***Kit Kat Essay***
*Ready, Set ~~STOP~~*

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Good evening.

Did you have a good day? It would seem so, since here you are downtown in time to enjoy a wonderful evening with friends and excellent food and a marvelous building with all the comforts one might ask for. None of us walked here from home, nor will we return using our shoe leather. Our circumstances compared to many of our citizens and much of the rest of the world is extremely comfortable.

The nature of this topic is not usually of interest to me, nor is it one that I had sought to know more about.

A friend had recommended a book he thought I should read. It turned out to describe an episode unlike many of us … indeed any of us … may have experienced. And it certainly got my attention. Its theme dealt with the loss of normal and regular functioning of all things electrical. It did not pose a situation where an enemy drops bombs or causes huge amounts of physical damage or personal injury. Rather it explained human behavior resulting from long-term denial of those daily living features upon which we normally rely.

For the record, the title is *One Second After*. The author is William R. Forstchen, and the kicker for me was that the forward was authored by Newt Gingrich. Regardless of the political element, that took it out of the arena of fanciful conjecture into the realm of honest possibility.

There are many who talk about getting ready for "the" disaster. In the 1950s, there was great fear among the population concerning the atomic bomb, and the thought of building a backyard bomb shelter seemed to be popular. You may recall that at the Greenbrier resort in White sulfur Springs West Virginia

underground accommodations were conceived and built to house our government and the entire Congress in the event of nuclear attack. Today that same space I'm told is utilized by the Greenbrier's casino.

Television programs have permeated the cable channels such as, *Doomsday Preppers,* or *Homeland,* or *Person of Interest* and other reality shows on surviving calamity. Here in Columbus, two months ago, a three-day, "Prepper-fest" was held at the Northland Performing Arts Center in which more than 600 people participated to stock up and learn about surviving in unconventional circumstances, which might occur as a result of a natural disaster or government shutdown. They were examining home defense systems, buying freeze-dried food, and becoming familiar with essentials necessary to face calamity. Many were trying to find answers of what to do if medicines, drinking water, or food were not readily available. What if your local and usually well-stocked grocery was empty? Would you know what to do?

Late last month the Fox channel featured' Judge Jeanine' Pirro in a program examining the vulnerability of the nation's power grid. Among other elements, the program interviewed a former Navy Seal discussing how easy it would be to take an electrical substation off-line with well-placed strategy and explosives.

In April just a year ago in California, gunmen attacked PG&E's Metcalf substation, shooting 17 large transformers in less than 19 minutes and got away before police arrived. This did not result in any blackouts but it certainly could have, as these substations were mostly constructed at a time when such threats were not considered. They often are located in remote areas and are unmanned, inasmuch as they are monitored remotely.

Interestingly enough, as I was working on this paper less than a week ago there was a sudden "thump" and all lights in my house went out. I sat in front of a dark computer screen without even a glow. Finding a small LED flashlight I kept handy, I made my way to the front of the house and looked south toward the Polaris shopping center and for most of three quarters of a mile there was nothing but darkness. It was the same story for maybe another mile behind us. I was the only one home at the time and that could've made for an interesting situation, if the power outage had been caused by an event which might have taken out more than just a couple of large neighborhoods served by a relatively small substation.

Happily, about 30 seconds later our automatic natural gas generator kicked off as did my neighbor's and we once again had lights. And power. And the ability to communicate. [When the generator activated, it also helped to assuage any buyer's remorse I might have had because the darn things are sort of expensive but wonderfully handy when you need them.] Thankfully, that need is a rare occurrence … but it may not be that way forever.

The morning after the power outage near Polaris, the March 13 edition of the Wall Street Journal carried a front-page article with the headline, "Grid Vulnerable to Sabotage."

The Journal suggested that a coast to coast blackout lasting for weeks if not months, could occur if just nine of the country's 55,000 electric-transmission substations were taken out in each of the nation's three big regional, but separate, power grids. The article cited a previously unreported study by the Federal Energy Regulatory Commission (FERC).

There was pushback from the government upon the release of this story indicating it was a serious breach of strategic information that could be of value to our enemies. Happily WSJ did not publish the list of the 30 critical substations study bye the FERC.

By the way, how many of you knew that we had three separate power grids in the country? The Eastern grid is really Eastern and Midwestern and it extends north into Canada covering an area as far west as the Dakotas and south to Oklahoma. Texas has its own grid. And west of that is the western grid extending to the Pacific and north substantially into Canada.

What about the possibility of such a happenstance … that we would not have access to this miracle power which has made life so convenient?

The belief of many is more along the line of, not ***if*** it will happen but ***when***.

If the grid is compromised in some fashion … whether it be by terrorism, accident, or weather, we would lose the power to run those things that make our lives comfortable … and which we take completely for granted. To be sure, interruption of the grid for even a short time becomes quite serious and even life threatening. Do you recall the blackout we experience here in August 2003? It was started by a computer glitch and an overgrown tree in

Northeast Ohio. The department of energy report released on the 10th anniversary of that blackout said that disastrous weather is the primary cause of widespread power outages (remember hurricane Sandy?) and that future climate change is likely to make that problem worse.

When a portion of the power grid goes out, we lose the source of constant, reliable electric power on an extremely broad scale. So those things that rely on hardwired electrical current simply don't work.

However, more widespread and still deeper devastation would occur should we have an outage from a different source known as an electromagnetic pulse, or EMP. According to the Commission on EMP report, it is not surprising that a single EMP attack may well encompass and degrade at least 70% of the Nation's electrical service, all in one instant.

There are no doubt many in the room this evening to know a great deal more about EMPs than I do or I ever will. I would hope during our question-and-answer session the gaps I leave out will be filled. There's a great deal of science behind this topic most of which I simply don't understand. So my effort this evening is to try simplifying a very complex situation into words which accurately describe what we might experience.

So what is an EMP and how might it occur?

As described by author Bill Forstchen, "An EMP is shorthand for Electro Magnetic Pulse. It is a rather unusual and frightening by-product when a nuclear bomb is detonated above the earth's atmosphere. We all know that our atmosphere and the magnetic field which surrounds our planet is a thin layer which not only keeps us alive, but also protects us from dangerous radiation from the sun. On a fairly regular basis there are huge solar storms on the sun's surface which emit powerful jets of deadly radiation. If not for the protective layer of our atmosphere and magnetic field, those storms would fry us. At times though, the storm is so powerful that enough disruptive energy reaches the earth's surface that it drowns out radio waves and even shorts electrical power grids . . . this happened several years back in Canada.

Now imagine the detonation of a nuclear bomb, two hundred miles straight up as the same thing, but infinitely more powerful since it is so close by.

As the bomb explodes it emits a powerful wave of gamma rays. As this energy release hits the upper atmosphere it creates an electrical disturbance known as the Compton Effect. The intensity is magnified. View it as a small pebble rolling down a slope, hitting a larger one, setting that in motion, until finally you have an avalanche.

At the speed of light this disturbance races to the earth surface. It is not something you can see or hear, in the same way you don't feel the electrical disturbance in the atmosphere during a large solar storm.

For all electrical systems though, it is deadly."

Our federal government believed this to be so serious that in 2001 they established the Commission to Assess the Threat to the United States from Electromagnetic Pulse (EMP) attack and then reestablished it for fiscal year 2006 to continue to monitor investigate and make recommendations on the threat to the US.

In the Report of the Commission, they provided a number of items of interest.

First, they said several potential adversaries have or can acquire the capability to attack the United States with a high-altitude nuclear weapon-generated electromagnetic pulse (EMP). A determined adversary can achieve an EMP attack capability without having a high level of sophistication.

Second, EMPs are one of a small number of threats that can hold our society at risk of catastrophic consequences. An EMP will cover the wide geographic region within line of sight to the nuclear weapon. It has the capability to produce significant damage to critical infrastructures and thus to the very fabric of US society, as well as to the ability of the United States and Western nations to project influence and military power. It is not surprising that a single EMP attack may well encompass and degrade at least 70% of the Nation's electrical service, all in one instant.

The common element that can produce such an impact from EMP is primarily electronics, so pervasive in all aspects of our society and military, coupled through critical infrastructures. Our vulnerability is increasing daily as our use of and dependence on electronics continues to grow. The impact

of EMP is asymmetric in relation to potential protagonists who are not as dependent on modern electronics.

The current vulnerability of our critical infrastructures can both invite and reward attack if not corrected and might result in defeat of our military forces.

Here is the good news:  the Commission believes *Correction is feasible and well within the Nation's means and resources to accomplish.* The essence of their belief is to call for increased research and cooperation among the affiliated elements.

Let's keep going.

Briefly, a single nuclear weapon exploded at high altitude above the United States will interact with the Earth's atmosphere, ionosphere, and magnetic field to produce an electromagnetic pulse (EMP) radiating down to the Earth and additionally create electrical currents in the Earth. EMP effects are both direct and indirect. The former are due to electromagnetic "shocking" of electronics
and stressing of electrical systems, and the latter
arise from the damage that "shocked"—upset,
damaged, and destroyed—electronics controls then
inflict on the systems in which they are embedded.
The indirect effects can be even more severe than the direct effects.

The electromagnetic fields produced by weapons designed and deployed with the intent to produce EMP have a high likelihood of damaging electrical power systems, electronics, and information systems upon which American society depends.

Depending on the specific characteristics of the attacks, unprecedented cascading failures of our major infrastructures could result. In that event, a regional or national recovery would be long and difficult and would seriously degrade the safety and overall viability of our Nation.

The primary avenues for catastrophic damage to the Nation are through our electric power infrastructure and thence into our telecommunications, energy, and other infrastructures. These, in turn, can seriously impact other important aspects of our Nation's life, including the financial system; means of getting food, water, and medical care to the citizenry; trade; and production of goods and services. The recovery of any one of the key

national infrastructures is dependent on the recovery of others.

The longer the outage, the more problematic and uncertain the recovery will be. It is possible for the functional outages to become mutually reinforcing until at some point the degradation of infrastructure could have irreversible effects on the country's ability to support its population.

EMP effects from nuclear bursts are not new threats to our nation. The Soviet Union in the past and Russia and other nations today are potentially capable of creating these effects. Historically, this application of nuclear weaponry was mixed with a much larger population of nuclear devices that were the primary source of destruction, and thus EMP as a weapons effect was not the primary focus. Throughout the Cold War, the United States did not try to protect its civilian infrastructure against either the physical or EMP impact of nuclear weapons, and instead depended on deterrence for its safety.

What is different now is that some potential sources of EMP threats are difficult to deter—they can be terrorist groups that have no state identity, have only one or a few weapons, and are motivated to attack the US without regard for their own safety. Rogue states, such as North Korea and Iran, may also be developing the capability to pose an EMP threat to the United States, and may also be unpredictable and difficult to deter.

Certain types of relatively low-yield nuclear weapons can be employed to generate potentially catastrophic EMP effects over wide geographic areas, and designs for variants of such weapons may have been illicitly trafficked for a quarter-century.

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. Indeed, as recently as May 1999, during the NATO bombing of the former Yugoslavia, high-ranking members of the Russian Duma, meeting with a US congressional delegation to discuss the Balkans conflict, raised the specter of a Russian EMP attack that would paralyze the United States.

Another key difference from the past is that the US has developed more than most other nations as a modern society heavily dependent on electronics, telecommunications, energy, information networks, and a rich set of financial and transportation systems that leverage modern technology. This asymmetry is a source of substantial economic, industrial, and societal advantages, but it creates vulnerabilities and critical interdependencies that

are potentially disastrous to the United States.

Therefore, terrorists or state actors that possess relatively unsophisticated missiles armed with nuclear weapons may well calculate that, instead of destroying a city or 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.

Back to author William Fortschen.

EMP is different; it is not a rain of thousands of bombs, needing a vast and powerful military to deliver it, in which Russia and China are the only real threats in that realm . . . but unless seized by madness, their leaders know such an attack, within minutes would be met with thousands of bombs annihilating their country as well. It is a balance of terror that has now endured for nearly sixty years.

An EMP attack is different since it only requires but one nuclear weapon, detonated 300 miles above the middle of the United States. One bomb. The launch could even be done from a container ship somewhere in the Gulf of Mexico and in that instant, the war is already over and won.

What happens when this "pulse" hits the surface?

Those who might remember ham radio operators, or even the old CB radios of the 1970s can recall that if you ran out a wire as an antenna you could send and receive a better signal. The wire not only transmitted the very faint power of a few watts of electricity from your radio, it could receive even fainted signals in return. As the pulse strikes the earth's surface, with a power that could range up to hundreds of amps per square yard, it will not affect you directly, at most you'll feel a slight tingling, the same as when lightning is about to strike close by, and nearly all the energy will just be absorbed into the ground and dissipate.

The bad news, however, is wherever it strikes wires, metal surfaces, antennas, power lines it will now travel along those metal surfaces (in the same way a lightning bolt will always follow the metal of a lightning rod, or the power line into your house.) The longer the wire, the more energy is absorbed, a high tension wire miles long will absorb tens of thousands of amps, and here is where the destruction begins as it slams into any delicate electronic circuits, meaning computer chips, relays, etc. In that instant,

they are overloaded by the massive energy surge, short circuit, and fry. Your house via electric, phone and cable wires is connected, like all the rest of us into the power and communications grids. This energy surge will destroy all delicate electronics in your home, even as it destroys all the major components all the way back to the power company's generators and the phone company's main relays. In far less than a milli-second the entire power grid of the United States, and all that it supports will be destroyed.

Unlike a lightning strike, or other power surge, an EMP surge is "front loaded." It comes like a wall of energy, without any advance wave building up as a warning. It therefore slams through nearly all-commercial, and even military surge protectors already in place, and is past the "safety barrier" and into the delicate electronics before the system has time to react.

And what about your family? Where are they when this is happening? Like most of ours they may be widely dispersed handling the routine duties of the day or, are they away visiting family, friends, or at the vacation house hundreds of miles away? How do you now communicate with them? By what means will you locate their whereabouts and determine their safety? Your cell phone doesn't work neither does your landline. Forget about the computer; E-mails and texts are now a thing of the past. This raises the question that all of us may have thought about but I'm guessing most have yet to act on: the family emergency plan. Have you established a common meeting place? Have you even discussed with your family members how to react in the face of a communication blackout?

Here is more bad news regarding EMP. Your car won't work.
If you own a 1965 Volkswagen bug or Mustang you're ok. . .there are no solid state electronics under the hood, it still has an old fashion carburetor, the radio still might even have tubes rather than transistors. However, even that is in question. In 1962 both we and the Soviets detonated nuclear weapons in space (saber rattling during the Cuban Missile Crisis) and it is reported that a number of cars . . . their ignition systems a thousand miles away from the detonation were fried because of EMP. From about 1980 on, cars increasingly went solid state and by the 1990s were getting ever more complex computers installed. Consider a visit to the mechanic today. He runs a wire in under the hood, plugs it into his computer and within seconds has a full diagnostic, types in what his computer is suppose to do, the problem is solved and you are handed a rather large bill. We are blessed with great modern conveniences from airbag sensors, to fuel injectors and all

of it more and more dependent on computers. At the instant the "Pulse" strikes, the body of your car and the radio antenna will feed the overload into your vehicle's computer and short it out.

And planes? This is a terrifying aspect of an attack that no government report has publicly discussed along with the potential casualty rate in the first seconds after an attack. Commercial airliners today are all computer driven. In fact, from lift off to landing, a pilot no longer even needs to be in the cockpit, a computer can do all of it if need be. We certainly have learned this in the past 12 days as the search involving 26 countries for Malaysia flight 370 has occupied the news. It is estimated that at any given moment during regular business hours, somewhere between three to four thousand commercial airliners are crisscrossing the skies. All of them would be doomed, the pilots sitting impotent, staring at blank computer screens, pulling on controls that no longer respond as the plane finally noses over and heads in.

It is estimated that somewhere between 250,000 to 500,000 people will die in the first few minutes . . . more than all our battle casualties across four years of World War II.

Who would do this and why? Given the hatred and fanaticism of some of our enemies today, if they can obtain but one nuclear bomb, the temptation will be there. It does not even have to be a nation such as Iran or North Korea. . .it could be a terrorist cell who with enough money buy the components and then destroy their definition of "the great Satan."

Unless you are in a jet liner, plummeting to earth, or caught in a massive traffic jam of stalled vehicles on the interstate, you might not even know anything has changed. Sure the power is off, but we've all been through that dozens of times. You call the power company. But the phone doesn't work and that might be slightly more unnerving. You might go to your car to drive around and see what happened and then it becomes more unnerving when the car does not even turn over, nor any other car in your neighborhood.

Twelve hours later the food in your freezer starts to thaw, if it is winter and you don't have a wood stove the frost will start to penetrate in to your house, if summer and you live in Florida your house will be an oven. And that

will just be the start. And what about food? Forget the freezer, what do you have in cans that will keep and how much? For how long Will your family have food? And if the answer is weeks or even months, it might be a good idea to keep that storehouse a secret because it won't be long before rolling towards of hungry people will band together looking for most any kind of nourishment anyplace. And they will be armed! Will you have the means to protect your assets and your family?

Law enforcement will be powerless without radios, cell phones, and squad cars, unable to know where there is a crisis and how to react. The real horror show within hours will be in hospitals and nursing homes. They're required by law to have back up generators, but those generators are "hot wired" into the building so power can instantly kick in if the main system shuts down. That "hot wiring" means the Electro Magnetic Pulse will take out the generators and their circuitry as well.

If you are familiar with what happened in New Orleans after Katrina, multiply that ten thousand times over to every hospital and nursing home in America. Nearly everyone dependent on life support equipment in ICUs will be dead within hours. Nearly everyone in nursing homes dependent on oxygen generators, respirators, etc., will be dead or dying while depending on the time of year temperatures within plummet or soar.

As to medical supplies, not just in hospitals but across the nation to every local pharmacy, they are all dependent on something called Fed Ex. As we have perfected a remarkable system of instant delivery, guided by computers, local inventories have dropped to be more cost efficient and even for reasons of security with controlled substances, which to ordinary citizens means pain killers. Supplies will run out in a matter of days. Those of us dependent on medications to control asthma, heart disease, diabetes, and a host of other aliments which a hundred years ago would have killed us shortly after the onset. . .will now face death within days or weeks, unless the national power grid comes back on line quickly and order is restored.

How long would it take? Here is the bottom line of the entire issue and why the threat of a single EMP weapon is so dangerous. There is the serious potential that we might never be able to restore the system. One might ask why? It just means replacing some circuit breakers, pulling out fried chips in our cars and replacing them with new ones etc.

It is not that simple. The infrastructure America has developed since the beginnings of the Industrial Age, is now so vast, intricate and fragile, that it is like a delicate spider web, which if touched by a flame can instantly vanish.

It is disconcerting to contemplate the impact on our future should such a development occur. The possibility has been around for a long while but as not gained a great deal of traction among the public compared to the devastation it would provide. Perhaps by our increased awareness here and elsewhere changes might be implemented to make us more secure.

At least I would hope so.

Thank you.

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Sources:

*Report of the Commission to Assess the Threat to the United States from Electromagnetic Pulse (EMP) Attack*; *Volume 1: Executive Report 2004*

*"EMP 101" A BASIC PRIMER & SUGGESTIONS FOR PREPAREDNESS*
William R. Forstchen Ph.D., Author of "One Second After"

*Wall Street Journal*, March 13, 2014

*The Columbus Dispatch,* January 20, 2014, August 13, 2013

34 Minutes Reading Time