Interim *Report of the* Defense Science Board (DSB) Task Force on the Survivability of Systems and Assets to Electromagnetic Pulse (EMP) and other Nuclear Weapon Effects (NWE)

Summary Report No. 1

August 2011

Office of the Under Secretary of Defense
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The DSB is a Federal Advisory Committee established to provide independent advice to the Secretary of Defense. Statements, opinions, conclusions, and recommendations in this report do not necessarily represent the official position of the Department of Defense.

This report is unclassified and cleared for public release.

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WASHINGTON, DC 20301–3140

DEFENSE SCIENCE
BOARD

10 August 2011

MEMORANDUM FOR UNDER SECRETARY OF DEFENSE FOR ACQUISITION, TECHNOLOGY AND LOGISTICS

SUBJECT: Summary Report Number One of the Permanent Task Force on the Survivability of DoD Systems and Assets to Electromagnetic Pulse (EMP) and other Nuclear Weapon Effects

I am pleased to forward the first interim report of the Defense Science Board Permanent Task Force on the Survivability of DoD Systems and Assets to Electromagnetic Pulse (EMP) and other Nuclear Weapon Effects. Established both to report on progress toward meeting the EMP Commission recommendations and to conduct an ongoing independent periodic assessment, the Task Force will issue periodic assessments of the Department's progress in this area. The Task Force found significant progress in the DoD's nuclear survivability program over the previous two years.

I endorse the study's findings and encourage you to review them.

Paul G. Kaminski

Dr. Paul G. Kaminski
Chairman

OFFICE OF THE SECRETARY OF DEFENSE
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DEFENSE SCIENCE BOARD

August 5, 2011

MEMORANDUM FOR CHAIRMAN, DEFENSE SCIENCE BOARD

SUBJECT: Summary Report No. 1 of the Defense Science Board Task Force on the Survivability of DoD Systems and Assets to Electromagnetic Pulse (EMP) and Other Nuclear Weapons Effects (NWE)

The Permanent Task Force was established to assess the implementation of the Department of Defense Instruction (DODI) 3150.09 titled "Chemical, Biological, Radiological, and Nuclear (CBRN) Survivability Policy" and to assess the effectiveness of the management oversight group established by the DoDI. The Task Force also conducts periodic independent reviews and assessments of DoD's EMP survivability program and reviews other matters associated with nuclear survivability.

The Department of Defense nuclear survivability program has made progress over the previous two years. The Deputy Assistant to the Secretary of Defense for Nuclear and Chemical and Biological Defense Programs/Nuclear Matters is leading the implementation of DODI 3150.09, and the Military Departments are responding to their respective responsibilities. The Army possesses an improved process for independent review of survivability, the Air Force committed resources for testing major platforms for High Altitude EMP (HEMP) protection, and the Navy implemented a requirements review process. United States Strategic Command continued to devote resources and talent to identifying mission critical capabilities and assessing their survivability. Notwithstanding the progress over the last two years, operational and technical issues remain as outlined in the attached report.

Dr. Miriam John
Co-Chair

Dr. Joseph Braddock
Co-Chair

Defense Science Board (DSB) Task Force on the Survivability of Systems and Assets to Electromagnetic Pulse (EMP) and other Nuclear Weapon Effects (NWE)

Summary Report No. 1

Interim Report of the DSB Task Force

Executive Summary – Findings to Date

Background

- Standing Task Force established near end of the previous administration; re-approved March 2010
  - Ongoing oversight recommended in the 2010 DSB "NWE National Enterprise" study
  - Stand-down of the EMP Commission (EMPC) came with Department of Defense (DoD) requirement for biannual report on progress toward meeting EMPC recommendations and some form of ongoing independent periodic assessment
- Charter
  - "…assess implementation of the DoD Instruction covering nuclear survivability including EMP and … assess the effectiveness of the management oversight group established by the DoD Instruction"
  - "… conduct an independent review and assessment of DoD's EMP survivability program and review other matters associated with nuclear survivability"
- Three meetings held to date (July 2010, October 2010, January 2011)

Progress over the past two years

- Deputy Assistant Secretary of Defense for Nuclear and Chemical and Biological Defense Programs/Nuclear Matters (DASD (NCB)/NM) leading organized implementation of DODI 3150.09 "The Chemical, Biological, Radiological, and Nuclear (CBRN) Survivability Policy"
- Services are responding
  - Army improving process for independent review of survivability
  - Air Force committing resources for testing major platforms for HEMP protection
  - Navy implementing requirements review process and developing maritime standard
- U.S. Strategic Command (USSTRATCOM) continuing to devote resources and talent to identifying mission critical capabilities and assessing their survivability
  - With DASD (NCB)/NM oversight, seen as a major influence on Services' activities
- Some modest restoration of funds in National Nuclear Security Administration (NNSA) Survivability Campaign
- Department of Homeland Security (DHS) intent to start science and technology (S&T) program relevant to domestic response and recovery

Many areas of concern remain

- Operational
  - Non-concurrence by the Air Force for the new aircraft EMP standard with potential impacts on survivability requirements for new aircraft (F-35, tanker, next generation bomber, White House platforms)
  - Limitations of Service assessments that identify mission critical equipment instead of mission critical capabilities
  - Fragmentation of responsibilities and lack of priority for survivability of communications networks and command and control (C2) systems
  - Lack of engagement of Combatant Commands (COCOMs) except USSTRATCOM and very recently, European Command (EUCOM)
  - Limited understanding of survivability of infrastructure critical to DoD missions
  - Missile Defense Agency (MDA) has different criteria for hardening critical elements of the system
- Technical
  - Overall fragmentation of efforts - little movement to a national enterprise as recommended by two previous DSB task forces
  - The Defense Threat Reduction Agency (DTRA) lack of priority coupled with little progress toward a "21st century approach" augmenting above-ground simulators with advanced modeling/simulation
  - DTRA-NNSA Memorandum of Understanding (MOU) implementation diverted from original intent to focus on NWE
  - Technical enterprise continuing to atrophy

Introduction

The DSB Task Force is examining the ability of DoD's forces and critical supporting capabilities (e.g., communications, power) to survive, operate, and succeed on/in battlefields/battlespaces where nuclear weapons are threatening or are being employed. The most likely case(s) are use of nuclear weapons by others. Although fratricide is the least likely case, ignoring it is risky. Moreover, U.S. nuclear forces require an increased premium on reliability and survivability as further reductions occur. Understanding nuclear weapons effects (NWE) and mitigation options is a central military-technical matter. See Table 1 at the end of the report for a notional matrix of the scope of the problem and the Task Force's assessments to date.

State of Forces and Their Battle Command

U.S. strategic forces deterrence mission, for which survivability is a critical requirement, carries an even higher premium as force size decreases. Mission success depends not only upon survivable weapon and C2 systems and host infrastructure, but also on a force robust across the Doctrine, Organization, Training, Materiel, Leadership and Education, Personnel, and Facilities (DOTMLPF) spectrum to execute an assured second strike. Overall, the combination is judged adequate but fragile from a strategic mission perspective. DOTMLPF shortfalls have surfaced (and some are being corrected), but forces are thin in many places.

U.S. general purpose forces (GPF) and their theater nuclear survivability capabilities are another matter. On the positive side, GPF capabilities advanced dramatically in recent years as a result of leveraging the information and electronic device revolutions in all aspects of operational concepts and their DOTMLPF underpinnings. The affordability of networked information systems and improved persistence of surveillance technologies enabled previously unachievable collaboration and OPTEMPO between and among force components – small and large, Service and Joint – to great effect.

However, the ubiquitous dependence on Commercial-Off-The-Shelf (COTS) in almost all military and commercial systems that support military operations, while a natural evolution based on cost effectiveness, creates a twofold downside when considering nuclear survivability. First, the unknown response of virtually any basic COTS device to NWE leads to further uncertainties when inserting such devices in military systems. Second relates to the testability of the commercial long distance networks that enable long range reach-back. The network response to NWE is unknown and at that, scale is not testable.

In addition, understanding of the operational impacts of NWE and planning for mission success in nuclear environments have decayed. The principal source of this knowledge previously resided with approximately 15 personnel specialties across the Military Departments associated with theater nuclear forces (TNF) during the Cold War, but the elimination of TNF components was also accompanied by elimination of most of the

specialties, including those aspects which supported conventional force operational planning for determining how to fight through. Two residual specialties remain today:

1) Navy and Air Force specialists in air-delivered gravity bombs, many of whom spend almost all of their time supporting conventional operations vs. training for the unique aspects of nuclear missions, and

2) Army Functional Area (FA) – 52 personnel, who are unique across the Military Departments in their training, knowledge about NWE, and assignments in which that knowledge is applied (e.g., survivability guidance within the Army, hardening requirements, nuclear targeting, etc.).

Of equal concern to the Task Force is the loss of Flag Officer/General Officer awareness of how to deal with NWE.

In summary, the survivability, effectiveness, and adaptation of GPF to NWE is at best unknown. If GPF were subjected to a nuclear event in the foreseeable future, mission execution would depend upon combinations of luck and ingenuity in workarounds for failed equipment. There would almost certainly be an unnecessarily high human cost. The Task Force is not arguing for hardening GPF, but we do see the gap in knowledge of how vulnerable we might be and how to adapt operations through force architecture, Tactics, Techniques and Procedures (TTPs), redundancy, workarounds, etc., as a serious and potentially show-stopping issue.

Oversight

Numerous elements within DoD have policy and oversight responsibility in these areas. Broadly speaking, OSD(Policy) is the lead for setting nuclear related policies, strategies, priorities and direction. The Joint Chiefs of Staff (JCS) is the lead for military professional development education and training responsibilities. The OSD and Service acquisition community has hardware, network and technical integration responsibilities and the Military Departments maintain their Title 10 responsibilities for providing capabilities to COCOMs that meet their operational requirements and priorities.

The recently completed Nuclear Posture Review by OSD/Policy, consistent with historical precedence, did not address nuclear survivability except indirectly in maintaining the role of U.S. nuclear forces in strategic deterrence. In discussions with the Task Force, policy representatives note that this area is not one on the “radar screen” for conventional operations.

With respect to human resource and professional matters, the focus in the Air Force and Navy has been on training strategic forces on NWE and EMP issues, but not the GPF. Only the Army G-3 U.S. Army Nuclear and Combating WMD Agency (USANCA) has a GPF focus for nuclear weapons effects through the FA-52 contingent in that organization.

Within OSD acquisition, priority in DASD (NCB)/NM has been given to implementation of the nuclear aspects of DODI 3150.09, "The Chemical, Biological, Radiological, and Nuclear (CBRN) Survivability Policy." Implementation progress, especially in regards to EMP, is reported in a required biannual report to Congress (next report due September 2011). The established process advanced to the point that the Military Departments developed review processes for new or significantly modified equipment, and they are defining their mission critical equipment already in operation. The next step is to assess how best to understand equipment response to NWE and develop the best approach for achieving equipment survivability. Cost is the major consideration. The Task Force notes, however, that solutions for improving survivability for GPF have more options than the technical hardening required for strategic forces. To first order, choosing some combination of force architecture and redundancy, operational concepts and TTPs, and selective affordable technical hardening should form GPF component survivability strategies. Analysis and gaming can be usefully employed to establish the relative value of various approaches.

The Task Force applauds the leadership by the DASD (NCB)/NM. As the assessment process matures, both NM and the Services need to shift from identifying mission critical equipment to mission critical capabilities in order to develop the most robust and/or cost effective approach(es) to survivability.

A major concern of the Task Force relates to MIL STD 3023 for aircraft survivability to EMP, which has been in final coordination since the Fall 2010. Requirements are stated in terms of performance-based pass/fail criteria at mission-critical interfaces.

The Task Force understands that Commander, USSTRATCOM, supports the draft standard. The Navy and Army also concur with the standard. The AF Aeronautical Systems Center (ASC), however, disagreed with the standard. The Center believes that the acquiring service (in this case, the AF) should be able to tailor design margins. The Task Force does not yet understand the basis for the non-concurrence, but if driven all or in part by cost concerns, notes that historic data indicates minimal impact for designed-in hardening vs. significantly increased cost of retrofit after fielding.

Delaying the formal publication of MIL-STD 3023 could impact ongoing and planned (Next Generation Bomber, White House Military Office) acquisitions of mission critical platforms. The Task Force finds this situation serious as requirements have been or are being set in the programs of record and will be costly to reverse. The matter is being elevated to the CBRN Survivability Oversight Group-Nuclear (CSOG-N) Principals, who have decision authority concerning DODI 3150.09. Members of the Task Force are interested in survivability and mission success, which may not equate to platform hardening, but should be clearly achievable by other means. We urge the CSOG-N to resolve the issue as soon as possible.

Technical Community

Little has happened to create the national enterprise recommended in prior DSB and Threat Reduction Advisory Committee (TRAC) studies. Technical expertise and budgets continue to decline. The Task Force was extremely disappointed to learn that the MOU between DTRA and NNSA emphasized other areas when the original intent was to shore up NWE expertise to support both Departments. In the meantime, there are opportunities being lost. For example, the technical community should be exploiting tests and/or upgrades planned for operational hardware as vehicles to help rebuild and enhance the supporting technology base. The Task Force urged DTRA to engage in the planning for the March 2011 B-2 stealth bomber HEMP test to ensure that collected data supported code validation and development. Unfortunately that did not occur.

Path Forward

The Task Force plans to proceed in the near future as follows:

- Investigate the issues surrounding Air Force non-concurrence with MIL-STD 3023.
- Continue to systematically address elements of Table 1, with near-term emphasis on C2, commercial communications, and other key elements of critical infrastructure.
- Assess the Military Departments' mission critical methodologies to understand the best path or paths to move from identifying and evaluating mission critical equipment to mission critical capabilities.
- Pick up the charge from prior DSB and TRAC studies to "reinvent" the technology base as an interagency national enterprise, based on advanced modeling and simulation tools to augment a more limited set of effects simulators available today.

Table 1. Summary of Findings to Date

	Force Elements/Sectors (for CI)	C3 (Not yet addressed)	People (Not yet addressed)
Strategic forces – Nuclear	• STRATCOM assessments motivating Services and selected COCOM attention, assessments, remediation - Resources committed to aircraft assessments		
– Conventional and missile defense	• Stockpile maintained; design and certification of LEPs budgeted • Missiles maintained •MDA progress with ground facilities - Interceptor hardening? • Planned conventional capabilities not yet addressed		
Critical Infrastructure (CI)	• EMP Commission concerns with power and telecom • Progress not yet assessed		
General Purpose Forces	• Overall CSOG-N implementation of 3150.09 shining spotlight on Survivability, esp. EMP - Mission critical systems being identified - Assessments to follow? - Focus on individual system survivability does not guarantee mission assurance - Army process for new system requirements review being changed to allow earlier intervention in design/development - AF, Navy instituting new processes for requirements review		

Appendix A: Terms Of Reference

THE UNDER SECRETARY OF DEFENSE
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WASHINGTON, DC 20301-3010

MAR 01 2010

ACQUISITION,
TECHNOLOGY
AND LOGISTICS

MEMORANDUM FOR CHAIRMAN, DEFENSE SCIENCE BOARD

SUBJECT: Terms of Reference (TOR) – Defense Science Board (DSB) Task Force on the Survivability of DoD Systems and Assets to Electromagnetic Pulse (EMP) and other Nuclear Weapon Effects

You are requested to form a permanent DSB Task Force to assess all aspects of Survivability of DoD systems and assets to EMP and other nuclear weapon effects. This "DSB Task Force on EMP and Nuclear Survivability" should build on the work of the EMP Commission[1] completed in 2008 and related DSB efforts[2,3] to assess the status and suitability of the nuclear weapon effects enterprise – regarding ionizing radiation and associated effects that are unique to nuclear weapons – to meet DoD requirements for nuclear survivability.

The focus of the Task Force should be to assess implementation of the DoD Instruction[4] covering nuclear survivability including EMP and to assess the effectiveness of the management oversight group established by the DoD Instruction. Another task is to conduct an independent review and assessment of DoD's EMP survivability program, and review other matters associated with nuclear survivability, such as the first biennial DoD report to Congress[5] on EMP survivability.

The Task Force will be sponsored by me as the Under Secretary of Defense for Acquisition, Technology and Logistics. The Assistant to the Secretary of Defense for Nuclear and Chemical and Biological Defense Programs (ATSD(NCB)), is authorized to act upon the advice and recommendations of the Task Force.

Dr. Miriam John and Dr. Joe Braddock will serve as Co-Chairs of the Task Force. Non-governmental Task Force Members will be appointed Special Government Employees in accordance with applicable procedures. ATSD(NCB) will coordinate on all proposed Task Force Members and future changes to the membership list.

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[1] Commission to Assess the Threat to the United States from Electromagnetic Pulse Attack, PL 106-398, Title XIV
[2] Defense Science Board Task Force on Nuclear Weapon Effects Test, Evaluation, and Simulation, dated June 2005
[3] Joint Defense Science Board - Threat Reduction Advisory Committee Task Force (DSB-TRAC TF) on the Nuclear Weapons Effects National Enterprise, with terms of reference dated November 3, 2006
[4] DoDI 3150.09, "The Chemical, Biological, Radiological, and Nuclear (CBRN) Survivability Policy," dated September 17, 2008
[5] Section 1048, Duncan Hunter National Defense Authorization Act for FY 2009 (The initial report is scheduled to be submitted in February 2010.)

Colonel Michael Baehre of the Defense Threat Reduction Agency (DTRA) will serve as the Designated Federal Official (DFO). Mr. John Franco, also of DTRA, will serve as the alternate DFO. Changes to the primary or alternate DFO will be coordinated with the ASTD(NCB) and DSB DFO, Mr. Brian Hughes, and annotated by addendum to this TOR.

This Task Force will operate in accordance with the provisions of Public Law 92-463, the "Federal Advisory Committee Act," and DoD Directive 5105.4, the "DoD Federal Advisory Committee Program." It is not anticipated that this Task Force will need to go into any "particular matters" within the meaning of title 18, United States Code, section 208, nor will it cause any member to be placed in the position of acting as a procurement official. This Task Force TOR will be renewed every two years or upon change of either of the Task Force Co-Chairs.

Ashton B. Carter

Appendix B: Task Force Membership

Task Force Members

Dr. Miriam John, Co-Chair
Dr. Joe Braddock, Co-Chair
GEN John "Jack" Vessey, USA (Ret)
VADM Kevin Green, USN (Ret)
Dr. C. Bryan Gabbard
Dr. Ted Hardeback
Dr. Bob Hermann
Dr. Maneck Master
Dr. Gordon Soper
Dr. Jim Tegnelia
Dr. Joan Woodard

Executive Secretaries (DFOs)

John Franco, DTRA
COL Jeffrey Musk, DTRA

Government Advisors

LCDR Adam Samuels, OPNAV N857
Mr. John Maxey, AF/A5X
Mr. Nicholas Haugen, Mr. Bob Pfeffer,
Army USANCA
Mr. John Okuma, USA/ATEC
Mr. James McComb, Mr. R.C. Webb, MDA
Mr. Andy Metzger, USSTRATCOM/J3
Dr. Suzanne Strohl, TRMC
Mr. Mike Rooney, Dr. Bruce Wilson, DTRA/NT
Mr. Rufus Brinn, DTRA/OP
Mr. Mark Edwards, JCS/J8 JRO
DOT&E Representative – TBD
OSD (NII) – Mr David Dick
COL Manny Aponte, OSD Policy
Dr. Dave Crandall, NNSA
Mr. Todd Hoover, LLNL
Dr. Jim Lee, Dr. Mark Hedeman, SNL
Dr. Sharif Heger, LANL
Mr Rich Vojtech, Mr Anu Bowman, DHS
Ms Helen Mearns, Ms Kari O'Dell, Joint CBRO

Appendix C: Presentations to the Task Force

Name	Topic
July 15 - 16, 2010	
Dr. Gordon Soper, Dr Joan Woodard	Congressional EMP Commission Findings and Recommendations Regarding DoD
Dr Mim John, Dr Joe Braddock	Joint DSB/TRAC Task Force Findings, Recommendations and Status
Dr John Kuspa, DASD (NCB)/NM	DoD Instruction 3150.09, CBRN Survivability, Implementation Status
Dr John Kuspa, DASD (NCB)/NM	SecDef 2009 Report to Congress on EMP Survivability
Dr Suzanne Strohl, TRMC	2010 Strategic Plan for NWE Test & Evaluation
Mr Mark Sward, DTRA	DTRA Nuclear Weapons Effects Center
COL Jeff Musk, DTRA	DTRA/NNSA MOU and Joint Program Plan
October 12-13, 2010	
Hon Fred Celec	General Remarks
COL Brent Bredehoft, USANCA	Army Implementation of DoDI 3150.09 Status
Mr Joe Bailey, OPNAV/N867	Navy Implementation of DoDI 3150.09 Status
Mr Bob Bogstie, AF/A5X	Air Force Implementation of DoDI 3150.09 Status
Mr Baird Eubanks, MDA	Missile Defense Agency Implementation of DoDI 3150.09 Status
Ms Dee Morris, CJCS/J8	Draft CJCSI 3175.01, Joint CBRN Survivability
Mr Andy Metzger, USSTRATCOM/J354	Integrated Nuclear Survivability Report Status
Mr Kevin Cameron, NNSA	Status of NNSA Stockpile Stewardship Program
January 19-20, 2011	
Mr Brad Roberts, OSD Policy	DoD Leadership Views on Nuclear & EMP Survivability
Mr Mark Sward	Nuclear Weapons Effects Network Update
Lt Mark Demianovich, E-4B SPO	E-4 HEMP Test Overview
Maj Paul Adamson, NNSA	NNSA Nuclear Survivability Campaign Update
Mr John Franco, DTRA	Proposed DoD Nuclear Survivability Initiative

Mr Mark Edwards, CJCS/J8	CJCSI 3175.01 Update
Dr John Kuspa, DASD (NCB)/NM	DoDI 3150.09 Status and Update