

Loss of the Electric Power Grid:

A Nationwide Catastrophic Infrastructure Event



**EMPact
AMERICA**

prepare. protect. recover.

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EMPACT America is a bipartisan organization of concerned citizens focused on protecting the American power grid. EMPact America is a not-for-profit corporation (with IRS 501(c) 4 status). At EMPact America, we recognize the threat of an electromagnetic pulse (EMP) catastrophe to the power grid. This threat, from either a hostile nuclear source or a natural occurring solar flare, would destroy our critical infrastructures. These infrastructures deliver food, water, telecommunications, transportation, banking and finance. They are vital to the sustenance of modern America, and it is our mission to ensure their viability.

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"It would be hard to intentionally design an electrical delivery system more vulnerable and fragile than now."

- AMB James Woolsey, Past CIA Director

Introduction

EMPact America, the nation's leading advocacy organization on grid security and resiliency, was formed in 2009. We recognize the threat of an electromagnetic pulse (EMP) catastrophe to the power grid. An EMP threat would destroy our critical infrastructures. These same infrastructures deliver food, water, telecommunications, transportation, banking and finances. They are vital to the sustenance of modern America, and it is our mission to ensure their viability.

An Electromagnetic Pulse (EMP) was a phenomenon not well known or understood. Today, with our efforts and those of major scientists, legislators and experts in the field, EMP is becoming recognized as one of the greatest threats to our nation's critical infrastructure.

Hearings conducted by the Congressionally appointed EMP commission in 2004 and 2008, produced reports detailing the threats and consequences of an EMP attack in the United States. Those studies have never been refuted, yet nothing has been done to address the issue. Recently, research was also conducted by Lloyds of London detailing the potential losses that would be incurred should our nation experience an EMP.

The following report was compiled by Brigadier General Kenneth Chrosniak, a Senior Fellow at EMPact America. General Chrosniak details the importance of securing our nation's grid, the complexities of how it affects all of our critical infrastructure and the need for mitigation and preparedness planning at all levels.

First off, this is not intended to be a scholarly work, as you'll notice no footnotes nor endnotes (except for the obligatory suggested readings at the end). My purpose is to have a discussion with you, and the best way to start a discussion on a topic of such importance is with the **Bottom Line Up Front: there exists a clear and present danger to America (our Homeland) resulting from long-term and prolonged loss of sustained electric power.** This was publically confirmed and announced by past Secretary of Defense Leon Panetta and Secretary of the Department of Homeland Security (DHS) Janet Napolitano in their proclamation concerning the cyber threat to the electric grid. Currently, there is absolutely no government entity that has initiated any substantive plan for response or recovery from a prolonged catastrophic breakdown of our electric grid simultaneously occurring over multiple regions of America. Even the Obama administration's top science and technology advisor, John Holdren, warned in a March 10, 2011 New York Times article of the Electromagnetic Pulse (EMP) threat. He stated that such an EMP event could be enormous, and on the order of \$2 trillion during the first year in the United States alone, with a recovery period of 4 to 10 years.

Think about this, all of us (yes, especially the military) are totally dependent on Energy, which is our Homeland's most preeminent segment of Critical Infrastructure/Key Resources (CI/KR). We, as a nation, literally cannot survive without it. Any degradation or loss of electricity will eventually cause cascading failure to other CI/KR segments such as telecommunications, natural gas and oil, banking and finance, transportation, water supply systems, government services, and essential emergency services.

First Responders are, of necessity, inherently proactive and action-oriented, which is the motivation for this discussion with you. Every First Responder whether firefighter, police, or EMS, knows that you have to engage (attack) and deal up close and personal with the source of the problem-set as quickly as possible. Gaining spot on situational awareness as to the source location of the fire, making instantaneous law enforcement decisions, or performing triage at a vehicle accident all involve the best assessment at that time. More importantly, in their training and exercises they know it's best to always plan for the worst case situation. In the case of a nationwide loss of the electric grid, due to already well known threat causes, there are no existing viable training or exercises, or even valid assessments of severe and existing vulnerabilities since the all-encompassing Congressional EMP (Electromagnetic Pulse) Commission unclassified reports in 2004 and 2008. Additionally, many subsequent reports from competent sources such as the National Academy of Sciences, and many other official documents, have corroborated their original findings. After hearing and seeing news reports of catastrophes worldwide, how many times have you heard exclaimed, "I didn't think these kinds of things could happen here." Well, it's certain that heartbreak happens everywhere, but the obligation is on us as First Responders to ensure that the communities and citizenries we are responsible for are both knowledgeable and resilient to Prepare, Respond and Recover. By the time you finish this discussion, you should realize that the time for analysis and talk is over. Action is in order, immediately.

Our extremely tenuous and fragile electric grid, consists of over 9,000 electric generating units connected to over 200,000 miles of aged transmission lines, with hundreds of vulnerable extra high voltage (EHV) step-up and step-down transformers, thousands of other differing power level transformers. In essence, the 'nervous system' that runs our country (See Figure 1). Additionally, numerous and ubiquitous Supervisory Controlled Data Acquisition Systems (SCADA) systems make up an automated network which collect and analyze data, and generate reports. This network of devices gives utilities the ability to control and measure certain elements within the overall utility system such as water and natural gas pressure, to traffic lights.

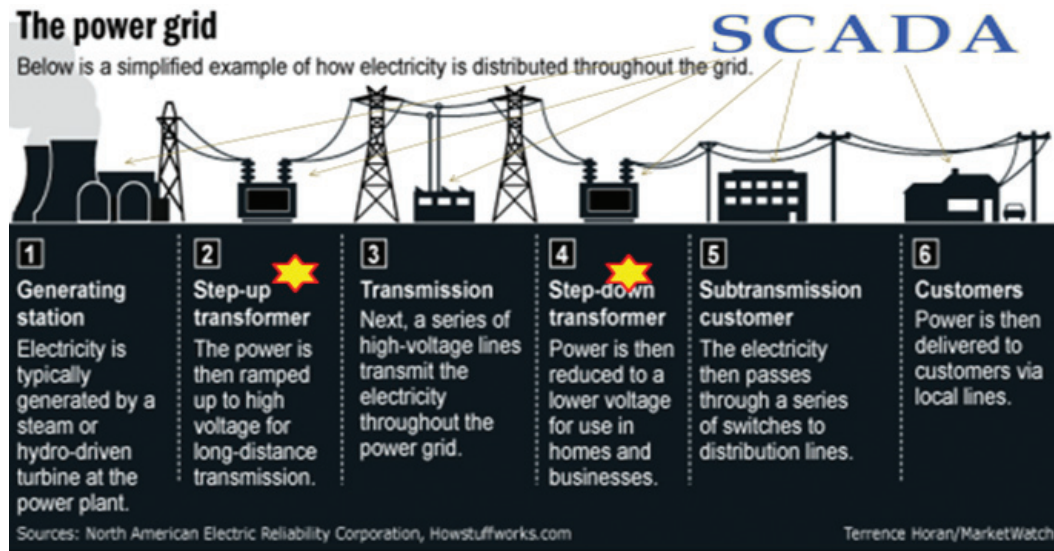
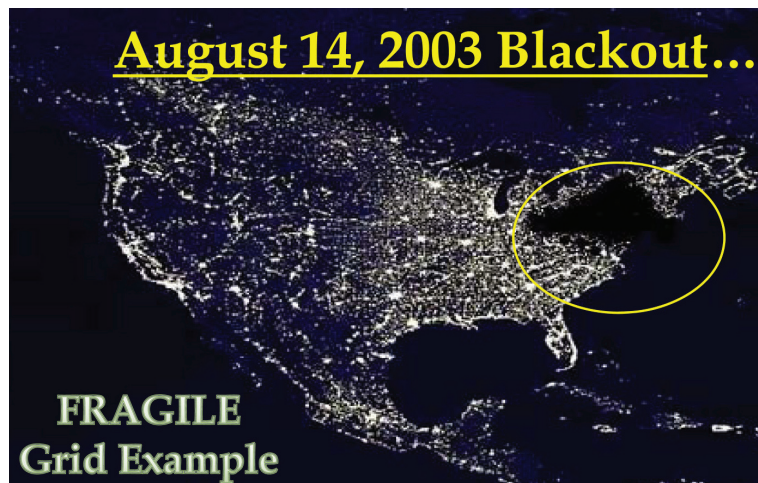


Fig. 1: The Power Grid, Simplified

To answer any question as to just how fragile the existing grid is, Figure 2 below provides a perfect example to illustrate the extreme vulnerability of our electric grid. Due to extreme heat, four sagging high voltage power lines near Dayton, Ohio, brushed onto untrimmed tree branches on 14 August, 2003. This event, compounded by an energy company computer system error (embedded malware), caused a cascade of failures that quickly left 50 million people without power for two days. This event resulted in the largest blackout in North American history, affecting the entire northeastern U.S. and Ontario, Canada, costing an estimated \$6 billion. It contributed to 11 deaths, and shut down 508 power generating facilities; 22 of which were nuclear power plants! Let this fact sink in: a nuclear power plant can only be restarted by a full-up external power grid; it cannot ‘blackstart’ itself.



August 14, 2003 Blackout...

...triggered by a tree branch touched by over-heated high voltage transmission line near Dayton, Ohio; further exacerbated by a ‘bug’ in First Energy’s XA/21 control room alarm system in Ohio, causing further cascading effects.

AFFECTED

- 508 generating units
- 256 power plants
- 20 nuclear reactors

Fig. 2: Example of Fragile Electric Grid

The design and function of such a complex grid touches, indeed even manages, critical aspects of your everyday life, without most of us possessing even a passing thought to its’ importance. You turn the light switch on in the bathroom and it gives you light, and you unknowingly expect it to. We have become dependent upon our cell phones, tablet computers and the internet which allows connection to the world and numerous services. Consider what we take for granted: water pressure for daily use in sanitation and fighting fires, your cell phone, the ubiquitous internet (that makes it possible for the doctor to

order Insulin for your child), the supply chain (Just-in-Time logistics) to enable production and delivery of that Insulin, the food industry, ambulances, hospitals, all forms of transportation, oil and natural gas refineries and delivery, refrigeration, air traffic controllers, and vital military installations and their supportive defense industrial base operations.

Our financial matters have also become increasingly, if not totally, dependent upon that all-mighty internet to deliver your pay, for bill-paying and investments, and even welfare, food stamps, pension, and social security check direct deposits to your bank. Oh, you get your checks by mail? Don't count on it, as the letter-sort machine and all apparatus supporting postal service functions will cease. Wall Street will not function without the connections the internet "grid" provides and essential satellite transaction connectivity, all of which are so completely dependent on it. Consider also what we unthinkingly rely on, our nuclear power generation system, with its critical pumping systems designed to cool the power plant core and also the old rods in the spent fuel pool. The same is true for oil and natural gas refineries and production facilities, and the transport by both land and rail to bring fuel products to market.

EMP Commission
Public Law 106-398,
Title XIV

Vulnerability of US Military and Civilian Systems

- One or a few high-altitude nuclear detonations can produce EMP, simultaneously, over wide geographical areas
- Unprecedented cascading failure of our electronics-dependent infrastructures could result
 - Power, energy transport, telecom, and financial systems are particularly vulnerable and interdependent
 - EMP disruption of these sectors could cause large scale infrastructure failures for all aspects of the Nation's life
- Both civilian and military capabilities depend on these infrastructures
- Without adequate protection recovery could be prolonged—months to years

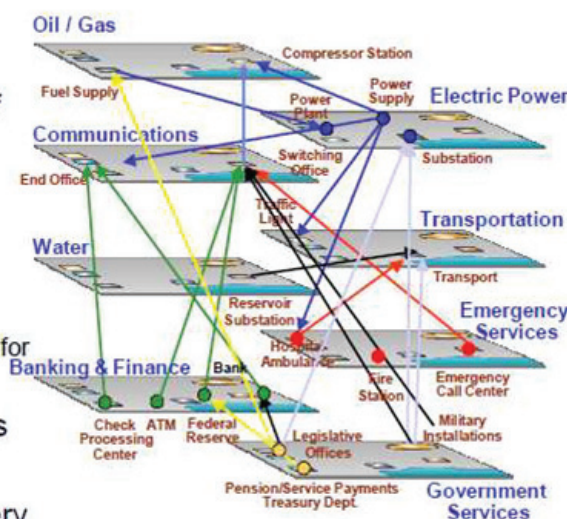


Fig. 3: Cascading effects.

Out of sight, yet vigilant above us as they assist America's needs, are numerous and critical commercial and military satellite systems. These have become essential to our life-sustaining communications network as well as to commerce, transportation, and the functioning of the defense of the Homeland. These satellites are extremely vulnerable, and may fail under conditions of a manmade (nuclear or cyber) or natural electromagnetic pulse events.

Mr. Joseph McClelland, past Director of the Federal Energy Regulatory Commission (FERC) Office of Energy Infrastructure Security, stated that private power utilities are not prepared to handle a catastrophic loss of power in that the effects would be profound on the entire national grid system. He stated that most crucial are the 350 plus large EHV transformers which are extremely vulnerable to threats, with little to no replacements on-hand, and (worst of all) nearly all are not made in our Homeland. Each requires specific design configuration, can take up to two years to produce, and later resulting in significant logistical

and transportation support for shipment and placement at its final destination. Worst case, (remember to always plan for worst case), we will not be able to even order, nor have the capability to deliver or emplace, most EHV's for multiple years due to doubtful replacement availability (other nations will need them also), severely limited transportation, or questionable available engineers for emplacement (among other concerns). I'll add more to these thoughts later in this discussion.

Existing manmade and natural threats

Right up front, if you're looking for 'climate change' as a threat, you'll find that it's more like headline-making rhetoric than the true existential threats cited below that should concern us all. I will not discuss it as an existential threat at this time.

Geomagnetically-Induced Currents

Earth often naturally experiences differing levels of geomagnetic disturbances (GMD) from solar flares (coronal mass ejections). While many do minor harm (mostly to GPS and communications), large scale "direct hits" could have, and have historically had, devastating impact on our Earth and its life. If a massive geomagnetic storm were to occur now, it could totally destroy modern electronics, leaving us "in the dark" for weeks, months or possibly years. Not preparing for a catastrophic solar event is similar to playing Russian roulette, as it's not "if", but "when" the event will occur.

Severe Weather

Severe weather is a common cause of damage to the electrical grid, with perfect examples such as the 2012 Derecho, Hurricane Sandy, and other incidents resulting in damaging high winds, flooding, extreme heat, drought, and earthquake. These events, along with the existing aging and fragile infrastructure and swollen population in urban areas has increased the threat on the grid overall. Of course the nation's utility industry has noteworthy experience in both preparation for and response to severe weather through better weather prediction and coordination with federal, state, and local responders and mutual aid agreements. In some cases smart grid and micro-grid innovations can also improve grid resilience and speed power restoration. But in the end, planning for worst-case scenarios should be ongoing, and exercised, as lessons learned from Katrina and Sandy indicate that we are not prepared at the worst case cataclysmic level.

Electromagnetic Pulse

"The threat remains grave, and the trend lines in many parts of the world are pointing in the wrong direction." - Former 9/11 commission members writing in "Reflections on the Tenth Anniversary of The 9/11 Commission Report."

Have you been informed by DHS that there are also credible manmade threats to the electric power grid in addition to solar flares and devastating Katrina and Sandy-scale storms? No, probably not. An electromagnetic pulse (EMP) generated from a high-altitude nuclear burst (HEMP) will destroy outdated and vulnerable EHV transformers (of which power utilities have critically low spares) and the fragile transmission system. An EMP is created by detonating a nuclear warhead between 50 and 500 kilometers above the earth's surface creating a pulse which can disrupt and disable electronic computers, electric power generation and distribution, and telephone and information systems over a substantial geographic area.

While this is a significant threat to grid security, there exists a limited number of actors that could execute such an attack, and such an attack would be a direct act of war. Furthermore, since high-altitude nuclear tests were banned by treaty in 1963, there is only limited scientific data about the impact of such

a nuclear detonation on modern infrastructure. Still, given the potential damage that an adversary could cause through EMP, both the government and the utility industry should work together to identify measures that could mitigate the effect of an EMP and rapidly restore power to key military, government, and civil facilities. Hardening key grid nodes, micro-grid technology, and generation capacity at key facilities are initial measures that could be taken to address vulnerabilities to an EMP attack.

Furthermore, a space-based nuclear blast will, overtime, degrade or disable satellites, severely impacting communications for civilian operations and military command and control of any FEMA or military Defense Support to Civil Authorities (DSCA) responses and recovery operations. Iran will soon have the capability to strike Israel and America with nuclear weapons, as will North Korea. Russia has been, and always will be, a continuing nuclear threat. Considering the fact that a satellite can act as a delivery system just as effectively as a missile, it is interesting to note that both Iran and North Korea have launched satellites with questionable functionality (North Korea's is a weather satellite that traverses over our Homeland). But then again, they really need an orbiting weather satellite in low-earth orbit, while many of their people are eating dirt! Recently a 'very' cyber-savvy General Officer told me that his/her (sorry, can't give the name due to a non-attribution agreement) greatest fear, and one that keeps him/her 'awake at night', is a HEMP attack over central Kansas that will take out our nations' electric grid for a very long time. This could easily be accomplished with an orbiting satellite, whether considered "operational" or a "failure." Or, by a vessel off any of our coasts. China is now in the process of hardening their east coast grid to EMP (E1) attacks.

Cyber and/or Physical attack

Another significant threat to your survival and the Homeland is the insidious nature of a coordinated cyber and/or physical attack on our power generation plants, transformers and CI/KR. We have an increasingly complex and networked grid, with increasing efficiency and overall situational awareness on the one hand, and increasing vulnerability to attacks from cyberspace on the other. Older grid systems are likely to have "air gaps" between the public Internet and SCADA systems, or other control systems. However, as smart grid technologies are connected, there will be more access points to the grid networks, requiring increased security awareness by utilities, device manufacturers, and the general public. A wide range of actors have sought to exploit cyber vulnerabilities in the U.S. electrical grid. On one hand, nation states like Russia, China, Iran, and North Korea look for vulnerabilities that would allow them to strike at the U.S. homeland.

Too frequently you hear about increased government, commercial and private cyber hacking. Nuclear power plants, banking systems, power generating plants, dams, chemical storage sites, the White House, FBI, the Pentagon and many critical infrastructures are vulnerable. Some of you may have had a shocking hit through Target chain stores credit cards; coincidentally well-named. Past Secretary of Defense Leon Panetta and former Secretary of Homeland Security Janet Napolitano have warned of an impending Cyber Pearl Harbor attack that could result in an electric breakdown due to cascading failure of critical infrastructures (power generating plants) across the nation. As of now there is no effective defense, other than constant 'patching', or a total disconnect/shut down from the internet.

An example of the effect of a cyber-attack on electric power transmission was proven and confirmed during a controlled "Aurora" test at the Idaho National Laboratory in 2007, in which controllers manipulated and "hacked" the computer network systems that controlled diesel generators involved the opening and closing of circuit breakers, resulted in an out-of synchronism/phase condition, placing stress upon the mechanical components of rotating equipment in the generator, causing it to smoke and shudder violently. It did so in this test very dramatically, as the repeated opening and closing, which resulted in power becoming "out-of-phase, resulted in 'cascading' damage to alternating current (AC) equipment in the system. A more sophisticated planned cyber-attack may cause a loss of load, severe cascading effects, and probable

collapse of the grid. This test is significant because it not only identified a major vulnerability, but it also demonstrated the ability for a computer virus to manipulate grid systems and cause physical damage. While this initial demonstration occurred in a controlled environment, it provided evidence of how future cyber-attacks might seek to use vulnerabilities in grid Control equipment to cause significant physical damage to grid components.

While the Aurora test proved conclusively that control systems can be hacked into easily, they can also be damaged via **kinetic (physical)** means. On 16 April 2013, there was a complex physical terrorist attack on the Metcalf transformer substation near San Jose, California, resulting in damage to multiple transformers from small arms fire (SAF). Many transformers were damaged due to small arms fire (SAF), but technicians made heroic efforts to maintain power to Silicon Valley. Although the FBI does not suspect terrorism, Jon Wellinghoff, FERC chairman at the time of the attack, disagrees with that assumption (and so do I). This was not a bunch of “Bubbas” out on a shooting spree, or union negotiation workplace violence. It was a very proficient tactical-level terrorist attack with the goal of performing reconnaissance and surveillance of response actions and destroying transformer liquid cooling tanks. By the way, prior to the Metcalf incident, attacks on utility equipment in the U.S had association with copper thieves, disgruntled employees, or others who sometimes took pot-shots at transformers, or small one’s on utility poles. This is a game changer. Recently the media used leaked FERC data to announce that a coordinated terrorist operation against nine key substations could cause a grid collapse across the entire country. U.S. Senators expressed ‘shock’ and outrage that such information was leaked, but believe me, this is old news to our enemies as they most assuredly have ‘surveilled’ these sites already and are well-aware of our most vulnerable transmission nodes within our massive grid. Of course significant importance to recovery from physical attack is the ability to quickly repair or replace destroyed or damaged equipment (usually transformers).

To add to what you may term “my paranoia”, oddly enough on the very same date-time group of the terrorist attack in San Jose occurred, a North Korean KSM-3 satellite was orbiting over New York City and Washington, D.C. from a southern trajectory (by the way, we have no southern oriented ballistic missile defense system in place), and at an ideal altitude for and EMP attack (400 km). Recently a North Korean freighter transiting the Panama Canal was discovered to contain two nuclear capable SA-2 missiles (but no warhead) hidden under their sugar cargo. Headed most likely for Cuba or Venezuela?

Some positive news! As cyber and physical threats continue to spread DHS and NERC have held grid security exercises to assess the readiness and resilience of electrical utilities. In 2006, DHS sponsored the first government-lead full-scale cyber exercise where over 115 different organizations, utilities, and levels of government met. Three more Cyber Storm exercises have occurred since then, with the most recent in fall 2013 occurring at the state and federal level. The North American Electric Reliability Corporation (NERC) has held a series of two cybersecurity exercises, GridEx I and GridEx II, occurred in the fall of 2011 and 2013, were sector-wide grid security exercise included utilities, organizations, and agencies from the U.S. and Canada. In the second GridEx drill both cyber and physical attacks were simulated, which tested the ability for utilities to respond to multiple, yet interconnected threats. Of course, these exercises assumed there would be no degraded or denied communications systems, which is not thinking ‘worst case’.

Directed energy weapons

Directed energy weapons (DEWs) use highly focused energy to create destructive effects across the electromagnetic spectrum with radio waves, visible light, or infrared heat that produce effects similar to an EMP. Their ease of use is a real concern for electric grid security, as they don’t involve the difficulty of a missile launch and nuclear detonation. DEWs also allow an attacker to target specific facilities rather than

a very large area, making their use seem to not rise to the level of a weapon of mass destruction. Many DEWs are in the development stages and remain classified. However, nations such as China place emphasis on their development and fielding. Just as with an EMP to EMP, mitigating a DEW attack involves a hardening key nodes, and improving grid response and resiliency.

So, what does this all mean?

A recently declassified National Research Council report, sponsored by DHS, stated “The U.S. electric power delivery system is vulnerable to terrorist attacks that could cause much more damage to the system than natural disasters such as Hurricane Sandy, blacking out large regions of the country for weeks or months and costing many billions of dollars.” And, that “the security of the U.S. electric power system is in urgent need of attention.” So, one can rightfully deduce that the DHS is fully aware that, for example, a cyber-attack on the power system could affect large regions of the country for weeks, months or even years, as they have acknowledged so before in sworn testimony before the U.S. Senate as recently as May 2013. The result would be significant societal unrest (you can use your imagination here) and helplessness, and complete and total vulnerability. Has DHS alerted you to be aware and prepare for that fact? No.

Tragically, your First Responder community is not aware of this either, and their help will not be guaranteed (or will be severely compromised). Your National Fire Service and fire academies are also not informed of this challenge, nor how to plan for response and recovery as the DHS has not provided guidance to firefighters and police, and has not developed plans or exercise scenarios to protect you regarding any long-term power outage strategy for emergency services. Nor have they done so for your police. For you First Responders reading this, now is a good time to imagine your duties at the firehouse without water pressure, no 911 comms (or a severely degraded network), limited refueling (if your equipment is functional to begin with), no fuel for your generator (if you have one to begin with), and no regional assistance/mutual aid! I’m sure you can think of others.

Taken individually any of these threats could result in long-term failure of the electric grid. To give you some perspective, a congressionally chartered EMP commission of eminent scientists (after an eight year study) concluded in 2008 that over 60% of our population would perish within one year of a multi-regional “grid-down” event. What is unforgivable **(and forms the real reason for me writing this to you)** is that while these threats may be unknown to you, your local, state and federal leaders have not been informed either by DHS to plan and prepare for these catastrophic high-impact/low-frequency events. I encourage you to read the report by simply searching “2008 EMP Commission Report” on the internet. Even though stimulated by the EMP Commission, as of this time your DHS leadership has been reluctant to incorporate EMP as an additional National Planning Scenario (NPS)! If they did so back in 2008, adequate planning and actionable scenarios for your survival would have been initiated and well on their way to fruition.

Mitigation Efforts

It’s unquestionably well-known that DHS, FEMA, the U.S. Northern Command (NORTHCOM), National Guard Bureau and state emergency management offices have excellent “All Hazard” (so called) plans ‘on the shelf’, and conduct superb training and exercises for local up to regional disasters. All performed well during hurricanes KATRINA and SANDY. **However, as of now there are no plans or exercises regarding a prolonged electric blackout lasting months or years involving multiple FEMA regions in the Homeland. DHS must immediately develop plans to assure command and control, situational awareness, and encourage localized resilience and empowerment.** DHS must immediately develop and implement a comprehensive and coherent suite of communications strategies in support of a national campaign (think Civil Defense from the old days) to foster public awareness and motivate individual citi-

zens and communities to be self-sufficient and resilient. **Do not think in the mistaken terms of the 72 hour mantra as DHS presently advises!**

First Responders think realistically, not in terms of maybes. So, right up front to my brother and sister First Responders out there: how much of a surge capability do you have in your firehouse, police or EMS station? Over time, a week, a month, several months, will you continue to report for duty while your family's survival concerns are heightened? Initially as a volunteer Firefighter, I will ensure my family is secure first and foremost. Then, if possible, I'll go to the fire station and find out if the 911 comms work, if there is hydrant water pressure, and see if the ladder truck operates (which in some cases it won't). But then again, who knows? No scenarios have been developed, tested, exercised, or planned for by DHS, FEMA or national fire service organizations. For fire protection alone, agencies of the DHS should ensure that fire apparatus manufacturers produce 'hardened' microprocessors in fire engines, ladder trucks, heavy rescue vehicles, ambulances and emergency 911 centers are designed and hardened to survive an EMP. Right now generators are critical, but are not available to all fire stations. Those that do have them should have a minimum of 30 days fuel supply on hand (preferably diesel), and essential repair parts.

DHS and FEMA are accountable to you to initiate and exercise these "true All Hazard" plans regularly at the regional, state, local, and tribal level to assist in your recovery efforts. For a start, DHS/FEMA should ensure development of training course material for First Responders on operational procedures after loss of power, develop an EMP attack consequence assessment tool to perform planning analysis and training, and set aside and protect hard to replace critical equipment and microprocessor components. In addition we must ensure that essential 911 communications are hardened and redundant, and enhance mutual aid supportive relationships. Note: the 911 system was severely compromised during the recent Derecho event on the east coast, and later during and after hurricane SANDY.

None of the above is being accomplished right now as fire, police and ambulance company chiefs have no idea what to do with the catastrophic, if not tragic, effects of having little to no electricity for very prolonged periods of time, over multiple regions of the country simultaneously, in a likely contaminated radiological environment. Just for fun, go and ask your local fire chief to explain the effects of an electromagnetic pulse on his/her department, and the effects of no electricity (e.g., no water pressure) for a 'prolonged' timeframe, and see what she or he has to say. You can then waste more time by asking your police chief the same question.

The Department of Energy (DOE), the Nuclear Regulatory Commission (NRC), the North American Electric Reliability Corporation (NERC), NORTHCOM and many Private Utility Companies (PUC) don't get a free pass either. All are complicit in not developing the vision, planning, training, exercising, and means to inform the American people of the threat to their survival. The NERC and PUCs state that the cost of preparation and hardening elements of the electric grid would be cost prohibitive. That is ludicrous, as it would cost on average about \$2.00 per year (that's a few cigarettes or half a pint of beer) to the average consumer bill to very basically ensure hardening of at least the most crucial 350 EHV transformers that are "key" to power restoration, and nearly impossible to replace after an event. Yes, the overall cost would possibly amount to two billion dollars, but this would be pale in comparison to the tremendous cost (in trillions of dollars) by doing nothing. Just read some of the dire research from Lloyds of London, a major insurance entity. You may not know this, but we send at least \$2 Billion dollars to Pakistan each year in foreign aid. The main issue here is that while it's clear that it is nearly impossible to truly secure the entire electric grid from all hazards, it is feasible to secure the most essential yet nearly impossible to replace or repair transformers and control systems. NERC speaks for industry, not for the Homeland, and consistently submits flawed and rosy-outcome self-assessment reports which are rarely, if ever, validated.

Department of Defense (DoD), Military Defense Support to Civil Authorities (DSCA) and FEMA

The situation in the military is unpromising. In July 1012, Dr. Paul Stockton (former Assistant Secretary of Defense for Homeland Defense) addressed the U.S. Army War College's Distance Education class of 2012, where he noted the potential of cascading and escalating failure of the electric grid on the Homeland and especially the military response following an earthquake around the New Madrid fault. He went on to emphatically reiterate the dire warnings of the 2008 Congressional EMP Commission report that a high-altitude nuclear burst (HEMP), a geomagnetic disturbances (GMD), coordinated physical and cyber-attacks, or a New Madrid type earthquake (or other natural disasters) could take down our fragile and unprotected grid. To get the 'big picture' of the presentation, please see Dr. Stockton's speech at www.youtube.com/watch?v=Frngxuc1fkDg. Be sure to advance the video to the 10:05 minute mark for his introduction and presentation.

Thinking of the military "cavalry coming over the hill" after a prolonged blackout event? Don't. Again, plan for the worst case! In a natural or manmade EMP event DHS and FEMA will instantly become overwhelmed, and will rely on the Department of Defense (DoD) to rescue our Citizens. The main command structure formed to do this in 2003 is NORTHCOM. Although NORTHCOM presently has adequate forces for smaller regional events, it lacks adequate federal forces to perform DSCA missions in a truly complex and prolonged event, as the 2010 Quadrennial Defense Review significantly lessened Chemical, Biological, Radiological and Nuclear Enhanced (CBRNE) forces. While some DSCA CBRNE forces may assist you initially (mainly elements of the National Guard), the operative word here is prolonged. You cannot be assured that the military will be there to help because, just as you, they are also heavily dependent for power from their surrounding community electric grid which supports all military installations, including the crucial defense industrial base and their supply chain providers. Nor does the military train or conduct exercises to operate within a degraded environment due to the loss of electric power over prolonged periods of time in vast urban and rural areas of the Homeland. A 2008 the Defense Science Board report stated that "critical national security and homeland defense missions are at an unacceptably high risk of extended outage from failure of the commercial electrical power grid." Ultimately, NORTHCOM will have to rely on untrained General Purpose Forces (GPF) in a large-scale event, as any responding CBRNE forces will quickly become non-effective. As for the training and exercising of GPF to assist in response and recover, they are in worse shape than the CBRNE forces.

Another specific concern that needs to be overcome is how can any responding DSCA forces, emergency managers and responders at all levels of government and in the private sector, maintain critical communications during and after an extreme space weather event or HEMP. A FEMA produced brief outlined the dire picture of this problem-set (as shown in Figure 4 below) which depicts the result of either military or commercial satellite communications (SATCOM) failure in low, mid and geosynchronous orbit after 30 days. The "POTS" line on the chart is the Plain Old Telephone System. You can readily see that after about a 30-day timeframe First Responders, FEMA, and any responding DSCA military assistance will be left to operate with severely degraded, denied or destroyed communications, and forced to use HF radio "line-of-sight" capability (as long as the fuel for generators holds out of course) because, like FEMA, the military relies on robust commercial and military SATCOM communication systems for ongoing response and recovery command and control. FEMA states that "line-of-sight public safety and commercial radio (HF, VHF, UHF, and microwave) will work if power (fuel for their generators) can be supplied to systems and receivers." Do they conduct exercises for this eventuality? No. However, spokesman David Trachtenberg of the Military Auxiliary Radio System (MARS), states that his organization conducts some training with the Army and Air Force to enable some level of communication capability. You may know them as 'Ham radio operators'. It's certain that these operators will be worth their weight in gold after the loss of satellite 'beyond line-of-sight' communications.

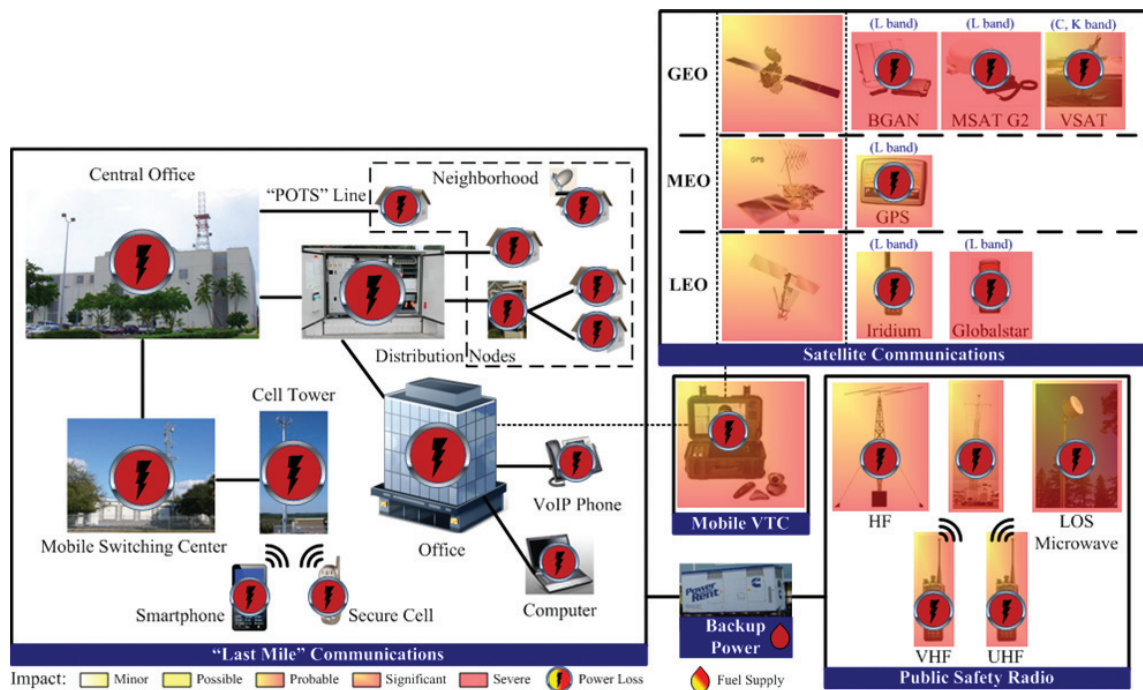


Fig. 4: FEMA slide indicating communications capability after 30 days of GMD-5 level solar event.

Another consideration many military and civilian leaders may not take into account when planning for recovery operations is PEOPLE. What will be the mindset, over time, of military personnel that initially do report or remain on duty during and after a catastrophic event no matter if they're Active Duty, Reserve or National Guard (either in the Homeland or overseas) after a prolonged period of time? With no contact from their families or loved ones, what will 'weigh heavily' on their minds? What will be their true 'readiness level' with that undeniable and mind-numbing uncertainty that is obvious with thoughts and concerns of their loved ones? Even if they do convoy out of an installations gate, will they be truly thinking of you first? So, at what point will they continue to man our military installations and support DSCA? The same goes for Defense Industrial Base (DIB) personnel (manned mainly by civilian workers). Will critical DIB functions continue without sufficient supply chain provider support? No, probably not. Many emergency response leaders, FEMA and military commanders will assume that personnel will remain on duty for the long haul. They will be proven wrong.

Any responding rescue and recovery forces that will be called upon to aid in a complex and dangerous environment must have been adequately trained and exercised to operate in an environment involving limited to no accessible fuel, severely degraded/denied communications (no viable command and control), severe societal unrest, possibly maneuvering in a likely radiological and/or chemical HAZMAT environment, and encountering overwhelming medical needs with a broken medical system, unknown mass casualties (graves registration), desperate sanitation conditions, in vast urban and suburban areas - **all at the same time**, and over a very prolonged period of time.

I won't take time here to discuss the societal problem areas associated with a prolonged loss of power. You can watch news footage of any natural disaster that occurred in the U.S. and you'll see looting and rampage at differing levels before, during and after. Let your imagination run with a scenario of your own choosing, and you'll be able to write your own survival TV series like Revolution or The Dome, recent National Geographic episodes on this matter, or the actions of civilians and officials in after action reports and lessons learned in the aftermath of hurricane KATRINA. These realities will be foremost in the minds of most sensible military personnel.

As of now, our country possesses no national plans, scenarios or exercises from DHS, FEMA, DoD, DOE or anyone for such a complex and truly catastrophic level of intensity. Remember, always plan for the worst case.

Nuclear Environment

Another critical area devoid of any substantive planning is the effect of a grid down environment on the 104 nuclear power plants in the Homeland. There may be power, but not for long, as initially during a grid blackout back-up power from in-place batteries and/or generators should start immediately to maintain essential coolant controls. These are essential to keep both the core and spent fuel pools (spent fuel pools store numerous discarded radioactive rods from the core) cool and safe. These batteries may last about 12-48 hours at best. After they stop, operating diesel generators should “kick-in” (but remember Fukushima?) but will eventually run out of fuel. Reserve fuel lasts about 7 days, maybe more, but with fuel resupply highly questionable as petroleum refineries and the rail and road fuel transportation system will be negatively affected also. Once generators run out of fuel, an intense exothermic fire will, over time, occur in the Zirconium cladding surrounding the spent fuel rods in the pool, soon followed by certain venting of Cesium-134. The core itself will become compromised some time later if a ‘blackstart’ cannot be accomplished in a timely manner to ensure proper cooling.

A Remedy Example for Local Survival (a relatively quick win example)

Need some good news that could be an excellent example of a viable Public-Private (industry) Partnership to actually save lives? In early Spring of 2012 a plan was proposed by EMPact America, a non-profit organization (emanating from Steuben Foods) in Elma, NY, to ‘hard wire’ (EMP proof) the Niagara Falls Air Force Reserve Base and International Airport located in VERY close proximity, (about 4 miles), from the Lewiston hydroelectric generating plant. This hydro plant has very attractive attributes: it’s a renewable source of energy that cannot be shut down (unless the Great Lakes dry up) by lack of a source water; it has maintained the Analog system (as opposed to the extremely vulnerable and ‘cyber hack-able’ digital system); and has ***the distinction of being the only power generating plant remaining operational during the 14 August 2003 Northeast blackout*** previously mentioned. Best of all, it has the ability to re-start itself (if indeed it ever does shutdown), and most outstandingly, **it can facilitate a black start for a downed nuclear power plant!** No single points of failure or other negatives were noted during the initial study by nuclear and electrical engineers from EMPact America.

As of this date very little has been done to date with Niagara Falls-Lewiston hydroelectric power plant proposal for nearly two years. But if/when it were to be completed, it would prove to be a tremendous lifesaver and a ‘cookie-cutter’ model for other hydroelectric plants in our nation to emulate. It could assure capabilities for effective and life-sustaining military DSCA at the nearby Niagara Falls Air Reserve base and international airport, and afford the surrounding communities with secure power to operate with a viable extended runway (with functioning Air Traffic Control), and the capability to receive/store any available military and civilian assistance aircraft. Additionally, the base could support a civilian and military command center for continuity of government, operations, and situational awareness, as well as a viable support system for military and civilian emergency services and law enforcement to continue. Also ensured will be the capability to receive, stage, and prepare for onward movement essential life-sustaining goods from any possible unaffected regions, and considerably more (bound only by one’s imagination). The cost to harden the line from the hydroelectric plant to the air base? Let’s say probably less than the ‘Cash-4-Clunkers’ debacle of the recent past. What’s the status of such a doable project? It’s going nowhere, as there has of now been no action by Western New York or New York State leaders to expedite this initiative for their citizens. **Oh yes, one reminder: it can facilitate a re-start of a downed nuclear power plant!** Yes, that includes nuclear power to New York City.

What else is being done to help you survive?

Here's some relatively good news (though not much for those not living near military installations). The Army is leaning forward in the foxhole with testing and development of "islands of power" -- micro-grids if you will -- called the SPIDERS initiative to provide sustained power to a select number of testing military installations. These micro-grids may consist of photovoltaic, wind, fossil fuel and varied sources of power that could provide at least 20% of power essential to sustain specific operations on the installation. Will they be able to assist you initially, most likely not. As this initiative is still in the formative testing stage as of this writing, it will most assuredly take years to put into operation after testing and validation.

The U.S. desperately needs a facility that can actually manufacture transformers at the critical 500kV and 765kV levels that are vital to the U.S. electric load demand. Right now there are no large EHV transformers produced in the Homeland. All are foreign made and must be transported to sites in the Homeland, and may require up to two years to manufacture. It's well-known in the power industry that moving such large 500kV and 765kV transformer (400+ tons) is among the most complex logistical challenges that exist for transport engineers. Overall, it takes an intensive 3 to 6 month planning window to coordinate all logistical requirements. To pull this all together in a short amount of time, days to weeks after a grid down event, will be literally impossible. Significant planning and preparation is essential, as such a process requires specialized planning and manning that will be difficult to marshal with respect to transport rail cars, transport truck/trailer, lift-rigs and most importantly trained personnel, who likely may not be available in a catastrophic scenario. Compounding the lack of technicians will be little to no fuel and no power to rail systems. Yes, plan worst case!



Road Transport of EHV Transformer



Rail Transport of EHV Transformer
(Only 20 railcars exist in the U.S.)

Fig. 5: Workers move wires, lights, and poles to transport a 340 ton transformer

To try to alleviate the EHV problem-set, the DHS had an ongoing prototype transformer replacement initiative called "Recovery Transformer ("RecX")", in which they had developed and tested a transformer that is lighter and more portable than the most common 345Kv HV transformer. After one full year of testing, it performed successfully (I could have told them it would succeed, and saved a lot of tax dollars). When manufactured and distributed, which will also take years, it would have proven a viable, yet

limited, addition to grid recovery. The unstated fact is that these recovery transformers design parameters were not broad enough to duplicate and replace critical generator step up (GSU) EHV transformers. Besides, it was transported from Ohio to Texas in highly optimum transport and installation conditions, and not the highly tenuous conditions likely following a truly catastrophic event. Some time ago Sharon Mahmood, DHS's Science and Technology director, told me that the test is over, and it was successful. However, as stated by Paul Parfomak of the Congressional Research Service, the manufacturer has received no orders for commercial production of these units as of February 2014, as the DHS is no longer funding the (successful) RecX program.

Additionally, a Spare Transformer Equipment Program (STEP) was approved by the NERC to strengthen private utility company's stockage in order to facilitate rapid replacement transformers that require long lead time to produce, and can be shared according to priority of need. It's intended to be a coordinated approach to increase inventory of spare transformers, and outline efforts to provide them to needing utilities. However, this is a limited program which actually facilitates replacement for maybe 5% of the need. And, transporting them to the stricken areas will be fraught with problems mentioned previously. Further, participation is purely voluntary, resulting in no commitment or mandatory sharing of these critical spares. Bottom-line, any transformer transfer will require approvals during extreme emergencies. So, this is a good time to remember the communications problems discussed earlier! It won't happen. Worse yet, that STEP program is optimally prepared to supply only about 5% of the required need. So, you'll have limited spares out there that will have to be identified and configured for specific placement in the transmission system, will possibly have to be transported by rail/highway to distant sites, and most importantly will require technical personnel to remove and replace transformers at the site. This is not a solution.

A real solution would involve industry planning for better protection of the transformers to begin with, and nearby pre-positioning and hardening replacement transformers at least for the critical EHV's, and for those aging transformers we already have in place and in service. It's important to have a sufficient number of spares emplaced now, while we have the optimal transport, placement and technical personnel capabilities in order to have 'offline and protected' EHV transformers co-located and at the ready. It's simple, think and plan worst case! Will it cost money, - sure it will. But will be worth the effort in mitigating the trillions of dollars of loss, and millions of lives.

What, you didn't know all this is happening around you?

It is unfathomable that you have not been told of these threats by your leaders, especially the one agency entrusted to keep you informed and secure. That's right, the DHS. The threats to your electric grid are real, and have been known by the responsible agencies for too long.

I've mentioned previously the importance of thinking and planning for the worst case scenario, as it's a basic tenet and building block of sound military planning in that a commander's staff must plan for the worst case situation as part of the military decision making process. The same should be true for disaster planning by the DHS, FEMA, State and local planners. This is where your government is failing you. Your leaders at all levels from your town/borough, county/parish, the president, the Congress, the electric industry, DHS, Nuclear Regulatory Commission, and surely the Department of Energy have been severely negligent. Not one is making recovery a priority, or even developing scenarios and exercises to deal with a complex, catastrophic event involving *a long duration power blackout*. Consider that several, if not all 10, FEMA regions in our Homeland could *simultaneously be affected* with limited to no communications ability, in a severe chemical and radiological HAZMAT environment, with dangerous societal unrest and chaos, and unavailable mutual aid from neighboring FEMA regions or adjacent communities. Right now, there is absolutely nothing to rely upon, no plans on the shelf to assist in our nation's survival in what

FEMA director Craig Fugate terms a ‘maximum of maxims’. Of course these agencies have concerned individuals, but they need responsible guidance from their superiors

Strategic level survival actions to date

Strategically our Congress and Senate are neutered, and have thus been of no help in ensuring our nation’s survival. In the past two years your leaders had the chance to pass the truly bipartisan *GRID Act* (H.R. 668) in 2011, but they failed to do so (picture my shocked look). Simply, this act would have given the federal government the authority to require the electric power industry to protect the national grid from EMP and the loss of essential power, and protect you. Well, some good news here, as Rep. Trent Franks of Arizona has reintroduced a similar bill called the *SHIELD Act* (H.R. 2417) in 2013. This totally bipartisan bill is literally languishing on Congressman Fred Upton’s desk, and should move forward to a full vote immediately!

Congressman Franks also introduced another house bill in 2014 called the *Critical Infrastructure Protection Act* (CIPA, H.R. 3410) which will ‘require’ the DHS to do what it should have done years ago, and include EMP threats as an additional National Planning Scenario. This would initiate development of crucial recovery and DSCA plans and scenarios I talked of earlier. I strongly encourage you to contact your federal representatives and ask them to support these two critical legislative efforts in the 2014 Congress. Additionally (just for the fun of it) contact your local, county, and state representatives and ask them what they are doing to make your community more resilient in the event of a prolonged electric grid blackout. Trust me; they won’t be able to answer you.

On the plus side, the State legislature of Maine has been most proactive in considering the welfare and survival of their citizens, and has passed a bill signed by their Governor to start the process of hardening their electric grid. There currently are additional States looking into the example that Maine has shown. Just recently the legislature of Arizona sent a bill to Governor Brewer asking her to initiate plans for food, water, and shelter in preparation for a catastrophic event. There are some initiatives planned in the form of tabletop workshops and conferences scheduled for this year by some States. Now is the time for Governor’s, State Adjutants Generals, and State/Regional and local-level emergency services planners and numerous others to step up to the plate in preparation for the survival of their citizens. Hopefully, building upon the excellent and informative ‘blueprint’ from the Congressional EMP Commission report from ‘way back’ in 2008, they can formulate a public-private partnership for our survival and our sovereignty as a nation. All States should follow suit, and not wait for the federal government to act.

What can you do right now?

Unfortunately, here I am again with the bad news: the time needed to “fix” the grid, even if the SHIELD Act or CIPA bill passed today, and NERC and industry got on the ball to help you survive, would take years. Prudence demands immediate action to the knowledge that we possess. Will you and your community leaders be prepared for a prolonged blackout? Again, do not continue to think in the limiting terms of the 72 hour to a week or more mantra as DHS states! Strive to prepare and stock as much provision as possible within your capacity to do so, for as long a term as you are financially able to -- preferably a year or more.

Most of all you have to find the resolve to counter the fear of the unknown, as we live in a most dangerous age with many threats to our existence. Any sane person is already scared. Tragic situation are all over the news, and crops up everywhere. But the duty is ours to reduce that fear with knowledge.

Most importantly, you must begin to realize that you cannot go it alone! Band together in neighborhoods

and communities for support and ‘security’. A great deal of food in reserve preparedness will not do you any good whatsoever if you lose it to looters or scavengers during a prolonged power outage. You will not be able to, in most cases, do everything by yourself. Your community and neighborhood likely includes carpenters, mechanics, dentists, medics, police, teachers, veterans, plumbers, fire and many other varied skilled tradespersons that will be instrumental in collective survival. You and your neighbors, planning and working together right now, will facilitate community protection and survival in times of chaos. If you plan together as a neighborhood or a community where many ‘pitch-in’ to prepare, - you will most undoubtedly cope better in any level of disaster than those communities that do nothing by waiting for the cavalry to come over the hill and rescue them. They will not be able to survive.

Plan on possibly making the fire or police stations ‘bastions of support’ as a depot of collective food, water, shelter, cots, power, for as long as possible. Remember, there are many fellow citizens to help guide and inform you. Lend your expertise to help others and gather your communities together, as it’s the only way in which you will survive. Most importantly, talk to your leaders and demand that they do their job for preparedness.

“Normally it is left up to us first responders to put Humpty Dumpty back together again. We can only do so much; it has to be a community effort, both government and the private sector. We didn’t build our cities by government alone, and when something BIG happens, government will never be able to do it alone.”

- Fire Chief Pat Sullivan, Gulfport, MS

To take one step further, consider joining an organization which is fighting for your survival, EMPact America: empactamerica.org. EMPact America is a no cost, dedicated non-profit and non-partisan group (which will not take any contributions), and exists only to prepare individuals and communities to work and survive together.

I must admit that I wrote this article written with an added personal motive, with the express purpose of not having the same horrors occur in my Homeland that I witnessed as a young officer in Vietnam ’67-’68, and later after two assignments as an older officer in the Bosnia-Herzegovina tragedy. Both produced common citizens and families fighting for the basics of survival. And this was not due to the loss of electric power which we face, but was initiated by a political-wartime schema alone. What stays in my memory for life is the image of individuals and families walking alongside roads and main supply routes in Vietnam with no expectation of any assistance whatsoever, most likely not knowing where their next meal will come from, or clean/potable water to drink, or safe shelter for their children. Then, while travelling all over Bosnia some 30 years later in villages and in once prosperous Sarajevo, I personally did not see a cow, horse, dog, cat or any animal anywhere, as many had to struggle to stay alive by eating what they could. From this later perspective as a husband, father, first responder, citizen (and ‘seasoned’ old man), I now fully realize and fear how easily this situation can happen here in our Homeland in a second.



Foot traffic in NYC during the August 14th 2003 blackout.....

IT CAN, INDEED, HAPPEN HERE IN A SECOND.

Hopefully this discussion with you will inspire you into action. Of all my research over the past few years relating to survival, I strongly encourage you to just Google and read the best document on the subject, and that is 2008 *Congressional EMP (Electromagnetic Pulse) Commission* report. It's an all-encompassing report which details and explains fully the fragility of the electric grid, the threats, and existing capability gaps and vulnerabilities. Most importantly, it discusses how to alleviate and lessen the devastating effect on our survival as individual citizens, and as a sovereign nation.

For the survival of our children and our Homeland, we and our government must act now. If you remember nothing else from this message, remember that in the end you are your own first responder, and inevitably on your own for planning. Remember that the power of one is formidable. But banding together can prove amazing!

“Want of foresight, unwillingness to act when action would be simple and effective, lack of clear thinking, confusion of counsel until the emergency comes, until self-preservation strikes its jarring gong—these are the features which constitute the endless repetition of history.”

- Winston Churchill

God Bless you on your survival, and the United States of America.

References

I've included a few documents outlined below, as just a small portion of the multitude of reference data available to you for further study to be informed on the dire present condition of your Homeland.

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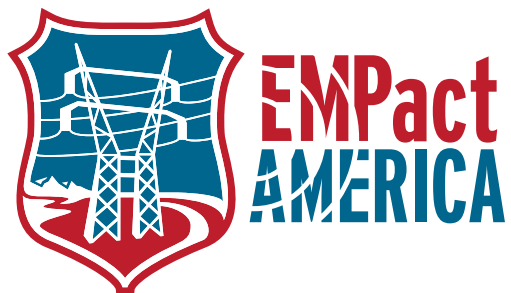
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