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Thank you Chairman Dorgan, Senator Domenici and distinguished members of the Committee for giving me the opportunity to comment on the National Nuclear Security Administration's Defense Nuclear Nonproliferation programs and 2009 budget request.

Today I would like to make three points:

1) Nuclear threat reduction continues to be one of the highest U.S. national security priorities. Unfortunately, the threat has become more complex and challenging since threat reduction programs began in 1992 with Russia and other states of the former Soviet Union. Today, we face a nuclear threat in North Korea, nuclear ambitions in Iran, a nuclear puzzle in Syria, recently nuclear-armed states in Pakistan and India, and an improved, but not satisfactory, nuclear security situation in Russia and other states of the former Soviet Union. Moreover, global energy and climate forces have brought about a resurgence of interest in commercial nuclear power that places additional demands on the threat reduction agenda. I favor a significant expansion of DOE/NNSA's programs in these areas beyond the President's budget request.

2) The greatest threats we face today are a breakdown of the nonproliferation regime and the possibility that terrorists may acquire nuclear weapons or fissile materials. To keep the most dangerous materials out of the hands of the world's most dangerous people requires a global network of nations that are committed to and capable of securing their own nuclear materials, preventing export, and are committed to nonproliferation. We must aggressively expand cooperative threat reduction programs to nations that require either technical or financial assistance and enlist those countries that have the technical and financial resources, but have historically played either a limited or no role in international nonproliferation efforts — namely, Russia, China and India. The hallmark of such cooperation must be partnership, technology and in-country presence.

3) Nuclear threat reduction and nonproliferation efforts must have strong technical underpinnings and participation. The close interplay of technology and diplomacy is crucial to effective policy and implementation. The NNSA and its laboratories represent the primary technical talent in these areas. Unfortunately, financial support and the nuclear research environment are insufficient to meet the challenges confronting us. I strongly support the DOE/NNSA Next Generation Safeguards Initiative and other efforts aimed at attracting more technical talent to these important areas.

Mr. Chairman, you requested that I comment on the adequacy of the President's Fiscal Year 2009 budget request for the National Nuclear Security Administration nuclear weapon nonproliferation efforts as well as the sufficiency of those efforts generally. The committee staff also requested that I comment on the broader policy issues, including on my recent visits to North Korea and India and what we should be doing to secure fissile materials around the world. I will touch on those subjects briefly and attach two articles that deal with some of these issues in greater detail.

The budget and adequacy of the defense nonproliferation programs.

I will restrict my comments to the big budgetary picture. The overall budget request is modest compared to the importance and impact of NNSA's nonproliferation efforts. I recognize the demands on the federal budget, yet the amount of money spent on these programs is small compared to dealing with the consequences of failure in any of its elements.

I strongly support NNSA's comprehensive effort to deal with nuclear threats and steps that it has taken to tailor its programs to the changing nature of the threats. Nevertheless, I believe we need a greater sense of urgency in completing some of the ongoing efforts and in launching new ones with adequate budgetary support.

The greatest threats we face today are a breakdown of the nonproliferation regime and the possibility that terrorists may acquire nuclear weapons or fissile materials. The most immediate challenges are North Korea and Iran. However, the recent developments in Syria demonstrate that efforts to acquire the bomb are more widespread than believed. The importance of keeping fissile materials out of the hands of terrorists is generally appreciated; the technical difficulty of doing so is not. I describe the technical challenges in detail in Attachment I. In addition, the resurgence of nuclear power, necessary to combat the world's energy and environmental crisis, must be supported by enhanced nonproliferation efforts if it is to succeed.

Changing partnership with Russia.

The nuclear threat changed dramatically with the end of the Cold War and the breakup of the Soviet Union. We came to be threatened more by Russia's weakness than its strength. Nunn-Lugar legislation followed by Nunn-Lugar-Domenici legislation established the Cooperative Threat Reduction program aimed primarily at Russia and the other states of the former Soviet Union. This innovative approach of working cooperatively with these nations helped them deal with the unprecedented situation of how to provide security for an enormous arsenal of nuclear weapons and an equally huge stockpile of fissile (bomb-grade) material in states that changed their political and economic systems dramatically, and whose centrally-controlled institutions collapsed almost overnight. Much progress has been made in helping Russia and the other states improve the security of their nuclear weapons and materials. Most importantly, nothing really terrible has happened in the Russian nuclear complex in the 16 years since the breakup of the Soviet Union.

However, much remains to be done. My colleague, Dr. Matthew Bunn, who is also testifying today, has provided detailed annual status reports of accomplishments and challenges. I want to provide a perspective based on my many visits to the Russian nuclear complex since 1992. As director of the Los Alamos National Laboratory at the time, I visited the closed and formerly secret cities housing Russia's nuclear weapons laboratories in February 1992. The nuclear facilities and materials that were previously protected by guns and guards were now vulnerable. We developed scientific collaborations to build trust, which allowed us, two years later, to sign the first contracts with three Russian institutions for materials protection, control and accounting (MPC&A) cooperation. This lab-to-lab program helped Russia begin to develop a modern system of protection and safeguards to secure its nuclear materials. Our focus was always that it is in their best interest to secure their own materials. The responsibility is theirs; all we can do is help. We helped them expand this program to the Russian nuclear navy and the civilian sector. We then also expanded the program to some of the other states of the former Soviet Union. With Senator Domenici's help, we tackled the problem of helping Russia secure its nuclear knowledge by engaging Russian technical specialists in various civilian research and industrial projects to help in the massive worker reorientation challenge the Russian nuclear complex faced. These programs have recently come under unjust criticism by the General Accountability Office. It was critical to augment the hardware-oriented technology programs with people-oriented efforts to enhance nuclear security.

Much of the focus on the MPC&A program with Russia has been to complete physical security upgrades. This phase of the program is nearing completion. Together with the general tightening of security during the Putin administration, these efforts have greatly improved the current nuclear security situation in Russia. The focus of U.S. efforts must now shift to the much more difficult problem of having the Russian complex sustain these security improvements and to develop better practices in the control and accounting of nuclear materials. Progress has been slow, partially because Russia has reverted to the Soviet practice of relying mostly on physical security and secrecy, and partly because Russia has a very different view of its vulnerabilities than we do. Russian practices reflect the belief that the Chechen rebels pose the greatest threat. Much less attention is paid to a potential insider threat.

A different approach to cooperative threat reduction will be required to make additional progress with the Russian nuclear complex. Money will be less important, but not irrelevant. In the 1990s, U.S. financial support was imperative. Today, thanks to oil prices of nearly \$120 a barrel, Russia has a large budget surplus. Yet, if the United States is to continue to influence Russian security and nonproliferation practices, it will need to continue to invest some funds to have such influence. Once Russia completes the current round of facility security upgrades with NNSA support, then I recommend that NNSA support its laboratories to conduct a broad range of cooperative programs with the Russian nuclear complex. Some programs will have direct security implications ó for example, continued work on best practices for MPC&A (especially control and accounting), promoting a security culture, eliminating the use of highly enriched uranium (HEU) in civilian applications, instrumentation development for nuclear detection and

forensics, nuclear attribution, nuclear materials registries and databases, regulations and practices to protect radiation sources, emergency response to nuclear incidents, and proliferation resistant reactors and fuel cycle research. Other programs will have indirect, but still important, benefits ó for example, nuclear energy R&D, environmental R&D, fundamental research in nuclear materials, radiochemistry and analytical chemistry techniques. We must also continue to encourage Russia to eliminate much of its surplus stock of fissile materials and to consolidate its still massive nuclear complex. In summary, we should strengthen and broaden our nonproliferation collaboration with Russia by supporting our own technical specialists to work with Russian technical counterparts. We should phase out direct financial support to Russia except in those cases where the investment is necessary to keep it meaningfully engaged.

Expanding cooperative threat reduction beyond Russia.

I applaud the NNSA efforts to expand its nonproliferation activities and threat reduction programs beyond Russia. These programs in the other states of the former Soviet Union have significantly reduced the global nuclear threat. The breakup of the Soviet Union created four nuclear weapons states out of one. The CTR program reversed that dangerous situation by getting Ukraine, Kazakhstan and Belarus to return Soviet nuclear weapons to Russia by 1996. However, these states also had considerable inventories of nuclear materials and a robust nuclear infrastructure that was largely left in place. Similarly, other states such as Uzbekistan and Georgia had nuclear materials and nuclear facilities. The former Soviet satellite states in Eastern Europe also had vulnerable nuclear materials and facilities. NNSA cooperative programs in these countries have reduced, but not eliminated, the threat. These programs should be expanded and molded into longer-term partnerships with these states to help them manage their nuclear dangers while also getting the benefits of civilian nuclear applications.

The NNSA also correctly assessed the need for cooperative nuclear threat reduction beyond the borders of the former Soviet Union. To keep the most dangerous materials out of the hands of the world's most dangerous people requires a global network of nations that are committed to and capable of securing their own nuclear materials and preventing export. There are approximately 40 countries that possess either nuclear materials or the necessary nuclear infrastructure to produce nuclear materials. There are more than 100 countries that use ionizing radiation sources (for medicine, industry, agriculture or research) that could fuel a radiological dispersal device; the so-called dirty bomb. Whereas the importance of securing nuclear materials is generally appreciated today, the technical difficulty is not. In Attachment I to this testimony I detail why this is much more difficult than simply locking up these materials the way we guard gold at Fort Knox.

The technical components of global security initiatives are crucial. To secure nuclear materials requires global partnerships and global reach. The DOE/NNSA and its laboratories are in the best position to develop such partnerships. I recommend a two-pronged approach: 1) Aggressively expand cooperative threat reduction to countries that require either technical or financial assistance, and 2) Enlist those countries that have the technical and financial resources, but have historically played either a limited or no role

in international nonproliferation efforts. In both cases, cooperation with the International Atomic Energy Agency (IAEA) is imperative.

1) *Aggressively expand cooperative nuclear threat reduction globally.* The NNSA Global Threat Reduction Initiative has made significant gains in securing or removing highly enriched uranium from research reactors and research facilities in countries that had difficulty securing it. For example, partnerships between host countries, the United States, Russia and the IAEA resulted in the repatriation of HEU from Romania, Bulgaria, Uzbekistan and other countries to Russia. In many cases, the NNSA has helped to convert research reactors to operate with low enriched uranium to remove the proliferation risk and allow the removal of HEU. Similar partnerships have helped countries to better manage and secure their radiation sources. The financial requirements for these efforts have been modest. These programs should be expanded and expedited.

Countries such as Pakistan, Libya and Kazakhstan pose special challenges. In my view, Pakistan represents the greatest nuclear security challenge. It has all the technical prerequisites: HEU and plutonium; enrichment, reactor and reprocessing facilities; a complete infrastructure for nuclear technologies and nuclear weapons; largely unknown, but questionable, nuclear materials security; and missiles and other delivery systems. It views itself as threatened by a nuclear India. It has a history of political instability; the presence of fundamental Islamic terrorists in the country and in the region; uncertain loyalties of some civilian (including scientific) and military officials; and it is home to A.Q. Khan, the world's most notorious nuclear black marketeer. Helping Pakistan secure its nuclear materials during these challenging times is made difficult by the precarious position of its leadership and the anti-American sentiments of much of its populace. Yet, such cooperation is imperative.

Libya presented a very special case that required technical cooperation. Once Libya decided it was in its interest to eliminate its covert nuclear program, it was crucial to do so effectively and completely, and to learn as much as possible about nonproliferation patterns and practices from Libya's nuclear program history. NNSA technical specialists did a superb job in both cases.

Kazakhstan also presented a special challenge. It possessed nuclear materials and nuclear reactors when it achieved independence from the Soviet Union. Next to Russia, it had the most extensive and sophisticated nuclear infrastructure, including the sprawling Semipalatinsk nuclear test site. Much progress has been made thanks to NNSA cooperative programs, those of the Department of State and the Department of Defense, and the non-governmental efforts of the Nuclear Threat Initiative. Yet, several serious challenges remain, such as the final disposition of the spent fuel from its fast reactor at Aktau, remain.

I recommend that the NNSA extend its technical reach even further. By working closely with the IAEA, it can help countries effectively meet their obligations under the United Nations Security Council Resolution 1540. Resolution 1540 requires states establish and enforce legal barriers to acquisition of weapons of mass destruction whether

by terrorists or by states. It requires states to ensure that they have the infrastructure in place to address the threat posed by non-state actor involvement in any aspect of the proliferation of weapons of mass destruction. The United States was instrumental in developing this resolution and in getting it adopted. Now, it must take the next step and help provide technical assistance to countries that are struggling to meet its requirements.

2) *Enlist the developed nuclear countries to more effectively secure nuclear materials and prevent nuclear proliferation.* During the Cold War, the United States and Soviet Union cooperated to prevent nuclear proliferation. After the break up of the Soviet Union, U.S. efforts focused on helping Russia deal with its risks. As indicated above, these risks have been reduced considerably through U.S.-Russian cooperation. However, Russia has not re-engaged effectively to strengthen international efforts. Although it has cooperated with the United States in repatriating some weapons-usable nuclear material from the former states of the Soviet Union or its former satellites, its leadership on the global scene is not commensurate with its nuclear status. Although it has promoted international cooperation in reactor technology, providing nuclear fuel services, and storing nuclear waste, it has promoted global export of its own nuclear technologies without sufficient consideration of nuclear proliferation consequences. It has not contributed much to resolution of North Korea's nuclear crisis and has been less than helpful in resolving the Iranian nuclear dilemma.

Historically, China has not played a constructive role in limiting nuclear proliferation. Its past and current relationship with Pakistan remains troublesome. However, in recent years China has shown an interest in becoming constructive. Its 2005 nonproliferation policy paper represents a step in the right direction. China is tightening its export controls and has joined the Nuclear Suppliers Group (NSG). It has begun to engage constructively with the United States to improve the security of its nuclear materials in the civilian sector. The two countries have also begun to cooperate to improve the management and security of radiation sources in China. China has chosen not to engage more fully with the United States to cover its defense nuclear sector because its grievances over the Cox Report have not been addressed. In the past few years, China has also played a constructive role in trying to resolve the North Korean nuclear crisis by hosting the Six-Party Talks, although its approach differs from that of the United States because its strategic interests in North Korea differ. The bottom line is that China can and must do more to work effectively on global nuclear proliferation challenges. Although China will be guided by its own interests, the United States will play a pivotal role in how and when China engages.

India has, not surprisingly, been missing from the global nonproliferation effort. Since India is outside the nonproliferation regime because it did not sign the NPT, it is viewed by many as a proliferator. It views itself as a legitimate nuclear weapon state with a commendable nonproliferation record. India's nuclear program has been shaped largely by the international sanctions that followed its first nuclear test in 1974. The sanctions appeared to have done little to limit India's nuclear weapon program, but they have limited its nuclear energy program and prevented cooperation in nonproliferation. Some welcome progress has been made recently in the area of nuclear reactor safety through

cooperative efforts between the U.S. Nuclear Regulatory Commission and the Indian Atomic Energy Regulatory Board. There is much that should be done to work with India on its domestic safeguards and on its international nonproliferation support.

The European Union has been a constructive member of the international nonproliferation effort. Several of its members have promoted global nuclear security and combating nuclear terrorism through G-8 initiatives with the United States. The EU-3 (Germany, France and the United Kingdom) have led the frustrating nuclear negotiations with Iran over the past few years.

In recent years, the United States has carried the brunt of the international burden in preventing nuclear proliferation and combating the potential of global nuclear terrorism. It played the leading role in helping Russia cope with the nuclear dangers inherent in the breakup of the Soviet Union. We have turned our attention to focus on the global nature of the threat but, despite U.S. efforts, we appear to be losing ground. It is critical to enlist the full participation of the other major players in the nuclear arena. They should be enlisted in partnerships that span a broad spectrum of nuclear cooperation: This should include, for example, best practices in nuclear materials security, development of nuclear materials data bases, nuclear detection technologies, proliferation risk analysis, emergency response, nuclear forensics and attribution.

The IAEA's role should be strengthened. The international safeguards effort is under enormous strain. The special inspection in North Korea and Iran require significant effort. The IAEA's overall workload has increased dramatically over the past 25 years. The number of safeguarded facilities has increased more than three-fold and the amount of HEU and separated plutonium has increased six-fold. The Additional Protocol has increased the number and complexity of inspections. Yet, the overall budget of the agency has remained relatively flat. The expansion of commercial nuclear power will tax the IAEA beyond its current capacity.

Strengthening the nonproliferation regime and expanding nuclear power.

The nonproliferation regime is under stress. North Korea's nuclear program and Iran's determined drive to uranium enrichment demonstrate how some nations use the NPT's promotion of civilian nuclear programs clandestinely to develop nuclear weapons or develop the nuclear weapon option. This problem is compounded by the fact that Article X allows nations to withdraw from the treaty without penalty. The recent revelations about Syria's clandestine nuclear program are especially troublesome because it was generally believed that national technical means would detect such a massive effort long before it entered such an advanced stage. The nonnuclear weapons states express an additional concern. They contend that the nuclear weapon states have not met their Article VI obligations toward nuclear disarmament. These differences contributed to the disastrous outcome of the 2005 NPT review conference. Prospects for the 2010 conference look just as grim unless progress is made on the North Korean and Iranian problems and on Article VI obligations.

All of these concerns have surfaced just when commercial nuclear power is poised to take off globally because of worldwide energy demand and concerns about global climate change. An expansion of nuclear power will bring additional challenges to secure more nuclear material in more countries and to prevent additional states from turning their nuclear energy capabilities into nuclear weapons programs. The DOE's Global Nuclear Energy Partnership is a step in the right direction, but it needs better definition domestically and must become truly global to take into account the needs of the principal partners as well as those interested in future nuclear power.

Strengthening U.S. technical capabilities to combat proliferation and nuclear terrorism.

The proliferation of nuclear weapons and weapons capability is growing. The danger of nuclear terrorism is real. This is not a fight the United States can win alone. We cannot simply push the dangers beyond our borders. It is imperative to forge effective partnerships to combat the dangers of nuclear terrorism and the proliferation of nuclear weapons. Meeting these challenges will require diplomatic initiative and technical cooperation. The United States must lead international diplomacy and DOE/NNSA must provide technical leadership and capabilities.

Unfortunately, the technical talent and facilities at the DOE/NNSA laboratories are steadily eroding. The technology base for nonproliferation and counter-terrorism activities rested on robust research programs in nuclear weapons and nuclear energy. Nuclear energy programs in the United States are just re-emerging from a couple of decades of inactivity. Nuclear weapons research has declined and has increasingly restricted its breadth of research. Moreover, facilities that were previously available for safeguards research are more difficult and costly to access. Consequently, more of the burden has fallen on the nonproliferation and verification budget of the NNSA. It has not kept up with the increased need for technical innovation in these areas.

In addition, much of the safeguards technology developed and deployed around the world was typically demonstrated and refined domestically in U.S. nuclear facilities. These domestic safeguards technology development programs provided the foundation for measurement technologies, systems analysis and modeling in safeguards. For example, in the mid-1990's the Los Alamos National Laboratory had over \$7 million in domestic safeguards funding primarily focused on advancing the state of the art in nondestructive analysis. Today, it is approximately \$250,000. Most of the domestic funds are expended for physical protection - guns, bullets and concrete to repel external threats based on the design basis threat. Consequently, we are falling behind in applying modern technologies to safeguard our domestic facilities and our technology base for safeguards is at risk. Moreover, it has become increasingly difficult to operate domestic nuclear facilities productively. The regulatory environment combined with a risk-averse operating environment has made it difficult to get work done, consequently losing the interest of some of the talent necessary for such programs. Recruitment of new talent in safeguards and other areas important in safeguards and verification has been difficult. A recent study by the American Physical Society and the American Association for the

Advancement of Science¹ pointed out the great difficulty in educating and training scientific talent in nuclear forensics and disciplines such as radiochemistry.

The DOE/NNSA leadership has recognized these problems and recently launched the Next Generation Safeguards Initiative. This initiative would strengthen domestic capabilities by launching a generational improvement in safeguards technologies. It would greatly enhance the application of modern information technologies to safeguards. Other priorities include advanced safeguards approaches and proliferation risk assessments; enhanced modeling and simulation tools to better integrate safeguards into the design of new facilities; improved automation and automated process monitoring systems with real-time data transmission; better measurement technologies; and portable and multifunctional detectors. The Initiative recognizes the need to transfer these improvements to the IAEA so that it can deploy them in the field to meet the demand for greater and more sophisticated inspections. It also recognizes the need to build university laboratory partnerships to provide educational support and training opportunities for the next generation of safeguards specialists. The Initiative also properly recognizes the need to leverage the nuclear capabilities of other nations to strengthen domestic and international safeguards capabilities. I strongly encourage the DOE/NNSA to develop this initiative and Congress to provide adequate funds.

I want to make some final comments on the importance of having our technical specialists on the ground in country. The NNSA technical teams in Russia have been crucial in assessing the risks in the Russian nuclear complex, in comparing technologies and approaches to nuclear security and to learn from Russia's practices and experience. My recent trip to India's nuclear centers underscored the importance of an in-country presence. I gained a much better appreciation for their domestic safeguards and security practices. I learned just how strongly the Indian nuclear energy program is geared to self-reliance. I learned how international sanctions over more than 30 years have slowed India's drive toward nuclear energy, but most likely not done much to slow its nuclear weapon progress. I found that whereas sanctions slowed progress in nuclear energy, they made India self-sufficient in nuclear technologies and world leaders in fast reactor technologies, while much of the world's approach to India has been to limit its access to nuclear technology, it may well be that today we limit ourselves by not having full access to India's nuclear technology developments. Such technical views should help to advise the diplomatic efforts with India.

I have been in North Korea five times in the past four years and visited the Yongbyon Nuclear Center three times, including this past February 14. I have had sufficient access to make a reasonable technical assessment of North Korea's nuclear capabilities. North Korea has the bomb, but not much of a nuclear arsenal. It has most likely produced and separated between 40 and 50 kilograms of plutonium, sufficient for about six to eight bombs. I believe that North Korea is seriously disabling its Yongbyon nuclear facilities and that elimination of plutonium production is within reach. I was able

¹ Michael May, Chair, "Nuclear Forensics Role, State of the Art, and Program Needs," Joint Working Group of, AAAS, APS Physics, 2007.

to witness the activities of the DOE/NNSA technical teams on the ground in Yongbyon. They have done a superb job supervising the disablement of the Yongbyon facilities and they have very ably advised and supported the diplomatic process. I provide a detailed report of my observations and conclusions in Attachment II.