Robert J. Marks:

Welcome to Mind Matters News. I'm your very concerned host Robert J. Marks.

Robert J. Marks:

Greetings. In 1989, our own sun electromagnetically disrupted the US power grid. Something scientists call a coronal mass ejection, CME from the sun was about the size of 36 Earths and it erupted from the sun surface. It set off a geomagnetic superstorm the result was what scientists called geomagnetically-induced currents on Earth. These electrical surges infiltrated power grids all over North America and Northern Europe, and even destroyed a transformer at a nuclear power plant in New Jersey.

Robert J. Marks:

Even more seriously, Canada's Hydro-Quebec power grid crashed when the safety systems sensed the power overload caused by the ground currents. The failure knocked out electricity to six million people in Northeastern Canada for as long as nine hours. Now this was nature. EMPs come from man-made nuclear explosions. Hearing though we hear about is from nuclear explosions frying the power grid in all of our electronics. A worst case scenario was reported by a federal committee called the National Coordinating Center for Communications, the NCC.

Robert J. Marks:

This is a 2019 report. They talk about high altitude EMPs and you take the H from high altitude and then put in the EMP and you get a HEMP. So they're talking about HEMP risks. And this is a quote from their report. It says, "HEMP disruption and damage to critical infrastructures can occur across multiple time zones with one or more nuclear bombs exploded at high altitudes in the near region space. A single nuclear burst 250 miles above Kansas could destabilize much if not most of the US power grid. Likewise, one HEMP burst over north America could significantly disrupt regional or continental data infrastructures such as the internet and our television radio phone and cellular networks." There the quote ends.

Robert J. Marks:

Now an explosion 250 miles above the Earth is about as high as the US Space Station is from Earth. So the EMP just described would need to be detonated in outer space. Now, no one wants to militarize outer space, but as I pointed out in my book The Case for Killer Robots, cases like this can result in threats from our adversaries and unfortunately forced the issue. This is one of the many reasons former President Donald Trump formed the United States Space Force as a separate branch of the United States military.

Robert J. Marks:

And this is not theory. This is not a bunch of physicists scribbling on notepads with equations. There's experimental verification. We know EMPs from nuclear explosions zap electronics. A 1962 test of a 1.4 megaton bomb exploded 250 miles above the Pacific Ocean disrupted global communications and blew out streetlights on the ground in Hawaii. There weren't many satellites in 1962, but the explosion zapped some of them that were there. This included the British Ariel 1 satellite and the US, a Telstar satellite.

Robert J. Marks:

So today we know the GPS is controlled by satellites. And so a thermonuclear bomb 250 miles above the Earth would destroy a lot of the satellites that's responsible for our GPS. This is one of the reasons, by the way, we have nuclear test ban treaties. I used to think that nuclear test ban treaties were put in place so that people wouldn't develop thermonuclear bombs anymore. Well, that's probably one of the reasons, but another one was every time you exploded one of these bombs there was EMP effects in different parts of the world.

Robert J. Marks:

Now here comes the chilling part. Russia and China both have the technology to detonate at EMP from space. EMP threats from US adversaries from less developed countries like North Korea and Iran would have to be detonated closer to the ground, but nevertheless could do severe damage. So what is going on here? To help us understand, our guest today is Dr. Sarah Seguin who is an expert in the area of electromagnetic compatibility.

Robert J. Marks:

Dr. Seguin was formerly on the faculty at the University of Kansas. And by the way, that's where this explosion has to occur above the state of Kansas. She then helped develop Third Iron. She helped developed Third Iron, it's a software business, and currently does research at Baylor University. Dr. Seguin, welcome.

Sarah Seguin:

Thank you so much. I really appreciate the time to be on this podcast.

Robert J. Marks:

Well, you are going to educate us and I'm afraid scare us from the research that I've been doing about EMPs. So I want to talk about EMP specifically in the power grid. An EMP miles above Kansas, above your former employer university campus could wipe out the American power grid according to this report. More realistic, EMPs from USA adversaries would not be that powerful. Just in general, could you give us an overview how vulnerable is the United States power grid to general EMPs?

Sarah Seguin:

Well, it's really hard to know the answer to that question unless you're the specific power grid. So when I was looking into this a bit, it really depends on the specific power grid. But in general, if you think about like how easily an electromagnetic pulse could couple into the power grid, well, all you need is a really good conductor. Well, what do you need in the power grid? Well, to get electricity to folks you need really good conductors and we have them, many of them not buried.

Sarah Seguin:

The lines that are buried would have a little better shielding, but the ones of course for really long lines, we bury our electrical lines in large cities and newer cities of course. But if we're running them from really long links, we're running them across fields and they're in the sky, if you will. I mean, above the ground anyways. So it really depends how each individual power transmission grid is hardened for electromagnetic pulses. And in the process of doing some research, I found a report by NRECA, which is one of America's co-op.

Sarah Seguin:

These electrical co-ops are places that basically take care of power distribution. You have your power company, they do the generation of the power, but then there's these various cooperatives across the United States that then basically figure out how to distribute this power which is very non-trivial. Anyways, their conclusion from a 2019 report was that an electromagnetic pulse would not have widespread impact on the electrical grid. Now, I actually tend to agree with you that an electromagnetic pulse put in the right place knowing certain vulnerabilities of, for example, certain local power distribution centers could take down a large portion of the grid. You would definitely want to go through city centers to have the most impact.

Robert J. Marks:

You know when we drive by these power substations, I look over, and again, I'm not an expert in the field but I don't see any shielding there. I don't see any protection.

Sarah Seguin:

Yeah. So there's one not too far from my suburb and I find it super fascinating. I don't know if they caught me looking one day, but they've actually covered. They've recently covered their fence so I can't look in, but I find them super fascinating. And actually when I'm just driving down the road, I love looking at these power lines and figuring out like ... Now they mount cell towers on them as well. And in general, I think that they are more concerned with lightning. They're probably more hardened for something like lightning, but the actual like terroristic threat. I don't think that they have spent too much time hardening the grid for that.

Robert J. Marks:

That's a little bit scary. I in also prepping for this podcast, I ran across an article in Forbes and it says and this was published in June 2021 so it wasn't that long ago. There was a federal committee called the EMP Task Force on National and Homeland Security and they issued a scary report specifically on China's ability to conduct an EMP attack in the United States. Now according to Forbes, China now has super EMP weapons. And again, they might be an outer space. They have satellites in outer space.

Robert J. Marks:

They also say that China knows how to protect itself against an EMP attack. So I have no idea what's happening in China, but apparently according to Forbes they're doing things about hardening their power grid. And they have developed protocols to conduct a first strike attack on the United States. It would be a devastating Pearl Harbor sort of incident should they ever choose to do that. That's just chilling. Do you know if there's been any proactive attempts to protect the US power grid?

Sarah Seguin:

I am not privy to that information. I think that there has been because there have been some recent reports identifying the issue. I think that there has been some discussion, but are we putting funding into it? I question that. I think we should be though.

Robert J. Marks:

Yeah, hopefully. What's the physics behind EMPs frying the power grid? One of the places I believe is transformers. I hear a lot about EMP taking out transformers. What's the physics that happens that zaps transformers with EMPs?

Sarah Seguin:

So you talked about China and possibly even they might have satellites that could direct the energy, which is very terrifying to me too. And I can think about it actually being possible. It'd be expensive, but certainly for someone determined may be possible. Honestly you could build something where you're just a person walking by with some dedicated antenna as well. And in general, what the physics is is it creates a very large electromagnetic wave that then is designed to couple into these transformers and these substations very well.

Sarah Seguin:

So you would know in general how the substation works and you'd create a frequency that would couple in well. And then you can literally induce the currents from that electromagnetic wave that then could actually just completely take out the electronics. And transformers. The big problem is is the way ... I mean, you're an electrical engineer. You know how a transformer works, right?

Robert J. Marks:

Yeah, I know enough to be dangerous. Yes.

Sarah Seguin:

I think that's all of us, right?

Robert J. Marks:

That's true. And so I'm wondering if the transformers, it's just a thought. I don't know if this is what happens, but I would imagine that the wires we get so hot, they would melt the insulation and everything would be shorted out.

Sarah Seguin:

Right. I think that would probably be one of the main mechanisms. Just like have this huge current induced. Yeah, it shorts it out and then once it's shorted out, then nothing's going to work. And also you'd have big currents induced across the grid that way. And then you could take out other people's electronics near the substation as well.

Robert J. Marks:

And we think about EMPs originating from big nations like China and Russia, and also from smaller countries, North Korea and potentially Iran. So this brings up the topic of terrorism. How much would a small EMP device cost a terrorist that wants to do some damage?

Sarah Seguin:

Well, I think that you could probably do it for several thousand dollars and do a very directed EMP to something like the power grid or some building that you were trying to ... I don't want anybody to knock on my door because I'm definitely not thinking about doing this.

Robert J. Marks:

Okay, okay.

Sarah Seguin:

But you could definitely do it for several thousand dollars and you could direct it to a specific building just in the way that other terrorist attacks have been directed to specific buildings or specific stations in the past.

Robert J. Marks:

Okay, that's a little bit scary now. For a few thousand dollars if you could build an EMP, we're not talking about explosions here or thermonuclear bombs going off. Rather we're talking about super antennas, if you will. Is that a fair statement?

Sarah Seguin:

Yeah. This is not talking about having any nuclear material. This is actually creating a very specific device that you know would affect the electronics that you want to affect. So you could create, for example, we've read the Russia has created something which is basically a directed electromagnetic pulse for taking down UAVs at specific microwave frequencies.

Sarah Seguin:

So what you could do, you would have to have some prior knowledge of the substation you wanted to take down or the building. But you could very specifically having some knowledge, which wouldn't be very difficult to get. Spend many thousands and do some major damage if you chose a significant important target. And of course I could name any number of those and so could anybody listening to this podcast, but we would hope that no one would.

Robert J. Marks:

Hopefully, but our adversaries sometimes are very creative. Getting back to the power grid there is as we mentioned a lot of talk about improving the infrastructure in the United States. And one of the questions is what would it take to harden the US power grid? And I read one source and I don't know about the validity of the source. There's so much fake news out here today, but this is from a place called the Foundation for Resilient Societies.

Robert J. Marks:

And we will provide links on the podcast notes to a lot of the articles that we referenced here so you can go and check out and verify this. But one source says that the first order cost model would be an overnight cost of EMP protecting the US bulk electric system to be on the order of $255 billion. Now, when people get into billions and trillions, I think that they begin to lose focus on what that means. We are about trillion dollar stimulus packages. And if you look at that, how much is a trillion? Is it bigger than a billion? Yeah, it's a thousand times bigger than a billion, but what does that mean?

Robert J. Marks:

Well, $1 trillion if we divided it between the 328 million people in the United States, that's over $3,000 per capita. So if we were to have the United States citizenry pay for that $1 trillion, then each man, woman and baby would have to cough up $3,000. And so in order to fix the power grid, this one source says that it would be $776 per capita. And they're talking about 255 billion. So we have a long way to go and that's scary. Finally, Sarah, how scared of you are EMPs and the vulnerability of the United States to EMPs as a specialist in electromagnetic compatibility on the EMPs?

Sarah Seguin:

I am worried. I think that we should put some funding after hardening our electrical grid and other important targets such as certain buildings, for example, government buildings to make sure that in the event of an electromagnetic pulse. If we truly are just going for the electromagnetic pulse and not like one attached to an explosion, which of course there's other issues associated with that. I think that we should be putting some funding after that. And I am worried, but do I sleep at night? Well, yeah. I mean, there's all sorts of things to worry about that are scarier than electromagnetic pulses.

Robert J. Marks:

There are so many things to worry about. You got to pick one and work on it, right?

Sarah Seguin:

That's right.

Robert J. Marks:

Okay. Well, thank you very much, Sarah. This has been a fun chat. Our guest today has been Dr. Sarah Seguin. She's an electrical engineer who specializes in electromagnetic compatibility, including. This to me is very scary stuff. Nevertheless, until next time be of good cheer.

Announcer:

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