SECTION 18—WEAPONS EFFECTS AND COUNTERMEASURES TECHNOLOGY

OVERVIEW

This section addresses twelve technology areas that are used to evaluate the survivability and hardening of military systems against the effects of nuclear and other advanced weapons. Recognizing the trend towards consolidation of defensive technologies, "hardening" has been included within the broader category of countermeasures. The eight nuclear-related areas include Detonation-Induced Shock Waves, High Altitude Electromagnetic Pulse, Source Region Electromagnetic Pulse, Nuclear Radiation and System Electromagnetic Pulse, Thermal Radiation, Electromagnetic Propagation, Pulsed Power Weapons Effects Simulation, and Underground Testing. The four non-nuclear technology areas are **Induced Shock Waves from Penetrating Weapons**, Laser Weapons, Particle Beam Weapons, and High-Power Microwaves. Only one of the 12 technology areas in this section, Induced Shock Waves from Penetrating Weapons, contain technologies that are militarily critical. The eight nuclear technology areas, as well as the penetrating weapons technology, are directly related to WMD. All of the non-nuclear technologies are considered as emerging technologies, and these will be considered in detail in Developing Critical Technologies. Since weapons effects technologies are specifically focused on military applications it is not surprising that a modest level of dual-use applications have been identified so far. Current dual-use applications account for about 15 percent, which could potentially be increased to more than 25 percent.

SECTION 18.1—INDUCED SHOCK WAVES FROM PENETRATING WEAPONS

OVERVIEW

Technologies in this section address methods for simulating and evaluating the effects of penetrating weapons (PW) on surface, space, and underground targets. These weapons destroy targets by rupturing the impacted material. The high incident kinetic energy per square meter of these penetrating weapons produces intense shock waves in the target. The extremely large pressures and shearing forces associated with the shock waves generated in the projectile-target interaction are intended to exceed the latter's elastic limit. Depending on the host material, this can result in permanent disfigurement due to plastic flow ablation, vaporization, cratering, and even ionization of the target. The simulation technologies of this section, consisting of testing, analysis, and software, provide a quantitative basis for establishing the survivability of targets. It is also important to note that PWs that can attack underground targets (such as bunkers containing chemical or biological weapons) are relevant to weapons of mass destruction. With few exceptions the technologies addressed in this section have not reached their ultimate capability. The technologies covered in this section may have 20–30 percent dual-use applications. They include, for example: body armor for law enforcement, bomb containment systems, aircraft protection against bird strikes, and survivability of satellites against micrometeorites.

Table 18.1-1. Induced Shock Waves from Penetrating Weapons Militarily Critical Technology Parameters

TECHNOLOGY	Militarily Critical Parameters Minimum Level to Assure US Superiority	Critical Materials	Unique Test, Production, and Inspection Equipment	Unique Software and Parameters	Export Control Reference
SIMULATION OF PENETRATING WEAPON EFFECTS ON SURFACE TARGETS	Simulation of the effects on land surface targets of: - long rod penetrators of velocities > 1.8 km/s - shaped charged jets capable of penetrating RHA @ > 10 charge diameters - EFPs capable of producing projectile lengths > 1 charge diameter	Composite materials consisting of metals, foams, ceramics, adhesives, layers of metals and high explosives, and very dense materials, special constructions that can resist fragmentation and absorb shock waves, and Rolled Homogeneous Armor (RHA).	Projectile launchers capable of imparting velocities exceeding 1.8 km/s in laboratory-scale facilities; test targets and physical models, and instrumentation for HPVI assessments.	Validated computer programs and algorithms for evaluating and optimizing reactive armor configurations, and assessing kinetic energy target effects on modules, including material models.	WA ML 17, 21, 22 USML XXI
SIMULATION OF PENETRATING WEAPON EFFECTS ON BURIED TARGETS	Depth and payload capability for penetrating into or close to a target buried more than 2 m.	Boulder fields on surface, reinforced concrete slabs on bunker, soil, penetration-resistant armor on bunker, and high density case materials	Test facilities for simulating multi-layer ground/bunker penetrating configurations under battlefield conditions.	Validated software programs that describe projectile penetration through the ground.	WA ML 17, 21, 22 USML XXI

(Continued)

Table 18.1-1. Induced Shock Waves from Penetrating Weapons Militarily Critical Technology Parameters (Continued)

TECHNOLOGY	Militarily Critical Parameters Minimum Level to Assure US Superiority	Critical Materials	Unique Test, Production, and Inspection Equipment	Unique Software and Parameters	Export Control Reference
SOFTWARE	Validated computer codes and algorithms that include EOS models at high strain rates for predicting hypervelocity impact against armor, fragments against space targets, and penetration against buried objects with uncertainties 20%	None identified	Not applicable	Validated computer Lagrange-Eulerian codes and algorithms that predict the performance of penetrating weapons against targets and include material models; input/output signals of sensors in single/multiple impact warheads, fractionation, vaporization, melt.	WA ML 17 USML XXI