PDR

70-25

Energy Systems Group
8900 De Soto Avenue
Canoga Park, CA 91304
Telephone: (213) 341-1000
TWX: 910-494-1237
Telex: 181017

Rockwell International

June 21, 1979

In reply refer to 79ESG-6218

Mr. James G. Partlow, Chief
Material Control Licensing Branch
U.S. Nuclear Regulatory Commission
Division of Safeguards
Washington, D.C. 20555

Dear Mr. Partlow:

This is to inform you of an impending R&D effort at the Energy Systems Group to be conducted in the Rockwell International Hot Lab (RIHL). The activities will involve the development and checkout of a process for removal of zirconium cladding and a possible uranium-zirconium intermetallic compound (UZr_2) from uranium-molybdenum alloy fuel rods from the Fermi reactor.

This work will be done as an R&D effort as authorized under our Special Nuclear Material License, No. SNM-21, and requires no license amendments or modifications. Consequently, this letter is to present a description of the proposed development process for your information.

Dissolution recovery of this fuel is planned by E. I. Du Pont, Savannah River plant. However, uranium and zirconium are known to react at high temperature to form UZr_2. This compound is known to result frequently in an uncontrolled reaction in the presence of HNO_3, the normal dissolver acid used at the Savannah River plant. Energy Systems Group has contracted with DOE-Savannah River to declad the fuel and to remove the UZr_2 to enable Du Pont to recover the material. To accomplish this, a single element is being shipped for the performance of decladding tests. Three test processes have been devised and will be evaluated for feasibility. These processes are hydriding, centerless grinding, and oxidation.

To accomplish these tests, one Fermi fuel assembly will be transferred into Cell 4 of the RIHL and disassembled. The assembly consists of 140 fuel pins as U-10% Mo, enriched to 25.3% in U-235. A total of 4673 grams of U-235 is contained in the assembly. Thus, each pin contains 33.4 grams of U-235, together with a negligible amount of Pu. Of the 140 pins, 10 will be transferred into Cell 1 for testing, 10 will go into Cell 2 for possible use in the test plan, and the remainder will either be recanned and transferred back to the RMDF for storage or held in the hot cell until completion of all tests, when it will be returned with the test material. Thus, only 668 grams of U-235 is planned to be used in the test program.

The 10 pins in Cell 1 will be weighed and cut into 3 to 5 sections, depending on the test process, and each section will be uniquely numbered to retain traceability. Each of these sections will be weighed, dimensionally measured, and all data recorded on a data sheet.

For the hydriding test plan, sections of pins will be loaded into a boat and put in a furnace at a temperature of 600° to 950°C in a H_2 atmosphere and hydrided and cooled at different time frames and temperatures to determine minimum conditions for spalling to occur. If spalling occurs, the spalled material will be gathered and measured for U content; the intact fuel pins will be weighed and dimensioned and data recorded. The pins will then be examined for the presence of UZr_2. If spalling does not occur, the section will be measured as in the previous paragraph and then beat with a hammer until the hydride and possibly the fuel is broken. In both cases, the removed material will be sampled and analyzed for U content. If these tests fail to produce adequate separation of the U and UZr_2, this approach will be abandoned and centerless grinding will be tested.

For the centerless grinding test plan, nine pin sections (three pins) will be ground on settings for three feeds and three speeds, and dimensional measurements will be made and recorded on a data sheet. These steps will continue until the pin diameters have been reduced by at least 0.020 in. After evaluation of these tests and data, two full-length pins will be ground using the most effective of the three feeds and three speeds until their diameters have been reduced by 0.020 in. or until all evidence of Zr and UZr_2 is removed, whichever occurs last. At this point, the zirconium end caps will be cut off. This material and grindings will be sampled and analyzed for uranium content.

The results of these tests will be evaluated conjointly with those from hydriding, and the process and parameters that have the best yield in terms of cost, material accountability, and ease of disposal will be adopted.

If neither hydriding nor grinding is successful, the uranium will be oxidized to a fine powder. To aid in oxidation of the uranium, the pins will be cut into short lengths of approximately 1 in. long. These pieces will be loaded into a furnace and heated while wet air flows slowly through the furnace. The zirconium may also oxidize to a powder, or it may remain a hollow cylinder. After the furnace cools, the powder and any large pieces will be collected into separate piles and each will be sampled and analyzed for U.

Based on the results of this test, parameters will be changed in a series of runs to optimize the process in terms of processing time, completeness of the oxidation reaction, and degree of U-Zr separation.

To determine the level of separation achieved in the various processes, the uranium contents of the products must be measured. Because the actual activity of the fuel is unknown, the type of measurement used will be determined following each process.

All data on the processes undertaken will be recorded on process data sheets and laboratory notebooks. At the conclusion of these development efforts, all data will be collected and a final report and material balance will be issued.

If you have any questions or need further information, please call me.

Sincerely yours,

M. E. Remley, Director
Health, Safety & Radiation
Services
Energy Systems Group

cef:4/10-12