The objective of the Ordnance and Ballistics Technology Working Group Meeting is to provide researchers, developers, and program managers (from government, academia, and industry) a forum for the exchange of information on current work related to the advancement of the technology and application of ballistics and weapon systems. The meeting provides a forum for classified, export-controlled, and limited distribution papers in the areas of ballistics, weapons effectiveness, and bomb and warhead technology. The symposium is classified at the SECRET/NOFORN level and is limited to the following US agencies: DoD, DoD Contractors, DoE, FBI, CIA, and DHS.

SCHEDULE AT A GLANCE

**Monday, July 29, 2019**

**Early Bird Registration**
Hyatt Regency Hotel & Spa, Monterey
5:00 – 6:30 PM

**Tuesday, July 30, 2019**

**Registration & Security Check-In**
Naval Postgraduate School - Glasgow Hall Courtyard
7:00 – 8:00 AM

**General Session & Plenary Speaker**
8:00 – 9:00 AM

**Session I: Penetration Mechanics**
9:00 – 10:25 AM

**Session II: Warhead Technology – Shaped Charge and EFP**
10:45 – 1:55 PM

**Session III: Energetics – Explosives and Propellants**
2:15 – 4:40 PM

**Reception**
Hyatt Regency Hotel & Spa, Monterey
5:00 – 7:00 PM

**Wednesday, July 31, 2019**

**Registration & Security Check-In**
Naval Postgraduate School - Glasgow Hall Courtyard
7:00 – 8:00 AM

**General Session & Invited Speaker**
8:00 – 9:00 AM

**Session IV: Ballistics**
8:30 – 11:35 AM

**Session V: Reactive Materials**
11:35 – 3:05 PM

**Thursday, August 1, 2019**

**Registration & Security Check-In**
Naval Postgraduate School - Glasgow Hall Courtyard
7:00 – 8:00 AM

**General Session & Invited Speaker**
8:00 – 9:00 AM

**Session VI: Blast and Frags**
3:25 – 5:10 PM

**Session VII: Protection Systems**
11:45 – 3:15 PM

Special thanks to our host and co-sponsor, the Naval Postgraduate School!
**MONDAY, JULY 29, 2019**

5 - 6:30 PM  EARLY BIRD REGISTRATION  
HYATT REGENCY MONTEREY HOTEL AND SPA IN MONTEREY

**TUESDAY, JULY 30, 2019**

7:30 AM  REGISTRATION AND SECURITY CHECK-IN  
NAVAL POSTGRADUATE SCHOOL, GLASGOW HALL COURTYARD

8:00 AM  INTRODUCTORY REMARKS  
GLASGOW 102

James Miller  
Dynetics, Huntsville, AL  
Meeting Co-Chair

Robert D. Ciccarelli  
DE Technologies, Inc., King of Prussia, PA  
Meeting Co-Chair

8:15 AM  INVITED PRESENTATION

Dr. John D. Corley  
Ordnance Sciences Core Technical Competency Lead, Air Force Research Laboratory, Eglin AFB, FL

**SESSION I: PENETRATION MECHANICS**

9:00 AM  SESSION INTRODUCTION  
GLASGOW 102

Edward Kennedy  
Army Research Laboratory, Aberdeen, MD  
Session Chair

9:05 AM  PENETRATION-EFFICIENT COMPOSITE KINETIC ENERGY PENETRATORS

Brett Sorensen  
U.S. Army Research Laboratory, APG, MD

Lee Magness • Timothy Cler

9:25 AM  TERMINAL EFFECTS OF A NON-TRADITIONAL HYPERVELOCITY NAVAL STRIKE WEAPON

David West  
Naval Post Graduate School, Monterey, CA

Joseph Hooper
9:45 AM   MEASURING THE EFFECT OF NOSE SHAPE ON PENETRATOR PERFORMANCE - NEW TEST DATA AND SCALABLE PENETRATION TRENDS

Nicolas Jarrett
Applied Research Associates, Albuquerque, NM

Alma Oliphant • Craig Doolittle • Bryan Norris

10:05 AM   105MM IGNITION SYSTEM FLAME FRONT CHARACTERIZATION AND DESIGN ADVANCES

Paul Henderson
CCDC-AC, Picatinny Arsenal, NJ

Joe Cosme • Christopher Csernica

10:25 AM   COFFEE BREAK
GLASGOW HALL COURTYARD

SESSION II: WARHEAD TECHNOLOGY – SHAPED CHARGE AND EFP

10:45 AM   SESSION INTRODUCTION
GLASGOW 102

Michael Steinberg
GD-OTS, Niceville, FL
Session Chair

Nick Peterson
US Army CCDC Aviation and Missile Center, Redstone Arsenal, AL
Session Chair

10:50 AM   FURTHER DEVELOPMENT OF TANDEM WARHEADS FOR A MULTIPURPOSE SHOULDER LAUNCHED MISSILE SYSTEM

Daniel Suarez
US Army RDECOM-ARDEC, Picatinny, NJ

David Pfau • Jack Pincay • Greg Stunzenas

11:10 AM   JAVELIN FORM FACTOR COMPACT SHAPED CHARGE

Erik Goetzke
Northrop Grumman IS, Plymouth, MN

Nick Peterson • Justin Sweitzer • Nausheen Alshehab

11:30 AM   DEVELOPING A SYMMETRIC RADIALY FIRING WARHEAD WITH MULTIMODE EFFECTS

Brian Pavlovic
US Army RDECOM-ARDEC, Picatinny, NJ

Yinhua Wu • Peter Rottinger
11:50 PM  LONG STANDOFF JET PERFORMANCE FOR SHAPED CHARGES OF INTEREST

Richard Mudd
U.S. Army Research Laboratory APG, MD

Steven Boyer

12:10 PM  LUNCH
HERMANN HALL BALLROOM

1:10 PM  SESSION II (CONTINUED)

1:15 PM  PLANAR SHAPED CHARGE JETS

Geremy Kleiser
US Air Force Research Laboratory, Eglin AFB, FL

David Lambert

1:35 PM  INVITED ADDRESS

Ann E. Rondeau, Ed.D.,
Vice Admiral, U.S. Navy (Ret.), President, Naval Postgraduate School

1:55 PM  SHAPED CHARGE LINER AFFORDABILITY INITIATIVE FOR AGM-114R MULTIPURPOSE WARHEAD

Brian Doyal
General Dynamics Ordnance and Tactical Systems, Niceville, FL

Michael Steinberg • Dan Boeka

SESSION III: ENERGETICS – EXPLOSIVES AND PROPELLANTS

2:15 PM  SESSION INTRODUCTION
GLASGOW 102

Jessica Tobin
Naval Air Warfare Center, China Lake, CA
Session Chair

Kyle Mychajlonka
Nammo Talley Inc., Mesa, AZ
Session Chair

2:20 PM  SENSITIVITY OF SHAPED-CHARGE WARHEAD PERFORMANCE TO VARIATION IN EXPLOSIVE CHARACTERISTICS

Brian Doyal
General Dynamics Ordnance and Tactical Systems, Niceville, FL

Michael Steinberg • Jamie Neidert • Cynthia Buford
2:40 PM  FUTURE MIL-STD-1316 COMPLIANT CL-20 BASED INITIATION FORMULATIONS USING COUPLED MICROSTRUCTURE, INITIATION AND SPALL CHARACTERISTICS

Eric Welle
US Air Force Research Laboratory, Eglin AFB, FL

Jonathan Essel • Knepper • Dodson

3:00 PM  THE ADDITIVE MANUFACTURING OF 20 MM ELECTRIC ACTUATED GUN PRIMERS THROUGH THE DAPR DAN PROJECT WITH REACTIVE NANOCOMPOSITE INKS

Jonathan Essel
Naval Air Warfare Center, China Lake, CA

Zachary Doorenbos, • Matthew Kubik • Alicia Hughes

3:20 PM  COFFEE BREAK
GLASGOW HALL COURTYARD

3:40 PM  REVIEW OF AGENT DEFEAT WEAPONS TESTING, TARGETS AND PHENOMENOLOGY

James Black
DTRA RD-CXW, Eglin AFB, FL

4:00 PM  PARAMETER DESIGN STUDY OF AN EXPLOSIVELY DRIVEN GUN USING CTH AND DAKOTA

Nathan Reichenbach
U.S. Army Research Laboratory APG, MD

Paul Conroy • Richard Summers • Joseph Koby

4:20 PM  COUPLED MODELING, SIMULATION AND EXPERIMENTATION BASED DESIGN OF AN EXPLOSIVE TRAIN

Eric Welle
US Air Force Research Laboratory, Eglin AFB, FL

J. Davis • R. Kelleher • M. Meadows • A. Diggs

4:40 PM  ADJOURN

5:00 – 7 PM  RECEPTION
HYATT REGENCY MONTEREY HOTEL AND SPA IN MONTEREY
7:00 AM  REGISTRATION AND SECURITY CHECK-IN  
NAVAL POSTGRADUATE SCHOOL, GLASGOW HALL COURTYARD

8:00 AM  INVITED PRESENTATION
US Army Colonel John Rafferty  
Long Range Precision Fires CFT

SESSION IV: BALLISTICS

8:30 AM  SESSION INTRODUCTION  
GLASGOW 102
Donald Carlucci  
US Army Futures Command, Picatinny Arsenal, NJ  
Session Chair

8:35 AM  INNOVATIVE NITROGEN-DOPED BORON PROPELLANTS, PART II-25MM GUN FIRINGS AND CHARACTERIZATIONS
Thelma Manning  
US Army RDECOM-ARDEC, Picatinny, NJ
Michael Fair • Viral Panchal • Eugene Rozumov • James Barnes • Paul Matter

8:55 AM  USE OF A CONTROL MAP TO MAXIMIZE MANEUVER FOOTPRINT OF BALLISTICS-CORRECTED GUIDED PROJECTILES
Paul Zemany  
BAE Systems Information & Electronic Systems Integration, Inc., Hudson, NH
Matt Chrobak • Egor Degtiarev

9:15 AM  ENHANCED M940 MPT-SD CARTRIDGE LETHALITY AND BALLISTIC PERFORMANCE
David Rophael  
Combat Capabilities Development Command - Armaments Center, Picatinny Arsenal, NJ
Nicole Sapp

9:35 AM  DEVELOPMENT OF A TEST STAND FOR HIGH SPIN RATE TESTING OF ARTILLERY ROCKET MOTORS
Logan McLeod  
National Technical Systems
Seth Siddle-Mitchell • Daniel Vo • Ductri Nguyen
9:55 AM  FLUID-STRUCTURE INTERACTION COMPUTATIONAL MODELING AND EXPERIMENTATION ON LOW-MACH EXTERNAL BALLISTICS

William Schwartz
Northrop Grumman Innovation Systems, Plymouth, MN

10:15 AM  COFFEE BREAK
GLASGOW HALL COURTYARD

10:35 AM  DEFEATING SHOT LOCALIZATION WITH SMALL ARMS LOW NOISE SUPersonic PROJECTILE

Greg Kangas
GREAT LAKES SOUND AND VIBRATION INC., Houghton, MI

10:55 AM  A SUMMARY OF THE REAPr (RECORDER FOR EMBEDded ACCELERATION AND PRESSURE RESPONSE) INSTRUMENTATION TESTING AND CAPABILITIES

David Truncellito
Applied Research Associates, Albuquerque, NM

11:15 AM  AUTO-CATALYTIC HEAT GENERATION OF FOAMED CELLULOID COMBUSTIBLE CASES IN 120MM TANK AMMUNITION

Samantha Scutti
Combat Capabilities Development Command - Armaments Center, Picatinny Arsenal, NJ

Brian Hunter • Jeff Krug • Viral Panchal

SESSION V: ENERGETICS – REACTIVE MATERIALS

11:35 AM  SESSION INTRODUCTION
GLASGOW 102

Alexandra Reinert
NSWC IHEODTD, Indian Head, MD
Session Chair

Nydeia Bolden
US Air Force Research Laboratory, Eglin AFB, FL
Session Chair

11:40 AM  ANALYTIC MODELS FOR THE ENERGY RELEASE OF REACTIVE MATERIALS

Joseph Hooper
Naval Post Graduate School, Monterey, CA

Jacob Kline • Christopher Milby

12:00 PM  LUNCH
HERMANN HALL BALLROOM

1:00 PM  SESSION V (CONTINUED)
1:05 PM  NEUTRALIZATION OF HOME-MADE EXPLOSIVE MATERIAL BY WAY OF REACTIVE MATERIALS

Paul Redner
US Army RDECOM-ARDEC, Picatinny, NJ

Robert Koch • Richard Fong • Deepak Kapoor

1:25 PM  CHARACTERIZATION OF BARRIER THICKNESS FOR REACTIVE FRAGMENT ENERGY RELEASE

Anne Kyner
NSWC Indian Head Explosive Ordnance Disposal Technology Division, Indian Head, MD

1:45 PM  COMPUTATIONAL MODELING OF HIGH-DENSITY REACTIVE MATERIALS

Thomas McGrath
NSWC Indian Head Explosive Ordnance Disposal Technology Division, Indian Head, MD

James Warner • Cameron Stewart • Jason Hackl

2:05 PM  CONCOMITANT 3D PRINTING OF NANOSTRUCTURED METAL AND POLYMERS FOR ENERGETIC APPLICATIONS

David Thomas
ASU Research Enterprise, Scottsdale, AZ

Bruno Azeredo

2:25 PM  CHARACTERIZATION OF FRAGMENTATION AND ENERGY RELEASE BEHAVIOR OF REACTIVE METAL COMPOSITES

Michael J. Hargather
New Mexico Tech / EMRTC, Socorro, NM

Jamie Kimberley • Steven Thoma • Phil Martellaro

2:45 PM  COFFEE BREAK
GLASGOW HALL COURTYARD

SESSION VI: WARHEADS – BLAST AND FRAGS

3:05 PM  SESSION INTRODUCTION
GLASGOW 102

Daniel Suarez
US Army Futures Command, Picatinny Arsenal, NJ
Session Chair

Joseph DeGezelle
Northrop Grumman Innovation Systems, Plymouth, MN
Session Chair
3:10 PM  **CONFORMAL PANEL WARHEAD FOR AERO-HEATED AIR-TO-GROUND MISSILES**  
Michael Denigan  
US Air Force Research Laboratory, Eglin AFB, FL  
Michael Murphy • Darin L. Kielsmeier • John Granier  

3:30 PM  **LETHALITY ANALYSIS TECHNIQUES FOR FRAGMENTATION PANEL WARHEADS**  
Eric L. Scarborough  
US Air Force Research Laboratory, Eglin AFB, FL  
Michael Denigan • Samuel Tipton  

3:50 PM  **SPEAR WARHEAD DEVELOPMENT**  
Sean Treadway  
Corvid Technologies, Mooresville, NC  
Mike Worsham • Todd Hadley  

4:10 PM  **BLAST OVERPRESSURE MODELING OF COMPLEX TARGETS FOR PERSONNEL LETHALITY ANALYSIS IMPROVEMENT**  
John M. Steen  
US Army CCDC Aviation and Missile Center, Redstone Arsenal, AL  
Jon M. Kilpatrick • Allen W. Pike • Gustavo Emmanuelli  

4:30 PM  **OPTICAL DIAGNOSTICS APPLIED TO DETONATION AND FRAGMENTATION OF THE MK 84 MUNITION**  
Phillip Reu  
Sandia National Laboratories, Albuquerque, NM  
Russell Teeter • Mark Anderson • Daniel Guildenbeche  

4:50 PM  **NUMERICAL MODELING OF THE DETONATION AND FRAGMENTATION OF THE MK 84 MUNITION**  
Russell Teeter  
Sandia National Laboratories, Albuquerque, NM  
Phillip Reu • Daniel Rogers • Steven Attaway  

5:10 PM  **ADJOURN**
THURSDAY, AUGUST 1, 2019

7:00 AM  REGISTRATION AND SECURITY CHECK-IN
NAVAL POSTGRADUATE SCHOOL, GLASGOW HALL COURTYARD

8:00 AM  INVITED PRESENTATION JEMTP STATUS

Stanley DeFisher
US Army RDECOM-ARDEC, Picatinny, NJ

SESSION VI: WARHEADS – BLAST AND FRAGS (CONTINUED)

8:30 AM  SESSION INTRODUCTION
GLASGOW 102

Daniel Suarez
US Army Futures Command, Picatinny Arsenal, NJ
Session Chair

Joseph De Gezelle
Northrop Grumman Innovation Systems, Plymouth, MN
Session Chair

8:35 AM  LOW COLLATERAL WARHEAD DESIGN AND EXPERIMENT

Chandler Clough
U.S. Army Research Laboratory APG, MD

Jason Davis • Drew Marable • Darin Kielsmeier • Adolphus McDonald

8:55 AM  ADDITIVE MANUFACTURING OF AF9628 STEEL FOR ORDNANCE APPLICATIONS

Erin Hager
CCDC AvMC, Redstone Arsenal, AL

Ryan O’Hara • Philip Flater • Ryan Kemnitz

9:15 AM  ADVANCED DATA COLLECTION FOR NON-TRADITIONAL MUNITIONS

James Mathis
Southwest Research Institute, San Antonio, TX

David Stevens • David Hogg • Robert Tynan

9:35 AM  PARTICLE IMAGE VELOCIMETRY AND ITS ADVANTAGES IN IMAGING MULTIPHASE

Charles M. Jenkins
US Air Force Research Laboratory, Eglin AFB, FL
9:55 AM  ENHANCED TERMINAL EFFECTS: A TECHNOLOGY DEMONSTRATION

Andrew C. Ihnen
NSWC Indian Head Explosive Ordnance Disposal Technology Division, Indian Head, MD

Samuel B. Emery • Kevin W. Genson • Clark R. Newbold

10:15 AM  COFFEE BREAK
GLASGOW HALL COURTYARD

10:35 AM  SECOND GENERATION AEROSTABLE PENETRATOR TECHNOLOGY DETONATION TESTING

David Bittle
US Army RDECOM-ARDEC, Picatinny, NJ

David Kafrouni

10:55 AM  KINETIC ENERGY WARHEAD (KEWH) DEVELOPMENT

Matt Rontti
Northrop Grumman Innovation Systems (NGIS), Plymouth, MN

11:15 AM  INVITED PRESENTATION - WEAPONIZED SUAS TRENDS

Chris Gstattenbauer
NGIC, Charlottesville, VA

SESSION VII: PROTECTION SYSTEMS

11:45 AM  SESSION INTRODUCTION
GLASGOW 102

Joel Stewart
US Army Research Lab, APG, MD
Session Chair

11:50 AM  LOW-COLLATERAL ANTI-ROCKET-PROPELLED GRENADE (RPG) WARHEADS

Vincent Schuetz
Naval Air Warfare Center, China Lake, CA

12:10 PM  LUNCH
HERMANN HALL BALLROOM

1:10 PM  SESSION VII (CONTINUED)

1:15 PM  ANALYTIC SHAPED-CHARGE CODE DEVELOPMENT WITH FORMATION, PROPAGATION, BREAKUP, AND PENETRATION CALCULATIONS

Justin Sweitzer
Practical Energetics Research, Inc., Huntsville, AL

Paul Reitmeier
1:35 PM  COMPUTATIONAL DESIGNS TO TAILOR THE VELOCITY OF EXPLOSIVELY 
DRIVEN PLATES IN EXPLOSIVE REACTIVE ARMORS 

Joel Stewart 
U.S. Army Research Laboratory APG, MD 

1:55 PM  LATERAL-CONFINEMENT EFFECTS ON THE BALLISTIC RESPONSE TO 
RELEVANT SMALL-ARMS THREATS OF CERAMICS HAVING SMALL THICKNESS 
AND LATERAL DIMENSION 

Jason McDonald 
U.S. Army Research Laboratory APG, MD 

Andrew Tonge • Sikhanda Satapathy 

2:15 PM  COMPUTATIONAL SIMULATION OF SHATTER GAP IN HARD ARMOR 

Christopher Freitas 
Southwest Research Institute, San Antonio, TX 

2:35 PM  AN ANALYSIS OF BALLISTIC HELMET PROTECTION AND SKULL FRACTURE 
PATTERNS 

Erika A. Matheis 
Bennett Aerospace, Cary, NC 

Samantha L. Wozniak • Ashley E. Eidsmore • Karin A. Rafaels 

2:55 PM  FRACTURE/FAILURE BEHAVIOR, AND BALLISTIC PERFORMANCE OF VARIOUS 
SILICON CARBIDE CERAMIC MATERIALS IN LIGHTWEIGHT 
CERAMIC/COMPOSITE LAMINATE ARMORS 

Mark D. Andrews 
U.S. Army Research Laboratory APG, MD 

Lee S. Magness • James Campbell 

3:15 PM  ADJOURN
ALTERNATE SESSIONS

SESSION I: PENETRATION MECHANICS

NONE

SESSION II: WARHEAD TECHNOLOGY – SHAPED CHARGE AND EFP

MULTI ROLE WARHEAD CHARACTERIZATION
Becca Loudin
CCDC AvMC, Redstone Arsenal, AL

Brent Deerman • Darin Kielsmeir

ANALYSIS AND DESIGN OF A COUNTER-UNMANNED AIRCRAFT SYSTEM (C-UAS) WARHEAD
Brian Pavlovic
US Army RDECOM-ARDEC, Picatinny, NJ

Henry Hsieh • Peter Rottinger • Lamar Thompson

ANTI-ARMOR WARHEAD DESIGN WITH FORWARD FRAGMENTATION
Drew Marable
Practical Energetics Research, Inc., Huntsville, AL

Paul Reitmeier • Scott Amos

TESTING AND EVALUATION OF VIPER WARHEADS LOADED WITH FEM LX-14 EXPLOSIVE
Arthur S. Daniels
Practical Energetics Research, Inc., Huntsville, AL

Nicholas R. Peterson • Nausheen Al-Shehab

DEVELOPMENT AND TESTING OF A HIGHER PERFORMANCE LINEAR SHAPED CHARGE FOR DEMILITARIZATION OF UXO
Stanley DeFisher
US Army RDECOM-ARDEC, Picatinny, NJ

Gregory Stunzenas • Bill Adams • Erik Wrobel
GATOR LANDMINE WARHEAD CHARACTERIZATION AND REPLACEMENT APPROACH

Gawain Chan
U.S. Army RDECOM-ARDEC, Picatinny, NJ

Edward W. Chin • Peter Rottinger • Brian Pavlovic

EVALUATION OF A 2.75" DIAMETER HIGH-EXPLOSIVE ANTI-TANK (HEAT) TANDEM SHAPED CHARGE WARHEAD DESIGN CONCEPT WITH ANTI-PERSONNEL ANTI-ARMOR (APAM) CAPABILITIES

Edward Lustig
NSWC Indian Head Explosive Ordnance Disposal Technology Division, Indian Head, MD

Jonathan Millan

WARHEAD PERFORMANCE OF ARMY MISSILE SYSTEMS AGAINST ARMORED TARGETS

Scott Hill
Practical Energetics Research, Inc., Huntsville, AL

Darin Kielsmeier • Rebecca Turner • Kim Williams

SESSION III: ENERGETICS – EXPLOSIVES AND PROPELLANTS

NONE

SESSION IV: BALLISTICS

MOTION MEASUREMENT PACKAGE

Anthony Opperman
Orbital Research

Edward Rapp

PROPULSION DEVELOPMENT FOR 120-MM M865A1 TANK CARTRIDGE

Adriana Eng
US Army RDECOM-ARDEC, Picatinny, NJ

Manfredi Luciano • Brian Wong • Hany Malek • Vinod Nagori

CURVED TRAJECTORY GRENADE LAUNCHER

Chris Fortunato
ASU Research Enterprise, Scottsdale, AZ

Lloyd Brown
SESSION V: ENERGETICS – REACTIVE MATERIALS

NOVEL TECHNIQUES FOR INVESTIGATING ENERGY RELEASE AND THE COMBUSTION OF REACTIVE MATERIAL FRAGMENTS

Alexandra A. Reinert  
NSWC Indian Head Explosive Ordnance Disposal Technology Division, Indian Head, MD

Anne Kyner

LETHALITY ASSESSMENT OF THE HIGH-DENSITY REACTIVE MATERIAL (HDRM) ENHANCED WARHEAD FOR THE 57MMK332 MOD 0 GUIDED ROUND

Thoai Nguyen  
Naval Surface Warfare Center, Dahlgren Division, Dahlgren, VA

Dan Piwowar • James Sambrook • Erika Wood

SESSION VI: WARHEADS – BLAST AND FRAGS

EXPLOITING ELECTRICAL POWER DELIVERY DEVICES FOR DAMAGE MECHANISMS

Geremy Kleiser  
US Air Force Research Laboratory, Eglin AFB, FL

Ian Kowalczyk • David Pugh • Jason Gilliam

ADVANCED MORTAR WARHEAD DEVELOPMENT

Joseph DeGezelle  
Northrop Grumman - Innovation Systems Sector, Plymouth, MN

BLU-139/B 500 LB. PENETRATOR

Derek Plymate  
Northrop Grumman - Innovation Systems Sector, Plymouth, MN
A BODY ARMOR MODEL TO EVALUATE CHANGE OF BACK FACE DEFORMATION REQUIREMENT

Sikhanda Satapathy
U.S. Army Research Laboratory APG, MD

Timothy Zhang • Jason McDonald • Brian Schuster
Northrop Grumman offers an extraordinary portfolio of capabilities and technologies that enable us to deliver innovative systems and solutions for applications that range from undersea to the battlefield, and into outer space and cyberspace. Our core competencies are aligned with the current and future needs of our customers and address emerging global security challenges in key areas that are critical to the defense of our nation and its allies. Amongst our vast defense product portfolio is our innovative warhead technology, Lethality Enhanced Ordnance (LEO), which eliminates unexploded ordnance and improves warhead performance. Our solution contains no sub-munitions to cause unintended harm to civilians and infrastructure, and provides equal or greater performance required by the warfighter. Using our unique optimizer modeling tool, LEO technology is easily configured to meet existing warheads' overall mass and center of gravity for a much more effective warhead. Designs can also be miniaturized to allow for a larger rocket motor and extend munition range while maintaining the same level of effectiveness as traditional warhead technology. Ask us about our game changing warhead technology today or visit us on the web at www.northropgrumman.com.
Dynetics provides responsive, cost-effective engineering, scientific, IT solutions to the national security, cybersecurity, space, and critical infrastructure sectors. Our portfolio features highly specialized technical services and a range of software and hardware products, including components, subsystems, and complex end-to-end systems. The company of more than 2,000 employee-owners is based in Huntsville, Ala., and has offices throughout the U.S. For more information, visit www.dynetics.com.

**GENERAL DYNAMICS**
Ordnance and Tactical Systems

General Dynamics Ordnance and Tactical Systems (GD-OTS) designs and produces advanced warhead systems of all types, including shaped charge, blast fragmentation, area attack, and penetrator warheads. The company is a leader in the development and manufacture of large-, medium- and small-caliber direct and indirect-fire ammunition; as well as mortar systems, gun systems, and lightweight tactical vehicles. GD-OTS designs and manufactures composite structures, precision metal components, and control actuation systems for missiles and rockets; and for numerous commercial and aerospace applications. The company also develops and produces propellants and powder for a variety of defense and commercial applications.

**NETWORKING BREAK SPONSORS**
Upcoming National Armaments Consortium Collaboration Opportunities

DoD Ordnance Technology Consortium (DOTC) 19-05 Collaboration Event
August 20-21, 2019
Parsippany, NJ
www.nacconsortium.org

NSTIC Industry Day
September 4, 2019
Fredericksburg, VA
www.nstic.org

AMTC Collaboration Event
February 2020
Huntsville, AL
www.amtcenterprise.com