The Institute for Foreign Policy Analysis

National Security Update

A Two-Pronged Strategy to Counter the Electromagnetic Pulse Threat and its Potential Impacts

This *IFPA National Security Update* examines electromagnetic pulse (EMP), the potentially catastrophic threat it poses to the United States, the potential impacts of an EMP event, and sets forth as a national priority a two-pronged strategy to counter the EMP threat that includes ballistic missile defenses and the protection of critical U.S. infrastructures. Key recommendations of this two-pronged strategy include:

1. Ballistic Missile Defenses

- Increase the number and capabilities of *Aegis* missile defense ships and interceptors to enable boost/ascent-phase interception and optimize their deployment zones to counter EMP and southern-trajectory attacks;
- Build *Aegis* Ashore sites to counter southern trajectory and terrorist threats; and,
- Deploy in space a missile defense system based on proven technologies produced during the Strategic Defense Initiative as part of the *Brilliant Pebbles* program, together with more recent technological advances.

2. Protect Critical U.S. Infrastructures

- Harden our critical ground- and space-based infrastructures, particularly the U.S. power grid against the effects of EMP;
- Make preparations to reconstitute key portions of the grid and restore essential services rapidly;
- Protect U.S. nuclear reactors from meltdowns;
- Pass the long-stalled Shield Act by Congress which directs U.S. electric-power companies to safeguard the national grid from EMP; and,
- Reconvene the EMP Commission.

What is EMP?

An electromagnetic pulse is a short burst of electromagnetic energy caused by the rapid acceleration of charged particles. An EMP event could materialize in two forms: nuclear and non-nuclear and can either be man-made or originate because of natural occurrences such as solar storms.

EMP resulting from even a relatively unsophisticated nuclear attack represents an existential threat to the United States. It could make the U.S. infrastructure inoperable, cripple our society,

and lead to deaths numbering in the millions. A natural EMP incidence such as an intense solar storm could also result in devastating human and physical damage.

To date, the issue of EMP, its implications, and the development of strategies/methods to counter it have not been addressed sufficiently by U.S. government decision makers: this lack of attention and planning is a conundrum considering the potential cataclysmic ramifications an EMP event holds for the United States.

Man-Made EMP and Its Impact

The most lethal man-made form of EMP results from the detonation of a nuclear weapon. It occurs when a nuclear weapon explodes high in, or above, the atmosphere at an altitude between 25 to 249 miles. The detonation rapidly releases photons in the form of gamma radiation and x-rays which disperse in every direction away from the blast. These energetic particles produce massive current and voltage surges, disabling, damaging, or destroying unhardened electronic equipment, electric power systems, and other critical infrastructures on the ground and in space within the vicinity of the nuclear-blast radius. Most of the U.S. civilian infrastructure is unhardened and thus highly susceptible to EMP.

The effects of an EMP attack would be catastrophic with the subsequent radiation released extending for many miles. For example, a nuclear weapon detonated at a height of approximately 62 miles would expose objects located within an area 725 miles in diameter to EMP causing massive voltage spikes that could destroy vital U.S. electronic infrastructure including the electric grid, energy, telecommunications networks, transportation systems, banking, the movement of inventories, and food processing and distribution capabilities. Greater burst heights would expose even larger areas to EMP.

The consequences of EMP were discovered following U.S. atmospheric nuclear-weapons tests in the Central Pacific. On July 9, 1962 during the Starfish Prime test, a 1.4 megaton nuclear weapon was detonated 249 miles above Johnston Island in the Pacific Ocean. The effects were felt 870 miles away in Hawaii: street lights, alarms, circuit breakers, and communications equipment showed signs of distortions and considerable damage. In addition, the EMP generated by the Starfish Prime detonation damaged at least six satellites, all of which eventually failed due to the blast. Other satellite failures following the test were linked to the effects of the detonation.[i]

The Congressionally-mandated 2004 *Report of the Commission to Assess the Threat to the United States from Electromagnetic Pulse (EMP) Attack*[ii] brought the issue of EMP and the threat it posed into public discussion. (Congress is now considering ill-conceived changes to how the EMP Commission is currently constituted as well as to its charter – described in more detail in the concluding section of this Update). In addition, the Independent Working Group (IWG) on Missile Defense has produced numerous publications, White Papers, and op-eds highlighting the deleterious impacts of both man-made and naturally occurring EMP together with viable approaches to counter them. IWG members have also provided testimony to Congress on the subject.[iii]

Today, the destruction resulting from an EMP detonation would be substantially greater than at the time of the Starfish Prime test given the ubiquity of fragile electronic devices and systems and our greater reliance on them to run critical infrastructures. U.S. satellites, both civilian and military – but especially the former which are largely unhardened – are particularly vulnerable

to EMP effects as was demonstrated following the Starfish Prime test. Because the United States is the most dependent nation on space capabilities/assets, it is also the most vulnerable. For example, the U.S. military relies on its space assets for almost all its operations.

In addition, as stated in the EMP Commission Report, "The national security and homeland security communities use commercial satellites for critical activities including direct and backup communications, emergency response services, and continuity of operations during emergencies."[iv] U.S. space systems in low-Earth orbits are particularly susceptible to EMP attacks. In addition, EMP could have devastating consequences for the control systems and ground infrastructure of space systems. The destruction or disabling of such satellites would have catastrophic implications for homeland security and for the U.S. military as well as for the overall economy and society.

Moreover, an EMP burst could directly affect the 3,000 commercial and military flights airborne at any given time over the United States possibly causing them to crash. Many of these aircraft, which are dependent on electronic-interface fly-by-wire control systems, could become unguided missiles plunging to Earth leading to many thousands of fatalities and enormous physical damage.

Depending on the specific characteristics of an EMP attack, unprecedented cascading failures of our major infrastructures could result. Disabling even one of the elements of our critical infrastructure, such as electricity or telecommunications, would have severe consequences for others – effects from which an advanced, technologically dependent society such as the United States might not easily recover. In that event, a regional or national recovery would be long and difficult and seriously degrade the safety and overall viability of the United States.

The primary paths for catastrophic damage to the United States are through our electric power infrastructure and subsequently into our telecommunications, energy, and other infrastructures. These, in turn, can seriously impact other important aspects of life including: the means of getting food, water, and medical care to the citizenry; the financial system; trade; and production of goods and services.

The recovery of any one of the key national infrastructures is dependent on the recovery of others. The longer the outage the more problematic and uncertain the recovery will be. It is possible for the functional outages to become mutually reinforcing until at some point the degradation of infrastructure could have irreversible effects on the country's ability to support its population. In testimony to Congress in 2008 members of the EMP Commission stated that, depending on the burst height and the explosive yield of the nuclear weapon detonated, millions of Americans could die within a year following an EMP attack from starvation, disease, and societal collapse.

Who Could Carry Out a Nuclear EMP Strike?

An EMP attack is one of the most serious, but deplorably least acknowledged threats currently confronting the United States and its allies. Such an attack could be carried out by rogue states or terrorists. Several countries already have, or could soon acquire, EMP-strike capabilities. A determined adversary can achieve this capability without having a high level of sophistication.

Today, North Korea has the capability to execute EMP attacks. This reality has been made clear by its possession of nuclear weapons, estimated to number 60. In addition, North Korea claimed that its nuclear test on September 3rd, its most powerful nuclear detonation to date, was a hydrogen bomb. It also possesses the requisite delivery systems. For example, North Korea has carried out 13 missile launches so far in 2017 including two in July that experts believe demonstrate intercontinental ranges capable of striking Hawaii and Alaska as well as targets in the continental United States. Although North Korea may not yet have developed the ablative shielding to protect a nuclear warhead from destruction during reentry into the atmosphere or precise guidance systems, it would not need these capabilities to carry out an EMP attack.

It is also reported that North Korea has tested nuclear weapons especially designed to enhance EMP effects and that such attacks are an integral part of its military planning and doctrine.[v] Moreover, in 2004 the EMP Commission was told by senior Russian military officials that information on EMP had been "inadvertently" transferred to North Korea. In addition, these officials acknowledged that Russian scientists had helped North Korea with the development of its missile and nuclear programs and that Pyongyang would probably develop EMP weapons within a few years.[vi]

Further substantiating this capability is the fact that North Korea (and Iran) launches satellites to the south where they approach the United States from our mostly undefended south. For example, in 2012 and 2016 North Korea launched satellites orbiting in a southern trajectory that regularly pass over the United States.[vii] If a satellite was secretly outfitted with a nuclear weapon it could be detonated over the United States to produce EMP with devastating consequences.[viii] Neither the ablative shielding of the satellite-launched nuclear device, as noted above, nor an accurate guidance system would be necessary to accomplish an EMP attack above the atmosphere as would be the case for a reentry vehicle to strike a U.S. city.

Since the United States currently lacks robust early-warning radar coverage in the southern hemisphere, postures its ground-based interceptors in Alaska and California to counter ballistic missiles approaching from the north, and normally does not have its *Aegis* sea-based missile defenses appropriately prepared or positioned to counter this threat, a satellite concealing a nuclear weapon and traversing a southern trajectory could blindside the United States.

Iran is reported to have tested whether its ballistic missiles, such as the *Shahab*-3 or the Scud, could be detonated by remote control while still in high-altitude flight. A plausible explanation for such tests is that Tehran is developing the capability to explode a high-altitude nuclear EMP weapon.

In addition, the 2008 EMP Commission Report[ix] stated that in the late 1990s Iran had launched a ballistic missile from a barge in the Caspian Sea and sent electronic signals that suggested it triggered the detonation of a simulated nuclear weapon at an altitude of approximately 249 miles to produce EMP.

Although Iran signed the Joint Comprehensive Plan of Action (JCPOA) nuclear deal, it will be in a much stronger position at the end of the agreement to produce nuclear weapons. However, it is possible that it will break out of the treaty beforehand. In either case, it would only be a short matter of time before Tehran can mate nuclear warheads to its growing inventory of ballistic missiles giving it an EMP capability.

Moreover, terrorist groups, possibly acting as surrogates to North Korea, Iran, or Pakistan, could get nuclear weapons and place them on ballistic missiles such as Scuds that they can easily purchase to launch from vessels near U.S. coasts to undertake an EMP strike without the need for the warhead to reenter the atmosphere. The EMP Commission identified such a launch as a credible way to threaten the American people with an EMP attack.[x]

These threats are exacerbated by Russia's nuclear modernization and missile programs, first-use nuclear strategy, and belligerent actions in East Europe and elsewhere; and by China's nuclear and space system modernization and aggressive activities in the South China Sea. Both nations have the capability to launch EMP attacks.

For example, in May 1999 during the NATO bombing of the former Yugoslavia, high-ranking members of the Russian Duma meeting with a U.S. Congressional delegation to discuss the Balkans conflict raised the specter of a Russian EMP attack that would paralyze the United States. Moscow and Beijing are also helping rogue states/terrorists develop asymmetrical strategies and capabilities to conduct EMP and cyber attacks on critical U.S. civilian, commercial, and military targets.

The United States currently possess ballistic missile defense (BMD) capabilities and assets that can begin to address the EMP threat. These include *Aegis* BMD ships, particularly if positioned in proximity to North Korean launch sites which may enable boost/ascent-phase intercepts, or if patrolling in the Gulf of Mexico – together with land-based *Aegis* configurations which could be deployed along the Gulf Coast – to counter the southern trajectory and terrorist-ship launched threats. Coupled with our existing ground-based interceptors in Alaska and California and the Terminal High Altitude Area Defense (THAAD) missile defense system currently being deployed in South Korea, these systems form a nascent layered defense to counter EMP and southern trajectory/terrorist attacks.

However, as will be described in greater detail in the concluding section, much more needs to be done to confront the EMP and other evolving threats, including augmenting the existing BMD capabilities noted above together with developing space-based systems capable of providing boost-phase interception.

Natural Incidents of EMP

EMP can also be generated by natural occurrences such as solar storms. For example, the sun produces coronal mass ejections (CMEs), giant clouds of solar plasma inundated with lines of magnetic fields that are propelled from the sun during strong, long-duration solar flares. A CME (sometimes referred to as a geomagnetic disturbance or GMD) can propel over ten billion tons of solar matter outward from the sun's atmosphere with the power of a billion hydrogen bombs. If a CME hit Earth it would interact with the Earth's magnetic field to produce powerful electromagnetic fluctuations.

On September 2, 1859, the largest solar storm ever recorded propelled an intensely powerful CME directly at Earth. Called the Carrington Event, this CME destroyed most of the telegraph systems – the leading technology of its day – in the Northern Hemisphere and in Europe. Fortunately, technology was not nearly as advanced and indispensable to human life in 1859 as is the case at present. Today, a Carrington-like event would be far more devastating on our electronic-dependent

society: after overwhelming the Earth's protective magnetic field, it could disable/destroy satellites, power grids, and other critical infrastructure resulting in the loss of trillions of dollars and widespread death.

If a CME occurred today, like a man-made nuclear EMP event, it would have cascading effects on our space- and ground-based critical infrastructures. According to U.S. government estimates, a powerful CME event would cause $2 trillion in damage in the first year alone and take 4 to 10 years to recover.[xi] Modern civilization would be severely disrupted as the technologies and systems that support and enable human life were disabled/destroyed by the enormous electromagnetic force of the CME.

Earth witnessed a near-miss CME event on July 23, 2012 when a succession of coronal mass ejections sped through Earth's orbit. According to U.S. scientists, this CME was so powerful that it reached Earth's orbit in only 19 hours. If it had arrived nine days earlier it would have made a direct impact on Earth resulting in severe devastation.[xii]

Most CMEs rocket harmlessly through space; approximately 30 hit Earth every year with the majority defected off the planet's atmosphere. However, NASA solar scientists state that although the probability of a massive CME directly hitting Earth is low, "it could happen at any time … and if it does the results could be catastrophic to modern human society."[xiii]

How the United States can address natural EMP incidents is discussed in greater detail in the next section. Suffice it to say here that efforts to maintain the sustainability and rapid reconstitution of the U.S. electric grid and other ground- and space-based critical infrastructure must be undertaken to guard against the devastating impacts of a Carrington-force CME event.

Conclusions and Recommendations: A Two-Pronged Strategy to Address the EMP Threat

To counter the threats posed by EMP, both man-made and natural, the United States as a first-order priority should develop and implement a two-pronged strategy.

The first prong is ballistic missile defense. In the near-term the United States should expand the number, capabilities, and mission of the U.S. Navy *Aegis* missile defense ships. *Aegis* BMD ships, which currently provide theater defense, are the most operationally reliable, agile, and successful element in the U.S. missile defense architecture. Their mission should be expanded to include homeland defense.

Aegis' key BMD components are operating on over 33 U.S. Navy *Aegis* cruisers and destroyers around the world. These components have also been deployed in a land-based *Aegis* Ashore configuration that is currently operational in Romania and will soon be operational in Poland. *Aegis* Ashore batteries could be deployed rapidly at U.S. military bases near our coasts, particularly along the Gulf of Mexico, which would operate in conjunction with nearby *Aegis* BMD ships and our homeland ground-based missile defense sites in Alaska and California.

Existing command and control systems can help *Aegis* BMD systems intercept ballistic missiles while increasing maritime domain awareness to help U.S. naval assets locate and interdict a threatening vessel approaching U.S. territorial waters to launch an EMP attack. Enhanced early

warning and track information is especially important to provide early warning and track ballistic missiles approaching from the south where U.S. coverage is currently less robust.

This near-term missile defense architecture would help protect America against direct attack and begin countering the EMP threat immediately. Such an initiative would also help deter such an attack. Other proposed approaches, such as a new East Coast ground-based missile defense site which is advocated by several members of Congress, will take years to deploy and may not provide the needed capability against threats from the south that, as noted earlier, are growing rapidly.

Other near-term actions the United States should take as part of this first prong include:

- Increase funding to deploy additional *Aegis* ships and interceptors while also accelerating the deployment of more effective interceptors such as the Standard Missile-3 IIA (being developed jointly in a U.S.-Japanese program) to be more capable of engaging ICBMs in their boost/ascent-phase (the optimum time for interdiction) and especially to counter key EMP threat scenarios, e.g., from ship-borne missiles off our coasts or attacks launched by North Korea.

- Position additional *Aegis* ships in proximity to North Korean launch sites (i.e., in the Sea of Japan) to augment the probability of successful boost/ascent-phase intercepts. Complete rapidly the deployment of the THAAD missile defense system in South Korea.

- Develop diplomatic initiatives to support *Aegis* system operations near the North Korean coasts to enable these means to counter North Korean missile or satellite launches.

- Given the short warning time (one to three minutes or less) to enable boost/ascent-phase interdictions, grant pre-delegation authority to the on-the-scene *Aegis* BMD ship commander to launch interceptors to shoot down satellite and/or ballistic missile launchers during their boost/ascent phases.

- Develop unmanned high-altitude, long-endurance aerial vehicles (UAVs) with capabilities for early warning and boost-phase intercept as a short-term response to these threats.

- Determine whether the existing Advanced Medium-Range Air-to-Air Missile (AMRAAM) deployed on U.S. fighter aircraft would be capable of interdicting North Korean ballistic missiles within the atmosphere during their boost phase.

- Develop quickly the concept of operations and assessment of the number and type of *Aegis* BMD ships and *Aegis* Ashore sites needed to protect against EMP threats launched from off our East, West, and Gulf coasts to address our vulnerability to attacks from the south; begin deploying those assets as soon as practical.

- Augment U.S. early warning and command and control capabilities to provide maritime domain awareness to identify and prevent suspicious vessels from approaching in sufficient proximity to U.S. shores to initiate an EMP attack and to provide sufficient information to counter such an attack.

- To counter a satellite attack from a southern polar trajectory where U.S. radar/sensor coverage is less focused, deploy forward-based sensors to enable *Aegis* ships and the California ground-based missile defense site to interdict a satellite attack.

As a national priority, the United States should deploy a twenty-first-century space-based defense system to address the EMP and other rapidly evolving threats. It would protect the U.S. homeland, our overseas troops, and friends and allies against ballistic missiles in all phases of their flight. Their boost-phase intercept capability would provide the most effective way to defeat ballistic missiles carrying multiple warheads and/or decoys including against EMP attacks.

Specifically, the United States should:

Deploy a cost-effective, affordable twenty-first-century space-based interceptor system building on the *Brilliant Pebbles* (BP) technologies developed during the Strategic Defense Initiative (SDI) that were sufficiently mature in 1991 to be approved by Pentagon acquisition authorities. To reduce costs and deployment times, an updated BP system would leverage the innovative technologies, products, launch services, manufacturing and management processes and know-how developed and utilized in the commercial sector and elsewhere in the almost three decades since BP was originally envisioned.

A rigorous cost analysis conducted by the Pentagon's Acquisition Executive in the late-1980s (independent of the SDI) estimated *Brilliant Pebbles* would cost $10 billion in 1988 dollars – or about $21 billion in 2017 dollars – for research, development, deployment and operations over a twenty-year span. A new BP program may cost even less given developments in the commercial sector and lower launch costs while providing vastly greater protection than all current U.S. land- and sea-based missile defenses.

A BP space-based missile-defense system would protect the U.S. homeland, our overseas troops, and friends and allies against ballistic missiles of all types including from EMP attacks. It would provide intercept capabilities in every phase of a ballistic missile's flight, but most importantly, during the boost phase when a ballistic missile is most vulnerable and has not released its nuclear warheads and decoys.

In addition, a revised BP system would make missile defense cost effective and less expensive than nuclear offensive systems, keeping us on the right side of the cost-exchange ratio that currently favors the offense. Moreover, it would also support other vital U.S. national security missions and enhance the survivability of critical space assets on which practically all U.S. military operations depend.

The second prong is hardening U.S. critical infrastructures but especially the electric power grid together with preparations to reconstitute key portions of the grid quickly to restore essential services if it is put out of action by a natural event such as a solar storm or a nuclear EMP attack. Essentially all U.S. civil critical infrastructure depends on the currently unhardened electric grid. Hardening the grid would make it much more likely that critical infrastructures can return to service quickly after an EMP event. As former ABC *Nightline* anchor Ted Koppel has stated in his book, the electric grid is the U.S. Achilles' heel vulnerable to EMP strikes as well as to cyber warfare and cyber hackers.[xiv]

A crucial approach to minimizing the adverse effects from loss of electrical power is the speed of restoration. By protecting key system components needed for restoration, by structuring the network to fail gracefully, and by creating a comprehensive prioritized recovery plan for the most critical power needs, the risk of an EMP attack having a catastrophic effect can be reduced significantly.

In addition, it is vital to protect U.S. nuclear reactors to eliminate the possibility of the type of reactor meltdowns that occurred in Japan following the 2011 earthquake and tsunami resulting in electric power generation shortfalls and nuclear contamination. Protecting the grid from the worst threat, i.e., a nuclear EMP attack, will also mitigate lesser threats including natural EMP from solar storms, non-nuclear EMP from radiofrequency weapons, cyber-attacks, physical sabotage, and severe weather.

Congress should pass the long-delayed Secure High-Voltage Infrastructure for Electricity from Lethal Damage (Shield) Act which mandates that electric power companies protect the national grid from EMP with technologies the Defense Department used for a half-century to harden military assets.

The current EMP Commission has been instrumental in bringing to the attention of the U.S. government and the broader public the serious consequences of EMP and the steps needed to address this threat. It should be allowed to continue this important work without the delays the changes called for in the House version of the Fiscal Year 2018 Defense Policy Bill would create. Therefore, during the upcoming Senate-House Conference Committee to finalize the 2018 Defense Policy Bill, the Senate conferees should vote to eliminate Section 1699B included in the House Defense Bill which calls for a new EMP Commission and its termination shortly after the release of its final report on EMP.[xv] Disbanding the current Commission and its seasoned experts as Congress deliberates the formation of a new one will only result in unnecessary and costly delays in addressing the EMP threat which, as North Korea's recent nuclear test and missile launches clearly underscore, is growing in scope and magnitude.

Endnotes

[i] "The 50th anniversary of Starfish Prime: the nuke that shook the world," by Phil Plait, *Discover Magazine*, July 9, 2012. See http://blogs.discovermagazine.com/badastronomy/2012/07/09/the-50th-anniversary-of-starfish-prime-the-nuke-that-shook-the-world/#.WXoumrpFw7M.

[ii] *Report of the Commission to Assess the Threat to the United States from Electromagnetic Pulse (EMP) Attack,* Volume 1: Executive Report, 2004. See http://www.empcommission.org/docs/empc_exec_rpt.pdf.

[iii] For example, *Missile Defense: Challenges and Opportunities for the Trump Administration*, by Henry F. Cooper, Malcolm R. O'Neill, Robert L. Pfaltzgraff, Jr., and Rowland H. Worrell, November 2016, http://www.ifpa.org/pdf/IWGWhitePaper16.pdf. *A Near-Term Strategy to Counter the EMP Threat,* White Paper by Henry Cooper and Robert L. Pfaltzgraff, Jr., 2014, http://highfrontier.org/wp-content/uploads/2014/06/IWGWhitePaper-2.pdf. "How to Protect A Vulnerable America From EMP Threat," *Investor's Business Daily*, by Henry F. Cooper and Robert L. Pfaltzgraff, Jr., October 3, 2014, http://www.investors.com/politics/perspective/countering-an-emp-attack-on-america/. *Countering the EMP Threat: The Role of Missile Defense*, White Paper by Henry Cooper and Robert L. Pfaltzgraff, Jr., July 2010, http://www.ifpa.org/pdf/IWGWhitePaper.pdf. *Missile Defense, the Space Relationship, and the Twenty-first Century*, The Independent Working Group, January 2009, http://www.ifpa.org/pdf/IWG2009.pdf.

[iv] *Report of the Commission to Assess the Threat to the United States from Electromagnetic Pulse (EMP) Attack,* Volume 1: Executive Report, 2004, p.44. See http://www.empcommission.org/docs/empc_exec_rpt.pdf.
[v] "North Korea Poses EMP Threat," by Daniel John Sobieski, *The American Thinker*, May 2, 2016, http://www.americanthinker.com/articles/2016/04/north_korea_poses_emp_threat.html.
[vi] Personal Communication between Dr. William R. Graham, EMP Commission Chairman, and Ambassador Henry F. Cooper, former Director, Strategic Defense Initiative.
[vii] "North Korea Launches Satellite to Space," *Space.com*, by Bill Wall, February 8, 2016. See https://www.space.com/31860-north-korea-satellite-launch.html.
[viii] North Korea again demonstrated this capability on February 7, 2016. See https://www.csis.org/analysis/north-korea%E2%80%99s-february-2016-satellite-launch for a discussion of the implications of this test for ballistic missile applications.
[ix] *The 2008 Report of the Congressional Commission to Assess the Threat to the United States from Electromagnetic Pulse Attack,* or the EMP Commission, can be found at http://www.empcommission.org/.
[x] In July 2008, EMP Commission Chairman Dr. William R. Graham testified to the House Armed Services Committee that Iran had launched missiles from vessels in the Caspian Sea and "detonated the warhead near apogee, not over the target area where the thing would eventually land, but at altitude" . . . exactly the profile of an EMP attack. See "U.S. Intel: Iran Plans Strike on U.S." by Kenneth R. Timmerman, July 29, 2008, http://www.newsmax.com/Newsfront/iran-nuclear-plan/2008/07/29/id/324724/.
[xi] "We're shockingly unprepared for an extreme weather event that could fry Earth's power grid," by Sarah Kramer, *Business Insider*, April 2, 2016. See http://www.businessinsider.com/solar-storm-effects-electronics-energy-grid-2016-3?r=UK&IR=T.
[xii] Ibid.
[xiii] "Earth's Greatest Threat: The Sun and Its CMEs," by Eric McLamb, *Ecology.com*, May 1, 2014. See http://www.ecology.com/2014/05/01/earths-greatest-threat-cmes/.
[xiv] *Lights Out: A Cyberattack, A Nation Unprepared, Surviving the Aftermath*, by Ted Koppel (New York: Penguin Random House, 2015).
[xv] "National Defense Authorization Act for Fiscal Year 2018," *Report of the Committee on Armed Services House of Representatives*, July 2017, p. 288. See https://www.gpo.gov/fdsys/pkg/CRPT-115hrpt200/pdf/CRPT-115hrpt200.pdf.

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