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DUN-AOP-213 RD
Hanford Category C-65

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This document consists of 10 pages, [REDACTED]

HANFORD TOLL IRRADIATION STUDY

W. K. Woods

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By Authority of R M Owen
CG-NMP-1, 9-28-94

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HANFORD TOLL IRRADIATION STUDY

- I. Objective of study is to provide a basis for establishing charges for irradiation of neptunium for private parties on a toll basis. All costs, including target preparation, irradiation, and chemical processing, are to be itemized so that the customer can buy such services as he wishes. (cf. Table B)
- II. Toll Irradiation Study conditions for both Hanford and Savannah River were specified by AEC-HQ in memoranda on April 23, 1969 and June 2, 1969, and teletype on July 24, 1969.
- III. All RL cases are based on COPE Case 14-B-1, which assumes no reactor shutdowns and AEC neptunium at RL starting in FY 1973.
- IV. We are computing for KKN conditions. We may also compute for a requested KN condition at a later date. The KN condition would require higher driver enrichment in K reactor and lower uranium exposures in N reactor.

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- V. A demand schedule for Pu-238 production by toll irradiation has been established as follows:

<u>Year</u>	<u>Pu-238 Required (Kg)</u>
FY 1973	3
74	6
75	16
76	50
77	80
78	90
79	100

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- VI. In one set of cases, RL Irradiates all AEC neptunium, then superimposes additional neptunium from non-AEC sources to meet the toll irradiation demand. These cases are large enough to warrant neptunium processing in Purex the first year, and BNW facilities are not required. (cf. Table A)
- VII. In another set, RL irradiates RL neptunium only, and then superimposes additional neptunium from non-AEC sources to meet half of the toll irradiation demand. BNW facilities would be required for the full production campaign if we irradiate RL neptunium only, so we do not plan to cost this case. When irradiating RL neptunium plus half the toll neptunium, BNW facilities will be required for about 2 1/2 years before we graduate to Purex. (cf. Table A)

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VIII. Special assumptions involving DUN are as follows:

- A. All neptunium irradiations are done in the K reactors in 4-tube clusters to produce minimum Pu-236 content in Pu-238.
- B. Two different irradiation modes are computed, as follows:

	COPE Mode	Special Mode
	low	high
Neutron flux		
Target blackness, gm Np/ft	100	56
Irradiation time	4 mo.	3 mo.
Time out of reactor	4 mo.	3 mo.
Neptunium burnout	.123	.115
Pu-238 quality	91.6%	91.0%
Pu- ²³⁹ 238 not made per unit Pu-238	1.00	1.37

The special mode is intended to minimize neptunium inventories. Both modes are based upon irradiating neptunium for two E-metal cycles.

- C. Maximum neptunium batch size is 400 kg.
- D. All neptunium targets are fabricated in building 3708 or building 313. The latter facility, which can process 20 kg Np daily instead of 10 kg per day, is needed for batches of neptunium greater than about 300 kgs.
- E. It is assumed that neptunium is loaded in the central two-thirds of the process tube, and that depleted uranium is used in both ends. If depleted uranium is not permitted downstream of the neptunium, the Pu-239 production will be decreased by 0.14 gm per gm Pu-238.

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- F. It is assumed that transition from E-Np loading to natural uranium loadings can be made by delaying discharge of some E metal for a few weeks.
- G. It is assumed that for large neptunium batches, it will not be necessary to charge all of the neptunium prior to charging E metal.

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TABLE A

NEPTUNIUM PROCESSING RATES, (KG / YEAR)
 (Special Irradiation Mode)

<u>Year</u>	<u>All AEC Np</u>	<u>All AEC Np + Toll Irrad.</u>	<u>RL Np Only</u>	<u>RL Np + 1/2 Toll. Irrad.</u>
FY 73	326	356	35	50
74	433	494	75	105
75	443	606	104	185
76	515	1025	129	383
77	533	1347	153	561
78	567	1483	175	634
79	620	1632	194	703

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IX. Special assumptions involving BNW are as follows:

- A. All processing of irradiated neptunium will be done in C Cell of building 324.
- B. Maximum steady processing rate will be 100 kg Np per year.

X. Special assumptions involving ARHCO are as follows:

- A. All processing of irradiated neptunium other than in building 324 will be done in Purex.
- B. Irradiated neptunium will be allowed to cool for 45 days.
- C. Minimum batch size is 100 kg of neptunium.
- D. It is assumed that Pu-238 batches processed in Purex will pick up 350 grams of Pu-239.
- E. Assume average batch size is 280 kg neptunium.
- G. There will be a minimum of two campaigns per year in Purex, except during a transition from building 324 to Purex. In the COPE mode there will be three campaigns per year. In the latter years of the Special mode there will be four campaigns per year. Each campaign will require 16 days of turnaround time.

Pu-238 and neptunium will be denitrated in building 234.

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XI. Capital requirements used in the study are as follows:

Building 3708	about	300,000
" 313	about	1,000,000 additional
" 324	"	800,000
" 202-A (Purex)	"	950,000
" 234 (Z)	"	2,100,000

As instructed, these new facility costs are to be amortized both (a) over the campaign period, and (b) using expected service lives.

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TABLE B
TOLL IRRADIATION STUDY

DUN-AOP-213 RD

COST DATA (in thousands of \$)A. Budgetary Costs (incl. O/H's):

1. Np-237 Target Fabrication
 - a. Fabrication
 - b. Assembly
 - c. Purification
2. Fuel Cycle Costs for U (Allocated):
 - a. Offsite U Fabrication
 - b. Onsite U Fabrication
 - c. Burnout (UO₃) and U Losses
 - d. Separations Cost (incl. waste disposal)
 - e. Transportation and security shipments
3. Reactor Costs (Alloc.) for U and Targets
4. Target Separation Costs

Total Budgetary Costs

B. Non-Budgetary Costs - Depreciation:

1. Target Fabrication
 - a. Fabrication
 - b. Assembly
 - c. Purification
2. Fuel Cycle (Allocated):
 - a. Offsite Fuel Fabrication
 - b. Onsite Fuel Fabrication
 - c. Separations (incl. waste management)
3. Reactor Costs (Allocated) for U and Targets
4. Target Separations

Total Depreciation (Non-Budget)

C. Total AEC Manufacturing Costs
(Add Budgetary and Non-Budgetary)D. Full Recovery Costs:

1. AEC Added Factors:
 - a. Target Fabrication
 - b. Offsite U Fabrication
 - c. Onsite U Fabrication
 - d. Burnout (Fed. Reg. Less UO₃)
 - e. Reactor Costs
 - f. Fuel Separations
 - g. Target Separations
 - h. Total Added Factor
2. Blending

Total Full Recovery Costs

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TABLE B
TOLL IRRADIATION STUDY
(continued)

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- E. Unit Cost Per Gram of Pu-238 (excluding Np-237)
1. Np-237 Fabrication, Assembly, & Purification
 - a. Budgetary Cost
 - b. AEC Manufacturing Cost
 - c. Full Cost Recovery
 2. Np-237 Irradiation
 - a. Budgetary Cost
 - b. AEC Manufacturing Cost
 - c. Full Cost Recovery
 3. Np-237/Pu-238 Separation
 - a. Budgetary Cost
 - b. AEC Manufacturing Cost
 - c. Full Cost Recovery

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NOTE:

In calculating the AEC added factor, the percentages provided (by separate memo) for each operation, should be applied to total Manufacturing Costs, i.e., budgetary and nonbudgetary costs, except in the case of burnout, in which the added factor will be the difference between the budgetary and nonbudgetary costs and burnout costs at the published price.