Flagship testing

From this year, the FPA's Blockley Fire Test Laboratory is being used for testing International Maritime Organisation Standard 1165, for which the facility was intended. ***Simon Bartlett*** *explains…*

IN 2012, the Fire Protection Association (FPA) began adding to its already extensive Fire Research, Training and Test Laboratory in Gloucestershire by creating its 'IMO' high temperature test facility. The rig construction was based on the requirements of the International Maritime Organisation's (IMO) test standard MSC/Circ.1165. The standard itself was designed to evaluate the extinguishing effectiveness of water-based total flooding fire-extinguishing systems for the protection of engine-rooms and cargo pump-rooms and was developed for systems using ceiling mounted nozzles or multiple levels of nozzles.

The associated test compartment was constructed from a steel frame clad with corrugated steel sheets with the internal dimensions of 10.5m x 10.5m x 5.5 m (width x length x height) and because of its design allowed the FPA to set fires with a far higher heat output without the risk of damaging the infrastructure. Within the compartment an engine block mock-up was constructed from 5mm steel sheet measuring 1.0m x 3.0m x 3.0m (width x length x height) surrounded by a floor plate system of 4.0m x 6.0m x 0.75m (width x length x height) to create a more realistic environment.

The IMO test facility was used to great effect when the FPA tested fire protected cables for Carnival. The building and its internal clutter was perfect to recreate a representative environment in which the cables were used, and a large liquid fuel spray burner accurately recreated the potential fire threat within a ship's machinery space.

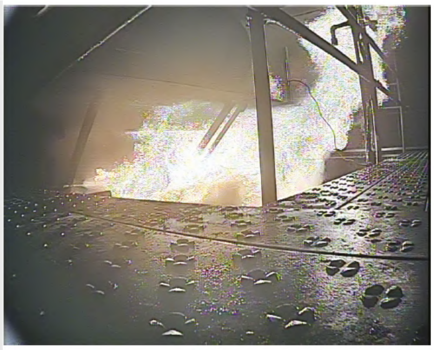
This realistic environment and fire source enabled a hot gas layer to build up around the cables while ensuring good ventilation to maintain the fire. Configurations were then set to ensure the resulting flames reached almost up to the cable trays, thus exposing the cables to the highest possible temperatures. By utilising the FPA's extensive knowledge of active suppressions systems and deployment scenarios, a water spray systems was then designed and incorporated into the test rig, recreating likely performance conditions on board ship.

IMO test standard

Although a number of large fire tests have been conducted in the IMO Test Facility, it hadn't been used for its intended purpose of testing to MSC/Circ.1165 until this year. The 1165 test covers the minimum fire-extinguishing requirement and prevention against re-ignition for fires in engine-rooms. By successful completion of the fire tests, the system should show it has the capability of extinguishing a variety of fires that can occur in a ship's engine-room. The FPA was asked by a client to test a high-pressure watermist fire extinguishing system in a realistic environment, using the fires as specified the IMO standard. These are a combination of high and low pressure spray fires, with a series of pool fires of varying sizes.

To generate the low-pressure spray fire, fuel was pumped into the test rig via fixed pipework and discharged through an atomising spray nozzle. The spray from the nozzle was ignited from a pilot fire located directly in front of the nozzle. Rather than using the standard diesel fuel, the customer asked for the actual fuel used on board their vessel, creating a deviation from the standard, but making the test more representative. The fuel was sprayed at a flow rate of 0.16 kg/s and was achieved with a pump built by the FPA operated at a target pressure of 10.7 bar.

During the test programme, the pressure of the fuel spray system was set and monitored via a logged pressure transducer installed in the fuel line near the spray nozzle. The high-pressure spray was operated and lit in a manner analogous to the low-pressure spray. However, the FPA accommodated the client's high pressure requirement of 0.05 kg/s at 207 bar, which was described by the FPA laboratory staff as similar to a jet engine. Both the low and high pressure spray fires were operated for 15 seconds prior to operation of the watermist system.


Pool fires were conducted using a representative lube oil. Fuel trays were filled to a depth of 50mm with oil prior to each applicable test. To light the oil, heptane was poured over the surface of the oil, which was then ignited with a lit taper. All pool fires were initially allowed to burn for a minimum of two minutes before activation of the watermist system, as per the 1165 standard. However, an additional 45 seconds was later added to the pre-burn time for pool fires, as initial tests found the lube oil fire slow to develop across the surface of the tray. This ensured the fire was fully developed by the end of the pre-burn period.

In addition to the pool fires, a flowing fuel fire was designed to demonstrate the suppression system's capability of managing fire in a situation where isolation of the fuel delivery system had failed. For the test method specified by MSC/Circ. 1165, heptane is continuously pumped to a 1m x 3m tray on top of the engine block, and allowed to run down the side and into a 2m x 2m bilge tray by way of a notch in the wall of the top tray. Ignition takes place at a point half way down the engine block, and the resultant fire spread occurs both upwards to the top tray and downwards to the bilge. Again, heptane was not representative of the fuels used by this client, so the above test was not relevant in this form and therefore the FPA redesigned the test to ensure it worked with the recommended fuel, while ensuring the test remained as close to the original as possible.

One step further

As mentioned, before the 1165 tests are the minimum requirement for a water based extinguishing system on board a maritime vessel. As part of this recent work, the FPA were asked to enhance the IMO Circ. 1165 test to provide an environment that was much closer to the client's machinery space environment. This involved dramatically reducing the volume of free space within the compartment and fill it with 'clutter' that was representative of the systems seen on board their vessel.

The FPA identified any features in their engine room that would have had a direct influence on the fire and the ability of the watermist system to suppress the fires and subsequently recreated them within the IMO Test facility. These included:

1. Chamfered ceiling – constructed from corrugated sheeting suspended from a unistrut frame.
2. Suspended walkway – constructed from scaffolding frame and steel scaffold planks.
3. Stairs upper level – constructed for scaffolding and steel scaffold planks.
4. Mezzanine compartment – support frame and floor constructed from scaffolding, compartment walls constructed from corrugated sheets.
5. Pipework arrays – constructed from 150mm diameter spiral duct work mounted at 100mm spacing in a 4 x 3 array.
6. Rectangular duct work – constructed from 500 x 200mm rectangular cross section duct work.
7. Generic equipment block – 1800mm x 1800mm x 2500mm (width x depth x height), constructed from 1.5mm mild steel sheet.
8. Electrical enclosures – 400mm x 800mm x 2000mm (width x depth x height), constructed from 1.5mm mild steel sheet.
9. Simulated sub-compartments and corridors – constructed from stiffened corrugated steel sheet, secured to the scaffold uprights of the suspended walkway.

In general and as previously mentioned, machinery space on board a maritime vessel is usually extremely cluttered. This not only changes the percentage volume of a space, but also there is sometimes a necessity in ship design to allow ships' systems to infringe upon a manufacturer's watermist system guidance for clear space around a nozzle. In turn, this can have an impact on a watermist nozzle's ability to produce a quality mist, as it can take up to a metre for the water to successfully break up into fine water droplets. Any obstruction in this area can cause degradation in the nozzle's ability to produce fine water droplets, thus potentially reducing the system's overall ability to suppress a fire.

In order to replicate these situations in the IMO Test conducted, the FPA replicated infringements around a small number of nozzles, to test the system in a realistic environment.

Overall, the trials proved to test the system to the limit and much further than the basic IMO Test. From this testing, the watermist system bought by the client proved to be far more robust than expected, which provided the client with the assurance that watermist was the right suppression system for their application.

UKAS accreditation and beyond

The next step in ensuring that the FPA's IMO rig remains a world class facility is to gain UKAS 17025 accreditation for the 1165 test. This accreditation will provide assurance that the processes for conducting and recording the test are to a high standard and that the FPA would be able to provide certification for this test in the future. This would then lead to accreditation with the Maritime Coastguard Agency (MCA) and the test rig would join a small number currently operating around the world ❑

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