



Fuzing & Ordnance Systems

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Development of a Hard Target Void Sensing Fuze for High Mechanical Shock Load Applications

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Presented By

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“This presentation consists of L-3 Corporation general capabilities information that does not contain controlled technical data as defined within the International Traffic in Arms (ITAR) Part 120.10 or Export Administration Regulations (EAR) Part 734.7-11.”

Agenda

- Intelligent Penetrating Fuze CRADA
- Program Overview
- Design Overview
- 1st Howitzer Test Series Results
- Design Updates
- 2nd Howitzer Test Series Results
- Team Members
- Summary

Intelligent Penetrating Fuze CRADA

- CRADA between Air Force Research Laboratory Munitions Directorate and L-3 FOS
- The CRADA was adopted to:
 - Exchange information & advance current technology for next generation intelligent fuzing for hard target penetrators



Program Overview

- Review past lessons learned
- Develop system concepts
- Review & iterate design concepts
- Develop detailed design
- Build prototype hardware and perform environmental tests
- Perform 1st series howitzer tests
- Evaluate test results & update design
- Perform 2nd series howitzer tests
- Evaluate test results & prepare final report

Design Overview

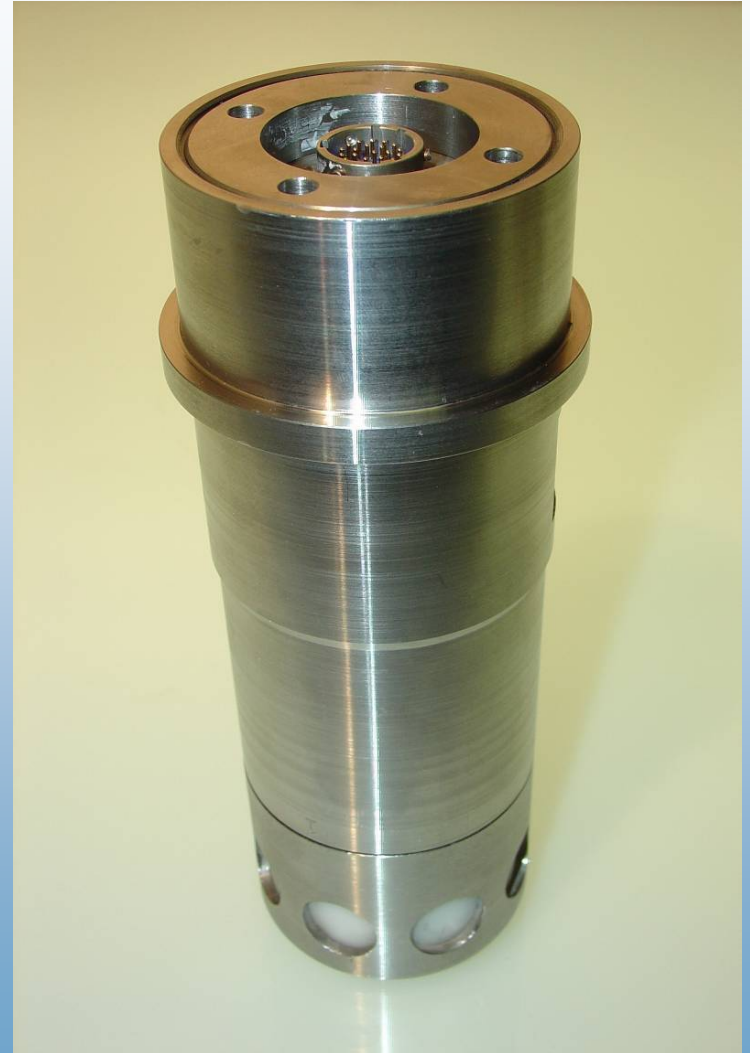
- Multiple concepts and trade studies reviewed
- Modular approach selected
- Cantilevered fuze structure selected
- Design developed for structure and impact survivable modules
 - Arm & Fire Module
 - Intelligent (data recorder) Module



Initial Design

Design Overview

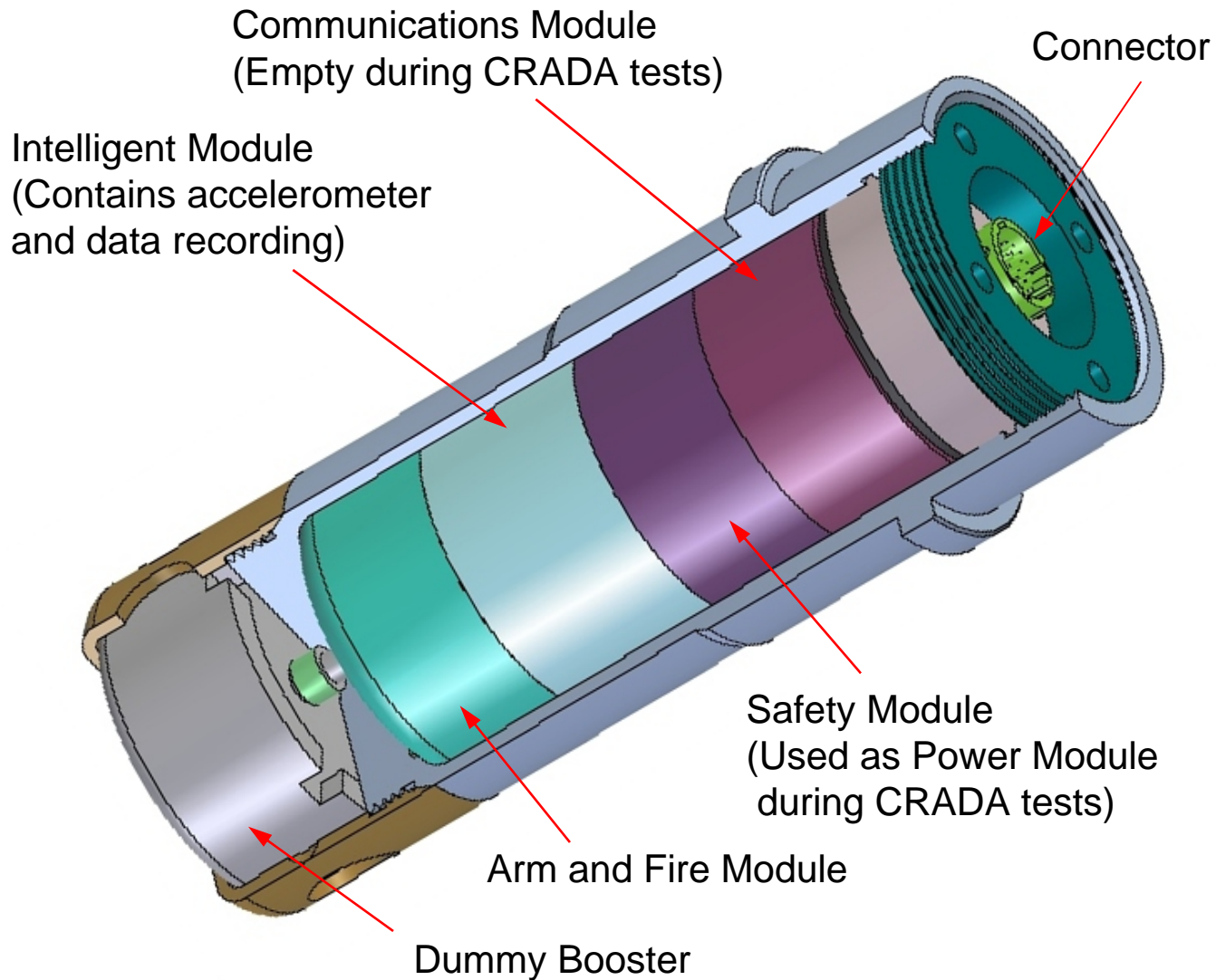
- In-house testing performed
 - Thermal shock
 - Mechanical shock
 - Air gun tests
- 1st howitzer test series performed
- Design updates made



Final Design

Design Overview

Final Configuration



1st Howitzer Test Series Results

- AFRL Howitzer tests – Jan 2008
 - 1st shot 9 inch, 5000psi
 - 2nd shot 2 ft thick target, 5000psi
 - 3rd shot 2ft thick target followed by another 2ft thick target, 5000psi
- Results
 - Same hardware fired in first two shots with inert LEEFI
 - Arm/Fire module survived and still functions
 - STUBBI projectile stuck in wall on third shot
 - Very high g impact
 - Live LEEFI fired



1st Howitzer Test Series Results



Shot #1

Shot #3



1st Howitzer Test Series Results

- Results Cont'd
 - Mechanical design proved to be robust.
 - Only mechanical failure was external connector broke free during impact
 - Main disappointment of the test was the inability to record data
 - Recorder reset due to main connector
 - Internal damage on 2nd & 3rd shots
 - Arm/fire module survived high g shock
 - No redesign required



Design Updates

- Mechanical design improvements made to 1st Iteration Hardware
 - Module – alignment feature changed for each cup to make more robust during impact
 - Fuze body was modified in order to use existing mounting hardware provided by AFRL
 - FOS engineering reports exist for each design improvement

Design Updates

- Electrical Design Improvements made to 1st Iteration Intelligent Module
 - Major redesign
 - Changed microcontroller
 - Real-time data storage with non-volatile memory
 - Incorporated removable accelerometer module
 - Allows use of surface mount or screw mount accelerometers from multiple suppliers
 - These changes were derived from separate IRAD program for a standalone data recorder
 - Next paper provides information on FOS Data Recorder
 - Added Void sensing Algorithm provided by ARA



2nd Howitzer Test Series Results

- AFRL Howitzer tests – July 2008
 - 1st shot 2ft thick, 5000psi
 - 2nd shot 2ft thick, 5000psi
 - 3rd shot complex target, 9” wall, 3.5 ft air gap, 9” wall
- Results
 - Valid data retrieved from all analog and digital inputs
 - No damage to fuze structure, electronic modules and connector
 - The power module and intelligent module still functioned through main connector
 - Visual verification of LEEFI initiation
 - Recorder data showed LEEFI detonated at proper time

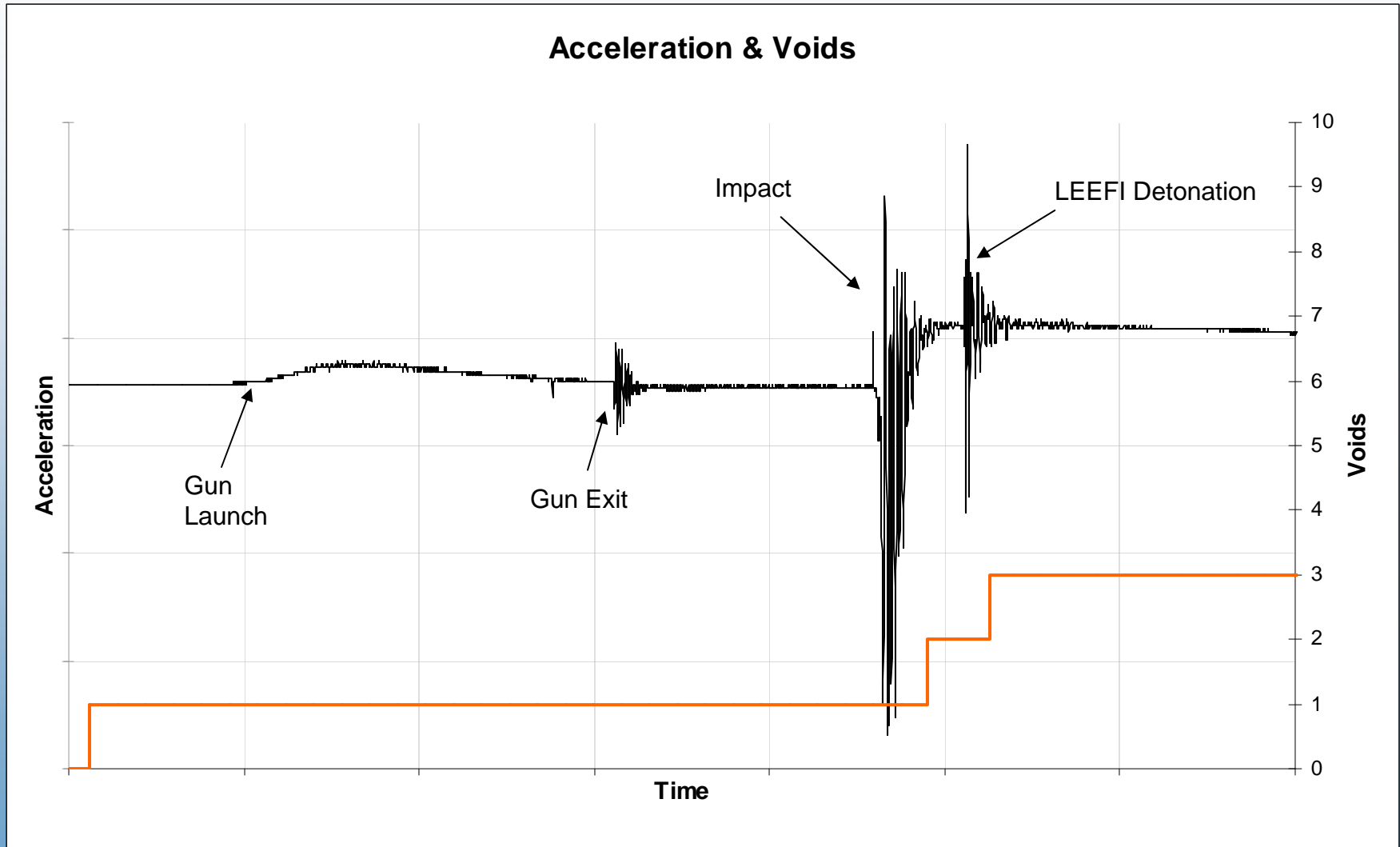


2nd Howitzer Test Series Results



2nd Howitzer Test Series Results

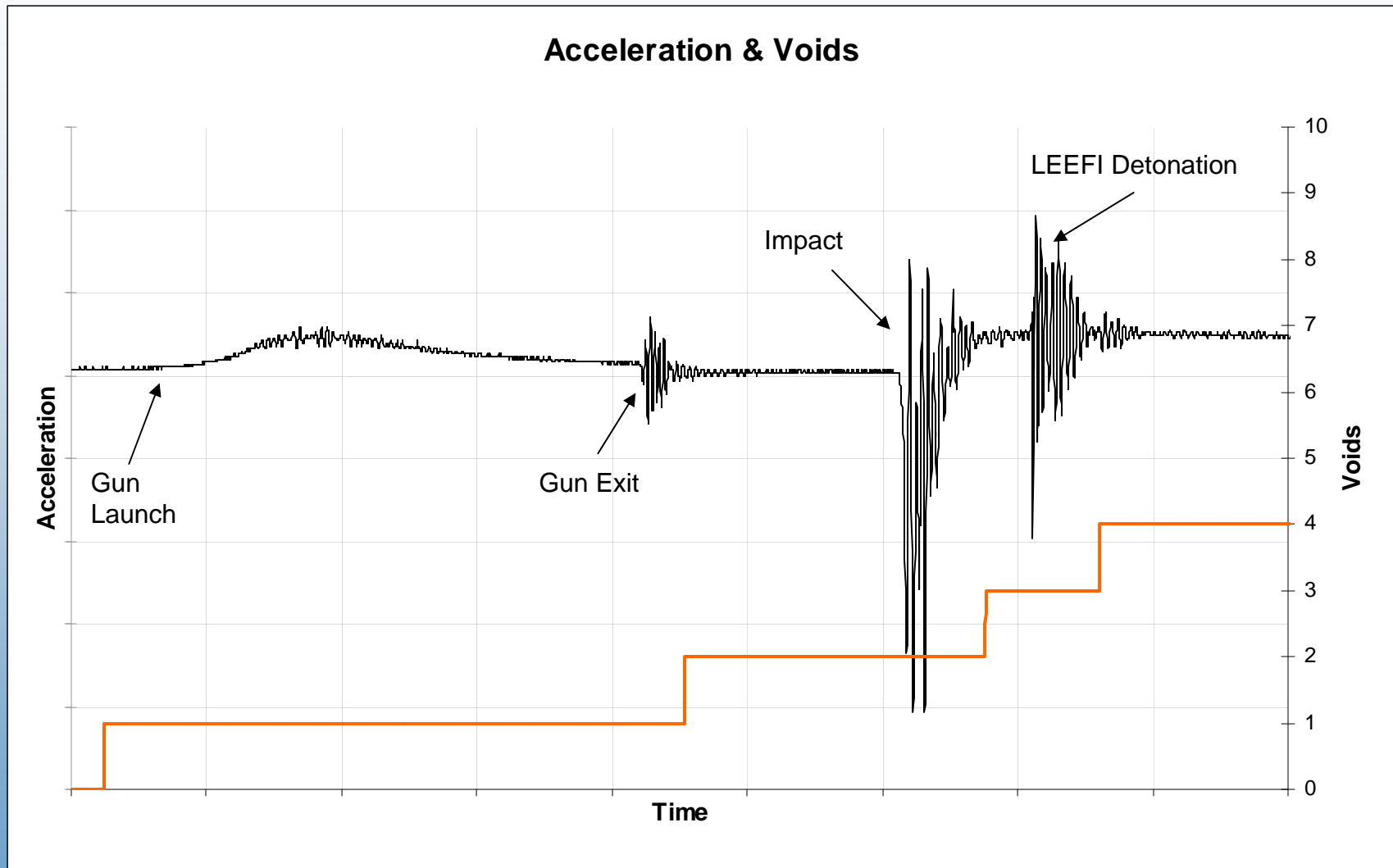
Shot #1



2ft thick, 5000psi

2nd Howitzer Test Series Results

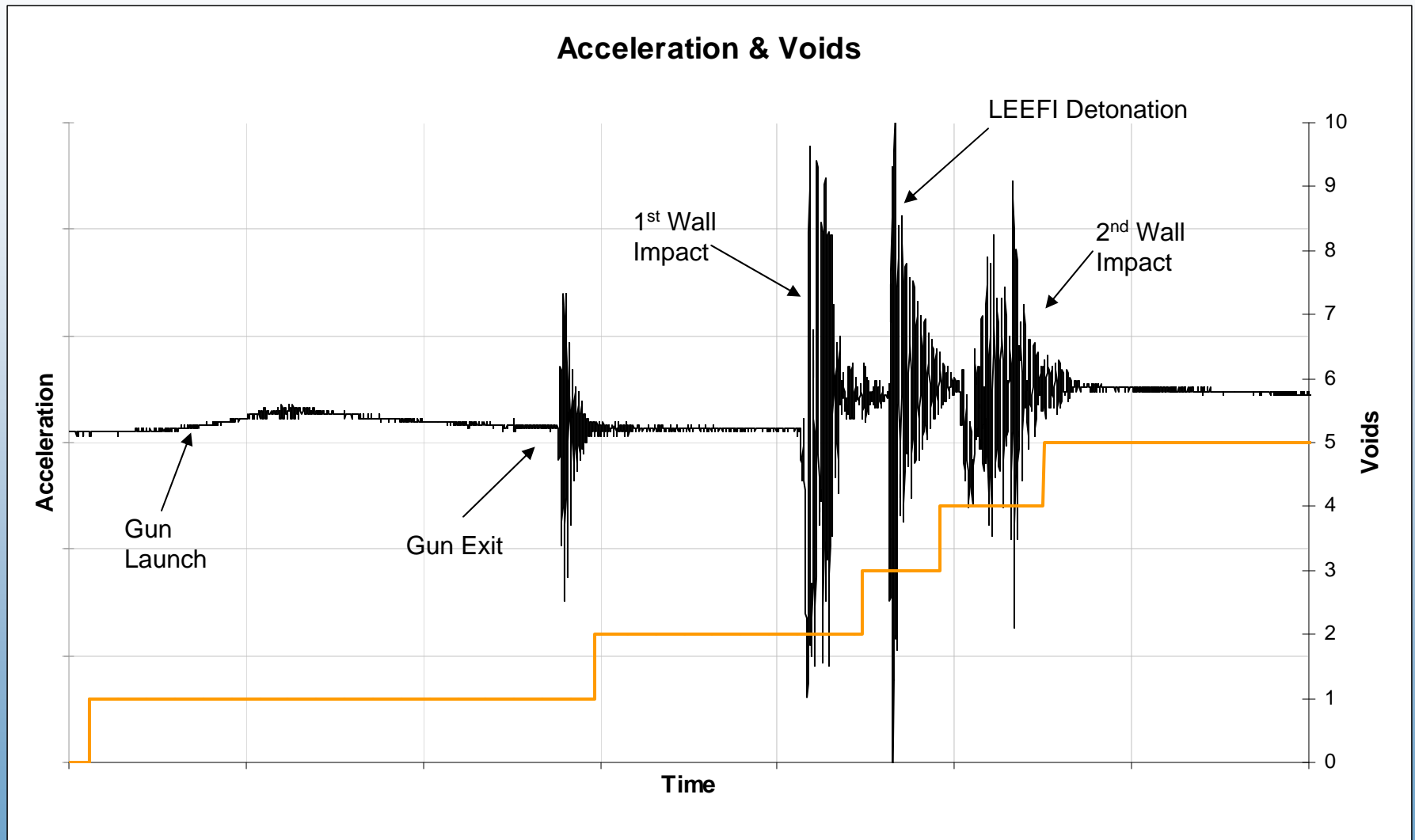
Shot #2



2ft thick, 5000psi

2nd Howitzer Test Series Results

Shot #3



Complex Target, 9 inch target then 3.5 ft air then 9 inch target

CRADA Team Members

- L-3 FOS

- Scott Colegrove
- Noah Desch
- Marc Worthington
- Perry Salyers
- Dave Lawson

- Eglin AFRL

- Tim Tobik
- Howard White
- Kelly Oliver
- Dick Mabry
- Mark Lynch
- Fuze Experimentation Facility Team

- ARA

- John Perry
- Ron Lundgren



Summary

- L-3 FOS developed a survivable Intelligent Penetrating Fuzing system with data recording and void/layer detection
- L-3 FOS has demonstrated the ability to provide a fuzing system for current and future requirements
- L-3 FOS Fuzing can provide for:
 - Functionality in high g complex targets
 - Ordnance data recording & void detection
 - Survivable “Next Generation” high velocity penetrating systems
- Initial intelligent module started the idea for a standalone FOS Data Recorder
 - Provides capability of redundant data collection in booster cup
 - See next paper for L-3 FOS Data Recorder Presentation

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