Directed-Energy Weapons

MAJOR CLARK P. CAMPBELL

A new generation of direct-fire weapons is about to appear on the battlefield. Technology in both the East and the West is rapidly approaching the point where tactical directed-energy (DE) weapons can be mass produced.

DE systems have the potential to perform more efficiently than conventional systems in numerous battlefield tasks. As technology permits, specific DE systems for these tasks may appear on the battlefield, although some of the desired systems may not be possible until well into the next century.

Nevertheless, to win battles in the next war, our soldiers must understand this new weaponry. Planning and training for operations in a DE environment cannot wait until our forces are engaged in combat.

The types of directed energy most likely to be developed for battlefield tasks fall generally into four categories: laser, radio frequency, particle beam, and sonic.

These four types of directed energy have some common characteristics that are essential to an understanding of their natural advantages and limitations:

- Potential DE weapons — with the exception of nonnuclear electromagnetic pulses (EMPs) — are direct-fire systems; they must have line of sight to hit the target.
- DE systems are fast. The beams from laser, radio frequency, and particle beam weapons travel at near the speed of light. (For example, in the time it takes a laser beam to travel one mile, a targeted aircraft traveling at Mach 2 moves a little more than one-eighth of an inch.)
- DE systems are adversely affected by precipitation, dust, and other obscurants.
- DE systems have unique signatures that make it easier to identify, locate, and destroy them.
- DE systems are not magic; they obey the laws of physics. Common sense countermeasures, therefore, can be extremely effective.

Laser

The laser is the system most people envision when they think about directed energy. Lasers project amplified beams of stimulated light that transfer radiant energy. Depending on the power levels of the system, damage from lasers may vary greatly. They can temporarily blind the human eye, or they can burn through the skin of an aircraft.

Identifying enemy laser systems will be difficult. Not all lasers are formed from visible light; therefore, observers will not always see a beam. Laser systems may be fielded in a variety of sizes, from a low-powered, handheld weapon to a high-powered system mounted on a tank chassis or in a fixed site. The medium- and high-powered systems may provide a detectable signature of ionized air that will partially surround the beam. This ionized air will glow for several seconds, smell of ozone, and crackle like high-voltage electricity.

Lasers are nonballistic — they will hit where they are boresighted. For practical purposes, then, they are limited by line of sight, not by range. As an example, a laser with the power to melt the windshield of an aircraft at 6,000 meters will have enough power to blind personnel at ranges well beyond 10,000 meters. Most terrain, though, will not support surface-to-surface shots beyond 5,000 to 6,000 meters.

Smaller, more mobile laser weapons may have broad beams (up to 5 meters in diameter at 5,000 meters). They will be used primarily to destroy optics, to crack and melt cockpit coverings and vehicle wind screens, and to destroy the eyesight of soldiers.

Medium- and high-powered lasers will be mounted on large vehicles or set up in fixed sites. Their primary purpose will be to destroy aircraft, thin-skinned vehicles, and other soft targets. They may be used also to blind armored vehicle crewmen or to channel the vehicles so they can be destroyed more easily by conventional systems. As with other direct-fire systems, lasers will normally be employed in pairs to cover each other.

Lasers require state-of-the-art fire control and normally must be held on the target for several seconds to burn into the target's electronics, fuel, or ammunition. Unfortunately, the human eye can be destroyed in milliseconds by medium- and high-energy systems.

Although lasers seem to be the perfect weapon, their effectiveness can be kept to a minimum. The easiest and surest way to foil a laser system is to use terrain in much the same way it is used to avoid other types of direct fire. The atmosphere, too, diminishes the effectiveness of lasers, and dust, snow, fog, and rain all limit the range and the effectiveness of a laser beam. In addition, the higher the power of the laser, the greater the effect of obscurants. For example, before a unit assaults, artillery can be used to stir up dust and smoke in the vicinity of suspected lasers to effectively deny the enemy the full use of his DE systems.

Current night sights, night-driving devices, and night-vision goggles can all be destroyed by lasers, although they will not damage the eyes of the soldiers using these devices. Protective masks and hoods can be used to protect vision by reducing the vulnerability from peripheral shots. In addition, vision blocks and windows on vehicles can be partially or completely screened with expedient curtains.

Many laser beams that are invisible to the eye will be visible through thermal sights or, during periods of darkness, through night-vision devices. Once detected, a laser beam can be traced back to its location, and the system can be destroyed by artillery or direct fire. Lasers will not normally be employed in cities because of the large number of polished surfaces that can reflect beams and endanger supporting troops.

Particle Beam

A particle beam weapon directs a beam of atomic or subatomic particles that can be either charged or neutral. They differ from other forms of directed energy in that they transmit matter, not just waves of energy. When and if they appear on the battlefield, particle beams will resemble in appearance and effect the "Buck Rogers Death Ray." Fortunately, technology seems to be a long way from producing a tactical particle beam system.

But if particle beam weapons do appear, and if one is operating nearby, its signature will be the visible sheath of ionized air around the beam, a noise like thunder each time it fires, and high levels of radiation in the vicinity of the beam. Particle beams will completely destroy all targets in their line of sight. In addition, particle beams will penetrate buildings, vehicles, armor, or even several layers of sandbags. They will not pass through terrain features, but they may scatter enough radiation to harm any personnel directly under the beam.

Countermeasures against particle beams are limited, but one practical solution is to identify possible sites early by detecting radiation. Particle beams will be severely affected by precipitation, dust, and electrical storms, and their beams will not travel well under these conditions. The system can thus be approached with less risk.

Early particle beam systems will be large, with their crews separated from the projector to avoid radiation hazards. To operate, they will require either tons of chemical fuels or some type of nuclear power. Particle beams, therefore, are clearly the most unlikely type of directed energy to use for a tactical weapon. But if they are used, their effects will be catastrophic.

Sonic

Sonic weapons project compression waves that may be generated by mechanical or electronic means. These waves differ from radio frequency waves in that they are transmitted by vibration of the atmosphere, and they travel at the speed of sound. Most research with sound has been conducted within the range of human hearing, but infrasonic (below the audible range) and ultrasonic (above the audible range) sound also may have military potential.

Sonic systems will be relatively short range. A high power system could have damaging effects only out to about 2,000 meters, and the projectors could be identified by large horn-shaped sirens or parabolic dishes. This newcomer to directed energy is expected to be used as an antimateriel system (mine clearing, for example).

Sonic waves may have the potential to blur vision and cause nausea, fear, and confusion, but research into this potential has been limited.

A practical countermeasure for sonics is to move to the flanks and take advantage of the system's limited range. Terrain, precipitation, and obscurants will not provide a significant amount of protection inside the weapon's effective range, but the horn or dish of the projector will be vulnerable to both direct and indirect fire.

Radio Frequency

Radio frequency weapons include microwave, millimeter wave, and nonnuclear EMP. A nonnuclear EMP is the only type of directed energy that has a potential for indirect-fire delivery. It has no antipersonnel capability, and countermeasures against it will come primarily from good operations security and equipment hardening.

Radio frequency beams travel in much the same way as light waves do, but they are absorbed and reflected differently. The radio frequency waves pass through glass, plastics, and fabrics with little or no energy loss and guide on metallic objects such as wires. In addition, radio frequency systems are not as susceptible as lasers are to weather and obscurants. Their beams are invisible both to the eye and to current night-vision devices. Radio frequency systems can be detected by locating the parabolic "dish" antenna used to direct the beam.

Radio frequency systems will be used to damage electronics and to cause injury to personnel. A soldier who is engaged by an undetected radio frequency weapon, for instance, may first notice intense pain from burned skin or heated bones.

Operational ranges for radio frequency systems will be less than those expected of a laser, but it is possible to have mobile systems that can damage personnel and equipment at several thousand meters. The diameter of a beam can be expected to be considerably larger than the beam of a laser system.

Obviously, the best way to counter a radio frequency weapon is to detect it before entering its field of fire. Possible locations of radio frequency weapons can be determined by conducting a map analysis to determine the best fields of fire. Once detected, the "dish" antenna is vulnerable to damage from artillery and direct fire.

Tactical radio frequency systems will have little effect on personnel inside armored vehicles. A suggested countermeasure is to prepare an armored vehicle by removing antennas, disconnecting radios, covering unneeded vision blocks, and buttoning up. Then the radio frequency system can be flanked and destroyed.

Radio frequency systems in built-up areas will be more difficult to counter as they may be employed at very close ranges, penetrating all but the thickest of structures by way of openings, wires, and pipes. In this situation, basements and sewers can be used for moving to positions from which the radio frequency weapon can be destroyed.

If a dismounted soldier is hit by a radio frequency beam, the only countermeasure he can take is to drop to the ground and crawl to the nearest cover. Unless the device is extremely close, his chances of survival are excellent as the waves take at least several seconds to cause incapacitating burns.

CONCLUSION

Many of these directed energy weapons may sound highly futuristic and therefore not worth worrying about right now. But this attitude in the past has wasted thousands of lives. In 1914, for example, professional soldiers did not recognize the effects the machinegun would have on their tactics and operations until it had done considerable damage.

The first units to come under attack by directed energy weapons will succeed or fail on the basis of their knowledge and training. Even if hardened equipment and protective clothing are not available to these units, they can still deal with DE systems by taking advantage of the natural vulnerabilities and limitations and by teaching their soldiers to apply common-sense countermeasures.

MAJOR CLARK P. CAMPBELL is assigned to the 1st Battalion, 509th Infantry (Airborne) in Italy. A 1971 graduate of Norwich University, he has served with the Combined Arms Combat Developments Activity as a project officer for light forces and for directed-energy concepts.

Reorganize Platoon

LIEUTENANT COLONEL RALPH A. HALLENBECK

There are several problems with the currently prescribed organization of an M113-equipped mechanized rifle platoon, problems that might well be solved by a proposed new organization.

Under the current organization, a mechanized rifle platoon has three identical rifle squads and a platoon headquarters. Each squad has an M113, as does the platoon headquarters. Each squad APC has one radio, and the headquarters track has two. Each squad APC also has a caliber .50 machinegun and a Dragon that is mounted at the track commander's turret.

The track commanders (TCs) are normally the squad leaders or, in the case of the headquarters vehicle, the platoon leader. When the platoon fully deploys and uses both mounted and dismounted elements, the squad leaders go with their dismounted elements, while the M113s usually follow and support their respective squads. The platoon leader normally also dismounts and may or may not take the platoon sergeant and a radiotelephone operator (RTO) with him.

In this case, several things are likely to happen. First, the Dragons and caliber .50 machineguns — the most potent weapons in the platoons — will either be left unmanned, or they will be manned by whoever is available. Second, the squad leaders will have no radio communication with their respective vehicles. Thus, only rarely will any of the APCs be well positioned (far enough away from the target and with good fields of fire) to support the dismounted soldiers with either their caliber .50 machineguns or their Dragons.

In fact, the platoon's four M113s either tend to be left out of the action or used at improper ranges. Even if the platoon sergeant is left in charge of the four vehicles, he has only an ad hoc organization to assist him — one that has had little or no training as an integral maneuver unit in its own right.