Plutonium Utilization (II)

Wolfgang Kersting, Consultant, Bliekastel, Germany
Michael Sadniki, Independent Operational Research Consultant, West Yorkshire, United Kingdom
Emile Vanden Bemden, FEX, Rhode St. Genese, Belgium
Werner Couwenbergh, Belgonucleaire, Brussels, Belgium
Andreas Friedrich, Department of Foreign Affairs, Bern, Switzerland

David Albright: What I'd like to do is briefly introduce each speaker on our next panel, and they will all speak in order before there are questions. This is a fairly large panel, so we will have to hold the speakers very carefully to their allotted time.

The first speaker will be Wolfgang Kersting. He is a nuclear-fuel consultant, who in his 40-year career has covered both nuclear research and applications. He has worked at Euratom, the Jülich Center, Gulf General Atomics of the United States, and other organizations. In 1980 Mr. Kersting became the Managing Director of Interuran, which later became part of the Cogema group and merged with Urangesellschaft. Mr. Kersting served as CEO of Urangesellshaft until 1996.

The second speaker is Michael Sadnicki, who since 1992 has acted as an independent operational research consultant, specializing in economic analyses of the nuclear industry. Issues that he has covered include: PWR profitability, nuclear liabilities, the 1996 privatization of British Energy, and the proposed NIREX deep repository. More recently, and really why he is here today, he has concentrated on the economics of reprocessing spent fuel at the Thorp plant, and the profitability of Sellafield MOX Plant. Since 1998 he has been a member of the British government's Radioactive Waste Management Advisory Committee.

The third speaker will be Emile Vanden Bemden. Mr. Vanden Bemden is the Managing Director of FEX, an independent consulting group that contracts with a variety of governmental and industrial organizations in the nuclear area. Previously, he held numerous positions with Belgonucleaire, including Deputy General Director from 1986 to 1990. He is being joined by Mr. Werner Couwenbergh, the Assistant to the Managing Director of Belgonucleaire, a position he has held since February of 1998. He joined Belgonucleaire in early 1997 after spending a year as a lecturer in formal methods at the University of Ghent.

And the final speaker, since we liked him so much yesterday, is Andreas Friedrich from the Swiss Department of Foreign Affairs. Unlike yesterday, he will not be talking about plutonium management guidelines, but about Switzerland.

Wolfgang Kersting: Good morning ladies and gentlemen, thank you very much. I'm very grateful to be here. By way of introduction, I would like to say that I'm not an historian, disarmament expert, or a philosopher, so I consider my presentation to be "factual," which, of course, is something that also can be debated. I'm representing and reporting on the industrial view—which is basically, as you know, MOX utilization—in Jülich, Germany.

Two months ago there was a very detailed workshop of experts in Germany. I'd like to begin my talk with the conclusions from this workshop. I should mention that the participation of that workshop was, in my judgment, a fairly representative mix of the plutonium community—industrial people, opponents and fans—everyone.

One conclusion of the workshop is that the recycling of German plutonium is possible in the near future, based on existing permits, and that the disposition rate can even be increased. We do not think that we have piled up an unbelievably high stockpile of plutonium that we can not get rid of it.

Second, the industry's position—and this was not really contradicted at all at the workshop—is that the fabrication of MOX fuel and its use in reactors is the only industrially developed, experienced and safe solution for plutonium disposition. I remind you: This is in Germany.

Finally, the workshop found that alternatives—and we have a very special form of German immobilization developed by the German "ÖKO-Institute" ("Ecological Institute"), which I will call the "MOX-as-waste" alternative—are not realistic solutions for Germany's main inventories. Such alternatives are practical only for residual quantities, for instance material from the Hanau facility, and from other facilities that have been or are being decommissioned.

Figure 1:
History of MOX Experience and Plutonium Recycling

1963	ALKEM (initally for FBR MOX Fuel)
1966	First MOX fuel for thermal Pu recycling at VAK Kahl
1974	Atomic Law: Preference for reprocessing/recycling
1978	"Service Agreements" with Cogema/BNFL
1987	Construction of "new MOX facility" at Hanau
1988	Stop of Wackersdorf reprocessing project
1989	"New Contracts" for reprocessing with Cogema/BNFL
1991	Stop of Kalkar FBR project
1992	Stop of ALKEM MOX facility
1995	Stop of construction of "new" Hanau facility
1996	First substitute MOX fuel from France

Before I start to go into details, let me present you with a little bit of a background of Germany's historical development (figure 1). In 1963 ALKEM was founded as a shareholding company of German and foreign owners, initially for fast breeder fuel production. But from the beginning ALKEM started to develop MOX fuel for thermal reactors because, even then, MOX fuel had to be tested in thermal reactors, since Germany didn't have a fast-breeder reactor. In 1966, VAK Kahl, a small power reactor, was the first reactor to have MOX fuel inserted.

At that time, we also had first individual agreements for reprocecessing small quantities of light-water reactor fuel with the French government; that is with the CEA, because Cogema didn't exist yet. And also, during those years, I personally already had the privilege to be authorized and to be able to sell plutonium for the European fast-breeder reactor program—I don't think that too many people have been able to do that.

One of the basic points for the German development and for the German plutonium stockpile is in the 1974 Atomic Law, which had a clear preference for reprocessing and recycling. It is not the marketing capabilities of BNFL and Cogema that forced the German industry to reprocess spent fuel. Rather, it is the German government, which asked the utilities to do something with that fuel besides final direct disposal.

So during following years, up to 1978, we had a group of contracts, or "service agreements," with the European reprocessors. Later, in 1987, the construction of the so-called "new MOX facility" at Hanau started. The old facility was based on the first ALKEM facilities.

Shortly after all these initiatives started—the signing of contracts with BNFL and Cogema, the beginning of the construction of a new MOX facility, and of course the development of our own capacities for reprocessing, beginning with a small reprocessing facility at WAK in Karlsrühe—the closure of the Wackersdorf reprocessing project was announced.

So something else had to be done. The service agreements were not enough. I remind you that Germany still had the preference for the reprocessing of its spent fuel. If a utility wanted to operate a reactor, it had to demonstrate that it was doing something regarding reprocessing.

The only demonstration after the stop of the Wackersdorf project was to sign additional long-term contracts. So after the first set of service agreements, you have the second set of so-called "New Contracts" for reprocessing, with the same reprocessors. Again, it was German law, not the capabilities of BNFL and Cogema, that forced us to do that.

After these new activities, we had a whole set of setbacks, as you can see from figure 1. The fast-breeder project in Kalkar was stopped. At the time, it was no longer a project—it was a fast breeder. It didn't operate, but it was ready and it was stopped. Also, the ALKEM MOX facility was stopped, and production ceased. And in 1995, the official announcement of the end of Hanau facility construction was delivered. The new Hanau facility was almost ready at the time, and it was mentioned yesterday that components of that facility may be available for other purposes.

Only shortly after that, in 1996, Germany received the first substitute MOX fuel from France, even though we could have produced such fuel ourselves.

Figure 2 shows the fuel experience in German reactors regarding MOX.

I have mentioned VAK Kahl already, starting in 1966. This was followed by Obrigheim, which was still a demonstration reactor. Afterwards, there followed the full-sized commercial reactors, which continues to this day. The cumulative total quantity is something about 12 tonnes of fissile plutonium as of the end of last year.

Figure 3 on the following page shows inventory commitments, and is organized by utilities. The grouping is slightly different from figure 2 because that was organized by reactors. The reactors are owned by utilities—some partly or by joint ventures—and the utilities have contractual commitments.

And you can see in the column labeled "inventories," there are still inventories from the old service agreements with Cogema and BNFL. These inventories, of course, are

Figure 2: MOX Fuel Experience in German Reactors

Station	MOX Fuel Since	total kg Pu_{fiss} (as of 12/99)
VAK Kahl	1966	32
KWO Obrigheim	1972	694
GKN Neckar	1981	728
KKU Unterwesser	1984	1,653
KKG Grafenrheinfeld	1985	980
KWG Grohnde	1988	952
KKP Phillipsburg	1988	1,886
KBR Brokdorf	1989	2,032
KRB Gundremmingen	1995	1,351
KKI Isar	1998	1,174
	Total	***11,482***

Data: Brueskamp/EtzmuB, Juelich, Jan. 13 - 14, 2000

Figure 3: Pu Inventories and Contractual Commitments

	Inventories (MOX not fabricated)		Commitments (Contractual min.)		Total
Utility	Service Agreements	New Contracts	Service Agreements	New Contracts	Total, as of 12/1998
BAG e.a.	1,652	–	448	2,462	4,562
EnBW	116	–	684	1,260	2,060
GKN	830	–	834	705	2,369
HEW	1,860	–	1,650	–	3,510
KWO	303	–	163	–	466
PE KK	2,050	–	2,761	2,341	7,152
RWE E	5,040	–	2,190	–	7,230
KLE	–	–	–	780	780
Total	***11,851***	–	***8,730***	***7,548***	***28,129***

Data: Brueskamp/EtzmuB, Juelich, Jan. 13 - 14, 2000

not at the utilities—they are at the reprocessors. MOX fuel has not been fabricated from those quantities, but will be. You can also see that there are no inventories yet from new contracts.

In the next column, labeled “commitments,” you can see the commitments of the service agreements on the left, and of the new contracts on the right. The service-agreement commitments are minimum commitments. These are actual quantities that will have to be disposed of. The new contract-quantities are also minimum quantities that have to be taken according to the long-term agreements, or else high penalties will have to be paid. These assumptions are collected by utilities, and they present the current status in Germany. So we have a total of about 28 tonnes of fissile plutonium to be disposed of.

It is a little confusing to have all these numbers, but these are rather firm, and are based on utility planning and existing permits and, I should add, based on our existing experience. So these are not plans for how we would like to do it—rather, these are things we have done over the past 20 or more years. We are quite familiar with MOX fuel; MOX fuel does not scare us. In fact, MOX fuel behaves very well in our reactors, and even the “ÖKO” researchers do not object to MOX fuel. The only difficulty that utilities have is that the spent fuel needs a longer decay period after it has been taken out of the reactor, and more space before it can be put it into interim storage.

You can see in figure 4 that the capability to work down Germany’s inventory exists. There are a few utilities that are still waiting for a license—in one case, waiting since 1990—but these delays are not based on any technical reasons. But if our government wants to support the disposition of plutonium—and this goal was mentioned explicitly during that Jülich workshop, because there were government people present—then these license applications may finally be approved.

Figure 4: Reactor MOX Capacities and Disposition (kg Pu_{fiss})															
Capacities		**Disposition Based on Existing Permits**													
		1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	**Total**
KKI	**392**		392	690	298	392	784	784	784	294	196				**4,614**
KKG	**298***														
KKP	**450**		390		390	450	450	450	450	360		390		293	**2,160**
GKN	**390**					96		390		390					**2,339**
KWO	85	disposition included in KKP and GKN													**510**
KBR	**333**	861	399	861	663	597	597	597	861	861	861				**7,158**
KKU	**264***														
KWG	**264***														
KRB	**604**		630	630	630	630	630	630	630	630	630	630	630	290	**7,220**
KKB		application suspended													
KKK	320	application since 1990 for disposition over 11 years													**3,500**
KLE		to be applied for after Pu availability (after 2005)													**800**
Total															***28,301***

** Increase applied for* *Data: Brueskamp/EtzmuB, Juelich, Jan. 13 - 14, 2000*

Also, we have a pending application to increase the percentage of plutonium in MOX fuel. This can be done, but it is uncertain if it will be done soon. But anyway, the estimates in figure 4 are based on the existing permits, and they show that the disposition of 28 tonnes of fissile plutonium can be accomplished in German reactors by the year 2011. We think that this is a foreseeable future, and we think that this shows that the plutonium stockpile, in Germany at least, is not too large to be disposed of. And again, I'd like to point out we have the best experience we can think of with this type of disposition.

To conclude my presentation, I would argue that both the technical capability and the safe-reactor capacities for MOX plutonium disposition are sufficient for our civil inventories. For higher disposition rates—that is, if we want to dispose of the plutonium more quickly, or if we want to dispose of other plutonium besides German civil plutonium, such as Russian plutonium from weapons, as has already been suggested—more MOX fabrication capacities are needed. The MOX fabrication does not have to be in Germany.

I would like to add that another outcome of the Jülich workshop was that it is extremely difficult in Germany to get a license for any facility that is in any way connected to nuclear activities. I think the situation is similar in the United States. We have existing facilities for the disposition of plutonium—that is, our reactors. But we do not have facilities for the immobilization of any plutonium in Germany, and this may be the crucial sticking point of any other alternatives in Germany.

Thank you very much for your attention.

Michael Sadnicki: Good morning ladies and gentlemen, I'd like to thank David Albright and ISIS for the opportunity to come here today to present the UK position to you. I should make clear that I'm speaking for myself, and not as a member of the government's Radioactive Waste Management Committee.

First, a very brief review of the UK reactor stock. The UK has six, relatively old magnox reactors; seven middle-aged, oxide fuel, advanced gas reactors; and one relatively new PWR—the Sizewell-B, which has a power of 1.2 gigawatts.

As regarding reprocessing plans, all of the magnox spent fuel is reprocessed at the Sellafield B205 plant. For the advanced gas reactors, most of the spent fuel will be reprocessed at Thorp, along with the foreign LWRs. There are currently no plans to reprocess Sizewell-B spent fuel.

However, the options for using MOX fuel in the UK are quite limited. The six magnox reactors cannot use MOX—it is not practicable in the time available. For the AGRs, it is technically possible to use MOX, but the cost of reactor modifications would be so great that it could be regarded as prohibitive. The PWR could burn MOX, but at the moment there is no economic incentive to do so. Moreover, British Energy—the reactor's owner—has told the House of Lords Select Committee on Waste Management that it has no plans whatsoever to burn MOX.

So this is the peculiar UK position that a number of speakers alluded to yesterday, especially Jim Finucane and David Albright—the UK is a major generator of civil separated plutonium, but it cannot be a major plutonium consumer.

Figure 1: Thorp: The BNFL Case For (In 1993 profitability over baseload years, £ billion)

Revenue			6.0
Costs			
	THORP Capital Cost	1.75	
	Associated Plant	0.85	
	Operating Costs	2.60	
	Decommissioning	0.30	
Total Costs			5.5
Operating Profit			0.5

Figure 1 gives a very brief overview of the economics of Thorp when BNFL justified it in 1993.

At the core of those figures were Japanese and German contracts, and as you just heard, the contracts were to the advantage of everybody. BNFL was expecting to make a profit from it, and the foreign customers had limited domestic spent fuel management infrastructure. When the contracts were signed, all the parties were operating under the paradigm that plutonium recycling was a desirable goal, and that plutonium was an asset.

Figure 2 on the following page gives just a feel for the split between the UK and overseas fuel. The figure differentiates also between the first 10 years, which we call the "baseload," and the "post-baseload" period. Above the heavy line in figure 2 is the baseload, where you'll see the familiar figure of nearly 7,000 tonnes of heavy metal. Below the solid line there is a lighter solid line. Above this line are figures to show what the contracts looked like in 1993. Below the lighter line are figures showing the distribution between UK and foreign-origin fuel today. In this figure, you see basically two significant changes over the last seven years. First, the new contract prices for British Energy were adjusted very low as part of the arrangement for the 1996 privatization. So British Energy is completely agnostic between reprocessing and dry storing spent fuel, and thus the numbers there have gone up. Simultaneously, because of the change in the German Atomic Law in 1993, the foreign contracts have gone down. There were some immediate cancellations, for example, and some later instances of German utilities not taking up options.

Figure 2: Thorp Contracts (tHM)

	UK AGR	Foreign LWR	Total
Baseload (1994 to ~2004?)	2,200	4,700	6,900
Post-baseload (next 10 yrs), as predicted in 1993	1,850	1,600	3,450
Post-baseload (next 10 yrs), as predicted in 2000	3,400	500	3,900

As a result, Thorp is exposed in the post-baseload period. The majority of its contracts are from a customer that is actually indifferent between reprocessing and dry storing spent fuel.

So, where do we stand in the year 2000? There is now a bit of an opportunity for reappraisal in the UK. Part of this is in connection with the proposed privatization that's on the agenda for BNFL, the Public-Private Partnership.

It is possible that reprocessing may once have been profitable, but that is not the issue now. The issue is where we can go, and at least three things have changed. First, the capital cost of Thorp is sunk, but also much of the income is sunk as well. There is a large element of pre-payment. Second, in general the prices are lower for reprocessing, and specifically the prices BNFL is getting from British Energy are lower. Third, the alternative of dry storage is straightforward, cheap and proven.

And here, I would really like to disagree with one participant who posed a question regarding costs of production yesterday to Mr. Chebeskov. I was a bit disappointed that the debate is still in terms of the rather tired old statistic from the 1994 OECD/NEA report, which said that reprocessing was just about 10 percent more expensive than dry storage. We've looked at this in some detail. If any of you want to know why it's really 200–300 percent more expensive, even in terms of the OECD's own figures, I've got a copy of our findings. Please go ahead and talk to either myself or my colleague, Fred Barker, and we'll make sure you get a copy of the full report.

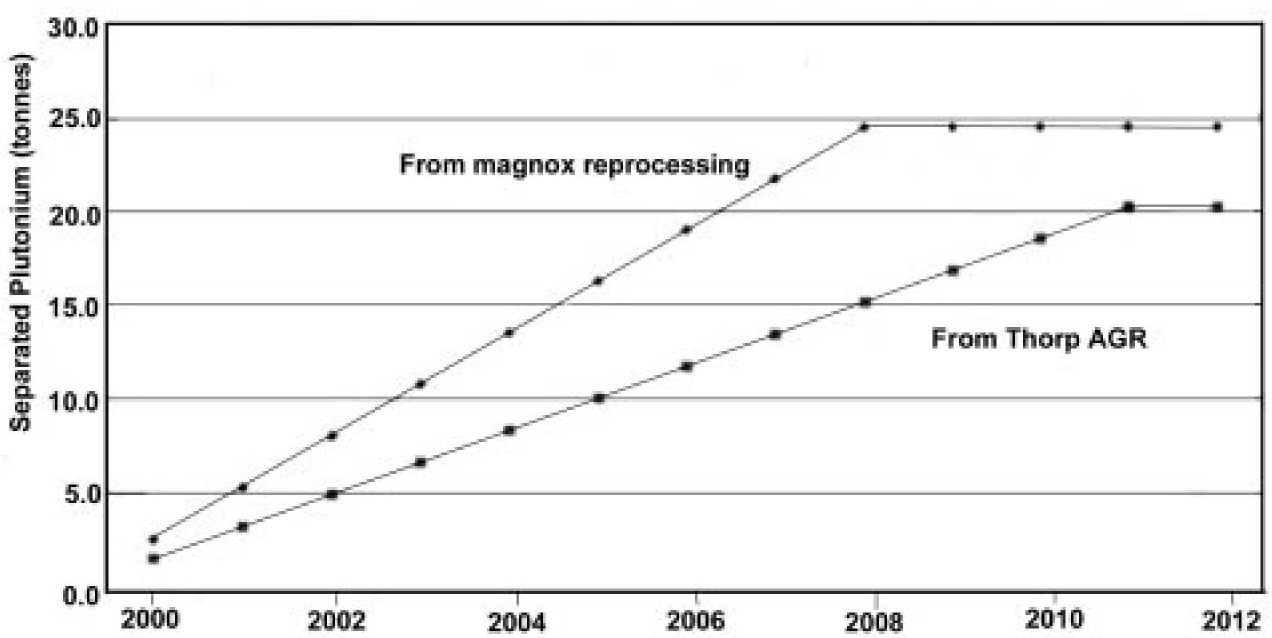
In that report, we looked at the options for the possible renegotiation of the German contracts. We concluded that there were significant savings to be made by changing from reprocessing to dry storage. The estimated savings were sufficiently great and both parties could gain. There is a potential that both parties get out of the logjam that they are currently in, if they could find that external stimulus to start the process off.

What has happened, really, is that the two imperatives for reprocessing—as far as the United Kingdom is concerned—are gone now. The military imperative is gone, and the fast breeder imperative is gone. And so, plutonium may not be an asset; it may be a liability. In terms of the debate in the UK, plutonium may or may not be declared a waste. This is something that has just recently come on the political agenda, starting with the Royal Society report in 1998. The House of Lords Select Committee Report on Radiation Waste Management then looked at this issue. There then followed the UK government response. And then, coming up very shortly, the UK government's own radiation waste review. We expect that one of the issues will be how much of the plutonium might be declared a waste.

That leads to the question: How much plutonium does the UK have? As of today, my estimates are that the UK has about 62.8 tonnes of separated civil plutonium, including 53.5 tonnes from magnox spent fuel, 5 tonnes from AGR spent fuel, and 4.3 tonnes from other sources. In addition, we have close to 16 tonnes of foreign-owned separated plutonium.

Next I would like to offer some projections as to where that might get to under current plans (figure 3). I must make clear that these are merely estimates of the future, and they are meant to be non-controversial estimates. They're based on published information from BNFL and the UK Department of Trade and Industry, and they're just straightforward projections of what should happen under BNFL's current business plan for magnox and the current contracts for Thorp.

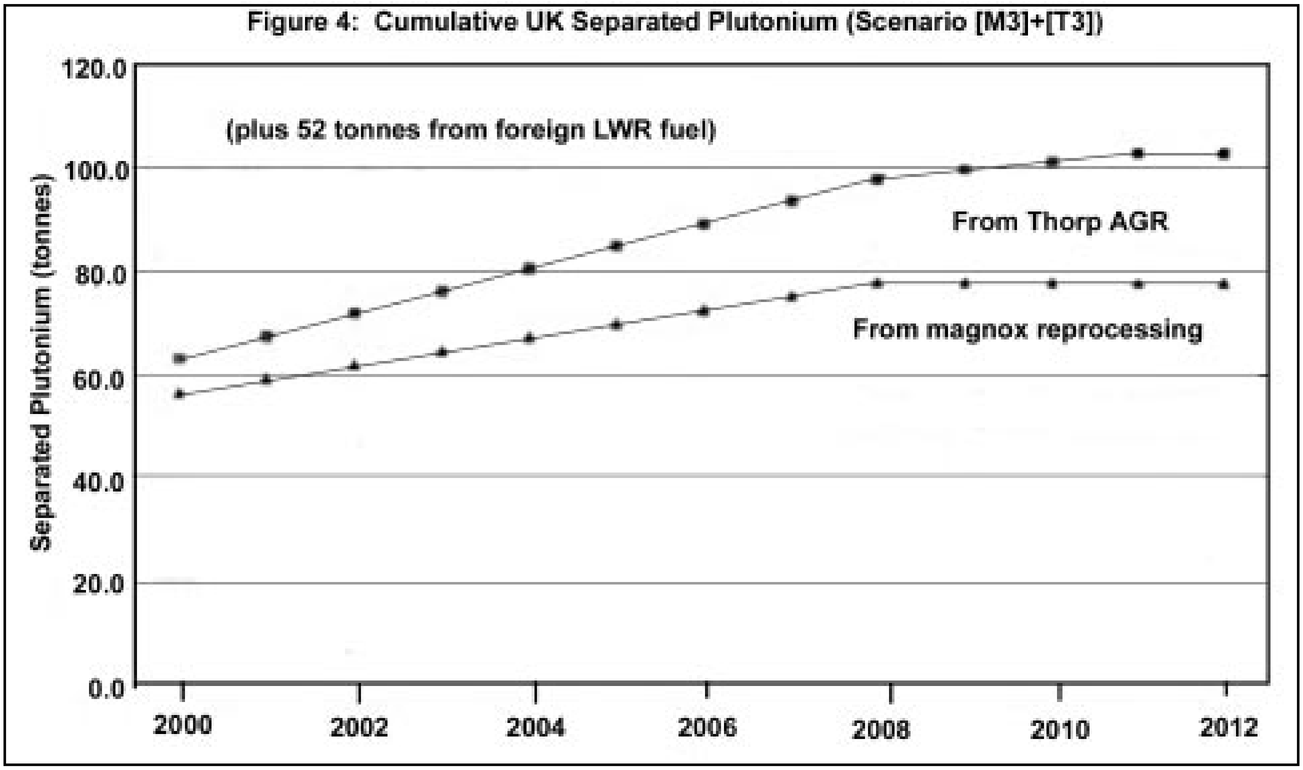
Figure 3: UK Future Production of Separated Plutonium (Scenario [M3]+[T3])



And you see from figure 3, we're going to get about another 25 tonnes from magnox processing, and over 20 tonnes just from Thorp AGR—that's our own.

Figure 4 shows how the separated plutonium accumulates over the next 12 years. By 2010 or 2011 the UK will have over 100 tonnes of UK separated civil plutonium. In addition, the UK will have reprocessed about 50 tonnes of foreign LWR spent fuel.

This is interesting in itself. The debate in the last 10 years has tended to be in terms of looking at the wastes. The argument has been put forward that the legacy of historical reprocessing is so great, that it actually doesn't matter much whether you reprocess or not. Analysis such as that in figure 4 shows that it *does* matter. *Everything* matters.



And so again, we've got this irony of the UK position. The UK is going to be making over 100 tonnes of separated plutonium, but the UK has no plans to consume its own MOX.

So now I'll move on to the SMP, the Sellafield MOX Plant.

First, a little bit of history. The plant was constructed by about 1997, and since January 1998 there've been various Environment Agency consultations on the justification for the proposed SMP discharges. This highlights a quirk in the UK planning process; that is, there exists no effective, automatic mechanism for a full scrutiny of all the pros and cons of a proposed nuclear facility such as the SMP before it's built. The debate is happening now, and it is a very intense debate. But the £300–500 million that has been spent—as far as the debate over the economics is concerned, that capital is now regarded as sunk. So this is really a rather strange quirk—first the money gets spent, and then you decide whether you think it is worth it to operate the plant, given the sunk costs.

But even with this sunk capital, there is still an intense discussion within the consultation procedure as to whether the plant will make money. Basically, the debate is between the consultants who are advising the Environmental Agency and between independent observers. The debate is sort of a "duel-with-spreadsheets-at-100-paces," and it's going on at this moment.

The point is that the debate is not just going on in the conference halls; rather it is going on within the mechanism of the justification process. So it's really a rather pleasing development. They comment on our comments, and then we then comment on their comments. It would be better if we could all get together in a room, but because of the legal aspects surrounding all of this, we can't do that. But at least there is a controlled comment process on what the forecasts mean. And we've gotten as far as agreeing on what we disagree. It's a pity that that didn't happen in 1993 with Thorp.

The main issue in the debate—the only really important issue—is the potential size of the MOX market. I use the word "market" in a very limited sense here: what BNFL will contract to provide. There is no "world MOX market." There perhaps will be a series of agreements between MOX producers and MOX consumers, and each agreement will be governed by its own special political, economic, and technical constraints.

The argument we're conducting is in terms of a BNFL's reference case, and no one knows what that reference case is, outside of BNFL. But we think it's about 80 tonnes a year. And here—this is just so important, and I agree with the comments made by Mr. Chebeskov yesterday—the throughput is crucial. If you don't get the throughput at the SMP, it will not make money, even with the capital costs sunk. So, in that context, the size of the contracts they have at the moment are very important. BNFL, as part of the procedure, has announced that it has 6.7 percent of the reference case—that sounds to me like one-sixteenth. So what I think we're talking about is one-sixteenth of 80 tonnes per year. In other words, they have contracts for 5 tonnes a year of throughput at the moment.

So now let me bring you up to date on some more history, from where I left off. Let me make clear at the outset that this has not happened at SMP, because as I said, the SMP is not producing yet. Rather I am talking about activities that happened at the MOX Demonstration Facility, also at Sellafield. Around September 1999, it became clear that there had been some irregularities—perhaps data falsification in connection with fuel pellet dimensions. BNFL announced that the Japanese shipment was not involved. The pace heated up in December, as Japan refused to accept the shipment, and the shipment has to come back to the UK.

Also in December, Switzerland announced faults with BNFL-produced MOX fuel. And I have to make clear that this was an old story, which was not by itself controversial. The Swiss problem happened much earlier, but the Japanese controversy made it resurface. The real story was that again—much more important in a sense—there were data irregularities with the Swiss consignment.

On February 18 of this year the Nuclear Installations Inspectorate published three separate reports on Sellafield. One report had to do with MOX fuel pellet dimensions, one with the general conditions and safety and procedures on the Sellafield site, and one to do specifically with the stores of highly active, liquid waste. All three reports asked very serious questions.

On February 20, there was then the announcement that shipments to Germany were also involved in these possible data irregularities. And this month, last week, Preussen Elektra announced concern over such irregularities, and that it was canceling the contract for the moment, and the German government suspended the MOX shipments.

That's where we are in the UK today. It's a very, very crucial period. There're two possibilities, and we genuinely don't know which way things will go.

First, it might be that reprocessing and MOX are on a downward spiral from which they will not recover. Now that should not matter to BNFL. It could reposition itself in the world market for site cleanup, where BNFL is a major player, and where it has much experience.

The alternative possibility is that it will turn out that all these events over the last few months have actually been blips in a transition to a MOX future. We don't know which is happening. I just want to make it clear that matters are continuing, and the justification process has not stopped. The process may certainly be slowing down, but we still expect a decision on the SMP. However, it is uncertain where this process will lead. Similarly, the partial privatization of BNFL may be slowed down, but we expect that it will remain on the agenda.

We've basically got two options for the management of separated plutonium. For the UK fuel: Is there an alternative to indefinite storage? That is the only real alternative we have in the UK. For the foreign fuel, the question is: Is there an alternative to MOX? They have to take the plutonium back, but how are they going to take it back?

And that's what Fred Barker and I are trying to do at the moment. We've got a MacArthur Foundation research grant to look at plutonium disposition in the UK. What we are trying to do is conduct a full economic comparison across all of the options of plutonium disposition, including long-term storage, MOX, and immobilization options. We're looking very hard at the experience that has been accumulated in the United States and Germany, in particular, at least in thinking about these things.

The thing is that in the UK we must put these alternatives very quickly and firmly on the agenda, otherwise they will not be considered.

So I'm going to ask you again, if you're interested in maybe looking at our interim report in the next couple of weeks, please get in contact with myself or Fred today. We are interested in dialogue and comments on this report. Thank you very much.

Emile Vanden Bemden: Ladies and gentlemen, thank you very much for giving me this opportunity to talk about the current situation in the European Union.

I would begin with France. In France, the civil plutonium stockpile is greater than 70 tonnes. Less than half, about 40 percent, is foreign. The UP2 reprocessing plant, entirely devoted to reprocessing the French spent fuel, extracts nearly 7.2 tonnes of plutonium when working at 850 tonnes of heavy metal (tHM) per year. Today, 20 reactors of 900 MWe are partially loaded with the 100 tonnes HM of MOX produced per year by Melox under its present licence, which is also devoted to fuel with MOX the French reactors. The 100 tonnes HM of Melox fuel contain to date 5.3 tonnes plutonium. These figures are illustrated in figure 1.

In France, the EDF long-term strategy is based on the principle of "Plutonium Equal Flows," which means that the yearly amount of plutonium separated is equal to the yearly amount recycled in the reactors. At this time the expected equal flows—use as MOX of the 7.2 tonnes plutonium yearly separated by reprocessing—is not reached, and the excess civil plutonium stored is still growing. Therefore, but also for economical reasons, EDF wants to license and apply the "MOX Parity Management" project, as I will explain in a minute. For the past few years EDF has implemented for its MOXified reactors the licensed "Hybrid Fuel Management," which concerns an annual reload of the reactors with a quarter of the uranium fuel assemblies present in the core, as in all the French non-MOXified 900 MWe reactors, and a third of the MOX ones. However, the hybrid-core management restrains the average fuel discharge burn up to 37 GWd/tHM for the MOX and 43 GWd/tU for the uranium fuel, compared with the 45 GWd/tU for the current full uranium fuel quarter-core reload management.

The goal of MOX Parity Management is to achieve parity between uranium fuel and MOX fuel performance with significant increase of the total average burnup. In consequence of the burnup increase of the MOX fuel, is an increase of plutonium content to 8.6 percent. This means that when

Figure 1: France

+ **Pu Stockpile**: >70 t Pu_{tot} <half foreign
+ **UP2:** 850 tHM spent UO2 fuel; 7.2 t Pu_{tot} /year
+ **Melox:** 100 tHM MOX fuel/year, licensed

+ **Today:**
  -- 20 Reactors (900): loaded with 100 t MOX/year
  -- Melox MOX fuel: 100 t HM/year, or 5.3 - 8.6 t Pu/year, according to the application of MOX parity
  -- Plutonium stock is growing

+ **Equal Flows:** 7.2 t/yr Pu_{tot} produced; 7.2 t/yr Pu_{tot} used (5.3 - 8.6 t Pu/year)

+ **Future Possibilities:**
  -- MOX parity: 8.6 t Pu/year. Pu Stock is decreasing
  -- 28 reactors "MOXified"
  -- Increase of Melox capacity

+ **Probable Timing:**
  -- Equal flows at equilibrium within a few years
  -- Remainder: ~20 tonnes Pu permanent buffer stock

the project will be applied, the 100 tHM MOX, produced annually by Melox under the present license, when fuelling the French 900 MWe reactors, will contain 8.6 tonnes plutonium. This exceeds the equal flows point, or the 7.2 tonnes plutonium which is annually separated at UP2. The implementation phase of the MOX Parity Management started in March 1999.

Application of the MOX Partity Management Plan is planned to occur in 2004, allowing the French civil plutonium stock to decrease progressively.

As of the end 1998, France owned about 40 tonnes separated civil plutonium. The plutonium stock will probably reach over 50 tonnes in 2004. Later on, owing to the MOX fuel parity and the progressively applied higher discharge burn up, the plutonium stock will slowly decrease to reach a normal industrial production buffer stock in around 2015, which could be estimated to be around two year's worth of MOX production.

In the UK the situation is quite different, as Michael Sadnicki has just discussed. In the UK, the plutonium stockpile is over 70 tonnes and almost 10 tonnes are foreign. The stockpile grows by about 2–3 tonnes per year, mainly due to the reprocessing of magnox GCR spent fuel. The situation is described in figure 2.

BNFL is projecting some possibilities to limit the plutonium stockpile growth for the magnox reactors, which are fuelled with magnesium-clad fuel that must be reprocessed without delay, because of the fast oxidation of magnesium by air or water. BNFL is examining, therefore, the possibility of fuelling those magnox reactors with a uranium oxide fuel, called "MAGrox," which is clad with stainless steel and can be stored like any other oxide fuel.

Figure 2: United Kingdom

+ **Pu Stockpile**:
  -- ~70 t Pu_{tot} (10 t foreign)
  -- Stockpile growth ~ 2/3 t/year (without foreign Pu stock growth)

+ **Project Under Preparation to Limit Pu Stock Growth:**
  -- MAGrox fuel for magnox reactors
  -- MOX use in AGRs
  -- MOX use in Sizewell B

BNFL is doing a demonstration of that MAGrox fuel, but of course it will take time to be licensed and applied. If the MAGrox fuel could be used, it could help to stabilize the plutonium stock, if the AGR fuel is not reprocessed any more.

BNFL is also examining the use of MOX in the AGRs, but it seems to be difficult, mainly because of the size of the fuel elements and the continuous unloading-loading system adopted.

MOX use is also contemplated in Sizewell-B. If MOX should be used in Sizewell, then almost 15 tonnes of plutonium could be used up through the end of the lifetime of the Sizewell reactor. However, to implement these possibilities, they must be fully demonstrated and all appropriate licences, including the one for the SMP, must be obtained. Therefore, a very long time will elapse before the elimination or otherwise the stabilization of the UK civil plutonium stock could be achieved, if no international action is taken in the meantime—for instance, at the EU level—to burn the UK civil plutonium in the EU licensed reactors under appropriate commercial terms.

In the other countries of the European Union, outside France and the UK, there are six with nuclear programs. Two of them—Finland and Spain—have practically no separated plutonium. Spain had signed a comprehensive fuel delivery contract with France to fabricate the fuel and to reprocess the spent fuel of the Vandellos 1 reactor, a gas-cooled reactor that has been shut down since 1990. Practically no plutonium remains in Spain, according to the terms of the contract.

Figure 3: EU Plutonium and MOX Market (outside of France and the United Kingdom)

	MOX Decided	Undecided
+ EU Countries		
– Belgium -	*	
– Germany -	*	
– Netherlands -		*
– Sweden -		*
+ Other Countries		
– Switz. -	*	
– Japan -	*	

+ Total MOX fuel to be fabricated from separated Pu from reprocessing plants in the European Union:

EU Countries: 429 tHM
Other Countries: 584 tHM

As shown in figure 3, four other countries remain. Of these, Belgium and Germany have decided to use all their plutonium as MOX until the exhaustion of their stocks. There is also Netherlands, which owns for the moment almost two tonnes of plutonium, and Sweden, which several years ago entered into a reprocessing contract. However, Sweden stopped reprocessing after having reprocessed under 40 tonnes of spent fuel. Sweden has, as a matter of fact, decided to use the separated plutonium, close to one tonne, as MOX. Negotiations on this began in 1998; they were stopped for a time, but they are again going forward.

Other non-EU countries, Switzerland and Japan, are reprocessing their spent fuel in the EU. They have also decided to have their separated plutonium fabricated into MOX in the EU production plants. This must be considered when examining the needed MOX fuel production capacity in the EU.

If we take into account all the reprocessing contracts that are signed to date with Cogema and BNFL by the last six countries, outside France, there is still almost 430 tonnes of MOX to be fabricated for the four EU countries, and 580 tonnes for Switzerland and Japan—but of course, mostly for Japan.

Figure 4 on the following page shows the number of reactors in Europe that are licensed to use MOX. In the EU and Switzerland, there are 35 such reactors yearly fuelled today with more than 150 tonnes of MOX. Potentially, the 35 reactors could accept more than 200 tonnes per year.

Figure 4: Reactors Licensed to use MOX

Country	Number of Licensed Reactors	MOX (tonnes/year)
France	20	100
Germany	10	<50
Belgium	2	10
Switzerland	3	<12
Total	**35**	**<170**

As for the total amount of MOX to be fabricated annually, let us look at the situation in a ten-year plan, which seems to be realistic, since it takes into account all of the firm reprocessing contracts existing today (figure 5). In such a plan, one would have to fabricate yearly, Japan MOX included, almost 195–200 tonnes HM of MOX. Now, the production capacities—including Melox, which is licensed for 100 tonnes—CFCa, which is licensed for 40 tonnes, as is BN P_0—one arrives to a total capacity of slightly over 180 tonnes HM of MOX, also taking into account the small demonstration capacity of MDF in the UK. This shows that a lack of MOX production capacity exists if such a 10-year plan would be applied.

It is to note that the technical capacity of Melox is over 160 tonnes of MOX per year and that the non-licensed SMP plant has a technical capacity of 120 tonnes per year. Potentially, therefore, an additional 180 tonnes of MOX fuel production capacity exists in the EU. However, there is no assurance today that the needed licences will be granted.

To conclude now (figure 6), the possible use of MOX in the 35 licensed reactors, including Switzerland, could reach 200 tonnes per year. The average yearly MOX use demand in reactors, including Switzerland, but excluding Japan, of course—because they will use their fuel in their own reactors—is 145–150 tonnes during that 10-year block, and on the basis of the signed reprocessing contracts. So the 145–150 tonnes could easily be used by the licensed reactors in the EU and in Switzerland.

Figure 5

a) Total MOX to be Fabricated Annually (10-yr. plan)

	tonnes HM/yr.
France	100
Other EU countries	43
Switzerland	>2
Japan	50
Total	***>195***

b) MOX Production Capacities (tonnes HM)

	Licensed	Not Licensed
MELOX	100	60
CFCa	40	
BN Po	40	
MDF	< 8	
SMP		120
Total	***> 180***	***180***

c) Amount of Plutonium Not Utilized

France and Others: 20 - 30 t Pu buffer stock
UK: > 60 t Pu to be utilized in the long term

The average yearly MOX fuel production demand, including Switzerland and Japan, since Japan will probably have its fuel fabricated in Europe, is 195–200 tHM per year. The actual licensed MOX production plant capacities in the EU is between 180–185 tonnes. So we see that there is, in the average, a lack of licensed MOX production capacities in the EU, if we take as a reference a 10-year MOX fuel use plan. Taking into account the unavoidable fluctuation of MOX production demand and the necessary production reserves, a capacity increase of about 20 percent seems justified in such a plan.

Of course, the 10-year plan I have described is hypothetical, even if realistic. If an important reduction in reprocessing demand occurs after the presently signed contracts, and if the time to eliminate the present stocks appears not to be critical, then a MOX production capacity increase is indeed useless. One must also not forget the huge UK stock, which will require the long run availablity of MOX production capacities if the MOX route is chosen.

Figure 6: Summary of MOX Utilization 10-Year Plan

Possible MOX used in licensed reactors, including Switzerland, but excluding Japan: ~ 170 t HM/yr

Average yearly MOX-use demand, including Switzerland, but excluding Japan: 145-150 t HM/yr

Average MOX product demand, incuding Switzerland and Japan: 1195 - 200 t HM/yr

Licensed MOX capacities, without Melox increased capacity and SMP: 185 - 190 t HM/yr

Remains Normally After this 10-Year Plan:

Production buffer stock : ~ 20 t Pu
The probably still subsisting UK stock ~ 70 t Pu

Taking an approach based on the licences granted now and the nuclear energy policies adopted today in the EU, after the exhaustion of the actual civil plutonium stocks in Belgium, Germany, the Netherlands, and Sweden, a plutonium buffer stock will still be necessary for the remaining MOX fuel markets—France and other possible countries—which could reach about 20 tonnes around 2015, assumed to be an eight year’s worth of MOX production.

Probably in addition to this, the 60–70 tonnes civil separated plutonium, or even more, stored in the UK, will still exist also at that time.

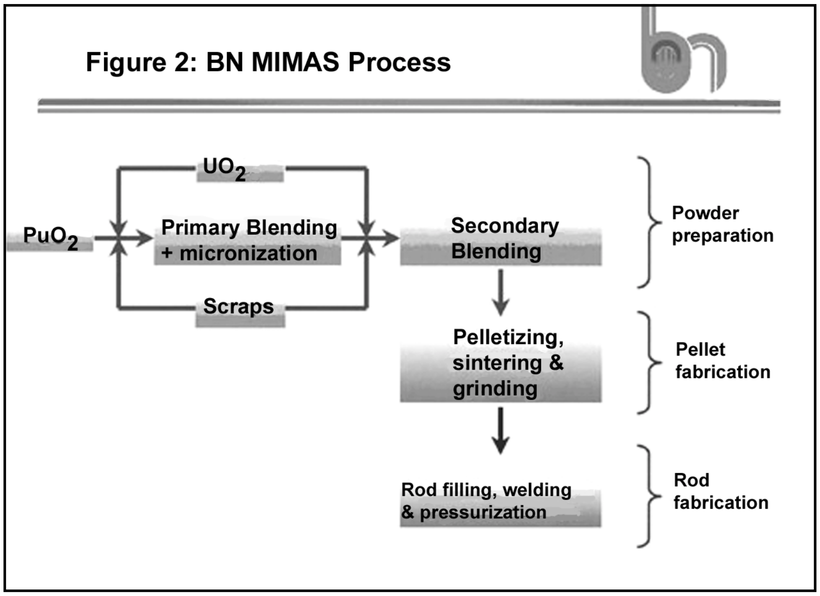
This concludes my presentation.

Werner Couwenbergh: Good morning everyone, during the next five minutes, I’d like to give you a short overview of the MOX fabrication experience in Belgium.

First of all, let me show you a photograph of the P_0 nuclear MOX plant (figure 1), which has the capacity of 40 tonnes per year.

Figure 1: P_0 MOX Plant

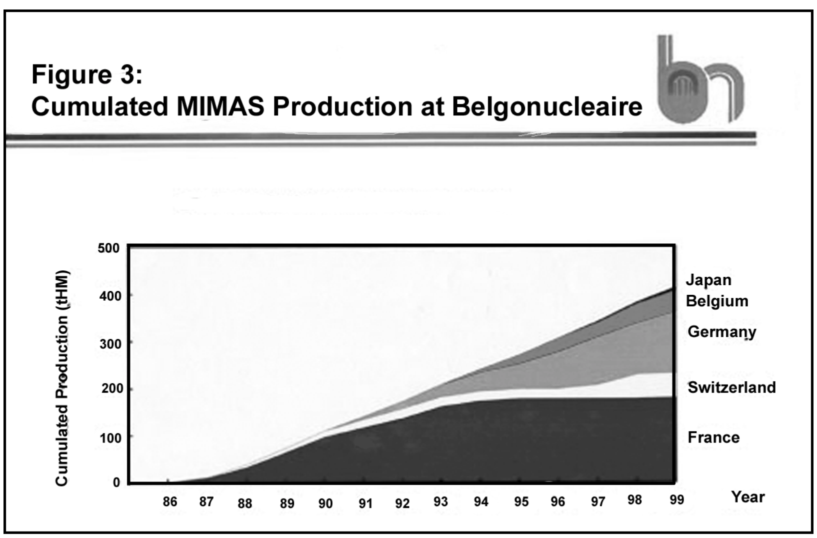
Belgonucleaire developed the MIMAS process, which stands for “miconization of the MOX supply,” and is represented in figure 2 on the next page. In this process, plutonium oxide, uranium oxide and recycled scraps are mixed into the primary blend, then micronized. The primary blend enrichment of about 30 percent is then further diluted to the desired final enrichment during secondary blending. The powder is then pressed into tablets, which are then sintered, grinded, and finally put into fuel rods.



Belgonucleaire started industrial MOX production in 1986, and since then has produced over 420 tonnes of MOX. This corresponds to over 220,000 fuel rods, with which over 800 PWR and almost 300 BWR fuel assemblies have been produced. A total of 64 reloads have been introduced into reactors, and 23 tonnes of plutonium have been recycled this way. It is important to know that there have been no fuel rod failures due to fabrication.

Figure 3, below, shows the cumulative MIMAS MOX production by Belgonucleaire since 1986. In the beginning, we produced mainly for France, but we are now producing for Switzerland, Germany, Belgium, and Japan. At the end of 1999, the accumulated production reached 418 tonnes.

The MOX fuel produced by Belgonucleaire has been used in 21 light-water reactors, of which three were BWRs. The assembly average burnup of over 50 gigawatts-days has been reached, with the highest burnup of over 60 gigawatt-days per tonne of heavy metal. To date, the highest enrichment produced was 8.3 percent plutonium.

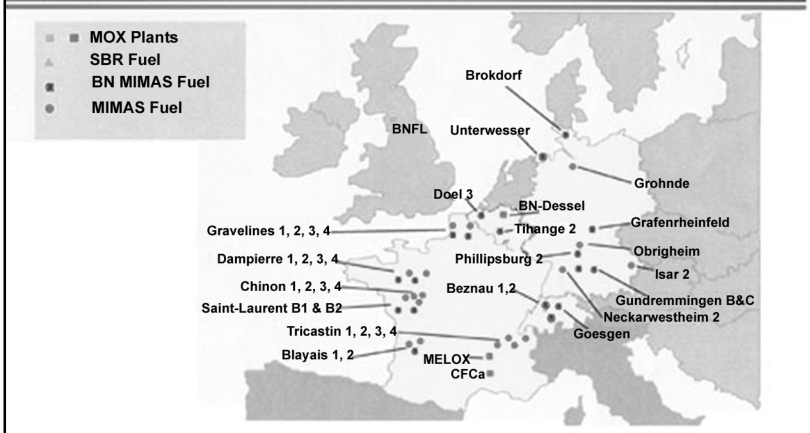


Some of the commercial reactors that will be loaded with MOX fuel are in Belgium, Germany, France, and Switzerland (figure 4, next page). Japan also has several reactors, which are not yet loaded.

So, let me just finish with some conclusions. First, MOX fuel is a mature industrial product, and the Belgonucleaire MIMAS process has been adapted by Cogema for its Melox and Cadarache plants. Today, 98 percent of the MOX fuel that is fabricated is done so by the MIMAS process. Belgonucleaire is a partner in the team selected to fabricate MOX with ex-weapons plutonium from the United States. The MIMAS process is also a strong candidate for the MOX plant in Russia, and for a MOX plant in Japan.

Andreas Friedrich: Good morning, I'm going to give you a quick update on the Swiss policy on nuclear energy and recycling of plutonium. First, in terms of hardware, let me remind you that today there are five nuclear reactors operating in Switzerland, with a total net capacity of more than 3,000 megawatts. They generate annually more than 23,000 gigawatts. That's between 35–45 percent of our total electricity production depending on the hydro-share, which depends on the weather.

Figure 4: Reactor Cores Loaded with MOX Fuel (Commercial Reloads)



Status as of December 1999

Because of the limited size of the Swiss nuclear program, there are no fuel-cycle facilities in the country, and we rely entirely on services in other countries. Uranium fuel and uranium enrichment for our power plants have so far been provided by the United States, by the European firms of Eurodif and Urenco, and by Techsnabexport in Russia. The fuel elements have been manufactured in Belgium, France, Germany, Italy, Spain, Sweden, the UK and the United States.

At the end of the 1960s and early 1970s, the operators of our plants have signed reprocessing contracts with Cogema for 147 tonnes of heavy metal. At the end of the 1970s new contracts for a minimum of 880 tonnes were signed with Cogema and BNFL. Out of these contracts, which will last until the year 2002, 845 tonnes of reprocessed uranium and 5.7 tonnes of plutonium will result.

Experimental MOX elements have been used in the Beznau power plant since 1978. Today the use of MOX is a standard operating procedure in the Beznau power plants, and since 1997 MOX has also been used in the Goesgen power plant. By 2004 or 2005, all of the plutonium resulting from reprocessing of spent fuel from our reactors will have been recycled.

Beznau uses fuel with up to 40 percent of plutonium, and Goesgen with up to 33 percent. This allows us to consume annually about 500 kilograms of plutonium in these PWRs. Plutonium recycling in BWRs has not been earnestly considered, since production costs of such fuel would have been higher due to the different uranium enrichment of the fuel.

A few words about research activities. Advanced fuel-cycle research has been carried out at the Paul Scherrer Institute, which is a national research laboratory affiliated with the Swiss Federal Institute of Technology. R&D in reactor physics and material technology has been directed towards recycling of plutonium aimed at increased plutonium consumption in LWRs (higher burnups, increased MOX loading fractions, and the possibility of developing plutonium fuel free of uranium). At the same time, within the framework of existing national and international research contracts and cooperation agreements, work has been done on plutonium burning and minor-actinide transmutation in advanced systems, such as fast reactors and accelerator-driven devices.

Before concluding, I have to mention some recent developments that will affect plutonium use in Switzerland. For a number of years, political opposition against reprocessing has grown. Fuel element transports to reprocessing plants have increasingly become the target of anti-nuclear activities by some environmental organizations. In the future, plutonium use in Switzerland will most probably be subject to two new restrictions. First, the reprocessing of spent fuel will be prohibited. Second, the air transport of nuclear material containing plutonium will be prohibited. These new limitations, *inter alia*, are being proposed in a draft nuclear energy law that the Swiss Federal Council approved on March 7, 2000. The draft law is to replace, in 2002 at the earliest, the atomic energy law dating back to 1959. This draft is now being sent to all Swiss Cantons, interested organizations, and political parties, for comments by June 15. In light of the comments received, a revised draft will then be submitted to parliament later this year.

Under the proposed new law, the companies running nuclear power reactors will have to terminate existing contracts for reprocessing spent fuel at Sellafield and La Hague as of a date certain to be determined in the new law—probably, at the latest, the date of the entry into force of the new law.

Recent discoveries of certain irregularities at Sellafield have probably made it easier for the Federal Council to confirm its decision in principle—taken last autumn—to propose a ban on reprocessing.

This new legislation will not necessarily put an end to the use of MOX fuel in Swiss power plants. The Swiss utilities will still be allowed to buy foreign plutonium for MOX fabrication—even from dismantled weapons—if this was an attractive option in commercial terms. However, in reply to yesterday's allusion made by Ms. Holgate, I have to stress that the potential use of MOX fuel with Russian weapons plutonium has never been discussed to date within the competent Swiss authorities. The only thing I can say, at this stage, is that there do not seem be any legal barriers so far, and that some of the utilities would not be opposed, as long as their participation did not entail any extra costs for them.

To summarize, I would note that Switzerland has, for many years, been a user of plutonium for civil purposes. However, the reprocessing of Swiss spent fuel will come to an end soon, because it is no longer commercially attractive. At the same time, future legislation will most probably not permit such fuel-cycle operations. Thank you.

David Albright: Are there any questions for our panelists?

Q: Mike Sadnicki, I wonder if I might put you on the spot. Could you discuss the quality problem with the UK MOX? Can you say anything about the root causes of this problem? Is there something wrong with the design of the process? Is it just bad management and dishonesty? What are the lessons learned from what's going on in the UK for MOX manufacturers around the world?

Michael Sadnicki: I don't think that I can say too much about this. The general feeling that we're getting from BNFL and the Nuclear Installations Inspectorate is that there were basically—as far as I understand it—failures of procedure. But they extend to more than just the lower levels of management, and we've been promised a good root-and-branch look through at all levels of management. Beyond that, I'm not really competent to comment. I think that there may be someone from BNFL here today, I hope so, that might be able to help a bit more.

Kevin O'Neill: Is there someone here from BNFL?

Q: I'm from BNFL. I think that your depiction is very accurate. We are still assessing the cause of the situation, which was an additional redundant step in the quality assurance check that wasn't done properly. I think some of the press have probably made it out to be worse than it is. But in the nuclear business, as you all well know, any lack of attention to quality and safety is a heavy burden. So we are getting to the bottom of it. Our new plant, when it's operating, will not have the opportunity for this type of situation to occur, since it is fully automated, and thus the operator can not avoid doing what's going to be done on an automated basis.

Q: Could one of the panelists provide any information on the plutonium storage cost and MOX fabrication cost in Europe?

David Albright: Who would like to answer that question: How much does Germany pay to store plutonium in France and Britain once it's separated? Does anyone here want to try to answer this?

Michael Sadnicki: I certainly can't answer that question in terms of a number. The details of the contracts have not been made available. We can tell you privately the sort of estimates we're coming out with. But it's important to stress here that these costs depend so much on particular circumstances. You have to look at what facility is being built, where it's being built, what the transport costs are, etc. And I think it's very dangerous to talk about the "price or cost per kilogram" or a "price or cost per tonne." The number that was being discussed yesterday—that plutonium storage costs so much per gram—well actually, it costs only a little more to store 100 tonnes of plutonium than it costs to store one tonne. So it's often very misleading to quote these statistics out of context.

Kevin O'Neill: Did you have something to add?

Q: Yes, this is just a clarification, because it comes up over and over again. Storage costs are largely capital costs and personnel costs, and the number of personnel are going to be about the same if you have one kilogram, or 10,000 kilograms. So storage costs are mostly fixed costs.

Also, we talk about costs, and then in the same breath we talk about prices, but they're two different things. Yesterday, we heard a lot about "economics" that had nothing to do with economics. There was arithmetic about one thing or another. Economics involves a lot of things—it involves the future, it involves not just storage of the material, but what the implications are, it involves the political aspects that some of us have been talking about—and that's what economics is. It's not just the difference between a couple of projections. And I think we've been very sloppy in using the term "economics" when all that we really mean are cost comparisons.

David Albright: Does anyone know what utilities pay to Cogema and BNFL to store their plutonium? I don't want to put Mr. Guais on the spot, but is this confidential information, or is it public?

Jean-Claude Guais: Oh no, it's absolutely commercially confidential.

Kevin O'Neill: Are there any other questions?

Q: The call for the immobilization of UK separated plutonium is certainly of a high order, and I'd like to know how it can be done. Let me estimate the following for you: Let us assume that you are correct that, through 2010, the UK will accumulate 100 tonnes of separated plutonium. Looking into the next 10 years of reprocessing of the gas-cooled reactor fuel—of the AGR and magnox reactors—this is 120,000 tonnes. Assuming one percent fission products, then we're talking about 120 tonnes of fission products. That is insufficient to meet the U.S. spent fuel standard for immobilization. So my question is: Would the UK consider using the fission products from foreign fuel? That would be a very interesting policy, and I think that a foreign country would love to take part in that, because the fission products now have to go back to the country. A related set of questions is: Will the UK not follow the U.S. spent-fuel standard? If not, what standard will the UK follow for the immobilization of separated plutonium?

Michael Sadnicki: I'll try and answer that question very carefully, because I have to make clear when I'm speaking for myself and when I'm speaking for the UK government.

The UK is not yet formally considering any immobilization strategies. This is the work that Fred Barker and myself are just starting to do. We certainly try to make the options that we are looking at as sensible as possible, and therefore in the first round we didn't look at using foreign material in that process. We try to keep it separate. We're looking at a range of immobilization options. We're very concerned that we get a full discussion of immobilization, that we attack the difficulties associated with a spent-fuel standard, and that we don't hide away from it. And that's really what we're hoping to do in the interim report that I've referred to, which we'll be circulating in the next few weeks. We want a full discussion of all these problems, but we haven't tread as far as thinking of utilizing foreign materials as well. That would be far down the line, and we've got to get the thing on the agenda first. I hope that answers your question a bit.

Q: I have a question for Mr. Kersting. You stated that alternatives such as "MOX-as-waste immobilization" are not realistic solutions. I frankly don't know what you mean—could you please explain that? Are you saying that MOX could not be a suitable waste material?

Wolfgang Kersting: No, no. The MOX-as-waste alternative—this is a special idea of the German "ÖKO-Institute." It involves fabricating low-quality MOX rods and mixing them with regular spent fuel rods for direct disposal. "MOX-as-waste"—it is just a term that I used for this special type of immobilization. My statement was that we do not think that this is a solution for the main civil plutonium inventory in Germany.

Q: So you're not speaking of spent MOX fuel?

Wolfgang Kersting: No, no, no. This is a mixture of regular spent fuel rods and newly produced, lower quality MOX rods.

Michael Sadnicki: Can you give some indication as to why you think it's not the solution?

Wolfgang Kersting: Well, there are several reasons. Mainly, it is not a solution because we don't have the facilities for it. If we want to have such a facility in Germany, we need 10 years for licensing, construction, and so on. But we want to get rid of the plutonium quickly. However, we think it is a solution for the smaller quantities that cannot be MOXed—definitely yes.

David Albright: I think we're going to return to this discussion this afternoon.

Q: Well, I'd like to comment on this, because I think that it is an important point. A lot of the presentation of Mr. Kersting was based on this workshop held in Jülich. I happened to have been there myself. I can't really agree with the industry's statement that there was agreement that MOX is just perfect, and everything else is basically rubbish.

I think it was an interesting debate that took place, and that it was most surprising that people agreed that there are actually quantities of German plutonium that have to be dealt with differently than through MOX.

The other point—which I thought was really important—is that it is actually being done. I don't know whether or not the people in this room are aware of the storage-pin immobilization option—some people call it "Kentucky Fried MOX," because it is fast and cheap. What you basically do is fabricate MOX fuel without meeting all of the qualifications for nuclear use. You run the plutonium through a MOX fabrication plant—so to that extent it's wrong to say that the installations aren't there. Siemens, right now, does storage pins at its Hanau facility, and they have put through approximately half a tonne of plutonium. I think it's a very significant point, and that it should be addressed here.

I also came to this conference to find out more about other people's views on this immobilization strategy, because it hasn't been mentioned before.

Wolfgang Kersting: I didn't use the word rubbish. Rather, I said that this option does not seem to be the solution for the main quantity, and the facilities for the main quantities are not there. It is a very interesting aspect, and this is why I have mentioned it. I confirm that there was an agreement that this is an alternate solution, but there was no contradiction to the main statement that MOX is the solution for the main inventory.

David Albright: We have time in the afternoon to return to this, in fact, I'd like to recruit one of you to speak this afternoon about this. I was to give a talk about this as a "stand-in" for someone from the "ÖKO-Institute." If you don't mind, I'd like to bring this up during the break. Are there other comments?

Q: I have two questions. One is for Mr. Kersting: I want to know your views of the consequences of the latest BNFL data falsification scandal. We hear that the MOX shipments have been suspended now. I wanted to know what you think the effect will be in the immediate future for the MOX shipments to Germany, and also the consequences of the whole relationship between Germany and BNFL.

The other question is for Mr. Couwenbergh: You mentioned that the MIMAS process is a strong candidate for a MOX plant in Russia. I wanted to ask if you could give some more details about the status of those considerations, regarding the situation with the MOX plant in Germany and Belgonucleaire's involvement in that project. Thank you.

Wolfgang Kersting: Regarding the falsification, I think even the Nuclear Installations Inspectorate report said that there was never any danger, so it was really a procedural problem, and, of course, it is a matter of dishonesty.

I do not think that this incident makes any difference regarding the reliability and the safe disposition of plutonium in MOX fuel, but I'm sure it's a severe problem for BNFL.

Q: OK. But my question was if you expected any consequences on the use of MOX in Germany?

Wolfgang Kersting: No, as I said, not on MOX use in Germany. But there may be severe consequences for BNFL. That is a problem, but it's a commercial problem, in my opinion.

Werner Couwenbergh: I'm not a specialist on the MOX project, but as I understand it, a lot of the material from the Hanau plant will be used, but I think the process in Germany was very close to the MIMAS process. Mr. Vanden Bemden may have more details on that.

Emile Vanden Bemden: As a matter of fact, there were two processes that were used in Germany. One such process is very similar to MIMAS in that there is a master blend and a second blending.

As you know the MIMAS process is used in different countries, particularly in France. In Germany, it's not called MIMAS, but it's practically the same. France, Germany, and Russia are in negotiations to build a MOX plant in Russia. There is, of course, a fair chance that it will be the MIMAS process.

Q: My question is to Mr. Kersting. You indicate that this MOX process in Germany proceeds swimmingly through 2011. I'm puzzled by this, because Germany is now led by a Green coalition government that is committed to phasing out nuclear energy. Aren't there some severe political constraints that face this whole problem?

Wolfgang Kersting: No, I don't think so, because the German government phase-out intentions are not clearly settled. As of today, there is no political consensus on how to do it, and the timeframes being discussed are on the order of 30 years. The reactors that I mentioned are all in that timeframe. This does not implicate the German utilities' intention to extend that period of whatever the remaining time will be. This is within that timeframe.

Kevin O'Neill: I think we've reached the conclusion of our panel and discussion. Thank you all, there'll be a short break.