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Strengthening the Nuclear Nonproliferation Regime: Focus on the Civilian Nuclear Fuel Cycle

Arian Pregenzer and David Saltiel

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Introduction

Leaders around the world and across the ideological spectrum agree that the global nonproliferation regime is facing a serious test. The emergence of sophisticated terrorist networks, black markets in nuclear technology, and technological leaps associated with globalization have conspired to threaten one of the most successful examples of international cooperation in history. The rampant proliferation of nuclear weapons that was predicted at the start of the nuclear age has been largely held in check, and the use of those weapons avoided. Nonetheless, with the 35th anniversary of Treaty on the Non-Proliferation of Nuclear Weapons (NPT), the threat of nuclear proliferation seems more serious than ever.

Although experts readily concede that there exist many pathways to proliferation, the threat posed by the misuse of the civilian nuclear fuel cycle has received considerable recent attention. While the connection between nuclear energy and nonproliferation has been a topic of discussion since the dawn of the nuclear age, world events have brought the issue to the forefront once again. U.S. President George W. Bush and I.A.E.A. Director General Mohammad ElBaradei have both highlighted proliferation risks associated with the civilian nuclear power programs and called for revitalizing the nuclear nonproliferation regime to address new threats. From the possibility of diversion or theft of nuclear material or technology, to the use of national civilian programs as a cover for weapons programs – what many have called "latent proliferation" – the fuel cycle appears to many to represent a glaring proliferation vulnerability.

But just as recognition of these risks is not new, neither is recognition of the many positive benefits of nuclear energy. In fact, a renewed interest in exploiting these benefits has increased the urgency of addressing the vulnerabilities. Global energy demand is expected to at least double by the middle of the century and could increase even more quickly. Much of the new demand will come from the rapidly expanding economies in China and India, but much of the developing world stands poised to follow the same path. This growth in demand is paralleled by concerns about global warming and the long-term reliability of carbon-based fuel supplies, which expanded use of nuclear power can help to address. For these reasons and others, many countries in Asia have already clearly signaled that nuclear energy will play a key role for years to come.

Numerous proposals have been made in the last two years for reducing the proliferation risk of the civilian nuclear fuel cycle. These range from a ban on export of enrichment and reprocessing technology to countries not already possessing operational capabilities,

to multinational management of the nuclear fuel cycle, to strengthening existing monitoring and security mechanisms. The need for international willingness to enforce nonproliferation commitments and norms has also been emphasized. Most of these proposals could significantly impact the production of nuclear energy.

Because the successful strengthening of the nonproliferation regime and the expansion of nuclear energy are so closely related, any successful approach to resolving these issues will require creative input of experts from both the nuclear energy and nonproliferation communities. Against this backdrop, Sandia National Laboratories organized its 14th International Security Conference (ISC) around the theme: "Strengthening the Nuclear Nonproliferation Regime: Focus on the Civilian Nuclear Fuel Cycle." The goal of the conference was to begin a constructive dialogue between the nuclear energy and nuclear nonproliferation communities.

The ISC agenda was structured to produce a systematic review of the connection between civilian nuclear energy programs and the proliferation of nuclear weapons and to identify constructive approaches to strengthen the nonproliferation regime. The conference began by reviewing the energy and security context that has, once again, raised the profile of this issue. A discussion of the risks associated with the civilian nuclear fuel cycle was then used to inform analysis of several potential risk-management tools. The conference concluded by looking for lessons from the past, as well as looking forward to future opportunities in the future with a particular focus on East Asia.

In this paper we summarize the debates and ideas which emerged during the conference. Although we have drawn on material presented by speakers and comments made by participants, we do not quote or cite the specific contributions of individuals. More details on the conference agenda and specific presentations is available at the conference website: http://www.intlsecconf.sandia.gov/

Global Energy Demand and the Role of Nuclear Energy

Even conservative estimates predict that energy demand will double by the middle of the century and could grow much more rapidly. While increased energy efficiency could constrain this growth somewhat, the bulk of the demand will come from the developing economies of China and India, countries which most experts acknowledge will not be at the forefront of energy conservation efforts as they try to rapidly reach economic parity with the developed world.

The rest of the developing world will not be far behind in their demand for energy. By some estimates, as many as two billion people continue to live without reliable access to electricity, a key requirement for prosperity, health, and human welfare. As the link between prosperity and security is more widely recognized, it will be in the interest of all to find sustainable ways to provide energy to increase the global standard of living.

This growth in demand, coupled with growing concerns about both the reliability of supply of carbon-based fuels and the long-term effect of their use on the environment has

focused attention on sustainable alternatives. Although certainly concerned with protection of the environment, sustainability also entails reliable access to energy at a reasonable and predictable price. Part of the solution to sustainability will be the expanded use of renewable energy sources, but most seem to agree that nuclear energy will also need to be a significant element in the global energy mix.

For nuclear energy to play a markedly increased role in supplying global energy needs, the challenges of cost, safety, waste disposition and proliferation must be addressed. With the price of oil at record highs, nuclear energy has become more economically competitive on a relative basis than in the past. However, public concern about the safety of nuclear power has limited the expansion of nuclear energy in many countries. Concern about the link of nuclear power to nuclear weapons historically has not played such an important role in affecting public opinion, but this could change as the threat of nuclear terrorism and proliferation receive greater attention.

Issues of cost, proliferation and safety all converge on the issue of nuclear waste, which may be the most serious impediment to the growth of nuclear energy. Dealing with the problem of waste not only requires addressing the safety and security of waste disposal sites, but also requires exploring ways to minimize its volume to reduce the cost of long term storage, and altering its composition to limit its usefulness to potential proliferators.

Assurance of supply of nuclear fuel is another critical element of the long-term viability of nuclear energy. Although currently abundant, uranium reserves are, like petroleum and natural gas, finite resources. A sustainable nuclear energy future will require extracting as much energy from these finite reserves as possible. This requirement, coupled with the requirement of reducing nuclear waste, lead many nuclear energy experts to advocate a "closed" fuel cycle that includes the reprocessing or recycling of spent nuclear fuel. However, the nonproliferation community has generally opposed such recycling, since current methods result in the separation of plutonium that can be used to make nuclear explosives.

An Evolving Global Security Environment

In the last few years, concerns about nuclear terrorism and revelations of clandestine nuclear programs have provoked a reconsideration of the international nuclear nonproliferation regime. No longer is it just states that must be stopped from developing nuclear weapons: non-state actors, unhindered by treaties and international norms, seek nuclear material for everything from dirty bombs to full-scale nuclear weapons. Nuclear black markets have been discovered that can provide services ranging from nuclear weapon design information to supplies of sensitive nuclear technology. The potential for such networks to supply weapon-useable nuclear material (or even nuclear weapons) cannot be ignored.

In addition, since the Nuclear Nonproliferation Treaty (NPT) places no restrictions on the acquisition of enrichment and reprocessing technologies, as long as they are subject to international safeguards, nor imposes penalties on states that withdraw from the treaty,

some fear that the NPT has been or could be used to legally develop the knowledge and tools necessary for a nuclear weapons program. These "latent" nuclear weapon states could then withdraw from the NPT without consequence, a scenario referred to as "breakout." Finally, a growing number of states outside the NPT possess nuclear weapons but are not subject to international obligations to control the export of sensitive nuclear technology or material.

In this context, the desire for nuclear energy, coupled with the increased access to technology and information, has heightened concern about the link between civilian nuclear energy programs and nuclear weapons programs. Weakening this link lies at the heart of many recent proposals for strengthening the nuclear nonproliferation regime.

The Proliferation Risk of the Civilian Nuclear Fuel Cycle

Whereas much attention is now focused on the civilian nuclear fuel cycle, its relative risk as compared to other paths to proliferation is not often discussed. Conference participants were asked to address the issue of relative risk, then, looking specifically at the civilian fuel cycle, to identify absolute risks that warrant particular attention.

There was general agreement that the civilian nuclear fuel cycle poses less risk than inadequately secured nuclear material or weapons, and that research reactors using highly enriched uranium also pose higher risks. Clandestine military programs, uncoupled to civilian activities, were also acknowledged as posing a high risk.

Some argued that legitimate civilian fuel cycle programs pose a very small proliferation risk – that they have been the source of neither past nor present proliferation. For example, they argued, the recently-discovered black-market network in nuclear technology was rooted in the Pakistani nuclear weapons infrastructure, rather than in legitimate civilian nuclear activities; and Iran's clandestine activities were not linked to its open civilian program.

Addressing the absolute risk of the civilian fuel cycle, all agreed that creating or diverting weapons useable material poses the greatest risk, which focuses attention on enrichment and reprocessing capabilities. Traditionally, the risk of reprocessing has received greater attention than that of enrichment, primarily because of the perceived greater difficulty of procuring or developing enrichment technology. Although the availability of centrifuge technology through the black market has recently altered this assessment, concerns about reprocessing remain high in the nonproliferation community. Most regard an "open" fuel cycle, i.e., one that that does not reprocess spent nuclear fuel, as posing the least risk.

However, several participants argued that reprocessing of spent nuclear fuel could actually reduce proliferation risk if carried out under strict safeguards, since the time during which separated plutonium is available is relatively short. They argued that after conversion to mixed oxide fuel, its value to potential proliferators is less than the eventual value of untreated spent fuel. They characterized the open fuel cycle as shifting

the burden of proliferation to future generations, as the cooled spent fuel could be mined for its plutonium content.

Some participants argued that assessing the risk of the civilian fuel cycle could not be done in isolation of considering the nonproliferation credentials of individual countries. They argued that not all states pose the same risk, and that criteria for assessing risk should be developed. Japan was cited as an example of a "low-risk" country, based on several criteria: legal renunciation of nuclear weapons, an obvious need for nuclear power, complete transparency of its nuclear program, an exemplary record of compliance with nonproliferation rules and norms, and numerous proactive efforts to promote nonproliferation.

There was general acknowledgement that risk-assessment tools that would help establish consensus on the proliferation risk of the civilian fuel cycle would be of great value. They would be useful in building a global consensus about priorities for reducing the proliferation risk of the fuel cycle, and they also could be an important confidence building measure among states that question each others' intent and motivation.

Reducing the Proliferation Risk

Since the advent of nuclear energy, political and technical experts have been working to address the proliferation risk of the civilian nuclear fuel cycle. The creation of the IAEA, the signing and ratification of the NPT, the development of safeguards regimes, and multiple proposals for more formal international fuel cycle management tools are only a few of the many important efforts. In the last year, numerous proposals have been made for changing, supplementing, and strengthening traditional approaches. Based on the preceding discussion of nuclear energy needs, proliferation threats, and the risks of the civilian fuel cycle, conference participants were asked to consider a variety of these approaches and to evaluate their effectiveness in reducing proliferation risk.

Changing the Regime

Many recent proposals from governments and the IAEA seem to imply that the current nonproliferation regime is fundamentally flawed and needs to be altered significantly. These proposals all share the idea that the best way to reduce risk is to prevent some countries from having full control over the full fuel cycle while still finding ways to confer the benefits of nuclear energy. Roughly, the proposals can be described as either strategies of denial or strategies of multilateral cooperation.

Denial Strategies

In their strongest form, denial strategies would prevent any country not currently in possession of enrichment and reprocessing technologies from acquiring them. Proponents argue that the only way to be certain that sensitive technologies are not misused is to prevent their continued spread.

Less restrictive approaches would deny access to only those states considered likely to misuse or irresponsibly safeguard nuclear technology and material. Such "criteria-based" export controls would require exporting countries to consider a set of factors prior to issuing an export license, such as whether the technology in question makes economic sense (i.e., does a country with a very small-scale nuclear energy program have a reasonable need for an enrichment facility), whether the requesting state has a strong history of nonproliferation compliance, and whether the region into which the technology would be imported is politically stable.

Related to the call for more stringent export controls are proposals for a moratorium in the development of additional enrichment and reprocessing capacity anywhere in the world, including those countries with existing capabilities. Justification for a moratorium is based on the fact that current supplies of enriched uranium outstrip demand, and will continue to do so for several decades. With respect to reprocessing, the argument is that current methods are simply too risky, and that until different, "proliferation-resistant" recycling technologies are developed, reprocessing cannot be justified.

Regardless of their views on the merits of denial strategies, conference participants were generally skeptical that any of these ideas would be well-received at the upcoming NPT Review Conference. Stricter export controls are likely to draw protests and claims of discrimination, and could lead some states to seek such capabilities clandestinely or to develop them indigenously. In addition, many argued that denial will be ineffective, since technical know-how is already widely disseminated and a growing number of countries now possess the indigenous capability to develop the full fuel cycle. They argued that denial strategies will have the greatest impact on legitimate industry and countries who play by the rules, rather than on the real risk, namely, states and non-state actors who intend to misuse the technology in the first place.

In a similar vein, some participants argued against imposing a moratorium on new capacity development. Since enrichment facilities are extremely capital-intensive and require long-lead times and long-term commitments, a moratorium could reduce confidence in the ability of existing market mechanisms to assure supply into the future. Lack of confidence in existing suppliers could result in states rushing to acquire their own enrichment capabilities now, rather than risk supply shortages in the future.

Multilateral Cooperation Strategies

Advocates of multilateral cooperation argue that the way to discourage additional countries from acquiring the full fuel cycle is to assure adequate, cost-effective supplies of nuclear fuel in the future through international mechanisms. (It is worth noting that all of the technology denial approaches are closely coupled with some form of supply guarantee.) Some also argue that multinational oversight of sensitive technologies and facilities would reduce the risk of their misuse or diversion by a state seeking to "break out" of the NPT. Providing spent fuel and waste management services is often seen as an additional incentive for countries to accept a multinational approach.

Multilateral or multinational approaches (MNAs) have a long history dating back to the 1946 U.S.-initiated Baruch plan and have received regular reconsideration over the past 60 years. The most recent exploration was conducted by the IAEA Expert's Group on Multilateral Nuclear Approaches, an effort chaired by Conference speaker Bruno Pellaud. The final report of the Expert's Group sets out a stepwise pathway through which greater international oversight of the civilian fuel cycle might be realized.

The report recommends beginning with strengthening fuel service supply assurances, particularly enrichment services, as an incentive for states with relatively small nuclear energy programs to voluntarily forego national control of sensitive technologies. Supply assurances could be guaranteed by industry through long-term, transparent contracts and agreements or could include government- or IAEA-backed guarantees through the establishment of fuel banks.

A more ambitious step would involve putting existing fuel cycle facilities under some form of multinational control. Such control could be exercised either through joint ownership of a facility that would continue to be operated by a single country (i.e., the current Eurodif model) or through more substantial multinational involvement with different stages of R&D and operations occurring in several countries and involving a multinational staff (i.e., the current URENCO model). Underlying both scenarios is the premise that the system would be self-policing with all partners scrutinizing the behavior of each other. Going one step farther, constructing and operating all new facilities under multinational control was noted as a possibility for the future.

The concept of voluntary MNAs that build on existing market mechanisms and do not involve establishing additional bureaucratic controls was widely regarded as valuable. However, even proponents of MNAs acknowledged that such arrangements would not address the range of risks associated with the fuel cycle. Countries motivated to develop a latent nuclear weapons capability would be unlikely to participate in such arrangements voluntarily, even with strong economic incentives. Multinationally controlled facilities could help in reducing the risk of "breakout" and to some extent, the risk of illicit diversion of material might be reduced because of the self-policing function and the existence of fewer total facilities to monitor. However, some argued that by involving multiple countries, technology diffusion might actually become more difficult to control. In addition, if new multinational facilities were constructed in states not already possessing nuclear weapons or fuel cycle facilities, new vulnerabilities could be introduced.

Ultimately a major benefit of MNAs would be as confidence building measures among states that have a legitimate interest in nuclear energy. This could be particularly valuable in conflict-prone regions where perceptions and misperceptions about nuclear intentions might drive conflict and even proliferation. The economic benefits to be gained from MNAs could also decrease the demand for national control of fuel cycle services in countries planning for expansion of nuclear power in the future. However, many expressed skepticism in the ability of the international community to actually guarantee fuel supply. Others noted that although the prospect of spent fuel and waste

management services could be an important incentive for countries to participate in MNAs, specific ideas for international spent fuel repositories have been plagued with both political and technical problems, and a viable solution remains elusive.

Strengthening the Existing Regime

Conference participants all agreed that much progress could be made in the fight against proliferation simply by strengthening or better implementing tools that have already been developed.

The IAEA Additional Protocol

Of all the tools considered during the conference, none received stronger support than the Additional Protocol (AP). Because it offers far greater transparency and intrusiveness than traditional safeguards agreements, the AP would significantly impede facility misuse and the construction of clandestine facilities and would offer advanced warning of activities which might lead to NPT withdrawal.

Even while voicing support for the AP, several participants noted that it would not substantially increase the ability to detect clandestine facilities nor would it speak to the question of enforcement of rules and norms.

Enhancing the Nonproliferation Culture within Industry

Several participants, including representatives of the nuclear industry, noted that an added emphasis on creating a security and nonproliferation "culture" among industrial actors could not only reduce the proliferation risk but also increase confidence in the system. In much the same way that the nuclear industry created a robust, self policing safety culture following the Three Mile Island accident, industry was encouraged to take a leadership role in building a norm of vigilance at all levels. Such an approach would arguably be in the best interest of industry, since a single case of proliferation would have disastrous consequences for the business.

There was concern, however, over the issue of transparency. Representatives of industry felt that opening security measures to additional outside scrutiny, as is done with safety, might actually create vulnerabilities. More thinking needs to be done to identify ways to balance the value of transparency with the need for security.

Advanced Fuel Cycle and Monitoring Technologies

Some participants argued that in the long-term, the most effective way to reduce the risk of the civilian fuel cycle would be a wholesale technology shift to make it far less transferable to weapons production. The IAEA's International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO) and the multinational Generation IV International Forum (GIF) are both devoting substantial resources to developing new technologies, as well as ways to evaluate their "proliferation resistance." The goal is to

create fuel cycles and processes that are more easily monitored and result in result in waste that is less attractive for use in weapons, and more suitable for long-term disposal. Concepts for tamper-proof, "disposable" reactors that minimize fuel handling, are also being considered as ways to reduce proliferation risk. Such technologies would also enhance the long-term viability of the nuclear industry.

Under the best conditions, however, these new technologies will not be available for many years and thus offer no prospect of addressing the proliferation risks stemming from current and near-term nuclear energy production. Moreover, the most optimistic proponents of advanced fuel cycles and next-generation reactors agreed that preventing states from using older technology will be nearly impossible.

To address current proliferation risks, new technologies might be considered to improve monitoring of both enrichment and spent fuel treatment processes. Existing monitoring techniques are imprecise in their measurement of both material quantity composition, leave substantial portions of sensitive processes unmonitored, and incur significant time lags before the collected data can be analyzed. These weaknesses make misuse or diversion less detectable and fuel cycle activities less transparent. "Real-time accountability" tools could address these flaws and might also reduce the monitoring costs by automating measurement tasks that would otherwise have to be performed by inspectors.

While some participants thought that advanced process monitoring could provide a useful additional tool for the IAEA, others questioned whether it would truly be practical in large-scale industrial facilities and cautioned that it could divert attention from more pressing concerns. Not only could it produce false positives that would require attention from inspectors, but strict standards for acceptable levels of variability would need to be defined. Resources devoted to such detailed process monitoring might better be devoted to bigger picture concerns.

Lessons Learned from the Past

In considering ways to manage the risk of proliferation in the future, lessons from that past should not be overlooked. Most participants who addressed this issue expressed the view that neither technology restrictions nor multinational management arrangements would have prevented past efforts to develop nuclear weapons.

Upon examination of cases in which governments have chosen to relinquish a nuclear weapons program, it is difficult to find common themes. A change in threat perception (in the case of South Africa), transition from military to civilian government (Brazil and Argentina), and pressure by powerful allies (Taiwan and South Korea) have all contributed to the decision to abandon military programs. Export controls alone were insufficient to effect change in all these cases. In the case of Brazil, restrictions on trade in nuclear technology resulted in a massive indigenous nuclear R&D program which made significant progress in developing full fuel cycle capabilities. Removal of the original reason for pursuing nuclear weapons (national prestige, perceived security

threats, or domestic political posturing) was arguably the most important factor in bringing about change in policy.

In cases where states have successfully pursued a nuclear weapons program outside the auspices of the NPT, it was done independently of a civilian nuclear power program. Research reactors played an important role in the military programs of India, Pakistan and Israel. Again, removing the reasons behind development of a nuclear weapons program would be a prerequisite for any decision to disarm, or even to restrict further development.

In applying these lessons to the case of Iran, participants observed that Iran bears certain resemblances to the case of Brazil and Argentina: Iran now likely has the indigenous capability to develop nuclear weapons, and its leaders seem to perceive nuclear weapons as a symbol of modernity and prestige. Peaceful regime change, brought about by internal forces and accompanied by economic incentives to solve other pressing domestic problems, may bring about a change in policy. Technology denial is seemingly no longer an option, although the prospect of technical cooperation in selected areas might be an incentive to abandon military nuclear programs.

A Closer Look at East Asia

Although the concern about the proliferation risk of the civilian nuclear fuel cycle is clearly a global issue, the problem is more acute in East Asia than anywhere else. Northeast Asia is the only region in which nuclear generating capacity is expected to grow over the next twenty years (capacity will actually decline everywhere else). Ambitious projections suggest that China alone could construct 40 new reactors by the middle of the century and will almost certainly build enrichment and reprocessing capacity to match.

The increased demand for nuclear energy is a manifestation for the growth in demand for energy generally throughout the region. Demand is driving up prices, but it is also heightening tensions in a region already beset by conflicts and mistrust. With the exception of China, the region is poor in both uranium reserves and available land on which to construct spent fuel storage and disposal facilities. With energy security a growing concern and energy independence a much sought after goal, countries in the region will need to start making decisions very soon that will affect both the course of nuclear energy and nonproliferation regionally and globally.

China's possession of nuclear weapons and the fact that its nuclear energy program is young but poised to expand substantially in the near future makes it a special case in the region. Chinese researchers are on the forefront of advanced reactor technology and plans are being developed for the construction of fuel cycle facilities. China's choices about export control and regional cooperation will be perhaps the most fundamental factor in determining the course of proliferation issues associated with nuclear energy. Most outside observers agree that for now, however, China's focus on economic development has taken priority over these longer-term questions.

Just as Northeast Asia is at a turning point, countries in Southeast Asia such as Indonesia and Vietnam are just starting to plan for a nuclear energy future. The opportunity to consider new approaches for the region is now. Facing the daunting task of initiating a nuclear energy program, countries in Southeast Asia might be particularly amenable to technology cooperation as an incentive to participate in new approaches. Decisions about national reprocessing and enrichment needs have not been made in these countries and could, under the right circumstances, be influenced.

Ideas for regional cooperation are not new to East Asia. In the 1990s alone, more than 20 proposals were made by recognized scholars from both inside and outside the region. Most suggested an Asian analog to Euratom (commonly coined either Pacatom or Asiatom). While each proposal differed in scope and ambition, nearly all concluded that the most promising avenues for cooperation lay in regional cooperation on safety issues and on spent fuel and waste management.

For all the promise of regional cooperation, many speakers and participants warned of potential pitfalls. The details are extremely important and no one should assume that the Euratom model can be transported wholesale to Asia given the unique challenges of the region. As one participant noted, cooperation done badly could actually increase regional tensions. In sum, the general feeling was that, at least initially, the real value of regional cooperation would be in building confidence among players in the region.

Conclusions

The conference concluded with a roundtable discussion in which conference participants were asked to both highlight the most important points raised thus far and to propose specific actions for the future.

Key Points

Panelists again sought to put the proliferation risk of the civilian nuclear fuel cycle into a larger perspective, and reiterated their concerns with several proposals for managing the risk.

The Civilian Nuclear Fuel Cycle is not the Greatest Risk to Proliferation

There was general agreement that the civilian nuclear fuel cycle poses less risk than inadequately secured nuclear material or weapons, and that research reactors using highly enriched uranium also posed significant risks. Although all agreed that enrichment and reprocessing facilities pose a risk, there was little enthusiasm for an overhaul the nonproliferation regime at this point. Several panelists argued that attempts to fundamentally alter the regime distract attention from more important matters, namely implementing existing tools and enforcing existing norms.

Distinguish Between Positive and Negative Tools for Managing the Risk

The need to evaluate risk of the nuclear fuel cycle in much broader context was also emphasized. The world today faces many “threats” in addition to proliferation and

terrorism, including insufficient energy resources and environmental degradation. When considering tools to manage the proliferation risk of the civilian nuclear fuel cycle, some participants suggested distinguishing between positive and negative tools. Positive tools are those that reduce the proliferation risk without increasing other risks, such as energy insufficiency or environmental degradation, and were viewed as having a greater likelihood of success. Developing risk assessment methodologies that would help achieve consensus on the risk of the civilian fuel cycle relative to other risks could be a useful endeavor.

Further Restrictions on Trade Could be Counter Productive

Some panelists argued again that further restrictions on trade would be ineffective and perhaps counter productive. They argued that increased controls on trade would neither reduce the risk of "breakout" by countries already in possession of the entire fuel cycle, nor prevent indigenous development or clandestine procurement. In fact they could motivate states to rush to develop additional capabilities before restrictions are in place. According to this perspective, a better approach would be to demonstrate that the current market has the capacity to supply needs far into the future. They argued that because of the long-lead times required even to maintain existing capacity, any moratorium on developing new capacity for enrichment and reprocessing would erode confidence in the long term viability of supplies.

Technological Solutions have Limited Value in Reducing Risk

In arguing for a "pause" before developing new enrichment and reprocessing facilities or additional enrichment capacity, some argued that it would provide time to develop new methods of process monitoring, or to incorporate higher levels of proliferation resistance into the fuel cycle. They suggested that real-time process monitoring could give the international community additional tools that would stiffen resolve to deal with non-compliance quickly and resolutely. Others, however, expressed skepticism that "technical fixes" would markedly reduce the proliferation risk in the short term, since older technologies will remain available and since process monitoring cannot prevent misuse. Some expressed the view that pursuit of new technological solutions often is used to justify political inaction. The general sentiment seemed to be that political will was far more important than new technology.

Multinational Approaches as Confidence Building Measures

Multinational approaches received mixed reviews. Some viewed MNAs, particularly in their most ambitious forms, as unlikely to be accepted for a host of reasons. Others argued that MNAs failed to directly respond to the most urgent proliferation threats and vulnerabilities. Defenders of the concept, however, argued that MNAs might be a good vehicle through which to encourage greater acceptance of other tools. Responding to critics who dismissed MNAs as lacking relevance, proponents pointed out their potential value as confidence building measures to increase transparency and reduce regional tension – both important factors in reducing demand for nuclear weapons.

Reducing Demand for Nuclear Weapons is Critical

There was also general agreement that the efforts to prevent proliferation ultimately hinge on removing the motivation for countries to develop nuclear weapons. Reducing intent deserves much more attention, and will be required to prevent indigenous or clandestine military nuclear programs.

Recommendations for the Future

Recommendations for practical steps that could be taken in the near term fell into three general categories: reinforce and strengthen existing mechanisms, increase incentives for countries not to develop the entire fuel cycle, and decrease the risk of "breakout."

Reinforce Existing Mechanisms

Pushing for universal compliance with the Additional Protocol and strengthening states' abilities to implement and enforce existing export control mechanisms were recommended as being important near term priorities. Offering technology cooperation that could advance nuclear energy programs or enhance nuclear security in exchange would be in the interests of all parties, and was viewed as more likely to succeed thatn "negative tools" which focus only on prohibition and denial.

Strengthening the physical security for facilities containing sensitive material and technology should also be pursued. In addition, some suggested that more robust use of the Proliferation Security Initiative for interdiction of suspicious shipments would be more effective than imposing additional restrictions on trade.

Increase Incentives for not Developing the Entire Fuel Cycle

Some argued that the highest priority should be placed on development of solutions for spent fuel disposition as a way to reduce incentives for near-term reprocessing. They argued that overcoming political barriers to new international approaches should be a near term goal.

Others argued that a high priority should be placed on developing methods to encourage trade within the legitimate nuclear market as a way to limit clandestine activities.

Some suggested that the prospect of increased technical cooperation could be an incentive to forego developing the entire fuel cycle. Topics for technical cooperation could include proliferation-resistant fuel cycle technology, physical security technology, and nuclear safety.

Decrease Risk of Breakout

Most participants agreed that the problem of states withdrawing from the NPT after acquiring the means to produce fissile materials was a threat to which the tools discussed during the conference largely failed to address.

Systematically looking at breakout scenarios for fuel cycle states and assessing the institutional, legal, and security mechanisms which might inhibit withdrawal or at least limit its consequences was suggested as a worthwhile exercise.

Negotiating and implementing a fissile material cutoff treaty was suggested as a means to universally ban the production of fissile material for weapon purposes. Its associated verification regime could also allow increased monitoring of enrichment and reprocessing facilities.

Some also suggested developing another "addition" to the NPT that would make safeguards commitments irreversible. This would preclude states from keeping unsafeguarded material or facilities after withdrawal from the NPT

Value of Continuing Dialogue

Although there was much debate about the best paths forward, disagreements did not always divide nuclear energy and nonproliferation experts. On several points, including the need to reduce demand for weapons, the importance of enforcing existing norms, the value of voluntary, incentive-based approaches, and the importance of positive tools that reduce proliferation risk while not damaging prospects for sustainable nuclear energy, the two communities were in strong agreement. Additional work involving both communities, particularly focused on the specific issues affecting East Asia, offers the promise of a growing international consensus on the most useful, sustainable paths to reducing the proliferation risk of the civilian nuclear fuel cycle.