Don't let the lights go out in America.

SecuretheGrid Coalition

May 4, 2015

A Rebuttal to the Edison Electric Institute White Paper "Electromagnetic Pulses: Myths vs. Facts"

In a paper dated February 2015, the electric utilities' think tank, the Edison Electric Institute (EEI), made a number of representations about the phenomenon of electromagnetic pulse (EMP) and its implications for the nation's bulk power distribution system (popularly known as "the grid"). In the interest of correcting what EEI characterizes as "myths and facts," the Secure the Grid (STG) Coalition – a group of scientists, engineers, national security practitioners, legislators and other leaders in this field – offers the following fact-checking by way of rebuttal.

EEI "Myth: All magnetic interference is the same."

STG Fact-Check: Although there are important differences between man-made and natural EMPs, best practices for mitigation should be based on an "all hazards" strategy that, wherever possible, seeks common solutions. The Department of Defense, the Department of Homeland Security and the Congressional EMP Commission have practiced or endorsed planning for "all hazards" as the most cost-effective strategy.

That is because, despite the differences between enemy-induced and naturally occurring EMPs, there are also commonalities that make it possible to defend against "all hazards" simultaneously and cost-effectively. For example, a properly designed Faraday cage can protect electronics from nuclear EMP, non-nuclear EMP weapons, directed energy weapons, accidental electromagnetic transients, and even kinetic threats from sabotage and severe weather. Similarly, a properly designed surge-arrestor can protect electronics from nuclear and non-nuclear EMP weapons, natural EMP and over-voltages induced by cyber attack and severe weather.

By contrast, EEI's recommended approach results in "stove-piping" in which planning for mitigation of each threat is pursued independently and often blind to common solutions. Typically, this approach does not take into account the fact that threats can happen simultaneously with dynamic consequences that can overwhelm piecemeal defenses. It is also virtually guaranteed to be the least cost-effective solution to securing the grid against not only EMP, but other means of attacking our most critical of critical infrastructures, as well.

EEI and the electric industry generally like to emphasize the differences between phenomenology to make more credible their claim that protecting the electric grid against these varied threats is too complex and too costly. A case in point is their effort to completely disassociate the naturally occurring EMP caused by geomagnetic disturbances (GMD) from the EMP produced by a nuclear weapon.

In fact, GMD-induced EMP is very similar to the long-wavelength EMP produced by a nuclear weapon. Both are called E3 EMP by the Department of Defense and the Department of Homeland Security. Both are called by the scientific community magneto-hydrodynamic EMP (or MHD EMP). And the effects of both natural GMD and nuclear E3 EMP can be stopped from damaging transformers by blocking devices, surge-arrestors and other technology.

The failure of EEI and industry to use an "all hazards" strategy for protecting the grid may account for their inflated cost estimates for grid protection in other states. For example, in Maine, the electric utilities industry estimated that the cost of protecting the state grid from natural EMP would be $43 million – but independent experts, including a vendor willing to do the work, established that the job could be done for $12 million.

The EEI white paper propounds in connection with its first "myth" a number of so-called "facts" that are erroneous and misleading.

EEI "Fact":

- High-Altitude Nuclear Blast EMP: A high-level EMP caused by the detonation of a nuclear weapon in the atmosphere is a high-consequence, low-likelihood threat that would have a potentially catastrophic impact on society. Further, since the planning and launching of a nuclear attack on U.S. critical infrastructure would be an act of war or terrorism, the federal government must be primarily responsible for preventing high-level EMPs as a matter of national security. The impacts of a high-level EMP on the electric grid are still not fully understood, but are being studied by the Electric Power Research Institute, the federal national labs, and others, with some mitigation strategies, such as shielding equipment and procuring spare equipment, already being utilized.

STG Fact-Check: The admission by EEI that an attack unleashing high-altitude electromagnetic pulse would be a "high-consequence" event is welcome and gives lie to arguments made by utilities and others that that is not the case. Assigning low probability to such an event, however, flies in the face of a bipartisan consensus that nuclear terrorism and the nuclear threat from rogue states is the greatest man-made threat facing the United States.

President Obama has made the nuclear threat the focus of his foreign policy through negotiations to stop Iran's nuclear weapons program and by promoting the worldwide abolition of nuclear weapons – both highly controversial initiatives judged by most experts as unlikely to succeed.

The Obama White House has issued to state and city emergency planners a "Planning Guidance for Response to a Nuclear Detonation" warning that high-altitude EMP and EMP from a nuclear weapon detonated in a city would damage the electric grid and other systems. Moreover, there is

a bipartisan consensus that an act of nuclear terrorism is likely or inevitable, as reflected by the following quotations:

- MODERATOR: What is the single most serious threat to U.S. national security?
  KERRY: Nuclear terrorism.
  PRESIDENT BUSH: I agree with my opponent....(*2004 Presidential Debate*)

- "The likelihood of terrorists detonating a nuclear weapon in an American city is inevitable if the United States continues on its present course with respect to preventing nuclear terrorism." (*Graham Allison, Harvard JFK School of Government, October 24, 2005*)

- "The main threat is the nuclear one. I am convinced that this is where Osama bin Laden and his operatives desperately want to go." (*CIA Director George Tenet, 2008*)

- The Congressional EMP Commission found that a high-altitude EMP attack is the most likely nuclear threat from terrorists and potential state adversaries, as reflected by quotes below from its 2004 report:

  "China and Russia have considered limited nuclear attack options that, unlike their Cold War plans, employ EMP as the primary or sole means of attack."

  "…Terrorists or state actors that possess relatively unsophisticated missiles armed with nuclear weapons may well calculate that, instead of destroying a city or a military base, they may obtain the greatest political-military utility from one or a few such weapons by using them – or threatening their use – in an EMP attack."

  "The current vulnerability of U.S. critical infrastructures can both invite and reward attack if not corrected...."

In the past eleven years, we have learned that high-altitude EMP is explicitly called for in the military doctrines of Russia, China, North Korea and Iran. According to Rep. Trent Franks, a recently translated Iranian doctrine refers to the use of EMP against the United States in over 20 places.

It is, moreover, disingenuous and inaccurate to characterize the impact of this sort of "high consequence" event as "potentially catastrophic" and "not fully understood." In fact, every official assessment of a high-altitude EMP attack has concluded that it would *devastate* an unprotected electric grid, precipitating the collapse of other critical infrastructures and dire repercussions for the population, economy and national security that would be nothing less than catastrophic.

It *is* the federal government's responsibility to prevent EMP and other attacks on our nation. That said, it is the responsibility of those who own and operate some 85% of the electric grid's infrastructure to minimize the consequences of such attacks should they nonetheless occur – especially in an environment in which there is growing reason to believe that official efforts to deter and prevent them may be insufficient.

EEI "Fact":

- Directed Energy EMP Weapons: This category of devices may pose a more narrowly focused EMP threat to a single facility or piece of equipment similar to a traditional physical attack. Thus, mitigation strategies include more typical physical protection measures such as line-of-site security, access controls, and system redundancy.

STG Fact-Check: Presumably, by "directed energy EMP weapons," EEI is referring to radio frequency weapons (RFWs) that can achieve locally effects comparable to those a high-altitude EMP attack would cause over large areas. The implication that RFWs are of less concern because their impact would be confined to "a single facility" is misleading since, according to a study conducted for the Federal Energy Regulatory Commission, the successful disruption of operations at just *nine* key transformer substations around the United States would shut down the grid nationwide.

Commercially available EMP testers can be utilized for this purpose. Alternatively, RFWs can be assembled from readily available electronic components. Such realities underscore the misleading nature of EEI's assurances that EMP attacks are "low probability" events.

It is a disservice for the Edison Electric Institute not to include among the needed "mitigation strategies" against radio frequency weapons the hardening of transformers against the sorts of power surges such devices can generate.

EEI "Fact":

- Solar Flare GMDs: GMDs caused by solar flares are naturally occurring events the electric industry has addressed for decades. They result in two types of risks: (1) damage to bulk power system assets (e.g., transformers); and (2) loss of reactive power support, which could lead to voltage instability and power system collapse. Based on these risks, the North American Electric Reliability Corporation (NERC) has developed mandatory and enforceable GMD industry standards that are on track for implementation and further refinement.

STG Fact-Check: While utilities have indeed contended for years with relatively minor geomagnetic disturbances (GMD), EEI's assertion that "the electric industry has addressed [them] for decades" is misleading on two counts.

First, the electric industry has actually suffered power disruptions and damage from some of the relatively minor GMDs that have occurred. In 2014, the *Space Weather Journal* published data showing a correlation between relatively minor space weather and power outages. Zurich Insurance recently reported that $2 billion a year is lost by utilities and their customers by the effects of run-of-the-mill solar storms.

Second, and much more importantly, the United States has not experienced for 156 years an intense geomagnetic disturbance of the magnitude known as a Carrington-class solar storm. Saying the electric industry is prepared for the latter because it has coped with much less severe

GMDs is like saying a city is protected against earthquakes because it has suffered only minor damage when hit by Richter Scale Level 1 tremors. It will be too late to take the sort of corrective actions needed to survive the predicted Big One *after it hits*.

The only "electric infrastructure" in place at the time the last Carrington event occurred was comprised of rudimentary telegraph systems. Many of their lines and offices caught fire as a result of the powerful electromagnetic pulses unleashed by the 1859 solar storm.

NASA estimates that the probability such a powerful GMD will occur in the next decade is 12%, and 50% over the next fifty years. Nothing done by the electric industry to date will ensure that its critical assets will fare better *when*, not if, the earth is subjected to the next Carrington-class solar storm.

EEI offers a misleading reassurance that the North American Electric Reliability Corporation has the situation in hand because there is a NERC GMD standard that is "on track for implementation." In fact, the proposed NERC standard relies upon a highly controversial, untested and non-peer reviewed theory that a powerful solar storm will be very localized, affecting an area of just 10 square kilometers, and be very slow. Had the resulting, artificially low standard for protection been in place in 1989, it would not have prevented the destruction of the high-voltage transformer at the Salem New Jersey nuclear power plant that was melted by a much less powerful solar storm than a Carrington-class event.

EEI "Myth: Utilities are self-regulated for reliability and security at the federal level."

STG Fact-Check: Prior to the 2003 Northeast Blackout, which affected 50 million people, electric grid reliability and security were unregulated. An industry trade association had set voluntary standards, but compliance was spotty. After that event, a U.S.-Canada task force identified the voluntary standards system as a prime contributor to the disruption and attendant power outages.

In response, Congress designed a hybrid regulatory system, whereby a private successor to the trade association, the North American Electric Reliability Corporation, would set mandatory standards. The Federal Energy Regulatory Commission would have authority to request, review, and approve – *but not change* – NERC's standards.

EEI "Fact":

> Pursuant to the Energy Policy Act of 2005, all electric utilities are subject to mandatory reliability standards, including standards addressing GMDs, cybersecurity, and physical security. These standards are developed and enforced by NERC and approved by the Federal Energy Regulatory Commission (FERC). NERC is an independent, American National Standards Institute-certified, standards-setting body. FERC also has independent authority to enforce the mandatory reliability standards and to order NERC to develop new standards.
>
> The NERC standards process is open and transparent, and leverages the experience of industry experts. NERC's independent Board also has the authority to approve or request that drafting teams develop a specific standard. Additionally, FERC can, and has, required NERC to develop standards to address specific issues, including the GMD and physical security standards.

STG Fact-Check: It is important to remember that NERC is a private corporation, governed by the vote of its membership, which consists mostly of electric utilities. In fact, seventy percent of NERC members are representatives of electric utilities.

It should come as no surprise that electric utilities would be reluctant to impose grid protection standards on themselves, especially when those standards might reduce profits and increase liability. In fact, NERC's track record since designation as a self-regulatory organization in 2006 has borne this out.

Even the simplest standards take years for NERC to develop and adopt. For example, an errant tree branch was one cause of the 2003 Northeast Blackout affecting 50 million people, but NERC took *ten years* to approve a "vegetation management" standard for tree-trimming.

On more complicated standards – such as those for solar storm protection and cyber security, NERC inserts technical loopholes and highly problematic self-exemptions. For example, NERC cyber security standards exempt the communication networks that utilities use to manage grid substations.

Too often, FERC exhibits the symptoms of regulatory capture, acceding as NERC delays and waters down standards, transferring risks of blackouts and their costs from electric utilities onto the nation as a whole.

For example, on June 19, 2014, FERC approved a first-phase NERC operational standard to protect against geomagnetic solar storms. While this standard requires electric utilities to take real-time actions during solar storms, there is no requirement to gauge the intensity of the storms' impact on transmission lines as they are occurring.

On December 17, 2014, the NERC Board of Trustees adopted a second-phase hardware standard to protect against geomagnetic solar storms. This standard is under unprecedented appeal by a partner in the Secure the Grid Coalition, the Foundation for Resilient Societies, due to inadequate quality control.

EEI "Myth: The electric power industry is not responsive to threats such as EMP and GMD."

EEI "Fact":

> NERC has developed mandatory and enforceable reliability standards to help protect the grid from the impacts of GMDs. Ongoing technical assessments of these threats continue to adequately define their scope and magnitude so that the electric sector can respond with sensible and effective mitigation measures as part of its overall risk management strategy.
>
> FERC approved the first phase of the GMD standards in June 2014, and they will become enforceable on April 1, 2015. NERC filed the second-phase GMD standards with FERC in January 2015. FERC is expected to issue a notice of proposed rulemaking to approve the standard in the spring of 2015.

STG Fact-Check: Consider three examples of serious deficiencies in the current draft NERC GMD standard:

1. It fails to establish standards for mandatory installation and operation of geomagnetic induced current (GIC) monitors at sites of high voltage transformers within the Bulk Power System.

2. It fails to require of NERC-registered entities, or to propose that FERC require, public release of current GIC monitor data or those that become available in the future (including crossings of critical thresholds). Neither does it require more general public release of GIC data from all GIC monitors deployed now or in the future within the U.S. bulk power distribution system. This raises concerns that the NERC-proposed standard facilitates wholesale market manipulations and antitrust violations by market traders with preferential access to non-public GIC data or GIC data networks. And

3. It fails to validate the NERC Benchmark Model for geomagnetic disturbance assessments against actual historical GIC data within the United States. Consequently, the NERC GMD model might in practice serve to *discourage* and *even obstruct* needed hardware protection of the North American bulk power system from severe solar geomagnetic storms

Withholding such scientific data has the effect of concealing risks to public safety.

EEI "Fact":

> While standards ensure that every electric utility meets a baseline level of security, the electric industry also relies on close coordination and partnerships with law enforcement and security agencies of the federal government to help defend against hostile nation-states or attacks against the United States, especially in the case of nuclear threats from an EMP device.

STG Fact-Check: Coordination and partnerships between industry and the law enforcement and security agencies are to be encouraged. As noted above, however, the expectation that the federal government will do its utmost to "defend against hostile nation-states or attacks against the United States, especially…nuc-lear threats from an EMP device" is no excuse for the utilities' failing to take effective steps to negate such threats' devastating effect on the grid and the nation. That is especially so given the fact that law enforcement and security agencies are highly unlikely to provide timely warning of nuclear threats from national actors or terrorists.

Even if such warnings could be assured, since NERC and FERC have yet to adopt any standards with respect to a nuclear or non-nuclear man-made EMP event, the electric industry is wholly unprepared for those contingencies. All other things being equal, that seems unlikely to change, given the widespread ignorance about the EMP threat that appears to exist among public utility commission officials and the electric power industry (as reflected in, and exacerbated by, the seriously flawed EEI white paper).

The record of the electric industry's lack of preparedness for commonplace threats, such as physical sabotage, cyber attacks, and severe weather inspires little confidence that it will act to prevent an EMP-induced catastrophe – unless, that is, the utilities are compelled to secure the grid.

EEI "Myth: It would cost only $2 billion to protect the entire grid from any EMP attack."

EEI "Fact":

> Some EMP advocates claim that, based on a 2008 report of the Congressional EMP Commission, it would cost only $2 billion to protect the national electric grid against EMP threats. However, the EMP Commission report does not directly state such costs, nor do several members of the EMP commission agree with that claim.
>
> One leading EMP advocate who cites the $2 billion figure has suggested that $2 billion would cover only the cost to protect transformers, with an additional $20 billion needed to protect the entire electric grid. And, a former Department of Defense official familiar with EMP threats and the Commission report has testified the $2 billion figure could be "off by a factor of ten or more." Thus, cost estimates to protect the grid have not been shown to be reliable or accurate.

STG Fact-Check: Estimates of the costs of securing the grid against man-caused and naturally occurring EMP do vary. Usually, that is the case because the estimates derive from differing plans and technologies and from judgment calls made on how much to rely on "hardening" versus "smart planning."

One of the estimates cited by EEI was contained in the 2008 report of the Congressional EMP Commission. Contrary to the Institute's representation, on pages 60-61 of that document, the costs for protecting the national electric grid against EMP are itemized. They add up to $2 billion.

That report by the Congressional EMP Commission offered this assessment of the most expensive part of protecting the grid – hardening transformers and other high-value components: "There are several thousand major transformers and other high-value components on the transmission grid....The estimated cost for add-on and EMP hardened replacement units and EMP protection schemes is in the range of $250 million to $500 million" (p. 60). These estimates reflect the unanimous view of the distinguished scientists and engineers who served on the EMP Commission.

An advisory group officially recognized by Congress as the EMP Commission's successor, the EMP Task Force on National and Homeland Security, issued a 2013 report entitled *Apocalypse Unknown: The Struggle To Protect America From An Electromagnetic Pulse Catastrophe*. This document includes three different plans and cost estimates for protecting the national electric grid – all of them costing $2 billion or less.

In the 2013 report, two members of the Task Force – its chairman, Dr. William Graham (who also served as chairman of the EMP Commission), and former Director of Central Intelligence R. James Woolsey – wrote: "The [EMP] Commission estimated that in 3-5 years ALL the nation's critical infrastructures could be protected from EMP for $10-20 billion." The EMP Commission reports recommended protecting all the nation's critical infrastructures from an EMP catastrophe, and provided guidance on how to protect all the critical infrastructures.

EEI "Fact":

> The debate over the cost to protect the electric grid from EMPs also ignores the reality that other sectors of the economy likely will be affected by a nuclear EMP attack, including other critical infrastructure sectors upon which the electric sector depends to generate or distribute electricity. It makes little sense to protect the electric grid while ignoring these other critical infrastructure sectors.

STG Fact-Check: EEI's suggestion that unless all critical infrastructures are protected, none should be protected, makes no sense. It is akin to insisting that, unless you can prevent all household fires, you should not eliminate the causes of those you *can* prevent. Such advice is calculated to ensure that nothing is done about protecting the electric grid from EMP and is a formula for disaster.

The EMP Commission recommended – and the EMP Task Force continues to recommend – that the electric grid be protected *first*, as it is the "keystone" critical infrastructure, necessary to the recovery and operation of all the others.

If the electric grid is protected against all hazards, with smart planning and preparation, we have a shot at recovering all the other critical infrastructures in time to save millions of lives and avert a threat to the existence of the nation. If the electric grid, on the other hand, is *not* protected and suffers sustained and

widespread disruption, the nation will likely be devastated catastrophically, even if the rest of the critical infrastructures were somehow relatively resilient.

EEI "Myth: There are quick, easy and low-cost solutions, such as blocking devices, to protect the electric grid from all threats."

EEI "Fact":

> Many EMP mitigation techniques remain unproven and are potentially more expensive than claimed by their promoters, many of whom stand to benefit from their deployment. Further, placing blocking devices on the grid could have unintended consequences for an event that is relatively unlikely to happen. For instance, some mitigation measures to prevent damage from an EMP could actually reduce the effectiveness of measures to address GMDs, which occur much more frequently.

STG Fact-Check: In point of fact, "EMP mitigation techniques" have been developed, applied and refined by the Department of Defense for over *fifty years*. There is, as a result, a wealth of experience and technology for the electric utilities to draw upon – *provided* they actually want to make their assets more resilient against man-induced and naturally occurring electromagnetic pules, among other hazards. Unfortunately, that does not appear to be the case at present, nor is it likely to be in the future, absent their being required to do so.

The cost of securing electric and electronic devices against electromagnetic pulse is clearly considerably less if EMP resiliency is integrated into the design from the start, rather than added in afterwards. Still, even the costs of retrofitting such assets to "harden" them against this threat are a fraction of those associated with replacement – if it can be done at all. For instance, today it is – as a practical matter – *impossible* to replace large numbers of high-voltage transformers in a short period of time.

Speaking of the U.S. military, it is noteworthy that the Commander of U.S. Northern Command, Admiral Bill Gortney, recently ordered the relocation of key elements of his headquarters back into the underground bunker complex known as Cheyenne Mountain *because it is EMP-hardened.* This suggests that the danger of electromagnetic pulse is now such that it is irresponsible – and actually reckless – to perpetuate the vulnerability of the civilian electric grid to that threat.

EEI "Fact":

> The best risk mitigation for an EMP event, especially one as severe as a high-altitude nuclear explosion, is prevention. The prevention or preemption of such attacks is within the purview of the nation's law enforcement, military, and intelligence functions.

STG Fact-Check: Actually, the best risk-mitigation for an EMP event is protection of the grid by installation of proven, cost-effective technologies that the Department of Defense has used for over five decades to protect critical defense assets. That is especially true given the

uncertainty that attends our ability to anticipate, let alone prevent, enemy attacks on our infrastructure.

It should go without saying, moreover, that preventive and preemptive wars – such as those waged in recent years in Iraq and Afghanistan – are *not* preferable alternatives to investing in the means of protecting the grid against an EMP attack. The suggestion is absurd and outrageous that we should wage wars – with all their costs in lives and national treasure – rather than effect realistic and affordable remedies to the EMP threat to the grid.

Even if we could be assured of prevailing, the toll entailed for the country and its people would certainly vastly exceed the relatively modest cost of paying for EMP protection. The U.S. Federal Energy Regulatory Commission has estimated that the associated additional charge to the average ratepayer would an increase of about 20 cents annually. Surely, ratepayers – or, for that matter, taxpayers – would prefer to invest such a trivial amount rather than send their sons and daughters off to fight preventive and/or preemptive wars against Iran, North Korea, China and Russia.

The argument for going to war instead of investing in the resiliency of the grid becomes even more preposterous when the danger of severe solar storms is factored into the equation. No amount of warfare is going to prevent the sun from devastating our bulk power distribution system. Only enhanced resiliency can accomplish that. Given the inevitability of another Carrington-class solar storm, we must act to protect the grid against EMP and do so in a manner that assures it can survive all hazards, not just the naturally occurring kind.

EEI "Myth: An EMP event that would take down the grid is 'easy to perpetrate.'"

EEI "Fact":

> This is false. To fully understand the likelihood, we must again understand the threats.
>
> Directed-energy Weapon: To cause significant damage to the grid, dozens of directed energy weapons would need to be built, deployed and detonated in a coordinated attack across the country – without being detected or stopped by law enforcement first. While not impossible, such a scenario is substantially more complicated to plan and carry out than claimed.

STG Fact-Check: As discussed above, according to a study conducted for the Federal Energy Regulatory Commission, it would require the destruction of as few as *nine* critical high-voltage transformer subtations – not "dozens" – to take down the U.S. grid.

Given what is in the public domain about the presence in the United States or just across its border of cadres of Islamic State, al Qaeda, Hezbollah, Iranian Revolutionary Guard Corps and Hamas operatives and the ease with which EMP testers or generators can be acquired, it is pollyannish to believe either of two things: that 1) the complexity of such an attack exceeds the capabilities of skilled terrorists, let alone state-sponsors of terrorism or 2) law enforcement will assuredly detect in time and be able to foil such a plot if it is mounted. Under these

circumstances, it is malfeasant not to take steps to protect at a minimum such critical substations against electromagnetic pulse and other hazards.

EEI "Fact":

> High-Altitude Nuclear Explosion: The list of adversaries with this capability is significantly smaller and well-known, and the material required to produce and launch such a device is highly monitored by U.S. intelligence authorities and international organizations. Again, the prevention of such attacks is the responsibility of the nation's military and intelligence agencies.

STG Fact-Check: Once again, the electric utilities are seeking to fob off onto others responsibility that clearly rests with them. The record of "U.S. intelligence authorities and international organizations" successfully monitoring, let alone preventing, nuclear threats does not inspire confidence about their future prospects for doing better with regard to high-altitude EMP attacks.

With respect to situational awareness of emerging threats, U.S. and international authorities more often than not have been taken by surprise by the proliferation of nuclear weapons, including: the USSR's development of the atomic and hydrogen bombs; Israel and South Africa's development of nuclear weapons in the 1960s and 1970s; Iraq's being within six months of developing a nuclear weapon in 1991 (a fact only discovered in the aftermath of the first Persian Gulf War); India and Pakistan testing nuclear weapons in 1998; North Korea developing nuclear weapons in 1994 and testing them in 2006; and the late discovery of Iran's nuclear weapons program in 2003 – a program that had been ongoing for nearly 20 years.

With respect to the United States' ability to prevent EMP attacks, the nation has no capacity to *detect*, let alone shoot down, ballistic missiles launched off of ships or from territories to our south. The Iranians are among the enemies of this country that have practiced the former; they have also declared their intention to deploy missiles in Venezuela, which could give them the capability to do the latter, as well.

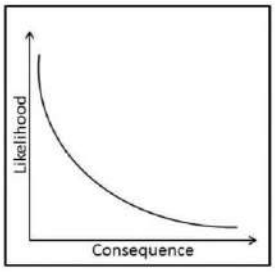
While there are actually thousands of relatively short-range ballistic missiles around the world that could be used to mount a sea-launched HEMP, the co-chairman of the Secure the Grid Coalition and former Director of Central Intelligence R. James Woolsey has observed that there are also other ways of carrying out a high-altitude electromagnetic pulse attack:

> Recently declassified documents show that the North Koreans recruited Russian scientists back in the early 1990s to build a nuclear weapon that could deliver a major EMP shot….The North Koreans now have the Bomb, so delivering it may be as simple as hiding a small nuclear device in a satellite and having it detonate while in orbit over the US.
>
> But it's not just state actors we should be worried about. Terrorist groups, if they can get their hands on some fissile material, and they wouldn't need a lot, could set off an EMP blast by attaching a small nuclear device to a simple weather balloon and detonating it once it gets 20 miles or so above the ground.

EEI "Myth: Electric utilities are completely unprepared for an EMP event."

EEI "Fact":

Electric utilities plan for a number of threats to the grid. As they make their risk-based threat assessments, they identify the likelihood and consequence of each threat to understand their security priorities.



Solar storms, some of which can cause GMD events, are naturally occurring phenomena that come with some prior warning. Utility system owners and operators recognize the risks posed by solar storms and have put into place operating processes and procedures to manage GMD risks.

The high-altitude nuclear weapon scenario is noteworthy because its consequences could be extraordinarily high; however, given U.S. military and intelligence community capabilities, as well as geo-political deterrence efforts, the relative likelihood of such an attack is very low. Additionally, with strategic EMP shielding, spare equipment stockpiles, and partnerships with government, the electric utility industry already is taking preparatory steps to respond and recover. Still, in the case of potentially high-consequence, low-likelihood events like a nuclear attack, the most effective mitigation strategy is deterrence, prevention, or preemption by military means.

STG Fact-Check: Repeating these misleading assertions about the nature of the GMD and HEMP threats – and what is being done and by whom to mitigate them – does not make them more valid. Having addressed each of these EEI claims above, there is no need to rebut them again here.

It is, however, noteworthy in connection with such claims that the Texas Senate Natural Resources and Economic Development Committee took testimony from three representatives of the electric utilities on April 21, 2015. In the course of arguing against better standards to protect the grid from electromagnetic pulses, they reluctantly admitted in response to questions from State Sen. Bob Hall that the steps their industry has taken to date would be inadequate to ensure the survival and recovery of the grid in the event it is exposed to high levels of EMP. Walter Bartel of CenterPoint Energy, Mark Carpenter of Oncor, and John Fainter, president of the Association of Electric Companies of Texas (AECT), all acknowledged the reality of the threat before conceding that they were not prepared to contend with it. (Perhaps as a damage-control measure, AECT subsequently distributed the misleading EEI white paper to bolster their lobbying against Sen. Hall's grid safety legislation, SB 1398.)

EEI "Fact":

The use of a directed energy weapon may be statistically more likely, but the consequence is much less because it would be a localized event. In addition, with 45,000 substations across the United States, the destruction of one or two substations would not have a widespread impact on the grid. A larger coordinated attack could have a potentially broader impact, but is less likely to occur because such coordinated plots have a higher chance of detection and intervention by law enforcement and intelligence agencies.

The previous rebuttal to essentially the same arguments made earlier by EEI applies to this section.

EEI "Myth: Electric utilities don't take threats to their infrastructure seriously."

EEI "Fact":

> Protecting the nation's electric power grid and ensuring a reliable and affordable supply of energy are top priorities for the electric power industry. Electric utilities take all threats to the grid seriously, whether they are natural disasters or man-made threats.
>
> Electric utilities also have every incentive to protect their systems: first, there is a public service responsibility to maintain reliable and affordable electricity service; second, there is an economic incentive to keep the lights on. To help keep electricity reliable and affordable, utilities and state regulators assess each type of threat to grid security as part of an overall risk management strategy.

STG Fact-Check: Such platitudes and assurances ring hollow in the face of the actual conduct of the electric utilities. While reliability and even affordability of energy supply have received considerable attention from the industry, resiliency – particularly against the most stressing of threats, namely EMP – has received the kind of treatment evident throughout the EEI white paper: minimizing the danger; assigning responsibility for dealing with it to others; and, when all else fails, offering blithe assurances that everything is under control, thanks to regulatory standard-setting, information-sharing and/or plans and procedures in place or under development.

The Secure the Grid Coalition challenges EEI to identify even one electrical utility company that has actually *protected* its assets against EMP and GMD and that could, therefore, be truthfully pointed to as a best-practices standard. Should one or more be found, the question then would occur: How long would it take for the rest of the industry to achieve a comparable level of resilience? The first appears to be a null set, which in turn means that – absent federal- or state-level executive and/or legislative or regulatory action – the grid's existing vulnerability will be perpetuated until after it has translated into potentially catastrophic losses to the American people and the nation. At that point, of course, it is too late.

EEI "Myth: The industry has done very little continuity planning for hard-to-replace equipment such as large power transformers."

EEI "Fact":

> The electric power industry has taken specific steps to prepare for, prevent, respond to, and recover from threats to the electric grid. Electric utilities plan for all types of contingencies and have spare equipment available as part of their business continuity planning. Just as utilities share emergency restoration crews as part of the industry's voluntary mutual assistance program, they also share transformers and other equipment regularly.

STG Fact-Check: The truth is, the electric power industry has *not* taken steps, "specific" or otherwise, to "prevent, respond to and recover from" the magnitude of threat posed to the grid by man-caused or naturally occurring electromagnetic pulse. They have *not* planned for this contingency. They do *not* have spare equipment available to cope with its repercussions. There is *no capacity* in terms of emergency restoration crews or sharing of transformers to contend with the widespread, simultaneous and devastating effects of severe EMPs.

As evidence of the sort of contingency planning the electric utilities *have* undertaken, the EEI white paper cites two initiatives: the Spare Transformer Equipment Program (STEP) and the *SpareConnect* online tool. Both are valuable as far as they go. It is just that neither of them will go the distance in the event of a devastating EMP event.

The STEP initiative should not be confused with a robust capacity to replace the number of on-line high-voltage transformers likely to be damaged or destroyed by such an event. There are today a relatively small number of spare transformers in the U.S. inventory and many of those are co-located with the ones they would replace – raising the prospect that they, too, would be made unusable in the event a nearby transformer blows up or catches fire.

Fewer still are compatible with locations in the grid for which they were not designed. Efforts to develop standardized and relatively easily transported transformers are laudable, but do not currently involve the highest-voltage transformers. And even standardized HV transformers designed to operate at lower voltages are not being produced in significant numbers.

The problem with an online tool like the *SpareConnect* is that – even if its inventory were sufficient to make an appreciable dent in what is likely to be needed in the aftermath of a catastrophic EMP attack or solar event – the Internet is unlikely to be operating. Like so much else about the assurances provided by the electric utilities, the *SpareConnect* program is no more resilient than the grid that it is supposed to help contend with more or less day-to-day contingencies.

Such misrepresentations demand formal inquiries by legislators and regulators, alike. To the extent that they do not stand up to scrutiny, those engaging in misleading officials, regulators, lawmakers, business and other consumers and the general public must be held accountable. And corrective actions must be taken to bring actual capabilities into alignment with these assurances.

EEI "Myth: Regardless of cost, we must immediately make all necessary investments to protect the electric grid from an EMP."

EEI "Fact":

> Deploying expensive technology that is unproven is not effective risk management.
>
> The electric power sector often is described as the most critical of the critical infrastructure sectors. While it is true that other critical sectors depend on a reliable supply of electricity for their operations, the electric power industry likewise is dependent on other critical infrastructure sectors for business continuity as well. Electric utilities need: water to cool their systems and to create steam that spins generating equipment; telecommunications to operate the grid; and transportation and pipeline systems to move the fuel sources they use. Thus, our adversaries don't have to just attack the electric grid to disrupt power.
>
> It takes a coordinated effort among different critical infrastructure sectors and the government to protect grid reliability and operations. In the case of a high-level EMP event that could potentially render any device containing a microprocessor inoperable, the issue should be addressed across all critical sectors by national defense authorities. Again, the best strategy to protect against such EMP events is to prevent them from occurring in the first place.

STG Fact-Check: As has been noted above, the Secure the Grid Coalition and most others knowledgeable about the vulnerabilities of our critical infrastructures to EMP believe that – given the dependence of the vast majority of Americans on its goods and services – such deficiencies must be corrected comprehensively. Addressing those of the grid itself is the obvious place to start. Addressing those of the critical infrastructures needed to ensure the continuing operation of the grid should receive comparable triage priority. Doing nothing about the former because the latter also needs to be addressed is not an option.

Assuring the survival of the grid will buy time for and enable remediation of other parts of the infrastructure, if necessary after an EMP event occurs. After-the-fact remediation is undesirable in the extreme, but far preferable to trying to achieve a black start of a devastated grid *and* bring back to life catastrophically degraded water, food, medicine, financial, transportation, telecommunications and other infrastructures.

It is certainly true that the best outcome is to prevent an EMP event. In the case of enemy action, however, we cannot be assured of doing so. Therefore, we need to take steps both to make such an attack futile, and therefore less attractive as an asymmetric warfare option, and to hedge against the eventuality that we will fail either to deter or defend.

Again, in the case of naturally occurring geomagnetic disturbances, prevention is simply not an option, leaving only protection as the only choice – and *all-hazard* protection as the only responsible course of action.

EEI "Myth: Industry and government are not adequately sharing information in order to ensure grid security."

STG Fact-Check: The EEI white paper goes on at some length about various industry-government information-sharing arrangements. Like its other red-herrings, this "myth-fact" section conjures the image that an image that is either immaterial or irrelevant. Whether the official and private sectors are sharing information is not the point. The real issue is the character and quality of the information they are exchanging.

For example, as is made clear by a Secure the Grid Coalition-prepared compilation of the executive summaries of eleven different studies commissioned by or for the federal government entitled, *Guilty Knowledge: What the U.S. Government Knows about the Vulnerability of the Electric Grid but Refuses to Fix*, our authorities have ample evidence of the danger posed by EMP and other mortal threats to the grid. As all of these studies are in the public domain, so do the electric utilities.

Yet, the information being shared in the several "public-private partnership" channels described in the EEI paper seems assiduously to avoid exchanges concerning realistic assessments of the danger posed by EMP. Even if some such information *is* being shared, nothing practical is being done by either the official sector or the private one to prepare the grid to withstand, and continue to operate effectively after, an enemy-caused or natural electromagnetic pulse.

Conclusion

Despite the myriad defects in the Edison Electric Institute white paper "Electromagnetic Pulses: Myths vs. Facts" documented in these pages, the Secure the Grid Coalition welcomes its publication. This presentation of the electric utilities' position on key issues – involving characterizations of their preparedness and that of the national bulk power distribution system they largely own and operate to contend with EMP events of either the man-induced or naturally occurring kind – creates a long-overdue opportunity: We can now begin a vigorous and informed debate about the extent to which we are inviting disaster by persisting in a business-as-usual approach to the issue of grid vulnerability.

With the help of the fact-checking provided by this response to the EEI paper, the Secure the Grid Coalition looks forward to participating in that debate and to ensuring that those responsible for protecting our nation and its people, economy and security do so on the basis of the *real* facts, not the real *myths*.