PERFORMANCE TESTING AND APPROVAL STANDARDS FOR FIRE SAFETY SYSTEMS

Results of a full-scale fire test

Submitted by the United States

SUMMARY

Executive summary: This document summarizes the results of a full-scale fire test programme conducted by the United States to evaluate the effects of fire exposure on fixed gas fire-extinguishing system agent storage containers and components located within the protected space.

Action to be taken: Paragraph 3

Related documents: 1974 SOLAS Convention, as amended; FSS Code and MSC/Circ.848

General

1 The United States has recently completed a research and development programme that evaluated the potential damage to fixed gas fire-extinguishing system agent storage containers, valves and related components when stored within the protected space and exposed to known fire sources. An executive summary of the Coast Guard Research and Development Center test report, An Evaluation of the Potential Failure Modes for Gaseous Agent Fire Extinguishing Systems Installed within the Protected Space, is set out in the annex. The full report may be accessed on the internet at http://www.rdc.uscg.gov/Reports/2007/2007-0193A-Public.pdf. The United States will also provide paper copies of the report to Members upon request.

2 The results of the research programme suggest that some extinguishing system components will likely fail in approximately ten minutes when exposed to the conditions produced during a fully developed machinery space fire. Based on this information, the test series evaluated the fire-extinguishing capability of a system where fire damage had caused the loss of a single cylinder. When the total quantity of the fire-extinguishing medium discharged was reduced to the minimum extinguishing concentration, the system was still able to extinguish tray fires, but was not capable of extinguishing heptane spray fires. As a result, recommendations are made for additional safeguards when installing systems within the protected space.
Action requested of the Sub-Committee

3 The Sub-Committee is invited to note this information in connection with its ongoing work on the FSS Code and Revised Guidelines for the approval of equivalent fixed gas fire-extinguishing systems, as referred to in SOLAS 74, for machinery spaces and cargo pump-rooms (MSC/Circ.848).

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ANNEX

AN EVALUATION OF THE POTENTIAL FAILURE MODES FOR GASEOUS AGENT FIRE-EXTINGUISHING SYSTEMS INSTALLED WITHIN THE PROTECTED SPACE

Executive summary

1 A full-scale fire performance evaluation was conducted to evaluate the risk of installing gaseous agent fire-extinguishing system components within the space they are protecting. Fire testing was carried out to identify the potential failure modes of the system and its components when exposed to typical machinery space fires.

2 The evaluation assessed the survivability of a number of halocarbon and inert gas fire suppression system components against a range of fire exposures. The results suggest that components containing plastic or rubber parts are likely to fail in approximately ten minutes, when exposed to the conditions produced during a fully developed compartment fire. An analytical assessment of various sized agent storage containers suggests that the pressure relief valves would vent the extinguishing agent during approximately the same fire exposure conditions that caused the failure of plastic or rubber parts.

3 A series of heat flux mapping tests were also conducted to identify the potential exposures to system components at various locations throughout a machinery space, considering a range of fire sizes. The results of the mapping and component testing were analyzed to identify situations that could potentially damage the system. The assessment developed the minimum required safe separation distance needed to prevent a single fire from damaging more than one agent storage container, as a function of the total compartment volume. The assessment also showed that unprotected cylinders located high in the space would fail in about ten minutes for a majority of the likely fire scenarios.

4 Based on these findings, a test was conducted to determine if the loss of an agent storage container in the protected space would prevent the system from extinguishing a fire. The current design requirements in the Revised Guidelines for the approval of equivalent fixed gas fire-extinguishing systems, as referred to in SOLAS 74, for machinery spaces and cargo pump-rooms (MSC/Circ.848) consider a single failure involving the loss of one container to be an acceptable consequence. This is based on the consideration that the system is still capable of discharging the minimum extinguishing concentration of agent. The test was conducted in a 500 m³ test room in accordance with circular MSC/Circ.848, using containers connected to a short length of unbalanced discharge piping. The system, when tested flowing the minimum extinguishing concentration, was unable to extinguish a 1.1 MW obstructed heptane spray fire located on the side of the diesel engine mockup.

5 The test results show that the loss of an agent storage container is not an acceptable single failure condition, and systems installed within the protected space should be designed and installed in a manner to ensure that the design concentration of agent (1.3 times the minimum extinguishing concentration) can be discharged under all expected fire scenarios.
6 The test results indicate that the installation of agent storage containers within the protected space should be limited to applications where the use of a manif oled system located outside the space is not possible. If the system is to be installed in the protected space, additional safeguards should be considered, including:

.1 the agent storage containers should be located within A-30 rated steel enclosures;

.2 the agent storage containers should be located low in the space, preferably at the lowest deck level;

.3 the agent storage containers should be separated by the minimum separation distances defined in the report to minimize potential fire damage; and

.4 the system should be arranged to allow discharge within ten minutes of fire occurrence to ensure that it will not be damaged by fire exposure.