IM Operational Assessment

"A pillar for weapon & platform survivability"

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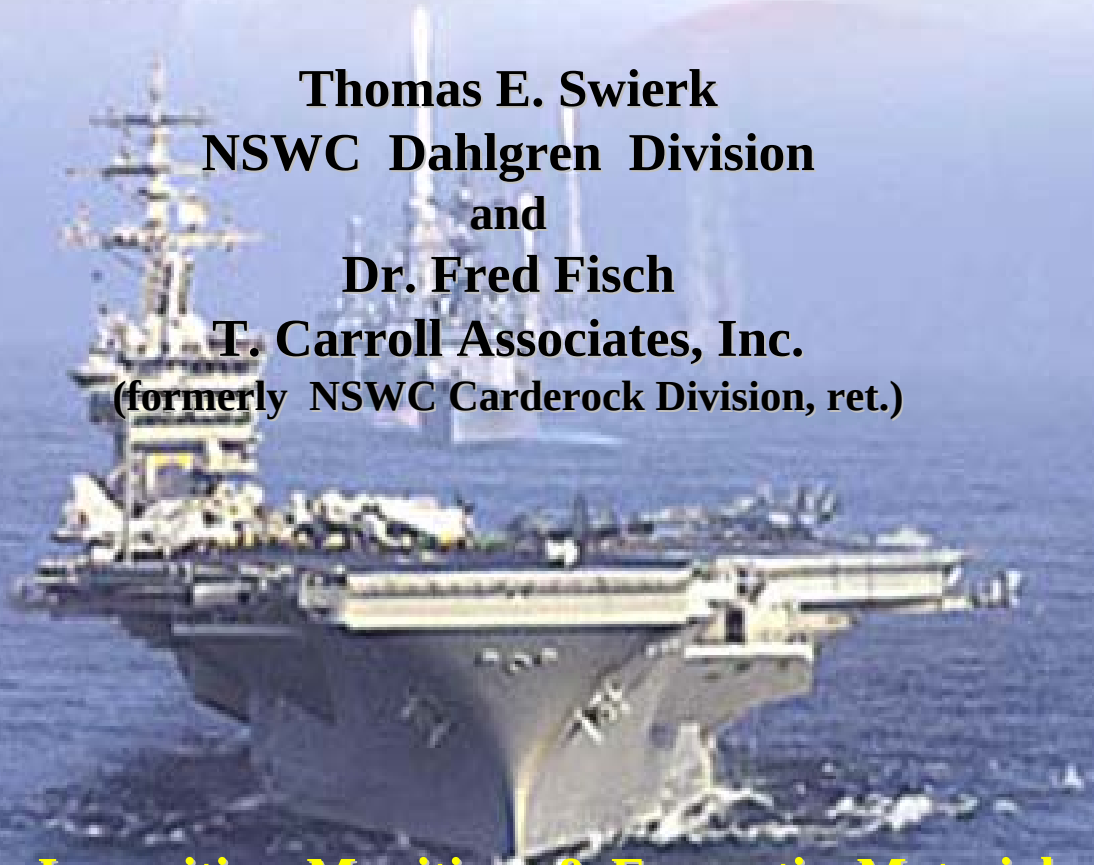
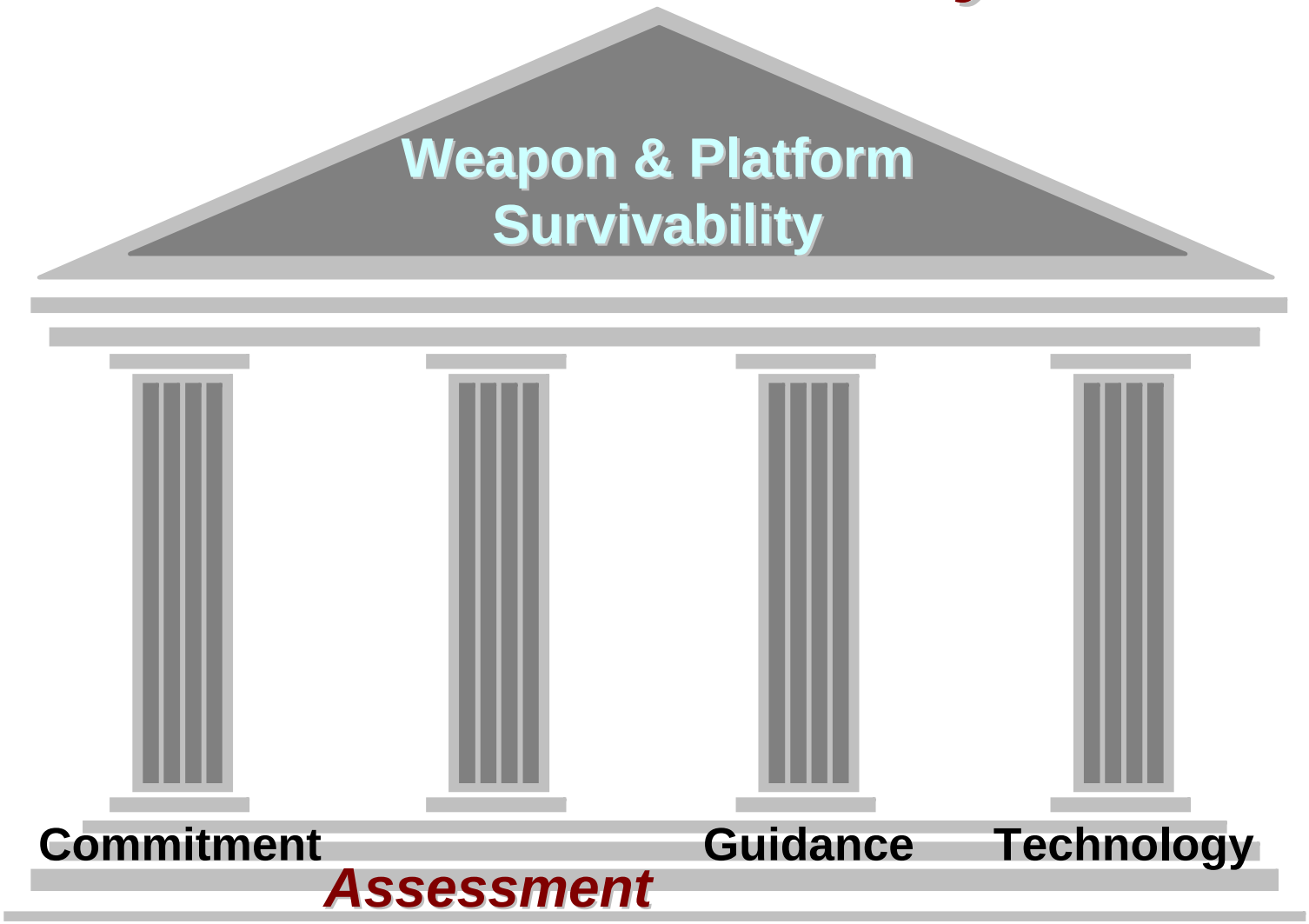


- **Insensitive Munitions & Energetic Materials Technology Symposium**

November 2004

IM is Critical to Ordnance Safety For the US Navy



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Outline

- Introduction & Background
- Case Studies
- Assessment Process
- Analytical Tools & Models
- Outcome & Utility of Study
- Status & Continuing Work

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} **Project coordination, accident scenario analysis (system safety support), event & campaign analyses, Assessment Final Report**

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} **Ship vulnerability modeling (Carderock support)**

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} **Facilitate & maintain Project *War Room***

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Background

Why is another IM Assessment needed ?

- **Attempt to answer the questions**
  - ***How much IM is enough ?***
  - ***Are we there yet with SOTA IM technology ?***
  - ***Are selected waivers acceptable risks ?***
- **We need to improve our IM metrics.**
  - **For certification and waivers (if needed)**
  - **To assess risk mitigation for S^3.**

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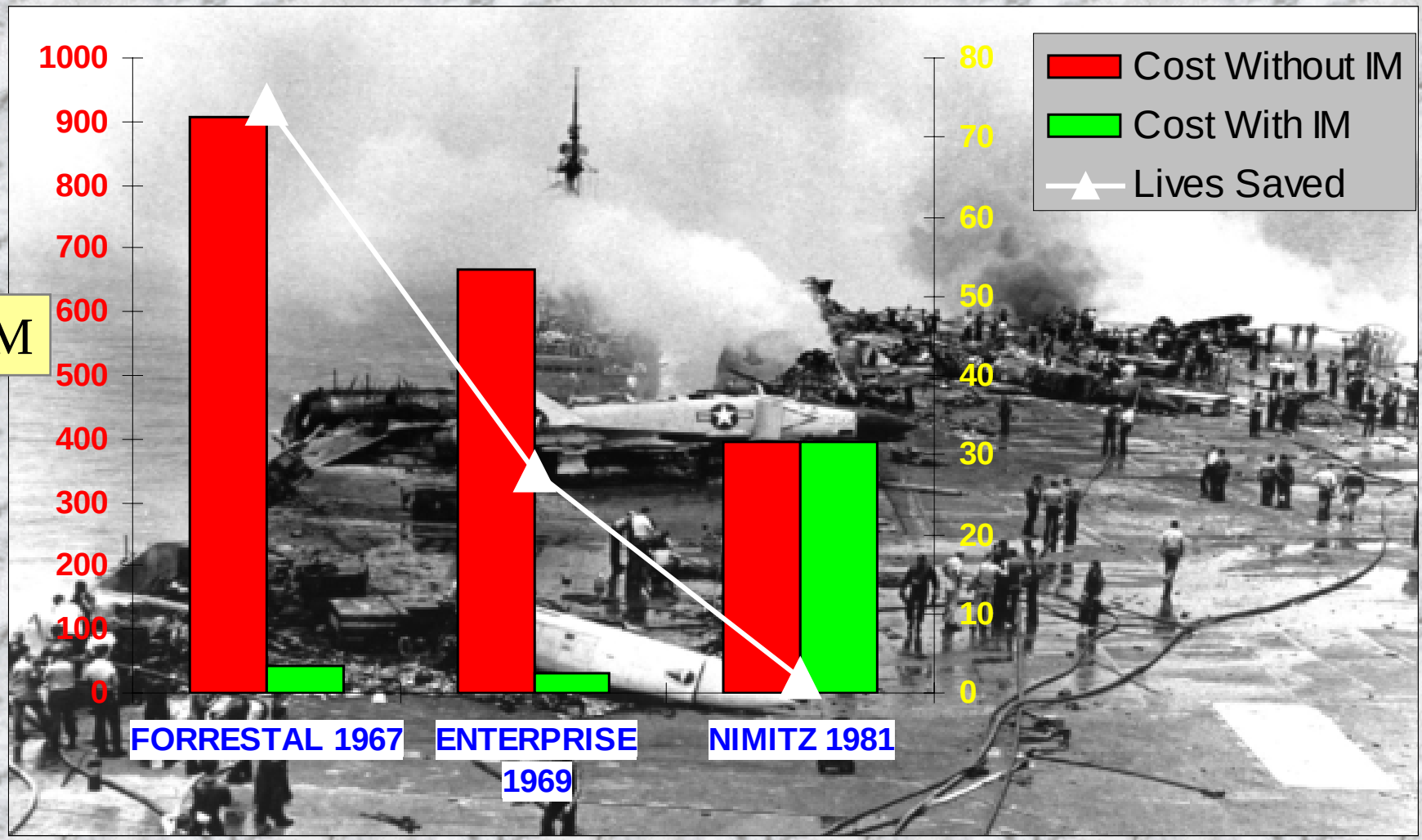
Carrier Accidents — The IM Benefit



104 sailors would have survived if IM technologies had been deployed aboard these CVs.

Data extracted from Center for Naval Analyses (CNA) Report, "A Historical Perspective of Insensitive Munitions and Their Estimated Contribution to CV Safety", CRM 90-260 / March 1991.

Focus of Study

Loss of …

Catastrophic IM Event =

Critical Resources + $ +

Operational Readiness & Capability

Operational Assessment

Project Objectives

Principle Objective & Focus:

Determine the likely outcome of an explosive attack or accidental events aboard naval vessels at sea or in port to assess the *operational utility* of current and projected *IM improvements*.

Other top level objectives:

- **Determine the impact of munition reactions on the operational environment for future *IM waiver* assessments.**
- **Determine how *personnel, $$ and combat readiness* are affected in each case study.**
- **Conduct "*what if*" trade studies as enablers for the decision makers for *stowage & logistic* issues.**
- **Conduct sensitivity analyses that identify critical parameters for future *IM technology* improvements.**
- **Provide a focus for future *6.1 / 6.2 / 6.3 IM Technology* programs.**

Case Studies

Surface Combatant DDG

Supply Ship T-AKE

Port Operations

Aircraft Carrier CVN

IM Assessment Process

The Assessment process includes four basic tasks for each of four case studies and an all-inclusive IM Analysis summary:

- Process steps
  - Scenario development
  - Threat description

  } ***Defines the case studies***

  - Event analysis
  - Outcome analysis

  } ***M&S based tasks to quantify results***

- IM analysis summary

Assessment Scenarios

Case Studies

Threats	DDG	T-AKE	CVN	Port Ops
Combat				X
Accident				
Asymmetric (terrorist)	X	X	X	

Typical Accident Scenarios

Accidents are most likely to occur as a result of *human interaction*

- flight deck ops
- VERTREP / UNREP ops
- magazine & dockside handling

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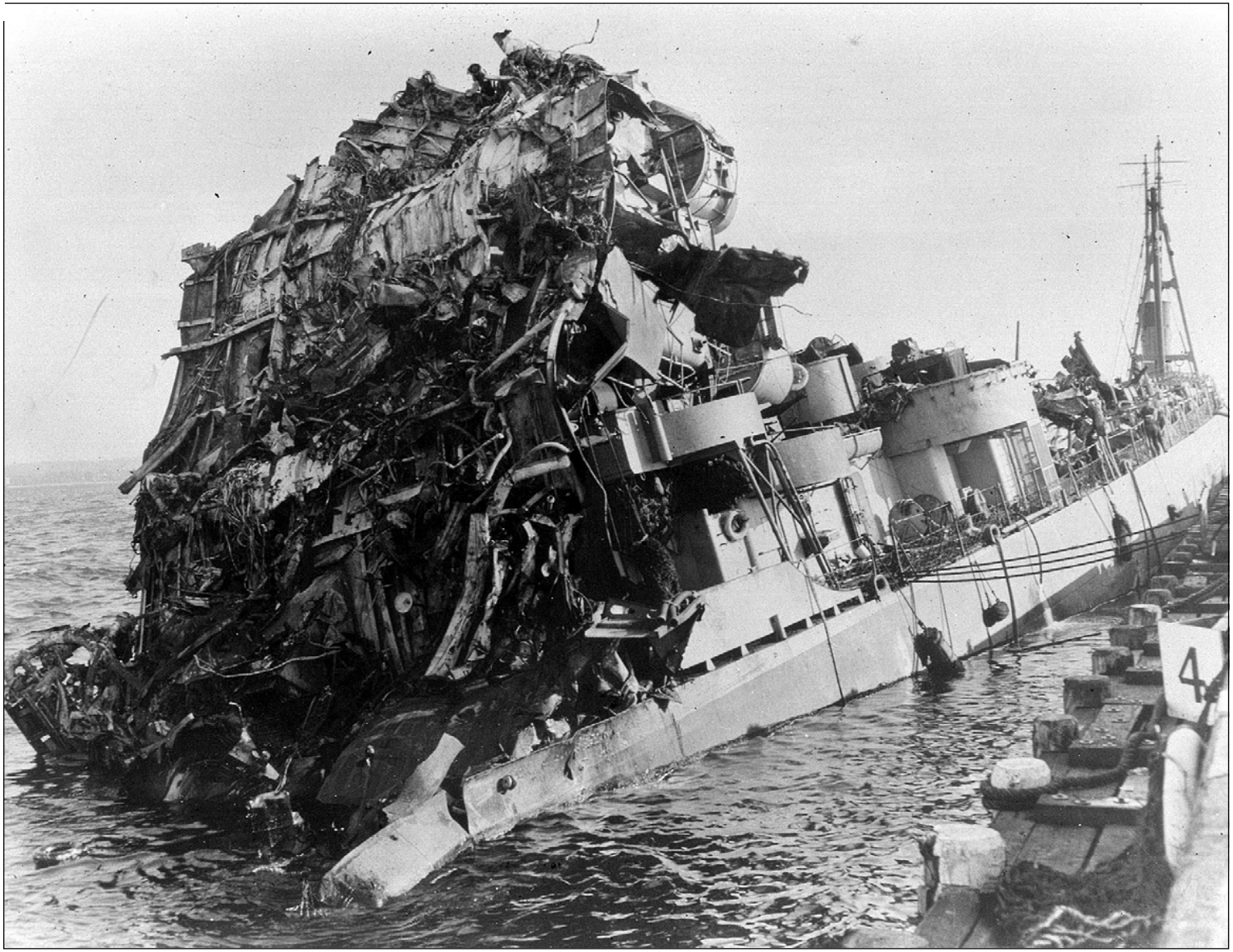
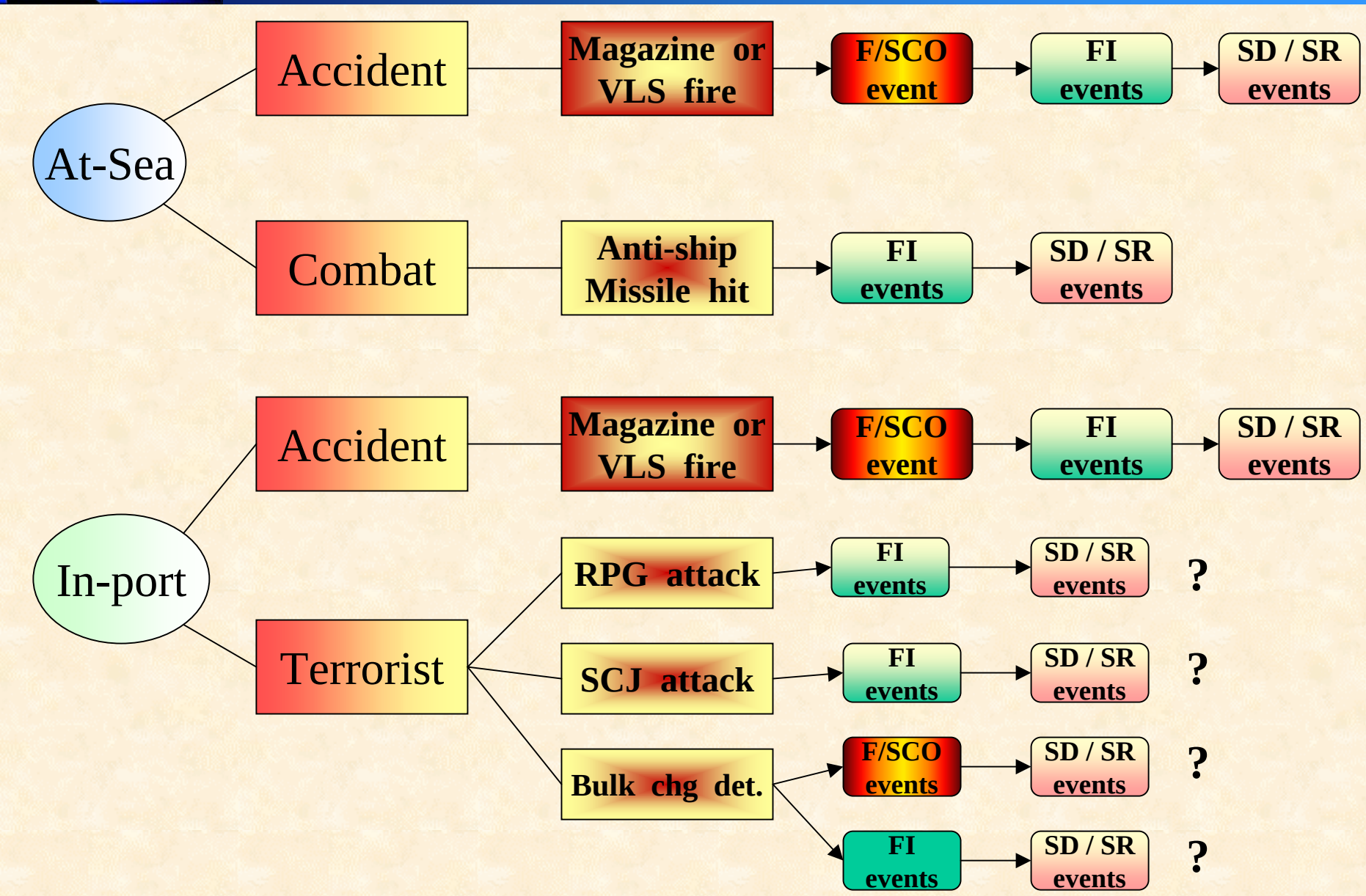
Magazine accidents are catastrophic !



Hypothetical IM Hazard Scenarios



Analysis Approach

Consider 3 IM situations:

- *Pre-IM* inventory (what we had in 1984)

IM baseline.

- *Current* inventory (some IM compliance)

Determine ROI in IM technology during the last 20 years.

- *Future* inventory (FULL IM compliance)

Determine ROI in IM technology during the next 10+ years.

Questions Addressed:

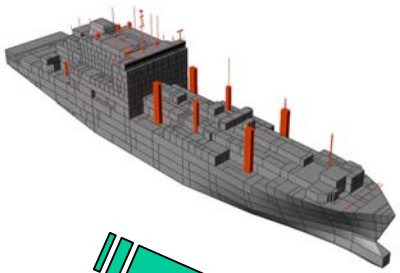
How well have we done in improving ship survivability & combat readiness with our in-service IM inventory ?

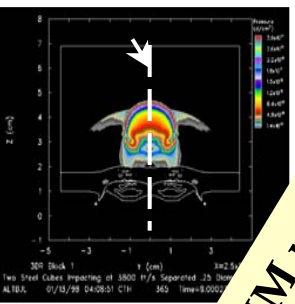
Can we do more to improve ship survivability & combat readiness ?

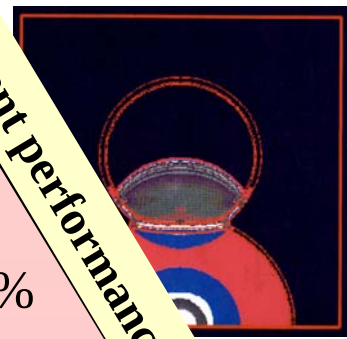
Should answer the questions:

- *What's the RISK of what we have ?*
- *What's the best way to mitigate these hazard & safety risks ?*

Hierarchy of Analytical Tools







Mission need → weapon system compliance → IM requirements

Mission capability → system capability → Component performance

Platform & campaign analyses

Military Utility & Military Worth Studies

40%

Ship vulnerability & damage assessments & analyses

Engineering Models ASAP, FATEPEN, + others

40%

Weapon response to IM hazards & external stimuli

Physics-based Continuum Codes CTH, SMERF, ALE3D, + others

20%

IM Hazards Technologies

Energetic Materials

New Crystals/Molecules
Crystal Morphology
Nano-Technology Material
Advanced Binders
Binary Energetics
Crystal Coating
Suppression Agent
Modeling & Simulation

System Design

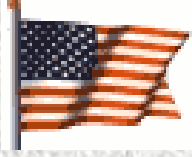
Liner Materials
Passive/Active Venting
Coating
Scoring
Thermal Protection Material
Barrier/Ballistics Material
Sensors
Fuze and Initiators
Modeling & Simulation

Packaging

Suppression Systems
Passive/Active Venting
Storage Configuration
Packing Container Material
Thermal Protection Material
Barrier/Ballistics Material
Modeling & Simulation

M&S used to assess these technologies early in the Design Cycle

M&S Initiative Roles / Structure



Deputy Under Secretary of Defense (S & T)
Dr. Charles Holland

HPCMP
- DMSO
- Sensors
- Weapons
- Info Systems
- Bio Systems
- Strategic Envir R&D

OUSD(AT&L)/DS/LW&M
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ODUSD (S&T) Weapon Systems
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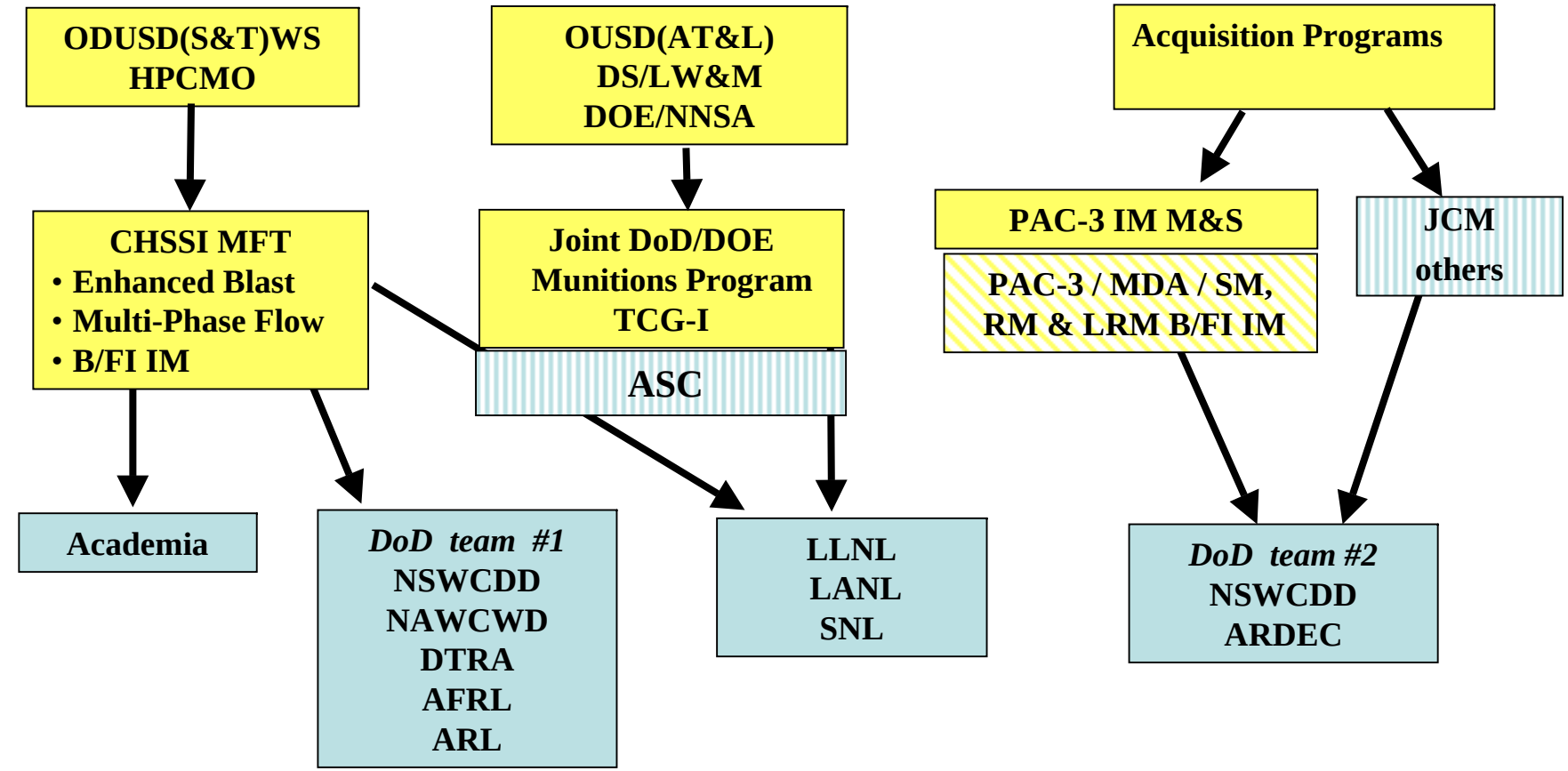
Mr. Bob Garrett, NSWC

DOD / DOE MOU, Adv. Numerical Methods & Material Modeling (TCG-I) Lead
Mr. Bob Garrett, NSWC

DTO WE.92
Munitions M&S

Munitions M&S Task

M&S Initiative Spiral I Activities



Encourage industry participation in these M&S activities.

DOTC

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SVM Process

Input

Ship Description
- Structure
- Vital Components
- Systems
- Loss Criteria
- Fire Zones
- Magazine Data

Attack Parameters
- Warhead
- Approach
- Trajectory
- Hit Distribution
- Fuzing

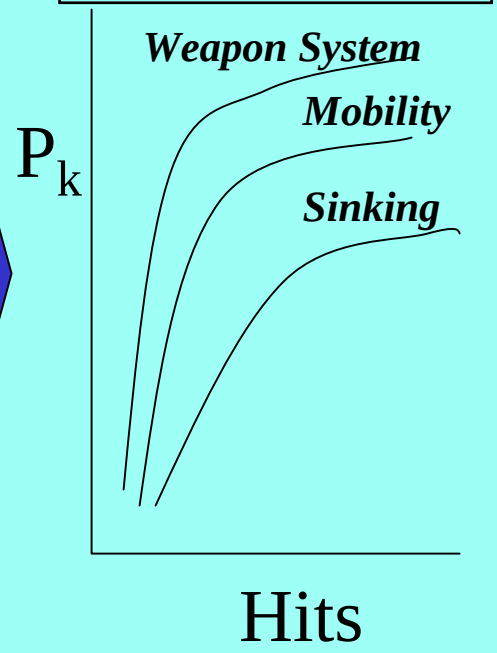
Penetration Models
Locate Burst Points

Damage Models
- Blast
- Fragmentation
- Acceleration
- Flooding
- Fire
- Mass Detonation

Loss Criteria
- Sinking
- System Inactivation

Output

Inactivation Probabilities



Vulnerability Metrics

Primary Mission Area "M-Levels" (MOB, C3I, AAW, etc.)		
M-Level	***General Defintion***	***% of Performance Level***
M1	No Degradation	90-100
M2	Minor Degradation	70-89
M3	Major Degradation	60-69
M4	Mission Precluding Deficiencies	0-59*

"SORTS" Definition Of Combat Readiness (NWP-1-03.3)

* For Survivability Assessments, M4, Mission Loss, is defined as less than 50% of wartime performance capability by agreement with OPNAV

Overall Combat Readiness "C-Level"	***General Definition***	***Required "M-Levels"***		
		MOB	***C3I***	***Mission Areas: AAW, ASW, ASUW, etc.***
C1	Fully Combat Ready	M1	M1	Two or more M1, No more than one M2
C2	Substantially Combat Ready	M2	M2	Two or more M2, No more than one M3
C3	Marginally Combat Ready	M3	M3	Two or more M3, No more than one M4
C4	Not Combat Ready	M4	M4	Two or more M4

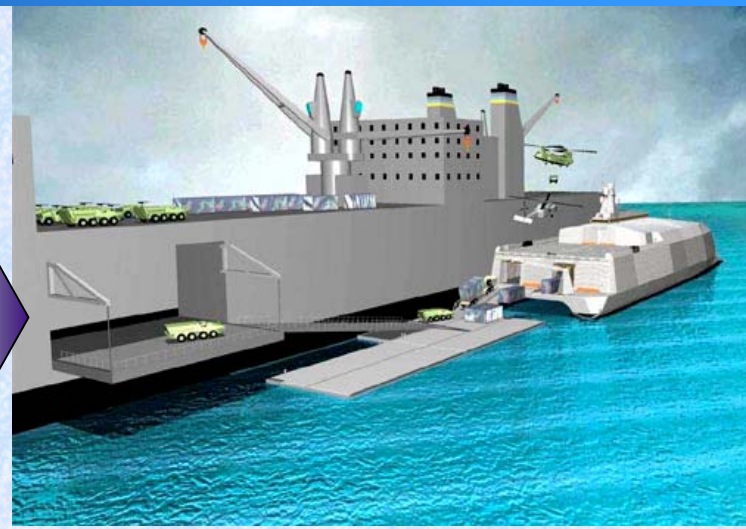
Overall Combat Readiness Levels

How IM effects Naval Operations

Case Studies

Operations	DDG	T-AKE	CVN	Port Ops
Limited Mission (single ship)	Major	Major	Catastrophic	Moderate
Campaign (several ships)	Moderate	Catastrophic	↓	Major or Catastrophic
Theater Operations (air, land & sea)	Minimal	↓	↓	↓

Anticipated Results



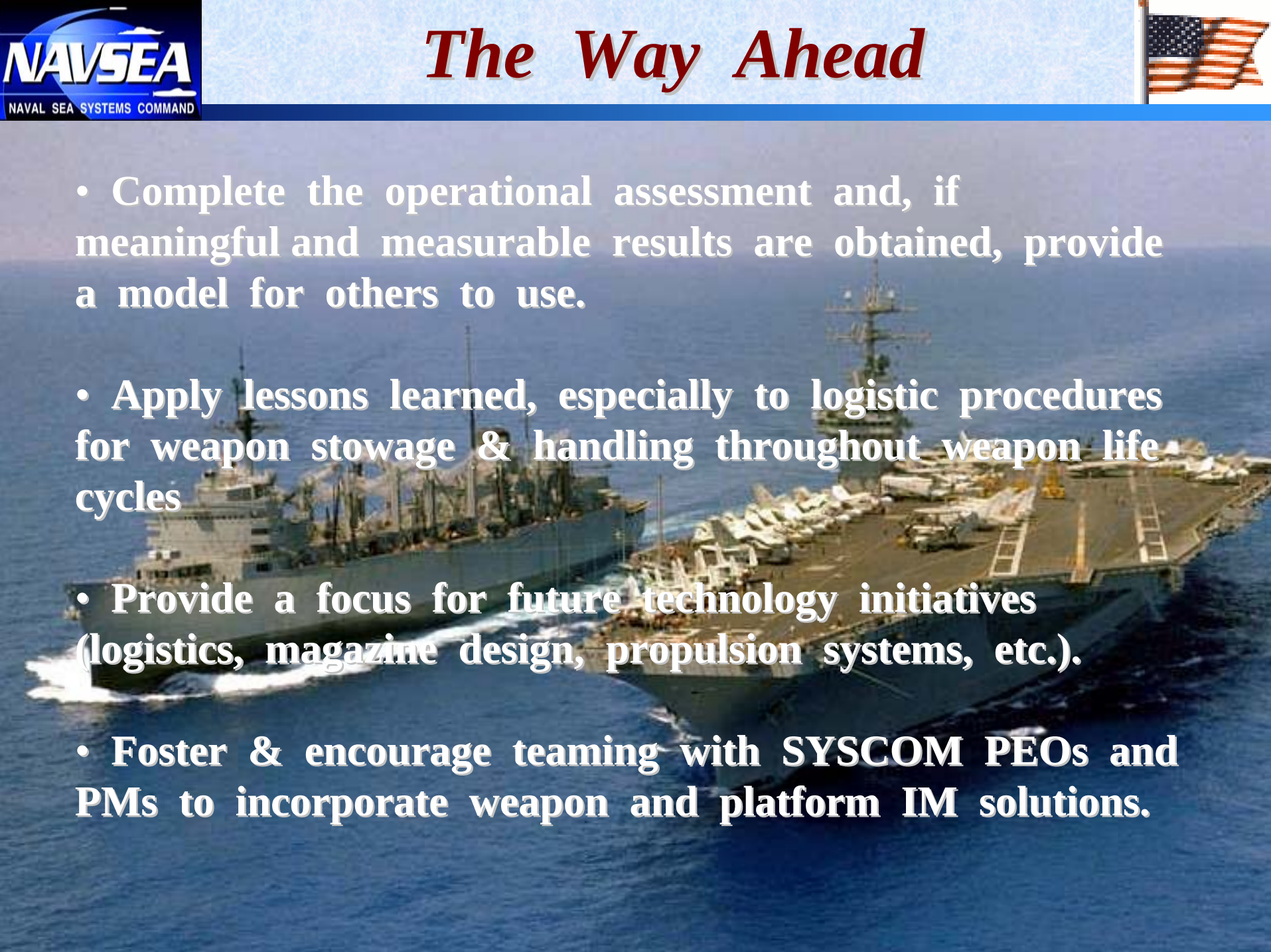
- Loss of supply ships are very costly to Navy operations, especially for *SEA BASING* operations — effects operations & joint forces.

- Historically, carrier losses are catastrophic from all perspectives — loss of resources & operational capability.

- Need to limit mass chain reactions (> type III) where many ships & dockside munition stockpiles are present — logistics & Q-D arcs are critical factors.

- Need to limit mass burning reactions — improved propellant technology required.

The Way Ahead



- Complete the operational assessment and, if meaningful and measurable results are obtained, provide a model for others to use.

- Apply lessons learned, especially to logistic procedures for weapon stowage & handling throughout weapon life cycles

- Provide a focus for future technology initiatives (logistics, magazine design, propulsion systems, etc.).

- Foster & encourage teaming with SYSCOM PEOs and PMs to incorporate weapon and platform IM solutions.