

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)					DATE February 2000			
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-Wide/Applied Research - BA2					R-1 ITEM NOMENCLATURE Nuclear Sustainment & Counterproliferation Technologies; 0602715BR			
COST (In Millions)	FY1999	FY2000	FY2001	FY2002	FY2003	FY2004	FY2005	Cost to Complete
Total 0602715BR Cost	210.0	214.5	230.9	237.8	244.7	249.1	230.9	Realigned
Project AB Test & Simulation Technology	61.7	64.5	0.0	0.0	0.0	0.0	0.0	Realigned
Project AC Weapon Systems Lethality	34.1	23.1	0.0	0.0	0.0	0.0	0.0	Realigned
Project AE Weapon Safety & Operational Support	31.8	38.8	0.0	0.0	0.0	0.0	0.0	Realigned
Project AF Weapon System Operability	43.1	44.5	0.0	0.0	0.0	0.0	0.0	Realigned
Project AG Scientific Computations & Information Systems	21.0	24.6	0.0	0.0	0.0	0.0	0.0	Realigned
Project AI Hard Target Tunnel Defeat and NTS Sustainment	10.9	10.5	0.0	0.0	0.0	0.0	0.0	Realigned
Project AL Classified Program	2.4	1.7	0.0	0.0	0.0	0.0	0.0	Terminated
Project AN Thermionics	3.0	2.9	0.0	0.0	0.0	0.0	0.0	Completed
Project AQ Deep Digger	2.0	3.9	0.0	0.0	0.0	0.0	0.0	Completed
Project BB Small Business Innovative Research	0.0	0.0	4.7	4.3	4.5	4.5	4.7	Continuing
Project BC Force Protection & Technology Applications	0.0	0.0	11.0	11.2	8.6	6.7	7.0	Continuing
Project BD Weapons Effects Technologies	0.0	0.0	60.7	62.8	68.7	75.8	80.0	Continuing
Project BE Testing Technologies & Integration	0.0	0.0	10.4	10.8	11.4	11.7	11.9	Continuing
Project BF CP Operational Warfighter Support	0.0	0.0	39.7	40.7	41.8	39.0	39.5	Continuing
Project BG Nuclear Operations	0.0	0.0	47.6	54.2	52.4	53.7	24.7	Continuing
Project BH System Survivability	0.0	0.0	56.8	53.8	57.3	57.7	63.1	Continuing

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A. Mission Description and Budget Item Justification

The mission of the Defense Threat Reduction Agency (DTRA) in the conduct of the Defense Wide/Applied Research RDT&E program is to reduce the threat to the United States and its allies from nuclear, biological, chemical (NBC), conventional and special weapons through counterproliferation (CP) programs; U.S. nuclear deterrent sustainment; and to provide technical support on weapons of mass destruction (WMD) matters to the DoD Components. These programs directly reflect the National Military Strategy, support the provisions of Joint Vision 2010 and are directed by the JCS in the Joint Strategic Capabilities Plan (Nuclear Annex). Responsive to the oversight of the Counterproliferation Council and the Nuclear Weapons Council, the specific program entities are grouped into projects.

During its first year of operation, DTRA has faced many challenges in the process of focusing agency organization and resources to the threat reduction mission. This has required a transition from predecessor agencies' legacy programs and support baseline resources to integrated DTRA programs and resources. Particular attention has been devoted to realigning the research and development investment programs. The project structure in this PE for FY 2001 and out represents that realignment.

The DTRA Applied Research program is divided into the key areas of Nuclear Sustainment and Counterproliferation Technologies. The major budget items in development for these two areas follow:

Counterproliferation (CP):

The DTRA is the DoD focal point for programs and activities to reduce the threats posed by WMD proliferants. Former programs have been redirected and focused into six broad CP programs and three areas of enabling technologies to accomplish the counterproliferation mission. New, forward-thinking activities have been identified and prioritized to support the DTRA mission and the DoD CP strategy for responding to the full spectrum of crises and preparing now for an uncertain future. The CP programs support national guidance, the DTRA strategic vision, and Service and CINC operational customers. This program element provides the innovative technologies and concepts underpinning all CP programs.

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Mission Description and Budget Item Justification (cont'd)

- Vulnerability assessments of strategic U.S./Allied systems leading to strategies for improved survivability. Provides input to assessment training programs, engineering designs and new construction practices to support sound force protection, vulnerability mitigation, and collective protection principles.
- Development of WMD analysis and simulation tools for the warfighter including target planning and assessment; hazardous materials transport and collateral effects prediction; consequence assessment; and anti-terrorism/force protection.
- Development and application of state-of-the-art nuclear weapons effects models to support nuclear weapon stewardship and system hardness design.
- Development, maintenance, and use of unique DoD test and simulation facilities (to include infrastructure) and enabling technologies that are used to evaluate the impact of hostile environments from conventional, nuclear, and other special weapons on military or civilian systems or targets.
- Examination of existing U.S./Allied capabilities to hold hardened, deeply buried targets at risk; evaluation of capabilities against known or projected potential targets; and evaluation of new technologies for possible application against known shortfalls.
- Targeting and Intelligence Community (IC) support to warfighters that provides functional vulnerability assessments of hostile foreign systems.

Nuclear Sustainment:

The nuclear sustainment program, driven by the specific taskings of the National Strategy, National Military Strategy and the Joint Strategic Capabilities Plan, has two projects, i.e., Nuclear Operations and System Survivability.

- Nuclear Operations develops and supports the National Nuclear Mission Management Plan, Nuclear and WMD Emergency Response Capability, nuclear and WMD training expertise for

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Mission Description and Budget Item Justification (cont'd)

DoD, nuclear weapon systems safety assessments, nuclear planning systems, nuclear deterrent option analyses, technical support for nuclear C4I requirements and WMD threat mitigation analyses.

- The System Survivability Project develops simulator technology (nuclear, blast, thermal, radio frequency (RF) propagation, and optical/infrared (IR) background effects), electronics technology (radiation-hardened microelectronics, balanced electromagnetic hardening technology, radio frequency threat reduction), assessment and protection technology, and provides technology to support the Congressionally mandated Nuclear Test Personnel Review. These development areas directly support the development of survivable and reliable systems for the warfighter.

Together, the Counterproliferation Technologies and Nuclear Sustainment projects comprise a critical component of the ability of the Department to meet the technology and sustainment challenges posed by the emerging international environment and the National Military Strategy. The coverage of the projects ranges from counter-terrorism through conventional conflict through countering WMD threats to the maintenance of the national strategic nuclear deterrent. Through these projects, DTRA is a major contributor to the requirements posed by the Shape, Respond and Prepare strategy for the defense of the nation.

It should be noted that information concerning Project AL is classified per DoD Directive 0-5205.7, Para B.2.f.

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Project AB - Test & Simulation Technology - Development of effective, survivable, and economical weapon systems requires robust testing technologies and simulation capabilities to support acquisition managers, nuclear effects researchers, and decision-makers. This project develops, provides and maintains unique DoD test and simulation facilities and enabling technologies that are used by the Defense Agencies, the Services and other federal agencies to evaluate the impact of hostile environments from conventional, nuclear and other special weapons on military or civilian systems and targets. These facilities provide blast, thermal, electromagnetic pulse, mechanical impulse, ionizing radiation and radio frequency propagation environments and testbeds to support DoD and national test requirements. This project leverages fifty years of testing expertise to investigate weapons effects and target response to a spectrum of hostile environments that could be created by proliferant nations or terrorist organizations with access to advanced conventional weapons or weapons of mass destruction (nuclear, biological and chemical).

The project includes the upgrade of existing simulators and test support technologies to extend the utility and life of simulators, the decommissioning of under-utilized simulators, and the development of new simulators to support emerging customers from DoD/Department of Energy (DOE), National Security Agency (NSA), and U.S. Allies. Additionally, it provides the innovative, enabling technologies that make simulator enhancements and new facilities technically feasible and cost effective. Specific programs in this project include: 1) Based on user test requirements, maintain two existing test centers--one at Maxwell Physics International in San Leandro, California, and one at Arnold Engineering Development Center (AEDC) in Tullahoma, Tennessee, including the development, construction and checkout of the new Decade x-ray facility; development of technologies to provide enhanced radiation sources on the Decade simulator. 2) Development of communications and radar propagation effects simulators, and infrared and optical scene generators; partnership with Sandia National Laboratories (DOE) to develop technologies in energy storage, power flow, plasma switches, debris shields, and radiation sources that are applicable to stockpile stewardship and DoD strategic systems sustainment. 3) Characterization, optimization and operation of the Large Blast/Thermal Simulator (LB/TS) at White Sands Missile Range (WSMR), including the demonstration of a non-ideal airblast simulation capability. 4) Maintenance of the Advanced Research Electromagnetic Simulator

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Project AB - Test & Simulation Technology (cont'd)

(ARES) electromagnetic pulse (EMP) facility at Kirtland AFB. 5) Operation and maintenance of the Thermal Radiation Test Facility (TRTF) at Kirtland AFB. 6) Target defeat assessments for precision-guided and special weapons against Weapons of Mass Destruction (WMD) related targets. 7) Refurbishment, maintenance, characterization, and evaluation of the Magnetic Flyer Plate Facility for testing of stockpile systems in cooperation with the Department of Energy, U.S. Navy's Strategic Systems Programs, Lawrence Livermore National Laboratory, and Sandia National Laboratory. This Project is applicable to stockpile stewardship and DoD strategic systems sustainment.

The project provides test beds for full- and sub-scale tests that focus on weapon-target interaction with fixed, hardened facilities to include hardened aboveground bunkers, cut-and-cover facilities and deep underground tunnels. This effort supports the Services' requirements for hard target defeat testing and emphasizes teaming with the Services to assess weapon-target interaction of existing and developmental weapon systems. Specific activities include test bed design and construction, instrumentation and data collection, test coordination and execution, and post-test analysis and documentation.

This project relies on hardening and simulation technologies (Testable Hardware and Aboveground Testing/Underground Testing (AGT/UGT) Correlation) funded under Project AF and supports the evaluation of weapons lethality accomplished in Projects AC and AI. Funded programs support JCS Joint Warfighting Capabilities: Control Space, Counterproliferation, Discriminate Attack, Global Reach and Situational Awareness, and also provide support to STRATCOM, EUCOM, USFK (PACOM), and ACOM.

FY 1999 Accomplishments

Test & Simulation (\$22,765K)

Continued Radar Nuclear Effects Corruption and Simulators (RNECS) development for testing of the User Early Warning Radars (UEWRs).

Initiated development of the Wide Band Channel Simulator (WBS).

Began initial operational test planning for the Inflight Interceptor Communication Systems (IFICS).

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Project AB - Test & Simulation Technology (cont'd)

Developed a modified version of the RNECS corruptor software and installed it into the National Missile Defense (NMD) Ground-Based Radar (GBR) Hardware-in-the-Loop (HWIL) facility.

Initiated the development of the True Display Simulator to provide an infrared (IR) test set to support testing of IR focal planes.

Completed modifications to LB/TS for blast and thermal diagnostics. Tested one Navy ship decking and six Israeli tactical systems.

Continued to respond to emerging user testing needs through R&D upgrades.

Continued to provide high explosive (HE) simulation infrastructure and test support, and maintained Permanent High Explosives Test Site (PHETS) facility at WSMR and Chestnut Site at Kirtland AFB.

Completed large scale high explosive test in hard rock.

Continued to rehab test target facilities at WSMR.

Continued to support LB/TS maturing Non-Ideal Air Blast (NIAB) technology, window testing capabilities, and testing of vehicles against ideal nuclear airblast and thermal effects.

Continued HE infrastructure support of Phase 2 Advanced Concepts Technology Demonstration (ACTD), Antiterrorism, and Hard Target Defeat (HTD) Testing.

Continued phenomenology testing of penetration of weapons into rocks and into damaged concrete. Continued penetration testing into granite. Initiated testing into limestone.

Continued Joint Attack Stand-Off Missile (JASSM) infrastructure test support of three out of five fundamental target types. JASSM program also supports the CP and HTD program.

Continued Advanced Research Electromagnetic Simulator (ARES) refurbishment effort.

Completed ARES support of small operation testing and the TRW, Inc., Army tent tests.

Radiation Simulators (\$24,889K)

Completed closure of the high power microwave facility at Maxwell Physics International.

Continued to support ongoing nuclear weapons effects (NWE) testing programs by maintaining DTRA's suite of radiation simulators.

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Project AB - Test & Simulation Technology (cont'd)

Demonstrated high-spectral fidelity hot x-ray sources on the PITHON simulator.
 Demonstrated and deployed quick-turnaround, cold x-ray diagnostic system to improve user testing efficiency.
 Continued development of large survivable passive debris shields for cold x-ray testing on the Double-EAGLE simulator.
 Completed Decade Quad in the hot x-ray mode at AEDC.
 Optimized Decade Quad hot x-ray source performance for user testing.
 Initiated development of the Decade cold x-ray source to include the power flow technology to combine the four modules.
 Developed Decade improvement program for power flow technologies to support improved fidelity and intensity of x-ray sources.
 Demonstrated 50% increase in the efficiency of long-implosion soft x-ray sources in support of Decade and future x-ray simulators.
 Demonstrated high-fidelity cold x-ray sources on the Z facility at Sandia National Laboratories.
 Demonstrated active debris mitigation techniques for debris-free exposures greater than 300 cm².
 Developed current density-imaging, plasma radiation source (PRS) diagnostics with demonstration of a Plasma Opening Switch (POS) diagnostic.
 Doubled efficiency of laser plasma x-ray sources for nuclear weapons effects testing, using the Nova laser, and commenced development of improved sources using the Omega laser.
 Continued development of a transportable, compact, high-fidelity hot x-ray simulator for in-plant electronics testing.

Weapon/Target Interaction (\$12,775K)

Developed and validated tunnel targeting capability for system component level.
 Continued to construct and rehab test target facilities, provide utilities, to maintain the construction capability infrastructure, and to execute tests for CP, HTD, and Hard and Deeply Buried Targets (HDBT) programs.

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Project AB - Test & Simulation Technology (cont'd)

Continued tunnel testbed facility outfitting and utilization in tunnel defeat demonstration series.

Initiated design of second tunnel facility.

Continued to develop signature requirements and munitions effectiveness assessment for hard target defeat.

Collected operational signatures for tunnel testbed facility.

Began rehab of industrial targets for the assessment of WMD component damage, target response, and collateral effects for conventional weapons and enhanced payloads.

Small Business Innovative Research (SBIR) (\$1,314K)

Supported the Small Business Administration (SBA) National Direction by actively seeking small business contractors to perform innovative research.

Executed Agency-approved SBIRs.

FY 2000 Plans

Test & Simulation (\$30,613K)

Complete RNECS development and begin initial operational tests for NMD.

Develop mitigation techniques for GBR in a nuclear-disturbed environment for incorporation into RNECS to support testing.

Continue communication/radar atmospheric effects simulator participation in operability assessment/warfighting exercises.

Evaluate NMD UEWRs for operability and continue advanced SATCOM Simulation Test

Support to MILSTAR, IFICS, and Global Positioning System upgrades.

Develop advanced optical scene generator techniques and capabilities to support testing of NMD IR sensors.

Continue to provide HE simulation infrastructure and test support, and maintain PHETS facility at WSMR and Chestnut Site at Kirtland AFB.

Continue to rehab test target facilities at WSMR.

Complete LB/TS NIAB development and tests, improve window testing capabilities, and continue testing of vehicles against nuclear airblast and thermal effects.

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Project AB- Test and Simulation Technology (cont'd)

Continue HE infrastructure support of Phase 2 ACTD, Antiterrorism and HDT Testing.

Continue phenomenology testing of penetration of weapons into rocks and into damaged concrete.

Continue penetration into limestone and complete testing into damaged concrete.

Continue infrastructure support of JASSM test support of three fundamental target types.

Radiation Simulators (\$24,643K)

Continue to support ongoing nuclear weapons effects testing programs by maintaining DTRA's suite of radiation simulators.

Upgrade cold x-ray, debris-free test capabilities on Double-EAGLE at Maxwell.

Initiate and complete Advanced Concepts Experiments (ACE-4) research and development testbed closure.

Upgrade control systems on radiation simulators at Maxwell Physics International for improved reliability.

Enhance remote on-line simulator access data encryption and access control capabilities.

Complete hardware modifications to the Decade Quad for the cold x-ray mode at AEDC.

Demonstrate a 30% increase in the hot x-ray dose and improved reproducibility on the Decade Quad.

Continue the development of power flow and high-dose and high-dose-rate hot x-ray technologies to support improved fidelity and intensity of Decade x-ray sources.

Initiate development of active debris mitigation techniques for debris-free exposures on the Decade Quad greater than 500 cm².

Continue the development of improved efficiency long-implosion cold x-ray sources in support of Decade and future x-ray simulators.

Demonstrate and characterize high-fidelity plasma radiation sources on the Z facility at Sandia National Laboratories.

Complete conversion of high-density plasma models to high-performance computers.

Complete the development of the Compact X-Ray Simulator and begin the demonstration phase at a system developer's plant.

Demonstrate distributed laser-produced x-ray source technology.

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Project AB - Test & Simulation Technology (cont'd)

Continue risk reduction planning and the development of technology to dramatically improve the capability of non-nuclear x-ray test facilities.

Weapon/Target Interaction (\$8,068K)

Conduct operational tunnel defeat demonstrations using existing and developmental weapons.

Demonstrate reconstitution times and costs after each demonstration.

Collect signatures of the tunnel facility for characterization before, during, and after each weapon application.

Exercise target planning tools through each of the participating CINCs.

Initiate construction of tunnel facility #2 of a different functional type in a different geology.

Complete penetration testing into limestone and damaged concrete.

Conduct weapon lethality experiments to evaluate new weapons for functional defeat of tunnel facilities.

Small Business Innovative Research (\$1,176K)

Support the Small Business Administration (SBA) National Direction by actively seeking small business contractors to perform innovative research.

Execute Agency-approved SBIRs.

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Project AC - Weapons Systems Lethality - This project addresses the lethality of the full spectrum of weapons, including advanced conventional and nuclear weapons, against the target base of today and tomorrow -- ranging from ultra-hard underground facilities to above ground, unhardened surface facilities and other special facilities that may be associated with the production, storage or deployment of weapons of mass destruction. Helping to maintain the continued effectiveness of the nuclear deterrent, this project also seeks to provide decision makers and warfighters expanded conventional weapon options against well-protected, high-priority targets. The program relies extensively on advanced numerical methods, as well as laboratory scale experiments, intermediate and full-scale field tests and operational test data to quantify functional and physical damage criteria and collateral effects. Project results will be provided to operational planners through PC-Based analytic prediction and visualization tools, multimedia hypertext databases, and technical manuals. Central to this support is an automated expert system to assist in pre-strike target planning and post-strike battle damage assessment. Technology developed in this project will also enable civil agencies to assess engineering designs to mitigate direct and collateral damage from terrorist attacks such as occurred at the Oklahoma City Federal Building, Khobar towers attack in Saudi Arabia, and the U.S. Embassies in West Africa. Additionally, the technology developed directly supports force protection issues, operations other than war and DoD support to civil authority.

On a broader scale, improvements in weapon effects and target response codes will be used to upgrade and expand physics-based modeling and simulation. These improved codes include: coupled finite difference-finite element codes, structure-medium interaction codes, groundshock propagation codes suitable for jointed and/or layered media and high resolution dynamic codes capable of predicting the transport of hazardous aerosol clouds over complex terrain. The understanding of weapon-target interaction resulting from this project will support the generation of weapon system requirements for the changing worldwide target base and provide a quantitative basis for planning contingency operations against high value targets. It will also improve the understanding of target/weapon interactions and their consequences for battle damage prediction and assessment. The project also allows the assessment of collateral effects from counterforce attacks, military strikes, terrorist action, incident or accident from nuclear facilities.

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Project AC - Weapons Systems Lethality (cont'd)

Project AC also includes the development of advanced weapons hardware technology. It supports the development of high power electromagnetic (EM) source technology for warfighting applications and hardening technologies for emerging radiofrequency (RF) threats. This project also includes electrothermal chemical (ETC) gun advanced technology and projectile lifting body programs per memorandum of agreement (MOA) with the Navy; ETC gun technologies for direct-fire (tank) applications, per MOA with the Army; and initiates development of ETC gun technologies for future indirect fire (artillery) Army applications.

FY 1999 Accomplishments

Nuclear Weapons Effects Phenomenology (\$7,342K)

Provided technical support to Director of Military Support (DOMS) and Federal Emergency Management Administration (FEMA) under Federal Response Plan Exercise and special event support.

Delivered new operational commander exposure guidance to NATO.

Developed initial Electromagnetic Pulse Vulnerability Number (EMP-VN) methodology.

Provided on site training and operational support during NATO Able Alley.

Provided support for Air Force Agent Defeat weapons phase study.

Supported OSD theater nuclear force study.

Provided weapons effects support to STRATCOM-led SAND DUNE Study.

Supported Joint-Staff India Pakistan study.

Weapon/Target Interaction (\$12,005K)

Developed detailed analysis of blast effects on First and Third Generation Aircraft Shelters to include the effects on stored assets and protection viability.

Provided technical support, hardware/software to integrate weapons effects, target response codes in distributive interactive environment.

Developed 3-dimensional, real-time visualization of targets with variable damage levels from physics-based weapon effects.

Developed an initial multi-weapon attack model for Munitions Effects Assessment (MEA).

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Project AC - Weapons Systems Lethality (cont'd)

Participated in a Joint ALLIED FORCE MEA exploitation team that gathered "ground truth" of attacks against high value targets in Kosovo.

Received accreditation of MEA 3.1 by the Joint Technical Coordinating Group for Munitions Effectiveness (JTTCG/ME).

At the request of Deputy Secretary of Defense, executed a full-scale truck bomb test for forensic analysis of the Kohbar Tower Terrorist bombing.

Produced and distributed over 500 copies of the CD-ROM revision of the Design and Analysis of Hardened Structures (DAHS) manual and began work on an update to DAHS, based on state-of-the-art technology.

Completed field-scale and full-scale testing to reduce the uncertainty of penetration tests into rock, weathered rock, and hardened targets using advanced weapon concepts.

Initiated the Integrated Target Planning Tool Set (ITPTS) that provides the warfighter a standardized weaponeering framework for a full spectrum of weapons and targets.

Released Hazard Prediction and Assessment Capability (HPAC) version 3.2, a suite of software tools supporting target planning and collateral effects mitigation on WMD targets.

Provided Operational Planning/Battle Damage Assessment to support JCS Deputy Directorate for Targets (J2T) for Operation Desert Viper, Desert Fox, and Allied Force NATO operations.

Provided WMD and industrial hazard assessment for each associated target nomination during Operation Allied Force, Desert Fox, and other classified operations.

Integrated HPAC tools into Joint Warning (JWARN) and Reporting system.

Integrated HPAC into Army's Space and Missile Defense Command Post Engagement Ground Effects Model (PEGEM) theater missile engagement code.

Briefed comprehensive HPAC Verification and Validation (V&V) Program to Chemical and Biological Community.

Developed and maintained Automated Weather Data Servers providing full-time, classified and unclassified, world-wide weather support for all HPAC users.

Maintained selected Air Force and Navy weather forecast and observation products.

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Project AC - Weapons Systems Lethality (cont'd)

Maintained ETC plasma ignitors, to overcome temperature-induced performance degradations.

Completed pack-up for transportation of the Green Farm Electric Gun R&D Facility so as to vacate Marine Corps Air Station Miramar (due to BRAC realignment) by 30 Sep 99.

Maintained EM gun firing operations until Dec 98 in support of the United States/United Kingdom (U.S./U.K.) program and ETC phenomenology and gun testing operations until Jun 99.

Demonstrated in a five-round repeatability firing series—a 39% increase in muzzle energy performance from the M256 120mm tank gun.

Demonstrated performance of lightweight composite five-inch gun rocket powered projectile at Wallops NASA firing site.

Completed isotopic inventories for reprocessing facilities and time-varying reactor source terms.

Integrated worldwide population database into HPAC and Consequence Assessment Tool set (CATS), providing nuclear casualty estimates and a readily updateable database capability.

Technical Information (\$1,247K)

Completed and demonstrated integrated NWE computational aids.

Updated 2 chapters of Effects Manual-1 (EM-1).

Application of Nuclear Weapons Expertise (\$13,082K)

Constructed brassboard compact power sources.

Defined the vulnerability of nuclear reactors and nuclear reprocessing facilities to advanced conventional weapons effects.

Applied High Power Microwave/Electromagnetic (HPM/EM) hardening technology to critical, disaster recovery, communications hub in partnership with the U.S. Telecommunications industry.

Reviewed the lethality models for Soviet missile silos in light of current technical information to support a Defense Intelligence Agency (DIA) request. Supported revision of vulnerability number (VN).

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Project AC - Weapons Systems Lethality (cont'd)

Fielded a Beta test version of an assessment tool for evaluating vulnerabilities to radio frequency attack. This software modeling product is capable of estimating backdoor protection requirements using innovative cavity absorption and device rectification models completed under science and technology (S&T) contracts.

Completed the laboratory phase of a retrofit protection hardware research effort and began the verification phase with a full-scale field test. This effort quantified the benefits of various protection techniques, developed new measurement processes, and developed new measurement hardware needed to analyze and quantify protection for RF attack.

Completed the basic material and design research on monolithic microwave integrated circuit (MMIC) protection devices. Commenced planning to build a prototype device for sensitive communication receiver protection.

Developed a totally passive version of the popular Witness Chip RF detector. This device features a unique, unpowered fiber optic sensor head.

Completed the laboratory phase of studying the behavior and quantifying the parameter associated with forming retrofit RF protective layers from mesh materials.

Small Business Innovative Research (\$451K)

Supported the Small Business Administration (SBA) National Direction by actively seeking small business contractors to perform innovative research.

Executed Agency-approved SBIRs.

FY 2000 Plans

Nuclear Weapons Effects Phenomenology (\$5,342K)

Distribute completed Volumes 1 and 3 of Nuclear Weapon Manual and Output Handbook.

Complete evaluation of targeting techniques for high enthalpy tunnel airblast for STRATCOM.

Complete initial 2-dimensional nuclear weapon output calculations for strategic systems.

Complete EMP-VN system development for long lines for STRATCOM and DIA.

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Project AC - Weapons Systems Lethality (cont'd)

Complete electronic interactive version of the EM-1 nuclear phenomenology/effects series.

Complete the development of a lethality and collateral effects assessment tool for nuclear strikes on a full spectrum of WMD targets for NATO and STRATCOM.

Implement HEMP and Source Region EMP Targeting Applications (SREMPTAPS) tools for DIA-specified potential threat weapons.

Continue the development of models of long term impact of nuclear hazards on the ecosphere.

Complete the ground motion analysis of Degelan tests.

Initiate non-ideal airblast phenomenology update.

Complete fallout micro-physics modeling leading to updated fallout code.

Technical Information (\$938K)

Update final chapters of Effects Manual-1.

Continue Project Graybeard archiving efforts.

Applications of Nuclear Weapons Expertise (\$9,071K)

Develop and integrate MEA for application of nuclear weapons to defeat WMD targets, agents and material.

Develop both physical/functional defeat models for enhanced warhead concepts such as high temperature incendiary.

Develop advanced solid-state technology for microwave applications with a service partner.

Integrate RF detection device ("Witness Chip") into existing commercial off the shelf (COTS) and military specification (MILSPEC) equipment.

Complete the joint assessment of mobile telecommunications hardware susceptibility to radio frequency threats.

Incorporate innovative monolithic integrated circuit (MMIC) limiter device using substrate conduction into a sensitive communication receiver in cooperation with the Office of Naval Research.

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Project AC - Weapons Systems Lethality - (cont'd)

Investigate various advanced composite materials to develop a frequency selective shielding capability to pass desired signals, but inhibit damaging signal frequencies.

Weapon Target Interaction (\$5,771K)

Deliver Lethality/Vulnerability models for reinforced-concrete wall damage due to internal and soil bursts to MEA 4.0.

Release MEA technology preview to support CP and Tunnel Defeat Demonstration (TDD) programs. Include Joint Attack Stand-Off Missile (JASSM) and Tactical Tomahawk Penetration Variant (TTPV) in this technology preview.

Deliver IMEA 4.0 to the warfighter in fall of FY00.

Upgrade reinforced-concrete wall damage models for MEA 5.0

Integrate into MEA 5.0 new reinforced-concrete wall damage models.

Obtain accreditation for the MEA 4.0 that includes the Tunnels Module.

Conduct an Integrated Target Planning Tool Set (ITPTS) functionality demonstration.

Deliver ITPTS version 1.0 to the warfighter.

Complete an anti-terrorism (AT) analysis of the National Military Command Center, vital facilities in Washington, DC, and embassies for Department of State, and assist in the analyses of high-interest facilities in the Washington, DC area.

Complete a forensic analysis of East African terrorist bombings in association with the FBI.

Deliver preliminary computational structural dynamics (CSD) code using advanced numerical methods.

Develop new, fast-running algorithms for use in AT Planner, using the best available computational fluid dynamics (CFD) codes to define blast loads, and CSD codes to assess structural and personnel hazards.

Conduct precision wall damage tests on hardened reinforced concrete walls.

Convene Nuclear Regulatory Commission (NRC) panel to develop V&V guidelines for CSD codes.

Continue enhancement of Protective Structures Analysis and Design System.

Establish a Conventional Weapons Effects Database.

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Project AC - Weapons Systems Lethality - (cont'd)

Complete a Battle Damage Assessment of high-value targets in Kosovo, in association with the FBI.

Complete a Force Protection Analysis of key Command and Control Complexes in Kosovo, in association with Force Protection Branch.

Test and Simulation (\$1,285)

Demonstrate HE charge design for tunnel airblast simulation.

Execute proof-of-principle nuclear airblast in tunnel simulation.

Small Business Innovative Research (\$644K)

Support the Small Business Administration (SBA) National Direction by actively seeking small business contractors to perform innovative research.

Execute Agency-approved SBIRs.

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Project AE - Weapon Safety and Operational Support - This project is critical to the maintenance of a safe, secure and reliable nuclear deterrent. Stockpile support efforts in this project include nuclear weapons stockpile technology for weapon system sustainment, probabilistic risk-based system safety assessments, and nuclear physical security policy/requirements validation. Reliability efforts include participation and assistance to Dual Revalidation, Annual Certification, and the Stockpile Stewardship Program. This project performs research and development in support of nuclear contingency planning, force structure deployment and employment options, innovative nuclear command and control concepts, nuclear mission planning, vulnerability assessments, safety assessments, advanced survivability concepts, and theater missile defense against Weapons of Mass Destruction (WMD) delivery systems and warheads. Vulnerability assessments of DoD and Allied fixed and mobile Command, Control and Communications (C3) assets subjected to WMD effects are also part of this project. This project includes Modeling and Simulation Center efforts to integrate weapons effects into High Level Architecture (HLA) compliant environments to support operational training and exercise. Oversight, technical support and curriculum review for the Defense Nuclear Weapons School (DNWS) and other DoD nuclear training activities are also provided.

This project is in direct support of Presidential Decision Directives (PDD) and taskings and requirements from OSD, the Joint Staff and CINCs. Relevant directives include National Security Strategy of Engagement and Enlargement, National Security Science and Technology Strategy, National Military Strategy, Joint Strategic Capabilities Plan, Presidential Decision Directives, Defense Planning Guidance, and prioritization memorandums from CINCs. These efforts have been closely coordinated with Joint Staff, OSD offices, CINCs and Services, Department of Energy, Federal Emergency Management Agency and the Federal Bureau of Investigation. The thrust of this project supports the JCS Joint Vision 2010 Warfighting Capabilities of Dominant Maneuver, Precision Engagement, and Full-Dimensional Protection.

FY 1999 Accomplishments

Nuclear Operations (\$17,859K)

Continued the safety assessment for the dual capable fighter aircraft in Europe.

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Project AE - Weapon Safety and Operational Support (cont'd)

Continued the safety assessment of the B-52H aircraft.
 Began B-2 Weapon System Safety Assessment (WSSA) at the request of the Air Force Safety Center.
 Analyzed and quantified DOE Nuclear Detonation Safety Exceptions (NDSEs).
 Conducted Fuel Fire Modeling and Testing to support ongoing WSSAs.
 Developed a WSSA data base to archive completed WSSAs.
 Began storage vault blast effects testing and analysis at the request of the Air Force Safety Center.
 Began development of portable, mobile, and rapidly deployable radiation detection and measurement system comprised of remote sensor linked to central receiving/processing station via Radio Frequency (RF) signals.
 Conducted Forces Support nuclear and WMD technical analyses as required by CINCs, Services, Joint Staff, OSD, and Nuclear Weapons Council (NWC) on force structure, weapons safety and security, theater missile defense, counterproliferation, planning, and international military and political security issues.
 Completed WMD Threat Analyses for Aerial and Sea Ports of Debarkation for Strategic Air and Sea Lift.
 Delivered the NATO Nuclear Planning Systems Training System prototype to Supreme Headquarters Allied Powers Europe (SHAPE).
 Completed DTRA role in the development of the Air Vehicle Planning System project with transfer of the program to STRATCOM.
 Completed the DTRA initial support effort for the Nuclear Target Data Feed project of NATO targeting support.
 Completed deterrence framework analyses (China, INDO-PAK, Non-State Actors, Iraq) in support of requirements from STRATCOM, USFK/PACOM, CENTCOM, Assistant Secretary of Defense (ASD) (Strategy & Threat Reduction), ASD (Special Operations & Low-Intensity Conflict)(SOLIC), and Director, Counterproliferation Policy.
 Completed coordination of and planning for USAFE Force-on-Force (FoF) exercise.
 Completed planning support and asset allocation in support of AFSPACECOM/20th AF for ICBM Security engineering test plan.

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Project AE - Weapon Safety and Operational Support (cont'd)

Completed initial planning and definition of FoF test program for ICBM facilities.
Completed consequence management support to ACOM for development of the requirements and training of DoD response forces.

Continued deterrence framework analyses as requested by CINCs and OSD.

Continued workshops and area focus reports examining the future international context as it impacts nuclear and WMD options, planning requirements and deterrence.

Continued NATO nuclear planning support, especially analyses of future C4I and planning systems for nuclear operations and WMD threat analyses.

Continued European Theater support issues (Joint Theater Surety Management Group, High Level Group, dual capable aircraft operations, NATO WS3 vaults, Replacement Training Weapon (RTW)).

Continued nuclear support for PACOM-operational issues/nuclear options.

Continued prediction calculation (PdCALC) system support and integration with U.S. Army Nuclear and Chemical Agency (USANCA) nuclear effects model.

Continued Single Integrated Operational Plan (SIOP) support for STRATCOM J-5.

Continued WMD threat analysis for CENTCOM/USFK/TRANSCOM, focused on the chemical threat to air and infrastructure operations.

Prepared and provided direct support to NATO nuclear exercises (Able Staff) and assisted with nuclear exercises Able Crystal and Able Ally.

Continued to provide quick-turn analysis on WMD consequence issues for OSD, Services, and Joint Staff and provide weapons effects analysis to weapons Project Officer's Groups and weapons modification programs as required.

Continued development of an integrated reporting system for automated reporting of NBC activity and hazard predictions.

Provided support to the CINC planning staffs on NBC capability and impacts on warfighting capability.

Developed mission and consequence analysis for HQ Air Combat Command's (ACC) Agent Defeat Weapon phase studies and Analysis of Alternatives (AOAs).

Education/Training to Maintain Core Competencies (\$1,037K)

Provided nuclear operational training support to CINCs, Services, and OSD.

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Project AE - Weapon Safety and Operational Support (cont'd)

Continued development of general interest DoD nuclear training program.
Continued development, improvement, and integration of course materials for the DNWS.
Supported DoD and CINC exercises and wargames with WMD/target response analysis.
Expanded expertise outreach program to OSD and War Colleges.
Initiated a nuclear/WMD "train-the-trainer" program for the DNWS.
Provided vulnerability assessment training to critical infrastructure components.

Nuclear Weapons Stockpile Programs (\$990K)

In support of stockpile stewardship and reliability, continued participation in, and support to, the Dual Revalidation program with research, technical analysis, and assessment reports.
Provided technical support and recommendations to OSD, Joint Staff, Services, STRATCOM and other Combatant Commanders related to weapons safety, reliability, and performance.
Continued support to the Annual Certification program and support to the services' weapons life-extension programs.
Provided management and technical support to DoD programs for sustainment of the nuclear deterrent, and began development of a DoD-wide Nuclear Mission Management Plan (NMMP).

Modeling and Simulation (\$3,466K)

Upgraded and refined operations of the WMD Assessment and Analysis Center.
Continued integration of the lethality tool set with weather modules, underground target data, and the effects of enhanced payloads.
Continued technical and advanced modeling and simulation support to CINC sponsored exercises world-wide.
Provided an integrated program for analysis and testing of alternate strategies, force employment options and technologies.
Continued to provide technical and operational consequence analysis support for exercises and wargames.
Began development of a WMD model to include the use and effects of WMD in a joint theater-level simulation.

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Project AE - Weapon Safety and Operational Support (cont'd)

Implemented the Analysis and Assessments program to provide real-time support to Services and CINCs through enhanced infrastructure, deployment teams, integrated models, and technical support.

Updated and refined support database per CINCs, Services, and Joint Staff guidance and continued development of consequence analysis of WMD counterproliferation programs.

Nuclear Weapons Effects Phenomenology (\$1,171K)

Integrated the services' global and regional scale models with in-theater high resolution capability to provide seamless weather input for hazard prediction assessment from continental to local scale.

U.S./Allied Survivability & Operability in Nuclear/Designated Advanced Weapons Environments (\$5,942K)

Conducted Balanced Survivability and Integrated Vulnerability Assessments on DoD facilities as tasked by CINCs, Joint Staff, OSD, and NATO.

Assisted CINCs and intelligence community in target planning against hard and deeply buried facilities.

Conducted integrated vulnerability assessments of defense and critical national infrastructure facilities.

Applied sensor technology for target detection, target characterization and battle damage assessments.

Conducted two nuclear command and control mission assessments.

Conducted over 200 Chessmaster briefings to Flag/General Officer/senior civilian personnel in DoD and other government organizations.

Completed Phase I of Global Assessment of a major DoD support system.

Weapon/Target Interaction (\$1,364K)

Developed visualization tools for weapon effects models that are compatible with the High Level Architecture (HLA).

For a particular legacy model or simulation, continued to define a Simulation Object Model (SOM), integrated the Runtime Infrastructure (RTI) and HLA functionality into that model, and transformed the model's data structure into the SOM data representation.

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Project AE - Weapon Safety and Operational Support (cont'd)

Established a Weapons Effects Federation Object Model to allow interaction between SOMs and to effect the passing of weapons effects data between simulations.

FY 2000 Plans

Nuclear Operations (\$20,682K)

- Complete the safety assessment for the dual capable fighter aircraft in Europe.
- Complete the safety assessment of the B-52H aircraft.
- Continue B-2 WSSA.
- Continue to analyze and quantify DOE NDSEs.
- Conduct modeling and testing to support ongoing WSSAs.
- Continue the development and population of the WSSA database to archive completed WSSAs.
- Begin the C-17 Aircraft Transportation Study.
- Continue Storage Vault Blast Effects Testing and Analysis.
- Continue development of portable, mobile, and rapidly deployable radiation detection and measurement system, comprised of remote sensor linked to central receiving/processing station via Radio Frequency (RF) signals.
- Continue to conduct Forces Support nuclear and WMD technical analyses as required by OSD, Services, Joint Staff, and NWC on force structure, weapons safety and security, theater missile defense, counterproliferation, planning and international military and political security issues.
- Continue to conduct technical analyses to support CINCs, concerning nuclear and WMD operational force planning, counterproliferation, nuclear forces, command and control, and regional security issues in light of the changing international security environment.
- Continue to provide deterrence framework analyses as requested by CINCs and OSD.
- Continue to provide workshops and area focus reports, examining the future international context as it impacts nuclear and WMD options, planning requirements and deterrence.
- Continue to support NATO nuclear planning, especially analyses of future C4I and planning systems for nuclear operations and WMD threat analyses.

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Project AE - Weapon Safety and Operational Support (cont'd)

Continue to support European Theater issues (Joint Theater Surety Management Group, High Level Group, dual capable aircraft operations, NATO WS3 vaults, Replacement Training Weapon (RTW)).

Continue to provide nuclear support for PACOM operational issues/nuclear options.

Continue to provide PdCALC system support and integration with U.S. Army Nuclear and Chemical Agency (USANCA) nuclear effects model.

Continue to provide SIOP support for STRATCOM J-5.

Continue to provide WMD threat analysis for CENTCOM/USFK/TRANSCOM, focused on the chemical threat to air and infrastructure operations.

Maintain support to NATO nuclear exercises Able Staff, Able Ally and Able Crystal.

Provide analytical support in assessing STRATCOM's capability to effectively meet national objectives involving the SIOP, based on potential changes to the threat, national policy, and force structure.

Conduct an annual force-on-force (FoF) exercise to evaluate and validate policy standards as designated by the Security Policy Verification Committee (SPVC). Conduct FoF exercise in coordination with AFSPACECOM and 20th AF for ICBM security.

Complete SHAPE Survive to Operate (STO) analysis for NATO out-of-area operations.

Continue to provide quick-turn analysis on WMD consequences issues for OSD, Services, and Joint Staff and provide weapons effects analysis to weapons Project Officer's Groups and weapons modification programs as required.

Continue development of an integrated reporting system for automated reporting of NBC activity and hazard predictions.

Continue to provide support to the CINC planning staffs on NBC capability and impacts on warfighting capability.

Continue to develop mission and consequence analysis for HQ ACC Agent Defeat Weapon phase studies and AOA's.

Continue to provide analysis to the CINCs in support of their counterproliferation development missions.

Education/Training to Maintain Core Competencies (\$646K)

Continue to provide nuclear operational training support to CINCs, Services, and OSD.

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Project AE - Weapon Safety and Operational Support (cont'd)

Continue development of general interest DoD nuclear training program.
Continue development, improvement, and integration of course materials for the DNWS.
Continue to support DoD and CINC exercises and wargames with WMD/target response analysis.
Continue to expand expertise outreach program to OSD and War Colleges.
Continue the nuclear/WMD "train-the-trainer" program for the DNWS.

Nuclear Weapons Stockpile Programs (\$2,568K)

In support of stockpile stewardship and reliability, continue participation in, and support to, the Dual Revalidation and DOE Baseline programs with research, technical analysis, and assessment reports.
Continue to provide technical support and recommendations to OSD, Joint Staff, Services, STRATCOM and other Combatant Commanders related to weapons safety, reliability, and performance.
Continue support to the Annual Certification program and support to the services' weapons life-extension programs.
Continue to provide management and technical support to DoD programs for sustainment of the nuclear deterrent. Continue development and update of the DoD Nuclear Mission Management (NMMP) as directed.
Begin development of the Virtual Underground Test Program, which will use a combination of codes, models, simulators, and legacy test data to evaluate weapons system survivability, in support of requirements to maintain a survivable nuclear stockpile.

Modeling and Simulation (\$8,975K)

Continue to upgrade and refine operations of the WMD Assessment and Analysis Center.
Complete the development of a three dimensional, physics-based, weapons effects simulation, which includes weather modules, underground target data, and the effects of enhanced payloads.
Continue to provide technical and advanced modeling and simulation support to CINC sponsored exercises world-wide.

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Project AE - Weapon Safety and Operational Support (cont'd)

Continue to provide an integrated program for analysis and testing of alternate strategies, force employment options and technologies in a WMD environment, using state-of-the-art simulations.

Continue to provide technical and operational consequence analysis support for exercises and wargames.

Complete the development of a WMD module to allow the assessment of WMD operational plans, using existing joint theater-level simulations. Continue to implement the Analysis and Assessments program to provide real-time support to Services through enhanced infrastructure, deployment teams, integrated models, and technical support.

Continue to update and refine support database per CINCs, Services, and Joint Staff guidance and continue development of consequence analysis of WMD counterproliferation programs.

Maintain permanent (virtual) presence at the Joint Warfare Simulation Center (JWARS) and the Joint Simulation System (JSIMS), supporting WMD modeling within these critical programs.

U.S./Allied Survivability & Operability in Nuclear/Designated Advanced Weapons Environments (\$5,388K)

Continue to conduct Balanced Survivability and Integrated Vulnerability Assessments on DoD facilities as tasked by CINCs, Joint Staff, and OSD.

Continue to assist CINCs and intelligence community in target planning against hard and deeply buried facilities.

Continue to conduct integrated vulnerability assessments of defense and critical national infrastructure facilities.

Continue to apply sensor technology for target detection, target characterization and battle damage assessments.

Begin integration of infrastructure and event data into FBI Geographic Information System (GIS)-based tools.

Begin assessments and verification and validation of potential WMD scenarios and impacts.

RDTE&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2000
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Project AE - Weapon Safety and Operational Support (cont'd)

Begin implementation and testing of approved WMD mitigation strategies, CBR filtration, sensors, flow test, structural/window/heating, ventilation, and air conditioning (HVAC) system retrofit(s).

Weapon/Target Interaction (\$559K)

Continue development of visualization tools for weapon effects models that are compatible with the HLA.

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Project AF - Weapon System Operability - Current and future warfighters and weapon systems, including the associated Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) and support systems/equipment, must be able to survive and operate effectively through a spectrum of hostile environments. Planned efforts emphasize the development and demonstration of innovative and cost effective technologies to sustain the operability of U.S. and Allied Forces and systems to advanced conventional weapons, special weapons and limited nuclear attack. Military systems of interest include those that support military missions in the air, on land, at sea, or in space. The Smart Building program supports the software, modeling and simulation development to support a Joint Operations Center (JOC) with the FBI. Models will be consistent with existing FBI GIS-based tools and Responder Assets Management System (RAMS) integration. The Smart Building effort will provide the portable WMD equipment, and will also provide for facilities inspections and retrofits.

This project constitutes the DoD's resident science and technology expertise in nuclear and related operability matters. It develops and demonstrates affordable strategies and hardening technologies for U.S. systems; transfers the technical products to acquisition program offices; conducts component, subsystem, system and end-to-end performance testing and assessments as requested by the Services and CINCs; and provides support to the Office of the Secretary of Defense on technical and policy matters that relate to the acquisition of survivable systems and strategic system sustainment. Specific programs in the project include: development and demonstration of the enabling technologies for ensuring the continued availability of special materials and radiation-hardened microelectronics and photonic devices; development and demonstration of affordable hardening and mitigation methods that treat the adverse effects from electromagnetic, natural space and nuclear weapons engendered radiation (i.e., ionizing radiation and displacement damage), nuclear electromagnetic pulse (EMP), high power microwave (HPM) and nuclear atmospheric environments; direct support to warfighters by predicting and quantifying the operational impact/risk of nuclear, biological and chemical (NBC) and conventional battlefield environments on systems and personnel; development and demonstration of cost-effective system design and test certification techniques for

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Project AF - Weapon System Operability (cont'd)

testable hardware that do not require underground nuclear tests; methods for measuring and increasing soldier effectiveness on NBC battlefields; performance and cost analysis to support the Defense Acquisition Board; and joint efforts with system program offices to apply the Agency's expertise and technologies to specific Service applications.

This project provides the testable system design rules and protocols for users of nuclear effects simulators that are funded in Project AB. It also supports the following JCS Joint Warfighting Capabilities: Information Superiority, Counterproliferation, Electronic Warfare, and Precision Force.

FY 1999 Accomplishments

Nuclear Weapons Effects Phenomenology (\$10,534K)

- Supported Air Force Office of Testing and Evaluation Center (AFOTEC) Space-Based Infrared Satellite (SBIRS) Low Earth Orbit (LEO) COMM link (COMLNK) evaluation. Continued Optical Environment Support to SBIRS Program.
- Upgraded System Planning Intercept Evaluation Tool-DTRA (SPIET-D) version to include trapped radiation and High-altitude EMP (HEMP) effects.
- Supported National Missile Defense (NMD) analyses and development of System Requirement Document (SRD) and system operation in nuclear environments.
- Updated Advanced Systems Survivability Integrated Simulation Tool Set (ASSIST) PC shell for phenomenology codes.
- Developed advanced versions of COMLNK, Radio Wave Propagation in a Structured Ionized Medium (PRPSIM) & Performance Simulation (PERSIM).
- Improved models for Short Wave Infrared Radiation (SWIR) optical emission predictions.
- Revised U.S.-NATO standard Radiation Transport Code to include distributed hazards.
- Upgraded a new browser-based software tool, Integrated Nuclear Computational Tools (INCA), to include Source Region EMP (SREMP) and five other new nuclear weapons effects. Completed beta testing in the first quarter of FY 1999.
- Demonstrated proof-of-concept EMP Vulnerability Number (EMP-VN) Model for long-line-connected power and telecommunications systems of the military.

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Project AF - Weapon System Operability (cont'd)

Developed simulation and modeling of EMP Targeting of WMD, using coherent pulsed power and nuclear EMP Simulator Source based on air, land, and sea mobile platforms.

Upgraded STRATCOM C4 Assessment Tool (STRATCAT) tool set for STRATCOM and for Regional Commands specific C3I assessment mission requirements.

Upgraded the SREMP target assessment and planning system (SREMP TAPS), to include new and war-planners-required weapon design parameters.

Developed 3-D simulation of new Nuclear Weapon Effects (NWE) and Asymmetric Threat via SHYPS code, using the DoD high-performance computing (HPC) capability and in collaboration with Lawrence Livermore National Laboratory (LLNL).

U.S./Allied Survivability & Operability in Nuclear/Special Weapon Environments (\$13,918K)

Initiated development of protection technologies for visible sensors for ballistic missile defense (BMD) and spacecraft applications.

Began development of system electronic controller chip to implement the Testable Hardware protocols on C4I and space-based infrared system (SBIRS) spacecraft and BMD missile/interceptors.

Initiated an assessment of the feasibility of using high-performance computing models to reduce design margins and test requirements.

Began an electronic tool kit to automate Testable Hardware protocol design capability for sensor, spacecraft, and missile interceptor developers.

Captured underground testing (UGT) thermal structural response (TSR) data for use in design and test methods.

Initiated the development of a survivability assessment tool to evaluate multiple element architectures to nuclear effects.

Began incorporation of a nuclear weapons effects module/database into warfighter Electronic Battlebook for assessments of the Integrated Tactical Warning and Attack Assessment (ITW/AA) by USSPACECOM and USSTRATCOM.

Successfully conducted two non-ideal airblast experiments to measure damage to heavy armored vehicles to support JCS updates to the Joint Nuclear Targeting Manual.

Completed development and assessment of low-level radiation standards and fly-away dosimetry system for NATO.

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Project AF - Weapon System Operability (cont'd)

Continued development and evaluation of low-level radiological instrumentation support for warfighters/peacekeepers operating in post-Cold-War settings (i.e., <70 rem scenarios).

Completed HEMP test of Mobile Consolidated Command Center (MCCC).

Continued application of innovative, low-cost EMP/HPM hardening technology and proposed candidate electromagnetic standards and guidelines in accordance with the new technology.

Continued assessment and testing of critical, fixed-ground-based and mobile C4I facilities.

Radiation-Hardened Microelectronics, Materials, and Photonics (\$16,521K)

Demonstrated, tested and evaluated a radiation-hardened, low-power 400K gate array for U.S. Air Force.

Demonstrated low-power/high-speed, radiation-hardened (RH) 4M static random access memory (SRAM) prototype.

Demonstrated, tested and evaluated radiation-hardened, 16M SRAM integrated circuit technology (e.g., ≤ 0.25 micron critical feature size) for USAF and the Ballistic Missile Defense Organization (BMDO).

Demonstrated, tested and evaluated a radiation-hardened, 1M, non-volatile memory using Giant Magneto Resistive (GMR) material for USAF and BMDO.

Investigated and characterized single event effects in photonic devices and deep-submicron microelectronics for USAF and BMDO.

Demonstrated radiation-hardened digital Electronic Design Automation (EDA) System for USAF and BMDO.

Small Business Innovative Research (SBIR) (\$2,081K)

Supported the Small Business Administration (SBA) National Direction by actively seeking small business contractors to perform innovative research.

Executed Agency-approved SBIRs.

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Project AF - Weapon System Operability (cont'd)

FY 2000 Plans

Nuclear Weapons Effects Phenomenology (\$13,986K)

Support NMD analyses and development and system operation in nuclear environments.

Improve cell resolution for optical emission predictions.

Update early time Magnetohydrodynamic (MHD) Extended to Global Scale (MEGS) version for

Collisionless MHD (CMHD) and Magnetic Containment Regime (MCR) replacement.

Support SBIRS and NMD system analysis and operational development.

Replicate STRATCAT tool set in non-DoD Emergency Operations Centers.

Implement STRATCAT: V.3 on STRATCOM TS LAN and Global Command and Control System (GCCS).

Update HEMP and SREMP Vulnerability Number (VN) model for long-line coupled targets (power & telecom systems).

Implement HEMP and SREMP TAPS for DIA-specified potential threat weapons.

Integrate nuclear computational tools (INCA) to run ten lethality models covered by all of the nuclear effects covered in INCA.

Upgrade EMP-VN Model for specific WMD Targets.

Upgrade and transfer SREMP TAPS smart system for WMD Target Planning.

Develop end-to-end targeting models of WMD for the simulated nuclear EMP stress on targets via the new initiative.

Complete the development of STRATCAT tool and transfer the tool to CINC Commands.

Develop Shock Acceleration Model for nuclear burst pumped Radiation Belts.

U.S./Allied Survivability & Operability in Nuclear/Special Weapon Environments (\$13,754K)

Characterize the response of visible sensor technologies to nuclear weapons radiation environments.

Complete the development of a systems electronic controller chip to implement the testable hardware protocols on Air Force space systems and BMD missile/interceptors.

Complete feasibility assessment of high-performance computing models to reduce design margins and test requirements.

Project AF - Weapon System Operability (cont'd)

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Project AF - Weapon System Operability (cont'd)

- Deliver to program offices and government contractors an electronic tool kit to automate testable hardware protocol design capability for sensors, spacecraft, and missile/interceptors.
- Deliver TSR design and test methods for use in the design of survivable sensors, missiles, interceptors and reentry vehicles/bodies.
- Initiate assessment of the performance of BMD Family of Systems (FoS) in nuclear-disturbed environments.
- Deliver a prototype nuclear weapons effects module/database for the Warfighter Electronic Battlebook for assessments of the ITW/AA by USSPACECOM and USSTRATCOM.
- Conduct two non-ideal airblast experiments to measure damage to medium armored vehicles to support JCS updates to the Joint Nuclear Targeting Manual.
- Demonstrate integrated EMP/HPM test methods, techniques, and technologies that produce improvements over existing electromagnetic protection methodologies.
- Continue assessment and testing of critical national security assets.
- Characterize the response of advanced detector technologies to radiation.
- Upgrade non-upsettable processor controller for circumvention and recovery (C&R) for testable hardware protocol implementation.
- Complete the development of TSR test methodology for application to weapon systems operating in nuclear environments.
- Begin development of Airborne Nuclear Survey system with Army using existing Army Radiation Detection Indication and Computation (RADIACs).
- Begin development of internal and biodosimetry functions of fly-away dosimetry lab.
- Field-test and evaluate fly-away dosimetry system in scheduled nuclear weapons exercises.
- Assess NMD/TMD nuclear survivability testing and validation plans.
- Continue development and evaluation of radiation protection standards and risk measures applicable to equipment for NATO review.
- Initiate conceptual development of battlefield radiological measurement system adapted to unmanned aerial vehicle (UAV) platform.

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Project AF - Weapons System Operability (cont'd)

Begin integration of Smart Building (SB) infrastructure and event data into FBI GIS-based tools.

Complete SB assessments and Verification and Validation (V&V) of potential WMD scenarios and impacts.

Begin SB assessment of the counter WMD integrity of the as-built JOC.

Complete SB implementation and testing of approved WMD mitigation strategies, CBR filtration, sensors, flow test, structural/window/heating, ventilation, and air conditioning system retrofit(s).

Establish a SB operational counter-WMD cell within JOC for on-site and reach-back technical support and provide training as appropriate.

Radiation-Hardened (RH) Microelectronics, Materials, and Photonics (\$15,994K)

Demonstrate qualified RH 4M SRAM for USAF and BMDO.

Demonstrate prototype 1M non-volatile memory technology.

Demonstrate RH deep submicron (0.25 micron) technology for very-low-power, ultra-large-scale integrated circuits (ULSIC), e.g., 4M gate array, etc., for USAF and BMDO.

Test and evaluate photonics signal processing technology for USAF.

Publish sampling and identification of radiological agents standards.

Field a web-based version of consequence assessment tools for rapid assessment and initial detection teams.

Demonstrate RH star tracker/visible imager.

Small Business Innovative Research (\$716K)

Support the Small Business Administration (SBA) National Direction by actively seeking small business contractors to perform innovative research.

Execute Agency-approved SBIRs.

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Project AG—Scientific Computations & Information Systems. This project provides High Performance Computing (HPC), computational databases, and information products that enable the Agency's researchers to answer questions about Weapons of Mass Destruction (WMD) effects. Models, codes, and information products are developed to aid the design of experiments, predict types and levels of measurements required, establish system design requirements, assess performance, and provide system-specific predictions of weapons effects to DoD planners. Nuclear issues often require use of advanced computational resources, i.e., for investigation of the physics of weapon-target interactions, and for extrapolating test results into areas for which tests are no longer possible. This effort requires world-class high performance computing architecture with high bandwidth communications. This capability, currently with a hub at Los Alamos National Laboratory, is scheduled to transition to the new DOE and DoD HPC architecture over the FYDP. The Data Archival and Retrieval Enhancement (DARE) information system (a digital archive and retrieval system tailored to the specific needs of the researcher, the system designer, and developer) is supported by this project. This project funds the "Graybeard" efforts for collection of unique and potentially perishable nuclear data with appropriate prioritization based on technical value. The principal thrusts respond to warfighter requirements for survivable systems and effective weapons in the Joint Warfighting Technology Areas of Discriminate Attack, Global Reach, and Counterproliferation.

FY 1999 Accomplishments

Scientific Computing (\$8,259K)

- Continued computer operations support by providing centralized CRAY resources to researchers, Agency customers and RDT&E contractors.
- Continued DATACOM computational support by providing wide area connections.
- Continued computational support by providing annual support for the Scientific Computing Communications Network and by acquisition and upgrade of HPC equipment for the Data Center.
- Provided annual support for existing DTRA owned computing equipment located at Los Alamos National Laboratory and resources located at the Data Center.
- Provided increased processor speed and disk I/O for Data Center HPC equipment.

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Project AG—Scientific Computations & Information Systems (cont'd)

Provided classified access capabilities.

Monitored and assessed circuit utilization and investigated new communication technologies.

Graybeard Project (\$4,152K)

Continued Graybeard review, commentary and archival of perishable nuclear electronics/environmental test data, shock physics, for thermomechanical and biological effects data. Initiated Graybeard data capture of nuclear sources.

Continued review, commentary and archival of cratering, ejecta, dust and fallout test, nuclear effects test data for thin film, biological effects and transient radiation effects on electronics.

Accelerated Graybeard document review activities on ionization and electromagnetic (EM) effects.

Completed Graybeard free field airblast data commentary.

Continued incorporation of atmospheric and underground nuclear test data.

DASIAC (Information Analysis Center) (\$3,158K)

Provided scientific and technical information services and products as the DoD-wide repository for test photos, films, data, test records and other information products, through operation of the Information Analysis Center.

Continued operation of web site, providing radiation response of electronic parts.

Disseminated Science and Technology Digest.

Application of Nuclear Weapons Expertise (\$719K)

Drafted update of The Effects of Nuclear Weapons.

Reviewed draft Nuclear Weapon Effects textbook; continued drafting remaining chapters.

Completed and distributed Nuclear Effects Data Management and Analysis Systems and installed it on DARE and at UK's Atomic Weapons Establishment (AWE).

Completed validation of Advanced Numerical Methods. Compared results to precision test data.

Developed a 3D atmospheric code with column physics based on the Automatic Mesh Refinement (AMR) code.

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Project AG—Scientific Computations & Information Systems (cont'd)

DARE (\$4,679K)

Began preparation of DARE guide to blast effects on structures.
Expanded archival of information and knowledge of nuclear weapons and other WMD and Agency mission areas for retrieval in DARE as outlined in DARE Master Plan.
Developed and tested computational tools and system enhancements, which provide greater search, retrieval, storage and analysis capability to the DARE customer.
Initiated development of video/text interrelationship with hyperlink and other innovative knowledge enhancement and preservation tools.
Continued legacy document population.

FY 2000 Plans

Scientific Computing (\$7,118K)

Provide computational support for the Scientific Computing Communications Network; upgrade HPC equipment for the Data Center and enhance access to scalable DoD HPC Modernization Program (HPCMP) Systems and ensure DOE Accelerated Strategic Computing Initiative (ACSI) program.
Provide sustainment and enhancement of classified access capabilities to the Scientific Computing Resources.
Provide monitoring and assessment of circuit utilization and investigation of emerging communication technologies to support remote visualization and analysis of full physics, full fidelity, 3-dimensional calculations.
Generate precision data to verify and validate AMR.

Graybeard Project (\$5,667K)

Complete Graybeard work on High Altitude Nuclear Effects.
Continue review, commentary and archival of perishable nuclear electronics environmental test data, shock physics, test data, thermomechanical, biological and nuclear sources effects data.
Continue data review, commentary and archival of transient radiation effects on electronics, cratering, ejecta, dust and fallout, thin-film optics.

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Project AG-Scientific Computations & Information Systems (cont'd)

DASIAC (Information Analysis Center) (\$4,876K)

Provide scientific and technical information services and products as the DoD-wide repository for test photos, films, data, test records, and other information products. Publish and distribute Nuclear Weapons Effects textbook.

Application of Nuclear Weapons Expertise (\$719K)

Continue to supply authoritative data and provide requested analysis of the effects of nuclear weapons testing, and other DTRA mission areas.
Continue efforts to ensure that Nuclear Weapons Effects test data and results are preserved as DoD downsizes and laboratories with nuclear test data close.
Validate the AMR code, using field atmospheric data.

DARE (\$6,269K)

Continue to expand archival of information and knowledge of nuclear weapons and other Weapons of Mass Destruction (WMD) and Agency mission areas for retrieval in DARE as outlined in DARE Master Plan.
Continue to develop and test computational tools and system enhancements, which provide greater search, retrieval, storage, and analysis capability to the DARE customer.
Continue development of video/text interrelationship with hyperlink and other innovative knowledge enhancement and preservation tools.
Continue legacy document population.
Begin entry of nuclear simulation data.
Enhance data visualization tools.
Expand online access to DARE classified and unclassified resources.
Integrate automated test data recorder interface into DARE archive.

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Project AI - Hard Target/Tunnel Defeat & Nevada Test Site (NTS) Sustainment - The United States and its allies face a growing threat related to critical military targets hidden within and shielded by hardened, deeply buried tunnel complexes which house battle management facilities, command, control, and communications facilities, theater ballistic missiles and their transporter-erector-launchers (TELs), and biological/chemical/ nuclear weapons production or storage facilities. An objective of this program is to examine the existing U.S. and Allied capabilities to hold hardened, deeply buried tunnel targets at risk, thereby defining a current performance baseline. Any deficiencies will be identified and the ability of planned systems to address these deficiencies will be assessed. Finally, new technologies needed to mitigate remaining shortfalls will be evaluated as candidates for new hard target defeat acquisitions. Activities respond to priorities by the Office of the Under Secretary of Defense for Acquisition, Technology and Logistics (OUSD(AT&L)), Hard and Deeply Buried Target Defeat Capability Initiative and warfighting CINCs. Efforts in this program provide part of the technology base needed for counterproliferation activities conducted in other DoD programs.

The Presidential Decision Directive (PDD) on Stockpile Stewardship implemented an indefinite moratorium on underground nuclear testing while requiring retention of the capability to resume testing at Presidential direction. DoD has complied with this policy by realigning the previously existing underground test program to emphasize non-nuclear weapons test technology and facility development, and to conduct a program for an orderly decommissioning and mothballing of the national underground nuclear test assets. The following major tasks will satisfy this requirement: (1) continue test complex shutdown, and tunnel stabilization and preservation; (2) continue environmental characterization; (3) document testbed design and construction methodology; (4) maintain underground test readiness through joint test organization activities at NTS including counterproliferation and hard target defeat testing; and (5) support SOCOM efforts to develop tactics and techniques for JCS Joint Warfighter Capabilities of Discriminate Attack and Counterproliferation. Project AI is linked to Project AB, through which its testing is conducted, and to Project AC which leverages its weapons work.

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Project AI - Hard Target/Tunnel Defeat & Nevada Test Site (NTS) Sustainment (cont'd)
FY 1999 Accomplishments

Functional Defeat Characterization (\$1,911K)

Continued development and validation of remote site geologic characterization technology.

Initiated functional characterization and modeling of tunnel facilities.

Defeat Technology (\$6,281K)

Continued to evaluate weapon/target interactions for new weapon concepts, enhanced payloads, and target fragility.

Initiated penetration testing on other tunnel geologies.

Conducted weapon/payload testing to identify/quantify defeat mechanisms and evaluate effectiveness.

Developed improved new weapon/target interaction models to include penetration, portal damage, in-tunnel airblast and fragments, in-tunnel equipment response, and reconstitution.

Continued support for USD(A&T)'s Hard Target Defeat Capability program.

Began readiness testing of live weapons at NTS in preparation for tunnel defeat demonstrations.

Completed construction and outfitting of the full-scale tunnel facility and initiate demonstrations.

Initiated planning for and construction of a second tunnel facility representing a different target function.

Planning Tool Development (\$1,000K)

Continued automated weaponeering tool development by enhancing the Munitions Effects Assessment (MEA) tunnel module for structural and functional damage and battle damage assessment.

Initiated development of new planning tools to improve deliberate planning capabilities for hard target defeat.

NTS Sustainment (\$1,702K)

Maintained Agency activities at NTS in support of environmental remediation efforts.

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Project AI - Hard Target/Tunnel Defeat & Nevada Test Site (NTS) Sustainment (cont'd)

Provided on-site personnel to plan and supervise environmental remediation of Agency facilities.
Maintained one tunnel complex.

FY 2000 Plans

Functional Defeat Characterization (\$2,100K)

Continue development and validation of remote site geologic characterization technology.
Conduct geologic material properties tests for tunnel defeat demonstration facility.
Continue functional characterization and modeling of tunnel facilities.
Identify mission critical equipment and vulnerabilities for functions modeled in second tunnel facility.
Evaluate signatures for hard target defeat applications.

Defeat Technology (\$6,382K)

Continue to evaluate weapon/target interactions for new weapon concepts, enhanced payloads, and target fragility.
Continue penetration testing on other tunnel geologies.
Continue weapon/payload testing to identify/quantify defeat mechanisms and evaluate effectiveness for other tunnel functions.
Develop improved new weapon/target interaction models to include in-tunnel equipment response, and reconstitution for different tunnel functions.
Continue support for DoD and military service hard target defeat-related activities.
Complete readiness testing of live weapons at NTS in preparation for the first series of tunnel defeat demonstrations.
Conduct functional defeat demonstrations on the full-scale tunnel facility.
Complete planning for construction of a second tunnel facility representing a different target function.

Planning Tool Development (\$950K)

Continue automated weaponeering tool development by enhancing the MEA tunnel module for structural and functional damage and battle damage assessment for different tunnel functions.

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Project AI - Hard Target/Tunnel Defeat & Nevada Test Site (NTS) Sustainment (cont'd)

Continue development of new planning tools to improve operations planning capabilities for hard target defeat.

NTS Sustainment (\$1,100K)

Maintain Agency activities at NTS in support of environmental remediation efforts.

Provide on-site personnel to plan and supervise environmental remediation of Agency facilities.

Maintain one tunnel complex.

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Project AN - Thermionics - Meeting national objectives in both the military and civilian areas will require large capacity (40-100kW) nuclear space power systems having long lifetimes. Potential applications have been identified by the Air Force and NASA. The Air Force "New World Vistas" study, dated 15 December 1995, cites specific requirements for space nuclear power to accomplish force projection from space. NASA has identified requirements for power and propulsion for contemplated deep space missions and manned exploration. The objectives of the Advanced Thermionics Program are to advance the state of the art of thermionic power conversion in the United States, to develop high performance and highly reliable thermionic converters that provide high output power per unit of system mass, to demonstrate the capabilities of these thermionic converters, to show their feasibility for use in thermionic systems, and to develop corresponding system level conceptual designs. This effort supports the Defense Technology Area Plan for Space Platforms.

FY 1999 Accomplishments

In-core thermionic development (\$1,800K)

Continued work on test of high-performance and high-reliability converters for in-core thermionic fuel elements. Awarded a contract for development of close-spaced multi-cell converter module.

Microminiature Thermionic Converters (MTCs) (\$1,200K)

Continued to apply trial tricarbonate coatings on the emitter portion of the converters, and continued work on scandate coatings.

FY 2000 Plans

In-core thermionic development (\$2,000K)

Continue work on development of close-spaced multi-cell converter module. Continue development of appropriate solar power for thermionic applications. Award a contract for follow-on development of multi-cell converter module.

Microminiature Thermionic Converters (MTCs) (\$916K)

Complete testing of tricarbonate coatings on the emitter portion of the converters, and continue work on scandate coatings.

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Project AQ - Deep Digger - This project proposes to develop a "Deep Digger" design for attacking hard targets such as leadership or C3 Bunkers, underground factories, or weapon storage facilities. The U.S. Services have identified a need to defeat such hard and buried targets. Current weapons have only limited capability against these targets. A more effective penetrator capability such as that claimed by the inventor of "Deep Digger" is required.

This effort is responsive to U.S. Special Operations Command interests as well as the consolidated Mission Need Statement of the U.S. Air Force Combat Command and the U.S. Strategic Command. The "Deep Digger" system would be delivered by a guided munitions airframe such as used by the Air Force and the Navy. As an integrated weapon, this concept has application as a breaching tool.

FY 1999 Accomplishments (\$2,000K)

- Demonstrated the ability of the Deep Digger concept to explosively fracture rock and remove the resulting muck with statically placed high explosive charges.
- Developed and demonstrated a unique augmented penetration projectile device to be used, with great advantage, in the Phase II, Deep Digger.
- Finalized development of Deep Digger projectile.
- Considered energy constraints and developed most efficient gas generator for projectile.

FY 2000 Plans (\$3,888K)

- Develop and demonstrate a Special Operations Forces (SOF) projectile that can be fired from a near standard 1" gun (or 25mm gun) for defeating concrete blast doors and other hardened concrete walls.
- Evaluate and select the best rapid firing methodology/gun for use in Deep Digger concept.
- Initiate development of a true fieldable prototype of Deep Digger.

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Project BB - Small Business Innovative Research (SBIR) - This project provides the means for stimulating technological innovation in the private sector, strengthens the role of small business in meeting DoD research and development needs; fosters and encourages participation of minority and disadvantaged businesses in technological innovation; and increases the commercial application of DoD supported research and development results. These efforts are responsive to PL 102-564.

FY 2001 Plans

Small Business Innovative Research (\$4,750K)

Support the Small Business Administration (SBA) National Direction by actively seeking small business contractors to perform innovative research.

Execute Agency-approved SBIRs.

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Project BC - Force Protection and Technology Applications - This project supports Assessment and Mitigation Technologies, which conducts mission vulnerability assessments of strategic U.S./Allied systems to facilitate the development of investment strategies for improved survivability, to include nuclear command and control. This program also ensures that assessment training programs, engineering designs, and new construction embody sound force protection, vulnerability mitigation, and collective protection principles. DTRA technologies and expertise are applied to enhance U.S. capabilities across the spectrum of the counterproliferation and force protection missions. These may include development of sensor technologies for initially identifying the consequences of WMD through countering or protection against this threat. Some of the program's products and services include the Balanced Survivability Assessments (BSA), the Smart Building (see Project AF) program's strategic facility construction design and cost estimates, vulnerability out-briefs and written reports, overall vulnerability trend data, National and NATO conferences for Underground Facility Managers, and multi-disciplined technical engineering expertise support.

FY 2001 Plans -

Balanced Survivability Assessments (\$5,948K)

- Conduct balanced survivability and integrated vulnerability assessments on DoD facilities as tasked by CINCs, the Joint Staff, and OSD.
- Continue integrated vulnerability assessment of defense and critical national infrastructure facilities.
- Initiate a vulnerability mitigation technology development program.

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Project BC - Force Protection and Technology Applications (cont'd)

Smart Building Program (\$5,037K)

- Continue integration of infrastructure and event data into Department of Justice (DoJ)-based tools.
- Complete assessments and Verification and Validation (V&V) of potential WMD scenarios and impacts.
- Complete implementation and testing of approved WMD mitigation strategies, chemical/biological/radiological (CBR) filtration, sensors, flow test, structural/window/heating, ventilation, and air conditioning (HVAC) system retrofit(s).
- Complete an operational counter-WMD cell within Joint Operations Center (JOC) for on-site and reach-back technical support, and provide training as appropriate.
- Complete assessment the counter WMD integrity of the as-built JOC.

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Project BD - Weapons Effects Technologies - This project provides for the development and application of products and services to meet WMD and other special weapons effects challenges. This is accomplished using state-of-the-art science and engineering capabilities, including advanced first principles analysis, engineering modeling, simulation and networking technologies, and precision laboratory scale and field testing capabilities (supported by Project BE). The project integrates and applies these advanced capabilities to support decision making in the face of rapidly evolving WMD threats in both military and civilian sectors. Products being developed include WMD target planning and assessment tools, WMD hazardous materials transport and collateral effects prediction tools, tools and technologies used to mitigate the effects of WMD on facilities and people, and consequence assessment tools to evaluate and respond to WMD events. Additionally, this project develops the enabling technologies used to produce anti-terrorist/force protection tools. This project also develops technologies to support Force Protection assessments and forensic analysis of terrorist events as well as advanced blast mitigation/retrofit techniques. Such tools developed on this project are used to enable other projects including BC, and BF. Also, they are made available to civilian, counter-terrorism and disaster response support organizations.

This project also maintains the capability to address nuclear weapons effects problems. This involves development and application of state-of-the-art nuclear weapons effects models to DoD problems, thereby providing effective stewardship for the nation's nuclear weapons effects knowledge, technologies, and capabilities. In addition, the project maintains a national archive of nuclear phenomenology, involving perishable nuclear test data and expert interpretation, weapons effects models that encode our knowledge base, and a modern computer-based architecture for retention and access to such archives. These capabilities are used in direct support of the warfighter and are used to enable other projects including BG and BH.

In direct support of these products and services to the warfighter, this project also provides and maintains a world-class High Performance Computing (HPC) architecture with high band-width communications required for direct support to the warfighter. This service enables the application of state-of-the-art first principles models to WMD

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Project BD - Weapons Effects Technologies (cont'd)
 problems and supports the development of improved models and migration to advanced computing architectures.

FY 2001 Plans

Structural Response and Mitigation Technology (\$13,353K)

Complete precision tests for validating Lethality/Vulnerability (L/V) models that are used in the Integrated Munitions Effects Assessment (IMEA).

Complete tests on Former German Democratic Republic C3I equipment and develop functional defeat model.

Conduct precision tests on conventionally constructed-unhardened reinforced concrete and masonry walls, steel deck slabs and develop engineering level models for MEA.

Develop multiple shot wall damage algorithms for MEA 5.0.

Complete V&V guidelines for computational mechanics codes.

Integrate, test and evaluate models L/V models in IMEA 5.0. Perform component and system level tests to assure compliance with joint targeting/munitions effects validation and verification criterion.

Integrate the initial set of weaponeering tools into the initial Integrated Target Planning Tool-set (ITPTS 1.0).

Perform component and system level tests to assure integration of the first six-weaponeering tools into ITPTS 1.0. Assure compatibility with the Defense Intelligence Agency data space ATHENA and the JCS/J2T Joint Targeting ToolBox.

Scientific Computing (\$16,102K)

Complete Graybeard nuclear test data review, commentary and archival on airblast, cratering & ejecta, and dust & fallout, electronics interaction, and biological effects.

Provide scientific and technical information services and products as the DOD-wide repository for test photos, films, data, test records, and other information products.

Continue review, commentary and archival of perishable nuclear environmental radiation, thermo-mechanical, and electromagnetic test data.

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Project BD - Weapons Effects Technologies (cont'd)

Continue Computational support by providing annual support for the Scientific Computing Communications Network and maintain HPC equipment for the Data Center, such as increased memory and additional CPU's to extend the life of existing systems and enable them to accommodate additional workload from decommissioning of older vector machines.

Provide classified access capabilities for the Data Center. Deploy new communications technologies to support remote visualization and analysis of full physics, full fidelity, 3-dimensional calculations.

Collateral Effects (\$16,977K)

Complete development of high-resolution probabilistic weather capability necessary for target planning of WMD facilities to support the warfighter.

Develop short- and long-term human casualty models to support CINC requirements.

Complete industrial hazardous material source term modeling for Hazard Prediction and Assessment Capability (HPAC).

Evaluate urban modeling capability at 2001 Presidential Inauguration using the HPAC.

Provide counter-terrorism planning and urban transport and dispersion modeling capability for joint DoD/DOE support of Salt Lake City Winter Olympics.

Complete collaboration of DOE and DoD anti-terrorism hazard prediction capability verification and validation effort.

Advanced Weapons Effects Phenomenology (\$14,296K)

Support National Missile Defense/Theater Missile Defense with detailed nuclear phenomenology and analysis to aid in the development of models of system operation in nuclear environments

Complete non-ideal airblast phenomenology update in direct response to request of U.S. Army.

Complete development of the EMP (Electromagnetic Pulse) targeting models for Strategic Command (STRATCOM).

Complete development of the STRATCOM C4 Assessment Tool set (STRATCAT) and transfer the final version of the tool to STRATCOM.

Install STRATCAT in non-DoD emergency operating centers.

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Project BD - Weapons Effects Technologies (cont'd)

- Complete upgrade of fallout casualty assessment tools with incorporation of scavenging.
- Complete detailed first principle upgrade of EMP tools to include Source Region EMP (SREMP) Tool sets.
- Complete detailed benchmark calculations of delivery system impact on nuclear weapon output spectrum.
- Initiate upgrade of high/low altitude nuclear environment to assess nuclear effects on military system design.
- Complete all cratering and ground shock work.

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Project BE - Testing Technologies and Integration - This project provides a unique national test-bed capability for Weapons of Mass Destruction (WMD) facility characterization, weapon-target interaction, and WMD facility defeat for various types of test/demonstration functions to support acquisition managers, weapon effects researchers, and counterproliferation (CP) and non-proliferation programs. The project develops, provides and maintains unique national test-beds used by the DoD, the Services and other federal agencies to evaluate the impact of hostile environments from WMD, conventional, nuclear, and other special weapons on military or civilian systems and targets. This project leverages fifty years of testing expertise to investigate weapons effects and target response to a spectrum of hostile environments that could be created by proliferant nations or terrorist organizations with access to advanced conventional weapons or WMD (nuclear, biological and chemical). Specific programs supported by this project include: (1) Hard Target Defeat (HTD); (2) Anti-terrorism (AT); (3) CP Counterforce Advanced Concept Technology Demonstration (ACTD); (4) Special Operations Forces (SOF); and (5) Nuclear Facility Defeat Program. This program maintains testing infrastructure to support warfighters, other government agencies, and friendly foreign countries testing requirements on a cost reimbursable basis. This project also develops strategy and planning for a national WMD test-bed infrastructure focusing on nuclear, biological, and chemical facilities; and the hard and deeply buried facilities in which activities are often located. The project provides infrastructure support for full and sub-scale tests that focus on weapon-target interaction with fixed soft and hardened facilities to include aboveground facilities, cut-and-cover facilities and deep underground tunnels. Specific activities include testbed design and construction, instrumentation and data collection, test coordination and execution, and post-test analysis and documentation. This project directly supports Projects BC, BD, and BF, and PE 0603160BR, Project BK.

FY 2001 Plans

Test-Bed Operation and Support (\$8,821K)

Continue to provide unique national test-bed capabilities for weapon-target interaction and WMD programs. Provide an inventory of unique targets, infrastructure support, and

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Project BE - Testing Technologies and Integration (cont'd)

expertise for conduct of major integrated test programs, including instrumentation maintenance, gauge installation, data recording, source diagnostics, environmental support, safety support, experiment installation, experiment fielding, and test fielding.

Field Support (\$769K)

Continue to provide infrastructure support for maintenance of government vehicles, transportation of equipment, communications, utilities for facilities, rental of facilities, supplies, custodial service, and procurement of equipment in support of test execution.

Nevada Test Site (NTS) Environmental Remediation (\$842K)

Continue systematic environmental assessment and remediation on the tunnel complexes at NTS for which DTRA is responsible.

Develop Corrective Action Plan for N-tunnel muck pile and Corrective Decision Document for T-tunnel muck pile.

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Project BF - CP Operational Warfighter Support - This project will provide targeting and Intelligence Community (IC) support, introduce customers to CP technologies and products, develop DoD compliant simulations that exploit CP models for target planning and collateral effects prediction, and demonstrate selected mature CP capabilities in an operationally realistic environment. The current focus for technology demonstrations is on the defeat of hard targets and nuclear related facilities. The technical approach is to integrate technologies developed in other CP projects, to conduct a full spectrum of tests to verify capability enhancement, to expose customers to these capabilities in exercises, wargames and demonstrations, to institutionalize CP technologies into customer operations, and to support customer use of these capabilities during contingency operations. This approach is based on four thrusts that support outside customer requirements. The four thrusts are Targeting and IC Support, a Weapons of Mass Destruction (WMD) Assessment and Analysis Center (WMDAAC), a Hard Target Defeat (HTD) program, and a Nuclear Facility Defeat program. When complete, the CP Operational Warfighter Support project will provide the bridge between the CP technology base and operational community needs. The overall project goal is to support the JCS, the warfighting commanders-in-chief (CINCs) and Services/agencies engaged in countering WMD threats and to protect the U.S. and its allies against military or terrorist use of WMD. Access is provided to technical databases, software models and tools, and subject-matter experts to support warfighting CINCs and other DoD agencies, federal, state, and local governments, and civilian agencies in their CP mission.

Targeting and IC Support. Targeting and IC Support provides functional vulnerability assessments of hostile foreign systems in support of warfighter and IC requirements. It assists the CINCs and IC in target planning against hard and deeply buried facilities. The assessments leverage databases, methodologies, and technical expertise developed during Balanced Survivability Assessments (Project BC). Details of specific individual assessments are classified.

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Project BF - CP Operational Warfighter Support (cont'd)

WMD Assessment and Analysis Center. The WMDAAC provides both an operational resource for information and analysis and a research and development facility to improve U.S. capabilities to defend against WMD threats and to mitigate consequences of nuclear, chemical, and biological weapons use or release of hazardous materials. It provides DoD and non-DoD customers with a centralized, comprehensive resource for WMD information and analysis. The WMDAAC objectives are to: (1) provide warfighters and first responders with ready access to mature computer models, computer databases, and expert information on WMD effects and countermeasures using reliable and proven operational equipment assets and communications networks; (2) operate a research and development facility for maturing and testing leading edge software, i.e., weapon effects models and next generation communications schemes; (3) ensure maximum utility of DTRA models in distributed interactive simulations through compliance with High Level Architecture (HLA) standards and protocols; (4) improve warfighter ability to counter WMD through field assistance, training, and information resources; and (5) provide a Modeling and Simulation Center of Expertise for DTRA program managers.

This project provides research and development of advanced simulations, to implement hardware and supply services for WMDAAC next generation communications connectivity to the user community, and to make technical support available to customers. Advanced simulations are developed from first-principles physics models produced in other CP projects (extensively Project BD). Daily center operation is supported from DTRA operation and maintenance funds.

Hard Target Defeat Program. The United States and its allies face a growing threat related to critical military targets hidden within and shielded by hardened, deeply buried tunnel complexes. These complexes may house biological/chemical/nuclear weapons production or storage facilities; battle management facilities; command, control, and communications facilities; and theater ballistic missiles and their transporter-erector-launchers (TELs). An objective of this project is to examine the existing U.S. and Allied capabilities to hold hardened, deeply buried tunnel targets at risk, thereby defining a current performance baseline.

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Project BF - CP Operational Warfighter Support (cont'd)

Any deficiencies will be identified and the ability of planned systems to address these deficiencies will be assessed. Finally, new technologies needed to mitigate remaining shortfalls will be evaluated as candidates for new hard target defeat acquisitions. Activities respond to priorities by the Office of the Under Secretary of Defense for Acquisition, Technology and Logistics (OUSD(A,T&L)), Hard and Deeply Buried Target Defeat Capability Initiative and warfighting CINCs. This project focuses weapon/target interaction and target planning tool technology base efforts completed in Project BD on tunnel applications. The program depends on test planning and execution support from Project BE. Products from this project are transitioned to PE 0603160BR, Project BK for C3I facility demonstration. Efforts in this program provide part of the technology base needed for counterproliferation activities conducted in other DoD programs.

Nuclear Facility Defeat Program. Nuclear Facility Defeat (NFD) will provide the National Command Authority (NCA) and combatant commands means to deny critical nuclear production, processing, fabrication and storage capability of an adversary, without the prohibitive political consequences of large radiation releases downwind of the target. Once the intelligence community determines the adversary's nuclear production cycle, critical facilities can be targeted to eliminate overall capability. NFD provides methods to functionally kill selected facilities, predict and minimize resulting collateral effects. Additionally, this program will enhance our ability to predict the consequences of terrorist action against nuclear facilities. This program focuses weapon/target interaction, target planning tool, and hazard prediction tool technology base efforts completed in Project BD on nuclear facility applications. The program depends on test planning and execution support from Project BE. This program will transition to PE 0603160BR, Project BK starting in FY03 for operational demonstration.

FY 2001 Plans

Targeting and IC Support (\$1,899K)

Continue assessments of hostile facilities based on JCS and CINC priorities. Details are classified.

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Project BF - CP Operational Warfighter Support (cont'd)

WMD Assessment and Analysis Center (\$11,771K)

Design and implement redundant, fault-tolerant WMDAAC architecture to meet mission requirements and insure sustained operations during a WMD threat or incident.

Augment security measures to neutralize evolving cyber intrusion risks.

Acquire and install multi-tasking application server, new domain name servers, and firewall modules to increase capabilities and augment rapid-retrieval mass data storage.

Provide supplemental power sources for assured continuity of operations.

Provide high-speed data connectivity for operational and research and development customers using Defense Information Systems Network-Leading Edge Services (DISN-LES) advanced communication connectivity for web-based data handling and wide-band satellite communications for multiple remote users and deployed teams.

Continue technical and advanced modeling and simulation support to CINC sponsored exercises worldwide and consequence analysis support for exercises and wargames.

Continue implementation of the Analysis and Assessments program to provide real-time support to Services through enhanced infrastructure, deployment teams, integrated models, and technical support.

Continue to update and refine support database per CINCs, Services, and Joint Staff guidance and to develop WMD consequence analysis capabilities.

Maintain permanent (virtual) presence at the Joint Warfare Systems (JWARS) and Joint Simulation Systems (JSIMS), supporting WMD modeling within these critical programs.

Hard Target Defeat Demonstrations (\$10,627K)

Continue fielding support and damage repair for functional defeat demonstrations on the full-scale tunnel facility at Nevada Test Site (NTS).

Conduct test planning, instrumentation and data analysis for functional defeat demonstrations.

Provide and install critical equipment necessary for functional defeat demonstrations on a second tunnel facility representing a different target function i.e., command, control, communication and intelligence for weapons of mass destruction (C³I/WMD).

Conduct simulated tunnel facility operations to support signature/sensor evaluations.

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Project BF - CP Operational Warfighter Support (cont'd)

Continue construction of a second tunnel facility representing a different target function (C³I/WMD) to be used for functional defeat demonstrations.
 Conduct functional defeat demonstrations on the full-scale tunnel facilities.
 Conduct experiments to determine reconstitution time after a functional defeat attack.
 Continue to construct/repair hard targets to support other test requirements.
 Continue planning and calculations for a large high explosive tunnel facility test.

Hard Target Defeat Technology (\$11,142K)

Continue development and validation of remote site geologic characterization technology.
 Conduct geologic material properties tests for tunnel defeat demonstration facility.
 Continue functional characterization and modeling of tunnel facilities.
 Identify mission critical equipment and vulnerabilities for functions modeled in the second tunnel facility.
 Continue penetration testing on other tunnel geologies to include multiple attacks on the same aimpoint.
 Continue weapon/payload testing to identify/quantify defeat mechanisms and evaluate effectiveness for other tunnel functions.
 Develop improved/new weapon/target interaction models to include in-tunnel equipment response, and reconstitution for different tunnel functions.
 Continue support for other DoD and military service hard target defeat-related activities.
 Continue automated weaponeering tool development by enhancing the MEA tunnel module for structural and functional damage and battle damage assessment for different tunnel functions.
 Continue development of new planning tools to improve operations planning capabilities for hard target defeat.
 Continue evaluation of signatures for hard target defeat applications.
 Continue to evaluate weapon/target interactions for new weapon concepts, enhanced payloads, and target fragility.

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Project BF - CP Operational Warfighter Support (cont'd)

Nuclear Facility Defeat (\$4,285K)

Complete modeling of nuclear enrichment facility and initiate modeling nuclear reprocessing facilities.

Continue integration of nuclear facility modeling into the Hazard Prediction and Assessment Capability (HPAC) prediction tool.

Improve human health factor effects modeling.

Continue target planning tool development for nuclear facilities.

Initiate NFD sensor integration, concept, and feasibility study.

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Project BG - Nuclear Operations - This project encompasses programs formerly contained in Project AE (Weapon Safety and Operational Support) and Project AL (Classified Program) which transitioned from the Defense Special Weapons Agency into DTRA (Nuclear Operations, Education and Training, and Nuclear Weapons Stockpile Support). Project BG (Nuclear Operations) has reorganized these legacy activities as Nuclear Programs and CINC/Forces/Security Support and initiated a new activity--WMD (Nuclear) Protection Response. These programs directly reflect the National Military Strategy, support the provisions of Joint Vision 2010 and are directed by the JCS in the Joint Strategic Capabilities Plan (JSCP) (Nuclear Annex). Responsive to the oversight of the Nuclear Weapons Council, they provide critical support to the CINCs, Services, JCS and OSD. This new project is divided into three business areas described below: Nuclear Programs, CINC/Forces/Security Support, and WMD (Nuclear) Response Protection.

Nuclear Programs.

Safety: As tasked by the JSCP, the safety programs will provide CINCs, Services, and JCS with technical analysis, studies and research to identify and quantify risks and uncertainties of plutonium dispersal due to accidents, fires or natural causes during normal, peacetime operations of the nations nuclear weapon systems. Additionally, these studies quantify the probability of reduced safety assurance or Nuclear Detonation Safety Exceptions (NDSE) as identified by DOE Laboratories.

Nuclear Mission Management Plan (NMMP): As tasked by Deputy Secretary of Defense and Director, Defense Research and Engineering (DDR&E), and in support of national requirements to maintain a strategic nuclear deterrent, conduct assessments, develop long-range plans, and continue development of the DoD Nuclear Mission Management Plan to provide a comprehensive, integrated DoD roadmap for the continued sustainment and viability of U.S. nuclear forces, personnel, and infrastructure.

Stockpile Sustainment: Continue to act as DDR&E's Executive Agent for Annual Certification and Dual Revalidation and support related stewardship and sustainment activities.

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Project BG - Nuclear Operations (cont'd)

CINC/Forces/Security Support. As tasked by the JSCP and DoD Directives, these programs will provide CINCs, Services, JCS and DoD with focused analyses in support of nuclear planning and operations and WMD threat mitigation analyses as they pertain to the combat survivability of the forces. Additionally, they provide the DoD nuclear physical security applied research and force-on-force (FoF) testing programs.

WMD (Nuclear) Response Protection. Protecting our citizens and critical infrastructures at home is an essential element of U.S. national security strategy. Potential adversaries, whether nations, terrorist groups or criminal organizations, will be tempted to use weapons of mass destruction to match U.S. conventional weapon superiority. Promoting initiatives that allow us to detect those who would use weapons of mass destruction against us directly supports the National Military Strategy by promoting peace and stability.

FY 2001 Plans:

Nuclear Programs (\$20,239K)

Safety Program thrusts:

- Complete the B-2 Weapon Safety System Assessment (WSSA).
- Continue Storage Vault Blast Effects Testing and Analysis.
- Begin Long Term Storage WSSA.
- Analyze and quantify DOE Nuclear Detonation Safety Exceptions (NDSEs).
- Complete the C-17 Aircraft Transportation Study.
- Conduct modeling and testing to support ongoing WSSAs.
- Continue the development and population of WSSA database to archive completed WSSAs.

Stockpile Sustainment Program thrusts:

- Conduct annual certifications, at Presidential direction, of the continued safety and reliability of the U.S. nuclear stockpile in the absence of underground testing.
- Provide personnel, as tasked by Assistant to the Secretary of Defense for Nuclear, Chemical and Biological (ATSD(NCB)), for participation on the joint DoD-DOE Dual

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Project BG - Nuclear Operations (cont'd)

Revalidation teams, to conduct a multi-year, in-depth evaluation of the continued safety and reliability of specified weapons in the nuclear stockpile.

Continue evaluation of the W80 in support of the Air Force.

Prepare an annual performance report, as directed by Presidential Decision Directive (PDD), on the DoD stockpile sustainment accomplishments and future plans.

Continue development of the Virtual Underground Test program, which will utilize a combination of codes, models, simulators, and legacy test data to evaluate weapon system survivability, in support of requirements to maintain a survivable nuclear stockpile.

CINC/Forces/Security Support (\$10,313K)

Complete assessment of outyear nuclear command and control requirements for NATO/SHAPE/Allied Command Europe.

Provide maintenance of USEUCOM/SHAPE European Theater Nuclear Support Program to provide in-theater nuclear and WMD support to NATO (IS/IMS), SACEUR, SHAPE (Nuc Ops/ACOS Policy), EUCOM J-5N, and the Joint Theater Surety Management Group.

Continue support to STRATCOM and regional CINCs with specific nuclear and WMD threat analyses in support of SIOP preparation, development of integrated effects models, direct planning support to regional CINCs, and specific applications for the Deterrence Framework analytic structure.

Initiate a new forces support program examining the impact of follow-on START Agreements on nuclear planning and employment option development. Specific interest in the probable impact of advances in foreign missile defense capabilities vice smaller U.S. strategic deterrent capabilities.

Continue to directly support the curriculum development for the Defense Nuclear Weapons School.

Initiate a program to fully integrate the planning processes and target data sets of STRATCOM, regional CINC plans and NATO nuclear planning capability.

Provide a quality forum for the development of assessments of the impact of technology on the capability of the nuclear forces and plans to sustain the U.S. nuclear deterrent policy and strategy.

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Project BG - Nuclear Operations (cont'd)

Complete the WMD operational analysis for CENTCOM/USFK/TRANSCOM dealing with chemical threats to U.S./Allied military operations.

Conduct Force-on-Force exercise program focused on U.S. forces in USEUCOM/USAFE-Mighty Guardian series.

Expand the support of the AFSPACECOM/STRATCOM security analyses of ICBM forces.

WMD (Nuclear) Response Protection (\$17,000K)

Provide ability to accurately and quickly identify source of production of special nuclear material used in weapons or improvised devices.

Facilitate rapid and reliable identification of the source of shielded nuclear material (SNM) involved in a nuclear/radiological event/incident.

Develop portable, mobile, and rapidly deployable radiation detection and measurement System, a portion of which will be comprised of remote sensors linked to central receiving/processing station via RF signals.

Provide CINC Technical Support Groups (TSG) ability to employ the system based on intelligence cueing.

Develop and field passive and active SNM detection systems where capable of detection in cases where SNM is shielded; current detectors technologies do not perform well when SNM is shielded for gamma and/or neutron emissions.

Conduct applied research and development in order to enhance the capabilities of DoD to consistently defeat Improvised Nuclear Device (IND)/Radiological Dispersal Device (RDD) through the use of developed technologies, tools, and techniques.

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Project BH - System Survivability - These programs directly reflect the National Military Strategy, support the provisions of Joint Vision 2010, and are directed by the JCS in the Joint Strategic Capabilities Plan (Nuclear Annex). Current and future warfighters and weapon systems, including the associated Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR), missile defense and support systems/equipment, must be able to survive and operate effectively through a spectrum of hostile environments. Planned efforts emphasize the development and demonstration of innovative and cost-effective technologies to sustain the functional survivability of U.S. and Allied Forces and systems when confronted with threats from advanced conventional weapons, special weapons and limited nuclear attack. This project constitutes the DoD's resident science and technology expertise in nuclear and related survivability matters. It develops and demonstrates affordable strategies and hardening technologies for U.S. systems; transfers the technical products to acquisition program offices; conducts component, subsystem, system and end-to-end performance tests and assessments as requested by the Services and CINCs; and provides support to the Office of the Secretary of Defense on technical and policy matters that relate to the acquisition of survivable systems and strategic system sustainment.

Project BH encompasses programs formerly contained in Project AB (Test and Simulation Technology), Project AC (Weapons Systems Lethality), and Project AF (Weapon System Operability) which transitioned from the Defense Special Weapons Agency into the Defense Threat Reduction Agency. The new project is divided into the five business areas described below: Radiation Tolerant Microelectronics, Simulator Technology, Operability Assessments, Balanced Electromagnetic Hardening, and Human Survivability.

Radiation Tolerant Microelectronics. Responds to DoD space and missile system requirements for hardened microelectronics and photonics technology to support mission needs. The non-availability of this technology would adversely impact system survivability, performance, weight and cost. The program involves the development and demonstration of technology to support the fabrication of radiation-hardened microelectronics and photonics for DoD missions through private sector and government organizations. This is achieved

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Project BH - System Survivability (cont'd)

through the development and demonstration of enabling technologies to ensure the continued availability of special materials and radiation-hardened (RH) microelectronics and photonic devices.

Simulator Technology. Since the underground testing (UGT) moratorium, simulators have provided the only remaining experimental test bed for the development and validation of radiation-hardened DoD systems. The intensity and fidelity of these simulators do not match that of the UGT testbed, but, through this program, the agency develops, provides and maintains unique DoD radiation test facilities and enabling technologies that are used by the Defense Agencies, the Services and other federal departments (such as DOE) to evaluate the impact of hostile environments on military systems that support missions in the air, on land, at sea, or in space. The program also develops technologies to improve the intensity, fidelity, reliability, reproducibility, and cost effectiveness of existing and future simulators (including radiation sources, power flow and conditioning components, energy storage, diagnostics, instrumentation, other test support equipment, debris shields, and numerical models and computer codes for radiation sources and pulsed power components and test beds); develops concepts, plans, and risk reduction strategies for an affordable next-generation radiation simulator with substantially improved intensity and fidelity; based on user test requirements, support improvements to the two existing test centers, one at Maxwell Physics International (MPI) in San Leandro, California, and one at the Arnold Engineering Development Center (AEDC) in Tullahoma, Tennessee; installs and characterizes upgrades to the new Decade x-ray simulator and to existing radiation simulators at MPI. The Defense Science Board Task Force on Nuclear Effects Simulation is studying the need for improving DTRA's radiation simulator capabilities. Its recommendations will form the basis for a restructured program which could aggressively pursue developing some of the capability lost with the moratorium on underground testing.

Operability Assessments. Directly responds to warfighter and acquisition program survivability needs by providing solutions, including development of affordable technologies and methodologies for system-level and family-of-system-level assessments, hardening, and

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Project BH - System Survivability (cont'd)

testing of the effects of nuclear weapons. Includes development and demonstration of cost-effective system design and test certification techniques to produce hardware that can be tested without the need for underground nuclear tests. Provides testable system design rules and protocols for users of nuclear effects simulators.

Balanced Electromagnetic Hardening. Provides the necessary science and technology to ensure protection and survival of military battlefield and civilian infrastructure electronic systems against multiple EM environments, including nuclear electromagnetic pulse (EMP), high power microwaves (HPM), as well as WMD threats. Designs and develops innovative, low-cost, balanced EM protection and test technologies for weapon, C3, and supporting infrastructure systems to the CINCs, Services and other DoD agencies.

Includes development of high-power electromagnetic source technology for warfighting applications and hardening technologies for emerging radio frequency (RF) threats.

Human Survivability. Applies lessons learned from the Nuclear Test Personnel Review Program (O&M-funded) to allow warfighters and peacekeepers to quantify/mitigate the risk in post-Cold-War settings (i.e., limited nuclear exchanges, terrorist actions, radiological dispersal weapons, and other radiation risk scenarios) by developing field measurement and dosimetry systems to support military radiological guidelines for the protection of human resources. This provides direct support to warfighters by predicting and quantifying the operational impact of nuclear, biological and chemical (NBC) and conventional battlefield environments on systems and personnel; providing methods for measuring and increasing soldier effectiveness on NBC battlefields; providing performance and cost analysis to support the Defense Acquisition Board; and joint efforts with system program offices to apply the Agency's expertise and technologies to specific Service applications.

Project BH supports the following JCS Joint Warfighting Capabilities: Information Superiority, Counterproliferation, Electronic Warfare, and Precision Force.

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Project BH - System Survivability (cont'd)
FY 2001 Plans

Radiation Tolerant Microelectronics (\$20,400K)

Demonstrate prototype radiation-hardened memory circuits capable of storing one million bits of information and retaining the information in the absence of power. Complete the qualification, for space applications, of radiation-hardened memory circuits capable of storing four million bits of information.

Demonstrate technology to support the development of a radiation-hardened processor circuit capable of providing at least 100 million instructions-per-second operation.

Demonstrate advanced technology to support the development of radiation-hardened circuits capable of processing both analog and digital information.

Demonstrate a radiation-hardened 24 million (4 million gates) transistor circuit array to support satellite and missile onboard data processing needs.

Test and evaluate combined electrical and optical technology for wideband data processing applications.

Simulator Technology (\$18,120K)

Operate and improve DTRA's radiation simulators to support nuclear weapons effects testing.

Demonstrate the cold x-ray source for the Decade Quad and optimize output to double the initial yield

Demonstrate high-fidelity (>5 keV) cold x-ray source for advanced radiation simulators using a high-energy test facility ("Z") at Sandia National Laboratories.

Continue large-area (>500cm²) debris shield development for cold x-ray sources on the Decade Quad.

Complete the improvement of modular opening switch efficiency.

Begin the development of compact energy storage technology to improve the performance of the Compact X-ray Simulator by ten times in the same size package.

Begin to develop higher fidelity laser x-ray sources based on a higher power laser facility at the University of Rochester.

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Project BH - System Survivability (cont'd)

Continue the development of technology to dramatically improve the capability of non-nuclear x-ray test facilities.

Operability Assessments (\$8,917K)

Continue assessment and testing of critical national security assets.

Update development of the network assessment tool for USSPACECOM based on DTRA past assessments.

Complete MILSTAR transition operability assessment.

Develop a subsystem controller for fast circumvention and recovery (C&R) after radiation exposure.

Develop nuclear environment software modules for integration with Hardware-in-the-Loop (HWIL) facilities.

Conduct testing of User Early Warning Radars (UEWRs) in support of National Missile Defense (NMD) program upgrades. Develop radar disturbance mitigation techniques for NMD ground-based radar (GBR) and UEWRs.

Provide infrared (IR) scene testing of NMD/TMD (Theater Missile Defense) sensors.

Support IR and communications testing of Space-Based Infrared Satellite (SBIRS).

Continue communication/radar atmospheric effects participation in operational/warfighting exercises.

Complete development of an advanced IR scene generator.

Balanced Electromagnetic Hardening (\$8,235K)

Develop a unified electromagnetic (EM) environmental effects protection design tool.

Conduct integrated EMP/HPM test methods study.

Conduct case study on EM effects on civilian infrastructures supporting key DoD missions.

Perform HEMP test of National Military Command Center (NMCC).

Initiate Mission Degradation Analysis (MIDAS) case study on civilian infrastructure.

Complete proven commercial off-the-shelf (COTS) hardware kit, which provides easy-to-install devices and simple techniques to harden COTS computers against RF threats.

Perform susceptibility testing on at least one new class of foreign or U.S. asset.

Complete loan arrangement with service partner on amplitron modification.

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Project BH - System Survivability (cont'd)

Leading a joint working group of Navy and Air Force representatives to investigate the phenomenology of the interaction of high power radio frequency signals at the semiconductor junction level for disruption and damage effects. Extend results to circuit board and subsystem level to examine the synergetic effect on the circuit's functionality due to the external signal. Interpret the results to build models explaining how electronics are disrupted, and how we can better protect them.

Human Survivability (\$1,085K)

Continue development and evaluation of radiation protection standards and risk measures applicable to personnel/equipment for NATO review.

Implement "lessons learned" from test and evaluation to fielded fly-away dosimetry system.

Adapt/develop battlefield radiological measurement systems to unmanned aerial vehicle (UAV) platform.

Initiate conceptual development of biological dosimetry capability for fly-away dosimetry system.

Investigate new methods/agents for decontaminating mission-essential equipment that is radiologically contaminated above military guidelines.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2000
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B. Program Change Summary

	<u>FY 1999</u>	<u>FY 2000</u>	<u>FY2001</u>
Previous President's Budget	211.4	203.5	206.5
Current President's Budget	210.0	214.5	230.9

Change Summary Explanation:

The budget request represents a highly leveraged science and technology (S&T) program, consistent with Departmental S&T objectives. As part of the effort to better focus the Agency organization and resources to the threat reduction mission, substantial restructuring of DTRA's Program Element construct has occurred.

Changes in FY 00 are direct results of Congressional emphasis in the areas of Nuclear Weapons Effects, Discrete Particle Methods, X-ray simulators, "Deep Digger" and Thermionics technology. Changes in FY 01 support critical weapons of mass destruction assessments and response efforts.