

Planning To Fail: Building Aircraft Dependent Upon LASER

EWS 2004

Subject Area Aviation

Planning to Fail: Building Aircraft Dependent upon LASER  
EWS Current Issues Paper  
Submitted by: Captain J. L. Moore  
CG #3, FACAD: Major B. Montgomery  
20 February 2004

## Report Documentation Page

*Form Approved*  
*OMB No. 0704-0188*

Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

1. REPORT DATE <b>20 FEB 2004</b>		2. REPORT TYPE		3. DATES COVERED <b>00-00-2004 to 00-00-2004</b>	
4. TITLE AND SUBTITLE <b>Planning To Fail: Building Aircraft Dependent Upon LASER</b>				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) <b>United States Marine Corps, Command and Staff College, Marine Corps University, 2076 South Street, Marine Corps Combat Development Command, Quantico, VA, 22134-5068</b>				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT <b>Approved for public release; distribution unlimited</b>					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT <b>unclassified</b>	b. ABSTRACT <b>unclassified</b>	c. THIS PAGE <b>unclassified</b>			

## A NEEDED CHANGE

After serving Marine Corps aviation faithfully for 18 years, it's time for the Cobra to get a facelift. 280 AH-1W airframes will be remanufactured to theoretically new 0-hour aircraft with significant upgrades. The replacement--the AH-1Z (Zulu) model--will use a newer, smarter missile rack capable of launching both Hellfire II missiles and the Joint Common Missile (JCM). Although still under development, the JCM will be capable of targeting using imaging infrared, semi-active laser, and millimeter wave (MMW) radar. The JCM will provide great methods of targeting on an open battlefield, but in the urban environment the JCM will have serious shortfalls. Additionally, while the Zulu will achieve initial operational capability in 2006<sup>1</sup>, the JCM will not be fielded until at least 2008<sup>2</sup> (assuming it arrives on schedule). Ironically, without a direct-fire weapon that is capable of targeting in an urban environment, such as the TOW missile, the AH-1Z will be a less capable helicopter than the AH-1W.

IF IT AIN'T BROKE. . . .

The advent of precision guidance has forever changed warfare. The significant increase in probability of kill as a

---

<sup>1</sup> Lieutenant Colonel Michael T Sheerin "RE: Interview Question List" 8 January 2004, personal email of Captain Karl Crnkovich (10 January 2004).

<sup>2</sup> Colonel Larry Outlaw (USMC Ret.) Director of Government Affairs, Textron Corporation, telephone interview by Captain Karl Crnkovich, 16 December 2003.

result of precision guidance reduces the sorties required to service targets, thereby reducing the risk to pilots and aircraft. The probability of hit has obviously increased tremendously, which is actually what accounts for not only an increase in probability of kill, but a proportional reduction in collateral damage. It is within the framework of probability of hit where most laser targeting shortfalls can be addressed.

One of the many popular clichés heard in an attack helicopter squadron is, "The Hellfire [II] missile is capable of defeating any fielded vehicle." Due to the classification of information about the Hellfire, there are not citable empirical sources, but the accuracy of the statement can be attested to by any Cobra or Apache pilot. It's a buzz phrase which would be more accurately put, "The Hellfire II missile is capable of defeating any fielded target *it can hit*." The addition of these three words seems diffuse, but operations in the urban environment pose more difficulty than most would like to admit.

#### LASER PITFALLS

On an open battlefield, the Hellfire simply has to launch, gain altitude, find the designated laser spot, and hit it. The only complication is when the spot is not visible to the missile's seeker. Dust, smoke, and other environmentally generated obscurants can prevent the laser energy from reaching the intended target. Backscatter, which "refers to a portion of the

laser energy that is scattered back in the direction of the seeker by an obscurant,"<sup>3</sup> can give the missile the illusion of a valid spot prior to launch. Pre-launch, the missile can see the laser but when it launches and climbs, it loses it. A laser spot can also be hidden from the Hellfire above it by an indentation or compartment on the target.

The Hellfire can be programmed two ways: 1) launch and look for a designated target; or 2) launch *only* when a target is visible. The second option is habitually used by 85% of survey respondents to improve the probability of a hit. While this does help detect both faulty laser designators and internal system problems, it does not help with faulty targeting. The missile only understands that it sees a laser, not where the laser is.

#### COLLATERAL DAMAGE

When the Hellfire loses the spot, it climbs and continues to fly out to maximum range. This becomes a problem when you consider things like the Iraqi tendency to ring its cities with revetted armor. Shots tend to be from the 500-1000m range in order to counter the revetments and holes used to protect the targets. The 8000m fly-out range of the missile could cause it to unintentionally detonate up to 7000m beyond the intended target, potentially in a populated area. In an unsolicited

---

<sup>3</sup> Joint Publication 3-09.1 p II-7

email about the K model Hellfire, one pilot stated, "We also did a lot of shots at 400-500 meters (with Kilos). . ."<sup>4</sup> The consequences of a 100 pound missile detonating in a noncombatant's house or CNN hotel room, in a day and age when collateral damage assessments are made by teams of lawyers, would be severe.

#### MANMADE OBSTACLES

Glass is another hurdle that must be overcome when attempting to hit a target in an urban environment. Glass affects both laser and infrared (IR) targeting. For example, if a laser hits a surface such as a window, it will reflect and the missile will follow the reflection. Glass also plays a huge part in the infrared arena. While night vision goggles operate in the nearly visible portion of the IR spectrum, forward-looking infrared (FLIR) sensors use the opposite end. It is common knowledge among FLIR users that the far IR wavelength cannot pass through glass; instead, the glass becomes opaque. While this is a minor consideration given that the JCM will use imaging IR to build a picture of the target for itself, it makes it impossible to engage a sniper-like target behind glass using any of the three types of guidance proposed for the JCM.

Finally, millimeter wave radar works well in a relatively flat environment where tanks and vehicles stand out, but is

---

<sup>4</sup> Ronald M. Cannizzo, e-mail to author, 20 January 2004.

unusable when objects such as houses or huts that could give as large a radar return as a vehicle are present. The LONGBOW MMW fire control system, in conjunction with the LONGBOW Hellfire, is a very effective way of overcoming radar shortfalls. Aircraft equipped with the LONGBOW system are capable of detecting and categorizing vehicles based solely on their radar return. Once identified by the radar, the locations of targets can be transmitted to other aircraft armed with the LONGBOW Hellfire. The missile flies to the target location, turns on its own internal radar, and strikes the target. It is an amazingly effective targeting system, but, unfortunately, is not slated for purchase as part of the AH-1Z upgrade.

The key to the lethality of the Hellfire is its top-down attack. The missile flies high into the sky, and then dives down on the top of the target. Again, in a flat world, this is ideal because the armor on tanks is the thinnest on top, and therefore, the most vulnerable to penetration. 67% of the Cobra pilots surveyed encountered situations during Operation Iraqi Freedom (OIF) where a top-down attack was prevented by Iraqi's using overpasses and groves of palm trees to hide beneath. The problem here is twofold: 1), the loss of the laser spot in flight by the missile; and 2), the missile will probably impact the overhead cover instead of the target. The end result is that the missile can neither see the spot nor strike the target.

## SYSTEM ERRORS

One final laser guidance shortfall merits mention. The technique of forcing a Hellfire to get a positive lock before launching *slightly* improves the probability of kill. Assuming there are no impediments to the laser illuminating the target, and that the missile will not strike an obstacle in flight, there are still mechanical problems which can cause misses.

An imaginary line known as the armament data line (ADL) exists along the center axis of the aircraft, running from tail to nose. This line is used to align (or "bore-sight") the weapon systems so that they all point at the same imaginary spot. The gun, rocket pods, LASER, FLIR, TOW and Hellfire launchers are all bore-sighted to the ADL. Although the current Cobra often fails bore-sight, it can still be flown. The majority of the time the bore-sight is correct even if the computer indicates a failure, but occasionally the sight is truly off. That means that while the pilot may be pointing the crosshairs at the target, the laser could be pointing somewhere completely different. Therefore, one of the risks associated with using a laser to designate a target is that it can result in a miss solely based on bore-sight error.

## POTENTIAL TOW REPLACEMENTS

Currently, a weapon known as the Advanced Precision Kill Weapon System (APKWS) is under development and testing at Naval

Air Warfare Center, China Lake. APKWS is a laser seeker designed to screw into existing 2.75" rockets. Some would argue that the APKWS is good enough to replace the TOW. The APKWS will fly a flatter trajectory than the Hellfire, but unlike of the flat glide of a TOW, it will arc. Considering the shortfalls of laser designation, and the small warhead size of the 2.75" rocket warhead when compared to the 6" TOW, APKWS cannot fill the void.

#### ALWAYS HAVE A BACKUP PLAN

Some would say that we just do not need the TOW because the Hellfire is better and the JCM will be *much* better. Targeting errors aside, there is a distinct advantage to having more than one missile system. Survey participants who have fired precision guided missiles (PGM's) in combat have had one of the two missile systems fail 52.5% of the time, but were able to continue the fight because the other was operational. Excluding the laser sharing technique known as buddy lasing, if an AH-1Z loaded with Hellfire missiles and APKWS has a problem with their laser, they essentially become a flying machine gun. As indicated by the survey results, this happens one out of every two flights. Without provisions for a TOW-like weapon, the 2006 fielding of the Zulu will be a Hellfire-only aircraft for at least two years. Given the tendency of contractors to miss

scheduled completion dates, it could be quite some time before the Zulu has anything other than the Hellfire missile.

#### SQUASHING RUMOURS

Many people have said that the reason the TOW is not going to be included on the AH-1Z is because it is nearing the end of production. That is partially true. Actually, only the older versions of the TOW are at the end of production. Raytheon has developed a newer version which the Army will use on its Stryker ATGM vehicle, Bradley Fighting Vehicles, and a HMMWV variant.<sup>5</sup> Among the many benefits of the new missile is its extended range and cost effectiveness. Existing TOW 2 series missiles, such as the ones used by the Marine Corps, can be returned to Raytheon and upgraded. Upgrading old TOW 2 missiles instead of buying new ones nets a savings of 20-40%, and extends the shelf life ten years.

The TOW costs approximately 20% less than the Hellfire, and it is a safe bet that when the numbers are in for the JCM it will be more expensive than the Hellfire. The TOW's guidance is not affected by ambient conditions such as dust or smoke. It does not succumb to the errors of laser reflection, laser bore-sight error, or laser entrapment. It does not have to see through glass to hit the target beyond it. Above all, it is a

---

<sup>5</sup> "TOW 2B/TOW 2B AERO," *Tube Launched Optically Tracked Wire-Guided (TOW 2B)*, Raytheon, [http://www.raytheon.com/products/tow\\_2b/ref\\_docs/tow2b.pdf](http://www.raytheon.com/products/tow_2b/ref_docs/tow2b.pdf).

direct line of sight weapon. If you can see it, you can shoot it. Range restrictions do apply, but they have been reduced. Only 28% of surveyed pilots found the TOW system more reliable than the Hellfire, yet having two separate PGM systems kept 100% of pilots in the fight when the single system proposed for the AH-1Z would have made half of them useless. That's right: every surveyed pilot has had a system failure that was overcome by virtue of having two missile systems.

For these reasons, the Marine Corps must have a direct-fire, precision guided missile system to fill the TOW void. The Marine Corps can either develop a new one, or save the money and use one that is both familiar and proven. Without something to fill the gap, the AH-1Z will be less capable on the battlefield than the AH-1W.

## Bibliography

Joint Publication 3-09.1

Outlaw, Colonel Larry (USMC Ret.) Director of Government Affairs, Textron Corporation. Telephone interview by Captain Karl Crnkovich. 16 December 2003.

Sheerin, Lieutenant Colonel Michael T. "RE: Interview Question List". 8 January 2004. Personal email of Captain Karl Crnkovich. (10 January 2004).

"TOW 2B/TOW 2B AERO." *Tube Launched Optically Tracked Wire-Guided (TOW 2B)*. Raytheon.  
[http://www.raytheon.com/products/tow\\_2b/ref\\_docs/tow2b.pdf](http://www.raytheon.com/products/tow_2b/ref_docs/tow2b.pdf)