Non-Lethal Directed Energy – Radio Frequency (RF) / High Power Microwave (HPM)

Non-Lethal Weapons Research and Technology Development Industry Day
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http://jnlpwp.defense.gov

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Background

• RF/HPM directed energy technologies provide for unique non-lethal (counter-materiel and counter-personnel) effects with extended range.

• Though their operational utility is desirable, the use of RF/HPM directed energy weapons remains limited due operational range, size, weight, and cost.

• The JNLWD is focused on developing advanced RF/HPM technologies to enable smaller, lighter and more capable non-lethal directed energy weapons.
Technical Objectives

- Determine the feasibility of new concepts and technologies that enable smaller, lighter and more capable non-lethal directed energy weapons and address multiple types of targets.

- Develop and demonstrate novel RF/HPM technology breadboards and prototypes to address various targets:
  - Personnel
  - Vehicles
  - Vessels
  - Aircraft
  - Threat electronics
  - Facilities

- Integrate improved RF/HPM technologies with existing systems and platforms.
Relevant Work

• Solid State High Power Microwave (HPM) Source
  – Performers:
    • Los Alamos National Laboratory
    • NSWC Dahlgren
  – Focus/Performance Goals:
    • Develop a 50 MW, dielectric based Non-Linear Transmission Line (NLTL) source for HPM applications
      – Multi-frequency waveforms from a single source vice multiple tubes
    • Perform lab and field testing of a Low Power NLTL breadboard source to verify feasibility
    • Investigate new waveform regime for RF Vehicle Stopping (shorter pulse & multiple frequency)
  – Project terminated due to material science immaturity
Relevant Work

• Short Pulse / Low Duty Cycle Assessment
  – Performers: NSWC Dahlgren
  – Focus/Performance Goals:
    • Identify effective vehicle/vessel stopping waveform parameters with low average power requirements, enabling a substantially smaller RF Vehicle Stopper system
      – Implement effects-based design
    • Complete laboratory and open air vehicle/vessel susceptibility testing
    • Compare results to current vehicle and vessel stopping data
    • Perform a system trade-off analysis to determine the benefits of a short pulse vehicle/vessel stopping system compared to the RFVS demonstrator design in terms of size, weight, and effectiveness
Relevant Work

• Compact, High Gain, HPM Antennas
  – Pennsylvania State University – Meta-materials
  – University of Missouri-Columbia – Advanced Dielectrics
  – Focus:
    • Assess the feasibility of applying dielectrics and meta-materials to enable the development of compact, high-gain antennas for preferred frequencies and output power levels employed by non-lethal high power microwave applications

• Advanced High Energy Density Capacitors
  – University of Missouri-Columbia
  – Focus:
    • Assess feasibility of new materials to develop smaller, high-voltage capacitors to reduce size of high power microwave subsystems
Relevant Work

- **Thermal Management Phase I Small Business Innovative Research (SBIR)**
  - Topic #: Navy102-110
    - Advanced Cooling Technologies, Inc. (M67854-11-C-6506)
    - Allcomp, Inc. (M67854-11-C-6507)
    - International Mezzo Technologies (M67854-11-C-6508)
    - Altex Technologies (M67854-11-C-6509)
    - Thermal Form & Function, Inc. (M67854-11-C-6510)
  - Focus:
    - Design next generation cooling/thermal management system to meet identified system performance specifications relevant to vehicle stopper systems and the 30 kW ADT systems.

- **Thermal Management Phase II SBIR (Pending Award)**
  - Focus:
    - Fabricate and test cooling/thermal management design.
    - Conduct system analysis and design tradeoffs.
Research & Development Tasks

Enabling Technologies:
- Compact, Steerable High Gain Antenna
- Short Pulse Regime Sources
- Long Pulse Regime Sources
- Prime Power Systems
- Thermal Management Systems

• Reduced size & weight
• Improved capability

Existing System Demonstrators/Prototypes:
- Multi-Frequency RF Vehicle Stopper
- RF Vessel Stopper
- Non-Lethal Unmanned Aerial Vehicle HPM Payload
- Pre-Emplaced Electric Vehicle Stopper

Potential Platforms:
- Light Tactical Vehicles
- Unmanned Vehicles/Vessels
- Unmanned Air Vehicles

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Research & Development Tasks

General types of tasks required for RF/HPM technology and development:

• Feasibility studies and technology assessments

• Target vulnerability tests utilizing effects-based design approach

• Build, test and demonstration of component technologies

• Comparison of novel approaches with existing technologies

• Integration of component technologies with existing breadboard and prototype systems

• Integration onto various platforms
Capabilities

General capabilities and expertise that may be required to execute planned RF/HPM technology tasks:

• Engineers/Scientists with expertise in

  • High power microwaves
  • Pulsed power
  • High power vacuum tubes
  • Other high power sources (NLTL’s, FEGs, etc.)
  • Antennas
  • Prime power
  • Power conditioning
  • Computational electromagnetics
  • Statistical electromagnetics
  • Physics
  • Electrical engineering
  • Materials science
  • Statistics (design of experiment, data Analysis, linear regression, etc.)
  • Systems integration
  • Systems engineering

• Facilities and equipment to develop, build, and test component technologies, subsystems, and systems

• Facilities to perform electromagnetic vulnerability tests, antenna characterizations, and high power source characterizations.
Questions?

Please submit questions by 29 June 2012:

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