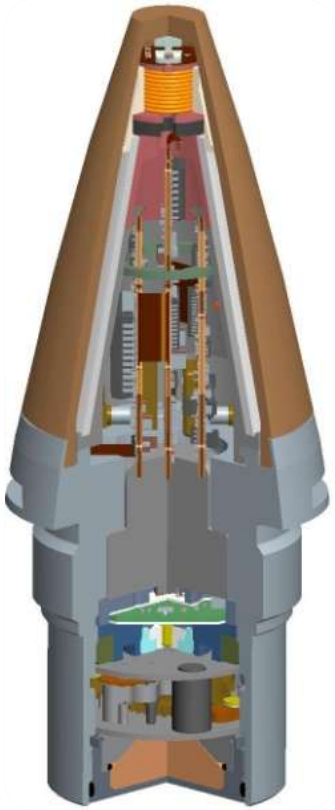
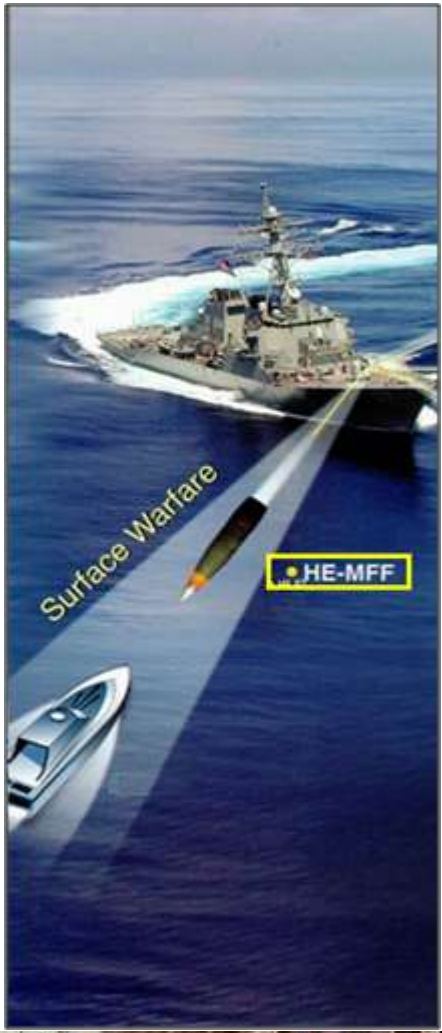
Multi-Function Fuze Capability Against High Speed Mobile Water Attack Craft

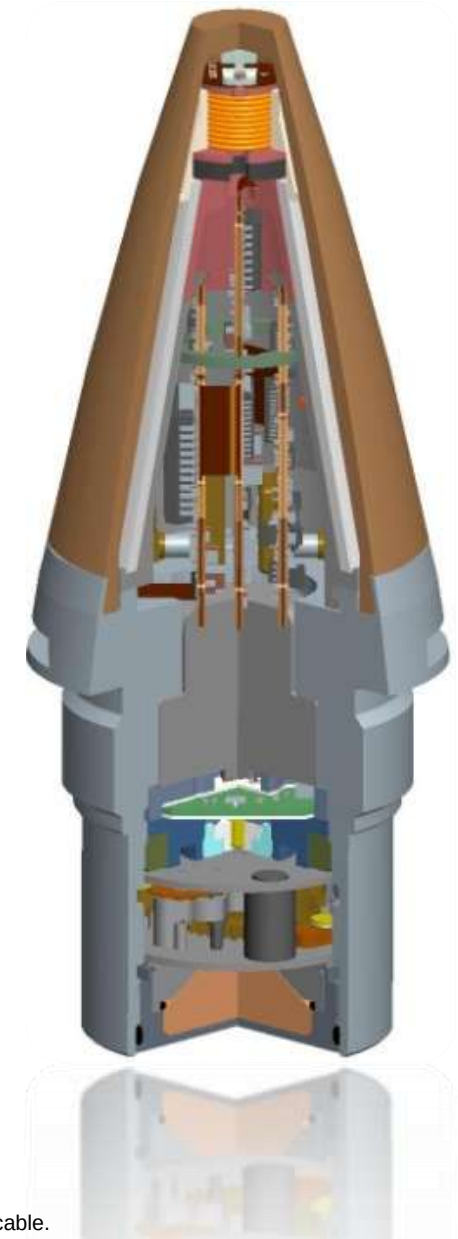




55th Annual NDIA Fuze Conference
Presenter: James Ring
ATK Propulsion & Controls

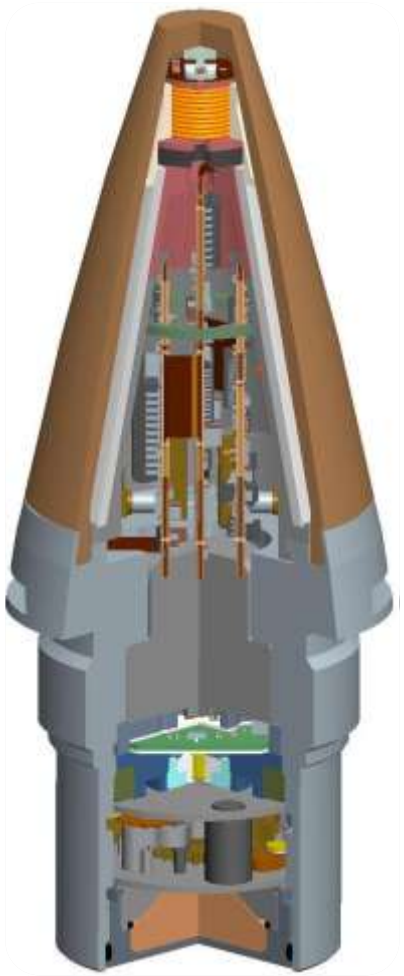
Presentation Agenda

- Functional Overview
- Design And Production Background
- Major Components & Subassemblies
- Fuzing Concept
- Benefits vs. Today's 5" Gun Solution
- Performance Results
- What's Next
- Summary
- Acknowledgements



Functional Overview

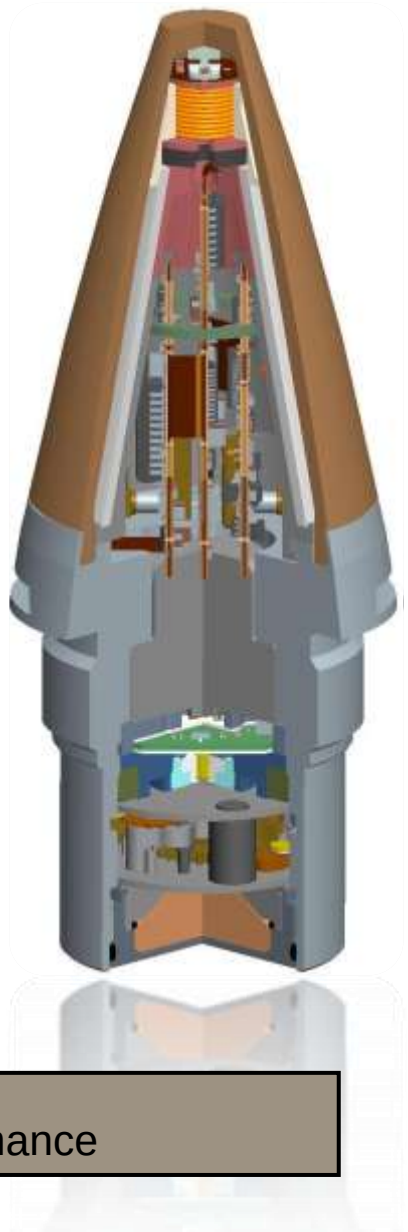
- MK419 is a Multi-Function Fuze (MFF) for the Navy 5” Gun
- Inductively Set by the Navy’s MK 34 electronic fuze setter
- Selectable Operational Modes
  - Air Proximity (AIR)
  - Height of Burst (HOB)
  - Autonomous (AUTO)
  - Electronic Time (ET)
  - Point Detonate (PD)
- Primary safety mechanism is the MK 60 Safe and Arm
- Flight power is provided by Lithium Reserve Battery
  - Activated by setback and spin
  - Provides electronics power for >105 seconds



MFF Is A Single Fuze Solution That Supports All Required Modes Of Operation

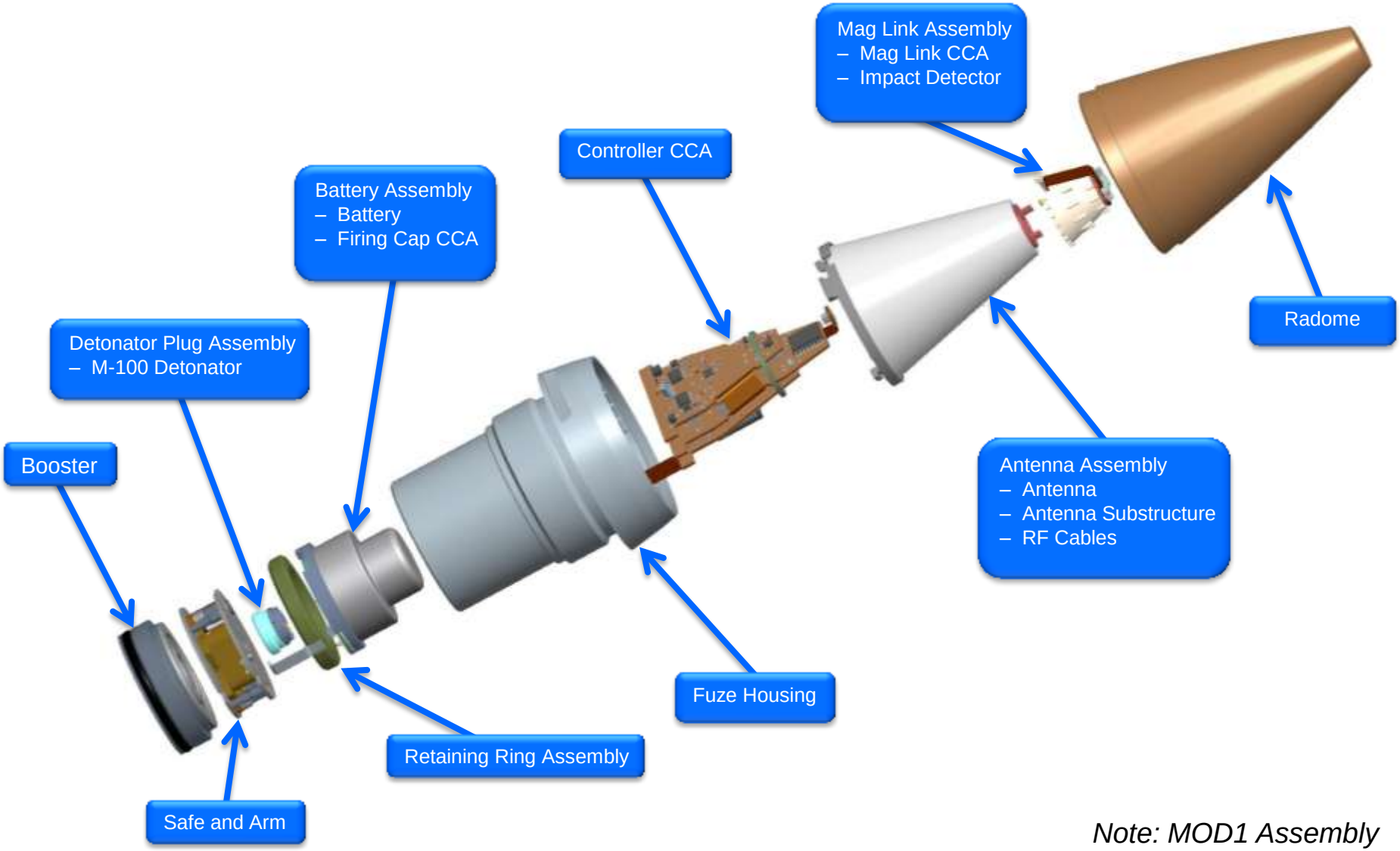
Design And Production Background

- MOD0 Design (~1980s to 2001)
  - Early design efforts began in the late 1980's by Motorola
  - Transitioned to ATK in 1998
  - Qualification in 2000
- MOD0 FAAT And Production (2001 to 2004)
  - First Article Acceptance Testing (FAAT) in 2001
  - Produced at ATK production facility
- MOD1 Production Improvement Program (PIP) (2009 to 2011)
  - Reduced AUPC
  - Exceeded functional capability
- MOD1 Production Planned for 2011
  - Planned to be manufactured at ATK's production facility



MOD1 Simplified Design and Assembly
Increases Reliability, Lowers Cost, and Improves Performance

Major Components & Subassemblies

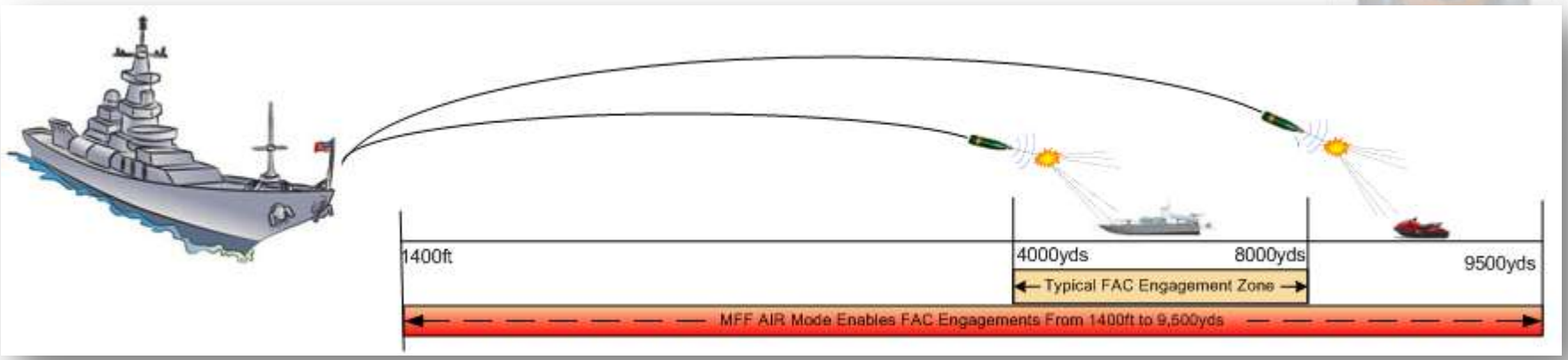


Note: MOD1 Assembly

MOD1 Updated Subassemblies Greatly Simplify Assembly Operations

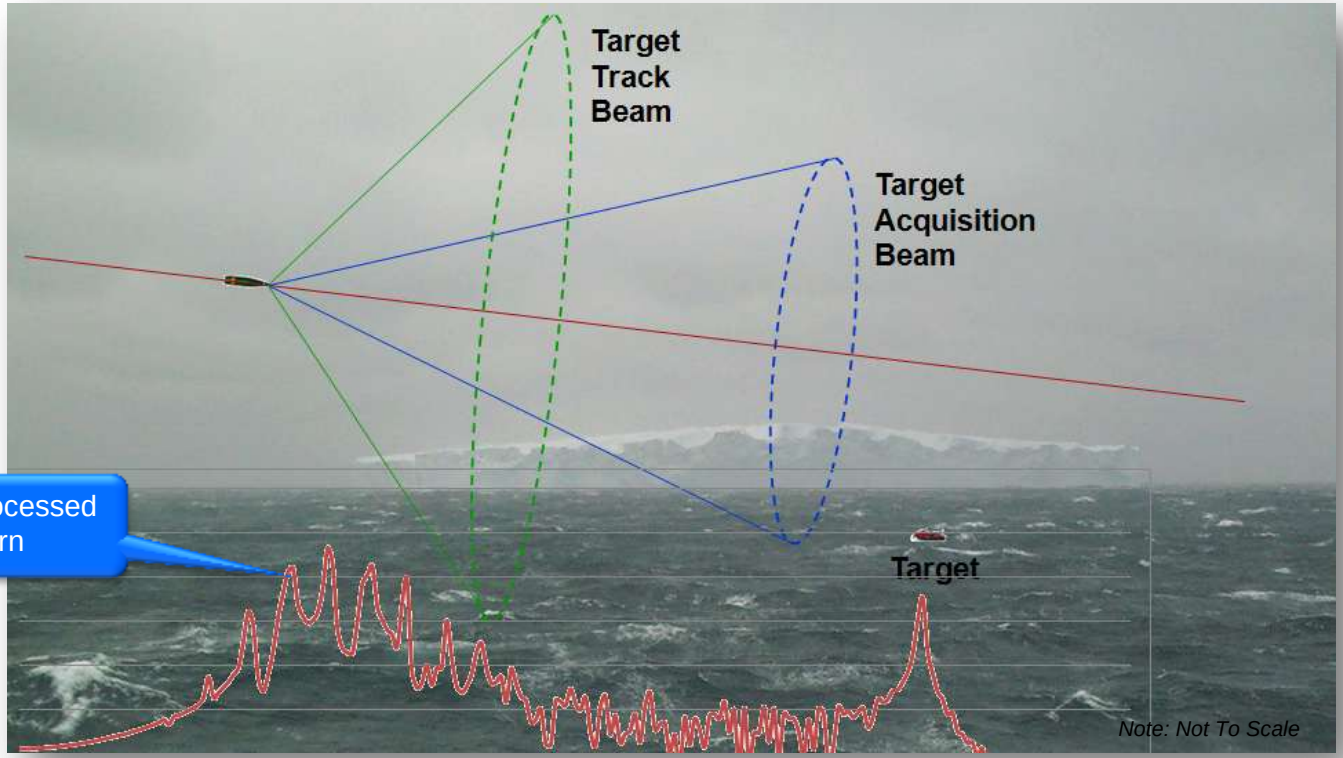
Fuzing Concept

- Fast Attack Craft (FAC) provide serious threats to Navy ships
- Navy 5” Gun with ***currently deployed*** MOD0 and new MOD1 MFF fuzes
- **“Use-As-Is”** existing MFF AIR Mode fuzing capabilities
- Engagement range from 1400ft to 9500 yards
- Engagement of very small Radar Cross Section (RCS) targets
- Ability to engage targets in various sea states



MFF Provides Navy With Immediate Solution To FAC Threats

Fuzing Concept



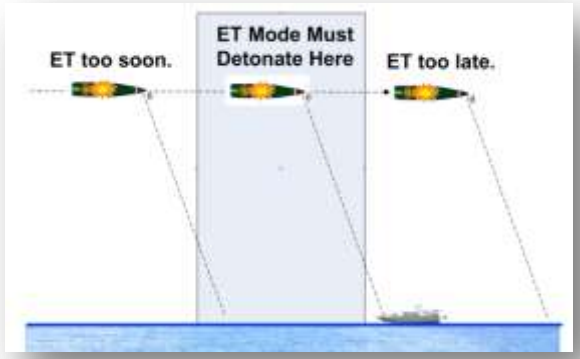
Simulated Un-processed Radar Return

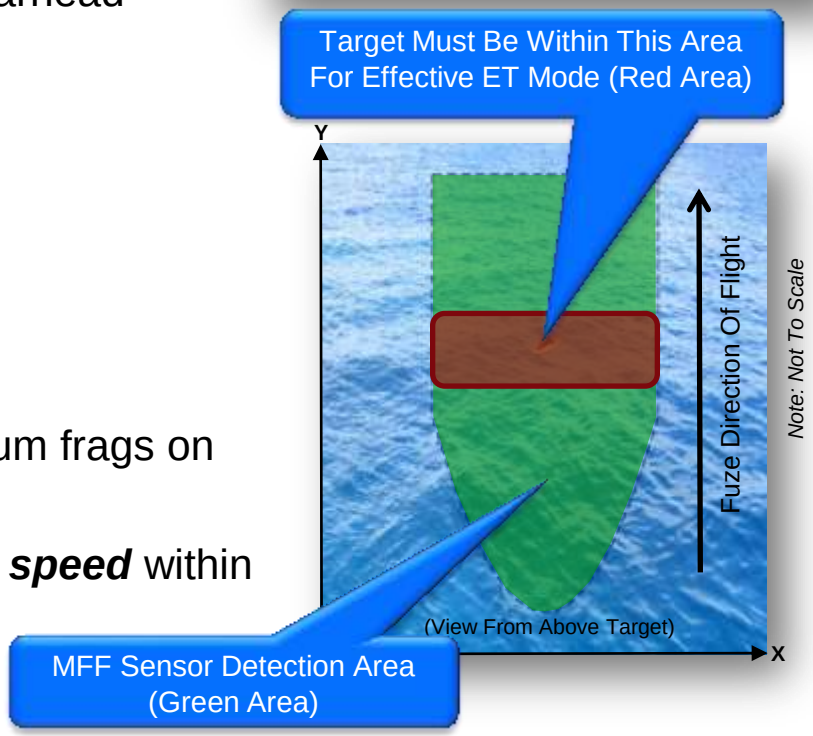
- MFF scans water for targets without detonating on sea clutter in various sea states
- Target Acquisition Beam (search mode)
  - Signal processing dynamically focuses radar toward expected target area
  - Filters out sea clutter to enable fuze to operate very close to water
- Target Track Beam (locked and tracking mode) tracks target to optimum burst angle

MFF Dynamic Signal Processing Filters Sea Clutter And Detects Valid FAC Target

Benefits vs. Today's 5" Gun Solution

- Electronic Time (ET) Mode Against FAC Targets
  - High Explosive with high velocity fragments
  - Current 5" artillery FAC counter measure
  - Fuze must detonate within a small time window to hit FAC target.
  - Small errors will result in a miss or reduced warhead fragments on target:
    - Electronics timing error
    - Gun Weapon System error
    - Change in target direction or speed
- MFF AIR Mode Against FAC Targets
  - High Explosive with high velocity fragments
  - Detonates at ***optimal fuzing angle*** to maximum frags on target
  - Adapts when FAC ***changes direction and/or speed*** within sensor detection area





MFF Detonates At Optimal Fuzing Angle To Maximize Warhead Effectiveness

Performance Results

- Dahlgren, Potomac River, in November 2004 (MOD0)
  - Objective: Detect and fuze on small boat targets
  - Functioned and localized fragment pattern on target
  - Initial assessment of sensor detection distance threshold
- Dahlgren, Potomac River, in June 2007 (MOD0)
  - Objective: Further evaluation of MFF against boat targets
  - Functioned and localized fragment pattern on target
  - Boat targets were destroyed on first shot
- Dahlgren, Potomac River, in Dec 2010 (MOD1)
  - Objective: Verify MOD1 Sea Clutter Rejection feature
  - Sea Clutter Rejection performance exceeded expectations

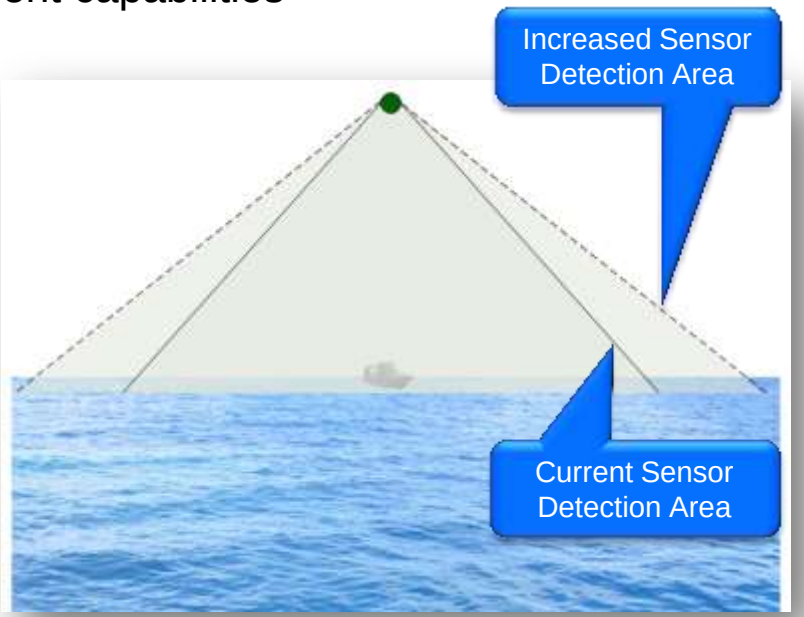
MOD0 Fuzing on RCS of 1.3m²

MOD0 Fuzing on RCS of 0.37m²

MFF Successfully Detected And Fuzed On Small Boat Targets

What's Next

- Further characterization in various RCS targets in various sea states
- Navy system operational analysis of 5" gun using MFF AIR mode
- Define requirements (ie: RCS, sea states, ect..)
- Qualification testing
- Develop enhancements to optimize and enhance current capabilities
  - Increase maximum sensor detection area
  - Optimize target validation algorithm
  - Optimize performance in various sea states
  - Optimize for maximum range of 5" gun
  - Implement ET Mode as the backup mode

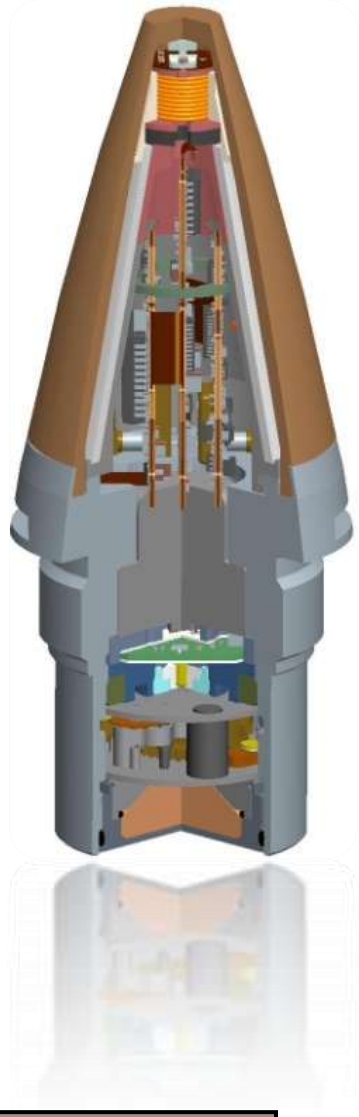


Note: View From Aft

Future Enhancements Will Optimize Effectiveness For Tomorrow's FAC Threat

Summary

- MFF has ***immediate*** defeat capability against FAC targets
- Ballistic testing has ***verified performance***
- MOD1 has ***improved*** performance and capability
- Need to qualify and characterize MOD1 against FAC targets
- Quick-turn enhancements can ***optimize*** current capability
- MOD1 production line is ready ***today*** to build additional fuzes for this effort



MFF Provides An ***Immediate And Effective*** Solution To FAC Threats

Acknowledgements

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