**Component: NAVY**

**Topic #:** N201-002

**Title:** Focused Directed Energy Antenna System (FoDEAS) for Long-Range Vehicle/Vessel Stopping with reduced overall system size, weight, power consumption, thermal cooling, and system cost (SWAP/C2)

**Technology Areas:** Weapons

**Acquisition Program:** Joint Non-Lethal Weapons Directorate

**ITAR:** The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

**OBJECTIVE:** Develop a Focused Directed Energy Antenna System (FoDEAS) using high power microwave (HPM) – (wideband) frequencies to electronically attack threat vehicle and vessel engines and embedded threat electronics. Provide long-range, non-lethal vehicle/vessel stopping capabilities with a wideband HPM antenna that incorporates frequency carve-outs that allows the use of this Non-Lethal Weapon (NLW) without interference to or with critical communication, navigation, and/or radar (frequencies) systems.

**DESCRIPTION:** Typical directed energy weapon (DEW) systems that employ high-power microwaves to electronically attack and disable/neutralize critical electronics on-board vehicle or vessel targets rely on a high peak power narrow band (single frequency) waveforms. These HPM DEW often employ a very large (~ 10-15 foot diameter) and heavy (> 150 pound) high gain (25 – 30 dBi) antenna system. These large/heavy narrow band antenna systems are designed to accommodate 10’s to 100’s of Megawatts of high peak power and they achieve their high antenna gain and resulting high beam directivity via their large antenna diameters [Ref 1]. These HPM DEW systems produce short duration waveform pulses of energy that disable control electronics embedded in threat vehicle/vessel engines.

A second class of HPM DEW systems are HPM systems that operate by employing waveforms that are composed of multiple frequencies in a (full) single waveform. These HPM weapons system are called wideband HPM weapons. These wideband HPM sources have several advantages over narrow band sources (e.g., klystrons or magnetrons source which tend to be bulky, heavy, expensive, and require significant maintenance costs). Wideband HPM sources generate their power/waveforms by employing various high-speed switching technologies that drive smaller, lower power vacuum-tube devices or semiconductor switches [Ref 2] but they also typically project this power using omni-directional antenna systems [Ref 3]. These omni-directional wideband antenna systems are often more effective at neutralizing the electronics on-board vehicle and vessel engines (as there are more frequencies available to interact with critical electronic components) but as they are omni-directional (non-focused – non-directional), they do so typically at shorter ranges [Ref 4]. Typically, the most effective wideband HPM counter-electronic frequencies fall in the 100 MHz to 900 MHz and 1 – 3 GHz (VHF/UHF) wavebands.

So shorter effective ranges based on typical omni-directional antenna systems is the first key disadvantage to employing wideband HPM DEW systems. Wideband HPM sources pose a second problem in that given their most effective counter-electronic capabilities fall in the 100 MHz to 900 MHz and 1 – 3 GHz frequency ranges, these exact frequency ranges are where several key military and commercial communications, navigation, and radar system operate at specific single frequencies. Thus, these wideband HPM systems could interfere with these systems and impede the operation and performance of these other systems. An example of this would be frequency bands used by global positioning systems (GPS). Deployment of vehicle stoppers using compact wideband technology can be greatly accelerated by the development of such systems with frequency ‘carve-outs’ of the order of 20 MHz centered around critical frequencies such as those used for GPS. This will enable the directed and targeted use of this technology on hostile vehicles without interference with other critical systems either in an urban environment or in a battlefield.

**PHASE I:** Analyze, select, and define a compact/lightweight wideband high power microwave source technology that operates in the...
100 – 900 MHz or 1-3 GHz frequency ranges. Develop a corresponding compact/lightweight HPM antenna technology development plan and complete an HPM antenna technical design that handles the HPM source power requirements and also incorporates frequency ‘carve-outs’ to allow for non-interference operation with specific DoD and commercial communication, navigation, and/or radar (frequencies) systems as defined in references [4] and [5]. The prototype design in Phase II shall be complaint with the following basic system prototype MIL Standards: MIL-STD-810 (Environmental Engineering Considerations); MIL-STD-461 (Electromagnetic Interference (EMI)); and MIL-STD-881 (Prototype Specifications). Ensure that the overall size and weight of the proposed system (HPM source and antenna system) is less than 350 pounds, has an antenna diameter less than 1.5 meters, and provides a peak field intensity that can stop vehicle and vessel engines at ranges of 250 meters or more. Develop a Phase II plan.

PHASE II: Develop a scaled wideband HPM/Antenna System prototype for test and evaluation to determine its capability in meeting the performance goals defined in the Phase II development plan and the JNLWD/Marine Corps requirements for a long-range Vehicle/Vessel Stopper system. Demonstrate the system prototype performance through prototype evaluation against a Government-owned vehicle and vessel engine target set (located at Naval Surface Warfare Center Dahlgren Division) and by modeling/analytical methods over the required range of parameters including numerous deployment cycles. Based on evaluation results, refine the prototype into an initial design that will meet Joint Service requirements. Prepare a Phase III development plan to transition the technology to the JNLWD and support a transition to a Joint Program Office within the DoD.

PHASE III DUAL-USE APPLICATIONS: Support the JNLWD/Marine Corps in transitioning the technology for Joint (to include Marine Corps) use. Develop this long range compact HPM vehicle/vessel stopper prototype for evaluation to determine its effectiveness in an operationally relevant environment. Support the JNLWD/Marine Corps for test and validation to certify and qualify the system for Joint DoD use.

A compact, long-range vehicle/vessel stopping capability has significant commercial applications beyond the DoD. Other government agencies, such as the Department of Justice (DoJ) and the Department of Homeland Security (DHS), have vehicle and vessel stopping missions. Local civilian law enforcement, specifically has these type of missions to support both port security and vehicle interdiction (car chases). Currently overall system size, weight, and cost have hindered the use of these systems by these agencies. This SBIR topic specifically addresses overall system size, weight, power consumption, thermal cooling, and system cost.

REFERENCES:


KEYWORDS: Directed Energy; High Power Microwaves; HPM; Ultra-wideband; Wideband HPM; Vehicle Stopper; Vessel Stopper; Non-Lethal Weapons; NLW