Fire Resistant Watertight Structural Doors

NSRP BP & SDMT Meeting
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Agenda

1. Project Background/Overview
2. Project Management
3. Phase I Description
4. Phase II Preparation
5. Technology Transition
Ingalls Shipbuilding

- Building four classes of ships simultaneously—11 ships currently under construction
- Sole builder of the *San Antonio*-class (LPD 17) amphibious transport docks and the *America*-class (LHA 6) amphibious assault ships
- One of two builders of DDG 51 *Arleigh Burke*-class destroyers
- Sole builder of the *Legend*-class National Security Cutters for the U.S. Coast Guard
- Largest private manufacturing employer in Mississippi – over 11,000 employees
Fire Resistant Watertight Structural Doors

The need

- Structural doors aren’t fire resistant, and fire resistant doors aren’t structural (i.e., watertight)
- We need a door that is both fire resistant AND watertight
Overview

*Fire Resistant Watertight Structural Doors*

**The Big Idea**
- Structural doors aren’t fire resistant, and fire resistant doors aren’t structural (i.e., watertight)
- We need a door that is both fire resistant AND watertight

**The Plan**
- Start with the new family of Navy watertight doors
- Research: Testing of various configurations
- Test: Qualification Testing for Fire in Phase II
- Implement: Revise drawings

2020
2020
2021
2022
The Team

Ingalls Shipbuilding
Parisa Ghandehari, John Walks, Michael Thompson, Tim Gates

STI Marine
Terry Mannion, Julio Lopes

Southwest Research Institute
Karen Carpenter, Kyle Fernandez

NAVSEA/NSWC
Usman Sorathia, NSWCCD Code 612
Brian Griffin, NAVSEA 05
Kurt Hartsough, NAVSEA Philadelphia Code 333

ATI
Jim House, NSRP Project Manager

Newport News Shipbuilding
Alicia D’Aurora Harmon, Program Technical Representative
The Roadmap

**PHASE 1**

**Task 1**
- Project Initiation

**Task 2**
- Validate requirements with NAVSEA
- Perform risk reduction test
- Submit test report

**Task 3**
Develop Door Test Plan

**Task 4**
Execute Door Testing:
- Fire test
- Hydrostatic test
- Shock testing mounting method

**PHASE 2**

**Task 5**
- Compile test results
- Pursue NAVSEA approvals

**Task 6**
- Revise drawings
- End of project
Phase 1

Project Initiation
Material Selection

Fire testing of materials at component level, intumescent expansion

E-Wrap Marine
- Flexible material - easy to install, even on small diameter cable bundles
- Compact - few layers required for protection
- Endothermic - releases chemically bound water to have a cooling effect
- Low Density - weighs less than competing wraps
- Tested to ASTM E1725 for circuit integrity
- Performance Criteria - Circuit Integrity Protection
- Standards - ASTM E1725
- Values - 1 and 2 hour ratings

MWS Marine Wrap Strip
- Provides rapid intumescent expansion
- Forms flexible, water-resistant seals

MFS - Marine Firestop Sealant
- Provides rapid intumescent expansion
- Forms flexible, water-resistant seals
Preparation

Exploratory fire testing of materials at door level at STI Marine

18x36 Pre-delivery

E-Wrap pin welded to steel
Fire Testing

Exploratory fire testing of materials at door level at STI Marine

30 Minutes into fire test – unexposed side

View of door inside
Observations

Post test - fire side

Door opened from non-fire side
Observations

- MWS Wrap Strip around door flange
- Wrap Strip Expansion & Dog
- MFS Sealant around Hinges

BEFORE

AFTER
Thermocouples Readings

MIL-STD-3020

Transmission of heat shall not raise any individual temperature measurements 181°C (325 °F) above the initial temperature. The average temperature rise is not relevant.

267°F
291°F
279°F
253°F
260°F
Final Test Plan

Test plan developed and approved

Figure 1. SwRI’s Large-Vertical Furnace.
Phase 2

Approval and planning for Phase 2
Qualification Tests

- Doors already shock qualified
- A small scale shock test will be performed on the mounting method of fire resistant material on the door

- Performed a risk reduction test on a small door
- Fire tests will be performed based on MIL-STD-3020

- Doors already passed hydrostatic testing
- A hydrostatic test will be performed after fire exposure
- Acceptance criteria is not clear
Shock Test

*Developing lightweight shock test procedure*
Developing Test Fixture

Test fixture design for 26”x66”QA and 30”x66”ID doors

26” X 66” Fire Test Door Fixture
Fabricate Qty 1

30” X 66” Fire Test Door Fixture
(Fabrication Not Required)

All dimensions are the same in the 30”x66” test fixture. Orient the door sump for fire testing. Access for fire door cut-out should be in accordance with NFPA 80 and/or local and/or state building codes.
Hydrostatic Test

Developing test fixture design for hydrostatic test chamber
Technology Transition

- Test Reports
- Final Project Workshop Materials
  - NAVSEA drawings
    - Re-issue existing drawings
    - Instruction for insulating the doors
  - PMS cards
    - Update existing PMS card
    - Add inspection and maintenance instruction of intumescent material
- Industry discussions
**Summary**

**The need**
- Structural doors aren’t fire resistant, and fire resistant doors aren’t structural (i.e., watertight)
- We need a door that is both fire resistant AND watertight

**The plan**
- Research
  - Begin with new family of Navy watertight doors from prior NSRP project
  - Testing of various configurations of STI Marine Firestop materials
- Qualification testing for fire in Phase II

**Implementation**
- Results
  - Compile test results and pursue NAVSEA approvals
- Final product in revised drawings

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**A more elegant and cost-effective solution**