulation II-1/44, IACS SC185 and IACS SC124, this generator may be used for restoring operation of the main propulsion plant, boilers and auxiliaries where any power supplies necessary for engine operation are also protected to a similar level as the starting arrangements.

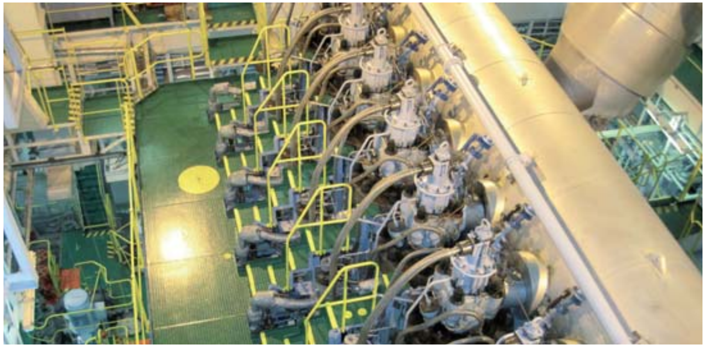
This can be accomplished by shedding all nonessential load from the main switchboard i.e. fans, galley non-essentials etc. and closing the feedback breaker thereby allowing the emergency generator to power the main switchboard.

When ready to restore power to the main switchboard from the main generators, it will be necessary to open the tie-in breaker in the control room. This will isolate the emergency generator from the main switchboard. It is now possible to close the main generator breaker, which will in turn open the emergency generator breaker. To restore power to the emergency switchboard, crank the tie-in breaker and close. The feedback breaker (emergency generator room) will open and may be closed by pressing the push button on the main switchboard.

Before back-feeding power from the emergency switchboard, breakers for non-essential equipment must

RECOVERY AFTER A BLACKOUT

- During blackout and failure to start the emergency generator the stand by generators may be able to be manually started possibly after reset of trips. It is not unknown for ship staff to concentrate too much on starting the emergency generator but failing to recognise that the auxiliary generators may be available for start.
- Before starting the generator set, start the pre-lubrication priming pump if the supply for the same is given from the emergency generator; if not, then use the manual priming handle (provided on some auxiliary engines).
- Start the generator and take it on load. Then immediately start the main engine lube oil pump and main engine jacket water pump as per the procedure put forward in the SMS for such recovery after blackout.
- Reset breakers and start all the other required machinery and system. Then reset breakers that are included in preferential tripping sequence (non-essential machinery). Again these start up procedures should be part of the SMS.
- Once power has been restored on vessels with an "auto restart sequence" for electrical equipment, personnel should be delegated to ensure that all essential equipment has started



Top platform of a large slow speed marine engine

AREAS OF SPECIFIC FOCUS

ISM CODE

- The "International Management code for the Safe operation of ships and for pollution prevention" (ISM code) at section 9.1 requires that the SMS should include procedures ensuring that non-conformities, accidents and hazardous situations are reported to the company, are investigated and analysed with the objective of improving safety and pollution prevention.
- We have mentioned under the section on preventive actions above the importance of a root cause analysis and the implementation of the findings of any investigation. This is a requirement of the ISM code.
- Section 10 of this code, as amended, covers requirements for maintenance of the ship with the below excerpts given to highlight what the company and vessel staff should put in place for main engine and electrical equipment maintenance and safe operation :

10.1 *The company should establish procedures to ensure that the ship is maintained in conformity with the provisions of the relevant rules and regulations and with any additional requirements which may be established by the company.*

10.2 *In meeting these requirements the company should ensure that:*

1 *inspections are held at appropriate intervals;*
2 *any non-conformity is reported, with its possible cause, if known;*
3 *appropriate corrective action is taken*

Procedures should be developed to ensure that maintenance, surveys, repairs and dry-docking are carried out in a planned and structured manner with safety as a priority.

Maintenance procedures should include (amongst others) :
- steering gear;
- main engine and auxiliary machinery;
- emergency lighting

The company should arrange for inspections of its vessels to be carried out at regular intervals. These inspections should be executed in compliance with the appropriate procedures by competent and qualified personnel.

There should be procedures for reporting non-conformities and deficiencies that should include a time scale for completion of corrective action.

10.3 *The company should identify equipment and technical systems the sudden operational failure of which may result in hazardous situations (i.e. critical equipment).*
The SMS should provide for specific measures aimed at promoting the reliability of such equipment or systems. These measures should include the regular testing of stand-by arrangements and equipment or technical systems that are not in continuous use.

10.4 *The inspections mentioned in 10.2 as well as the measures referred to in 10.3 should be integrated into the ship's operational maintenance routine.*

Once the critical systems have been identified, procedures should be developed to ensure reliability of these systems or the provision of alternative arrangements in the event of sudden failure. The procedures implemented should include the regular testing of stand-by systems in order to ensure that one failure does not result in the total loss of that critical function. Maintenance routines should include the regular and systematic testing of all such critical and stand-by systems.

Critical equipment listings may include (amongst others) :
- generators including emergency generator;
- steering gear;
- fuel systems;
- lubricating oil systems;
- emergency stops and remote closing devices;
- communications systems;
- main engine propulsion systems.

- IACS have produced a nine page guidance document entitled "IACS Recommendation 74 "A GUIDE TO MANAGING MAINTENANCE IN ACCORDANCE WITH THE REQUIREMENTS OF THE ISM CODE"" and we would recommend that this document is made available onboard in addition to this Guideline.

SUMMARY

Whether a blackout or loss of propulsion incident gives rise to $5 or $50 million claim depends mainly on vessel location at the time of the incident. However, as we have said above, by investigating all incidents properly and taking preventive and corrective actions, it is much more likely that when an incident does occur the consequences will be much reduced. We must all remember that if an incident has occurred in benign conditions, it can and will happen again when the conditions are not so benign.

From our perspective it is considered that all propulsion loss incidents should be treated with the same level of urgency of investigation and root cause analysis; regardless of the overall severity of the situation experienced. We note that a large proportion of propulsion loss investigations identify that the blackout or main engine failure has a history of previous occurrence; and that proper detailed root cause analysis and near miss investigation could have prevented the subsequent casualty.

CASE STUDIES

A.

A converted ferry carrying out a harbour pleasure cruise with 400 revellers on a New Year's party, lost propulsion when the drive coupling between the gearbox and the propeller shaft sheared causing a collision with a multi-million dollar motor cruiser.

The converted ferry had been taken out of service after many years. It was of an older design with propellers at each end (i.e. a double ended ferry) and the crew should have been able to transfer control to the other end. It appears that no one knew how to transfer control or the crew lost situational awareness due to a lack of training and practice.

The vessel was eventually assisted by some marine safety tugs that were setting up fireworks for New Year celebrations.

This is considered to be a collision caused by a lack of properly documented and prepared procedures. In addition the value of proper induction / familiarisation of on-signing officers and crew is also well illustrated by this incident.

B.

The vessel was using shaft generator in restricted waters. The engine room was on stand-by, as the vessel navigated between buoys in a dredged channel proceeding up river. Approaching a much larger vessel coming down river, the vessel moved towards the edge of the channel. The interaction with the bank resulted in the main engine slowing down. The decrease in main engine speed was sufficient to cause the shaft generator breaker to open, and a blackout occurred. The interaction with the bank pushed the bow of the vessel back across the channel at 90 degrees to the original course. The larger vessel coming down stream collided with the subject vessel amidships. The subject vessel sank closing the channel for several days until such time as the vessel was refloated.

If the correct procedures had been followed, i.e. two alternators in operation during standby while in restricted waters, the casualty would have been avoided.

C.

A vessel which used only marine diesel oil as fuel on board bunkered at a port in Northern Europe. At this port the vessel also loaded a full cargo of grain. Shortly after departure the main engine stopped due to blockage of the filters and failure of the fuel pumps (the alternators also failed). Investigation revealed significant quantities of water in the fuel oil settling and service tanks and heavy bacterial contamination.

The vessel had to be towed to port where the fuel pumps were replaced, the tanks, including double bottom storage tanks, cleaned and treated with a biocide to remove the contamination. This took approximately 10 days.

A root cause analysis identified the failure of ship's staff to operate the purifier when transferring fuel from the settling to the service tank and the failure to drain water on a regular basis from the service and settling tanks as the dominant causative factors.

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