

# DEFENSE SCIENCE AND TECHNOLOGY STRATEGY AND PLANS

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**D**efense S&T Strategy

**B**asic Research Plan

**D**efense Technology Area Plan

**J**oint Warfighting Science & Technology Plan

**D**efense Technology Objectives

OVERVIEW  
OF S&T  
PROGRAM

HOW TO  
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DOCS

EXIT

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## CHAPTER XV

### HARD AND DEEPLY BURIED TARGET DEFEAT

#### A. DESCRIPTION

*Hard and Deeply Buried Target Defeat (HDBTD)* is the capability to deny sanctuary to adversaries by developing end-to-end capabilities for detection, characterization, target planning, defeat, and combat assessment directed at deeply buried, tunneled, and other hard-to-defeat, high-value facilities. HDBTD employs a full range of measures to destroy, disrupt, or deny hard and deeply buried target facilities as well as mission-critical elements within the networks that support or are supported by such facilities.

This Joint Warfighting Capability Objective (JWCO) was validated by the Joint Chiefs of Staff (JCS) on December 22, 1999. Approval came at a stage in the preparation of the JWSTP at which it was not possible to have the full participation of DoD components that is needed to develop a complete JWCO chapter. This partial chapter defines parameters for the HDBTD JWCO and provides the starting point for development of the complete plan to be included in the next edition of the JWSTP.

Hard and deeply buried targets (HDBTs) involve all types of hardened aboveground, shallow underground, and deep underground structures or targets. Deeply buried facilities are a particularly challenging subset of targets. The technical activities addressed in this chapter include projects that are directed specifically at deeply buried complexes, plus efforts directed at the full range of hard targets.

HDBTs differ with respect to such factors as:

- Facility function (C<sup>4</sup>I; operations; basing for surface-to-surface missiles, aircraft, artillery, and other systems; production and storage of WMD-related or conventional munitions; and other types of military forces, materiel, and infrastructure)
- Depth of burial or other protective cover
- Physical layout and extent
- Infrastructure features (external and internal)
- Active and passive defenses
- Camouflage, concealment, and deception (CC&D) measures
- Proximity of civilian populations, cultural sites, and other juxtapositions impacting collateral damage assessments
- Susceptibility to hard, functional, and full-dimensional defeat
- Sensitivity to time of delivery.

Shortfalls in HDBTD capabilities were identified during the Persian Gulf War and in subsequent conflicts. The Strike and Information Operations (IO) Joint Warfighting Capabilities Assessment (JWCA) teams have worked with combatant commanders to continue identifying and assessing these shortfalls. There are current requirements developed by combatant

commanders for improvements in HDBTD capabilities, including a joint mission needs statement validated by the Joint Requirements Oversight Council.

In the Concept for Future Joint Operations (CFJO) (Reference 21), the JCS address asymmetric counters—measures that adversaries might implement to offset U.S. conventional military superiority. Underground facilities are one of these counters. The CFJO states, “Some potential adversaries have already buried key facilities several hundred feet underground, making their destruction by conventional munitions extremely difficult.” The CFJO also indicates that, of the asymmetric counters considered, underground facilities are likely to be among the easier for adversaries to implement and among the more effective against the United States.<sup>1</sup>

The objective in HDBTD technical programs is to develop the capabilities needed to physically destroy or functionally disrupt military operations within an adversary’s hardened facilities. The adversary’s ability to utilize such facilities to accomplish a military mission is the target, not the facility itself.

This objective is accomplished using a full-dimensional defeat approach to targeting that can be conceptualized in terms of concentric circles.<sup>2</sup> In the case of a hardened command and control facility, the innermost ring might consist of the personnel and equipment that perform C<sup>2</sup> functions. The hardened facility that houses and protects these people, systems, and functions is the next ring. Links between the facility and objects in the immediate area (e.g., power lines, water pipes, roads) would constitute the next ring. The outermost circle might contain all the units that input information to the facility or respond to commands issued from it. This is a network of networks (to include networks within facilities) in which the most important critical nodes for some missions might not be located within the hardened facility itself. Some of these targets are “strategic” in the sense that their defeat would make a significant contribution to the achievement of conflict objectives. Figure XV-1 illustrates the HDBTD concept.

Some of the technical efforts addressed in this chapter are being accomplished as part of a Department of Defense/Department of Energy defense programs pilot project for developing improved capabilities for defeat of hard and deeply buried targets (Reference 32).

## B. OPERATIONAL CAPABILITY ELEMENTS

Five core operational capabilities must be achieved:

- *Detect*—detection of hard and deeply buried targets, and identification of target functionality and network context
- *Characterize*—characterization of hard and deeply buried targets and related network nodes, including geology, structure, information systems, equipment, and status
- *Plan*—target planning
- *Defeat*—neutralization (physical destruction or mission-critical functional disruption)
- *Assess*—combat assessment.

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<sup>1</sup> *Concept for Future Joint Operations (CFJO): Expanding Joint Vision 2010*, OJCS, May 1997, pp. 15–16.

<sup>2</sup> Full-dimensional defeat is used in preference to functional defeat because the latter term is often limited to measures directed at within-facility capabilities. Full-dimensional targeting is directed at mission-critical elements both within the facility and outside its perimeter.

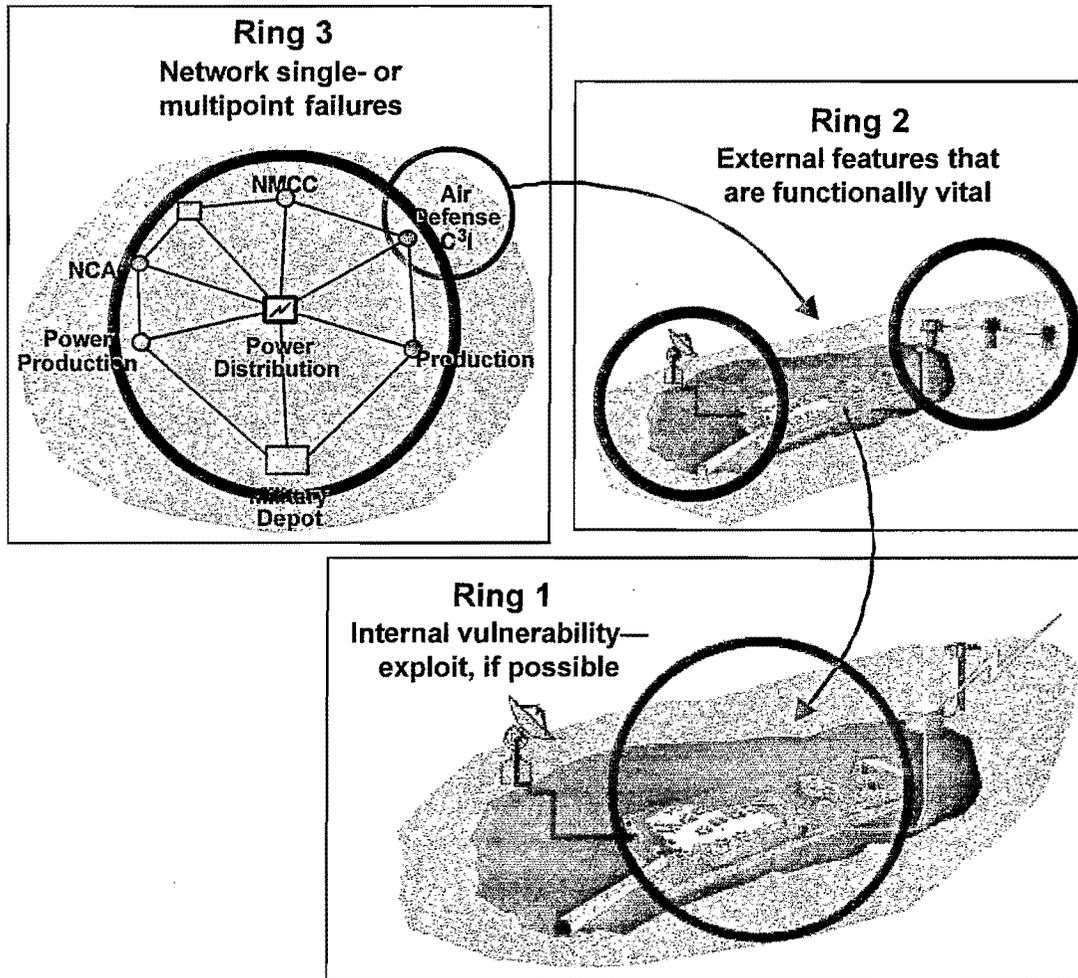


Figure XV-1. Concept—Hard and Deeply Buried Target Defeat

Some technology programs are relevant to multiple capability objectives. Sensor technologies are needed to detect, characterize, and assess HDBT.

**Detect.** HDBT must be identified using all-source intelligence. Concurrently, all-source intelligence must be employed to identify the networks that support or are supported by facilities. Denial and deception (D&D) must be overcome.

Detection is a dynamic process. Some HDBT may be of only intermittent importance. For example, shelters for mobile surface-to-surface missiles may be priority targets if they contain missiles and launchers. In some cases, the functions performed by a facility may evolve due to campaign developments. A target database is needed to support assembly, analysis, and use of detection information.

**Characterize.** Characterization provides the detailed assessment needed to support full-dimensional targeting directed at mission-critical elements within a facility or the information systems and networks that support or are supported by it. Characterization also supports preventive defense and policy implementation for treaty compliance, estimation of foreign leadership objectives and activities, and identification of facility-related policy issues. This operational capability is based on all-source intelligence, appraisal of analogous facilities and geologies,

reverse engineering, and physics understanding. Monitoring is integral to characterization; facility-related activities and their importance vary over time. As with detection, a dynamic target database is needed and D&D must be countered.

**Plan.** Planning encompasses command, control, and communications functions that support planning and execution at multiple levels of command. In broad terms, this operational capability element involves:

- *Planning for defeat of HDBT and associated networks.* Some of this planning involves target-set-unique considerations (e.g., utilization of realistic, physics-based facility and network models to support aimpoint selection).
- *Integration of HDBT-specific planning with other theater and national planning.* This includes establishment of connectivity with, and integration of, planning processes and systems accomplished at multiple locations and command levels. It also involves measures to improve the responsiveness, flexibility, integration, and adaptivity of all planning and execution activities.
- *Planning that is specific to subsets of targets.* For example, planning could help to minimize collateral hazards that might result from defeat of facilities related to weapons of mass destruction (WMD).

A mix of deployed and reachback capabilities is required.

**Defeat.** To accomplish either physical destruction or functional disruption, a number of capabilities are required. Defenses must be countered; some HDBTs are protected by Integrated Air Defense Systems (IADSS). Suitable delivery systems for both physical and functional defeat (with respect to range, munitions carriage, etc.) must be available. Weapon-target interactions must be understood, and munitions, weapon systems, and techniques with the required lethality or effects must be available. Munitions, weapon systems, and techniques must be delivered such that critical target elements are within their radius of lethality or effect. In some cases, this may require use of penetrating weapons. In other situations, precise three-dimensional delivery may not be required (e.g., when advanced radio frequency weapons are employed for functional defeat of electronics).

**Assess.** Combat assessment determines the effectiveness of force employment. It involves battle damage assessment, munitions effects and functional disruption assessments, and reattack recommendations. The primary purpose of combat assessment is to identify recommendations for the course of military operations.

During the Gulf War, there were situations in which it was difficult to accomplish combat assessment—for example, following conventional munitions attacks on hardened aircraft shelters. While it was obvious that the shelter had been penetrated, it was not possible to see inside the facility to determine if the aircraft had received critical damage. In attacks conducted against buried bunkers, tunnels, or other hard targets, the problem is even more challenging.

Sensors and other systems are required to develop the information required for combat assessments. Tools responsive to the specific requirements of combat assessment involving hard and deeply buried targets are needed.

### C. FUNCTIONAL CAPABILITIES

Table XV-1 identifies the functional capabilities needed for HDBTD and shows their primary contributions for realization of the operational capability elements. These functions fall into three broad categories:

- Critical functions for HDBTD missions (sensors, overcoming clutter and D&D, sensor data fusion, target database, C<sup>4</sup>/planning and execution system, connectivity/integration, delivery systems, enhanced weapons, improved lethality, survivability, and decision process analysis and assessment)
- The most important enabling technologies for current and new HDBTD missions (modeling and simulation, high-performance computing, autonomous systems, distributed systems, miniaturized systems)
- Preventive defense (sensors developed for HDBTD missions may be important in treaty verification and proliferation prevention).

**Table XV-1. Functional Capabilities Needed—Hard and Deeply Buried Target Defeat**

Functional Capabilities	Operational Capability Elements				
	Detect	Characterize	Plan	Defeat	Assess
1. Sensors	•	•			•
2. Overcoming Clutter and D&D	•	•			•
3. Sensor Data Fusion	•	•			•
4. Target Database	•	•	•		•
5. C <sup>4</sup> /Planning and Execution System			•		
6. Connectivity/Integration			•		
7. Delivery Systems				•	
8. Enhanced Weapons for HDBTD				•	
9. Improved Lethality				•	○
10. Survivability	•	•	•	•	•
11. Modeling and Simulation	•	•	•	•	•
12. Simulators and Testbeds	•	•		•	•
13. High-Performance Computing	•	•	○		•
14. Autonomous Systems	•	•		•	•
15. Miniaturized Systems	○	○			○
16. Distributed Systems	○	○			○
17. Preventive Defense	○	○			
18. Decision Process Analysis and Assessment		•	•	•	

• Strong Support

○ Moderate Support

**Sensors.** Improved sensors are needed for detection, characterization, and combat assessment. Enhancements are needed in sensor range, resolution, wide-area coverage, and other attributes. Sensor systems require greater responsiveness in terms of data feeds to operators and retasking. Continuous (52/7/24), day/night, all-weather monitoring is essential. Multiple phenomenology solutions are also needed. Covert or less-obtrusive sensors are required. Novel applications of sensor technologies are necessary for some missions (e.g., sensors integral to ordnance to provide combat assessment data). Nondetectable, nonattributable means for forcing noncooperative emission from HDBTs to assist detection, characterization, and combat assessment are required.

**Overcoming Clutter and D&D.** Technologies and techniques are needed to overcome both natural and deliberate obscuration. In some cases, the solutions can be provided at the level of individual sensors (e.g., through improved filtering or better analysis of background environments). In other situations, multiple sensor systems or multiple phenomenology solutions are required. Concurrently, weapons are needed that depend less on the availability and accuracy of specific types of high-resolution sensor information for maximum lethality.

**Sensor Data Fusion.** Some of the sensor programs being pursued will, if successful, result in huge volumes of new information being available—potentially an increase of several orders of magnitude in inputs. Advanced fusion systems that can handle huge data flows and reduce these streams into operationally usable information are needed.

**Target Database.** A dynamic database is needed to manage a large amount of information concerning many HDBTD facilities and associated infrastructure, including information systems and networks. This database will be populated with inputs from sensors, historical data, reverse-engineering assessments, appraisals of analogous facilities or networks, and other sources. This database must have seamless links to the resources used in theater campaign and national planning.

**C<sup>4</sup>/Planning and Execution System.** Improvements in both deliberate and quick-response planning capabilities are needed. These improvements must be part of, and integrated with, similar enhancements in theater campaign and national planning systems and processes. Specific subfunctions that need to be enhanced include situation assessment, course-of-action development, collateral hazard prediction, network analysis, target planning and weaponeering, battlespace management, weapon/resource allocation, force management, and development of reattack recommendations. The objective is for HDBTD to be an integral part of national and theater planning and execution.

**Connectivity/Integration.** Some current systems and processes operate as “stovepipes” that come together imperfectly and only at senior levels of command. The optimal architecture would involve seamless exchange of information and database integration across sensors and types of information (e.g., SIGINT and IMINT), functions (e.g., intelligence and operations), command and control nodes within a theater, combatant commands (e.g., when USSTRATCOM forces are supporting theater operations), and national and theater systems and processes. Practical interim solutions may involve use of agent-based technology to achieve partial integration.

**Delivery Systems.** Increased range is needed to improve target coverage and allow use of standoff launch to enhance survivability of the delivery systems. Systems must be capable of operating in all conditions (day/night, all-weather). Precision navigation and guidance are needed.

**Enhanced Weapons for HDBTD.** Several improvements are specific to HDBTD missions. Improvements in penetration are needed to ensure that weapon effects occur in proximity to critical elements within a facility. Hard-target smart fuzing contributes to the same objective. Capabilities to conduct information operations also offer potential for HDBT defeat. Computer network attack, psychological operations, electronic warfare, and deception capabilities, in addition to physical destruction weapons, offer a broad range of options for full-dimensional defeat.

**Improved Lethality.** Significant enhancements in the lethality of munitions when used against HDBTD facilities are needed. A number of technologies might contribute to this objective, including hypersonic weapons, energetic materials, and radio-frequency weapons. There are requirements for weapons that provide the lethality needed for defeat of networks that extend over wide areas. There is also a need for weapons that provide a robust lethality solution that is not dependent on having high-resolution target information.

**Survivability.** Force protection and physical protection (to include hardening) covering the full threat spectrum is a necessary precondition for an effective, credible HDBTD mission capability.

**Modeling and Simulation.** Key M&S thrusts involve realistic physics-based models of targets and weapon–target interactions (virtual targets); target models and simulations that trace weapon effects to full-dimensional defeat of a HDBT facility; simulations that show the campaign impacts that result from defeat of HDBTD facilities; validated weapon lethality models; simulation of new weapons and sensors; simulations of background environments, clutter, and D&D to provide parameters for appraisal of sensor performance; and collateral effects predictions. These tools need to be provided as a mix of deployed and reach-back capabilities.

**Simulators and Testbeds.** High-fidelity physical simulations are needed to appraise the effectiveness of sensors, munitions, and functional defeat mechanisms when used against realistic simulated HDBTD facility targets. Such testing redresses shortfalls in current computational simulation capabilities.

**High-Performance Computing.** This is a critical enabling technology for both current and new types of HDBTD capabilities. Applications include modeling and simulation, on-platform fusion and reduction of sensor data, smart weapons and sensors, and reach-back technical support.

**Autonomous Systems.** Key developments include technologies that would make it possible to employ truly autonomous robots for sensor and other missions and for new types of brilliant distributed sensor networks.

**Distributed Systems.** Important sensor capabilities are provided by current technology systems (e.g., tactical unattended ground sensors). Qualitative improvements in monitoring capabilities are the objective in Smart SensorWeb and other advanced technology programs.

**Miniaturized Systems.** Microelectromechanical systems (MEMS) are a revolutionary technology. Micro-scale systems developed under the MEMS program would enable new types of small, unobtrusive sensors. It would also allow significant advances in the state of the art for guidance and control of weapon platforms and sensors. MEMS offers the prospects of very small systems that could operate within complex environments (e.g., buildings).

**Preventive Defense.** In addition to use during crises and conflicts, some sensor systems developed for HDBTD missions may also play important roles in support of treaty verification, proliferation prevention, and other forms of preventive defense.

***Decision Process Analysis and Assessment.*** Human decision making is critical to the missions and functions of HDBT facilities. Full-dimensional defeat must include the analysis and assessment of the processes and systems supporting decision making associated with HDBTs. This analysis and assessment will support the more human-dependent information operations capabilities such as deception and psychological operations, as well as more effective targeting of materiel-based capabilities such as computer network attack and physical destruction. Characterization of the processes and systems must include both physiological and psychological aspects of individuals as well as groups.