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Washington D.C. / 20520 USA

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US-Nuclear Regulatory Commission

Washington D.C. / 20555 USA

May 21st, 1980
HM/gti

Re: Application for granting a US-export license for 103.258 kgs of uranium (93 percent U-235 enriched) for the reactor THTR

Dear Sirs,

The Hochtemperatur-Kernkraftwerk GmbH, Uentrop, Federal Republic of Germany has entrusted us with the procurement of further 103.258 kgs of highly enriched uranium (appr. 93 % U-235 enriched) for the THTR-reactor. A correspondent application for granting the US-export license has been placed with US-Nuclear Regulatory Commission by our subsidiary Transnuclear Inc., Falls Church, Va. mid of May 1980.

In the following we give you the necessary technical background information which might be useful or necessary for the US-authorities to assess the technical and economic justification for that need of highly enriched uranium:

1. The highly enriched uranium applied for is intended for the production of fuel elements for the THTR reactor (thorium high-temperature reactor). At present this reactor is being built in Uentrop near Hamm, North Rhine-Westphalia.

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The THTR is a pebble-bed high temperature reactor. The core consists of about 675,000 spherical elements. In the first loading only 392,700 * elements contain uranium and thorium; absorber elements and spheres of pure graphite form the rest. In equilibrium (about 3 years after putting into operation) the total quantity of fuel elements containing uranium, however, is about 675,000 fuel elements. The reactor will work at an electric power of 300 MW. At this power about 170,000 fuel elements will be loaded per year. In the nuclear research center Jülich (KFA) a smaller reactor of the same type with the name AVR (Arbeitsgemeinschaft Versuchsreaktor) has been in operation for more than ten years at a power of 15 MW and with 100,000 elements in the core.

Helium gas flows through the pebble-bed for cooling. In case of the THTR the gas reaches a temperature of 750°C. The AVR reactor runs at a gas temperature of 950°C. Even higher gas temperatures are possible so that this reactor type cannot only be used for generation of electricity but also for carrying out chemical processes. This fact may become very important for the future since the German Federal Republic depends on the import of oil and gas to a great extent. For this reason the German Federal Republic has supported the development of this reactor type for many years. In the USA development work on this reactor type has also been carried out and sponsored by the government.

The THTR reactor is being built by the group

BBC, Brown Boveri & Cie, Mannheim

HRB, Hochtemperatur-Reaktorbau GmbH, Mannheim

NUKEM GmbH, Hanau.

It will later be operated by the HKG, Hochtemperatur-Kernkraftwerk GmbH. The HKG is an association of several German electric utilities. It is a joint European enterprise.

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* The number of 392,700 elements in the first core is given in the purchase contract of October 29, 1971. Therefore only this number will be used in the following. The measurements and calculations carried out since then lead to lower element figures.

2. The reactor is designed for the thorium cycle with highly enriched uranium (HEU). The element has a diameter of 60 mm and contains

1.03·g HEU, 93 % enriched
10.20 g Th

distributed in graphite in form of coated particles. Uranium and thorium are mixed.

The furtner HTR development in the German Federal Republic, however, will take as a basis a cycle of low-enriched uranium (LEU) in future. Whether there is the possibility of converting also the THTR-reactor from HEU to LEU, however, is not known in detail at present. Initial considerations lead, however, to the assuption that putting into operation and operation itself may be strongly affected by such conversion.

3. The production of spherical elements has been developed by NUKEM in Hanau and is possible only there or more precisely at the company HOBEG, Hochtemperatur-Reaktor-Brennelement GmbH which is a 100 % subsidiary company of NUKEM. The German authorities and also the operators of AVR and THTR are very much interested in the maintenance of a continuous production at NUKEM/HOBEG so that the existing know-how for the production of fuel elements for AVR and THTR is not lost.

The production lines at NUKEM/HOBEG are designed for a production capacity of 200,000 elements per year. The lowest through-put required for a continuous operation and the employment of highly spezialized staff is at least 50,000 elements annually. If the know-how and thus the capability of producing these elements shall not be lost, the production of the above-mentioned quantity of fuel elements must continue. The resulting stock of fuel elements will be consumed quickly at full load operation. For the AVR reactor 18,000 elements only are required per year.

If the THTR is converted from HEU to LEU as described above, the element manufacturer would probably be forced to stop production for some time. The duration of such a stop will on the one hand depend on the time required for the elaboration of new specifications and for the development of fuel and fuel element, and on the other hand it will depend on time-consuming testing of these elements in test reactors and licensing by the authorities.

4. Uranium balance for THTR

The quantity of HEU already received from the USA (93 % enriched) were:

month/year	kg u
6/72	48.038
8/72	48.021
11/72	47.997
2/73	16.317
3/73	31.683
4/73	48.083
7/73	48.023
3/74	96.025
6/74	63.948
12/74	16.009
1/76	47.949
7/77	103.082
6/78	120.005
	735.180 kg U
received from KFA Jülich *	15.000
from the uranium content in thorium**	1.384
	751.564 kg U (93 % emriched)

Thus

751.564 kg uranium

were at our disposal for production.

From this quantity following deductions have to be made:

	kg U
- 20,184 fuel elements for irradiation in the AVR	20.821
- losses during production of the first core	6.584
- losses during production of elements for the reloads till february 29, 1980	1.717
- for test samples***	0.080
sum	29.202

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* In 1974 20,184 elements were loaded into the AVR teactor for testing purposes. For these purposes the KFA in Jülich replaced 15.000 kg HEU. This quantity is lower than the 20.821 kg U which were used for irradiation.

** During fabrication uranium is mixed with the tenfold quantity of thorium. Thorium has a uranium content of about 100 - 200 ppm. Therefore we had to correct the received quantity for additional 1.384 kg U.

*** Measurements at EURATOM or other nuclear research centers.

The difference of 751.564 kg U minus 29.202 kg U

= 722.362 kg U (93 % enriched)

is available at NUKEM plant in form of finished elements, scrap, intermediate products, reference samples and as UF_6 which has not been converted yet. We round off in the following to 1/10 kg U and thus continue the calculations on the basis of 722.4 kg U. This quantity was itemized as follows on February 29, 1980:

	kg U
552,080 finsihed elements (partly still in the element fabrication; mostly on stock)	569.8
In the coating facility	20.0
In the facility for kernel production	33.7
In the conversion facility	0
As reference samples	1.2
In the analytical department	0.1
As UF_6/UF_4	85.7
As UO_2	1.7
As U_3O_8	0.1
As UNH solution	0.3
As impure U/Th scrap	8.6
In scrap reprocessing	1.2
total kg U (93 % enriched)	722.4

Looking on the element quantity finished by February 29, 1980 it should be considered that about 392,700 elements of the 552,080 are used for the first core. Since, however, the reactor needs 170,000 elements at full load per year, the balance of 159,380 elements only cover operation of about 11 months.

5. If the 569.8 kg U which are in the finished elements, are deducted from the present quanitity HEU of 722.4 kg U, a balance of 152.6 kg U remains. About 30 kg are necessary as required plant-surplus so that only 122.6 kg of uranium are left for production.

   Considering a production of 50,000 elements per year,. further 103 kg HEU will be processed into elements by February 28, 1982 so that only 19.6 kg U are available for production at this date; these 19.6 kg will cover a production period of 4 to 5 months. In the middle of 1982 our present HEU will be used up; production will therefore stop.

   It is a worthwhile consideration to bear in mind what a stock of about 652,000 finished elements in February 1982 will mean. Beyond the first loading this quantity will just cover about 1 1/2 years of reactor operation. A part therefrom will be considered by the reactor operator as reserve quantity.

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6. Summary

We hope to have demonstrated that in 2 years - around spring 1982 - further 103 kg HEU will be required so that the production of THTR elements at NUKEM/HOBEG can continue at the very low production rate of 50,000 elements per year. The continuity in production makes sure that the know-how to produce these elements which is existing at NUKEM/HOBEG only and nowhere else is being preserved.

We have therefore asked our customer HKG to apply for an export license for 103 kg HEU at the US authorities.

Should you have further questions with regard to this application, please do not hesitate to contact us. We would be prepared to discuss this case with you on the occasion of a planned visit with the US executive branch and NRC which is foreseen to take place during autumn of this years.

Yours faithfully
N U K E M GmbH

(Dr. G. Matz) (H. Müller)