



PAST AND PRESENT SUPPLY OF ENRICHED URANIUM FOR RESEARCH REACTORS IN THE EUROPEAN UNION

HANS MÜLLER

*Consultant of Fuel Cycle Services Division
RWE NUKEM GmbH, Industriestrasse 13, 63754 Alzenau - Germany*

ABSTRACT

In the last decade research reactor operators have focused mainly on the issues of disposal of spent research reactor fuel and the development of high density fuels. The safe supply of fresh uranium did not receive as much attention. This is surprising since the United States - who was the main supplier for LEU and HEU since the late 1950's - stopped supplying non-US research reactors with enriched uranium a decade ago. The reason for this stop of supply is described in this paper.

This paper explains how research reactors in the EU continued to operate during the last decade, in spite of the fact that their primary supply source had not provided LEU and HEU over the same period.

1. Historical background of supply of enriched uranium for research reactors

The timely availability of sufficient enriched uranium with the suitable U-235 assay is mandatory for the individual research reactor to guarantee continuous operation of its research reactor. In the former Eastern and Western world mainly the weapon states USA and Russia are supplying enriched uranium with higher U-235 assays as a spin-off of their military programs.

In the Western world the standard U-235 assays are either 19.75 % (LEU) or 93 % (HEU); in the former Soviet Union and its satellites the common U-235 assays were 36 and between 80 and 90 %. From the sixties of the 20th century until the mid eighties the USA supplied mainly HEU to research reactors outside the USA under the relevant bilateral agreements for cooperation, until 1974 even under lease conditions. This means, that until 1974 HEU remained the property of the USA while it was outside the USA for use in research reactors and later return as spent fuel to the USA.

In 1977, however, US President Carter became concerned about the "wide spread of weapons usable uranium" in research reactors worldwide. He initiated the International Fuel Cycle Evaluation (INFCE) and especially its working group 8 to minimize the traffic and use of HEU.

As a result of the working group 8 it was decided that the ideal U-235 assay in the sense of the non-proliferation should be less than 20 %, namely 19.75 %. The development of such high density fuel with the target of maintaining the same geometry of the fuel elements was initiated by the Reducing Enrichment in Research and Test Reactors (RERTR) Programme of the US-Department of Energy (DOE) with international cooperation. Declared preliminary target of the USA was at that time to reduce an export of 450 kg of HEU per year to 150 kg HEU outside the USA.

2. Stop of supply of LEU and HEU by the USA in the nineties

In 1992 supplies of LEU and HEU by the USA came almost to a complete stop. For supplies of HEU the U. S. Energy Act of 1992 limited exports according to the following criteria:

- 1.) There is no alternative nuclear fuel or target enriched in the isotope 235 to a lesser percent than the proposed export, that can be used in that reactor.
- 2.) The proposed recipient of that uranium has provided assurances that, whenever an alternative reactor fuel or target can be used in that reactor, it will use that alternative in lieu of highly enriched uranium; and
- 3.) The United States Government is actively developing an alternative reactor fuel or target that can be used in that reactors.

This new legislation stopped de facto US supplies of HEU to Europe which were so far the main customers with about 150 kg HEU per year. Only limited quantities of HEU have thereafter been supplied to the Canadian AECL which apparently met at this time the new US criteria for HEU supplies outside the USA.

In 1994 the USA had to stop as well completely the supply of LEU for several years due to a safeguards problem at the Y-12 plant in Oak Ridge.

The research reactor community having a demand of enriched uranium of US origin in order to return spent fuel to the USA faced more or less a disaster by the lack of US supplied LEU and HEU.

3. NUKEM's role in bridging the gap of US supplies

Since 1973 NUKEM, nowadays RWE NUKEM GmbH, plays a major role in the trading to nuclear fuels both for power and research reactors worldwide. The Fuel Cycle Department of RWE NUKEM GmbH is today the largest private trader of nuclear fuels which is its core business.

Although RWE NUKEM gave up manufacturing of fuel elements for research reactors in 1998 and handed over this business to the French company CERCA, NUKEM continued to be active in the field of LEU and HEU supplies after this date due to its experience in the external fuel cycle for research reactors. RWE NUKEM bridged the supply-gap in the nineties and supplied LEU to research reactors in the Western hemisphere and HEU to high flux reactors in the EU.

RWE NUKEM's ability to supply LEU and HEU was due to the availability of large stocks of no longer needed research reactor fuels from O-experiments which de facto had no or only slight burn-up after termination or shut down of those research or demonstration reactors in Europe, mainly in Germany. The no longer used fuels were treated in various uranium chemistry plants in the EU according to the requirements of the research reactor operators; i.e. mainly to produce LEU or HEU in the form of metal.

While the Western research reactors community in the last decade of the 20th century concentrated on issues of the back-end (open again the blocked path of returning of spent fuel elements to the USA) and the further development of high density fuels under the RERTR program, RWE NUKEM provided a reliable supply of LEU and HEU to research reactors in Europe, Canada, Japan and South-East Asia. All of the supply contracts were concluded with the concurrence of the Euratom Supply Agency. Otherwise many of the research reactors would have been forced to shut down due to lack of LEU and HEU of US origin.

4. Some details on RWE NUKEM's supply of HEU and LEU

In order to maintain its expert knowledge and to conserve its know-how, RWE NUKEM played an active role in the development of common and unified specification for enriched uranium for research reactors. The company is a member of the relevant ASTM-committee.

RWE NUKEM also contributed considerably to the solution of the so-called "U-232 problem" which was of relevance during the handling and processing of no longer needed uranium fuels in the EU.

The interruption of HEU supplies by the USA after 1992 caused serious difficulties to the high-flux reactors in the European Union because the USA had supplied HEU only as annual quantities for the individual reactors.

The inventory of HEU of the shut-down German demonstration reactor THTR received more than 1 tonne of HEU from the USA secured operation of all high-flux reactors in the EU. RWE NUKEM organized the recovery of the non-irradiated graphite spheres containing the HEU. The separation of the contained Thorium from the HEU was a complicated process however was completed successfully.

It is an open secret that Russia also contributed to the operation of high-flux reactors in the European Union. RWE NUKEM also played an important role on the securing of the HEU for the operation of the new Munich research reactor FRM-2.

With regard to bridging the gap of US supplies of LEU, RWE NUKEM organized in the EU the processing of several tonnes of no longer used LEU of US origin. The available material, stemming mainly from a O-experiment, and available as 20 and 35 % enriched uranium in the form of nickel plated metal platelets was denickelized and remelted. The 35 % enriched uranium was then blended down in induction furnaces to an enrichment of 19.75 % U-235.

The motive and motto under which RWE NUKEM acted in the past and continues in the field of research reactors is to contribute to the undisturbed operation of research reactors by reliable fuel supplies and related services.