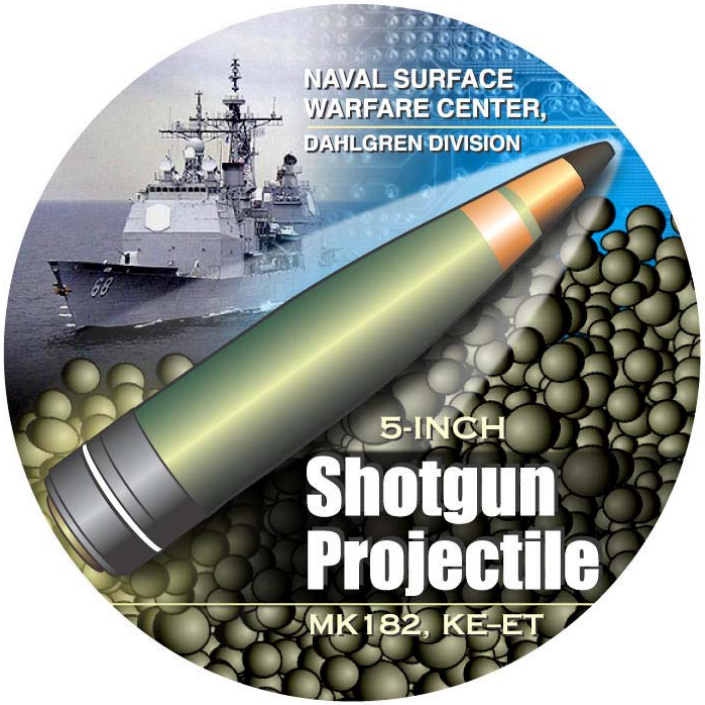
Lessons Learned From the Development of the U.S. Navy 5-Inch Ship Self-Defense Projectiles



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Agenda

- Ship Self-Defense
- Program Drivers
- Two Projectile Solution
- Program Overview
- Program Timeline
- Projectile Bodies
- Fuzing
- IM & Safety
- GWS Upgrades & Training
- Effectiveness
- What Is Next?

Sponsored By:

NAVSEA WARFARE CENTERS CRANE

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NAVSEA LOUISVILLE Gun Weapon Systems Station

GENERAL DYNAMICS Ordnance and Tactical Systems

BAE SYSTEMS

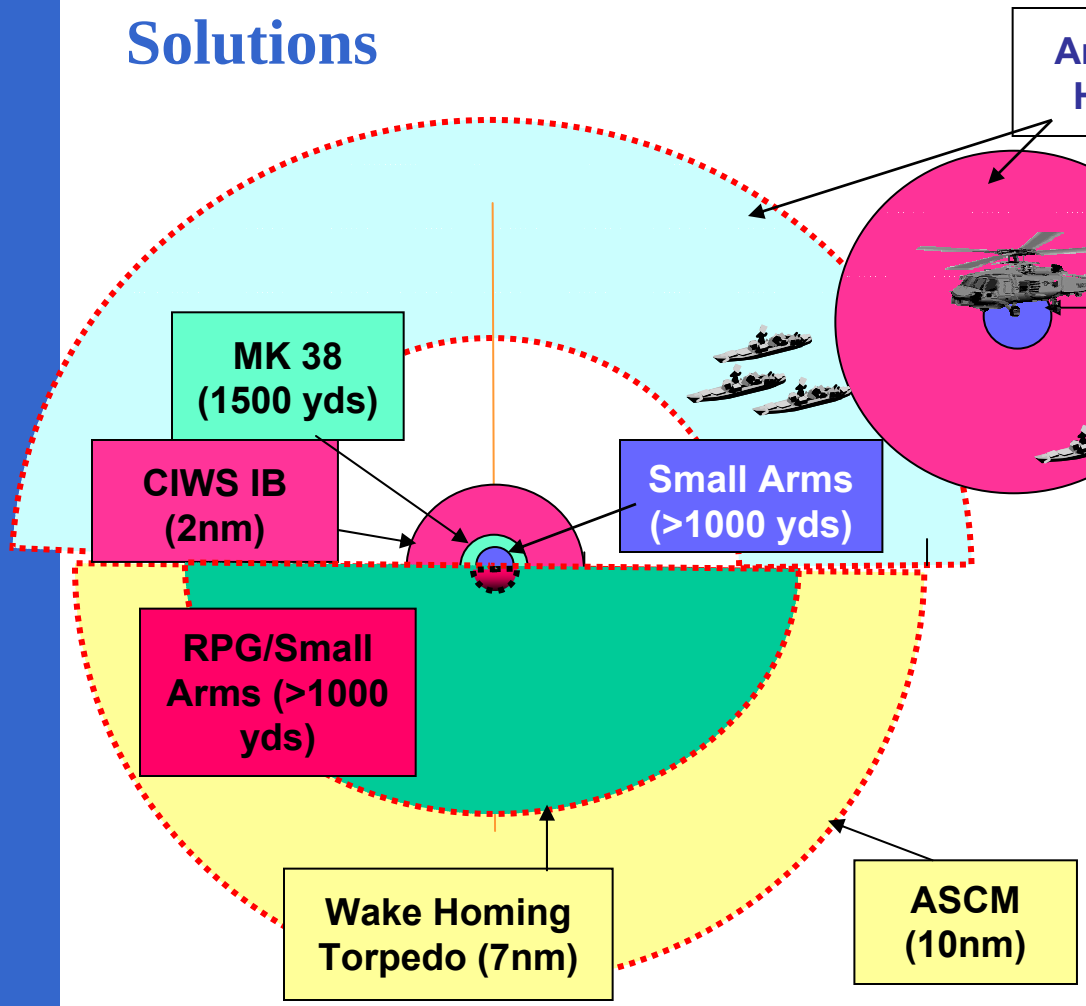
L3 communications BT Fuze Products

HEVI-SHOT

EDO corporation GLOBAL TECHNOLOGY REACH

Ship Self-Defense

Solutions



Threats

- Fast Attack Craft
- Fast Inshore Attack Craft
- Torpedo Boats

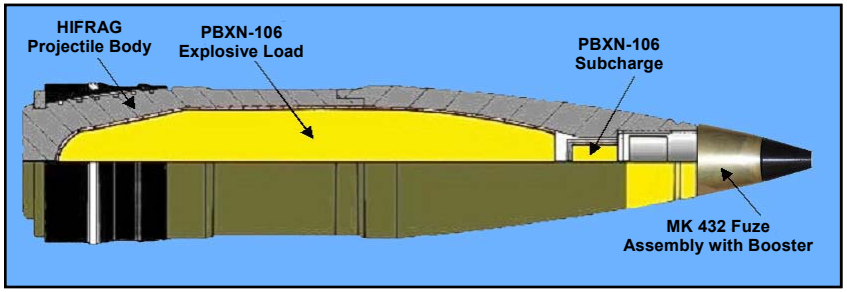
Threats

Program Drivers

- Immediate solution needed
  - Threat realized during USS COLE Incident
- Projectile assets available
  - HIFRAG projectiles in inventory
  - Cargo projectile bodies and fuzes in inventory with no qualified payload
- Field in minimal time
  - Minimal impact to GWS

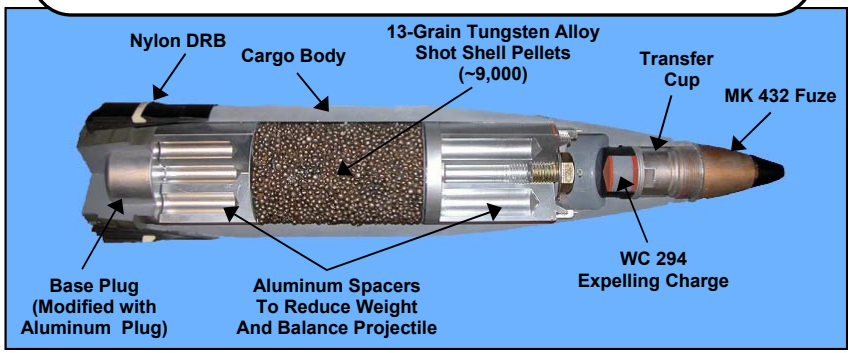
Two Projectile Solution

MK 179 HE-ET (High Explosive)



- Existing HIFRAG projectile retrofitted with MK 432 Electronic Time Fuze
- Implementation optimized for anti-personnel engagements
- Most effective at longer engagement ranges

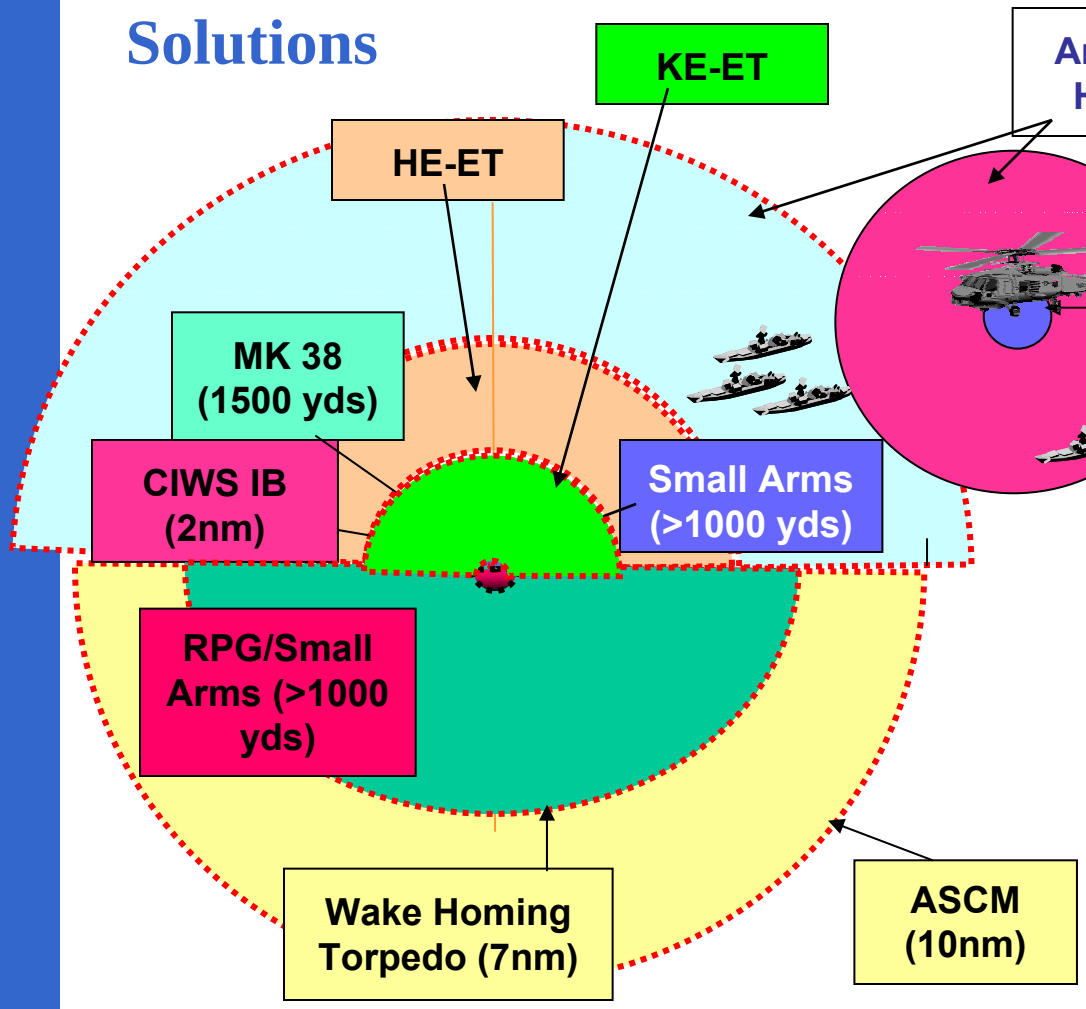
MK 182 KE-ET (Kinetic Energy) "BB Round"



- New payload for existing Cargo Projectiles
  - COTS tungsten pellets
- Same MK 432 ET Fuze
- Optimized for anti-personnel engagements
- Most effective at shorter engagement ranges

Ship Self-Defense w/HE-ET & KE-ET

Solutions



Threats

~~Threats~~

- ~~Fast Attack Craft~~
- ~~Fast Inshore Attack Craft~~
- ~~Torpedo Boats~~

Program Overview

- Product Improvement Program (PIP) initiated Fall ’02 as a demo in support of N76’s Hip-Pocket Task Force
- One time procurement of 8,000 rounds
  - 4,000 of each configuration
  - Rounds produced and in inventory
  - Reserved for CGs and DDGs that have received GWS upgrades and are deploying
- 1st CG & DDG deployed with HE-ET & KE-ET 2nd Qtr 2005

Program Timeline

- First Land Based Demonstration – Sep 02
- Safety Review Board Concurrance with Projectiles – Sep 03
  - Demo to WSESRB Concur with IOC = 54 weeks
- All projectiles loaded & in inventory – Feb 04
- Shipboard Test Series – Fall 03 to Fall 04 (4 events)
  - USS LAKE CHAMPLAIN
  - USS VELLA GULF
  - USS ROSS
  - USS PINCKNEY
- Ship Upgrades – Begun in Fall 04 (ongoing)
- Crew Training – Begun in Fall 04 (ongoing)
- Initial Operational Capability (on Deployers) – Mar 05

Fuzing

- HE-ET & KE-ET effectiveness dramatically enhanced by fuze performance
  - Precision timing – 10 msec setting increments
  - Timing Adjusted by Fire Control System for optimum burst location relative to target

MK 432 Mod 0 Electronic Time Fuze

Projectile Bodies

- Cargo projectile bodies were available in inventory
  - Fully qualified projectile without qualified payload
  - Flexible design allowed for easy integration of COTS tungsten pellets
  - Other needed parts designed to be manufactured by any machine shop
- HIFRAG projectiles in inventory
  - Chosen over available MK 64 projectiles due to lethality against personnel targets
  - Required only replacement of fuze, no other modifications

Cargo Projectile

IM & Safety

- KE-ET & HE-ET qualification included full Safety and IM test series
  - Safety Program
    - MIL-STD-2105 testing
    - Full WSESRB Approval
  - IM Program
    - Scores based on IM tests and analogy
    - Both projectiles passed with waiver
    - KE-ET most IM compliant 5-Inch projectile
      - Improvements needed to pass Fast & Slow Cookoff

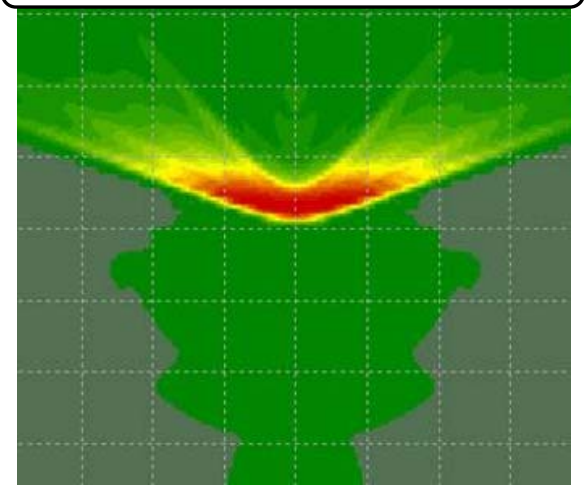
GWS Upgrades & Training

- GWS Upgrades
  - Fire Control Software
  - Optimized Ballistics
  - Fuze Setter
  - GWS upgrades in progress for all CG and DDG class ships
- Training
  - Short Term (FY05) – Program Office
  - Long Term (FY06+) – Afloat Training Group (ATG)

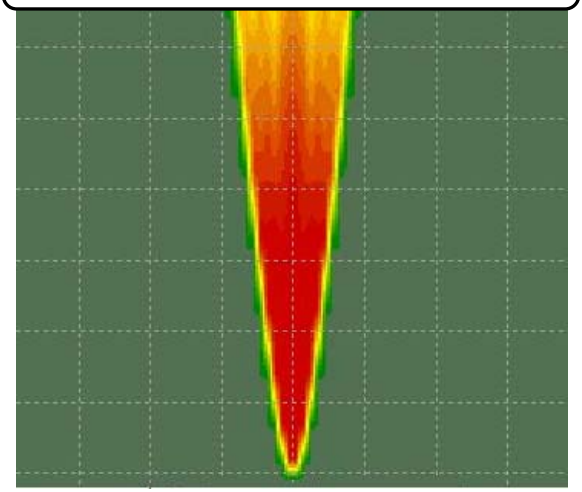
Effectiveness

- HE-ET very effective at longer ranges and against maneuvering targets
  - Wide fragmentation pattern still hits turning/maneuvering targets
  - Large number of high-speed fragments very lethal
- KE-ET very effective at shorter ranges and against straight line targets
  - Forward fragment blast very effective at low angles of fall
  - Long pattern compensates for range errors inherent to gun engagements
  - High density COTS pellets offer better penetration than steel fragments

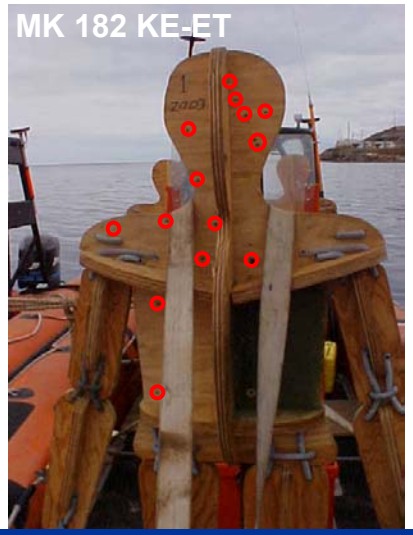
MK 179 HE-ET @ 5kyds



MK 182 KE-ET @ 3kyds



MK 179 HE-ET & MK 182 KE-ET Shipboard Test Results



Fragmentation and Lethality Models Validated within 10% by Land Based and Shipboard Testing

Potential Upgrades

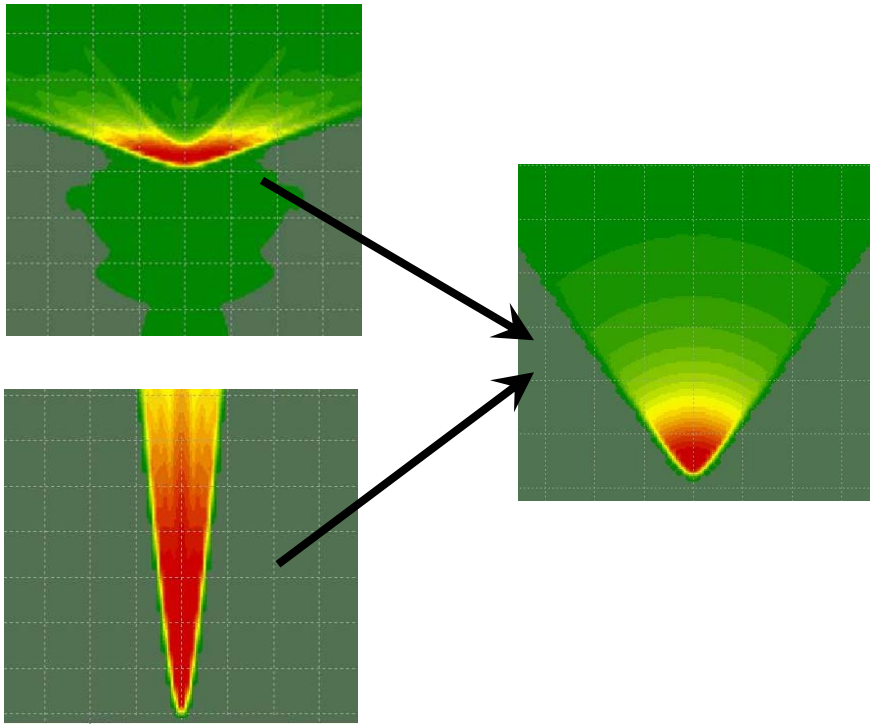
- HE-ET Potential Upgrades
  - Change shape of HE charge
  - Change fragmentation properties of projectile body
  - Incorporate high-density pre-formed fragments
- KE-ET Potential Upgrades
  - Forward expel payload for increased kinetic energy on target
    - Phase II SBIR Contract, Veritay Technology, Inc.
  - Upgrade payload to larger size/higher density pellets
  - Enhance radial pellet dispersion with mechanism or energetics
- Fuzing Upgrades
  - Multi-mode fuze would change from ET to Surface Proximity Mode at optimal range to extend maximum range
    - MK 419 Multi-Function Fuze (MFF)
    - EX 437 Multi-Option Fuze (MOFN)

What Is Next?

- NAVSEA approved a FY05 study of various concepts to find “Best Value” solution
  - Study report due for completion by end of FY05
  - Follow-on action to be determined by study findings
- Best Value
  - The best balance of the following factors to meet the program objective
    - Cost
    - Performance
    - Risk
    - Schedule
- Mission Kill
  - Firepower
  - Mobility
  - Personnel

What Is Next?

- Advanced Shotgun Projectile
  - One optimized projectile replacement for both KE-ET and HE-ET
  - Increases effectiveness from Anti-Personnel to Mission Kill
  - Address IM improvements



Ship Self-Defense Projectiles

- Quick turn around solution to immediate threat
- Successful qualification and IOC of two new projectiles
- Projectiles produced and in inventory
- Ship upgrades and crew training ongoing
- First ships on deployment with HE-ET & KE-ET
- Future upgrades being investigated in Advanced Shotgun Projectile Study

"Fully Field the 5" gun BB round to enhance capability against the small boat threat." -- CNO Guidance for 2005