

R&A: TBD

This paper describes objective technical results and analysis. Any subjective views or opinions that might be expressed in the paper do not necessarily represent the views of the U.S. Department of Energy or the United States Government.



Sandia
National
Laboratories

SAND2020-7592C

Advanced Fuzing Technology Sandia National Laboratories



ADVANCED
FUZING
TECHNOLOGY

PRESENTED BY

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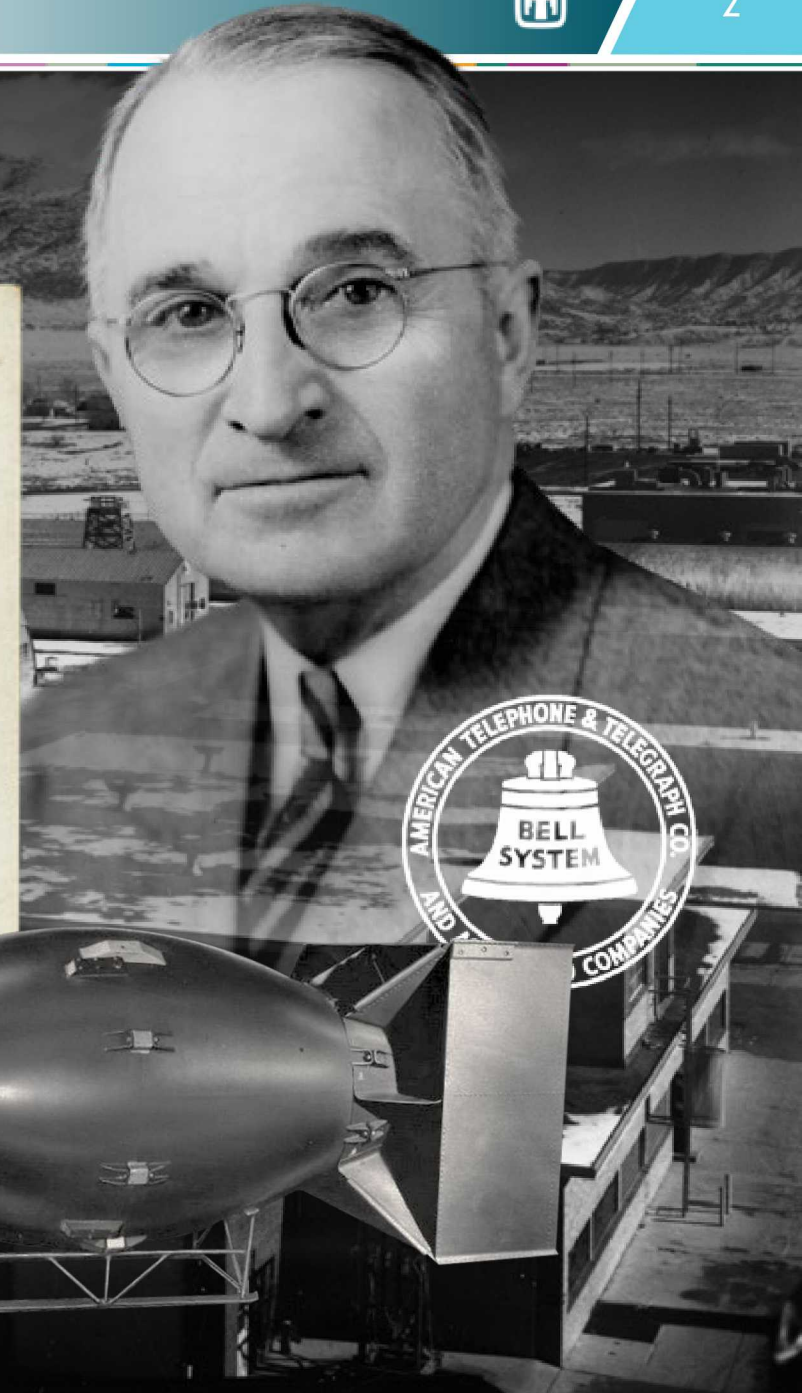
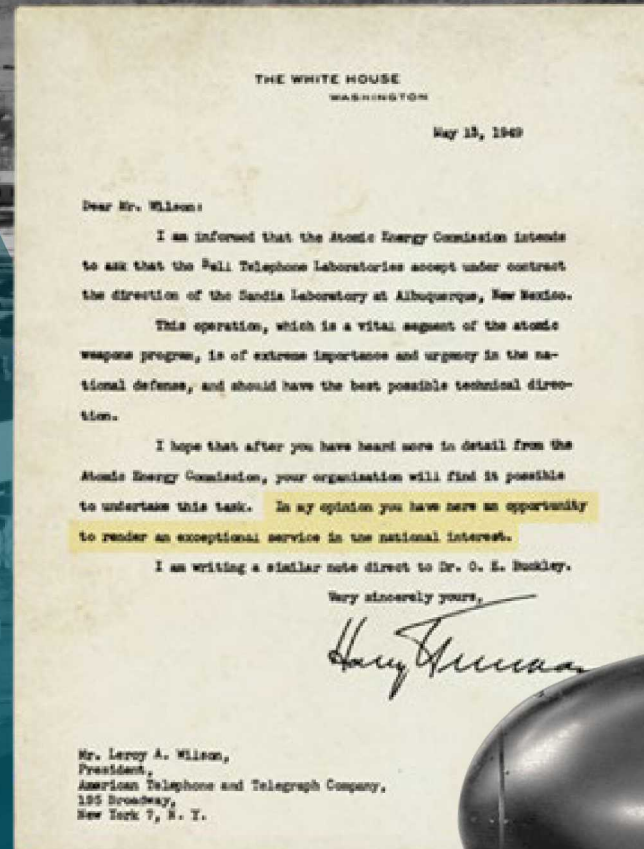


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SANDIA'S HISTORY IS TRACED TO THE MANHATTAN PROJECT

...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



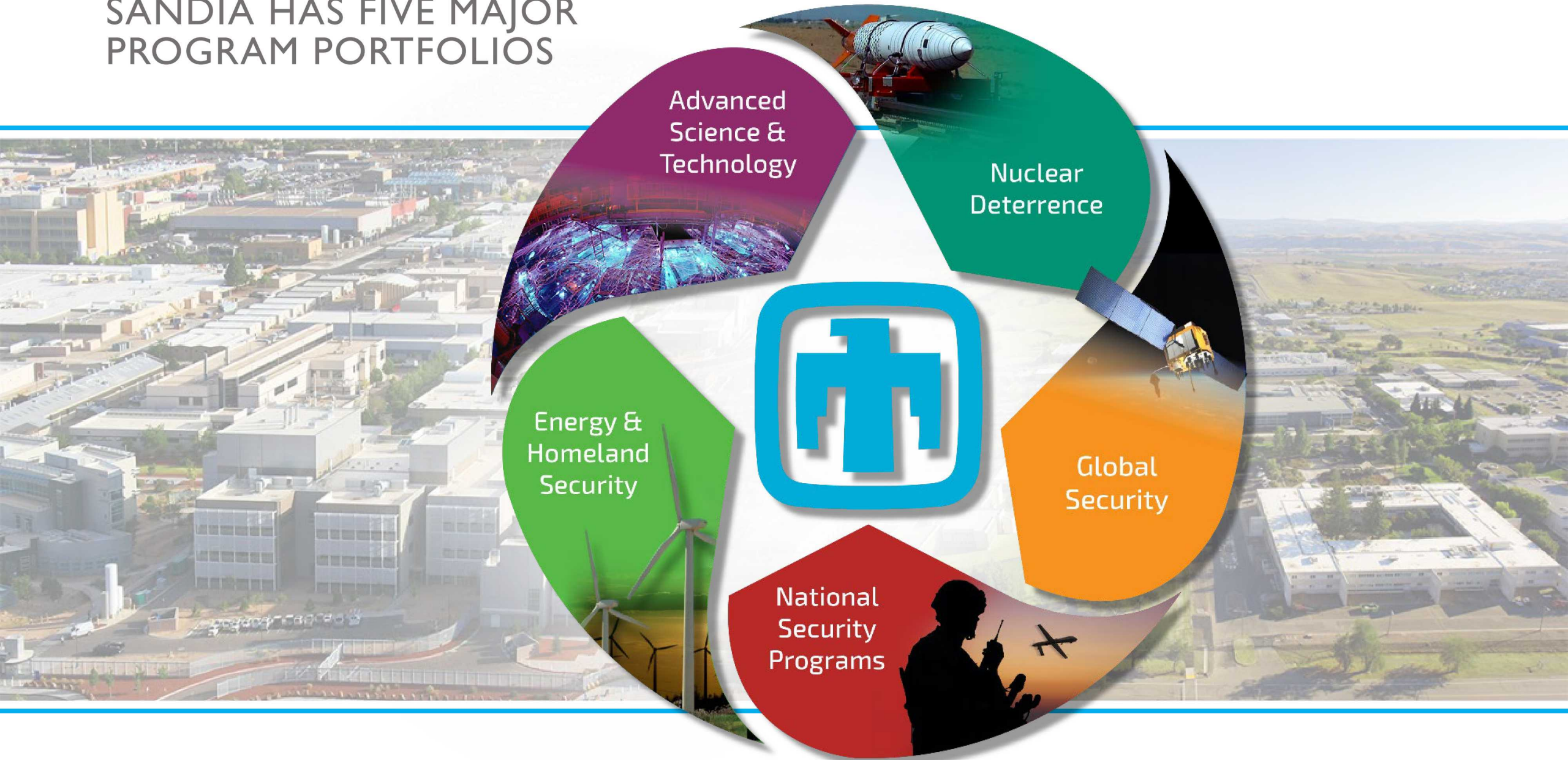
SANDIA IS A FEDERALLY FUNDED
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National Technology & Engineering
Solutions of Sandia, LLC, a wholly
owned subsidiary of Honeywell
International Inc.: 2017 – present

Government owned, contractor
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



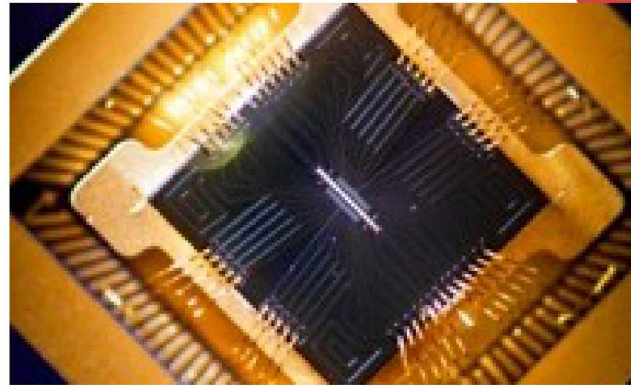
NATIONAL SECURITY PROGRAMS

Strengthens our nation's defenders

Surveillance &
reconnaissance



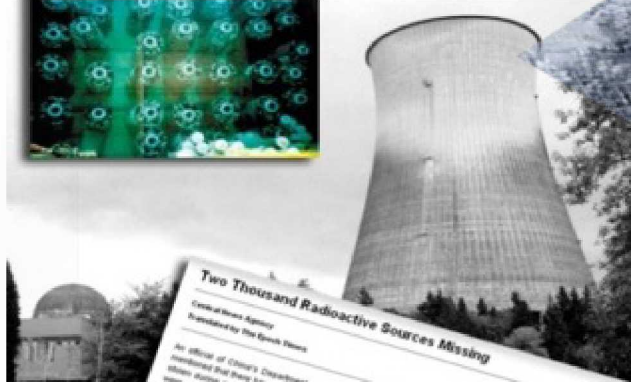
Information operations



Science & technology products



Integrated military systems



Proliferation assessment

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.)

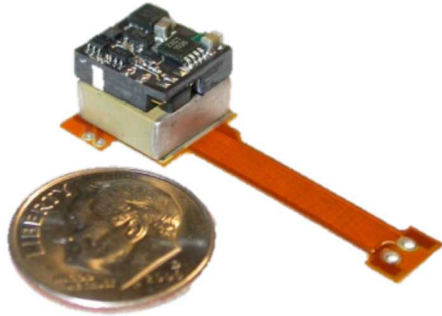
Joint Fuzing Technology Program (JFTP)

Joint Munitions Program (DOE/DoD)

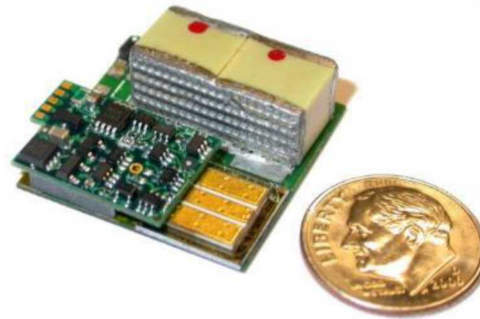
Fuzing industry partners (Raytheon, etc.)

Miniature & Multipoint

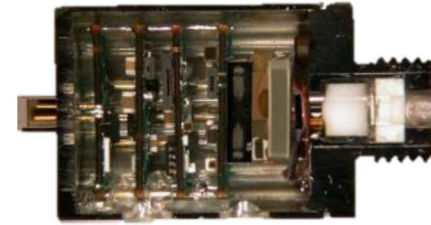
Small Firing Sets w/ Precise Timing



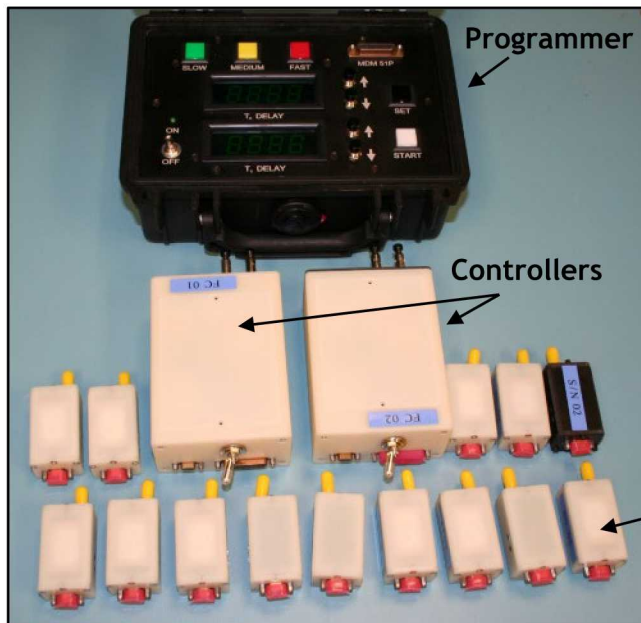
Miniature Electronic Safe-Arm Device



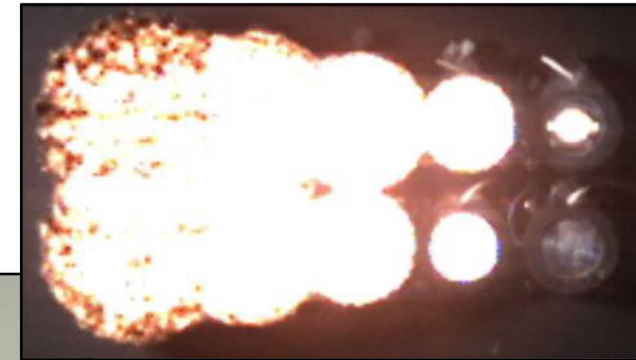
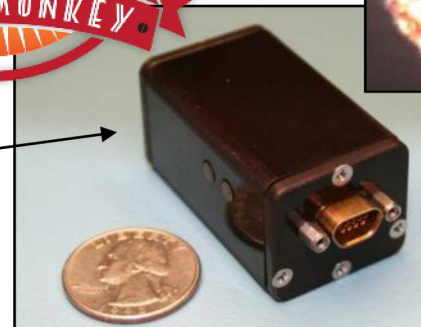
Miniature Electronic Safe-Arm Device



Hermetic, Miniature Firing System with Digital Logic



Firing Node



High Speed Video Capture
(sub- μ s timing)

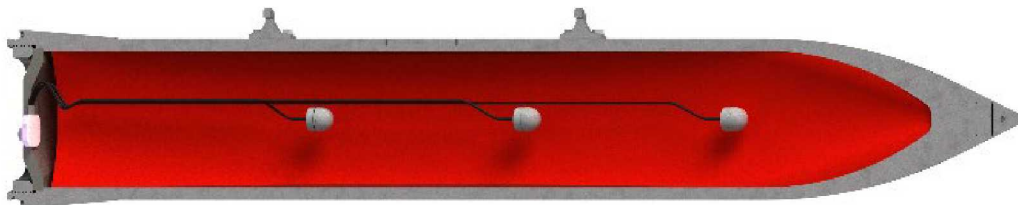
Embedded

Fuzing systems embedded in fill material for survivability

Traditional Fuzing Design



Distributed Fuzing Design



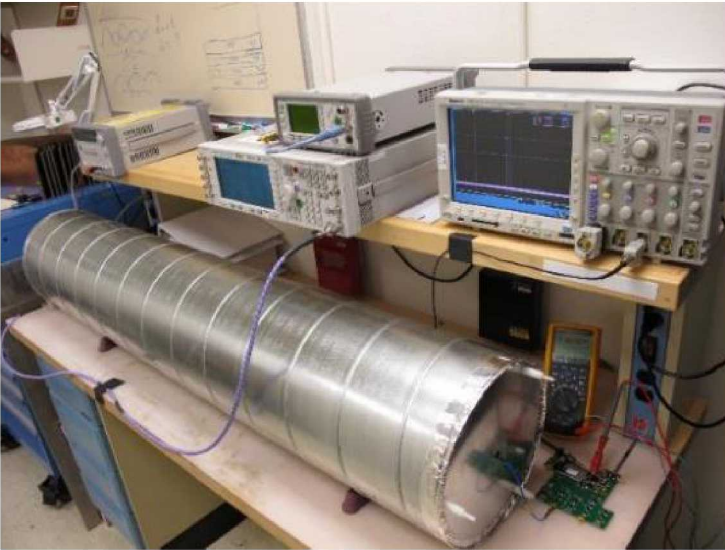
AFRL fuzing architecture design concepts



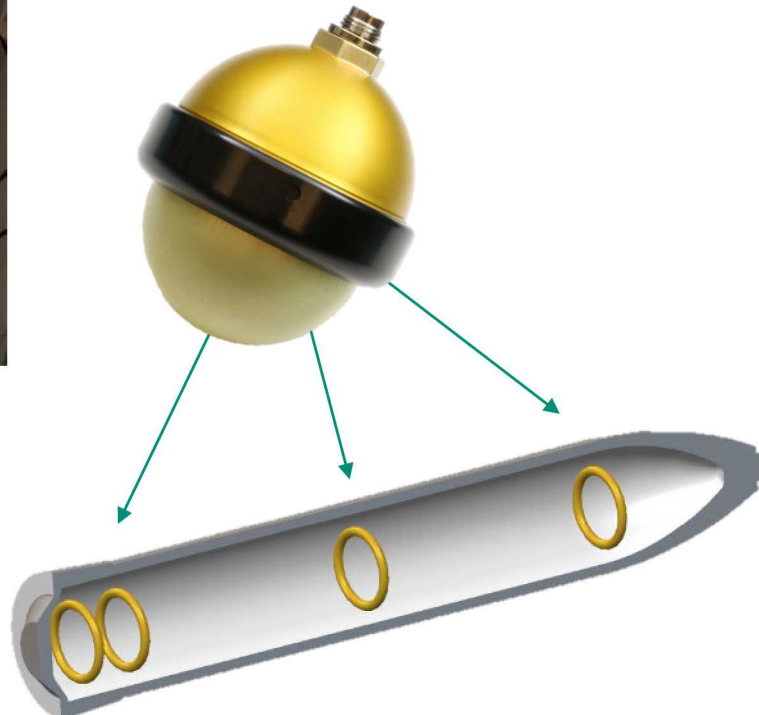
Embedded fuzes can enable survival in harsh system environments

Embedded

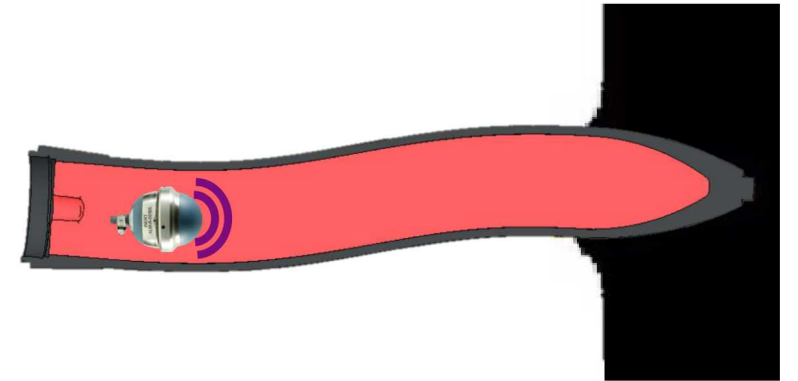
Fuzing systems embedded in fill material for survivability



Benchtop test of power distribution scheme



Notional design for EM power distribution to embedded fuzing nodes



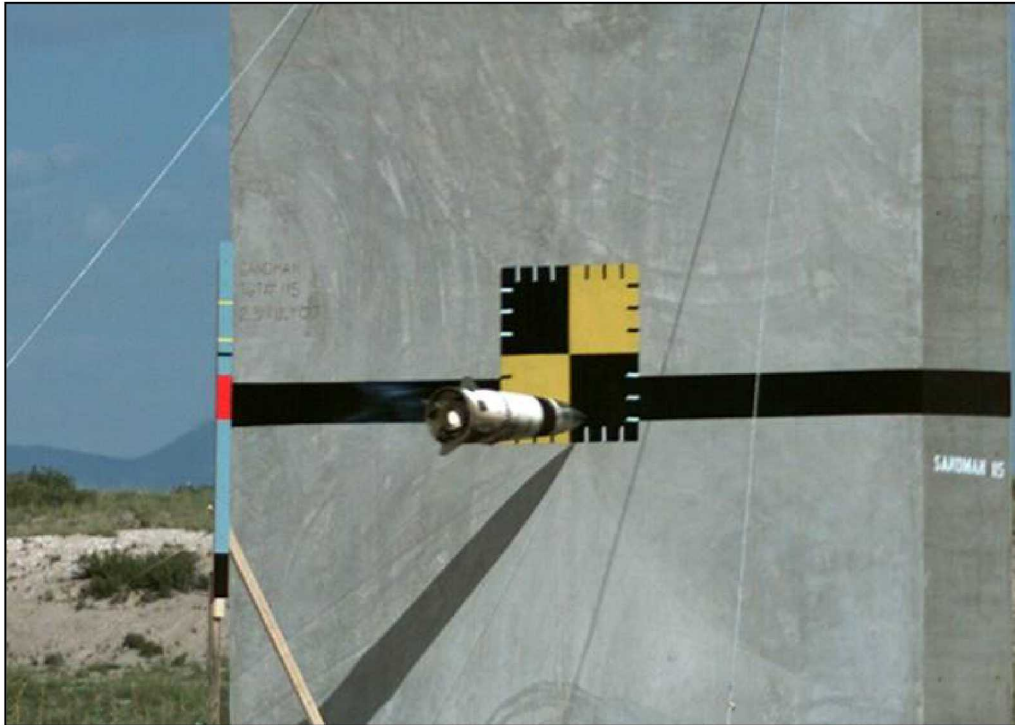
Research into enabling technologies for embedded fuzes in DoD JFTP

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

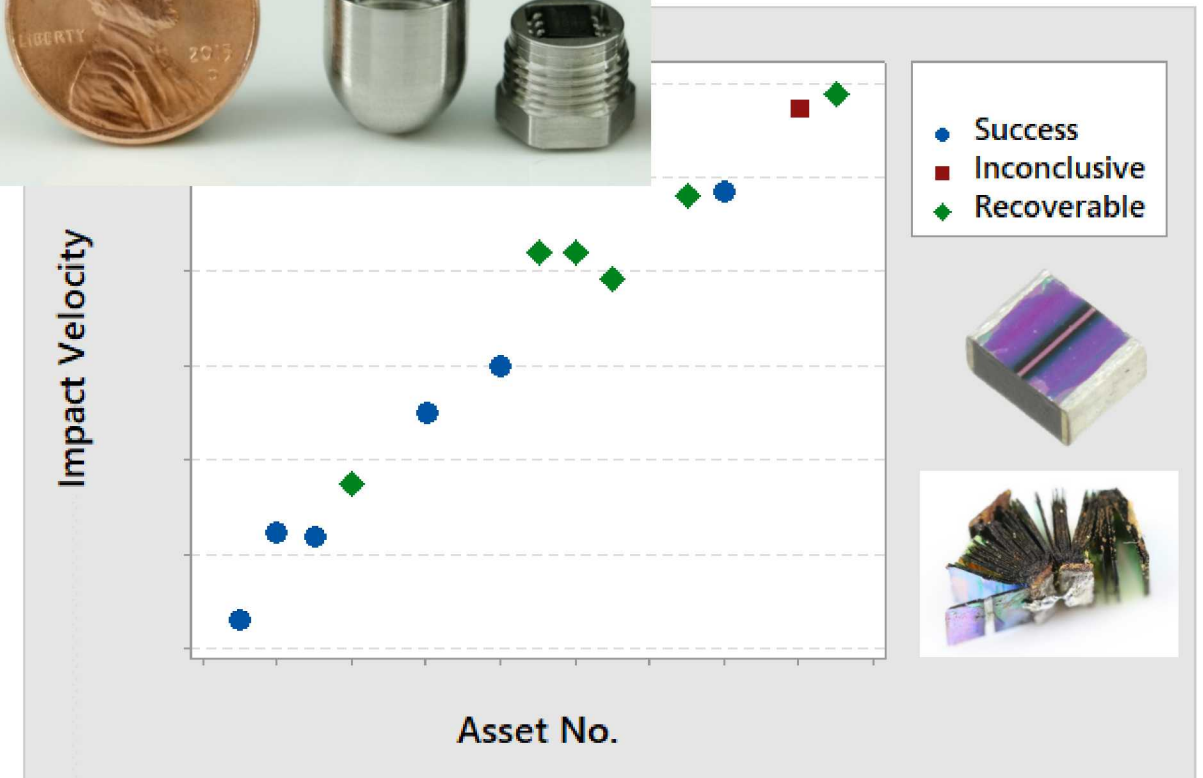
- Power distribution
- Safe/arm communication
- External environment detection

Hardened

Advancing the state of the art to ensure severe environment survivability



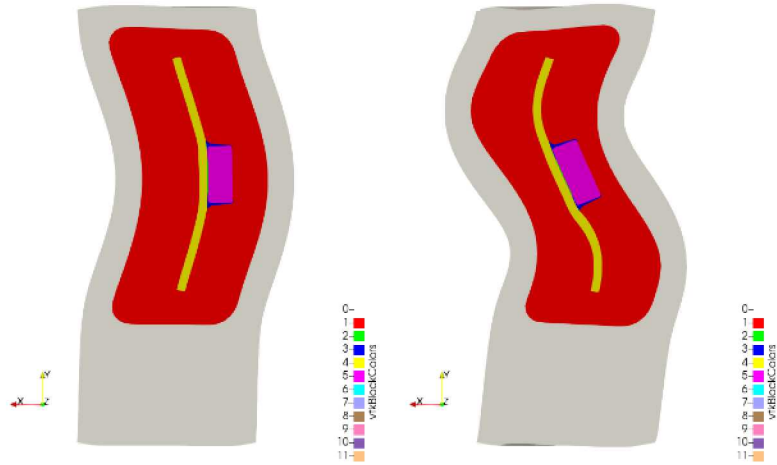
Full scale and sub-scale testing



Component/technology evaluation for high velocity impact survivability

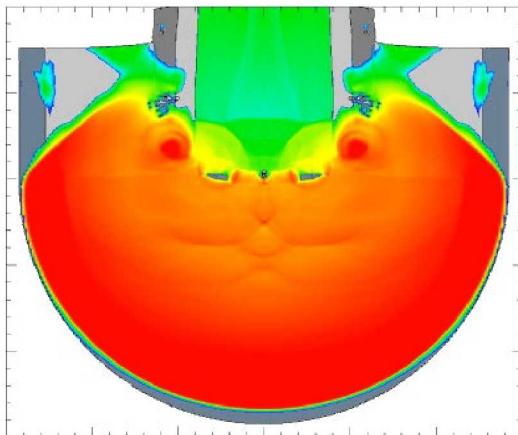
Understood

Leveraging capability to fully characterize fuze design space

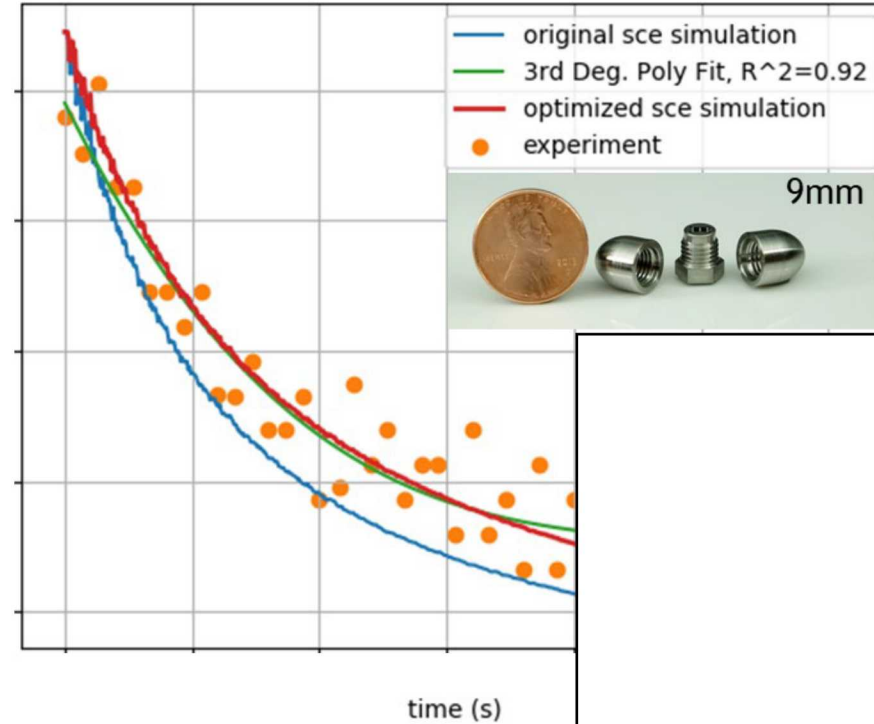


FEA studies of component designs

Modeling explosives
interface for design
basis trade studies



velocity (fps)



Modeling of relevant
environments



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

AEDR

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

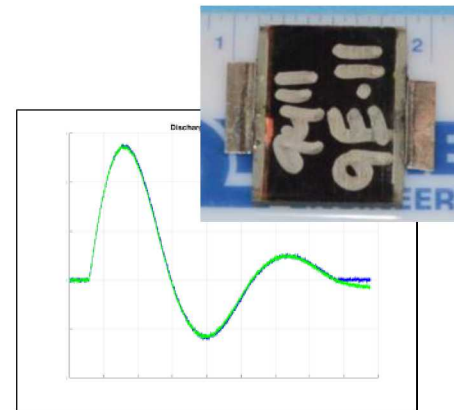
- High Voltage Capacitors
- Additive Manufactured Transformers
- High Voltage Switches

Explosives and Initiation Devices

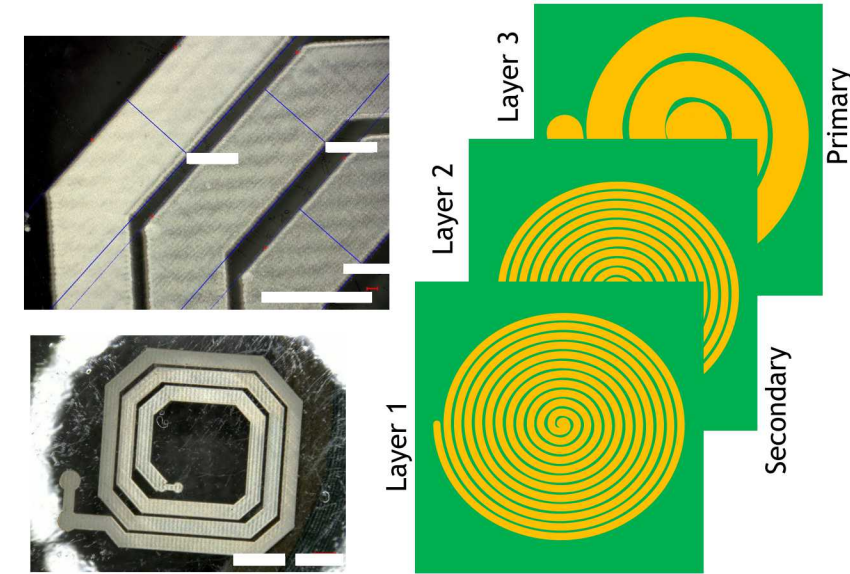
- Direct Header Deposition
- High-g survivable detonators

Survivable Electronics Research

- Shock Isolation Systems
- Encapsulants and Potting Materials development



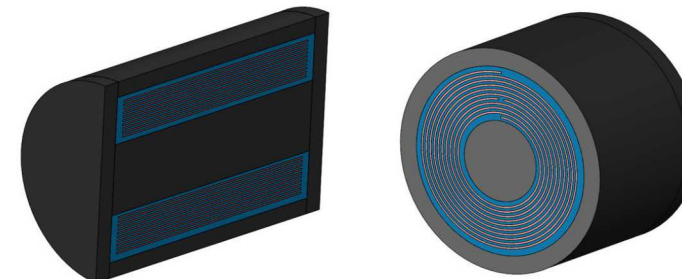
High Voltage Capacitor Development



Coreless Transformer and Direct Write Printing



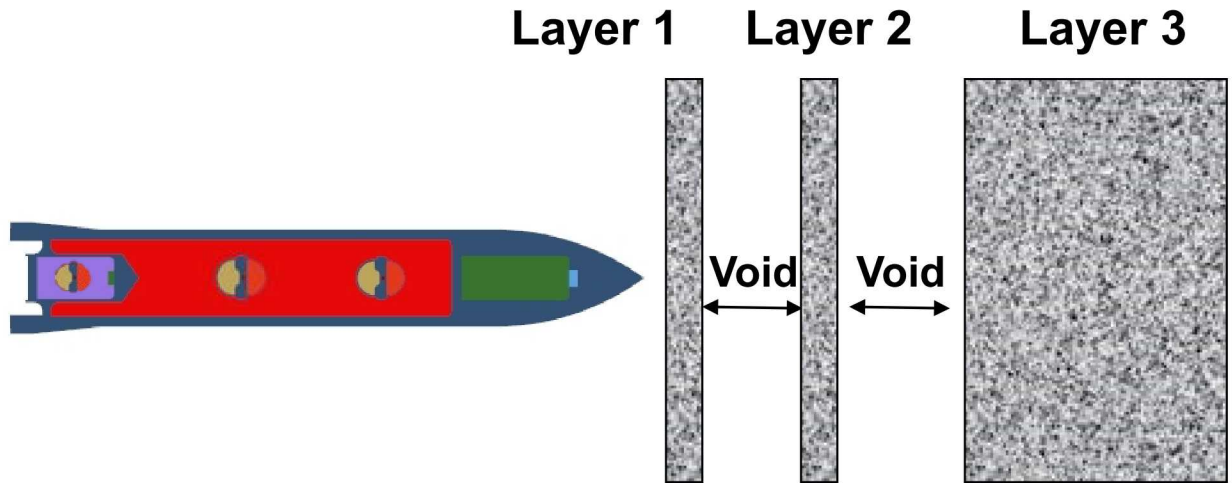
Low Complexity Sprytron



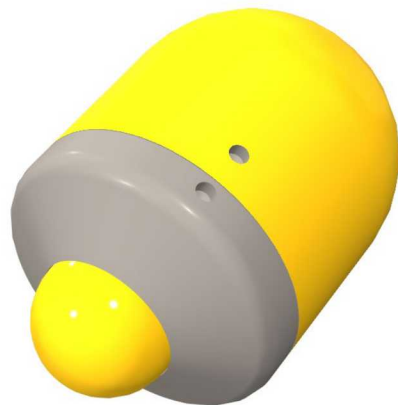
Advanced Manufactured Jellyroll Transformer

Forward Looking

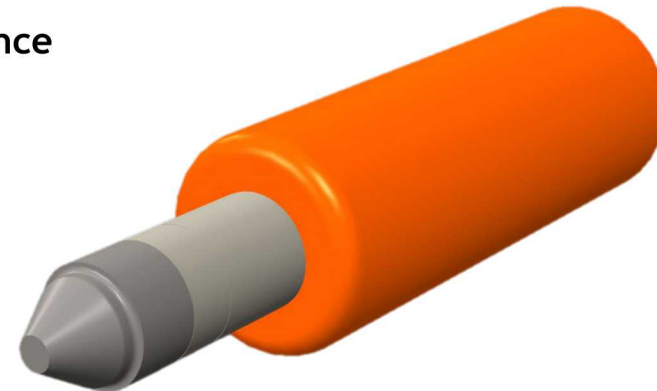
Advancing technologies for future applications through basic research



Development of algorithms to enable smart fuze intelligence



Conceptual designs to survive new environment regimes



Developing recoverable data recorder design concepts



Research into applicability of alternate component technologies for hard target applications

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



Exceptional Service in the National Interest
