Technical Report Documentation Page

1. Report No.	2. Government Accession Number	3. Recipient's Catalog No.
CG-D-05-99	ADA362577	

4. Title and Subtitle

Fire Safety Analysis of the 270' WMEC Medium Endurance Cutter

5. Report Date

OCTOBER 1998

6. Performing Organization Code

Project No. 3309.88 / UDI 18

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8. Performing Organization Report No.

R&DC 20/97

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10. Work Unit No. (TRAIS)

SHRD Report No. 116

11. Contract or Grant No.

DTCG39-96-F-E00073

12. Sponsoring Organization Name and Address

U.S. Department of Transportation
United States Coast Guard
Systems (G-S)
Washington, DC 20593-0001

13. Type of Report & Period Covered

Final Report
June 1996 – October 1998

14. Sponsoring Agency Code

Commandant (G-SEN)
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15. Supplementary Notes

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16. Abstract (MAXIMUM 200 WORDS)

This report documents the results of a comprehensive fire safety analysis of the 270' WMEC Medium Endurance Cutter. The Ship Fire Safety Engineering Methodology (SFSEM) and associated computer program, SAFE version 2.2, were utilized as an analytical tool to perform the analysis. The SFSEM is a probabilistic based fire risk analysis methodology. It is useful to conduct a structured and comprehensive analysis of the performance of all types of surface ships as a fire safety system. The SFSEM provides an integrated framework for analyzing fires on ships in comparison to established fire safety objectives. It accounts for all relevant aspects of fire safety including the growth and spread of fire, the effectiveness of passive design features such as barriers, and active fire protection features such as fixed and portable fire extinguishing systems, as well as manual fire suppression.

SAFE implements the SFSEM and evaluates the probability of space and barriers limiting a fire. The evaluation is conducted on a compartment-by-compartment basis. SAFE calculates the probable paths of fire spread for a user-specified time duration. SFSEM/SAFE has been successfully used to analyze the fire safety design of existing, as well as proposed ships.

The input data was based on information collected during a ship visit to the CGC SPENCER (WMEC 905) during the period 22-24 July 1996. Baseline fire safety analysis results show that with all passive and active fire protection features in effect, all compartments in the cutter exceed established fire safety objectives, both in port and at sea. With just passive fire protection in effect (without considering automated or manual fire protection), one compartment in the 270' WMEC fails to meet fire safety objectives in port and sea. Passive protection must be augmented by manual fire protection for all compartments to meet or exceed fire safety objectives in port and at sea.

Probable rooms of origin for fires that may spread to involve multiple compartments include the Engine Room, 3-103-0-E, and the Auxiliary Machinery Spaces (2-82-0-E and 3-82-0-E). A careful analysis of the results from the various output options in SAFE provided in this report may be effectively used to develop realistic fire scenarios to assist the crew in planning firefighting training drills.

17. Key Words	18. Distribution Statement
fire protection, cutter, fire safety, ship fire, engineering methodology	This document is available to the U.S. public through the National Technical Information Service, Springfield, VA 22161

19. Security Class (This Report)	20. Security Class (This Page)	21. No of Pages	22. Price
UNCLASSIFIED	UNCLASSIFIED		

EXECUTIVE SUMMARY

This report documents the results of a comprehensive fire safety analysis of the 270' WMEC Medium Endurance Cutter class as part of the Fire Safety Analysis of Cutters project. The Coast Guard selected CGC SPENCER (WMEC 905), Boston, MA, as representative of the class to be analyzed.

The Ship Fire Safety Engineering Methodology (SFSEM) and Ship Applied Fire Engineering (SAFE v2.2) computer program were utilized as an analytical tool to perform the analysis. The SFSEM is a probabilistic based fire risk analysis methodology, which provides an integrated framework for analyzing fires on ships in comparison to established Fire Safety Objectives (FSO). The SFSEM accounts for all relevant aspects of fire safety including the growth and spread of fire, the effectiveness of passive design features such as barriers, and active fire protection features such as fixed and portable fire extinguishing systems as well as manual fire suppression.

SAFE implements the SFSEM and evaluates the probability of spaces and barriers limiting a fire. The evaluation is conducted on a compartment-by-compartment basis. SAFE calculates the probable paths of fire spread for a user-specified time duration. SFSEM/SAFE has been successfully used in the past to analyze the fire safety design of existing, as well as, proposed ships.

SAFE input data were based on information collected during a ship visit to CGC SPENCER during the period 22-24 July 1996. In addition to collecting information necessary to develop the input data to run SAFE, a fire safety audit was conducted during the ship visit. The fire detection system consists of a zoned system that is subject to frequent false alarms with several detectors located within ventilation ductwork, which the crew seemed unaware of. There is a potential problem with the secondary means of egress from the Ordnance Workshop (2-40-1-Q). Several decks contain joiner bulkheads that terminate at the drop ceiling rather than continuing all the way to the deck above. This increases the likelihood that fire and smoke could travel between these spaces. Open doorways between the Crew Mess, Scullery and Galley also create one open room for smoke and fire to travel in.

Baseline fire safety analysis results in previously analyzed cutters indicate that fire protection levels in most compartments, with passive, automated, and manual fire protection measures in effect, generally meet fire safety objectives. Results of the baseline fire safety analysis of the 270' WMEC are consistent with these results and are in agreement with historical records for fires in U.S. Coast Guard cutters. With just passive fire protection in effect (without considering automated or manual fire protection), one compartment in the 270' WMEC fails to meet FSOs and one is very close to failing to meet FSOs. Passive protection, augmented by manual fire protection improves the margin of safety such that all compartments meet or exceed FSOs. Passive protection, augmented by automated fire protection, slightly improves the margin of safety (i.e. one compartment fails to meet FSOs and one is very close to failing to meet FSOs) due to the general lack of automated fire protection systems installed in the 270 WMEC.

By exercising the various output options available in SAFE, insight into probable rooms of fire origin and the sequence of compartments that are likely to be involved in fire paths from

these rooms may be obtained. Results indicate that the most probable rooms of origin for fires that may spread to involve multiple compartments include the Engine Room (3-103-0-E) and the two Auxiliary Machinery Spaces (2-82-0-E and 3-82-0-E). A careful analysis of the results from the various output options in SAFE documented in this report may be effectively used to develop realistic fire scenarios to assist the crew in planning fire fighting training drills.

Two issues were studied in the analysis of alternatives phase of this project. First, an analysis of the non-continuous joiner bulkheads permits insight into the magnitude of the impact on the overall fire safety of the cutter. Second, the hypothetical installation of automated fire protection systems in the Engine Room and Auxiliary Machinery Spaces was studied to determine and quantify the improvement in baseline fire safety levels. CO_2, FM-200 (Halon Alternative), Water Mist and AFFF Sprinkling systems hypothetically installed in the Engine Room and Auxiliary Machinery Spaces were studied. The following are the major conclusions from this phase of the project:

Non-Continuous Joiner Bulkhead Study:

- While eliminating all non-continuous joiner bulkheads (i.e. modeling all joiner bulkheads continuing to the underside of the deck above) increased the vessel's margin of fire safety, it was only a slight increase.

Alternative Automated Systems:

- Addition of any alternative automated suppression system (FM-200, Water Mist, or CO2) in the Auxiliary Machinery Spaces results in only a slight increase in the vessel's margin of fire safety.

- The results of this analysis show that, while the installation of an automated system in the Engine Room improves the margin of safety, the Engine Room presently exceeds fire safety objectives without an automated system by relying on existing passive and manual fire protection efforts. Also of importance is that this class of cutter was not designed or constructed to meet current SOLAS/CFR requirements for automated fire protection systems in the Engine Room as some recent Coast Guard cutters have been. These two facts support maintaining the current configuration of Engine Room fire protection features. It is noteworthy that the current practice of installing automated suppression systems in Engine Rooms arises from loss history, which indicates that the majority of costly fires originate in Engine Rooms. This is indicative of the substantial threat of a class B fire. Moreover, a large fire in the Engine Room would undoubtedly render the cutter unable to conduct Coast Guard missions for a significant period of time until costly repairs could be accomplished. These potential impacts must be weighed against the relative cost of retrofitting this class of cutters with an automated suppression system in the Engine Room.

The appendices in this report include the AutoCAD drawings and comprehensive tables of input data used to populate the baseline data set in SAFE. The detailed spreadsheets for calculating the probabilities of flame termination are included as supporting data. SAFE outputs from running the target, barrier, and path output options that comprise the baseline fire safety analysis results are also documented. The output data from the analysis of alternatives phase are also included.