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Book of Abstracts
November 2-5, 1998

Kellie Ann Beall, Editor

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Gaithersburg, Maryland 20899

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Flammable Liquid Storeroom 1: Halon Alternatives Technology Testing Results

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The Navy Technology Center for Safety and Survivability (NTCSS) has performed extensive intermediate scale and full scale research focusing on the evaluation of Halon replacement agents, i.e., in kind gaseous agents. Test have been conducted in shipboard machinery spaces and Flammable Liquid Storerooms (FLSRs) in which the primary fire threats are pressurized flammable liquids and three dimensional fuel leaks, respectively. This testing included initial candidate agent screening, detailed candidate technology evaluation, and the quantification of the suppression characteristics of HFC-227ea, heptafuoropropane (HFP), the Navy's clean agent halon replacement of choice.[1] The current focus of the Halon Alternatives Program is on the evaluation of self contained Halon Alternative Technologies for future shipboard implementation. These technologies fall into two groups: the first being those technologies which combine powder with HFP, the second being self contained water mist systems (with variations). Currently, testing is ongoing to quantify the performance of those technologies utilizing a blend of HFP and powder. Evaluation of self contained water mist technologies is slated to begin in the near future.

Alternative technology tests are conducted at the Naval Research Laboratory's Chesapeake Bay Detachment (CBD). Testing is currently being conducted in a 28 m^3 (1,000 ft^3) compartment representative of many of the smaller shipboard FLSRs. Tests being conducted simulate both an empty FLSR and an obstructed FLSR filled with mockups of fuel containers (sealed five gallon containers). The fuel used is a mixture of 80% methanol and 20% *n*-heptane. This mixture is designed to both challenge the suppression limits of the technology (i.e., the HFP cup burner value of 6.6% v/v HFP for *n*-heptane, 8.9% v/v HFP for methanol, and 8.3% v/v HFP for the mixture)[1] and to facilitate easy identification of fires through visible and IR cameras.

The primary fire scenario used for alternatives testing simulates a three dimensional, cascading fuel leak forming a pool on the deck of the compartment. This is accomplished through a metered fuel leak above deck level, coupled with a fuel pan near the deck to simulate pooled fuel, resulting in a combined fire size of near 200 kW. Eight small, telltale fires (on the order of one kW)[1] are placed around the compartment to gauge agent distribution within the compartment. The

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baseline alternative test scenario consists of ventilation for four minutes with small fires burning, then ventilation shutdown in anticipation of fire ignition at twenty seconds before agent discharge, followed by agent discharge at five minutes into the test. After agent discharge, ventilation dampers and fans remain closed for fifteen minutes, and then are activated for a final fifteen minute venting period. Testing utilizes a short, twenty second preburn instead of the longer, two minute preburn utilized in FLSR 1 testing. Although the longer preburn is more representative of an actual shipboard scenario, the shorter preburn is chosen in order to limit oxygen depletion in the compartment and challenge the limits of the alternative technology.[2] Reignition attempts are performed at both the cascading level and at the fire pan during hold time and during the final venting period. These reignition attempts are used both to gauge the effectiveness of the alternative technology in inerting the fire environment and to gain valuable data on compartment reclamation efforts, such as early entry by firefighting personnel.

Fuel leaks, ventilation, and alternative technology activation, are controlled remotely by the Experiment Running Personal Computer (ERPC). Thermocouples, located in trees at two compartment locations as well as placed throughout the compartment shelving, are used to quantify the temperature distribution. Analyzers continuously measure agent, oxygen, combustion products, and halide acid gases produced from interaction of agent and flame. Discrete (in time) gas measurements are taken for later analysis by gas chromatography. Fourier Transform Infrared Spectroscopy (FTIR) is also used to quantify acid gas content and to measure agent and methanol concentrations within the compartment. Suppression and reignition times are determined both through observation on infrared and visible cameras, and through temperature analysis.[1]

The results of alternative technology testing will be compared with results from baseline HFP testing in order to determine the advantage gained or lost through use of each technology. Technologies will be evaluated on the basis of their suppression performance and reignition protection, i.e, suppression and reignition times. The space and weight requirements of candidate technologies will also be weighed against that of an HFP fire suppression system. Compartment tenability concerns, as well as the residue and associated cleanup after discharging nonclean agents (e.g., powders or water) will also be addressed during final evaluation.

Results will be presented from technologies blending HFP and powders, and results from self contained water mist testing will be presented as available.

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