

Background

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Before the Lights Go Out: A Survey of EMP Preparedness Reveals Significant Shortfalls

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Abstract: An electromagnetic pulse (EMP) over the United States could end modern life in America overnight. Whether caused by an enemy attack (a nuclear device detonated above the atmosphere) or by a natural phenomenon (a geomagnetic storm), an EMP can cause entire regions of the country to lose electricity—permanently. Despite the EMP Commission's recommendations in 2004 and 2008, hardly any progress has been made in protecting the country from an EMP attack and its catastrophic results. The U.S. must prepare to deal with an EMP—now.

While the ability of an electromagnetic pulse (EMP) to inflict catastrophic damage on U.S. infrastructure has been a known fact for decades, insufficient efforts have been taken to mitigate the threat. A survey of congressional, federal, state, local, and international measures to deal with the threat reveals more complacency than action.

In order to prevent the catastrophic destruction that could result from either a nuclear missile detonated at high altitudes or intense solar eruptions that send blasts of radiation towards the Earth, initiatives are needed at all levels—from bilateral partnerships that focus on shared infrastructure to national leadership to state and local action.

Why Worry?

In July 1962, a high-altitude nuclear test dubbed Operation Starfish, conducted 400 kilometers above Johnson Island in the Pacific Ocean, first raised wide-

Talking Points

- While the ability of an electromagnetic pulse (EMP) to inflict catastrophic damage on U.S. infrastructure has been a known fact for decades, a survey of congressional, federal, state, local, and international measures to deal with the threat reveals more complacency than action.
- America—at all levels of governance—is unprepared for an EMP attack. Despite the clear recommendations of both the 2004 and 2008 EMP Commissions, as well as an official consensus among experts, U.S. government agencies have not moved their EMP-response planning beyond the theoretical stages.
- Initiatives are needed at all levels—from bilateral partnerships that focus on shared infrastructure to national leadership to state and local action.
- An EMP disaster is the catastrophe that should never happen. The means to address and mitigate the dangers to critical infrastructure are at hand. The United States needs a greater understanding of the danger—and the determination to act.

This paper, in its entirety, can be found at:
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spread concerns over electromagnetic pulses. During the course of the test, the recording instruments continually malfunctioned and affected electrical equipment more than 1,400 kilometers away in Hawaii.¹ The root cause of the problem? An electromagnetic pulse. This discovery led the U.S. military to harden many of the country's strategic defense systems, such as missile silos, against EMP effects, but little was done to implement measures to protect civilian infrastructure. That practice has remained virtually unchanged despite the ever-increasing proliferation of nuclear weapons and ever-increasing U.S. military and civilian dependence on electricity-based infrastructure.

An EMP is a high-intensity burst of electromagnetic energy caused by the rapid acceleration of charged particles. Nuclear weapons, non-nuclear weapons (radio-frequency weapons), or geomagnetic storms (often called space weather) can power an EMP, and the resultant changing magnetic field in the Earth's atmosphere can disrupt electrical systems.² An EMP has three main components: (1) An electromagnetic shock disrupts electronics, such as communication systems; (2) an effect similar to lightning rapidly follows and compounds the first component; and (3) the pulse flows through electricity transmission lines, overloading and damaging transmission distribution centers, fuses, and power lines.³

The State of Play

The U.S. government has made some efforts to address these threats. Current initiatives span prevention, protection, and recovery:

Congressional Action. Shortly before 9/11, Congress established the Commission to Assess the Threat to the United States from Electromagnetic Pulse (EMP) Attack. The EMP Commission's charter required the commission to assess:

- the nature and magnitude of potential high-altitude EMP threats to the United States from all potentially hostile states and non-state actors that have or could acquire nuclear weapons and ballistic missiles, enabling them to perform a high-altitude EMP attack against the U.S. within the next 15 years;
- the vulnerability of the United States military and especially civilian systems to an EMP attack, giving special attention to vulnerability of the civilian infrastructure as a matter of emergency preparedness;
- the capability of the United States to repair and recover from damage inflicted on U.S. military and civilian systems by an EMP attack; and
- the feasibility and cost of hardening select military and civilian systems against EMP attacks.⁴

Members of the EMP Commission testified before the House Armed Services Committee in July 2002, releasing a partially classified five-volume report on the United States' vulnerability to a potential EMP attack.⁵ The EMP Commission concluded that the United States was extremely vulnerable to a catastrophic EMP attack, finding "[o]ur increasing dependence on advanced electronics systems results in the potential for an increased EMP vulnerability of our technologically advanced

1. William R. Graham, "Electromagnetic Pulse (EMP) Attack," testimony of Dr. William R. Graham before the House Armed Services Committee, U.S. House of Representatives, July 10, 2008, at <http://www.empcommission.org/docs/GRAHAMtestimony10JULY2008.pdf> (August 4, 2011).
2. Dan Vergano, "One EMP Burst and the World Goes Dark," *USA Today*, October 27, 2010, at http://www.usatoday.com/tech/science/2010-10-26-emp_N.htm (August 4, 2011), and Jena Baker McNeill and Richard Weitz, "Electromagnetic Pulse (EMP) Attack: A Preventable Homeland Security Catastrophe," Heritage Foundation *Backgrounder* No. 2199, October 20, 2008, at http://origin.heritage.org/Research/Reports/2008/10/Electromagnetic-Pulse-EMP-Attack-A-Preventable-Homeland-Security-Catastrophe#_ftn5.
3. McNeill and Weitz, "Electromagnetic Pulse (EMP) Attack: A Preventable Homeland Security Catastrophe."
4. Commission to Assess the Threat to the United States from Electromagnetic Pulse (EMP) Attack, "Home," at <http://www.empcommission.org/> (August 4, 2011).
5. Clay Wilson, "High Altitude Electromagnetic Pulse (HEMP) and High Power Microwave (HPM) Devices: Threat Assessment," Congressional Research Service *Report for Congress*, July 21, 2008, p. 2, at <http://www.fas.org/sgp/crs/natsec/RL32544.pdf> (August 4, 2011).

forces, and if unaddressed makes EMP employment by an adversary an attractive asymmetric option.”⁶ The commission proposed a five-year plan aimed at protecting critical infrastructure from potential EMP attack.

The National Defense Authorization Act for fiscal year 2006 reestablished the EMP Commission to continue its efforts “to monitor, investigate, and make recommendations, and report to Congress on the evolving threat to the United States from electromagnetic pulse attack resulting from the detonation of a nuclear weapon or weapons at high altitude.”⁷

Numerous bills have been introduced, but Congress has not yet passed comprehensive legislation addressing EMP vulnerabilities.

The goals of the renewed commission were to assess the threats to U.S. critical infrastructure and provide recommendations to address vulnerabilities. This new commission released its final findings in 2008 through the publication of the Critical National Infrastructure Report, as well as testimony before the U.S. House Armed Services Committee. The commission concluded that an EMP attack on the United States would be devastating:

Should significant parts of the electrical power infrastructure be lost for any substantial period of time, the Commission believes that the consequences are likely to be catastrophic, and many people may ultimately die for lack of the basic elements necessary to sustain life in dense urban and suburban communities. In fact, the Commission is deeply concerned that such impacts are likely in the event of an EMP attack unless prac-

tical steps are taken to provide protection for critical elements of the electric system and for rapid restoration of electric power, particularly to essential services.⁸

The commission offered recommendations to improve U.S. preparedness for an EMP attack or a geomagnetic storm in 10 critical areas of national infrastructure including the electrical grid, food infrastructure, and U.S. space systems. The commission strongly urged the Department of Homeland Security (DHS) to “make clear its authority and responsibility to respond to an EMP attack” by developing contingency plans in cooperation with appropriate federal, state and local agencies, and industry.⁹ Furthermore, the commission recommended that DHS develop response protocols for an EMP attack and regularly practice this response through exercises with relevant government agencies and industry groups. The commission urged DHS to work with the Department of Energy and industry groups to identify and address vulnerabilities in the U.S. electrical infrastructure. The commission advised that the cost of critical infrastructure improvement should be split between government and industry.¹⁰

Congress has not yet passed comprehensive legislation addressing EMP vulnerabilities. Numerous bills have been introduced, but none were passed out of committee.

Following the 2008 EMP Commission report, legislation was introduced to address the threat of an EMP attack on the United States. In April 2009, H.R. 2195, “A Bill to Amend the Federal Power Act to Provide Additional Authorities to Adequately Protect the Critical Electric Infrastructure Against Cyber Attack, and for Other Purposes,” was introduced in the House, sponsored by Representative

6. William Graham *et al.*, “Report of the Commission to Assess the Threat to the United States from Electromagnetic Pulse (EMP) Attack,” Vol. 1, Executive Report, 2004, p. 47, at http://www.empcommission.org/docs/empc_exec_rpt.pdf (August 4, 2011).

7. Commission to Assess the Threat to the United States from Electromagnetic Pulse (EMP) Attack, “Home.”

8. Graham *et al.*, “Report of the Commission to Assess the Threat to the United States from Electromagnetic Pulse (EMP) Attack: Critical National Infrastructures,” April 2008, p. vii, at http://www.empcommission.org/docs/A2473-EMP_Commission-7MB.pdf (August 4, 2011).

9. *Ibid.*, p. 54.

10. *Ibid.*, pp. 61, 173.

Bennie G. Thompson (D-MS).¹¹ The bill cites the 2008 commission report on critical national infrastructures, notes the vulnerabilities of Supervisory Control and Data Acquisition (SCADA) components, and calls for the EMP Commission to consult with the Secretary of Homeland Security to identify such systems in the United States and “issue... such rules or orders as are necessary to protect critical electric infrastructure against vulnerabilities or threats.”¹² H.R. 2195 was referred to the House Subcommittee on Emerging Threats, Cybersecurity, and Science and Technology, but never made it past that committee.¹³

H.R. 4842, the Homeland Security Science and Technology Act of 2010, included provisions for the establishment of a commission on the Protection of Critical Electric and Electronic Infrastructures, which would continue the work of the EMP Commission. Although approved by the House, the Senate did not vote on H.R. 4842.¹⁴

In June 2010, H.R. 5026, the Grid Reliability and Infrastructure Defense (GRID) Act, sponsored by Representative Edward Markey (D-MA), was received in the Senate after passing the House in a voice vote.¹⁵ The GRID Act would amend the Federal Power Act to allow the Federal Energy Regulatory Commission (FERC) to issue new industry standards to protect critical infrastructure from cyber or EMP attacks. It defines “defense critical electric infrastructure vulnerability” as “a weakness in defense critical electric infrastructure that, in the

event of a malicious act using electronic communication or an electromagnetic pulse, would pose a substantial risk of disruption of those electronic devices or communications networks”; an EMP is identified as a “grid security threat.”¹⁶ The Secretary of Homeland Security is called upon to work with other agencies in order to “develop technical expertise in the protection of systems for the gen-

While Congress has established a decade-long record of studying the EMP issue, clearly there remains a lack of consensus on the severity of the threat and on an appropriate course of action.

eration, transmission, and distribution of electric energy against geomagnetic storms or malicious acts using electronic communications or electromagnetic pulse.”¹⁷ The President is to compile a list of defense-critical facilities not exceeding 100 in number that are vulnerable to electrical disruption.¹⁸ Finally, the owners or operators of large transformers are required to ensure the availability of replacements to restore the operation of the bulk-power system in the event that a given transformer is destroyed or disabled.¹⁹ The GRID Act was never put to a vote in the Senate.

During the final days of the 111th Congress, Representative Doug Lamborn (R-CO) sponsored H.R. 6471, “A Bill to Require the Director of National Intelligence to Submit a Report on the

11. U.S. House of Representatives, 111th Congress, 1st Session, “H.R. 2195, A Bill to Amend the Federal Power Act to Provide Additional Authorities to Adequately Protect the Critical Electric Infrastructure Against Cyber Attack, and for Other Purposes,” introduced in the House April 30, 2009.

12. *Ibid.*

13. *Ibid.*

14. The Library of Congress, “Bill Summary and Status 111th Congress (2009–2010) H.R. 4842 CRS Summary,” at <http://thomas.loc.gov/cgi-bin/bdquery/z?d111:HR04842:@@D&summl&> (August 4, 2011).

15. U.S. Senate, 111th Congress, 2nd Session, “H.R. 5026, An Act to Amend the Federal Power Act to Protect the Bulk-Power System and Electric Infrastructure Critical to the Defense of the United States against Cybersecurity and other Threats and Vulnerabilities,” reported in the Senate September 27, 2010, at <http://www.gpo.gov/fdsys/pkg/BILLS-111hr5026rs/pdf/BILLS-111hr5026rs.pdf> (August 4, 2011).

16. *Ibid.*, p. 3.

17. *Ibid.*, p. 19.

18. *Ibid.*, p. 13.

19. *Ibid.*, p. 12.

Foreign Development of Electromagnetic Pulse Weapons.”²⁰ Each country with an EMP weapons program was to be identified and its program assessed in detail, specifically focusing on whether a country’s incorporation of EMP weapons into its national security and military strategies “assume[s] that an EMP weapons attack can achieve effects similar to a direct nuclear attack, but not be subject to the deterrence calculations normally applied to nuclear weapons.”²¹ Instructions for classifying potential hostile EMP delivery platforms and assessing vulnerability of identified countries to an EMP attack are also outlined.²² The bill was introduced in the House on December 1, 2010, but never made it past the Intelligence Committee to which it had been reported.

On February 11, 2011, Representative Trent Franks (R–AZ) introduced H.R. 668, the Secure High-voltage Infrastructure for Electricity from Lethal Damage (SHIELD) Act.²³ The act essentially allows the FERC to enable emergency measures to protect the reliability of bulk-power systems and defense-critical electric infrastructure via directive of the President amid an imminent grid security threat. The act prescribes implementation procedures and cost-recovery measures. It also directs FERC to order the Electric Reliability Organization to submit reliability standards regarding these bulk-power systems from geomagnetic storms or EMPs. Furthermore, it directs the Secretary of the Department of Energy to establish a program to develop expertise on the protection of electric energy systems and to share

the findings with owners, operators, and users of the systems.²⁴ Several provisions of the GRID Act appear word-for-word, including the definition of “defense critical electric infrastructure vulnerability,” the list of no more than 100 defense-critical vulnerable facilities, and the measure requiring the availability of spare large transformers.²⁵ The SHIELD Act has been referred to the Committee on Energy and Commerce, as well as to the Committee on the Budget.

A full committee hearing of the Senate Committee on Energy and Natural Resources on May 5, 2011, discussed the issue of the vulnerability of U.S. critical infrastructure to cyber and EMP attacks. Some witnesses testified before this committee against legislation to mandate increased EMP preparedness standards. Yet, these witnesses are in the minority and do not represent the consensus view of various congressional and government commissions, nor the overwhelming bulk of the expert community on the subject.

The purpose of congressional commissions, like the EMP Commission, is to establish official consensus on the severity of threats and appropriate solutions—which the EMP Commission did. The EMP Commission’s report represents the consensus view of the defense and intelligence communities as well as the nuclear weapon labs.

Moreover, the Congressional Commission on the Strategic Posture of the United States independently re-examined the EMP threat, and concurred with the assessment and recommendations of the EMP Commission.²⁶ So, too, did the National Academy

20. U.S. House of Representatives, 111th Congress, 2nd Session, “H.R. 6471, A Bill to Require the Director of National Intelligence to Submit a Report on the Foreign Development of Electromagnetic Pulse Weapons,” introduced to the House December 1, 2010.

21. *Ibid.*

22. *Ibid.*

23. U.S. House of Representatives, 112th Congress, 1st Session, “H.R. 668, A Bill to Amend the Federal Power Act to Protect the Bulk-Power System and Electric Infrastructure Critical to the Defense and Well-Being of the United States Against Natural and Manmade Electromagnetic Pulse (‘EMP’) Threats and Vulnerabilities,” introduced to the House February 11, 2011, at <http://hdl.loc.gov/loc.uscongress/legislation.112hr668> (August 4, 2011).

24. *Ibid.*

25. *Ibid.*

26. See the Congressional Commission on the Strategic Posture of the United States, “America’s Strategic Posture,” United States Institute of Peace Press, 2009, at http://media.usip.org/reports/strat_posture_report.pdf (August 5, 2011).

of Sciences, the DOE–NERC report,²⁷ and the FERC interagency report.²⁸ In all, five commissions and major independent U.S. government studies have independently concurred with the EMP Commission's threat assessment and recommendations. Not one official commission or U.S. government study dissents from this consensus.

Providing for an Uncommon Defense

In April 2005, the Defense Science Board Task Force published a report on Nuclear Weapon Effects Test, Evaluation, and Simulation that describes how the armed forces formed requirements based on nuclear threats, such as EMP. It concluded that the U.S. Army has strongly considered nuclear survivability during the development of its new programs. The U.S. Army Nuclear and Chemical Agency (USANCA) is the agency that makes recommendations for the nuclear survivability requirements for the new systems in the U.S. Army.²⁹ The U.S. Army War College hosted a workshop in September 2010 to explore the threats, vulnerabilities, and preparedness related to an EMP attack.³⁰

In contrast, the U.S. Navy has had outdated directives and instructions pertaining to nuclear survivability since the early 1990s. However, the Navy's critical systems do maintain nuclear survivability and nuclear hardening requirements, which protect against EMP threats.

The U.S. Air Force's Nuclear Criteria Group Secretariat was inactivated in 1994, and it currently does not have a designated group that is responsible for creating and implementing nuclear survivability requirements.³¹ However, the strategic platforms within the U.S. Air Force still assess nuclear survivability; likewise with the U.S. Navy. The Department of Defense recognized the necessity of transitioning from requirements to capabilities-based acquisition in the protection of America against EMP threats in 2003. The implementation of an evolutionary acquisition strategy would increase the nation's preparedness against EMP attacks. The Department of Defense and the Department of Energy maintain facilities that support EMP simulators that calculate the impact of an EMP wave on an electrical system.³² Data from EMP simulators and nuclear tests gathered over 50 years led to the conclusion that any nuclear weapon can pose an EMP threat to the United States because the electric grid is fragile.³³ The conclusion can be helpful for considering which efforts should be undertaken against EMP at all levels of government.

The House Committee on Armed Services issued a report on H.R. 5136, the National Defense Authorization Act for Fiscal Year 2011, in which it expressed "concern about the vulnerability of Department of Defense critical infrastructure to electromagnetic pulse (EMP) attack."³⁴ Section 225

27. National Academy of Sciences, "Severe Space Weather Events—Understanding Societal and Economic Impacts: A Workshop Report," 2008, National Academies Press, at http://books.nap.edu/openbook.php?booksearch=1&term=emp&record_id=12507&Search+This+Book.x=29&Search+This+Book.y=12 (August 8, 2011), and North American Electric Reliability Corporation and the U.S. Department of Energy, "High-Impact, Low-Frequency Event Risk to the North American Bulk Power System," 2009, at <http://www.nerc.com/files/HILE.pdf> (August 5, 2011).
28. Federal Energy Regulatory Commission, "Electromagnetic Pulse: Effects on the U.S. Power Grid," 2010, at http://www.ferc.gov/industries/electric/indus-act/reliability/cybersecurity/ferc_executive_summary.pdf (August 8, 2011).
29. Defense Science Board Task Force, "Nuclear Weapons Effects Test, Evaluation, and Simulation," April 2005, at <http://www.acq.osd.mil/dsb/reports/ADA434656.pdf> (August 5, 2011).
30. Kevin Cogan, "In the Dark: Military Planning for a Catastrophic Critical Infrastructure Event," U.S. Army War College, May 2011, at <http://www.csl.army.mil/usacsl/publications/InTheDark.pdf> (August 5, 2011).
31. Defense Science Board Task Force, "Nuclear Weapons Effects Test, Evaluation, and Simulation."
32. *Ibid.*
33. Peter Vincent Pry, "What America Needs to Know About EMPs," *Foreign Policy*, March 17, 2010, at http://www.foreignpolicy.com/articles/2010/03/17/the_truth_about_emps (August 5, 2011).
34. U.S. House of Representatives, 111th Congress, 2nd Session, "H.R. 5136: National Defense Authorization Act for Fiscal Year 2011, Report of the Committee on Armed Services," May 21, 2010, p. 513, at <http://www.gpo.gov/fdsys/pkg/CRPT-111hrpt491/pdf/CRPT-111hrpt491.pdf> (August 9, 2011).

of the bill would require the Secretary of Defense to contract with an independent entity to “conduct an assessment of Department of Defense plans for defending the territory of the United States against the threat of attack by ballistic missiles, including electromagnetic pulse attacks.”³⁵ An entire section is devoted to the vulnerability of defense critical infrastructure to EMP, in which the Comptroller General is directed to review assessments of the threat of EMP attack, taking into consideration the findings of the EMP Commission.³⁶

The Army’s Research, Development, Test and Evaluation Justification Book for FY 2012 includes a project justification for a Mobile Tower System (MOTS) for use by Air Traffic Control.³⁷ The completion of developmental testing, “including high altitude electromagnetic pulse testing,” is listed under FY 2010 Accomplishments for MOTS.³⁸ A special congressional addendum to the Defense Logistics Agency’s Microelectronics Technology Development and Support Project lists electromagnetic shielding as a “critical enabler” for 3-D electronics arrays, and increased the allocation for that project from \$2.394 million in FY 2009 to \$4.775 million for FY 2010.³⁹

The Air Force’s Physics project in Defense Research Sciences “increased research into the susceptibility to upset of various electronic circuits when exposed to suitable electromagnetic waveforms,” and received an additional \$5 million for FY 2011, for a total allocation of \$50.47 million.⁴⁰ An Air Force Materials Project for Structures, Propul-

sion, and Subsystems received increased allocation between FYs 2010 and 2011, from \$18.810 million to \$22.109 million, respectively.⁴¹ This Materials project “Develops novel materials for electromagnetic interactions with matter for electromagnetic pulse (EMP), high power microwave, and lightning strike protection” for aircraft, spacecraft, launch systems, and missiles.⁴² Funding was transferred to this program in FY 2011 from Project 2100, an EMP suitcase developed for testing systems vulnerabilities by Applied Physical Electronics (APE); the EMP suitcase’s production was “driven by input from DoD groups,” according to APE’s Web site.⁴³

The U.S. military has increasingly incorporated civilian technology not designed to resist EMP attack into its systems.

Other Air Force systems whose electronic protection functions are being actively improved are aerospace sensors, including advanced sensor arrays.⁴⁴ The Radio-Frequency Warning and Countermeasures Technology Project “conducted research on the synergy between electronic protection and electronic attack technologies to realize more effective jamming” in FY 2010, and seeks to “provide active electronic protection architecture concepts” in the coming years.⁴⁵ Electromagnetic interference testing was part of FY 2010’s B-52 Modernization Project, and one of the planned upgrades for B-2

35. *Ibid.*, p. 218.

36. *Ibid.*, p. 513.

37. U.S. Army, “Department of Defense Fiscal Year FY 2012 Budget Estimates,” *Justification Book*, Volume 5A, February 2011, p. 229, at <http://asafm.army.mil/Documents/OfficeDocuments/Budget/BudgetMaterials/FY12/rforms/vol5a.pdf> (August 5, 2011).

38. *Ibid.*

39. Defense Logistics Agency, “Exhibit R-2, RDT&E Budget Item Justification: PB 2011: R-1 Line Item #47,” February 2010, p. 4, at http://www.dtic.mil/descriptivesum/Y2011/Other/0603720S_PB_2011.pdf (August 5, 2011).

40. U.S. Air Force, “Department of Defense Fiscal Year (FY) 2012 Budget Estimates,” *Justification Book*, Volume 1, February 2011, p. 33, at <http://www.saffm.hq.af.mil/shared/media/document/AFD-110211-028.pdf> (August 5, 2011).

41. *Ibid.*, p. 92.

42. *Ibid.*

43. Applied Physical Electronics, “EMP Suitcase: Compact 2100 Series,” 2009, at <http://www.apelc.com/applications.html> (August 5, 2011).

44. U.S. Air Force, “Department of Defense Fiscal Year (FY) 2012 Budget Estimates,” pp. 211, 307.

45. *Ibid.*, p. 359.

squadrons is EMP Hardening Testing.⁴⁶ The F-22 Modernization Project, whose budget was nearly doubled for FY 2012, includes improvements to electronics protection, as does the justification for F-16 squadrons.⁴⁷ The E-4B Airborne National Ops Center will be subjected to EMP testing “to validate the E-4B fleet compliance with updated EMP protection Military Standards.”⁴⁸

New F-15 radar enhancements will emphasize electronic protection, a new project for FY 2012.⁴⁹ The FY 2011 Plans for the Airborne Warning and Control System (AWACS) will “incorporate classified Electronic Protection measures.”⁵⁰ The integrated Command and Control Intelligence, Surveillance and Reconnaissance (C2ISR) capability for the Global Hawk aircraft is provided by the Multi Platform-Radar Technology Insertion Program (MP-RTIP) sensor, whose future studies and development include the implementation of electronic protection.⁵¹ Finally, the space segment of the Nuclear Detonation Detection System (NUDET NDS) incorporates an EMP sensor into GPS systems.⁵²

Department of Defense (DOD) standards regarding EMP preparedness have been robustly updated in recent years. A Standard Practice for Shipboard

EMP Mitigation document was updated in September 2009 for the first time since 1996.⁵³ The document gives EMP protection requirements precedence over standard electromagnetic interference protocol.⁵⁴ On December 1, 2010, the DOD updated the Interface Standard for Electromagnetic Environmental Effects Requirements for Systems, which “establishes interface requirements and verification criteria for airborne, sea, space, and ground systems, including associated ordnance.”⁵⁵ The document states that a system “shall meet its operational performance requirements after being subjected to the EMP environment.”⁵⁶ This EMP environment is detailed in the classified document “MIL-STD-2169: High-Altitude Electromagnetic Pulse (HEMP) Environment.”⁵⁷

In October 2010, the Defense Science Board (DSB) Task Force on the Survivability of DOD Systems and Assets to Electromagnetic Pulse (EMP) and Other Nuclear Weapons Effects held a meeting closed to the public.⁵⁸ The stated purpose of the meeting was “To obtain, review and evaluate information related to the Task Force’s mission focus to assess implementation of the DoD Instruction covering nuclear survivability including EMP.”⁵⁹

46. U.S. Air Force, “Department of Defense Fiscal Year (FY) 2012 Budget Estimates,” *Justification Book*, Volume 3, Part 1, February 2011, pp. 63, 96, at <http://www.saffm.hq.af.mil/shared/media/document/AFD-110211-032.pdf> (August 5, 2011).

47. *Ibid.*, p. 272, 227.

48. *Ibid.*, p. 699.

49. *Ibid.*, p. 251.

50. *Ibid.*, p. 459.

51. U.S. Air Force, “Department of Defense Fiscal Year (FY) 2012 Budget Estimates,” *Justification Book*, Volume 3, Part 2, February 2011, p. 315, at <http://www.saffm.hq.af.mil/shared/media/document/AFD-110211-041.pdf> (August 5, 2011).

52. *Ibid.*, p. 389.

53. U.S. Department of Defense Standard Practice, “Shipboard Bonding, Grounding, and Other Techniques for Electromagnetic Compatibility, Electromagnetic Pulse (EMP) Mitigation, and Safety,” September 17, 2009, at http://www.uscg.mil/petaluma/TPF/ET_SMS/Mil-STDs/MILSTD1310.pdf (August 5, 2011).

54. *Ibid.*, p. 13.

55. U.S. Department of Defense, “Electromagnetic Environmental Effects Requirements for Systems,” December 1, 2010, at http://www.assistdocs.com/search/document_details.cfm?ident_number=35794&StartRow=1&PaginatorPageNumber=1&doc_id=MIL-STD-464&search_method=BASIC (August 5, 2011).

56. *Ibid.*, p. 21.

57. *Ibid.*

58. “Office of the Secretary: Defense Science Board (DSB) Task Force on the Survivability of DoD Systems and Assets to Electromagnetic Pulse (EMP) and Other Nuclear Weapons Effects,” *Federal Register* Vol. 75, No. 176, September 13, 2010, p. 55577, at <http://www.gpo.gov/fdsys/pkg/FR-2010-09-13/pdf/2010-22753.pdf> (August 5, 2011).

59. *Ibid.*

The Task Force received, reviewed, and discussed “presentations from the military services and other Defense Department agencies and organizations on the implementation to the meeting’s date of DoD Instruction 3150.09.”⁶⁰ This Instruction is the Chemical, Biological, Radiological, and Nuclear (CBRN) Survivability Policy, last updated in August 2009.⁶¹ The document directs the Secretaries of the military departments and the chairman of the Joint Chiefs of Staff to “ensure that doctrine and training to support the DoD CBRN Survivability Policy (including electromagnetic pulse (EMP)) are reflected in force-on-force simulations” and, in the case of the latter, in war games.⁶² The chairman of the Joint Chiefs is also directed to “establish mandatory key performance parameters (KPP) for nuclear survivability (including EMP hardening)” for CBRN mission-critical systems.⁶³

Michael J. Frankel, executive director of the EMP Commission, testified before the Senate Judiciary Committee in August 2010.⁶⁴ In that testimony, Frankel noted that the commission’s final report presented 19 findings and made 17 recommendations to the DOD, all of which were classified, but that “the reaction of the Department may be characterized as positive...much of this positive effort redounds to the great credit of DoD management, the Office of the ATSD (Nuclear Matters), and the proactive leadership of US Strategic Command.”⁶⁵

DOD continues to invest in hardening these critical strategic assets. For example, the FY 2012 budget includes \$22.1 million in additional funding to harden Minuteman missiles against EMP attacks.⁶⁶ The military’s general purpose forces, however, remain vulnerable to the effects of an EMP attack. Those forces’ increasing reliance on high technology in fact makes an EMP attack an attractive option for potential enemies.

The U.S. military has increasingly incorporated civilian technology not designed to resist EMP attack into its systems. The 2004 EMP Commission concluded that although the U.S. military possesses many EMP-hardened assets, an EMP attack would still severely degrade the ability of fielded forces to operate effectively.⁶⁷ The Defense Science Board Task Force on Nuclear Weapon Effects Test, Evaluation and Simulation supported these conclusions in a 2005 report. The task force concluded that “The bottom line is that commanders and planners cannot be assured that today’s weapons platforms, command and control (C2), intelligence, surveillance and reconnaissance (ISR), and associated support systems will be available should a nuclear detonation occur.”⁶⁸

DOD has also published “Mil-Standard 188-125,” which describes methods for protecting against a high-altitude electromagnetic pulse for ground-based command and control facilities.⁶⁹ However, not all military systems are currently hardened against EMP. In addition, some DOD systems rely

60. *Ibid.*

61. U.S. Department of Defense, “Instruction: The Chemical, Biological, Radiological, and Nuclear (CBRN) Survivability Policy,” No. 3150.09, September 17, 2008 (Incorporating Change 1, August 17, 2009), at <http://www.dtic.mil/whs/directives/corres/pdf/315009p.pdf> (August 5, 2011).

62. *Ibid.*, p. 14.

63. *Ibid.*, p. 15.

64. Michael J. Frankel, testimony before the Judiciary Committee, U.S. Senate, “Government Preparedness and Response to a Terrorist Attack Using Weapons of Mass Destruction,” August 4, 2010, at http://kyl.senate.gov/legis_center/subdocs/080410_Frankel.pdf (August 5, 2010).

65. *Ibid.*

66. U.S. Department of Defense, “Operation and Maintenance Overview Fiscal Year 2012 Budget Estimates,” February 2011, p. 131, at http://comptroller.defense.gov/defbudget/fy2012/fy2012_OM_Overview.pdf (August 5, 2011).

67. Graham *et al.*, “Report of the Commission to Assess the Threat to the United States from Electromagnetic Pulse Attack, Volume 1: Executive Report,” p. 48.

68. Report of the Defense Science Board Task Force on Nuclear Weapon Effects Test, Evaluation, and Simulation, quoted in Wilson, “High Altitude Electromagnetic Pulse (HEMP) and High Power Microwave (HPM) Devices: Threat Assessment,” p. 15.

on commercial facilities, such as communications satellites and ground-based stations, to support military operations.

In April 2005, the Defense Science Board Task Force on Nuclear Weapon Effects (NWE) Test, Evaluation and Simulation published a report for DOD describing current and emerging threat environments. This included a CRS-15 comprehensive evaluation of future DOD capabilities for successful operation in nuclear environments. The DSB findings were independent, “but are highly consistent with the findings and recommendations of the Congressionally mandated Electromagnetic Pulse (EMP) Commission.”⁷⁰

In protecting against a high-altitude EMP (HEMP) from a nuclear-tipped ballistic missile, the most important resources that DOD provides are missile defenses. The importance of these programs, however, has been downgraded in recent years. The Obama Administration made large-scale cuts to the missile defense program in FY 2010, and its proposed budgets for FY 2011 and FY 2012 will not make up the lost ground. Similarly, the Administration has cancelled or sharply curtailed promising missile defense programs and joint projects with U.S. allies, including the Airborne Laser (ABL) and the “third site” missile defense system in Poland and the Czech Republic. Furthermore, the President signed, and the Senate consented to ratification of, the New Strategic Arms Reduction Treaty (New START) with

Russia, which imposes sweeping restrictions on U.S. missile defense options.⁷¹

Not Protecting the Homeland

The Department of Homeland Security has a set of 15 National Planning Scenarios as an element of its risk analysis mission.⁷² The scenarios describe possible high-consequence threat scenarios, such as terrorist attacks or natural disasters, but an EMP attack is not included. The EMP Commission has tried to convince the Department of Homeland Security to add it.

Despite the grave dangers posed by an EMP attack, an EMP threat scenario has yet to be incorporated into the National Planning Scenarios.

In 2008, under the National Defense Authorization Act for FY 2008, the Department of Homeland Security was required “to coordinate efforts with the [EMP] Commission for work related to electromagnetic pulse attack on electricity infrastructure, and protect against such an attack.”⁷³ Therefore, efforts were made to create inter-agency cooperation on such a critical threat to U.S. homeland security. Despite the grave dangers posed by an EMP attack, an EMP threat scenario has yet to be incorporated into the National Planning Scenarios.⁷⁴

69. MIL-STD-188/125-1 (NOTICE 1), “Military Standard Sheet: High-Altitude Electromagnetic Pulse (HEMP) Protection for Ground-Based C4I Facilities Performing Critical, Time-Urgent MISSIONS (Part 1—Fixed Facilities) (updated April 7, 2005),” July 17, 1998, at [http://www.everyspec.com/MIL-STD/MIL-STD+\(0100++0299\)/MIL-STD-188_125-1_NOTICE-1_24888/](http://www.everyspec.com/MIL-STD/MIL-STD+(0100++0299)/MIL-STD-188_125-1_NOTICE-1_24888/) (August 8, 2011).

70. Cheryl B. Olson, Valerie A. Stander, and Lex L. Merrill, “Report of the Defense Science Board Task Force on Nuclear Weapon Effects Test, Evaluation, and Simulation,” U.S. Department of Defense, April 2005, at <http://dodreports.com/pdf/ada434656.pdf> (August 8, 2011).

71. Baker Spring, “Sixteen Steps to Comprehensive Missile Defense: What the FY 2012 Budget Should Fund,” Heritage Foundation Backgrounder No. 2552, May 3, 2011, at <http://www.heritage.org/Research/Reports/2011/05/Sixteen-Steps-to-Comprehensive-Missile-Defense-What-the-FY-2012-Budget-Should-Fund>.

72. U.S. Department of Homeland Security, “National Preparedness Guidelines,” September 2007, at http://www.dhs.gov/files/publications/gc_1189788256647.shtm (August 8, 2011).

73. Wilson, “High Altitude Electromagnetic Pulse (HEMP) and High Power Microwave (HPM) Devices: Threat Assessments,” p. 22.

74. Department of Homeland Security, “National Preparedness Guidelines,” March 14, 2011, at http://www.dhs.gov/files/publications/gc_1189788256647.shtm (August 5, 2011), and Homeland Security Council, “National Planning Scenarios,” April 2005, at <http://media.washingtonpost.com/wp-srv/nation/nationalsecurity/earlywarning/NationalPlanningScenariosApril2005.pdf> (August 5, 2011).

In an August 2010 testimony, Michael Frankel, who served as executive director of the EMP Commission from its 2001 inception until its final 2009 classified report before the oversight committees, pointed out that the commission provided 75 unclassified recommendations, most of which were aimed at DHS, “intended to mitigate vulnerability and increase resilience of the nation’s critical infrastructures.”⁷⁵ Said Frankel: “Unlike the response of the DoD, there has been no detectable resonance as yet out of the DHS... As a result, the Commission’s recommendations seem to have simply languished.”⁷⁶ Indeed, the only recent DHS activity in which EMP was addressed was at a Critical Infrastructure Partnership Advisory Council Joint Sector Meeting held June 8, 2010, in which there was a 10-minute “Electromagnetic Pulse Update” from 2:40 p.m. to 2:50 p.m.⁷⁷

DHS inactivity regarding the threat of EMP attack is surprising, given that many provisions within the EMP Commission reports and proposed relevant congressional legislation are aimed at DHS in some capacity. Indeed, Washington State’s Department of Health Office of Radiation Protection offers more information to the public on EMP than does the DHS Web site, which merely contains a link to a 2004 Federal Emergency Management Agency preparedness manual.⁷⁸

No Energy at the Department of Energy

The Department of Energy (DOE) has tentatively begun to identify and take appropriate corrective action to protect the U.S. bulk-power system from EMP attacks or other electromagnetic disturbance. Like DHS, DOE has not moved past the theoretical stages to protect the bulk-power system of the United States. In July 2009, DOE collaborated with

the North American Electric Reliability Corporation (NERC), the DOE-designated industry group responsible for enforcing reliability standards for the U.S. bulk-power system, to host a workshop on high-impact low-frequency events. The workshop included approximately 110 attendees representing NERC, DOE, DHS, DOD, the Department of Health and Human Services, the EMP Commission, and the FERC. The workshop focused on three threats: (1) a coordinated cyber attack on the energy infrastructure, (2) a pandemic, (3) and natural geomagnetic disturbances and electromagnetic pulses.⁷⁹ The members of the workshop explored the threat of an EMP attack in depth. The workshop members concluded that

An E1 HEMP [the first blast of energy from a high-altitude magnetic pulse] event could simultaneously (within one power cycle) create malfunctions of electronic control equipment over thousands of kilometers. Traditional probabilistic planning and operating criteria do not provide sufficient protection from such a widespread, simultaneous impact. Restoration may also be complicated by the amount of equipment available to replace damaged assets.⁸⁰

The members of the workshop recommended that the efforts to mitigate the risks of an EMP attack should focus on the recommendations of the EMP Commission. Namely, given the infeasibility of hardening the whole system to EMP attack, preparations for an EMP attack should focus on minimizing the net impact of an attack. That is that government and industry should create plans to reduce the time needed to restore power after a crippling attack.⁸¹

75. Frankel, “Government Preparedness and Response to a Terrorist Attack using Weapons of Mass Destruction.”

76. *Ibid.*

77. U.S. Department of Homeland Security, “Critical Infrastructure Partnership Advisory Council—Oil and Natural Gas SCC/Energy GCC Joint Sector Meeting: Agenda,” June 8, 2010, at <http://www.dhs.gov/xlibrary/assets/cipac/cipac-energy-06082010.pdf> (August 5, 2011).

78. Washington State Department of Health, Office of Radiation Protection, “Electromagnetic Pulse (EMP),” October 6, 2010, at <http://www.doh.wa.gov/ehp/rp/factsheets/factsheets-htm/fs41elecpluls.htm> (August 5, 2011).

79. U.S. Department of Energy and the North American Electric Reliability Corporation, “High-Impact, Low-Frequency Event Risk to the North American Bulk Power System,” June 2010, p. 2, at <http://www.nerc.com/files/HILF.pdf> (August 5, 2011).

80. *Ibid.*, p. 89.

81. *Ibid.*, p. 96.

The members offered this specific recommendation for future action:

Specifically, NERC should create a task force to continue these efforts and build consensus around appropriate mitigation options for industry. The task force could consider developing a full “defense plan” for these risks—covering all considerations from system design implications to hardening existing assets to system restoration. The task force should also consider the need for mandatory standards on its findings, whether related to equipment specifications or Reliability Standards.⁸²

Along with urging the creation of a “defense plan” for the bulk-power system, the members of the workshop repeatedly urged DOE and DHS to work with their Canadian counterparts on the interlinked U.S. and Canadian infrastructure.⁸³ Although DOE in partnership with NERC has identified the threat posed by EMP attacks, the agency has not taken any further steps. Like DHS, DOE’s planning for the threat of an EMP attack remains modest.

National Space Weather Infrastructure

The National Weather Service provides space weather alerts and warnings. Assessments are made by the National Oceanic and Atmospheric Administration’s (NOAA) Space Weather Prediction Center. NOAA maintains a space weather scale for each type of event. The ratings on the scale range from minor to extreme. Hazards are described in terms of potential effects on humans, space-based assets (such as satellites), and terrestrial infrastructure. Accurately predicting space weather is still an evolving science.

Other federal agencies also provide essential support for predicting space weather. NASA provides science data from its research satellites. The U.S. Air Force provides observational data from the Solar Optical Observing Network and Radio Solar

Telescope Network. The U.S. Geological Survey provides ground-based data on the effects of solar electro-magnetic emissions.

Information from the Space Weather Prediction Center is provided to electric power grid operators, space-system managers, telecommunications operators, aviation and navigational systems operators, and surveying and drilling operations. Given sufficient warning, many of these users can implement mitigation measures to limit the effects of adverse space weather on their operations. Improving the means to develop and disseminate reliable long-term weather forecasts and minimize “false alarms” would greatly facilitate the implementation of cost-effective mitigation measures.

State and Local Efforts

State and local governments have also made efforts to defend the United States against EMP threats. An EMP does not only pose a threat to computers and electronics, but also to critical infrastructures, such as communications, transportation, banking and finance, and food and water supply, because they depend on electronics or electricity.⁸⁴ Therefore, an EMP event could cause great damage within a county or state. A few enlightened state and local governments have formulated plans in the case of an EMP event.

Overall, state and local governments remain poorly prepared for an EMP attack.

An example is Alaska. The Alaska State Emergency Response Commission added preparation for an EMP attack involving integration, implementation, and survivability measures to the state’s emergency response plan in 2007.⁸⁵ Additionally, many county-wide and state-wide municipal organizations in New York have passed resolutions to request immediate action to protect the citizens against threats

82. *Ibid.*

83. *Ibid.*, p. 101.

84. Pry, “What America Needs to Know About EMPs.”

85. Missilethreat.com, “Alaska to Revise Emergency Response Plan to Include Preparation for EMP Attack,” May 29, 2007, at http://www.missilethreat.com/archives/id.16/subject_detail.asp (August 5, 2011).

of EMP. The state has passed a bill to create the New York State EMP Critical Infrastructure Protection Commission. The commission has several duties including: educating itself about EMP and EMP threats to the state's infrastructures; gathering facts; making recommendations to state authorities informing local agencies and governments about the hazards of natural EMP events and man-made EMP events; analyzing the dangers of EMPs; and developing a plan to protect the state from an EMP event, respond to the aftermath, and recovery after the event.⁸⁶

Within the New York State Assembly, bill A4303-2011 was introduced by State Assembly Member for the 142nd District Jane Corwin and four co-sponsors. This act is currently attempting to establish a commission on EMP infrastructure protection within the State Assembly. The act intends for the commission to study findings and recommendations from national commissions regarding EMP defense with respect to New York's critical infrastructure systems and develop and recommend preparation and protection plans.⁸⁷ As it stands currently, the act has been referred to the Governmental Operations Committee. In addition, both the Erie County Association of Governments and the State of New York Association of Towns have drafted resolutions recommending this commission (Erie County's resolution also calls for support for EMP-related action from New York's federal representatives.).⁸⁸

Overall, however, state and local governments remain poorly prepared for an EMP attack. A 2007 survey of state adjutant generals, the officials responsible for overseeing National Guard units, found that few states were prepared for an EMP attack. The survey, conducted by the Institute of the North in conjunction with the Claremont Institute,

found that although 96 percent of adjutant generals surveyed indicated that they were concerned with the threat posed by an EMP attack, few had analyzed the actual impact details of an EMP attack. Furthermore, few of the adjutant generals surveyed indicated that they had made preparations, such as training, EMP hardening of systems, and the creation of formal emergency response plans for an EMP attack.⁸⁹ Overall, most states have not taken action to address vulnerabilities to EMP attacks.

International Efforts

There has not been much international cooperation related to EMP attack preparedness. NATO did release an EMP response report in 2009, but it contained few recommendations or proposals, largely focusing on providing a description of various EMP applications and attacks, with little to no mention of defense or countermeasures. Beyond NATO, it seems there will be little cooperation between the U.S. and other countries, some of which (Iran, Russia, and China) have likely considered the military application of EMP against the United States and its allies.

At the same time, national and international advocacy groups have emerged, focusing on EMP defense. One such group is EMPact America, a non-partisan and non-profit group devoted to implementing the EMP Commission's recommendations to protect infrastructure and educate the American people on the threat of EMP attacks and the potential solutions.⁹⁰ Another group, more international in scope, is the Electric Infrastructure Society (EIS) Council. The council's proclaimed role is to examine the future destructive potential of geomagnetic storms and EMP attacks from a global perspective. It aims to establish itself as an effective government-NGO partnership by enhancing education and international planning on these

86. EMPact America, "Learn About—Government Action," 2011, at <http://www.empactamerica.org/legislation.php> (August 5, 2011).

87. New York State Assembly, 2011-2012 Regular Sessions, "A4303-2011: Establishes the NYS EMP Critical Infrastructure Protection Commission," February 3, 2011.

88. EMPact America, "Learn About—Government Action: Legislation," 2011.

89. Press release, "Survey Finds Nation Vulnerable to EMP Attack: States Not Preparing," Institute of the North and the Claremont Institute, March 7, 2007, at https://www.claremont.org/repository/docLib/20070306_EMPrelease_final.pdf (August 5, 2011).

90. EMPact America, "About Us," 2011.

issues. Its board of advisers features various experts in the energy field, as well as current and retired U.S. policymakers.⁹¹

NATO has been updating key EMP-related documents of late. In January 2011, NATO revised its Allied Environmental Conditions and Tests Publication on Electrical and Electromagnetic Environmental Conditions.⁹² Contained in this publication is “Leaflet 256—Nuclear Electromagnetic Pulse,” which describes EMP origin and effects on military platforms and systems.⁹³ A 2009 May report of the Applied Vehicle Technology Panel Hybrid Vehicle Rating Criteria Task Group listed nuclear EMP as a threat for which vehicle vulnerability must be tested for survivability.⁹⁴

“Electricity could be out for months or years because the grid would need to be assembled completely anew since its components would melt.”

On November 14, 2010, Avi Schurr, the president of the EIS Council, made a presentation before the NATO Parliamentary Assembly on EMP and related risks to critical infrastructures.⁹⁵ In the presentation, Schurr described the threat posed by nuclear EMP strikes above the earth’s atmosphere as “potentially immense, but not yet sufficiently acknowledged.”⁹⁶ Schurr echoed the EMP Commission’s 2008 report when he warned that “electricity could be out for months or years because the grid would need to be assembled completely anew since its components would melt.”⁹⁷

Schurr went on to declare that potential damage of a severe EMP strike was too significant to ignore preventive measures, but that thanks to recent U.S. studies the threat is now better understood as preventable—so long as the upgrading and protection of the national electric grids ensues.⁹⁸ The summary of the presentation described a recently increased awareness of electric infrastructure security on a political level, and in September 2010 an inaugural summit was held “to set up a new security framework for the U.S. and Europe.”⁹⁹

Where We Are—Where We Need to Be

America—at all levels of governance—is unprepared for an EMP attack. Despite the clear recommendations of both the 2004 and 2008 EMP Commissions, U.S. government agencies have not taken planning for their response to an EMP attack out of the theoretical stages. This is especially alarming considering the official consensus on the severity of the threat and on appropriate solutions as articulated by the EMP Commission, the other aforementioned commissions, and the overwhelming majority of the expert community. DHS and DOE have both independently identified the United States’ vulnerability to an EMP attack, but have neither created emergency management plans nor taken action to better protect critical U.S. infrastructure from attack. DOD has begun to adopt the recommendations of the 2004 EMP Commission, but U.S. forces still remain vulnerable. State and local governments remain unaware and unprepared for the threat of an EMP attack.

91. EIS Council, “About Us,” 2011, at <http://www.eiscouncil.com/> (August 5, 2011).

92. NATO, “Electrical and Electromagnetic Environmental Conditions,” AECTP-250, 2nd Edition. January 2011, at <http://www.nato.int/docu/stanag/aectp/aectp-250-2.pdf> (August 5, 2011).

93. *Ibid.*, p. 88.

94. NATO, “Report of the Applied Vehicle Technology Panel Hybrid Vehicle Rating Criteria Task Group AVT-106,” *Hybrid Vehicle Rating Criteria*, May 2009, at <http://www.rta.nato.int/Pubs/rdp.asp?RDP=RTO-TR-AVT-106>. (August 5, 2011).

95. NATO, Parliamentary Assembly, “Summary of the Meeting of the Technology and Science Committee,” November 14, 2010, at <http://www.nato-pa.int/default.asp?SHORTCUT=2311> (August 5, 2011).

96. *Ibid.*

97. *Ibid.*

98. *Ibid.*

99. *Ibid.*

Current priorities for the U.S. are:

- **Build Comprehensive Missile Defenses.** Maintaining the capacity to interdict nuclear-tipped missiles is the most effective measure to guard against a HEMP attack. The U.S. missile defenses are not keeping pace with the proliferation of threats. It is time to reverse course. Establishing a robust ballistic missile defense is the most effective means of addressing the future threats to the U.S. and its allies resulting from the proliferation of missile technology and weapons of mass destruction. The U.S. must pursue missile defense programs that can intercept missiles in the boost and ascent portions of flight. Among these programs are the Airborne Laser, which is a modified air-to-air interceptor missile, future versions of the Navy's Standard Missile-3 (SM-3) interceptor, and, above all, reviving the development and deployment of space-based interceptors.
- **Develop a national plan to respond to space weather emergencies.** As a 2008 report by the National Academies, "Severe Space Weather Events—Understanding Societal and Economic Impacts," makes clear, "Modern society depends heavily on a variety of technologies that are susceptible to the extremes of space weather—severe disturbances...driven by the magnetic activity of the sun." The first step in addressing this issue must be educating the public and policy communities at the federal, state, and local levels about the risks and response options. Additionally, any effective plan will require enhanced, reliable long-range space weather forecasts.
- **Forge a bipartisan consensus in Congress to act on this issue.** The response to the EMP Commission's findings has been uneven within the United States government, with the Department of Defense taking the initiative and the

Department of Homeland Security apparently sitting idle. Congressional inaction has contributed to this uneven response.

- **Establish bilateral partnerships with other nations.** If the unthinkable happens, the U.S. and other developed nations must be able to accept foreign aid in the event of catastrophes. The U.S. should consider hosting international disaster exercises to increase the ability of countries friendly with the United States to readily accept aid from one another when disaster strikes. For some critical infrastructure the U.S. should promote establishing an industry-led, multinational rapid-response capability. Such a capability should be able to respond worldwide. Further, this could provide an effective mechanism to share best practices and integrate responses. This capability should be funded and controlled by the private sector to respond to threats to shared international critical infrastructure, such as telecommunications and the Western Hemisphere electrical grid.

An EMP disaster is the catastrophe that should never happen. The means to address and mitigate the dangers to critical infrastructure are at hand. The United States needs a greater understanding of the danger—and the determination to act.

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