National and Homeland Security at INL

- ***The United States of America is faced with unprecedented challenges in National and Homeland Security***
- ***The Idaho National Laboratories is well positioned to meet many of these challenges and enable sustainability for the long war***

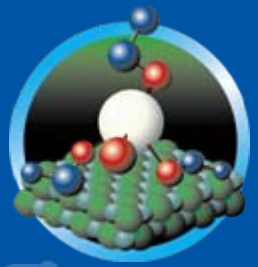
- **Multi-Directorate Federal R&D Laboratory**
- **Leverage science and engineering technologies to form international partnerships that address both DOE R&D and National and Homeland needs**
- **Annual budget of ca. $600M**
- **3,400 scientists, engineers, technicians, and other staff**
- **Three S&T Campuses on 890 square mile site**

The INL R&D

Mission execution is guided by five laboratory divisions

Nuclear Energy

National Security



Energy and Environmental Sciences

Advanced Test Reactor

Specific Manufacturing Capability

Idaho National Laboratory

Our Focus Areas Support *Multiple Missions and Enable Sustainability*

Global Security	National Defense	Homeland Security	Special Programs	Energy Security

Focus Areas

SCADA / Cyber/ Power Grid

Wireless Technology

Unmanned Vehicle Systems

Explosives Detection & Testing

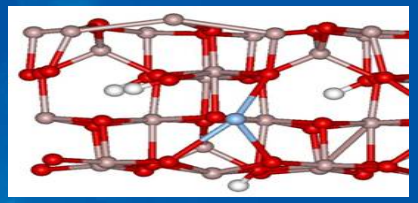
Chemical / Nuclear Detection, and Nonproliferation / Safeguards & Security

Special Mfg Center Emerging Armor-- Vehicle / Barrier/ Structural/ Personnel

Technology Platforms

Process Controls

Materials



Physics, Molecular Science, Modeling

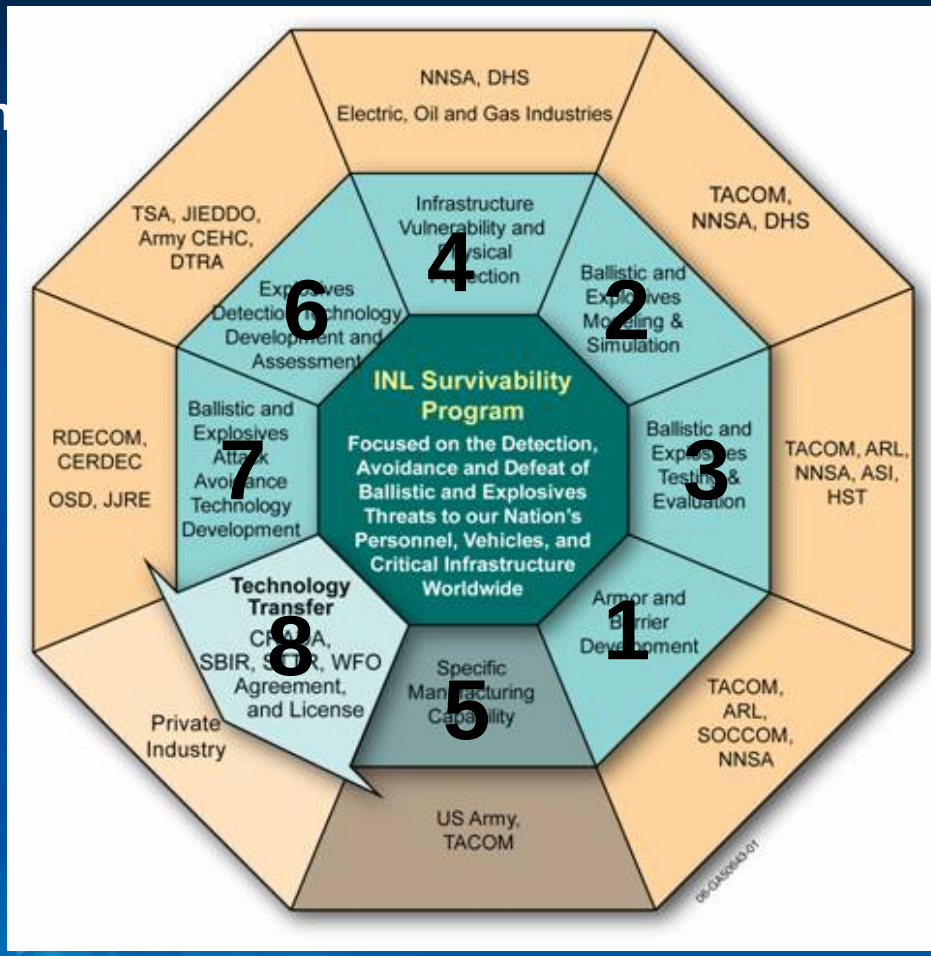
National & Homeland Security
Objectives & Key Customers We Serve

Mission Area	Customer	Strategic Objective
Global Security	NNSA	Reduce global nuclear threats through innovative nonproliferation and counterproliferation technologies
National Defense	DoD	Provide solutions to asymmetric threats and combat WMD
Homeland Security	DHS	Develop science and technology to protect critical infrastructure systems and improve resilience
Special Programs	Various Clients	Provider of choice, in selected areas, for technology based solutions to the U.S. Intelligence Community
Energy Security	DOE-OE	Enhance security and reliability of the nation's energy systems

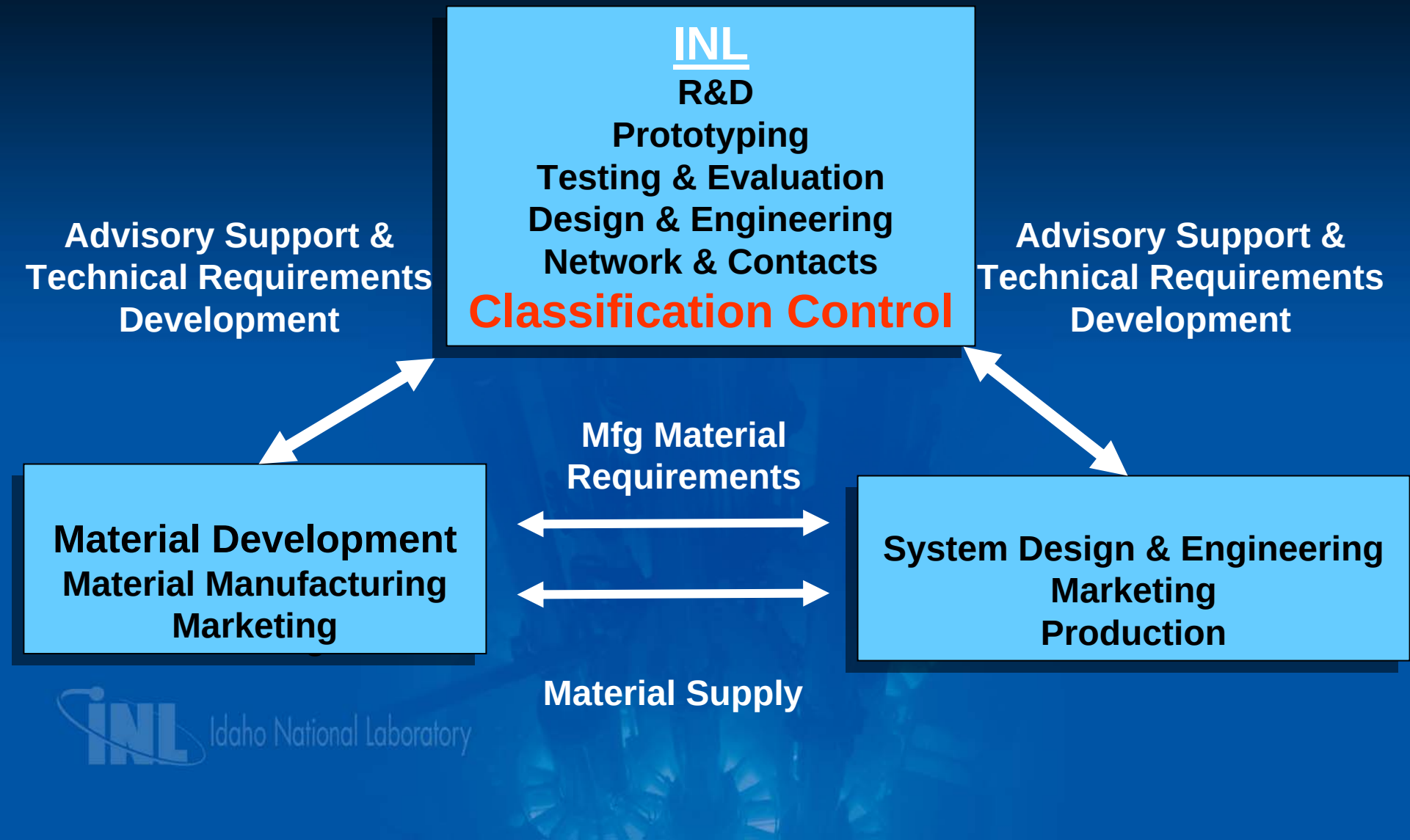
National and Homeland Security
INL Survivability Program (ISP)

The ISP is an Agile Collaboration of Capabilities at *One* Location

1. **Armor and Barrier Development**
2. **Ballistic and Blast Modeling Simulation**
3. **Ballistic and Blast Test & Evaluation**
4. **Critical Infrastructure Vulnerability Assessments**
5. **Specific Manufacturing Capability**
6. **Explosives Detection and Advanced Technology Development**
7. **Ballistics and Explosives Attack Avoidance & Hardware Development**
8. **Technology Transfer for Scale Up**
   Hardware to the End User



Example of INL Commercial Partnership in Survivability Systems Development



National and Homeland Security

INL Survivability Program (ISP) - Leadership

Armor Development

- Leadership in design, development, and testing of high-density, lightweight armor against multiple threats.
- Test range with extensive capability for confidential testing.
- INL armor proven against ballistic, kinetic, blast & frag threats.

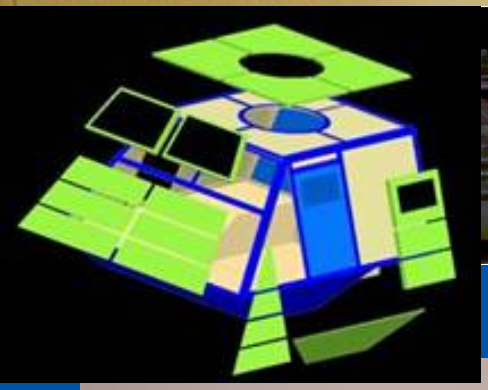
Explosives Testing

- Leadership in trace and bulk explosives detection, blast effects, shock and vibration analysis.
- Class Facilities: 20,000 Lb TNT equivalent test range and Class II, Div. I Operations Room for explosives assembly.
- Performance/ Resiliency Testing: Ballistic Penetration, Structural Analysis, Computer Modeling/Simulation,
- Development of Protective Countermeasures.

Technology Development

- Leadership through over 3,500 world-class scientists and engineers in technology development and national security solutions.
- Award-winning technologies in Global use: Idaho Explosives Detection System. Breaching Shotgun, Tactical Timed Firing Device, Change Detection System, PINS for Munitions Assessment

Armor and Barrier Development



- **Advanced Materials**
  - Ballistic Steels
  - Alloyed Metals
  - Ceramics
  - Transparent Ceramics
  - Polymers
  - Composites
  - Joining
- **Design & Simulation**
  - Ballistic
  - Blast
  - Fragmentation
- **Prototyping & Evaluation**
- **Special Manufacturing Center**
  - Over 9000 Abrams Premier battle tanks in use worldwide

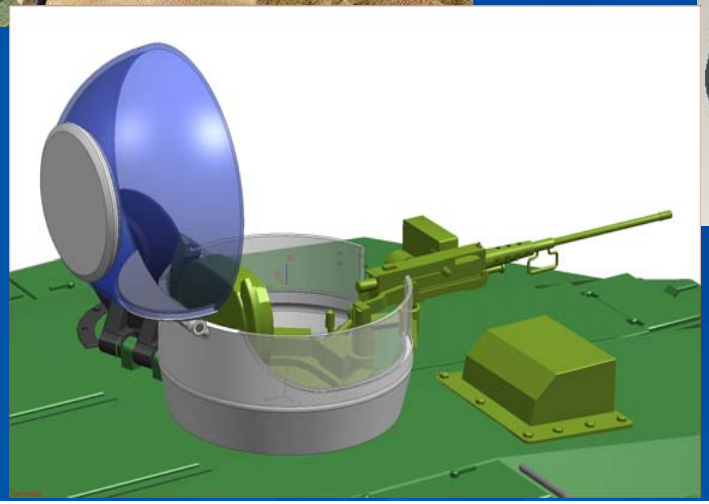
Optical Armor and Ballistic Results

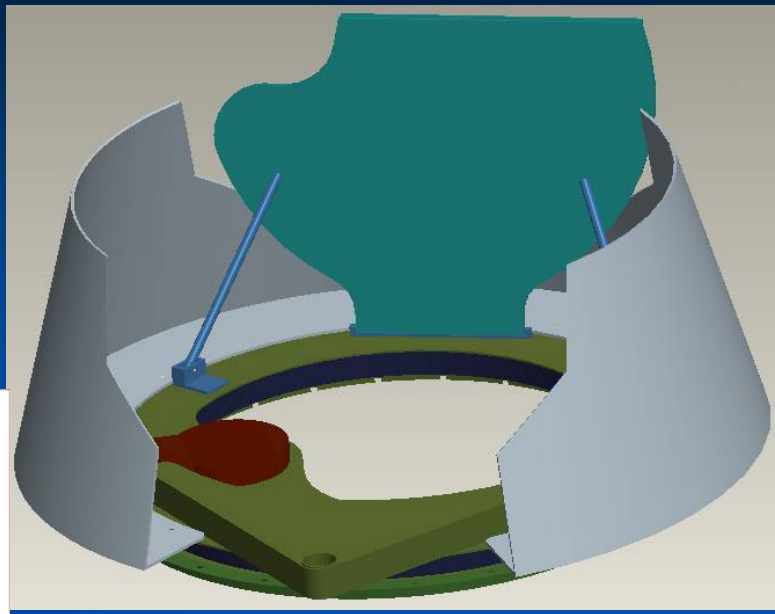
- Aluminum Oxy-Nitride is a “premier” transparent armor material. Today, AlON is not available to in commercial quantities. Presence of residual porosities will prevent full optical transparency
- INL is developing novel approaches to **pressure-less sintering** of ALON.

- Successful Target LOS AD = 10.5 lb/sq ft
- Design: ALON + polyurethane + polycarbonate
- Defeat: 30-cal APM2 @ 2810-2828 ft/sec @ 20.5’ standoff

Lightweight, High-performance Gunner Ballistic Cupola

INL CRADA Demonstration Project

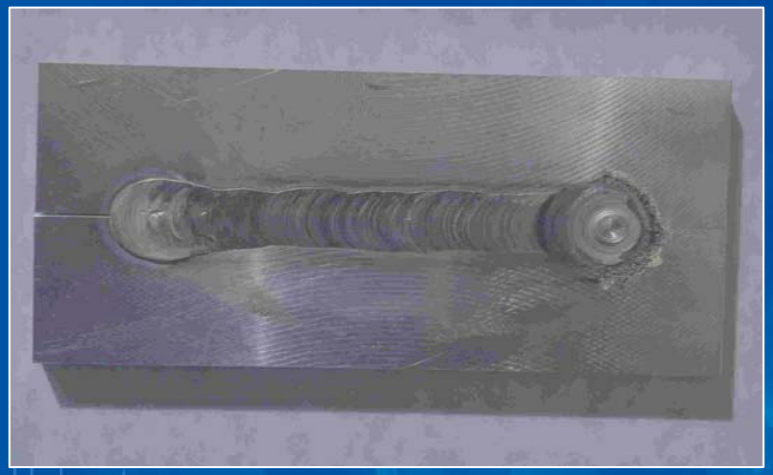


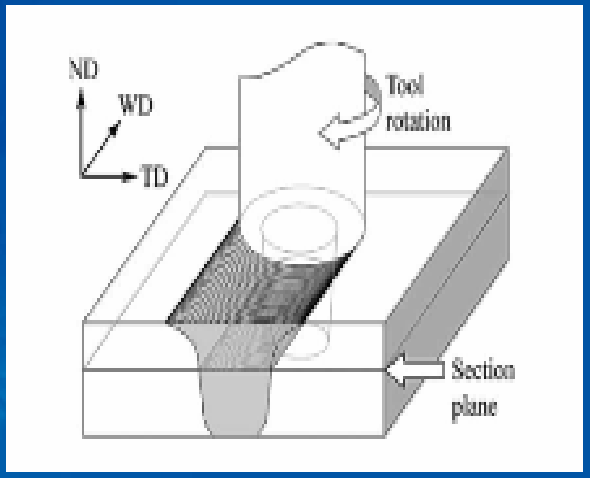


Improved Ballistic / Blast Resistant Conformal Armor Cupola

Joining and Welding of Metal Alloys Using Advanced Solid-State Friction Stir Welding

INL's Advanced Tooling Materials

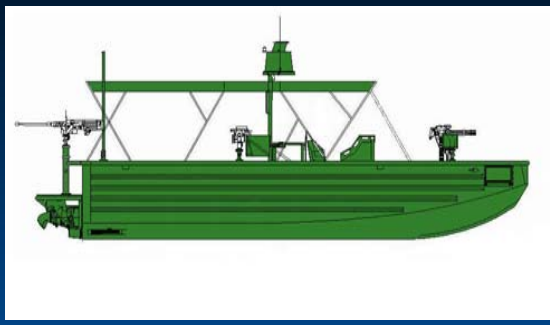




ISP's Full Scope Multi-Services Supports

Up-Armoring Special Operation Combatant Crafts

- **Armor expertise and T&E support to USSOCOM on retrofit armor solutions for the Coastal Assault Craft (CAC) and new Special Operation Craft – Riverine (SOCR)**
- **Consultation and design supports provided to SOCR builder**
- **Development of close-quarter ricochet and shrapnel suppression system**
- **Riverine fleet expanded from initial "x" to "y" units, based in Stannis, MS**
- **Currently deployed at Tigris River, Iraq**



INL Live-fire Range Complex & Capabilities

- 10 ranges
- Live fire training
- Various weapons

- **Surface Danger Zones = 4.7 miles. At the 20,000 lb range = 8 miles**
- **Live Fire Ballistic Test Range**
  - **30 cal, 50 cal APM2**
  - **14.5 mm BS32, BS41**
  - **20 mm FSP and AP**
  - **LAW and RPG**
  - **30 mm FSP and AP**
  - **Other: hypersonic**
- **Explosive R&D range**
  - **500 lbs.**
  - **20,000 lbs.**
- **Fabrication shop support**

Design and Simulation

- Vehicle Armor
- Personnel Protection
- Barrier Armor
- Ballistic Effects
- Blast Effects
- Combined Ballistic and Blast
- Molecular modeling (explosives)
- Molecular Engineering (novel organics)
- Processing of Ceramics and Polymers

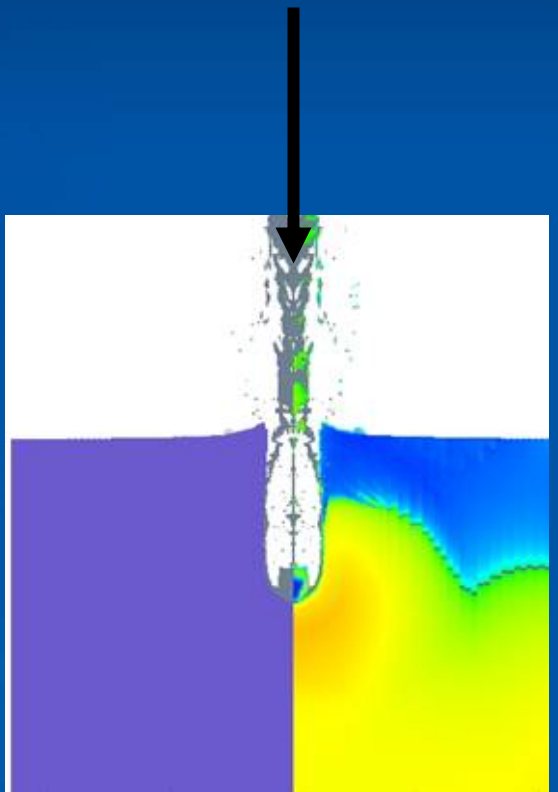
INL Applied Mechanics

INL Center For Advanced Modeling and Simulation (CAMS)

- **Analytical**
  - Nuclear Reactor safety analyses
  - Pressure vessels and piping
  - Flight safety
  - Shock and vibration
  - High-velocity and hyper-velocity impact
  - Blast
- **Experimental**
  - Impact
  - High strain-rate materials
  - High temperature materials
  - Shock and vibration
- **Design**
  - Prototype and One-of-a-kind

Analytical Tools:

- ✓ ABAQUS/ Explicit
- ✓ LS-DYNA
- ✓ CTH
- ✓ ALEGRA
- ✓ ALE3D



Explosives Detection & Defeat

Bulk Explosives Detection Programs

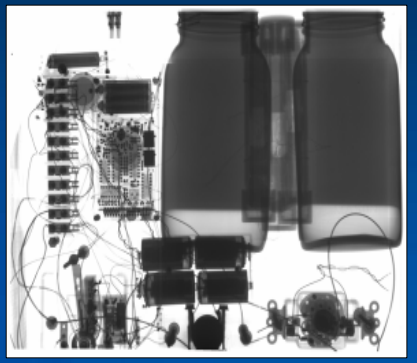
Trace Explosives Detection Programs

Tactical Timed Firing Devices/Disruptors

Bulk Explosives Detection Programs

Neutron Interrogation Systems - X-Ray and CT Technologies

1. **Portable Isotopic Neutron Spectroscopy (PINS)**
   --- Identifies chemicals/explosives in munitions



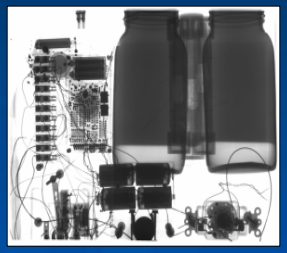
Single Munitions Scanner (SMS) (component of Mobile Munitions Assessment System (MMAS)

2. **Remote/Standoff Explosives Detection System (R/SEDS)**
   --- Detects explosives in medium-sized trucks and vans

Trace Explosives Detection Programs

I. Trace Detection Systems Testing – FAA and TSL

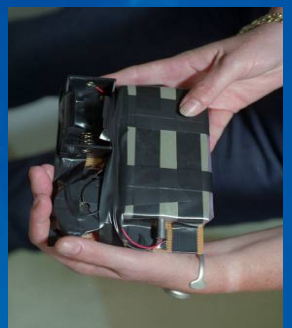
- Perform Independent Validation and Verification testing for the Transportation Security Administration (TSA)
- Test trace detection systems against actual explosive threats
  - IEDs in Electronic Devices
  - IED Manufacturers
  - IED Couriers
  - IED in Suitcases



- Ion Mobility (+-) Spectrometer research in trace explosives

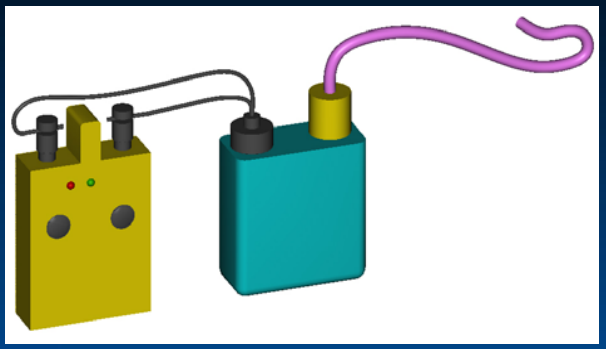
II. Trace Detection Systems Development

- Develop and test advanced Ion Mobility Spectrometer (IMS) concepts and prototypes
- TeraHertz Sensors R&D
- Advanced IMS modeling capability

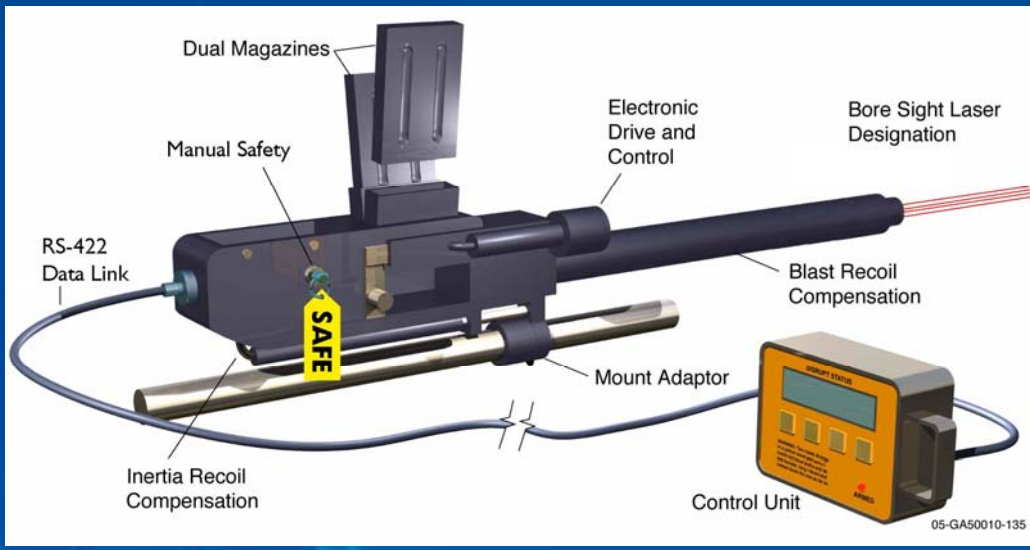


Tactical Timed Firing Devices/Disruptors

Remote Firing Devices



Multi – IED Disruptor uses "operator selected" kinetic energy penetrators



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Sponsor: Technical Support Working Group (TSWG)

Critical Infrastructure Test Range Complex

Idaho National Laboratory

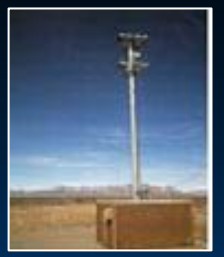
Critical Infrastructure Test Range Complex

- National, comprehensive program where technologies, systems and policies that protect the nation's critical infrastructure are developed, tested and validated under real-world conditions
- INL is the DOE National SCADA Test Bed
- INL separate site power grid. $100M's of isolated infrastructure investments over past 50 yrs.
- Research Test Beds include:
  - Explosives Detection (Bulk and Trace)
  - Explosives/Weapons Effects Testing
  - Unique Communications/Wireless Test bed
  - UAV Research
  - SCADA Vulnerabilities
  - Cyber Security and Physical Security
  - Contraband & Weapons Detection

INL's Unique Communications Range Capabilities

1) "Clean" Frequency Spectrum

- Low RF noise: No urban areas or military bases
- NTIA Experimental Radio Station, Local Spectrum Manager
- Can use Next Generation / International frequencies given: a) no harmful interference, b) test / experimental use only

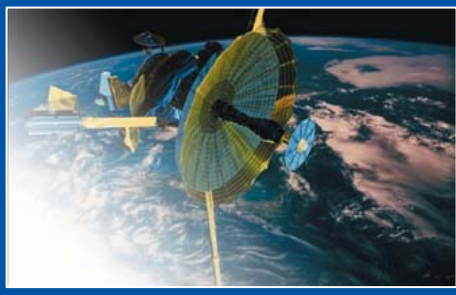


2) Full-Scale, Isolated Communications Networks

- Cell grid is isolated from PSTN, Fiber net isolated via DWDM
- Ability to link with other INL assets or external labs
- Future: Full Telco/ISP test range combined with Cyber R&D

3) "Open" Range that Cooperates with Commercial Vendors

- Commercial infrastructures are complex
- Mix of worldwide (foreign) vendors
- Leverage testing experience with cutting-edge commercial technologies



4) Flexible, Multi-program Lab

- Confluence of a variety of infrastructures (Cyber, SCADA, Comms, Physical)
- Variety of capabilities (R&D, Integration, IV&V Test, QRC, Train, Analysis …)
- Range assets, simulation resources, engineering, and operations staff

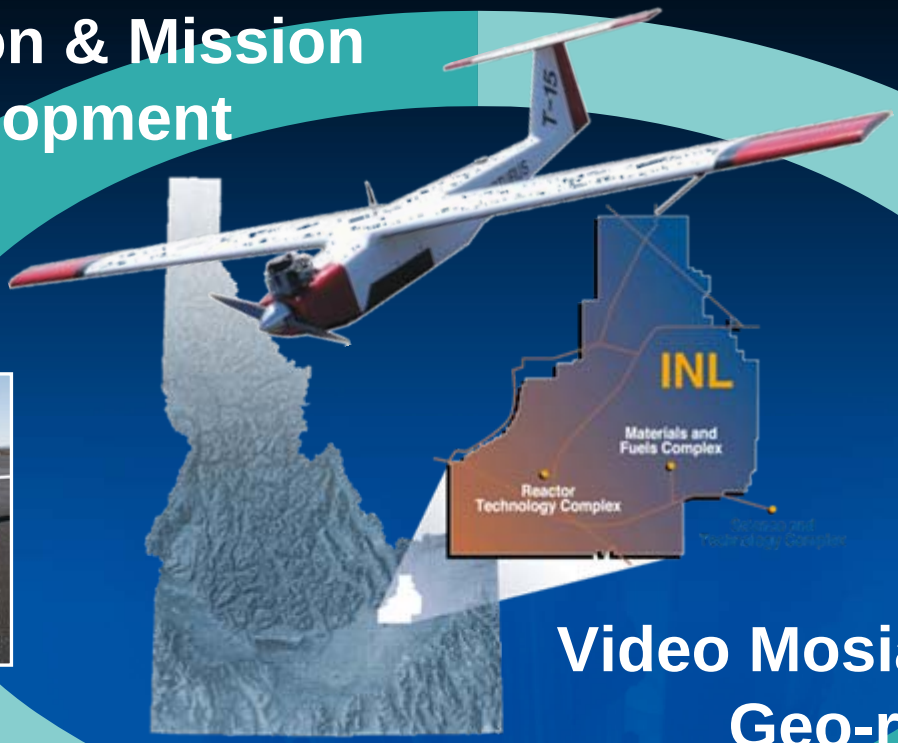
Robotics

- DOD Unmanned Systems Program Area
- Robotic Autonomous Countermine Development
- Robotic Intelligent NOde (RINO)
- Next-Generation User Interface Development
- UAV Autonomous Flight Operations
- Geospatial Data Collection/Exploitation
- Unmanned Air/Ground Vehicle Collaboration

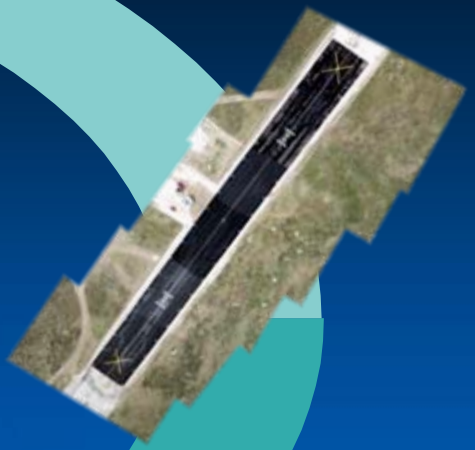
DOD Unmanned Systems Program Area

Application & Mission Development

Unmanned Systems R&D



INL Facilities Infrastructure

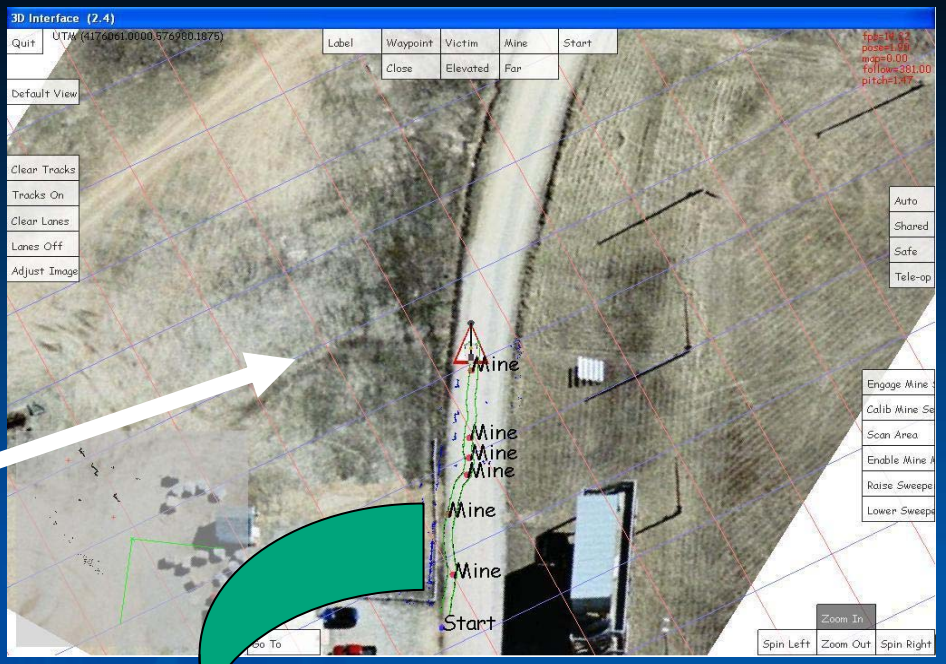


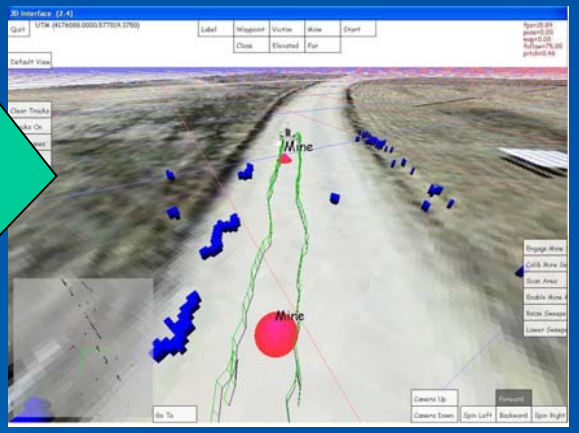
Video Mosiac, Stabilization, Geo-referencing

Robot Intelligence Kernel

Idaho National Laboratory

Robotic Autonomous Countermine Development





- 4 times faster than trained human
- 100% (134 / 134) Detected SLM
- Low Cost

Robotics: Robotic Intelligent NOde (RINO)

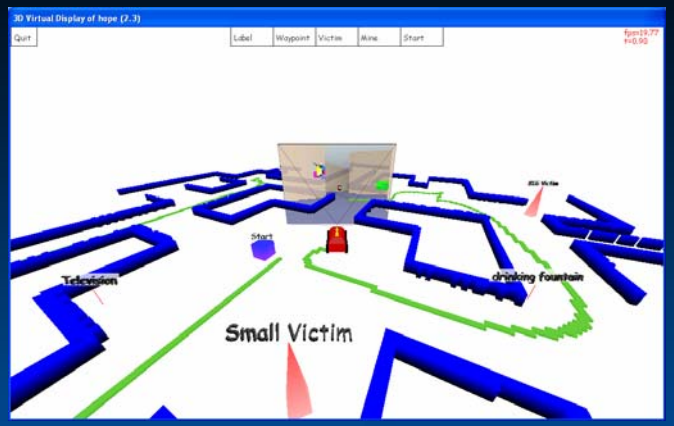
- **Capability for 5 mission variants with and *without* human**

Mode of Autonomy	Defines Task Goals	Supervises Vehicle Direction	Motivates Motion	Prevents Collisions
Teleop	*Human*	*Human*	*Human*	*Human*
Safe	*Human*	*Human*	*Human*	*Robot*
Shared	*Human*	*Human*	*Robot*	*Robot*
HLTasking	*Human*	*Robot*	*Robot*	*Robot*
Autonomous	*Robot*	*Robot*	*Robot*	*Robot*

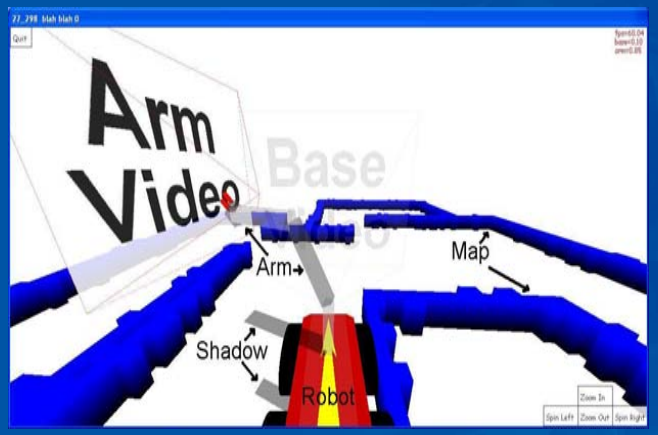
- **Development of an autonomous unmanned system for COTS 4-Wheel ATV for test and demonstration of sensors, behaviors, and payloads for ground based Unmanned Vehicles System Development.**

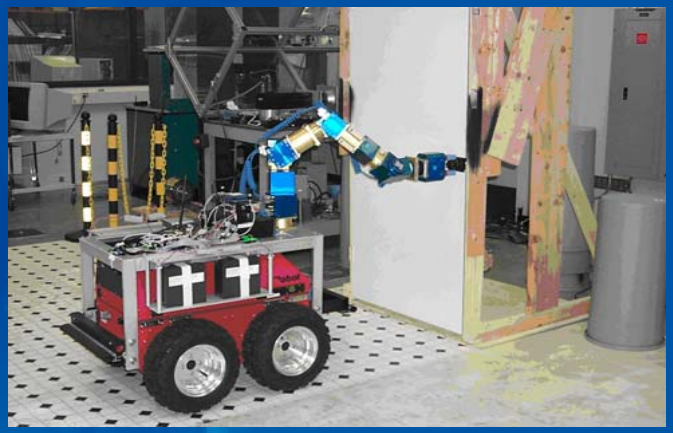
- **Affordability: commercial ATV Ground Vehicles**

Next-Generation User Interface Development

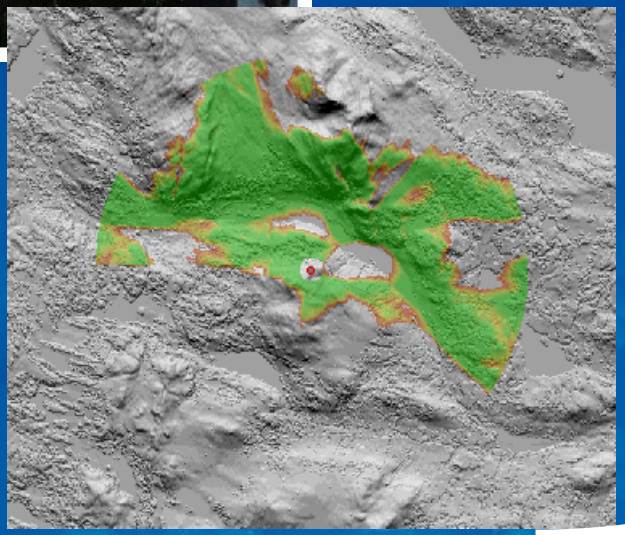


- **Detection and Recognition → Decision and Action**





UAV Autonomous Flight Operations
Geospatial Data Collection/Exploitation



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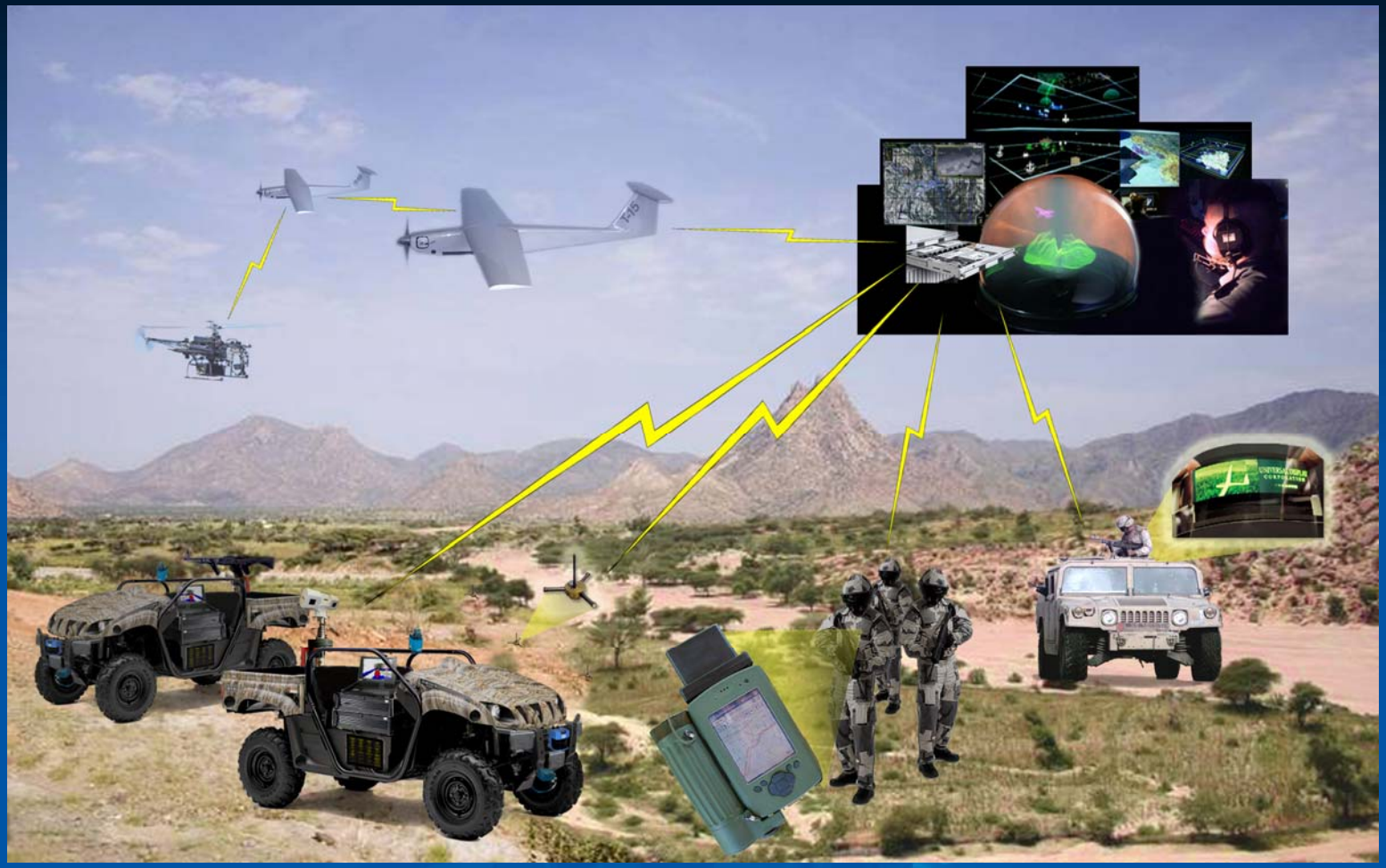
Unmanned Air/Ground Vehicle Collaboration



Idaho National Laboratory

Idaho National Laboratory INL

National and Homeland Security at INL

- The United States of America is faced with unprecedented challenges in National and Homeland Security
- The Idaho National Laboratories is well positioned to meet many of these challenges and enable sustainability for the long war

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john.garnier@inl.gov