**Scalable Compact Ultra-short Pulse Laser Systems (SCUPLS)**

Agency:

Department of Defense

Branch:

Navy

Program | Phase | Year:

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Solicitation:

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Open Date:

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Description:

TECHNOLOGY AREA(S): Weapons

OBJECTIVE: Develop a lightweight and energy efficient next-generation Ultra-Short Pulse Laser (USPL) system that can produce sustainable and controllable plasma at range capable of inducing a full spectrum of scalable non-lethal effects.

DESCRIPTION: Past efforts to develop USPL weapon systems that generate scalable laser induced plasma effects (LIPE) have shown some promise [Ref 2], but these efforts were not able to achieve the desired effects at the required range. The developed system was cumbersome and not feasible to be integrated on a small tactical vehicle. Previous Marine Corps SBIR efforts were able to achieve the following: 1. Extended duration flash-bang effects with maximum flash brightness of 2 million candela using 10 Hertz pulse repetition rate at 30 meter range 2. Sustainable maximum acoustic blast of 147 dB at 30 meter range 3. Produced a sufficient level of thermal discomfort on human skin at 30 meter range In addition to the above achievements, these efforts were able to prove that voice commands might be delivered at very long ranges but the final prototype was not able to deliver “intelligible” voice commands at 100 meters. The data generated by these past efforts are currently being verified and validated by the Government via an ongoing non-lethal laser induced plasma effects science & technology (S&T) effort being funded by the Joint Non-Lethal Weapons Directorate (JNLWD) and being performed by Space and Naval Warfare Systems Command (SPAWAR) Systems Center Pacific. The U.S. Marine Corps is seeking an innovative solution to develop a Scalable Compact Ultra-short Pulse Laser Systems (SCUPLS) weapon system that will comprise a suite of two (or more if needed) USPL weapon systems. It should at least include a femtosecond (fs) USPL that can initiate the Plasma (igniter laser), and a nanosecond USPL to flash heat the ignited plasma to create enhanced non-lethal effects such as flash bang effects, thermal ablation for pain, and delivery of intelligible voice commands at range. This SBIR topic will enable the advancement of possible full spectrum of effects capabilities from non-lethal to lethal, along with added Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) system capabilities. The SCUPLS weapon system should consist of the following system specifications: 1. Two USPL systems: (1) Igniter (Power: 1J per pulse; Pulse width: min 10fs; Pulse Repetition Frequency (PRF): 4000 – 5000 Hz). (2) Heater (Power: 20 – 40J per pulse; Pulse width: 10ns – 100ns; PRF: 10-30 Hz) 2. Flash-bang effect with acoustic blast of ~ 165+ dB at minimum distance of 100 meters 3. Flash blind effects (6-8 million candela) at minimum distance of 100 meters 4. Full scalable thermal ablative effects through common natural clothing (i.e., fabric, denim, leather, etc.) at minimum distance of 100 meters 5. State-of-the-Art C4ISR capabilities for incoming object detection, secure two-way communications and delivery of intelligible voice commands such as “get out” to warn individuals at minimum distance of 100 meters and up to 1000 meters 6. Size, weight, and power consumption, and thermal cooling designed in such a way that the final construct would integrate into a small tactical vehicle such as: Joint Light Tactical Vehicle (JLTV) or High Mobility Multipurpose Wheeled Vehicle (HMMWV) 7. Sufficiently environmentally hardened and rugged to meet military environmental design and test tailoring process in accordance with MIL-STD-810G [Ref 3]

PHASE I: Formulate a design concept and integration approaches for the desired SCUPLS weapon system as specified above. Explore possibilities to address key military suitability issues such as overall system size, weight, and power consumption, and thermal cooling. Determine the technical feasibility of the design concept and model key elements that can be developed into a functional product for the Marine Corps through analytical modeling and simulation to provide initial assessments of the concept performance. Provide a Phase II plan to develop the system to include performance goals and key technical milestones while addressing technical risks and challenges.

PHASE II: Based on results of Phase I, develop a SCUPLS prototype that can be employed from a small tactical vehicle as specified in the Description section above. Evaluate the prototype to determine its capability in meeting the specifications identified in the Description. Demonstrate and validate system performance through prototype evaluation and modeling or analytical methods to include suitability, safety, durability, and environmental performance for operational test and evaluation on a DoD range. Using results from performed testing and evaluation, refine the prototype into an initial design that will meet the Marine Corps requirements. Prepare a Phase III development plan to transition the technology to the Marine Corps use.

PHASE III: Support the Marine Corps in transitioning the technology for Joint Service and Marine Corps use. Develop additional SCUPLS prototypes that have been optimized for additional small tactical DoD platforms to include other small military vehicles, vessels, and unmanned systems. Evaluate and determine each design’s operational effectiveness and added capabilities achieved in an operationally relevant environment. Support the JNLWD/Marine Corps for test and validation to certify and qualify the system for Joint Service to include Marine Corps use. The technologies developed under this SBIR topic will meet the DoD JNLWP operational needs [Ref 1] and will also have direct application to many other U.S. Government agencies as well as civilian law enforcement. The Department of Homeland Security, Department of State, Department of Justice, the Secret Service, and Customs and Border Protection also desire this full spectrum of effects capability. The ability to non-lethally interdict a threatening person or persons has utility in many security and crowd control applications to include several municipal applications.

REFERENCES:

1: DoD Directive 3000.03E, DoD Executive Agent for Non-Lethal Weapons (NLW), and NLW Policy, 27 September 2017. http://jnlwp.defense.gov/Resources/Publications/

2:  Department of Defense Non-Lethal Weapons Program. "Non-Lethal Laser Induced Plasma Effects (NL LIPE)". Mr. David B. Law, Joint Non-lethal Weapons Directorate 2015. (uploaded to SITIS)

3:  MIL-STD-810G w/Change 1, Department of Defense Test Method Standard, Environmental Engineering Considerations and Laboratory Tests, 15 April 2014. http://everyspec.com/MIL-STD/MIL-STD-0800-0899/MIL-STD-810G\_CHG-1\_50560/

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