U.S. NON-PROLIFERATION POLICY AND PROGRAMS REGARDING USE OF HIGH-ENRICHED URANIUM IN RESEARCH REACTORS

Richard A. Lewis

U.S. Department of State
Washington, D.C.

BACKGROUND

Uranium enriched to 90-93%, supplied by the U.S., is now used in 141 research and test reactors* in 35 countries around the world with a cumulative power of 1714 mw. Since of the order of 3 kg of ^{235}U is involved annually in fuel fabrication, fresh fuel transport and storage, reactor operation, and spent fuel cooling and return per megawatt of research reactor power, it is estimated that more than 5000 kg of vey high-enriched uranium is handled each year to operate these reactors.

Recent U.S. assessments have led to the tentative conclusion that in only approximately 11 of these reactors, generally those of highest power or power density, is the use of 90-93% enriched uranium currently a technical necessity. Universal use of the best state-of-the-art fuel technology would permit an estimated 90 of these reactors to use 20% enriched fuel, and estimated 40 others to use 45% enriched fuel, without significant performance degradation.

If advanced research reactor fuel development programs currently under way in the U.S. and elsewhere are successful, it may, in fact, be possible to operate virtually all of these reactors on less than 20% enriched uranium in the longer term. The physical and economic practicality of these developmental fuels must, of course, await future assessments.

The wide-spread use of 90-93% enriched uranium today is a result of fuel technology limitations prevailing 5-15 years ago, the ready availability of uranium of this enrichment from the U.S. in the past, and the costs involved in introduction of new fuel technologies and enrichments into existing fuel fabrication facilities and reactors. Because of the limited reactor fuel market and the substantial costs involved in gaining safety and operating approvals for changes to reactor designs there is great pressure on fuel fabricators and reactor operators to standardize on well-proven fuel designs, and not to adopt marginal technological improvements--particularly in the absence of apparent economic benefits. Generally, these pressures have led to standardization of

*The special-purpose reactors, KNK-II, AVR, THTR, DRAGON, and RAPSODIE in the FRG, UK, and France are not included in this discussion.

U-Al alloy and U-ZrH fuel technologies developed in the 1950's which, if 90-93% enriched uranium is available, are adequate for all but the highest power, highest performance, research reactors.

DEVELOPMENT OF U.S. POLICY

Current U.S. policy is to minimize the use of high-enriched uranium in research reactors, and minimize supporting fuel cycle inventories, in the U.S. and throughout the world and to achieve this objective as quickly as possible without imposing unreasonable reactor performance or economic impacts on the reactors involved. Where use of low-enriched uranium (i.e. <20% enriched) is not practical for technological or economic reasons, U.S. policy is to encourage use of the lowest practical enrichment. It is recognized that, for practical reasons, the number of intermediate enrichments used (i.e., between 90-93% and 20%) must be limited. There is a growing concensus that one intermediate enrichment should be chosen, and standardized upon, and that the best choice for this is 45% enriched.

This policy is designed to implement that part of U.S. non-proliferation policy which has the goal of minimizing access to weapons-usable materials while continuing to support legitimate peaceful uses of atomic energy. The U.S. government believes that current international commerce in high-enriched uranium for use as research reactor fuel is unnecessarily large and constitutes a significant diversion and terrorist threat that can be reduced without creating undue hardship to the operation of these reactors. This threat is considered to be particularly acute during fresh fuel fabrication, transport, and preirradiation storage. However, even after irradiation the uranium in spent research reactor fuel that was originally 93% enriched is still approximately 80 to 90% enriched and cannot be ignored as a potential threat.

STEPS TO IMPLEMENT U.S. POLICY

The U.S. government has taken three major steps to implement policy in this area. These are:

- Tightened export controls on high-enriched uranium.
- A major R&D program to provide the technical basis for use of reduced enrichments in research reactors and to encourage commercial suppliers to make available reduced-enrichment fuels.
- A program, for which funds are being requested from congress, to provide fuel and fuel services to support reduced-enrichment reactor conversions.

The use of high-enriched uranium in U.S. research and test reactors is being evaluated under essentially the same technical and economic criteria as are used to assess export requests. U.S. policy is being implemented so as to avoid giving a commercial advantage to any U.S. or non-U.S. fuel manufacturer.

EXPORT CONTROLS

Export controls on high-enriched uranium are being implemented under a presidentially-approved executive branch policy. This policy has two major parts; one dealing with use of the lowest practical enrichment and the other dealing with minimizing inventories of weapons-usable material:

With regard to existing reactors to which the U.S. has supplied high-enriched uranium for fuel prior to April 27, 1977, (i.e., those reactors for which the U.S. government has an established history of fuel supply), exports of 90-93% enriched uranium are being restricted to the minimum amount necessary to maintain normal operation until the reactor can be converted to the use of reduced enrichment. The criteria for reduced-enrichment conversions is that the lowest enrichment should be used for which reactor performance and fuel cycle costs are not significantly adversely effected.

Regarding new reactors for which the U.S. has had no history of high-enriched uranium supply prior to April 27, 1977, more limiting criteria must be met. For these reactors no 90-93% enriched uranium will be supplied unless the president personally finds that:

-- The project is of exceptional merit.

-- The use of less than 20% enriched uranium is clearly not technically feasible.

If the "exceptional merit" criteria is met, but the use of less than 20% enriched uranium is not feasible without substantial performance and/or cost penalties for a particular case in this category, then the lowest reasonable enrichment would be expected to be used.

In order to minimize inventories of weapons-usable material and to assure that the policy is being effectively implemented, the president has specified that he must personally approve each export of uranium enriched to greater than 20% ^{235}U which exceed either of two threshhold criteria:

-- The export license application for the project or facility is for a quanity of uranium containing in excess of 15 kg ^{235}U.

-- The export would cause the total unirradiated uranium inventory (>20% enriched) in the country involved to exceed 15 kg of contained ^{235}U.

THE U.S. DOE REDUCED-ENRICHMENT RESEARCH AND TEST REACTOR PROGRAM

To support U.S. non-proliferation policy initiatives restricting use of high-enriched uranium in research reactors, the US/DOE has undertaken a 7 year $23 million program (concentrated in FY 1979-82) to demonstrate the technical feasibility of reduced-enrichment conversions of reactors currently using 90-93% enriched uranium fuel or designed for use of this enrichment. This program approaches the physics, engineering, safety, and fuel fabrication problems of reduced-enrichment conversions for each of the four basic types of research reactors on a generic basis. Generic conversion feasibility studies are being prepared and published. In addition, specific technical support for conversion studies in cooperation with the affected reactors is offered by the U.S. program. Substantial fuel technology development and demonstration is being undertaken, with appropriate technology transfer, to support and encourage fuel fabricators to supply reduced-enrichment fuels.

The DOE program is divided into near-term and long-term phases. Near-term objectives are to facilitiate and encourage early universal application of the best state-of-the-art fuel technologies so as to accomplish enrichment-reduction conversions to 45% and 20% enrichment wherever possible within the next 2-5 years. Long-term objectives are to develop and demonstrate advanced fuel technologies making nearly universal use of less than 20% enrichment feasible. The program includes up to four full-scale in-reactor demonstrations of reduced-enrichment fuels.

REQUEST FOR FUNDS FOR FUEL AND FUEL SERVICES

In May, 1978, at the UN Special Session on Disarmament, the U.S. announced that congressional approval would be requested for three programs to support U.S. non-proliferation goals. Among these were two programs directly affecting research reactor fuel enrichment policies:

-- Authorization of up $5 million over 5 years to provide 20% enriched, or, in exceptional cases, 45% enriched uranium fuel for research reactors through the IAEA. Preference would be given to developing countries party to the NPT who would receive the material, in approved cases, at no cost.

-- Authorization of up to $1 million annually in "fuel cycle" services for research reactors, principally for the purpose of supporting fuel fabrication services which would assist in the reduction of fuel enrichments. Preference in providing these funds would be given to developing countries.

Congressional approval of these programs is being actively sought for implementation beginning in FY 1980. Similar voluntary contributions from other nations are being sought.