

Using EMPs in Warfare

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Robert J. Marks:

Welcome to Mind Matters News. I'm your charming host, Robert J. Marks.

Robert J. Marks:

Greetings. We've heard about the use of EMPs to fry our electronics. Frying electronics would be useful in warfare. One of the uses of EMPs is defensive, and I'm pretty excited about it because it answers a question that I've had for quite a while. Specifically, how do you deal with drone swarms?

Robert J. Marks:

Our guest today to talk about this is Dr. Sarah Seguin. She is an expert in electromagnetic compatibility. Dr. Seguin was formerly on the faculty at the University of Kansas. She then helped develop the software business Third Iron, and is now doing research at Baylor University. Welcome Sarah.

Sarah Seguin:

Thank you so much. I'm happy to be here and excited to talk about this topic.

Robert J. Marks:

Yeah. We talked about this a little bit in the first podcast. EMPs can be in the microwave frequency range. Microwave ovens don't use EMPs, but the microwave radiation is contained in the oven by a Faraday cage. A Faraday cage is a metal surrounding that keeps the microwaves inside. It can also be used to gate microwaves from the outside from getting in. One question, not about specifically EMPs, but just in general microwaves, can a steady dose of low power microwaves, not a pulse, but just a slow continuous exposure to microwaves make us sick?

Sarah Seguin:

It can, and there have been some studies... Which you can even go to PubMed yourself and look up things like Havana Syndrome and look at it yourself. So the reason being is microwaves actually work by the fact that they operate at the resonant frequency of water, which is 2.45 gigahertz and water is a polar molecule. Basically what happens is these microwaves generate electromagnetic energy at 2.45 gigahertz, and they have mixers that send it all over the metal cavity of the microwave and then, while these electromagnetic waves are bouncing around the cavity of the microwave, the polar molecule that is water will basically want to continuously realign itself with the electromagnetic wave.

Sarah Seguin:

So this water molecule moving around then causes the food to heat up. Which is why if you put something that's not really high in water into your microwave, it doesn't heat up. So how does that relate to the human body? Well, I am not a physician or medical doctor, but in general, most figures out there say that we as humans are made up of what... 80% water? And so continuously realigning our water molecules and heating us up could have very bad effects on us.

Robert J. Marks:

Okay,

Sarah Seguin:

But 2.45 gigahertz, does that sound like a familiar frequency to you as well? 2.4 gigahertz is actually wifi, right? So then you're-

Robert J. Marks:

Oh. So I wonder if people have done this research into putting cell phones next to your head and cell phones, of course, work on microwaves at the same frequency as your microwave oven. Is that going to fry your brain?

Sarah Seguin:

So at the power levels in general... For example, one of the conferences I always go to for IEEE, the EMC symposium, they do have papers on this sort of thing and you can Google for papers..., go to Google scholar or whatever, for papers on this sort of thing. But in general, at the power levels that we are subjected to by our wifi by our cell phones, in general, they probably aren't going to hurt us. Although the jury still out.

Sarah Seguin:

They are still doing studies about that. But if you were to just increase the power a bit more, it has been connected with all sorts of possible brain injury, unfortunately. So yes, microwaves can damage a human, but it has to be at the right power levels. At least that seems to be the answer in the relevant literature right now.

Robert J. Marks:

Interesting. Yes. You mentioned, I think the Havana studies where I think it was Russia is suspected of using microwaves in a van in 2016 to make some of the US ambassadors sick. That's where the Havana thing came from.

Robert J. Marks:

One of the things I read in the Forbes article... The Forbes article was entitled 'The Pentagon Fears that Deadly Microwave Weapons are Undetectable.' It says that the US is concerned because the radiation that makes us sick, the microwave radiation is hard to detect. Is this right? Can you detect these low doses of microwaves if say for example, I'm in an embassy somewhere and I want to detect whether some adversary is zapping me with a continuous stream of microwaves?

Sarah Seguin:

So when the news originally broke... I've been kind of fascinated about this myself, about Havana syndrome and then I kind of dug in more to it. I was fascinated with can we detect this? And the answer is I actually think that we can. I think that we could make little sensors that are the size of a cigarette pack, if you will, or gum pack, maybe a little larger, a couple gum packs and that if you kept it always on you, it could maybe have for example, a warning when electromagnetic waves, particularly microwaves went above a certain level.

Sarah Seguin:

So I read that Forbes article as well. Thank you giving me that Forbes article, but I disagree. I think that we could build detectors and for example, it seems like what Russia is suspected of doing or some other combatant is that they deliberately focus the energy at the building, probably. So it seems to me, you could also put certain detectors in a building because certainly microwaves that don't hurt us like with our cell phones, those are measurable because if they weren't measurable, we wouldn't be having cell conversations, right?

Robert J. Marks:

Exactly.

Sarah Seguin:

I wouldn't be talking to you over the wifi. So, when I read that I was very skeptical. Of course, maybe they know something I don't, and I'm sure they'd know a lot that I don't, but I do think that you could build a detector and I'm kind of fascinated with the possibility of doing that.

Robert J. Marks:

Yeah. Yeah. You make a good point. We already have microwave detectors, except they're not used for detectors, those are our cell phones. They receive signals at microwave frequencies and our phones can detect them. So why can't we monitor and detect signals at a higher level? The ones that make us sick?

Sarah Seguin:

I would certainly think you could. In general... Apple, I think locks it out the last time I checked, but in general, you could get an Android device and put on a better wifi or they do already have wifi antennas and you can see the levels. You can walk around your house and see the levels of the wifi and find, for example, if you want it to make your wifi better, find the low spots or the high spots and put repeaters where the low energy is.

Robert J. Marks:

Yes. I was doing some research with our mutual friend, Charlie Bayless, and we went out to the Waco airport and we turned on one of these devices that not only detected it, but could identify the cell phones. It was really spooky because we walked by and we got one name just out of the air and we said, wonder who this is? So we Googled it and we found out he was a student at Baylor university. It's scary. If they could detect that they should be able to detect microwaves that hurt you. Yeah, I totally agree with you. \.

Robert J. Marks:

So back to EMPs. We know that the low level microwaves can have a long-term effect on you. What about an EMP? Will an EMP which is a pulse as opposed to a steady dose of microwaves, will that have an effect on humans?

Sarah Seguin:

Well, you made a really good point. Humans are really resilient. That's why we've done so well over the years. So in general, what happens and of course, as I said, I'm not a physician, but in general, it's time to exposure. So an EMP would be a very short event. So it probably... Unless you were at the source of

the EMP, that might be different, but in general, for a very short event, people are probably going to be just fine. The microwaves affecting those people, it was very long-term exposure at higher than normal microwaves that would normally be propagating around your house for wifi or for your phone or whatever. But it was for a very long period of time. Whereas an EMP, the whole idea behind it is it's a very brief event that causes large transient currents to be induced on the devices that are affected.

Robert J. Marks:

Okay. And so we wouldn't have large currents induced in our biological selves is probably the answer, right?

Sarah Seguin:

Yeah. Probably not. Like I said though, if you were right next to it, there is a possibility that an EMP could have an effect, but in general, over the widespread area that it had an effect, I don't think so.

Robert J. Marks:

Okay. Well, let's talk a bit about EMPs and warfare. Clearly anybody that has a capability of doing a thermonuclear bomb is going to be a potential source of EMP in a warfare scenario. There are also missiles, I understand, which can be launched and detonated, and their detonation gives a smaller EMP sort of pulse. So we have these bullets that we can aim towards people and things like aircraft carriers, and they would have an EMP effect.

Robert J. Marks:

Aircraft carriers are awesome tools of warfare, but in modern hot warfare, when high tech missiles are exchanged, aircraft carriers are sitting ducks. Their entire purpose is to sit there and get the planes in the air. Then they will probably be destroyed and sunk, unfortunately. But with the EMPs, we get a different sort of story. There's a potential that EMPs can take out the planes by disabling their electronics. What can the EMPs do to, for example, aircraft in the air?

Sarah Seguin:

So we are fortunate to some extent that aircrafts would not fly without some hardening to electromagnetic pulses, because they have to be hardened to things like lightning. Lightning of course is basically a natural phenomenon that creates electromagnetic pulse. So of course, now the people creating an electromagnetic pulse would know that these aircraft have some hardening to lightning and probably, I imagine electromagnetic pulse because if we're talking about military vehicles, are we talking about passenger...

Robert J. Marks:

No. We're talking about military vehicles, yes.

Sarah Seguin:

Okay. So when it comes to military, they already do build a lot of that. There's various military standards, but are they still vulnerable to electromagnetic pulses if they were made to directly target them? Yes. And they are particularly vulnerable because they're in the air and if their electronics just stopped working, especially for something like a helicopter that doesn't have any sort of natural help to stay in the air, it would just fall out of the sky.

Robert J. Marks:

Like a rock.

Sarah Seguin:

Yes.

Robert J. Marks:

One of the other things that we have in the military in our tool chest is submarines and they are probably the most stealth of all warfare tools. They are under the water and you can't use radar on them because electromagnetics doesn't go through water. I've heard it described as the same thing as a laser pointer shined through a glass of chocolate milk. It doesn't go very deep into the chocolate milk. It just attenuates and nothing happens. That's a reason that we use sonar underwater as opposed to radar. So the question arises now, will EMPs work on a submarine? Will submarines be disabled by EMP blasts?

Sarah Seguin:

The answer to that is generally if they're under the water, they'll probably have some shielding and have some protection. However, there is some vulnerability that someone could know with knowledge create any EMP that could possibly affect a submarine.

Sarah Seguin:

For example, when a submarine is surfaced, that is not its natural state from a design standpoint. For example, if some people were out on the deck while it's service or something, then you have more openings and also a direct path that is not... We'll call the water having, the way you said, sort of a shielding effect if you will. It doesn't have the water to shield it from that electromagnetic energy. So if it is surfaced or possibly if they knew well... The periscopes?

Robert J. Marks:

Yeah. periscopes. Oh, now that's... So let's talk about periscopes. If there was a periscope, could the electromagnetic pulse go down the periscope and hit the submarine?

Sarah Seguin:

It possibly could. It would depend on how the periscope is designed. I'm certain that there's some really smart folks designing submarines, group of folks if you will. So they probably do think about things like that, but it could be designed or for example, perhaps you could create a missile that is not designed to actually do damage to the submarine, but just get close enough to the submarine such that you could make it subject to an electromagnetic pulse.

Sarah Seguin:

Now, the thing that we have naturally working for us in the case of a submarine and hardening towards electromagnetic pulses is the fact that it's just a big metal box. In order to survive the pressures of the water, it's basically welded and connected really well. Well, it turns out that that also makes a really excellent shield to an electromagnetic pulse. But if you could pierce it just a bit, say not enough damage to sink the submarine, but pierce it enough to get inside that shell, then you could create an electromagnetic pulse that went off to affect the electronics.

Sarah Seguin:

So they're a little more immune than, for example, airplanes, but there could be a possibility for a creative electromagnetic pulse that could affect a submarine, but highly unlikely. There are lots of other easier ways to affect it.

Robert J. Marks:

That's fascinating. We have a colleague at Baylor, Dr. Erik Blair, who served on a nuclear power submarine, and he would go down under the water for long periods of time. Total blackout. No news, no communication and nobody knows where these submarines are at. It is incredibly stealth.

Robert J. Marks:

I want to talk about swarms a little bit. One of the things that are raised in my book, the case for killer robots is the most chilling I think of application of artificial intelligence, and that is autonomous swarms of drones. The problem with swarms is they're hard to destroy. You go kick over an anthill and you stomp and kill most of the ants. You come back in a week and that anthill is rebuilt. You got to get them all in order to destroy the total anthill, the total swarm.

Robert J. Marks:

It's the same thing with swarms of attacking drones. You have to get them all and if a few sneak through, they can still accomplish the mission and if they're autonomous, it's really scary stuff. If you want to get some chills on what swarms can do, watch the movie *Angel Has Fallen* with Morgan Freeman as the president. It has in the beginning, an attack of one of these drone swarms.

Robert J. Marks:

So how do you defend against these things? Well, one of the things you can do is have dog fights that is launch your own defensive swarm and have them go up and engage these drones one of the time. But I tell you doing that would require some really heavy technology and would be very expensive to do. Israel has developed a laser weapon that can take a drone out of the sky, but one drone at a time so you'd need a lot of these laser weapons to take the drums out of the sky. And I always wonder how these laser weapons would work on a cloudy day. I'm not sure what they do.

Sarah Seguin:

I think they'd have troubles.

Robert J. Marks:

They would have troubles. Now, Sarah and I... Dr. Seguin and I talked way before it was announced that Russia had come up with the solution. She had the idea of using EMP weapons. Now this would not be a thermonuclear explosion. This would be, I believe like a super ray gun that you could point towards a swarm and totally disable them. So Sarah, how would a ray gun that you can aim a drone, a swarm, and take out all the drone swarm, how would that work? Do you think there'll be effective?

Sarah Seguin:

I think that they could be effective, but it'll be generally probably have to be in very close range, I think, of the drone swarm.

Robert J. Marks:

Oh, because of the attenuation of the beam as it goes out?

Sarah Seguin:

That's correct.

Robert J. Marks:

The spreading? Okay.

Sarah Seguin:

Yeah. Because as it propagates, it's going to attenuate quite a bit. What's interesting is that it's definitely possible, and you could just say that you don't or you aren't concerned with the biological cost. So definitely at these high levels, a human, if they were exposed to this or animals would probably have some effect because they're literally just radiating a large amount of electromagnetic energy towards this. And in general, because it's not associated with an explosion, they probably have to give it a larger amount of exposure time to induce the currents to cause these electronics to fault.

Robert J. Marks:

Oh, I see.

Sarah Seguin:

So then you're... Well obviously, there's a human cost if you're under attack from a drone swarm and there's a worry of various assets that you want to protect, but also to create that amount of energy, you can definitely direct it, but it's only so directional. As anybody knows who's tried to shield electromagnetic energy or try to propagate it, it's still going to propagate behind it and around it.

Sarah Seguin:

So I think that it is possible to create a weapon. Of course, it's a lot easier to create one if you know the specific vulnerabilities of the drone but the idea is that you need a defensive system that doesn't know the vulnerabilities of the drone.

Robert J. Marks:

Okay. And then in the next step of the arms race, it would be hardening the drones, but hardening the drones would increase the weight and therefore the mobility and the time that the drones can spend in the air. Right?

Sarah Seguin:

Yeah. One easy thing that you can do. For example, what they do now to airplanes that are made out of carbon composite to help harden them for lightning, for example, is they use metalized paint. So that is definitely one thing you can do is sort of, if you will spray paint... It's a little bit more complex than that because you need a certain amount to shield, et cetera, et cetera. But if you were to basically use conductive paint on these... But even that for a drone, which in general is going to be extremely light, that's going to add an amount of weight that might not be acceptable as well.

Sarah Seguin:

So I think the idea with a swarm is that you just build a bunch of cheap things that in general, you know it's vulnerabilities, but it'd be very hard to, for example, with a directed electromagnetic energy that you could bring them all down with. So it's about overwhelming the weapon.

Robert J. Marks:

Oh my goodness. I mentioned that you and I had talked about this a while back and we're beginning to think seriously about all this. It was totally your idea. But then there was a Forbes article entitled 'Russia's Developed an EMP Weapon Against a Drone Swarm.' So Russia has developed your idea and I'm not sure if the United States has something equivalent, but I certainly hope so because this is chilling stuff.

Robert J. Marks:

Again, the drone swarm, I think the autonomous unmanned drone swarm is one of the most chilling applications of artificial intelligence in warfare because it's going to be very hard to defend against. I read one military expert that says they can expect up to... I think this might be a little bit of hyperbole, but he said up to a million elements in a drone swarm, which is astonishing.

Sarah Seguin:

Really?

Robert J. Marks:

Yes. Yes.

Sarah Seguin:

That is astonishing.

Robert J. Marks:

How do you do them? You can't do them one at a time. You can't do a defensive one-on-one dog fight with all of the elements in the swarm. So the EMP sounds like a great solution. It's like having a bug spray. You can go step on the ants one at a time and that takes forever or you could go spray the anthill with some insect killer and kill them all at once. That's what the EMP would do. That would be astonishing. I was really impressed with that solution because autonomous drone swarms have been worrying me for quite some time.

Sarah Seguin:

And Raytheon, and this is all in the open literature articles you can search, Raytheon has actually developed directed energy weapons. One of the most famous ones that's easy to Google is... They have a crowd control weapon, which I don't believe was ever actually implemented as a crowd control weapon but it was developed.

Robert J. Marks:

Okay. You got to tell me. How do we do crowd control with an EMP device? What would be the effect?

Sarah Seguin:

It's not using an EMP. What it's using is directed energy that's at a frequency that actually causes to feel like your skin is itching.

Robert J. Marks:

Really?

Sarah Seguin:

Yeah.

Robert J. Marks:

Oh my gosh. I got to find out the frequency for that. That would be a fun trick to play on your colleagues.

Sarah Seguin:

Like all great technology like microwaves, I'm sure it was discovered by accident, right?

Robert J. Marks:

Yeah.

Sarah Seguin:

Maybe not. I don't know. I can't remember the frequency. I apologize. But yes, they have a directed energy crowd control weapon if you will, but I don't think it's actually been implemented at least in the US. But I did find some articles that talked about how the military is pushing various contractors to do more directed energy weapons. So I sincerely hope that they are working on it as well and it's just really quiet and it just got out with Russia.

Robert J. Marks:

Yeah. A lot of this development I'm sure is classified. So hopefully the United States with all of the accelerated emphasis on the military infrastructure is looking at this. And I know both you and I, Sarah worked with research offices on unclassified material from the army and the Navy and I tell you, working with these people is just wonderful. We do no classified work currently, but these people are very focused on getting tools to the American war fighter and are very impressive people.

Sarah Seguin:

Yeah. We have some really brilliant researchers and technologists working in the United States to develop great tools.

Robert J. Marks:

We do, and they just need to be set free and they are going to develop great countermeasures to some of these chilling weapons.

Robert J. Marks:

Well, thank you, Sarah. That was been a fascinating chat. Our guest today has been Dr. Sarah Seguin, an electrical engineer who specializes in electromagnetic compatibility and in the area of EMPs. So, until next time be of good cheer.

Speaker 3:

This has been Mind Matters News with your host, Robert J. Marks. Explore more at mindmatters.ai. That's mindmatters.ai. Mind Matters News is directed and edited by Austin Egbert.

Speaker 3:

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