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Testimony of Curtis Birnbach to the House Committee on Homeland Security

My name is Curtis Birnbach and I am the president of Advanced Fusion Systems. While the main thrust of my company is fusion energy research, one of our subsidiaries has developed technology to protect the electric power grid from EMP attack. I wish to address the threat to our nation posed by both electromagnetic pulse (EMP) and solar storms. At the risk of sounding glib, I bring you good news and bad news.

The bad news is that this threat is all too real. I have been working on EMP-related technologies for many years. I have built electrically-driven EMP generators and have extensively studied the phenomenology of intense ultra-short pulses. I would like to summarize this work to help bring focus to the critical aspects of this problem. EMP from a nuclear detonation or solar storms poses a unique threat in that it can instantly destroy our civilization. I do not make this statement lightly. Our society is totally dependent on the continuous supply of electricity. Should our electricity be suddenly withheld, our society would immediately collapse.

While I am sure that you have already been briefed on the general aspects of this problem, I wish to focus on the two most critical components we use to deliver:: transformers and generators. If they don't function, we can't deliver electricity and life as we know it stops. The generators and transformers have two very important things in common: they are very expensive and they

take years to replace. The worst-case victims of either an EMP attack or a solar storm are our generators and large substation transformers.

This brings me to the first of two points in my testimony: The United States does not have a domestic transformer manufacturing capability for large substation-class transformers. These devices are made exclusively on the Pacific Rim and in Europe. Large transformers typically take three to five years to obtain and put into operation. The production capacity of existing overseas manufacturers is quite limited. Should the sudden need for rapid delivery of a couple of hundred transformers occur, these manufacturers would be unable to supply our requirement. Further, as they are not US corporations, they have no incentive to delay other existing customers to supply our needs in the event of an emergency. Also, a solar-sourced EMP event may well affect electric power equipment in many other countries exacerbating the supply situation.

The situation with generators has common elements. While we do have some manufacturing capacity for large generators in the United States, it is limited and should a large number be suddenly needed, it would take years to meet that need. If equipment manufacturers are also unable to function because of a lack of electricity we end up with a chicken and egg situation; we can't have one without the other.

There is no way that this country can exist for a couple of months, no less many years without electricity. To compound this situation, our utilities may not be insured against this type of loss. Even if they were insured, the insurance companies would suffer potentially crippling losses if

utilities were destroyed over a wide area. Our financial system, our medical system, our communication systems, our public safety systems - none could function without electricity. Most companies including utilities would simply cease to exist. There is a real likelihood of civil unrest.

Stockpiling transformers will not work. According to Platts Energy Reporting, there are over a quarter of a million large transformers, and close to 20,000 generators. The transformers are not standardized so the number that would have to be stockpiled is prohibitively large. For every large transformer there are about a thousand smaller transformers, of which only a small fraction are produced domestically.

DARPA tried to run a program to build "universal transformers" that could be stockpiled. This effort proved impractical as there is too much variation among transformers.

I did promise some good news. My company has developed a grid-level protection system. This system can protect our country from these threats. We have developed an EMP Protective System (EPS). Each EPS unit will protect a single phase which is one of three wires (phases) that are typically used in high-power electrical devices. Generators have three wires while transformers have 6 wires. Once an EPS is installed, it will detect the pulse of an EMP, safely conduct it to ground, and immediately be ready for the next pulse. These switches were originally designed to operate under conditions similar to those encountered in an EMP attack or solar storm. They are totally autonomous and react in a small fraction of a billionth of a second. They contain a built-in detection system which is the only way you can get a protective device to work quickly enough to be of use.

We have looked at some representative sites for installation of these protective devices. As an example, I would like to discuss protection of the Niagara Hydroelectric Plant. This is one of the most important power stations in this country. While I will not go into specific details for security reasons, based on what limited information is available to me, I have estimated that the entire complex could be protected for somewhere between \$75 and \$100MM. The cost of this protection would also be expected to be included in the rate base for the utility so that ultimately the small cost of the protection is borne by consumers who will be receiving a more secure supply of electricity. Compared to the ten billiondollars that this station might be expected to cost to replace, this one time cost of 1% is a small cost to protect the plant.. This one time cost of the equipment to protect the plant is all or partially offset by the reduced insurance premiums for a plant that has this protection in place. Obviously, a detailed engineering study would be necessary to refine this number, but it provides an order of magnitude of the cost of this protection.

I have also done estimates on transmission substations. Large transformers cost around \$1.5MM to protect. All incoming and outgoing lines in a substation must be protected, but in most cases, this protection is also the same devices that are protecting the transformers. A typical large substation, has at least ten lines of 115KV or more, and dozens of transformers. When balanced against the cost of a large substation, which can cost a half billion dollars, the cost of protection is typically 10% of the total cost. In either case, the cost is a fraction of the replacement cost of substations or generators, or the lost revenues that the utilities would suffer over a period of several years as a result of the attack. The loss of revenue far exceeds the replacement cost of

the equipment. The economic and societal costs of being without electricity are of course far greater than the losses of the utility.

While these numbers may seem large, remember that this is not a single-year expenditure. It will take several years to fully implement this type of protection. Implementation of EPS protection is cheap insurance in the face of such losses. These estimates do not include the deaths, injuries, civil unrest and such that would be likely consequences of these events, particularly once it became clear that the disruption would last for extended periods of time.

My company is committed to help resolve this problem. By making these protective devices available, we are offering a viable option to the unthinkable scenarios I have described. We are funded through the private sector. We are only looking to have the government support the purchase of these devices. There has been significant interest in this technology overseas.

In order to make grid protection available and affordable in a reasonable period of time, state and federal legislation encouraging the purchase of EPS technology for critical elements of the electric grid is needed. Three legislative measures should be considered:

1. Tax credits for private utilities purchasing EPS equipment for the purpose of grid protection,
2. Grants to utilities for installation of critical EPS equipment at vital locations
3. Providing government-backed bonding authority to raise money to provide EPS funding to rural electric systems and others who need it.
4. FERC agreement to include these devices in the rate base.