Lasers On the Modern Battlefield

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The U.S. armed forces now use lasers in training devices, range finders, illuminators, target designators, and communications. Eventually, this list will also include laser countermeasure systems and weapons. As the use of lasers on the battlefield increases, the likelihood of damage to eyes and optical devices will also increase.

Almost all tanks, and many aircraft and artillery fire control vehicles as well, have laser range finders that can cause damage to unprotected eyes within small arms range. The biggest differences among these lasers are in wave length and power level.

Some examples of lasers with different wave lengths are the range finder on the M60A3 tank, which uses a ruby laser; the range finder on the M1 tank, which uses a neodymium YAG (yttrium aluminum garnet) laser; and the multiple integrated laser engagement system (MILES), which uses a gallium arsenide laser. Unfortunately, protection against lasers of one wave length will not necessarily protect against those of another wave length.

All lasers can present eye hazards. Even "eyesafe" lasers are not safe at extremely close range, and magnifying optics geometrically increase the effects of a laser; for example, seven-power binoculars magnify laser energy seven times seven, or 49 times the power of the laser.

The damage from a laser can range from temporary flash blindness, similar to that from the flash bulb on a camera, to partial loss of vision, to permanent blindness. When soldiers use binoculars or other magnifying optics, the danger is greater, or they can be affected at greater ranges. Pilots, vehicle and tank gunners, antitank guided missile gunners, scouts, soldiers in long range surveillance units, and forward observers are therefore the most susceptible.

Nevertheless, all military eye injuries reported so far have been to individuals who were not wearing the correct protective eyewear, or who failed to understand the danger of lasers. Preparing soldiers for operations on the laser battlefield therefore requires attention to doctrine and training.

As indicated in the U.S. Army Training and Doctrine Command's 1990 study, *Directed Energy Training Awareness Study*—doctrinal infor-mation on directed energy weapons (DEWs) is not receiving enough emphasis from higher commands and is not reaching most Army personnel. The study therefore recommends the addition of a DEW engagement—similar to a nuclear, biological, chemical engagement—in Bradley, TOW, and tank gunnery, in which a crew is warned and must take appropriate action, such as putting on protective eyewear or filters and using electro-optics instead of direct-view optics. (This study is available through the Defense Technical Information Center, DTIC, Document #AD-B166 169.) Doctrine now recommends the thermal sight as the best choice for eye protection, and the effects of both friendly and enemy lasers should be added to the Simulations Network (SIMNET) training simulator.

Additional information on laser threats can be found in the Combined Arms Training Activity (CATA) Special Text 1-1, *Directed Energy Warfare (DEW) Awareness Training*, and a CATA laser awareness tape. Familiarity with FM 8-50, *Prevention and Medical Management of Laser Injuries*, is essential for all medical personnel.

A list of scenarios in which lasers can be integrated into training is available in Fleet Marine Force Manual (FMFM) 3-55, *Tactical Directed Energy*. A change to FM 71-2, *The Tank and Mechanized Infantry Battalion Task Force*, will expand the DEW section to include how to fight with directed energy weapons. Eventually, offensive and defensive DEW tasks should also be added to mission training plans (MTPs).

Laser awareness training is particularly important to the Army National Guard and Army Reserve, because they have limited training time and much of their equipment does not have the same level of laser protection as that in the Active Army.

Additionally, I believe that a rotation focused on laser effects should be planned and executed at the National Training Center and the Joint Readiness Training Center for both active and reserve component units. The results of these rotations could be used to help fill the gaps in the Army's doctrine, as the Marine Corps has done with Fleet Marine Force Manual (FMFM) 3-55. Likewise, I hope some farsighted Army officer at the Command and General Staff College or the Naval Post Graduate School might consider working on a study of U.S. Army offensive and defensive laser doctrine.

Finally, the armed services must ensure that the development of joint

doctrine continues so that they will be better able to work together in a DEW environment. To help individuals with laser training, I have produced a bibliography of articles and books that is available upon request. (Write to me at Foreign Analysis Division, Directorate of Threat and Security, ATTN: ATZB-IST, Fort Benning, GA 31905-5372; or call 706-545-1561 or DSN 835-1561.)

Units that have a planning mission involving the former Yugoslavia must ensure that their soldiers have adequate laser protective eyewear and that they are thoroughly briefed on its use. Before its dissolution, Yugoslavia had an extensive laser industry and produced hand-held, tripod-mounted, and tank laser range finders. Fortunately, it appears that all of these range finders are neodymium YAG, operating at a wave length of 1.06 microns, against which the current laser protective eyewear is effective. These lasers are not visible to the naked eye, however. *Jane's Battlefield Surveillance* lists the OMU-2, a Yugoslavian artillery laser range finder, as the most powerful laser, with an operational range of 30 kilometers. Its power level of two megawatts and its beam divergence of 0.7 milliradian translate to a hazard of 900 meters to unprotected eyes.

The Yugoslavians have also produced a number of laser detectors and warning devices fitted to vehicles and ships. The range of wave lengths for these systems is .66 to 1.1 microns, which will detect all U.S. lasers, including ruby, gallium arsenide, and neodymium.

Perhaps the most important things to remember about laser eye injuries are that they occur at the speed of light and that they must be quickly and accurately identified and evacuated for treatment. Research is beginning to indicate that the probability of long-term sight loss can be reduced if an injury is treated correctly within 24 hours. Ideally, laser casualties should be evacuated as soon as possible to San Antonio, Texas, the home of both the Army's and the Air Force's top eye specialists. (Army medics have received a special card containing information on testing and evacuating soldiers with laser eye injuries.)

Medical units should prepare for and conduct laser mass casualty exercises. One unprotected Bradley company, for example, could present a battalion aid station with as many as 45 casualties. Aid stations can also expect to handle many soldiers who think they have been hit by lasers when they have not; proper

training will help prevent these "psychological" casualties.

A new generation of more powerful lasers operating in different wave lengths is designed to attack eyes and electro-optical sensors. The effects of these weapons on eyes include flash-blindness, a temporary degradation in visual acuity; glare or dazzle, indicating a temporary degradation in visual acuity that could cause a mission to be aborted at night; minimal lesions, minor retinal burns and dark spots in the field of vision; or hemorrhagic lesions, severe retinal burns with bleeding inside the eye and immediate loss of vision, some of which can be permanent. Damage to optics includes the temporary saturation of a forward looking infrared (FLIR) sensor or image intensifier; crazing, or surface cracking, which indicates permanent damage to the surface of optical material; and fogging, which indicates permanent damage to the surface of an optical material by cracking not visible to the naked eye.

In addition to training and doctrine, survival on the laser battlefield also requires the correct warning and protective equipment. Although lasers can determine range, guide munitions to targets, and damage eyes and optics, most of them can also be detected by laser warning receivers and blocked by smoke, dust, rain, snow, and laser filters.

The only laser warning receiver in the Army's inventory is the AN/AVR-2 for helicopters, but the Army does have the ballistic laser eye protection system (BLEPS), and each unit should have sets on hand for all personnel. (This system loses its protection if it is used with magnifying optics such as binoculars.) The aviation community has recognized the laser threat to pilots and has a variety of laser glasses and visors available.

The number and the types of lasers on the battlefield will continue to increase. Leaders and equipment operators must know not only what their laser devices can do but what protection the equipment can offer. For example, not all versions of the Bradley fighting vehicle have the same level of laser protection, nor do all sights on the same vehicle.

The use of lasers on the modern battlefield is more than a safety issue; it is an operational issue that encompasses the need for doctrine, training, and equipment. Still, as with the nuclear, biological, and chemical (NBC) environment, the laser environment will not present a significant problem if soldiers are adequately trained and equipped for it.

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