The RERTR Program*

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INTRODUCTION

The Reduced Enrichment Research and Test Reactor (RERTR) Program was established in 1978 at the Argonne National Laboratory (ANL) by the Department of Energy (DOE), which continues to fund the program and to manage it in coordination with the Department of State (DOS), the Arms Control and Disarmament Agency (ACDA), and the Nuclear Regulatory Commission (NRC). The primary objective of the program is to develop the technology needed to use Low-Enrichment Uranium (LEU) instead of High-Enrichment Uranium (HEU) in research and test reactors, without significant penalties in experiment performance, economics, or safety. Eliminating the continuing need of HEU supplies for research and test reactors has long been an integral part of U.S. nonproliferation policy. This paper reviews the main accomplishments of the program through the years.

1. Fuel Development

An important goal of the RERTR program is to develop LEU fuels with much higher uranium density than those used in the past with HEU. In the course of this work, the qualified uranium densities of the three main research reactor fuel types used with HEU when the program began have been significantly increased (UAl_x-Al, from 1.7 to 2.3 g/cm^3; U_3O_8-Al, from 1.3 to 3.2 g/cm^3; and $UZrH_x$, from 0.5 to 3.7 g/cm^3).

New fuel types have also been developed. For the most important fuel so far developed by the program, U_3Si_2-Al, the NRC has issued a formal approval[1] of its use in research and test reactors with uranium densities up to 4.8 g/cm^3.

After a pause of several years, the RERTR program is now developing fuels with even higher uranium densities, and DOE has pledged to Congress that it will continue to support this effort until its objectives are met. Initial activities include production of microplates of dispersion fuels containing U-Mo and U-Zr-Nb alloys, and other uranium compounds, with various matrix materials. Irradiations are scheduled to begin during 1997 in the Advanced Test Reactor.

2. Reactor Analysis

The RERTR program has upgraded and developed many methods and computer codes to assess the performance and safety aspects of research reactors using LEU fuels. Addressing neutronics, fuel cycle, thermal-hydraulics, transient analysis, and radiological consequences, these methods and codes have undergone extensive validation.[2] The program's computational and design capabilities have created an international standard.

Extensive studies have been conducted, with favorable results, on the performance, safety, and economic characteristics of LEU conversions. These studies include many joint study programs, which have been in progress for about 29 reactors from 18 different countries.

The RERTR program has also coordinated the safety evaluations for the U.S. university reactors undergoing LEU conversion as required by the 1986 NRC rule.[3] In addition, during the past year the RERTR program was tasked by DOE to assess the feasibility of converting to LEU each DOE research reactor currently using HEU.

3. ^{99}Mo Production from LEU

The RERTR program is pursuing an analytical/experimental program to establish the feasibility of using LEU instead of HEU in fission targets for the production of ^{99}Mo, the most important medical radioisotope produced in research reactors. The goal is to develop and demonstrate viable technologies compatible with the processes used at various international production sites.

In cooperation with the University of Illinois and the Indonesian National Atomic Energy Agency (BATAN), procedures have been developed for dissolution and processing of LEU silicide targets and LEU metal foil targets. These procedures are ready for demonstration on full-size targets with prototypic burnups.

4. Russian RERTR Program

The RERTR program and several major Russian institutes are collaborating in a program to develop and demonstrate within the next five years the technical means needed to convert from HEU to LEU fuel approximately 26 Russian-designed research reactors. The main Russian institutes contributing to this undertaking are the Research and Development Institute for Power Engineering (RDIPE), the Bochvar Institute of Inorganic Materials (VNIINM), the Novosibirsk Chemical Concentrates Plant (NZChK), the Yekaterinburg Branch of RDIPE, and the Kurchatov Institute. Both DOE and RF Minatom have expressed strong support for this initiative.

5. Reactor Conversions

Twelve foreign research reactors which required U.S.-origin HEU supplies when the program began have been fully converted to LEU fuels. These reactors include ASTRA (Austria), DR-3 (Denmark), FRG-1 (Germany), JMTR (Japan), NRCRR (Iran), NRU (Canada), OSIRIS (France), PARR (Pakistan), PRR-1 (Philippines), RA-3 (Argentina), R-2 (Sweden), and THOR (Taiwan).

Nine U.S. research reactors have been fully converted to LEU fuels. These reactors include FNR (Michigan), RPI (New York), OSUR (Ohio), VPIR (Massachusetts), ISUR (Iowa), MCZPR (New York), UMR-R (Missouri), RINSC (Rhode Island), and UVAR (Virginia).

Three foreign reactors, including IEA-R1 (Brazil), SSR (Romania), and TR-2 (Turkey), have been partially converted, and two more, GRR-1 (Greece) and HOR (Netherlands), have fabricated LEU cores. Safety evaluations for four additional domestic reactors have been completed, and calculations for four more reactors are in progress. Approximately 60% of the work required to eliminate use of HEU in U.S-supplied research reactors has been accomplished.

6. Spent Fuel Disposition

Ensuring proper disposal of spent research reactor fuels has always ranked high among RERTR program priorities. Early reprocessing studies had concluded that the fuels developed by the RERTR program could be reprocessed at the Savannah River Site, but were rendered moot by the expiration of the Off-site Fuel Policy in 1988.

Since then, the RERTR program has contributed to the best of its ability to the resolution of this crucial problem affecting many reactors with which it was cooperating. The DOE Final Environmental Impact Statement [4] and Record of Decision[5] have established favorable conditions for the return of spent research reactor fuel, and paved the way for fuel shipments expected to eliminate, over a thirteen-year period, the large inventories of spent fuel which currently fill the pools and storage facilities of many research reactors.

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