NDIA's 53nd Annual Fuze Conference

US NAVY OVERVIEW

Rev 7.4 – 20 May 09

Randall Cope

Associate Dept. Head for Energetics

NAWCWD, China Lake CA

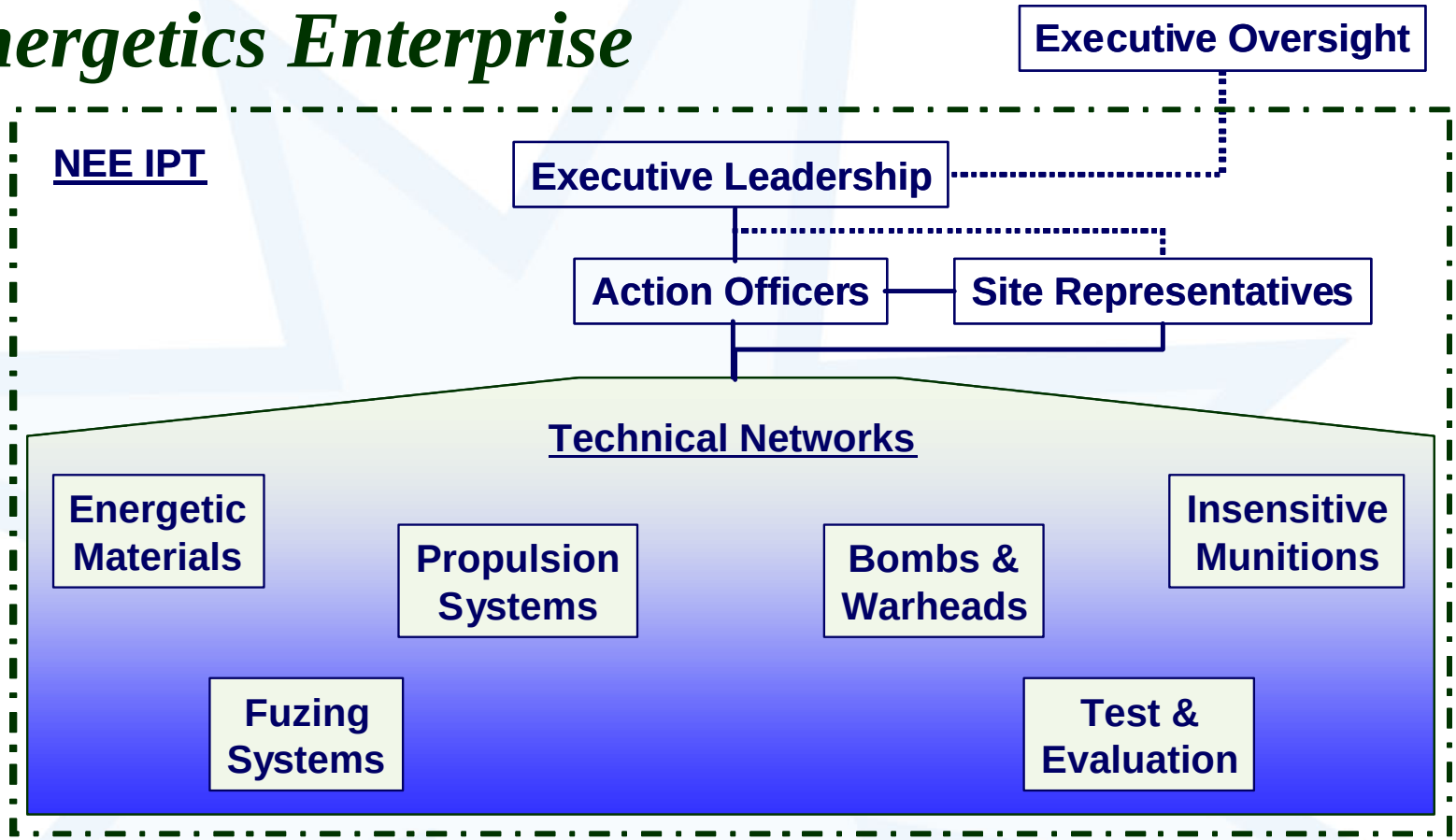
NAVAIR

NAVSEA
WARFARE CENTERS

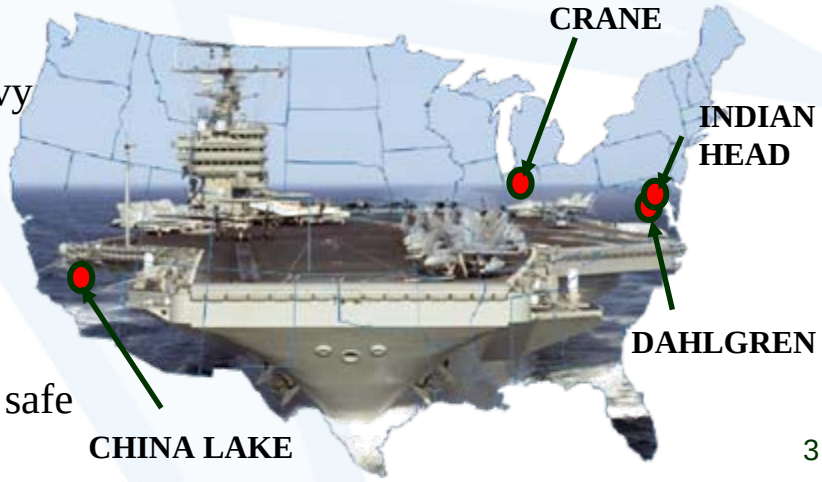
Outline

- **Naval Energetics Enterprise Overview**
- **Fuze Safety Review Process & Panel**
- **Capabilities**
- **Future of Fuzing**
- **Summary**

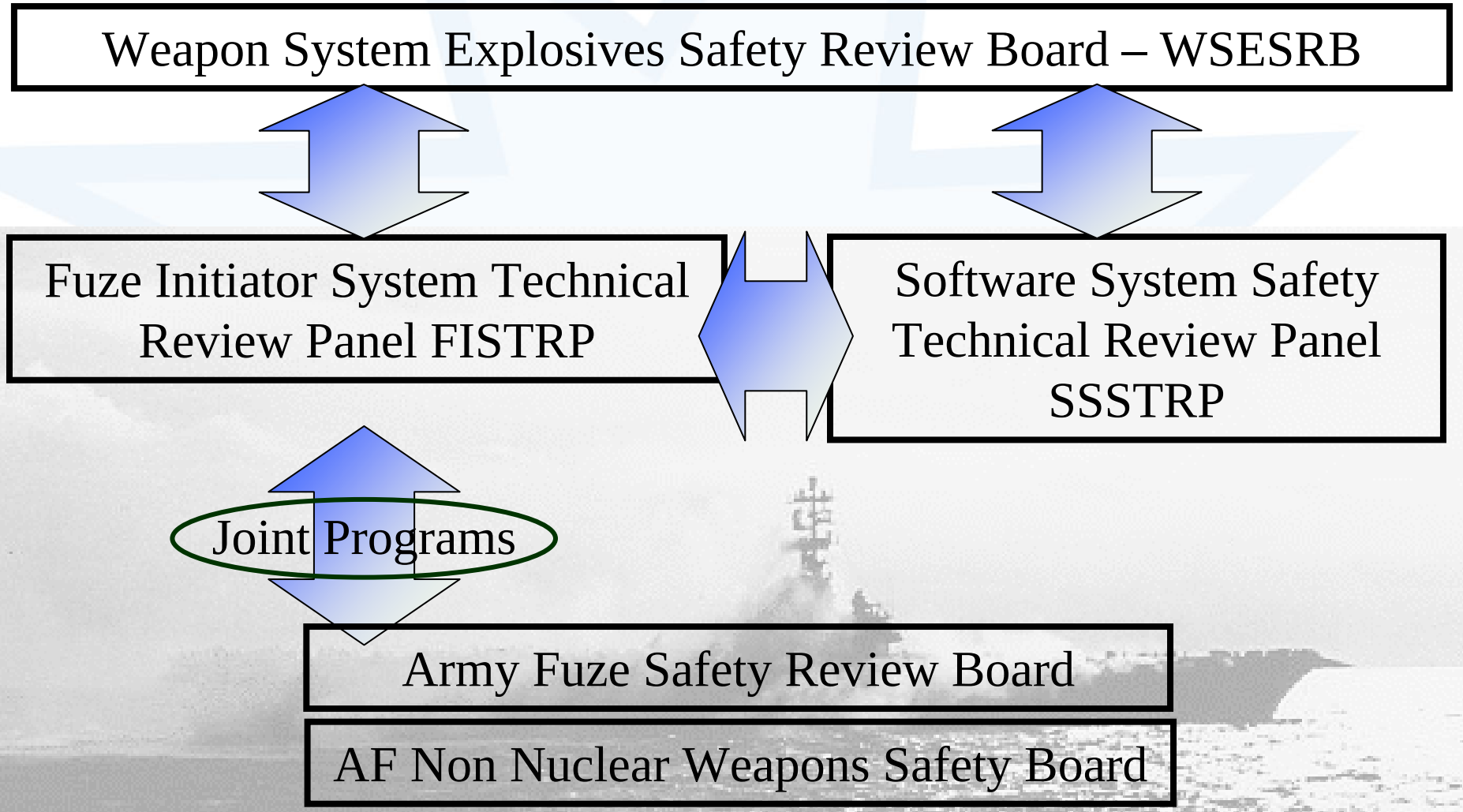
Navy Energetics Enterprise



- Provide stewardship of unique Navy capabilities to ensure current and future Navy warfighting requirements are attainable and supportable
- Speak with a single Navy voice
- Work together to improve efficiency and rationalize resources to provide responsive, safe and affordable ordnance solutions



Navy Fuze Safety Review Process



Fuze and Initiation Systems Technical Review Panel (FISTRP)

Panel Chair – Jack Waller

Panel Members –

Raymond Ash
Randy Cope
John Hendershot
John Kandell
Scott Pomeroy
Melissa Milani
Ralph Balestieri
Micheal Demmick
John Hughes
David Libbon
Gabriel Soto
Tinya Coles-Cieply
Bradley Hanna
George Hennings
Eugene Marquis
Brian Will

Current Topics of Interest/Challenge

Charge-Based Memory – Reconfigurable Logic
Environmental Sensing for Smart Weapons

MIL-STD-1316 STANAG 4187
MIL-STD-1901 STANAG 4368
MIL-STD-1911 STANAG 4497

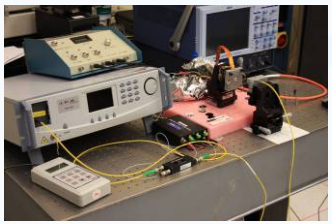
Fuze & Initiation Technology Development Capabilities at Indian Head

MEMS Clean Room

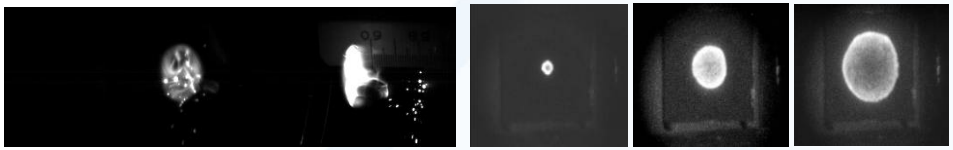
Navy Unique Facility for Integrating Micro System, Electronics , Initiation and Explosives Component Technologies

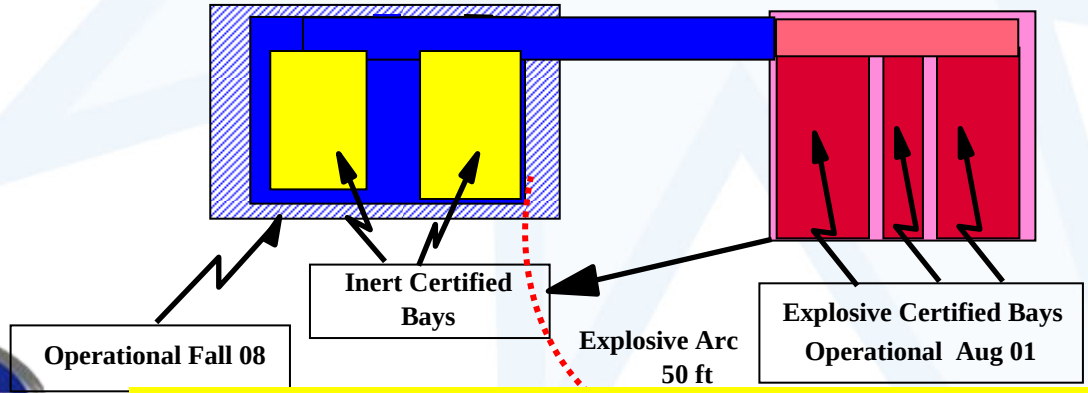
- Class 10,000 Clean Room
- Explosive and Micro Systems Assembly
- Component Packaging
- Device Characterization
- Fiber Optic Integration
- Electrical and Mechanical Testing
- Photonic Doppler Velocimetry (PDV)
- Firing Circuits & Diagnostic Suite

Parallel Seam Welder



PVD





10 Gm Explosive Test Chamber

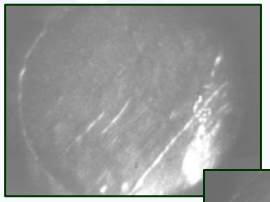
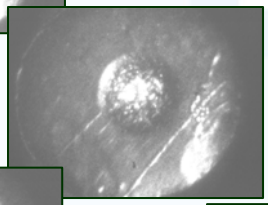
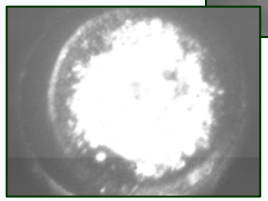
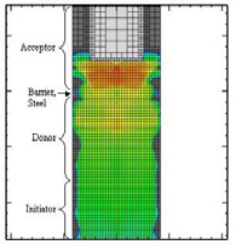
State of the Art Facility

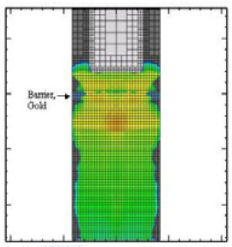
Fuze & Initiation Technology Development Capabilities at China Lake

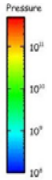
Cutting Edge Design Capabilities
- MEMS Design
- ASIC Design
- CAD/CAM

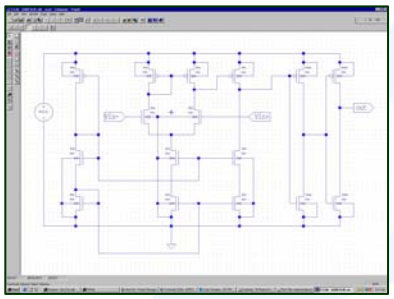
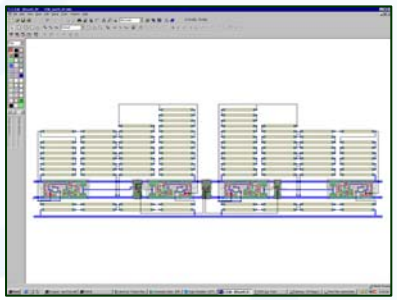
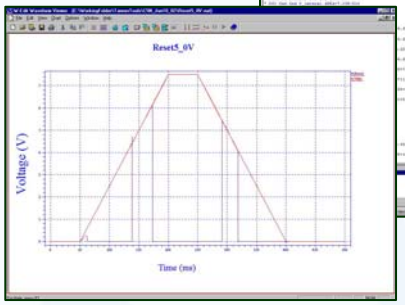
Test capabilities
- Small and Large Scale Test Facilities
- Fuze Laboratory
- P749

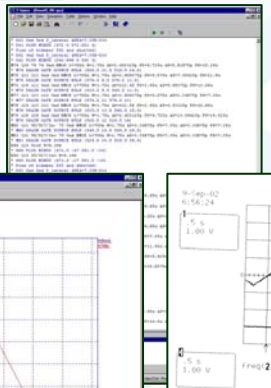
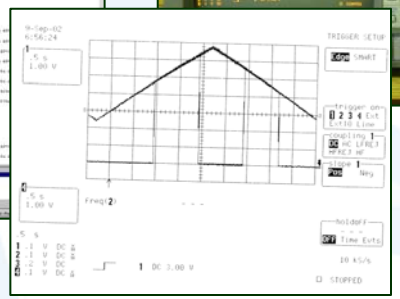
EFI detonators & Initiators

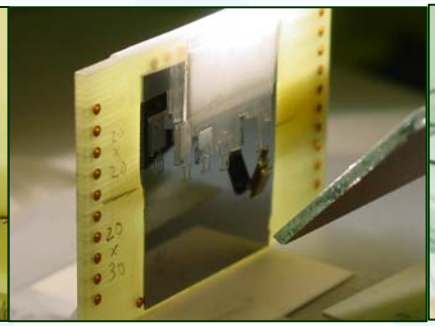











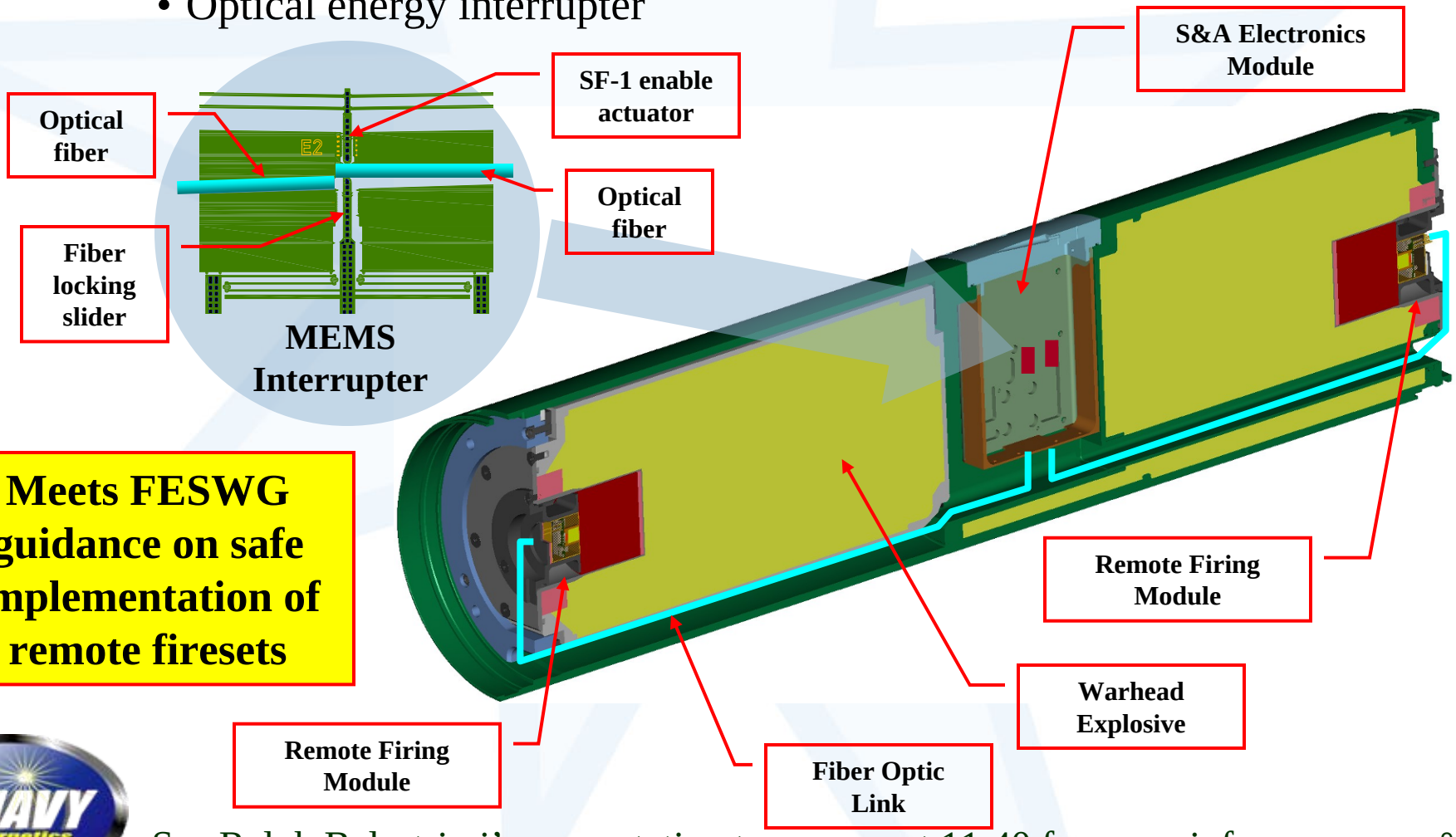

Next Generation Fuze Technologies

- Miniature Munitions
  - Low cost, small size
    - Common Architecture S&As
      - Leveraging of existing designs
      - Modular architectures
    - MEMS technology for low cost fuzes
    - Miniature ESAD technology
    - RF Proximity sensor for small high speed targets
      - Flexible proximity sensing through DSP
      - Use broadband/Spread Spectrum technology
    - Thin film thermal battery
- Niche applications
  - Performance more important than cost
    - Higher end guided applications, multi-mode weapons
    - Survival of harsh environments
    - Very high reliability

Optically Linked Remote Firesets

Components

- Remote miniature firesets with high voltage EFIs
- Optical charging energy
- Optical energy interrupter



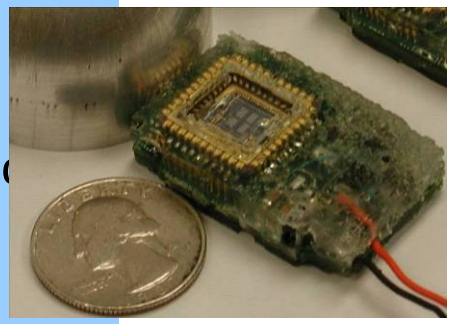
Meets FESWG guidance on safe implementation of remote firesets

See Ralph Balestrieri's presentation tomorrow at 11:40 for more info

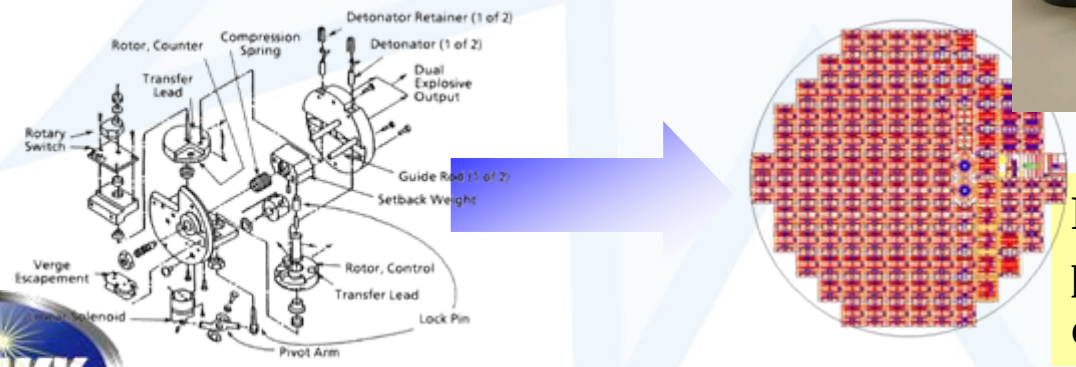
MEMS S&A Technology

Revolutionary Research . . . Relevant Results

- Capitalizes on commercially available IC large scale batch fabrication techniques
- In-Situ (formed in place) micro detonator technology … no energetic waste material … no processing equipment exposed energetics
- Reduces fuze cost and size
- Successfully demonstrated in 40,000 G setback environment



MEMS in-situ detonator based S&A device technology currently TRL 5

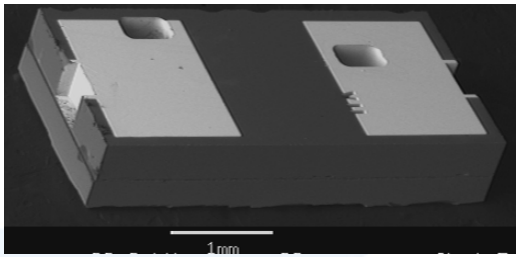


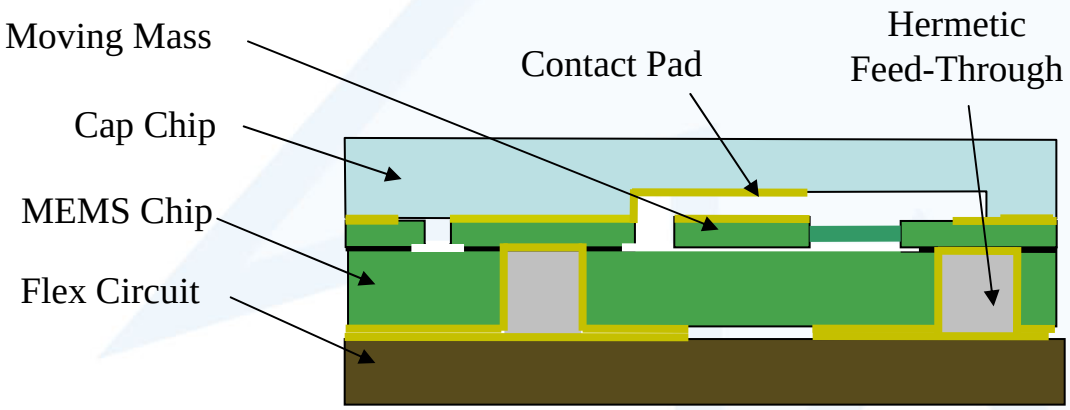
From tens of mechanical parts per fuze to 100's of fuze chips per single wafer

See Dr. Dan Jean's presentation tomorrow at 9:00 for more info

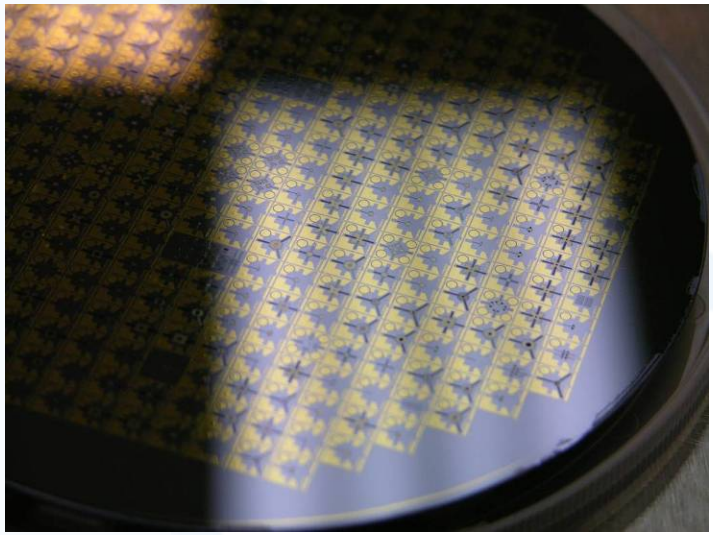
Contact Switch for Point Detonation

- MEMS Based Impact Sensor
  - Low profile: less than 900 µm tall
  - Withstand 50 kG launch, detect 150 G
  - 2 rounds of design and fabrication completed in 2007 (60 sensors delivered)
  - 1 round of design and fab in 2008, (15 sensors delivered)
  - Hermetically sealed, size is 2 x 4 x 0.8 mm





Surface Mount Switch Schematic

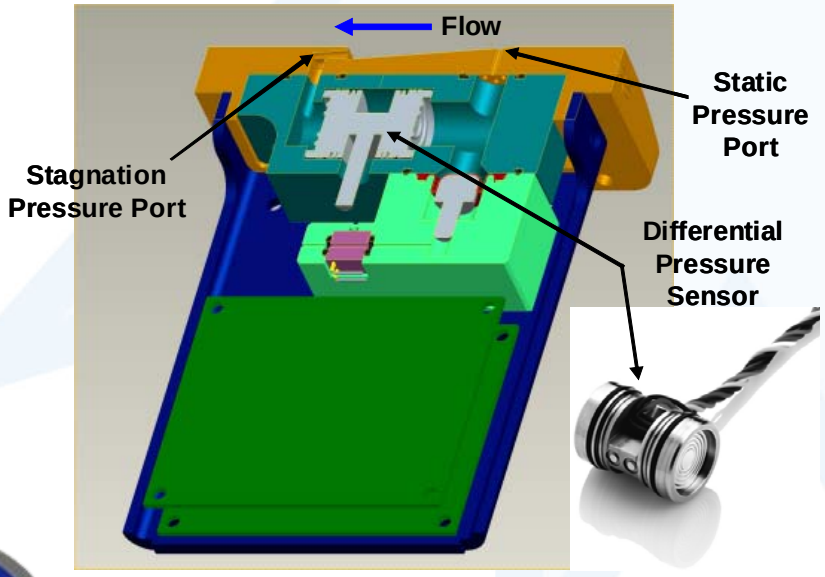


4” Wafer of Contact Switches

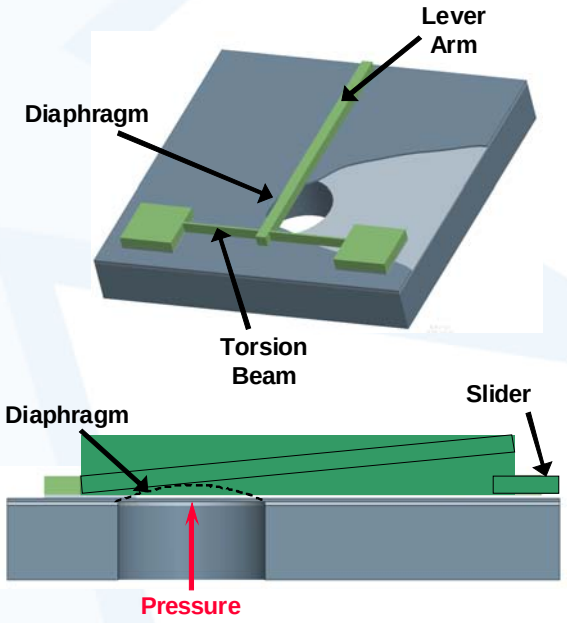
See Eddie Chen’s presentation tomorrow at 2:00 for more info

MEMS Underwater Sensors

- **Miniature sensors developed for torpedo applications**
- **Differential pressure flow sensor**
  - **Incorporates a silicon MEMS piezoresistive pressure sensor**
  - **Difference between the total pressure and the static port correlates to the flow speed for a given fluid**
- **Hydrostat**
  - **Microfabricated diaphragm that deflects with pressure**



Differential Pressure Flow Sensor



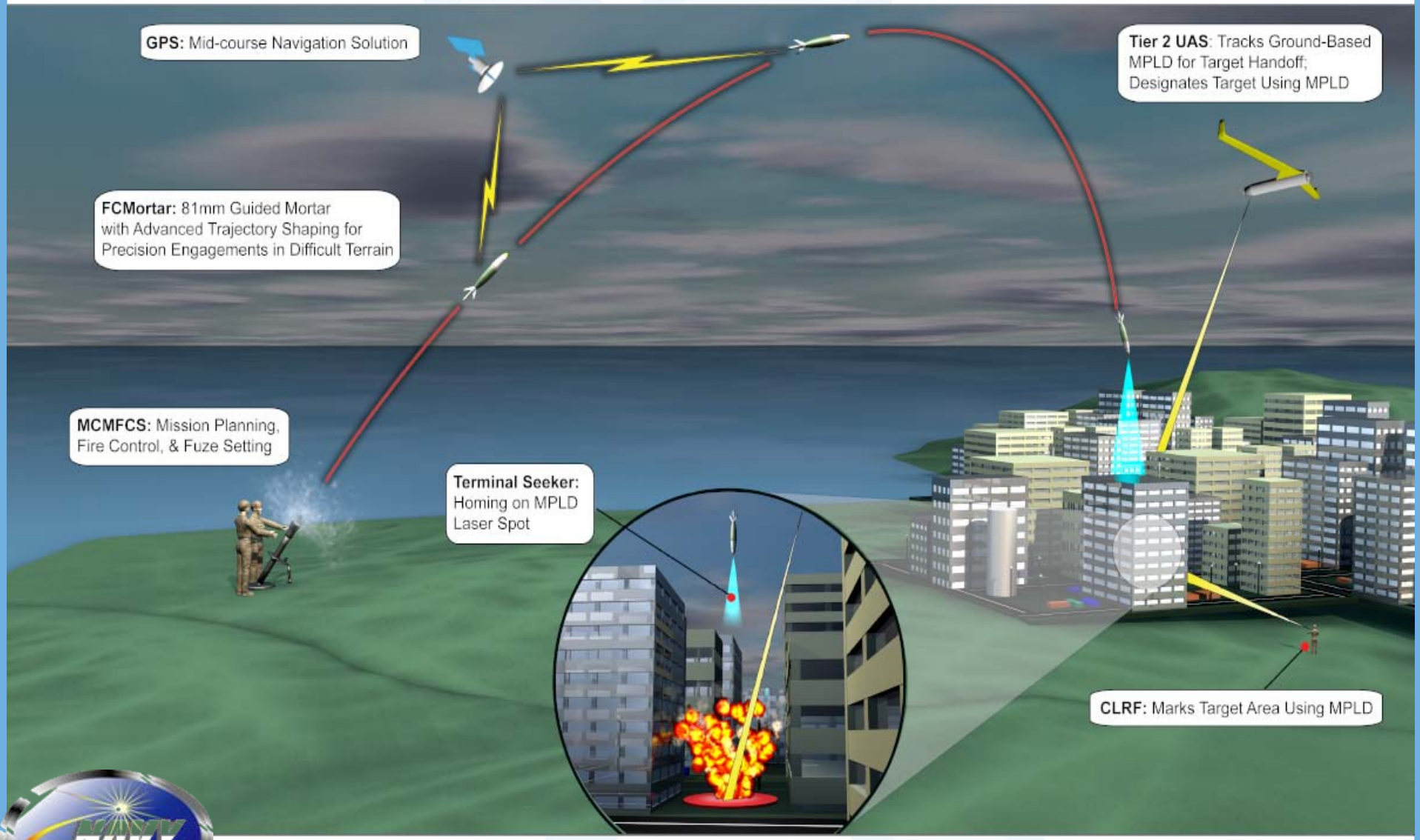
MEMS Hydrostat

Miniature Munitions and Low Cost Applications

- **Developing low-cost solutions for miniature applications**
  - Utilizing COTS components
- **Component Evaluation**
  - High-Voltage Ceramic Capacitors
    - Size, Cost, Energy Output, Temp and Voltage Coefficients, and durability
  - Transformers
    - Charge time w/ available input power
      - Fast charge time applications
      - Low power applications
    - Size and Cost
  - High-Voltage Switches
    - Planar, MCT, Gas Breakdown Tubes, and Sprytron
    - Size, Cost, and Efficiency
- **Full-custom ASIC design**

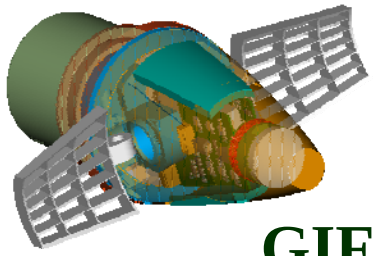
Precision Urban Mortar Attack

PUMA



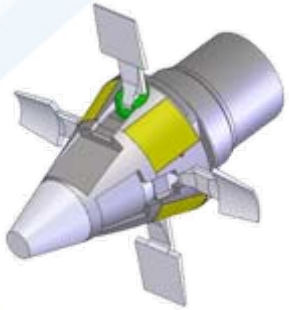
See Luke Steelman's presentation at 1:20 this afternoon for more info

Long Range Gunnery Technology

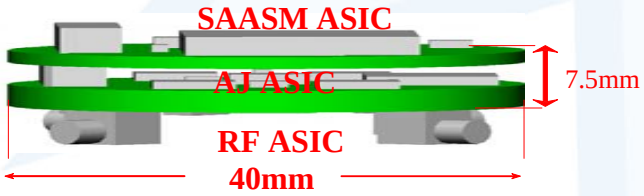


GIF

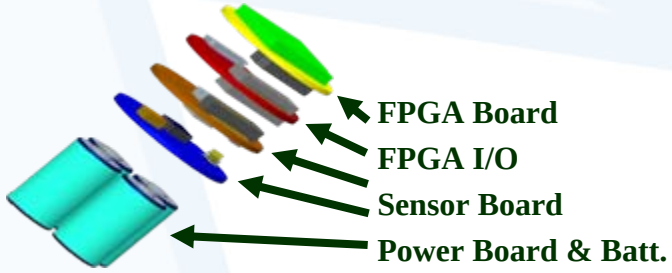
- **GIF - Guidance Integrated Fuze Demonstration**
  - TRL 5-6, Close-Loop Guidance – May 2008
- **VIPER Fuze Design**
  - Preliminary Design and Basic Research Completed
- **ETF - Electronic Test Fuze**
  - UUT Control & Power, Sensors, Telemetry Data
- **GPS P(Y) SAASM Receiver**
  - Available Mar. 2010, (C/A version available now)



VIPER



SAASM GPS Receiver



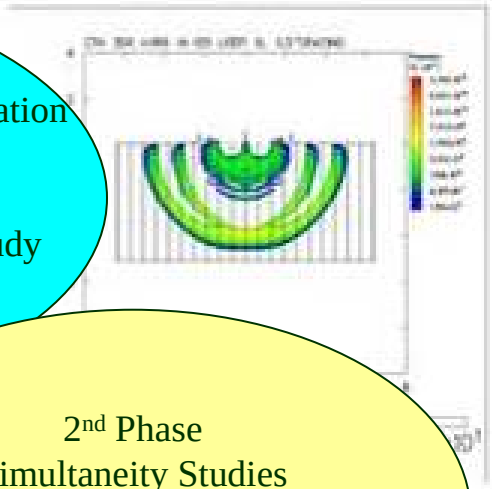
ETF

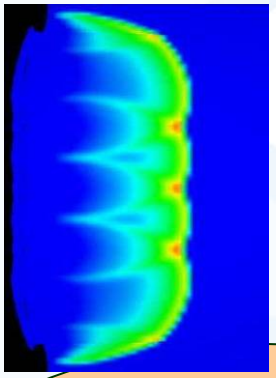
See Wayne Worrell's presentation at 2:20 this afternoon for more info

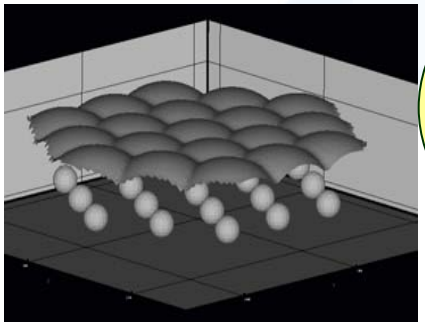
Extremely Insensitive Detonating Substance (EIDS) Initiation System

- An Initiation System that emulates large diameter boosters for use in initiating EIDS materials
- OSD funded through Joint Insensitive Munition Technology Program
- Joint Navy (NEE) led effort with Air Force, Army, & Los Alamos participation
- Improved IM performance through elimination of large, relatively sensitive booster
- System requires simultaneous initiation of multiple detonation points

1st Phase (Current Phase)
Modeling to develop theoretical configuration
Development of fireset electronics
Initiation System Configuration
Initiation Growth & Corner Turning Study
EFI PIC Development
Feasibility Study







2nd Phase
Simultaneity Studies
Detonation Merging & Wave Shaping
Initiation Growth Modeling & Testing
Fireset & Initiation System Optimization

3rd Phase
Large Scale EIDS Material Testing
Large Scale Critical Diameter Testing
MIL-STD-2105 Testing (Limited)

See Dave Olson's presentation tomorrow at 11:00 for more info

Summary

Today's Navy

- **NEE - Leveraging the abilities of multiple installations**
- **FISTRP / FESWG / Joint Reviews - Safety conscious**
- **Cradle to grave support of the warfighter**
  - **Concept**
  - **Advanced Development**
  - **Research and Development**
  - **In-Service Support**
  - **Quality Assurance**