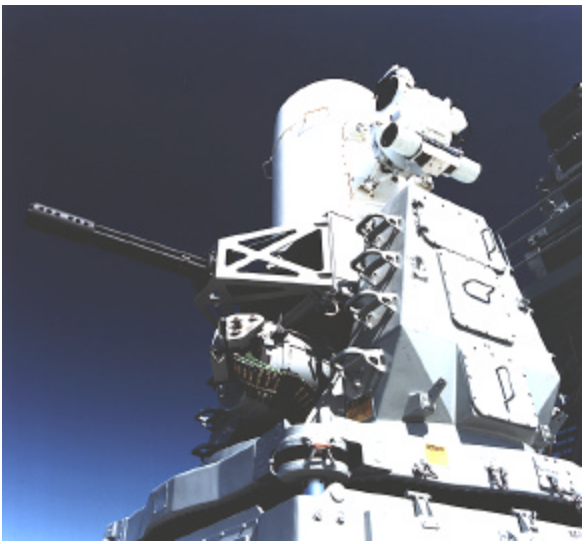
PHALANX

In-Port or High Value Site Defense Using Frangible Self-Destruct Penetrator Ammunition



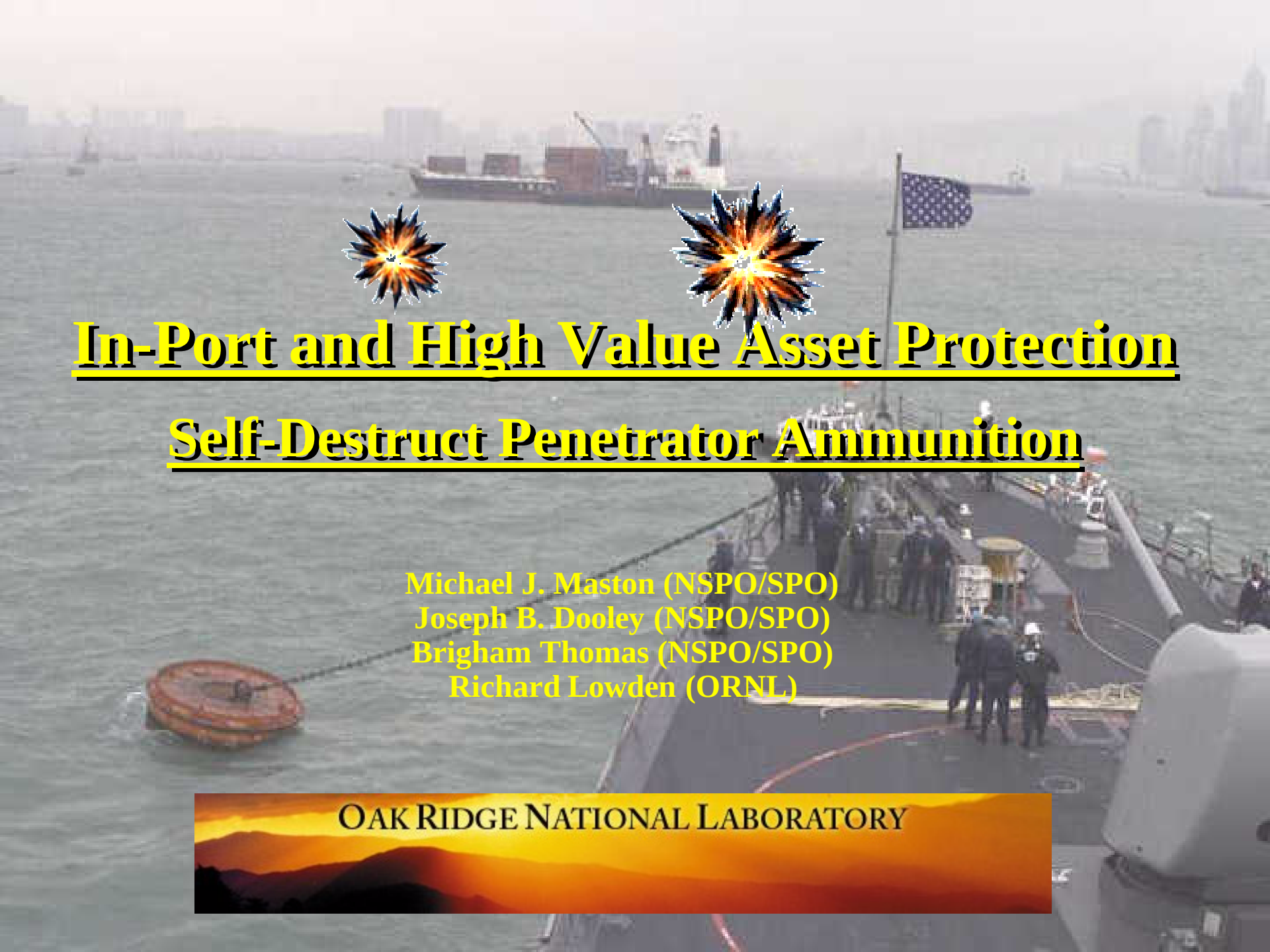
Mr. Scott Martin
sgmartin@west.raytheon.com
Raytheon Electronic Systems
Mr. Mike Maston
yau@y12.doe.gov
Oak Ridge National Laboratory

17 April 2002

Raytheon

Today's Agenda

- **Self-Destruct Penetrator Ammunition**
- **Employment of S-DP Ammo for High Value Site Defense**



In-Port and High Value Asset Protection

Self-Destruct Penetrator Ammunition

Michael J. Maston (NSPO/SPO)
Joseph B. Dooley (NSPO/SPO)
Brigham Thomas (NSPO/SPO)
Richard Lowden (ORNL)

OAK RIDGE NATIONAL LABORATORY

Self-Destruct Ammo Overview

- Review of Technical Requirements
- Review of Relevant Technology
- Projectile Concept
- Technical Issues
- Programmatic Issues
- Technical Growth Options

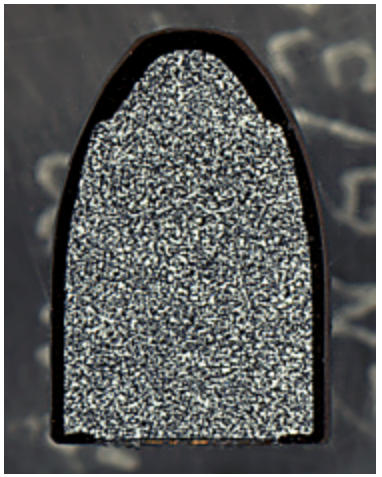
Technical Requirements

NATIONAL SECURITY PROGRAM OFFICE

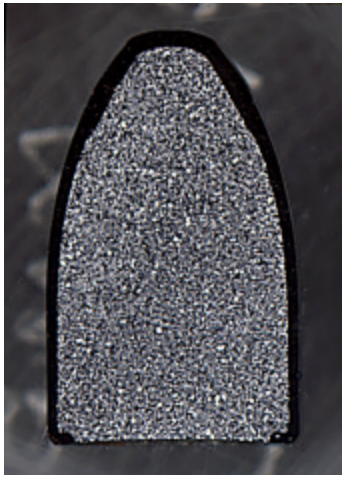
- **New generation ammunition for HVS and in-port defense**
  - **non-ricochet**
  - **self-destructs if misses target(s) and/or at preset range(s)**
  - **prevents/reduces hazard to personnel and property from “miss” - No “fall of shot” collateral damage**
- **7.62mm* - 20mm to include 12 gauge shotgun**
  - **fully interchangeable in existing weapons**
  - **improved or comparable ballistics**
  - **existing or improved target damage effects**
- **Storage life comparable to existing ammunition**

Relevant Technology

- **Development of frangible, non-lead replacement training ammunition**
  - **same operating pressures**
  - **same ballistics**
  - **same recoil**
  - **same function**
- **Mixed powder metal construction developed and validated**
- **Patented for US Government (1998)**
  - **US Patent No. 5,760,331(and others)**
  - **International patents pending**



Tungsten-Zinc Core



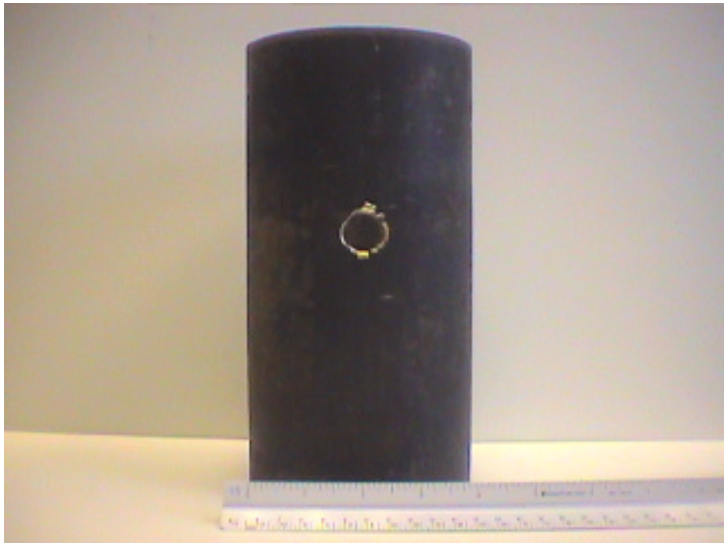
Tungsten-Tin Core

Key Lessons Learned

It is possible to engineer a projectile as a system -- not just a slug

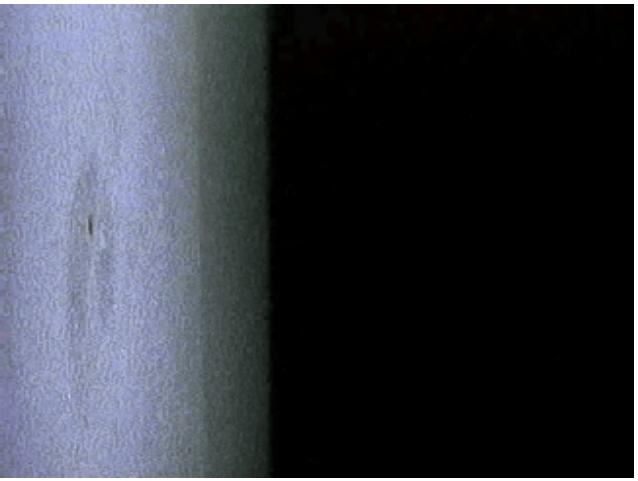
- **Flight performance**
- **Target effects**
- **External Geometry**
- **Producibility**

50 Caliber Penetration Test



- 150 meters
- 2200 fps, ~ 12 - 14 kilojoule target impact
- 750 grain projectile
- round franged after impact

Key Demonstrations



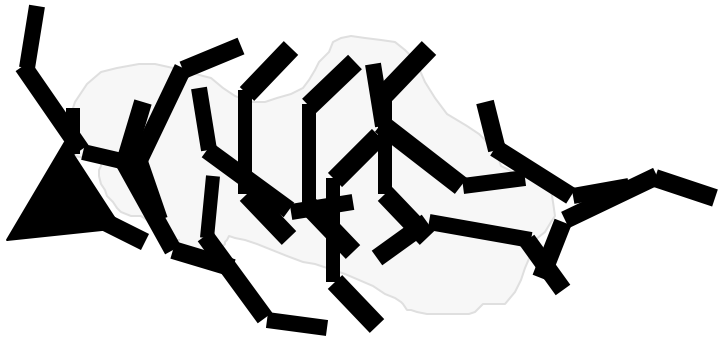
Lead & Non-Toxic Rounds

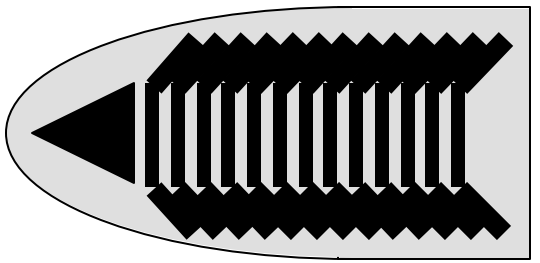
Thermograph of Impact

Against High Explosive

Technical Issues

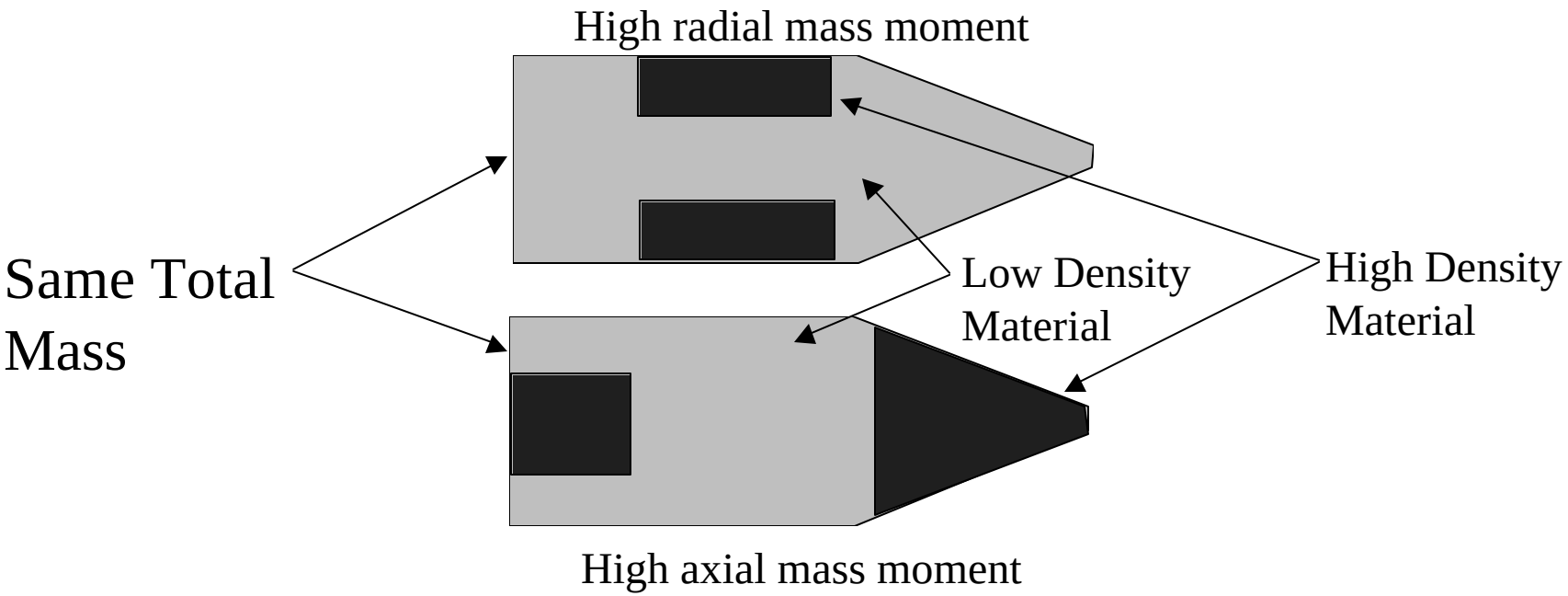
- **Details of projectile design**
- **Survival of stress environment**
- **Damage capability of projectile**
- **Efficacy of self-destruct system**
  - **30 - 50 caliber, 20mm + provides sufficient design space for internal destruct charge**
  - **smaller than 30 caliber will require additional study**
  - **Provide multiple timing delays**
    - **1000', 2000', 3000' rounds**





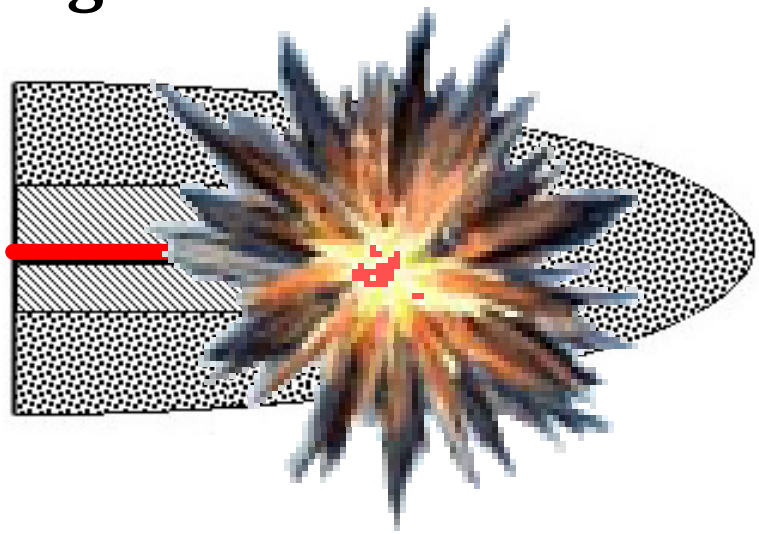
Technical Issues-Design

- **Duplicate existing projectile(s)**
  - **Shape**
  - **Features (driving bands, sabot interface, etc.)**
  - **Weight**
  - **CG and CP**
- **Analytical tools and methods to deal with this exist**



Technical Issues-Self Destruct

- **Materials have not yet been fragmented explosively**
  - **To date tests have been:**
    - **Impact after firing**
    - **Hard targets (frangibility) and soft (expansion)**
    - **Compression testing**
  - **Explosives may be different**
- **Can resolve by testing**



Technical Issues - Summary

- **No obvious “showstoppers”**
- **Multiple options exist for attaining product performance**
- **Options can be tested to verify**
  - **in parallel with other development**
  - **mockups can be used for test pending final hardware**

Growth Options

- **"Command Destruct" projectile**
  - **adds mission flexibility at cost of complexity**
    - **"Jamming" and inadvertent destruct issues**
  - **several key components exist**
  - **manufacturing process can accommodate**
- **"Steerable" projectile**
  - **elements of technology exist**
  - **significant issues in mechanization of concept**
  - **significant debate about true feasibility**

Characteristics of a High Value Site Defense

Raytheon

PHALANX

- **Positive Command & Control**
- **Positive Target ID**
- **Quick Response**
- **Capability Against a Large Target Set**
  - **High speed, air, surface (ground or sea)**
- **Programmable Engagement & Safe Approach Zones**
- **Limit Collateral Damage**

Demands a System Which Can Neutralize Multiple Threats & Types In a Single Engagement

Phalanx Overview

Raytheon

PHALANX

Primary Mission:

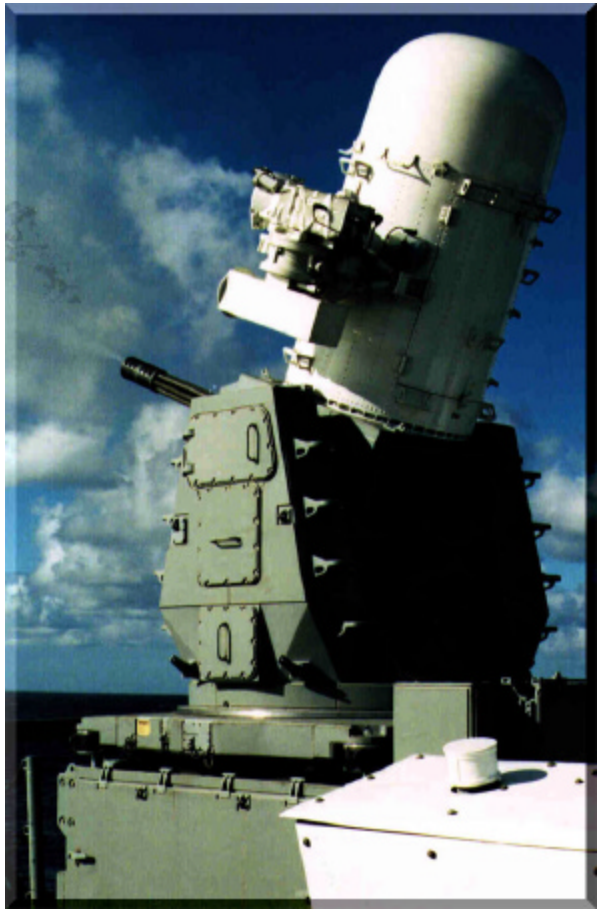
Terminal Defense Against ASCMS and High Speed Aircraft Penetrating Other Fleet Defensive Envelopes

Added Missions:

- Surface Mode
  - Counter Small, Fast Surface Craft and Slow Flying Helicopters and Aircraft
- Sensor Support For Close-in Missile Engagements

Benefits:

- Supports Multiple Roles In Ships Self Defense
- Autonomous Or Integrated Operation
- Fast Reaction



Phalanx CIWS Evolution

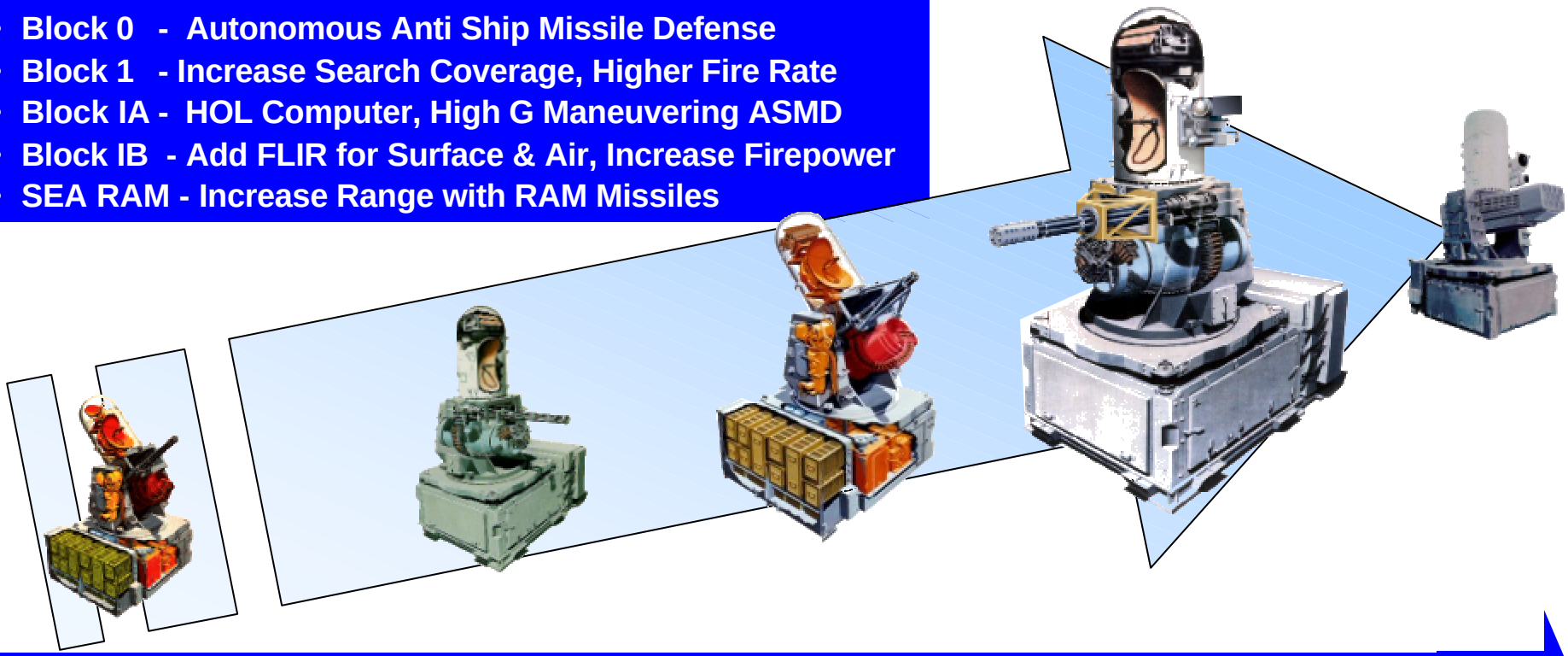
Raytheon

PHALANX

79-87	87-95	95-97	97-98	99-01

A Proven Family of CIWS Solutions

- Block 0 - Autonomous Anti Ship Missile Defense
- Block 1 - Increase Search Coverage, Higher Fire Rate
- Block IA - HOL Computer, High G Maneuvering ASMD
- Block IB - Add FLIR for Surface & Air, Increase Firepower
- SEA RAM - Increase Range with RAM Missiles



Block 0	Block 1	Block 1A	Block 1B	SEA RAM

The Phalanx CIWS Has Been Continuously Improved

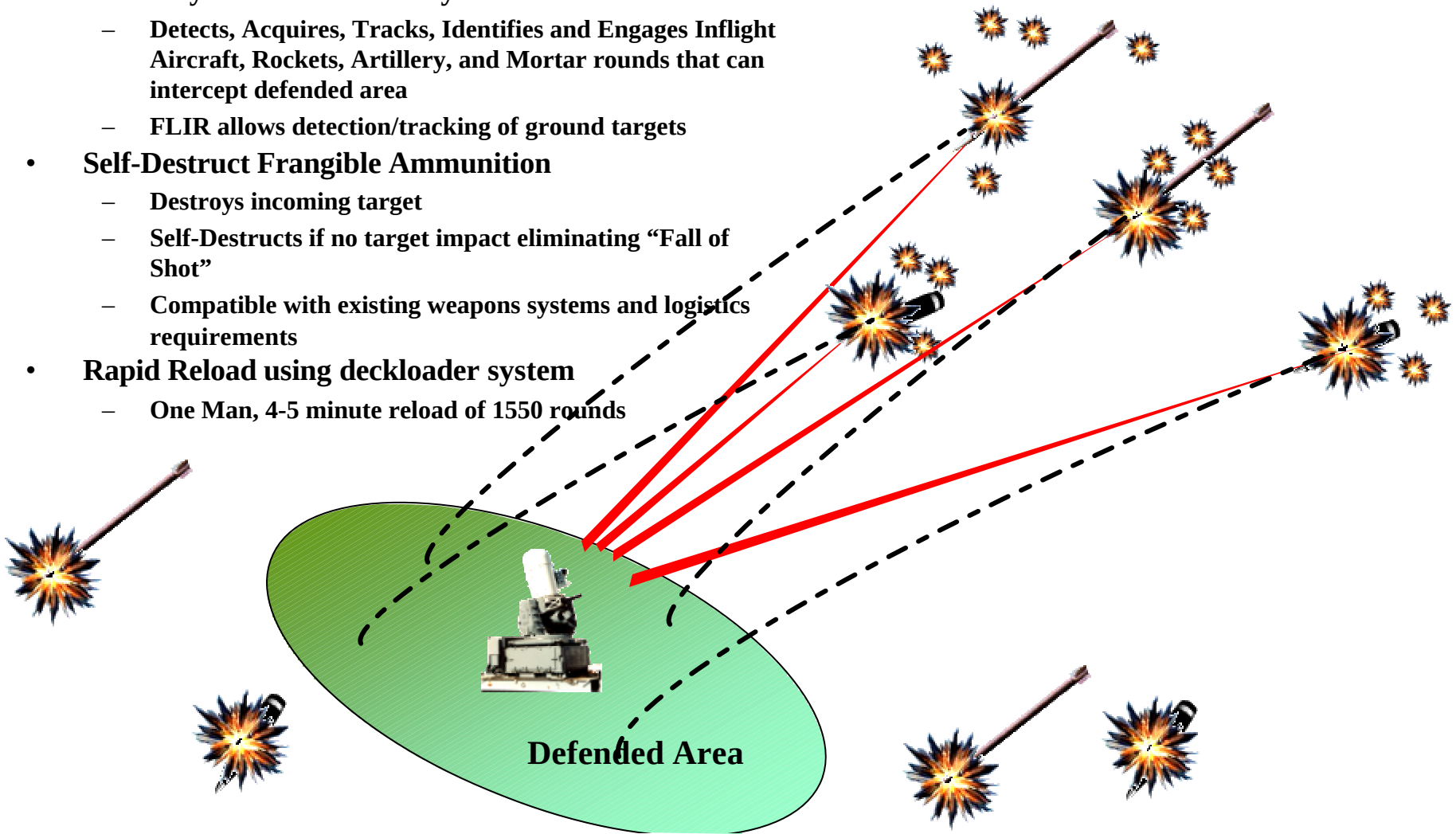
Operational Concept for In-Port or High Value Site Defense Self-Destruct Penetrator Ammunition

Concept of Operation

Raytheon

PHALANX

- **HVSD System Can Receive External Cue of Launch/Aircraft flight deviation**
  - **Air Traffic Control Radar**
- **HVSD System Autonomously**
  - **Detects, Acquires, Tracks, Identifies and Engages Inflight Aircraft, Rockets, Artillery, and Mortar rounds that can intercept defended area**
  - **FLIR allows detection/tracking of ground targets**
- **Self-Destruct Frangible Ammunition**
  - **Destroys incoming target**
  - **Self-Destructs if no target impact eliminating "Fall of Shot"**
  - **Compatible with existing weapons systems and logistics requirements**
- **Rapid Reload using deckloader system**
  - **One Man, 4-5 minute reload of 1550 rounds**

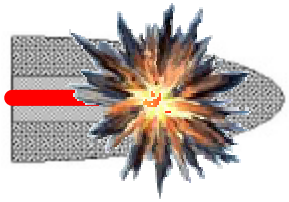


Basic Technology

- **Phalanx Block 1B CIWS**
  - Advanced Fire Control
  - 155 mm Projectiles Routinely Used as targets
  - Autonomous detect/track/engage
  - Consistently demonstrate 2-8 hits
  - Receive target designations/supply target info

Demonstration of Multiple hits Per Engagement

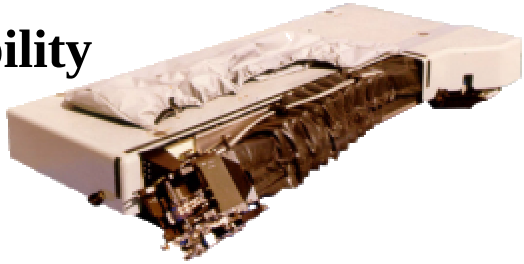
- **ORNL Powdered Tungsten Technology**
  - Lethal Projectile
    - Tailorable Penetration Capability
    - Energy Expended Inside Target
  - Fall of Shot/Ricochet Prevention
    - Frangible
    - Pyrotechnic Fuzing



Full Penetration at Entrance Point

No Penetration Opposite Entrance Point

- **WDC Rapid Reload Maintains Defensive Capability**
  - Deckloader deployed in 3 navies
  - One Man Operation
  - 4-5 Minute Magazine Reload



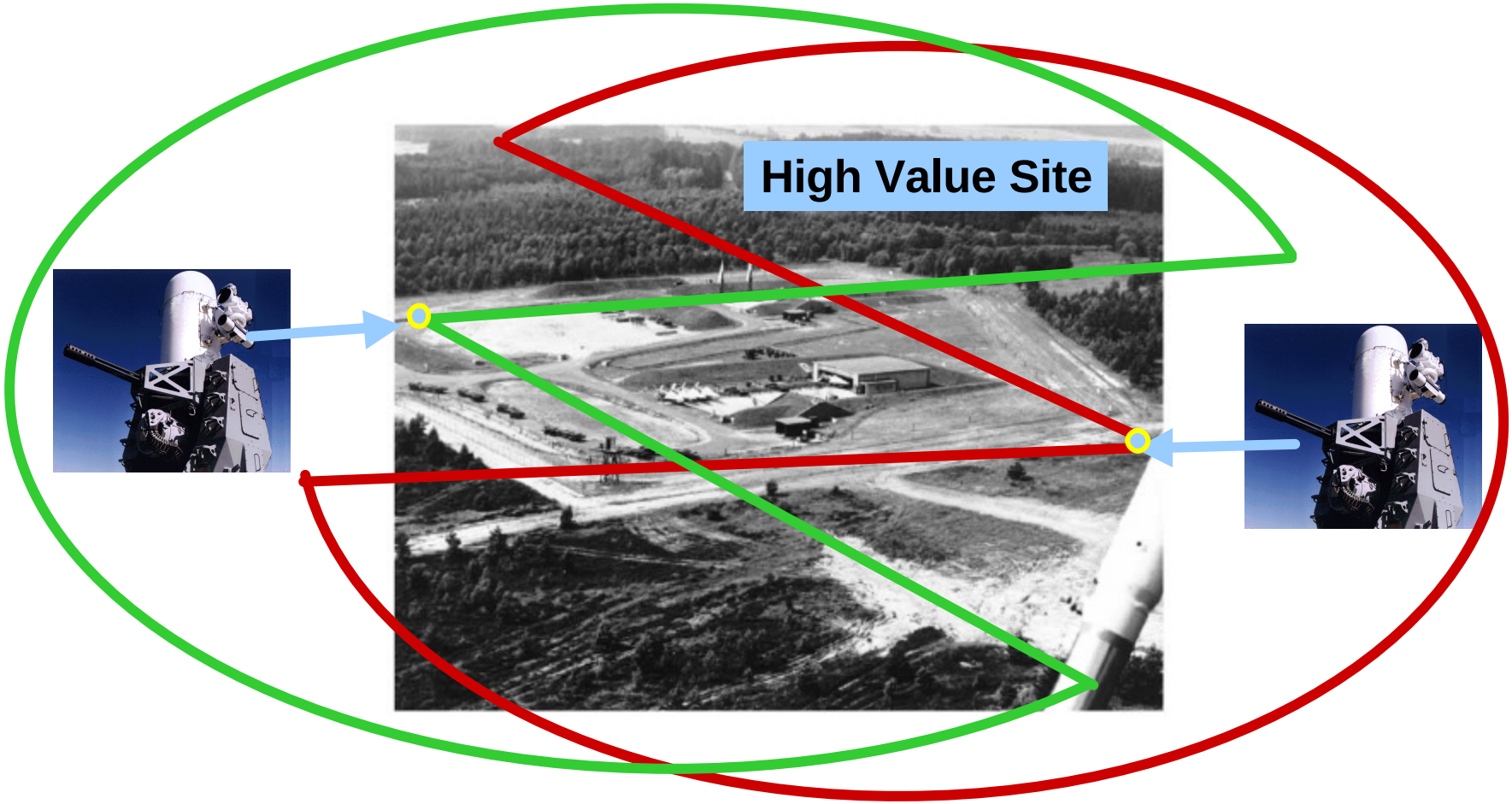
Demonstrated Reload Capability

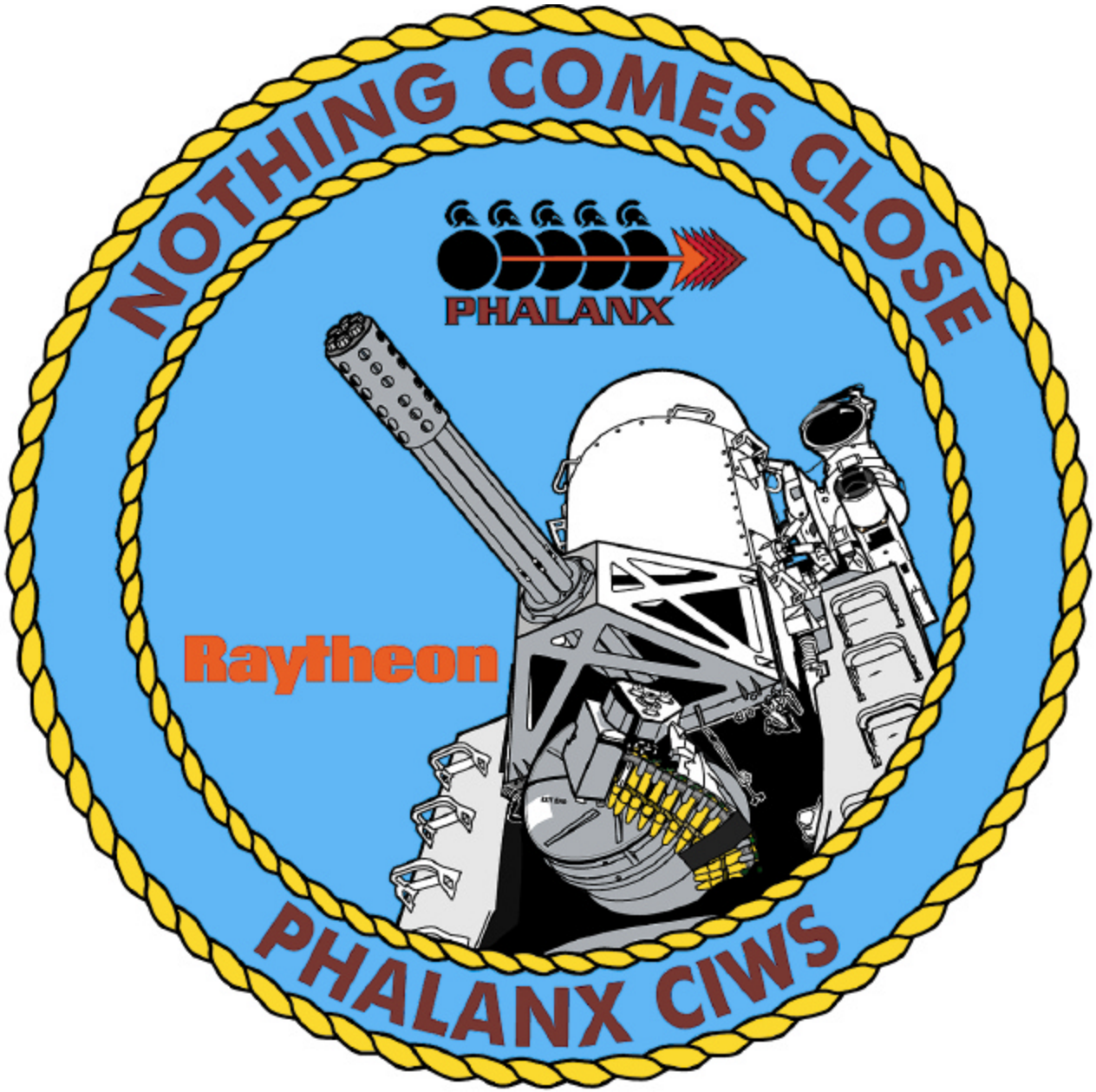
Proper Placement Provides Overlapping Protection

Raytheon

PHALANX

- 2 Weapon Systems (Minimum) Per Site Provides 360 Degree Coverage
- Proper placement would Allow Both Systems to Engage
- Provides Surveillance/Control for Road/Water Route Access Routes




NOTHING COMES CLOSE
PHALANX
Raytheon
PHALANX CIWS