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RESEARCH AND DEVELOPMENT ALLOCATIONS AND
PLANT ASSISTANCE SUPPORT
FY-1966

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AUTHOR

M. C. Leverett

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RESEARCH AND DEVELOPMENT ALLOCATIONS AND

PLANT ASSISTANCE SUPPORT

FY-1966

M. C. Leverett

November 22, 1965

Classification Cancelled and Changed To

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By Authority of DS Lewis,
CG-NMP-1, 4-25-94

By DK Hanson, 5-11-94

Verified By J E Sauerly 5-16-94

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I. INTRODUCTION

An allocation of \$1,320,000 of O2 Reactor and Metallurgy funds was previously made to the Pacific Northwest Laboratories, and the Process Technology work order support which N-Reactor Department expected to provide during FY 1966 was estimated.⁽¹⁾

The R&D allocation was based on the 189 budget proposals⁽²⁾ which were prepared early in 1965 and the following program identifications were provided.

<u>189 No.</u>	<u>Title</u>
R-1	Physics Studies
R-2	Thermal Hydraulic Studies
R-3	Zircaloy Studies
R-5	Control, Instrument and Systems Analysis
R-6	Chemistry
R-8	Gas Atmosphere Studies
R-9	Graphite Studies
R-10	Nuclear Safety Research
M-1	Fuel Development
C-1	Coproduct Development

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The integrated five year research and development program was subsequently formulated with the assistance of Pacific Northwest Laboratories and the following research and development program missions were defined. (3)

<u>Mission</u>	<u>Title</u>
1	Defense Plutonium Mission
2	Coproduct Mission
3	Integrated Site Operation
4	Non-Defense Plutonium Mission
5	Plutonium Burning Program
6	Pu-238 Program
7	U-233 Program
8	Co-60 Program
9	Po-210 Program
10	High Power Density Fuel Program
11	Small Reactor Modernization
12	Fundamental and General Studies
13	Nuclear Safety Program
14	Columbia River Studies
15	Waste Management; Fission Product Recovery

Revised 189 proposals have been prepared and the work is being reprogrammed in accord with the mission plan. The following program discussions outline research and development needs and BNW allocations in accord with the mission requirements. The level of R&D is maintained at the original level specified in reference 1 (\$1,320,000), with the exception that \$130,000 for the payment of offsite irradiation unit costs is now held within NRD. This is in accord with previous arrangements between respective Finance operations to provide for direct billing of an offsite cost in order to eliminate trans-billing through BNW accounts.

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The Plant Assistance work order support has been reduced from our previous estimate to a level commensurate with, and necessitated by, the actual AEC Financial Plan allocation. The new estimates, specifically applying to program areas, are shown in Section II along with the R&D dollars.

New end function codes have been established for cost accumulation on the mission basis and these are listed in Table I. NRD end function codes already established were used in all cases possible, and the additional end functions assigned were chosen to match the mission numbers.

Previous codes will be recast in accord with the mission allocations. The R&D monies shown in Section II, however, are for the complete fiscal year and are not in addition to funds expended to date under the old program nomenclatures.

Costs accumulated through November 1965 under R-1, R-2, R-3, R-5, R-6, R-8, R-9 apply in the Defense Plutonium area and will therefore be recast into the Defense Plutonium No. 1 mission. Costs for Nuclear Safety and Coproduct have been separately broken out in the past and these costs will be recast against the applicable codes given below. Costing on a mission basis using the codes given in Table I will be initiated on December 1, 1965.

References

1. Letter, RL Dickeman to SL Fawcett, "Research and Development and Plant Assistance Support - FY 1966," dated July 6, 1965.
2. HW-80908, "NRD Research and Development Budget for FY 1966 and Revision of Budget for FY 1965," dated March 23, 1965 (Secret)
3. RL-GEN-22 REV1, "Richland Integrated Process Development Program," July 30, 1965, Plus Supplements 1 through 15. (Secret)

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TABLE INRD Program End Function Codes

<u>Major End Function</u>	<u>Codes</u>	
N1 Defense Plutonium		
Physics Studies	R1	7460-4520-130.R1
Thermal Hydraulics	R2	7521-4560-130.R2
Zircaloy Development	R3	7510-4530-130.R3
Control, Inst. & Systems	R5	7452-4530-130.R5
Chemistry	R6	7510-4550-130.R6
Graphite Studies	R9	7540-4550-130.R9
Fuels Development	M1	** xxxx-4550-130.M1
Pu Safety Improvement	R7*	xxxx-4510-130.R7
N2 Coproduct Development		
Physics Studies	CD	7460-4520-130.CD
Thermal Hydraulics	"	7521-4560-130.CD
Zircaloy Development	"	7510-4550-130.CD
Control, Inst. & Systems	"	7452-4530-130.CD
Chemistry	"	7510-4550-130.CD
Graphite Studies	"	7540-4550-130.CD
Driver Development	T1*	xxxx-4550-130.T1
Target Development	T2*	xxxx-4550-130.T2
N3 Integrated Site	N3*	xxxx-4520-130.N3
N4 Non Defense Plutonium	N4*	756X-4540-130.N4
N5 Pu Burning	N5*	xxxx-4520-130.N5
N6 Pu-238	N6*	or xxxx-4520-130.N6 xxxx-4550-130.N6
N8 Co-60	N8*	756X-4550-130.N8
N13 Nuclear Safety	R4	or 7653-4510-130.R4 7630-4550-130.R4

* New end function codes. Others are the same as previously used.

** xxxxx - BNW code depends on organization doing the work.

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II. R&D FUND ALLOCATIONS

The allocations shown in this section are based on the current estimates of program needs. As the programs progress, or if program emphasis changes, it may be necessary to make adjustments. Such adjustments would be planned within the total fund allocation to BNW, unless NRD research and development funds are further reduced by the AEC.

Table II summarizes research and development allocations to the Pacific Northwest Laboratories. The discussions which follow describe the scope of the work, associated cost codes and key dates. Estimates of the Plant Assistance (work order) supporting specific areas of technology are also given in these discussions.

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TABLE IISummary of R&D Allocations to BNW

<u>NRD Program Manager</u>	<u>BNW Organization</u>	<u>R&D Allocation</u>
W. S. Nechodom	<u>Reactor Physics</u>	
	Defense Pu, No. 1	\$ 90,000
	Coproduct, No. 2	50,000
	Pu-238, No. 6	20,000
		\$ 160,000
D. W. Leiby	<u>Systems Res., Instr. and Systems Development</u>	27,000
R. H. Shoemaker	<u>Eng'g Development, Thermal Hydraulics</u>	
	Defense Pu, No. 1	70,000
	Coproduct, No. 2	113,000
		\$ 183,000
R. E. Trumble (M. Lewis)	<u>Chem. Effluents & Tech. Nuclear Safety, No. 13</u>	55,000
	<u>Chem. Lab. Analytical Section</u>	6,000
M. Lewis	<u>Reactor & Mat. Technology, Metal Devel. and Metal Fab Subsections</u>	
	Defense Pu, No. 1	104,000
	Coproduct, No. 2	207,000
	Non-Defense Pu, No. 4	20,000
	Cobalt-60, No. 8	15,000
	Pu-238, No. 6	42,000
	<u>Ceramics Res. & Dev. Pu-238</u>	20,000
		\$ 408,000
	<u>Metallurgy Research Def. Pu, No. 1</u>	120,000
	<u>Eng'g Dev., Coolant Systems Dev. Defense Pu, No. 1</u>	80,000
	<u>Materials Res. & Service, Graphite Res. & Development Defense Pu, No. 1</u>	100,000
	<u>Chemical Research Section, Chemical Separations Coproduct, No. 2 Pu-238</u>	40,000 5,000
		\$ 45,000

GRAND TOTAL RESEARCH AND DEVELOPMENT

\$1,184,000

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BNW Organization . . . . . Reactor Physics, BNW (Dawson)
 Mission . . . . . Defense Pu (189, NRD #1)
 Responsible -- for NRD . . . . . W. S. Nechodom
 Fund Allocation. \$90,000
 Cost Code 746x-4520-130.R1

Both experimental and theoretical physics work will be required in support of the Defense Plutonium Mission.

A continuing theoretical physics program will be required in the following areas:

- a. Development of improved theoretical physics models and correlation of these models with the results of experimental measurements. Work is currently concentrated on development and normalization of the transport theory codes (THERMOS and PROGRAM S), and on two-dimensional diffusion theory models.
- b. Maintenance of up to date cross section libraries, as source tapes for use in the various theoretical physics calculations.
- c. Development and improvement of fuel burnup analysis codes.

Experimental tests in the PCTR will be instituted this year and completed in FY 1967 in support of a revised plutonium-producing fuel element for the N-Reactor which will operate effectively at a power level of 4800 Mw. Initial theoretical investigations indicate that the dimensions of this fuel will be different enough from those of the startup fuel element to require verification of the theoretically calculated physics parameters.

Milestone

Initiate PCTR and exponential tests for high power operation.

May 1966

BNW Organization . . . . . Reactor Physics, BNW (Dawson)
 Mission . . . . . Coproduct (189, NRD #2)
 Responsible -- for NRD . . . . . W. S. Nechodom
 Fund Allocation. \$50,000
 Cost Code 7460-4520-130.CD

Studies in both experimental and theoretical physics will be required in support of the coproduct program.

The results of a preliminary Physical Constants Test Reactor experiment on the coproduct fuel geometry are being evaluated, to derive values for the infinite multiplication factor, cell flux distribution, thermal neutron utilization, resonance escape probability, and fast fission factor. The reactivity effect of coolant removal has also been measured. The results of this assessment will be used to determine the accuracy of theoretical physics models which are used in the calculation of lattice parameters, and will provide a means of normalizing these calculations. In addition to this analysis, a PCTR experiment will be performed on the final coproduct fuel design, to confirm the lattice parameters of the fuel to be utilized in a full reactor load.

Theoretical studies are being carried out to define the possible consequences of loss of coproduct target material from a fully loaded reactor. These studies are aimed toward defining the degree of engineered safeguards which are required to protect against such an event.

Since a "non-removable" target has now been chosen, this work is less urgent than formerly. The work in progress should be carried to a logical and useful conclusion however.

Milestones

Complete analysis of preliminary coproduct PCTR tests	November 1965
Initiate PCTR test of final coproduct design	February 1966
Complete PCTR test of final coproduct design	April 1966
Complete preliminary kinetics study of target-loss event	February 1966

BNW Organization . . . . . Reactor Physics, BNW (Dawson)
 Mission. . . . . Pu-238* (189, NRD #6)
 Responsible -- for NRD . . . . . W. S. Nechodom
 Fund Allocation \$20,000
 Cost Code 7460-4520-130.N6

Production of Pu-238 and other non-weapons products is characterized by the need to irradiate the target materials in coolant tubes separate from the driver fuel, or in non-homogeneous arrays within each coolant tube. These loadings then consist of arrays of mixed lattices of targets and fuel. The theoretical calculation of the reactivity behavior of such mixed lattices is less certain than calculations performed in simple, uniform arrays. Since the possibility of full reactor loadings of such arrays is projected, experiments have been initiated to provide bases for normalizing the theoretical models which have been developed, and for the development of improved models. Initial experiments will be performed in an exponential pile, to determine the feasibility of measuring the material buckling of such arrays and the effective rod strength in such loadings.

The theoretical physics work described under the Defense Plutonium Mission also applied to these programs; in some cases the reactor fuel mix will be designed to produce both weapons grade plutonium and the special product.

A continuing basic neutron cross section measurement program is conducted. During this fiscal year the cross section measurements will be performed primarily on heavy isotopes: Pu-239 and U-238. If possible within scheduling limitations and available funds, measurements on Np-237 will be incorporated. In addition, scattering law measurements in light water will be performed to extend the result of earlier measurements to higher energies and higher water temperatures.

* Includes miscellaneous support from other non-Pu missions.

BNW Organization . . . . . Systems Research Section
Instruments & Systems Dev. (Worlton)

Mission. . . . . Coproduct (189, NRD #2)

Responsible -- for NRD . . . . . D. W. Leiby

Fund Allocation. \$27,000

Cost Code 7452-4530-130.CD

In the areas of controls, instruments and systems analysis, provide analog computing services for the analyses and evaluation of the performance of the N-Reactor Plant System and Subsystems. Particular emphasis should be placed upon evaluating the effects of the Phase II modification of the plant and the feasibility of operating the plant at 120 percent rated power. Provide on-site assistance in the collection of data, system testing and adjustment, and evaluation of plant performance during Phase II conversion and Plant Improvement Program.

This \$27,000 has been essentially expended during the first four months of FY 1966. The continuance of these activities at a somewhat reduced rate will be supported by Plant Assistance work orders from NRD at an average rate of \$2500 per month for the remainder of the fiscal year.

Work order No. C-73202, issued October 27, 1965, is for funding to the end of CY 1965. Bi-monthly work orders of \$5000 will be issued thereafter through the end of FY 1966.

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BNW Organization . . . . . Engineering Development (Harty)
 Thermal Hydraulics (Batch)
 Mission . . . . . Defense Plutonium (189, NRD #1)
 Responsible -- for NRD . . . . . R. H. Shoemaker
 Fund Allocation \$70,000
 Cost Code 7521-4560-130.R2

Tube and Tube Flow Distribution

Studies are required to determine the distribution of flow to the three coolant subchannels of production tube and tube fuel. The objective of these studies is to obtain corrections for hydraulic inputs to a computer code used for design and analysis of N-Reactor fuel elements. Laboratory experiments were complete early in FY 1966 and analysis of data will be finished by November 1966.

Boiling Burnout Heat Flux Program

Burnout heat flux experiments will be required with a modified tube and tube fuel geometry to determine the conditions of process tube flow rates, pressures and powers at which boiling burnout would occur and will provide data for establishment of future operating limits. Ranges of experimental conditions will be applicable to reactor conditions at 120 percent of design power. Experiments will start in the last quarter of FY 1966 and will continue into the first quarter of FY 1967.

Heat Transfer Coefficients Under Film Boiling Conditions

A program is being conducted to determine heat transfer coefficients for typical N-Reactor cylindrical fuel geometries under film boiling conditions and forced convection. Results will be applicable to thermal hydraulic analysis of fuel behavior during individual process tube and reactor cooling system transients. It is expected that specific application will be found in studies of fuel temperature history during process tube flow instability. Thus it will be possible to more accurately assess the nuclear safety implications of instability transients under conditions of the elevated tube powers contemplated for the future. Experimental work will be complete by the end of the fiscal year.

BNW Organization . . . . . Engineering Development (Harty)
 Thermal Hydraulics (Batch)
 Mission. . . . . Coproduct (189, NRD #2)
 Responsible -- for NRD . . . . . R. H. Shoemaker
 Fund Allocation \$113,000
 Cost Code 7521-4560-130.CD

Boiling Burnout Heat Flux Program (Coproduct)

Short models of tube and tube coproduct fuel are being tested to determine the condition of process tube flow rates, pressures and powers at which boiling burnout would occur and will provide data for establishment of future operating limits. Early models represent a preliminary design of a heavy (20 lb/ft) driver-target element and will provide valuable information as to the effects of thermal and geometric boundary conditions on boiling burnout heat flux. These experiments will be followed by models representing the geometry of the coproduct demonstration test fuel. Initial experiments will be complete in December 1965. Tests with the demonstration load geometry will start in February 1966 and will be complete in June 1966.

Two Phase Pressure Drop Experiments

During the second quarter of FY 1966 work will begin on fabrication of a full length cosine heated model of the coproduct (demonstration load) fuel geometry. In June 1966 experiments will start to determine the boiling pressure drop characteristics of the simulated fuel under prototypical flow rates, pressures and tube powers representing the 4800 Mw reactor operating level (a 20 percent increase in maximum tube power). Data from these experiments will be used in safeguards analyses and to refine estimates of safe operating margins of pressure, process tube flows and outlet temperature for avoidance of sustained operation under film boiling conditions. The experiments will be completed in September 1966.

BNW Organization	Chemical Effluents & Tech. (Irish)
	Particulate Gas Waste Res. (Schwendiman)
Mission.	Nuclear Safety (189, NRD #13)
Responsible -- for NRD	R. E. Trumble
Fund Allocation	\$55,000
Cost Code	7653-4550-130.N9 \$35,000 (fuel melting and
	7653-4510-130.N9 <u>15,000</u> fission product
	<u>\$50,000</u> release)
	7653-4510-130.N9 <u>\$ 5,000</u> (noble gas release)
	<u>\$55,000</u>

Fuel Melting and Fission Product Release

The objective of this program is to obtain quantitative data on the fractional fission product release from failed fuel. The data are needed for hazards calculations estimating environmental consequences.

The failure mode of the fuel is to be observed and reported. The fission products released from the failed fuel are to be isotopically analyzed to determine:

- a. the fractional release of significant isotopes subsequent to failure; and
- b. the fractional release of noble gases as a function of time-after-fuel-failure.

The data, conclusions and interpretations of data are expected by February 1, 1966. The analysis should include, in addition to a description of the test, the estimated accuracy of the data. The tests are approximately 40 percent complete at this time.

Noble Gas Release

Additional work with the Particulate Waste Research Section involves the study of noble gas release. The ultimate goal is to establish means of minimizing the noble gas release from nuclear material processing facilities. Initial funding will cover studies of the release rate of noble gases from water solution, and should reveal;

- a. noble gas release rate or time to "complete" release from a solution assuming continuous uniform mixing;
- b. the release time assuming no mixing;
- c. literature available on the subject - a bibliography.

BNW Organization . . . . . Chemical Laboratory, Analytical (Holt)

Mission . . . . . Nuclear Safety (189, NRD #13)

Responsible -- for NRD . . . . . R. E. Trumble

Fund Allocation \$6,000

Cost Code 7630-4510-130.N9

To provide the necessary analytical services supporting nuclear safety studies involving the ground disposal of radioactive effluent. The estimated sampling frequency and need follows:

Monthly

Spring Samples:

3 spring samples, 3 time/week,
approx. 40 samples/month @ \$10.00   \$ 400

Well Samples:

1 well sampled at 3 depths, 3 times
weekly, approx. 40 samples/month
@ \$10.00   400

5 wells sampled monthly at 4 depths,
20 samples @ \$10.00   200

Estimated Monthly Cost   \$1,000

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BNW Organization . . . . . Metallurgy Development Section (Wick)
 Fuel Design (Last)
 Metal Fabrication (Minor)

Mission . . . . . Defense Pu (189, NRD #1)

Responsible -- for NRD . . . . . M. Lewis

Fund Allocation \$104,000

Cost Code 756X-4550-130.M1

Work order support of \$30,000 from Chemistry and Metallurgy, NRD, is also estimated.

Precise density and dimensional measurements are required for standard production fuel elements to the extent of about 2 to 3 percent of the total manufacturing output. Consultation and design services are required for specialized equipment used for making the remote post-irradiation measurements in 100-N Basin. Associated data processing services and evaluation of swelling and dimensional change data are also required. Examination of failed fuel elements in the Radiometallurgy Laboratory and interpretive analyses are required as part of this program.

BNW Organization . . . . . Metallurgy Development Section (Wick)
 Fuel Design (Last)
 Metal Fabrication (Minor)

Mission . . . . . Coproduct Driver Development
 (189, NRD #2)

Responsible -- for NRD . . . . . M. Lewis

Fund Allocation \$97,000

Cost Code 756X-4550-130.CD

Driver elements for large scale production tests in N-Reactor (PT-8, 13 and 36) are to be measured and their densities determined before irradiation. Post-irradiation examination of elements from these tests will be required. The uranium alloys used in these test elements are to be characterized metallurgically and changes induced by various heat treatments are to be determined. Measurements of mechanical properties are to be made and when swelling performance data is available correlation with measured properties will be sought. Relative corrosion rate measurements, of British and standard alloys, in high temperature water are being determined.

An experimental capsule irradiation of wide variety of alloys is being carried out. Careful pre-and post-irradiation characterization of the samples plus density change measurements will provide a basis for selecting promising alloys for larger scale testing as fuel elements and should show what metallurgical factors are of importance in determining the swelling resistance of an alloy.

Analyses and testing of fuel element supports will be required for the present coproduct design and to determine requirements for supports for elements of new designs.

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BNW Organization . . . . . Metallurgy Development Section (Wick)
 Fuel Design (Last)
 Metal Fabrication (Minor)

Mission . . . . . Coproduct Target Development
 (189, NRD #2)

Responsible -- for NRD . . . . . M. Lewis

Fund Allocation \$110,000

Cost Code 756X-4550-130.CD

Prototypical targets made from sintered pellets of lithium aluminate will be fabricated, irradiated and extracted on a pilot plant scale. In order to assure optimization of the target material other fabrication methods for gamma lithium aluminate and similar ceramic materials are to be evaluated. The candidate processes offer a wide variation of capital costs, operating costs and product attributes. The in-reactor performance (esp. gas release), the extractability, and the performance of the materials during temperature transients associated with reactor accidents will probably vary to some degree. Prototype elements are to be fabricated, characterized, irradiated, and subjected to tests appropriate for determining the performance characteristics of materials produced by the fabrication processes of interest. Investigation of ceramic systems containing lesser amounts of lithia, such as lithium alumino-silicates and the spinel ($\text{Li}_2\text{O} \cdot 5\text{Al}_2\text{O}_3$), will be required.

Water absorption and retention during processing steps will be measured and the process requirements for keeping the water content at a low level will be determined. The degree of loss of lithia during high temperature processing steps will be measured and the process requirements for maintaining control of the composition will be determined. Ex-reactor tests will be carried out on unirradiated prototype elements. These tests will be designed to provide information on the behavior of target elements after failure of the cladding occurs under normal operating conditions and during high temperature transients following reactor accidents.

BNW Organization . . . . . Metallurgy Development (Wick)
 Metal Fabrication (Minor)
 Metal Process Design (Last)

Mission . . . . . Non Defense Plutonium
 (189, NRD #3)

Responsible -- for NRD . . . . . M. Lewis

Fund Allocation \$20,000

Cost Code 756X-4540-130.N4

Metallurgical evaluation of uranium alloys and of changes induced by various heat treatments are being carried out in support of high exposure tests to produce non defense plutonium in the N-Reactor with tube-in-tube metallic uranium fuel elements. These fuels will be made with alloys believed to have a lower swelling rate than standard uranium. This work also applies in the support of the Defense Plutonium Mission.

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BNW Organization . . . . . Metallurgy Development (Wick)
Mission . . . . . Cobalt 60 (189, NRD #8)
Responsible -- for NRD . . . . . M. Lewis
Fund Allocation \$15,000
Cost Code 7564-4550-130.N8

Cobalt target elements will be fabricated for an in-reactor demonstration of capability to produce Co-60. Cladding requirements for this purpose will be evaluated and tested in-reactor.

BNW Organization . . . . . Ceramics Research & Development (de Halas)
 Plutonium Fuels Engineering (Olsen)

Mission . . . . . Coproduct (189, NRD #2)

Responsible -- for NRD . . . . . M. Lewis

Fund Allocation . . . . . No direct allocation is planned. Work
 order support from the Metallurgy
 Development Section will be provided as
 required to support the following scope.

Fabrication of coproducer target elements containing gamma lithium aluminate by vibrational compaction of impacted and classified powder and by vibrational compaction of sintered spheres will be studied. Prototype elements will be made, evaluated, irradiated, and re-evaluated. Process capabilities will be determined. Other new processes will be devised and proposed for consideration.

BNW Organization . . . . . Metallurgy Development (Wick)
 Ceramic Research & Development (de Halas)

Mission . . . . . Pu-238 (189, NRD #6)

Responsible -- for NRD . . . . . M. Lewis

Fund Allocation . . . . . \$42,000 Metallurgy Development
 \$20,000 Ceramics Research & Development
 \$62,000

Cost Code 756X-4550-130.N6

It appears from preliminary analysis that directly cast neptunium aluminum alloy elements are the most desirable for producing Pu-238 in N-Reactor. A test of this concept will be performed during FY-1966.

Metallurgical technology required to perform this test and to optimize this concept for production use in N-Reactor will be developed. Fuel and target designs and fabrication processes including cladding methods will be evaluated for lowest cost performance. Criteria will be developed to provide an on-the-shelf capability to move into Pu-238 production on short notice.

Neptunium bearing ceramic target elements will also be prepared for reactor irradiation. Although in early tests, reliability and timeliness will be overriding, development of a minimum cost process (commensurate with normal reliability requirements) will be carried out. A demonstration lot of elements prepared by this process will be irradiated and evaluated. Primary consideration will be given to development of a process for which N-Fuels Section can be equipped without excessive capital costs.

This program is still in the initial planning stage. For this reason it may be necessary to change the distribution of these funds within the Materials and Reactor Technology organization. If the allocation from the AEC is changed it may be necessary to similarly change the distribution of these monies between the Defense Plutonium or Coproduct missions and Pu-238 mission.

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BNW Organization . . . . . Metallurgy Research Section (Cadwell)
 Materials Engineering (Wheeler)

Mission . . . . . Defense Plutonium (189, NRD #1)

Responsible -- for NRD . . . . . M. Lewis

Fund Allocation \$80,000
 Plant Assistance work order support
 of \$20,000 from Chemistry and Metallurgy
 NRD, is also estimated

Cost Code 751X-4550-130.R3

Continuing studies are being conducted on the effects of absorbed hydrogen on process tube integrity. The crack propagation characteristics of Zr-2 will also continue to be evaluated to conditions beyond those already studied. An internal dosimeter for process tube irradiation will be developed. Plant assistance will be by work orders issued to support evaluations of graphite coolant tubes removed from N-Reactor and to evaluate current process tube surface temperature limits.

BNW Organization . . . . . Metallurgy Research (Cadwell)
 Chemical Metallurgy (Dillon)

Mission . . . . . Defense Plutonium (189, NRD #1)

Responsible -- for NRD . . . . . M. Lewis

Fund Allocation \$25,000

Cost Code 7513-4550-130.R3

Efforts will continue on determining the effectiveness of zirconium oxide film as a long term barrier to hydrogen absorption. To the extent possible under these funding limitations, effects of radiation on long term corrosion rates of Zr-2 in hot water will be measured and evaluated in terms of their significance to N-Reactor.

Effects of beryllium and uranium concentrations on the corrosion of weld and braze regions of N-Reactor fuel elements will be evaluated. The objective of this work is to define whether those materials in the weld may be a cause for N fuel ruptures.

DECLASSIFIED

BNW Organization . . . . . Metallurgy Research (Cadwell)
Reactor Metals (Bement)

Mission . . . . . Defense Plutonium (189, NRD #1)

Responsible -- for NRD . . . . . M. Lewis

Fund Allocation \$15,000

Cost Code 7512-4550-130.R9

Nominal support will be given to the continuation of the surveillance
irradiation program in the ETR.

DECLASSIFIED

BNW Organization . . . . . Engineering Development (Harty)
Coolant Systems Development (Ayres)

Mission . . . . . Defense Plutonium (189, NRD #1)

Responsible -- for NRD . . . . . M. Lewis

Fund Allocation \$80,000
Plant Assistance work order support
of \$45,000 from Chemistry and
Metallurgy NRD is also estimated

Cost Code 7522-4550-130.R6

Intentionally defected fuel elements that have been irradiated in coproduct and SDT production tests will be tested in the I.R.P. loop to determine induction periods and corrosion rates of the uranium alloys.

Corrosion rates are being measured for high crud levels under N-Reactor temperature conditions. Carbon steel pitting rates will be measured in variously adjusted filtered water. Continuing measurements will be made of corrosion coupons in N-Reactor loops. Work orders are issued to conduct certain process technology tests on N-Reactor components.

Effects of decontamination chemicals in crevices will be studied. Corrosion evaluations are being completed for materials to be used for complete system decontamination. Characterization of radionuclides in N-Reactor cruds will continue as funds are available. Assistance will be provided in defining and evaluating decontamination processes. Work orders are issued to evaluate safety features in disposal of decontamination solutions.

BNW Organization . . . . . Materials Research & Service (Nightingale)
 Graphite Research & Development (Yoshikowa)

Mission . . . . . Defense Plutonium (189, NRD #1)

Responsible -- for NRD . . . . . M. Lewis

Fund Allocation \$100,000
 Plant Assistance work order support of
 \$45,000 from Chemistry and Metallurgy
 NRD, is also estimated.

Cost Code 7542-4550-130.R9

The effects of a wide variety of parameters on irradiation-induced dimensional changes in graphite are being studied to provide techniques for avoiding in N-Reactor the consequences of stack distortion. Parameters under investigation are mechanical stress, high temperature (to 1200 C) irradiation, cyclic temperature irradiation, and sample size. Simultaneously, analyses are being performed to determine the effects of dimensional changes in graphite bars on moderator stack integrity.

Work orders are issued to support work on monitoring in-reactor graphite oxidation and irradiation samples in channels 74 and 60, and to evaluate nitrogen as an alternate reactor atmosphere.

BNW Organization . . . . . Chemical Research (Walling)
 Chemical Separations (Harmon)

Mission . . . . . Coproduct (189, NRD #2)

Responsible -- for NRD . . . . . M. Lewis

Fund Allocation \$40,000

Cost Code 7613-4550-130.CD

Sodium tetraborate dissolution and extraction rate measurements will be made on irradiated and unirradiated samples of lithium-bearing ceramic materials. Process parameters will be determined. Alternate processes will be studied to a limited degree. Irradiation tests of materials prepared by different processes will be performed and extraction rates measured. The relationship between gas release and dissolution will be determined. The mechanisms of gas retention and release, for helium, tritium and tritium oxide, will be studied to a degree commensurate with the available funds. Side reactions leading to unwanted by-products such as boranes will be investigated.

Materials for crucible construction will be evaluated and a recommendation made. The combination of molten aluminum, the tetraborate flux and lithium aluminate may be very aggressive.

Problems related to scaling up the tetraborate dissolution process from laboratory thimbles to production-scale crucibles will be defined. Means for increasing the dissolution rate, for stirring, and for increasing the fluidity of the melt will be studied. The requirements for sodium tetraborate purity will be determined and the lowest cost grade suitable for this application will be determined.

[REDACTED]

BNW Organization . . . . . Chemical Research (Walling)
Chemical Separations (Harmon)

Mission . . . . . Pu-238 (189, NRD #6)

Reponsible -- for NRD . . . . . M. Lewis

Fund Allocation \$5,000

Cost Code 7613-4550-130.N6

To carry out extraction and process development studies relative to the chemical separation of Pu-238. The results of these studies would serve as the criteria for the further development of an efficient and economic production separations process.

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