Cefor

Memo 6
Technical Forum

22 May 2017

Fire risks due to leakage from low pressure fuel pipes

Objective

Following engine room (ER) fires, investigations often find the cause to be a leaking oil pipe or equipment placed very close to a potential ignition source – a so called hot spot[1]. Shielding in way of physical barriers constraining potential leaks and/or insulation of hot spots with a surface temperature > 220 °C, are often found to be either insufficient, poorly maintained or degraded.

The risk of fires resulting from leaks in high pressure systems has decreased with the implementation of new design rules for the fuel pipes in 2003 (requiring double walled or jacketed pipes). However, the low pressure oil system still impose a significant risk and our main concern is that this risk may be overlooked or considered less important.

The objective of this memo is therefore to raise awareness about the risks associated with leaks from low pressure fuel oil pipes/equipment, as well as hot spots, in the ER, and encourage industry stakeholders to consider possible action to mitigate the risks.

Introduction

Every year fires on board vessels lead to the tragic loss of lives and severe damages to vessels. More than one third of all fires on board start in the ER, and one of the most common reasons for such fires is flammable oil hitting hot surfaces. The IMO Safety of Life at Sea Convention (SOLAS) provides the key regulatory framework for fire safety on board ships. Measures to control leaks of flammable liquids and ignition sources in the ER are described in Reg.II-2/4[2], and require, among others, ship designers and operators to:

- use suitable materials in piping conveying flammable oils;
- minimise the number of joints in such piping;
- use screening and jacketed high pressure fuel oil pipes to prevent flammable oil sprays; and
- properly insulate hot surfaces.

[1] E.g. engine 'body', indicator valves, cylinder hoods, exhaust pipe from each cylinder, exhaust manifold, foundation and lifting lugs on exhaust ducts, turbochargers and surfaces of floodlights.

[2] See also MSC.1/Circ.1321: Guidelines for measures to prevent fires in engine-rooms and cargo pump rooms, 11 June 2009.

In other words, the underlying principles of SOLAS Reg.II-2/4 clearly focus on the most relevant risk factors associated with ER fires. However, based on the many fires still occurring, there is reason to question whether these requirements are sufficient or if more detailed and prescriptive requirements are needed.

Equally important is also to question whether the procedures for control and enforcement of these requirements are adequate? This relates not only to the procedures applied during annual/renewal surveys and port state control when the vessel is in operation, but also to the procedures for design approval and survey applied during the newbuilding phase. This is the time when the actual ER arrangement with pipe routings and need for screening and insulation of hot surfaces are agreed between the yard, owner and Flag State/classification society.

Case experience:
Fuel oil leak from filter ignited by hot spot on turbo charger exhaust manifold

A vessel experienced a large explosive fire around the forward end of one of the main engines when fuel oil spray from a failing bolt in a filter housing reached an uninsulated part of the hot turbo charger (TC) gas casing. The subsequent investigation concluded that the most likely cause of the leak was the improper tightening of a stud bolt in the filter during maintenance. When the filter was brought back in operation and under pressure, the bolt eventually ejected causing a fuel leak. The fuel filter was located very close to the TC, but there was no screening in place or other physical barriers preventing the fuel from spraying onto the TC casing. The investigation also concluded that the likely ignition source was a hot spot caused by insufficient insulation of the TC casing.

IMO guidelines regarding filters and strainers (MSC.1/Circ.1321):

Filters and strainers should be located as far away as practicable from hot surfaces and other sources of ignition. They should not be located in positions where spillages could fall onto the flywheel or other rotating machinery parts and be sprayed around. Suitable drip trays should be provided under filters and strainers. A vertical spray shield that will prevent a high pressure fuel or lubricating oil leak from coming into contact with a hot surface should be installed between the strainer and the hot surface. If a hot surface cannot be insulated or the oil filter cannot be located in a safe position, it should be installed in parallel with another filter. The spray shields should be installed in such a manner as to not impede the servicing of the filter or strainer.

Filters and strainers should be inspected every time they are opened for cleaning and the cover gaskets or seals should be renewed when necessary. Satisfactory seating and tightening of the cover should be verified before the system is put back into service. The filter or strainer should also be carefully bled of air before returning the unit into service.

Inspection and maintenance – practices and challenges

It is not uncommon that once removed, a cladding/protective device is either not replaced or altogether misplaced. Furthermore, as priority often will be on known, high risk, high pressure fuel pipes, low pressure fuel pipes may often be ignored during surveys.

Improvement areas

There is a general need to increase focus on hot spots and the risk of fires igniting from low pressure fuel pipes.

To reduce the fire risk due to leakage from low pressure fuel pipes onto hot spots, the following areas are important:

- Routing of pipes
  - Flammable liquid piping related to potential ignition sources
  - Screening of piping joints and pressurized equipment
  - Easy inspection and observation of leaks
- Flexible hoses
  - Only allowed for facilitating relative movement between two connections
  - Max length 1.5m, full screening
  - Limited lifetime, bends, scuffling, contact
- Filters
  - Suitable means for venting and depressurizing
  - Only cocks or valves with drain to safe location allowed
- Insulation material
  - Exhaust gas casings & TC vs direct lagging and shielding
  - Need for regular inspection & maintenance
- Safety culture
  - Crucial to the safety of crew, passengers and ship
  - Engine room cleanliness
  - Home-made drip buckets and leak deflectors
  - Overhauling standard and techniques
  - ISM Code Ch. 3 (Company responsibility for safety), Ch. 6 (Resources and personnel) and Ch. 10 (Maintenance of ship and equipment)

Recommendations

Fuel pipes may fail due to errors in either design, lack of or faulty maintenance and/or the human element (operation).

To prevent fires and reduce the consequences, we encourage all stakeholder to pursue this subject discussing both preventing and mitigating efforts with a few suggestions from our side;

- Preventive:
  - Use thermography routinely on board to measure hot spots (temperature areas above SOLAS requirement of 220^{0}C) during normal operation of the machinery[3].
    - Particular focus on extent and quality of insulation.
  - Include maintenance & inspection of insulation in the Planned Maintenance System.
  - Include maintenance & inspection of low pressure systems in the Planned Maintenance System.
  - Establish procedures for control and enforcement of requirements during annual/renewal Class surveys during operation.
  - Consider port state campaign to effectively raise the awareness.
  - Consider the need for a possible revision of SOLAS.
  - Establish procedures for design approval and survey applied during the newbuilding phase.
- Mitigating:
  - Establish secondary barriers and firefighting preparedness to avoid escalation of a fire.

[3] Survey results indicate that around 80 per cent of vessels checked had exposed areas in excess of the SOLAS requirement, ref. Burgoynes/UK P&I Club – Engine Room Fires report