National Institute for Deterrence Studies & Peter Huessy Seminar

Nuclear Deterrence Without Full-Scale Nuclear Testing: Stockpile Stewardship, Confidence, and Risk

April 24, 2026, 10:00-11:00 AM (Eastern)

Webinar Transcript

How to cite:

National Institute for Deterrence Studies. *Nuclear Deterrence Without Full-Scale Nuclear Testing: Stockpile Stewardship, Confidence, and Risk*. Huessy Seminar featuring Dr. George H. Miller, hosted by Peter Huessy. YouTube video, April 24, 2026. https://youtu.be/aghOM7EmIIg.

Abstract:

In this Huessy Seminar hosted by the **National Institute for Deterrence Studies (NIDS)**, Dr. **George H. Miller**, former Director of Lawrence Livermore National Laboratory and a key architect of the U.S. nuclear weapons enterprise, examines whether the United States can sustain a **credible nuclear deterrent without returning to full-scale nuclear testing**. Drawing on decades of experience as a nuclear weapons designer and laboratory leader, Dr. Miller explains the origins, evolution, and technical foundations of the **Stockpile Stewardship Program**, which was established following the end of the Cold War to maintain confidence in the U.S. nuclear stockpile under a testing moratorium.

Dr. Miller reviews historical approaches to nuclear certification, clarifying that confidence in nuclear weapons has never rested on testing alone but rather on expert judgment supported by testing data, non-nuclear experiments, advanced simulation, and rigorous peer review. He traces the transition from Cold War practices—characterized by frequent testing, rapid replacement cycles, and a vast production complex—to today's stewardship model, which relies on a smaller stockpile, significantly enhanced computational power, sophisticated experimental facilities, and an extensive legacy nuclear test database.

The seminar addresses key debates surrounding nuclear testing and arms control, including lessons from past testing moratoria, the Comprehensive Test Ban Treaty, and differing international interpretations of what constitutes a nuclear explosion. Dr. Miller assesses the technical successes of stockpile stewardship, identifies enduring and emerging risks—particularly related to production infrastructure, material aging, and institutional

overconfidence—and evaluates the feasibility of modernizing the stockpile, including current warhead replacement programs, without resuming nuclear testing.

Concluding with a discussion of over-the-horizon challenges such as cyber threats, artificial intelligence, advanced manufacturing, and evolving defensive systems, Dr. Miller argues that while nuclear deterrence is inherently risk-based, the Stockpile Stewardship Program provides **adequate confidence** to sustain and adapt the U.S. nuclear enterprise. He contends that returning to nuclear testing would offer limited marginal benefit at high cost and that the most effective means of reducing risk lies in strengthening production infrastructure, experimental capabilities, and disciplined technical judgment.

Executive Summary

In this Huessy Seminar hosted by the **National Institute for Deterrence Studies (NIDS)**, Dr. **George H. Miller**, former Director of Lawrence Livermore National Laboratory, assesses whether the United States can sustain a **credible nuclear deterrent without returning to full-scale nuclear testing**. Drawing on decades of experience as a nuclear weapons designer and laboratory leader, Dr. Miller concludes that the answer is **yes—provided risk is carefully managed and the nuclear enterprise remains strong**.

Dr. Miller explains that confidence in U.S. nuclear weapons has never depended on nuclear testing alone. Even during the Cold War, warheads were certified through expert judgment supported by limited testing, non-nuclear experiments, conservative design margins, simulation, and rigorous peer review. Nuclear tests were valuable but rarely operationally representative and never statistically sufficient. The **Stockpile Stewardship Program**, established after the Cold War, builds on this same foundation while adapting to a smaller stockpile, longer weapon lifetimes, and the absence of explosive testing.

He highlights the major advances that now underpin stewardship, including vastly improved computational power, sophisticated experimental facilities such as the **National Ignition Facility**, and a uniquely large database of over **1,000 U.S. nuclear tests**. Together, these tools provide a deeper understanding of weapons physics, aging materials, sensitivities, and failure modes than was possible during the testing era.

Dr. Miller reviews debates surrounding nuclear testing moratoria and arms control agreements, including ambiguities in the Comprehensive Test Ban Treaty. While adversary behavior warrants continued scrutiny, he argues that U.S. policy should be guided by national interests rather than reflexively returning to testing, which would be costly and yield limited additional confidence.

A key theme of the seminar is **risk management**. Dr. Miller identifies the most serious risks facing the nuclear enterprise today as stemming not from the absence of testing, but from a fragile **production infrastructure**, aging legacy warhead designs, and the potential for institutional overconfidence. He emphasizes the need for sustained investment in production capacity, expanded non-nuclear experimentation, and rigorous critical review.

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Looking ahead, Dr. Miller assesses current modernization efforts—including the **W87-1, W80-4, and W93**—as achievable with adequate confidence so long as they remain grounded in previously tested designs. He cautions that highly exotic nuclear concepts would carry unacceptable risk without testing. He also highlights emerging challenges such as cyber threats, artificial intelligence, advanced manufacturing, and sensor proliferation, which increasingly target the broader deterrence system rather than warheads alone.

Dr. Miller concludes that the Stockpile Stewardship Program provides **adequate confidence** to sustain and modernize the U.S. nuclear deterrent without resuming nuclear testing. He judges that the most effective path forward lies in strengthening production infrastructure, replacing legacy systems with more robust designs, and maintaining disciplined technical judgment—rather than returning to nuclear explosive testing.

Unabridged Transcript

(Note: A.I. assisted, there will invariably be some word errors in the following transcript.)

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Kimberly Cherington
Good morning and welcome. I'm Kimberly Cherington and on behalf of the National Institute for Deterrence Studies, thank you for taking the time to join us for this important discussion today with Dr. George Miller. A special welcome to those of you joining us live. We appreciate your attendance.

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Kimberly Cherington
We encourage you to submit your questions throughout the presentation using the chat or the Q&A button at the top of your screen. We will address those questions during the Q&A portion of our seminar. We hope you'll join us virtually on June 5th as we welcome Frank Rose, former Principal Deputy Administrator of the National Nuclear Security Administration, who will speak on missile defense, its effectiveness now and into the future. We are hosting 2 live events in Washington, DC, at the Capitol Hill Club. Rear Admiral Weeks will join us on May 15th and Lieutenant General Lutton in person on June 3rd.

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Kimberly Cherington
These intimate seminars offer a unique opportunity to engage directly with these distinguished leaders, ask questions, participate in discussion, and enjoy breakfast provided by NIDS and our wonderful sponsors. In partnership with BRF, NIDS presents the 5th Annual Nuclear Triad Symposium, which will take place on June 18th at Louisiana State University, Shreveport. You can find more and register for this live symposium on our website, along with all of our events at Think Deterrence.com. Please follow us on LinkedIn and subscribe to our newsletter to receive important event updates. Today, we are honored to welcome Dr. George Miller, who joined the Lawrence Livermore National Laboratory staff in 1972 as a physicist and nuclear weapons designer. He developed several weapons for the stockpile. He retired as lab director.

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Kimberly Cherington
in December 2011. Miller's leadership at the lab was instrumental in securing national nuclear security and advancing the development of advanced energy solutions. We welcome you today. And now I'm pleased to introduce our host and moderator for today's discussion. Mr. Peter Huessy, President of geostrategic analysis and a senior fellow here at NIDS. Peter, over to you.

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Peter Huessy
Kimberly, thank you for your introduction and for your great work that you do on this. George, thank you for joining us today. I do want to say shout out to our friends from Tech Source, Northrop Grumman, BRF, and Bechtel, who have been longtime sponsors of these seminars, also sponsors of our symposium that we are doing in Shreveport in June. I also want to say hello to some of our special guests today. Frank Miller is with us and Henry Sokolski, both of which have been speakers. I want to say hello to Jim Howell, another speaker, and Don Cook, and also to my friend Bob DeGrasse from...Bechtel, thank you for joining us. And an individual whose father was a good friend of mine, Bill Hain, is here today. His father worked for Senator Nunn on the Armed Services Committee.

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Peter Huessy
was a great friend and a great staffer. George, I want to thank you for coming to talk to us today about nuclear testing and the Stockpile Stewardship Program. It's an honor to have you here. And on behalf of NIDS and our sponsors and our guests, I want to thank you for coming. And it's over to you, Sir.

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Miller, George H.
Great. Thanks very much, Peter. I'm really pleased to be here. Some of you who know me realize I could talk on this subject for hours, so I'll try to hit the high points. Because nuclear testing is a complex subject. It's intertwined with the Deterrence approaches, what Brad Roberts calls theories a victory. There are really important technical issues, but also military requirements, force structures, not only what the US needs, but also what our adversaries may be doing. I'm going to focus on the technical issues and try to draw out maybe some lessons from the history, as well as talking about the nature of the program, some of its successes, and the risks that I think we all have to live with. That's really my framework. We're talking about this kind of a subject. It's really how do you manage the risks?

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Miller, George H.
across the entire enterprise. When you think about how we got here during the Cold War, confidence in the US deterrent was the result of a whole bunch of factors. People think about testing, but it was really a whole bunch of factors. We had a diverse stockpile with many different weapons and different types.

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Miller, George H.

We had a very large and very capable production complex that allowed us both to fix problems if we found them and respond to changes. We had continuous development so that the capabilities in the weapons themselves both in terms of safety and security and military needs were changing continuously. And the weapons were in the stockpile for relatively short periods of time. And we had nuclear testing, which allowed us to advance the science, understand better,

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Miller, George H.
the nature of these weapons, and guaranteed that we had the expertise to do that. Every single one of these aspects have changed at the end of the Cold War. It's not just nuclear testing, but it's everything. And so the Stockpile Stewardship Program was designed

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Miller, George H.
to provide confidence in the deterrent in very changed circumstances. There were a number of things that had to be accomplished within the nuclear weapons enterprise. We had to monitor the stockpile to ensure that it maintained the original design intent, produce components to replace aging ones, certify that the changes themselves were not going to adversely affect the weapons. We had to adapt changing security and safety requirements and respond to military needs as they changed. So the vision of the stewardship program was to ensure confidence.

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Miller, George H.
without nuclear testing, while enabling a small, less diverse stockpile that was easier to maintain and a production complex that was agile, flexible, and cost-effective. We did this by proposing significantly increase the capability of the lab complex to develop a better approach to sustainment. Again, what I mean by that is during the Cold War, we understood what was happening to the stockpile literally by tearing weapons apart. That puts added burden on the production complex.

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Miller, George H.
and create a warhead replacement program that would change the nature of the weapons from the highly optimized legacy Cold War weapons to ones that had more robust performance margins, longer lifetimes, and were easier to fabricate and maintain. I think when you...

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Miller, George H.
think about this problem, it's important to understand what I loosely call some of the realities of nuclear weapons and realities of the nuclear weapons testing program. Nuclear weapons are an unusual combination of physics and engineering.

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Miller, George H.
They're highly nonlinear. So if you don't do things right, they can be sensitive to small changes. And they were never tested in a statistically significant fashion or in a way that covered the entire operating regime over which the military intended to employ them.

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Miller, George H.
In fact, almost none were ever operationally tested, and very few were tested even with the production hardware. And those had to be modified to be tested underground. The approach that was taken was what we loosely call simulation-based.

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Miller, George H.
very familiar to scientists and engineers today. So, we used the best simulations, computer simulations that were available. And these were done in concert with extensive non-nuclear and very limited nuclear testing. The

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Miller, George H.
A design approach was to design them with sufficient performance margin so that the sensitivities and the unknowns did not affect the performance. This whole process was embedded in an extensive peer review and surveillance program. It continuously evolved.

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Miller, George H.
as our knowledge and understanding of the weapons and the underlying science improved. In fact, if you look historically, the number of tests required to do anything changed dramatically over time, from large numbers to smaller numbers. And in fact, many of the tests were what I would call experiments.

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Miller, George H.
to look at and try to understand new ideas as we developed what today is the modern stockpile. So again, I think it's most important that people understand nuclear weapons were never certified by nuclear tests. Nuclear tests were important. Not always even the most important part of the process, but nuclear weapons were certified and confidence was established by statements of judgments by technical experts, backed up, as I said, by nuclear tests, significant non-nuclear tests, and then simulations to both tie it together and look across the entire potential range of capabilities that the military needed. In fact, during the 1958 to 61 moratorium, weapons were put into the stockpile at a time when we knew very little about the underlying nature of them, because the modern stockpile was just being developed. Weapons were put in the stockpile that were never tested. Some of them were never tested. Most of them were tested after the moratorium, and in fact, worked just fine.

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Miller, George H.
There are a few lessons, I think, that come out of the history of negotiating and developing the comprehensive test ban. Those discussions started very early in the history of the program. In fact, as I said, there's a moratorium from 1958 to 61.

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Miller, George H.
that was initially proposed by the USSR. And in fact, the USSR broke the moratorium with a

very large test program. The perspective, I think the technical perspective at this time is included in a letter from the founders of the lab that I was honored to work for.

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Miller, George H.
Eli Lawrence and Edward Teller, in which they said, we cannot maintain a fast-moving science and technical nuclear weapons program without tests. That's both because the modern stockpile was just being developed and because the knowledge of the underlying science and physics was fairly limited at that time.

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Miller, George H.
We had a reduced threshold starting in 1996, the TTBT.

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Miller, George H.
Again, one of the important lessons from this is that there was a significant controversy about whether the Russians were cheating or not. It resulted in a lot of exchange between the US and the USSR and a set of experiments at each other's test sites. Following that, there were a lot of discussions about what the next arms control agreement might be. Most of them involved successively lowering the threshold from 150 kilotons of the TTBT, you know, in steps, you know, going down eventually to very low yields. Harold Brown, for instance, suggested that we have a permanent limit of three to five kilotons.

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Miller, George H.
There was never an agreement on what was in fact to be banned. And this, I'll come back to this when we talk about the CTBT.

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Miller, George H.
In 1996, in response to Congress, I wrote a report about nuclear testing along with some of my colleagues at Livermore. It extended the analysis of previously disclosed test anomalies, again, things that didn't work quite the way we expected.

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Miller, George H.
Most of these, the unclassified examples, are almost all from early in the weapons development program. And when I testified in front of Congress, I had two comments in the midst of a lot of a long discussion that I think are important for this discussion.

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Miller, George H.
First of all, I said at that time, we were not ready for significantly reduced test limits because of the capability that the complex had in terms of experiments, simulation, and our underlying knowledge. The second thing I said is...We have identified and are already starting to take steps that would prepare us for more restrictive limits. This is because one of the responsibilities of the national labs has always been to be ready and able to respond in the best possible way for

whatever directions the government might choose to pursue. And so, thinking about an environment in which tests are significantly limited has been part of the program since its inception.

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Miller, George H.
The moratorium was established by Congress in 1992, the so-called Hatfield-Exon Mitchell Amendment that was signed by President George H.W. Bush and extended by President Clinton. There are a number of things leading up to the decision by President Clinton a few years later to have a comprehensive test ban and pursue it. I think one of the most insightful ones was produced by the Jason's. This is an unusual Jason report in that in addition to the normal Jason cohort of experts, an expert from each of the national laboratories, and I say real experts who were instrumental in creating the modern stockpile, were part of that particular study. And they had a number of comments. I'll just mention a few. One was that underground testing at any yield below that required to initiate a boosting is of limited value, and that the problems that occurred in the past, which were either connected to or relied on nuclear tests, were due principally to the more limited knowledge and computational capabilities that existed at the time. That was one of the conclusions of the Jason report. And as you know, President Clinton announced in 1995 that he was going to pursue a comprehensive test ban that included a concrete and very specific set of safeguards and programs to help the US ensure confidence in a testing environment where none that made nuclear yield were allowed.

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Miller, George H.
The ratification hearings occurred in 99. I think it's important to understand that the treaty itself bans nuclear explosions without actually defining them. And so there has been quite a discussion about what is actually being banned.

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Miller, George H.
This was clarified on the US part by Ambassador Ledogar when he testified in front of the Senate about the hearings. And then at that time, he said that hydronuclear experiments, which do produce small amounts of yield would be banned and that the Russians agreed to that. So that's the US interpretation. I can tell you from personal experience, that's not the Russians' definition of a nuclear explosion. What they said is if it makes less yield than the high explosive, it's not a nuclear explosion.

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Miller, George H.
So I think there's been a lot of consternation about what the particular treaty itself is banned. As you know, it was signed but never ratified. During the ratification hearings, again, just focusing on Livermore, where I'm from, The director at the time, Bruce Tarter, said that the Stockpile Stewardship Program has an excellent chance of ensuring confidence. Again, there were risks, which Bruce talked about. His 2 predecessors, Roger Batesole and John Knuckles, recommended that the treaty not be agreed upon. And so again, even within Livermore, there was a significant disagreement about what the approach should be from an arms control point

of view. So let me talk a little bit about the Stockpile Stewardship Program. In many respects, it is a continuation of the methodology that we used when we had full-scale nuclear testing.

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Miller, George H.
Confidence is based upon expert judgment that's founded on nuclear experiments and non-nuclear experiments, extensive simulation and theory. Today, we use the data from over 1000 U.S. nuclear tests to ensure that we are making the right choices.

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Miller, George H.
Again, in the context of nuclear testing, that's a significant advantage for the United States, that database itself. That's been pointed out by people like Sig Hecker in some of the things that he has written. We have extremely better tools today than we had when testing ended. That was the reason for Dr. Tarter's comment that it has an excellent chance because those tools did not exist at the time those ratification hearings were put in place. But many of them, not all of them, but many of them do exist today.

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Miller, George H.
Today, we understand a lot more about nuclear weapons and how they work from a technical and scientific point of view, what their sensitivities are, what their failure modes are than we did when we were, when we ceased doing nuclear tests. We continue to emphasize conservative design margins, and we have a really expanded and more extensive review process, both within the laboratories, between the laboratories, and between the Department of Energy.

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Miller, George H.
and the Department of Defense. And when I say peer review, you know, for me, peer review means you're actually being reviewed by peers who actually do work. And so, for instance, in the annual assessment that the Livermore Lab director does, he is given information from Los Alamos based upon Los Alamos analysis of the Livermore, the systems for which Livermore is responsible. So that is an addition to the process that didn't exist 30 or 40 years ago.

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Miller, George H.
So in my view, the program is technically sound. It's cost effective. There are risks, some of which I will talk about in a minute. And it provides the basis not only for doing what we have been doing, which is maintaining, stewarding the stockpile, but it also provides the basis for modernizing and transforming the stockpile as the country's needs change over time.

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Miller, George H.
There have been significant advancements in the tools. For instance, the computational capability has increased by something like 100 million times. That's A lot. Again, if you think about it, the stockpile that I designed, I did on a computer that has significantly less power than your Apple Watch. So that capability really has enabled a lot more understanding of the physics

and the interaction between the physics and the engineering realities. We have much better experimental capability.

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Miller, George H.
in terms of things like the National Ignition Facility, the radiographic capabilities at Los Alamos, our ability to understand experimentally materials and how they themselves are changing, for instance, plutonium and experiments that are done at the Nevada test site.

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Miller, George H.
We understand how people, how materials age better, and we have the ability to better understand the sensitivities and uncertainties.

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Miller, George H.
I think it's important to understand that there have been a number of successes. Many of them, unfortunately, are classified, so I can't talk about them. But we have enhanced the robustness of the weapons in the stockpile and the designs that are moving forward. We have done experiments that allow us to understand the behavior of plutonium, which is a really critical material. Some of those experiments have occurred in Nevada. Some of them have occurred in the National Ignition Facility. One of the major physics problems that we had in the era of nuclear testing, which we called the energy balance problem. Said another way, we didn't understand how to conserve energy in our calculations. We have solved that problem. In addition, many of the anomalies, things that we didn't understand during the era of testing, have now been resolved. And that's really important in terms of providing a confidence that in fact we have taken everything into account. As I said, in addition to that, what we have tried to do within the confines of the existing stockpile is enhance the performance margins so that any remaining uncertainties are taken care of.

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Miller, George H.
And the things that we still don't understand are well taken care of by the performance margins we have built into our systems. As I said, we have significantly enhanced the review structure. There is

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Miller, George H.
one set of data that is shared by the entire community, and then the different organizations evaluate it from their own perspectives, from the laboratory directors' perspectives, and independently for the Department of War, the US STRATCOM has an independent review of that same data.

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Miller, George H.
and each make their own independent judgments about the nature of the stockpile. So to date, we have successfully stewarded the stockpile, and we are beginning to transform the stockpile as the needs of the country have changed.

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Miller, George H.
So my personal assessment of our ability to respond to new military requirements is that if we stay with systems that are within the database of well understood and well tested systems, this can be done with adequate confidence.

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Miller, George H.
And that includes things like replacement of the legacy systems that are currently going on, like the W87-1, the W80-4, and the W93. Those can be done with very good confidence. We can develop systems with new delivery modes.

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Miller, George H.
But they have characteristics that are similar to things that we have done in the past. Again, the things that fall into this area are things like Sicklemen. Many people have suggested we consider additional regional systems like we did with the ground launch cruise missile and the Pershing.

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Miller, George H.
maneuvering, re-entry vehicles, hypersonic. I think those are all things that can be done within the confines of what we understand and what we have confidence in doing. There's a bunch of what I would call exotic new systems. Again, my example is nuclear-directed energy as we pursued during strategic defense initiative like the X-ray laser, where we have a high degree of uncertainty. And so this would take, would involve substantial risk to do without nuclear testing. And there's a bunch of systems in between that I would just say fit into the category of It depends. Some of them, depending upon exactly what you're trying to do, are okay in terms of the risks that you're taking. In some, you would take more risks. So my view of risk, we had risks at the time we were doing nuclear testing. Again, principally those risks were, we did not understand the nature of the highly integrated physics and engineering of those systems. And so there was a lot of residual uncertainties. Many of those have gone away.

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Miller, George H.
Today, for me personally, the biggest risk is the production complex. It has limited responsiveness, long lead times, and it's very fragile. It will have a hard time responding to problems, and it has a hard time responding to the changes that we see occurring. So today, for me, that is the biggest risk. The warhead designs are still largely a legacy Cold War designs. They are manufacturing complex, subject to aging effects.

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Miller, George H.
They're hard to remanufacture, and they've been around a long time. So that's my second biggest risk. The third is I do worry about the laboratories themselves because they are subject to overconfidence.

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Miller, George H.
So there's a need to emphasize a culture of critical thinking, what one of my mentors, Johnny Foster, referred to as turning over every rock. And one of the important problems in this area is, in my judgment, a need for more experimental, not nuclear, but non-nuclear.

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Miller, George H.
because the experiments that we do today are very expensive and they're far too infrequent. And so that is also a risk. So, sort of in summary, I would say the stockpile stewardship programs provide adequate confidence. Again, nothing, neither when we were doing nuclear testing nor today is everything completely risk-free, but I use the word adequate. And that's because we have greatly improved understanding of weapons physics and engineering. We can validate it with an extensive nuclear test database and modern experiments that, in fact, tell us a lot about the why, as opposed to just the what t we got from nuclear testing.

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Miller, George H.
I think the Stockpile Stewardship Program provides the basis both to sustain and transform the nuclear enterprise. Again, my own personal judgment is that nuclear testing provides limited marginal value.

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Miller, George H.
And it would be very expensive to go back to nuclear testing. And the trade-off between giving up existing capability to get nuclear testing, in my view, is a bad trade-off. What we have is of more importance than the value we get for nuclear testing. Again, as an experimental scientist, you know, all data is important and valuable. The question always becomes in a real system, you know, what's the benefit and what's the cost? And in my judgment, additional nuclear testing is of limited value in my in my judgment. For me, the highest and most cost-effective way to buy down risk is focusing on the production infrastructure to create an infrastructure that is highly capable, agile, flexible, and much more cost-effective than the one we had during the Cold War.

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Miller, George H.
We should continue to replace legacy systems with ones that have more margin and that are easier to manufacture and maintain. And that I think we can do this without a return to nuclear testing.

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Miller, George H.
So again, I look forward to the questions to draw out more details on some of the things that I have have broached, again, hitting just the just the wave tops. But Peter, I look forward to the questions.

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Peter Huessy

Thank you, George, very much. That was a really good summary. I'm just going to walk you through the questions we've had. Some of them you have answered in part, but some of them you may want to expand. First question was, when I wrote down originally is, you've answered the hypothetical question of what are the negative consequences of nuclear testing. But I had another question, and that would be, what would be the nature of events that might push the United States into adopting testing?

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Miller, George H.
You know, I have been asked this question for decades, really since the start of the Stockpile Stewardship Program. You know, I think for me, the answer tends to be ones in which there is more political

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Peter Huessy
Yeah.

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Miller, George H.
then there is technical content. You know, I think that, quite frankly, the US is in a very good position because of the number of past nuclear tests that we've had. And so most of the technical issues that we have I think can be answered adequately without returning to nuclear testing. However, you know, should the Chinese or the Russians start doing full scale, you know, 100 kiloton or even 10 kiloton tests, you know, that calls into calls into question, you know, what should the US response be? And I think in that context.

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Miller, George H.
You know, when one of our peers begins to do full-scale nuclear testing, that calls into question, what should the response be? And I think one of the potential subjects for discussion would be, should we return to testing? As I said, it's really expensive, in my judgment, to return to testing. And so there are other things, perhaps, that we might want to to to think about and should think about.

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Peter Huessy
George, we talked about this before the event went live, and I, I don't want to, I want to make sure that...

0:35:34.371 --> 0:35:53.971
Peter Huessy
There are a number of questions about China's alleged renewed underground testing. And the questions I get are, does this open the door to a new approach to US testing? Do we need to respond to this? Does it affect the annual certification process need to be updated? You may or may not go there if you want, but I know, but please address that issue because a number of people have asked.

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0:36:2.371 --> 0:36:21.731
Miller, George H.
I think that's a really important question. I have to be a little careful in what I say. I think what the Russians and Chinese may be doing is important to understand. And it's important for the US to respond based upon

0:36:8.211 --> 0:36:8.771
Peter Huessy
Right.

0:36:22.11 --> 0:36:41.91
Miller, George H.
what it thinks is actually going on. With respect to the implications for the United States, I think the US responses will likely be other than a return to testing, because in my judgment, what the...

0:36:30.891 --> 0:36:31.411
Peter Huessy
Mhm.

0:36:41.451 --> 0:36:59.731
Miller, George H.
What the Russians and the Chinese may be doing is in their best interests. What we should do is what's in our best interests. And I don't believe that what they're doing impacts our confidence in our stockpile at all.

0:36:49.131 --> 0:36:49.491
Peter Huessy
K.

0:37:1.811 --> 0:37:20.131
Miller, George H.
you know, what is of more importance is what are they doing and why are they doing it with respect to their deterrent forces. So the question is, does it, does what they're doing impact our deterrent forces? And if so, how should we respond? And again, my own judgment,

0:37:6.611 --> 0:37:7.171
Peter Huessy
Okay.

0:37:20.611 --> 0:37:26.291
Miller, George H.
Is that we can respond without having to need without having the need to return to testing?

0:37:27.11 --> 0:37:46.491
Peter Huessy
Okay. I had a question of my own. I said, it's kind of a, if you go back to the limited test ban treaty and then the ban on atmospheric testing and then the CTBT, which we didn't ratify, what's the connection between those agreements on testing and nuclear arms control?

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0:37:49.811 --> 0:38:7.971
Miller, George H.
Well, yeah, obviously there, you know, there is a connection. You know, when you limit testing, you do limit both. You certainly limit, you know, what is possible to do from a vertical proliferation point of view.

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Peter Huessy
Right.

0:38:9.651 --> 0:38:29.331
Miller, George H.
Again, I think, again, I've had this argument many times with many different people. My own personal view is it does not inhibit significantly horizontal proliferation at the early stages, because I think people can do as we did. I mean, the first nuclear device the US designed, you know, was in fact used in anger without having been tested and worked just fine. So I think entry level horizontal proliferation, it's not a big deal, but I think it does provide a significant inhibition for vertical proliferation. So I think, you know, again, it goes along with other arms control treaties, in my judgment. It is not, I think we're at a stage where it's not the driver anymore.

0:39:10.851 --> 0:39:30.371
Miller, George H.
You know, certainly going from atmospheric to the threshold test band, which was, you know, limited us to 150 kilotons, that has an influence on, you know, how big a warhead you can confidently put into the stockpile. And so it does have, that has a significant inhibition. I think that the current situation inhibits some countries and not others.

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Peter Huessy
We have a question here about the W87-1 Warhead Program. And the question is whether, how is that related to the credibility of simulation-based programs under the Stockpile Stewardship Program?

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Miller, George H.
Yeah, so again, all of the programs that are currently going on, the 87.1, the AD-4, all of them are making use of the enhanced capabilities that have been developed. Both of these systems are based upon well-tested systems that we have important data from nuclear tests. So, the nuclear tests that we have done in the past are used as part of the certification basis of those systems. And they have made changes that you know, have to be validated. I mean, again, if you think about this in a spectrum, you know, warheads change just sitting there because they age. I mean, they're, you know, as Sig Hecker once said, you know, plutonium is sort of like a living metal because it changes because it radioactively decays. And we have a responsibility and have, you know, since we since 1992 of certifying that those changes do not affect performance. And so then, you know, we have in the past done programs where we changed components. We had to certify that those, that the changes in components were okay. We have done that.

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0:41:33.891 --> 0:41:52.611
Miller, George H.
The 87-1 and the 80-4 are further steps that we have to change. Again, they are closely related to things that we have tested before, but they're not identical. And so it's just another step along the way, where in this case, the steps are a little bit bigger than what we have had to do before.

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Miller, George H.
The W93, which is being done for the Navy, is a step beyond that. Again, my own personal judgment is these can all be done with adequate confidence, appropriate levels of risk without nuclear testing.

0:42:8.131 --> 0:42:17.651
Peter Huessy
What would be the programs, if any, that you would adopt that would better deter our adversaries from conducting explosive nuclear testing?

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Peter Huessy
Should you determine that they are or going to contemplating going forward?

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Miller, George H.
So, you know, phrased exactly the way you phrased it, I don't think there are deployments that would inhibit their nuclear testing. I think that I think a more important question for me, a slight variation on what you what you said is, given what we see the Russians and the Chinese and other adversaries doing, what should we be doing? And so while it's not my wheelhouse, so to speak, it's more in the wheelhouse of people like Frank Miller, but I'm a great fan of...

0:43:2.531 --> 0:43:26.971
Miller, George H.
of moving forward with what loosely I would call regional systems. You know, SLCM-N, you know, ground-based deployable systems that Frank has talked, Frank and others have talked about. We're very

0:43:27.51 --> 0:43:34.131
Miller, George H.
was doing with the SS-20s. I think that's the kind of game that we are in right now and we need to respond.

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Peter Huessy
Mm.

0:43:35.491 --> 0:43:48.371
Peter Huessy
Question, a number of people have asked the question about the existing stockpile stewardship

program. Can it adequately address the question of the impact of material age and degradation on weapons performance?

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Miller, George H.
It has to date. It continues to be something that we are watching very carefully. Again, my own judgment in these matters is we understand the nature of aging. You know, that is how high explosives or plutonium or other materials that are in nuclear weapons, how they age, you know, when do we need to replace them? You know, when does aging become a significant risk? We don't understand it perfectly. We understand it a lot better. And we understand it adequately. Again, I think everybody understands…

0:44:32.691 --> 0:44:51.811
Miller, George H.
For instance, you know, when does plutonium aging become something that you have to, where you have to replace the existing systems? That puts a huge demand on the production complex when you have to start replacing all of the plutonium. So again, both Livermore and Los Alamos doing theory simulation experiments, you know, both in Nevada and elsewhere, are trying to understand that. We do understand it a lot better. I'm comfortable with where we are right now.

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Miller, George H.
But again, it's an area that needs continued vigilance and exploration because we don't understand it perfectly.

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Peter Huessy
If a test ban has been supported to preclude the development of new types of nuclear weapons, which is one of the arguments made for it.

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Peter Huessy
If you were trying to make that argument, how would you say it had been successful? What weapons do you think they've been precluded from being deployed?

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Miller, George H.
Yeah, again, I think this is an important debate that I have participated in a lot in the past. And it's sort of your definition of new. I like the previous congressional commission's definition. You know, new is new military characteristics. It's not whether it's physically different.

0:45:57.731 --> 0:45:58.291
Peter Huessy
True.

0:46:0.371 --> 0:46:21.531
Miller, George H.
And so, you know, we have been developing weapons that replace legacy systems, you know,

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again, largely with existing military characteristics. I think the ones that have been precluded, I alluded to some of them. There are the, what I would call the exotic systems like nuclear directed energy.

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Miller, George H.
Those certainly, in my judgment, are far too risky to pursue without full-scale nuclear testing. They were hard when we could do nuclear testing. So I think it's an unacceptable risk to try to develop those without nuclear testing. And there's some in between.

0:46:41.11 --> 0:46:55.331
Miller, George H.
And it's a little hard in this environment for me to talk about exactly which ones are hard and which ones are easy. But suffice it to say, there are some that are significantly more risky than others.

0:46:45.691 --> 0:46:46.451
Peter Huessy
No, I hear you. Right. Okay

0:46:59.491 --> 0:47:19.51
Peter Huessy
Looking at over the future, whether it's AI or what are the risks to our stockpile that you think we have to look over the horizon? Let me tell you what I'm talking about. The head of Global Strike Command told us in this conference we're doing in June, tell me what unconventional threats there are to our nuclear Deterrence that I don't know about and tell me what they are and what I might do about them.

0:47:31.11 --> 0:47:32.211
Peter Huessy
Narrow it down to...

0:47:33.91 --> 0:47:41.171
Peter Huessy
confidence in our nuclear stockpile. What are the threats over the horizon we might want to take a look at?

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Miller, George H.
You know, again, I think that, for me, the obvious ones are things like the combination of AI and cyber, you know, particularly, you know, in things like supply chains, you know, and those are really, really complicated threats. I think there are a lot of threats that, you know, fall in the category of, you know, what I call the convergence of advanced manufacturing and cyber and computer and AI. I mean, you know, drones are a trivial example of that.

0:48:20.131 --> 0:48:20.691
Peter Huessy
Mhm.

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0:48:27.11 --> 0:48:44.531
Miller, George H.
You know, those kinds of things can be really dramatically different in terms of the environment. I personally worry a lot about the development of, you know, loosely what I would call defensive systems.

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Miller, George H.
You know, right now in the Cold War, you know, the cost curve was always on the offensive side. I worry that the cost curve could be flipped and, you know, and defensive systems, you know, become far more prevalent, far more capable, in a cost-effective way. You know, those can certainly threaten, you know, the capabilities. They're not literally threatening the warheads themselves, but the delivery modes. You know, I worry about the proliferation of sensors of all varieties. And, you know, the ability to synthesize all of that data and come up with an understanding of, you know, where are the targets that you want to hit.

0:49:44.931 --> 0:50:4.51
Miller, George H.
You know, not just the warheads themselves, but the entire operational structure that's required to have nuclear weapons. So, you know, again, for me, there's a whole raft of things of that nature, most of which attack the system as opposed to warheads themselves.

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Peter Huessy
I have one question here from Henry Sokolsky, always ask good questions. And he says, what can the labs do to help the private sector harden our satellites against nuclear effects?

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Miller, George H.
Let's see, the biggest thing that we can do is to make sure that they understand what the threats are. You know, that often gets into complications of classified data and whatnot. And so I think the first thing

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Miller, George H.
you know, is just making sure that there is a mechanism by which the real threats, you know, are taken into account for the way that they design. Sandia in particular worries about hardening of electronics.

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Miller, George H.
a lot. And so I think there are techniques that have been developed that we need to make sure are ubiquitous in the design of the satellite systems. Again, as you know, everybody knows,

0:51:16.51 --> 0:51:36.411
Miller, George H.
It's far easier and far less expensive to do it from the beginning than it is to try to retrofit something. It's all about how do you design and what are the design requirements? And so I

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think those are both areas where the NNSA labs have important information that needs to be made available to the company, to the entire industrial complex.

0:51:42.131 --> 0:51:47.891
Peter Huessy
I'm going to turn it over to our president, Jim Petrosky. And Jim, Go ahead and please ask George any questions you might, any comments you might want. And we have a few minutes more and then I may turn it over to Kimberly to talk about what is going on in the future with our programs and what's scheduled. Or I may have a couple other questions. George, I may come back to you. So Jim, over to you, sir.

0:52:7.811 --> 0:52:8.51
Miller, George H.
Sure.

0:52:10.491 --> 0:52:34.531
James Petrosky
Yeah, thank you. And I'm going to apologize up front because I had to step out because of construction. It was going up my house. So I don't know if you answered this question, but we have a question for Henry Sokolski. Actually, Henry, if you want to come on, I will let you ask the question directly, but it's in our chat. It says, might the further spread of nuclear weapons to additional nations impact America's ability to determine medium and superpower nuclear war?

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James Petrosky
And if so, I thought that was an interesting view, you know, as we look at the signaling that goes on with our testing, George.

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Miller, George H.
Yeah, again, for me, those worries are very real, but I don't personally see the connection to nuclear testing. You know, those issues are driven by the systems the U.S. develops.

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Miller, George H.
how it talks about our use of those systems, how the US talks about extending the umbrella of our deterrent to other countries. You know, again, you know, we talked a little bit about this, you know, the ability to assure our allies of the nature of our commitment to them. And things like deployable systems, you know, which can be brought in, you know, in a contingency fashion, I think could be very important. A number of people have written about that.

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Miller, George H.
And again, my own personal experience has been through watching the development of the INF Treaty and SS-20s, GLCMs and Pershing IIs. I think all of those, I think there's an important set of lessons in that whole exercise. But again, I think it has more to do with US systems and commitments than it does nuclear testing per se.

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0:54:14.611 --> 0:54:33.571
James Petrosky
Okay, no, that's great. Yeah, the disconnect or connect there. I think many people try to draw the line and not sure where to draw it. I have another question and sort of related to a question that came up from Stephen Swartz and also from Lacina T.O.

0:54:33.971 --> 0:54:53.571
James Petrosky
And that has to do with my experience on the Casper project, which I chaired for almost 14 years. And that was that we looked at stockpile stewardship without, you know, certain pieces of equipment in place. And what we learned, and I'm just curious about

0:54:52.531 --> 0:54:52.811
Miller, George H.
Yes.

0:54:53.811 --> 0:55:16.131
James Petrosky
Your thoughts is we learned more about the systems without explosive testing because of the scientific methodologies that were being applied and the control we had inside of the laboratory. I was wondering about your thoughts about not only that laboratory experience, but maybe what the future holds, because we're advancing many laboratories to include those at Los Alamos.

0:55:16.651 --> 0:55:22.451
James Petrosky
I know you're not there currently, but I'm sure that you're well connected there. So maybe those comments on the future.

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Miller, George H.
Yeah, you know, again, I completely concur in that point of view. Many, I have observed many other people have observed that we know more about how a nuclear weapon works now than we ever did when we were doing nuclear testing. And that's a, you know, that's a really important point. You know, it has to do with the capability of simulations, but it also has to do, importantly, with the experimental capability and the ability to actually measure stuff that you care about. I mean, that's a problem with nuclear testing is that the devices themselves do not lend themselves to making the kind of measurements that I, as a scientist, really wanted. You know, it could tell me what happened, it couldn't tell me why. And the non-nuclear experiments and the enhanced simulation capabilities have given us

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James Petrosky
Yeah.

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Miller, George H.
the answers to many different why questions that we have had. I would personally believe that

it's going to continue. You know, again, there is no such thing in my judgment for a long time as a first principles physics and engineering calculation.

0:56:40.771 --> 0:56:40.931
James Petrosky
Yeah.

0:56:42.51 --> 0:57:1.171
Miller, George H.
And so we still have a lot to learn. I think we have a methodology by using and taking proper care of performance margins. We have a method of dealing with the things that we don't know and the things that we know matter. But

0:57:1.251 --> 0:57:9.491
Miller, George H.
Still, it could be improved, and there are many different experimental capabilities that I wish we had that we don't.

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James Petrosky
Yeah, as a scientist, we're never done, right? There's always something more we want to know. Yep. Good.

0:57:14.371 --> 0:57:14.771
Miller, George H.
Right.

0:57:17.211 --> 0:57:36.51
Miller, George H.
Yeah, and I, again, I think I think that's an important point, but it's want to know why. You know, it's not we're going to study this forever. I mean, that to me is the big difference between a national lab and a university. You know, universities want to study something forever for good reasons.

0:57:27.571 --> 0:57:27.811
Peter Huessy
Yeah.

0:57:29.411 --> 0:57:29.971
James Petrosky
Yes.

0:57:36.451 --> 0:57:54.691
Miller, George H.
You know, we want to study it for why, because it impacts the mission. And so our motivation for understanding is in fact to reduce the risks, you know, to make the capabilities that we provide the country more robust.

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Peter Huessy
Exactly.

0:57:41.171 --> 0:57:41.811
James Petrosky
Very good.

0:57:55.811 --> 0:58:15.251
James Petrosky
Yeah. Okay. Well, thank you very much, George. I really appreciate what you've talked about today. I think it's very important for us. I want to thank you for your commitment to our nation's nuclear stockpile stewardship and to our nation overall. It's greatly appreciated and certainly much needed.

0:58:15.651 --> 0:58:33.971
James Petrosky
And I hope that our audience heard something to sort of take back with them, question, think about, but understand where this issue lies. And I think you filled a lot of those gaps in. So at this point, I'm going to turn back over to Kimberly to close us out. That way, I respect everyone's time that's left. Kimberly, up to you.

0:58:37.251 --> 0:58:56.371
Kimberly Cherington
Thank you so much, Dr. Miller. I will repeat that and we can't thank you enough for being here today to answer these important questions. If you're new to NIDS, we are a 501c3 non-profit organization supported by our generous donors and dedicated to advancing peace and stability through a strong national security and nuclear deterrent. We wanted to let you know that May is Deterrence Matters Month here at NIDS, during which we will share daily insights, facts, and stories highlighting the importance of our Deterrence force and the people who keep our nation safe.

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Kimberly Cherington
We invite you to follow us on LinkedIn and share our content with your network to help us spread the word. Thank you for your support and for being part of our growing community. And we hope you have a peaceful day and a peaceful weekend. Thank you for being here.

0:59:34.131 --> 0:59:53.331
Peter Huessy
George, on behalf of NIDS and myself, thank you for doing a great job. We appreciate it very much. And Kimberly will get you a transcript in the video and also send you the questions that a couple weren't answered, but I think you answered them in part. But do with them what you want. But thank you, sir, very much for a very great presentation.

0:59:53.531 --> 0:59:56.851
Miller, George H.
Great. Thank you for inviting me. It was a great opportunity. Thank you.

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0:59:58.291 --> 0:59:58.931
Miller, George H.
Bye-bye.

0:59:59.571 --> 1:0:0.51
Peter Huessy
Bye.

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