Modular High Energy Laser Weapon System

TSgt William H. Brigham IV

Joint Special Operations University Enlisted Academy

**Abstract**

The MHELWS, while conceptual in this writing, is based on systems already in use by the DoD. It adopts a high energy laser weapon that was previously applied as the HEL-1 developed by General Atomics as an air threat elimination tool. The application of a directed energy weapon to an air asset represents a significant jump in combat capability across all platforms. Technology has advanced to the point that an employable laser weapon is a realistic option in the U.S. Military arsenal, and to overmatch any potential adversary and maintain airspace and battlespace superiority, we must strive to adopt new systems thought not possible in a near-peer or peer-peer fight. MHELWS represents the cutting edge of technology applied as an air-to-ground or air-to-air weapon. The very thought of a laser weapon challenges long-standing ideas of what a weapon can and cannot be. Use this document to apply a holistic process in taking the MHELWS from idea to reality.

**Modular High Energy Laser Weapon System**

The modular high laser weapons system (MHELWS) challenges the very infrastructure of many military components because of the weapon design. Historically, there has been some sort of ammunition associated with weaponry, and until very recently, technology prevented a laser weapon system powerful enough to match kinetic weapon solutions. The very nature of a combat-capable modular laser is to avoid collateral damage associated with explosive weapons and re-engineer airstrikes.

**History**

For the last 50 years, the military has been developing and utilizing lasers to project air power across the globe. Development of systems like the LANTIRN and Sniper advanced targeting pod allowed air assets to employ laser-guided munitions by way of laser range designator. Modern-day systems like the AN/DAS-4 built by Raytheon (J. Keller, 2018) offer a wide variety of sensor packages along with the ability to use a laser target marker and laser range designator. These capabilities allow for intelligence, surveillance, and reconnaissance but do not have a stand-alone strike capability. These systems pair with kinetic munitions to ensure lethality in a combat environment. In future fights, the desire to pair a weapons system with assets that have smaller payloads allows flexibility in airpower projection cross-platform using directed energy systems.

**Munitions**

The modular high energy laser weapons system is *ammunition-free* because it has a zero-expenditure rate of physical ammunition. According to the 2020 department of defense budget request, 21.6 Billion dollars was allocated toward the investment of munitions and missiles (DoD, 2019). The application of a high energy laser weapon would allow the DoD to invest in other areas once the system reached an initial operation capability (IOC). Additionally, a highly modular system allows for interoperability within all components to allow multiple funding sources and ensures that there is no combat capability gap as the new weapon system comes online and the DoD sunsets legacy systems.

**Airpower Projection Flexibility**

As the MHELWS becomes the new norm for combat airpower projection, it enables multiple platforms that are not considered offensive to adopt strike capability. Weapons systems previously not armed with offensive capability such as the CV-22, HH-60G, and C-17 would be able to employ the MHELWS on a case by case basis. These assets would be able to efficiently run the weapon system because of the high-output electrical systems they already possess. Additionally, mission design series (MDS) such as the F-15E, MQ-9, and AC-130J would gain a strategic advantage in previously unusable areas by way of non-ordinance lethal engagement with the high energy laser weapon system. Moreover, when paired with a phased array radar such as the APG-63(V)3 (Raytheon.com), the MHELWS can be used as a weapon to establish air superiority in contested environments. The system is also modular in that it can be rail mounted/pylon mounted, self-contained, or a combination of both to facilitate ease of maintenance and interoperability. The flexibility and low cost of the system far out weights the cost of IOC and R&D.

**Operational Systems Testing**

Testing for the new system could occur in the current AO's already using kinetic systems. Due to the sensitive nature of new system capabilities, the TTP's developed would then be applied based upon MDS limitations. The High Energy Laser (HEL-1) developed by General Atomics already exhibited similar characteristics as a defense system and was scheduled for application on the pred-C Avenger in 2018 (J. Mchale, 2018). Developing a lethal system with more inductors and high output would allow a weaponized version to be used cross-platform. Power generation on smaller assets can be supplemented with the addition of a *power bank* that would ensure weapon lethality by storing energy and boosting laser output during engagements. The power bank could be rail or internally mounted, depending on the platform. Moreover, the system could also be used as a supplement or in place of current targeting systems. Testing could be linear and adopt a phased approach to facilitate change management. The change process to a non-kinetic weapon represents a paradigm shift in the way operators currently execute their mission.

**Change Process**

To properly facilitate the change process, the 17-step process is applied to evaluate precisely what this would look like for the MHELWS

Step 1- Warning Order: The WARNO on the new weapons system would present itself much like an MDS capability brief to commanders and SEL's. GCC's and COCOMS would be the first to receive capability briefs on the system to prepare a full-scale application.

Step 2- Communicate the details: once R&D complete, a 6-month timeline for application for the weapons system would be the nominal outcome. An 18-month timeline for full application and fielding is realistic with the 6-month course of action being the most ambitious timeline, reserved for special operations forces. Urgency is critical, timely execution equals a more capable combat force.

Step 3- Address Initial Concerns: the most prevalent concern with a system like the MHELWS is the initial power requirements for the asset. Smaller MDS’s would have problems running the weapons systems without significant electrical system modification. The secondary concern would be the significant change in tactics the weapon requires. The expected area of resistance would be to stick with “tried and true” methods of kinetic weapon employment.

Step 4- Identify change project lead/change manager: the change managers for the MHELWS would be an O-6 at joint staff and GS-14 for continuity to see the project through. Additionally, there would be an E-9 assigned as A3M or MAJCOM equivalent.

Step 5- Identify Change Agents: assigning individual service representatives for the project would ensure joint venture success. The change agents would be at the 0-4 and E-7 levels in each unit to validate and champion the vision or *sell the sauce* to facilitate effective change. Interoperability at the tactical and operational level would be the real measure of success.

Step 6- Create Early Adopters: establishing approximately 5 initial cadre at each unit in the ranks of both O-3 and E-6 would create early adopters and solidify the credibility of the system. Some sort of initial cadre course either sponsored through a test unit or advanced instructor course would also facilitate initial tactics and keys to success.

Step 7- Communicate the Vision and Short-Term Success: Operational use with a fully functioning weapons system would produce the metrics required to measure initial success levels. Due to the broad range of applications available, a joint functional manager would need to be established somewhere in the J3 realm to compile all the first variations of use. Allowing creativity and testing at the operational levels would allow for innovation and practical application by operators to think *outside the box* when utilizing the new weapon.

Step 8- Unfreeze/Break: Once IOCs are met and the system is validated, initial sunset of kinetic weapons systems may begin. Removing *legacy* kinetic hardware is expected to create minor setbacks in the form of operator learning curve as the paradigm shift to directed energy weapons begins.

Step 9- Anticipate Setbacks: The desire of operators to maintain kinetic weapons capability will arise and, the full replacement of gravity weapons may not occur on certain weapons systems due to capability gaps that directed energy weapons are unable to fulfill. IOC relies on the end-user to accept such losses, and it is expected that during fielding of the new system, there will be some instances where the system is deemed ineffective by users, and the desire to switch back to kinetic systems may occur in some units. Maintaining success stories and truth data will ensure the full transition to the new system in those instances.

Step 10- Provide Fixes: Utilizing after-action reports (AARs) for all initial weapons engagements ensures that user data is compiled. Centralizing this data and having a cloud database all users can access serves as "self-help" during this process. Additionally, initial cadre will continue to be identified, and key players will have constant input on best practices to ensure constant improvement is being made as the transition is made from conventional to non-conventional weapons.

Step 11- Change (Enterprise-Wide): Assets that demonstrate high levels of success will make a full transition to MHELWS in place of or in addition to kinetic weapons. Full Mission Capability (FMC) should be attainable within the first year of weapon system IOC.

Step 12- Tweak the Process: Adjustment to TTP’s and MDS specific employment is expected as user knowledge and ability increases over time. The same database used to compile AARs can be exploited to make constant minor adjustments as previously non-weaponized MDS's become combat-capable.

Step 13- Re-Freeze: at the 18- month mark, all MDS's projected to have the MHELWS should be at least IOC, and those platforms previously performing kinetic duties should be FMC with the new system. Change agents would do best to ensure utilization of the system is widely accepted, and keys to success are already met.

Step 14- Probationary Period: After 18 months, the GS-14 position established to ensure continuity should generate a full report to assess success rates and again utilize the AAR database as a metric to determine the feasibility of entirely replacing specific kinetic capability with the MHELWS.

Step 15- Make the Change Permanent Policy: At the 24-month mark, updated tech data and systems capabilities should be published. Additionally, full systems integration should be demonstrated during large scale exercises, and interoperability testing should be complete. Systems training should be accomplished at the initial B course or flight training unit to ensure the weapons system is incorporated at the very beginning of baseline instruction. This ensures users arrive at combat-ready units already familiar with how to use the weapons system.

Step 16- Communicate the Policy: Success stories should be shared, and the weapons system should be briefed as to the *new normal* to re-freeze the process and solidify change.

Step 17- Monitor and Adjust as Necessary: Programs office should still work to enhance the system, and work to fund upgrades and new systems capabilities. Expect software or hardware upgrades yearly in line with funding requests.

**Conclusion**

The application of the MHELWS is progressive and modular. It enables new capability across all services and creates a platform for low or no collateral damage strikes. Additionally, it replaces legacy kinetic weapons to some capacity and allows previously non-offensive MDS's to become combat-capable. It utilizes a modular system to ensure low cost and easy maintenance. Utilizing a 17-step change process, a full 24-month life cycle of the system is examined to ensure logical execution of system implementation can occur. The MHELWS represents a paradigm shift in modern warfare as it replaces traditional kinetic weapons with a lethal directed energy weapon for use against multiple target sets. Finally, it reduces funding requirements by eliminating the need for physical ammunition; the weapon itself is only limited by power output.

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