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BUDGET FOR FY 1966
AND REVISED BUDGET FOR FY 1965
SEPARATIONS RESEARCH AND DEVELOPMENT PROGRAM

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BUDGET FOR FY 1966
AND REVISED BUDGET FOR FY 1965
SEPARATIONS RESEARCH AND DEVELOPMENT PROGRAM
(02 50 10 15 1)

By

W. S. Frank

Research and Engineering
Chemical Processing Department

April 1, 1964

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HANFORD ATOMIC PRODUCTS OPERATION
RICHLAND, WASHINGTON

Work performed under Contract #AT(45-1)-1350
between the Atomic Energy Commission and the General Electric Company.

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SCHEDULE 189

Additional Justification for Operating Costs

RICHLAND
OPERATIONS OFFICE

SPECIAL NUCLEAR MATERIALS
PROGRAM

1. Contractors: General Electric Company		Contract No. AT(45-1)-1350		Task No.	
2. Project Title: Separations Processes		189 No.		3. Budget Activity No. 02 50 10 15 1	
4. Date Prepared: April 1, 1964		5. Method of Reporting: Annually		6. Working Locations: Hanford, 200 Areas 300 and	
7. Person in Charge: W. S. Frank Principal Investigators:		8. Project Term Continuing From: To:			

9. Man Years:	<u>FY 196 4</u>	<u>FY 196 5</u>	<u>FY 196 6</u>
(a) Scientific and Technical	36.4	36.0	33.2
(b) Other	20.0	21.0	18.5
Total	<u>56.4</u>	<u>57.0</u>	<u>51.7</u>
10. Costs:	<u>FY 196 4</u>	<u>FY 196 5</u>	<u>FY 196 6</u>
(a) Direct Labor (Including Continuity of Service)	637,000	645,000	585,000
(b) Materials, Technical Services, Subcontracts	999,000	917,000	793,000
Total Direct	<u>1,636,000</u>	<u>1,662,000</u>	<u>1,372,000</u>
(c) Indirect Expenses	333,000	340,000	322,000
Total Operating Cost	<u>1,969,000</u>	<u>2,002,000</u>	<u>1,694,000</u>
(d) Equipment	205,000	155,000	20,000
(e) Irradiation Unit Cost			

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 ADDITIONAL JUSTIFICATION FOR OPERATING COSTS

SCHEDULE 189

RICHLAND**OPERATIONS OFFICE**

02 50 10 15 1 - Separations Processes

Scope

The Separations Research and Development Program consists of eleven identifiable activities in four general areas of effort. The activities and their proposed levels of effort are listed in the following table.

Activity	Manpower and Costs (in thousands of dollars)					
	FY 1964		FY 1965		FY 1966	
	Man Yrs.	Costs	Man Yrs.	Costs	Man Yrs.	Costs
Chemical Processes	8.9	258	6.5	191	5.7	168
— (011) Current Processes	5.9	188	15.1	460	15.5	495
— (012) Innovations & New Business	14.8	446	21.6	651	21.2	663
Subtotal						
Process Equipment & Control	2.9	118	3.5	129	3.0	123
(031) Equip. & Materials of Construction	6.1	187	5.5	138	2.7	74
(032) Control Instruments & Systems	9.0	305	9.0	267	5.7	197
Subtotal						
Waste Management			0.5	18	0.6	25
(041) Low-Level Waste Disposal	6.8	232	5.0	198	4.4	148
(043) Waste Sludge Characterization & Removal	5.5	191	4.3	154	2.6	91
(044) Alkaline Waste Processing	5.2	180	3.3	114	2.3	87
(045) Acid Waste Processing	3.7	128	3.5	120	3.0	105
(046) Waste Immobilization	5.6	290	5.7	362	5.6	193
(047) Waste Packaging	26.8	1,018	22.3	966	18.5	649
Subtotal						
By-Products	5.8	200	4.1	118	6.3	185
(051) Recovery and Purification						
Total, Separations Development	56.4	1,969	57.0	2,002	51.7	1,694

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RICHLANDOPERATIONS OFFICE02 50 10 15 1 - Separations Processes

For each of the identifiable activities, the major accomplishments of the last year are listed, together with the proposed goals for the next two years, in the following pages. Significant trends in the program are noted below.

Chemical Processes

Efforts will continue, but at a declining level of expenditure, to find ways of reducing cost and improving the quality of current products. An increasing effort will be made to develop technology in several new potential product areas. Included in the latter group are the following: (a) clean U^{233} (i.e., product containing less than 1 ppm U^{232}) from irradiation of Th^{232} , (b) Po^{210} from irradiation of bismuth, (c) Pu^{238} from irradiation of Np^{237} utilizing a closely coupled irradiation - separation process to improve yield and unit cost, and (d) americium recovered from Pu^{241} for subsequent irradiation to Cm^{242} .

Activities planned are in the areas of adapting and improving on existing process schemes and of exploring new methods which may result in marked increases in the feasibility of developing these product areas because of improvements in the cost picture. Significant achievements in any of these efforts would greatly improve the potential for diversification of activities at the Hanford facility.

Process Equipment and Control

Efforts will continue at a modest level to develop superior materials of construction, process equipment, and process control. This effort is expected to result in increased safety, decreased processing costs, and improved product quality.

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OPERATIONS OFFICE

02 50 10 15 1 - Separations Processes

Waste Management

An intensive effort will be continued during the next two years to develop the detailed technology required to implement the Waste Management Program. The required level of development effort in this area is expected to decline rapidly starting in FY 1966.

The returns from this effort are expected to accrue in four areas:

- 1) The in-tank solidification program is designed to evaporate the relatively non-heating wastes to salt cakes in existing underground tanks. This program will permit the re-use of existing tanks such that the total costs of the program will be less than the cost of the new tanks that would be required to maintain continuity of production by present methods.
- 2) The fractionization of wastes is designed to remove the long-lived, heat-producing isotopes from the bulk of the self-heating wastes for separate high-integrity storage; the residual wastes are then to be solidified in underground tanks with the non-heating wastes. If implemented on this schedule, this program will preclude the need to build replacement tanks for self-boiling wastes when the existing tanks fail; by about 1973, virtually all of the long-lived hazardous radioisotopes can be immobilized for long-term storage.
- 3) The fractionization program will make potentially valuable isotopes more available for beneficial use. The fission products of primary interest - cesium, strontium, cerium, and promethium - can be isolated as crude fractions that can be made available as ready sources of supply.
- 4) About one ton of technetium could be recovered while the wastes are being fractionized if the nominal additional cost is considered justified.

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By-Product Recovery

During FY 1963, the Division of Isotopes Development evidenced an increasing interest in, and willingness to support, fission product recovery programs at Hanford. The DID is also supporting at Hanford the development of technology for the encapsulation of purified product in end-use forms. Because of this trend, the expenditure of O2 funds in support of fission product isolation has been curtailed. However, a considerable amount of work is needed to develop the technology for conversion of the "product stream" from the waste management operation to a form suitable for encapsulation for beneficial use. This work, which has received relatively little effort to date, will increase modestly over the next few years. Consequently, the expenditure pattern in this program shows a temporary decrease in FY 1965, followed by a modest rise in FY 1966.

Approved:

P. H. Reinher
 General Manager
 Chemical Processing Department

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SCHEDULE 189

RICHLAND
OPERATIONS OFFICE

SPECIAL NUCLEAR MATERIALS
PROGRAM

1. Contractors: General Electric Company		Contract No. AT(45-1)-1350	Task No.
2. Project Title: Separations - Current Processes		189 No.	3. Budget Activity No. 02 50 10 15 1 (011)
4. Date Prepared: April 1, 1964	5. Method of Reporting: Annually	6. Working Location: Hanford, 300 Area	
7. Person in Charge: W. S. Frank Principal Investigators: M.T. Walling, Jr., A.M. Platt		8. Project Term: Continuing From: To:	

9. Man Years:	<u>FY 196 4</u>	<u>FY 196 5</u>	<u>FY 196 6</u>
(a) Scientific and Technical	6.7	5.2	4.6
(b) Other	2.2	1.3	1.1
Total	<u>8.9</u>	<u>6.5</u>	<u>5.7</u>
10. Costs:	<u>FY 196 4</u>	<u>FY 196 5</u>	<u>FY 196 6</u>
(a) Direct Labor (Including Continuity of Service)	102,000	76,000	66,000
(b) Materials, Technical Services, Subcontracts	112,000	82,000	70,000
Total Direct	<u>214,000</u>	<u>158,000</u>	<u>136,000</u>
(c) Indirect Expenses	44,000	33,000	32,000
Total Operating Cost	<u>258,000</u>	<u>191,000</u>	<u>168,000</u>
(d) Equipment			
(e) Irradiation Unit Cost			

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SCHEDULE 189

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OPERATIONS OFFICE

02 50 10 15 1 (011) - Current Processes

11. Reactor Concept - Not applicable
12. Materials - Not applicable
13. Dates and Titles of Publications (Other Than Progress Reports)

All topical reports were released through AEC Files.

14. Scope

The current processes sub-program in separations is directed toward increased adaptability of existing process systems as necessary to meet changing AEC production requirements safely and at a reduced unit cost.

15. Relationship to Other Projects

This sub-program is highly interrelated with all other programs in Separations Development and with reactor programs that alter chemical processing needs. Because of direct chemical involvement, a particularly close relationship exists with the waste disposal and by-product recovery programs.

16. Technical Progress in FY 1964

- a. Laboratory and engineering feasibility studies were continued in the search for alternate plutonium reductants. Two chemical reduction procedures were explored for the preparation of U(IV), and the potential use of sodium formaldehyde sulfoxalate as a plutonium reductant in Purex is currently being evaluated.

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02 50 10 15 1 (011) - Current Processes

16. Technical Progress in FY 1964, continued

- b. Continued to provide technology as needed in support of processing NPR fuel elements in the Redox Plant. Initiated studies pertinent to processing NPR fuel elements in the Purex process (use of Zirflex head-end process).
- c. Techniques of vapor-phase chromatography were greatly developed during this period and used to detect the minor components in Purex diluent which are reactive toward oxidizing acids. Simple tests were developed for diluent quantity, and a silica gel treatment for new diluent was demonstrated. This treatment removes reactive trace components in both synthetic and petroleum hydrocarbons.

17. Expected Results in FY 1965

- a. Engineering feasibility study of the use of alternate plutonium reductants will continue, directed toward utilizing a reactant that will not contribute to the quantity of waste salts.
- b. The feasibility of using trilauryl amine to extract trace quantities of technetium from Purex wastes will be established.
- c. Technology will be defined to permit the use of the Zirflex process in Purex and to increase the flexibility of the Purex Plant to process higher enrichment fuels and/or thorium.
- d. Laboratory studies will continue to develop a better correlation between available tests and analyses of available (Purex) diluents and their performance in the Purex Plant.
- e. A search for organic scavengers for iodine to assist in clean-up of the solvent will be undertaken.

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02 50 10 15 1 (011) - Current Processes

18. Expected Results in FY 1966

Emphasis will continue on developing new technology as required to permit the processing of new products and enriched uranium in Purex.

19. Description and Explanation of Major Materials, Equipment and Subcontract Items

There are no expenses associated with this program other than those normal to this type of development activity.

20. Proposed Results

The use of alternate plutonium reductant such as sodium formaldehyde sulfoxalate as a replacement for Iron(II) in the Purex process will reduce the iron content of Purex raffinates, thereby reducing nitric acid corrosion of stainless steel equipment, minimizing sludge deposition (and attendant problems) in waste storage tanks, and facilitating future processing of Purex waste. It is estimated that savings up to one million dollars per year may be realized by these improvements.

Successful development of tri-lauryl amine extraction of technetium will make this rare metal recoverable from current process wastes.

Proposed Obligations for Related Construction Projects

None

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RICHLAND
OPERATIONS OFFICE

SPECIAL NUCLEAR MATERIALS
PROGRAM

1. Contractors: General Electric Company		Contract No. AT(45-1)-1350	Task No.
2. Project Title: Separations - Innovations and New Business		189 No.	3. Budget Activity No. 02 50 10 15 1 (012)
4. Date Prepared: April 1, 1964	5. Method of Reporting: Annually	6. Working Location: Hanford - 300 Area	
7. Person in Charge: W. S. Frank Principal Investigators: M.T. Walling, Jr., A.M. Platt		8. Project Term: Continuing From: To:	

	<u>FY 1964</u>	<u>FY 1965</u>	<u>FY 1966</u>
9. Man Years:			
(a) Scientific and Technical	4.0	9.3	9.8
(b) Other	1.9	5.8	5.7
Total	<u>5.9</u>	<u>15.1</u>	<u>15.5</u>
10. Costs:	<u>FY 1964</u>	<u>FY 1965</u>	<u>FY 1966</u>
(a) Direct Labor (Including Continuity of Service)	67,000	170,000	176,000
(b) Materials, Technical Services, Subcontracts	89,000	212,000	225,000
Total Direct	<u>156,000</u>	<u>382,000</u>	<u>401,000</u>
(c) Indirect Expenses	32,000	78,000	94,000
Total Operating Cost	<u>188,000</u>	<u>460,000</u>	<u>495,000</u>
(d) Equipment			
(e) Irradiation Unit Cost			

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02 50 10 15 1 (012) - Innovations and New Business

11. Reactor Concept - Not applicable

12. Materials - Not applicable

13. Dates and Titles of Publications (Other Than Progress Reports)

All topical reports were released through AEC Files.

14. Scope

Several new potential product areas for production operations have been identified. The objective of this R&D program is the development of technology in support of processing methods required in these product areas.

Included in the group of potential product areas are the following: (a) clean U²³³ (i.e., product containing < 1 ppm U²³² from irradiation of Th²³², (b) Po²¹⁰ from irradiation of bismuth, (c) Pu²³⁸ from irradiation of Np²³⁷ utilizing a closely coupled irradiation - separation process to improve yield and unit cost, and (d) americium recovered from Pu²⁴¹ for subsequent irradiation to Cm²⁴².

The activities planned are both in the areas of adapting and improving on existing process schemes and exploring new methods which may result in marked increases in the feasibility of developing these product areas because of improvements in the cost picture.

15. Relationship to Other Projects

Some facets of these studies are interrelated with other programs in separations development at other AEC - Contractor sites. In these instances, however, they represent new effort in that either a new

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02 50 10 15 1 (012) - Innovations and New Business

15. Relationship to Other Projects, continued

approach is being used or adaptation to existing equipment is involved. Specifically, the work on thorium reprocessing is interrelated with programs of high-density thoria production at other AEC - Contractor sites, and Pu²³⁸ from irradiated Np²³⁷ is currently produced at another AEC - Contractor site but not by a closely coupled irradiation - separation system.

16. Technical Progress in FY 1964

- a. Extensive calculations were made on the effect of thorium irradiation variables upon U²³³ quality and upon chemical reprocessing problems.

Preliminary calculations were made of the radiations to be expected from heavy element isotopes under recycle target irradiation conditions, removing previously held concern in connection with thorium calcination and refabrication operations. In the course of the work, an important but previously unrecognized nuclear mechanism (photo neutron) for production of U²³² impurity was discovered.

- b. The first(demonstration) sample of high quality U²³³ was isolated and purified in B-Cell of the High-Level Radiochemical Facility.
- c. Studies were initiated on the dissolution of thoria to define technology for processing irradiated thoria targets in the Redox and Purex plants.
- d. Experimental studies directed at the preparation of high-density thorium oxide were initiated. Kilogram quantities of thoria were prepared and delivered for initial fabrication and irradiation experiments. Adaptations of the Sol-Gel Process for semiworks-scale production in existing, but modified, equipment were scouted with highly favorable results.

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02 50 10 15 1 (012) - Innovations and New Business

16. Technical Progress in FY 1964, continued

- e. Laboratory work was initiated on Pa^{233} process chemistry directed toward close-coupled re-processing schemes which might permit the isolation of Pa^{233} , to allow subsequent decay to isotopically pure U^{233} .
- f. In the area of separating polonium from irradiated bismuth, two new methods were conceived for separating Po^{210} from irradiated bismuth metal. One method is based on carrying polonium on cerium bismuthide and permits recycling the bismuth to the reactor. In the preliminary tests, 81 percent of the polonium was concentrated in five percent of the bismuth. The other concept involves the removal of volatilized polonium from bismuth oxide without removing the bismuth from the reactor.
- g. High throughput Po^{210} production processes were studied and flowsheets developed for potential solvent extraction and volatility processes.
- h. Potential techniques and problems in close reactor - separations coupling for Pu^{238} production were investigated. A simple batch-extraction process for separating plutonium from neptunium using a tertiary amine extractant was scouted. Good separation was achieved (separation factors of 350 - 750). The process appears to have promise for application in a close-coupled separations scheme.
- i. In the area of americium recovery, the dependence of Am(III) extraction upon solvent composition (DBBP concentration) and salting strength were determined, permitting optimization of the flow-sheet for americium recovery. Specific cation effects as well as the H^+ ion effect were also determined. Methods were developed for testing the purity of DBBP, and of distinguishing DBBP from TBP. Work was also carried on in behalf of identifying impurities in D2EHPA and on the detection and analysis of impurities in hexone, using vapor-phase chromatography (VPC).

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02 50 10 15 1 (012) - Innovations and New Business

16. Technical Progress in FY 1964, continued

- j. Samples of diethers were obtained in an effort to verify their advantages of high solvent power and chemical stability as indicated in scouting experiments.

17. Expected Results in FY 1965

- a. The potential of close-coupled processing schemes for irradiation and separation of Th^{232} and U^{233} will be evaluated, and the most promising processes will be developed if warranted.
- b. The process chemistry of Pa^{233} , including solvent extraction behavior, will be studied, aimed at isolation of Pa^{233} to allow decay to isotopically pure U^{233} .
- c. The chemistry of thorium dissolving will be studied, including the factors affecting oxide dissolution and iodine behavior and control. Techniques for production-scale dissolution and feed acid removal will be demonstrated.
- d. The shielding requirements of 1 ppm product will be experimentally determined (by addition of Th^{228} to natural uranium or by other techniques) and assistance given in establishing product specifications.
- e. Process flowsheets permitting processing of thousand-ton quantities of irradiated thorium through the Redox Plant will be developed. This work will include conversion to oxide suitable for re-fabrication as high-density targets.
- f. If a demand for polonium develops, studies will be initiated on the precipitation of intermetallic compounds; vapor pressure measurements of Bi_2O_3 and of polonium; volatile polonium compounds; and solvent extraction from nitrate solutions containing other anions. These efforts are

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17. Expected Results in FY 1965, continued

directed toward the development of alternative polonium concentration techniques and improved polonium-bismuth separations processes. Engineering evaluation of attractive alternative processes will be undertaken.

- g. If economic studies indicate promise in the area of close-coupled neptunium - plutonium separations schemes, further effort will be directed toward the amine extraction process or alternative processing schemes.
- h. In the area of americium recovery, studies will be made of an alternative solvent, "Aliquot-335" (a tertiary amine). Further consideration will be given to curium extraction and decontamination from rare earths as a logical extension of the americium recovery program.
- i. A program to evaluate new solvents for possible use in the Purex Plant will be continued. Initial studies will be with diethers; others will be included on the basis of promise or changing needs of the plant. Promising developments will be scouted in a pilot plant.

18. Expected Results in FY 1966

- a. Work will continue, as justified, on preparation of dense thorium targets, thorium dissolution and acid removal, Pa chemistry, thorium and U²³³ extraction and decontamination, and thorium recycle problems.
- b. Separation of polonium from bismuth by new processes such as volatilization will continue under study.
- c. Research on close-coupled neptunium - plutonium separation schemes will continue if warranted.

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02 50 10 15 1 (012) - Innovations and New Business

18. Expected Results in FY 1966, continued

- d. Work on new solvents will be continued as justified by potential need.
- e. Work will be initiated in support of new products and services as they are identified.

19. Description and Explanation of Major Materials, Equipment and Subcontract Items

There are no expenses associated with this program other than those normal to this type of development activity.

20. Proposed Results

Significant achievements in any of the subject efforts would greatly improve the potential for diversification of activities at the Hanford facility.

In the area of thorium production, the work will provide the technology in support of an anticipated commitment to produce multikilogram quantities of U233 containing very little (perhaps < 1 ppm) U232 and will lead to lower unit costs through better integration with existing production operations. R&D in the area of polonium solvent extraction will result in a capability for separating polonium from irradiated bismuth that greatly exceeds the existing capability within the AEC complex. If a polonium volatility process is demonstrated to be feasible, the unit cost of polonium would be markedly reduced. Efforts in the area of developing a neptunium - plutonium separation process closely coupled to the irradiation operation are directed toward reducing the cost of Pu²³⁸ and increasing the supply through lower recycle loss and reduced inventory of neptunium.

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02 50 10 15 1 (012) - Innovations and New Business

21. Proposed Obligations for Related Construction Projects

If a large-scale thorium program is authorized, capital costs of one and one-half to two million dollars to equip Redox, and about five million dollars for thoria densification are visualized.

If the polonium program is authorized, a capital cost of two to four million dollars would be required, depending on the choice of production scheme, production rates, and timing desired.

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Additional Justification for Operating Costs

RICHLAND
OPERATIONS OFFICESPECIAL NUCLEAR MATERIALS
PROGRAM

1. Contractors: General Electric Company		Contract No. AT(45-1)-1350	Task No.
2. Project Title: Separations - Equipment and Materials of Construction		189 No.	3. Budget Activity No. 02 50 10 15 1 (031)
4. Date Prepared: April 1, 1964	5. Method of Reportings: Annually	6. Working Locations: Hanford, 200 West and 300 Area	
7. Person in Charge: W. S. Frank Principal Investigators: A. M. Platt, J. B. Fecht		8. Project Term: Continuing From: To:	

	<u>FY 196 4</u>	<u>FY 196 5</u>	<u>FY 196 6</u>
9. Man Years:			
(a) Scientific and Technical	1.8	2.2	2.0
(b) Other	1.1	1.3	1.0
	<u>2.9</u>	<u>3.5</u>	<u>3.0</u>
Total			
	<u>FY 196 4</u>	<u>FY 196 5</u>	<u>FY 196 6</u>
10. Costs:			
(a) Direct Labor (Including Continuity of Service)	33,000	40,000	34,000
(b) Materials, Technical Services, Subcontracts	65,000	67,000	66,000
	<u>98,000</u>	<u>107,000</u>	<u>100,000</u>
Total Direct			
(c) Indirect Expenses	20,000	22,000	23,000
	<u>118,000</u>	<u>129,000</u>	<u>123,000</u>
Total Operating Cost			
(d) Equipment			
(e) Irradiation Unit Cost			

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02 50 10 15 1 (031) - Equipment and Materials of Construction

11. Reactor Concept - Not applicable
12. Materials - Not applicable
13. Dates and Titles of Publications (Other Than Progress Reports)

All topical reports were released through AEC Files. In addition, the following articles were released.

1. H. L. Brandt and B. M. Johnson, "Forces in a Moving Bed of Particulate Solids with Interstitial Fluid Flow," A.I.Ch.E Journal 9, 771 (1963).
2. R. E. Burns and R. F. Maness, D. C. Drennan, C. L. Peterson, "Material for Nuclear Power Reactor Fuel Dissolvers," I & EC, Prod. Res. and Dev. 2, 163 (1963).

14. Scope

The objective of this program is to provide an improving technology in the areas of equipment and materials of construction to support continued improvement in the separations business in the areas of safety, plant reliability, and operating costs. The planned activities encompass the development and testing of equipment and materials of construction, often initiated with exploratory research and carried through to pilot-plant testing, and engineering evaluation of design concepts.

Relationship to Other Projects

These studies are highly interrelated with all other programs in separations development. They especially complement the chemical processes development activities and are expected to have beneficial impact on waste disposal and by-product recovery activities.

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02 50 10 15 1 (031) - Equipment and Materials of Construction

16. Technical Progress in FY 1964

- a. Development of a new ion-exchange resin movement system continued, directed toward the demonstration of a remotely operable contactor capable of high plutonium purification factors.
- b. The interrelationships existing between the characteristics of process solutions and the design of a Purex 1C pulse column on the one hand, and the extraction efficiency and processing capability of the column on the other, were studied in a specially instrumented and controlled test facility. Quantitative information was obtained regarding flooding capacity as a function of position within the column and the interrelation between dilute-phase hold-up and solvent-extraction efficiencies.
- c. Attained improvements in valve and agitator technology through (1) evaluation of new packless hydraulic control valves, and (2) definition of hydraulics in two-phase mixing in agitated tanks.
- d. Completed a study of stress cracking of mild steels by alkaline nitrate solutions pertinent to selection of materials and designation of fabricating techniques for the Purex AX Tank Farm.
- e. Conducted a study of the mechanisms involved in the formation of scale and consequent loss of heat transfer efficiency in titanium heat-exchangers in Purex service. Studies have resulted in a recommendation to modify operating procedures to avoid silica deposition in the Purex H4 concentrator. To date, no positive evidence of scaling affecting heat transfer under Purex F-6 conditions has been found in the laboratory studies.
- f. The capability of more than 30 types of plastics and 40 types of rubbers to withstand the chemical and radiation environments of separations plants was determined.

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16. Technical Progress in FY 1964, continued

- g. Procedures were developed for the vapor deposition of metals, particularly tungsten, on metal and ceramic substrates as a means of producing equipment useful in particularly corrosive environments.

17. Expected Results in FY 1965

- a. Techniques to improve ion-exchange resin movements in semicontinuous contactors will be demonstrated.
- b. The use of the specially instrumented pulse column will be extended to other Purex extraction systems to define the interrelationships between process solution characteristics, column design, processing capability, and extraction efficiency for each column.
- c. Studies on vapor phase deposition of metals will be continued as a means of producing equipment operable in exceptionally corrosive environments.
- d. The use of metallic materials of construction in the environments to be encountered in new separations processes will be studied. The studies will involve corrosion testing, development of corrosion testing techniques, and chemical inhibition of corrosion.
- e. The behavior of new plastics, coatings, and elastomers in radiochemical plant environments will be determined.

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18. Expected Results in FY 1966

- a. The correlation of pulse column performance parameters using the highly instrumented column will be concluded.
- b. The behavior of new plastics, coatings, and elastomers in radiochemical plant environments will be determined.
- c. The behavior of new alloys in radiochemical plant environments will be determined.

19. Description and Explanation of Major Materials, Equipment and Subcontract Items

Special material and equipment purchases are a necessary part of the activities under this program, funds for which are incorporated in the over-all budget estimates as based on historical requirements normal to this type of development activity.

20. Proposed Results

Improved materials of construction and better understanding of physical and chemical attack will translate into long-term economic gains by reducing equipment failure and replacement costs, and by extension of plant service life. Better equipment design is expected to result in increased process flexibility and improved safety at reduced cost.

21. Proposed Obligations for Related Construction Projects

None

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Additional Justification for Operating Costs

SPECIAL NUCLEAR MATERIALS
PROGRAM

RICHLAND
OPERATIONS OFFICE

1. Contractors: General Electric Company		Contract No. AT(45-1)-1350	Task No.
2. Project Title: Control Instruments and Systems		189 No.	3. Budget Activity No. 02 50 10 15 1 (032)
4. Date Prepared: April 1, 1964	5. Method of Reporting: Annually	6. Working Location: Hanford - 200 West and 300 Area	
7. Person in Charge: W. S. Frank Principal Investigators: A. M. Platt, J. B. Fecht		8. Project Term: Continuing From: To:	

9. Man Years:	<u>FY 1964</u>	<u>FY 1965</u>	<u>FY 1966</u>
(a) Scientific and Technical	4.4	3.8	2.0
(b) Other	1.7	1.7	0.7
	6.1	5.5	2.7
Total	<u>FY 1964</u>	<u>FY 1965</u>	<u>FY 1966</u>
10. Costs:	70,000	63,000	31,000
(a) Direct Labor (Including Continuity of Service)	85,000	52,000	29,000
(b) Materials, Technical Services, Subcontracts	155,000	115,000	60,000
Total Direct	32,000	23,000	14,000
(c) Indirect Expenses	187,000	138,000	74,000
Total Operating Cost			
(d) Equipment			
(e) Irradiation Unit Cost			

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RICHLAND

Operations Office

02 50 10 15 1 (032) - Control Instruments and Systems

11. Reactor Concept - Not applicable
12. Materials - Not applicable
13. Dates and Titles of Publications (Other Than Progress Reports)

All topical reports were released through AEC Files. In addition, the following articles were released.

1. N. P. Wilburn, "Mathematical Determination of Concentration Profiles in Two-Phase Continuous Countercurrent Extractor," August 7, 1963. Presented at the A.I.Ch.E. Northwest Regional Meeting, Portland, Oregon, October 25, 1963. HW-SA-3139.
2. N. P. Wilburn, "Characterization for Automatic Control of a Typical Chemical Process," January 7, 1964. To be presented at the American Society of Quality Control in April, 1964. HW-SA-3313.

14. Scope

The objective of research and development in the field of control instruments and systems is to provide improved operating and control methods for radioactive processes. The studies encompass the development and field testing of new and improved analytical methods and instrumentation. Results are expected to be incorporated in existing plant systems or established as design bases for new facilities as required.

15. Relationship to Other Projects

Process control equipment and systems developed under the program are directly applicable to similar processing activities at Hanford and at other similar AEC-Contractor sites.

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02 50 10 15 1 (032) - Control Instruments and Systems

16. Technical Progress in FY 1964

- a. Laboratory evaluation of instrumentation to detect plutonium at very low concentration was continued. The use of both cerium-activated scintillating glass and measurement of the 17 kev plutonium x-ray was investigated. Two instruments, one of each type, are now being proof-tested.
- b. A multipurpose pulse amplifier was developed for use in both alpha and gamma counting systems.
- c. The effects of high-level gamma radiation on the accuracy of a BF_3 neutron-detector tube was studied. The study was directed toward obtaining measurement of neutron radiation in the presence of high gamma radiation in certain process cells.
- d. An evaluation was made of an alternate detector for neutron radiation using He-3. The unit has the capability of measuring both fast and thermal neutrons and is considerably more sensitive than BF_3 units.
- e. A portable belt-mounted radio transceiver was developed for communication in highly contaminated areas.
- f. A portable critical incident alarm was designed and constructed.
- g. Instrumentation was developed to determine column density (i.e., mean density of process streams in the pulse column) which is an important variable in column operation as it indicates the hold-up of the dispersed phase and gives an indication of the efficiency of mass transfer.
- h. The techniques associated with automatic data logging were thoroughly investigated, and the study of feasibility of this technique in Purex operations is in progress.

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02 50 10 15 1 (032) - Control Instruments and Systems

- i. A mathematical model of the operation of the Purex C Column has been developed which predicts column performance within two percent.

17. Expected Results in FY 1965

- a. The program of developing instrumentation for direct measurement and control of process solutions will be continued. Improved control and safety are the goals.
- b. Instruments will be developed for detecting an inadvertent shipment of "green" (underaged) metal to the separations plants.
- c. Studies will be undertaken to reduce noise and interference in electronic equipment applicable to plant analytical and control instrumentation systems.

18. Expected Results in FY 1966

The program of developing and evaluating improved instruments will be continued at a sharply reduced level of effort along the lines outlined above.

19. Description and Explanation of Major Materials, Equipment and Subcontract Items

Funds for special fabrication and/or the purchase of instrument components will be required and are included in the estimated budget needs.

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02 50 10 15 1 (032) - Control Instruments and Systems

20. Proposed Results

Improved process reliability, product quality, and operational safety are the principal gains expected from direct support activities under this program.

21. Proposed Obligations for Related Construction Projects

None

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SPECIAL NUCLEAR MATERIALS

PROGRAM

RICHLAND
OPERATIONS OFFICE

1. Contractors: General Electric Company	Contract No. AT(45-1)-1350	Task No.
2. Project Title: Waste Management - Low-Level Waste Disposal	189 No.	3. Budget Activity No. 02 50 10 15 1 (041)
4. Date Prepared: April 1, 1964	5. Method of Reporting: Annually	6. Working Locations: Hanford - 300 Area
7. Person in Charge: W. S. Frank Principal Investigators: E. R. Irish	8. Project Term: Continuing From: To:	

	<u>FY 1964</u>	<u>FY 1965</u>	<u>FY 1966</u>
9. Man Years:			
(a) Scientific and Technical	0.0	0.3	0.4
(b) Other	0.0	0.2	0.2
Total	<u>0.0</u>	<u>0.5</u>	<u>0.6</u>
10. Costs:	<u>FY 1964</u>	<u>FY 1965</u>	<u>FY 1966</u>
(a) Direct Labor (Including Continuity of Service)	-	6,000	7,000
(b) Materials, Technical Services, Subcontracts	-	9,000	13,000
Total Direct	<u>0</u>	<u>15,000</u>	<u>20,000</u>
(c) Indirect Expenses		3,000	5,000
Total Operating Cost		<u>18,000</u>	<u>25,000</u>
(d) Equipment			20,000
(e) Irradiation Unit Cost			

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OPERATIONS OFFICE

02 50 10 15 1 (041) - Low-Level Waste Disposal

11. Reactor Concept - Not applicable
12. Materials - Not applicable
13. Dates and Titles of Publications (Other Than Progress Reports)

All topical reports were released through AEC Files.

14. Scope

Research and development in the field of low-level waste disposal is directed toward an improved understanding of the radiological aspects of environmental waste dispersal practices, and toward developing better dispersal methods consistent with national and local standards in optimum balance with economic and operational factors.

The program activities concern the development of safe and economical techniques and processes for reducing the concentration of radioactivity in high-volume liquid and gaseous effluents prior to their discharge to the environment. Additionally, continuing study is conducted to provide more detailed knowledge of local environmental factors and waste characteristics that are fundamental to decisions on present and future practices.

15. Relationship to Other Projects

This program encompasses scientific pursuits similar to those conducted under the Radioactive Residue Process Development Program supported by the Division of Reactor Development, and the Terrestrial Ecology Earth Sciences Program supported by the Division of Biology and Medicine. This program, however, is

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02 50 10 15 1 (041) - Low-Level Waste Disposal

15. Relationship to Other Projects, continued

especially oriented to the development of waste disposal technology of most probable value to Hanford separations process waste systems, and shares some areas of common interest with the Hanford Irradiation Processing Department and the Hanford Laboratories.

16. Technical Progress in FY 1964

No work was undertaken under this program in FY 1964. The anticipated work on characterization of iodine-131 in gaseous effluents was not continued principally because of reduced emphasis on processing short-cooled irradiated metal.

17. Expected Results in FY 1965

Laboratory-scale scouting studies will be initiated on the treatment, disposal and recovery of Purex and fission product extraction process organic wastes. Studies will include incineration techniques.

18. Expected Results in FY 1966

- a. Subject to findings of the scouting studies of organic disposal methods, further work may include pilot-scale studies with non-radioactive simulated organic wastes.
- b. Follow-up studies may be required for treatment of specific low-level wastes originating in the Waste Management Program.

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02 50 10 15 1 (041) - Low-Level Waste Disposal

19. Description and Explanation of Major Materials, Equipment and Subcontract Items

A capital expenditure of \$20,000 in FY 1966 for pilot plant equipment to evaluate disposal of organic wastes by incineration will be made if justified by earlier results.

20. Proposed Results

The major results of this program will be improved radiological safety and minimum long-term cost for low-level waste disposal.

21. Proposed Obligations for Related Construction Projects

None

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OPERATIONS OFFICE

SPECIAL NUCLEAR MATERIALS
PROGRAM

1. Contractors	General Electric Company	Contract No.	AT(45-1)-1350	Task No.	
2. Project Titles	Separations - Waste Sludge Characterization and Removal	189 No.		3. Budget Activity No.	02 50 10 15 1 (043)
4. Date Prepared:	April 1, 1964	5. Method of Reporting:	Annually	6. Working Locations:	Hanford - 200 East and 300 Area
7. Person in Charge:	W. S. Frank	8. Project Term	Continuing		
Principal Investigators:	A. M. Platt, J. B. Fecht	From:		To:	

9. Man Years:	<u>FY 196 4</u>	<u>FY 196 5</u>	<u>FY 196 6</u>
(a) Scientific and Technical	4.1	2.9	2.7
(b) Other	2.7	2.1	1.7
Total	<u>6.8</u>	<u>5.0</u>	<u>4.4</u>
10. Costs:	<u>FY 196 4</u>	<u>FY 196 5</u>	<u>FY 196 6</u>
(a) Direct Labor (Including Continuity of Service)	77,000	56,000	50,000
(b) Materials, Technical Services, Subcontracts	115,000	98,000	70,000
Total Direct	<u>192,000</u>	<u>164,000</u>	<u>120,000</u>
(c) Indirect Expenses	40,000	34,000	28,000
Total Operating Cost	<u>232,000</u>	<u>198,000</u>	<u>148,000</u>
(d) Equipment	105,000	30,000	
(e) Irradiation Unit Cost			

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02 50 10 15 1 (043) - Waste Sludge Characterization and Removal

11. Reactor Concept - Not applicable

12. Materials - Not applicable

13. Dates and Titles of Publications (Other Than Progress Reports)

All topical reports were released through AEC Files.

14. Scope

The purpose of this program is to provide the technology to remove or otherwise process the self-heating waste sludges accumulated in underground storage.

The program activities encompass the characterization of actual waste sludges and the development and field demonstration of sludge removal techniques.

15. Relationship to Other Projects

This program is highly interrelated with all other separations development programs relating to waste and by-product processing. For example, flowsheet changes in the separations plants can alter the characteristics of future alkaline waste sludges. Sludge removal technology will influence alkaline waste processes development and its integration in the over-all waste treatment plan.

16. Technical Progress in FY 1964

- a. Laboratory-scale studies continued on the removal of Purex stored waste sludge from the tanks and the treatment of the sludge for strontium removal.

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02 50 10 15 1 (043) - Waste Sludge Characterization and Removal

16. Technical Progress in FY 1964, continued

- b. An in-tank test of sluice-mixing of the sludge layer in a high-level waste tank was initiated. The object was to break up and partially leach the layer and obtain a suspension that can be pumped to another tank for dissolution and "desalting" for strontium and residual cesium recovery. Grab samples from one of the high-level waste tanks were characterized for further treatment.
- c. Engineering studies were made to determine the routing of sludge for strontium recovery in support of the B-Plant Phase III design.

17. Expected Results in FY 1965

- a. Flowsheets for routing of sludge will be optimized for maximum recovery of strontium and minimum cost of processing through the B-Plant facility.
- b. Sludge removal and treatment flowsheets will be firmed up, and prototypical equipment will be demonstrated.

18. Expected Results in FY 1966

Field-testing of sludge removal techniques will be completed.

19. Description and Explanation of Major Materials, Equipment and Subcontract Items

Expenditure of \$30,000 will be made for prototypical sluicing and sludge transfer equipment in FY 1965. An expenditure of \$105,000 was incurred for sluicing equipment during FY 1964.

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20. Proposed Results

The technology obtained in this program is expected to furnish a basis for design of improved waste treatment facilities. The successful treatment of sludge to permit re-use of self-boiling waste tanks will obviate the need for new tanks and will result in lower unit costs. The removal of sludge, or contained strontium-90, will greatly improve long-term control of the hazards of storing wastes in tanks. The potential also exists for developing economic recovery capability for neptunium, plutonium, and by-products as a result of related information obtained under Program 02 50 10 15 1 (044).

21. Proposed Obligations for Related Construction Projects

Specific obligations of this program are for the technological support of long-term Purex waste treatment plans, encompassing the proposed Waste Fractionization Facility (Budget Item 64-a-2, \$4,200,000) and the East Area Waste Treatment and Transfer Facility (Budget Item 65-(4) \$2,000,000).

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SPECIAL NUCLEAR MATERIALS
PROGRAM

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1. Contractors	General Electric Company	Contract No.	AT(45-1.)-1350	Task No.
2. Project Title:	Separations - Alkaline Waste Processing	189 No.		3. Budget Activity No. 02 50 10 15 1 (044)
4. Date Prepared:	April 1, 1964	5. Method of Reportings	Annually	6. Working Locations: Hanford - 200 West and 300 Area
7. Person in Charge:	W. S. Frank	8. Project Term	Continuing	
Principal Investigators:	A. M. Platt, M. T. Walling, Jr., and E. R. Irish	From:	To:	

9. Man Years:	FY 196 4	FY 196 5	FY 196 6
(a) Scientific and Technical	3.3	2.5	1.5
(b) Other	2.2	1.8	1.1
Total	5.5	4.3	2.6
10. Costs:	FY 196 4	FY 196 5	FY 196 6
(a) Direct Labor (Including Continuity of Service)	62,000	48,000	29,000
(b) Materials, Technical Services, Subcontracts	96,000	80,000	45,000
Total Direct	158,000	128,000	74,000
(c) Indirect Expenses	33,000	26,000	17,000
Total Operating Cost	191,000	154,000	91,000
(d) Equipment			
(e) Irradiation Unit Cost			

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02 50 10 15 1 (044) - Alkaline Waste Processes

11. Reactor Concept - Not applicable

12. Materials - Not applicable

13. Dates and Titles of Publications (Other Than Progress Reports)

1. G. L. Richardson, "Solvent Extraction Processes for Recovery of Radioactive Materials," October 18, 1963, presented at the A.I.Ch.E. Northwest Regional Meeting, Portland, Oregon, October 25, 1963. HW-SA-3211.
2. J. L. Nelson, G. J. Alkire, and B. W. Mercer, "Inorganic Ion Exchange Separation of Cesium from Purex Type High-Level Radioactive Waste," Industrial and Engineering Chemistry, Process Design and Development Quarterly, to be published early in 1964.

14. Scope

The objective of this program is to provide the technology for the treatment of existing alkaline wastes for increased safety during long-term storage. The past and current practice of storing (and aging) alkaline wastes as slurries in underground tanks is an appropriate method of reducing short-lived fission products to innocuous concentrations but fails to answer long-term needs for the safe containment of long-lived heat-emitting isotopes.

The activities under this program are concerned with the development of economical techniques for the removal of cesium-137 and strontium-90 (the principal isotopes of concern) from alkaline wastes. The recovery of neptunium and plutonium from the stored sludges is also to be investigated. Initially, emphasis has been placed on the study of Purex alkaline waste processes in accord with priority objectives of the over-all waste containment program.

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This program is highly interrelated with all other separations development activities, especially in the areas of waste containment and disposal and by-product recovery. Particularly close integration is necessary with the sludge removal, acid waste processes, and waste solidification programs because of inseparable common interests.

16. Technical Progress in FY 1964

- a. The removal of cesium from actual alkaline waste supernate with Linde AW 400 ion exchange media was demonstrated successfully in a plant test, and the chemical flowsheet was firmed up.
- b. Recovery of ammonium carbonate from cesium ion exchange eluates was evaluated on a pilot plant scale and found to be easily workable.
- c. Experiments with simulated Redox waste supernate show that Duolite C-3 phenolic resin is the best exchanger of those tested for removal of cesium from this waste. Preliminary experimental work has shown that cesium may be removed from sludge leach solutions by ion-exchange technology.
- d. A process was developed for efficient (> 95%) removal of strontium from dissolved sludge. The object was to separate strontium from the bulk of the iron and other inerts so as to reduce the load on the B Plant solvent extraction equipment and to decrease process chemical costs. A process using carbonate complexing and lead-carrier precipitation was carried through laboratory, hot cell, and successful cold semiworks testing.
- e. Pilot-plant data necessary to support design were developed for the solvent-extraction process for the removal of cesium from alkaline waste solutions using 4-sec butyl (2- α -methyl benzyl) phenol (BAMBP) in a hydrocarbon diluent. This process is regarded as a back-up for zeolite adsorption.

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17. Expected Results in FY 1965

- a. Laboratory-scale runs with Redox alkaline waste supernatants will be carried out to firm up the chemical flowsheet and evaluate process variables with actual waste. Chemical flowsheets will also be firmed up for removal of cesium from Purex and Redox alkaline sludge leach solutions.
- b. Hot-cell leaching, sludge dissolution, and strontium concentration tests will be conducted with significant quantities of actual tank sludges. Laboratory experiments will be carried out to assist in the resolution of the difference between the precipitation efficiency so far achieved in the plant (Purex Head-End) and that obtained in the cold semiworks and hot cells.
- c. The physical state and chemical form of the neptunium and plutonium in tank sludge will be determined, and the ease and feasibility of recovery will be investigated.
- d. Engineering support of the design of the solvent-extraction system for recovering strontium using D2EHPA and cesium using BAMBP will be provided as needed. Solvent stability and treatment processes will be verified.

18. Expected Results in FY 1966

- a. Laboratory-scale experiments with actual alkaline sludge leach solutions will be carried out to finalize the chemical flowsheet for cesium removal.
- b. The recovery of neptunium and plutonium, if feasible, from sludge will be further developed.
- c. Definition of flowsheets for the recovery of strontium and residual cesium from dissolved sludge will be completed. Engineering research and development in support of this program will be terminated.

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Additional Justification for Operating Cost

SCHEDULE

189

RICHLAND**OPERATIONS OFFICE**

02 50 10 15 1 (044) - Alkaline Waste Processes

19. Description and Explanation of Major Materials, Equipment and Subcontract Items

There are no expenses associated with this program other than those normal to this type of development activity.

20. Proposed Results

This program will contribute to the optimum integration of all aspects of the Waste Management Program. The major result will be improved control over the long-term hazards of radioactive waste containment at optimum over-all cost. Flexibility, to integrate with by-product recovery needs, will be inherent to the system.

21. Proposed Obligations for Related Construction Projects

Specific obligations of this project are for the technological support of long-term Purex waste treatment plans, encompassing the proposed Waste Fractionization Facility (Budget Item 64-a-2, \$4,200,000) and the East Area Waste Treatment and Transfer Facility (Budget Item 65-(4), \$2,000,000).

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Additional Justification for Operating Costs

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SPECIAL NUCLEAR MATERIALS
PROGRAM

1. Contractors	General Electric Company	Contract No.	AT(45-1)-1350	Task No.
2. Project Titles	Separations - Acid Waste Processing	189 No.		3. Budget Activity No. 02 50 10 15 1 (045)
4. Date Prepared	April 1, 1964	5. Method of Reporting	Annually	6. Working Locations
7. Person in Charge		8. Project Term		
W. S. Frank		Continuing		
Principal Investigators		From To		
A. M. Platt, M. T. Walling, Jr.				

	<u>FY 196 4</u>	<u>FY 196 5</u>	<u>FY 196 6</u>
9. Man Years:			
(a) Scientific and Technical	3.1	1.9	1.3
(b) Other	2.1	1.4	1.0
Total	<u>5.2</u>	<u>3.3</u>	<u>2.3</u>
10. Costs:	<u>FY 196 4</u>	<u>FY 196 5</u>	<u>FY 196 6</u>
(a) Direct Labor (Including Continuity of Service)	58,000	37,000	26,000
(b) Materials, Technical Services, Subcontracts	91,000	58,000	39,000
Total Direct	<u>149,000</u>	<u>95,000</u>	<u>70,000</u>
(c) Indirect Expenses	31,000	19,000	17,000
Total Operating Cost	<u>180,000</u>	<u>114,000</u>	<u>87,000</u>
(d) Equipment			
(e) Irradiation Unit Cost			

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02 50 10 15 1 (045) - Acid Waste Processes

11. Reactor Concept - Not applicable
12. Materials - Not applicable
13. Dates and Titles of Publications (Other Than Progress Reports)

All topical reports were released through AEC Files. In addition, the following articles were released.

1. W. V. DeMier, G. L. Richardson, A. M. Platt, and W. H. Swift, "Development of Radioactive Waste Fractionization and Packaging Technology," January 23, 1963. Presented at the A.I.Ch.E. National Meeting, Buffalo, New York, May 5-8, 1963. HW-SA-2786.
2. G. L. Richardson, "Solvent-Extraction Processes for Recovery of Radioactive Materials," October 18, 1963. Presented at the A.I.Ch.E. Northwest Regional Meeting, Portland, Oregon, October 25, 1963. HW-SA-3211.

14. Scope

The objective of research and development on acid waste processes is to provide the technology required to process the radiochemical wastes from the Purex operations for the removal of long-lived fission products as a step toward the safe, economical, long-term containment of radioactive materials.

15. Relationship to Other Projects

This project is highly interrelated with all other separations development activities, especially in the areas of waste containment and disposal and of by-product recovery. Particularly close integration

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02 50 10 15 1 (045) - Acid Waste Processes

15. Relationship to Other Projects, continued

is necessary with developments on alkaline waste processes (044) because of inseparable common interests. Immobilization (046) and packaging (047) studies are complementary, and must be completed to make effective use of the new technology.

The Division of Reactor Development is also supporting work in this area at Hanford and at other sites. This program is specifically oriented to Hanford's needs in the immediate future and, although this technology is of value to the DRD-supported work, direct use of this technology is improbable since the fuels and separations processes of interest to the DRD are so different.

16. Technical Progress in FY 1964

- a. Laboratory and hot cell experimentation was completed for a process of denitration and partial neutralization of acid waste solution using sugar. Primary benefit is to Purex operation, but the process also results in lower salt content and easier processing of Purex waste. The process has been adopted for routine plant use.
- b. Laboratory effort was directed toward definition and development of methods of avoiding solvent degradation in the CSREX Process; this potential process (co-extraction of cesium, strontium and rare earths) and the D2EHPA Process for extraction of strontium and rare earths were developed through pilot-plant-scale operations, and engineering studies were conducted which led to definition of equipment specifications for a facility which could utilize either process. Final choice will be based on the conclusions drawn from the laboratory studies of solvent degradation in the CSREX Process.
- c. Definitive chemical flowsheets and equipment specifications for the phosphotungstate precipitation process for cesium removal were developed, based on a successful demonstration of the process in a full-level plant run.

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02 50 10 15 1 (045) - Acid Waste Processing

17. Expected Results in FY 1965

- a. Laboratory studies of solvent degradation in the CSREX Process and the mechanism of the synergistic effect of BAMBP and D2EHPA in the system will be carried on, and a decision will be made between the use of the D2EHPA or CSREX Process. Emphasis will also be placed on improving the scrubbing and stripping operations, on removing impurities from D2EHPA, and on a search for a more stable substitute for BAMBP.
- b. Solvent specifications will be developed as a basis for purchase.

18. Expected Results in FY 1966

- a. The solvent-extraction flowsheets will be optimized through additional studies of solvent clean-up procedures, rework flowsheets, etc.

19. Description and Explanation of Major Materials, Equipment and Subcontract Items

There are no expenses associated with this program other than those normal to this type of development activity.

20. Proposed Results

The results of this project will contribute to the optimum integration of all aspects of the Waste Management Program. Flexibility to integrate with by-product recovery needs will be inherent to the system.

21. Proposed Obligations for Related Construction Projects

Specific obligations of this project are for the technological support of long-term Purex waste treatment plans, encompassing the proposed Waste Fractionization Facility (Budget Item 64-a-2, \$4,200,000).

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SPECIAL NUCLEAR MATERIALS
PROGRAM

1. Contractors: General Electric Company		Contract No. AT(45-1)-1350		Task No.	
2. Project Title: Separations - Waste Immobilization		189 No.		3. Budget Activity No. 02 50 10 15 1 (046)	
4. Date Prepared: April 1, 1964		5. Method of Reporting: Annually		6. Working Locations: Hanford - 200 East and 300 Areas	
7. Person in Charge: W. S. Frank Principal Investigators: A. M. Platt, J. B. Fecht		8. Project Term: Continuing From: To:			

	<u>FY 196 4</u>	<u>FY 196 5</u>	<u>FY 196 6</u>
9. Man Years:			
(a) Scientific and Technical	2.2	2.0	1.8
(b) Other	1.5	1.5	1.2
Total	<u>3.7</u>	<u>3.5</u>	<u>3.0</u>
10. Costs:	<u>FY 196 4</u>	<u>FY 196 5</u>	<u>FY 196 6</u>
(a) Direct Labor (Including Continuity of Service)	41,000	39,000	33,000
(b) Materials, Technical Services, Subcontracts	65,000	61,000	52,000
Total Direct	<u>106,000</u>	<u>100,000</u>	<u>85,000</u>
(c) Indirect Expenses	22,000	20,000	20,000
Total Operating Cost	<u>128,000</u>	<u>120,000</u>	<u>105,000</u>
(d) Equipment			
(e) Irradiation Unit Cost			

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RICHLAND**OPERATIONS OFFICE**02 50 10 15 1 (046) - Waste Immobilization

11. Reactor Concept - Not applicable
12. Materials - Not applicable
13. Dates and Titles of Publications (Other Than Progress Reports)

All topical reports were released through AEC Files. In addition, the following articles were released.

1. L. L. Ames, Jr., "Mass Action Relationships of Some Zeolites in the Region of High Competing Cation Concentrations," Vol. 48, pp 686-882, July-August (1963) American Mineralogist.
2. L. L. Ames, Jr., "Some Zeolite Equilibria with Alkali Metal Cations," American Mineralogist (in press).
3. W. V. DeMier, "Fixation of Radioactive Fission Products on Inorganic Ion Exchange Media," October 16, 1963. Presented at A.I.Ch.E. Northwest Regional Meeting, Portland, Oregon, October 25, 1963. HW-SA-3233

14. Scope

The objective of this program is to develop the technology required to stabilize radiochemical wastes for safe long-term storage. The program is concerned with two types of wastes, viz., 1) the high-salt, moderate activity wastes such as coating wastes, and 2) the isolated, long-lived fission product fractions such as cesium, strontium, rare earths.

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02 50 10 15 1 (046) - Waste Immobilization

15. Relationship to Other Projects

This program is analogous to a portion of a broad program sponsored by the Division of Reactor Development at Hanford Laboratory and many other sites to develop techniques for the long-term storage of radiochemical wastes. However, this program is specifically oriented to the treatment of wastes in existence and expected to be produced at Hanford, while the technologies being developed under DRD sponsorship are applicable to other types of wastes. Duplication of effort is avoided, and cross-use of information is optimized by conducting the parallel laboratory investigations within a single development organization in Hanford Laboratories.

16. Technical Progress in FY 1964

- a. Heat transfer analyses and mock-up tests were completed to provide design bases for the in-tank solidification prototype unit.
- b. Preliminary evaluation and engineering feasibility studies of a "second generation" design of an in-tank solidification system were completed. The design, which results in a lower cost installation, uses immersed electrical heaters in lieu of heated air to provide heat for evaporation of waste solutions.
- c. Studies of heat dissipation from underground tanks were initiated with measurements of Hanford soil thermal conductivities and moisture contents. Analytical evaluation of heat dissipation was partially completed.
- d. A method based on the use of binary exchange data was developed to predict the equilibrium strontium and cesium loadings on zeolites from multicomponent systems. Calculated and experimental loading values show good agreement. The shape of strontium and cesium breakthrough curves was determined as a function of exchanger particle size, column geometry, temperature, and flow rate.

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02 50 10 15 1 (046) - Waste Immobilization

16. Technical Progress in FY 1964, continued

- e. Kilocurie quantities of strontium-90 were loaded on zeolite in the hot cell facility and the loading and drying flowsheets evaluated with actual waste materials. Studies were initiated on the long-term stability of the loaded zeolite.
- f. Engineering-scale studies of zeolite loading of heat-producing fission products continued with completion of thermal stabilization studies and evaluation of transient heat transfer aspects. Conceptual annular storage vessels were constructed and tested for operability. Laboratory experiments show that strontium and cesium loaded on zeolites are not significantly volatile up to 700 °C and can be eluted after such heat treatment.

17. Anticipated Results in FY 1965

- a. Evaluation of immersion heating for in-tank solidification will be completed and the technical basis established for a second generation unit.
- b. Detailed evaluation of heat dissipation from the in-tank solidification program will be completed.
- c. The zeolite cartridge storage system for strontium-90 and cesium-137 will be studied in the hot cells, with particular emphasis on the production and recombination of radiolytic gas, temperature-pressure characteristics, corrosivity, and retrieval of absorbed strontium and cesium.

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02 50 10 15 1 (046) - Waste Immobilization

18. Expected Results in FY 1966

Theoretical and experimental (hot cell) studies will continue to define the thermodynamic and kinetic parameters involved in the absorption and long-term storage of cesium-137 and strontium-90 on zeolites in sealed containers.

19. Description and Explanation of Major Materials, Equipment and Subcontract Items

Only those expenses normal to this type of development are included in the budget estimates; no unusual equipment needs are anticipated.

20. Proposed Results

This program will contribute to the optimum integration of all aspects of the Waste Management Program. Flexibility to integrate with by-product recovery needs will be inherent to the system.

21. Proposed Obligations for Related Construction Projects

This activity is in direct support of the Phase II B-Plant activation program (Budget Item 62-a-2, \$1,500,000) and of the In-Tank Solidification Program (Budget Item 02-90, Equipment Not Included in Construction Projects) currently being implemented.

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SPECIAL NUCLEAR MATERIALS
PROGRAM

1. Contractors: General Electric Company		Contract No. AT(45-1)-1350	Task No.
2. Project Title: Separations - Waste Packaging		189 No.	3. Budget Activity No. 02 50 10 15 1 (047)
4. Date Prepared: April 1, 1964	5. Method of Reporting: Annually	6. Working Locations: Hanford - 300 Area, 200 West & 200 East	
7. Person in Charge: W. S. Frank Principal Investigators: J. B. Fecht, M. T. Walling, Jr.		8. Project Term: Continuing From: To:	

	<u>FY 196 4</u>	<u>FY 196 5</u>	<u>FY 196 6</u>
9. Man Years:			
(a) Scientific and Technical	3.2	3.3	3.3
(b) Other	2.4	2.4	2.3
Total	<u>5.6</u>	<u>5.7</u>	<u>5.6</u>
10. Costs:	<u>FY 196 4</u>	<u>FY 196 5</u>	<u>FY 196 6</u>
(a) Direct Labor (Including Continuity of Service)	62,000	64,000	62,000
(b) Materials, Technical Services, Subcontracts	178,000	236,000	94,000
Total Direct	<u>240,000</u>	<u>300,000</u>	<u>156,000</u>
(c) Indirect Expenses	50,000	62,000	37,000
Total Operating Cost	<u>290,000</u>	<u>362,000</u>	<u>193,000</u>
(d) Equipment	125,000	175,000	
(e) Irradiation Unit Cost			

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02 50 10 15 1 (047) - Waste Packaging

11. Reactor Concept - Not applicable

12. Materials - Not applicable

13. Dates and Titles of Publications (Other Than Progress Reports)

All topical reports were released through AEC Files. In addition, the following article was released.

1. W. V. DeMier, G. L. Richardson, A. M. Platt, and W. H. Swift, "Development of Radioactive Waste Fixation and Packaging Technology." January 23, 1963.
Presented at the A.I.Ch.E. National Meeting, Buffalo, New York, May 5-8, 1963.
HW-SA-2786

14. Scope

The objectives of this program are to develop the technology required to package processed radio-chemical materials and to define the conditions required for safe, long-term storage. The principal effort will be directed toward the packaging and storage of fission product concentrates.

The packaging effort will embrace the development of concepts and design features of the desired package type, remotely operated closure procedures and devices, remote transfer devices, and improved area enclosures for the containment of radioactive particles. The entire concept is to be compatible with installation in a cell existing within the B-Plant canyon.

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02 50 10 15 1 (047) - Waste Packaging

15. Relationship to Other Projects

This program is analogous to a portion of a broad program sponsored by the Division of Reactor Development at many sites to develop techniques for the long-term storage of radiochemical wastes. However, this program is specifically oriented to the treatment of wastes in existence and expected to be produced at Hanford, while the technologies being developed under DRD sponsorship are applicable to other types of wastes. Duplication of effort is avoided, and cross-use of information is optimized by conducting the parallel laboratory investigations within a single development organization in Hanford Laboratories.

16. Technical Progress in FY 1964

- a. The design and procurement specifications of the equipment for the prototype waste packaging cell were completed, and much of the equipment was purchased. Included are a remote welder, manipulators, and various equipment for loading and drying the ion-exchange media and for transporting and decontamination of the containers. The facility will be so constructed that it will be useable in the production facility.

17. Expected Results in FY 1965

- a. The prototype equipment will be constructed, tested, and modified to meet production requirements. It is anticipated that several variations of the basic equipment will be constructed and tested to obtain an optimum, reliable operation.
- b. The suitability of on-plant sites for the ultimate storage of high-level packaged wastes will be evaluated with regard to geological, hydrological, and geophysical factors.

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02 50 10 15 1 (047) - Waste Packaging

18. Expected Results in FY 1966

Engineering support of the waste packaging prototype will be provided as it is tested and evaluated within the B-Plant complex.

19. Description and Explanation of Major Materials, Equipment and Subcontract Items

Funds in the amount of \$175,000 are included in FY 1965 for special prototype equipment to demonstrate packaging techniques.

20. Proposed Results

The results of this program will contribute to the optimum integration of all aspects of the Waste Management Program. Flexibility to integrate with by-product recovery needs will be inherent to the system.

21. Proposed Obligations for Related Construction Projects

Specific obligations of this program are to provide technology for the Phase II activation of B-Plant (Budget Item 62-a-2, \$1,500,000) and for modifications to the 212-N Storage Basin (being requested in the FY 1966 Budget).

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SPECIAL NUCLEAR MATERIALS
PROGRAM

1. Contractors: General Electric Company		Contract No. AT(45-1)-1350		Task No.	
2. Project Title: Separations - By-Product Recovery and Purification		189 No.		3. Budget Activity No. 02 50 10 15 1 (051)	
4. Date Prepared: April 1, 1964		5. Method of Reportings: Annually		6. Working Locations: Hanford - 300 and 200 East Areas	
7. Person in Charge: W. S. Frank Principal Investigators: A. M. Platt, M. T. Walling, Jr.		8. Project Term: Continuing From: To:			

9. Man Years:	<u>FY 1964</u>	<u>FY 1965</u>	<u>FY 1966</u>
(a) Scientific and Technical	3.6	2.6	3.8
(b) Other	2.2	1.5	2.5
Total	<u>5.8</u>	<u>4.1</u>	<u>6.3</u>
10. Costs:	<u>FY 1964</u>	<u>FY 1965</u>	<u>FY 1966</u>
(a) Direct Labor (Including Continuity of Service)	65,000	46,000	71,000
(b) Materials, Technical Services, Subcontracts	101,000	52,000	79,000
Total Direct	<u>166,000</u>	<u>98,000</u>	<u>150,000</u>
(c) Indirect Expenses	34,000	20,000	35,000
Total Operating Cost	<u>200,000</u>	<u>118,000</u>	<u>185,000</u>
(d) Equipment			
(e) Irradiation Unit Cost			

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02 50 10 15 1 (051) - By-Product Recovery and Purification

11. Reactor Concept - Not applicable
12. Materials - Not applicable
13. Dates and Titles of Publications (Other Than Progress Reports)

All topical reports were released through AEC Files. In addition, the following article was released.

W. W. Schulz, J. E. Mendel, and G. L. Richardson, "Solvent Extraction Recovery and Purification of Strontium-90," I & EC, Proc. Des. & Dev., 2, 134 (1963).

14. Scope

The objective of this program is to develop the technology required to recover specific fission products in the chemical form and purity needed. The source of material is assumed to be the current or stored radiochemical wastes from the Purex process, or the partially treated wastes to be available under the Waste Management Program.

15. Relationship to Other Projects

This program is allied with programs of the Division of Isotope Development to recover fission products for beneficial use. This program is specifically oriented to the economic recovery of these materials from Hanford waste, and the concentration and conversion of these materials to a form suitable for transfer to another agency for conversion to end-use form. Close integration with the Hanford Waste Management Program is required to assure that the technologies developed are mutually compatible.

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02 50 10 15 1 (051) - By-Product Recovery and Purification

16. Technical Progress in FY 1964

- a. One kilogram of technetium was recovered in a plant demonstration of the adsorption process on anion exchange.
- b. Purification of the recovered technetium was undertaken. It was discovered that technetium is extractable by primary amines under the conditions proposed for neptunium-plutonium recovery from Purex acidic wastes. Studies were made to determine whether it will be possible to recover technetium economically as a routine by-product of Purex neptunium recovery.
- c. A process for Ce-TRE separation suitable for use at the Strontium Semiworks was developed using cerium-catalyzed persulfate oxidation and batch D2EHPA extraction. The process was successfully used to meet ORNL needs for cerium and promethium and has also been adopted by FPDL at Oak Ridge. The process yields products of higher quality than previously achieved, and gives Hanford the potential capability to accumulate promethium at the classified HIP rate.
- d. Engineering feasibility studies were made of the recovery of the ZrNb from Purex acid wastes and of the purification of promethium in the Strontium Semiworks.

17. Expected Results in FY 1965

- a. Technetium processing, purification, and reduction-to-metal studies will be completed.
- b. The development of processes for the economic recovery of other fission products, such as Sb¹²⁵ and Zr-Nb⁹⁵, will be continued as appropriate.

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02 50 10 15 1 (051) - By-Product Recovery and Purification

17. Expected Results in FY 1965, continued

- c. Definition of process chemistry, engineering flowsheets, and equipment requirements pertinent to purifying and converting the various "product solutions" from the Waste Management Program to a material suitable for fabrication into sources will be undertaken.

18. Expected Results in FY 1966

Engineering studies and development work will continue, as required, to meet the needs of fission product recovery programs sponsored by the Division of Production.

19. Description and Explanation of Major Materials, Equipment and Subcontract Items

There are no unusual expenses anticipated under this program.

20. Proposed Results

This program is expected to provide the required technology to provide at a reasonable cost fission product compounds of suitable purity for fabrication into sources.

Proposed Obligations for Related Construction Projects

This technology will be used in portions of the Waste Fractionization Facility (Budget Item 64-a-2, \$4,200,000) and in the Hanford Isotopes Plant (proposed Budget Item 65-(5)).

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