

R&A: TBD

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Sandia  
National  
Laboratories

SAND2020-7592C

# Advanced Fuzing Technology

## Sandia National Laboratories



*PRESENTED BY*

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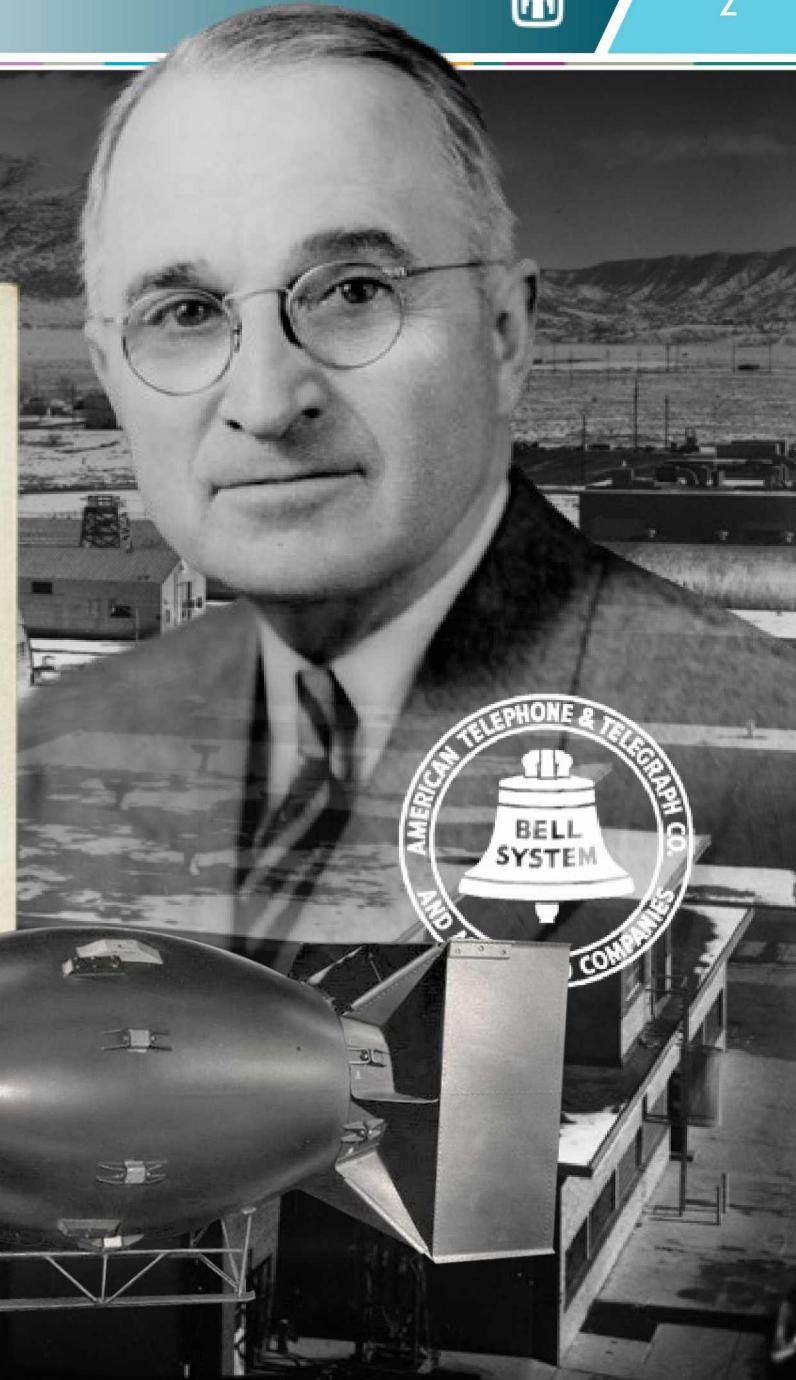
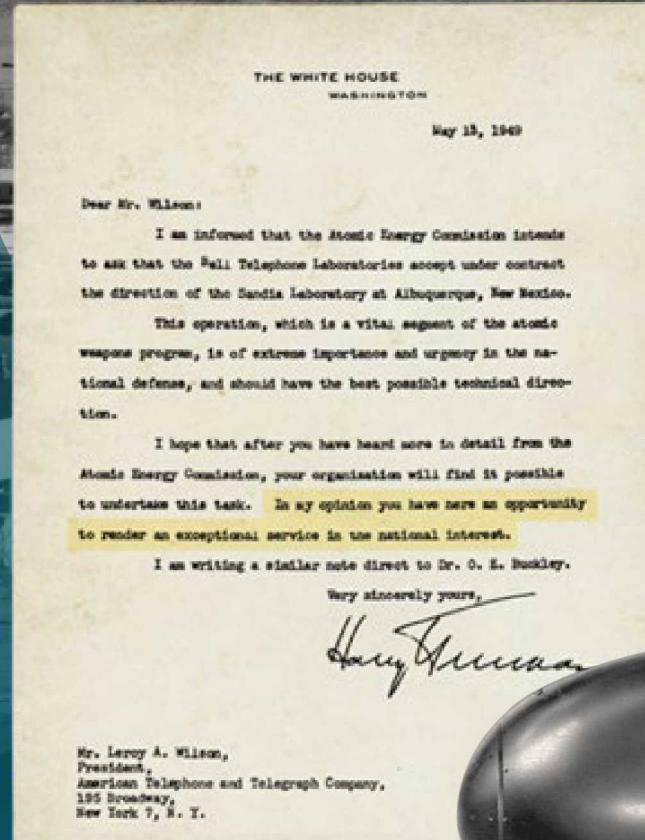


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# SANDIA'S HISTORY IS TRACED TO THE MANHATTAN PROJECT

*...In my opinion you have here an opportunity to render an exceptional service in the national interest.*

- July 1945  
Los Alamos creates Z Division
- Nonnuclear component engineering
- November 1, 1949  
Sandia Laboratory established
- AT&T: 1949–1993
- Martin Marietta: 1993–1995
- Lockheed Martin: 1995–2017
- Honeywell: 2017–present



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operated



# SANDIA HAS FIVE MAJOR PROGRAM PORTFOLIOS



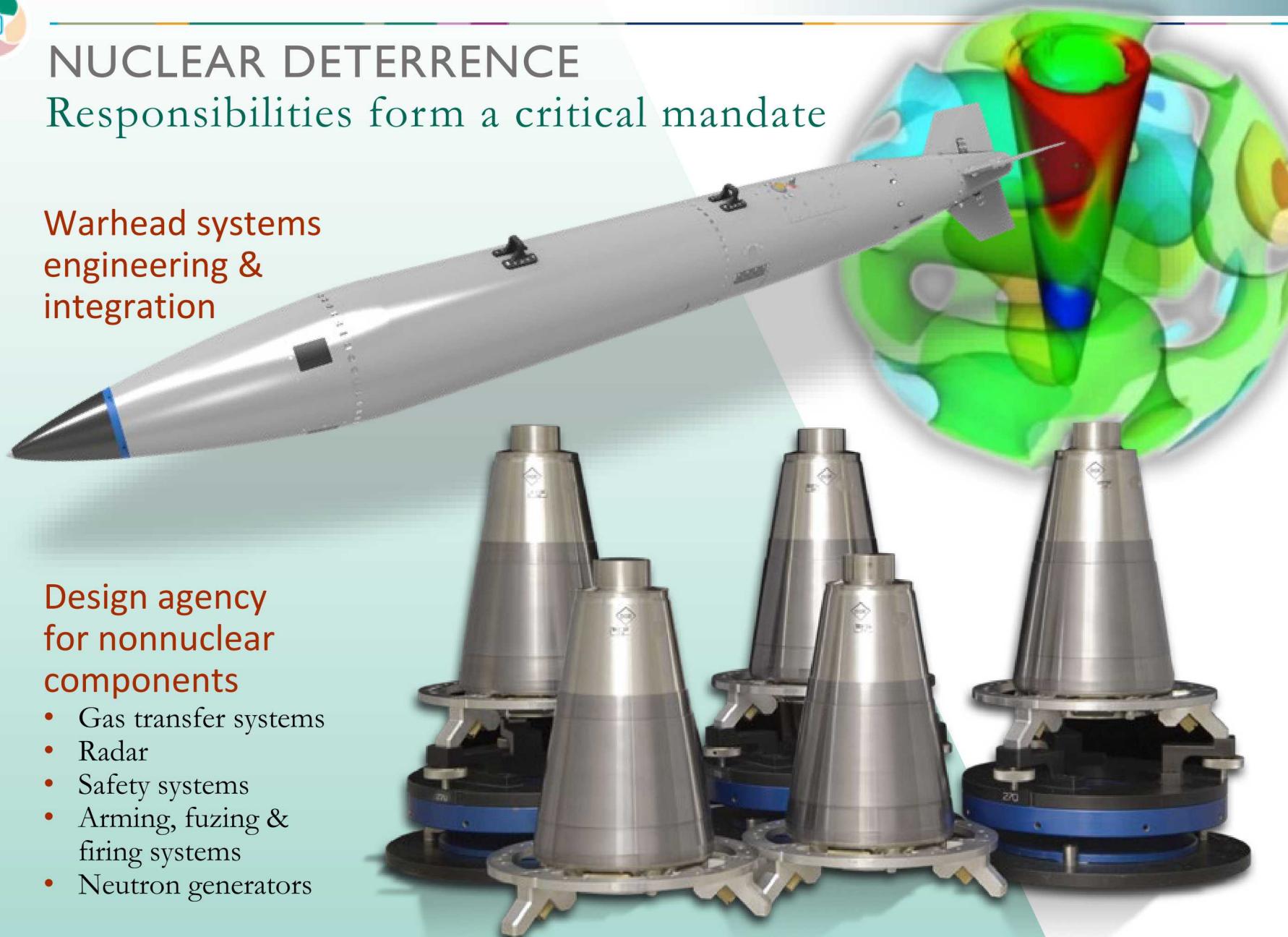
# NUCLEAR DETERRENCE

Responsibilities form a critical mandate

Warhead systems  
engineering &  
integration

Design agency  
for nonnuclear  
components

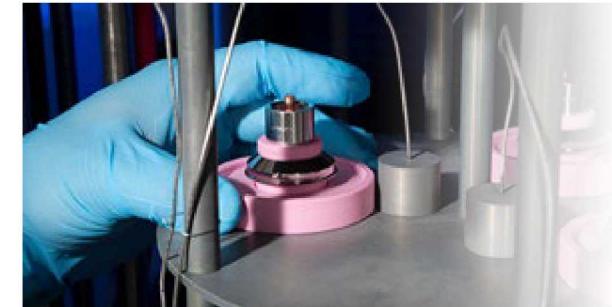
- Gas transfer systems
- Radar
- Safety systems
- Arming, fuzing & firing systems
- Neutron generators



Multidisciplinary  
capabilities

Required for design,  
qualification, production,  
surveillance, computation/  
experimentation

- Major environmental test facilities & diagnostics
- Materials sciences
- Light-initiated high explosives
- Computational analytics



Production agency

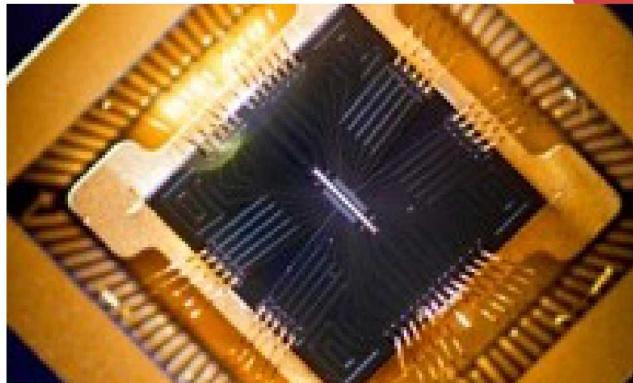
- Neutron generators
- Sandia external production
- Microelectronics
- Thermal battery backup

# NATIONAL SECURITY PROGRAMS

## Strengthens our nation's defenders



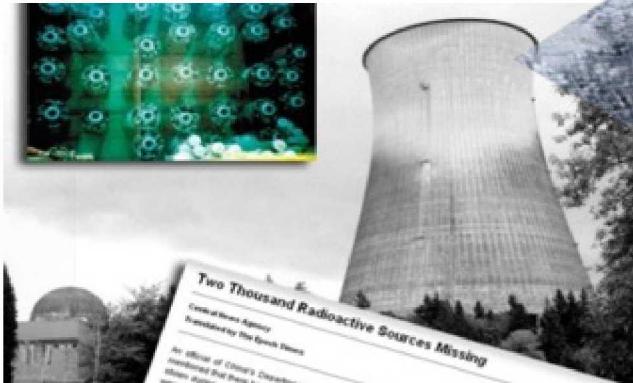
Information operations



Science & technology products

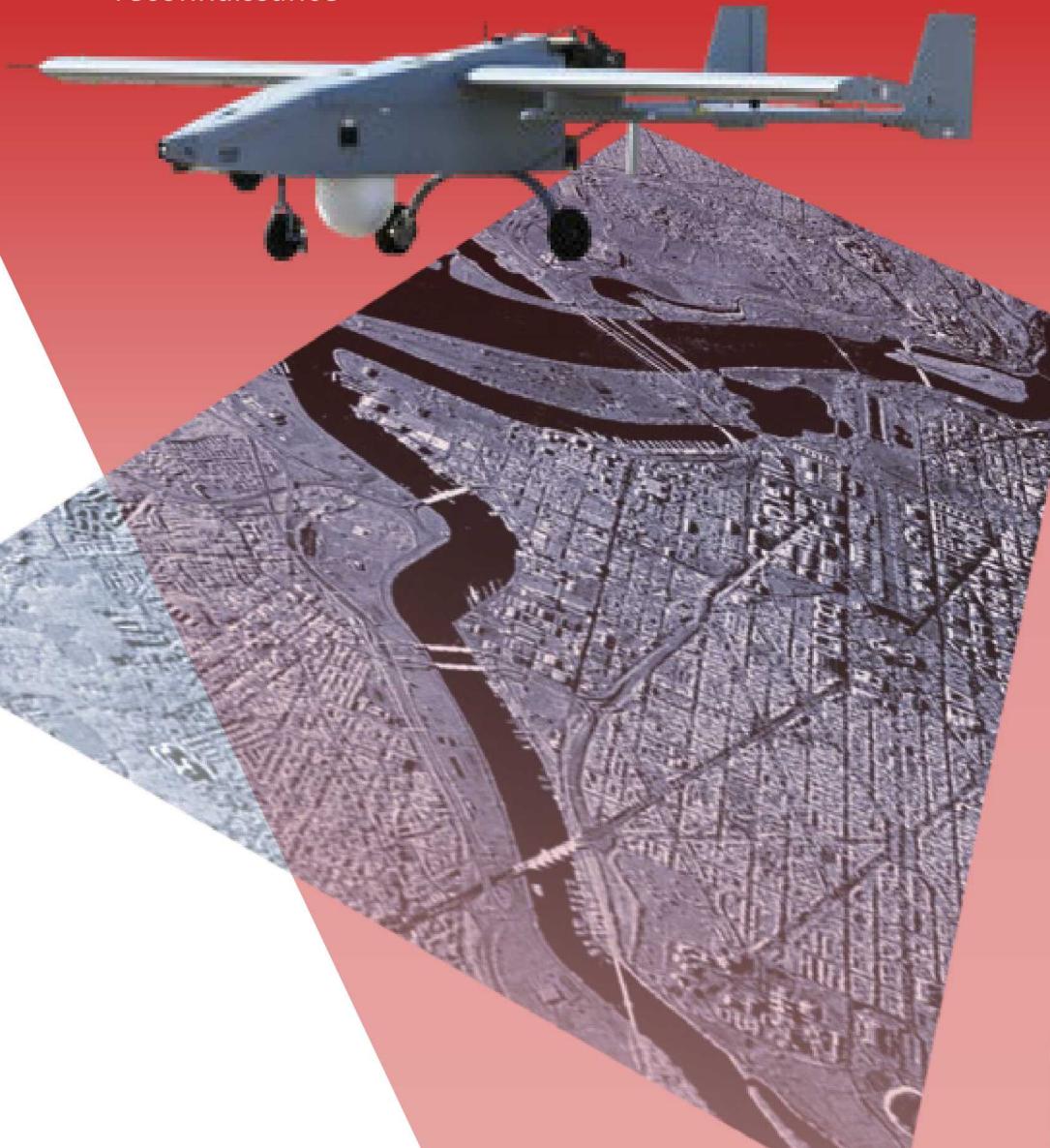


Integrated military systems



Proliferation assessment

Surveillance & reconnaissance



# Advanced Fuzing Technology Dept

Advanced Fuzing Technology seeks to develop fuzing and firing systems that are on the forefront of technology

- **Miniature** --- smallest in the world
- **Multipoint** --- with precise timing
- **Embedded** --- within the explosive system
- **Hardened** --- against mechanical shock
- **Understood** --- by state of the art simulation & experimentation
- **Safe** --- by military standards
- **Reliable** --- by proven demonstration & margin
- **Forward Looking** --- for emerging and future applications



Advanced Fuzing Technology is responsible for the **design of fuzing devices** for both the **Nuclear Deterrence** and **National Security Programs** missions at Sandia

*Unique understanding of both mission areas and customer needs*

## Customers/partnerships

DOE/NNSA

DoD - (AFRL, DTRA, Navy SSP, NSWC IHOEDTD, ARDEC, etc.)

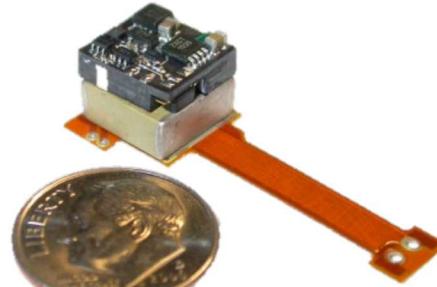
Joint Fuzing Technology Program (JFTP)

Joint Munitions Program (DOE/DoD)

Fuzing industry partners (Raytheon, etc.)

# Miniature & Multipoint

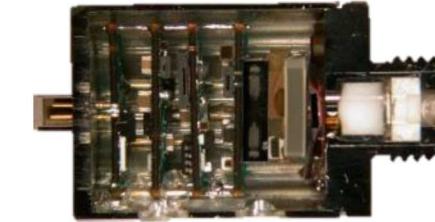
## Small Firing Sets w/ Precise Timing



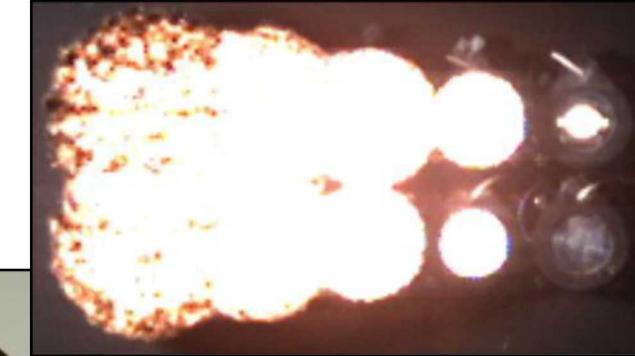
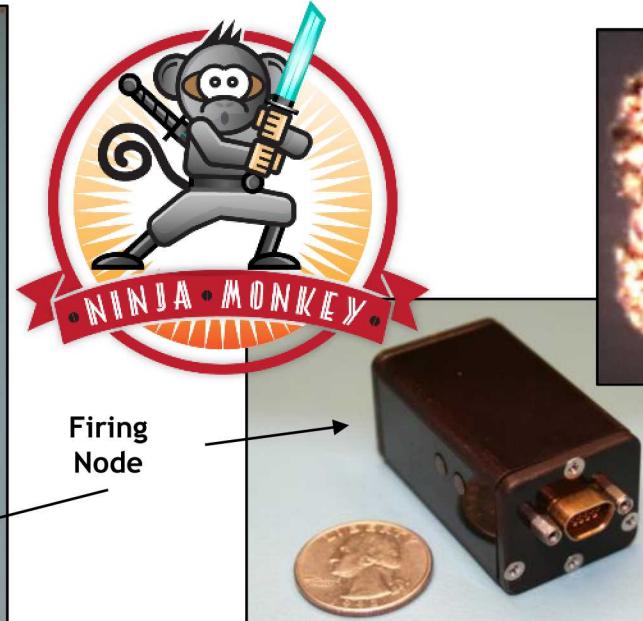
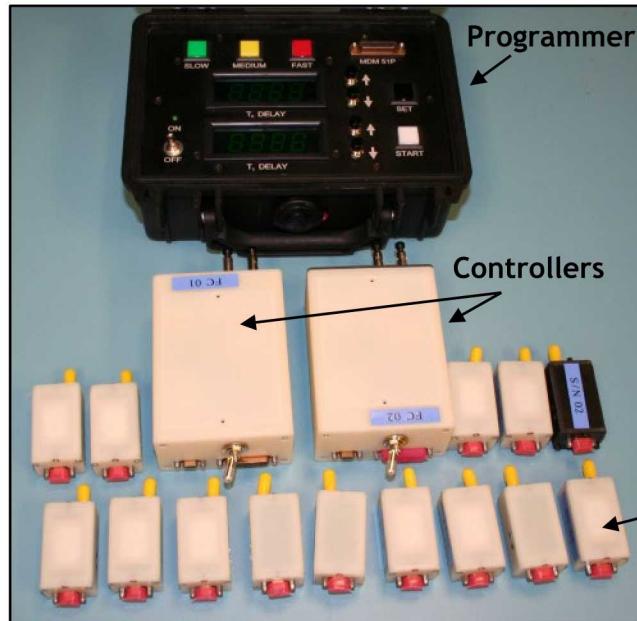
Miniature Electronic Safe-Arm Device



Miniature Electronic Safe-Arm Device



Hermetic, Miniature Firing System with Digital Logic

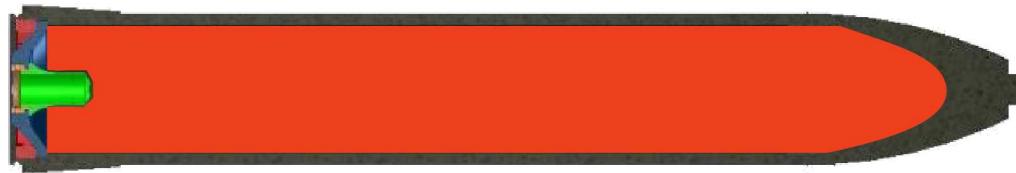


High Speed Video Capture (sub- $\mu$ s timing)

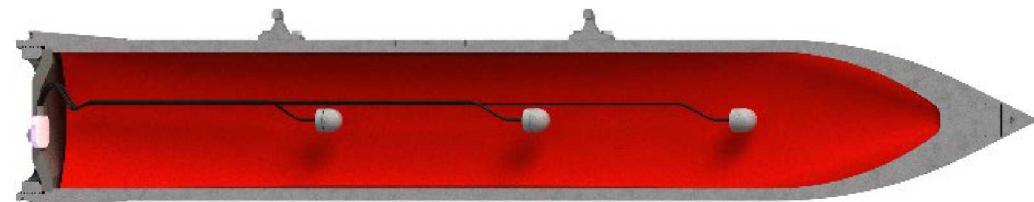
# Embedded

*Fuzing systems embedded in fill material for survivability*

## Traditional Fuzing Design



## Distributed Fuzing Design



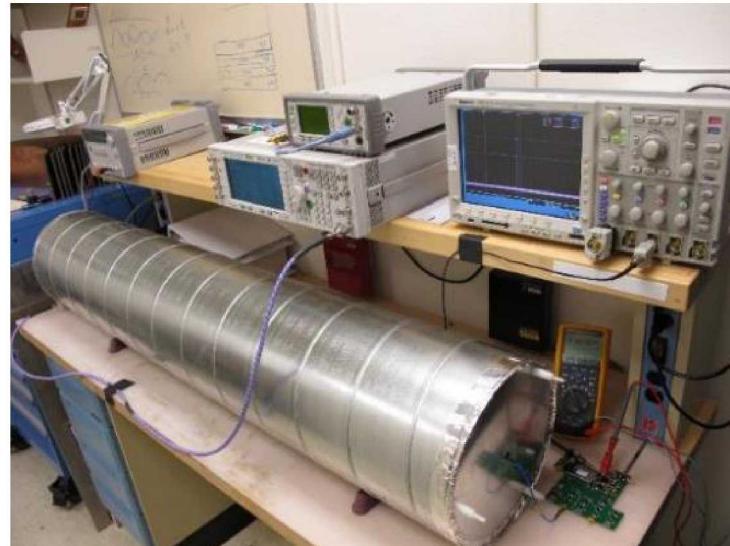
AFRL fuzing architecture design concepts



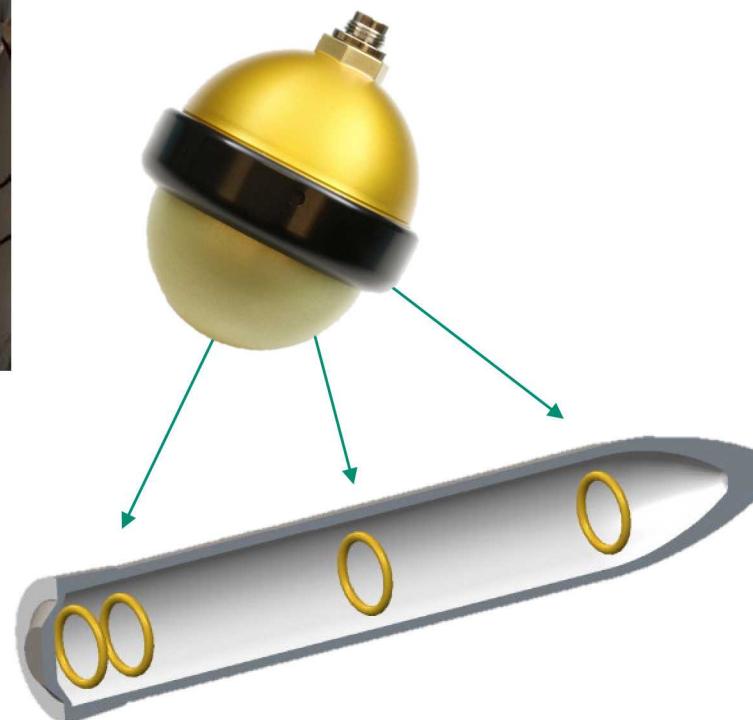
**Embedded fuzes can enable survival in harsh system environments**

# Embedded

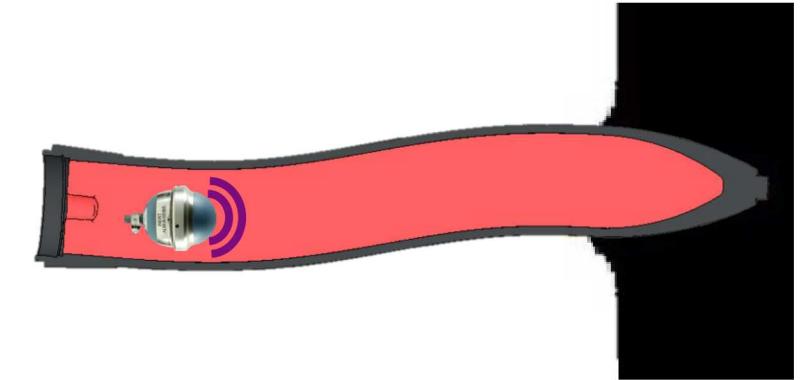
## *Fuzing systems embedded in fill material for survivability*



Benchtop test of power distribution scheme



Notional design for EM power distribution to  
embedded fuzing nodes



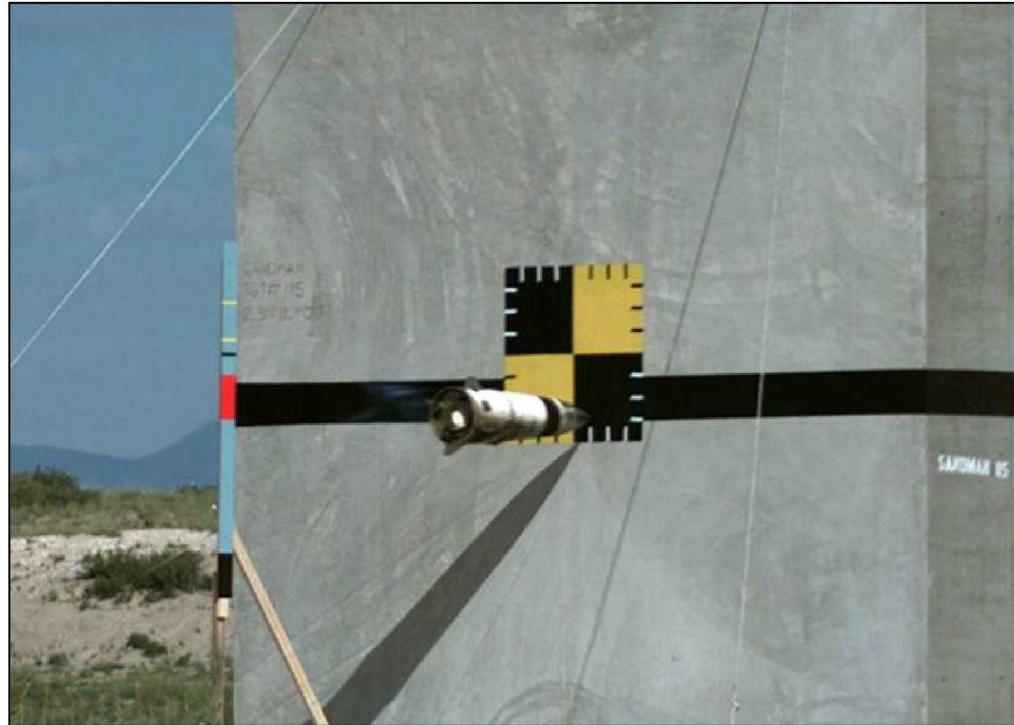
Research into enabling technologies for  
embedded fuzes in DoD JFTP

Working to provide solutions for  
embedded fuzes to operate internally  
without hard-wired connections, including  
all aspects of operation, such as:

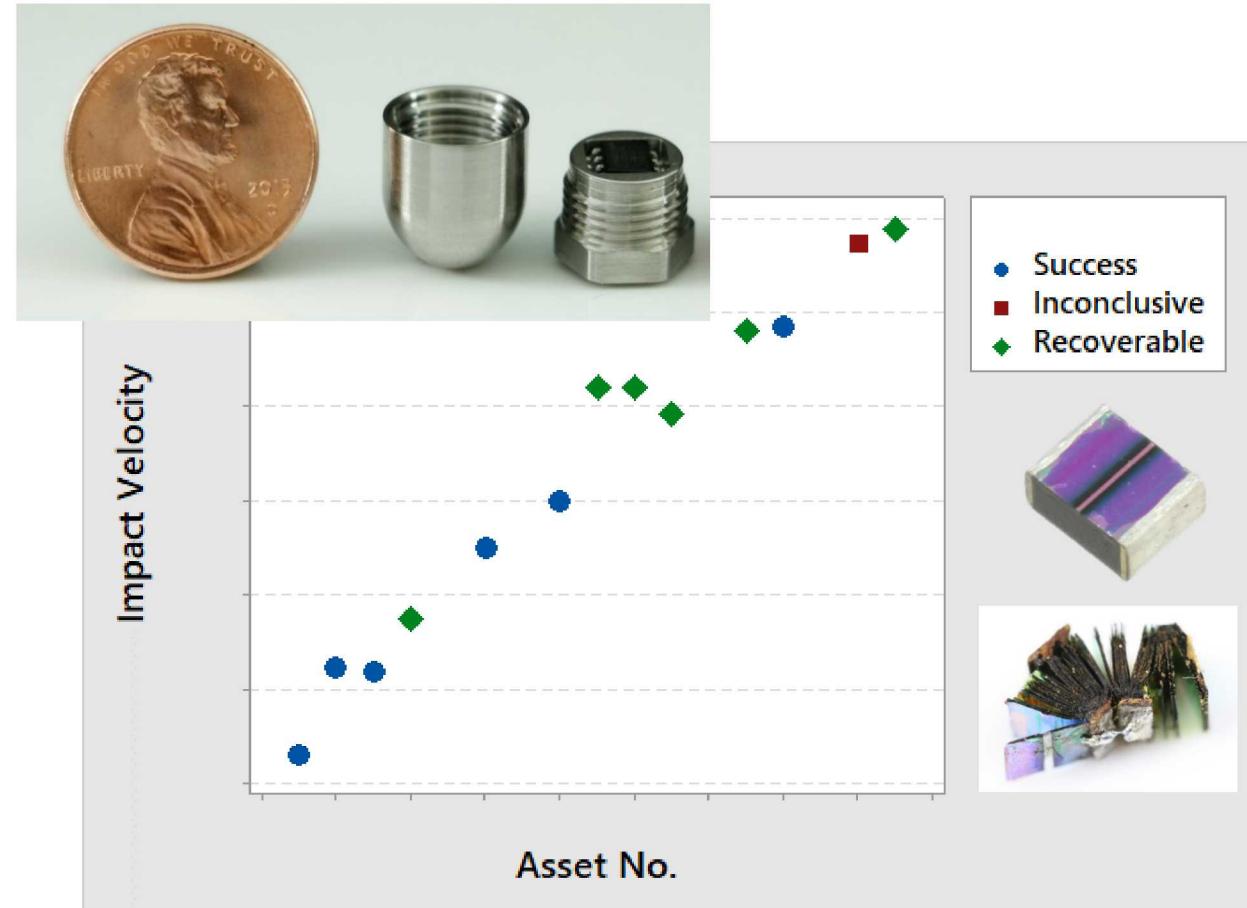
- Power distribution
- Safe/arm communication
- External environment detection

# Hardened

*Advancing the state of the art to ensure severe environment survivability*



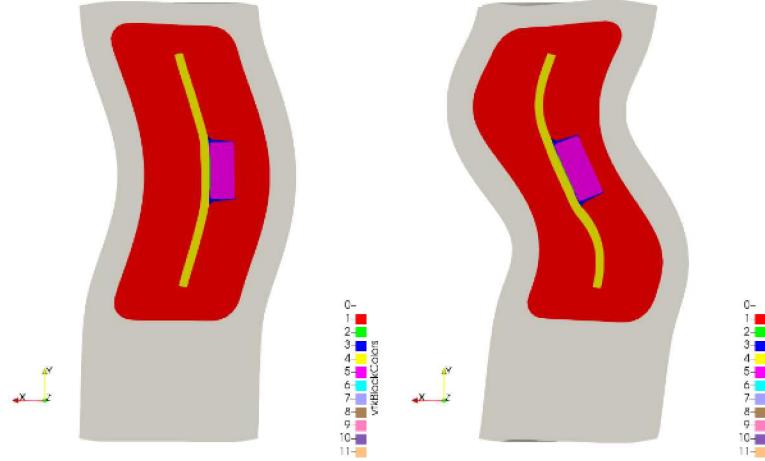
Full scale and sub-scale testing



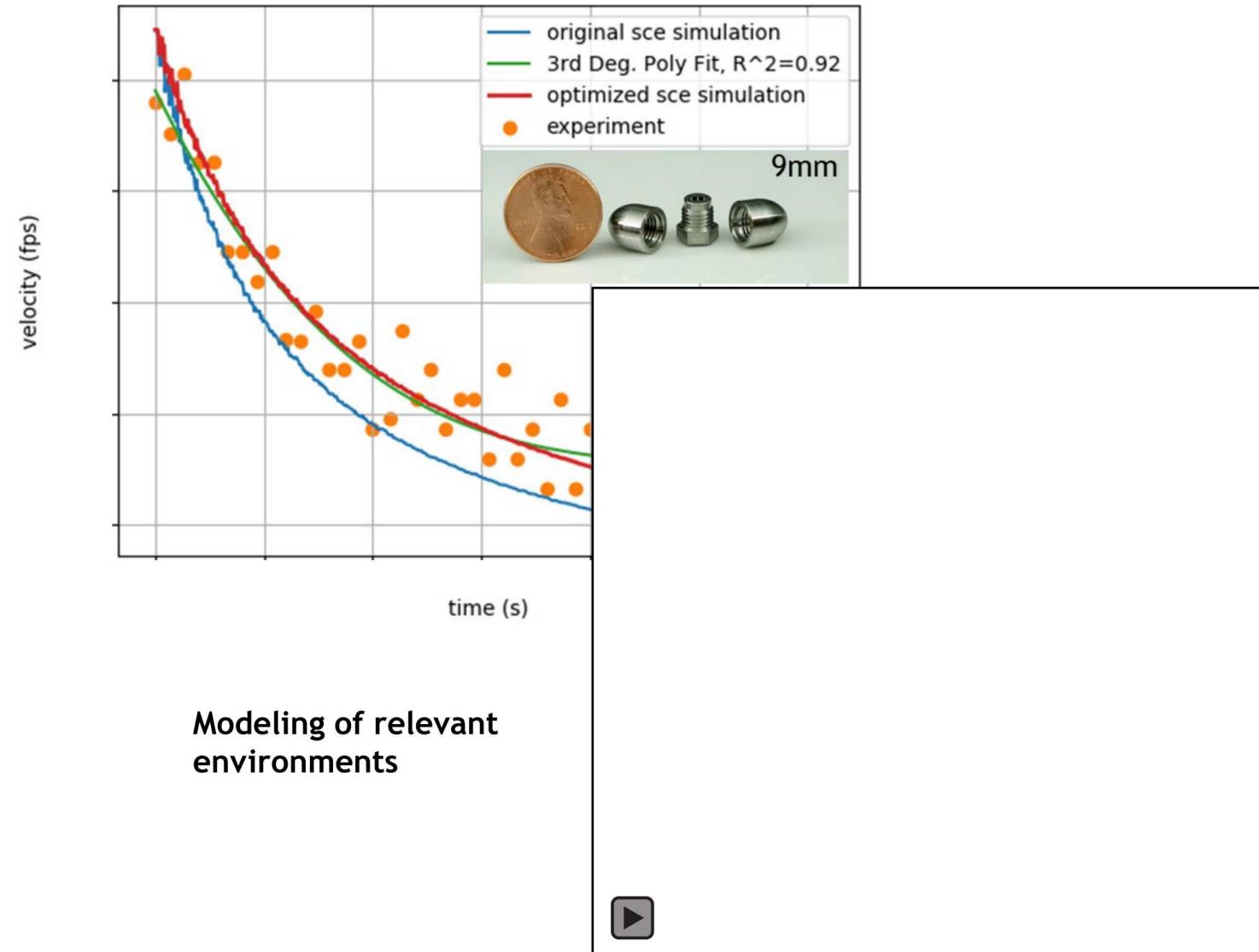
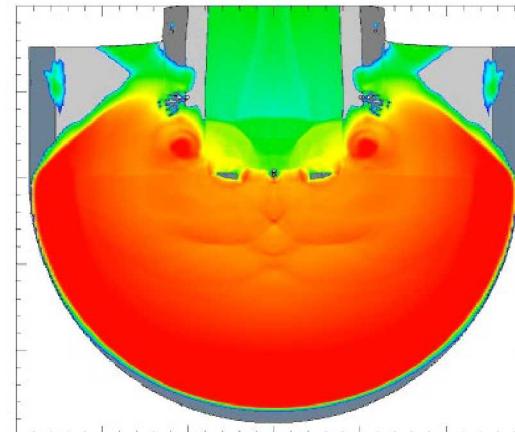
Component/technology evaluation for high velocity impact survivability

# Understood

*Leveraging capability to fully characterize fuze design space*



Modeling explosives interface for design basis trade studies



# Understood

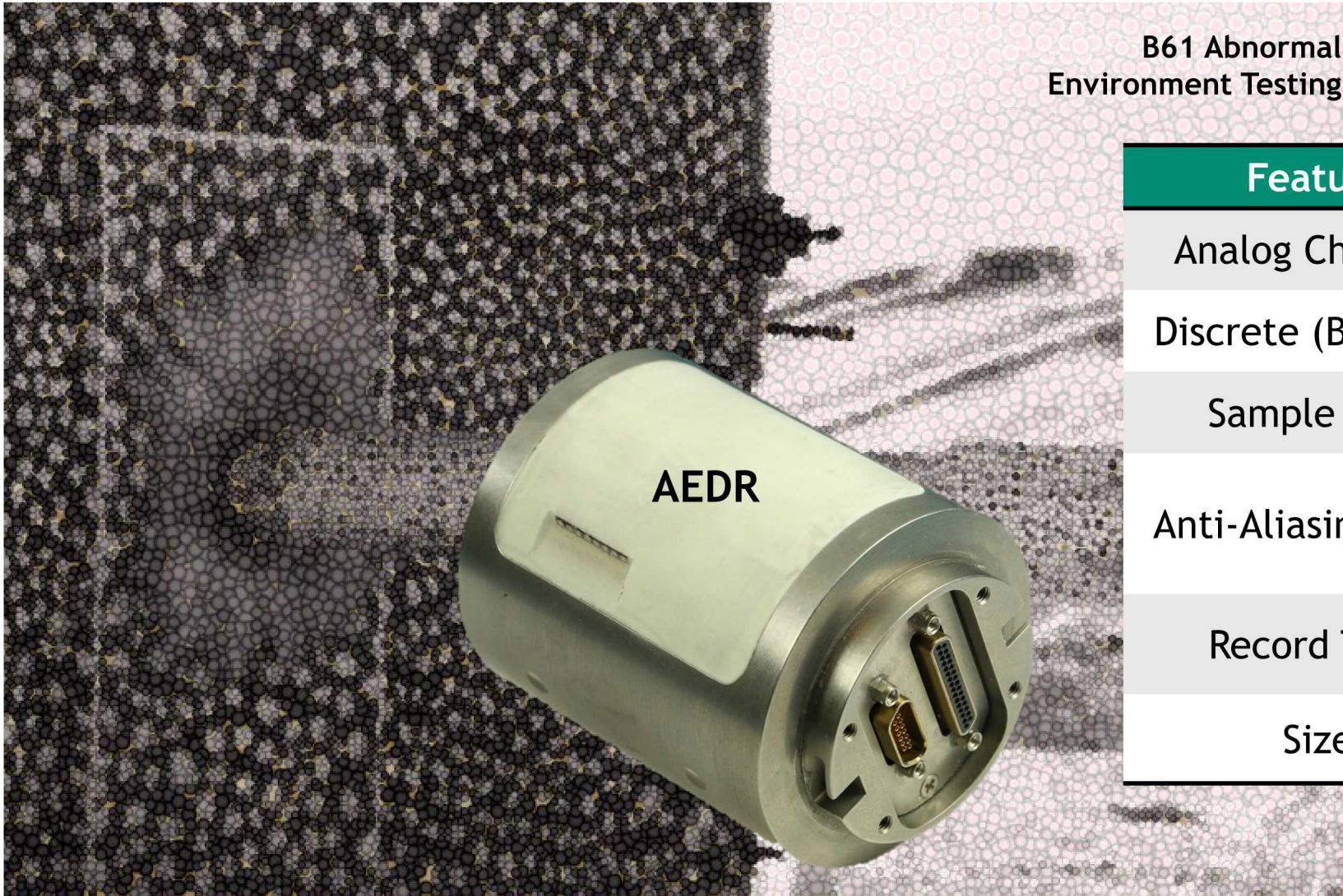
*Conducting novel experimentation to verify designs*

EMRTC water  
impact testing



# Understood

*Developing state-of-the-art instrumentation to record harsh environments*



B61 Abnormal  
Environment Testing

Feature	Value
Analog Channels	4
Discrete (Bi-Level)	2
Sample Rate	250 ksps
Anti-Aliasing Filter	50 kHz Bandpass, 7-Pole Butterworth
Record Time	213 seconds, with 75 ms pre-trigger
Size	1.4 lbs Ø2.35" x 3.0"

## Safe & Reliable

*Designs proven through demonstration and designed to safety standards*



# Leveraged Capabilities

## *Working across SNL, DoD and DOE*

### Materials and Component Research

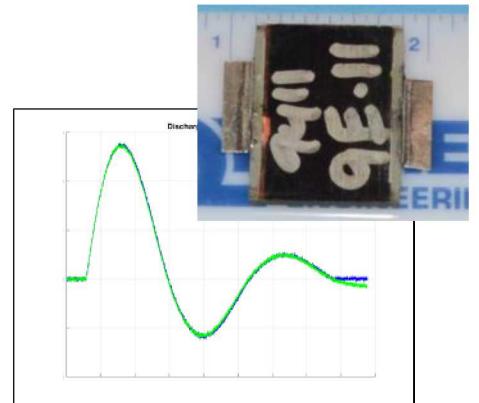
- High Voltage Capacitors
- Additive Manufactured Transformers
- High Voltage Switches

### Explosives and Initiation Devices

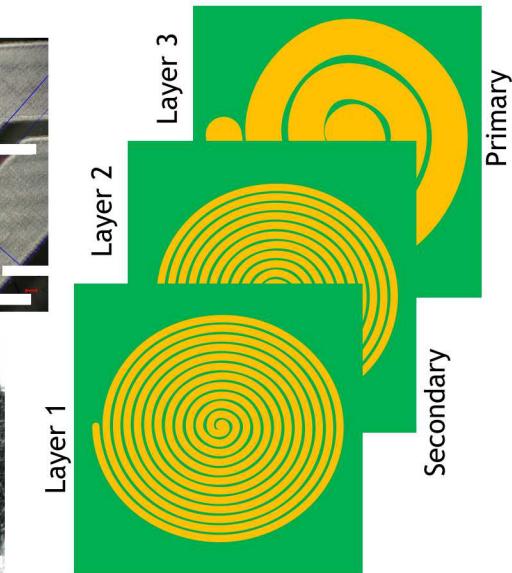
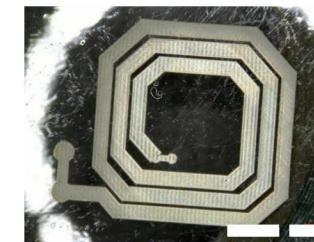
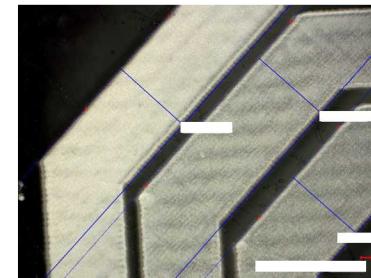
- Direct Header Deposition
- High-g survivable detonators

### Survivable Electronics Research

- Shock Isolation Systems
- Encapsulants and Potting Materials development



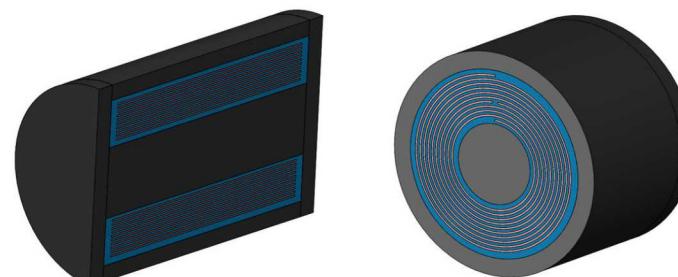
High Voltage Capacitor Development



Coreless Transformer and Direct Write Printing



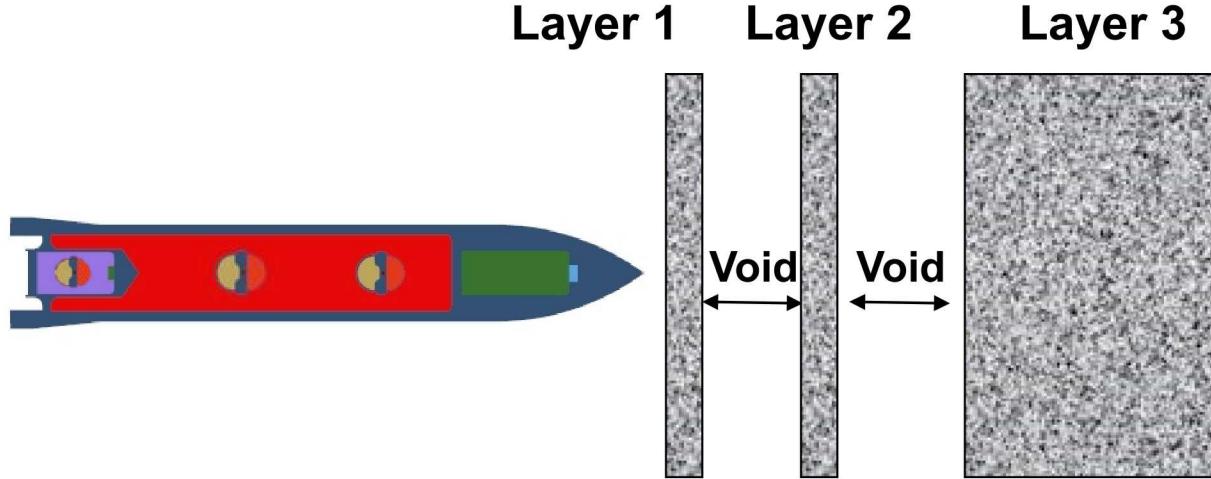
Low Complexity Sprytron



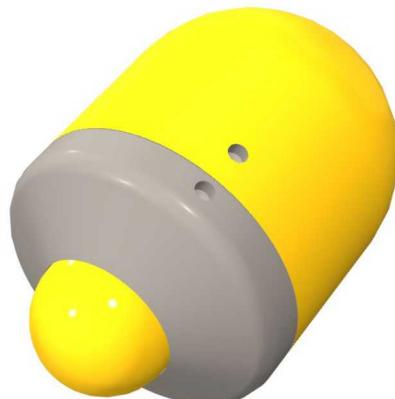
Advanced Manufactured Jellyroll Transformer

# Forward Looking

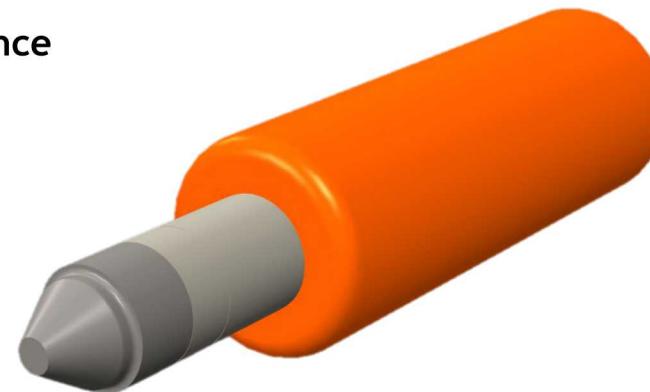
*Advancing technologies for future applications through basic research*



Development of algorithms to enable smart fuze intelligence



Conceptual designs to survive  
new environment regimes



Developing recoverable data  
recorder design concepts

## Current R&D Efforts

- 3D Printed Fuzing Components
- Wireless Safe, Arm & Fire Communication System
- RF Signature Detection for Smart Fuzing Applications
- Polymer Multi Layer Capattery
- Explosive Model Development



Research into applicability  
of alternate component  
technologies for hard target  
applications



Exceptional Service in the  
National Interest

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