“DIRECTED ENERGY IS A GAME-CHANGING TECHNOLOGY”

Insights from Colonel E. Thompson from the Air Combat Command USAF

INTRODUCTION

Directed energy systems have the potential to provide resilience, lethality, and overall air dominance in future air combat scenarios. While there has been much discussion regarding the US Air Force (USAF) implementing directed energy technologies on aircraft by 2020, what is the reality of it? What are the current USAF priorities for directed energy systems?
Ahead of Directed Energy Systems 2018, we had the opportunity to gain exclusive insight from **Colonel Michael E. Thompson, Chief, Advanced Weapons Systems (A5/8ZW), HQ Air Combat Command USAF** regarding current operational use cases for directed energy, and challenges the service is currently facing in the development and integration of directed energy systems into their mission capabilities and platforms.

The comments provided by Colonel E. Thompson in this article do not reflect official ACC policy.

DFIQ: What current priorities does the USAF have for directed energy systems? Why are they becoming a key focus of the USAF?

Col. T: While Air Combat Command (ACC) has no currently defined requirements for directed energy systems, we are very interested in the potential opportunities it could afford; if the technology matures to where the Air Force determines a requirement can be materialised with directed and counter-directed energy technology, this will drive our efforts at Air Combat Command to prioritise investments accordingly. We continue to monitor developments from industry, defense laboratories, and sister services, and we will remain poised to provide expertise during any ongoing efforts to develop directed energy plans and outline different potential use cases.

The USAF's Strategic Master Plan focuses on five main priorities:
- Develop capabilities to ensure freedom of action for the joint force
- Leverage and integrate new approaches, technologies and capabilities
- Deliver more effects at range
- Increase resiliency when presence within the battlespace is required
- Retain the ability to operate across the full spectrum of operations.

So why is directed energy important to the ACC? It is a game-changing technology that will bring more resilience to forces in highly contested environments. Directed energy weapons have the ability to improve our:

Lethality by both defeating the enemy's ability to Find, Fix, Track, Target, Engage, Assess, and to use offensively against adversary threats

Persistence with rechargeable weapons that allow greater station time and magazine depth

Asymmetric weapons with **low to no collateral damage**

Defensive capability by keeping threats outside the damage zone

What cases is the USAF currently using des for? What lessons can be drawn from these?

ACC supports efforts to operationalise directed energy weapons across the enterprise in order to complement kinetic weapons and deliver key battlefield effects against adversary forces and technologies.

Currently, there are three operational use cases for directed energy systems in the USAF:

Forward Airbase Defence

Forward bases and operating locations for the USAF can no longer be considered sanctuaries. From an Air Force doctrinal perspective, the protection of these locations from attack through the air is included under the defensive counter air. The current key threats faced by forward bases are UAVs, rockets, artillery, mortars, and cruise and ballistic missiles.

While High Energy Lasers (HELs) & High Power Microwaves (HPMs) could provide a potential counter to the air threats mentioned above, there are still technological hurdles that must be overcome. For example, the lack of an infinite power source means that current HELs don't actually have "infinite magazine depth." As such, countering a 40-UAS swarm with a 15-shot system would not provide an end-to-end solution. Moreover, HPMs could be used to provide a broad, sectored countermeasure against UAV swarms, but deconfliction from friendly assets would require more detailed coordination, command and control, and battle management.

Precision strike

ACC is monitoring the efforts of other services/agencies regarding this particular operational use case, particularly as it relates to the maturing of technologies that would enable the integration of HELs/HPMs onto airborne platforms. Of primary concern here are the challenges of achieving the necessary SWaP-C – size, weight, power and cooling. While we remain keenly interested in leveraging DES capabilities for defensive applications on an aircraft, the challenges of beam control and cueing for HELs in an airborne environment have led us to look at offensive systems as a way to learn more about and mitigate those challenges.

“Forward bases and operating locations for the USAF can no longer be considered sanctuaries”

Aircraft self protect

The environments within which we operate are becoming increasingly contested and our ability to protect our platforms and airmen operating there is vitally important. ACC continues to support efforts to advance directed energy solutions with the potential to provide rechargeable, deep-magazine protection capabilities against advanced threats.

We are currently undertaking the SHiELD (Self Protect High Energy Laser Demonstrator) Advanced Technology Demonstration programme with Boeing as the lead integrator.

The project aims at studying the aerodynamics effects on lasers and:

- Demonstrate a rechargeable HEL in a representative fighter environment to defeat relevant missile threats
- Reduce or retire the risk and resolving technical challenges of power-scaling, beam quality, thermal management and packaging
- Feed parallel efforts to improve laser weapons capabilities for future fighter/bomber, along with the protection of high-value airborne assets
- Provide off-ramp capabilities as the technology for laser weapons systems matures

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There have been a lot of talks of the ACC looking to implement a laser on a F-35 recently. What is currently happening and could this be a reality in the near future?

There is a misconception that ACC is specifically looking to integrate lasers on the F-35. The truth is that a pod-based HEL (like in the SHiELD ATD) provides opportunity to put that system on a number of different platforms. If the system where not in a pod, the laser weapon system would need to be designed specifically (and perhaps uniquely) for each platform because the SWaP-C requirements could be different for each. What we do want to achieve through the demonstration of this technology is to answer the question: Can we use laser effects to protect airborne platforms and properly control the beam in an aerodynamic environment? The lessons we will learn from there could then be applied to other platforms.

What use cases of des from other American services or foreign nations is the ACC currently watching with interest?

We are monitoring and coordinating with Air Mobility Command (AMC) on their laser weapon system effort. AMC is very interested in putting a defensive HEL system on high-value airborne assets; they are leveraging efforts made by the Navy and their test to field the 60kW HELIOS (High Energy Laser and Integrated Optical-dazzler with Surveillance) system on a ship.

Moreover, the Army, Air Force and Navy are all interested in achieving a 150kW-class laser, but those efforts are less coordinated than they could be. This is a concern because it could lead to each service ultimately fielding very similar systems, with each spending their own money and not gaining the benefit of close coordination and collaboration. The real difference for each system is how it will be integrated on air, land and sea platforms. In addition, the majority of efforts to date have focused primarily on the development of the laser itself and not the more difficult task of integrating them on the various platforms to make them a weapons system. Establishing an executive agent for each operational use case, with DoD-level oversight to share lessons learned from all services, would be a useful step forward to develop an executable road-map for integrating these HEL systems efficiently on different platforms.

What main challenges is the US currently encountering in the development and integration of directed energy systems into their capabilities?

Aside from the obvious technical challenges, understanding who has responsibility for base defense; doctrine states it is primarily an Army role, though the Air Force has a responsibility. Increasing joint efforts between the two services will help ensure solutions will be interoperable and effective. Technically, power and thermal management, as well as getting to a SWaP-C that enables integration of systems on airborne platforms, remain a primary challenge. Moreover, we need to better understand how DES will complement kinetic weapons systems because thy can afford the ability for forces to achieve intended effects with little/no collateral damage. Lastly, safety is another one of our concerns during exercises: how far do lasers go? If the laser misses its target, where does it go and do we need to block all air traffic to avoid any collateral damage? How do we assess the threat during training exercises? ■

HEAR MORE FROM COLONEL E. THOMPSON ON TRANSITIONING DIRECTED ENERGY WEAPONS TO PLATFORM-BASED APPLICATIONS

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