# Nuclear Technology

## NT.01 Nuclear Operability and Survivability Testing Technologies

**Objectives.** Provide the means to validate/revalidate the survivability and operability of military systems in a proliferant nuclear threat environment. Underground nuclear testing (UGT) was a major means used to validate system survivability/vulnerability; however, with the cessation of UGT, full-scale subsystem/system hardening validation and survivability testing of both new and existing nuclear delivery systems in UGTs has been eliminated. Present aboveground x-ray simulation facilities cannot provide the fluence, spectrum, or test area necessary to test systems larger than 2,500 $cm^2$. Present blast, shock, and thermal test facilities cannot produce the "true" nuclear effects environment. To ensure the continued safe, secure, and effective operations of our military systems, existing hardening technologies, methodologies, modeling, and aboveground simulation facilities must be improved. This DTO also provides critical understanding of nuclear phenomenology issues essential for the reliable operation of strategic, $C^4I$, and missile defense systems in nuclear environments.

**Payoffs.** Improvements in our nuclear simulation testing capabilities and understanding of nuclear phenomenology will increase our confidence in the survivability of both existing and new military systems. During FY99, the DECADE Radiation Test Facility (DRTF) IOC provided twofold improvement in hot x-ray capability.

**Challenges.** Technical challenges include (1) improving simulator fluence area products by 400%; (2) increasing soft x-ray debris shields by a factor of three; (3) increasing simulator power flow by 50%; (4) developing nonideal airblast simulation test capabilities into the Large-Blast/Thermal Simulator (LB/TS); (5) correlating past underground nuclear test data with aboveground, hardware-in-the-loop, and modeling data; (6) improving understanding of atmospheric IR emissions in nuclear environments to optimize the operation of IR sensors on theater and missile defense systems and the Space-Based Infrared System; and (7) improving understanding of weapons output, thermal, and material phenomenology to support the development of more accurate nuclear consequence assessment models.

**Milestones/Metrics.**

FY2000: DTRF provides threefold improvement in cold x-ray test capability.

FY2001: Complete NIAB test series at LB/TS; modify driver gas tubes/mothball LB/TS.

FY2002: Improved scene-generation dynamic display technology for simulating nuclear clutter.

FY2003: Improve cold x-ray capability by 3X on Decade-Quad.

FY2004: Advanced Nuclear Clutter Simulator supports NMD seeker testing.

FY2005: Reduced energy operation of the National Ignition Facility supports nuclear effects x-ray testing.

| Customer POC | Service/Agency POC | USD(A&T) POC |
|---|---|---|
| Mr. Robert GOODMAN<br>USA/SMDC | Mr. Richard GULLICKSON<br>DTRA/NSSS | Mr. Fred CELEC<br>ODDR&E |
| Dr. Barry HANNAH<br>USN/SSP | Mr. Matt HOLM<br>DTRA/CSD | |
| Dr. Ted HARDEBECK<br>STRATCOM | | |
| Maj Donald ROBBINS, USAF<br>HQ USAF/XONO | | |

**NT.01 S&T Funding ($ millions)**

| PE | Project | FY00 | FY01 | FY02 | FY03 | FY04 | FY05 |
|---|---|---|---|---|---|---|---|
| 0602715BR | AB | 31.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0602715BR | AL | 1.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0602715BR | BE | 0.0 | 8.3 | 8.4 | 8.7 | 8.9 | 9.0 |
| 0602715BR | BG | 0.0 | 1.6 | 2.1 | 0.0 | 0.0 | 0.0 |
| 0602715BR | BH | 0.0 | 19.6 | 19.8 | 20.8 | 20.9 | 22.0 |
| | **DTO Total** | **33.1** | **29.6** | **30.3** | **29.5** | **29.8** | **31.1** |

## NT.02 Electronic System Radiation Hardening

**Objectives.** Develop enabling technology to support the fabrication of radiation-hardened electronics and photonics, and develop test/design protocols to validate system survivability using aboveground tests. The electronics- and photonics-enabling technology includes advanced materials and design or process methods for deep-submicron technology. The test/design protocols include identification of the minimum test set for system survivability verification. This type of electronics technology is required to validate the survivability of space and missile systems such as MILSATCOM, SBIRS, GBI, GPS, USSTRATCOM strategic systems, SBL, SBR, $C^4I$ systems, etc. This enabling technology forms the basis from which DTO SE.37 (High-Density, Radiation-Resistant Microelectronics) produces final products for space and missile systems.

**Payoffs.** The payoffs from this DTO include (1) affordable technology and state-of-the-art electronics and photonics, and (2) cost-effective protocols to support system hardening and survivability verification to enable DoD systems to survive and perform their mission in natural and nuclear weapon-generated radiation environments. During FY99, this DTO demonstrated radiation-hardened, 0.35-µm complementary metal oxide semiconductor (CMOS) bulk and silicon-on-insulator microelectronics for a 16X reduction of weight and power, and delivered final validated protocols for design and test of hardened EO sensors, missile interceptors, and space systems.

**Challenges.** The challenges include maintaining circuit radiation robustness as size and power are reduced and performance is increased for each new generation of microelectronics, and verifying or validating system survivability without underground tests.

**Milestones/Metrics.**

FY2000: Demonstrate deep-submicron (0.25-µm) technology for radiation-hardened, low-power microelectronics technology for l00X reduction in weight and power. Develop hardening techniques for advanced photonic sensors. Demonstrate the applicability of high-performance computing simulations in reducing design margins for hardened systems, and deliver an automated toolkit to support system developers in implementing protocols.

FY2001: Demonstrate 0.25-µm technology for a 4-M gate array, 16-M SRAM, and 32-bit 100-MIP digital signal processors and microprocessors. Demonstrate functional, integrated, hardened technologies for space surveillance or missile interceptor applications.

FY2002: Deliver advanced hardened controller technology for system upset and recovery and demonstrate hardened advanced photonic sensors.

FY2003: Develop 0.18-µm, radiation-hardened technology, including silicon-germanium bipolar transistors for system-on-chip circuits for a 100X increase in density and a 10X increase in performance. Deliver advanced methodology for hardening COTS devices.

FY2004: Demonstrate rad-hard, giant magneto-resistive material for high-density, embedded nonvolatile memory technology. Verify system hardness validations using advanced modeling and simulation techniques.

FY2005: Develop electronic design automation tools to enable development of a radiation-hardened 0.18-µm CMOS system-on-a-chip for the next-generation military space systems. Demonstrate performance of hardened sensor systems and hardened COTS systems in combined radiation environments using enhanced aboveground test simulators.

| Customer POC | Service/Agency POC | USD(A&T) POC |
|---|---|---|
| Ms. Karen BASANY<br>SMC/MTA | Mr. Matt HOLM<br>DTRA/CSD | Mr. Fred CELEC<br>ODDR&E |
| Dr. Ted HARDEBECK<br>STRATCOM | Dr. Les PALKUTI<br>DTRA/NSSE | |
| Mr. A. KUEHL<br>USA/SMDC | | |

## NT.02 S&T Funding ($ millions)

| PE | Project | FY00 | FY01 | FY02 | FY03 | FY04 | FY05 |
|---|---|---|---|---|---|---|---|
| 0602715BR | AF | 16.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0602715BR | BH | 0.0 | 18.4 | 16.3 | 17.0 | 17.4 | 19.9 |
| | **DTO Total** | **16.6** | **18.4** | **16.3** | **17.0** | **17.4** | **19.9** |

## NT.03 Hard-Target Defeat

**Objectives.** Deliver to the warfighter an end-to-end deliberate planning capability for the defeat of tunnel facilities. This capability will include the ability to characterize a facility through the fusion of multisensor data and reverse engineering to identify critical functional nodes and potential vulnerabilities; identify functional disruptions and time to reconstitute when complete destruction of the facility is impossible or undesirable; assess numerous attack strategies in an automated fashion; assess bomb damage; and identify maximum lethality potential of conventional weapons beyond which other means, such as nuclear weapons, will be necessary. The lethality of several advanced weapon concepts resulting from the hard- and deeply buried-target defeat capability acquisition program and related service efforts will also be evaluated as part of this program.

**Payoffs.** The payoffs from this DTO include (1) providing the theater commander a tool to readily define optimal attacks against several types of tunnel facilities; (2) providing the ability to assess whether an available tunnel attack option will provide the desired military objectives, including estimates for loss of facility function and time to repair; and (3) assessing advanced sensor and weapon concepts designed to advance the hard-target defeat capability.

**Challenges.** The fundamental difficulty in targeting tunnel structures is the inability to directly penetrate the rock overburden to place the desired weapon effects within the central facility. This necessitates attacking by other means, which includes the following challenges: (1) accurately characterizing the layout and function of an underground facility with only limited data from available sensors; (2) identifying weaknesses that could be effectively exploited with current weapons, and the length of time required to repair; and (3) developing advanced weapon and warhead effects to provide adverse (damaging) environments as far into the facility as possible.

**Milestones/Metrics.**

FY2000: Demonstrate a capability to deny and disrupt operational (missile) tunnel facilities for a minimum of 48 hr using current conventional weapons; develop and incorporate target reconstitution models. Begin construction on tunnel testbed #2 (WMD production/storage). MEA tunnel module 4.0 released.

FY2001: Complete MEA Tunnel Module Version 5.0 (Missile Ops Tunnels). Prepare attack plans for tunnel testbed #2 ($C^3$ Facility). Demonstrate by HE simulation the effectiveness of nuclear weapons in defeating deep structures using precise, low-yield attacks.

FY2002: Demonstrate a capability to deny and disrupt $C^3$ operations located in tunnels for at least 7 days with current and advanced conventional weapons. Encompass data into MEA Tunnel Module Version 6.0

FY2003: Construct testbed #3, a simulated WMD facility. Collect signatures during construction.

FY2004: Operations signature collection and conventional weapon attacks at testbed #3. Demonstrate capability to deny and disrupt WMD production and storage facilities located in tunnels.

FY2005: Continue weapon attacks at testbed #3. Completion and release of MEA tunnel module version 7.0. planned for FY06.

| Customer POC | Service/Agency POC | USD(A&T) POC |
|---|---|---|
| Dr. Barry HANNAH<br>USN/SSP | Mr. Douglas BRUDER<br>DTRA/CPOH | Mr. Greg HULCHER<br>OUSD/AT |
| Maj Skip MURRAY, USAF<br>STRATCOM, J541 | Mr. Matt HOLM<br>DTRA/CSD | |
| LT James C. PAPINEAU, USN<br>USN/JSOC | | |
| Maj Buzz SAWYER, USAF<br>HQ USAF/XOR | | |

**NT.03 S&T Funding ($ millions)**

| PE | Project | FY00 | FY01 | FY02 | FY03 | FY04 | FY05 |
|---|---|---|---|---|---|---|---|
| 0602715BR | AB | 6.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0602715BR | AC | 4.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0602715BR | AI | 10.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0602715BR | BE | 0.0 | 2.1 | 2.3 | 2.7 | 2.8 | 2.8 |
| 0602715BR | BF/CP | 0.0 | 18.9 | 18.0 | 17.6 | 17.9 | 18.3 |
| | **DTO Total** | **20.4** | **21.0** | **20.3** | **20.3** | **20.7** | **21.1** |

## NT.04 Prediction and Mitigation of Collateral Hazards

**Objectives.** Establish the capability to accurately predict and mitigate the hazards to civilian and military populations when weapons of mass destruction (WMD) materials are released into the atmosphere by an event of military or domestic concern.

**Payoffs.** The tool provides the warfighter with the capability of predicting the amount of WMD material expelled and the subsequent downwind hazard from a conventional counterforce attack on WMD facilities. Additionally, the tool provides the user the capability to predict hazards and their uncertainties due to accidental, terrorist, or any other release of toxic materials. This effort will also provide agent defeat methods and materials.

**Challenges.** The most severe technological barriers are the provision and coupling of high-resolution (<1 km) weather predictions with atmospheric transport calculations, including scavenging effects of rainout/washout; and describing transport/effects uncertainties. Other technology challenges in this DTO are WMD source dynamics, including the response of facilities and equipment containing WMD materials and other dangerous materials.

**Milestones/Metrics.**

FY2000: Demonstrate a significant improvement in the ability for long-range, high-resolution forecasting of WMD health hazards (rainout and scavenging). Validate capability to estimate transport errors and probabilities due to weather prediction, source, transport, and other uncertainties.

FY2001: Demonstrate an integrated, automated capability for predicting collateral hazards to human populations resulting from possible dispersal of chemical or biological agents and radiation released during or after attacks on WMD targets. Complete urban transport/effects capability at city-scale resolution. Test and exercise initial street- and building-scale resolution capability.

FY2002: Provide final Counterproliferation II ACTD capabilities

FY2003: Validate prediction methodology using scaled tests of nuclear weapon storage facilities and hardened targets such as tunnels. Complete validation of urban transport/effects capabilities including street- and building-scale resolution

FY2004: Deliver full-capability urban transport/effects capability for counterproliferation and domestic applications.

FY2005: Provide hazard prediction capability for additional toxic materials, weapons, and target classes to support counterproliferation applications.

| Customer POC | Service/Agency POC | USD(A&T) POC |
|---|---|---|
| LTC Bruce BARRETT, USA<br>HQ USPACOM, J54K | Mr. Matt HOLM<br>DTRA/CSD | Mr. Fred CELEC<br>ODDR&E |
| LTC Tab BLAZEK, USA<br>USEUCOM | Dr. Leon WITTWER<br>DTRA/CPWE | |
| LTC Bud PRUITT, USA<br>STRATCOM, J55 | | |

**NT.04 S&T Funding ($ millions)**

| PE | Project | FY00 | FY01 | FY02 | FY03 | FY04 | FY05 |
|---|---|---|---|---|---|---|---|
| 0602715BR | AC | 1.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0602715BR | AE | 1.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0602715BR | AF | 3.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0602715BR | BD | 0.0 | 9.4 | 11.0 | 15.4 | 18.5 | 20.0 |
| 0602715BR | BF/CP | 0.0 | 2.6 | 2.2 | 2.3 | 0.0 | 0.0 |
| 0602715BR | BH | 0.0 | 1.1 | 1.1 | 1.1 | 1.1 | 1.2 |
| | **DTO Total** | **6.2** | **13.0** | **14.3** | **18.8** | **19.6** | **21.2** |

## NT.05 Balanced Electromagnetic Hardening Technology

**Objectives.** Develop and demonstrate innovative and affordable technologies and methodologies for integrated hardening and testing of military systems against high-power microwave (HPM) and high-altitude electromagnetic pulse (HEMP) effects. Specific technology objectives of this baseline program include developing an EM-hardened ac power cord; a PC-based protection tool; a generic, simple-to-install hardware "kit" for hardening commercial off-the-shelf (COTS) computers; an RF attack detector (Witness Chip); and a unified EM pulse (EMP)/HPM protection and test methodology. This program responds to requirements identified by the Joint Chiefs of Staff, the services, and USD(A&T).

**Payoffs.** Integrated hardening against multiple battlefield threat environments (i.e., HPM and HEMP) will reduce hardening cost, size/weight, and procurement costs (design and test time), and provide residual protection against other EM threats (e.g., indirect lightning). Hardening cost savings of up to 30% and comparable weight reductions can be achieved if composite shielding materials become realizable. Cost savings of 20%–25% over the life of a system are also expected with the improved testing and maintenance/surveillance methodologies developed under this program. In FY99, a prototype hardened ac power cord was demonstrated to enhance COTS equipment survivability and significantly reduce life-cycle costs. A second effort was initiated to develop field-expedient methods for characterizing COTS immunity to EMP and HPM environments.

**Challenges.** The Secretary of Defense has initiated a mandate to transition from a 25% COTS/75% MILSPEC equipment ratio in military systems to 75% COTS/25% MILSPEC. At the same time, budgets for military procurement are undergoing drastic reductions. A key challenge is to ensure that this COTS equipment is survivable to the wide range of existing and emerging battlefield EM environments.

**Milestones/Metrics.**

FY2000: Determine feasibility of integrated EMP/HPM test methods that reduce test costs and duration. Market the EM hardened ac power cord as a commercial product. Complete the joint assessment of cellular telephone hardware susceptibility to EM (HPM). Develop an advanced solid-state HPM test source in conjunction with a service partner. Harden a sensitive, DoD high-interest asset and demonstrate in laboratory tests.

FY2001: Develop an EMP/HPM COTS PC kit and a Unified E3 Matrix protection design tool. Expand the susceptibility database by testing a new class of electronic equipment.

FY2002: Integrate the substrate conduction protection technology (prototyped in FY00) into existing COTS/MILSPEC equipment. Investigate the use of upper-microwave or millimeter-wave regimes for upset/interference with electronics.

FY2003: Update MIL–STD–188–125 and MIL–STD–2169. Assess digital battle space architectures for susceptibility to EM upset or damage. Perform susceptibility testing on one new class of foreign or U.S. asset.

FY2004: Apply HPM/EMP hardening technology to a new class of warfighter system. Integrate threat environments and protection design codes. Perform susceptibility testing on one new class of foreign or U.S. asset.

FY2005: Improve generic hardening techniques to provide protection to any military and civilian system from emerging threats.

| Customer POC | Service/Agency POC | USD(A&T) POC |
|---|---|---|
| Mr. Richard CULLEN<br>USSPACECOM | Lt Col Manny APONTE, USAF<br>DTRA/NSSE | Mr. Fred CELEC<br>ODDR&E |
| LTC P. K. SIMMONS, USA<br>USSTRATCOM | Mr. Matt HOLM<br>DTRA/CSD | |
| | Mr. Walter SCOTT<br>DTRA/NSSE | |

## NT.05 S&T Funding ($ millions)

| PE | Project | FY00 | FY01 | FY02 | FY03 | FY04 | FY05 |
|---|---|---|---|---|---|---|---|
| 0602715BR | AC | 1.9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0602715BR | AF | 2.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0602715BR | BH | 0.0 | 4.4 | 4.6 | 5.2 | 5.0 | 5.8 |
| | **DTO Total** | **4.7** | **4.4** | **4.6** | **5.2** | **5.0** | **5.8** |

## NT.06 Survivability Assessments Technology

**Objectives.** Develop data through analyses to support the acquisition, operation, and maintenance of $C^4$ and weapon systems that must be employed in a combined nuclear effects environment; and utilize DTRA tools to perform operability, survivability, vulnerability, and connectivity assessments for current and proposed systems in combined nuclear effects environments. The products of this program (data and improved tools) support the CINCs' need for affordable and responsive solutions to meet survivability requirements. These same assessment tools are also applied to evaluate and analyze potential mitigation solutions that are proposed to solve system vulnerabilities identified in the assessments. This program responds to requirements identified by Joint Chiefs of Staff, combatant CINCs, services, and other DoD organizations.

**Payoffs.** The products from system assessments provide the warfighter with critical data to ensure the survivability of critical $C^4$ and weapon systems. In FY99, the GPS Operability Assessment Report was completed and delivered.

**Challenges.** The conduct of timely, accurate, and relevant assessments of components, systems, networks, and system-of-systems requires the development of robust tools for the evaluation of atmospheric effects. Furthermore, analytical tool development is based on a small sample of empirical test data. Additionally, the tools require a myriad of numerical calculations to provide a relatively accurate assessment.

**Milestones/Metrics.**

FY2000: Deliver initial USSPACECOM network assessment tool to provide exercise support.

FY2001: Complete development of the Network Operability Assessment Methodology. Revise and deliver final network analysis tool.

FY2002: Deliver Milstar Transition Operability Assessment.

FY2003: Deliver NORAD/USSPACECOM Warfighter Support System (N/UWSS) Requirements Report.

FY2004: Deliver USSPACECOM Tactical Warning/Attack Assessment Operational Assessment reflecting NMD requirements.

| Customer POC | Service/Agency POC | USD(A&T) POC |
|---|---|---|
| Mr. Al BUCKLES<br>USSTRATCOM/J6 | Mr. Matt HOLM<br>DTRA/CSD | Mr. Fred CELEC<br>ODDR&E |
| Mr. Richard CULLEN<br>USSPACECOM | Mr. Bill SUMMA<br>DTRA/NSSA | |
| Mr. John GRAZIOSE<br>NAVSEA, PMS–452 | | |
| Dr. Jeremy KAPLAN<br>DISA 8 | | |
| Dr. Les PIERRE<br>BMDO/JNP | | |

**NT.06 S&T Funding ($ millions)**

| PE | Project | FY00 | FY01 | FY02 | FY03 | FY04 | FY05 |
|---|---|---|---|---|---|---|---|
| 0602715BR | AE | 6.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0602715BR | AF | 1.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0602715BR | BC | 0.0 | 6.0 | 6.1 | 6.4 | 6.5 | 6.8 |
| 0602715BR | BF/CP | 0.0 | 1.9 | 1.8 | 2.0 | 2.1 | 2.1 |
| 0602715BR | BH | 0.0 | 0.9 | 0.9 | 1.1 | 1.1 | 1.1 |
| | **DTO Total** | **7.9** | **8.8** | **8.9** | **9.5** | **9.7** | **10.0** |

## NT.07 Integrated Comprehensive Weaponeering Capability

**Objectives.** Develop an integrated comprehensive weaponeering capability (ICWC) that provides the warfighter a standardized weaponeering framework to conduct pre-attack planning and post-attack assessment for the full spectrum of weapons and targets, including weapons of mass destruction (WMD) targets. The ICWC integrates newly developed and existing weaponeering, damage assessment, and collateral effects tools. It provides the warfighter with seamless integration of multiple tools for an end-to-end analysis capability. It also integrates these tools with the planning systems and information spaces.

**Payoffs.** By providing the warfighter a standardized weaponeering framework, the ICWC greatly increases weaponeering efficiency while minimizing warfighter training requirements. It expedites cross-service weaponeering and joint/coalition planning. The ICWC will provide the warfighter with decision support for tool selection and tool use that is based on target characteristics, intelligence, and time available. Additionally, it provides the warfighter with a common target description language that is shared by the tools. In FY99 the ICWC architecture was defined, a common target description language was established, three tools were integrated, and demonstration of the three tools accessing the common target folder was completed.

**Challenges.** The ICWC has three critical challenges. First, a wide and diverse set of legacy and new weaponeering tools must be integrated into a single look and feel. Second, the ICWC must be available to a wide range of geographically distributed weaponeers across multiple services and allies. Third, ICWC must be compatible with current, near-term, and future service and joint planning software (e.g., Rapid Application of Air Power (RAAP), Air Force Mission Support System (AFMSS), Naval Tactical Aircraft Planning (TAMPS), Global Command and Control System (GCCS), Joint Targeting Toolbox (JTT), Theater Battle Management Core System (TBMCS)) while being usable on a wide range of platforms (from PC-class to large workstations). ICWC will also be compatible with intelligence community information spaces (e.g., Modernized Integrated Database (MIDB), ATHENA, Counteractive Protection System (CAPS)).

**Milestones/Metrics.**

FY2000: Demonstrate an ICWC I with initial set of three weaponeering capabilities that have a common look and feel. The demonstration will integrate a subset of ICWC with the JTT and a DIA intelligence database (ATHENA). Begin ICWC II with additional tools and enhanced functional integration.

FY2001: Demonstrate ICWC II during a mini-exercise that supports J.04, Counterproliferation II ACTD; integrate three additional tools, increase weaponeering throughput by 2X, and reduce training requirements by 5X.

FY2002: Deliver ICWC II; begin ICWC III with the final set of tools and full functional integration.

FY2003: Demonstrate ICWC III during an operational exercise that supports the final operational exercise for J.04. Deliver ICWC III as a final deliverable.

| Customer POC | Service/Agency POC | USD(A&T) POC |
|---|---|---|
| LTC Hal MEYER, USA<br>STRATCOM, J55 | Mr. Michael E. GILTRUD<br>DTRA/CPWS | Mr. Fred CELEC<br>ODDR&E |
| LTC Steve PEREZ, USA<br>HQ EUCOM, J5–N/CP | Mr. Matt HOLM<br>DTRA/CSD | |

**NT.07 S&T Funding ($ millions)**

| PE | Project | FY00 | FY01 | FY02 | FY03 | FY04 | FY05 |
|---|---|---|---|---|---|---|---|
| 0602715BR | AC | 4.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0602715BR | BD | 0.0 | 3.9 | 3.4 | 3.0 | 0.0 | 0.0 |
| 0602715BR | BF/CP | 0.0 | 1.5 | 1.5 | 1.0 | 0.0 | 0.0 |
| | **DTO Total** | **4.5** | **5.4** | **4.9** | **4.0** | **0.0** | **0.0** |

## NT.08 Nuclear Weapon Safety and Reliability

**Objectives.** (1) Provide revalidation of the safe, reliable performance of the nuclear warheads in the stockpile in collaboration with DOE, and technical support for annual certification; (2) develop and apply methodologies for assessing the safety of nuclear weapons in DoD custody and associated weapon systems; and (3) provide technical support for sustainment of DoD strategic mission capabilities. The mission requirement for this DTO is found in the Nuclear Posture Review, Presidential Decision Directive 15, the Quadrennial Review, the Nuclear Weapons Employment Plan, the JSCP, and the May 1997 report from the Secretary of Defense to Congress on DoD Nuclear Weapon Systems Sustainment programs.

**Payoffs.** The payoffs include ensuring a safe, reliable, and survivable enduring nuclear stockpile and strategic deterrent systems through the generation of (1) validated codes and models, effectively archived baseline data, and revalidated stockpile-to-target sequence of nuclear warheads and weapon systems for certification in the absence of underground testing (UGT); (2) improved and validated operational safety procedures based on probabilistic risk assessments of accidents involving nuclear weapon delivery systems; (3) technical support resources for DoD collaborations with DOE for nuclear stewardship; and (4) an independent source of nuclear technical support and advice for all of DoD. Specific achievements for FY99 include completion of a dual revalidation of the W–76, a DOE-proposed streamlined baselining method for future warhead studies; a DCA (Europe) Weapon System Safety Assessment (WSSA).

**Challenges.** Some strategic systems are likely to be deployed beyond their original planned service lives. Safety and reliability will continue to be imperatives. The Comprehensive Test Ban Treaty removes a major tool for strategic system performance validation. The precipitous decline in acquisition of strategic systems is leading to a degradation of nuclear hardening and survivability skills and tools. The maintenance of AGT simulator facilities in the absence of pressing acquisition test needs is difficult. Their availability when new or modified systems ultimately require testing or to obtain material characterization or computer code simulation validation data is paramount.

**Milestones/Metrics.**

FY2000: Publish first edition of the DoD Nuclear Mission Management Plan. Complete Virtual UGT Scoping Study.

FY2001: Complete B2 WSSA. Complete weapon storage vault blast testing. Begin development of Virtual UGT Tool.

FY2002: Complete storage vault blast testing analysis.

FY2003: Complete long-term storage and CONUS-based DCA WSSAs. Conduct Virtual UGT proof-of-principle demonstration.

| Customer POC | Service/Agency POC | USD(A&T) POC |
|---|---|---|
| Col David CHERRY, USAF<br>HQ USAFE/SE | Mr. Gerald BAIRD<br>DTRA/NSNP | Mr. Fred CELEC<br>ODDR&E |
| Mr. Carl GROSS<br>ALC/LMR | CDR Bruce JACKABON, USN<br>DTRA/NS | |
| Dr. Barry HANNAH<br>USN/SSP | Ms. Cathy MONTIE<br>DTRA/NS | |
| Dr. Billy MULLINS<br>USAF/XON | | |
| Col A. STRAUS, USAF<br>AFSE | | |

## NT.08 S&T Funding ($ millions)

| PE | Project | FY00 | FY01 | FY02 | FY03 | FY04 | FY05 |
|---|---|---|---|---|---|---|---|
| 0602715BR | AE | 7.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0602715BR | BG | 0.0 | 8.3 | 9.0 | 9.7 | 0.0 | 0.0 |
| | **DTO Total** | **7.8** | **8.3** | **9.0** | **9.7** | **0.0** | **0.0** |

## NT.09 Nuclear Phenomenology

**Objectives.** Develop and provide prediction tools for nuclear weapons effects phenomenology and its interaction on systems to develop and understand the nuclear weapon-related free field; provide nuclear weapon target interaction lethality information; and provide nuclear weapons phenomenology information to the warfighter in usable form. The DTO addresses the lethality of the full spectrum of nuclear weapons and applies directly to the understanding of weapon–target interaction to support the generation of weapon system lethality analysis requirements for the changing worldwide target base. The DTO also provides for nuclear weapons effects and their consequences for battle damage prediction and assessment.

**Payoffs.** Payoffs of this DTO are in improvements in the warfighters ability to hold at risk very hard targets with greatly reduced collateral damage. Significant new techniques for nuclear weapons effects analysis for exploitation will lead to increased confidence in the lethality of new and existing military systems. Greatly increased understanding of the nuclear weapon output related to effects will help to bridge the technology gap resulting from the loss of the underground nuclear effects test capability. This DTO will provide the tools required for development and analysis of system designs and those required for use in an overall system test.

**Challenges.** Technical challenges are presented by the rapidly developing need to hold evolving enemy targets at risk using the reduced stockpile, and recognizing greatly increasing political and environmental constraints. As a result, we must improve our understanding of weapons outputs and target interactions without underground testing, using only calculations and the ASCI capabilities of DOE laboratories, and apply this understanding to update effects calculational capabilities and develop innovative targeting techniques to defeat increasingly clever enemies—both national and terrorist.

**Milestones/Metrics.**

FY2000: Complete foreign nuclear weapons effects output documentation for nuclear weapon point designs.

FY2001: Provide new-generation nuclear fallout calculation techniques and multidimensional output calculations.

FY2002: Complete documentation of output energy coupling transport based on weapon outputs from SBSS-driven warhead modifications and calculations

FY2003: Complete overhaul of the EMP/SREMP effects analysis methods and target assessment and planning tools in use by the warfighters.

FY2004: Complete the development of baseline calculations to understand in detail uncertainties associated with the first-principle codes.

FY2005: Complete revision of high-altitude and underground burst nuclear weapons codes and their transfer to massively parallel computers.

| Customer POC | Service/Agency POC | USD(A&T) POC |
|---|---|---|
| Dr. Barry HANNAH<br>USN/SSP | Mr. Matt HOLM<br>DTRA/CSD | Mr. Fred CELEC<br>ODDR&E |
| Dr. Ted HARDEBECK<br>STRATCOM | Mr. Thomas E. KENNEDY<br>DTRA/CPWP | |
| Mr. Mike MARTINEZ<br>USAF/NWCA (CP) | | |

## NT.09 S&T Funding ($ millions)

| PE | Project | FY00 | FY01 | FY02 | FY03 | FY04 | FY05 |
|---|---|---|---|---|---|---|---|
| 0602715BR | AC | 5.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0602715BR | AF | 6.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0602715BR | BD | 0.0 | 9.8 | 8.8 | 8.3 | 11.7 | 15.6 |
| | **DTO Total** | **11.9** | **9.8** | **8.8** | **8.3** | **11.7** | **15.6** |