

DISCUSSION PANEL: FUTURE DIRECTIONS AND STRATEGIES

David Albright, ISIS (Chair)

Luther Carter, Independent Journalist

Harold Bengelsdorf, Bengelsdorf, McGoldrick and Associates

Wolfgang Kersting, Consultant, Blikaatel, Germany

Ed Helminski, Exchange Monitor Publications (Commentary)

David Albright: The first speaker on this panel will be Luther Carter. He is an independent writer, who for many years covered environmental and arms control issues for *Science*, the journal of the American Association for the Advancement of Science. In 1989, he was elected a Fellow of the AAAS for “distinction in science journalism.” He has won competitive fellowships and grants from a number of prestigious foundations. He is the author of the well known book *Nuclear Imperatives and the Public Trust: Dealing with Radioactive Waste*, which was published by Resources for the Future, and also the author of many other publications.

The second speaker will be Harold Bengelsdorf, currently a principal in the consulting firm of Bengelsdorf, McGoldrick and Associates. Before retiring from the government in 1982, he held numerous senior positions in the Department of Energy and its predecessors, and also at the State Department. Throughout his career, he has been involved in the negotiation of numerous bilateral and multilateral nuclear and nonproliferation agreements, including the development of full-scope IAEA safeguards arrangements, codified as INFCIRC/153. More recently, he has worked for several international clients in Japan and Western Europe, as well as a support contractor to various U.S. agencies and national laboratories.

And then the last speaker will be Wolfgang Kersting, whom you know.

And finally, Ed Helminski will offer some commentary. He is the president of the Exchange Monitor Publications Forums, which he founded in 1982. He has been involved in energy policy and nuclear waste issues for over 30 years in both government and non-governmental capacities. In 1974, in conjunction with AAAS, he convened the first conference on high-level nuclear waste for state legislatures—which I guess took a lot of bravery at that time. In 1976, as the Director of Energy and Natural Resources for the National Governors’ Association, he helped to convene the first White House conference on energy, and he later became the Deputy Director of the White House Management Task Force on Energy Shortages during the Carter administration.

So, Luther, do you want to begin?

Luther Carter: Thank you David. To start off, I’d like to say that I’m a journalist, and I claim all the privileges and immunities of my class. The operational significance of that disclaimer is that if my remarks give rise to technical questions, you should ask my collaborator, Professor Pigford.

I have made an effort to put out enough copies of the article that Tom Pigford and I wrote, that was published in *Issues in Science and Technology*. I hope you have had a chance to peruse it.

We began our study by declaring the existence of a paradox in plutonium policies. On the one hand, you have the secure disposition of military plutonium as a high government priority, pursuant to an

agreement between the United States and Russia, and signed off on by the major industrial countries. But disposition of commercial plutonium is not given the same priority. Not at all. Yet, less than 10 kilograms of reactor-grade plutonium can be used to make a weapon that is small enough to fit into a van and powerful enough to devastate a major city.

Now, I don't mean to dismiss IAEA safeguards and the safeguards of countries like Britain and France, and I think that we would stipulate that these safeguards reduce the risk of diversion, theft, and forcible seizures to a low level. However, the consequences of failure in this regard are so great that we nonetheless think that the risk is unacceptable.

In this conference, we've all seen that much of the attention has had to do with the status and possibilities for MOX recycling. But MOX recycling does not reduce the risk of diversions, or theft, or forcible seizures. On the contrary, as we see it, the risk will actually increase.

BNFL has referred to the security of its central stores of plutonium at Sellafield as being similar to the security at Fort Knox. Whether this is true or not, we don't know. But we accept that the central storage of plutonium is surely more secure than the use of MOX in a civil fuel cycle. We see no justification whatsoever for treating military plutonium as posing a major risk, while at the same time continuing to tolerate the separation of commercial plutonium, and accepting that an open-ended MOX recycling program poses the same kind of risk. This makes no sense, and it is truly a policy paradox.

Now, how do you resolve this paradox? Stop commercial reprocessing as soon as possible, and let the commercial plutonium producers and recyclers turn their substantial skills and industrial capabilities to an effort to convert all separated plutonium to a proliferation resistant form. Also, all governments concerned should give new priority and emphasis to the deep geologic disposal of the containers of immobilized plutonium and spent MOX fuel.

I should note that while we see open-ended MOX recycling—fed by the continued separation of plutonium by reprocessors—as unacceptably risky, we think that a MOX program of finite and relatively brief duration is acceptable. Some will regard what we propose as altogether unrealistic—as a non-starter—but we say: “Not necessarily so.” This is not simply a variation of what President Jimmy Carter proposed in 1977. Since that time, the economic and political burdens of reprocessing and plutonium recycling have become much clearer.

In part, it's a simple case of nonperformance. You heard what our colleague at this conference said about the situation in the UK, where there's a large and steadily growing accumulation of separated plutonium and no plans for using it. But in terms of risk, as we indicated earlier, the British situation is actually better than that in countries where MOX recycling is moving ahead. There's no economic justification for any of this; at best, the economics of MOX recycling versus direct disposal are a wash, and here I think we're being quite generous.

While the nuclear industry's need for plutonium is nil, its need for a solution to the problem of storage and disposal of its spent fuel and high-level waste is very great. The present global inventory of spent fuel is on the order of 130,000 tonnes.

What we are calling for is a grand compromise: Let the commercial producers of plutonium stop separating plutonium, and commit themselves to secure plutonium disposition. At the same time, let

governments in the United States, Europe, Russia, Japan, and elsewhere commit to establishing a global network of internationally sanctioned storage and disposal facilities.

We believe that a key to motivating governments to act is to redefine the purpose of geologic disposal. Classically—and indeed today—the purpose is to protect people from dangerously high doses of radiation. This purpose of geologic disposal is very important, but it has not served to motivate governments to deal with the problem with urgency and high priority.

This could change if geologic disposal could take on the singularly important goal of providing the final, crucial step in plutonium disposition—a step greatly that would enhance the security and irreversibility of the disposition program. Geologic disposal has figured officially as the final step in disposition all along, but has not been given the emphasis it deserves; if it had received such emphasis, then we believe that the Yucca Mountain project in Nevada would be much further along than it is. Yucca Mountain—the most advanced geologic repository project in the world, by far—won't come online until 2010, and that's being highly optimistic.

Parenthetically, I should point out that we see a successful U.S. project in Nevada as a central precondition of any further development of a global system of storage in geologic disposal facilities. We're talking about a sea-change in attitudes, and not just on the part of the nuclear industry. Leaders in government as well as in the larger nonproliferation community will have to recognize the danger that separated commercial plutonium poses. All will have to come together behind a program where industry and government collaborate in overcoming this problem. We think a deal of the kind we have just described is what is called for, and I look forward to answering your questions later, if you have any.

Thank you.

David Albright: Thank you, Luther. Hal, the floor is now yours.

Harold Bengelsdorf: I think that I had a medical reaction to what Luther just said.

David, since this is the concluding session, before I begin my remarks I have to congratulate you for pulling this conference together. It is a rare occasion to bring people together with sharply differing views on how separated civil plutonium can best be managed. From my perspective, ISIS is probably one of the most respected nongovernmental organizations in town dealing with nonproliferation issues. Now, that's not an excessive complement, given the competition.

I don't know what I would have said this afternoon if I was given a blank page, without having heard Luther's proposition. But I would like to comment here—as I was invited to do by a journal that recently published an article by Luther and Tom Pigford that carried a similar message to the presentation you just heard from Luther. Part of my objective at this point is to get all of you very upset so that this tranquil meeting will end up with people rolling on the carpet and throwing things at each other. From my perspective, this meeting has just been too congenial.

However, more seriously, I would like to make a few general comments on the “civil plutonium situation.” I would like to share with you, drawing on too many years of experience, my own perceptions as to how other countries view this issue and to conclude by offering my recommendations as to the basic orientation I think the United States needs and must take in addressing the issue of how best to manage civil plutonium.

Let me just say very clearly at the outset, I do not profess to have a neat, tidy solution to the problem. I think this is a complex situation, which deals with a variety of national perceptions and threats. But I have to say, Luther, that I don't see how anybody can responsibly say that the civil plutonium issue has been downplayed or ignored by U.S. policymakers and others in either this or previous administrations. I would argue, if anything, that the hype has run the other way.

Indeed, many people have devoted many years of their careers trying to build an international structure to deal with this problem. This is not a new issue. The whole IAEA safeguards system was structured to give emphasis to applying the most intensive safeguards to where weapon-usable materials are aggregated in the greatest quantities. Frankly, I think that this is a disservice to the nonproliferation community to suggest that this issue has been ignored.

I also think there have been a number of shibboleths that have had too much currency in this area. The issue of how to deal with civil plutonium is important, but it also is very important to move, if we can, away from the current atmosphere of theological confrontation on the issue, and towards an atmosphere of a more reasoned exchange of views that, hopefully, will lead to greater consensus. I'm not that optimistic that we can really achieve this goal, but I think that we should be able to put behind us some misperceptions if we are to have a more reasoned exchange of views.

One is the issue of whether or not we need to worry about different kinds of plutonium. The IAEA regime, from its very start, was contrived to recognize that essentially all forms of separated plutonium can be used to make nuclear weapons. Historically, reactor-grade material admittedly has not been the material of choice for dedicated nuclear weapons programs. Also, the civil fuel cycle has not been the preferred route for acquiring nuclear weapons. Looking to the future, I continue to believe that reactor-grade plutonium is unlikely to be the material of choice for proliferators, but I think that it has to be accepted that it is a material one should be concerned about and that requires rigorous controls. I also think that it is very appropriate that the IAEA has not differentiated—either in the safeguards or physical security areas—in treating different grades of plutonium, with the exception of materials containing very high percentages of Pu 238.

I wish we could get the issue of whether we need to worry about reactor-grade plutonium off the agenda. The fact is, all weapons designers and independent experts have agreed that it is feasible to make very destructive nuclear weapons out of reactor-grade plutonium, and that this is a technical goal that probably can be achieved by a number of nations and not just sophisticated nuclear weapon states. Hence, like other weapon-usable materials, one has to assure this material is well safeguarded and well controlled.

Then there is another myth that we should discard—namely, unreasoned fears about the advent of the so-called “plutonium economy.” What are we really talking about? Maybe there were some illusions or visions about a decentralized use of plutonium in the 1970s. Also, there were some events several decades ago where some of the nuclear suppliers were intemperate in some of their export arrangements. But that happened 20 or 30 years ago. Right now, we're talking about a very limited number of countries that are engaged in, looking at, possessing or seriously contemplating active plutonium use in the civil nuclear cycle.

However, notwithstanding this fact of life, every time there's some kind of transaction involving separated plutonium, whether it's moving MOX from one country to another or something else, the

opponents—who fundamentally are in contempt of all beneficial usage of plutonium—hype the subject, and say that the specific transaction which will take place is serving to open the floodgates for uncontrolled global plutonium use. Now, I don't expect this rhetoric to change, but it's not helpful to a constructive dialogue to be subjected to such hyperbole.

As a related point, I have never found it very helpful to rail and generalize about plutonium in abstract terms. To me, the risks associated with plutonium use, how it's approached, and judging when its use is acceptable is a matter to be addressed in a country-specific context. I do not know of any responsible U.S. official in any administration who has ever really advocated the wide dispersal of separated plutonium to all countries, the wide dispersal of reprocessing, or the wide dispersal of enrichment facilities. This issue has to be looked at in specific terms—in terms of where the threats really are and what the implications are if plutonium is used in one country as against another.

Now, let's look at the threat. We've spent two days at this conference looking down the throats of the UK, the European countries and Japan with a large magnifying glass, and not a word has been said about Russia. From my perspective, something should be said, before this meeting adjourns, to identify where the major threats are, and I think we know where they are. One of the gravest of these is the "loose-nuke" situation that we're facing in Russia, and that is the problem area now demanding our highest priority.

I am one of those people who feel that while the United States has been moving in the right direction in helping the Russians get on top of their problem, the U.S. commitment has been grossly inadequate for the magnitude of the job. I repeat—grossly inadequate. Also, we are not very good at maintaining really long-term commitments. We have planted a lot of seed money to assist the Russians, but whether we have the constancy to stay with this issue over a period of time, I simply don't know.

Then, in terms of other major threat areas, you have the so-called "problem countries." India, Pakistan, North Korea, Iraq, Iran, Israel, and so on. I do not wish to say that the discussions we've had over the past two days have no relevance to those situations, but I think the points have been only marginally relevant to these specific country situations. As troubling as these country situations are, they have relatively little to do with how plutonium should be managed in countries with very solid nonproliferation credentials like Europe or Japan.

I favor transparency. It's a great concept; I embrace it, it should be advocated, and it should be pursued. This is part of a constructive process, but—for Pete's sake—are most of the countries we are talking about over the past two days the real threats? Are we really that concerned about the plutonium in vaults in the UK and France? Most countries with significant plutonium inventories, fortunately, are our close allies, whose cooperation has been fundamental to the elaboration, articulation and ongoing implementation of the nonproliferation regime, and whose cooperation we need in maintaining the strength and health of that regime.

I do not wish to suggest that our emphasis on the plutonium stockpiles in those countries has represented misplaced emphasis. But I sometimes wonder about the degree of emphasis and, in my view, lack of balance.

Having made these points, I certainly agree with those who argue that it is important for the international community to come to better grips with the sizeable stocks of currently excess separated

plutonium that have been built up in the civil fuel cycle, let alone those coming out of the nuclear weapons arsenals, and to try to establish a better balance in the supplies and demands for this material.

However, as a practical matter, it must be recognized that there still remain some sharply different views between the United States and other countries over how this balance in plutonium supply and demand can best be achieved and over the role plutonium can best play in the future. Many individuals in France, the UK, Japan, and even in the United States—if they have the courage to speak up—continue to believe that over the long term, plutonium can be an important energy asset and that it is better either now or later to consume this material in reactors than indefinitely store it in some form, let alone treat it as a waste. Several countries believe that it is preferable, for a variety of reasons, to pursue some form of recycling of spent fuel, in contrast to the once-through fuel cycle. I believe their intensity of feeling about this issue has been illustrated by the fact that they have been prepared to go down this road even though they are suffering some economic penalties, obvious criticism and headaches in the process.

Fundamentally, many individuals of this view believe it is simply dumb to try to throw away plutonium rather than to plan to use it either now or later. Thus, even if they have no immediate plans for large-scale plutonium use, they simply recoil against burying or immobilizing the stuff. Many also believe that the burning of plutonium in their countries will have important advantages to energy security as well as to the long-term viability of nuclear power. Perhaps most importantly, from a nonproliferation perspective, many individuals believe that the most credible way to reduce plutonium stocks is to burn the material in reactors. They also are of the view that in recent years, the United States has seriously undervalued the long-term proliferation risks associated with simply keeping plutonium in spent fuel. Thus, from longer-term energy and nonproliferation perspectives, I sincerely believe many people in the nuclear communities around the world continue to wish to put plutonium to constructive, beneficial use.

In addition, I believe we have to face the painful fact that a number of people in the international nuclear community believe that too many nonproliferation specialists in the United States overly dramatize the proliferation risks that are associated with the potential misuse of the civil nuclear fuel cycle. They point out that historically, nations that have acquired nuclear weapons have done so through the use of dedicated military facilities rather than through attempts to misuse civil facilities that are under international safeguards. This does not deny the fact that the civil nuclear fuel cycle, including reactor-grade plutonium, can be used to produce material for nuclear weapons and that, accordingly, it is essential to keep civil programs under rigorous and effective international safeguards and physical protection.

In light of these various considerations, while reprocessing may not now be a growth business, there is little likelihood, in my view, that countries like France or Japan will completely abandon the idea of the closed fuel cycle. While Russia may now be open to concluding a moratorium on reprocessing at Mayak, the Russian Federation remains strongly committed to the fast reactor and recycling, as witness Minatom's interest in the BREST reactor concept. Neither, in my view, are countries like France or Japan likely to embrace simplistic formulas that all reprocessing should be immediately stopped and that the international regime should be immediately reconfigured, as proposed by Luther Carter, to move all spent fuel into a limited number of storage facilities. This is far too grandiose an approach to have any near term and realistic prospects of acceptance.

I agree, however, that it would be desirable to explore the establishment of international facilities for the storage of spent nuclear fuel. Frankly, this is a very old idea, that has yet to come to any practical fruition because of the general indisposition of most states to accept spent fuel accumulations from other countries. Nevertheless, it may be possible that some nations may now be prepared to pool their energies to establish some international facilities for storing or disposing of their spent nuclear fuel in common. In addition, in light of the long-term risks associated with plutonium inventories in spent fuel, it may be desirable in some cases to try to store the spent fuel in a few select countries with very strong nonproliferation credentials and under continuing effective safeguards.

Within the context of these remarks, I believe that it is in the best interest of the United States to approach the issue of civil plutonium management in a non-doctrinal and non-theological manner that recognizes that we may need to cope with a variety of national situations and to work cooperatively with nations who may sometimes differ with us on the management of the nuclear fuel cycle.

In some cases, the best solution may be for the United States to continue to encourage the application of extremely rigorous and effective safeguards and physical security measures to the existing classical recycling activities that already exist. In other cases, we might wish to support the aggregation of spent fuel in international or regional facilities. However, this route will only become credible if some basic conditions can be met: There will have to be a host state truly willing and able to accept the material. Moreover, the arrangements, including nonproliferation conditions that will apply will have to be acceptable to all interested parties, including the United States if “U.S.-origin” spent fuel is to be transferred from third countries to a central facility.

In still other cases, we might wish, in time, to encourage countries who strongly favor recycling to consider weaning themselves off or avoid the conventional PUREX reprocessing scheme that produces pure separated plutonium and to consider replacing it with potentially more proliferation-resistant approaches that allow recycling to occur, while always avoiding the presence of separated plutonium. This seems to be the direction that Minatom now favors with the BREST fuel-cycle approach. However, such advanced fuel-cycle concepts have to be further developed and fully evaluated. In addition, unfortunately, the United States has almost emasculated its own independent ability to explore these approaches—let alone significantly influence foreign directions—by killing its own R&D capabilities in the field. I strongly hope that DOE will now seek to rectify this situation as it seeks to identify possible new R&D areas that might advance the proliferation resistance of future nuclear power systems.

In still other cases, the only practicable near-term solution may be to simply store excess separated plutonium in very well protected and safeguarded conditions until subsequent decisions are taken as to its further disposition. This could be in its current or some altered form. In this regard, I support continued modest R&D aimed at the evaluation of immobilization approaches for the disposition of plutonium. This is an important component of DOE’s “dual track” program. However, I have serious doubts whether most other nations will be prepared to embrace the concept of immobilization as a significant plutonium management technique if they equate this with throwing away the material or with some form of irrevocable commitment to the once-through fuel cycle. Rather, most nations may prefer to simply keep their plutonium stocks under rigorous institutional controls as they evaluate next steps and plan their future programs.

In summary, I believe the objective on the part of the United States should be to minimize risks wherever they occur and that the United States should be prepared to support a variety of solutions and approaches that best fit specific national situations.

I am sorry. I seem to have run out of steam, and time as well. Thank you.

David Albright: Our next speaker is Wolfgang Kersting.

Wolfgang Kersting: I'm particularly grateful for Mr. Bengelsdorf's remarks for two reasons: First, he directed some remarks at Mr. Carter that I would have liked to make in a similar way, but given my linguistic restrictions, I do not think that I could have done it so well.

I am also grateful because he introduced very well what I would like to share with you. I was also asked by ISIS to be more brief in my remarks than the other speakers on this panel, because I have already addressed this conference today. You can help me to compensate for this discrimination by asking a lot of questions, if you are not too tired.

I would like to discuss an idea that has already emerged during the conference, both yesterday and today: That is, making use of MOX fuel from Russia in non-Russian reactors.

The idea was developed more than two years ago when the Russian Ministry of Atomic Energy made extensive efforts to market additional services in the nuclear fuel cycle, including both the supply side and the back-end side—including reprocessing. The latter was not very popular in Europe, especially in Germany. But there are other services which have become popular; for example, many of you may not know that German and Swiss reactors regularly use uranium fuel produced in Russia. This fuel has been qualified by Siemens licenses and German government qualification procedures.

This was a first step to increase hard currency income in Russia, and thereby decreases proliferation risks. We all have heard horrible stories about how hundreds of thousands of Russian experts are not being paid or are paid very low salaries, and that materials may not be as secure as we would like.

We think that the best way to minimize these risks is through commercial cooperation, thereby increasing the income for Minatom workers. This idea caught on among a small group of industrial companies in Europe—including Switzerland, Germany, and Belgium—that have just started a discussion. The discussions have been rather active, but governments have not officially been involved. I can, however, confirm that there have been a lot of discussions, some of which include government officials.

Just let me explain some of the characteristics, which are given in figure 1. The main idea is to use MOX fuel—derived from ex-weapons plutonium from Russian weapons—in European countries, not just in Russia. However, I would even go one step further: Don't use the fuel in Russia at all. We are thinking of disposing of this material in European LWRs for several reasons. I mentioned the first reason already in the morning—we think that we have the best operational records and experience with MOX fuel. We also think that the disposition rate can be increased and the disposition time can be shortened considerably. The 1.5 tonnes per year (mentioned in the left-hand column in the figure) in Russia is a figure that Minatom has confirmed several times. Russian officials have said numerous times that they could not dispose of more than 1.5 tonnes of plutonium per year. And this would be done in reactors that definitely would need costly and time-consuming upgrades to bring them up to the standards of German reactors that use MOX fuel.

So, we can save money. We can also save time—both in preparation and in disposition. As the figure indicates, we think that the fuel costs can be reduced by using components from the Hanau MOX

facility, compared to the construction of a new facility entirely, as will be done in the United States.

As for the reactors: I do not think that the U.S. reactors need any additional upgrading, although I do not know this for certain. We know that upgrading the Russian reactors would require considerable funds. But we also know that Western European reactors do not need anything, because they are accustomed to MOX fuel. Of course, there will have to be tests; I know that, for their own secure feelings, the U.S. utilities involved in the program are reinventing some of the wheels that we, in Europe, invented in Europe a while ago—I can understand that. But this is not necessary in Europe.

We also have to assume considerable testing—and thus considerable expenditures—involved in Russia.

Figure 1: Disposition of Weapons Plutonium				
	USA "Dual Track"		Russia "National Treasure"	
Concept		MOX fuel	MOX fuel	MOX fuel
Use		national (6 LWRs)	national (4 LWRs; 1 FBR)	international (European LWRs)
Experience		past	some	good
Dispos. Rate		2 t / yr	1.5 t / yr	> 2.5 t / yr
<u>Cost of</u>				
–fuel		full	lower	lower *
–reactors		–	considerable	–
–tests		some	considerable	–
–transports		domestic	domestic	international
–safeguards		?	high	higher
Funding		public/private	public	public/private
* with components of Hanau MOX facility				

Transportation issues have also been mentioned. As an engineer, I really do not know why the transfer of MOX fuel should be such a special thing—but for some people it is. Therefore, MOX transports in Germany are very costly, but they are not at all a public issue. In both the U.S. and the domestic Russian program there will have to be domestic transports. Whether or not this is easier than transporting fresh MOX from Russia through other countries or over the Baltic Sea to Western Europe—again, I wouldn't know—I could imagine that under an international authority these transports reasonably could be done. Right now, in Germany the transports of spent fuel are not reasonable, anyway.

Regarding safeguards: I have included a question mark for the United States in the figure. Here, I am referring to the costs of safeguards—I do not question the level of safeguards in the United States, but rather the costs of them. I assume rather high costs in Russia, because a lot of things have to be done in a way that are new to Russia. We also have to assume that there will, perhaps, even be higher costs for safeguards if international transports and transfers are involved.

Lastly, I would talk about funding. We think that there are appreciable benefits derived from doing it internationally. First, a very simplistic analysis shows that the MOX fabrication and use could be funded through low-interest loans—perhaps from the European Development Bank—that could be repaid if utilities are willing to pay regular uranium fuel prices. We have utility groups that are interested and willing to do that if—and this is very important—they would be asked by the governments to support this disarmament exercise.

Much more interesting is an additional service which Minatom is promoting; that is, if back-end services could be added. This is an option which is not applicable to my own country—Germany has its own domestic solution, and we have spent more than a fortune on own solutions already. So, I do not think that German utilities would be willing to add additional money to have an outside solution, as long as they're forced to prepay for our domestic solution. However, other countries—the first being Switzerland—have shown a high interest in back-end solutions in Russia.

The first step would involve spent MOX fuel going back to Russia, because that is where the plutonium originated from. I think it is more than logical that if this material does not stay in the country where it was used as fuel, that it at least goes back to the country from where it came. But additional services could be added for regular fuel for countries who are willing to agree to this, and where the utilities do not have any other solutions. This can be a major income stream for the Russian nuclear industry. I think there are countries in Europe and in East Asia that are even more interested in this. I think a further benefit—which has not been mentioned—is that close commercial cooperation would bring people together, thereby supporting nonproliferation by increasing transparency.

I thank you.

David Albright: Finally, Ed Helminski has been asked to comment on the preceding talks. Ed?

Ed Helminski: Thank you. I have looked at some of the presentation materials that have been handed out at this conference. What struck me was that, once again, the United States was telling the world what it should do to solve a problem in an arena—the disposition of civil separated plutonium—that it has almost nothing to do with. Secretary of Energy Richardson's address at the IAEA, where he called for an international program, was like Tony Blair coming to an international meeting and saying that he was going to help the international community and devote British resources to the nonproliferation of handguns.

If Blair did that, we would say: "Handguns from Britain? They don't have any there, so how can they tell us what to do?" Similarly, the United States is not in the civil separated plutonium business.

So why has this become an initiative in the United States? It's not going to be funded by Congress, which is barely supporting the military plutonium program that we are already doing with Russia.

We've just heard a proposal to burn Russian MOX fuel in European reactors. When the U.S. delegation went to Europe a year or two ago to ask exactly this question, the answer was no. Essentially, Senator Domenici was laughed out of at least a couple countries when he proposed taking U.S. MOX and burning it in European reactors.

But we do need to have an integrated international program to deal with plutonium. Why don't we start from that premise? Why don't we use the IAEA to start from that premise and forget about the artificial distinction we've created between civil separated plutonium and weapon-grade plutonium? If we do that, the non-weapon states and the weapon states can work together without the United States saying "you ought to do it this way," and without the United States accusing the non-weapon states—and I've heard this today—of not having adequate safeguards. It puts us in a position that we've always been in with regard to whole plutonium picture, from the time when France and the UK were developing breeder reactors—we were in the scenario, beginning in 1977, of condemning any use of plutonium for energy resources.

We are also talking about the international disposal of high-level waste and spent fuel. The Russians have come out with a very detailed proposal for an international storage facility to make a lot of money—a net profit of \$10 billion over 10–20 years. The proposal is interesting in that it was intended to show the Duma that \$21 billion in revenues can accrue to Russia—not profit but revenues—over the next ten years by accepting foreign spent fuel.

Are we ready, as an international community, to let that happen in Russia? The proposal, which makes a big deal about the money, was leaked because the Duma has to enact a law that essentially would allow the import of radioactive waste. What better way to do that than to hold out \$21 billion in possible revenues?

But an international repository is not going to work right now. At the international repository conference in Denver last year, a lot of countries were afraid that Secretary Richardson was indeed going to support such an initiative. He ended up not doing so, because of a lot of international pressure. But in talking to folks from Spain, Finland, and Germany, their intent was that: Yes, maybe somewhere down the line we should talk about this—but let's get one located in one country first.

Finland has essentially taken a step forward, but they've also said: "We'll take care of our own but no one else is coming in. This is not an international repository." We're going to have problems paying for the disposal of high-level waste in some countries like the Czech Republic—they cannot afford a program. Czech officials will talk to you about that, but they'll also say: "Don't ever mention that I said anything about an international repository."

The reasons why it won't work are the same reasons why it hasn't worked for low-level waste in the United States. If you want the worst example of these kinds of proposals, I point to the U.S. "low-level waste compact system," which essentially established a regime where states, if they gathered together, could restrict waste coming in from other states into their region. The participating states were given authority by Congress to interrupt state commerce—they could prohibit the transport of any more low-level waste into their region if they built a disposal facility. They haven't, and we don't have any such facilities after 20 years—20 years in trying to develop a low-level waste site that would only take waste from a limited number of states.

The reason that none of them started is because they said—and this is ridiculous—"If we're first, we know what is going to happen. They're going to repeal the low-level waste compacts law in Congress and give us all the waste." That happened in Nebraska and California, and these sorts of objections have been going on.

Notably, Interior Secretary Bruce Babbitt, when he was the Governor of Arizona, endorsed and supported a regional low-level waste site in California. Now he has prohibited the development of that site.

So this concept of an international repository won't work. It won't work until someone stands up—and it has to be the United States—and actually offers an alternative—"We will construct an international repository."

The last point I want to make takes off of Secretary Richardson's speech at the IAEA. He committed to help the world find a solution to civil separated plutonium. Since we have a MOX program underway, I wonder why he didn't offer that system to the world to burn civil separated plutonium. Instead, he offers only to share immobilization. I leave you with that.

David Albright: Thank you. Are there any comments or questions for our panelists?

Q: I have a couple quick comments. I disagree somewhat with Ed in that I believe that someday there will be an international repository. You mentioned the Czechs. But when you have the Bulgarians talking about putting spent fuel in the ground; then there are the Ukrainians; Mexico may be another—people are going to stand up and say: “That’s unacceptable.” They just won’t be able to afford to do it safely, and I don’t think that the international community as a whole will sit back and say that it’s a smart thing to do. Some other alternative has to come about.

Ed Helminski: May I respond to that? Because it has happened. You have may forgotten, but we were ready to ship low-level waste to Mexico because we didn’t have a place for it in California. It seemed like a good idea, and there were people thinking about that. The point is that it was a solution for U.S. low-level waste, and there were people who really didn’t care about how Mexico was going to develop that low-level waste disposal facility.

A few years ago, I believe, there was some talk of a site in China, in the Gobi desert, for high-level waste. Was China ready to do that? I doubt it, but countries were seriously thinking about that. There is this problem of, “yeah, let’s give up the risk.”

We’re talking about the world having a sense of being an international community. I hate to tell you, but in the United States, in terms of dealing with low-level waste, we can’t even deal at the national level with the problem.

Q: I think the answer to that is that the Barnwell project was working fine before the politicians came in to decide that we needed to solve a problem that didn’t exist.

Ed Helminski: No, that’s not true at all, actually. Barnwell was open, but the governors of South Carolina, Washington, and the others were concerned not about disposal, but about the fact that they were taking waste from states that were not doing anything. They had problems with the way those generators were shipping waste to those sites.

There was a fire in Washington. There were problems in Nevada. They—those governors—wanted to take control, but they were committed still to take waste at that time. Then the issue became equity sharing: Why should Barnwell take everybody’s waste?

The best place for low-level waste is in Nevada. But we have not had a president—either a Republican or Democrat—that’s willing to stand up and say: “This is the place where it belongs, because it’s the safest place in the country.”

Q: Changing the topic completely, I have questions for Mr. Kersting about his proposal, which I think is really interesting. But I really wonder if the MOX fuel would be less expensive. I’m wondering who is going to pay to dismantle the Hanau facility, store it before it is moved, move it, reassemble the facility in Russia, transport the MOX fuel, and pay for safeguards? I think these are questions that need to have some answers. Would the German and Swiss utilities be willing to pay more for that MOX from Russia?

Wolfgang Kersting: The last question is easier to answer: No, they would not pay more. Of course not.

The other questions are difficult. It's an assumption that time and money can be saved by using parts of the Hanau facility. You are definitely right: Taking the facility apart in a proper way will cost money. Siemens is not willing to pay that money—it will just scrap it; and time is really of the essence, because components at the facility have been lying there for quite a while. This will cost money. But the assumption is that some time and money can be saved. It remains to be seen.

Ed Helminski: I'd like to comment on that. There was an effort two years ago for the United States to pay the transportation costs. There was a group talking to the administration to do exactly that.

Luther Carter: Not to take away any time from other questioners, but I would like to claim a point of privilege in my reply to my friend Harold Bengelsdorf. Just as he is impatient with what I've had to say, I'm quite impatient with what he's had to say, because what I think he's done is offer a comfortable rationale and justification for the *status quo*.

The truth is, reactor-grade plutonium is weapons-usable, and by the year 2010 there may be some 250 tonnes of it, with no economic justification whatsoever. Now, IAEA safeguards, which I hold in some regard, may prevent a catastrophe, but why take the risk?

The recent MOX shipment by sea to Japan involved two special ships sailing in tandem. The holds containing the MOX fuel were welded shut, and I would regard that as quite a credible precaution. If the MOX recyclers are going to resort to precautions of a similar level, isn't that going to greatly increase the cost of an activity that already is uneconomic?

One thing was said about the Russian "loose nukes" plutonium problem having a greater priority. I agree with that, but I would note—and maybe I didn't explain it in my remarks—that what Professor Pigford and I have proposed would have to do with the disposition of the Russian warhead plutonium as well and the commercial plutonium.

David Albright: Are there other comments?

Q: Thank you. I have a comment, based on what I have heard so far on the viability of Yucca Mountain.

This whole problem of a repository would be much easier if we knew where the best site was, which presumes that the nuclear establishment can do good science on repository-related issues. The search for a U.S. repository, from 1982 on, has been an abysmal scientific failure, and I want to illustrate with just one example. Yucca Mountain was selected as a site because it is believed to be an unsaturated repository and that it will remain that way for the duration. It's very important to find out if there's ever been water in there. After the tunnel was first drilled, a Siberian geologist went in there and collected some samples. He found minerals that had hot water trapped in them. Now, it took my institute, which has eight people including support staff, to find this Siberian geologist and bring him here so he could present his findings in Nevada. That was in 1998. He was disputed because he didn't have a high-tech saw to prepare his samples. So, my institute bought a \$3,000 high-tech saw. My institute spent \$15,000 for this Siberian scientist to analyze mineral deposits from Yucca Mountain, and he published the only peer-reviewed data to date on whether or not these minerals actually contain hot water.

The Department of Energy, after billions of dollars of expenditures, has yet to publish any peer-review data whatsoever. The state of Nevada also has not done it. Now, everybody admits that if

there has been hot water in the recent geologic past, then it's not only not the best repository, but also that it will be a pretty lousy place. But the environmental impact statement is due to be published before the Energy Department's own program to date these hot water mineral deposits is going to be finished. It took us to muscle the DOE to at least start a research program, which it is not now doing. So we've got a process in which the nuclear establishment doesn't really want to do good science on a repository.

Nevada was selected as a political place. It's on land that's claimed by the Western Shoshone people. Now, the Supreme Court has said that it's not important, that we've compensated them, and the Interior Secretary is keeping the money for them, even though they've refused the money.

Now, all of these are very real issues. It's not about 100,000 years from now. It's about how we're dealing with people today. Can the nuclear establishment and the people that advocate nuclear repositories come up with a plan that is going to satisfy some of us that the nuclear establishment is actually serious about finding a place that anybody else believes is good? I don't believe that the Department of Energy has ever met a repository that it didn't like.

We need a better process. I'd be for a repository if we had a decent process, but we don't right now.

David Albright: Are there any other questions?

Q: Yes, I just had a few comments for Wolfgang Kersting on his project. The first is that, if I understand you correctly, the proposal is to pay back for the development loan by a scheme involving Russian-origin uranium. As everybody in this room knows, whenever somebody is dreaming up some grand scheme to get Russia involved in the international nuclear community, it inevitably involves paying for it by moving Russian uranium from one place to another. In Europe, which is where we are talking about, the European Union has imposed a quota for enrichment services in uranium of 20 percent from the Russian Federation. If I am not mistaken, this quota is close to being exhausted in most European countries. If that were to happen, there would have to be some sort of political process to get the European Union to change its policy in an area where they have been pretty inflexible, up to now.

The second comment I have regards the political situation in Germany. The current Vice-Chancellor and Foreign Minister is a certain Joschka Fischer, who has made his entire political career on opposing the construction of the Hanau plant in the state of Hesse, when he was the Environment Minister and chief regulatory authority there. There is a strong view among certain people in the German administration, in several executive agencies, that because of Fischer's personal enmity and his political background, that he would not allow that facility to be dismantled and sent to Russia. In particular, if he did so, he would be vulnerable to attacks from the Greens and from the anti-MOX lobby in Germany that Fischer—at the time that he opposed the construction of the plant—relied upon.

Wolfgang Kersting: You are right regarding the Euratom quota for Russian uranium: It is almost exhausted. If you now think of the Russian uranium contained in the MOX fuel, then we simply assume that the import quota will not be applied to MOX from an international disarmament exercise.

Unfortunately you are also right regarding Minister Fischer's former role in the Hanau development. We have soft signals that his views may have changed, but I can only agree with your analysis that he

has to be very careful not to overstress his fundamentalist Green supporters. It will not be easy, but we are confident that our government will do the right thing.

Harold Bengelsdorf: I'd like to comment on Ed Helminski's observations. I think one needs to be a little careful about overstatement on some of these things. I would like to think that the door may still be open to internationalizing the use of plutonium, particularly of the Russian material. I don't think the Domenici experience, which you referred to, is a good test-case. He's a great man, but in the usual American-sensitive manner, the U.S. Senatorial team—two or three Senators—that explored burning excess plutonium parachuted down in Paris on Monday, saw a couple countries, said: "Would you burn the stuff?" and—you know, it's amazing—they didn't get an OK by Thursday. Then they came back and said that we should forget about this option.

I do think—I like to think—that there's a germ of an idea here. There's something of an international interest and responsibility here, and so long as the host states are amenable to doing it, there's still a possibility—maybe for a second—as we move from two tonnes a year to five tonnes a year.

Having said that, you commented on the international Non-Proliferation Trust idea, and the Russian initiative. As some of you know, my partner Fred McGoldrick and I probably have been on the skeptical side of this issue, but I think one has to be very careful not to be too dismissive, because my perception is that one has to take some of these initiatives seriously. I don't at this juncture think it is all self-evident that they'll fail.

Ed Helminski: You may be right, Harold, on your assessment of an international program to burn Russian MOX; what I was referring to was a rejection of burning U.S. MOX. If the world leadership, through the P-8, would agree for security reasons that this is for the international good, and it will not cost the rate payers any more, then it can be done. It takes the wherewithal of the P-8 to get that commitment, based on international security. I think it will work for the Russian side, but it'll take a while.

On the Non-Proliferation Trust proposal, my only problem with that is that the recipient country is the same country we're dealing with on the problem of 'loose nukes.' Also, the other problem with the proposal is that it doesn't recognize the sovereignty of Russia—it's basically said that an international body is to police the disposition—and that's also disingenuous.

If Russia can do this, if it wants to do it, then it will set up a process to do it. If Russia can't set up such a process, then it shouldn't be done. We shouldn't be telling Russia: "We want you to do this, we're going to give you all this money, but we don't trust you to set up the right safeguards." That's not going to work. I don't think it should work, and I think it's a terrible proposal.

David Albright: That stimulated some questions, who was first...

Q: I certainly must appeal to the statements that, based on past experience, it can't be done. Past failures do not mean that we can't look to the future.

I was surprised, when we were working on the CISAC committee for the reactor options, that we fairly quickly set aside—for reasons I won't go into—the proposal to build HTGR's to burn 80 percent of the plutonium. But it was easy for those of us familiar with fuel-cycle calculations to see that there was a special need for plutonium that hadn't been applied, namely Canada. Because Canada

has a natural uranium fuel cycle, by policy choice, with a very limited burnup. The Canadians have, in the past, denied any interest in using plutonium, even though they know that if they could go to higher burnups they would be much more economical.

We ignored the State Department, and tentatively explored this with the technical people at Ontario Hydro; not surprisingly, they were interested. I thought they must be as naïve as I was. But to my surprise the Canadian government encouraged them. Of course, it hasn't materialized to my knowledge—I know that they are still studying this option with U.S. support—but at least that experience says that you'd be surprised where the cooperation does occur. I don't know if it was because they were interested in extending their burnup, or because they're interested in the money, and to my surprise they found it uneconomical. But at least it was a good reason in the first place to contract them, and it's an example that things are possible.

Q: Just one comment, and a question for Harold Bengelsdorf. I find it interesting that there hasn't been any discussion here—and perhaps it's a little bit of an aside—about some of the externalities that are going to affect reprocessing in Europe. The first is the OSPAR process, and also renewed calls by some of the Nordic countries and Ireland who are seeking a halt to reprocessing at Thorp in the aftermath of the BNFL MOX scandal.

Another externality to the closed nuclear-fuel cycle is what to do with the reprocessed uranium that's built up to hundreds and hundreds of tonnes. I haven't heard any discussion or any ideas put forth by any of the companies about how that material is going to be recycled. I know some of it is being reused, but it is a very, very tiny amount. Essentially, this is nuclear waste that deserves more attention, and is going to have more bearing on the whole question of reprocessing.

One thing I find quite interesting is that the last three accidents in Japan have been related to the plutonium-recycling program. To me, it seems increasingly—particularly in Japan, and now in Britain, and some other countries in Europe—that the further down this path of reprocessing and reuse of plutonium that we go, the more problems there are for nuclear power. The September 1999 criticality accident at Tokai has given the nuclear industry a real black eye in Japan. It appears to me that the plutonium industry is an albatross—a big stone around the nuclear power industry's neck—particularly in Japan.

I'm just wondering how far you are willing to go in risking the viability of nuclear power itself by continuing to push so strongly for the recycling of plutonium of spent nuclear fuel?

Harold Bengelsdorf: That's the most flattering question that I've ever been asked, because it imputes to me the position that I'm "in charge" of the direction that these programs will take.

I can't really comment on the vagaries of the public acceptance issue in the UK, and I know that this is your position, and it's hard for me to write a script here. My own judgment here is that the JCO accident at Tokaimura should not have occurred. The post mortems that the Japanese have done have been severely self-critical—appropriately so—from start to finish. It's not the kind of accident that should have happened in today's climate.

I was in Japan shortly after the accident, and I met with a cross section of senior people there in the reactor programs. My own opinion is that they have taken this very seriously and they may well come out of this stronger. Now it was unfortunate, but part of the dialogue on this issue was the hype.

That poor gentleman who was a victim of the accident should not have died. The accident should not have happened. But I think one has to look at the thing in the perspective of other industrial accidents. I don't think any industry is accident-free. I can't write the script for the Japanese, nor will I speak for them, because they have to speak for themselves. My own judgment is that they have a strong, on-going interest and commitment to proceed with the closed fuel cycle. I would surmise—if you asked me to speculate—that there will be slippages with their closed-cycle program, but they'll stay the course for a variety of reasons, which I personally have found persuasive.

Now, I know that you (the questioner), and people who share your view, will try to continue to dramatize the risks and the alleged risks associated with the fuel-cycle approach—that's part of the dynamic. And you will, in my judgment, try to impute to the closed fuel cycle all kinds of evils. Everybody knows that's the game. My sense is that you're not going to prevail on this. Thank you.

Q: Just a short comment to Ed Helminski—I liked your illustration on handguns.

Harold, you mentioned in your comment to Ed Helminski about the international community being helpful for plutonium disposition. My sense is that my country, Japan, cannot simply burn the Russian plutonium, simply because they won't adhere to the international plutonium guidelines, i.e. that there is the balance between supply and the demand.

You see, we don't have excess capacity, and in that sense our policy is principle-driven. We want to stick to that idea. We want to be more transparent, in the sense that we don't want to change the course of our policy in the nick of time just because there is some other necessity. We want to stay on course in terms of the plutonium balance.

And I also want to say that, in my opinion, many of the closed fuel cycle countries might have felt a little offended if the risk of proliferation is assessed to have increased simply because there is a stockpile build-up. Japan is committed to IAEA safeguards, and by bilateral agreements. We have many different legal and institutional arrangements that prohibit us from diversions. Thanks.

Harold Bengelsdorf: I was generalizing. I was really thinking more of Ukraine as a candidate to burn the plutonium, than of Japan. I think it's a national decision, and you know, that's all I can say.

I am happy you brought up Japan's policy to avoid stockpiling plutonium on its territory. I really get tired of Japan or others having to continually apologize for its posture. From my perception, Japan should get credit for its nonproliferation policies. For example, Japan is the only non-nuclear weapons state in the world that's imposed on itself this constraint of not having a surplus.

Luther Carter: Well, I would say that having a balance between plutonium separation and using the MOX is not an asset at all. I emphasize that in my paper. Using the MOX recycle mode actually increases the risks, because there is more vulnerability.

Ed Helminski: The only thing that I can say is that there ought to be some way that the United States can re-approach the issue of civil separated plutonium in a way with the non-weapons states to make it an integrated program with the weapons plutonium, rather than going about it separately.

If, indeed, the United States is going to offer some countries the option of processing it into MOX—and some people aren't ready—then if we're going to have a MOX fabrication facility, and we're

going to use MOX here, we should be open to the idea. If Britain is not going to do anything with its separated plutonium, and there's not a repository to put it in, and burning it as MOX is a better way of handling it, then we should make that offer. It's a genuine offer to deal with civil separated plutonium. And we've got to be a little more genuine with what we're doing.

The United States has to proceed with a repository. Comments were made that we haven't had a good process. Well, maybe we ought to correct that process through having an international body to review the science that's going on. Various countries have done that.

Why don't we set up an international community of scientists of irrefutable reputation? We've got to gain public confidence. Let's set something up so we can implement the proposal that's been put forward by Dr. Pigford and Luther Carter. Something has to break somewhere, and it's not going to, if we continue to go the way we are right now.

David Albright: I'd like to end it right there, and I'd like to thank you all for your participation. I hope this conference was informative, if not enjoyable. Certainly we've gotten a lot out of it, and that's certainly one of the reasons we do this, is that we learn a tremendous amount of information and get a deeper understanding of the differences between the different groups, and that helps us. So thank you again. □