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United States Coast Guard

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January 9, 2013

MEMORANDUM

From: J.W. MAUGER, CAPT
COMDT(CG-ENG)

Reply to Attn of: LCDR J. Miller (202) 372-1372

To: J. A. SERVIDIO
COMDT(CG-5P)

MR. PAUL BELFORTI
PRESIDENT, PASSENGER VESSEL ASSOCIATION

Subj: FINAL DELIVERABLES: 5A POLICY WORKING GROUP

This memo delivers the final report of the subject workgroup for your review and approval at the Spring 2013 Passenger Vessel Association – US Coast Guard Quality Partnership meeting. The Team Leaders for this workgroup unanimously recommend that you approve this report.

Background: In 2011, this workgroup was chartered to "*explore possible methods of validating the 5A policy in general, and to explore methods of facilitating the application of the policy to 5A vessels in the future.*" Through the workgroup, subject matter experts from the industry and Coast Guard completed a thorough review of existing policy, past and current design and construction methods, and developed new data and models to evaluate Coast Guard policy with respect to very low fire load spaces. Through this research, the work group identified a Performance Guideline which, when applied consistently with the documented assumptions in the analysis, meets the requirements in the existing policy of Change 1 of Navigation and Vessel Inspection Circular (NVIC) 9-97.

The U.S. Coast Guard Marine Safety Center is in the process of incorporating Enclosure (2) into a technical note to guide plan reviewers in the proper application of Coast Guard policy on this issue.

While this work group was successful in addressing design and construction issues associated with 5A spaces, it also highlighted a need to review and document best practices for operational requirements associated with very low fire load spaces.

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Encl: (1) USCG/PVA 5A Working Group Report of Study dated December 18, 2012
(2) 5A Space Performance Guidelines dated December 18, 2012
(3) USCG/PVA 5A Policy Work Group Leadership Memo dated December 18, 2012

Copy: COMDT(5PS, 5PC, CVC)
USCG Marine Safety Center
Mr. John Duclos, Gladding-Hearn
Mr. Archie Nichols, Nichols Brothers
Mr. Pete Lauridsen, Passenger Vessel Association

USCG/PVA 5A WORKING GROUP REPORT OF STUDY

December 18, 2012

Background: The "5A policy", first established by policy letter in 1994, is a relaxation of structural fire protection requirements in Subchapter K for A-60 boundaries between certain passenger spaces and areas of refuge, embarkation areas, external escape routes, and other adjacent spaces. The policy is conditional upon the use of a very low design fire load in the 5A space as well as other design and operational requirements. By controlling the fire load, vessel designers and operators are able to use aluminum construction with minimal insulation thereby reducing vessel weight and increasing operational efficiency.

Since 1994, substantial increases in size, complexity, and furnishings of Subchapter K passenger boats raised Coast Guard concerns about the assumptions and safety margins inherent in the 5A policy. At the same time, significant advances in computational fire modeling capabilities enabled the Coast Guard and designers to take a more thorough look at the issue. In 2010, Change-1 to Navigation and Vessel Inspection Circular (NVIC) 9-97 "Guide to Structural Fire Protection" revised the 5A policy to require designers to submit a performance-based engineering analysis to support the relaxation of the fire protection requirements for 5A spaces. Given the potential costs and complexity involved with performing such an analysis, the Coast Guard and the Passenger Vessel Association agreed to form a working group, under the aegis of the USCG/PVA Quality Partnership, to study this issue with the intent to identify "pre-approved" arrangements for 5A spaces which may be accepted in lieu of a full engineering analysis. The working group was chartered in Fall 2011, with the goal of delivering a report to the QP in Fall 2012.

Report of Study Overview: The USCG/PVA 5A Working Group developed a method of validating the 5A policy using current fire protection engineering analysis techniques. The validation method completed by the group included the following:

a. Select a representative 5A vessel for the analysis;

b. Construct a Fire Dynamics Simulator (FDS) computer model of the test vessel and define the assumptions of the simulations;

c. Employ a Coast Guard graduate student at the University of Maryland College Park (UMCP) to develop and complete an experiment to fire test select materials to collect heat release rate data for the fire modeling;

d. Conduct FDS simulations for the test vessel with fire data obtained from the UMCP experiment program and interpret the results; and

c. Develop performance-based guidelines taking into account the results of the FDS simulations.

Test Vessel and FDS Model: The group selected the M/V IYANOUGH (O. N. 1185366) as the 5A test vessel. This vessel, operated by the Massachusetts Steamship Authority (one of the key operational partners in this working group), was deemed to be representative of the state-of-the-art of current 5A vessels in passenger service. The M/V IYANOUGH is a 144.5' long aluminum vessel certificated to carry 393 passengers. A two-deck model with an interior staircase and an un-insulated aluminum deck between the two spaces was constructed in FDS of the M/V IYANOUGH passenger spaces. Working group representatives from USCG Headquarters, the Marine Safety Center, and Gladding-Hearn Shipbuilding visited the vessel in order to observe arrangements and record the as-built dimensions. An FDS model of the vessel was constructed from the general arrangement plans and the as-built observations and measurements.

UMCP Experiment Program and FDS computer simulations: A thesis completed by a UMCP graduate student determined the burning characteristics and heat flux dependent ignition time of certain materials representing the primary fire loads aboard the M/V IYANOUGH. This data was obtained by completing cone calorimeter testing on the seat cushion foam and fabric provided by the vessel seat manufacturer. A majority of the foam used in the seats had a density of 38 kg/m^3, a combustible weight of approximately 1.7 kg, and a tear factor of 200 N. This type of foam was used for testing and assumed to be the main fire load contributor. There are a select few other types of foam with slightly different properties used in the seats in small quantities to prevent excessive compression and provide additional comfort. These foams were not tested because they were not assumed to be a main fire load contributor. The fabric on the seats was available in an assortment of designs and colors, but the type of fabric was a consistent blend of 60% worsted wool and 40% polyester.

The material properties, measured through experimentation, were entered into the FDS model to determine what effects a burning seat cushion would have on other combustibles within the 5A space. FDS simulations of the two-deck M/V IYANOUGH model were conducted via multi-processor computer using these seat material ignition time data sets. In conjunction with running the FDS simulations at the exact dimensions and fire load of the M/V IYANOUGH, additional simulations were completed with 2 and 3 times the fire load as well as variations in compartment volume and placement of the fire loads. The performance criteria during the 60 minutes after detection of the fire for the FDS model 5A space were as follows:

a. The aluminum deck underneath the area of refuge must not reach 200°C over any square meter;

b. No single point of the deck will reach 400°C; and

c. The refuge area (second deck of the model) will remain free of smoke.

Report of Study Results: The experimental program and fire modeling conducted in cooperation with UMCP determined that, without suppression, a fire starting in a single seat will spread to a maximum of 10 seats (2 rows of 5) for the base case (as built) arrangement. This conclusion is based on:

a. A fire involving an individual seat (that meets the requirements below) will likely ignite adjacent seats that are less than 12" away;

b. A fire involving a single row of seats (with a maximum of 5 seats) will likely ignite seats in an adjacent row in a back-to-back arrangement regardless of the angle of the seat;

c. Rows facing the same direction will not ignite an adjacent row provided the distance between rows is greater than 30" (measured front to front);

d. Rows facing each other will not allow fire spread provided the knee gap is greater than 18" (measured front to front) apart AND tables or other intervening furnishings are "fire resistant" per 46 CFR 116.423;

e. Carpet or other floor covering meeting the low flame spread requirements of IMO FTP Code Annex 1 Parts 2 and 5 (for floor coverings) will not become involved in a fire originating on seating meeting the requirements of this policy.

These results form the basis for a set of performance guidelines that can be used by industry, as an alternative to a full performance-based analysis to obtain a relaxation of the structural fire protection required for areas of refuge, embarkation areas, and external escape routes. This report of study did not address every possible scenario involving the use of 5A spaces aboard passenger vessels. Arrangements not addressed in the guidelines may require additional performance-based analysis.

References/Accompanying Documents:

a. USCG/PVA 5A Working Group Charter;

b. Fire Growth Evaluation for Regulations of Fire Severity for Type 5A Spaces on Sea Fairing Vessels (UMCP Thesis by Noel Thomas Shriner, FPE, 2012); and

c. 5A Space Performance Guidelines.

5A Space Performance Guidelines

December 18, 2012

Introduction: These performance guidelines are intended to guide designers and operators in the design and maintenance of Type "5A" spaces as equivalent to the structural fire protection requirements in 46 CFR Subchapter K. Where NVIC 9-97, Change 1 (Guide to Structural Fire Protection) calls for a performance based analysis, these guidelines may be used instead. However, deviation from the performance guidelines may require a more detailed analysis as these guidelines do not address every vessel configuration. These guidelines were developed based on fire test data and subsequent computer analysis as documented in the Report of Study dated December 18, 2012.

a. **5A Space Requirements and Conditions**

1) Transient fire load must be controlled:
    a. To prevent a fire from extending past the row of origin.
    b. To prevent the obstruction of aisles or escape paths.
    c. Not to exceed a combustible weight of 0.5 lb/ft^2.
2) Seating density and restrictions:
    a. No more than 5 contiguous seats in a row. Each group of contiguous seats must be separated by an aisle or bulkhead.
    b. No more than 300 seats in any space.
    c. Seats must be fixed and arranged to comply with 46 CFR 116.820.
    d. A 5A space with an interior or exterior refuge area directly above is limited to a maximum enclosed volume of 24,750 ft^3 (700 m^3).
    e. A 5A space with an interior or exterior refuge area directly above is limited to a minimum enclosed volume of 8,830 ft^3 (250 m^3).
    f. The minimum acceptable distance between rows facing the same direction (measured front to front) is 30 inches.
    g. The minimum acceptable distance between rows facing each other (the "knee-gap") is 18 inches.
    h. Tables and other intervening furnishings must be "fire resistant" per 46 CFR 116.423.
    i. Back to back seating arrangements of a maximum of 10 total seats are permitted (i.e. two rows of 5 seats can be placed back to back with no restriction on the minimum acceptable distance between them).
    j. The combustible fire load in the space from construction and outfitting materials does not exceed 5 kg/m^2 (1 lb/ft^2).
3) All carpet or other floor coverings must meet the low flame spread requirements of IMO FTP Code Annex 1 Parts 2 and 5 (for floor coverings).
4) Primary engine room access must not open to a 5A space or any corridor directly accessing a 5A space.
5) The following conditions must be met per NVIC 9-97, Change 1, Section 4.2:
    a. Fire load calculations, in accordance with section 4.3 of NVIC 9-97, Change 1, must be used to demonstrate compliance with the limits set in this guideline. Unless they are included in the fire load calculation, life jackets must be stored in closed, non-

perforated, noncombustible containers, and all electrical cable insulation must be located behind non-perforated, noncombustible ceiling panels or bulkhead linings.

b. Any installed interior finishes or trim must be approved under approval series 164.012, 164.112, 164.009, or 164.109.
c. Furniture and furnishings, draperies, curtains, rugs and carpets must be fire resistant in accordance with 46 CFR 116.423. Additionally, all upholstery, padding and cushions must be fire resistant. Case furniture must be constructed entirely of noncombustible materials, except that interior finish materials or paint approved under approval series 164.012 or 164.112 may be applied to exposed horizontal surfaces.
d. Any aluminum frame windows fitted in the bulkheads used to separate refuge areas, lifeboat embarkation stations, or escape routes from type 5A spaces must be either Coast Guard approved A-0 windows, or provided with steel retaining clips. Ordinary glass (tempered or laminated) with steel clips are acceptable for the exterior bulkheads of 5A spaces located below or adjacent to areas of refuge.
e. The aluminum deck of a 5A space does not require top-side A-class insulation.
f. A USCG type approved fire detection and manual fire alarm system must be installed in accordance with 46 CFR 118.400. Smoke detectors must be fitted in all accommodation, control stations and service spaces.
g. A fire pump and fire main system complying with 46 CFR 181.300-320 must be installed for vessels greater than 19.8 m (65 feet).
h. The shell plating and framing below the main deck must be A-0 construction for a distance that extends at least 300 mm (12 inches) below the lightest load waterline. Insulation is not required for voids and fuel tanks meeting conditions (i) and (j) below.
i. Fuel tank boundaries may be un-insulated aluminum or steel construction provided:
    i. the fuel tank boundaries are not adjacent to a potential source of ignition, or
    ii. fuel tank boundaries are not adjacent to a space containing more than 2.5 kg/m^2 (0.5 lb/ft^2) fire load. Sight glasses, when permitted by Subchapter F, should be constructed in a manner to preserve the fire integrity of the bulkhead and shall comply with 46 CFR 58.50-10(a) (6).
j. Voids and other spaces where the fire load does not exceed 2.5 kg/m^2 (0.5 lb/ft^2) and constructed of steel or aluminum do not require insulation.
k. Stairs and ladders located entirely within a type 5A space or stairs located entirely within a stair tower enclosure may be constructed of un-insulated aluminum or steel.
l. 5A vessels may be allowed excursion permits if the proposed function is within the approved arrangement and fire load assumptions. If the excursion is a food event, the food is to be prepared ashore and brought aboard for serving (no cooking aboard).
m. In public areas, one A-II portable fire extinguisher must be provided for every 45 m^2 (500 ft^2) of deck area or fraction thereof.

6) Seat construction restrictions:
    a. Must have noncombustible frames.
    b. Total combustible weight of each seat must not exceed 1.75 kg. For bench type seating, assume at least 18 inches of bench width per seat.

c. Cushions and upholstery must be tested and be determined to be fire resistant in accordance with the following:
   i. Composite system of chairs meets UL 1056 (withdrawn) or CAL TB 133; or
   ii. Individual component tests may be considered equivalent if cushions and other padding meet CAL TB 117, and upholstery meets NFPA 701; or
   iii. FTP Code, Annex 1, Parts 7 and 8.

b. Equivalence Allowed (Provided the requirements and conditions listed above are satisfied, the following arrangements may be accepted)

1) SFP boundaries between 5A spaces and refuge areas may be non-combustible and smoke tight (C') in lieu of A-0 bulkheads required by 46 CFR 114.400.
2) Up to 0.5 lb/ft^2 of the weight of floor coverings that meet the IMO FTP Code Annex 1 Parts 2 and 5 may be excluded from the 1 lb/ft^2 fire load limit.
3) Stanchions within a 5A space that support a deck between two 5A spaces may be of un-insulated aluminum construction.
4) Bathrooms with a single toilet and sink with vanity, that do not have storage provisions for other materials, may be considered part of the space in which they are located, and not necessarily a separate type 8 space.
5) Consistent with the treatment of areas of refuge on other U.S. passenger vessels, the space above need not be considered an area of refuge for the purposes of a fire in a space, if there is sufficient refuge located elsewhere on the vessel.

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December 18, 2012

MEMORANDUM

From: USCG/PVA 5A POLICY WORK GROUP TEAM MEMBERS

Reply to Attn of: CG-ENG-4 LCDR J. Miller (202) 372-1372

To: USCG/PVA 5A POLICY WORK GROUP TEAM LEADERS

Subj: APPROVAL OF FINAL DELIVERABLES

Please review the enclosed report of the workgroup's activity and draft performance guidelines to be incorporated into Coast Guard plan review and inspection policy.

Please sign below to indicate your approval of the enclosures. Once fully signed, a copy of the enclosures and this signature memorandum will be sent to the Co-Chairs of the Quality Partnership for their acceptance.

Thank you for your participation and leadership during this working group effort.

SIGNATURES:

John W. Mauger
Captain, U. S. Coast Guard
Chief, Office of Design and Engineering Standards

John P. Nadeau
Captain, U. S. Coast Guard
Commanding Officer, Marine Safety Center

John Duclos
Gladding-Hearn Shipbuilding

Archie Nichols
Nichols Brothers Boat Builders

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Encl: (1) Report of Study dated December 18, 2012
(2) 5A Performance Guidelines dated December 18, 2012