WHITE PAPER ON:

SILENT ELECTROMAGNETIC RIFLE

Submitted To: Dr. Matt Willis and Mr. Joshua Israel

Office of the Deputy Assistant Secretary of the Army, Research and Technology

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In Response To: Army Expeditionary Technology Search (xTechSearch)

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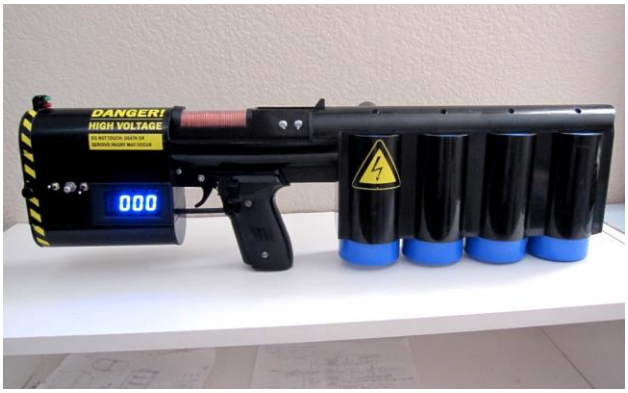
SILENT OPERATING ELECTROMAGNETIC RIFLE

A. Proposed Army Modernization Priority that Aligns to this Submission:

Arcflash Labs, LLC proposes an innovative design for a silent electromagnetic rifle, which can increase Soldier Lethality during close-range engagements where maintaining silence provides the weapon operator with a tactical advantage. Conventional firearms, while simple to operate and high in muzzle energy, also emit muzzle flash and an unmistakable report. A conventional firearm such as the M4 rifle produces up to 134 dB of noise, even when fitted with an advanced suppressor. For comparison, a police siren produces 115 dB and a jackhammer produces 130 dB. That is more than enough noise to betray an operator's position during close-quarters combat and/or stealth operations, when the ability to strike in silence is often vital to survival and lethality. The proposed rifle is a battery powered linear accelerator, which uses electromagnetic force to accelerate a projectile to lethal energies without making any sound whatsoever.

B. Proposed Concept and Current Technological Maturity:

The proposed rifle is designated EMR-01, and is approximately the size and weight of an M240 machine gun. It is a multi-staged, switched reluctance-type coilgun which generates an accelerating force on a projectile through electromagnetic interactions between the projectile and a series of drive coils. The EMR-01 does not make use of any explosive charge or compressed gas, so no sound is generated by the acceleration. The key innovation behind the EMR-01 is that it combines recent technological advancements to produce lethal muzzle energies that have never before been obtained from a handheld electromagnetic accelerator. These recent advancements include high power density batteries, miniaturization of capacitors, advanced semiconductor switches, and Arcflash Lab's proprietary power supply technology.



An electromagnetic coilgun accelerates a projectile to lethal velocities without producing any sound.

The EMR-01 is powered by a small, low-cost lithium polymer battery pack commonly used to power RC airplanes. A proprietary ultra-compact, ultra-high output power supply module boosts the battery voltage and charges a bank of high-voltage capacitors which store up to three kilojoules of electrical energy. When the trigger is pulled, a series of five tuned electromagnetic drive coils are switched in careful sequence by a bank of high-current thyristors, dumping the electrical energy into the drive coils and creating a "wave" of electromagnetic thrust that accelerates the projectile through the barrel towards the target. The muzzle energy of the EMR-01 is expected to be in excess of 100 joules with a 260 grain caseless projectile. The EMR-01 is expected to fire 60 round per minute, and a single battery charge is expected to power 50 shots.

The EMR-01 is based on technology and design practices that Arcflash Labs developed over the course of 10 years. Arcflash Labs has a proven track record of successful technology demonstrations, producing five handheld accelerators over the past 10 years, many of which set records in the field of electromagnetic weapons. The first working Arcflash prototype was the CG-33 coilgun, which achieved its first live-fire demonstration in 2010. The CG-33 validated the effectiveness of a portable high voltage capacitor bank with thyristor switching and demonstrated record-setting muzzle energy of 25 joules with a single drive coil.

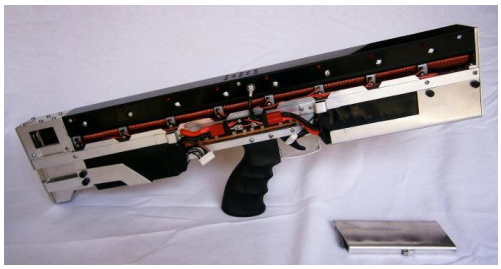
The second prototype, the CG-42, employed lithium polymer battery packs for increased power output, and became the world's first fully-automatic handheld electromagnetic gun when it was successfully tested in 2013. The CG-42 also employed a series of eight drive coils, demonstrating precision timing required for multi-staged projectile acceleration. The CG-42 also attained a 3x efficiency improvement over the CG-33, achieving 3x more shots per battery charge.

Seeking higher muzzle energies, Arcflash Labs also designed the world's first handheld railgun in 2015, which led to major advancements in power supply technology and capacitor bank design. These advancements were demonstrated by a second handheld railgun that was completed in 2017, which achieved a 400% improvement in power output and energy storage capacity.

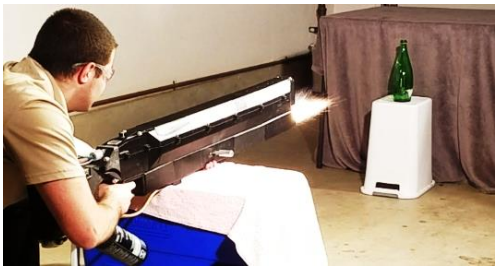
Arcflash Labs is currently producing its fifth electromagnetic gun, the EMG-01 coilgun. The EMG-01 is Arcflash Lab's first commercial product, and contains digital coil control electronics with nanosecond precise timing, which paves the way for implementation of the control systems necessary to construct the EMR-01.

Arcflash Labs proposes an R&D project, in which the EMR-01 is advanced from conceptual design to a working prototype. Key activities will include high-fidelity modeling and simulation of the EMR-01, optimizing the design for

2010: The Arcflash CG-33 set a muzzle energy record for a handheld coilgun.


2013: Arcflash CG-42 became the world's first fully automatic handheld coilgun.


2015: Arcflash Labs built the world's first handheld railgun.


2017: The second railgun demonstrated Arcflash Lab's advanced power supply.

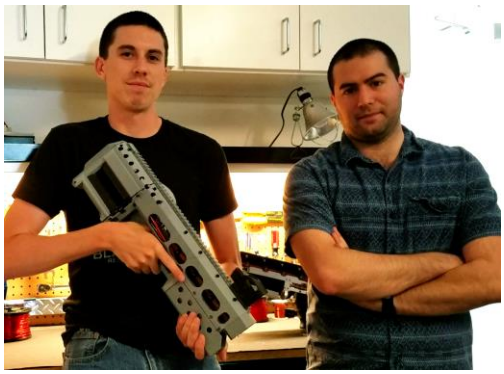

2018: ArcFlash EMG-01 demonstrates digital, high-precision coil control electronics.

maximum performance, building a testbed to demonstrate key components and system integration, construction of a fully functional prototype, and prototype testing to demonstrate performance and reliability. Deliverables of the project will include the working prototype, a design data package, and a PDR presentation.

C. About Arcflash Labs, LLC

Arcflash Labs, LLC is a veteran owned small business specializing in the development of ultra-high energy pulsed power systems. It is the world's first and only corporation producing handheld electromagnetic accelerators. Arcflash Labs was founded with the goal of advancing pulsed power technologies and disrupting the 500-year-old firearms industry with 21st century alternatives.

Arcflash Labs was founded by Mr. David Wirth and Mr. Jason Murray, both of whom are Aerospace Engineers and former Air Force Officers. They possess a total of 20 years combined experience in electromagnetics research and pulsed power supply design, and 12 years of experience working on DoD contracts. Both have a longstanding record of success in developing high-profile electromagnetic weapon demonstrators. Mr. Wirth holds a DoD Secret clearance, and Mr. Murray holds a DoD Top Secret Clearance. Arcflash Labs is headquartered in San Diego, with an office in Los Angeles, California. If Arcflash Labs is chosen to participate in the Phase II Technology Pitch, the preferred location is Playa Vista, California.



Arcflash Labs Cofounders, Jason Murray (left) and David Wirth (right).