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INTRODUCTION

Well, I think most of you know our company from the last meeting in May in Vienna, so I won't steal your time with explaining and demonstrating the same techniques that we have heard this morning from the other speakers. I would just take some words to explain the order of business with highly enriched uranium. NUKEM handles around almost two tons of highly enriched uranium a year and it was necessary to satisfy all the new physical protection philosophies. That means that we have to install storage and safe fabrication sites for a lot of money, 2.5 meter thick concrete walls, and different alarm systems. So just to demonstrate how silly this business is, we have just overcome this for highly enriched uranium, and now we speak about low enriched uranium for which we don't need all of these investments to make this business safe.

I would just like to concentrate my words on the status of fabrication and considerations in my company concerning the medium enriched uranium and low enriched uranium. In TABLE I are the different fuel types (see column 1) and then we have the fabrication in column 2; (The reason that I use the blackboard this morning is that I try to demonstrate all the techniques. However, all the speakers before me did this and in theory we are not so far away from each other.) the experience of my company in kg. In column 3 is the irradiation experience of these fuels types. Column 4 shows the studies and calculations made in our company for lower and medium enriched fuels. The preliminary fabrication tests and calculations are in column 5, and in column 6 we have the delivery time for a prototype core in months after UF_6 supply. Column 7 shows the time for the development of specifications including irradiation time in years for 6 and 7, and column 8 is the estimated cost of 6 and 7. There is just one fuel that is not in this summary and that is U-Zr. We now see how complex and sophisticated this business is. I have told you already that we have installed for a lot of millions of Deutsche Mark the physical protection, storage vaults, and things like that. Now we have to investigate all these different types of fuels for, as you see, a lot of money. Maybe these are a lot of optimistic figures; anyway the question is, does this make all the overall nuclear situation worldwide easier or not. I cannot answer for the moment, but anyway we have a lot of problems before us.

TABLE I.

1. Fuel Type	2. Fabrication Experience (kg)	3. Irradiation Experience (kg)	4. Studies and Calculations	5. Preliminary Fabrication (to Support Calculations)	6. Delivery Time For a Prototype Core (Months After UF_6 Supply)	7. Time for Development of Specs. Incl. Irradiation Time (Years) for 6, & 7	8. Estimated Cost of 6, & 7 (Million DM)
UAl alloy (up to 30 wt%)	∿ 3 to HEU ∿ 100 kg LEU	same					
UAl_3-Al (up to 35 wt%)	∿> 1 to HEU	same					
U_3O_8-Al ∿35 wt%	35 kg	same					
UAl alloy (special critical assemblies) up to 45 wt%	50 kg (∿ 42 wt%)	same	X	X	6	1.5 - 2.5	1
UAl_3-Al up to 50 wt%	-	-	X	X	6 - 15	2 - 3	1.5 - 2.5
UAl_2-Al and U_3O_8-Al up to 60 wt%	-	-	X	X	12 - 24	2.5 - 3.5	2 - 3
UO_2 plate type for LEU (diff. shapes & sizes)	-	-	X	X	6 - 15	2 - 3	1 - 2
UAl_3-Al up to 60 wt%	-	-	X	X	15 - 24	2.5 - 3.5	2 - 3
UAl_2-Al U_3O_8-Al up to 70 wt%	-	-	X	-	20 - 30	3 - 4	2 - 3
Diff. Oxides such as U/Mg mixture - plate type and rods	- (> 10.000 to for power reactor)	- (same)	X	X	10 - 20	2 - 3	1 - 2
U_3Si-Al and Others	- (10 to with d.u. U Mo 8% 6/4/2/1 for very sophisticated shielding)	- (-)	X	X	approx. 3 years	approx 5	3 - 6

Status of fabrication experience/standards and considerations at NUKEM concerning the development of high density fuels in connection with the adoption of new, resp. advanced fabrication and quality control methods.

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TRAVELLI (ANL): You quoted the times that are needed to have the preliminary fabrication for a whole core. Would the times needed to have a few fuel elements that one could consider using in demonstration tests for burnup be of the same order of magnitude or could some fuel elements of these types be produced at a much earlier date?

HASSEL: Let us say a core is something around 24-28 fuel elements. You need these figures I wrote down. If you just need two or three fuel elements, you can save one month or two months, because if you start a series of productions, you have the rest of the assemblies some 20% later in time.

GIETZEN (General Atomic): Do you intend to develop all of these various fuel forms in parallel or do you anticipate selecting two or three forms for development?

HASSEL: Of course, we start with the well known U-Al alloys and dispersion and U_3O_8 because, as I told already at the meeting in Vienna, we think a lot of problems can be solved with those fuel types, so there is a certain possibility to come within a short time to fuel which is right or satisfactory for 45% enrichment philosophy. But parallel to this anyway we should start the rest of this list and add if necessary, and if there are customers who have an interest and pay for this, to come to advanced type fuel elements for use in different reactors, maybe not in existing ones, but in new reactors which will be designed in the future in other countries or in our country.

LEWIS (Department of State): Does NUKEM currently plan to set up 20% or 45% enriched production lines? What is the status of thinking about that? Presumably one would use it with the best available technology.

HASSEL: I told you that we handle almost two tons of highly enriched uranium. Highly enriched until now we understand above 20% enrichment. So we are rather flexible in handling different fuels and different fuel elements with all kinds of enrichment. It is just a question of fabrication surplus and things like that. So to switch over from one enrichment to another is just a commercial question, to hold it separately for the uranium balance for the IAEA controls, safeguards, and so on.

SCHLAPPER (University of Missouri): What you are saying then is you could run multiple lines with let's say one line with 20% enrichment, one 45%, one HEU. Is that correct? And if so, how are you going to handle that from a safeguard standpoint?

HASSEL: That depends on what you understand on the line. We have three separate fabrication lines and within these three fabrication lines we can then switch over from one enrichment to another to another. So we have to clean some equipment and handle rather big fabrication surplus if it is just one order, one project. It is just a commercial question, not a technical one.