Directed Energy – Different Challenges

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DEPS ANNUAL SYMPOSIUM
LIHUI, HAWAII, 14-18 November 2005

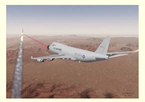
Scientists Develop Hardware.

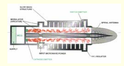
Operators Need Tactics.

Testers Need Tools.

DE Weapon Portfolio


Tesla 1895


ABL 2005...


MILO


Handheld EMP


ATL 2005...


RADAN

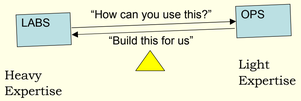

LAIRCM 2004


ZEUS 2005

Three Categories:
- High *Power* Microwave – damage primarily "inside out", electrical.
- High *Energy* Laser – damage primarily "outside it", structural. Or sensors.
- *Non-Lethal* DE (nominally much less power) – effect-based, functional or biological attack.

DEWs come from Research Lab Sponsorship – Technology Base Push

- DE weapons require heavy research investment and are championed by AFRL scientists developing new hardware.
- Technology demonstrations have spanned 32 years.
- MITRE report June 2004 – DOD study finds educating military users is required to mitigate false starts in the early 1990s: Tactics, Techniques, Procedures are required!
- AFFTC Roadmap June 2004 – based on AFMC DE Consortium experience, preparation of DE experts is the #1 shortfall.



For 30 years, physics-based arguments haven't delivered DE Weapons.

- Speed of light
- Precision engagement
- No collateral damage
- No re-constitution costs
- Deep magazine

Speed of light lasers are not "shoot and forget weapons". They require dwell-time, cannot engage more than one target at a time, and require more stringent tracking capability. Target tracking is more stringent because we need *continual registration* on target instead of point tracking. All the target has to do is break image registration. Unlike normal weapons, after energy arrives on target, the target has time to sense the inbound energy, and take action before a kill is accomplished.

Precision Engagement casually implies touching the target with a small fingerprint, but the real issue is how big of a fragmentation umbrella is created when the weapon acts, and this becomes a collatoral damage issue. Lasers must contend with scattered light to human and sensor fratricide. For HPMs, precision engagement doesn't apply to "exposure in beam". Differentiate precision effect vs. precision crater.

Collatoral Damage usually recognizes only physical damage. With HPM weapons designed to have effects less than destruction, the definition must include having an effect that was not intended. Legal consequences of RF illumination? Accidental laser blinding? Knocking out medical or first responder functionality? Legal and financial fallout of using DEWs will be real, even if it's a different type of collatoral damage. Knowing how long it takes for latent HMP damage to manifest requires considerable knowledge/modeling of the system being attacked, the weapon being used, and the employment scenario.

Re-constitution cost traditionally includes metrics on only the physical environment. With non-lethal DEWs, the legal environment will have a much longer coat-tail.

Deep Magazine traditionally includes metrics on only the "expendable round". Although DEWs may have inexpensive marginal cost, the first shot against a target requires orders of magnitude more capital investment. Higher up front costs have implications in acquisition and CONOPS.

Absence of CONOPS

Civilian Peace	Terrorism	MOOTW	Nation State Conflict	Nuclear War
LAPD	SOC,FBI, CIA, DHS	SOC, CIA	ACC, AMC SOC, NSA, *xx*COM	STRATCOM

CONOPS not needed in this region for some weapon systems

Who are the operational sponsors in this region?

DE extends *much* farther




How *is as important as* ***hardware***.

Operator perspective is a better funding story.

- Covert Operations
  - -No triangulation on the shooter
  - -Plausible deniability
- First bullet is 80% of the value
- Rheostatic power (≠ controllable weapon effects)
- Intelligence Burden - target effects as f(time)
- Target granularity 1000x, + material, red configuration, installation environment, reconstitution capability.
- Intrinsic reciprocity
- Defend large geographic areas

Reciprocity. A good transmitter is a good receiver. DEW technology can support quick turn ISR to shooter application. If an optic system can put down a 4" spot from 100 km, we should ponder surveying from 100km with a 4" spot. Ability to see the enemy, and shoot with the same platform/optical train.

DE weapons are variable power, almost always. "Disrupt, Degrade, Deny, Disable, Destroy." But make a clear distinction from controllable weapon effects. This gap points toward a LARGE funding line that will have to be answered with scalable testing (big open air ranges), and M&S, and target effects.

BDA was easier with kinetic weapons. When we applied weapons, "not broke" became "broke" and stayed that way. Now we consider reset times, logistic supply times for replacement parts, operational irrelevance, red team skill level to mitigate the effect.

Target knowledge has to increase by an order of 10, cubed. Beyond weather and moon patterns, DE needs a-priori intelligence collection on configuration, material, local environment, reconstitution, etc.

Dwell time issues require real-time analysis of BDA. Part of the ability to determine weapons effect needs to be built into the weapon itself rather than collected with other assets during the next 24 hours of the ATO cycle.

Aiming and pointing have no time or space burdens (weapon transit time, and slew inertia).
DE weapons are energy application processes, versus kinetic weapons are events.

Attack on Air Doctrine

United States doctrine presumes asymmetric technology advantages, and air superiority. These tenets of air power are uniquely threatened by DEWs.

- Comm/Computers/Networks – We have a lot more to lose, so they'll choose HPMs
- Stealth Technology – RF stealth negated with relatively simple laser scanning
- Air Superiority – Over their territory, they use ground based HEL/HPM while we're forced to fly ours in theatre (power, packaging, durability)

Red on Blue threat forces us to be capable in the DEW arena.

Mandatory Instrumentation Wedge

When testing **Kinetic Weapon** effects, application of the mass or explosive energy and effect of that contact are simultaneous events. The T&E community is familiar testing with this paradigm.

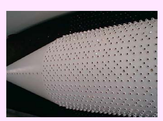
Testing **Directed Energy** Weapons effects requires additional information because application of energy must be decoupled from effect of that energy. We must measure energy as it leaves the weapon, as it arrives at the target (before interacting with the target), and finally, the effect it has on the target. *"3 measurements instead of 2".*

The second measurement is where we have a huge gap between program test requirements and test capabilities.

Targets have to match

- DEW testing requires technically advanced targets, matched to specific weapons.
- Precision Impact Range Area (PIRA) at AFFTC is used for weapon drops of multiple types into an instrumented "sand box". *Not* possible for DE.
- Targets must fool the sensor suite and computer logic of the System Under Test. Since they're matched to individual weapon programs, each program must purchase it's own targets.
- Tight coupling of the test target and the test weapon is similar to Electronic Warfare. Placement of DE technology under the EW test directorate is proper.





Smart targets example: ABL's Proteus Target Board.

Target Sustainment

"Think PMEL instead of range asset"

- Urban scenario setup / teardown
- Calibration – When? How? Who?
- Varied form factors - briefcase, scaffold, wearable, buildings, aircraft.
- Conditioned storage
- Data management
- Analysis techniques
- Deployment labor costs
- Sensor replacement – predictive mx? scheduled mx? upon failure?
- Temperature / flight cycles
- Axial alignment & Bore-sight accuracy

DE National Program Management needs concerted organization.

- Information Operations contains the Electronic Warfare Mission Area. Electronic Warfare contains Directed Energy. Is Directed Energy Information Operations?
- Traditional funding lines avoid DE, e.g. "we do targets, not instrumentation"
- JCS directives, without institutionalized understanding and sponsorship at the lower levels, yield "Hail Mary" funding.
- Gravity wins over mechanical bullets. Regulatory guidance wins over DE.
- DE ranges will sell services rather than location. "Going to the DE range" will mean hiring the experts, not renting facilities, because testing demands diverse range sites and deployable teams.

Summary

- Users have a new tool set that operates across all facets of conflict. Multi-agency CONOPS will influence what's fielded, and when.
- Directed Energy needs sponsors in a zero sum game.
- Promotional arguments haven't worked for 30 yrs. Lesson learned: Talk ops, not physics.
- Balance of expertise is tilted too much toward scientists, with a void of operation planners.
- We need to clarify roles and responsibilities of the Directed Energy community.
- Targets – case study of costs and required mindset change