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ERDA Light Water Reactor Fuel

by

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DISCLAIMER

ERDA LIGHT WATER REACTOR FUEL RECYCLE ASSISTANCE PROGRAM*

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ABSTRACT

The Energy Research and Development Administration is funding a program to assist the closing of the back-end of the light water reactor fuel cycle. The program uses resources of industrial and academic groups and those of technology laboratories throughout the ERDA complex. The ERDA Division of Waste Management, Production, and Reprocessing has the responsibility for overall program management, and the Savannah River Operations Office is responsible for field management and program implementation. The technology program in the ERDA laboratories is coordinated by the Du Pont Company which is the operating contractor for the Savannah River site. The program focus is a conceptual design of an integrated fuel recycle complex. Program components include the actual design activity, design liaison, technology support, economic analyses, environmental effects and analyses, and assessments of alternatives to reprocessing and recycle. Also, some longer range technology development not immediately applicable to the conceptual design is supported.

To assure the availability of all necessary technology to close the back end of the light water reactor fuel cycle, the Energy Research and Development Administration (ERDA) is funding a program which uses the resources of industrial and academic groups and those of ERDA laboratories to provide this technology. The ultimate objective of this and related programs is to provide an optimized fuel cycle system for the disposition of spent fuel elements from light water reactors. This paper describes the structure of the program, its organization, and possible alternatives that may influence its future course.

The program was initiated in December 1975 after considerable consultation and review with various ERDA divisions, other Federal agencies, and American industrial groups that were known to be interested in light water fuel reprocessing and recycle. The program (Table 1) was funded initially by the former ERDA Division of Nuclear Fuel Cycle and Production and is now funded by its successor the Division of Waste Management, Production, and Reprocessing.

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* Work developed under ERDA Contract No. AT(07-2)-1.

ERDA's Savannah River Operations Office is responsible for field management and implementation. Du Pont's Atomic Energy Division – ERDA's prime contractor for the Savannah River site – coordinates the program.

TABLE 1

ERDA Light Water Reactor Fuel Recycle Assistance Program

Objective:	Provide an optimized fuel cycle system for disposition of spent LWR fuel elements
Initiated:	December 1975
Funding:	ERDA Division of Waste Management, Production, and Reprocessing FY 1976 and 76A – $\$8.5 \times 10^6$ FY 1977 – $\$24.9 \times 10^6$ FY 1978 – $\$26.5 \times 10^6$ (anticipated)
Administration:	Savannah River Operations Office
Coordination:	Du Pont Atomic Energy Division

The major elements of the program are:

- Conceptual Design of an Integrated Fuel Recycle Complex
- Design Liaison
- Technology Support Program
- Industrial Participation
- Academic Participation

The conceptual design of an integrated fuel recycle complex (IFRC) is the primary focus. The actual design activity is the responsibility of a special group in the Du Pont Engineering Department. The Savannah River Plant and the Savannah River Laboratory provide the liaison between those groups providing the needed technology (technology support program) and the designers of the complex. This arrangement readily identifies technological gaps to the management of the technology support program.

The conceptual design of the IFRC is broken down into the modules listed in Table 2. This modular approach facilitates the design activities and will ultimately enable review and consideration by industrial and other groups according to their individual interests. The approach also allows the technology support program to be organized so that the liaison group can provide direct input to the separate design modules.

TABLE 2

Conceptual Design Modular Components

Spent Fuel Receipt and Storage
Fuel Reprocessing – Separations
Uranium Processing and Finishing
Plutonium Processing and Finishing
Mixed Oxides Fuel Fabrication
HLW-ILLW Processing and Fixation
Solid Waste Processing and Disposal
Power, General, Service, and Site

Thirteen ERDA laboratories are currently participating in the technology support program. As shown in Table 3, the technology support program is organized by categories that relate to the needs of the design modules. Participation by the various ERDA laboratories is based upon the recognized expertise of each in specific fields, and, of course, on their availability of resources and willingness to participate. The program allows for some parallel effort, where validation of results by a second, independent group is judged to be desirable.

TABLE 3

Technology Support Program

Category	SRL	ORNL	HEDL	PNL	INEL	LLL	ANL	RFP	ORGDP	LASL	ARHCO	BNL	BHARC
Liaison-ERDA Labs	X												
Economic & Env. Studies	X		X	X			X					X	
Fuel Receipt & Storage			X	X									
Head-End Process	X	X		X									
Off-Gas Treatment	X	X		X	X								
Purex Process	X	X		X			X						
Finishing Process	X		X	X				X	X	X			
Waste Management	X		X	X	X			X			X		
Environmental Effects	X	X	X	X		X	X						
Safeguards													
General Support	X			X		X							X

The industrial and academic participation in the program is administered exclusively by ERDA's Savannah River Operations Office. Contracts are negotiated with such groups to provide both general and specific input to the program. In those cases for which the input is sufficiently specific to support the conceptual design effort, direct contact is established between the design liaison groups and the university or industrial organization. Such program elements may then supplant some or all of an analogous element at one of the ERDA laboratories. For example, a contract between ERDA and Westinghouse Electric Corp. will provide technology support to the conceptual design on the mixed oxides fuel fabrication module. All contracts, as of March 1, 1977, between ERDA and industrial or university groups are listed in Table 4.

TABLE 4

Industrial and Academic Participation

Contractor	Program
Scientific Application Inc.	Off-Gas Treatment
Westinghouse Electric Corp.	Mixed Oxide Fuel Fabrication
Boeing Co.	Head-End Systems
General Atomic Co.	Pulse Column Development
IRT Corp.	Instrumentation for Fuel Reprocessing Complex
Nuclear Assurance Corp.	U. S. Spent Fuel Disposition Capabilities
University of South Carolina	Professional Manpower and Training Needs of Fuel Cycle
	Mathematical Modeling of Voloxidation Process
Kansas State University	Education Modules for Fuel Cycle
Oregon State University	Radionuclide Removal and Resuspension Rates for Atmospheric Transport and Diffusion Calculations
University of Arizona	Environmental Effects of Reprocessing Plant in an Arid Region
Clemson University	Use of Functionalized Glass Beads for Waste Removal

The overall program is being coordinated to provide a preliminary design layout and early readouts of cost estimated for an initially specified IFRC in late 1977 or early 1978. For these preliminary results, the IFRC is based on existing technology. The technology support program will provide a basis for design of an improved IFRC and a more reliable cost estimate, which are scheduled for completion in mid-1980. The "improved" IFRC is expected to specify more technologically advanced process steps and more extensively evaluated and optimized safeguards and effluent controls. Also, much more information will be available by 1980 that can be applied to the preparation of an environmental impact statement and for licensing considerations.

A number of external factors could influence the future course of the program. As stated earlier, the ultimate objective of the program is to provide an optimized fuel cycle system for the disposition of spent fuel from light water reactors. Obviously, reprocessing and recycle of spent fuel is just one method of disposition. Alternative reprocessing options, such as no separation or incomplete separation of plutonium or uranium, are already under study with respect to the impact on the feasibility and cost to the nuclear power industry. Alternative fuel cycles, such as the tandem cycle in which spent fuel may be reconfigured but not processed chemically, may be evaluated as they pertain to an integrated program. Even the throwaway fuel cycle is a disposition option. Factors external to the program, including GESMO, public reaction, and guidelines that originate with Federal agencies, could influence the program direction and alter the course of action in future months.

In summary, ERDA has under way a carefully defined program of assistance to the light water reactor fuel cycle. The goal of the program at this time is limited to providing a conceptual design of an integrated fuel recycle complex based on established technology. At completion, this program should make available information of significant value in planning for future action directed toward closing the back end of the light water reactor fuel cycle.