KISH P & I LOSS PREVENTION CIRCULAR KPI-LP-46-2012
(Analysis of the Machinery Failure Cases)

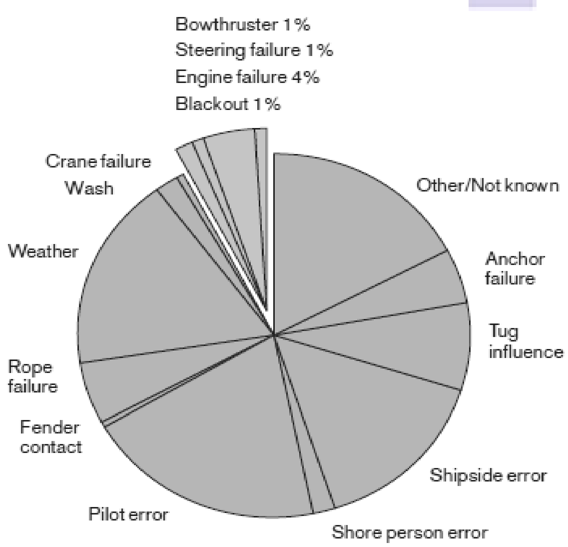
➢ 1-Introduction:

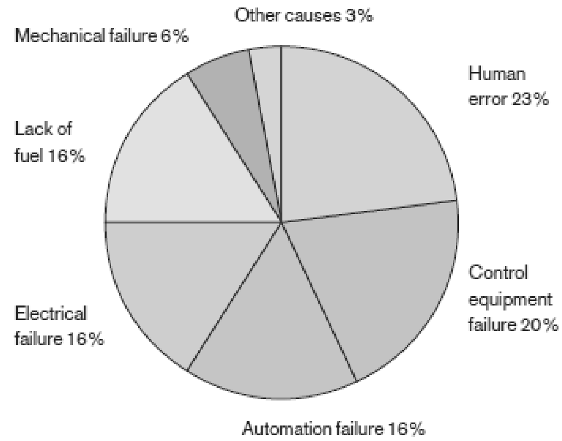
Machinery failures are reported to have been too many. They include various equipment & devices. Increasing numbers of main engine failure related incidents and accidents following blackouts have caused great concern.
The information included here is extracted from the data provided by a reputable risk assessment team who have carried out extensive analysis on the issue.

A significant number of these cases are for third party property damage, many of which are enormously expensive and in some cases amount to millions of dollars. They could be attributed, directly or indirectly, to main engine failures or electrical blackouts.
Vessels being out of control as a result of these problems have caused extensive damage to berths, locks, bridges, dolphins, navigational marks, loading arms, cranes and gantries along with other moored ships.

Consequently collision and grounding claims can similarly be caused by these failures.
It is no exaggeration to suggest that main engine failures and blackouts tend to occur most regularly at the point in a voyage where the ship is at its most vulnerable. In confined waters or entering and leaving port, the stable loads which will generally prevail with the ship on passage are disturbed. *There is additionally some evidence that compliance with the low sulphur fuel regulations and changing from one grade of fuel to another has exacerbated these problems.*

Causes of Large third party property claims





Causes of Black-Outs

Reports from pilots, operating in emission control areas where fuel grade changes have been implemented, indicate that these problems have become quite widespread, noting that ships regularly seem to be experiencing power losses, invariably at critical times in their manoeuvres and which are attributed to 'fuel problems'.
Vulnerability of ships to such problems has also tended to increase as a result of the 'self-sufficiency' of modern vessels, the provision of lateral thrusters tending to persuade operators to minimise their dependence upon tug assistance in port waters. Thus, where in an earlier era a vessel experiencing mechanical difficulties would be merely held safely in position by assisting tugs, a single tug in attendance may not be able to sufficiently intervene with a large ship suffering a blackout or main engine failure at a critical point in the manoeuvres.
The consequences of main engine failures or blackouts leading to steering gear failure can be disastrous in terms of third party property damage claims which can result.
An entire canal system or waterway could be put out of action as a result of an out of control ship damaging a lock or bridge, while months of expensive inactivity could be suffered should a specialist berth with bulk loaders or gantries be damaged by a ship.
The costs of ships rendered inactive as a result of third party damage can be substantial as can all claims from collisions and groundings attributable to such causes.

➢ 2-Blackouts:

While there may be an understandable reluctance to admit to having such a problem, with a total of 26% of chief engineers claiming that they had never had a blackout on board any ship, it is considered that this is likely to be understated.
There were **9%** of chief engineers who reported that they had experienced more than ten blackouts. The graphical representation above indicates that such problems are certainly not unknown, with around three quarters of all chief engineers questioned reporting blackouts.
The stated causes of blackouts, which are thought to be fairly accurate, are similarly revealing and may be listed as:

- Automation failure (auxiliaries load control/sharing failure etc)

● Control equipment failure (e.g. governor failure, defective trips for high temperature cooling or low lub/oil pressure etc)
● Electrical failure (e.g. overload, reverse power trip, preferential trip device failure etc)
● Lack of fuel (e.g. blocked filters, water in fuel, fuel supply piping and pump failures etc)
● Mechanical failure (e.g. lack of compression, engine seizure, loss of lubrication, overheating etc)
● Human error
● Other causes

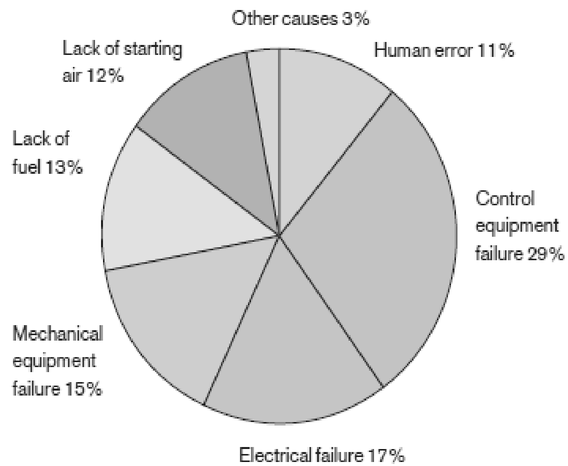
Out of all reported blackouts, the highest number (23%) was attributable to human error.
Several of these incidents were caused by procedural errors - ‘pressing the wrong button’ - and stopping or tripping an on-load generator.

A further 16% were caused by electrical failure and a notably high number of these blackouts were reported as a result of starting bow thrusters and deck machinery such as mooring winches or cranes, with insufficient electrical power being available. It is clearly not always realised that the starting current of electrical motors can be several times the full ‘on load’ current and starting large motors can sometimes cause breakers to trip and lead to blackouts. While many modern ships have in-built safety features to prevent this happening, it is still a sensible precaution to have routines in place to ensure that adequate generating power is available before starting large electrical motors.
A shortage of fuel supply to the generating engines accounted for 16% of reported blackouts, with a high proportion of these attributed to blocked fuel filters.
Automation failure was blamed for 16% of blackouts, failure of control equipment 20% and mechanical failure 7% of those reported. There was, however, no noteworthy reason provided for these failures.

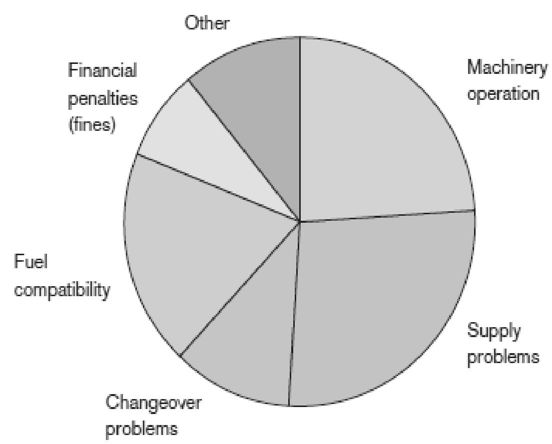
- **3-Main Engines manoeuvring failures:**

There was a perhaps understandable reluctance to report main engine manoeuvring failures, with a high percentage of engineers reporting fewer than four failures during their careers and a surprising 44% admitting to no failures at all.
These failures were categorised as follows:
● Control equipment failure (e.g. governor failure, load control failure, defective trips for high temperature cooling or low lub/oil pressure etc).
● Electric failure (e.g. loss of electrical power etc)
● Human error
● Lack of fuel (e.g. blocked filters, water in fuel, fuel supply piping and failure of pumps etc)
● Lack of starting air
● Mechanical failure (e.g. reversal system failure, lack of compression, engine seizure, loss of lubrication, overheating, crankcase oil mist, scavenge fire, gearbox problems etc)
● Other causes

Causes of M/E manoeuvring failures



Problems with Low Sulphur matters



As is illustrated in above diagram, control equipment failure accounted for the greatest proportion of main engine manoeuvring failures, this being mainly caused by the lack or leakage of control air, along with other malfunctions. Blackouts, as discussed earlier accounted for the next highest cause of electrical failure.
Of the 15% of mechanical failures, these were attributed to defects with pneumatic valves, start air valves and defects in reversing systems.
Lack of fuel accounted for 13% of failures, and as with generator failures, blocked filters were identified as the main reason for these. While 12% of manoeuvring failures were attributed to a lack of starting air, 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.
Human error of various kinds accounted for a further 11% of failures.

- **4-Low sulphur fuel problems:**

Of the chief engineers questioned 11% confirmed that they have experienced, or were anticipating, problems complying with the low sulphur fuel regulations.

It might however be suggested that these are relatively early days, and the spread of emission control areas relatively limited. Stricter implementation of regulations and an extending network of SECAs around the world may well see the problems multiplying for those aboard ship.

Problems already encountered and reported to the assessors included that of supply and storage, difficulties with machinery operation, fuel compatibility difficulties, changeover problems, financial penalties and others.

Supply and storage problems were reported by the chief engineers of ten ships. While there is now said to be widespread availability of low sulphur fuel around the world at the major bunker supply ports, the cost differential compared to high sulphur fuel is about $20 to $80 per tonne.

Storage problems have been reported on particularly older ships because of the lack of dedicated settling/ service tanks for both types of fuel, difficulties being encountered when changing from one grade of fuel to another.

Some ships reported having problems with machinery operation when operating on low sulphur fuel, which included fuel oil lubrication of pumps and nozzles, sticking fuel pumps, generator starting problems, fuel oil leakages and delayed pick up speed of engines.

Some other ships suffered compatibility problems between the two fuel types, resulting in purifiers requiring more frequent cleaning and filters becoming blocked. It is also pointed out that if a vessel changes over from higher sulphur fuel (HFO), when MGO is introduced into the system it may act like a solvent, releasing any tar-type residues which then collect in the fuel filters/ strainers and clog them.

Only four ships reported having any problems when changing over from one fuel type to another and one vessel reported that the changeover time had been miscalculated and the ship had been subsequently fined and detained.

It was reported that 60% of ships took up to 12 hours to change the main engine over from one type of fuel to another. However, this included many ships which were operating exclusively on low sulphur fuel. Some 28% of ships took between 12 and 24 hours to effect the changeover and the remainder longer.

It was reported that 66% of ships had dedicated storage tanks for low sulphur fuels and if the ship is equipped with two day service tanks, then the requirement for the changeover procedure will be very much reduced.

It is assumed that the one day service tank will contain higher sulphur fuel (HFO) with the other tank already filled with the required low sulphur fuel oil. Thus the whole procedure will only require the isolation of the feed from the HFO service tank and the flushing of the feed pipeline to the engines from the low sulphur day or service tank.

If the ship is equipped with only a single day or service tank then flushing of the system will take very much longer, this procedure consisting of:

● Reducing or emptying as far as is possible the settling tank of the previous HFO

● Flushing the pipeline to the settling tank and filling it with low sulphur fuel

● Reducing or emptying as far as possible the day or service tank

● Flushing the connecting pipeline from the settling tank to the service or day tank with low sulphur fuel from the settling tank

● Filling the service tank with low sulphur fuel and commencing to use this fuel before entry into the SECA.

It was reported that 19% of ships had required new equipment to be installed in order to run the engines or boilers and 28% had been required to carry more than one lubricant. If engines are expected to operate for lengthy periods within an emission control area, then the lubricating /cylinder oils may need to be replaced by low base number oils. The engine manufacturer's guidance should be obtained about this matter.

Only 2% of ships considered that they had inadequate storage capacity for the different grades of oils.

In order to run on low sulphur fuels, 10% of ships reported that they needed to adjust the fuel pumps of their engines.

- **5-Recommendations to reduce the risk of power losses and blackouts:**

  - ✓ Engine and boiler manufacturers should be consulted for advice on operation with low sulphur fuel and the need for any equipment/system modifications
  - ✓ Ensure correct maintenance of all equipment; engines, purifiers, filters, fuel systems and sealing arrangements
  - ✓ Ensure fuel oil viscosity and temperature control equipment is accurate and fully operational
  - ✓ Ensure that system temperature and pressure alarms, fuel filter differential pressure transmitters etc are accurate and operational
  - ✓ Ensure fuel changeover procedures are clearly defined and understood
  - ✓ Ensure that engineers are fully familiar with fuel systems and main engine starting systems and establish 'failure to start' procedures. These should include familiarisation with operation locally and from the engine control room
  - ✓ Ensure that the starting air pressure is monitored during manoeuvring operations and that the deck department appreciates the limitations of starting air availability
  - ✓ During standby, run two (or more) generators in parallel whilst ensuring sufficient power availability should one stop or trip. Monitor and balance switchboard power loads equally
  - ✓ Test the astern operation of the main engine prior to arriving at the pilot station and, if practical, before approaching the berth
  - ✓ 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
  - ✓ Ships fitted with shaft generators should, where appropriate, change over to auxiliary generator power well before entering restricted waters and undertaking critical manoeuvres. Manufacturer's guidelines should be followed and ship's staff guided accordingly.