Fire Extinction System Selection Criteria

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The purpose of the Naval Research Laboratory's (NRL) Halon 1301 Total Flooding Replacement Program is to investigate all available halon alternative technologies and their applicability for shipboard use. NRL has conducted laboratory, (LSC), intermediate, (ISC), and real scale (RSC) tests with evaporating liquid replacement agents, fine solid aerosols, and water mist.

In the quest to optimize evaporating liquid systems (HFCs, PFCs, IFCs), and new alternative technologies, the need has developed for a better definition of the performance envelope of these suppression systems.

There is not a unique criteria for determining successful fire extinction for large fires, as there is with well defined laboratory cup burners. Even with cup burners, different configurations and / or operating protocols can elicit different results. All the more so with fire (type, size, fuel), discharge, compartment, and test protocol variations in large tests.

Does successful extinction have to occur within a certain time period? Must it be complete with no residual wisping flamlets? Is there a level of maximum acceptable product generation or collateral damage? Can reflashes and / or reignitions (sustained burning) be tolerated and for how long is the protection required? Is fire control or extinction the critical parameter? Different types of suppression agents will have different behavior with different threats. How can different agents be best compared and evaluated? All these are questions that need to be answered for each particular application before any fire suppression (or explosion protection) system selection is made.

This paper discuses criteria for the determination of successful fire suppression (partial and total), reignition potential (spacial and temporal), agent design concentration and discharge time, and agent distribution in the protecting space. Examples will be given from standard Navy and industry operating procedures.

A better definition of the suppression system performance will result in an optimized selection of a retrofit or new total flooding fire protection or explosion inertion system.

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Successful Halon Replacement

- The optimum solution is the NON-FIRE.
  Design the asset/facility to eliminate or greatly reduce the threat/occurance of fire.

- The Asset/Capability is the focus, not Halon replacement.
  Minimize the impact of fire damage/disruption independent of fire extinguishment.

- Many, if not most, solutions have already been developed.
  Employ intelligent Fire Protection Engineering with currently available technology, allowing reduced uncertainty and costs.

Replacements, Alternatives, Next Generation

Halon, Water, Foam, Carbon Dioxide, Powder, Nothing
In-kind Halon replacement
Fine Water Mist (other liquids)
Inert Gas
Fine Solid Aerosol
Combinations, Hybrids
Developing and to be developed additional technologies.

There are many generating and dispersing techniques.

Protection Requirements

1. Define the operational requirement/capability you need to protect.
2. Determine the envelope of probable threats.
3. Employ design and passive fire protection to diminish the treat envelope.
4. Determine the degree of active fire protection required.

Fire Protection:

Realistic worst case - complete systematic evaluation.

Many assumptions on current systems are questionable.

Exploration, documentation of current system, hardware, deficiencies.

Need complete, step back, consideration.

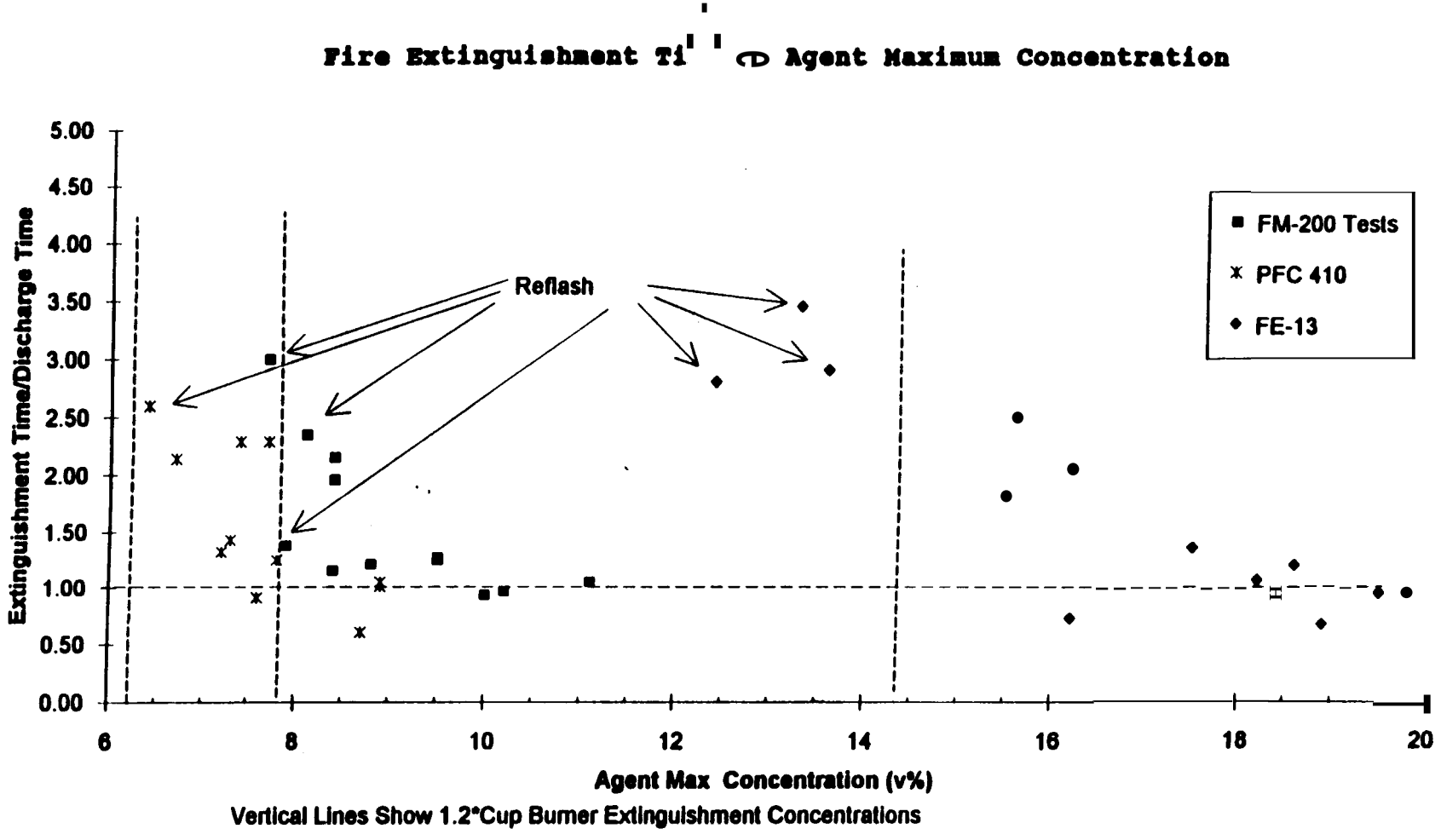
Components:

Candidate materials
Dissemination
Distribution
Aftermath - toxicity, corrosivity, clean-up
Extinction Success Criteria

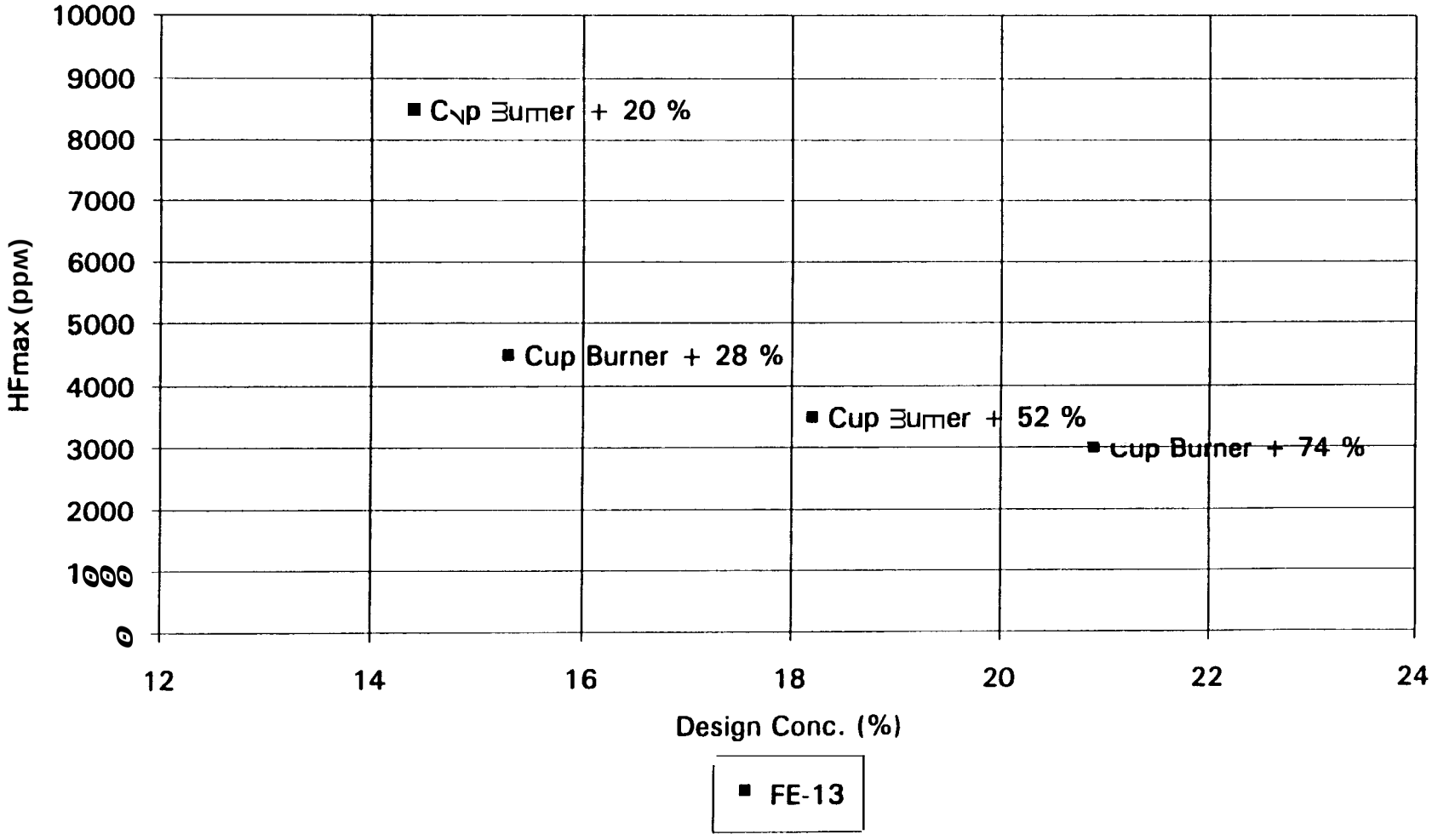
Overall Response Time Requirements

- Detection
- Suppression System Activation
- Dissemination
- Distribution
- Control
- Extinguishment

Extinction time depends on agent concentration at the fire, as does agent fire product generation.


Fire Extinguishment Ti
Agent Maximum Concentration
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Extinguishment Time/Discharge Time
Reflash
FM-200 Tests
PFC 410
FE-13
6
8
10
12
14
16
18
20
Agent Max Concentration (v%)
Vertical Lines Show 1.2*Cup Burner Extinguishment Concentrations

HF Generation from FE-13 As Function of Design Concentration
0.23m2 n-heptane pool fire in 56m3 compartment, 5-6 sec. discharge times



Extinguishment vs Control

- Is fire control suficient?
- Is fire knock-down with greatly reduced heat output sufficient/acceptable?
- Is extinguishment of major fires sufficient and can small flamlets be tolerated?
- At what point can the fire fighting party take over? Or is complete, unmanned fire extinguishment required?

The answers will be influenced by the availability of a trained and equipped response party and how much down time can be tolerated.

Non Halon-like Techniques

Aerosol Mists - liquid and solid

Cleanliness, visibility, toxicity, electrical conductivity, and environmental characteristics may require compromises in desired/acceptable requirements.

Fine Water Mist - Current Capabilities

- Control - not extinguishment.
- Obstruction, shadowing effects.
- Prolonged time to control smaller fires.
- Reflash protection requires continued mist generation.

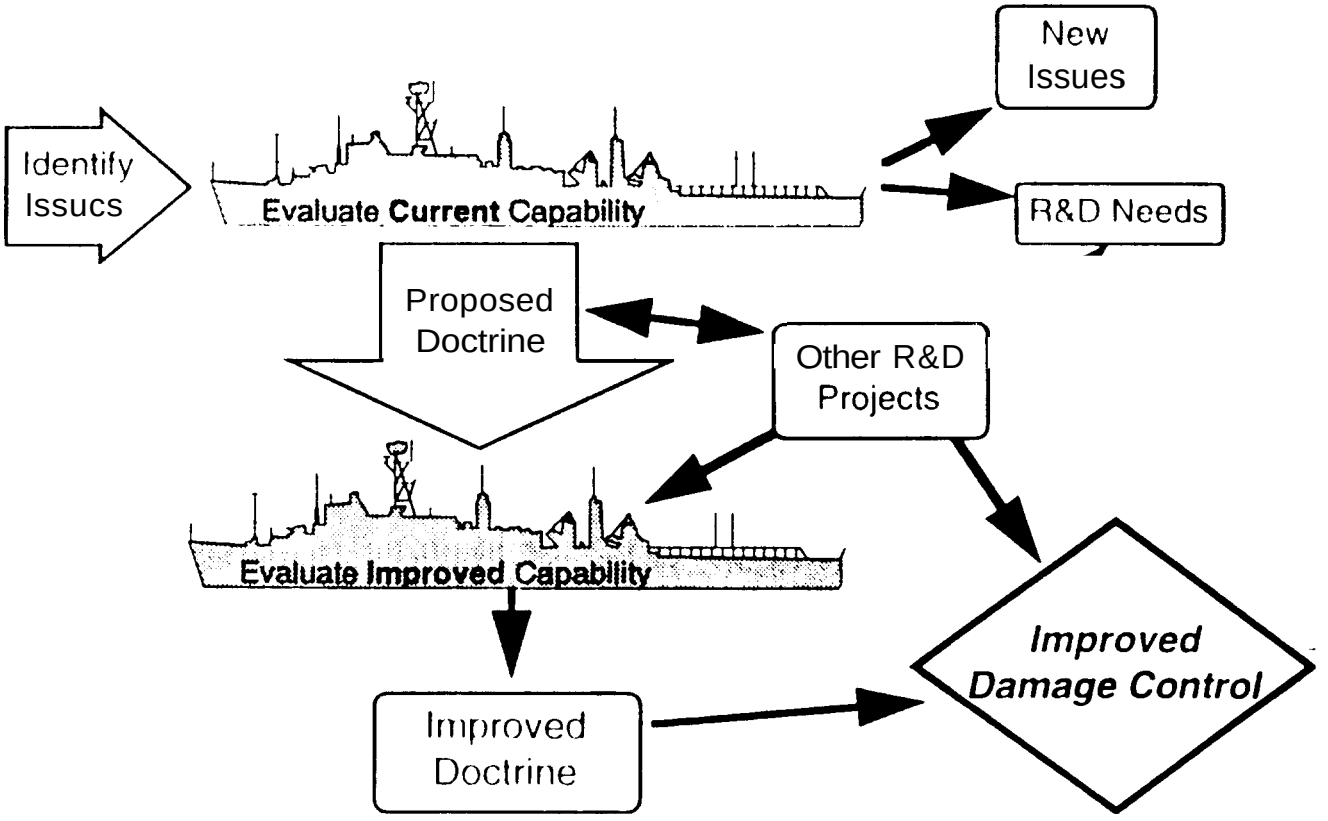
In many scenarios, current capability is acceptable with participation of fire fighting party.

What Is Success?

- Technical
- Operational
- Logistical
- Environmental
- Political
- Timing

Different entities, different administrative levels may have very different criteria and reasoning.

Successful fire protection requires an overall integrated approach.



Test Comparisons

- What parameters influence fire test outcome?
- Are the assumptions valid?
- How can different tests, especially with different test beds, agents, and investigators be validly compared?

Transitioning Research Into Application

- Who is supplying the funding?
- What does the customer feel is needed?
- What should the customer need?
- What requirements are critical, desirable, acceptable?
- What can we provide?
- How will it be implemented?

Integrated Fire Protection System Design