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The Looming Threat of a Solar Superstorm

July 2016

During Superstorm Sandy in late October, 2012, my family lost power. We were informed that it might be weeks before power was restored.

Fortunately, unlike many of our neighbors, we had an electric generator and survived quite nicely for a couple of days. I had purchased a generator (5,500 watts) powerful enough to power all of the critical elements in the house – furnace, water pump, refrigerators and freezers, microwave, and several lights.

However, we began to run low on gasoline for the generator and set out with what fuel we had in the car to obtain more gasoline. To our disappointment, we found that there were no gas stations at which we could fill up. Either they had no power; or if they had a generator, they had run out of fuel.

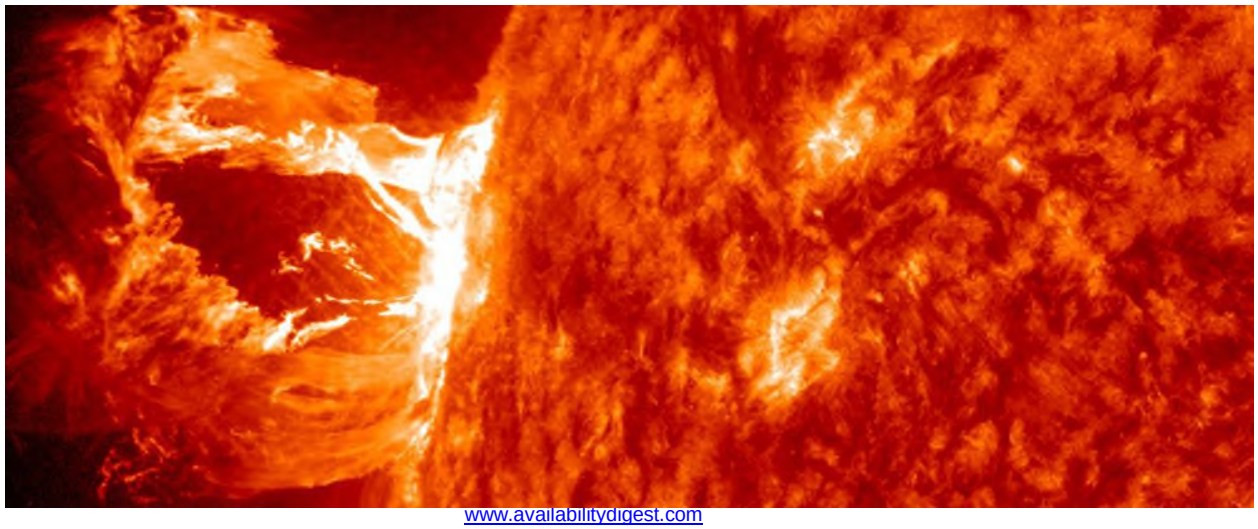
We were lucky. Our power was restored in another day. However, neighboring areas were without power for weeks.

It drove home to me the consequences of a long power outage. What if we had been without power for months? Could such a calamity happen? The answer is yes, and the culprit is a solar superstorm.

It appears that solar superstorms occur about once every 150 years. The last one was 157 years ago. Be prepared!

What Is a Solar Storm?

A solar storm is a mass of electrons, ions, and atoms burst into space by a solar flare. A solar flare is a sudden flash of brightness observed near the Sun's surface. Solar flares are numerous. They occur anywhere from several per day to once per week, depending upon the Sun's 11-year solar cycle.



The magnetized plasma of a solar storm shock wave travels at millions of miles per hour. Such a burst of electromagnetic activity is called a “coronal mass ejection,” or CME. If a CME hits the Earth, it can cause mass outages of power grids and communications.

The solar flares that cause CMEs originate with sunspots. A sunspot is a darkened area of reduced surface temperature on the Sun. The number of sunspots varies with the 11-year solar cycle. Sunspots can last from days to months. Their size typically ranges from ten miles to 100,000 miles, and they may travel across the sun at a rate of hundreds of miles an hour.

Once sunspots erupt, an initial wave of radiation strikes Earth within minutes. This radiation travels at the speed of light. Since the CME comprises particles, it moves much more slowly (albeit at millions of miles an hour) and takes a day or two to reach Earth.

We have warnings of incoming CMEs. We have satellites positioned between the Sun and the Earth that monitor the Sun for solar flares and for CMEs.

A CME distorts the Earth’s magnetic field. Just like a moving magnet will induce a current in a coil of wire, the movement of the Earth’s magnetic field caused by a CME induces a current in the soil of the earth. This current can enter high-voltage transformers that are grounded to protect them from lightning strikes. The currents from a strong solar storm are intense enough to destroy the transformers. It is this action that allows a strong solar storm to take down our power grids.

In addition, the electromagnetic interference of a solar storm can interrupt radio communications, disable GPS, and cause satellites to spin out of control.

Quebec Plunged Into Darkness

On March 13, 1989, a solar storm disrupted electric power throughout most of the Canadian province of Quebec. Rushing toward Earth at a million miles an hour, the geomagnetic disturbance of the solar storm created electrical currents in the ground beneath most of North America.

The electrical currents found a weakness in the electrical power grid of Quebec. Within minutes, the entire province of Quebec lost power. It took twelve hours to restore power to the Quebec residents and businesses.

The same storm disabled several satellites, which tumbled out of control for several hours.

The Carrington Event

The strongest solar storm ever recorded occurred in 1859. An incredible surge of charged particles sent by the sun slammed into Earth’s atmosphere and caused havoc on the ground. Large currents were induced into telegraph wires (the Internet of its time). Telegraphs sent out sparks that ignited several wild fires. Northern lights were reported as far south as Cuba.

The 1859 storm is called the “Carrington Event” after the British amateur astronomer, Richard Carrington, who observed the solar flare and associated it with the effects of the solar storm that occurred two days later. He was the first to realize the link between activity on the sun and geomagnetic disturbances on Earth.

What Impact Would a Carrington Event Have Today?

In 1859, the peak of technology was the telegraph. There were no power grids, no radio transmitters, no GPS. Today is a different story.

If a Carrington Event should occur today, there is a mass of technology that would be affected. GPS systems would be taken down. Mobile phones would be useless. There would be no way for first responders to communicate with each other. Satellite communications would be at risk. So much of our daily life is governed by communications. How could we use credit cards if there were no satellite communications? There would be no capability for wire transfers or automated clearing-house transactions. There would be no online banking. Maybe there would be no "online." We would become a cash and barter society.

However, the big fear is the electric grid. Power surges caused by CMEs can blow out giant transformers. These transformers can take months or even years to replace.[1] Major cities could be without power for weeks or months, or perhaps for over a year.

A 2013 report published by Lloyd's insurance company estimates that a Carrington Event would result in power outages affecting twenty to forty million Americans for a duration lasting from two weeks to two years.

How would we survive? We depend on power for so many of our essential needs. Without power, perishable foods and medicines would spoil. Fuel and water relying on electrical pumps would become inaccessible. We would have no communications. The twin specters of social collapse and mass starvation would stalk entire continents. Back to the Dark Ages.

However, we do have warning of the approach of a CME. In a pinch, power companies could elect to protect their electric grids by taking them offline before the storm strikes. Solar storms tend to pass in a couple of hours. Being without electricity for a few hours is certainly preferable to being without it for weeks.

Unfortunately, current forecasting of solar storms is still in its early days. Space-weather predictions are where weather forecasting was sixty or seventy years ago. There would certainly be many false alarms, which would cause an equal number of unnecessary power outages.

A Carrington Event aside, even smaller solar storms can wreak havoc. The "Halloween Storm" of 2003 disrupted communications, caused a power outage in Sweden, and created auroras as far south as Florida and Texas.

What Is the U.S. Doing To Protect Itself?

Not much!

A 2011 Department of Homeland Security report stated:

> "The U.S. government lacks comprehensive, national-level geomagnetic storm risk management assessments and strategies for a large-scaled storm that could knock out power along the entire Eastern seaboard"

Several bills have been put before the U.S. Congress, and all have failed. There is currently another bipartisan bill being introduced. It would authorize replacement of solar-monitoring satellites that are nearing end-of-life, and it would provide funds for further research.

Like the bills before it, the outlook for this bill is not good.

[1] High-Voltage Transformers – The Power Grid's Achilles Heel, *Availability Digest*; March 2016. http://www.availabilitydigest.com/public_articles/1103/ehv_transformers.pdf

Lessons Learned

I take away several thoughts from the above description of solar storms.

We don't know if a solar storm will hit us. If one does, we don't know when. We may or we may not get a day or two warning.

What we need is cash so we can continue to get the essentials necessary for survival. It's time to get some cash on hand.

We need a generator to supply our home with electricity. We need gas for the generator and for our cars. We need to have a plan for family members to communicate.

Communities should prepare by stockpiling non-perishable foods and by creating a rationing plan to distribute these foods.

The Lloyd's report notes that Carrington-level events are thought to take place every 150 years. The last one was 157 years ago. Be prepared!

Acknowledgements

Information for this article was taken from the following sources:

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