Fuzing & Firing Systems at Sandia National Laboratories

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Sandia’s Four Mission Areas

Nuclear Weapons

Defense Systems and Assessments

Energy, Resources, and Nonproliferation

Homeland Security and Defense

Infrastructure Protection

Catastrophic Event Mitigation

B1 bomber drops B83

Shuttle Heat Shield Inspection

WIPP
Evolution of Sandia’s Advanced Fuzing/Firing Systems Technologies

53rd Annual Fuze Conference
Lake Buena Vista, FL
May 19-21, 2009

Focus on Design and Weaponization

- **Mission**: design, engineer, integrate, test, and provide production interface, for all non-nuclear components of a nuclear weapon

- **Radar Fuzes**
- **Impact Fuzes**
- **Firing Sets**
- **Shock Absorbers**
- **Casing**
- **Detonators**
- **Capacitors**
- **Switches**
- **Switch Tubes**
- **Rectifiers**
- **Programmers**
- **Neutron Generators**
- **Reservoirs**
- **Stronglinks**
- **Batteries**
- **Timers**
- **Spin Generators**
- **Parachutes**
- **Ejector Systems**
- **PAL Controllers**
- **Explosives**

Maintain deep foundation of science and engineering in our technical competencies to position the nation to evaluate and respond to developments in the international environment or to developments in the weapons technology of other nations.
Evolution of Sandia ESAD Fuze Technology

Firing Set Design Evolution

Patriot ESAD 1980’s

AMRAAM ESAD 1990’s

M²CDU 2004

MicroCDU 2000

Mini ESAD 1999
SNL Fuzing/Firing Systems Investment Areas

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- Fuze Technology Development
  - Advance the fuze technology and component development to support the requirements of our new national challenges
  - Explore strategies to survive new environments through miniaturization, integration, and robust packaging

- Penetration Environment Characterization
  - Need to better understand the Hard Target penetration environment and fuze component environment

- Modeling and Simulation
  - Need the ability to model and predict environments seen by firing systems as penetrating warheads impact hard targets
Fuze Technology Development

Miniature Electronic In-Line Fuze Modules
Meet safety theme MIL-STD 1316E and MILSTD1901A

Monolithic MicroCDU (M²CDU)
Rugged, Miniature, In-Line CDU for ESAD

0.36” × 0.40” × 0.20” (T)

FMP2 Hardened Firing Set

Modeling of Sensor Response for Target Detection Improvements

Multipoint Initiation and Selectable Firing

Controller w/ Firing Unit

Low-Current Carrying Wires

Redundant or distributed initiation devices
Penetration Environment Characterization

MinPen (’97) 3 Axis Recorder
MilliPen (’99) Single Axis Recorder
3AMP (’02) 3 Axis Recorder
3DDR (’09) 3 Axis DTRA Data Recorder

High-G Instrumentation

Test Article Pre-Test
Test Article Post-Test
Modeling and Simulation

Full System Modeling

Weapon Component Level Modeling

Modeling of individual circuit components
Fuze Technology Investment Partners

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DTRA
Hard Target Fuzing and Instrumentation Research

DOE
Nuclear Weapons Advanced Development

Army - AMRDEC
Hardened selectable output warheads

DoD/DOE Joint Munitions Program
Weapons research in Areas of joint interest

Air Force - AFRL
Collaborative teaming for hard target defeat

Navy - SP
High speed Hard target defeat

Sandia Laboratory Directed Research and Development (LDRD)
High Speed Hard Target Warhead Development

CRADA Partners

Unclassified Unlimited Release

Sandia National Laboratories
Sandia works with Los Alamos and Lawrence Livermore National Laboratories to develop Firing and Initiation Systems for Nuclear Weapons.
Joint DoD/DOE Munitions Program (JMP)

DoD-DOE Memorandum of Understanding

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• MOU signed by DoD/DDR&E and DOE/DP in 1985
• Goal: explore and develop technologies intended to bring about major improvements in non-nuclear munitions benefitting both Depts.
• Jointly funded by DoD and DOE-Labs
• Focus and adapt the DOE nuclear weapons technology-base to enable major advances in DoD warfighting capabilities
• Support long-term R&D at the 3 DOE NW labs with DoD & DOE oversight
• Cooperative, jointly-funded efforts in:
  - Initiation, Fuzing, & Sensors
  - Energetic Materials
  - Computational Mechanics & Material Modeling
  - Warhead Technologies
  - Munitions Lifecycle
• Requires a balance between DoD and DOE priorities
• Participation is government only; technologies transitioned thru DOTC and lab mechanisms
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Joint Munitions Program & Fuzing/Firing Systems Projects

- Los Alamos, Lawrence Livermore, and Sandia National Labs have active R&D projects in this area.
- Technologies such as Exploding Foil Initiators, Monolithic Micro Capacitive Discharge Units (M²CDU), and Low-Temperature Co-fired Ceramic (LTCC) Transformers have been developed and transitioned.
- Once technologies are sufficiently mature, they are offered for transition to industry through the Defense Ordnance Technology Consortium (DOTC) (http://www.nwec-dotc.org/) and laboratory mechanisms.
- DOTC development programs are opportunities to reduce new technology risk and achieve production readiness.
What is a Fuze?

Simplified Fuzing Functions

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What is a Fuze?

Simplified Fuzing Functions  (As applied to Post Impact Survival Fuzing)

Fuze

- Target Detection Device (TDD)
- Firing Subsystem
- Initiation Subsystem

Not Required to Survive Impact

Must Survive Post-Impact

Safing and Arming Device (S&A)
DTRA Funded Fuze Diagnostic Recorder (FDR)

Focus Areas

- Safing and Arming Device (S&A)
- Target Detection Device (TDD)
- Firing Subsystem
- Initiation Subsystem
PROJECT GOAL:
- Improve electronic hard target fuzes by monitoring and recording post-impact critical functions in harsh impact environments.

RESEARCH OBJECTIVES:
1. Improve understanding of weaknesses and failures in electronic firing systems exposed to hard target environments.
2. Develop methodologies for data collection of post-impact critical components to enable objective #1.
3. Improve impact detection and target sensing by monitoring a suite of inertial impact sensors.
Questions?

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