

97-121
2005

[H.A.S.C. No. 108-37]

**THE REPORT OF THE COMMISSION TO ASSESS THE THREAT TO THE U.S. FROM
ELECTROMAGNETIC PULSE ATTACK**

**COMMITTEE ON ARMED SERVICES
HOUSE OF REPRESENTATIVES**

ONE HUNDRED EIGHTH CONGRESS

SECOND SESSION

**HEARING HELD
JULY 22, 2004**

HOUSE COMMITTEE ON ARMED SERVICES

One Hundred Eighth Congress

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C O N T E N T S

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APPENDIX:

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THURSDAY, JULY 22, 2004
THE REPORT OF THE COMMISSION TO ASSESS THE THREAT TO THE U.S. FROM ELECTROMAGNETIC PULSE ATTACK

STATEMENTS PRESENTED BY MEMBERS OF CONGRESS

Hunter, Hon. Duncan, a Representative from California, Chairman, Committee on Armed Services

Skelton, Hon. Ike, a Representative from Missouri, Ranking Member, Committee on Armed Services

Taylor, Hon. Gene, a Representative from Mississippi, Committee on Armed Services

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Graham, William R., Chairman, Commission to Assess the Threat to the United States from Electromagnetic Pulse Attack

APPENDIX

PREPARED STATEMENTS:

[The Prepared Statements can be viewed in the hard copy.]

Hunter, Hon. Duncan

Skelton, Hon. Ike

DOCUMENTS SUBMITTED FOR THE RECORD:

[The Documents submitted can be viewed in the hard copy.]

Report of the Commission to Assess the Threat to the United States from Electromagnetic Pulse (EMP) Attack by Dr. John S. Foster, Mr. Earl Gjelde, Dr William R. Graham, Dr. Robert J. Hermann, Mr. Henry M. Kluepfel, General Richard L. Lawson, USAF (Ret.), Dr. Gordon K. Soper, Dr. Lowell L. Wood Jr., Dr. Joan B. Woodard

QUESTIONS AND ANSWERS SUBMITTED FOR THE RECORD:

[The Questions and Answers can be viewed in the hard copy.]

Mr. Langevin

THE REPORT OF THE COMMISSION TO ASSESS THE THREAT TO THE U.S. FROM ELECTROMAGNETIC PULSE ATTACK

House of Representatives,

**Committee on Armed Services,
Washington, DC, Thursday, July 22, 2004.**

The committee met, pursuant to call, at 9:03 a.m., in room 2118, Rayburn House Office Building, Hon. Duncan Hunter (chairman of the committee) presiding.

OPENING STATEMENT OF HON. DUNCAN HUNTER, A REPRESENTATIVE FROM CALIFORNIA, CHAIRMAN, COMMITTEE ON ARMED SERVICES

The CHAIRMAN. Okay, folks. We will fire up here. Today is our prayer breakfast, and, you know, that is very important for Members of Congress, a very important beginning of the day. We have a few Members over there right now. I think Ike is still there, but we will come to order and Mr. Taylor will sit in for Mr. Skelton here.

The hearing will come to order. Our guests this morning are members of the Commission to Assess the Threat to the United States From Electromagnetic Pulse Attack. Its Chairman, Dr. William Graham, will give us the highlights of the Commission's report, and he is accompanied by several distinguished members of the Commission: Dr. John Foster, Mr. Earl Gjelde, Mr. Henry Kluepfel, General Richard Lawson, Dr. Joan Woodard and Dr. Lowell Wood.

We would like to just thank you all first for putting in the time that you have on this Commission. Welcome to the committee. We all look forward to your testimony. We appreciate your appearance.

My understanding from Dr. Graham is that he will present the Commission's testimony, but that other Commissioners will respond to questions.

I also want to remind Members that Commissioners will deliver a members-only classified briefing in 2212 after the hearing.

National security experts have known about electromagnetic pulse (EMP) for decades, at least since the atomic bombs were used at the end of World War II. During the Cold War, we thought about it primarily in terms of ensuring the credibility of our nuclear deterrent, so we hardened a large number of our military systems in order to operate in a nuclear environment.

Since the Cold War, however, several trends have forced us to think about EMP in a new way. The proliferation of nuclear weapons and the rise of new nuclear powers with small nuclear arsenals have forced us to think about EMP as an asymmetric threat in its own right. At the same time, our economy is increasingly dependent on the electronic systems vulnerable to electromagnetic pulse.

We heard a lot about this problem in the 1990's, but nobody had a good handle on it. So this committee took the lead in creating a national commission to look into the problem. We are here today to review its findings and recommendations.

So, folks, thanks again for appearing before the committee. We look forward to your testimony.

I want to turn to my good friend, Mr. Taylor, to make any remarks he might want to make.

We also want to give thanks to Roscoe Bartlett for his great work in this area and initiative and Curt Weldon who has also undertaken this as a very major part of his agenda. We have Members on the committee who have really focused on this problem. We think it is timely, and I want to let them make a comment or two also.

But, first, Mr. Taylor, do you have any remarks you would like to make?

[The prepared statement of Mr. Hunter can be viewed in the hard copy.]

STATEMENT OF HON. GENE TAYLOR A REPRESENTATIVE FROM MISSISSIPPI, COMMITTEE ON ARMED SERVICES

Mr. TAYLOR. Thank you, Mr. Chairman.

I am going to, if you do not mind, read a prepared statement by Mr. Skelton.

"Mr. Chairman, I join you in welcoming our distinguished witnesses. Thank you for holding this important hearing.

"I appreciate the hard work the Commission members undertook to better understand a threat that is viewed by most as complex and arcane. As the report points out, to launch an EMP attack, an adversary needs a ballistic missile, a nuclear warhead, the ability to mate the two and the ability to fire it to the right point in the atmosphere or space so the detonation produces an electromagnetic pulse.

"Clearly, China and Russia have this capability, and perhaps a rogue nation like North Korea, but an EMP attack is not an easy task for a terrorist group, the threat I worry about most, unless they get outside help. This is why I think the Commission's report underscores the need for more vigorous leadership by the United States on nuclear non-proliferation.

"We should be making it as difficult as possible for terrorists to get a hold of uranium or plutonium, the key ingredients to nuclear weapons. Non-proliferation is not foreign aid. It is our first line of defense.

"It is not foolproof, but there are no foolproof answers to thwarting a nuclear weapon attack, including an EMP attack. But by making it difficult to acquire fissile materials, we also make it more likely that we can detect when a terrorist group obtains them. There is no down side to a tough nuclear non-proliferation regime.

"Today, U.S. nuclear non-proliferations programs are plodding along at the pre-September 11 funding levels. They are being held up by bureaucratic issues, like liability.

"I look forward to the testimony of our witnesses, but I believe what we hear from them today should spur Congress to insist on a more vigorous non-proliferation program."

I yield back the balance of my time.

The CHAIRMAN. I thank the gentleman from Mississippi.

I would like to turn to Mr. Weldon and then to Mr. Bartlett. Both of them have spent a great deal of time and effort really focusing on this very important issue.

Curt, thank you for all your work here. Do you have a statement you would like to make?

Mr. WELDON. Thank you, Mr. Chairman. I will give you a prepared statement for the record, but I would like just to make a couple of general comments and to join you in thanking Roscoe. He has been a tireless advocate for a higher awareness of the EMP phenomenon.

We all know that a single nuclear weapon detonated to an altitude of 500 kilometers could produce an EMP that would blanket the entire continental United States, potentially damaging or destroying military forces and civilian communications, power, transportation, water, food and other infrastructures on which modern society depends. In fact, I think it is the ultimate terrorist threat.

The EMP has been the focus of significant government funded research and testing for over 30 years. However, most of these efforts were conducted during the Cold War and focused on hardening strategic systems against a massive nuclear attack from the Soviet Union. Far fewer resources have been dedicated to examining the potential vulnerability of the United States civilian and industrial infrastructure to an EMP attack.

I raised this issue with the electric and utility industry and also with the Homeland Security Agency during a hearing there, and they really were not even aware of what the possibilities and what the threats were.

Moreover, since the Cold War, U.S. military and civilian systems have become increasingly dependent on advanced electronics that are even more vulnerable.

The potential vulnerability of the United States of an EMP attack may be a matter of graver moment now that missiles and nuclear weapons are proliferating. Terrorists in possession of a nuclear weapon could make an EMP attack against the United States merely by firing a scud missile off a freighter. The launch mode has been tested by Iran, the world's leading sponsor of international terrorism.

Some analysts have suggested that nations having smaller numbers of nuclear missiles, such as China or North Korea, may consider an EMP attack against U.S. military forces regionally to degrade the United States' technological advantage or against the U.S. national electronic infrastructure. In fact, I would think China would look at this as a way to totally isolate Taiwan, if, in fact, they were going to move on that nation.

Analysts have also suggested that Russia's new military doctrine, which gives unprecedented emphasis to limited nuclear options, may assign increased importance to EMP attacks or the threat of such attacks as a way of exercising nuclear blackmail or limiting nuclear conflict in the event of a confrontation with the U.S.

In fact, Roscoe Bartlett was a part of a delegation that I led to Vienna in May of 1999 meeting with five Russian leaders to try to find a way to resolve the war in Yugoslavia, which we did.

But during the course of our early discussions when the Russians were acting very negatively toward America, a senior Russian, who at that time was the Chairman of the International Affairs Committee, the head of the Yabloko faction in Russia, a very dominant political party in Russia, and had been the former Soviet Ambassador to the U.S., Vladimir Lukin, made a statement that Roscoe and I could not believe.

He said, "You know, you think you can tear people apart as you are doing in Serbia, but we have the ultimate ability to bring you down," and he referred to EMP.

So here was a high-level Russian official, someone who had been the ambassador to our country, mentioning the fact of something that we all knew that was a part of Russia's strategic nuclear doctrine that EMP has been, was and is a critical component.

That is why Congress took the lead in establishing this Commission. In fact, the last hearing we held on this was nearly 5 years ago, October 7 in 1999. At that hearing, it became apparent to us that there were fundamental unresolved questions about EMP.

In fact, there were some at that point in time on the President's Critical Infrastructure Team who would not even talk about EMP! They said, "Well, it is so remote, we do not want to talk about that possibility" or, "It is too costly for us to worry about." Well, unfortunately, we do not have the luxury of saying it will not happen or it is too costly.

There did not appear to be any agreement, and that is why we took the suggestion of my good friend and colleague and put into place, with the support of the Chairman, the legislation to create this Commission.

The Commission has been working for two years. The Commissioners were carefully chosen. There is not a partisan bone in their body. They are scientists. They did their job in an absolutely fantastic way. I monitored the progress throughout the past two years in talking to their executive director Peter Pry and to Commission members on numerous occasions and have been constantly impressed with the quality of their work.

Now we are here to receive the report. Hopefully, this report will give us a blueprint that will help us protect the U.S. from EMP. That is a staggering achievement. The work of the Commission could save the United States from one of the few threats capable of utterly destroying us as a society.

For this reason, I believe the EMP Commission will be remembered as one of the few truly great Commissions, a landmark Commission. Few commissions play the role of both alerting Congress and the American people to a potentially catastrophic threat, at the same time providing guidance to policymakers about how to address the threat.

So I am happy to be a part of this. I look forward to the hearing and the classified session afterwards.

Mr. Chairman, I thank you for your enlightened leadership to allow us to be here today to receive this report.

[The prepared statement of Mr. Weldon can be viewed in the hard copy.]

The CHAIRMAN. Well, I want to thank you, Mr. Weldon, for all the hard work you have done on this very important issue. I turn to the gentleman who has brought up EMP at almost every relevant hearing and consistently pushed for it along with you, and that is our colleague, Roscoe Bartlett of Maryland.

Roscoe, thank you for all your hard work. Do you have a statement?

Mr. BARTLETT. Thank you very much, Mr. Chairman.

Yes, I have at a number of hearings where it was appropriate to ask our military people how much of their warfighting capability would remain after a robust EMP laydown. Most frequently, the generals and the admirals turn to their staff who is behind them, and then they say, "Gee, we will get back to you on the record for that."

What we see today here is a really good example of the tyranny of the urgent, and the urgent thing today is to look at the 9/11 commission report, which is trifling in importance in comparison to what you are going to present today. But that is today and that is urgent, and so we, for the longer run, will make sure that we get the kind of visibility for your report that we need.

My colleague mentioned the President's Commission on Critical Infrastructure that testified before us. General Marsh was here, and we asked him about EMP, and he said, "Well, we did not think there was a very high probability that that was going to happen, and so we did not look at it anymore."

Then when it came my time for questioning, I said, "Gee, with that attitude, if you have not already, I am sure, General, when you go home tonight, you are going to cancel the fire insurance on your home because there is not a very high probability your home is going to burn, so why should you have fire insurance on it?"

That is all I am asking for for our Country, is an investment the equivalent of your fire insurance policy on your home. You know, you do not pay a guard to stand all night to awaken you if your home burns, but you do a prudent thing and you get fire insurance on your home, and that is what I would hope that we can do in this country.

One of the Central Intelligence Agency (CIA) agents who are knowledgeable in this area told me that several years ago he briefed one of the Army Joint Chiefs on the EMP threat, and, after the briefing, the General cussed him out. He said, "Why did you do that? Why did you have to ruin my day? You know there is nothing I can do about that. Why did you want to make me feel bad?" That is not the right response to this problem.

Congressman Weldon mentioned our meeting in Vienna, Austria, and the comment that Vladimir Lukin said. Now he was not a happy camper at that point in our meeting there because he had been sitting there in that hotel room for a couple of days with his arms crossed on his chest, looking up at the ceiling. At one point, he said, "You spit on us, and now why should we help you?"

After that, he made the comment that Congressman Weldon referred to. He said, "If we really wanted to hurt you with no fear of retaliation, we would launch an Submarine-launched Ballistic Missile (SLBM), we would detonate a nuclear weapon high above your country and shut down your power grid for six months or so."

Curt understands enough Russian that he turned to me, and he said, "Roscoe, did you hear what he said?" Well, of course, I heard it. I did not understand any of it until the translator. But Curt had understood it when he said it.

Then the third-ranking Communist was there, Alexander Shabanov, who smiled and said, "If one weapon would not do it, we have some spares."

So it is not that our enemy does not know that this is a big vulnerability in our country. This is, in fact, the ultimate asymmetric attack, not just on our military, but on our culture, on our society as a whole.

I remember back several years ago we had a hearing on this in the Small Business Committee. It was a field hearing out at the Applied Physics Lab, and Dr. Lowell Wood was there.

You know, there is nothing that does not effect small business. When you are on Small Business, you can have a hearing on anything you wish because anything and everything can effect small business, and, certainly, this would affect small business.

Dr. Wood had referred to a robust EMP laydown over our country as a giant continental time machine which would move us back a century in technology. I said, "Dr. Wood, our population today in this distribution could not be supported by the technology of a century ago," and his unemotional answer was, "Yes, I know. The population will shrink until it can be supported by the technology."

I want to thank you all very much for what was a very diligent, two-year study, and you can be assured that we will spare no effort to make sure that America understands this threat and America responds appropriate to the threat.

Thank you very much, Mr. Chairman, for convening this hearing, and I look forward to this hearing and the classified briefing afterwards.

Thank you, sir.

The CHAIRMAN. I thank the gentleman. Once again, thank you for all your efforts in this area.

So, since we have offered the opportunity to Mr. Weldon and Mr. Bartlett to make an opening statement, does anybody else have a statement they would like to make here?

If not, Dr. Graham, we understand you will give the report, and all of the members stand ready to answer questions. Once again, to all of our members, thank you very much for your work for our country, and, sir, the floor is yours.

Dr. GRAHAM. Thank you, Mr. Chairman and distinguished members of this committee.

The CHAIRMAN. Incidentally, you know, we are getting out today possibly, and so we have members running all over the place. This is kind of the hurry-up-and-finish day for lots of us on lots of projects, and so we should have more members here. Maybe they will come in, but, again, this is the day of flying coattails. We have the 9/11 Commission out briefing folks, too.

STATEMENT OF DR. WILLIAM R. GRAHAM, CHAIRMAN, COMMISSION TO ASSESS THE THREAT TO THE UNITED STATES FROM ELECTROMAGNETIC PULSE ATTACK

Dr. GRAHAM. We understand that timing is everything, but, if our work is substantial, I am sure it will continue in its interests and effect for some time.

I would also like to thank my fellow Commission members, both those here today and the two who were not able to join us, Dr. Robert Hermann and Dr. Gordon Soper. All nine members of the Commission contributed substantially, as well as the staff of the Commission sitting behind us, and the report that we provided to you and will release today is the unanimous view of this Commission.

The next view graph, please.

This is the charter that you gave us in summary form, and, while that is up, I would like to give you our bottom line.

What we have concluded is that several potential adversaries have or over the next 15 years, which was the time horizon you mandated for us, over that time, can acquire the capability to attack the United States or its interests, friends and allies with a high-altitude nuclear weapon-generated electromagnetic pulse. Not only that, but a determined adversary can achieve an EMP attack capability without having a high level of sophistication.

EMP is one of a small number of threats that can hold our society at risk of catastrophic consequences and might result in the defeat of our military forces. EMP has the capability to produce significant damage to critical infrastructures and, thus, to the very fabric of U.S. society, as well as to our ability to project influence and military power abroad.

The common element that can produce such an impact from EMP is primarily electronics, so pervasive in all aspects of our society and military, coupled through critical infrastructures. Our vulnerability is increasing daily as our use and dependence on electronics continues to grow. The impact of EMP is asymmetric in relation to potential protagonists who are not as dependent as we are on modern electronics.

Finally, the current vulnerability of our critical infrastructures can both invite and reward attack if it is not addressed and corrected. Correction is feasible and well within the nation's means and resources to accomplish.

The next view graph, please.

Seven of the nine Commissioners were nominated by the Secretary of Defense, the current Secretary, Secretary Rumsfeld, and two were nominated by the director of the Federal Emergency Management Agency, and those nominations were then reviewed and approved by the leadership of both parties in both Houses of Congress. So we feel we have a strong mandate for the activities that we conducted.

They are expert in diverse areas of science, technology and related activities, and they worked together very well as a team over the two-year period that you described. They are largely here today, and, since this Commission has such a broad mandate, not only is their diverse set of skills important, but they will undoubtedly participate in responses to your questions as well.

The next view graph, please.

The form of our report to you is shown here. We have already submitted to you the first, second, and fourth volumes of our report.

The fifth volume, having to do with an assessment of threat at the highly sensitive code word level, is still in review by the intelligence community for appropriate classification, and it will be highly classified.

The third volume on critical infrastructure assessments contains the bulk of the detail of our work, and that is still in editing and will be submitted to you in due course. We hope it will be unclassified.

Next view graph, please.

We also have extensive staff papers and analyses. We sponsored technical work by various elements of the government and the private communities, and we held a number of workshops, including one workshop with two retired, but still quite active Russian military generals who gave us their perspective on the subject.

The next view graph, please.

High-altitude EMP produced by high-altitude nuclear detonations has occurred and has been observed, and its effect has been observed. It first came to the attention of many of us as a unique and, at the time, poorly comprehended phenomena, poorly predicted, at the Starfish event in July of 1962, when even though the burst was 800 miles from Honolulu and barely above the horizon—and, therefore, the fields produced at that location were not within even an order of magnitude of what they could be—they still produced a number of effects in Hawaii, including burning out streetlight strings, setting off burglar alarms, taking down telecommunications facilities and about 15 other events that were subsequently recorded.

Next view graph, please.

While Starfish was conducted over a large body of water in the Pacific, the Soviet Union is the only country that has conducted high altitude nuclear tests over a large land mass, and, in 1994, General Loborev presented data on the effects of EMP from a high altitude burst that were observed by the Russians during their test series also around 1960.

His observations about the EMP damaging power supplies, spark gaps, numerous other components and leading to immediate loss of power transmission and communications, physical damage as well upset, were consistent with our own observations and our own predictions.

The Russians in this case had long transmission lines that acted as antennas well matched to receive some components of the EMP pulse. This was over a relatively sparsely populated area of the Soviet Union. By comparison, the U.S. is covered essentially end to end by a national power grid or grids that look from space like a large network of antennas tuned to receive the various components of the EMP spectrum.

Next view graph, please.

EMP effects from nuclear bursts are not new threats to our nation. The Soviet Union in the past and Russia and other nations today are certainly capable of creating these effects, and, certainly, they understand them. However, throughout the Cold War, the United States did not try to protect our civilian infrastructure against either the physical or EMP aspects of nuclear weapons in any determined way, instead depending primarily on deterrents for safety.

What is different now is that some potential sources of EMP threats are very difficult to deter. They can be transnational terrorist groups that have no particular state identity or no overt state identity and might have only one or a few nuclear weapons, but are motivated to attack the U.S. without regard for their own safety.

Axis-of-evil states, such as North Korea and Iran, may also be developing the capability to pose an EMP threat to the United States and may also be unpredictable and difficult to deter.

Certain types of relatively low-yield nuclear weapons can be employed to generate potentially catastrophic EMP effects over wide geographic areas, and designs for variance of such weapons may have been illicitly trafficked for a quarter century.

China and Russia have considered limited nuclear options that, unlike their Cold War plans, employ EMP as the primary or sole means of attack, and both Mr. Weldon and Mr. Bartlett described one instance in which they were the recipients of such threats.

Another key difference from the past is that the U.S. has developed, more than most nations as a modern society, a heavy dependence on electronics, telecommunications, energy, information networks and a rich set of financial and transportation systems that leverage modern technology. They make our society very efficient, but they also make it very vulnerable.

Therefore, terrorists or state actors that possess relatively unsophisticated missiles, such as the Scuds that were described, armed with nuclear weapons may well calculate that, instead of destroying a city or a military base, they may obtain the greatest political military utility from one or a few such weapons by using them or threatening their use in an EMP attack.

The current vulnerability of U.S. critical infrastructures can both invite and reward that attack, if not corrected. However, correction is feasible and well within the nation's means to accomplish.

The next view graph, please.

The electric power network is probably the most fundamental of all the nation's critical infrastructures, all of which depend on the energy delivered by the electric power grids. Assessment of the commission on the electric power grid is that that grid is in danger of functional collapse during an EMP event over a very wide area.

For example, protective relays and electronic switches, which may protect the grid, may be damaged by fast rising early components of the EMP pulse, while the late time EMP component can couple energy into long runs of transmission lines which can overload and damage long lead time items on the grid.

For example, large power transformers today are all manufactured offshore and typically have lead times, even when ordered in small numbers, on the order of a year. We do not maintain large stockpiles of these, and, in some cases, we do not maintain any stockpiles at all in the U.S. So there is a time lag associated with replacing damaged power grid components that can be very substantial.

Next view graph, please.

Everything is dependent on electrical power availability, but telecommunications is the other fundamental infrastructure on which we depend, and it, too, requires that power. The financial system of this country is critically dependent on telecommunications, which in turn depends on power.

The Federal Reserve System, with whom we spoke at length, has gone to great lengths to address and mitigate potential vulnerabilities in the telecommunications systems on which it is so critically dependent. Far more monetary transfers occur today electronically than in any other form, but, in the end, they ultimately rely on the proper functioning of electronics and the telecommunications grid.

All infrastructures are increasingly dependent today on supervisory control and data systems, sometimes called SCADA systems. We did experiments on SCADA systems and determined that widespread failure of SCADAs would not only make recovery very difficult, but, in fact, it is very likely to occur under a determined EMP attack.

Next view graph, please.

In fact, we had tested under the Commission's direction a number of critical infrastructure systems—power, telecommunication, transportation, emergency services and SCADAs related to energy distribution and other control mechanisms—and we found vulnerabilities in all of these systems. The vulnerabilities were both upset, but also permanent damage, depending on the specifics of the case, and all well within the range of EMP threats.

Next view graph, please.

With the mandates you gave us, it was particularly challenging to look at the civilian infrastructures, we discovered, as we proceeded, because the civilian infrastructure is very tightly coupled, and it has interdependence that is very complex.

We have just shown a few aspects of it in this diagram, but the way we have recovered from infrastructure failures in the past has been to note that they have tended to be single infrastructures to begin with, like the Northeast power grid collapse of last summer, and that they have been somewhat geographically constrained and often have been brought about by control failures, not by permanent damage to the system, which was certainly the problem in the Northeast power blackout.

So, by working in from the edges, the operators were able to restore the system, but to restore power, you need telecommunications, and to maintain telecommunications, you need power, and to get out to facilities to fix them, you need transportation, and you may need emergency services to clear transportation routes, and you may need government services to direct activities, and you may need banking, finance or at least the ability to obtain funds to carry out these activities, and, finally, of course, you need energy, transport, oil and gas to run power systems.

So, when you put all that together, you find you have a multidimensional chicken-and-egg problem that, should all of those infrastructures be disrupted and/or experience damage simultaneously over a large area, you have a very complex problem of restoration and repair of the national infrastructure.

One thing we have also found is that today the U.S. does not have the ability to model such complex interactions, and this is probably one reason that even in simpler cases why major disruptions seem to come as a surprise, such as the Northeast power blackout again.

Next view graph, please.

To turn to the military aspects of the EMP threat for a moment, the end of the Cold War relaxed the discipline for achieving EMP survivability within the Department of Defense and gave rise to the perception that an erosion of EMP survivability of military forces was an acceptable risk. Again, Congressman Bartlett cited specific examples of that in his experience.

EMP simulation and test facilities have been mothballed or dismantled, and research concerning EMP phenomena, hardening, design, testing and maintenance has been substantially decreased. However, the emerging threat environment, characterized by a wide spectrum of actors that include near peers, such as Russia, established nuclear powers, rogue nations, subnational groups and terrorist organizations that either now have access to nuclear weapons and ballistic missiles or may have such access over the next 15 years have combined to place the risk of EMP attack and adverse consequences to the U.S. to a level that is not acceptable.

Next view graph.

Current policy is to continue to provide EMP protection to strategic forces and their controls, command and control. However, the end of the Cold War has relaxed the discipline for achieving and maintaining that capability for our strategic forces.

I emphasize that today we have a new strategic triad that involves not only our offensive forces, but our defensive forces, and our responsive infrastructure that supports the military in providing the EMP protection to each of these components, including the defensive forces, in our view, is very important.

We feel the department must continue to pursue the strategy for strategic systems to ensure that weapons delivery in the new triad is survivable and that there is at a minimum a thin line of command and control capability that can detect threats and direct delivery systems and defense systems.

The Department of Defense has the capability to do this, and the cost can be within reasonable and practical limits. However, they require, to be within those limits, knowledge, skill and experience of expert cadres within this country.

The answers, such as you got, that there is nothing we can do about the problem, in my view, tend to be the response of people who themselves do not have the knowledge, skill and experience to address EMP hardening, design, development and maintenance. But that expertise does exist in the U.S., although it is a diminishing resource, as people retire or go on to other fields.

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The situation of general purpose forces is more complex. Our increasing dependence on advanced electronic systems results in the potential for increased EMP vulnerability of our technologically advanced forces and, if unaddressed, make EMP employment by an adversary an attractive asymmetric option.

The United States must not permit EMP attack to defeat its capability to prevail. The Commission believes it is not practical to protect all the tactical forces of the U.S. and its coalition partners from EMP in a regional conflict. A strategy of replacement and reinforcement will certainly be necessary.

However, there is a critical set of capabilities that is essential to tactical regional conflicts that must be available to these reinforcements. This set includes satellite navigation systems, satellite and airborne intelligence and targeting systems, and adequate communication infrastructure, as well as missile defense.

The current capability to field the tactical force for regional conflict is inadequate in light of this requirement.

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Overall, little can be accomplished without the sustained attention and support of the leadership of the Department of Defense, the Department of Homeland Security and, of course, the Congress.

This will require the personal involvement and cooperation among the Secretary of Defense, the Chairman of the Joint Chiefs, the service Chiefs and the appropriate congressional oversight committees, as well as the Secretary of the Department of Homeland Security and his staff.

They must oversee the development of strategy, reaffirm criticality of survivable and enduring military forces, and also survivable and enduring critical infrastructure for the civilian components of the U.S. society.

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Addressing our thoughts on strategy and our recommendations, an EMP attack is one way for a terrorist or transnational terrorist group, as well as a country hostile to the U.S., to use a small amount of nuclear weaponry, potentially just one weapon, in an effort to produce a catastrophic impact on our society, but, of course, that is not the only way.

In addition, there are potential applications of surface-burst nuclear weaponry, biological and chemical warfare agents, and possibly cyberattacks that might cause damage that could reach and produce large-scale, long-term levels and results.

The first order of business is to prevent any of these attacks from occurring. The U.S. must establish a global environment that will profoundly discourage such attacks. We must persuade nations to forego obtaining nuclear weapons or to provide acceptable assurance that these weapons will neither threaten the vital interests of the U.S. or fall into threatening hands.

For all others, we must make it difficult and dangerous to acquire the materials to make nuclear weapons and the means to deliver them. We must hold at risk of capture or destruction anyone who has such weaponry wherever they are in the world. Those who engage in or support these activities must be made to understand that they do so at the risk of everything they value. Those who harbor or help those who conspire to create these weapons must suffer serious consequences as well.

In the case these measures do not completely succeed, we must have vigorous interdiction and interception efforts that thwart delivery of all such weapons. To support this strategy, the U.S. must have intelligence capability sufficient to understand what is happening at each stage of developing threats.

In summary, the cost of mounting such attacks must be made great in all respects and the likelihood of successful attack rendered unattractively small. The current national strategy for the war on terrorism already contains all of these elements.

Threat of an EMP attack further raises what may be at stake. To further forestall an EMP attack, we must reduce our vulnerability to EMP and develop our ability to recover should it occur. We should never allow terrorists or axis-of-evil states or others hostile to us a cheap shot that has such a large and potentially devastating impact.

In addition to many things that have been written recently about terrorist threats, I would add a seconding to what Mr. Weldon and Mr. Bartlett said that we understand today that it is possible to launch ballistic missiles—Scuds, for example—from ships off our shore in a way that brings them near our shores covertly and can propel nuclear weapons well above the atmosphere over our coastal regions.

Scuds are a glut on the world market today. We have had instances of private collectors buying them and having them show up literally on our docks and facilities.

The U.S. has a history of responding to threats after damage has been done, but, in terms of the offshore environment, the thousands of ships that sit off our shore moving legitimate cargo, I believe that the emphasis we need to place on knowing where those ships came from, who is on them, what they carry, what their capability is is an underappreciated issue in terms of dealing with terrorists and threats today.

It certainly is a subject that between the Coast Guard, which is part of the Department of Homeland Security now, the Department of Defense and other agencies of the government, we can put more emphasis and focus on to our great benefit.

The next view graph, please.

Our executive summary outlines a number of actions that we believe, while relatively modest in cost, can be profound in their effects. They include, as I mentioned, pursuing intelligence, interdiction and deterrence to discourage these attacks—protecting critical components of the infrastructure with particular emphasis on those that have damage would require long periods of time to repair or replace—maintaining the capability to monitor and evaluate the condition of critical infrastructures, recognizing an EMP attack and understanding how its effects differ from other forms of damage, planning to carry out systematic recovery of critical infrastructures, training, evaluation, Red Teaming and periodically reporting to the Congress on those capabilities, defining the Federal Government's responsibility and authority to act, recognizing the opportunities for shared benefits—a more rugged infrastructure would effect more than just the EMP response—and, finally, conducting better research to understand the infrastructure systems' effects and developing cost-effective solutions to manage these effects.

Today, I read excerpts of the reports on the 9/11 Commission and thought about the Northeast power blackout of last summer, August 14, which we have looked at very extensively. There are interesting common threads between the two, but the most striking common thread that is in both cases, both in the 9/11 attack and in the Northeast power blackout, is the people responsible for the command, control, surveillance and orderly response, in both cases, had little visibility into what was happening, did not understand what was going on, had not planned, trained or equipped themselves for responding to the threat, and were basically working in an environment of substantial confusion when determined action would have very, very beneficial.

What we are proposing in our schedule of activities that I just described is that we overcome that tendency not to understand disasters before they occur and make good preparation for it. That is not an expensive activity, but it is a very valuable one.

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We will address further conclusions and recommendations particularly associated with military capabilities of the U.S. in closed session because of the classification of the issues.

Finally, Mr. Chairman, I would like to say again that the EMP threat, as you have identified, is one of the few potentially catastrophic threats to the U.S. By taking action, the threat can be reduced certainly to much lower levels than it is today, that the U.S. strategy to address the threat should balance prevention, preparation, protection and recovery, and that critical military capabilities must be survivable and enduring to underwrite U.S. global strategy.

The threat is real, the opportunity is at hand to address it, and the way forward, I believe, is clear.

Thank you very much.

[The prepared statement of Dr. Graham can be viewed in the hard copy.]

The CHAIRMAN. Well, thank you, Mr. Chairman, and thank you to all the members of the Commission.

Let me go back to your last point on military survivability of critical core areas. If you were going to give a grade to the U.S. military, I would say up through the end of the Cold War, in terms of having protection against EMP, what would you give them? If you give them a grade, not an A, B, C, D, E, F, but, say, if a 10 was the best and a 1 was the worst, where would you go?

I would ask any Members to chime in on this. Let me make that two-piece question. Where do you think we have gone since the end of the Cold War? Has there been a difference? Were we doing a good job before? Are we doing a poor job now? Has it been moderate in both eras?

Dr. GRAHAM. Let me call on General Lawson, if I might, since he was in line command positions in the military for many years before he retired, and then also ask any of the other commissioners that might wish to respond to the question.

General LAWSON. Mr. Chairman, I think that if you talk about the military structure, we started in our deliberations and our actions in response to EMP threats with the strategic forces. I think we went from somewhere around a two or a three, and, over the years, we have built up both the knowledge and the capability so that our strategic forces I would assess somewhere between a seven and a eight.

I think, since that time, since the wall came down, as we got into the acquisition of newer forces and so on, there were some aspects of those newer forces that we continued with some pieces of the hardening programs, and we understood hardening all that well, but the attention given to hardening vis-a-vis other things that we wanted to put in terms of capability aboard those weapons systems, I guess I would say that we moved hardening from the absolutely required item in the development of new weapons systems to a nice-to-have kind of an idea.

At the very same time, though—and this is the issue that I think we slipped the most in—at the very same time that we were relaxing our attention to hardening, we were extraordinarily increasing the electronic systems, circuits in those systems so that not only were the weapons systems themselves more susceptible to EMP, but the command and control directions that would be given to them were much more susceptible.

As a result, the overall situation would take us to where I would say we are somewhere in the four to five range at best today and moving in the wrong direction. The priorities have eroded for both philosophical reasons and reality reasons, and, as a result, there is not the kind of personal attention.

That is why one of the items that we put into the report was the personal attention of the Secretary, the service Secretaries, the service Chiefs and the Chairman. It is going to require that kind of attention to get down into the military bureaucracy the importance of this issue.

The CHAIRMAN. Thank you very much, General.

I would like to go right down the line on this point: where we have been, where we were at one time, where we have gone and how reasonable it would be to get back to what we think would be an adequate level.

If we go right down the line, Mr. Gjelde, do you have a position on that?

Mr. GJELDE. Yes, sir. I concur completely in what General Lawson had to say and would suggest that the pervasiveness of electronics in our military system and capability to project force, as we use it and as we have seen it in recent days, is something that is extremely vulnerable and not at all protected.

The CHAIRMAN. Okay.

Dr. Woodard.

Dr. WOODARD. Something I would add is that we did in our reviews through the last two years discover that there are places within the military today where, because of individual leadership and their attention to this, that it is doable to have robust systems in place with good maintenance and testing and viability hardening maintained in the systems that are out there in the strategic forces. So there are pockets with good leadership that are contributing today to what we have in the four to five range.

The CHAIRMAN. There are pockets of what you would call robust protection.

Dr. GRAHAM. Let me come back after my fellow commissioners respond, Mr. Chairman.

The CHAIRMAN. Okay. Yes.

Dr. Foster.

Dr. FOSTER. Well, Mr. Chairman, I agree with what has been said. It seems to me that, with the end of the Cold War, the U.S. phased down its nuclear weapons focus and program in priority. So it phased that down. At the same time, we entered a new environment, a different set of potential adversaries.

To face up to that situation and the asymmetries that everyone has talked about, we did make a very aggressive and effective effort at attaining a very remarkable conventional military capability. But we have not modernized the nuclear stockpile nor for the current situation, and nor have we had any major efforts underway to redress the vulnerabilities that have increased, both in the military and in the civilian sector, to the possible attacks that have been discussed.

The CHAIRMAN. Okay. Thank you.

Dr. Wood.

Dr. WOOD. It is perhaps quite important to understand, Mr. Chairman, that while these trends that my colleagues have just spoken to and that Dr. Foster summarized extremely well have been occurring, that the cost to fix problems with respect to EMP vulnerability are roughly a factor of ten more expensive than the cost to prevent those problems from arising in the first place.

If you design and build a system to be EMP robust, it adds something on the order of one percent to the cost of that military system. If you go back afterwards and try and inject EMP robustness into a system that is already deployed in the field, the cost is roughly a factor of ten higher. It could be ten percent. It could be as much as 20 percent.

So the trend that we have seen since the end of the Cold War is especially worrisome in that fixing the problems, the vulnerabilities that we have built into our systems, as they have become technologically advanced, it is going to be much more expensive than having prevented those problems from arising or occurring in the first place.

So it is crucial to recognize these early and to start the fixes soon so that we do not continue to pile up due bills for the out-years, the out-decades, having EMP-vulnerable military systems that did not need to be and at relatively very modest cost early on could have been prevented from being vulnerable.

The CHAIRMAN. So you think we should mandate the spec going in at least with strategic systems?

Dr. WOOD. At the very least, with respect to any systems, sir, that we wish to have work in wartime. As my colleagues have pointed out, the strategic systems of this country are relatively robust. In absolute terms, not robust at all, but they are relatively robust.

The conventional military forces' systems, as my colleagues have pointed out, are very soft, indeed. If we do not wish to have those systems work in an EMP environment, we are in a fine posture at the present time. If they are ever called upon to work, we are in danger of suffering grave losses and likely military defeat.

The CHAIRMAN. Mr. Kluepfel.

Mr. KLUEPFEL. I totally agree with all the Commissioners' comments so far. We did hear from some of the forces that they are putting more discipline into the future systems, and the idea of putting it in early into this Future Combat Systems was recognized and testified to.

You know, Congressman Bartlett was there at the time I was at the Dahlgren testing site, and one of the questions he asked was "Is this really reflective of a true nuclear test, the pulse testing?" and the point that he made out to General Marsh about the insurance, "Would you cancel your insurance?," the military is critically dependent upon commercial systems, telecommunications systems, to support the military mission.

The President's National Security Telecommunications Advisory Committee (NSTAC) has looked at that since 1985 and actually has seen and tested and recognized that it is a problem with respect to EMP. You hit things hard enough, and things will break. Although they had good results, they found out you have to add it to the standards, just like insurance. You have to add it to the standards and the requirements, and all of that has been done in the past. So telecommunications is good news. It is relatively robust.

But the military, to answer your question, Chairman Hunter, needs to take a real hard serious look at the standards and implement those.

Dr. GRAHAM. Mr. Chairman, may I make one additional comment?

That is that after the end of the Cold War and after the Comprehensive Test Ban Treaty was negotiated, the Department of Energy established a Stockpile Stewardship Program. While we are not developing new nuclear weapons today, at least part of the intention of that program is to maintain and continue a cadre of people expert in nuclear weapon design and expert in understanding the functioning of nuclear weapons. It is a substantial program in the Department of Defense.

However, no such program was implemented within the Department of Defense to maintain and promulgate our skill and capabilities in nuclear weapons effects, protection, hardening, maintenance, surveillance and so on. That just came very close to falling off the table.

Small efforts have been done to recapture what we have learned, generally by people who are otherwise retiring from the business, but to maintain a cadre, to continue it, to train the next generation, to keep the simulation and test facilities going, none of that has been done.

If you look at the Stockpile Stewardship Program and you look at the Nuclear Weapons Effects Program, it is like night and day, and I believe there is no justification for such a neglect of the Nuclear Weapons Effects Program within the government.

The CHAIRMAN. Johnny Foster, you looked like you were reacting to that. Do you concur with that?

Dr. FOSTER. I certainly do, Mr. Chairman.

The CHAIRMAN. Okay. Thank you very much, folks.

Mr. Skelton.

STATEMENT OF HON. IKE SKELTON, A REPRESENTATIVE FROM MISSOURI, RANKING MEMBER, COMMITTEE ON ARMED SERVICES

Mr. SKELTON. Mr. Chairman, thanks for calling this hearing. It is very interesting. We have heard Mr. Weldon and Mr. Bartlett speak on this issue for some time, and we appreciate the experts here. I have an observation and one question.

The observation is it would be interesting for someone to dovetail your recommendations with the recommendations that are coming forth from the briefing we had at 7:30 this morning from the Kean-Hamilton Commission on September 11. I think that might prove very fruitful for someone to do that. I pass it on to you, Dr. Graham.

My question is this: Other than the one 1962 experience that you had regarding Hawaii, are there any other experiences that you had which would lead you to believe the catastrophic nature of such a blast in the air, going all the way back to Hiroshima, Nagasaki and all the way through the various tests that we have had through the years?

Dr. GRAHAM. Yes, Mr. Skelton. I will call on Dr. Wood to address this further because I know he is studied this at length.

We certainly have the reports that we have received from Soviet test activities, nuclear weapons test activities at high altitude, that confirm our own views on that, and we believe there is more information available there if the U.S. would just get organized in a deliberate effort to obtain that information.

We actually had one more seminar planned, but we were not able to get the visas approved in time to get the scientists in to talk to us about it, but they were willing to do that under reasonable circumstances. But what we have seen from their data suggests that, in fact, they have observed what we have observed.

We have also observed the EMP effects and even the subtleties that make the high-altitude effects so pervasive from lower-altitude tests. They are not as extensive, but the geomagnetic turning effects are there on lower-altitude tests as well.

Finally, we have compared calculations with the Russians and others, and there is a general agreement of this effect, although our estimates may be as much as a factor or two lower than the Russian estimates, and we have not completely resolved that yet.

Finally, there is a phenomenon called the geomagnetic storm that can occur during particular parts of the sunspot cycle that perturb the earth's magnetic field and produce large, but low-frequency currents, similar to what large-yield nuclear weapons produce.

We had an instance in 1989 when a large geomagnetic storm led to the functional collapse of the Hydro-Quebec power generation system, and the U.S. is the primary customer for that power. So we lost a very substantial amount of power from Canada.

If you would like more details on that, I know Mr. Gjelde, who was formerly the chief engineer for the Bonneville Power Administration, would be glad to talk to you about that.

But perhaps Dr. Wood has a comment first.

Dr. WOOD. I would just underscore the remarks made by Chairman Graham with respect to the uniformity and the consistency of the measurements that have been made of high-altitude EMP by the United States and the Soviet Union primarily.

EMP is produced primarily and in its most spectacular forms only by high-altitude nuclear explosions, sir, so that the Japanese raids, the early testing that was done in the Pacific and over Nevada, and so forth is not particularly relevant because those explosions occurred at such low altitudes.

At the higher-altitude explosions in the late 1950's and the early 1960's, in the atmospheric test series of both the United States and the Soviet Union, EMP was consistently observed at the levels that were subsequently rationalized and seen to be a consistent body of physical evidence.

This is particularly strong in the circumstance of the Soviet Union where they detonated most of their high-altitude explosions over their own territory and, thus, had an opportunity to make extensive measurements. That large body of physical data has come forth in a somewhat fragmentary fashion, idiosyncratic fashion really over the years.

But, since the end of the Cold War, in particular in the context of cooperation against large-scale terrorism, Russian workers and, indeed, the Russian government has indicated a willingness to collaborate with the United States against the common threat that EMP poses to both the Russian Federation and the United States in the hands of both state-substate-scale actors to Russian and American civilizations.

So there is the prospect for substantially improved understanding in the United States as far as what was actually observed, but the large program that the government supported from the early 1960's up into the early 1990's to understand nuclear weaponry effects has run a very consistent thread through the limited body of experimental data that exists to the end of atmospheric testing.

So, yes, there is an experimental base upon which a very substantial edifice of detailed technical understanding with simulation and calculation has been erected.

Mr. SKELTON. Mr. Chairman, thank you.

The CHAIRMAN. Oh, yes.

Dr. Foster, go ahead.

Dr. FOSTER. Well, Mr. Chairman, I agree with the points that have been made by my colleagues. I would just like to sort of make a summary point, and that is, yes, there is some uncertainty in the type of nuclear warhead that might be burst overhead, and, for any type of warhead, there is some uncertainty in the kind of fields that would be produced. However, there is no uncertainty about our vulnerability. There is a certainty that we can do something about it.

The CHAIRMAN. Thank you very much.

Mr. Weldon.

Mr. WELDON. Thank you.

Thank you all for your outstanding work, and, Dr. Foster, I think you hit the nail on the head with that very profound statement. Hopefully, that is a wakeup call for this country to finally pay attention to the potential effects of EMP by our adversaries.

Based upon what I have heard here—and I am not a scientist and never pretend to be one—if a country has the capability of, say, a low-complexity Scud missile system or, certainly, the Shahab system that Iran now has or the systems that North Korea possesses, both No Dong and Taepo Dong, if they couple that with a crude nuclear weapon, they, in fact, have an EMP capability, although you could debate the effectiveness of that EMP capability.

Is that correct, Dr. Graham?

Dr. GRAHAM. It is correct, but I would add to it that if a country or a group wished to conduct an EMP attack, they would in all likelihood think about the nuclear weapon design and think about the design type that would produce the greatest effect within the limits of their technology.

We are concerned that a great deal is known about that subject today in the world, and, therefore, it is not a secret, which is available only to the U.S. and, say, to the Russians. We can go into the specifics of that more in closed session, if you wish.

Mr. WELDON. Dr. Graham and other members, my understanding of the Chinese and the People's Liberation Army (PLA) is that they have a very robust program, both in terms of cyberwarfare, nuclear capability and potential use of EMP, and perhaps we should ask for a response as to whether or not you think this is plausible, since Jiang Zemin just this past week, for the first time that I know of in the modern history of China and Taiwan relations—or the entire history of China and Taiwan relations—placed a date certain that Taiwan would be brought back into the fold of China and that date certain is 2020. They have never given a date before.

Now, with the Chinese coming out with such a bold statement by Jiang Zemin, who now heads the Chinese military, since his retirement from the political leadership, would it not be plausible that the Chinese would do a burst over Taiwan, and, if they did such a burst, what would it do to Taiwan's ability to defend themselves, to respond and to operate as a civil society? Would it make it significantly easier for the Chinese to then simply overrun Taiwan as a nation?

Dr. GRAHAM. Congressman Weldon, we did not look specifically at Taiwan, but I have been there several times and know it is a rapidly evolving modern society, which itself has an increasing dependence

on electronics, both in its civil infrastructure and in its military capabilities, and, therefore, it would have the associated vulnerability that comes from that dependence on electronics.

Furthermore, their dependence on U.S. forces able to deploy in that area would also reflect a potential vulnerability to EMP, since many of those forces have fallen under the same general policy that particularly our general purpose forces have fallen under historically and certainly in the last decade.

Mr. WELDON. Some of the issues raised, Mr. Chairman, by the members of the commission underscore the need for what we did last year, even though we had to fight the Senate and actually fight the administration for a while, in establishing a nuclear strategy forum, which Dr. Foster is a leader on.

The nuclear strategy forum was designed to have discussions about these very problems and lack of understanding and awareness relative to the need for additional testing, the status of our nuclear stockpile, and so I would just underscore to my colleagues that that event last year that we pushed in the House, I think, is now very visibly evident that it is critical because of a need for us to understand fully not just what our nuclear strategy should be, but the nuclear effects issue.

So I would just say to my colleagues that I think we were well-advised in doing what we did.

Let me get into the area of the joint U.S.-Russian initiative that Dr. Wood mentioned. It just so happens that last year in our defense bill, we created the establishment of the Teller-Kurchatov Alliance for Peace. Edward Teller and Igor Kurchatov were the two fathers of the nuclear weapons in both the U.S. and Russia.

Now the head of Kurchatov Institute, Dr. Evgeny Velikhov, is very eager to establish a more proactive relationship for the peaceful purposes of dealing with nuclear energy. Is that, Dr. Wood, potentially a forum since Livermore is involved with that effort, to begin a formal process of engaging the Russians?

They just changed their chief of military operations this past week. General Baluevskii has now been put in the head position. I had a chance to meet with him one month ago in Moscow. He has now taken General Kvashnin's place as the top military general, and I think he has a different outlook on perhaps U.S. American relations and the military.

So, Dr. Wood, would that be perhaps a vehicle that we could begin to move aggressively into what you alluded to?

Dr. WOOD. Yes, Mr. Weldon, I believe that that is, indeed, the case. The recent events in the Russian military to which you referred, of course, appear, at least on the surface, to be somewhat hopeful in respect to the progress of more collegial relationships between the American and Russian military establishments, the potential collaboration with leaders, civilian leaders, then Soviet, now Russian military technologists, such as academicians.

Evgeny Velikhov, the head of the Kurchatov Institute personifies, I believe, at least has prospects. So I very much applaud the committee's initiatives along these lines, both with respect to the Teller-Kurchatov fellowships and the nuclear strategy forum initiative.

These are directions in which U.S. policy and practice surely should go.

Mr. WELDON. Excellent. I thank you for those very encouraging words.

One final issue—I know my time has expired—we have not talked about, which, I think, is the ultimate question for America, and that is the moral ethical dilemma caused by an EMP laydown. We understand what would happen if America were attacked with a nuclear warhead. It would be a quick, it would be a decisive response.

I do not think America has yet thought through what our response would be if a freighter off of our coast with a low-complexity Scud missile on a nuclear warhead was launched, and it took out the entire

information technology (IT) capability for the East Coast, what our response would be if no one were directly injured by that attack.

In fact, is that a concern that we should be looking at, the moral, ethical issue of what we would do in case of an EMP laydown either by a known nation or by an unknown adversary?

Dr. GRAHAM. Mr. Chairman, we reflected on that as a possibility, noting in particular that one of the motivations for an EMP versus a direct nuclear attack by a hostile power might be to try to mitigate our response to it, and it is much as you describe, a dilemma. We did not explore extensively what particular response we might have.

Perhaps one of my fellow commissioners would like to say something further about it. Dr. Wood?

Dr. WOOD. Mr. Chairman, it is a matter of historical record that the United States took the lead in establishing the legitimacy of nuclear explosions at high altitude and in space over international waters over 4.5 decades ago, the Argus experiments, which led to the discovery at least in the military context of the Van Allen radiation belts.

So there can be very little doubt with respect to international law and historical precedent that the detonation of nuclear explosives over international waters is something that certainly we as a nation asserted the right to engage in. So there has to be a lot of consideration these days in the context of a civilization, which is vastly more dependent and also much more soft with respect to EMP considerations than was the case in the days of the Argus experiments to which I referred.

Exactly what are the international norms, what does international law say, if anything, and what is our posture if people detonated nuclear explosives over, say, the sea of Japan or off the Atlantic coast or whatever? The intent might be malicious and, indeed, the impact might be catastrophic on the United States or on its friends or forces abroad, but the precedents and the lack of international law in those circumstances lies in front of us all.

The CHAIRMAN. I thank the gentleman.

Mr. Israel.

Mr. ISRAEL. Thank you, Mr. Chairman.

Thank you very much for your service to our country in addressing this critical issue.

I have the privilege of co-chairing the Congressional Advisory Group at the National Defense University (NDU) which engages in a variety of tabletop exercises and simulations. Mr. Bartlett and I just attended an NDU tabletop with respect to the Straits of the Taiwan just last week.

To your knowledge, has there been any tabletop exercise, has there been any simulation, any war-game that anticipates an EMP attack, and, if there has not been, do you believe that that would, in fact, be a useful exercise for NDU, the Pentagon or any other relevant entity?

Dr. Graham, do you want to answer that?

Dr. GRAHAM. Thank you. Let me poll the Commission and see if they have any experience with that.

General Lawson.

General LAWSON. No, sir.

Dr. GRAHAM. Dr. Wood.

Dr. WOOD. I do not believe there has been any formal exercise, certainly not to my knowledge. There has been extensive discussion of what the impact of Chinese EMP laydowns would be, not on Taiwan,

which is, after all, considered by China to be part of its own territory, but on U.S. forces in the region which might be involved in the active defense of Taiwan.

In particular, the consequences of EMP laydown on U.S. carrier task forces has been explored, and, while it is not appropriate to discuss the details in an open session like this, the assessed consequences of such an attack, a single-explosion attack, are very somber.

Since that is a circumstance in which the target might be considered a pure military one in which the loss of life might be relatively small, but the loss of military capability might be absolutely staggering, it poses a very attractive option, at least for consideration on the part of the Chinese military.

I would also remark that Chinese nuclear explosive workers at their very cloistered research center in northwestern China very recently published an authoritative digest and technical commentary on EMP in English, in a Chinese publication.

It is very difficult to understand what the purpose of publishing a lengthy, authoritative article in English in a Chinese publication would be, if it was not to convey a very pointed message. This came not from military workers. It came from the people who would be fielding the weapon that would conduct the attack.

Dr. GRAHAM. Dr. Pry on our staff has made a survey of foreign writings on EMP, and he noted that while U.S. exercises have not to our knowledge played that scenario, Chinese military writings have discussed that scenario. So it is certainly something they have thought of and it is within their mind.

I have observed generally over the last 40 years that there is a tendency in the U.S. military not to introduce nuclear weapons in general and EMP in particular into exercise scenarios or game scenarios because it tends to end the game, and that is not a good sign. I think it would be a very interesting subject for the NDU group to take up and see and force them not to end the game. Time will not stop if such an event happens. Let them understand what the consequences will be.

Mr. ISRAEL. Mr. Kluepfel.

Mr. KLUEPFEL. Yes, Congressman Israel, I just wanted to mention that when we performed outreach to the financial community and telecommunications community, both of those at senior levels suggested that this ought to be included in the homeland security tabletop exercises because of the significant and overwhelming consequences of the attack with respect to the electric power.

Telecommunications is rather robust, but it would cause a great deal of congestion that you would need emergency tickets—they would be national technical systems (NTS)—put together during that period of congestion, and power is lost for extended periods sometimes. It would be a real problem.

So the recommendation that we got back from the seniors is that there ought to be included in that tabletop exercises.

Mr. ISRAEL. So, in view of that rather sobering news that our adversaries may, in fact, be engaging in these exercises and we, to your knowledge, have not engaged in those exercises, you believe that it would be useful for NDU to conduct that kind of exercise?

Dr. GRAHAM. Yes, I believe that it would, and I believe the commission concurs.

Mr. ISRAEL. Thank you.

I am going to invite my colleagues, those who are interested, to join me in suggesting to NDU that they begin organizing that kind of exercise.

Thank you, Mr. Chairman. I yield back.

Mr. WELDON [presiding]. I thank the gentleman for making an excellent point, and I would be happy to join with him in some communication to the NDU in that regard.

Mr. Bartlett is recognized.

Mr. BARTLETT. Thank you.

One of you mentioned collateral effects, and I noticed that in your little description of what happened at Starfish that you made the note that the sky was swept clean of satellites. Would you tell us what a single high-altitude burst of a large weapon anywhere in the world would do to the world's satellites?

Dr. GRAHAM. Yes. Mr. Bartlett, we recognize that you could not create a high-altitude EMP with a nuclear explosion without also producing other effects, and one of the most significant would be pumping the Van Allen belts with radiation from the nuclear explosion.

This was discovered during the 1962 test series, and it was not predicted. In fact, the effect was predicted the other way, that it would dump the Van Allen belts. In fact, it raised their level of radiation very substantially.

The effect is that for low-earth orbit satellites, which include some of our overhead collection systems, some telecommunications systems, although not the majority of them which tend to be geosynchronous rather than low-earth orbit, and some other types of satellites, the satellite would degrade very rapidly to the point where within a matter of days to weeks, it would no longer be functional, unless the satellite was specifically hardened to an elevated radiation level in the Van Allen belts before the satellite was placed on orbit. To my knowledge, no commercial satellites have been hardened to that degree.

As you go higher in orbit, by the time you get halfway to synchronous altitude where the global positioning satellites orbit, the constellation of them orbit, it is likely that only the direct exposure of the large yields, putting immediate radiation on the satellites, could upset or damage them.

When you go to geosynchronous orbit where our telecommunication relays tend to be because they are at a fixed point in the sky, then it would take a burst of substantial size and certainly in line of sight to those satellites to cause them problems.

So the major concern is the low-earth orbit satellites, and you can more or less figure those are going to be gone within days to weeks after a high-altitude nuclear burst, unless they have been specifically hardened to the high-altitude nuclear effect, and that is something that is costly enough that it would not be done for any commercial satellite without further motivation.

Mr. BARTLETT. Dr. Wood.

Dr. WOOD. I agree with everything that Chairman Graham just remarked, and I think he summarized it very cogently.

I would comment that the feature of high-altitude nuclear explosives that pump the Van Allen belts and induce this rapid failure of satellites is their fission explosive yield. It is the fission products that are injected into the Van Allen belts that cause the so-called burndown of unhardened satellites, which, of course, as he said, includes all commercial ones in low-earth orbits.

Particular types of EMP explosives might not have a large fraction of their total energy in the form of fission yield, and, indeed, advanced EMP-type explosives might have only very small fission yields, and we can go into this in more detail in the briefing subsequently.

It is not uniformly the case that high-altitude explosions aimed at producing EMP will destroy satellites at even the low-earth orbit. It is certainly the case for conventional nuclear weaponry; for advanced EMP weaponry, perhaps not.

Mr. BARTLETT. I have a number of questions and presume that there will be other rounds here and opportunity in the closed session.

If China were to detonate a weapon high over our carrier task force, can we note in this session what would the effects on the carrier task force be?

Dr. GRAHAM. Mr. Bartlett, several years ago, the Navy dismantled the one simulator it had for exposing ships directly. It was the Empress simulator located in the Chesapeake Bay. So I do not believe any direct experimental work has been done for quite some time.

However, the general character of modern naval forces follows the other trends we have described, which is an increasing dependence upon sophisticated electronics for its functionality, and, therefore, I believe there is substantial reason to be concerned.

Any other commissioners?

Mr. BARTLETT. Dr. Wood.

Dr. WOOD. In open session, sir, I do not believe it is appropriate to go much further than the comment that I made to Mr. Israel that the assessments that are made of such attacks and their impacts are very somber.

The Navy generally believes, that portion of the Navy that is at all cognizant of these matters, that because they operate in an extremely radar-intensive environment, they have a great deal of electromagnetic gear on board, some of which radiates pulses—radar pulses, for instance—because they can operate in that type of environment, that they surely must be EMP robust.

These free-floating beliefs on the part of some Navy officers are not—repeat not—well grounded technically.

Mr. BARTLETT. Just one final question—then I will come back in another round—you mentioned the disruptive effects of the geomagnetic storm. In terms of relative intensity, how does a geomagnetic storm compare to a large—and I understand that the Soviet and now the Russian these scientists actually built nuclear weapons that are EMP enhanced. Relatively, how powerful would the effects of a high-altitude EMP blast be as compared to a geomagnetic storm?

Dr. GRAHAM. Let me ask Commissioner Gjelde to respond to that, Mr. Bartlett.

Mr. GJELDE. We have experience with geomagnetic storms disrupting electrical power systems, as the Chairman had mentioned earlier on with Hydro-Quebec, and in the northern regions of the United Kingdom and of Scandinavia. Perhaps they are in Russia as well. We do not have information on that.

These are relatively lower yield in comparison to a larger EMP weapon that would take place. The characteristics of EMP are multiple. One aspect of the EMP burst is to create a geomagnetic pulse in the system that is translated or collected through large transmission lines and then creates a big direct current which then hits the end of the line, if you will, on that and the equipment on the end of the line and can damage it.

The analysis that we had run for the commission indicated that probably a 100-year geomagnetic storm would be equivalent to a modest-sized nuclear weapon that provided a similar component, but recognizing with an EMP weapon there are other characteristics that occur in time and in nature ahead of this singular aspect of geomagnetic equivalence.

So the risk from an EMP weapon is that these other phenomena disrupt the electronic protective systems on electrical systems. Then, in effect, when the equivalent of a geomagnetic storm hits, it blows right through what would have been protective systems and goes in to damage equipment.

Mr. BARTLETT. Thank you.

Thank you, Mr. Chairman.

Dr. GRAHAM. Let me add, Mr. Bartlett, but very briefly in passing that we thought there were significant collateral benefits from providing better understanding, preparation and protection from EMP which would affect us in other situations than a nuclear high-altitude burst.

This is one, that if, in fact, we prepare the network and our response, our training to be able to respond to geomagnetic storms better and particularly large geomagnetic storms, that will help its EMP hardening. Obviously, the converse is true as well, that if we do the EMP hardening, the power grid is more likely to continue to function through this geomagnetic storms.

Mr. WELDON. I thank the gentleman.

Mr. Trent is recognized.

Mr. FRANKS. Thank you, Mr. Chairman.

Mr. WELDON. I meant Trent Franks. I am sorry. I said Mr. Trent. I meant Mr. Franks.

Mr. FRANKS. It is all right. Thank you, Mr. Chairman.

Panel members, you know, I believe that commissions such as yourselves are essentially America's invisible front line because it is said that the more a nation sweats in peace, the less it bleeds in war, and I truly believe that you folks should be commended in a profound way because you have not only identified a significant threat to our stability and our defense, but that you have given thoughts to the priority responses that we might have.

I have to say I think that probably the biggest challenge in something like this, you know, especially those of us that are not as well versed in the science of what you deal with, is it seems like you presented an array of pretty significant threats and a broad plethora of issues, and I think that the essence of good leadership is being able to separate the critical from the peripheral.

Having said that, it is probably an unfair question, but if you were the czars of the day, if you were to try to point out what you think is our number one priority response to this issue in terms of defense as a nation, not so much in maintaining our other infrastructure, but defense of the Nation to keep us at least capable of defending ourselves post an EMP attack, what would be your advice to this committee to begin to pursue in terms of, as I say, the number one priority?

If you just had one, what would it be?

Dr. GRAHAM. Well, you may get a range of answers.

I will start by saying that I think the number one priority would be to make our leadership aware of this threat and to ask them to begin a systematic process of preparing to deal with it before we are faced with the threat, rather than the situation we seem to be in so often which is to basically be unaware of a type of threat until it occurs and then suddenly be faced with very critical decisions with essentially no time to analyze what is happening and plan for that response.

I think flowing from that would be a very productive set of actions that could prepare us for this and allow us to recover as effectively as possible.

Having said that, let me ask the other Commissioners if they have other thoughts.

Dr. Wood.

Dr. WOOD. Tasks facing the Congress with respect to the EMP threat may be bunched into three classic stacks, Mr. Franks: to find and declare national policy and issue mandates to the executive;

number two, to prudently provide enabling resources; and, three, to oversee the executive implementing actions in a diligent and persistent manner.

There is a time-honored recipe for sweating in peacetime rather than bleeding in wartime, and it is respected because it invariably does the job when it is done well. You of the Armed Services Committee have been commendably proactive in recognizing the problem that you have led the Federal Government in the creation and tasking of the EMP commission.

The task immediately before you, I believe, is to consider our core recommendations and see whichever of them conform to your wisdom and to the fiscal year 2005 authorizations of the Defense and Homeland Security Departments and conference actions during the next few months.

The key recommendation is thoughtful, action-laden annual reporting from both departments to the Congress on executive actions taken and legislative steps needed to effectively and efficiently move the nation's EMP defensive agenda.

A sentinel action which the committee itself might take is the designation of a senior staff member to carry out the committee's policies regarding EMP as a full-time responsibility, thereby signalling to everybody the committee's seriousness of purpose and commitment to follow through on the full set of EMP issues.

It is well known that a single serious and dedicated staffer can make an enormous impact if he or she clearly enjoys the committee's confidence and backing, and it is an impact at this scale that is now called for, Mr. Chairman, if the EMP issue is to be seriously joined by the entire Federal Government over the next few years.

Thank you, sir.

Mr. FRANKS. Thank you, sir. That is a good answer.

I am just about out of time here, and I have a question that I think is going to be more appropriate in the classified area, but, just briefly, it seems that the altitude factor, both in terms of the weapon itself and in terms of the position of the satellites that might be damaged by it, is a big issue, and the type of weapon, whether the EMP yield is enhanced.

Can you just give us the briefest overview on that, and then I will thank you all very much.

Dr. GRAHAM. Perhaps, as far as the phenomenology is concerned, I could say a word, and then Dr. Foster, Dr. Wood, Dr. Woodard might want to comment further on the weapon type since they all are associated or have been associated with the national laboratories. Of course, Mr. Gjelde was the chief operating officer of the Department of Energy at one time as well. So I am surrounded by experts in the weapons business.

But, as far as the phenomena goes, somewhere in the vicinity of 30 to 40 kilometers and up from there to many hundred kilometers, the high-altitude EMP phenomena will produce significant fields as far as the effects they can produce in the atmosphere and on the surface of the earth are concerned. So that is a first approximation to the altitude range.

It tends to be for some of the components of the electromagnetic effect a line-of-sight phenomena which is why Starfish effected Hawaii, even though it was 800 miles away. It was still within line of sight, although low on the horizon.

I suspect we would all be more comfortable to discuss the nuclear weapon design issues and characteristics in the closed session, but let me see if any of my colleagues want to say something about that here.

Dr. Wood.

Dr. WOOD. Chairman Graham has summarized it very cogently, 30 to 300 kilometers altitude is the one, depending on whether you are interested in having very localized effects or going up toward 300 kilometers that is the nominal altitude that is always quoted for a bomb burst over Omaha being able to EMP impact the entire continental United States. So that brackets it.

It depends somewhat on the yield, the type of weapon and so forth, matters that, as the Chairman said, are best discussed in the classified briefing.

Mr. KLUEPFEL. One other comment, Mr. Franks, is that when the Congress recognized the satellite infrastructure as a critical infrastructure for the United States, that created a problem in that the commercial satellite is not protected as well as it ought to be.

Mr. Teets, the then Chairman of the National Security Space Architect, asked the NSTAC to look at the problem of the vulnerability of the commercial satellites, and the commissioner testified to the impact on low-earth orbit satellites.

So it is in the NSTAC's satellite task force report that was issued, and so the commercial satellite providers around the table were convinced that they were extremely vulnerable to this because the EMP hardening had not been applied, had not been requested for low-earth orbits.

Mr. WELDON. Thank you, Mr. Franks.

Dr. Gingrey is recognized.

Dr. GINGREY. Thank you, Mr. Chairman.

I hope you can answer this question. I may not be able to get to the closed session, but, obviously, if it is not appropriate for open session, we can save it for then.

In the overall context of the things that we worry about, obviously, there is a lot more, I think, public awareness of the threat of chemical, biological and nuclear weapons. Obviously, we are talking about that a lot in search for evidence of and that sort of thing. In Operation Iraqi and Enduring Freedom, you do not hear a lot about EMP threat.

How would you give those threats a relative value scale, if you will, or is it more a cascade of, let's say, if we were subject to an EMP attack? Then is our great fear the follow-up would be that this would be a hand-in-glove operation and either a nuclear or a chemical or a biological attack would come cascading down that we really could not respond to because we had disrupted all of our ability to defend ourselves because we are so dependent upon electromagnetic technology?

Dr. GRAHAM. Well, I am sure we all share your view that we are more comfortable in discussing this in a closed session, but I think we can say that the various effects you described and the various types of threats are not mutually exclusive and, in fact, in combination can be of even greater impact than any one of them alone at a time.

So I think your concern is very well justified and something that we should include in our thinking about this fortunately relatively small set of types of attacks that can have very, very substantial, adverse implications to the U.S.

Are there other comments?

Mr. KLUEPFEL. Yes.

Mr. Gingrey, I would also put in there cyber attack. I have been involved in the assessment of attacks against the telecommunications and the communications infrastructures, and the worst time to suffer an attack is when you are trying to reconstitute and recover. So I think the potential of someone recognizing an EMP in hand with a combined cyberattack at the time when your defenses are low is real.

Dr. WOOD. Then just following up on the Chairman's point, a very standard error that we Americans tend to fall into is what I was taught many decades ago to think of as the "blue-preferred red attacks." There are many types of attacks that we, in some sense, would welcome at least in relative terms because we are well prepared to deal with them.

But the blue-preferred red attacks are not the red-preferred red attacks. We found that out very dramatically on 9/11. We simply were totally unprepared in that particular context to be attacked, and the consequences were devastating.

We have to expect that our adversaries will attack us in fashions that are maximally convenient for them and maximally damaging for us, and EMP is such a flavor of attack.

Mr. WELDON. I thank the gentleman.

I just have one follow-up question before we move to the closed session. I know Mr. Bartlett probably has other opening questions.

But our job here is—as you know, we are not scientists, except for people like Roscoe. We are lay personnel who have the responsibility to set the policy for our security—to take the information and work with our military establishment to respond to threats that we identify.

But our other job is to take the threats and do as much as possible, simplify them for our other colleagues who are not on this committee and who will not take the time to sit through an EMP hearing and try to characterize the nature of this threat, as Dr. Gingrey just tried to do, in relation to everything else.

So I am going to try to simplify this. This is a very nonscientific process, but I am going to compare the threat to the threat that we have had of ballistic missile attack against our troops and our country.

I would still characterize that threat as one that we are still unprotected but moving in the right direction to provide an ultimate layer of protection to a number of different technology and scenarios.

I would characterize the threat from an EMP laydown as unprotected moving in the wrong direction. Would you all agree with that?

Dr. GRAHAM. Yes, sir.

Dr. WOOD. Yes.

Mr. WELDON. Would each of you?

Mr. KLUEPFEL. Yes.

General LAWSON. Yes.

Mr. WELDON. Anyone disagree with that characterization?

Dr. WOOD. Crucially, Mr. Chairman, it is important to understand that with the end of the Cold War where we worried about EMP attacks conducted with megaton weaponry, nowadays we look to advanced EMP attacks which might be conducted with an entirely different class of weaponry, kiloton-scale weaponry, something very different under the sun.

Mr. WELDON. Yes, sir?

Mr. KLUEPFEL. Yes, Mr. Chairman. If you combine the interdependencies of critical infrastructures, although I said telecommunications is quite robust, you know, no one infrastructure can survive on its own, and, if you lose electric power over an extended period of time, we are really hurting.

Mr. WELDON. So let the record show that all seven commissioners present agree that they would characterize, as I did, the threat as one of being unprotected moving in the wrong direction.

Mr. Bartlett is recognized.

Mr. BARTLETT. I would just like to follow up on the question that Dr. Gingrey asked about our vulnerability and the possibility that after a robust EMP laydown, they would then take advantage of our weakness to attack us with a biological or a chemical weapon.

Dr. Woodard, just about a year ago, I spent four or five hours in a very good briefing in your institution, and I just want to ask you about the scene that some might paint of the potential of an EMP attack. I go back to the Russian Communist Shabanov's statement that, if one weapon would not do it, we have some spares.

Suppose that a peer adversary or a near-peer adversary—we have at least two of them now, and there will be several more shortly nuclearized; Russian and China now certainly have plenty—were to use six of the weapons specifically designed for EMP effects, strategically detonated above our country, if someone had described the aftereffects of that as producing a society in which the only person you can talk to is the person next to you, unless you happen to have an old hams outfit that has vacuum tubes that are a million times less susceptible—I do not know, but they might also go with the new weapons—and the only way you could go anywhere was to walk.

Now is that a potential for a determined near peer with enough weapons to use six of them in a near simultaneously robust EMP laydown over our country, that the only person you can talk to is the person next to you and the only way you can go anywhere is to walk?

Dr. WOODARD. As we conducted our review, Mr. Bartlett, over the last couple of years, it became more and more evident that in every aspect of our life, our very existence, that the use of electric power, telecommunications and electronics is pervasive.

So your statement, in terms of the type of attack scenario, we can get into that in the closed session, but a determined enemy in the timeframe we talked about, 15 years, could very well have the capability to have the impact that you are describing.

Mr. BARTLETT. Yes, I just wanted to get that on the public record. There were a couple of your slides—I know we do not have time to bring them back up—where you mentioned holding our society at risk. One of the slides talked about—I forget the exact words you used—it would end life—paraphrasing—as we know it in this country. I am not sure about that kind of a massive breakdown and with these large transformers taking a year-and-a-half to two years to build and coming from somewhere else, you know.

Dr. Wood, your characterization of this is a large continental time machine that would move us back a century in technology, and my question then was, "But, Dr. Wood, the technology of a century ago could not support our present population and distribution," and your unemotional response, "Yes, I know. The population will shrink until it could be supported by the technology."

When I look at the technology of a century ago and where we are today, Dr. Wood, I would imagine that that shrink might be a good two-thirds of our present population?

Dr. WOOD. The population that this continent carried late in the 19th century, sir, was almost a factor of 10 smaller than it is at the present time. We went from where we had 70 percent of the population on the farms feeding 30 percent of the people in the villages and cities to where 3 percent of the population on the farms at the present time feeds the other 97 percent of the country.

So just looking at it from an agricultural and food supply standpoint, if we were no longer able to fuel our agricultural machine in this country, the food production of the country would simply stop because we do not have the horses and mules that used to tow the agricultural gear around in the 1880's and 1890's.

So the situation would be exceedingly adverse if both electricity and the fuel that electricity moves around the country, the diesel fuel and so forth, if that went away and stayed away for a substantial interval of time, we would miss the harvest, and we would starve the following winter.

Mr. BARTLETT. Isn't it possible that the ultimate effects on our society from a robust EMP laydown, although initially maybe few or no people would be killed, might be greater than the effects of ground-burst nuclear weapons in a nuclear exchange?

I see Dr. Graham nodding his head in assent.

Dr. GRAHAM. Yes. In a way, we thought that was a threshold for our consideration because a determined adversary probably could manage to place a nuclear weapon on the surface, either by ballistic missile or other means, but, in fact, we concluded that, as you say, while producing no immediate fatalities, a high-altitude nuclear burst could over a period of time measured in weeks to months—and possibly, in some cases, even shorter—cause more fatalities than a nuclear burst directed at a population area.

Of even greater concern is the fact that recovery from the high-altitude event could be more difficult. In a nuclear burst in a city, however devastating it would be—and it would certainly be devastating—we have the rest of the country that we can bring in from the periphery of the attacked area to try to help in the recovery and help the survivors as much as possible.

But with a high-altitude nuclear burst, the area affected would be sufficiently large that it would not be possible to bring in enough support through the periphery in a rapid fashion to recover the area in a quick and responsive manner. So, if you will, the peripheral effect is much more difficult to take advantage of with a high-altitude nuclear burst, and, therefore, the overall effect could be much more devastating.

Mr. BARTLETT. Mr. Chairman, I would like to close with just one other observation, and that is referring back to Vladimir Lukin's statement "without fear of retaliation." If this attack came from the sea, there would be considerable uncertainty as to the origin of the attack.

Years ago, there was only one potential origin, the Soviet Union. Today, there are, what, four or five or so? There is India and Pakistan and China and Russia and maybe North Korea, and who knows how many more in the near future?

I would submit, Mr. Chairman, that with the large uncertainty of the origin of the attack and the enormous catastrophic effects on our society, wouldn't you think that that would increase the probability of such an attack in the future?

I would ask the panel. Would not those two rather obvious realities increase the probability of attack? It is disastrous to us, and we would not even know from whom it came, if it came from the sea, as Vladimir Lukin suggested.

Dr. Wood.

Or Dr. Foster, then Dr. Wood.

Dr. FOSTER. I agree with your assessment, sir. It seems to me, however, that it is possible that one would know where it came from. It might take a long while, but the damage would have been done.

Dr. WOOD. From a game theoretic standpoint, end-person games are unstable, two-person games are stable. That basic consideration kept the peace of the Soviet Union for decades because, if an attack came from anywhere, we knew what the address of the attacker was, and, though we were incapable of defending against the attack, we were exceedingly capable in retaliating with respect to it and retaliating swiftly and in a fashion that clearly posed unacceptable damage to its potential attacker.

When it is no longer possible to confidently, superconfidently attribute the original of an attack, as it could be in the case of single-shots or silver-bullet attacks of the EMP flavor, you do not go out and burn

down another country on the basis of suspicion, and, in that sort of context, it becomes very difficult to retaliate because of the difficulty of attribution and, thus, deterrence automatically fails.

Dr. GRAHAM. Pardon me. One more response to your question just briefly: it seems to me this loops around to the major event of today, which is the 9/11 commission report, that the idea of hijacking airplanes and flying them into large office buildings was thought of by a number of people, but viewed as not being credible. That reminds me of the response that you received from the infrastructure commission that they did not worry about EMP because they did not view it as credible.

I do not know how to evaluate whether it is credible or not, but I do believe that the less attention we pay to something that we know is within the capability of adversaries of ours, the less attention we pay, the more likely it is to come and be visited on us, and that is exactly what happened in 9/11 which might happen here as well.

Mr. BARTLETT. The question that I was going to ask, and this is a great lead-in to it: Do you think that this kind of attack is more or less likely than that your personal home will burn? [Laughter.]

Mr. BARTLETT. Now you have fire insurance for your home. I would submit, you know, this is a big city, and very few homes burn, and there are a whole bunch of them here. I would suggest that the probability of this happening is considerably greater than that your individual home would burn. Now, if you are prudent enough to have insurance on your home, don't you think we ought to be nationally prudent enough to invest something in the equivalent of a fire insurance policy against this?

Dr. GRAHAM. I think we all certainly agree with your point, Mr. Bartlett.

Mr. BARTLETT. Thank you all very much.

Thank you, Mr. Chairman.

Mr. WELDON. I thank the gentleman. I think, Mr. Bartlett, we are in good hands with the recommendations of this commission.

We are going now to a closed session. We are going to adjourn this session and move to 2212 for a classified hearing.

Before I do that, the public and those in attendance that want to know more about this phenomenon, but obviously cannot get access to the classified information that we are going to now share might want to be aware of an article that ran in "Scientific American" in June of 2004, this year, written by Dan DuPont. Dan covers a lot of defense issues on the Hill.

It is a nine-page article entitled "Nuclear Explosions in Orbit," and it goes into great detail in the public arena of information that is out that you can read. It will not be the depth that we are going to go into now, but, certainly, it is available for the public to access on the Internet.

With that, we want to thank you all for an outstanding job. Your work, I think, is going to be a landmark, a sea change in the way that this committee and this Congress looks at this threat.

It is just unfortunate it has taken us five years to get to this point when we first started raising this issue with our leadership—this is not a political statement—all the leadership in both the military and non-military, pooh-poohed the idea of this ever happening. It is real, it is significant, and we are unprotected.

So your work, I think, will in the end be a landmark event in having this country turn around its response, and we look forward to the classified session.

This hearing now stands adjourned.

[Whereupon, at 11:07 a.m., the committee was adjourned.]