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CIPR newsletter

EMPs: An Emerging Catastrophe Risk

By Eric Nordman, Director of Regulatory Services and CIPR

◆ Introduction

Much is written about hurricanes, earthquakes, tornadoes, wild fires, terrorism and other known causes of catastrophic loss. However, little is written about electromagnetic pulses (EMPs). Sometimes called transient electromagnetic disturbances, EMPs are short bursts of electromagnetic energy with the potential to be very disruptive of many of the things we rely on today. Most of us are vaguely aware of EMPs from science fiction and action movies, where the hero saves the day by defeating the villain trying to deploy an EMP weapon to blow up a building or destroy the world. The purpose of this article is to shed some light on this dimly lit topic and take a look at its insurance implications.

◆ Electromagnetic Pulses

Why should we devote any of our worrying time to EMPs? The answer is the magnitude—or severity, in insurance terms—could be catastrophic or could perhaps even be placed in the mega-catastrophe category. One EMP known to us all is the lightning strike. It can cause damage to electrical equipment and physical damage or fire to buildings and trees; take out power poles or transformers; and cause electrical surges, damaging electric appliances as well as a host of other bad outcomes. Yet insurers readily cover lightning strikes and related fires in property insurance policies because they are predictable. There are many of them each year, and the insured losses can be readily quantified.

There are a wide range of EMPs, from the relatively benign to the catastrophic. An example of a benign EMP is static electricity. We have all experienced the mild electric shock when touching someone or something after sliding across a carpet. The mild electric shock is actually an EMP. The pulse from the EMP could appear in the form of a radiated electric or magnetic field or a conducted electric current. Its source could be natural or of human origin.

In terms of risk management, we worry about EMPs because they can damage electronic equipment, cause fires and destroy property. There is a branch of the engineering community, electromagnetic compatibility (EMC) engineering, devoted to the study of EMPs and the management of EMP effects. Electromagnetic compatibility engineers tell us EMPs can transfer energy in four distinct forms: 1) an electric field; 2) a magnetic field; 3) electromagnetic radiation; or 4) electrical conduction. When classifying EMPs, engineers describe them in terms of the type of energy (radiated, electric, magnetic or conducted), the range or frequencies and the description of the type of the pulse wave, including its shape, duration and amplitude. With the exception of a solar magnetic flare, radiation is the only form of EMP capable of acting over long distances.

There are other EMPs with less predictability than lightning. There are two types considered to have catastrophic potential. First is the use of an EMP to create a weapon. This is not science fiction. There are weapons in use today deploying an EMP as a primary component. They use the damaging effects of high-energy EMPs to create nuclear and non-nuclear weapons. It is possible for an EMP nuclear weapon to send us back to the Dark Ages. An EMP weapon is capable of destroying much of the electronic equipment we rely on every day. For example, if an EMP weapon were detonated, it could destroy all electronic devices within its range. It would take out computers, telecommunications, navigation systems and the power grid. To add insult to injury, the EMP weapon would likely destroy the electronic technology we would use to figure out who attacked us. Without this intelligence, we would be vulnerable to attack in the homeland. And the more reliant we become on these electronic devices, the more vulnerable we become.

Electromagnetic pulses are also difficult to detect. You cannot feel, smell or taste the radiation from EMPs, yet they are capable of great destruction. If a nuclear EMP weapon does not scare you, then perhaps the possibility of a severe solar storm will. Scientists believe a severe solar storm capable of knocking out much of the world's power grid is not just possible; it is a foregone conclusion. It will occur.[1]

Space weather can have catastrophic consequences for mankind. We have some fairly recent evidence pointing to the possibility of more to come. The Great Geomagnetic Storm of March 13, 1989, demonstrated what those consequences are. In an article on this storm, NASA scientists point out a solar storm resulting in powerful explosion led to the release of a 1-billion ton cloud of gas headed directly toward earth.[2] When the cloud reached Earth two days after the March 10, 1989, explosion, it resulted in a spectacular "Northern Lights" viewed as far away as Florida and Cuba.

"The magnetic disturbance was incredibly intense. It actually created electrical currents in the ground beneath much of North America," said Dr. Sten Odenwald, a NASA astronomer. "Just after 2:44 a.m. on March 13, the currents found a

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[1] Emanuelson, Jerry. "Electromagnetic Pulse Protection," accessed Oct. 6, 2014, at www.futurescience.com/emp/emp-protection.html.
[2] Odenwald, Sten. "The Day the Sun Brought Darkness," accessed Oct. 6, 2014, at www.nasa.gov/topics/earth/features/sun_darkness.html.

weakness in the electrical power grid of Quebec. In less than 2 minutes, the entire Quebec power grid lost power. During the 12-hour blackout that followed, millions of people suddenly found themselves in dark office buildings and underground pedestrian tunnels, and in stalled elevators. Most people woke up to cold homes for breakfast. The blackout also closed schools and businesses, kept the Montreal Metro shut during the morning rush hour, and closed Dorval Airport."[3]

And the worst news is the Great Geomagnetic Storm of March 13, 1989, was not "the big one." There is evidence of a Great Geomagnetic Storm of 1859, which was so powerful it was visible to the naked eye.

"At 11:18 a.m. on the cloudless morning of Thursday, Sept. 1, 1859, 33-year-old Richard Carrington—widely acknowledged to be one of England's foremost solar astronomers—was in his well-appointed private observatory," according to NASA. "Suddenly, before his eyes, two brilliant beads of blinding white light appeared over the sunspots, intensified rapidly, and became kidney-shaped."[4]

He realized he was witnessing something unprecedented.

"Just before dawn the next day, skies all over planet Earth erupted in red, green, and purple auroras so brilliant newspapers could be read as easily as in daylight. Indeed, stunning auroras pulsated even at near tropical latitudes over Cuba, the Bahamas, Jamaica, El Salvador and Hawaii," according to NASA. "Even more disconcerting, telegraph systems worldwide went haywire. Spark discharges shocked telegraph operators and set the telegraph paper on fire. Even when telegraphers disconnected the batteries powering the lines, aurora-induced electric currents in the wires still allowed messages to be transmitted."[5]

NASA scientists say what Mr. Carrington witnessed was a white-light solar flare. In other words, he saw a magnetic explosion on the sun or EMP.

Another noteworthy solar storm occurred in 1921. Scientists have estimated the strength of the May 1921 solar storm to have produced ground currents 10 times as strong as the Great Geomagnetic Storm of March 13, 1989. John Kappenmann of the Metatech Corporation did some simulation modeling of the likely impact of the 1921 storm on the power grid we have today.

"[Kappenmann] found more than 350 transformers at risk of permanent damage and 130 million people without power," according to NASA. "The loss of electricity would ripple across the social infrastructure with 'water distribution affected within several hours; perishable foods and medications lost in 12-24 hours; loss of heating/air conditioning, sewage disposal, phone service, fuel re-supply and so on.'"[6]

◆ Conclusion

These are scary scenarios. The vision of our power grid failing with no readily available substitute is frightening. We can envision planes falling from the skies, fried electronic equipment, disrupted communication systems and much of our infrastructure ceasing to function. Yet, as a society, though we recognize this potential, little has been done to prepare for this known black swan event.

I feel a bit like Chicken Little as I am writing this article. Perhaps we can begin to seriously discuss what scientists tell us is an eventuality. Only time will tell.

About the Author

Eric Nordman, CPCU, CIE, is the director of the NAIC Regulatory Services Division and the CIPR. He directs the Regulatory Services Division staff in a wide range of insurance research, financial and market regulatory activities, supporting NAIC committees, task forces and working groups. He has been with the NAIC for 23 years. Prior to his appointment as director of the Regulatory Services Division, Nordman was director of the Research Division and, before that, the NAIC's senior regulatory specialist. Before joining the NAIC, he was with the Michigan Insurance Bureau for 13 years. Nordman earned a bachelor's degree in mathematics from Michigan State University. He is a member of the CPCU Society and the Insurance Regulatory Examiners Society.

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[3] Ibid.
[4] Bell, Trudy E. and Tony Phillips. "A Super Solar Flare," accessed Oct. 6, 2014, at http://science.nasa.gov/science-news/science-at-nasa/2008/06may_carringtonflare/.
[5] Ibid.
[6] Phillips, Tony. "Severe Space Weather—Social and Economic Impacts," accessed Oct. 7, 2014, at http://science.nasa.gov/science-news/science-at-nasa/2009/21jan_severespaceweather/.

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