# STATUS REPORT

## DEVELOPMENT OF WATER MIST SYSTEMS FOR US NAVY SHIPBOARD MACHINERY SPACES

Robert L. Darwin (Naval Sea Systems Command)
Joseph T. Leonard (Naval Research Laboratory)
Gerald G. Back (Hughes Associates, Inc.)

Presented at the Halon Options Technical Working Conference,
Albuquerque, NM, 09-11 May 1995

# WATER MIST FIRE EXTINGUISHING S ST[illegible]

## ADVANTAGES

- Z[illegible]RO OZONE DEPL[illegible]TIO[illegible]N POT[illegible]NTIAL
- Z[illegible]RO GLOB[illegible] WARMING POT[illegible]NTIAL
- N[illegible]ON T[illegible]X[illegible]
- NON CORROSIVE (IF MADE FROM POTABLE WAT[illegible]R)
- TREMENDOUS COOLING CAPACITY

# WATER MIST FIRE EXTINGUISHING SYSTEM
## R&D APPROACH - OVERVIEW

- SMALL SCALE FIRE SUPPRESSION STUDIES WERE CONDUCTED TO DETERMINE OPTIMUM SYSTEM PARAMETERS FOR SUPPRESSION OF CLASS A AND CLASS B FIRES, INCLUDING:
  - TWO FLUID VS HIGH PRESSURE SYSTEM
  - DROPLET SIZE
  - MOMENTUM
  - CONCENTRATION, ETC.
- LARGE SCALE TESTS ARE BEING CONDUCTED IN SIMULATED MACHINERY SPACE TO VERIFY SYSTEM DESIGN AND PERFORMANCE

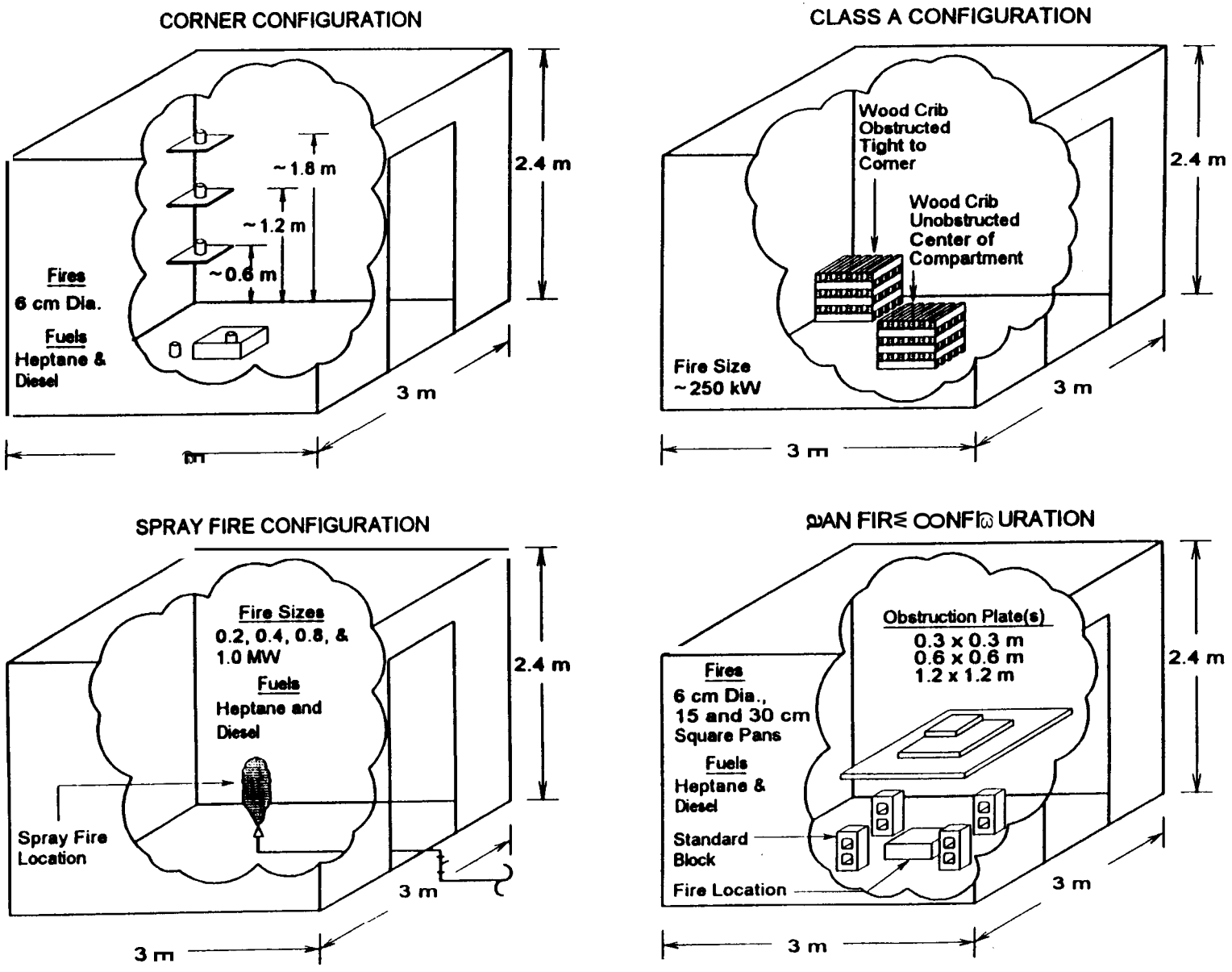



**Fig. 2 - Test fire scenarios**

# WATER MIST FIRE EXTINGUISHING SYSTEM

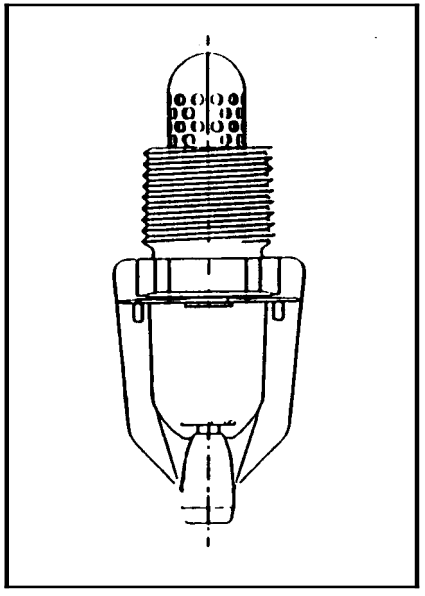
# SUMMARY OF SMALL SCALE TESTS AT CBS

---

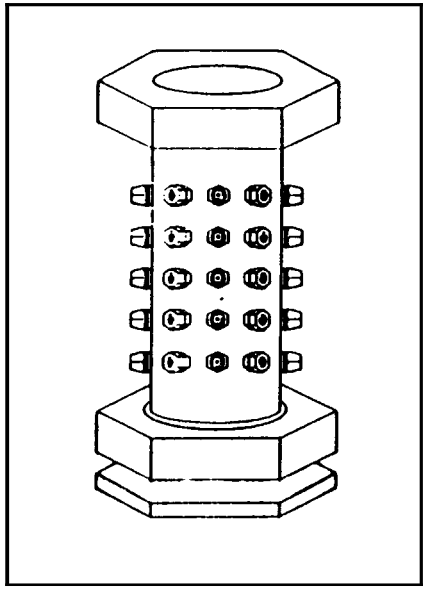
- OVER 730 FIRE TESTS WERE CONDUCTED
- TWO TYPES OF SYSTEMS WERE TESTED: DUAL FLUID AND SINGLE FLUID (LOW AND HIGH PRESSURE)
- ALL SYSTEMS TESTED EXTINGUISHED OVER 85% OF THE SPRAY AND UNOBSTRUCTED PAN FIRES
- SPRAY FIRES WERE EASIEST TO EXTINGUISH - USUALLLY WITHIN 10 SECONDS. PAN FIRES REQUIRED ABOUT 1 MINUTE FOR EXTINGUISHMENT
- OBSTRUCTED (HIDDEN) FIRES WERE DIFFICULT-TO-IMPOSSIBLE TO EXTINGUISH, DEPENDING ON THE SYSTEM

# WATER MIST FIRE EXTINGUISHING SYSTEM

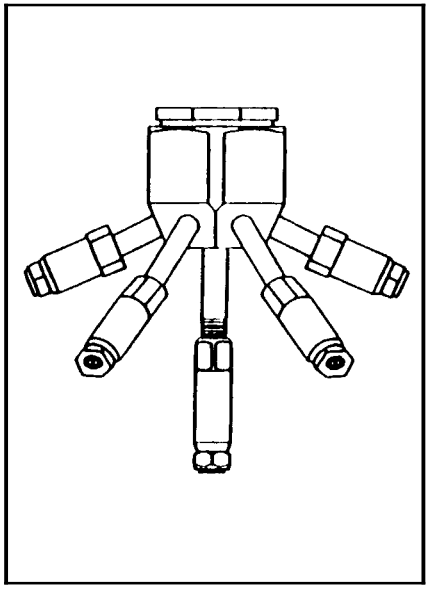
## NOZZLE SYSTEMS TESTED ON EX-USS SHADWELL



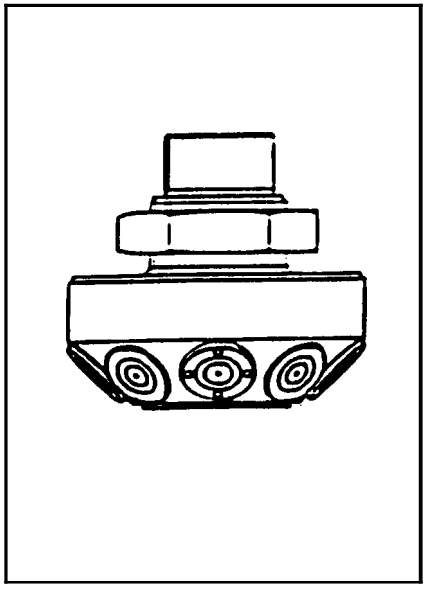
**Grinnell**
**200 psi**
**94 gpm**



**Baumac**
**1350 psi**
**72 gpm**



**Modified**
**SPRAYING SYSTEMS**
**1500 psi**
**58 gpm**



**Marioff**
**3000 ps**
**58 gpm**

# WATER MIST FIRE EXTINGUISHING SYSTEM

## FIRE SCENARIOS

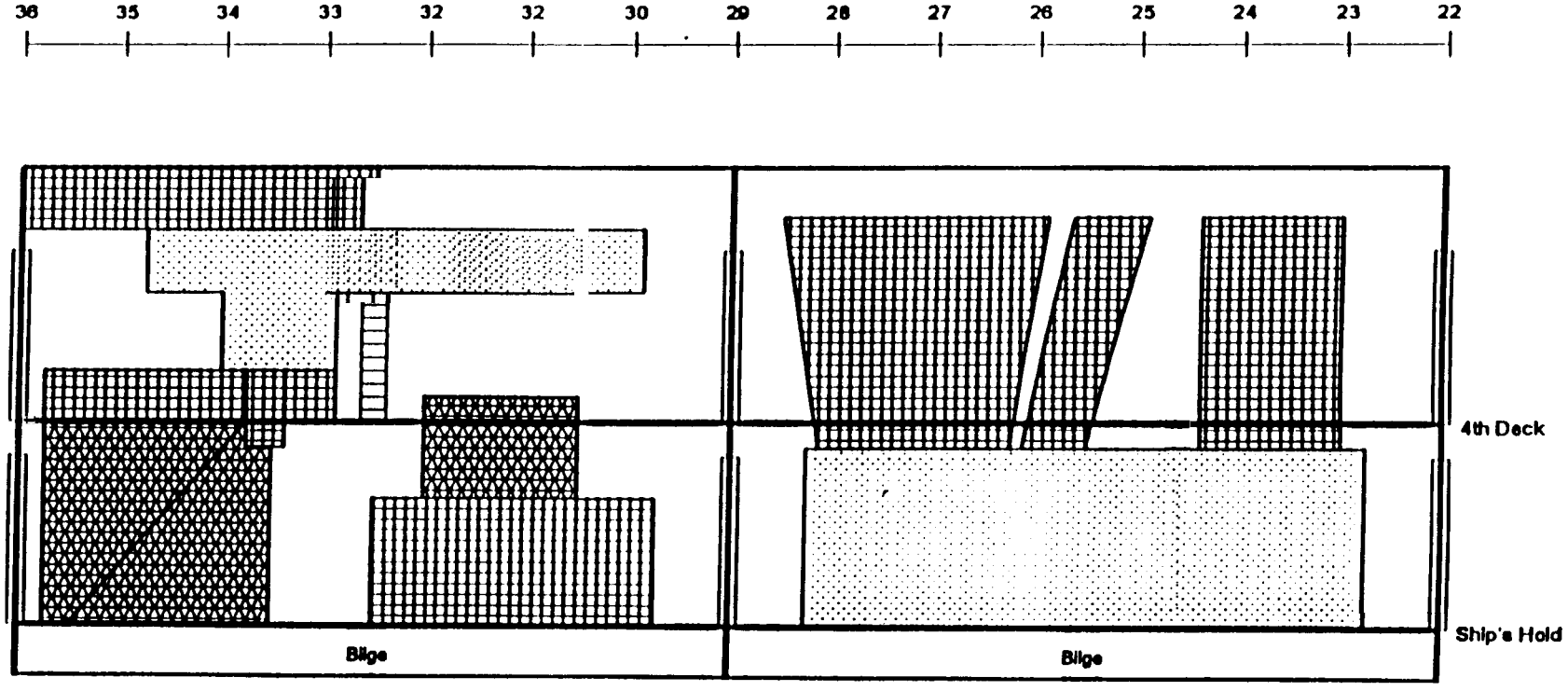
- 29 "TELL TALE" HEPTANE PAN FIRE
- HEPTANE PAN FIRES (1 FOOT SQUARE)
- SPRAY FIRE (250 kW) - SHIELDED
- SPRAY FIRE (2.5 - 6.5 MW) - UNSHIELDED

**An additional test was conducted using the modified Spraying Systems nozzles against a 10 MW Fire**

# WATER MIST TESTS ON EX-USS SHADWELL

- **PHASE I:** UNOBSTRUCTED MACHINERY SPACE
  - NOZZLES INSTALLED IN OVERHEAD ONLY
- **PHASE II:** OBSTRUCTED MACHINERY SPACE
  - NOZZLES INSTALLED IN OVERHEAD ONLY
  - NOZZLES INSTALLED AT TWO LEVELS (AS IN HALON INSTALLATIONS)
- **PHASE III:** OPTIMIZED SYSTEM (4Q95)
  - NOZZLES INSTALLED AT TWO LEVELS

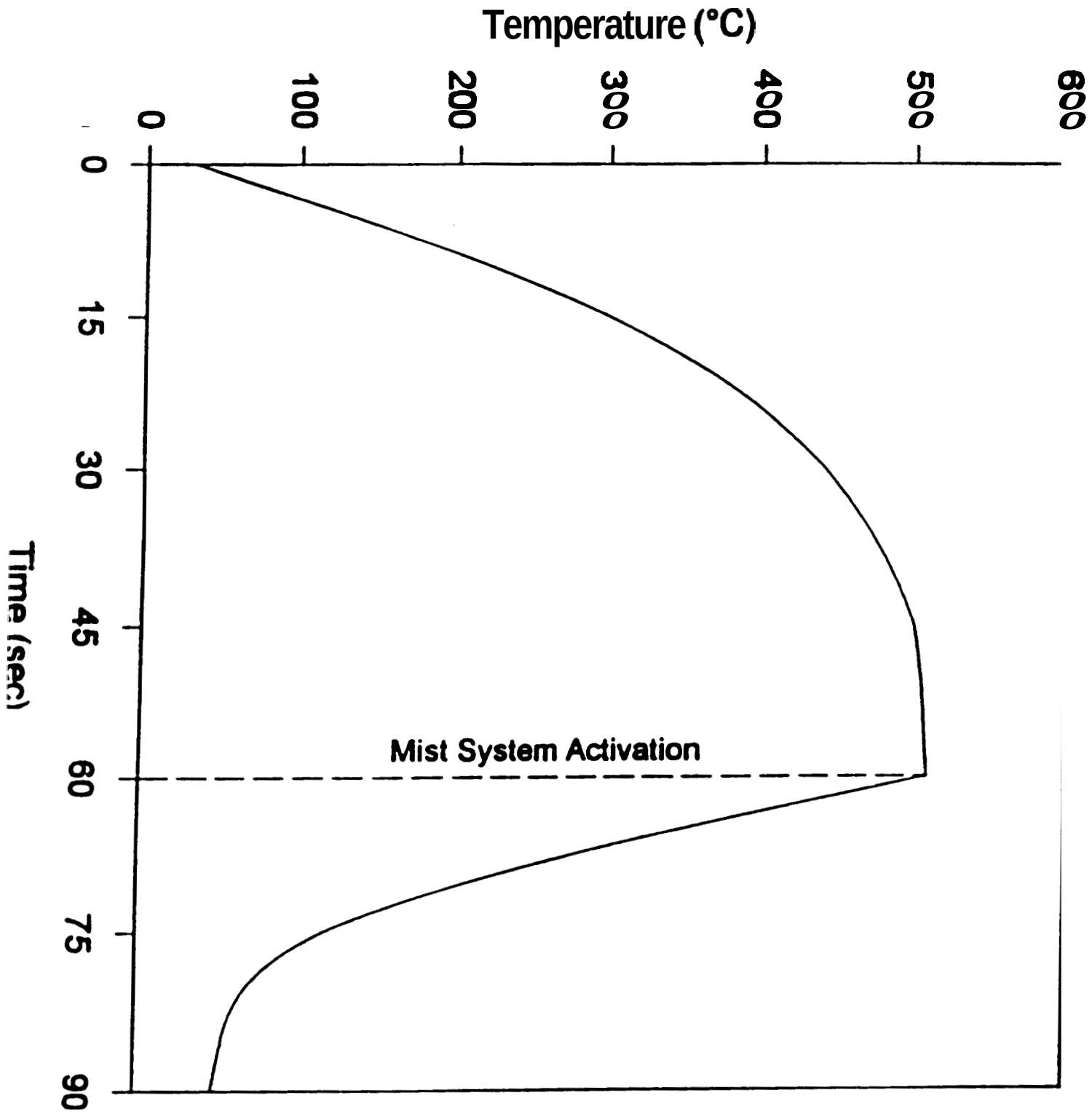
# Machinery Space Obstructions (Elevation View)



## FULL SCALE TEST RESULTS - MODIFIED COMMERCIAL NOZZLE

| Scenario | Extinguishment Time (min:sec) | | |
|---|---|---|---|
| System | Modified Commercial Nozzle | | |
| Nozzle Pressure | 105 bar (1500 psi) | 105 bar (1500 psi) | |
| System Flow Rate | 225 Lpm (58 gpm) | 166 Lpm (44 gpm) | |
| Application Rate | 1.34 Lpm/m$^2$ 0.032 gpm/ft$^2$ | 2.03 Lpm/m$^2$ 0.050 gpm/ft$^2$ | |
| Space Nozzle Location | Unobstructed Space | Obstructed Space | |
| | Single Level | Single Level | Bi-Level |
| Scenario #2 (4.5 MW)* | | | |
| Fire #1 | 2:00 | 1:45 | 0:20 |
| Fire #2 | 1:15 | 1:27 | 0:20 |
| Fire #3 | 1:30 | 0:40 | 0:20 |
| Fire #5 | 2:15 | 1:30 | 0:20 |
| Scenario #4 (7.5 MW)* | | | |
| Fire #1 | 1:30 | 1:20 | 0:20 |
| Fire #2 | 1:00 | 1:25 | 0:15 |
| Fire #3 | 0:45 | 0.50 | 0:20 |
| Fire #5 | 1:00 | 1:15 | 0:25 |
| Scenario #5 (7.5 MW)** | | | |
| Fire #1 | 3:45 | 2:30 | 0:40 |
| Fire #2 | No | NO | NO |
| Fire #3 | No | 0:20 | 0:40 |
| Fire #5 | 2:00 | 1:15 | 0:50 |

* - Ventilation *(exhaust* and supply) was secured during mist *system* activation.
** - Ventilation *(exhaust* and supply) remained operating during this test


Temperature (°C)
0
100
200
300
400
500
600
Time (sec)
0
15
30
45
60
75
90
Mist System Activation

# WATER MIST FIRE EXTINGUISHING SYSTEM

## FUTURE PLANS

- INTERMEDIATE SCALE TESTS TO OPTIMIZE PERFORMANCE OF SYSTEM
- SHIP IMPACT STUDY TO IDENTIFY OPTIONS FOR INSTALLING WATER MIST SYSTEM ON LPD-17 CLASS SHIPS
- FULL SCALE TESTS OF OPTIMIZED, MIL-SPEC WATER MIST SYSTEM ON EX-USS SHADWELL