ENFORM II: A Computational System for Light Water Reactor Logistics and Effluent Analysis

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September 1979

Prepared for the U.S. Department of Energy
under Contract EY-76-C-06-1830

Pacific Northwest Laboratory
Operated for the U.S. Department of Energy
by Battelle Memorial Institute

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PACIFIC NORTHWEST LABORATORY
operated by
BATTELLE
for the
UNITED STATES DEPARTMENT OF ENERGY
Under Contract EY-76-C-06-1830

Printed in the United States of America
Available from
National Technical Information Service
United States Department of Commerce
5285 Port Royal Road
Springfield, Virginia 22151

Price: Printed Copy \$____; Microfiche \$3.00

*Pages	NTIS Selling Price
001-025	\$4.00
026-050	\$4.50
051-075	\$5.25
076-100	\$6.00
101-125	\$6.50
126-150	\$7.25
151-175	\$8.00
176-200	\$9.00
201-225	\$9.25
226-250	\$9.50
251-275	\$10.75
276-300	\$11.00

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1.0 INTRODUCTION

ENFORM is a computer-based information system that addresses the material logistics, environmental releases and economics of light water reactor (LWR) operation. The most important system inputs consist of electric energy generation requirements, details of plant construction scheduling, unit costs, and environmental release factors. From these inputs the ENFORM system computes the mass balances and generates the environmental release information for noxious chemicals and radionuclides from various fuel cycle facilities (except waste disposal). Fuel cycle costs and electric power costs are also computed. Thus, the system is a tool that can assess the potential environmental effects and costs and benefits of various electric generation scenarios.

The ENFORM system was documented in BNWL-2195 (Heeb, Purcell and Cole 1977). The document described the data base used by the system and presented a brief synopsis of the logistics generator. No detailed programming information, however, was included.

The present document summarizes all code development subsequent to 1977 and provides programming instructions for the modules that are comprised in the ENFORM system. ENGEN, a code that uses a generation schedule specified by the user and isotopic data generated by ORIGEN, has been developed to produce a scenario-specific data base. Other codes (ENMAT, ENRAD, etc) have been developed to use data base information to estimate radioactive and nonradioactive release information.

This report describes the operation of the ENGEN model and the processes of calculating effluent releases. Input instructions for all ENFORM codes are then provided as Appendixes A through F. Appendix G presents output from a sample problem.

2.0 SYSTEM DESCRIPTION

The goal of the ENFORM calculational system is an integrated analysis of the LWR fuel cycle. Figure 2.1 displays the LWR fuel cycle as analyzed by the ENFORM system. Figure 2.2 shows the various computer modules that perform this analysis. Each fuel cycle process is generically modeled. Detailed physical as well as chemical processes have been analyzed and characterized. The emphasis has been on evaluating and modeling the environmental release characteristics. Isotopic information "upstream" (mine to reactor) of the reactor is predicted for uranium nuclides at enrichment and uranium decay products at the mine. "Downstream" (reactor to reprocessing) of the reactor, data on 175 nuclides are available. These nuclides include major fission products, actinides and activation products. The use of a generic fuel management model allows scenario-independent data to be utilized. As shown in Figure 2.1, the paths depicting uranium and plutonium recycle and the stowaway cycle are input options. Various recycle configurations are possible by controlling input parameters as well as the generation scenario.

Nonradioactive and radioactive release information is a major part of the analysis performed by the ENFORM system. The ENGEN code, making use of ORIGEN (Bell 1973) isotopic data and an input generation schedule, produces a detailed "scenario-dependent" data base. The ENMAT code, using input chemical release factors, integrates the ENGEN-produced data base to prepare a chemical release report for fuel cycle facilities. Chemical reports are readily producible for 250 chemicals routinely released from the fuel cycle facilities. The basis for all releases is mass released per mass processed. For example, in a uranium fabrication facility small amounts of nitric oxide (NO_2) are routinely released. An evaluation of various fabrication facilities has allowed an estimate of NO_2 release factors (based on throughput) to be evaluated. This release factor (kg NO_2 released/ kg U fabricated) can then be utilized generally to estimate NO_2 releases for all fabrication activities. Characterizing release factors on a "per mass processed" basis allows scenario-independent data to be universally applied.

FIGURE 2.1. The ENFORM Fuel Cycle Model

FIGURE 2.2. ENFORM Modular Components

Radionuclide emissions are handled differently from nonradioactive releases. Release factors for each nuclide are in units of gram atoms of a given isotope released per gram atom of that isotope processed. The gram atoms of each isotope are stored on the data base produced by ENGEN for a given scenario. Doses are then evaluated using predetermined dose factors. Various generic site characteristics were utilized to predict dose factors based on curies released to allow universal applications. Population doses are generically calculated for each fuel cycle facility as the product of system throughput, release factors and dose factors.

The next section, Section 3.0, describes the fuel cycle components used in the ENGEN module. Each subsection describes the logic ENGEN uses to model each fuel cycle operation. The goal is to consistently predict uranium and byproduct mass flows using an input set of fuel cycle parameters. Allowing input of different delay times in each step of the operation (mine, conversion, etc) increases model flexibility. Production efficiencies are also input to account for any production losses that occur.

3.0 FUEL CYCLE MODEL

Each component of the LWR fuel cycle has been generically modeled in the ENFORM system. Each fuel cycle activity uses input information and scenario data to describe and predict resource requirements for that particular activity. This section describes the modeling of each fuel cycle activity.

3.1 URANIUM MINE/MILL MODEL

The basic input and output functions of the ENGEN mine/mill model are depicted in Figure 3.1. The major input to the model is the domestic U_3O_8 (yellowcake) demand. This demand is scenario dependent, because various generation and recycle options strongly affect the requirements of U_3O_8 .

- DOMESTIC U_3O_8 DEMAND FROM CONVERSION FACILITIES
- U_3O_8 RESOURCE DATA
- FOREIGN U_3O_8 DEMAND
- IMPORTED U_3O_8
- PRICE DATA
- CONTRACTUAL DATA

- U_3O_8 PRODUCTION FROM MILLS
- ORE PRODUCTION FROM SURFACE AND UNDERGROUND MINES
- U_3O_8 PRICE

FIGURE 3.1. The ENGEN Mine/Mill Model

Given a yellowcake demand, the system uses a mining algorithm to model the depletion of domestic reserves. The domestic U_3O_8 reserves are characterized by grouping equivalent recovery cost deposits into data "blocks". Each block is characterized by information on total U_3O_8 reserves available at the specified recovery cost, fraction of the reserves occurring as surface deposits, average ore grade of the surface deposits, average ore grade of the underground deposits and milling recovery information.

The mining algorithm uses the assumption of a maximum annual output per block. That is, in any given year, a maximum fraction of the reserves in a constant recovery cost block can be mined. Typically this fraction is 1/15. If the demand for U_3O_8 is not met by a single block's output, adjacent higher-cost blocks are mined. This process occurs for all years when a U_3O_8 demand exists. The process proceeds from low-cost blocks to the higher-cost blocks, depleting blocks as appropriate.

Total U_3O_8 production is calculated by summing individual block contributions. Ore production is calculated from U_3O_8 production and ore grade mined to produce the U_3O_8 . Each block has different ore grades and the ore mined for each block is summed to obtain a total ore production. The split between surface and underground deposits is also estimated.

The following four relations represent the balance techniques used to calculate annual U_3O_8 and ore production:

$$U3O8S = \sum_{j=i_0}^{i_1} Y_j * FRS_j$$

$$U3O8UG = \sum_{j=i_0}^{i_1} Y_j * (1 - FRS_j)$$

$$ORES = \sum_{j=i_0}^{i_1} \frac{Y_j * FRS_j}{OGS_j * RFS_j}$$

$$OREUG = \sum_{j=i_0}^{i_1} \frac{Y_j * (1 - FRS_j)}{OGUG_j * RFUG_j}$$

where

U308S = annual U_3O_8 production from surface mines

U308UG = annual U_3O_8 production from underground mines

ORES = annual ore production from surface mines

OREUG = annual ore production from underground mines

Y_j = j^{th} block's annual U_3O_8 production

FRS_j = fraction of j^{th} block's U_3O_8 occurring as a surface deposit

OGS_j = ore grade for j^{th} block's surface deposits

RFS_j = milling recovery fraction for j^{th} block's surface deposit

$OGUG_j$ = ore grade for j^{th} block's underground deposits

$RFUG_j$ = milling recovery fraction for j^{th} block's underground deposit

i_0 = initial block mined this year (lowest cost)

i_1 = final block mined this year (highest cost)

The annual price of U_3O_8 is calculated based on the following relation:

$$P = \frac{HC * (TOTP - TOTC) + CP * TOTC}{TOTP}$$

where

P is the predicted U_3O_8 price

HC is the highest recovery cost encountered in this year

CP is the average contract price for U_3O_8 delivered this year

TOTC is the quantity of U_3O_8 delivered under contract this year

TOTP is the total quantity of U_3O_8 delivered this year.

3.2 CONVERSION MODEL

The input and output functions of the ENGEN conversion model are depicted in Figure 3.2. The model is characterized by a mass balance operation. The major input, UF_6 demand from the enrichment model, combines with input operational efficiencies and input material residence times to characterize the conversion requirements. The following relation represents the operation of the conversion process at any time period, i :

$$U3O8C_{i+n} = UF6_i / EFFC_i$$

where

$U3O8C_{i+n}$ = mass of uranium as U_3O_8 required by conversion process at $i+n$ time interval

n = number of intervals (quarters) material is held up in conversion

$UF6_i$ = mass of uranium as UF_6 demanded as output from conversion process in interval i

$EFFC_i$ = efficiency of conversion process in interval i .

- UF_6 DEMAND FROM ENRICHMENT PROCESS
- CONVERSION PROCESS EFFICIENCIES
- MATERIAL RESIDENCE TIMES

FIGURE 3.2. The ENGEN Conversion Model

3.3 ENRICHMENT MODEL

The enrichment model in the ENGEN system calculates the separative work units (SWU) and isotopic data associated with the enrichment process. Figure 3.3 displays the major input and output functions of the model. A variation of the logic in Figure 3.3 is used for the uranium recycle options. The feed mass of uranium is known in this case and the mass of product uranium that can be fabricated is calculated.

Figure 3.4 shows the mass flows associated with the enrichment process. The following relations represent the isotopic calculation (de la Garza 1977):

$$\frac{F}{P} = \frac{X_p - X_t}{X_f - X_t} \quad \text{and} \quad R_i = \frac{X_i}{1 - X_i - Y_i - Z_i}$$

The pertinent unknowns are:

$$Y_p = Y_f \cdot \frac{R_f/R_t^{-1/3} - 1}{R_p/R_t^{-1/3} - 1} \cdot \frac{X_p - X_t}{X_f - X_t}$$

$$Z_p = Z_f \cdot \frac{R_f/R_t^{-5/3} - 1}{R_p/R_t^{-5/3} - 1} \cdot \frac{X_p - X_t}{X_f - X_t}$$

- MASS AND ENRICHMENT (GOAL) OF PRODUCT URANIUM
- FEED URANIUM ISOTOPIC DATA
- TAILS ASSAY

- MASS OF TAILS
- SEPARATIVE WORK UNITS (SWU) REQUIRED
- MASS OF FEED URANIUM REQUIRED
- PRODUCT URANIUM ISOTOPIC DATA

FIGURE 3.3. The ENGEN Enrichment Model

WHERE:

f FEED STREAM
 p PRODUCT STREAM
 t TAILS STREAM
 P PRODUCT MASS
 F FEED MASS
 T TAILS MASS
 X ^{235}U WEIGHT FRACTION
 Y ^{236}U WEIGHT FRACTION
 Z ^{234}U WEIGHT FRACTION

FIGURE 3.4. Enrichment Process Mass Flows

Definitions are as described in Figure 3.4. For nonrecycle fuel cycle calculations Y_f is zero and simplifications occur. For recycle chains a goal enrichment is specified and modified based on the ^{236}U content. Since the ^{236}U content is scenario-dependent, an estimated penalty of 0.3% ^{235}U is added per percent ^{236}U present (de la Garza 1977). This relieves the scenario dependency and represents an adequate method of dealing with ^{236}U penalties.

The separative work units (SWU) involved are calculated by the following relations (de la Garza 1977).

$$\Delta = P[V(X_p) - V(X_t)] - F[V(X_f) - V(X_t)]$$

$$V(X_i) = (2X_i - 1) \ln \left(\frac{X_i}{1-X_i} \right)$$

where

Δ = separative work units (SWU)

P = uranium product, kg U

F = uranium feed, kg U

$V(X_i)$ = Value function

X_p = ^{235}U weight fraction in product stream

X_f = ^{235}U weight fraction in feed stream

X_t = ^{235}U weight fraction in tails stream.

3.4 REACTOR MODEL

The ENGEN input nuclear generation scenario is met by "building" the appropriate number of generic LWR plants. The key properties of the LWR generic plants, pressurized water reactors (PWR) and boiling water reactors, are given in Tables 3.1 and 3.2. These parameters are used in the fuel management model of ENGEN to predict discharge isotopics and recycle schemes. Details on these segments of ENGEN are found in the following sections.

Figure 3.5 displays the input and output functions associated with reactor operations.

TABLE 3.1 Generic PWR Data

Datum	Value	Unit
Core Thermal Power	3411	MWt
Net Electric Power	1156	MWe
Assembly Weight (U)	461.5	kg
Core Fuel Weight (U)	89.1	MTM
Thermal Efficiency	0.3389	--
Design Capacity Factor	0.7867	--
Assembly Rod Array	17 x 17	--
Rod Pitch	1.2598	cm
Pellet Density	95	% Theo.
Pellet Diameter	0.8192	cm
Fuel Rod Outer Diameter	0.9500	cm
Clad Thickness	0.05715	cm
Reload Batch Size	0.333	Core Fraction

TABLE 3.2. Generic BWR Data

Datum	Value	Unit
Core Thermal Power	3800	MWt
Net Electric Power	1277.0	MWe
Assembly Weight (U)	188.6	kg
Core Fuel Weight (U)	159.93	MTM
Thermal Efficiency	0.3361	--
Design Capacity Factor	0.7779	--
Assembly Rod Array	8 x 8	--
Rod Pitch	1.6256	cm
Pellet Density	95	% Theo.
Pellet Diameter	1.0566	cm
Fuel Rod Outer Diameter	1.2522	cm
Clad Thickness	0.08636	cm
Reload Batch Size	0.2500	Core Fraction

- NUCLEAR GENERATION SCENARIO
- RECYCLE/REPROCESSING OPTIONS
- REACTOR CHARACTERISTICS

ENGEN REACTOR MODEL

- DISCHARGE ISOTOPICS
- FABRICATED FUEL REQUIREMENTS
- DISCHARGE FUEL LEVELS
- REACTOR BUILD AND SHUTDOWN SCHEDULE

FIGURE 3.5. The ENGEN Reactor Model

3.4.1 Initial Conditions

One of the most significant input parameters of the ENFORM system is the nuclear generation scenario. Both PWR and BWR installed capacity must be specified for 100 years starting in 1977. The currently operating plants are included in order to predict their uranium requirements and spent fuel loadings. Table 3.3 summarizes the data used to model existing PWR and BWR facilities. By using this data in a generic fashion, the impact of these existing plants can be included in the analysis.

TABLE 3.3. Historical Development of LWRs

Initial Year of Operation	PWR			BWR		
	Number of Plants Started	Average Size, MWe	Cumulative Capacity, MWe	Number of Plants Started	Average Size, MWe	Cumulative Capacity, MWe
1960	-	-	-	1	200	200
1961	1	175	175	-	-	200
1962	1	265	440	1	70	270
1963	-	-	440	1	63	333
1964	-	-	440	-	-	333
1965	-	-	440	-	-	333
1966	-	-	440	-	-	333
1967	-	-	440	-	-	333
1968	2	503	1,446	-	-	333
1969	-	-	1,446	3	436	1,641
1970	2	494	2,434	2	726	3,093
1971	2	683	3,800	2	674	4,441
1972	4	685	6,540	4	696	7,225
1973	7	787	12,049	-	-	7,225
1974	7	763	17,390	5	904	11,745
1975	4	911	21,034	4	866	15,209
1976	4	930	24,754	1	1,067	16,276

In order to evaluate the impact of commercial reprocessing, the existing backlog of spent fuel has to be evaluated. The ENGEN model evaluates this backlog by a normalization process with the model-generated backlog and the published backlog values (ERDA 1978). Backlog values as of January 1, 1977, are:

PWR: 1373 metric tons

BWR: 969 metric tons

Total: 2342 metric tons

This fuel is assumed to be present in 1977 and is modeled as being reprocessed analogous to the remainder of the fuel in the scenario.

3.4.2 Reactor Logistics Model

In order to evaluate the heavy metal mass flows associated with reactor operation, each region (or reload) of a LWR is explicitly modeled. Each region of both a PWR and BWR is modeled from its discharge point backwards in time to mining and forward in time to reprocessing. Figure 3.6 shows how this process occurs within the ENGEN model. For each fuel cycle activity the time and value of heavy metal mass flow is predicted in the ENGEN system. Radioactive decay of fission products and actinides is included in the model. This information is generated for each quarter and summarized for all fuel cycle activities.

Figure 3.7 displays the operating history algorithm of the reactor logistics model. In this figure a PWR operating history is depicted. The model indicates the explicit modeling of each reload fuel type.

Table 3.4 summarizes the 28 LWR fuel types used in ENGEN. As shown in Figure 2.2, the ORIGEN analysis on these 28 fuel types is used as an input to the ENGEN Model. Detailed production and decay information (175 nuclides) has been generated for each fuel type. The ENGEN model uses this information together with a nuclear growth scenario to predict detailed mass flow and monitoring information.

(a) EACH FUEL CYCLE ACTIVITY REQUIRES AT LEAST 1 QUARTER OF HOLDUP TIME. SPENT FUEL IS ASSUMED TO BE DISCHARGED IN THE i^{TH} QUARTER. OTHER ACTIVITIES ARE ACCOUNTED FOR AS THEY OCCUR EITHER UPSTREAM OR DOWNSTREAM OF FUEL DISCHARGE.

FIGURE 3.6. Fuel Cycle Activity

FIGURE 3.7. PWR Operating History

TABLE 3.4. ENGEN LWR Fuel Types

Number	Reactor	Description	Fuel Type	Fissile Loading Wt%	Exposure MWD/MT
1	PWR	Initial Core Region 1	Fresh UO ₂	2.00	15,000
2	PWR	Initial Core Region 2	Fresh UO ₂	2.60	25,000
3	PWR	Initial Core Region 3	Fresh UO ₂	3.10	33,000
4	PWR	First Reload	Fresh UO ₂	3.20	33,000
5	PWR	Steady State	Fresh UO ₂	3.20	33,000
6	BWR	Initial Core Region 1	Fresh UO ₂	1.70	10,000
7	BWR	Initial Core Region 2	Fresh UO ₂	1.90	17,000
8	BWR	Initial Core Region 3	Fresh UO ₂	1.90	20,000
9	BWR	Initial Core Region 4	Fresh UO ₂	1.90	21,000
10	BWR	First Reload	Fresh UO ₂	2.70	26,000
11	BWR	Steady State	Fresh UO ₂	2.60	27,000
12	PWR	First Uranium Recycle	Recycle UO ₂	3.60	33,000
13	PWR	Second Uranium Recycle	Recycle UO ₂	4.73	33,000
14	PWR	Third Uranium Recycle	Recycle UO ₂	7.50	33,000
15	BWR	First Uranium Recycle	Recycle UO ₂	2.92	27,000
16	BWR	Second Uranium Recycle	Recycle UO ₂	3.80	27,000
17	BWR	Third Uranium Recycle	Recycle UO ₂	6.08	27,000
18	PWR	First Plutonium Recycle	MOX	3.45	33,000
19	PWR	Second Plutonium Recycle	MOX	3.75	33,000
20	PWR	Third Plutonium Recycle	MOX	4.78	33,000
21	BWR	First Plutonium Recycle	MOX	2.80	27,000
22	BWR	Second Plutonium Recycle	MOX	3.15	27,000
23	BWR	Third Plutonium Recycle	MOX	4.00	27,000
24	PWR	First Shutdown Region	Fresh UO ₂	3.20	11,000
25	PWR	Second Shutdown Region	Fresh UO ₂	3.20	22,000
26	BWR	First Shutdown Region	Fresh UO ₂	2.60	7,000
27	BWR	Second Shutdown Region	Fresh UO ₂	2.60	13,000
28	BWR	Third Shutdown Region	Fresh UO ₂	2.60	20,000

3.5 REPROCESSING MODEL

The input and output functions of the ENGEN reprocessing model are depicted in Figure 3.8. The reprocessing model uses the annual reprocessing capacity, spent fuel backlog, and ORIGEN isotopic data to develop actinide, fission product, and activation product throughputs at the reprocessing step. As in previous fuel cycle steps, mechanisms for process losses, material holdups, and radioactive decay are included. Each LWR fuel type (as summarized in Table 3.4) is analyzed and accounted for independently. Thus, detailed throughput information on the activation products, etc. is generated as a function of fuel type and time.

FIGURE 3.8. The ENGEN Reprocessing Model

3.5.1 Spent Fuel Backlog

In order to properly account for radioactive decay of radioactive materials the "out of reactor" time is the required parameter.

ENGEN tracks spent fuel discharges and at the initiation of reprocessing processes the spent fuel backlog on a "first-in-first-out" basis. The oldest fuel is reprocessed first, working through the backlog into younger fuels. Both the minimum age of fuel and level of reprocessing are input variables. In all cases decay of radioactive nuclides is accounted for.

4.0 DATA BASE PRODUCTION

The ENFORM data base, as depicted in Figure 4.1, is the data transfer mechanism from the logistics generator, ENGEN, to the various processor programs. The data base contains time and scenario-dependent mass flows for 175 nuclides at various process steps for LWR fuel types. The process steps for which information is recorded are shown in Table 4.1. The table shows throughputs for the 175 nuclides at each process step over a 100-year period.

a - UNDERGROUND MINE	i - URANIUM FUEL FABRICATION
b - SURFACE MINE	j - MIXED OXIDE FUEL FABRICATION
c - ACID LEACH MILL	k - REACTOR
d - ALKALI LEACH MILL	l - REACTOR STORAGE
e - AQUEOUS CONVERSION	m - REPROCESSING STORAGE
f - DRY CONVERSION	n - RADWASTE
g - CASCADE ENRICHMENT	o - RECOVERED URANIUM
h - CENTRIFUGE ENRICHMENT	p - RECOVERED PLUTONIUM

FIGURE 4.1. Data Base Configuration as Constructed for Each Nuclide

TABLE 4.1. Data Base Process Steps

Process Step	Throughputs ^(a)		
	Mass (kg-HM)	Oxide Products ^(b) (g-atoms)	Structural Products ^(c) (g-atoms)
Underground Mine	x	-	-
Surface Mine	x	-	-
Acid Leach Mill	x	-	-
Alkali Leach Mill	x	-	-
Aqueous Conversion	x	-	-
Dry Conversion	x	-	-
Cascade Enrichment	x	-	-
Centrifuge Enrichment	x	-	-
Uranium Fuel Fabrication	x	-	-
Mixed Oxide Fuel Fabrication	x	-	-
Reactor	x	x	x
Reactor Storage	x	x	x
Reprocessing Storage	x	x	x
Radwaste	x	x	x
Recovered Uranium	x	x	x
Recovered Plutonium	x	x	x

(a) The data base consists of two segments. The first volume contains heavy metal mass flows for all the fuel cycle operations. The second and final volumes contain throughputs for activation products, actinides and fission products.

(b) The oxide data contain fission product and actinide nuclides.

(c) The structural data contain activation product nuclides.

5.0 RADIOACTIVE EFFLUENTS MODEL

The release of radioactive materials to air or water is calculated by two modules: ENRADM and ENRADR. These two modules interrogate the data base and produce reports that describe annual radionuclide releases over the time period covered by the nuclear generation scenario.

ENRADM computes releases for the mine, mill, conversion, enrichment and fabrication plants. ENRADR computer releases for the reactor, spent fuel storage and reprocessing. Different parts of the data base are accessed by the two modules. ENRADM reads the first segment of the data base in which the annual amounts of heavy metal (kg) processed are stored by plant and by year. The mass (kg) released is the product of the release factor and the mass of heavy metal processed by the plant in the year of the release. The basic equation is:

$$REL(N,I,T) = GATS(1,I,T) * RELFAC(N,I)$$

where

GATS(1,I,T) is the first segment of the data base

N is the isotope being released

T is the year of the release

RELFAC(N,I) is the release factor

REL(N,I,T) is the release.

Both REL(N,I,T) and GATS(1,I,T) are in units of kilograms. Conversion to different units is calculated as follows:

Curies

$$CI(N,I,T) = 1.6283 \times 10^{16} * DECAY(N)/AWT(N) * REL(N,I,T)$$

where

AWT(N) is the atomic weight of isotope N, and

DECAY(N) is the decay constant (sec^{-1}).

Dose

$$REM(N,I,T) = DC(N,I) * CI(N,I,T)$$

where

DC(N,I) is the dose coefficient.

In contrast to ENRADM, ENRADR accesses all of the segments of the data base beyond the first (which contains processed masses). The number of gram atoms of a given isotope are stored on these latter segments, one isotope per segment. The appropriate equation is:

$$REL(N,I,T) = GATS(N+1,I,T) * RELFAC(N,I).$$

The conversion to curies is different in ENRADR because the units of REL (N,I,T) are in gram atoms. The conversion equation is:

$$CI(N,I,T) = 1.6283 \times 10^{13} * DECAY(N) * REL(N,I,T).$$

Both modules calculate doses in the manner indicated by the dose equation for ENRADM. Both modules also calculate dilution factors according to the following equation:

$$DILFAC(N,I,T) = CI(N,I,T)/STD(N,T)$$

where STD(N,T) is the applicable maximum concentration in air or water as specified in the relevant standard. The units DILFAC are cubic meters of air or liters of water.

5.1 RADIOACTIVE RELEASE FACTORS

The ENRADM release factors are in units of kilograms released per kilograms of heavy metal processed each year at the relevant plant. The methodology assumes that the release is proportional to the amount of material processed. For conversion, enrichment and fabrication, this assumption is fairly accurate. For uranium mines and mills, where accumulated piles of waste rock, ore, and tailings increase as the facility ages, the assumption is only appropriate.

The convention adopted in evaluating the release factor for these plants is that the release occurs at the halfway point in the life of the mine. This minimizes the errors associated with the assumed proportionality of release and throughput.

The ENRADR release factors are in units of gram atoms released per grams atoms processed. The isotopic content of the fuel material in the plant must be known in order to evaluate this type of release factor from measurements or other reference sources.

As an example, if a number of curies of a certain isotope are known to be released in a given year, and the amount of the annual heavy metal discharge is known, the concentration of the isotope in the discharged material must be known. This is obtained from a burnup and decay calculation which best describes the material discharged from the reactor during the year of the release. Once the value of the release factor is obtained, then the model is able to adjust the release to reflect changes in the isotopic makeup of the material being processed.

5.2 DOSE COEFFICIENTS

The dose coefficients translate a release in curies into a dose. Currently the following values can be calculated: annual dose to an individual; annual dose to a population; 50-year dose commitment to an individual; and 50-year dose commitment to the population. Doses received by the whole body, gastrointestinal tract, thyroid, bone, and lung are computed.

6.0 NONRADIOACTIVE EFFLUENTS MODEL

Nonradioactive releases are calculated by the ENMAT module. In ENMAT, the data base segment that contains the amount of heavy metal processed by each plant each year is accessed. This quantity is multiplied by the appropriate release factor to obtain the amount of material released in kilograms.

$$REL(N,I,T) = GATS (I,I,T) * RELFAC(N,I)$$

where the plant index I includes all plants in the fuel cycle from mine to reprocessing.

The nonradioactive releases do not have a widely-accepted methodology analogous to the dose concept used for radioactive materials. The dilution factor, however, can serve as an index of the consequences that may result from releasing a given quantity of material to the environment. It is defined as the amount of air or water that would be required to dilute a quantity of material to a concentration specified in an applicable standard. The dilution factor is computed by the following equation:

$$DF(N,I,T) = REL(N,I,T)/STD(N,I)$$

where $STD(N,I)$ is the standard. The units of the standard are mg/l for liquid releases and $\mu\text{g}/\text{m}^3$ for releases to the air.

6.1 NONRADIOACTIVE RELEASE FACTORS

ENMAT release factors are computed by dividing the amount of a given material released by the amount of heavy metal processed during the release period. The assumption is made that the amount of material released is proportional to the plant throughput. This approximation is less exact for the uranium mine and mill because the size of the waste rock, ore and tailings piles grows as the mine ages. The effect of this variation in release sources can be minimized by calculating the release at the midpoint of the facility's operating life.

6.2 DILUTION FACTORS

The standards used in calculating the dilution factor are maximum concentration values for air or water. For air three types of standards are used: emission standards, ambient air quality standards and toxicological standards. For water there are also three types used: federal guidelines and standards, water quality criteria, and toxicity data.

Federal standards have been used for SO_x , CO, particulates, oxidants and hydrocarbons. Water quality criteria published by the EPA can be a valuable source of maximum concentration. When water quality criteria are not available, they can be estimated using toxicology standards.

7.0 REFERENCES

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APPENDIX A

ENGEN INFORMATION AND INPUT INSTRUCTIONS

ENGEN COMPUTER CODE ABSTRACT

1. Name: ENGEN, The ENform Logistics GENerator
2. Computer: ENGEN has been developed and is operational on a Control Data Corporation (CDC) 7600 computer at Brookhaven National Laboratory.
3. Nature of the Problem Solved: The code uses an input LWR nuclear generation scenario with ORIGEN (Bell 1973) isotopic data to solve the nuclear fuel cycle logistics problem. Material mass flows are calculated for uranium, plutonium and 175 radioactive waste isotopes. Throughputs are computed for all fuel cycle operations. If desired, unit costs can be input and the ENCOST code can be exercised yielding fuel cycle cost information.
4. Method of Solution: Mass balance data at each step in the fuel cycle allow monitoring of material mass flows. The detailed models for mining, enrichment, "in reactor" exposure and reprocessing have been discussed in previous sections.
5. Restrictions on the Complexity of the Problem: The maximum scenario length is 100 years. Uranium and plutonium recycles are limited to a maximum of three exposures. Reprocessing, if utilized, is done on a first-in-first-out (FIFO) basis.
6. Typical Running Time: A full recycle case generating a data base will run 4.5 min on the CDC 7000. Logistics cases (no data base production) can be run in 0.5 min.
7. Important Features of the Code: Input holdup times of each fuel cycle facility, various degrees of uranium and plutonium recycle, detailed isotopic information, and economic information are significant features of the ENGEN code.
8. Related Programs: The basic isotopic information used by the ENGEN code is generated by the ORIGEN (Bell 1973) code. ENCOST, ENRADR, ENRADM, ENMAT, and UREM-I are auxilliary codes and use information generated by ENGEN.

9. Machine Requirements: The ENGEN code requires $762,000_8$ locations of storage on the CDC 7600. The code uses up to 4 direct access files and up to 4 binary files as well as normal input and output units. The direct access requirement for a full recycle case with data base production is approximately $4,900,000_{10}$ locations.

ENGEN INPUT DESCRIPTION

Input to the ENGEN program consists of case title information followed by a NAMELIST data block. The following schematic displays the outline of a typical ENGEN input deck:

```
Column 123456....  
    ENGEN CASE 1.25 SCENARIO 2B  
    END  
    $INDATA  
    NAMELIST data for ENGEN  
    $
```

Up to 10 title cards can be utilized. To end the title information, the word "END" should appear starting in Column one. The "\$INDATA" character set initiates the NAMELIST input section. Normal NAMELIST input rules apply to the \$INDATA block. All data must start in Column 2 and end in Column 72. Data can be repeated using the "N*" feature where N is the number of repeated entries. Commas are used as delimiters. The following list describes data input in the \$INDATA block. The default values of \$INDATA variables are displayed in Table A-1.

TABLE A.1. ENGEN Default Values

Variable Index	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
IOPT (1-20)	1	1	0	0	0	0	2000	0	0	1	0	0	0	0	0	0	0	0	0	0	0										
POWCAP (1-100,1)	100*0. (a)																														
POWCAP (1-100,2)	100*0.																														
CAPFAC (1-100,1)	100*0.7																														
CAPFAC (1-100,2)	100*0.7																														
XNCAP (1-40,1)	0.4	0.65	0.65	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.68	0.66	0.64	0.62	0.60	0.58	0.56	0.54	0.52	0.50	0.48	0.46	0.44	0.42	0.40	10*0.
XNCAP (1-40,2)	0.4	0.65	0.65	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.68	0.66	0.64	0.62	0.60	0.58	0.56	0.54	0.52	0.50	0.48	0.46	0.44	0.42	0.40	10*0.
XN (1-17,1)	0.	1.	1.	0.	0.	0.	0.	0.	2.	0.	2.	2.	4.	7.	7.	4.	4.														
XN (1-17,2)	1.	0.	1.	1.	0.	0.	0.	0.	0.	3.	2.	2.	4.	0.	5.	4.	1.														
RXSIZ (1-117,1)	0.	175.	265.	0.	0.	0.	0.	0.	503.	0.	494.	683.	685.	787.	763.	911.25	930.25	100*1156.													
RXSIZ (1-117,2)	200.	0.	70.	63.	0.	0.	0.	0.	0.	436.	726.	674.	696.	0.	904.	866.	1067.	100*1277.													
THEFF (1-8)	0.3389	0.3361	0.3389	0.3361	0.3389	0.3361	0.3389	0.3361																							
ILIFE (1-2)	30	30																													
CORMAS (1-2)	89.1	159.93																													
CORCAP (1-2)	0.7867	0.7779																													
CORPOW (1-2)	1156.	1277.																													
EN (1-28)	0.02	0.026	0.031	0.032	0.032	0.017	0.019	0.019	0.019	0.027	0.026	0.036	0.0473	0.075	0.0292	0.038	0.06375	0.0345	0.0375	0.0478	0.028	0.0315	0.04	0.032	0.032	0.026	0.026	0.026			
EXPDS (1-28)	15000.	25000.	33000.	33000.	33000.	10000.	17000.	20000.	21000.	26000.	27000.	33000.	33000.	33000.	27000.	27000.	27000.	33000.	33000.	33000.	27000.	27000.	27000.	11000.	22000.	7000.	13000.	20000.			
DIS234 (1-28)	1.06-4	1.49-4	1.59-4	1.63-4	1.63-4	7.25-5	6.63-5	6.2-5	6.07-5	1.5-4	1.45-4	4.8-4	1.415-3	3.603-3	4.52-4	1.422-3	4.046-3	1.09-5	2.02-5	4.05-5	1.07-5	2.12-5	4.42-5	2.45-4	2.03-4	2.15-4	1.91-4	1.67-4			
DIS235 (1-28)	9.25-3	8.421-3	7.762-3	8.241-3	8.241-3	9.174-3	7.05-3	5.839-3	5.475-3	7.569-3	6.653-3	1.1024-3	1.9697-2	4.3672-2	8.898-3	1.5726-2	3.5796-2	3.17-3	3.334-3	3.894-3	3.229-3	3.524-3	3.975-3	2.1196-3	1.367-2	1.9097-2	1.3877-2	9.845-3			
DIS236 (1-28)	1.933-3	3.043-3	3.902-3	4.093-3	4.003-3	1.399-3	2.065-3	2.234-3	2.281-3	3.273-3	3.229-3	1.5035-2	4.5876-2	1.2179-1	1.2107-2	3.681-2	1.0032-1	7.16-4	7.03-4	5.94-4	7.3-4	6.84-4	5.96-4	2.015-3	3.271-3	1.268-3	2.169-3	2.803-3			
DIS238 (1-28)	0.96547	0.9529	0.94328	0.44282	0.94282	0.97352	0.96589	0.95305	0.96208	0.95364	0.95325	0.92598	0.87797	0.75624	0.93999	0.90234	0.80289	0.92765	0.91549	0.894917	0.93771	0.92913	0.91241	0.96009	0.95204	0.96909	0.96427	0.95911			
DISP38 (1-28)	2.75-5	7.92-5	1.44-4	1.41-4	1.41-4	1.2-5	3.8-5	5.79-5	6.84-5	8.86-5	9.96-5	7.17-4	2.265-3	5.819-3	4.69-4	1.461-3	3.839-3	6.82-4	1.203-3	2.186-3	5.58-4	9.76-4	1.818-3	8.5-6	4.88-5	3.05-6	1.66-5	4.64-5			
DIS239 (1028)	4.723-3	4.986-3	5.032-3	5.023-3	5.023-3	3.7-3	4.121-3	4.207-3	4.23-3	4.202-3	4.221-3	5.542-3	6.763-3	8.266-3	4.625-3	5.562-3	6.862-3	1.2158-2	1.3443-2	1.5968-2	1.1565-2	1.1925-2	1.347-2	3.763-3	4.784-3	2.673-3	3.708-3	4.092-3			
DIS240 (1-28)	1.543-3	2.015-3	2.206-3	2.186-3	2.186-3	1.052-3	1.647-3	1.853-3	1.91-3	1.92-3	1.992-3	2.097-3	1.826-3	1.229-3	1.906-3	1.667-3	1.145-3	9.493-3	1.2597-2	1.6718-2	8.936-3	1.1449-2	1.6324-2	7.53-4	1.653-3	4.11-4	1.065-3	1.611-3			
DIS241 (1-28)	6.66-4	1.1-3	1.326-3	1.302-3	1.302-3	3.19-4	6.87-4	8.47-4	8.91-4	9.09-4	9.75-4	1.301-3	1.228-3	8.99-4	9.66-4	9.02-4	6.62-4	5.584-3	8.108-3	1.2726-2	4.435-3	6.252-3	9.391-3	1.97-4	7.58-4	6.99-5	3.25-4	6.6-4			
DIS242 (1-28)	1.24-4	3.26-4	5.07-4	4.85-4	4.85-4	4.56-4	1.74-5	2.67-4	3.02-4	3.16-4	3.7-4	4.03-4	2.52-4	9.51-5	3.06-4	1.94-4	7.4-5	3.196-3	6.377-3	1.1468-2	2.503-3	4.771-3	9.251-3	1.79-5	1.59-4	4.61-6	4.78-5	1.64-4			
ITIME (1-11,1)	2	2	2	4	1	4(b)	2	4	1	1	1																				
ITIME (1-11,28)	2	2	2	4	1	12	2	4	1	1	1																				
EFF (1-11,1)	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.																				
EFF (1-11,28)	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.																				
FRCMIL (1-2)	0.8	0.2																													
FRCONV (1-2)	1.	0.																													
FRCEMR (1-2)	1.	1.																													
TAILS (1-100)	0.0022	0.0022	0.002275	97*0.0025																											
RECYCU (1-100,1)	100*1.																														
RECYCU (1-100,28)	100*1.																														
RECYCP (1-100,1)	100*1.																														
RECYCP (1-100,28)	100*1.																														
EMAXU (1-100)	100*0.3																														
EMAXP (1-100)	100*0.3																														
IYRUR	1981																														
IYRUR	1981																														
RFCAP (1-117)	117*0.																														
LSTISO (1-10)	0	0	0	0	0	0	0	0	0	0																					
FRSTA	1																														
FRSTO	100																														
SEPEFP	0.995																														
SEPEPU	0.995																														
NUS	0																														
IB (1-8)	9	11	13	0	0	0	0	0																							
FOLMIN (1-8)	1.	1.	1.	1.	1.	1.	1.	1.																							
CAPLIM (1-8)	1.	1.	1.	1.	1.	1.	1.	1.																							
SEQ (1-8)	1500000.	750000.	2000000.	0.	0.	0.	0.	0.																							
YRI	0.333333																														
YRZ	0.666667																														
LIFE	30																														
THIS	40																														

(a) The NAMELIST convention of "N*" is used to show repeated values of variables. Where "*" appears, the indexed columns do not apply.
(b) Reactor design residence times are nominally in 4 quarter increments. Thus for PWRs 4, 8, and 12 are the design residence times. For BWRs the design increments are 4, 8, 12 and 16 quarters.

TABLE A.2. \$INDATA Namelist Block

Variable	Description	Units
IOPT (1)	-1, calculate PWR base fuel types with maximum print 0, bypass PWR 1, calculate PWR base fuel types with normal print	-
IOPT (2)	-1, calculate BWR base fuel types with maximum print 0, bypass BWR 1, calculate BWR base fuel types with normal print	-
IOPT (3)	-N, do N PWR uranium recycles with maximum print (N<3) 0, bypass PWR uranium recycles N, do N PWR uranium recycles with normal print	-
IOPT (4)	-N, do N BWR uranium recycles with maximum print (N<3) 0, bypass BWR uranium recycles N, do N BWR uranium recycles with normal print	-
IOPT (5)	-N, do N PWR plutonium recycles with maximum print (N<3) 0, bypass PWR plutonium recycles N, do N PWR plutonium recycles with normal print	-
IOPT (6)	-N, do N BWR plutonium recycles with maximum print (N<3) 0, bypass BWR plutonium recycles N, do N BWR plutonium recycles with normal print	-
IOPT (7)	N, the last year to build new reactors; calculate capacity factors 0, reactors have infinite lifetimes; use input capacity factors	years
IOPT (8)	-1, write data base and print all nuclide isotopics 0, don't write base 1, write data base and print only nuclide isotopics identified in LSTISO array	-

TABLE A.2. (contd)

Variable	Description	Units
IOPT (9)	0, don't print detailed mass tables 1, print detailed mass tables	-
IOPT (10)	0, use "design" reactor residence times 1, compute and use reactor residence times based on XNCAP array	-
IOPT (11)	0, include data for oxide fuels in making data base 1, include data for oxide fuels and structural materials in making data base	-
IOPT (12)	0, calculate reprocessing plant schedule, RPCAP 1, use input RPCAP	-
IOPT (13)	0, edit input data 1, no edit of input data	-
IOPT (14)	-2, print each reactor type, total reactor and separate yearling mass flows -1, print each reactor type and total reactor mass flows 0, print total reactor mass flows	-
IOPT (15)	-1, print maximum informative diagnostics 0, print minimum informative diagnostics	-
IOPT (16)	0, bypass cost analysis 1, perform cost analysis for "reprocessing-recycle" 2, perform cost analysis for "reprocessing-recycle" and the difference values between "no reprocessing" and the "reprocessing-recycle" pass 3, perform cost analysis for all three	-
IOPT (17)	-N, use economics data written on TAPE17; the value of N has the same numerical value as IOPT (16) 0, no effect 1, write mass flow data on TAPE17	-
IOPT (18)	0, no effect 1, write U_3O_8 demand schedule on TAPE18	-
POWCAP (1-100,1)	PWR installed capacity by year starting in 1977	MWe

TABLE A.2. (contd)

Variable	Description	Units
OWCAP (1-100,2)	BWR installed capacity by year starting in 1977	MWe
CAPFAC (1-100,1)	PWR capacity factors by year. If IOPT (10) is non-zero, CAPFAC will be computed	-
CAPFAC (1-100,2)	BWR capacity factors by year. If IOPT (10) is non-zero, CAPFAC will be computed	-
XNCAP (1-40,1)	PWR age-capacity factor relationship. A maximum plant life of 40 yr is allowed	-
XNCAP (1-40,2)	BWR age-capacity factor relationship. A maximum plant life of 40 yr is allowed	-
XN (1-17,1)	Number of operating PWRs by year starting in 1960	-
XN (1-17,2)	Number of operating BWRs by year starting in 1960	-
RXSIZ (1-17,1)	Average size of operating PWRs by year starting in 1960	MWe
RXSIZ (1-17,2)	Average size of operating BWRs by year starting in 1960	MWe
THEFF (1-8)	Thermal efficiency for reactor cycles 1-8	-
ILIFE (1)	Lifetime of generic PWR reactor (40 yr maximum)	years
ILIFE (2)	Lifetime of generic BWR reactor (40 yr maximum)	years
CORMAS (1)	Mass of uranium in generic PWR core	MT
CORMAS (2)	Mass of uranium in generic BWR core	MT
CORCAP (1)	Design capacity factor for generic PWR	-
CORCAP (2)	Design capacity factor for generic BWR	-
CORPOW (1)	Design capacity for generic PWR	MWe
CORPOW (2)	Design capacity for generic BWR	MWe
EN (1-28)	Fissile weight fraction by fuel type	-
EXPOS (1-28)	Exposure by fuel type	MWD/MT
DIS234 (1-28)	Discharge weight fraction ^(a) of ^{234}U by fuel type	-

(a) Discharge weight fractions are defined as kg discharged per kg HM charged.

TABLE A.2. (contd)

Variable	Description	Units
DIS235 (1-28)	Discharge weight fraction of ^{235}U by fuel type	-
DIS236 (1-28)	Discharge weight fraction of ^{236}U by fuel type	-
DIS238 (1-28)	Discharge weight fraction of ^{238}U by fuel type	-
DISP38 (1-28)	Discharge weight fraction of ^{238}Pu by fuel type	-
DIS239 (1-28)	Discharge weight fraction of ^{239}Pu by fuel type	-
DIS240 (1-28)	Discharge weight fraction of ^{240}Pu by fuel type	-
DIS241 (1-28)	Discharge weight fraction of ^{241}Pu by fuel type	-
DIS242 (1-28)	Discharge weight fraction of ^{242}Pu by fuel type	-
ITIME (1-11,1)	Residence times for Process Steps 1 to 11 for fuel type 1	quarters
•	•	•
•	•	•
•	•	•
•	•	•
•	•	•
ITIME (1-11,28)	Residence times for Process Steps 1 to 11 for fuel type 28	quarters
EFF (1-11,1)	Efficiencies (mass) for Process Steps 1 to 11 for fuel type 1	-
•	•	-
•	•	-
•	•	-
•	•	-
•	•	-
EFF (1-11,28)	Efficiencies (mass) for Process Steps 1 to 11 for fuel type 28	-
FRCMIL (1)	Fraction of uranium milling done by acid leach process	-
FRCMIL (2)	Fraction of uranium milling done by alkali leach process	-

TABLE A.2. (contd)

Variable	Description	Units
FRCONV (1)	Fraction of conversion done by aqueous process	-
FRCONV (2)	Fraction of conversion done by dry process	-
FRCENR (1)	Fraction of enrichment done by gaseous diffusion	-
FRCENR (2)	Fraction of enrichment done by gas centrifuge	-
FEED	²³⁵ U weight fraction in enrichment feed	-
TAILS (1-100)	²³⁵ U weight fraction in enrichment tails by year starting in 1977	-
RECYCU (1-100,1)	Fraction of uranium to be recycled for fuel type 1 by year	-
•	•	-
•	•	-
•	•	-
•	•	-
•	•	-
RECYCU (1-100,28)	Fraction of uranium to be recycled for fuel type 28 by year	-
RECYCP (1-100,1)	Fraction of plutonium to be recycled for fuel type 1 by year	-
•	•	•
•	•	•
•	•	•
•	•	•
•	•	•
RECYCP (1-100,28)	Fraction of plutonium to be recycled for fuel type 28 by year	-
EMAXU (1-100)	Maximum fraction of steady state LWR fuel replaced by uranium recycle by year	-
IYRUR	Initial year of uranium recycle	-
IYRPUR	Initial year of plutonium recycle	-
RPCAP (1-117)	Reprocessing plant capacity by year starting in 1960. If IOPT (12) is zero ENGEN will calculate a schedule	kg/yr
LSTISO (1-10)	Identification number of nuclide for which detailed isotopic data is required	-
PRSTA	Initial year of printout	-

TABLE A.2. (contd)

Variable	Description	Units
PRSTO	Final year of printout	-
SEPEFP	Separations efficiency for plutonium	-
SEPEPU	Separations efficiency for uranium	-
Ignore the rest of the \$INDATA block unless IOPT (12) is zero		
NUS	Number of years delay between startup of reprocessing plant	-
IB (1-8)	Yearly sequence number of plant startups in years from 1977	-
POLMIN (1-8)	Minimum fractional backlog available before reprocessing plants can start up	-
CAPLIM (1-8)	Reprocessing plants that are capacity limited	-
SEQ (1-8)	Reprocessing plant capacities	kg/yr
YR1	Fraction of capacity achieved for first year of reprocessing plant operation	-
YR2	Fraction of capacity achieved for second year of reprocessing plant operation	-
LIFE	Lifetime of reprocessing plants	yr
IHIS	Last value of IB for which specific plant data is used	-
IU308	Number of blocks of uranium ore in U308TB array (max. 25)	-
U308TB (1-25,1)	Title data describing ore blocks	-
U308TB (1-25,2)	Quantity of reserves	short tons
U308TB (1-25,3)	Recovery cost of U_3O_8	\$/lb- U_3O_8
U308TB (1-25,4)	Fraction of reserves occurring as open pit deposits	-
U308TB (1-25,5)	Ore grade of open pit deposits	U_3O_8
U308TB (1-25,6)	Ore grade of underground deposits	U_3O_8
U308TB (1-25,7)	Recovery fraction (U_3O_8 produced/ U_3O_8 mined for open pit deposits)	-
U308TB (1-25,8)	Recovery fraction (U_3O_8 produced/ U_3O_8 mined for underground deposits)	-

APPENDIX B

ENRADR INFORMATION AND INPUT INSTRUCTIONS

ENRADR COMPUTER CODE ABSTRACT

1. Name: ENRADR: the ENform RADionuclide Report Generator for Ractors and Reprocessing Processes.
2. Computer: ENRADR has been developed and is operational on a Control Data Corporation (CDC) 7600 computer at Brookhaven National Laboratory.
3. Nature of the Problems Solved: ENRADR uses the data base generated by ENGEN (specifically, the isotopic content) to calculate the releases of each radionuclide for each step in the nuclear fuel cycle. Release can be calculated for air or water and reported as grams, gram-atoms, curies, 50-yr dose commitment to an individual, 50-yr dose commitment to the population, or as a dilution factor.
4. Method of Solution: The isotopic contents generated by ENGEN for each scenario are stored on mass storage devices in word addressable form until reports are requested. In addition to these data, dose coefficients, release factors, and dilution standards are input.

Isotopic contents are in units of gram-atoms (GA) for each year. To generate each type of report from the gram-atoms stored on the disc file, the following equations are used:

Grams (GMS) are derived by $GA * Atomic\ Weight\ (AW)$.

Curies (CI) = $GA * Decay\ Constant\ (DIS) * 1.6283 * 10^{13}$

(conversion constant from disintegrations per second per gram-atom).

Grams released (GMSR) = $GMS * released\ factor\ (RF)$.

Curies released (CIR) = $CI * RF$.

50-yr dose commitment (DFYR) = $CIR * dose\ coefficient\ (DC)$.

Dilution factor (DF) = $CI * RF / dilution\ standard\ (DS)$.

5. Restrictions on Complexity of the Problem: The maximum table length is 100 years. Although the logistic solution is done by quarter years in ENGEN, the quarterly amounts are added to produce only annual amounts on the data base.

6. Typical Running Time: A full report for all of the radionuclides released to air or water for the PWR, BWR, and reprocessing combined is 1.8 to 1.9 seconds on the CDC 7600. A specific report showing the dilution factor for a single isotope for a single process takes about 1.5 seconds. Run time can be relatively high due to the word addressable file structure necessary to answer random queries.
7. Important Features of the Code: Generally, the output requested will be in terms of annual activity. ENRADR provides the capability of defining larger increments such as 5 yr or 10 yr time periods. Also, these time periods may start at any year and continue for any specified length. If any data are missing, such as release factors, dilution standards, etc., the missing data for the corresponding isotope are flagged to aid in error tracing.
8. Related Programs: The basic input data used by ENRADR are supplied by ENGEN. The code ENRADM parallels ENRADR but generates reports for the processes of mining through fabrication.
9. Machine Requirements: The ENRADR code requires 124,000₈ words of core on the CDC 7600. The word addressable data storage requirements are scenario dependent. Typical storage requirements range from 5 to 20 million characters.

TABLE B.1. Enradr Input Instructions

Card Type	Column	Variable Descriptions	Format
<u>GENERAL INPUT</u>			
1 - Data Base Control	1-5	IDATA1 - Starting year of the ENGEN data file	I5
	6-10	IDATA2 - Ending year of the ENGEN data file	I5
2 - Solubility Standards ^(a)	1-10	ID - 6 digit ORIGIN Id.	I10
	11-20	IH - Isotopic Symbol	A10
	21-30	IDAT - Date to identify the data contained on this card	A10
	31-40	E(1) - Insoluble Air Standard (μ Ci/ml)	E10
	41-50	E(2) - Soluble Air Standard (μ Ci/ml)	E10
	51-60	E(3) - Insoluble Water Standard (μ Ci/ml)	E10
	61-70	E(4) - Soluble Water Standard (μ Ci/ml)	E10
3 - Release Factors ^(b)	1-6	NUCC - 6 digit ORIGIN Id.	I6
	8	TYPE - 1 = Air, 2 = Water	I1
	10	"2"	I1
	21-30	RF(9) - Release factor for PWR	F10
	31-40	RF(10) - Release factor for BWR	F10
	41-50	RF(11) - Release factor for Reprocessing	F10
	78	IQ(9)(c) - Release factor quality for PWR	I1
	79	IQ(10)(c) - Release factor quality for BWR	I1
	80	IQ(11)(c) - Release factor quality for Reprocessing	I1
<u>CASE SPECIFIC INPUT</u>			
4 - Case Title	1-80	TITLE - Case title	A80
5 - Report Requests and Output Form	1-2	ITYPE - Report output form 1 = Plant type is the major heading. 2 = Isotope is the major heading.	I2
	3-4	UNIT - Type of report desired 1 = Gram-atoms throughput 2 = Grams throughput 3 = Curies throughput 4 = Grams released 5 = Curies released 6 = Dose commitment, 50-yr individual, air 7 = Dose commitment, 50-yr population, air 8 = Dose commitment, 50-yr individual, water 9 = Dose commitment, 50-yr population, water 10 = Dose commitment, 50-yr individual, air & water 11 = Dose commitment, 50-yr population, air & water 18 = Dilution factor, air 19 = Dilution factor, water	I2

TABLE B.1. (contd)

Card Type	Column	Variable Descriptions	Format
5 - Report Requests and Output Form (contd)	5-6	NUMISO - Number of radionuclides to report 99 = all	I2
	7-8	NUMPR - Number of plants to report	I2
	10	MEDIUM - Release medium, 1 = air 2 = water 4 = combined	I1
	13-15	NUMYR - Number of years to report	I3
	19-20	IDOSYR - Dose commitment 1 = first year commitment 50 = fiftieth year commitment	I2
	22-25	ISTART - Starting year of this report	I4
	27-30	IST2 - Year to start incrementing (defaults to ISTART)	I4
	34-35	INCRI - Increment between ISTART and IST2 (defaults to 1)	I2
	39-40	INCR2 - Cumulate and print cumulation (defaults to 1)	I2
	45	ISUM - Cumulate and print cumulation 0 = No 1 = Yes	I1
	50	ISNOT 0 = print all output 1 = print only output with valid release factors	I1
	1-80	ISO(I), where I = 1, NUMISO isotope identification (6 digit ORIGEN Id.) of the radionuclides desired in this report	8(4x,I6)
	1-6	PL(I), where I=1, NUMPR - Plants desired in this report 9 = PWR 10 = BWR 11 = Reprocessing	3I2

- (a) Card type 2 may be repeated for as many radionuclides as there are data and may be in any order. A card with a multi-punch 7-8-9 in column one signals the end of the card type 2 series.
- (b) One card required for each isotope. A card with 999999 punched in columns 1-6 signifies the end of the card type 3 series.
- (c) Release factor qualities are defined as: 1 = a reasonable but unsubstantiated guess; 2 = calculated or based on laboratory measurement; and 3 = based on some plant experience.
- (d) This card is not used if NUMISO = 99.

TABLE B.2. ENRADR PWR Isotope List

<u>Isotope</u>	<u>Origen ID</u>	<u>Air Release</u>	<u>Water Release</u>
³ H	010030	X	X
¹⁴ C	060140	X	
³² P	150320		
⁵¹ Cr	240510	X	X
⁵⁴ Mn	250540	X	X
⁵⁶ Mn	250560		
⁵⁵ Fe	260550	X	X
⁵⁹ Fe	260590	X	X
⁵⁸ Co	270580	X	X
⁶⁰ Co	270600	X	X
⁶⁵ Ni	280650		
⁶⁴ Cu	290640		
⁶⁵ Zn	300650		
⁸³ Br	350830	X	X
⁸⁴ Br	350840	X	X
^{83M} Kr	360831	X	
⁸⁵ Kr	360850	X	
^{85M} Kr	360851	X	
⁸⁷ Kr	360870	X	
⁸⁸ Kr	360880	X	
⁸⁹ Kr	360890	X	
⁸⁶ Rb	370860	X	X
⁸⁸ Rb	370880	X	X
⁸⁹ Rb	370890		
⁸⁹ Sr	380890	X	X
⁹⁰ Sr	380900	X	X
⁹¹ Sr	380910	X	X
⁹² Sr	380920		
⁹⁰ Y	390900	X	X
⁹¹ Y	390910	X	X
^{91M} Y	390911	X	X

TABLE B.2. (contd)

<u>Isotope</u>	<u>Origen ID</u>	<u>Air Release</u>	<u>Water Release</u>
^{92}Y	390920		
^{93}Y	390930	X	X
^{95}Zr	400950	X	X
^{95}Nb	410950	X	X
^{99}Mo	420990	X	X
$^{99\text{M}}\text{Tc}$	430991	X	
^{101}Tc	431010		
^{103}Ru	441030	X	X
^{105}Ru	441050		
^{106}Ru	441060	X	X
^{105}Rh	451050		
^{124}Sb	511240		
$^{125\text{M}}\text{Te}$	521251	X	X
^{127}Te	521270	X	X
$^{127\text{M}}\text{Te}$	521271	X	X
$^{129\text{M}}\text{Te}$	521291	X	X
^{131}Te	521310	X	X
$^{131\text{M}}\text{Te}$	521311	X	X
^{132}Te	521320	X	X
^{130}I	531300	X	X
^{131}I	531310	X	X
^{132}I	531320	X	X
^{133}I	531330	X	X
^{134}I	531340	X	X
^{135}I	531350	X	X
^{133}Xe	541330	X	
$^{133\text{M}}\text{Xe}$	541331	X	
^{135}Xe	541350	X	
$^{135\text{M}}\text{Xe}$	541351	X	
^{137}Xe	541370	X	
^{138}Xe	541380	X	

TABLE B.2. (contd)

<u>Isotope</u>	<u>Origen ID</u>	<u>Air Release</u>	<u>Water Release</u>
¹³⁴ Cs	551340	X	X
¹³⁶ Cs	551360	X	X
¹³⁷ Cs	551370	X	X
¹³⁸ Cs	551380		
¹⁴⁰ La	571400	X	X
¹⁴¹ La	571410		
¹⁴¹ Ce	581410	X	X
¹⁴³ Ce	581430	X	X
¹⁴⁴ Ce	581440	X	X
¹⁴³ Pr	591430	X	X
¹⁴⁴ Pr	591440	X	X
¹⁴⁷ Pm	611470		
¹⁸⁷ W	741870		
²³⁹ Np	932390	X	X

TABLE B.3. ENRADR BWR Isotope List

<u>Isotope</u>	<u>Origen ID</u>	<u>Air Release</u>	<u>Water Release</u>
³ H	010030	X	X
¹⁴ C	060140	X	
³² P	150320		X
⁵¹ Cr	240510	X	X
⁵⁴ Mn	250540	X	X
⁵⁶ Mn	250560		X
⁵⁵ Fe	260550		X
⁵⁹ Fe	260590	X	X
⁵⁸ Co	270580	X	X
⁶⁰ Co	270600	X	X
⁶⁵ Ni	280650		X
⁶⁴ Cu	290640		X
⁶⁵ Zn	300650	X	X
⁸³ Br	350830		X
⁸⁴ Br	350840		X
^{83M} Kr	360831	X	
⁸⁵ Kr	360850	X	
^{85M} Kr	360851	X	
⁸⁷ Kr	360870	X	
⁸⁸ Kr	360880	X	
⁸⁹ Kr	360890	X	
⁸⁶ Rb	370860		
⁸⁸ Rb	370880		
⁸⁹ Rb	370890		X
⁸⁹ Sr	380890	X	X
⁹⁰ Sr	380900	X	
⁹¹ Sr	380910		X
⁹² Sr	380920		X
⁹⁰ Y	390900		
⁹¹ Y	390910		X
^{91M} Y	390911		X

TABLE B.3. (contd)

<u>Isotope</u>	<u>Origen ID</u>	<u>Air Release</u>	<u>Water Release</u>
^{92}Y	390920		X
^{93}Y	390930		X
^{95}Zr	400950	X	
^{95}Nb	410950		
^{99}Mo	420990		X
$^{99\text{M}}\text{Tc}$	430991		X
^{101}Tc	431010		X
^{103}Ru	441030		X
^{105}Ru	441050		X
^{106}Ru	441060		
^{105}Rh	451050		X
^{124}Sb	511240	X	
$^{125\text{M}}\text{Te}$	521251		
^{127}Te	521270		
$^{127\text{M}}\text{Te}$	521271		
$^{129\text{M}}\text{Te}$	521291		X
^{131}Te	521310		X
$^{131\text{M}}\text{Te}$	521311		X
^{132}Te	521320		X
^{130}I	531300		
^{131}I	531310	X	X
^{132}I	531320		X
^{133}I	531330	X	X
^{134}I	531340		X
^{135}I	531350		X
^{133}Xe	541330	X	
$^{133\text{M}}\text{Xe}$	541331	X	
^{135}Xe	541350	X	
$^{135\text{M}}\text{Xe}$	541351	X	
^{137}Xe	541370	X	
^{138}Xe	541380	X	

TABLE B.3. (contd)

<u>Isotope</u>	<u>Origen ID</u>	<u>Air Release</u>	<u>Water Release</u>
¹³⁴ Cs	551340	X	X
¹³⁶ Cs	551360	X	X
¹³⁷ Cs	551370	X	X
¹³⁸ Cs	551380		X
¹⁴⁰ La	571400		X
¹⁴¹ La	571410		X
¹⁴¹ Ce	581410	X	X
¹⁴³ Ce	581430		X
¹⁴⁴ Ce	581440		
¹⁴³ Pr	591430		X
¹⁴⁴ Pr	591440		
¹⁴⁷ Pm	611470		
¹⁸⁷ W	741870		X
²³⁹ Np	932390		X

TABLE B.4. ENRADR Reprocessing Isotope List

<u>Isotope</u>	<u>Origen ID</u>	<u>Air Release</u>	<u>Water Release</u>
³ H	010030	X	
¹⁴ C	060140	X	
³² P	150320		
⁵¹ Cr	240510		
⁵⁴ Mn	250540		
⁵⁶ Mn	250560		
⁵⁵ Fe	260550		
⁵⁹ Fe	260590		
⁵⁸ Co	270580		
⁶⁰ Co	270600		
⁶⁵ Ni	280650		
⁶⁴ Cu	290640		
⁶⁵ Zn	300650		
⁸³ Br	350830		
⁸⁴ Br	350840		
^{83M} Kr	360831		
⁸⁵ Kr	360850	X	
^{85M} Kr	360851		
⁸⁷ Kr	360870		
⁸⁸ Kr	360880		
⁸⁹ Kr	360890		
⁸⁶ Rb	370860		
⁸⁸ Rb	370880		
⁸⁹ Rb	370890		
⁸⁹ Sr	380890	X	
⁹⁰ Sr	380900	X	
⁹¹ Sr	380910		
⁹² Sr	380920		
⁹⁰ Y	390900	X	
⁹¹ Y	390910	X	
^{91M} Y	390911		

TABLE B.4. (contd)

<u>Isotope</u>	<u>Origen ID</u>	<u>Air Release</u>	<u>Water Release</u>
^{92}Y	390920		
^{93}Y	390930		
^{95}Zr	400950	X	
^{95}Nb	410950	X	
^{99}Mo	420990		
$^{99\text{M}}\text{Tc}$	430991		
^{101}Tc	431010		
^{103}Ru	441030	X	
^{105}Ru	441050		
^{106}Ru	441060	X	
^{105}Rh	451050		
^{124}Sb	511240		
$^{125\text{M}}\text{Te}$	521251		
^{127}Te	521270		
$^{127\text{M}}\text{Te}$	521271		
$^{129\text{M}}\text{Te}$	521291		
^{131}Te	521310		
$^{131\text{M}}\text{Te}$	521311		
^{132}Te	521320		
^{130}I	531300		
^{131}I	531310	X	
^{132}I	531320		
^{133}I	531330		
^{134}I	531340		
^{135}I	531350		
^{133}Xe	541330		
$^{133\text{M}}\text{Xe}$	541331		
^{135}Xe	541350		
$^{135\text{M}}\text{Xe}$	541351		
^{137}Xe	541370		
^{138}Xe	541380		

TABLE B.4. (contd)

<u>Isotope</u>	<u>Origen ID</u>	<u>Air Release</u>	<u>Water Release</u>
¹³⁴ Cs	551340	X	
¹³⁶ Cs	551360		
¹³⁷ Cs	551370	X	
¹³⁸ Cs	551380		
¹⁴⁰ La	571400		
¹⁴¹ La	571410		
¹⁴¹ Ce	581410	X	
¹⁴³ Ce	581430		
¹⁴⁴ Ce	581440	X	
¹⁴³ Pr	591430		
¹⁴⁴ Pr	591440		
¹⁴⁷ Pm	611470	X	
¹⁸⁷ W	741870		
²³⁹ Np	932390		

APPENDIX C

ENRADM INFORMATION AND INPUT INSTRUCTIONS

ENRADM COMPUTER CODE ABSTRACT

1. Name: ENRADM: The ENFORM RADIONUCLIDE Report Generator for Mines through mixed oxide ($\text{PuO}_2\text{-UO}_2$) fabrication.
2. Computer: ENRADM has been developed and is operational on a Control Data Corporation (CDC) 7600 computer at Brookhaven National Laboratory.
3. Nature of the Problems Solved: ENRADM uses the data base generated by ENGEN (specifically the mass flows) to calculate the releases of each radionuclide for each plant in the fuel cycle process. Releases can be generated for air or water and reported as grams, gram-atoms, curies, 50 year dose commitment to an individual, or 50 year dose to the population.
4. Method of Solution: The mass flows generated by ENGEN for each scenario are stored on mass storage devices in word addressable form until reports are requested. In addition to these data, dose coefficients, release factors, and decay constants are input.

Mass flows are in units of kg product (KGP) for each year. To generate each type of report from the gram-atoms stored on the data file the following equations are used:

Grams (GMS) are derived by $\text{KGP} * 1000$

Curies (Ci) = $\text{GMS}/\text{AWT} * \text{decay constant (DIS)} * 1.6283 * 10^{13}$

(conversion constant from disintegrations per second per gram atom to Curies).

Grams released (GMSR) = $\text{GMS} * \text{release factor (RF)}$.

Curies released (CIR) * RF. 50-yr dose commitment (DFYR) = $\text{CIR} * \text{dose coefficient (DC)}$

50-yr dose commitment (DFYR) = $\text{CIR} * \text{dose coefficient (DC)}$.

5. Restrictions on Complexity of the Problem: The maximum table length is 100 years. Although the logistic solution is done by quarter years in ENGEN the quarterly amounts are added to produce only annual amounts on the data base.
6. Typical Running Time: A full report with the dose released by all of the radionuclides to air and water for the mines, mill, conversion, enrichment, and uranium fabrication combined is 3 to 4 seconds on the CDC 7600. A specific report with only one isotope and one process takes about one second.

7. Important Features of the Code: Generally, all output requested will be printed, even if the result is non-existent or zero. These zero tables may be suppressed to reduce the volume of output.

If any data are missing, such as release factors, decay constants, etc., the missing data for the corresponding isotope is flagged to aid in error tracing.

8. Related Programs: The basic input used by ENRADM is supplied by ENGEN. The code ENRADR parallels ENRADM but generates reports for the reactor and reprocessing processes. The code DOSFL is used to restructure and store the dose coefficients on a mass storage device for use by ENRADM and ENRADR.
9. Machine Requirements: The ENRADM code requires 117,000 words of core on the CDC 7600. The word addressable data storage requirements are scenario dependent. Typical storage requirements range from 5 to 20 million characters.

TABLE C.1. ENRADM Input Instructions

Card Type	Column	Variable Description	Format
<u>GENERAL INPUT</u>			
1 - Data Base Control	1-5 6-10	IDATA1 - Starting year of the ENGEN data file IDATA2 - Ending year of the ENGEN data file	I5 I5
2 - Decay Constants ^(a)	1-5 10-15 17-18 20-22 23 26-35 36-45	I - Card number NUK(I) - 6 digit ORIGEN Id. NAME(I,1) - Chemical symbol NAME(I,2) - Atomic weight NAME(I,2) - M = Metastable AWT(I) - Atomic weight DECAY(I) - Decay constant	I5 I6 A2 A2 A1 E10 E10
3A - Release Factors ^(b)	1-6 8 10 11-20 21-30 31-40 41-50 51-60 61-70 71-80	NUCC - 6 digit ORIGEN Id. Type 1 = air 2 = water "1" RF(1) - Release factor for underground mine RF(2) - Release factor for open pit mine RF(3) - Release factor for acid leach mill RF(4) - Release factor for alkali leach mill RF(5) - Release factor for aqueous conversion RF(6) - Release factor for enrichment RF(7) - Release factor for uranium fabrication	I6 I1 I1 F10 F10 F10 F10 F10 F10 F10
3B - Release Factors ^(b)	1-6 8 10 11-20 70 71 72 73 74 75 76 77	NUCC - 6 digit ORIGEN Id. Type 1 = air 2 = water "2" RF(8) - Release factor for mixed oxide fabrication IQ(1)(c) - Release factor quality for underground mine IQ(2)(c) - Release factor quality for open pit mine IQ(3)(c) - Release factor quality for acid leach mill IQ(4)(c) - Release factor quality for alkali leach mill IQ(5)(c) - Release factor quality for aqueous conversion IQ(6)(c) - Release factor quality enrichment IQ(7)(c) - Release factor quality for uranium fabrication IQ(8)(c) - Release factor quality for mixed oxide fabrication	I6 I1 I1 F10 I1 I1 I1 I1 I1 I1 I1 I1
<u>CASE SPECIFIC INPUT</u>			
4 - Case Title	1-80	TITLE - Case Title	A80
5-Report Requests and Output Form	1-2 3-4	ITYPE - Report output form 1 = Plant type is the major heading 2 = Isotope is the major heading UNIT - Type of report desired 1 = Gram-atoms throughput 2 = Grams throughput 3 = Curies throughput 4 = Grams released	I2 I2

ENRADM INPUT INSTRUCTIONS (contd)

<u>Card Type</u>	<u>Column</u>	<u>Variable Descriptions</u>	<u>Format</u>
5 - Report Requests and Output Form (cond)		5 = Curies released	
		6 = Dose commitment, 50 year individual, air	
		7 = Dose commitment, 50 year population, air	
		8 = Dose commitment, 50 year individual, water	
		9 = Dose commitment, 50 year population, water	
		10 = Dose commitment, 50 year individual, air and water	
		11 = Dose commitment, 50 year population, air and water	
	5-6	NUMISO - Number of radionuclides to report, 99 = all	I2
	7-8	NUMPR - Number of plants to report	I2
	10	MEDIUM - Release medium	I1
		1 = air	
		2 = water	
		4 = combined	
	13-15	NUMYR - Number of years to report	I3
	17-20	ISTART - Starting year of this report	I4
	24-25	IDOSYR - Dose commitment	I2
		1 = First year commitment	
		50 = Fiftieth year commitment	
6 - Radionuclide Identification ^(d)	1-80	ISO(I), where I = 1, NUMISO isotope identification (6 digit ORIGIN Id) of the radionuclides desired in this report	8(4x,I6)
7 - Plant Identification	1-16	PL(I), where I = 1, NUMPR 1 = Underground mine 2 = Open pit mine 3 = Acid leach mill 4 = Alkali leach mill 5 = Aqueous conversion 6 = Enrichment 7 = Uranium fabrication 8 = Mixed oxide fabrication	8I2

- (a) Card type 2 may be repeated for as many radionuclides as there is data and may be in any order. A card with a multi-punch 7-8-9 in column one signals the end of the card type 2 series.
- (b) Two cards required for each isotope. Nine cards with 999999 punched in columns 1-6 signifies the end of the card type 3 series.
- (c) Release factor qualities are defined as: 1 = a reasonable but unsubstantiated guess. 2 = calculated or based on laboratory measurement; and 3 = based on some plant experience.
- (d) This card is not used if NUMISO = 99.

TABLE C.2. ENRADM Underground Mine
Isotope List

<u>Isotope</u>	<u>Origen ID</u>	<u>Air Release</u>	<u>Water Release</u>
^{222}Rn	862220	X	
^{226}Ra	882260	X	X
^{230}Th	902300		
^{234}Th	902340		
^{235}U	922350	X	X
^{238}U	922380	X	X
^{234}U	922340	X	X
^{238}Pu	942380		
^{239}Pu	942390		
^{240}Pu	942400		
^{241}Pu	942410		
^{242}Pu	942420		

TABLE C.3. ENRADM Surface Mine
Isotope List

<u>Isotope</u>	<u>Origen ID</u>	<u>Air Release</u>	<u>Water Release</u>
^{222}Rn	862220	X	
^{226}Ra	882260	X	
^{230}Th	902300		
^{234}Th	902340		
^{235}U	922350	X	
^{238}U	922380	X	
^{234}U	922340	X	
^{238}Pu	942380		
^{239}Pu	942390		
^{240}Pu	942400		
^{241}Pu	942410		
^{242}Pu	942420		

TABLE C.4. ENRADM Acid Leach Mill
Isotope List

<u>Isotope</u>	<u>Origen ID</u>	<u>Air Release</u>	<u>Water Release</u>
^{222}Rn	862220	X	
^{226}Ra	882260	X	X
^{230}Th	902300	X	X
^{234}Th	902340		
^{235}U	922350	X	X
^{238}U	922380	X	X
^{234}U	922340	X	X
^{238}Pu	942380		
^{239}Pu	942390		
^{240}Pu	942400		
^{241}Pu	942410		
^{242}Pu	942420		

TABLE C.5. ENRADM Aqueous Conversion
Isotope List

<u>Isotope</u>	<u>Origen ID</u>	<u>Air Release</u>	<u>Water Release</u>
^{222}Rn	862220		
^{226}Ra	882260		
^{230}Th	902300		
^{234}Th	902340		
^{235}U	922350	X	X
^{238}U	922380	X	X
^{234}U	922340	X	X
^{238}Pu	942380		
^{239}Pu	942390		
^{240}Pu	942400		
^{241}Pu	942410		
^{242}Pu	942420		

TABLE C.6. ENRADM Enrichment Cascade
Isotope List

<u>Isotope</u>	<u>Origen ID</u>	<u>Air Release</u>	<u>Water Release</u>
^{222}Rn	862220		
^{226}Ra	882260		
^{230}Th	902300		
^{234}Th	902340		X
^{235}U	922350	X	X
^{238}U	922380	X	X
^{234}U	922340	X	X
^{238}Pu	942380		
^{239}Pu	942390		
^{240}Pu	942400		
^{241}Pu	942410		
^{242}Pu	942420		

TABLE C.7. ENRADM Uranium Fuel Fabrication
Isotope List

<u>Isotope</u>	<u>Origen ID</u>	<u>Air Release</u>	<u>Water Release</u>
^{222}Rn	862220		
^{226}Ra	882260		
^{230}Th	902300		
^{234}Th	902340		
^{235}U	922350	X	X
^{238}U	922380	X	X
^{234}U	922340	X	X
^{238}Pu	942380		
^{239}Pu	942390		
^{240}Pu	942400		
^{241}Pu	942410		
^{242}Pu	942420		

TABLE C.8. ENRADM Mixed Oxide Fabrication
Isotope List

<u>Isotope</u>	<u>Origen ID</u>	<u>Air Release</u>	<u>Water Release</u>
^{222}Rn	862220		
^{226}Ra	882260		
^{230}Th	902300		
^{234}Th	902340		
^{235}U	922350	X	X
^{238}U	922380	X	X
^{234}U	922340	X	X
^{238}Pu	942380	X	X
^{239}Pu	942390	X	X
^{240}Pu	942400	X	X
^{241}Pu	942410	X	X
^{242}Pu	942420	X	X

APPENDIX D

ENMAT INFORMATION AND INPUT INSTRUCTIONS

ENMAT COMPUTER CODE ABSTRACT

1. Name: ENMAT - The ENform MAterials Report Generator for all plants in the nuclear fuel cycle.
2. Computer: ENMAT has been developed and is operational on a Control Data Corporation (CDC) 7600 computer at Brookhaven National Laboratory.
3. Nature of the Problem Solved: ENMAT uses the data base file generated by ENGEN (specifically the mass flows) to calculate the quantities of materials released from each plant in the nuclear fuel cycle. Releases can be generated for air or water and reported as kilograms. These releases may also be presented as a dilution factor in cubic meters of air or liters of water.
4. Method of Solution: The mass flows generated by ENGEN for each scenario are stored on mass storage devices in word addressable form until reports are requested. In addition to these data, release factors and dilution standards are also required as input.

Mass flows are in terms of kilograms (kg). Kilograms released = $\text{kg} \times \text{release factor (RF)}$. Dilution factor = $\text{kg} \times \text{RF} / \text{dilution standard}$.

5. Restrictions on Complexity of the Problem: The maximum table length is 100 years.
6. Typical Running Time: A full report with material releases for all nuclear fuel cycle plants (mines, mill, conversion, enrichment, fabrication, reactor, and reprocessing) for air and water combined, takes about 6 seconds.
7. Important Features of the Code: In addition to the two basic types of tabled output (material releases and dilution factors) the control efficiency and effluent rates are also printed. An important capability of ENMAT is accomplished in a subprogram named RANK. RANK allows for the restructuring of the ENMAT output in a user specified hierarchy. This, in turn, provides output that shows which materials are most prevalent and in which plant they occur.

8. Related Programs: The basic input used by ENMAT is supplied by ENGEN. The codes ENRADR and ENRADM generate similar reports for the radionuclides. The program RANK restructures the output generated by ENMAT (see Item 7 above).
9. Machine Requirements: The ENMAT code Requires 105,000 words of core on the CDC 7600. The subprogram RANK uses 18,000 words of core. The word addressable data storage requirements are scenario dependent. Typical storage requirements range from 5 to 20 million characters.

TABLE D.1. ENMAT Input Instructions

Card Type	Column	Variable Descriptions	Format
1 - Title	1-80	TITLE - 80 column narrative	A80
2 - Case Identification	5	INVOL - 1 = mass flows	I1
	8-10	ITP - Number of years to be printed ≤ 100	I3
	12-15	IBTP - Beginning calendar year of output	I4
	20	NAP	I1
		1 = all plants are reported	
		2 = only selected plants are reported	
	25	NASC	I1
		1 = all materials are reported	
		2 = only selected materials are reported	
	30	IRPTP	I1
		1 = plant is major heading	
		2 = materials is major heading	
		3 = both types printed	
	35	IDIL	I1
		1 = material release report	
		2 = dilution factor report	
	37-40	IBASE - Beginning year of ENGEN data file	I4
	45	IRANK	I1
		0 = based report only	
		1 = ranked report only	
		2 = both	
3 - Plant Identification ^(a)	4-5	NP - Number of plants desired	I2
	6-60	NUMPC(I), where I = 1 through NP	11(3x,I2)
		1 = underground mine	
		2 = open pit mine	
		3 = acid leach mill	
		4 = alkali leach mill	
		5 = aqueous conversion	
		6 = enrichment	
		7 = uranium fabrication	
		8 = mixed oxide fabrication	
		9 = PWR	
		10 = BWR	
		11 = reprocessing	
	1-80	PLANT(I), PCAP(I), where I = 1 through 11 - plant number and plant capacity (see card type 3)	8(1x,I2,F7)
4 - Plant Capacities ^(b)			
5a - Release Factors (where I ≤ 300)(c)	4	KEMCLAS(I,1) - Card number "1"	I1
	6-7	KEMOUT(I,1) - Plant number (see card type 3)	I2
	10-16	KEMOUT(I,3) - Material class(d)	I7
	21-40	KEMOUT(I,6-8) - Material name	A21
	43-52	KEMOUT(I,9)) - Release factor, air	F10
	55	KEMOUT(I,12) - Release factor quality, air ^(e)	I1
	56-64	KEMOUT(I,10) - Release factor, water	F10
	67	KEMOUT(I,13) - Release factor quality, water ^(e)	I1
5b - Dilution Standards (where I ≤ 300)(c)	4	KEMCLAS(I,2) - Card number "2"	I1
	6-7	KEMSTD(I,1) - Plant number (see card type 3)	I2
	10-16	KEMSTD(I,2) - Material Class(d)	I7
	17-26	KEMSTD(I,6) - Dilution standard, air	F10
	29-35	KEMSTD(I,7) - Type of standard, air	A7
	37-38	KEMSTD(I,8)	A2
		S = current air standard	
		NS = non-standard	
	39-48	KEMSTD(I,9) - Dilution standard, water	F10
	51-57	KEMSTD(I,10) - Type of standard, water	A7
	59-60	KEMSTD(I,11)	A2
		S = current water standard	
		NS = non-standard	
	61-70	RU(I,3) - Reciprical volumn factor, air	F10
	71-80	RU(I,4) - Reciprical volumn factor, water	F10

TABLE D.1. (contd)

<u>Card Type</u>	<u>Column</u>	<u>Variable Descriptions</u>	<u>Format</u>
6 - Material Report List ^(f)	8-10 11-80	NCM - Number of materials to report NUMEM(I), where I = 1 through NCM - materials required in this report (pre-defined 7 digit material Id.)	I3 7(3x,I7)

(a) Card type 3 used only if NAP = 2.

(b) Card type 4 used only if IDSL = 2.

(c) Card type 5a and 5b are used in pairs. A card with 9999 in columns 1-4 signals the end of the type 5 series.

(d) See Table 1.

(e) Release factor qualities are defined as:

1 = a reasonable but unsubstantiated guess

2 = calculated or based on laboratory measurement

3 = based on some plant experience.

(f) Card type 6 is used only if NASC = 2. If more than seven materials are required, additional card type 6s may be used with a 8(8x,I7) format.

TABLE D.2. RANK Input Instructions

Card Type	Column	Variable Descriptions	Format
1 - General Control	3-5	NFIL - Number of material records generated by ENMAT	I3
	8-10	NUMRK - Number of required in final ranking ($\leq$ NFIL)	
	12-15	IYR - Year in which ranking is required IYR = 0 if other than annual ranking required	I4
	20	ISORT - Type of ranking desired (when IYR = 0)	I1
		3 = release factor	
		4 = dilution standard	
		5 = effluent rate	
		6 = control efficiency	
		7 = average material release	
		8 = cumulative material release	
	21-25	TYPE - Medium of material release to be ranked "AIR" or "WATER" (left justified)	A5
	34-35	INC - Time period increment desired in printout	I2
	41-52	CYCLE - Scenario description	A12
	60	IDIL - Type of file generated by ENMAT	I1
		1 = kilograms released	
		2 = dilution factors	
65		IPRNT	I1
		1 = summary printout	
		2 = complete printout	
66-70		3 = both	
		IBASE - Beginning year of ENMAT data file	I4

TABLE D.3. Material Numbering System

<u>Digit</u>	<u>Value</u>	<u>Description</u>
1	1	Element
	2	Compound
	3	Mixture
2	1	Metal
	2	Non-metal
	3	Organic
	4	Inorganic
3	1	Actinide
	2	Radioactive, non-actinide
	3,5	Non-radioactive
4,5,6,7	Arbitrary sequence for materials where the first 3 digits are equal.	

TABLE D.4. Underground Mine Effluent
Material List

<u>Effluent Material</u>	<u>Material ID</u>	<u>Air Release</u>	<u>Water Release</u>
Benzo(a)pyrene	2300017	X	
Aldehydes	2300001	X	
Hydrocarbons	2300002	X	
Carbon Monoxide	2400001	X	
Nitrogen Oxides	2400002	X	
Sulfur Oxides	2400003	X	
Rock Dust	3000001	X	
Particulates	3000002	X	
Cadmium	1130022	X	
Sulfur	1230001	X	
Uranium	1110001	X	X
Lead	1130023	X	X
Beryllium	1130021	X	X
Zinc	1130003	X	X
Kjeldahl Nitrogen	1250004		X
Phosphate	2400014		X
Selenium	1130002		X
Copper	1130024		X
Fluoride	2400007		X
Silica	2430002		X
Chloride	2400004		X
Magnesium	1130009		X
Calcium	1130007		X
Nitrate	2400005		X
Sulfate	2400006		X
Sodium	1130010		X
Ammonia	2400023		X
Aluminum	1130017		X
Titanium	1130025		X
Arsenic	1130006		X
Molybdenum	1130005		X
Vanadium	1130001		X
Suspended Solids	3000003		X
Manganese	1130006		X
Iron	1130012		X

TABLE D.5. Surface Mine Effluent
Material List

<u>Effluent Material</u>	<u>Material ID</u>	<u>Air Release</u>	<u>Water Release</u>
Uranium	1110001	X	
Carbon Monoxide	2400001	X	
Nitrogen Oxides	2400002	X	
Sulfur Oxides	2400003	X	
Aldehydes	2300001	X	
Particulates	3000002	X	
Hydrocarbons	2300002	X	
Rock Dust	3000001	X	
Kjeldahl Nitrogen	1250004		X
Nitrate	2400005		X
Selenium	1130002		X
Ammonia	2400023		X
Phosphorous	1250009		X
Fluoride	2400007		X
Aluminum	1130017		X
Beryllium	1130021		X
Calcium	1130007		X
Magnesium	1130009		X
Titanium	1130025		X
Molybdenum	1130005		X
Vanadium	1130001		X
Arsenic	1130006		X
Iron	1130012		X
Lead	1130023		X
Zinc	1130003		X

TABLE D.6. Acid Leach Mill Effluent
Material List

<u>Effluent Material</u>	<u>Material ID</u>	<u>Air Release</u>	<u>Water Release</u>
Particulates	3000002	X	
Rock Dust	3000001	X	
Sulfur Oxides	2400003	X	
Nitrogen Oxides	2400002	X	
Hydrocarbon	2300002	X	
Aldehydes	2300001	X	
Kerosene	2300003	X	
Uranium	1110001	X	X
Ammonia	2400023	X	X
Sulfuric Acid	2400030		
Isodecanol	2300018		X
Organic Acids	2300016	X	
Magnesium	1130009		X
Manganese	1130008		X
Silver	1130014		X
Cyanide	2400029		X
Sulfide	2400028		X
Titanium	1130025		X
Zinc	1130003		X
Lead	1130023		X
Nickel	1130013		X
Copper	1130024		X
Molybdenum	1130005		X
Chromium	1130026		X
Beryllium	1130021		X
Vanadium	1130001		X
Fluoride	2400007		X
Sulfate	2400006		X
Chloride	2400004		X
Aluminum	1130017		X
Iron	1130012		X
Sodium	1130010		X
Tertiary Amine	2300017		X
Calcium	1130007		X
Arsenic	1130006		X

TABLE D.7. Aqueous Conversion Effluent
Material List

<u>Effluent Material</u>	<u>Material ID</u>	<u>Air Release</u>	<u>Water Release</u>
Particulates	3000002	X	
Sulfur Oxides	2400003	X	
Nitrogen Oxides	2400002	X	
Carbon Monoxide	2400001	X	
Hydrocarbons	2300002	X	
Hydrogen Fluoride	2400012	X	
Hexane	2300013	X	
Fluorine	1250008	X	
Uranium	1110001	X	X
Fluoride	2400007		X
Copper	1130024		X
Sodium	1130010		X
Iron	1130012		X
Barium	1130027		X
Aluminum	1130017		X
Chloride	2400004		X
Sulfate	2400006		X
Calcium	1130007		X
Nitrate	2400005		X
Zinc	1130003		X

TABLE D.8. Enrichment Cascade Effluent Material List

<u>Effluent Material</u>	<u>Material ID</u>	<u>Air Release</u>	<u>Water Release</u>
Particulates	3000002	X	
Hydrogen Fluoride	2400012	X	
Sulfur Oxides	2400003	X	
Nitrogen Oxides	2400002	X	
Carbon Monoxide	2400001	X	
Kerosene	2300003	X	
Hydrocarbons	2300002	X	
Freon	2400024	X	
Xylol	2300009	X	
Acetone	2300008	X	
Trichlorethylene	2300007	X	
Chloroethene	2300006	X	
Ozone	1250007	X	
Uranium	1110001	X	X
Ammonia	2400023	X	X
Tributylphosphate	2300010		X
Varsol	2300011		X
Nickel	1130013		X
Iron	1130012		X
Copper	1130024		X
Chloride	2400004		X
Calcium	1130007		X
Cadmium	1130022		X
Fluoride	2400007		X
Nitrate	2400005		X
Chromium	1130026		X
Aluminum	1130017		X
Chlorine	1250010		X
Zinc	1130003		X
Phosphate	2400014		X
Sodium	1130010		X
Manganese	1130008		X
Silver	1130014		X
Molybdenum	1130005		X
Magnesium	1130009		X
Boron	1250002		X
Sulfite	2400018		X
Sulfate	2400006		X

TABLE D.9. Uranium Fuel Fabrication Effluent Material List

<u>Effluent Material</u>	<u>Material ID</u>	<u>Air Release</u>	<u>Water Release</u>
Isopropyl Alcohol	2300023	X	
Glycol Ethyl Ether	2300022	X	
Methyl Butyl Ketone	2300021	X	
Butanol	2300020	X	
Xylol	2300009	X	
Nitric Acid	2400028	X	
Zirconium	1130028		
Particulates	3000002	X	
Hydrogen Fluoride	2400012	X	
Sulfur Oxides	2400003	X	
Nitrogen Oxides	2400002	X	
Carbon Monoxide	2400001	X	
Hydrocarbons	2300002	X	
Ammonium Fluoride	2400019	X	
Uranium (Enriched)	1110001	X	X
Ammonia	2400023	X	X
Phosphorous	1250009		X
Boron	1250002		X
Chloride	2400004		X
Oil and Grease	2300014		X
Sulfite	2400018		X
Iron	1130012		X
Sulfate	2400006		X
Copper	1130024		X
Fluoride	2400007		X
Nitrate	2400005		X
Calcium	1130007		X
Sodium	1130010		X
Silver	1130014		X
Nickel	1130013		X
Magnesium	1130009		X
Manganese	1130008		X
Molybdenum	1130005		X

TABLE D.10. Mixed Oxide Fabrication Effluent Material List

<u>Effluent Material</u>	<u>Material ID</u>	<u>Air Release</u>	<u>Water Release</u>
Sulfur Oxides	2400003	X	
Hydrocarbons	2300002	X	
Nitrogen Dioxide	2400021	X	
Uranium (Enriched)	1110001	X	X
Plutonium	1110005	X	X
Phosphates	2400014		X
Sulfate	2400006		X
Nitrate	2400005		X
Chloride	2400004		X
Sodium	1130010		X

TABLE D.11. PWR Effluent Material List

<u>Effluent Material</u>	<u>Material ID</u>	<u>Air Release</u>	<u>Water Release</u>
Particulates	3000002	X	
Sulfur Oxides	2400003	X	
Nitrogen Oxides	2400002	X	
Hydrocarbons	2300002	X	
Aldehydes	2300001	X	
Carbon Monoxide	2400001	X	
Bicarbonate	2400022	X	
Magnesium	1130009	X	
Chloride	2400004	X	
Calcium	1130007	X	
Silica	2430002	X	
Potassium	1130020	X	
Sodium	1130010	X	X
Sulfate	2400006	X	X
Phosphates	2400014		X
Sulfite	2400018		X
Lithium	1130029		X
Volatile Amines	2300015		X
Chlorine	1250010		X
Boron	1250002		X

TABLE D.12. BWR Effluent Material List

<u>Effluent Material</u>	<u>Material ID</u>	<u>Air Release</u>	<u>Water Release</u>
Particulates	3000002	X	
Hydrocarbons	2300002	X	
Sulfur Oxides	2400003	X	
Nitrogen Oxides	2400002	X	
Silica	2430002	X	
Phosphate	2400014	X	X
Magnesium	1130009	X	X
Chloride	2400004	X	X
Nitrate	2400005	X	X
Chlorine	1250010	X	X
Calcium	1130007	X	X
Sulfate	2400006	X	X
Sodium	1130010	X	X
Bicarbonate	2400022	X	X

TABLE D.13. Reprocessing Effluent Material List

<u>Effluent Material</u>	<u>Material ID</u>	<u>Air Release</u>	<u>Water Release</u>
Fluorine	1250008	X	
Hydrogen Sulfide	2400011	X	
Hydrocarbons	2300002	X	
Nitrogen Oxides	2400002	X	
Sulfur Oxides	2400003	X	
Hydrogen Fluoride	2400012	X	
Ammonia	2400023	X	
Particulates	3000002	X	
Carbon Monoxide	2400001	X	
Chloride	2400004		X
Potassium	1130020		X
Calcium	1130007		X
Magnesium	1130009		X
Iron	1130012		X
Phosphate-Ortho	1250009		X
Nitrate	2400005		X
Carbon Dioxide	2400027		X
Sulfate	2400006		X
Sodium	1130010		X
Sulfite	2400013		X

APPENDIX E

ENCOST INFORMATION AND INPUT INSTRUCTIONS

ENCOST COMPUTER CODE ABSTRACT

1. Name: ENCOST, the ENform System Fuel Cycle COST Analysis Program.
2. Computer: ENCOST has been developed and is operational on a Control Data Corporation (CDC) 7600 computer.
3. Nature of the Problem Solved: The ENCOST code is executed as a subprogram of the ENGEN module. The ENCOST code can be executed in conjunction with an ENGEN run or executed alone using data as stored from previous ENGEN runs. The basic output from ENCOST is detailed cost reports on the particular fuel cycle evaluated. Cash flow data is calculated and used to produce levelized costs for each segment of the fuel cycle operation.
4. Method of Solution: Input unit costs are used with material mass flows at each fuel cycle operation to compute cash flows. These cash flows and power generation data are discounted and used to predict a power cost in mills per kilowatt-hour.
5. Restrictions on Complexity of the Problem: As with the ENGEN code, the maximum scenario length is limited to 100 years.
6. Typical Running Time: Executing the ENCOST program requires about three seconds on the CDC 7600.
7. Important Features of the Code: The annual cost of U_3O_8 (yellowcake) can either be input directly or a depletion algorithm can be used. The depletion algorithm models the depletion of domestic resources by the mining of more costly ore deposits. The projected U_3O_8 costs reflect this depletion.
8. Related Programs: Usually ENCOST will either be executed in conjunction with ENGEN or it will use data generated by ENGEN in a previous run. It is possible to run ENCOST with alternative data (not generated by ENGEN) if the input file is compatible. The input data format is specified in the input instructions.

9. Machine Requirements: Currently ENCOST is executed as an option in the ENGEN module. The machine requirements are identical with the ENGEN module.

TABLE E.1. \$CSTDAT Namelist Block

Variable	Description	Units
CINPRT (1-100)	Quantity of imported U_3O_8 by year	short tons U_3O_8
CONMIT (1-100,2)	Quantity of U_3O_8 delivered by year under contractual agreement	short tons U_3O_8
CONMIT (1-100,2)	Price of U_3O_8 delivered by year under contractual agreement	\$/lb
DFB (1-100)	Demand from foreign buyers by year	short tons U_3O_8
FRKK	Reciprocal of FRKK is the maximum fraction of any given ore block mined in one year	--
PMKT	Plutonium demand by year	kg fissile Pu/year
RINT	Discount factor	
UOPMN (1-100)	Cost of U_3O_8 from open pit mines by year	\$/lb U_3O_8
UUGMN (1-100)	Cost of U_3O_8 from underground mines by year	\$/lb U_3O_8
UACDML (1-100)	Cost of U_3O_8 from acid-leach mills by year	\$/lb U_3O_8
UALKML (1-100)	Cost of U_3O_8 from alkali-leach mills by year	\$/lb U_3O_8
UENCNT (1-100)	Cost of enrichment from gas centrifuges by year	\$/swu
UENDIF (1-100)	Cost of enrichment from gas diffusion by year	\$/swu
UUF ₆ (1-100)	Cost of UF ₆ conversion by year	\$/kg U
UUF (1-100)	Cost of UO ₂ fabrication by year	\$/kg U
UMOX (1-100)	Cost of mixed oxide fabrication by year	\$/kg Pu or U
UPWR (1-100)	PWR levelized operating and capital costs by year	mills/kWh
UBWR (1-100)	BWR levelized operating and capital costs by year	mills/kWh
USFSTR (1-100)	Cost of spent fuel storage by year	\$/kg
USFTRN (1-100)	Cost of spent fuel transportation by year	\$/kg

TABLE E.1. \$CSTDAT Namelist Block (contd)

Variable	Description	Units
USFREP (1-100)	Cost of fuel reprocessing by year	\$/kg
UPUSTR (1-100)	Cost of plutonium storage by year	\$/kg total Pu
UPUTRN (1-100)	Cost of plutonium transportation by year	\$/kg total Pu
UPUSAL (1-100)	Plutonium credit by year	\$/kg fissile Pu
UWDISP (1-100)	Cost of waste disposal by year	\$/kg
U308TB (1-25,1)	Title data describing ore blocks	--
U308TB (1-25,2)	Quantity of reserves	short tons
U308TB (1-25,3)	Recovery cost of U_3O_8	\$/lb U_3O_8
U308TB (1-25,4)	Fraction of reserves occurring as open pit deposits	--
U308TB (1-25,5)	Ore grade of open pit deposits	U_3O_8
U308TB (1-25,6)	Ore grade of underground deposits	U_3O_8
U308TB (1-25,7)	Recovery fraction (U_3O_8 produced/ U_3O_8 mined for open pit)	--
U308TB (1-25,8)	Recovery fraction (U_3O_8 produced/ U_3O_8 mined for underground deposits)	--

APPENDIX F

UREM INFORMATION AND INPUT INSTRUCTIONS

UREM COMPUTER CODE ABSTRACT

1. Name: UREM, a Uranium Resource Evaluation Model.
2. Computer: UREM has been developed and is operational on a Control Data Corporation (CDC) 7600 computer at Brookhaven National Laboratory.
3. Nature of the Problem Solved: The mass flows of U_3O_8 (yellowcake), uranium ore and mill tailings are predicted and analyzed based on an input uranium demand. Output includes annual mass flows of ore, U_3O_8 , and detailed information on tails assay and quantity.
4. Method of Solution: UREM analyzes the depletion of domestic uranium reserves. This depletion algorithm operates using data describing average domestic ore deposits and mass flow data to predict the price and ore grade characteristics associated with yellowcake production.
5. Restriction on the Complexity of the Problem: The maximum scenario length is 100 years. The maximum number of domestic ore date blocks is 25.
6. Typical Running Time: A typical case (100 year analysis) requires 0.4 seconds on the CDC 7600.
7. Important Features of the Code: Detailed mass flows for U_3O_8 , and uranium ore are estimated. Annual U_3O_8 price as well as average ore grade and tails grade are projected.
8. Related Programs: The U_3O_8 demand can be estimated using the ENGEN program. A direct data interface can be used to transfer scenarios data to UREM.
9. Machine Requirements: UREM-I requires 25,000₈ storage locations and normal input, output and scratch units on the CDC 7600 at Brookhaven National Laboratory.

UREM INPUT DESCRIPTION

The data used by UREM is input via a NAMELIST block entitled "\$DATA". A "\$" terminates the data. The variables described in this appendix are set in the NAMELIST block and follow the normal rules regarding delimiters and special characters. UREM input variables are as follows:

Variable	Description	Units	Default Value
IYEAR	Initial year for which uranium demand and mining information is needed	--	1977
EYEAR	Final year for which uranium demand and mining information needed. Note that EYEAR-IYEAR<100.	--	2076
IOY	0, do not print detailed yearly data. 1, print detailed yearly data.	--	0
IU308	Number of blocks of uranium ore in U308TB array (max 25)	--	21
IDS	0, uranium demand is input via NAMELIST. N, read uranium demand as Nth record on TAPE18.	--	0
FEED	Weight fraction of U-235 in natural uranium	--	0.00711
FRAC	1/FRAC is the minimum fraction of ore that can be removed from any particular block in any year	--	15
UDEMAND (1-100)	Demand for uranium by year	kg of uranium	--
CINPRT (1-100)	Quantity of imported U ₃ O ₈ by year	short tons U ₃ O ₈	0.0
DFB (1-100)	Quantity of foreign demand for domestic U ₃ O ₈ by year	short tons U ₃ O ₈	0.0
CONMIT (1-100,1)	Quantity of U ₃ O ₈ delivered via contractual agreement by year	\$/lb U ₃ O ₈	0.0
CONMIT (1-100,2)	Price of U ₃ O ₈ in contractual agreement by year	\$/lb U ₃ O ₈	0.0
U308TB (1-25,1)	Title data describing ore blocks	--	see Table F.1
U308TB (1-25,2)	Quantity of reserves	short tons	see Table F.1
U308TB (1-25,3)	Recovery cost of U ₃ O ₈	\$/lb U ₃ O ₈	see Table F.1
U308TB (1-25,4)	Fraction of reserves occurring as open pit deposits	--	see Table F.1
U308TB (1-25,5)	Ore grade of open pit deposits	%U ₃ O ₈	see Table F.1
U308TB (1-25,6)	Ore grade of underground deposits	%U ₃ O ₈	see Table F.1
U308TB (1-25,7)	Recovery fraction (U ₃ O ₈ produced/U ₃ O ₈ mined) for open pit deposits	--	see Table F.1
U308TB (1-25,8)	Recovery fraction (U ₃ O ₈ produced/U ₃ O ₈ mined) for underground deposits	--	see Table F.1

TABLE F.1. Reference Data in U308TB Array

Block	U308TB (1-21,1) Block Description	U308TB (1-21,2) Reserve Short Tons U308	U308TB (1-21,3) Recovery Cost \$/lb U308	U308TB (1-21,4) Fraction Open Pit	U308TB (1-21,5) Open Ore Grade % U308	U308TB (1-21,6) Underground Ore Grade % U308	U308TB (1-21,7) Recovery Fraction	U308TB (1-21,8) Recovery Fraction
1	10\$ RESERV	.2500 E + 06	24.00	.280000	.1600000	.2800000	1.0000	1.0000
2	10\$ PROBLE	.2750 E + 06	28.50	.280000	.1600000	.2800000	1.0000	1.0000
3	10\$ POSBLE	.1150 E + 06	33.00	.280000	.1600000	.2800000	1.0000	1.0000
4	10\$ SOCLTV	.1600 E + 06	34.00	.280000	.1600000	.2800000	1.0000	1.0000
5	15\$ RESERV	.1000 E + 06	37.50	.320000	.0800000	.1150000	1.0000	1.0000
6	15\$ PROBLE	.3100 E + 06	38.00	.320000	.0800000	.1150000	1.0000	1.0000
7	15\$ POSBLE	.3750 E + 06	42.00	.320000	.0800000	.1150000	1.0000	1.0000
8	15\$ SPCLTV	.9000 E + 05	46.00	.320000	.0800000	.1150000	1.0000	1.0000
9	30\$ RESERV	.2700 E + 06	59.50	.330000	.0461000	.0644000	1.0000	1.0000
10	30\$ PROBLE	.5050 E + 06	73.50	.330000	.0461000	.0644000	1.0000	1.0000
11	30\$ POSBLE	.6300 E + 06	73.50	.330000	.0461000	.0644000	1.0000	1.0000
12	30\$ SPCLTV	.2900 E + 06	80.50	.330000	.0461000	.0644000	1.0000	1.0000
13	50\$ RESERV	.1600 E + 06	91.50	.330000	.0226000	.0315000	1.0000	1.0000
14	50\$ PROBLE	.2800 E + 06	106.00	.330000	.0226000	.0315000	1.0000	1.0000
15	50\$ POSBLE	.3000 E + 06	111.00	.330000	.0226000	.0315000	1.0000	1.0000
16	50\$ SPCLTV	.6000 E + 05	121.00	.330000	.0226000	.0315000	1.0000	1.0000
17	NC SHALE 1	.5000 E + 07	150.00	.900000	.0070000	.0007000	1.0000	1.0000
18	NC SHALE 2	.8000 E + 07	200.00	.900000	.0040000	.0040000	1.0000	1.0000
19	NC GRNT 1	.8000 E + 07	250.00	.900000	.0015000	.0015000	1.0000	1.0000
20	NC SHALE 3	.2000 E + 09	300.00	.900000	.0017000	.0017000	1.0000	1.0000
21	NC GRNT 2	.1800 E + 11	350.00	.900000	.0017000	.0007000	1.0000	1.0000

APPENDIX G

SAMPLE PROBLEM

INPUT AS READ FROM CARDS

```

.....
CARD 1234567890123456789012345678901234567890123456789012345678901234567890
1 ECT RECYCLE SCENARIO = 350 GW BY 2000 = RECYCLE STARTING IN 1985
2 END
3 $INDATA
4 XNCAP(4,1)=22*.70,.64,.64,.64,.62,.60,.58,.56,.54,.52,.50,.48,.46,.44,
5 .42,.40,
6 XNCAP(4,2)=22*.70,.64,.64,.64,.62,.60,.58,.56,.54,.52,.50,.48,.46,.44,
7 .42,.40,
8 ILIFE(1)=40,40,
9 IYRUR=1985,IYRPU=1985,
10 EMAYU(1)=100*0.5, EMAYP(1)=100*0.5,
11 POWCAP(1,1)= 30300.,
12 33600.0, 34955.0, 38950.0, 44365.0, 51015.0,
13 58710.0, 71535.0, 81675.0, 90440.0, 98420.0, 106400.0,
14 114950.0, 124450.0, 135795.0, 147630.0, 159600.0, 172900.0,
15 186675.0, 200450.0, 214225.0, 228000.0, 241775.0, 254600.0,
16 266000.0, 273000.0, 281000.0, 288000.0, 296000.0, 304000.0,
17 313000.0, 319000.0, 321000.0, 322000.0, 320103.5, 318500.8,
18 317966.0, 315294.6, 312622.2, 307278.5, 301933.8, 296590.0,
19 288573.9, 280558.8, 269870.3, 261854.2, 253838.1, 248494.4,
20 240478.3, 235134.5, 229790.8, 224447.0, 219102.3, 213758.6,
21 208414.8, 203071.1, 197726.4, 192382.6, 187038.9, 181695.1,
22 176351.4, 173679.0, 168335.3, 165662.9, 162991.5, 160319.2,
23 159250.4, 158181.7, 157646.8, 157646.8, 154975.4, 154975.4,
24 154975.4, 154975.4, 32*n.,
25 POWCAP(1,2)= 16600.,
26 17400.0, 17400.0, 18145.0, 22135.0, 26505.0,
27 29450.0, 32395.0, 38740.0, 43225.0, 47215.0, 51205.0,
28 55440.0, 60230.0, 65930.0, 71820.0, 77805.0, 84455.0,
29 91390.0, 98325.0, 105240.0, 112195.0, 119130.0, 125400.0,
30 131000.0, 135000.0, 139000.0, 142000.0, 144000.0, 150000.0,
31 154000.0, 157000.0, 158000.0, 158000.0, 159096.5, 158299.5,
32 158033.5, 156706.3, 155378.2, 152722.0, 150045.8, 147409.6,
33 143425.3, 139282.4, 134129.6, 130145.3, 126161.0, 123505.7,
34 119521.4, 116865.2, 114209.0, 111553.8, 108897.6, 106241.4,
35 103585.2, 100929.0, 98272.8, 95617.5, 92961.3, 90305.1,
36 88977.0, 86320.8, 83664.6, 82337.4, 81009.3, 79681.3,
37 79150.2, 78618.2, 78333.2, 78353.2, 77025.1, 77025.1,
38 77025.1, 77025.1, 32*n.,
39 IOPT(1)=2*1,4*3,2050,1,1,1,1,0,
40 NUS=2,
41 IB(1)=26,29,30,32,34,36,38,40,
42 SED(1)=1.5E+6,7*2.E+4,
43 IMTA=26,ILIFE=40,YH1=n.333333,YH2=0.6666667,
44 IOPT(16)=1,1,1,
45 IOPT(8)=0,
46 IOPT(18)=0,
47 SEND
48 $CSTOAT

```

INPUT AS READ FROM CARDS

```

.....
CARD      1      2      3      4      5      6      7      8
49        12345678901234567890123456789012345678901234567890
50        CONHIT(1,1)=200*0.,RINT=1.07.
51        U3DATB(4,2)=.1E+6,.16E+4,
52        U3DATB(1,3)= 28.05,40.3, 57.1, 64.9, 36.7, 47.7, 55.2, 62.8, 55.,
53        70.2,73.7,80.7,94.1, 97.5, 98.8,108.2,
54        U3DATB(1,4)= 4*.28, 4*.114, 8*.064,
55        UACDHL(1)= 100*0., HALK*XL(1)= 100*0., IUDPT=0,
56        UENCFNT(1)= 100*100., UENDIF(1)= 100*100., UUF6(1)=100*5.46,UUF(1)=100*93.9,
57        USFREPI(1)= 100*236.4, HMDX(1)= 100*268.5,
58        UPWR(1)= 100*24.4, HRWR(1)= 100*24.4,
59        USFSTR(1)= 100*0., USFTRN(1)= 100*30.,
60        UPSTR(1)=100*0., UPHSAL(1)= 100*0., HMDISP(1)= 100*0.,
        SEND

```

REACTOR TYPES TO BE CALCULATED

```

PWR NO RCL
RWR NO RCL
PWR U RCL
RWR U RCL
PWR PU RCL
RWR PU RCL
PWR U SHTD
RWR U SHTD

```

3.5

[illegible]

[illegible][illegible]

SEND

VARIABLE RESIDENCE TIMES (HRS) ARE BASED ON DESIGN PARAMETERS AND EXPECTED OPERATING HISTORY

CHAIN	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
DESIGN	4	4	12	12	12	4	4	12	16	16	16	12	12	16	16	16	16	12	12	16	16	16	4	4	4	4	8	12
ACTUAL	6	11	16	14	14	6	11	16	20	19	19	14	14	14	19	19	14	14	14	19	19	19	8	15	8	15	21	21

INPUT POWER SCENARIO CANNOT BE KEY,FORTRAN VARIABLE POWCAP WILL BE ALTEREO=SEE TABLE 1

YEAR	CAPACITY FACTOR	REACTOR TYPE PWR		CAPACITY FACTOR	REACTOR TYPE BWR	
		REACTORS BUILT	DECOMMISSIONED		REACTORS BUILT	DECOMMISSIONED
1977	.63295	4.8	0.0	.68050	.3	0.0
1978	.65675	2.9	0.0	.68221	.6	0.0
1979	.66080	2.9	0.0	.69677	0.0	0.0
1980	.67609	1.7	0.0	.68548	.6	0.0
1981	.65735	4.7	0.0	.64424	3.1	0.0
1982	.65363	5.8	0.0	.64161	3.4	0.0
1983	.65040	6.7	0.0	.65581	2.3	0.0
1984	.63619	11.1	0.0	.66144	2.3	0.0
1985	.65041	8.7	0.0	.64303	5.0	0.0
1986	.65800	7.6	0.0	.65806	3.5	0.0
1987	.66595	6.9	0.0	.66290	3.1	0.0
1988	.66940	6.9	0.0	.66798	3.1	0.0
1989	.67048	7.4	0.0	.66921	3.3	0.0
1990	.67015	8.2	0.0	.66893	3.7	0.0
1991	.66802	9.8	0.0	.66661	4.5	0.0
1992	.66844	10.3	0.0	.66747	4.6	0.0
1993	.66970	10.4	0.0	.66879	4.7	0.0
1994	.66937	11.5	0.0	.66833	5.2	0.0
1995	.67022	11.9	0.0	.66870	5.4	0.0
1996	.67144	11.9	0.0	.66952	5.4	0.0
1997	.67255	11.9	0.0	.67002	5.4	0.0
1998	.67316	11.9	0.0	.67059	5.4	0.0
1999	.67325	11.9	0.0	.67033	5.4	0.0
2000	.67406	11.1	0.0	.67101	5.1	1.0
2001	.67511	10.0	1.0	.67196	4.4	0.0
2002	.67899	6.3	1.0	.67443	3.2	1.0
2003	.67743	6.9	0.0	.67372	3.2	1.0
2004	.67711	6.1	0.0	.67466	2.3	0.0
2005	.67416	6.9	0.0	.67122	3.1	0.0
2006	.67195	6.9	0.0	.66911	3.1	0.0
2007	.66840	7.8	0.0	.66618	3.1	0.0
2008	.66807	6.1	2.0	.66503	2.3	0.0
2009	.66874	1.7	0.0	.66547	1.6	3.0
2010	.66594	1.7	2.0	.66588	1.1	2.0
2011	.66431	0.0	2.0	.66239	1.9	2.0
2012	.66062	.5	4.0	.66325	1.6	4.0
2013	.65592	4.3	7.0	.66129	0.0	0.0
2014	.65584	2.3	7.0	.65915	2.3	5.0
2015	.65364	.8	4.0	.66092	1.7	4.0
2016	.65110	0.0	4.0	.65974	0.0	1.0
2017	.64840	0.0	4.8	.65407	0.0	.3
2018	.64289	0.0	2.9	.64821	0.0	.6
2019	.63648	0.0	2.9	.63945	0.0	0.0
2020	.62805	0.0	1.7	.63101	0.0	.6
2021	.62153	0.0	4.7	.62696	0.0	3.1
2022	.61519	0.0	5.8	.62291	0.0	3.4
2023	.60890	0.0	6.7	.61584	0.0	2.3
2024	.60613	0.0	11.1	.60788	0.0	2.3
2025	.60064	0.0	8.7	.60474	0.0	5.0
2026	.59348	0.0	7.6	.59811	0.0	3.5

YEAR	CAPACITY FACTOR	REACTOR TYPE PWR		CAPACITY FACTOR	REACTOR TYPE BWR	
		REACTORS BUILT	DECOMMISSIONED		REACTORS BUILT	DECOMMISSIONED
2027	.58516	0.0	6.9	.59024	0.0	3.1
2028	.57626	0.0	6.9	.58183	0.0	3.1
2029	.56698	.3	7.4	.57350	0.0	3.3
2030	.55553	3.6	8.2	.56536	0.0	3.7
2031	.54831	5.2	9.8	.55824	0.0	4.5
2032	.54332	5.6	10.3	.54773	1.7	4.6
2033	.54023	5.7	10.4	.54104	2.6	4.7
2034	.53874	6.9	11.5	.53793	3.1	5.2
2035	.54036	7.3	11.9	.53878	3.4	5.4
2036	.54426	7.3	11.9	.54211	3.4	5.4
2037	.55027	7.3	11.9	.54495	4.4	5.4
2038	.55540	9.6	11.9	.55577	3.4	5.4
2039	.56852	7.3	11.9	.56427	3.4	5.4
2040	.57697	8.8	11.1	.57239	4.0	5.1
2041	.59057	7.7	10.0	.58400	3.3	4.4
2042	.60274	4.0	6.3	.59429	2.1	3.2
2043	.60794	6.0	6.9	.59961	2.8	3.2
2044	.61740	5.1	6.1	.60772	1.9	2.3
2045	.62428	6.8	6.9	.61185	2.9	3.1
2046	.63461	6.9	6.9	.62086	3.1	3.1
2047	.65086	5.5	7.8	.63503	2.1	3.1
2048	.66178	6.1	6.1	.64268	2.3	2.3
2049	.67421	1.7	1.7	.65217	1.8	1.8
2050	.67829	1.7	1.7	.65893	1.1	1.1
2051	.68257	0.0	0.0	.67241	0.0	1.9
2052	.68321	0.0	.5	.68006	0.0	1.6
2053	.69282	0.0	4.3	.67967	0.0	0.0
2054	.69796	0.0	2.3	.69080	0.0	2.3
2055	.69932	0.0	.8	.70000	0.0	1.7
2056	.69788	0.0	0.0	.70000	0.0	0.0
2057	.69554	0.0	0.0	.69936	0.0	0.0
2058	.69229	0.0	0.0	.69773	0.0	0.0
2059	.68795	0.0	0.0	.69492	0.0	0.0
2060	.68246	0.0	0.0	.69085	0.0	0.0
2061	.67580	0.0	0.0	.68550	0.0	0.0
2062	.66799	0.0	0.0	.67850	0.0	0.0
2063	.65866	0.0	0.0	.67023	0.0	0.0
2064	.64817	0.0	0.0	.66069	0.0	0.0
2065	.63628	0.0	0.0	.64963	0.0	0.0
2066	.62318	0.0	0.0	.63730	0.0	0.0
2067	.60944	0.0	0.0	.62416	0.0	0.0
2068	.59475	0.0	0.0	.60998	0.0	0.0
2069	.57980	0.0	.3	.59506	0.0	0.0
2070	.56867	0.0	3.6	.57904	0.0	0.0
2071	.55867	0.0	5.2	.56183	0.0	0.0
2072	.54843	0.0	5.6	.54925	0.0	1.7
2073	.53714	0.0	5.7	.53847	0.0	2.6
2074	.52705	0.0	6.9	.52850	0.0	3.1
2075	.51718	0.0	7.3	.51873	0.0	3.4
2076	.50734	0.0	7.3	.50900	0.0	3.4

TABLE 1 INSTALLED OR NUCLEAR GENERATION CAPACITY AND CAPACITY FACTORS

CASE SCENARIO: ECT RECYCLE SCENARIO - 780 GW BY 2000 - RECYCLE STARTING IN

DATE: 04/27/79

TIME: 10.08.04

YEAR	PWR			BWR			LWR TOTAL		
	CAPACITY (MWE)	CAPACITY FACTOR (%)	GENERATION RATE (MWE)	CAPACITY (MWE)	CAPACITY FACTOR (%)	GENERATION RATE (MWE)	CAPACITY (MWE)	CAPACITY FACTOR (%)	GENERATION RATE (MWE)
1977	30300.	63.3	19179.	16600.	68.0	11296.	46900.	65.7	30800.
1978	33600.	65.7	22067.	17400.	68.2	11870.	51000.	66.9	34143.
1979	36955.	66.1	24420.	17400.	69.7	12124.	54355.	67.9	36895.
1980	38950.	67.6	26334.	18145.	68.5	12438.	57095.	68.1	38864.
1981	44365.	65.7	29164.	22135.	64.4	14260.	66500.	65.1	43278.
1982	51015.	65.4	33345.	26505.	64.2	17006.	77520.	64.8	50203.
1983	58710.	65.0	38165.	29450.	65.6	19314.	88160.	65.3	57578.
1984	71535.	63.6	45510.	32395.	66.1	21427.	103930.	64.9	67431.
1985	81605.	65.0	53076.	38760.	64.3	24924.	120365.	64.7	77843.
1986	90440.	65.8	59509.	43225.	65.8	28445.	133665.	65.8	87953.
1987	98420.	66.6	65542.	47215.	66.3	31299.	145635.	66.4	96763.
1988	106400.	66.9	71224.	51205.	66.8	34204.	157605.	66.9	105389.
1989	114950.	67.0	77072.	55480.	66.9	37128.	170430.	67.0	114162.
1990	124450.	67.0	83400.	60230.	66.9	40289.	184680.	67.0	123650.
1991	135755.	66.8	90647.	65930.	66.7	43950.	201685.	66.7	134588.
1992	147630.	66.8	98682.	71820.	66.7	47938.	219450.	66.8	146583.
1993	159600.	67.0	106885.	77805.	66.9	52035.	237405.	66.9	158882.
1994	172900.	66.9	113734.	84455.	66.8	56444.	257355.	66.9	172131.
1995	186675.	67.0	125114.	91390.	66.9	61113.	278065.	66.9	186154.
1996	200450.	67.1	134590.	98325.	67.0	65431.	298775.	67.0	200323.
1997	214225.	67.3	144078.	105260.	67.0	70527.	319485.	67.1	214467.
1998	228000.	67.3	153479.	112195.	67.1	75237.	340195.	67.2	228567.
1999	241775.	67.3	162774.	119130.	67.0	79856.	360905.	67.2	242451.
2000	254600.	67.4	171614.	125400.	67.1	84145.	380000.	67.3	255563.
2001	266000.	67.5	179579.	131000.	67.2	88027.	397000.	67.4	267394.
2002	273000.	67.9	185365.	135000.	67.4	91047.	408000.	67.7	276097.
2003	281000.	67.7	190359.	139000.	67.4	93647.	420000.	67.6	283742.
2004	288000.	67.7	195007.	142000.	67.5	95802.	430000.	67.6	290630.
2005	296000.	67.4	199550.	146000.	67.1	97999.	442000.	67.3	297329.
2006	304000.	67.2	204272.	150000.	66.9	100366.	454000.	67.1	304419.
2007	313000.	66.8	209210.	154000.	66.6	102592.	467000.	66.7	311624.
2008	319000.	66.8	213115.	157000.	66.5	104410.	476000.	66.7	317279.
2009	321000.	66.9	214665.	158000.	66.5	105145.	479000.	66.7	319344.
2010	322000.	66.6	214431.	158000.	66.6	105209.	480000.	66.6	319635.
2011	320634.	66.4	213000.	159097.	66.2	105385.	479731.	66.3	318230.
2012	318501.	66.1	210409.	158300.	66.3	104993.	478800.	66.2	315612.
2013	317966.	65.6	208559.	158300.	66.1	104682.	476266.	65.9	313670.
2014	315295.	65.6	206783.	156706.	65.9	103293.	472001.	65.7	310337.
2015	312622.	65.4	204343.	155378.	66.1	102692.	468000.	65.7	307607.
2016	308901.	65.1	201127.	154311.	66.0	101806.	463212.	65.5	303600.
2017	303357.	64.8	196696.	153987.	65.4	100718.	457344.	65.1	297838.
2018	300057.	64.3	192904.	153187.	64.8	99297.	453244.	64.6	292592.
2019	296702.	63.6	188444.	153187.	63.9	97956.	449849.	63.8	287013.
2020	294707.	62.8	185091.	152442.	63.1	96193.	447149.	63.0	281495.
2021	289292.	62.2	179803.	148452.	62.7	93073.	437744.	62.4	275259.
2022	282642.	61.5	173479.	144082.	62.3	89750.	426724.	61.9	266164.
2023	274947.	60.9	167415.	141137.	61.6	86917.	416084.	61.2	254797.
2024	265122.	60.4	158444.	138492.	60.8	84006.	402114.	60.7	244884.

2025	252052.	60.1	151393.	131827.	60.5	79722.	743879.	60.3	2313A1.
2026	243217.	59.3	144344.	127362.	59.8	76176.	770579.	59.6	22078A.
2027	235237.	58.5	137652.	123372.	59.0	72819.	358609.	58.8	210755.
2028	227257.	57.6	130959.	119382.	58.2	69461.	346639.	57.9	200720.
2029	219102.	56.7	124227.	115107.	57.3	66014.	334210.	57.0	190579.
2030	213759.	55.6	11874A.	110357.	56.5	62391.	324116.	56.0	181648.
2031	208415.	54.8	114276.	104657.	55.8	58424.	313072.	55.3	173215.
2032	203071.	54.3	110333.	100929.	54.8	55282.	304000.	54.6	165840.
2033	197726.	54.0	106810.	98273.	54.1	53169.	295999.	54.1	16002A.
2034	192383.	53.9	103644.	95618.	53.8	5145A.	288000.	53.8	155041.
2035	187039.	54.0	101067.	92961.	53.9	50086.	280000.	54.0	151079.
2036	181695.	54.4	98889.	90305.	54.2	48455.	272000.	54.3	147746.
2037	176351.	55.0	97041.	88977.	54.5	4848A.	26532A.	54.8	145297.
2038	173679.	55.5	96461.	86321.	55.6	47975.	260000.	55.6	144452.
2039	168335.	56.9	95703.	83665.	56.4	47209.	252000.	56.6	142732.
2040	165663.	57.7	95582.	82337.	57.2	47129.	248000.	57.5	142520.
2041	162992.	59.1	96257.	81009.	58.4	47310.	244001.	58.7	142298.
2042	160319.	60.3	96631.	79681.	59.4	47354.	240001.	59.9	141645.
2043	159250.	60.8	96815.	79150.	60.0	47459.	238401.	60.4	141941.
2044	158182.	61.7	97661.	78618.	60.8	4777A.	236800.	61.3	141054.
2045	157647.	62.4	9841A.	78353.	61.2	47941.	236000.	61.8	140864.
2046	157647.	63.5	100044.	78353.	62.1	48446.	236000.	62.8	140144.
2047	154975.	65.1	100A68.	77025.	63.5	4A913.	232001.	64.3	140164.
2048	154975.	66.2	102559.	77025.	64.3	49503.	232001.	65.2	13131A.
2049	154975.	67.4	104486.	77025.	65.2	50234.	232001.	66.3	131861.
2050	154975.	67.8	10511A.	77025.	65.9	50755.	232001.	66.9	13111A.
2051	154975.	68.3	105781.	74581.	67.2	50149.	229556.	67.7	131522.
2052	154369.	68.3	105466.	72594.	68.0	4936P.	226962.	68.2	134705.
2053	149394.	69.3	103503.	72594.	68.0	49339.	221988.	68.6	132333.
2054	146725.	69.8	10240A.	69667.	69.1	48124.	216392.	69.4	13025A.
2055	145752.	69.9	10192A.	67531.	70.0	47272.	213283.	70.0	14922A.
2056	145752.	69.8	101717.	67531.	70.0	47272.	213283.	69.9	149072.
2057	145752.	69.6	101376.	67531.	69.9	47223.	213283.	69.7	148754.
2058	145752.	69.2	100903.	67531.	69.8	47119.	213283.	69.5	148235.
2059	145752.	68.8	100271.	67531.	69.5	46929.	213283.	69.1	147472.
2060	145752.	68.2	99469.	67531.	69.1	46654.	213283.	68.7	146451.
2061	145752.	67.6	98500.	67531.	68.6	46293.	213283.	68.1	145172.
2062	145752.	66.8	97361.	67531.	67.9	45820.	213283.	67.3	143597.
2063	145752.	65.9	96001.	67531.	67.0	45261.	213283.	66.4	141715.
2064	145752.	64.8	94472.	67531.	66.1	44617.	213283.	65.4	139579.
2065	145752.	63.6	92740.	67531.	65.0	43870.	213283.	64.3	137132.
2066	145752.	62.3	90A30.	67531.	63.7	4303A.	213283.	63.0	134419.
2067	145752.	60.9	88A27.	67531.	62.4	42150.	213283.	61.7	131554.
2068	145752.	59.5	86687.	67531.	61.0	41192.	213283.	60.2	128475.
2069	145357.	58.0	84277.	67531.	59.5	40185.	2128A.	58.7	125057.
2070	141201.	56.9	80297.	67531.	57.9	39103.	208732.	57.4	119782.
2071	135240.	55.9	75554.	67531.	56.2	37941.	202771.	56.0	117603.
2072	128708.	54.8	7058A.	65369.	54.9	35904.	194077.	54.9	10651A.
2073	122083.	53.7	65576.	62040.	53.8	33407.	1A4123.	53.8	99027.
2074	114127.	52.7	60150.	58046.	52.9	30677.	172172.	52.8	97869.
2075	105696.	51.7	54664.	53767.	51.9	27890.	159462.	51.8	82595.
2076	97264.	50.7	49346.	49488.	50.9	25189.	146752.	50.8	74575.

INITIAL MATERIAL BACK-LOG PWR NO RCL TOTAL = 1373100. KG

INITIAL MATERIAL BACK-LOG BWR NO RCL TOTAL = 968900. KG

TABLE 2 REPROCESSING PLANT SCHEDULE

CASE SCENARIO: ECT RECYCLE SCENARIO - 380 GW BY 2000 - RECYCLE STARTING IN					DATE: 04/27/79		TIME: 10.08.04							
YEAR	INTERIM STORAGE	YEARLY ADDITION	FUEL BACK-LOG	REPROS. TOTAL	PLNT 1 OUTPUT	PLNT 2 OUTPUT	PLNT 3 OUTPUT	PLNT 4 OUTPUT	PLNT 5 OUTPUT	PLNT 6 OUTPUT	PLNT 7 OUTPUT	PLNT 8 OUTPUT	PLNT 9 OUTPUT	PLNT 10 OUTPUT
1960	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1961	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1962	1.	1.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1963	6.	4.	6.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1964	16.	10.	16.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1965	30.	14.	30.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1966	47.	17.	47.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1967	63.	15.	63.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1968	78.	16.	78.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1969	92.	14.	92.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1970	117.	25.	117.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1971	158.	41.	158.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1972	235.	77.	235.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1973	360.	126.	360.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1974	563.	203.	563.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1975	862.	298.	862.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1976	1332.	470.	1332.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1977	1963.	631.	1963.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1978	2831.	869.	2831.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1979	3835.	1004.	3835.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1980	4961.	1126.	4961.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1981	6166.	1205.	6166.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1982	7460.	1294.	7460.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1983	8831.	1371.	8831.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1984	9909.	1579.	10409.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1985	10813.	1904.	11813.	500.	500.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1986	10825.	2179.	12992.	1000.	1000.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1987	10470.	2478.	13303.	2167.	1500.	667.	0.	0.	0.	0.	0.	0.	0.	0.
1988	9189.	2886.	13356.	2833.	1500.	1333.	0.	0.	0.	0.	0.	0.	0.	0.
1989	7581.	3226.	12415.	4167.	1500.	2000.	667.	0.	0.	0.	0.	0.	0.	0.
1990	5540.	3488.	11040.	4833.	1500.	2000.	1333.	0.	0.	0.	0.	0.	0.	0.
1991	3729.	3689.	9229.	5500.	1500.	2000.	2000.	0.	0.	0.	0.	0.	0.	0.
1992	2315.	4086.	7815.	5500.	1500.	2000.	2000.	0.	0.	0.	0.	0.	0.	0.
1993	1224.	4409.	6724.	5500.	1500.	2000.	2000.	0.	0.	0.	0.	0.	0.	0.
1994	436.	4712.	5936.	5500.	1500.	2000.	2000.	0.	0.	0.	0.	0.	0.	0.
1995	178.	5242.	5678.	5500.	1500.	2000.	2000.	0.	0.	0.	0.	0.	0.	0.
1996	311.	5633.	5811.	5500.	1500.	2000.	2000.	0.	0.	0.	0.	0.	0.	0.
1997	921.	6110.	6421.	5500.	1500.	2000.	2000.	0.	0.	0.	0.	0.	0.	0.
1998	1314.	6560.	7481.	5500.	1500.	2000.	2000.	0.	0.	0.	0.	0.	0.	0.
1999	1582.	7101.	8415.	6167.	1500.	2000.	2000.	667.	0.	0.	0.	0.	0.	0.
2000	1612.	7530.	9112.	6833.	1500.	2000.	2000.	1333.	0.	0.	0.	0.	0.	0.
2001	1445.	8000.	9612.	7500.	1500.	2000.	2000.	2000.	0.	0.	0.	0.	0.	0.
2002	1156.	8544.	9990.	8167.	1500.	2000.	2000.	2000.	667.	0.	0.	0.	0.	0.
2003	610.	8993.	10110.	8833.	1500.	2000.	2000.	2000.	1333.	0.	0.	0.	0.	0.
2004	235.	9125.	9735.	9500.	1500.	2000.	2000.	2000.	2000.	0.	0.	0.	0.	0.
2005	265.	9531.	9765.	9500.	1500.	2000.	2000.	2000.	2000.	0.	0.	0.	0.	0.
2006	469.	9704.	9969.	9500.	1500.	2000.	2000.	2000.	2000.	0.	0.	0.	0.	0.
2007	815.	9846.	10315.	9500.	1500.	2000.	2000.	2000.	2000.	0.	0.	0.	0.	0.
2008	1493.	10178.	10993.	9500.	1500.	2000.	2000.	2000.	2000.	0.	0.	0.	0.	0.
2009	2314.	10371.	12014.	9500.	1500.	2000.	2000.	2000.	2000.	0.	0.	0.	0.	0.
2010	3713.	10699.	13213.	9500.	1500.	2000.	2000.	2000.	2000.	0.	0.	0.	0.	0.
2011	5123.	10910.	14623.	9500.	1500.	2000.	2000.	2000.	2000.	0.	0.	0.	0.	0.
2012	6752.	11129.	16252.	9500.	1500.	2000.	2000.	2000.	2000.	0.	0.	0.	0.	0.
2013	8472.	11220.	17972.	9500.	1500.	2000.	2000.	2000.	2000.	0.	0.	0.	0.	0.
2014	9408.	11102.	19574.	9500.	1500.	2000.	2000.	2000.	2000.	0.	0.	0.	0.	0.
2015	9964.	11381.	20799.	10167.	1500.	2000.	2000.	2000.	2000.	667.	0.	0.	0.	0.

	PLANT CAPACITY (MTH/YR)	1900.	1910.	1920.	1930.	1940.	1950.	1960.	1970.	1980.	1990.	2000.	2010.	2020.	2030.	2040.	2050.	2060.	2070.	2080.	2090.	2100.	2110.	2120.	2130.	2140.	2150.	2160.	2170.	2180.	2190.	2200.	2210.	2220.	2230.	2240.	2250.	2260.	2270.	2280.	2290.	2300.	2310.	2320.	2330.	2340.	2350.	2360.	2370.	2380.	2390.	2400.	2410.	2420.	2430.	2440.	2450.	2460.	2470.	2480.	2490.	2500.	2510.	2520.	2530.	2540.	2550.	2560.	2570.	2580.	2590.	2600.	2610.	2620.	2630.	2640.	2650.	2660.	2670.	2680.	2690.	2700.	2710.	2720.	2730.	2740.	2750.	2760.	2770.	2780.	2790.	2800.	2810.	2820.	2830.	2840.	2850.	2860.	2870.	2880.	2890.	2900.	2910.	2920.	2930.	2940.	2950.	2960.	2970.	2980.	2990.	3000.	3010.	3020.	3030.	3040.	3050.	3060.	3070.	3080.	3090.	3100.	3110.	3120.	3130.	3140.	3150.	3160.	3170.	3180.	3190.	3200.	3210.	3220.	3230.	3240.	3250.	3260.	3270.	3280.	3290.	3300.	3310.	3320.	3330.	3340.	3350.	3360.	3370.	3380.	3390.	3400.	3410.	3420.	3430.	3440.	3450.	3460.	3470.	3480.	3490.	3500.	3510.	3520.	3530.	3540.	3550.	3560.	3570.	3580.	3590.	3600.	3610.	3620.	3630.	3640.	3650.	3660.	3670.	3680.	3690.	3700.	3710.	3720.	3730.	3740.	3750.	3760.	3770.	3780.	3790.	3800.	3810.	3820.	3830.	3840.	3850.	3860.	3870.	3880.	3890.	3900.	3910.	3920.	3930.	3940.	3950.	3960.	3970.	3980.	3990.	4000.	4010.	4020.	4030.	4040.	4050.	4060.	4070.	4080.	4090.	4100.	4110.	4120.	4130.	4140.	4150.	4160.	4170.	4180.	4190.	4200.	4210.	4220.	4230.	4240.	4250.	4260.	4270.	4280.	4290.	4300.	4310.	4320.	4330.	4340.	4350.	4360.	4370.	4380.	4390.	4400.	4410.	4420.	4430.	4440.	4450.	4460.	4470.	4480.	4490.	4500.	4510.	4520.	4530.	4540.	4550.	4560.	4570.	4580.	4590.	4600.	4610.	4620.	4630.	4640.	4650.	4660.	4670.	4680.	4690.	4700.	4710.	4720.	4730.	4740.	4750.	4760.	4770.	4780.	4790.	4800.	4810.	4820.	4830.	4840.	4850.	4860.	4870.	4880.	4890.	4900.	4910.	4920.	4930.	4940.	4950.	4960.	4970.	4980.	4990.	5000.	5010.	5020.	5030.	5040.	5050.	5060.	5070.	5080.	5090.	5100.	5110.	5120.	5130.	5140.	5150.	5160.	5170.	5180.	5190.	5200.	5210.	5220.	5230.	5240.	5250.	5260.	5270.	5280.	5290.	5300.	5310.	5320.	5330.	5340.	5350.	5360.	5370.	5380.	5390.	5400.	5410.	5420.	5430.	5440.	5450.	5460.	5470.	5480.	5490.	5500.	5510.	5520.	5530.	5540.	5550.	5560.	5570.	5580.	5590.	5600.	5610.	5620.	5630.	5640.	5650.	5660.	5670.	5680.	5690.	5700.	5710.	5720.	5730.	5740.	5750.	5760.	5770.	5780.	5790.	5800.	5810.	5820.	5830.	5840.	5850.	5860.	5870.	5880.	5890.	5900.	5910.	5920.	5930.	5940.	5950.	5960.	5970.	5980.	5990.	6000.	6010.	6020.	6030.	6040.	6050.	6060.	6070.	6080.	6090.	6100.	6110.	6120.	6130.	6140.	6150.	6160.	6170.	6180.	6190.	6200.	6210.	6220.	6230.	6240.	6250.	6260.	6270.	6280.	6290.	6300.	6310.	6320.	6330.	6340.	6350.	6360.	6370.	6380.	6390.	6400.	6410.</
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TABLE 2 REPROCESSING PLANT SCHEDULE

CASE SCENARIO: ECT RECYCLE SCENARIO - 380 GW BY 2000 - RECYCLE STARTING IN					DATE: 04/27/79		TIME: 10.08.04							
YEAR	INTERIM STORAGE	YEARLY ADDITION	FUEL BACK-LOG	REPROB. TOTAL	PLNT 11 OUTPUT	PLNT 12 OUTPUT	PLNT 13 OUTPUT	PLNT 14 OUTPUT	PLNT 15 OUTPUT	PLNT 16 OUTPUT	PLNT 17 OUTPUT	PLNT 18 OUTPUT	PLNT 19 OUTPUT	PLNT 20 OUTPUT
1960	0.	0.	0.	0.	0.									
1961	0.	0.	0.	0.	0.									
1962	1.	1.	1.	0.	0.									
1963	6.	4.	6.	0.	0.									
1964	16.	10.	16.	0.	0.									
1965	30.	14.	30.	0.	0.									
1966	47.	17.	47.	0.	0.									
1967	63.	15.	63.	0.	0.									
1968	78.	16.	78.	0.	0.									
1969	92.	14.	92.	0.	0.									
1970	117.	25.	117.	0.	0.									
1971	158.	41.	158.	0.	0.									
1972	235.	77.	235.	0.	0.									
1973	360.	126.	360.	0.	0.									
1974	563.	203.	563.	0.	0.									
1975	862.	298.	862.	0.	0.									
1976	1332.	470.	1332.	0.	0.									
1977	1963.	631.	1963.	0.	0.									
1978	2831.	869.	2831.	0.	0.									
1979	3835.	1004.	3835.	0.	0.									
1980	4961.	1126.	4961.	0.	0.									
1981	6166.	1205.	6166.	0.	0.									
1982	7460.	1294.	7460.	0.	0.									
1983	8831.	1371.	8831.	0.	0.									
1984	9909.	1579.	10409.	0.	0.									
1985	10813.	1904.	11813.	500.	0.									
1986	10825.	2179.	12992.	1000.	0.									
1987	10470.	2478.	13303.	2167.	0.									
1988	9189.	2886.	13356.	2433.	0.									
1989	7581.	3276.	12415.	4167.	0.									
1990	5540.	3688.	11040.	8833.	0.									
1991	3729.	3689.	9229.	5500.	0.									
1992	2315.	4086.	7815.	5500.	0.									
1993	1224.	4409.	6724.	5500.	0.									
1994	436.	4712.	5936.	5500.	0.									
1995	178.	5242.	5678.	5500.	0.									
1996	311.	5673.	5811.	5500.	0.									
1997	921.	6110.	6421.	5500.	0.									
1998	1314.	6560.	7481.	5500.	0.									
1999	1582.	7101.	8415.	6167.	0.									
2000	1612.	7530.	9112.	6833.	0.									
2001	1445.	8000.	9612.	7500.	0.									
2002	1156.	8544.	9990.	8167.	0.									
2003	610.	8953.	10110.	8833.	0.									
2004	235.	9125.	9735.	9500.	0.									
2005	265.	9531.	9765.	9500.	0.									
2006	469.	9704.	9969.	9500.	0.									
2007	815.	9846.	10315.	9500.	0.									
2008	1493.	10178.	10993.	9500.	0.									
2009	2514.	10521.	12014.	9500.	0.									
2010	3713.	10699.	13213.	9500.	0.									
2011	5123.	10910.	14623.	9500.	0.									
2012	6752.	11129.	16252.	9500.	0.									
2013	8472.	11220.	17972.	9500.	0.									
2014	9408.	11102.	19574.	9500.	0.									
2015	9645.	11201.	20799.	10167.	0.									

2016	9753.	11248.	21253.	10433.	0.
2017	9045.	10792.	20545.	11500.	0.
2018	8338.	10793.	19838.	11500.	0.
2019	7472.	10633.	18972.	11500.	0.
2020	6222.	10250.	17722.	11500.	0.
2021	4801.	10079.	16301.	11500.	0.
2022	3756.	10455.	15256.	11500.	0.
2023	2719.	10444.	14219.	11500.	0.
2024	2817.	10098.	12817.	11500.	0.
2025	2350.	10200.	13017.	10000.	0.
2026	3005.	9944.	12339.	10667.	0.
2027	2349.	9343.	12349.	9333.	0.
2028	3271.	8922.	11271.	10000.	0.
2029	3870.	8599.	11870.	8000.	0.
2030	4091.	8221.	12091.	8000.	0.
2031	4161.	8070.	12161.	8000.	0.
2032	4132.	7971.	12132.	8000.	0.
2033	3788.	7656.	11788.	8000.	0.
2034	3342.	7354.	11342.	8000.	0.
2035	2842.	7500.	10842.	8000.	0.
2036	2209.	7347.	10209.	8000.	0.
2037	1370.	7161.	9370.	8000.	0.
2038	2500.	7130.	8500.	8000.	0.
2039	2854.	7022.	9521.	6000.	0.
2040	2373.	6851.	9706.	6667.	0.
2041	3085.	6713.	9085.	7333.	0.
2042	3671.	6545.	9671.	6000.	0.
2043	3725.	6054.	9725.	6000.	0.
2044	3744.	6019.	9744.	6000.	0.
2045	3607.	5844.	9607.	6000.	0.
2046	3589.	5942.	9589.	6000.	0.
2047	3590.	6000.	9590.	6000.	0.
2048	3716.	6126.	9716.	6000.	0.
2049	3793.	6077.	9793.	6000.	0.
2050	3273.	5440.	9273.	6000.	0.
2051	2765.	5492.	8765.	6000.	0.
2052	2334.	5549.	8334.	6000.	0.
2053	1763.	5429.	7763.	6000.	0.
2054	3319.	5546.	7319.	6000.	0.
2055	4824.	5503.	8824.	4000.	0.
2056	6236.	5412.	10236.	4000.	0.
2057	7198.	4942.	11198.	4000.	0.
2058	7408.	4877.	12074.	4000.	0.
2059	7068.	4993.	12401.	4667.	0.
2060	5951.	4843.	11951.	5333.	0.
2061	4862.	4912.	10862.	6000.	0.
2062	3816.	4954.	9816.	6000.	0.
2063	2653.	4877.	8653.	6000.	0.
2064	1479.	4826.	7479.	6000.	0.
2065	2314.	4835.	6314.	6000.	0.
2066	3118.	4804.	7118.	4000.	0.
2067	3798.	4640.	7798.	4000.	0.
2068	4382.	4545.	8382.	4000.	0.
2069	5033.	4650.	9033.	4000.	0.
2070	5917.	4444.	9517.	4000.	0.
2071	6156.	4639.	10156.	4000.	0.
2072	6879.	4723.	10879.	4000.	0.
2073	7635.	4756.	11635.	4000.	0.
2074	8364.	4729.	12364.	4000.	0.
2075	8333.	4636.	13000.	4000.	0.
2076	7458.	4498.	12792.	4667.	0.

PLANT CAPACITY (MTH/YR)

2000.

TABLE 3 LWR FUEL CYCLE TOTAL MATERIAL FLOW NO REPROCESSING

TOTAL RXS

CASE SCENARIO1

ECT RECYCLE SCENARIO - 380 GW BY 2000 - RECYCLE STARTING IN

DATE: 04/27/79

TIME: 10.08.04

YEAR	ELE GEN BILLION KW-HR	MINF 1000000 ST DRE	MILL 1000 ST U308	CONV 1000 MTU	ENRICHMT 1000 KG SWU	----- FABRICATION MT-HM U	----- REACTOR MT-HM U	----- REACTOR KG DISCHARGE FIS. PU	SPENT FUEL STORAGE MT-HM	REPRO. FUEL MT	----- RECOVERED U MTU	----- RECOVERED PU MT-PU	----- RAD.WST. MT
1977	231.6	4.2	9.7	7.4	5155.7	1376.	0.	0.	910.	1963.	0.	0.	0.0
1978	278.6	4.7	10.9	7.7	5302.0	1382.	0.	0.	1101.	1869.	0.	0.	0.0
1979	309.3	6.3	15.0	10.1	5859.3	1400.	0.	0.	1151.	1004.	0.	0.	0.0
1980	331.8	7.2	16.8	11.8	7027.7	1693.	0.	0.	1247.	1128.	0.	0.	0.0
1981	365.4	7.9	18.3	13.6	7975.4	2239.	0.	0.	1364.	1205.	0.	0.	0.0
1982	418.7	10.0	23.2	16.0	9273.7	2513.	0.	0.	1481.	1294.	0.	0.	0.0
1983	480.6	11.2	25.8	18.6	11212.1	2820.	0.	0.	1729.	1371.	0.	0.	0.0
1984	555.8	11.5	26.5	20.2	12163.2	3444.	0.	0.	2015.	1579.	0.	0.	0.0
1985	647.5	12.6	29.3	21.5	12809.6	3786.	0.	0.	2342.	1904.	0.	0.	0.0
1986	738.4	13.4	31.1	23.6	14387.6	3845.	0.	0.	2672.	2179.	0.	0.	0.0
1987	819.9	14.6	33.7	25.0	15148.6	4222.	0.	0.	3019.	2478.	0.	0.	0.0
1988	896.2	15.8	36.5	26.5	16226.7	4431.	0.	0.	3324.	2886.	0.	0.	0.0
1989	972.5	17.6	40.8	30.0	18026.3	4763.	0.	0.	3610.	3226.	0.	0.	0.0
1990	1053.3	18.9	43.7	32.5	19688.6	5292.	0.	0.	3845.	3458.	0.	0.	0.0
1991	1144.5	20.2	46.7	34.5	21104.7	5816.	0.	0.	4260.	3689.	0.	0.	0.0
1992	1246.2	24.2	51.4	37.9	22809.7	6206.	0.	0.	4620.	4086.	0.	0.	0.0
1993	1353.1	34.5	55.0	40.7	24864.9	6691.	0.	0.	4968.	4409.	0.	0.	0.0
1994	1486.4	37.3	58.0	43.6	26680.7	7285.	0.	0.	5425.	4712.	0.	0.	0.0
1995	1587.3	41.3	62.4	46.1	28223.8	7797.	0.	0.	5883.	5242.	0.	0.	0.0
1996	1711.7	44.3	65.7	49.4	30358.4	8210.	0.	0.	6300.	5633.	0.	0.	0.0
1997	1836.9	47.2	68.8	52.0	32031.7	8771.	0.	0.	6852.	6110.	0.	0.	0.0
1998	1961.8	50.1	72.1	54.0	33133.6	9213.	0.	0.	7313.	6560.	0.	0.	0.0
1999	2085.9	54.4	73.7	56.2	35052.4	9506.	0.	0.	7740.	7101.	0.	0.	0.0
2000	2205.4	60.8	74.2	57.1	35704.2	9956.	0.	0.	8283.	7530.	0.	0.	0.0
2001	2314.7	62.8	76.4	57.7	36102.5	10022.	0.	0.	8700.	8000.	0.	0.	0.0
2002	2402.5	65.6	78.3	59.5	37334.0	10011.	0.	0.	9096.	8544.	0.	0.	0.0
2003	2472.6	69.2	80.5	61.4	38307.9	10325.	0.	0.	9337.	8953.	0.	0.	0.0
2004	2534.4	79.5	81.6	61.6	38945.7	10527.	0.	0.	9597.	9125.	0.	0.	0.0
2005	2593.6	86.0	85.4	64.5	40018.7	10784.	0.	0.	9825.	9531.	0.	0.	0.0
2006	2654.6	92.7	86.0	66.0	41635.7	11071.	0.	0.	10007.	9704.	0.	0.	0.0
2007	2717.1	95.5	84.8	66.0	41705.1	11474.	0.	0.	10331.	9846.	0.	0.	0.0
2008	2774.1	103.7	85.4	65.4	41542.8	11382.	0.	0.	10687.	10178.	0.	0.	0.0
2009	2807.3	112.6	83.9	65.5	41645.1	11229.	0.	0.	10753.	10521.	0.	0.	0.0
2010	2816.4	110.2	82.4	64.0	40831.5	11213.	0.	0.	10989.	10699.	0.	0.	0.0
2011	2810.6	110.8	82.8	63.0	40019.3	10989.	0.	0.	11128.	10910.	0.	0.	0.0
2012	2795.8	109.7	82.1	63.9	40646.8	10785.	0.	0.	11262.	11129.	0.	0.	0.0
2013	2776.9	116.7	80.2	62.5	39845.0	10935.	0.	0.	11141.	11220.	0.	0.	0.0
2014	2760.5	120.7	78.3	60.8	38775.4	10805.	0.	0.	11465.	11102.	0.	0.	0.0
2015	2731.7	123.2	78.2	59.8	38105.9	10439.	0.	0.	11081.	11391.	0.	0.	0.0
2016	2689.5	123.4	77.5	60.5	38440.6	10191.	0.	0.	10723.	11288.	0.	0.	0.0
2017	2631.9	121.9	76.5	59.2	37892.3	10262.	0.	0.	10697.	10792.	0.	0.	0.0
2018	2578.9	123.5	77.5	58.9	37380.9	10103.	0.	0.	10457.	10793.	0.	0.	0.0
2019	2532.2	119.2	74.9	59.2	38071.2	9976.	0.	0.	10199.	10633.	0.	0.	0.0
2020	2484.2	113.1	71.0	55.9	36090.0	10133.	0.	0.	10136.	10250.	0.	0.	0.0
2021	2420.0	109.1	68.5	53.6	34382.4	9614.	0.	0.	10602.	10079.	0.	0.	0.0
2022	2341.7	104.6	65.7	51.6	33143.1	9161.	0.	0.	10291.	10455.	0.	0.	0.0
2023	2260.3	99.3	62.3	49.3	31868.0	8848.	0.	0.	10080.	10464.	0.	0.	0.0
2024	2167.1	96.9	60.8	47.2	30169.3	8504.	0.	0.	10136.	10098.	0.	0.	0.0
2025	2064.9	94.2	59.2	46.1	29554.5	8063.	0.	0.	9697.	10200.	0.	0.	0.0
2026	1968.2	90.2	56.7	45.0	28897.8	7894.	0.	0.	9121.	9989.	0.	0.	0.0
2027	1878.3	87.5	54.9	42.7	27341.6	7708.	0.	0.	8737.	9343.	0.	0.	0.0
2028	1790.2	86.6	54.4	42.0	26824.5	7306.	0.	0.	8388.	8922.	0.	0.	0.0
2029	1701.3	84.6	53.1	41.6	26480.1	7180.	0.	0.	8183.	8599.	0.	0.	0.0
2030	1618.0	82.5	51.6	40.1	25405.4	7126.	0.	0.	7982.	8321.	0.	0.	0.0

2031	1541.8	111.9	51.9	39.9	25065.4	6973.	0.	0.	7A49.	8070.	0.	0.	0.0	0.0
2032	1475.3	134.4	51.2	39.5	24935.9	6943.	0.	0.	7602.	7971.	0.	0.	0.0	0.0
2033	1421.1	129.4	49.6	38.4	24488.6	6973.	0.	0.	748A.	7656.	0.	0.	0.0	0.0
2034	1375.8	124.3	48.1	37.4	23643.6	6905.	0.	0.	7489.	7554.	0.	0.	0.0	0.0
2035	1338.1	124.3	48.1	36.9	23153.1	6697.	0.	0.	719A.	7500.	0.	0.	0.0	0.0
2036	1307.1	118.0	46.1	36.6	23141.8	6582.	0.	0.	7187.	7367.	0.	0.	0.0	0.0
2037	1283.5	112.5	44.4	34.1	21610.0	6626.	0.	0.	7044.	7161.	0.	0.	0.0	0.0
2038	1269.9	113.8	44.8	34.4	21412.0	6209.	0.	0.	6973.	7130.	0.	0.	0.0	0.0
2039	1258.0	116.1	45.5	34.3	21364.7	6132.	0.	0.	6812.	7022.	0.	0.	0.0	0.0
2040	1251.8	136.3	43.0	34.3	21746.5	6173.	0.	0.	6590.	6851.	0.	0.	0.0	0.0
2041	1255.9	146.4	45.0	33.9	21052.0	6160.	0.	0.	6340.	6713.	0.	0.	0.0	0.0
2042	1261.0	141.3	43.4	33.8	21572.3	5875.	0.	0.	6007.	6585.	0.	0.	0.0	0.0
2043	1263.9	140.0	43.0	34.0	21232.8	6043.	0.	0.	597A.	6054.	0.	0.	0.0	0.0
2044	1271.3	139.0	42.7	31.9	20147.1	5895.	0.	0.	5A93.	6019.	0.	0.	0.0	0.0
2045	1280.1	135.3	41.6	32.5	20506.1	5756.	0.	0.	6029.	5A64.	0.	0.	0.0	0.0
2046	1295.9	144.7	43.1	33.0	20359.6	5839.	0.	0.	6040.	5982.	0.	0.	0.0	0.0
2047	1309.6	249.4	42.1	32.0	20228.4	5718.	0.	0.	6111.	6000.	0.	0.	0.0	0.0
2048	1325.7	340.7	42.4	33.4	21052.1	5667.	0.	0.	5847.	6126.	0.	0.	0.0	0.0
2049	1347.7	321.5	41.0	31.9	20472.3	5754.	0.	0.	5382.	6077.	0.	0.	0.0	0.0
2050	1362.8	290.2	38.8	30.7	19916.7	5539.	0.	0.	5475.	5480.	0.	0.	0.0	0.0
2051	1366.9	281.9	38.3	29.6	18863.7	5264.	0.	0.	558A.	5492.	0.	0.	0.0	0.0
2052	1361.1	284.7	38.5	29.3	18632.5	5013.	0.	0.	5465.	5569.	0.	0.	0.0	0.0
2053	1346.5	273.3	37.7	29.4	18989.0	4947.	0.	0.	54A0.	5429.	0.	0.	0.0	0.0
2054	1327.3	275.2	37.8	28.8	18382.8	5023.	0.	0.	5556.	5556.	0.	0.	0.0	0.0
2055	1312.4	273.2	37.7	28.9	18468.4	4880.	0.	0.	516A.	5505.	0.	0.	0.0	0.0
2056	1306.9	330.2	37.6	29.4	18616.3	4893.	0.	0.	4930.	5412.	0.	0.	0.0	0.0
2057	1304.1	484.7	37.0	2A.3	18267.0	4922.	0.	0.	491A.	4962.	0.	0.	0.0	0.0
2058	1299.7	482.7	36.9	28.5	18140.7	4847.	0.	0.	4920.	4A77.	0.	0.	0.0	0.0
2059	1293.2	485.5	37.1	2A.7	18216.2	4813.	0.	0.	4913.	4993.	0.	0.	0.0	0.0
2060	1284.6	469.2	35.9	27.9	17998.6	4832.	0.	0.	4A8A.	4A83.	0.	0.	0.0	0.0
2061	1273.8	500.1	35.0	27.5	17561.5	4770.	0.	0.	4965.	4912.	0.	0.	0.0	0.0
2062	1260.6	510.3	35.7	27.0	17152.4	4658.	0.	0.	4792.	4954.	0.	0.	0.0	0.0
2063	1244.8	488.4	34.2	27.0	17459.1	4557.	0.	0.	4800.	4A37.	0.	0.	0.0	0.0
2064	1226.6	503.1	35.2	26.5	16741.5	4622.	0.	0.	4872.	4A2A.	0.	0.	0.0	0.0
2065	1205.8	510.5	35.7	27.2	17274.5	4442.	0.	0.	4713.	4835.	0.	0.	0.0	0.0
2066	1182.7	519.0	36.3	28.1	17797.5	4567.	0.	0.	4626.	4804.	0.	0.	0.0	0.0
2067	1157.8	501.5	35.1	27.3	17650.5	4706.	0.	0.	465A.	4680.	0.	0.	0.0	0.0
2068	1131.3	491.7	34.4	26.9	17141.6	4683.	0.	0.	4520.	4585.	0.	0.	0.0	0.0
2069	1102.4	477.1	33.4	26.2	16795.1	4548.	0.	0.	4605.	4650.	0.	0.	0.0	0.0
2070	1063.4	453.4	31.7	24.8	16183.4	4456.	0.	0.	4662.	4484.	0.	0.	0.0	0.0
2071	1014.5	437.0	30.6	24.3	15411.2	4306.	0.	0.	4752.	4639.	0.	0.	0.0	0.0
2072	956.7	426.1	29.8	22.9	14739.9	4111.	0.	0.	4751.	4723.	0.	0.	0.0	0.0
2073	892.5	430.0	30.1	23.1	14593.6	3964.	0.	0.	4661.	4756.	0.	0.	0.0	0.0
2074	823.1	430.0	30.1	23.2	14688.2	3933.	0.	0.	4577.	4729.	0.	0.	0.0	0.0
2075	751.0	430.0	30.1	23.2	14688.2	3964.	0.	0.	4320.	4636.	0.	0.	0.0	0.0
2076	679.8	430.0	30.1	23.2	14688.2	3964.	0.	0.	4067.	4458.	0.	0.	0.0	0.0
154454.1		4978.4	3821.7	2410156.1	660861.	0.	0.	649773.	645958.	0.	0.	0.0	0.0	
18020.9														

**** EQUILIBRIUM CHAIN TOO SMALL TO SUPPORT DESIRED PLUTONIUM RECYCLE FOR REACTOR TYPE****

TABLE 3 LWR FUEL CYCLE TOTAL MATERIAL FLOW REPROCESSING + RECYCL TOTAL RXS

CASE SCENARIO: ECT RECYCLE SCENARIO - 760 GW BY 2000 - RECYCLE STARTING IN DATE: 04/27/79 TIME: 10.08.04

YEAR	ELE GEN BILLION KW-HR	MINF 1000000 BT ORE	MILL 1000 BT U308	CONV 1000 MTU	ENRICHMT 1000 KG RWU	FABRICATION MT-MM U	REACTOR KG DISCHARGE PU-U	SPENT FUEL STORAGE MT-MM	REPRO. FUEL MT	RECOVERED U MTU	RECOVERED PU MT-PU	RAD.WST. MT
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1977	231.6	4.2	9.7	7.4	5155.7	1376.	0.	910.	1963.	0.	0.	0.0
1978	278.6	4.7	10.9	7.7	5302.0	1382.	0.	1101.	869.	0.	0.	0.0
1979	309.3	6.5	15.0	10.1	5859.3	1400.	0.	1151.	1004.	0.	0.	0.0
1980	331.8	7.2	16.8	11.8	7027.7	1693.	0.	1247.	1126.	0.	0.	0.0
1981	365.4	7.9	18.3	13.6	7973.4	2239.	0.	1364.	1205.	0.	0.	0.0
1982	418.7	10.0	23.2	16.0	9273.7	2513.	0.	1481.	1294.	0.	0.	0.0
1983	480.6	11.1	25.7	18.4	11212.1	2820.	0.	1729.	1371.	0.	0.	0.0
1984	555.8	11.1	25.8	19.8	11981.7	3448.	0.	2015.	1579.	0.	0.	0.0
1985	647.5	11.7	27.0	20.6	12262.8	3737.	49.	2342.	1904.	500.	483.	13.8
1986	738.4	11.5	26.7	21.6	13280.4	3696.	149.	2672.	2179.	1000.	966.	27.2
1987	819.9	11.5	26.7	22.0	13400.7	3900.	322.	3019.	2478.	2167.	2054.	67.0
1988	896.2	11.7	27.0	22.2	13994.3	3901.	530.	3324.	2886.	2833.	2715.	96.4
1989	972.5	12.4	28.8	24.9	15362.1	4008.	755.	3610.	3226.	4167.	3987.	146.8
1990	1053.3	12.8	29.6	26.4	16714.3	4325.	967.	3845.	3458.	4833.	4633.	162.4
1991	1144.5	13.6	31.4	28.0	17960.5	4698.	1118.	4260.	3689.	5500.	5272.	184.3
1992	1246.2	15.4	34.6	31.1	19753.9	5001.	1205.	4620.	4086.	5500.	5265.	190.8
1993	1353.1	19.9	39.0	33.7	21588.5	5448.	1243.	4968.	4409.	5500.	5259.	192.9
1994	1466.4	22.3	41.6	36.5	23432.6	5957.	1329.	5425.	4712.	5500.	5251.	194.9
1995	1587.3	26.4	46.1	38.9	25146.4	6404.	1392.	5883.	5242.	5500.	5245.	198.8
1996	1711.7	29.5	49.6	42.5	27927.0	6729.	1482.	6300.	5633.	5500.	5241.	199.6
1997	1836.9	32.3	52.6	45.4	30093.0	7265.	1507.	6852.	6110.	5500.	5237.	196.6
1998	1961.8	34.4	54.8	46.9	31432.7	7679.	1535.	7313.	6560.	5500.	5236.	196.8
1999	2085.9	35.0	55.6	48.5	33011.5	7892.	1614.	7740.	7101.	6167.	5871.	221.0
2000	2205.4	33.0	53.4	48.4	33683.9	8179.	1776.	8283.	7530.	6833.	6504.	246.1
2001	2314.7	40.6	53.7	48.5	33947.9	8067.	1955.	8700.	8000.	7500.	7137.	271.1
2002	2402.5	42.1	53.6	49.5	34922.7	7883.	2128.	9096.	8544.	8167.	7769.	295.9
2003	2472.6	42.7	54.3	50.6	35540.9	8015.	2309.	9337.	8953.	8833.	8402.	321.7
2004	2534.4	42.8	54.4	50.5	36070.5	8045.	2482.	9597.	9125.	9500.	9035.	347.8
2005	2593.6	46.0	53.2	53.2	37276.8	8225.	2559.	9825.	9531.	9500.	9031.	350.4
2006	2654.6	46.6	58.6	54.7	38837.3	8476.	2594.	10007.	9704.	9500.	9025.	356.4
2007	2717.1	46.8	57.4	54.4	38813.0	8867.	2607.	10331.	9846.	9500.	9019.	356.7
2008	2774.1	53.4	58.2	54.2	38697.9	8758.	2624.	10687.	10178.	9500.	9012.	358.8
2009	2807.3	55.3	56.8	54.4	39203.6	8592.	2638.	10757.	10521.	9500.	9009.	359.5
2010	2816.4	53.2	55.4	53.1	38675.2	8578.	2635.	10989.	10699.	9500.	9005.	360.0
2011	2810.6	53.9	55.9	52.2	38094.8	8354.	2635.	11128.	10910.	9500.	9005.	359.2
2012	2795.8	52.8	55.2	53.3	38864.9	8161.	2624.	11262.	11129.	9500.	9003.	359.4
2013	2776.9	56.6	53.0	51.9	38314.0	8323.	2612.	11141.	11220.	9500.	9001.	361.8
2014	2760.5	58.6	50.0	49.4	36908.9	8202.	2603.	11465.	11102.	9500.	9000.	363.5
2015	2731.7	55.1	47.8	47.4	35552.3	7751.	2688.	11081.	11391.	10167.	9635.	387.0
2016	2689.5	51.7	45.7	47.4	35323.2	7328.	2863.	10727.	11288.	10833.	10261.	415.5
2017	2631.9	47.9	43.3	46.0	35155.8	7217.	3045.	10697.	10792.	11500.	10902.	430.5
2018	2578.9	48.9	43.9	45.1	34307.6	6973.	3131.	10457.	10793.	11500.	10899.	435.8
2019	2532.2	45.1	41.5	45.7	35190.1	6821.	3155.	10149.	10634.	11500.	10892.	439.5
2020	2484.2	52.4	37.7	42.6	33749.5	6962.	3171.	10138.	10250.	11500.	10889.	442.0
2021	2420.0	51.9	35.1	40.1	31817.6	6412.	3202.	10602.	10079.	11500.	10885.	444.1
2022	2341.7	47.7	32.5	38.1	30850.0	5936.	3226.	10291.	10455.	11500.	10878.	446.2
2023	2260.3	48.1	30.2	36.3	30125.6	5570.	3279.	10080.	10464.	11500.	10874.	443.9
2024	2167.1	46.5	29.2	35.4	29202.1	5228.	3277.	10136.	10098.	11500.	10879.	438.2
2025	2064.9	45.6	28.7	33.7	28497.8	5010.	3053.	9697.	10200.	10000.	9454.	381.4
2026	1968.2	44.0	27.6	33.4	27466.7	4927.	2967.	9121.	9889.	10067.	10083.	406.2
2027	1878.3	41.9	26.3	31.2	26930.3	4869.	2840.	8737.	9333.	9333.	8825.	352.2
2028	1790.2	44.1	27.7	31.6	25564.3	4591.	2714.	8388.	8922.	10000.	9452.	376.6
2029	1701.3	45.9	28.9	32.3	27117.3	4587.	2594.	8187.	8599.	8000.	7552.	304.2
2030	1618.0	45.4	28.7	31.0	25011.1	4742.	2445.	7945.	8221.	8000.	7507.	275.3

2031	1541.8	47.1	29.6	31.4	24884.4	4708.	2265.	46221.	7849.	8070.	8000.	7544.	151.4	305.0
2032	1475.3	45.9	28.8	31.2	25096.2	4782.	2160.	64098.	7602.	7971.	8000.	7550.	147.0	303.3
2033	1421.1	44.3	27.8	30.8	24614.6	4897.	2075.	62151.	7488.	7656.	8000.	7548.	150.3	301.8
2034	1375.8	41.3	25.9	29.7	24283.2	4881.	2024.	61100.	7489.	7554.	8000.	7558.	145.1	297.1
2035	1338.1	41.0	25.8	28.9	23456.9	4793.	1903.	58097.	7198.	7500.	8000.	7559.	146.8	294.3
2036	1307.1	38.3	24.0	28.5	23470.8	4704.	1877.	57031.	7187.	7367.	8000.	7569.	140.6	290.3
2037	1283.5	34.5	21.6	25.9	21409.3	4777.	1849.	55694.	7044.	7161.	8000.	7575.	138.7	286.5
2038	1269.9	36.4	22.8	26.3	20782.3	4438.	1772.	53431.	6973.	7130.	8000.	7579.	138.7	282.0
2039	1258.0	40.0	25.1	26.1	20921.0	4334.	1798.	52687.	6812.	7022.	8000.	7588.	101.8	210.2
2040	1251.8	35.5	22.3	25.4	19145.8	4544.	1630.	47167.	6590.	6851.	6667.	6319.	114.8	232.7
2041	1255.9	38.7	24.3	25.7	19137.6	4414.	1746.	50807.	6340.	6713.	7333.	6957.	122.6	253.8
2042	1261.0	37.6	23.6	25.6	20469.9	4158.	1717.	48841.	6007.	6585.	6000.	5692.	100.8	206.9
2043	1263.9	37.9	23.8	25.9	19329.1	4422.	1621.	45410.	5978.	6054.	6000.	5693.	99.2	208.2
2044	1271.3	37.5	23.6	24.1	18626.8	4261.	1634.	45639.	5893.	6019.	6000.	5691.	99.5	209.4
2045	1280.1	36.6	23.0	24.6	19155.0	4115.	1641.	45693.	6029.	5864.	6000.	5684.	102.9	213.3
2046	1295.9	38.9	24.4	25.7	20032.0	4132.	1707.	47407.	6040.	5982.	6000.	5687.	98.6	214.9
2047	1309.6	37.2	23.3	24.5	19739.0	4022.	1696.	46347.	6111.	6000.	6000.	5684.	98.5	217.1
2048	1325.7	37.7	23.7	25.9	20570.9	3934.	1734.	47220.	5847.	6126.	6000.	5685.	99.1	216.1
2049	1347.7	36.2	22.8	24.3	19551.3	3974.	1781.	47916.	5382.	6077.	6000.	5691.	94.1	214.7
2050	1362.8	33.0	20.7	23.7	19204.5	3771.	1748.	47210.	5475.	5480.	6000.	5693.	92.6	214.1
2051	1366.9	32.4	20.3	22.6	18208.2	3691.	1573.	43607.	5588.	5492.	6000.	5688.	94.4	217.7
2052	1381.1	33.6	21.1	22.4	18269.5	3429.	1543.	43992.	5465.	5569.	6000.	5680.	98.9	221.6
2053	1346.3	34.1	21.4	23.2	19221.7	3323.	1625.	45360.	5480.	5429.	6000.	5675.	99.7	225.6
2054	1327.3	38.4	24.1	24.3	19494.7	3372.	1651.	45781.	5556.	5556.	6000.	5673.	99.3	227.7
2055	1312.4	40.8	25.6	24.9	20499.6	3472.	1409.	49274.	5166.	5505.	4000.	3778.	68.1	153.9
2056	1306.9	41.3	25.9	24.9	18608.0	3752.	1141.	42183.	4930.	5412.	4000.	3780.	65.8	154.3
2057	1304.1	39.6	24.9	23.4	18123.4	3771.	1151.	42371.	4918.	4962.	4000.	3781.	65.7	152.9
2058	1299.7	37.4	23.5	23.0	17392.2	3694.	1153.	42153.	4920.	4877.	4000.	3779.	66.4	154.3
2059	1293.2	35.8	22.5	22.7	16964.0	3539.	1273.	45838.	4913.	4993.	4667.	4403.	81.1	182.8
2060	1284.6	31.6	19.8	21.5	17313.3	3399.	1433.	40926.	4888.	4883.	5333.	5031.	90.2	212.6
2061	1273.8	29.7	18.6	21.1	17442.4	3160.	1609.	46406.	4965.	4912.	6000.	5655.	105.1	239.7
2062	1260.6	30.9	19.4	21.0	17772.2	2911.	1747.	50573.	4792.	4934.	6000.	5661.	100.8	238.5
2063	1244.8	28.4	17.9	21.1	17916.8	2875.	1683.	47806.	4800.	4837.	6000.	5669.	93.6	237.2
2064	1226.6	30.6	19.2	20.3	16738.4	2999.	1623.	45679.	4872.	4826.	6000.	5675.	88.7	236.4
2065	1205.8	35.5	22.3	22.6	17600.5	2851.	1592.	44620.	4713.	4835.	6000.	5673.	91.3	235.9
2066	1182.7	38.9	24.4	23.9	18829.6	3188.	1379.	38950.	4828.	4804.	4000.	3779.	63.9	157.5
2067	1157.8	37.9	23.8	22.7	16830.8	3594.	1112.	31759.	4658.	4680.	4000.	3773.	68.6	158.5
2068	1131.3	37.1	23.3	22.4	16556.1	3557.	1126.	32545.	4520.	4585.	4000.	3768.	72.5	159.1
2069	1102.4	35.6	22.3	21.9	16421.4	3413.	1134.	32742.	4405.	4650.	4000.	3765.	75.4	159.7
2070	1063.4	32.9	20.7	20.6	16070.0	3326.	1130.	32553.	4662.	4484.	4000.	3766.	74.5	159.6
2071	1014.5	31.0	19.5	20.0	15388.3	3171.	1135.	32570.	4752.	4639.	4000.	3765.	74.8	160.0
2072	956.7	30.3	19.0	18.8	14715.4	2971.	1139.	32801.	4751.	4723.	4000.	3765.	75.1	159.7
2073	892.5	31.1	19.5	19.3	14997.8	2816.	1148.	32688.	4661.	4756.	4000.	3771.	70.8	158.4
2074	823.1	29.8	18.7	19.2	14984.8	2843.	1090.	30527.	4577.	4729.	4000.	3780.	64.2	155.3
2075	751.0	27.9	17.5	18.3	14313.2	2914.	1050.	29330.	4320.	4636.	4000.	3783.	62.1	154.4
2076	679.8	24.6	15.4	17.3	13417.1	2859.	1105.	30579.	4067.	4458.	4667.	4423.	69.2	174.9

154454.1

3503.1

3138.1

3089.4

2296839.6

490142.

170720.

4756956.

649773.

645958.

633167.

599988.

9557.5

23620.8

YEAR	UNDERGROUND MINE	SURFACE MINE	DATA BASE PRODUCTION MASS (KG) ACID LEACH MILL	ALKALI LEACH MILL	AQUEOUS CONVERSION
1977	5357667.	2083537.	5952963.	1488241.	7379499.
1978	6049662.	2352646.	6721847.	1680462.	7741113.
1979	8297837.	3224992.	9214267.	2303566.	10133172.
1980	9281431.	3609445.	10312701.	2578175.	11789727.
1981	10122516.	3976534.	11247240.	2811810.	13553473.
1982	12837049.	4990630.	14258943.	3564736.	16042025.
1983	14224641.	5571805.	15805157.	3951289.	18631858.
1984	14278638.	5552028.	15862931.	3965733.	19807864.
1985	14964409.	5919493.	16627122.	4156780.	20627699.
1986	14781043.	5788183.	16423381.	4105845.	21560821.
1987	14788778.	5751191.	16431975.	4107994.	22044188.
1988	14977340.	5822966.	16637045.	4159261.	22270631.
1989	15924717.	6192945.	17644130.	4423532.	24917428.
1990	16399090.	6777424.	18221211.	4555303.	26365747.
1991	17416150.	6772947.	19351274.	4837820.	28013912.
1992	19691193.	7657670.	21879054.	5469765.	31149897.
1993	22380272.	7593525.	23979038.	5994759.	33691879.
1994	24208342.	7870032.	25624299.	6406075.	36478215.
1995	27267930.	8228645.	28397260.	7099315.	38922316.
1996	29589786.	8570355.	30496113.	7624028.	42516266.
1997	31678596.	8801782.	32354302.	8096076.	45361699.
1998	33144020.	8997402.	33745138.	8436285.	46909519.
1999	33679777.	9061823.	34193280.	8548320.	48481062.
2000	32187559.	8867269.	32839867.	8209966.	48781466.
2001	34321880.	6961742.	33026897.	8256724.	48515243.
2002	34707886.	6565363.	33015399.	8253850.	49532190.
2003	35142712.	6622386.	33412078.	8353020.	50603201.
2004	35226858.	6673320.	33458143.	8372036.	50518132.
2005	37641349.	6947068.	35670734.	8917683.	53168210.
2006	38048631.	6999991.	36038898.	9009724.	54702763.
2007	37580755.	6539990.	35296594.	8824149.	54674869.
2008	39630538.	5129881.	35808335.	8952084.	56214892.
2009	38856733.	4822588.	34943457.	8735864.	54397041.
2010	37886224.	4756228.	34113962.	8528490.	53120881.
2011	38195163.	4777352.	34378012.	8594503.	52164013.
2012	37730406.	4745574.	33980784.	8495196.	53258636.
2013	36558736.	4215746.	32619584.	8154896.	51887113.
2014	34820558.	3670323.	30800705.	7700176.	49594280.
2015	33199092.	3569494.	29414836.	7353709.	47625503.
2016	31688314.	3466153.	28123577.	7030893.	47391847.
2017	29962018.	3348115.	26648104.	6662027.	45979699.
2018	30417615.	3378925.	27033232.	6759308.	45067744.
2019	28682667.	3260638.	25554644.	6388661.	45680215.
2020	26684659.	2290397.	23180045.	5795011.	42575550.
2021	25070340.	1965714.	21625843.	5407211.	40104206.
2022	23185879.	1876862.	20018197.	5004548.	38125500.
2023	21769473.	1488511.	18606387.	4651597.	36287256.
2024	21026506.	1477710.	17971373.	4492847.	35393203.
2025	20633306.	1410961.	17637013.	4409253.	33728496.
2026	19895480.	1360375.	17004684.	4251171.	33618931.
2027	18964192.	1296697.	16209711.	4052178.	31240958.
2028	19942398.	1363583.	17044785.	4261196.	31609013.
2029	20778152.	1420729.	1759104.	4439776.	32293744.
2030	20644037.	1411550.	17644476.	4411119.	30983019.
2031	21318219.	1457656.	18220700.	4555175.	31448596.
2032	20735487.	1417811.	17722638.	4430660.	31224019.
2033	20016097.	1363622.	17107775.	4276944.	30752555.
2034	18654092.	1275670.	15945777.	3886700.	28773990.

2035	18546691.	1268164.	15852040.	3963011.	28889672.
2036	17315070.	1183936.	14799205.	3699801.	28473140.
2037	19586956.	1065747.	13321842.	3330461.	25899537.
2038	16451456.	1124886.	14061074.	3515268.	26345972.
2039	18094969.	1237263.	15465785.	3866446.	26094836.
2040	16037678.	1006593.	13707417.	3426854.	25412192.
2041	17495007.	1146240.	14952997.	3738249.	25666884.
2042	17024775.	1164007.	14551090.	3637772.	25567293.
2043	17154866.	1172982.	14462279.	3665570.	25850690.
2044	16978645.	1160933.	14511662.	3627916.	24103833.
2045	16570393.	1133018.	14162729.	3540682.	24638142.
2046	17582967.	1202254.	15028177.	3757044.	25740062.
2047	16801007.	1144787.	14359835.	3589959.	24539296.
2048	17048280.	1165694.	14571179.	3642795.	25932560.
2049	16382047.	1120140.	14001750.	3500437.	24326744.
2050	14912298.	1019644.	12745554.	3186388.	23668560.
2051	14636290.	1000772.	12509650.	3127412.	22569947.
2052	15190587.	1038673.	12983408.	3248852.	22443357.
2053	13434277.	1045335.	13191690.	3297923.	23182226.
2054	17382210.	1188596.	14857845.	3714361.	24329442.
2055	18464619.	1262538.	15781726.	3945431.	24905527.
2056	18672900.	1276780.	15959744.	3989936.	24939405.
2057	17920577.	1225339.	15316732.	3829183.	23779711.
2058	16926401.	1147361.	14467009.	3616752.	22987006.
2059	16206041.	1108105.	13851317.	3462829.	22691577.
2060	14268030.	975592.	12194898.	3048724.	21524835.
2061	13426389.	918044.	11475546.	2864487.	21089803.
2062	13966043.	984943.	11936787.	2984197.	20948441.
2063	12864657.	879635.	10995434.	2748859.	21057124.
2064	13850629.	947052.	11838145.	2959536.	20271524.
2065	16039408.	1096712.	13708896.	3427224.	22593509.
2066	17590588.	1202775.	15034691.	3758673.	23871307.
2067	17131644.	1171394.	14642431.	3660609.	22711695.
2068	16776611.	1147119.	14338984.	3584746.	22411101.
2069	16082855.	1099682.	13746030.	3436508.	21932325.
2070	14885267.	1017796.	12722451.	3180613.	20543506.
2071	14026237.	959059.	11988237.	2997059.	20033997.
2072	13702541.	936926.	11711573.	2927893.	18755512.
2073	14074413.	962353.	12029412.	3007353.	19294218.
2074	13495064.	922739.	11534247.	2883561.	19194905.
2075	12633739.	863845.	10798067.	2699517.	18336735.
2076	11116830.	760125.	9501564.	2375391.	17309496.
TAB	2099900606.	314148577.	1931239347.	482809837.	3089403935.
TOT	2099900606.	314148577.	1931239347.	482809837.	3089403935.

DATA BASE PRODUCTION MASS (KG)

YEAR	PUPPOL SHR SHOWN 3				
1977	0.				
1978	0.				
1979	0.				
1980	0.				
1981	0.				
1982	0.				
1983	0.				
1984	0.				
1985	0.				
1986	0.				
1987	0.				
1988	0.				
1989	0.				
1990	0.				
1991	0.				
1992	0.				
1993	0.				
1994	0.				
1995	0.				
1996	0.				
1997	0.				
1998	0.				
1999	0.				
2000	0.				
2001	0.				
2002	23.				
2003	17.				
2004	10.				
2005	14.				
2006	4.				
2007	0.				
2008	0.				
2009	0.				
2010	0.				
2011	105.				
2012	241.				
2013	251.				
2014	233.				
2015	504.				
2016	56.				
2017	804.				
2018	741.				
2019	275.				
2020	77.				
2021	154.				
2022	41.				
2023	428.				
2024	918.				
2025	732.				
2026	625.				
2027	858.				
2028	1158.				
2029	763.				
2030	741.				
2031	784.				
2032	866.				
2033	1005.				
2034	1122.				

2035	1258.
2036	1340.
2037	1468.
2038	1565.
2039	1172.
2040	1325.
2041	1481.
2042	1208.
2043	1154.
2044	1018.
2045	825.
2046	790.
2047	651.
2048	802.
2049	904.
2050	768.
2051	595.
2052	476.
2053	388.
2054	494.
2055	233.
2056	0.
2057	357.
2058	374.
2059	288.
2060	0.
2061	0.
2062	0.
2063	0.
2064	0.
2065	0.
2066	0.
2067	0.
2068	0.
2069	0.
2070	0.
2071	0.
2072	0.
2073	0.
2074	0.
2075	0.
2076	422.
TAB	34861.
TOT	34861.

COST REPORT FOR FCT RECYCLE SCENARIO - 340 GW BY 2000 - RECYCLE STARTING IN 1985

TABLE 6 MATERIAL THROUGHPUTS

MODE: REPROCESSING AND RECYCLE

DATE: 04/27/79 TIME: TODAY

YEAR	U3D8 LB	UF6 CONVERSION KG-U	--ENRICHMENT-- DIFFUSION SWU	---FABRICATION---		-----REACTOR-----		YEAR
				U FUEL KGU	MOX FUEL KG-M	PWR KWH	BWR KWH	
1	1977	.1935E+0A	.7379E+04	.9156E+07	.1376E+04 0.	.1415E+12	.9003E+11	1977
2	1978	.2184E+0A	.7741E+04	.9302E+07	.1382E+04 0.	.1790E+12	.9960E+11	1978
3	1979	.2994E+0A	.1013E+05	.9899E+07	.1400E+04 0.	.2047E+12	.1046E+12	1979
4	1980	.3351E+0A	.1179E+05	.7028E+07	.1693E+04 0.	.2239E+12	.1078E+12	1980
5	1981	.3655E+0A	.1355E+05	.7975E+07	.2219E+04 0.	.2463E+12	.1190E+12	1981
6	1982	.4634E+0A	.1604E+05	.9274E+07	.2513E+04 0.	.2786E+12	.1400E+12	1982
7	1983	.5136E+0A	.1863E+05	.1121E+08	.2820E+04 0.	.3188E+12	.1617E+12	1983
8	1984	.5155E+0A	.1981E+05	.1198E+08	.3444E+04 0.	.3749E+12	.1809E+12	1984
9	1985	.5403E+0A	.2063E+05	.1226E+08	.3737E+04 .4915E+02	.4404E+12	.2070E+12	1985
10	1986	.5337E+0A	.2156E+05	.1328E+08	.3696E+04 .1495E+03	.5005E+12	.2378E+12	1986
11	1987	.5340E+0A	.2204E+05	.1341E+08	.3900E+04 .3224E+03	.5548E+12	.2650E+12	1987
12	1988	.5407E+0A	.2223E+05	.1399E+0A	.3901E+04 .5297E+03	.6058E+12	.2903E+12	1988
13	1989	.5750E+0A	.2492E+05	.1536E+08	.4008E+04 .7550E+03	.6565E+12	.3159E+12	1989
14	1990	.5921E+0A	.2637E+05	.1671E+08	.4325E+04 .9672E+03	.7104E+12	.3428E+12	1990
15	1991	.6289E+0A	.2801E+05	.1796E+08	.4698E+04 .1118E+04	.7711E+12	.3733E+12	1991
16	1992	.7110E+0A	.3119E+05	.1975E+08	.5001E+04 .1205E+04	.8388E+12	.4072E+12	1992
17	1993	.7792E+0A	.3369E+05	.2159E+08	.5448E+04 .1243E+04	.9102E+12	.4427E+12	1993
18	1994	.8327E+0A	.3648E+05	.2343E+08	.5957E+04 .1329E+04	.9857E+12	.4805E+12	1994
19	1995	.9228E+0A	.3992E+05	.2515E+08	.6404E+04 .1392E+04	.1066E+13	.5208E+12	1995
20	1996	.9910E+0A	.4252E+05	.2793E+08	.6729E+04 .1482E+04	.1149E+13	.5623E+12	1996
21	1997	.1052E+0A	.4536E+05	.3079E+08	.7265E+04 .1507E+04	.1233E+13	.6039E+12	1997
22	1998	.1097E+0A	.4691E+05	.3143E+08	.7679E+04 .1535E+04	.1316E+13	.6433E+12	1998
23	1999	.1111E+0A	.4848E+05	.3371E+08	.7892E+04 .1614E+04	.1399E+13	.6866E+12	1999
24	2000	.1067E+0A	.4878E+05	.3344E+08	.8179E+04 .1776E+04	.1479E+13	.7264E+12	2000
25	2001	.1073E+0A	.4852E+05	.3395E+08	.8067E+04 .1955E+04	.1552E+13	.7619E+12	2001
26	2002	.1073E+0A	.4953E+05	.3492E+08	.7883E+04 .2128E+04	.1611E+13	.7912E+12	2002
27	2003	.1086E+0A	.5060E+05	.3554E+08	.8015E+04 .2309E+04	.1657E+13	.8154E+12	2003
28	2004	.1088E+0A	.5052E+05	.3677E+08	.8045E+04 .2482E+04	.1698E+13	.8356E+12	2004
29	2005	.1159E+0A	.5317E+05	.3728E+08	.8225E+04 .2559E+04	.1739E+13	.8546E+12	2005
30	2006	.1171E+0A	.5470E+05	.3844E+08	.8476E+04 .2594E+04	.1779E+13	.8748E+12	2006
31	2007	.1147E+0A	.5463E+05	.3891E+08	.8867E+04 .2607E+04	.1822E+13	.8948E+12	2007
32	2008	.1164E+0A	.5421E+05	.3970E+08	.8758E+04 .2624E+04	.1862E+13	.9121E+12	2008
33	2009	.1136E+0A	.5440E+05	.3920E+08	.8592E+04 .2638E+04	.1882E+13	.9248E+12	2009
34	2010	.1109E+0A	.5312E+05	.3844E+08	.8578E+04 .2635E+04	.1887E+13	.9294E+12	2010
35	2011	.1117E+0A	.5216E+05	.3809E+08	.8354E+04 .2635E+04	.1880E+13	.9303E+12	2011
36	2012	.1104E+0A	.5326E+05	.3846E+08	.8161E+04 .2624E+04	.1864E+13	.9313E+12	2012
37	2013	.1060E+0A	.5199E+05	.381E+08	.8323E+04 .2612E+04	.1853E+13	.9239E+12	2013
38	2014	.1001E+0A	.4959E+05	.3601E+08	.8202E+04 .2603E+04	.1839E+13	.9210E+12	2014
39	2015	.9559E+0A	.4763E+05	.3555E+08	.7751E+04 .2688E+04	.1815E+13	.9161E+12	2015
40	2016	.9139E+0A	.4739E+05	.3512E+08	.7328E+04 .2863E+04	.1787E+13	.9023E+12	2016
41	2017	.8660E+0A	.4598E+05	.3516E+08	.7217E+04 .3045E+04	.1744E+13	.8879E+12	2017

COST REPORT FOR ECT RECYCLE SCENARIO - 340 GW BY 2000 - RECYCLE STARTING IN 1985

TABLE 6 MATERIAL THROUGHPUTS

MODE: REPROCESSING AND RECYCLE

DATE: 04/27/79 TIME: TODAY

		U308	UF6	--ENRICHMENT--	---FABRICATION---	-----REACTOR-----			
YEAR		LB	CONVERSION	DIFFUSION	U FUEL	MOX FUEL	PWR	BWR	YEAR
----		-----	KG-U	SWU	KGU	KG-MM	KWH	KWH	----
42	2018	.8785E+04	.4507E+05	.3471E+08	.6973E+04	.3131E+04	.1703E+13	.8751E+12	2018
43	2019	.8304E+04	.4564E+05	.3519E+08	.6821E+04	.3155E+04	.1669E+13	.8631E+12	2019
44	2020	.7533E+04	.4258E+05	.3375E+08	.6962E+04	.3171E+04	.1635E+13	.8490E+12	2020
45	2021	.7029E+04	.4010E+05	.3142E+08	.6412E+04	.3202E+04	.1594E+13	.8261E+12	2021
46	2022	.6505E+04	.3813E+05	.3045E+08	.5936E+04	.3226E+04	.1544E+13	.7977E+12	2022
47	2023	.6047E+04	.3629E+05	.3013E+08	.5570E+04	.3279E+04	.1489E+13	.7712E+12	2023
48	2024	.5840E+04	.3539E+05	.2920E+08	.5228E+04	.3277E+04	.1421E+13	.7460E+12	2024
49	2025	.5731E+04	.3373E+05	.2840E+08	.5010E+04	.3053E+04	.1352E+13	.7129E+12	2025
50	2026	.5526E+04	.3382E+05	.2747E+08	.4927E+04	.2967E+04	.1288E+13	.6794E+12	2026
51	2027	.5267E+04	.3124E+05	.2693E+08	.4869E+04	.2840E+04	.1229E+13	.6494E+12	2027
52	2028	.5539E+04	.3161E+05	.2546E+08	.4591E+04	.2714E+04	.1170E+13	.6199E+12	2028
53	2029	.5771E+04	.3229E+05	.2712E+08	.4587E+04	.2594E+04	.1111E+13	.5900E+12	2029
54	2030	.5734E+04	.3098E+05	.2501E+08	.4782E+04	.2345E+04	.1059E+13	.5586E+12	2030
55	2031	.5921E+04	.3145E+05	.2488E+08	.4708E+04	.2265E+04	.1016E+13	.5252E+12	2031
56	2032	.5759E+04	.3122E+05	.2510E+08	.4782E+04	.2160E+04	.9801E+12	.4949E+12	2032
57	2033	.5560E+04	.3079E+05	.2441E+08	.4897E+04	.2075E+04	.9479E+12	.4730E+12	2033
58	2034	.5182E+04	.2971E+05	.2428E+08	.4881E+04	.2024E+04	.9190E+12	.4566E+12	2034
59	2035	.5151E+04	.2889E+05	.2346E+08	.4793E+04	.1903E+04	.8944E+12	.4435E+12	2035
60	2036	.4809E+04	.2847E+05	.2347E+08	.4704E+04	.1877E+04	.8740E+12	.4329E+12	2036
61	2037	.4329E+04	.2590E+05	.2141E+08	.4777E+04	.1849E+04	.8567E+12	.4266E+12	2037
62	2038	.4569E+04	.2635E+05	.2078E+08	.4436E+04	.1772E+04	.8475E+12	.4222E+12	2038
63	2039	.5026E+04	.2609E+05	.2092E+08	.4334E+04	.1798E+04	.8414E+12	.4164E+12	2039
64	2040	.4454E+04	.2541E+05	.1915E+08	.4544E+04	.1630E+04	.8383E+12	.4134E+12	2040
65	2041	.4859E+04	.2567E+05	.1914E+08	.4414E+04	.1746E+04	.8416E+12	.4141E+12	2041
66	2042	.4729E+04	.2557E+05	.2007E+08	.4158E+04	.1717E+04	.8458E+12	.4150E+12	2042
67	2043	.4765E+04	.2585E+05	.1933E+08	.4422E+04	.1621E+04	.8481E+12	.4157E+12	2043
68	2044	.4716E+04	.2410E+05	.1883E+08	.4261E+04	.1634E+04	.8533E+12	.4178E+12	2044
69	2045	.4602E+04	.2464E+05	.1915E+08	.4115E+04	.1641E+04	.8602E+12	.4197E+12	2045
70	2046	.4884E+04	.2574E+05	.2003E+08	.4132E+04	.1707E+04	.8716E+12	.4241E+12	2046
71	2047	.4667E+04	.2454E+05	.1974E+08	.4022E+04	.1696E+04	.8815E+12	.4279E+12	2047
72	2048	.4735E+04	.2593E+05	.2047E+08	.3934E+04	.1734E+04	.8935E+12	.4320E+12	2048
73	2049	.4550E+04	.2433E+05	.1985E+08	.3974E+04	.1781E+04	.9096E+12	.4379E+12	2049
74	2050	.4142E+04	.2367E+05	.1920E+08	.3771E+04	.1768E+04	.9194E+12	.4472E+12	2050
75	2051	.4065E+04	.2257E+05	.1821E+08	.3691E+04	.1573E+04	.9251E+12	.4416E+12	2051
76	2052	.4219E+04	.2244E+05	.1897E+08	.3429E+04	.1583E+04	.9256E+12	.4353E+12	2052
77	2053	.4287E+04	.2318E+05	.1922E+08	.3323E+04	.1625E+04	.9138E+12	.4326E+12	2053
78	2054	.4828E+04	.2433E+05	.1949E+08	.3372E+04	.1651E+04	.9013E+12	.4259E+12	2054
79	2055	.5129E+04	.2491E+05	.2090E+08	.3472E+04	.1409E+04	.8991E+12	.4172E+12	2055
80	2056	.5186E+04	.2494E+05	.1881E+08	.3752E+04	.1141E+04	.8923E+12	.4144E+12	2056
81	2057	.4977E+04	.2378E+05	.1812E+08	.3771E+04	.1151E+04	.8898E+12	.4141E+12	2057
82	2058	.4701E+04	.2299E+05	.1779E+08	.3694E+04	.1153E+04	.8861E+12	.4134E+12	2058

COST REPORT FOR FCT RECYCLE SCENARIO - 380 GW BY 2000 - RECYCLE STARTING IN 1985

TABLE 6 MATERIAL THROUGHPUTS

MODE: REPROCESSING AND RECYCLE

DATE: 04/27/79 TIME: TODAY

YEAR	U308 LB	UF6	--ENRICHMENT--	---FABRICATION---		-----REACTOR-----		YEAR	
		CONVERSION KG-U	DIFFUSION 9WU	U FUEL KGU	MOX FUEL KG-HM	PWR KWH	BWR KWH		
----	-----	-----	-----	-----	-----	-----	-----	----	
83	2059	.4501E+0A	.2269E+05	.1696E+08	.3539E+04	.1273E+04	.8811E+12	.4120E+12	2059
84	2060	.3963E+0A	.2152E+05	.1713E+08	.3399E+04	.1433E+04	.8746E+12	.4099E+12	2060
85	2061	.3729E+0A	.2109E+05	.1744E+08	.3160E+04	.1609E+04	.8666E+12	.4070E+12	2061
86	2062	.3879E+0A	.2099E+05	.1777E+08	.2911E+04	.1747E+04	.8572E+12	.4032E+12	2062
87	2063	.3573E+0A	.2106E+05	.1792E+08	.2875E+04	.1683E+04	.8460E+12	.39A6E+12	2063
88	2064	.3A47E+0A	.2027E+05	.1674E+08	.2999E+04	.1623E+04	.8332E+12	.3932E+12	2064
89	2065	.4455E+0A	.2259E+05	.1740E+08	.2851E+04	.1592E+04	.8187E+12	.3870E+12	2065
90	2066	.4886E+0A	.2387E+05	.1843E+08	.3188E+04	.1379E+04	.8025E+12	.3800E+12	2066
91	2067	.4758E+0A	.2271E+05	.1643E+08	.3594E+04	.1112E+04	.7852E+12	.3724E+12	2067
92	2068	.4660E+0A	.2241E+05	.1646E+08	.3557E+04	.1126E+04	.7869E+12	.3642E+12	2068
93	2069	.4467E+0A	.2193E+05	.1642E+08	.3413E+04	.1134E+04	.7467E+12	.3556E+12	2069
94	2070	.4134E+0A	.2056E+05	.1677E+08	.3326E+04	.1130E+04	.7170E+12	.3463E+12	2070
95	2071	.3896E+0A	.2003E+05	.1539E+08	.3171E+04	.1135E+04	.6779E+12	.3364E+12	2071
96	2072	.3806E+0A	.1876E+05	.1472E+08	.2971E+04	.1139E+04	.6351E+12	.3214E+12	2072
97	2073	.3909E+0A	.1929E+05	.1500E+08	.2816E+04	.1148E+04	.5913E+12	.3011E+12	2073
98	2074	.3748E+0A	.1919E+05	.1498E+08	.2843E+04	.1090E+04	.5451E+12	.2779E+12	2074
99	2075	.3509E+0A	.1834E+05	.1431E+08	.2914E+04	.1050E+04	.4972E+12	.2536E+12	2075
100	2076	.3088E+0A	.1731E+05	.1342E+08	.2859E+04	.1105E+04	.4500E+12	.2297E+12	2076

COST REPORT FOR FCT RECYCLE SCENARIO - 340 GW BY 2000 - RECYCLE STARTING IN 1985

TABLE 6 MATERIAL THROUGHPUTS (CNTD)

MODE1 REPROCESSING AND RECYCLE

DATE: 04/27/79 TIME: TODAY

YEAR	STORAGE		TRANSPORTATION		REPROCESSING		TRANSPORTATION		WASTE	PU	YEAR
	SPENT FUEL	PU	SPENT FUEL		SPENT FUEL		PU		DISPOSAL	SALES	
	KG-MM	GM-TOT	KG-MM-YR		KG		GM-TOT		KG	KG-FISS-PU	
1 1977	.1963E+07	0.	.1963E+07		0.		0.		0.	0.	1977
2 1978	.8687E+06	0.	.8687E+06		0.		0.		0.	0.	1978
3 1979	.1004E+07	0.	.1004E+07		0.		0.		0.	0.	1979
4 1980	.1126E+07	0.	.1126E+07		0.		0.		0.	0.	1980
5 1981	.1205E+07	0.	.1205E+07		0.		0.		0.	0.	1981
6 1982	.1294E+07	0.	.1294E+07		0.		0.		0.	0.	1982
7 1983	.1371E+07	0.	.1371E+07		0.		0.		0.	0.	1983
8 1984	.1579E+07	0.	.1579E+07		0.		0.		0.	0.	1984
9 1985	.1904E+07	0.	.1904E+07		.5000E+06		.3437E+07		.1345E+05	0.	1985
10 1986	.2179E+07	0.	.2179E+07		.1000E+07		.7025E+07		.2718E+05	0.	1986
11 1987	.2478E+07	0.	.2478E+07		.2167E+07		.1603E+08		.4696E+05	0.	1987
12 1988	.2886E+07	0.	.2886E+07		.2633E+07		.2204E+08		.9638E+05	0.	1988
13 1989	.3226E+07	0.	.3226E+07		.4167E+07		.3289E+08		.1468E+06	0.	1989
14 1990	.3458E+07	0.	.3458E+07		.4833E+07		.3778E+08		.1624E+06	0.	1990
15 1991	.3689E+07	0.	.3689E+07		.5500E+07		.4329E+08		.1843E+06	0.	1991
16 1992	.4086E+07	0.	.4086E+07		.5500E+07		.4467E+08		.1908E+06	0.	1992
17 1993	.4409E+07	0.	.4409E+07		.5500E+07		.4794E+08		.1929E+06	0.	1993
18 1994	.4712E+07	0.	.4712E+07		.5500E+07		.5379E+08		.1949E+06	0.	1994
19 1995	.5242E+07	0.	.5242E+07		.5500E+07		.6016E+08		.1948E+06	0.	1995
20 1996	.5633E+07	0.	.5633E+07		.5500E+07		.6367E+08		.1956E+06	0.	1996
21 1997	.6110E+07	0.	.6110E+07		.5500E+07		.6650E+08		.1966E+06	0.	1997
22 1998	.6560E+07	0.	.6560E+07		.5500E+07		.6689E+08		.1968E+06	0.	1998
23 1999	.7101E+07	0.	.7101E+07		.6167E+07		.7506E+08		.2210E+06	0.	1999
24 2000	.7530E+07	0.	.7530E+07		.6833E+07		.8332E+08		.2461E+06	0.	2000
25 2001	.8000E+07	0.	.8000E+07		.7500E+07		.9215E+08		.2711E+06	0.	2001
26 2002	.8544E+07	0.	.8544E+07		.8167E+07		.1015E+09		.2959E+06	0.	2002
27 2003	.8953E+07	0.	.8953E+07		.8953E+07		.1099E+09		.3217E+06	0.	2003
28 2004	.9125E+07	0.	.9125E+07		.9500E+07		.1174E+09		.3478E+06	0.	2004
29 2005	.9531E+07	0.	.9531E+07		.9500E+07		.1190E+09		.3504E+06	0.	2005
30 2006	.9704E+07	0.	.9704E+07		.9500E+07		.1208E+09		.3544E+06	0.	2006
31 2007	.9846E+07	0.	.9846E+07		.9500E+07		.1246E+09		.3567E+06	0.	2007
32 2008	.1018E+08	0.	.1018E+08		.9500E+07		.1290E+09		.3588E+06	0.	2008
33 2009	.1052E+08	0.	.1052E+08		.9500E+07		.1319E+09		.3595E+06	0.	2009
34 2010	.1070E+08	0.	.1070E+08		.9500E+07		.1345E+09		.3600E+06	0.	2010
35 2011	.1091E+08	0.	.1091E+08		.9500E+07		.1360E+09		.3592E+06	0.	2011
36 2012	.1113E+08	0.	.1113E+08		.9500E+07		.1374E+09		.3594E+06	0.	2012
37 2013	.1122E+08	0.	.1122E+08		.9500E+07		.1372E+09		.3618E+06	0.	2013
38 2014	.1110E+08	0.	.1110E+08		.9500E+07		.1368E+09		.3635E+06	0.	2014
39 2015	.1139E+08	0.	.1139E+08		.1017E+08		.1449E+09		.3870E+06	0.	2015
40 2016	.1129E+08	0.	.1129E+08		.1083E+08		.1566E+09		.4155E+06	0.	2016
41 2017	.1079E+08	0.	.1079E+08		.1130E+08		.1637E+09		.4345E+06	0.	2017

COST REPORT FOR FCT RECYCLE SCENARIO - TWO GW BY 2000 - RECYCLE STARTING IN 1985

TABLE 6 MATERIAL THROUGHPUTS (CNTD)

MODE: REPROCESSING AND RECYCLE

DATE: 04/27/79 TIME: TODAY

		-----STORAGE-----		--TRANSPORTATION--		--REPROCESSING--		--TRANSPORTATION--		WASTE	PU	
YEAR		SPENT FUEL	PU	SPENT FUEL	PU	SPENT FUEL	PU	SPENT FUEL	PU	DISPOSAL	SALES	YEAR
----		KG-MM	GM-TOT	KG-MM-YR	GM-TOT	KG	GM-TOT	KG	GM-TOT	KG	KG-FISS-PU	----
42	2018	.1079E+08	0.	.1079E+08		.1150E+08		.1655E+09		.4358E+06	0.	2018
43	2019	.1063E+08	0.	.1063E+08		.1150E+08		.1686E+09		.4395E+06	0.	2019
44	2020	.1025E+08	0.	.1025E+08		.1150E+08		.1692E+09		.4420E+06	0.	2020
45	2021	.1008E+08	0.	.1008E+08		.1150E+08		.1712E+09		.4441E+06	0.	2021
46	2022	.1046E+08	0.	.1046E+08		.1150E+08		.1761E+09		.4462E+06	0.	2022
47	2023	.1046E+08	0.	.1046E+08		.1150E+08		.1820E+09		.4439E+06	0.	2023
48	2024	.1010E+08	0.	.1010E+08		.1150E+08		.1826E+09		.4382E+06	0.	2024
49	2025	.1020E+08	0.	.1020E+08		.1000E+08		.1650E+09		.3814E+06	0.	2025
50	2026	.9989E+07	0.	.9989E+07		.1067E+08		.1771E+09		.4062E+06	0.	2026
51	2027	.9343E+07	0.	.9343E+07		.9333E+07		.1560E+09		.3522E+06	0.	2027
52	2028	.8922E+07	0.	.8922E+07		.1000E+08		.1715E+09		.3766E+06	0.	2028
53	2029	.8599E+07	0.	.8599E+07		.8000E+07		.1438E+09		.3042E+06	0.	2029
54	2030	.8221E+07	0.	.8221E+07		.8000E+07		.1479E+09		.3053E+06	0.	2030
55	2031	.8070E+07	0.	.8070E+07		.8000E+07		.1514E+09		.3050E+06	0.	2031
56	2032	.7971E+07	0.	.7971E+07		.8000E+07		.1470E+09		.3033E+06	0.	2032
57	2033	.7656E+07	0.	.7656E+07		.8000E+07		.1503E+09		.3018E+06	0.	2033
58	2034	.7554E+07	0.	.7554E+07		.8000E+07		.1451E+09		.2971E+06	0.	2034
59	2035	.7500E+07	0.	.7500E+07		.8000E+07		.1468E+09		.2945E+06	0.	2035
60	2036	.7367E+07	0.	.7367E+07		.8000E+07		.1406E+09		.2903E+06	0.	2036
61	2037	.7161E+07	0.	.7161E+07		.8000E+07		.1387E+09		.2865E+06	0.	2037
62	2038	.7130E+07	0.	.7130E+07		.8000E+07		.1387E+09		.2820E+06	0.	2038
63	2039	.7022E+07	0.	.7022E+07		.6000E+07		.1018E+09		.2102E+06	0.	2039
64	2040	.6851E+07	0.	.6851E+07		.6667E+07		.1148E+09		.2327E+06	0.	2040
65	2041	.6713E+07	0.	.6713E+07		.7333E+07		.1226E+09		.2538E+06	0.	2041
66	2042	.6585E+07	0.	.6585E+07		.6000E+07		.1008E+09		.2069E+06	0.	2042
67	2043	.6054E+07	0.	.6054E+07		.6000E+07		.9916E+08		.2082E+06	0.	2043
68	2044	.6019E+07	0.	.6019E+07		.6000E+07		.9949E+08		.2094E+06	0.	2044
69	2045	.5864E+07	0.	.5864E+07		.6000E+07		.1029E+09		.2133E+06	0.	2045
70	2046	.5982E+07	0.	.5982E+07		.6000E+07		.9858E+08		.2149E+06	0.	2046
71	2047	.6000E+07	0.	.6000E+07		.6000E+07		.9855E+08		.2171E+06	0.	2047
72	2048	.6126E+07	0.	.6126E+07		.6000E+07		.9909E+08		.2161E+06	0.	2048
73	2049	.6077E+07	0.	.6077E+07		.6000E+07		.9413E+08		.2147E+06	0.	2049
74	2050	.5480E+07	0.	.5480E+07		.6000E+07		.9258E+08		.2141E+06	0.	2050
75	2051	.5492E+07	0.	.5492E+07		.6000E+07		.9437E+08		.2177E+06	0.	2051
76	2052	.5569E+07	0.	.5569E+07		.6000E+07		.9892E+08		.2216E+06	0.	2052
77	2053	.5429E+07	0.	.5429E+07		.6000E+07		.9967E+08		.2256E+06	0.	2053
78	2054	.5556E+07	0.	.5556E+07		.6000E+07		.9932E+08		.2277E+06	0.	2054
79	2055	.5505E+07	0.	.5505E+07		.4000E+07		.6808E+08		.1539E+06	0.	2055
80	2056	.5412E+07	0.	.5412E+07		.4000E+07		.6577E+08		.1545E+06	0.	2056
81	2057	.4962E+07	0.	.4962E+07		.4000E+07		.6570E+08		.1529E+06	0.	2057
82	2058	.4877E+07	0.	.4877E+07		.4000E+07		.6642E+08		.1543E+06	0.	2058

COST REPORT FOR FCT RECYCLE SCENARIO - 3AD GW BY 2000 - RECYCLE STARTING IN 1985

TABLE 6 MATERIAL THROUGHPUTS (CNTD)

MODE1 REPROCESSING AND RECYCLE

DATA1 04/27/79 TIME1 TODAY

		STORAGE-----		--TRANSPORTATION--		--REPROCESSING--		--TRANSPORTATION--		WASTE	PU	
YEAR		SPENT FUEL	PU	SPENT FUEL	SPENT FUEL	SPENT FUEL	PU	DISPOSAL	SALES			YEAR
----		KG-MM	GM-TOT	KG-MM-YR		KG	GM-TOT	KG	KG-FISS-PU			----
83	2059	.4993E+07	0.	.4993E+07		.4667E+07	.8114E+08	.1828E+06	0.			2059
84	2060	.4883E+07	0.	.4883E+07		.5333E+07	.9022E+08	.2126E+06	0.			2060
85	2061	.4912E+07	0.	.4912E+07		.6000E+07	.1051E+09	.2397E+06	0.			2061
86	2062	.4954E+07	0.	.4954E+07		.6000E+07	.1008E+09	.2385E+06	0.			2062
87	2063	.4837E+07	0.	.4837E+07		.6000E+07	.9364E+08	.2372E+06	0.			2063
88	2064	.4826E+07	0.	.4826E+07		.6000E+07	.8868E+08	.2364E+06	0.			2064
89	2065	.4835E+07	0.	.4835E+07		.6000E+07	.9134E+08	.2359E+06	0.			2065
90	2066	.4804E+07	0.	.4804E+07		.6000E+07	.8687E+08	.1575E+06	0.			2066
91	2067	.4680E+07	0.	.4680E+07		.6000E+07	.8864E+08	.1585E+06	0.			2067
92	2068	.4585E+07	0.	.4585E+07		.6000E+07	.7247E+08	.1591E+06	0.			2068
93	2069	.4650E+07	0.	.4650E+07		.6000E+07	.7538E+08	.1597E+06	0.			2069
94	2070	.4484E+07	0.	.4484E+07		.6000E+07	.7446E+08	.1596E+06	0.			2070
95	2071	.4639E+07	0.	.4639E+07		.6000E+07	.7482E+08	.1600E+06	0.			2071
96	2072	.4723E+07	0.	.4723E+07		.6000E+07	.7514E+08	.1597E+06	0.			2072
97	2073	.4756E+07	0.	.4756E+07		.6000E+07	.7079E+08	.1584E+06	0.			2073
98	2074	.4729E+07	0.	.4729E+07		.6000E+07	.6419E+08	.1555E+06	0.			2074
99	2075	.4636E+07	0.	.4636E+07		.6000E+07	.6206E+08	.1544E+06	0.			2075
100	2076	.4458E+07	0.	.4458E+07		.4667E+07	.6922E+08	.1749E+06	0.			2076

COST REPORT FOR FCT RECYCLE SCENARIO - 340 GW BY 2000 - RECYCLE STARTING IN 1985

TABLE 7A PROJECTED UNIT COSTS

MODEL REPROCESSING AND RECYCLE

DATE: 04/27/79 TIME: TODAY

YEAR	U308 \$/LB	UFG CONVERSION \$/KG-U	--ENRICHMENT-- DIFFUSION \$/SWU	---FABRICATION--- U FUEL \$/KG	MOX FUEL \$/KG-MH	-----REACTOR----- PWR MILL/KWH	BWR MILL/KWH	YEAR
----	-----	-----	-----	-----	-----	-----	-----	----
1 1977	.2805E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	1977
2 1978	.2805E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	1978
3 1979	.2805E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	1979
4 1980	.4930E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	1980
5 1981	.4930E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	1981
6 1982	.4930E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	1982
7 1983	.4930E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	1983
8 1984	.4930E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	1984
9 1985	.4930E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	1985
10 1986	.4930E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	1986
11 1987	.4930E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	1987
12 1988	.4930E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	1988
13 1989	.4930E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	1989
14 1990	.4930E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	1990
15 1991	.4930E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	1991
16 1992	.3710E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	1992
17 1993	.6490E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	1993
18 1994	.6490E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	1994
19 1995	.6490E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	1995
20 1996	.6490E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	1996
21 1997	.6490E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	1997
22 1998	.6490E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	1998
23 1999	.6490E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	1999
24 2000	.6490E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	2000
25 2001	.6490E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	2001
26 2002	.6490E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	2002
27 2003	.6490E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	2003
28 2004	.6490E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	2004
29 2005	.6490E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	2005
30 2006	.6490E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	2006
31 2007	.6490E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	2007
32 2008	.6280E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	2008
33 2009	.6280E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	2009
34 2010	.6280E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	2010
35 2011	.6280E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	2011
36 2012	.6280E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	2012
37 2013	.6280E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	2013
38 2014	.7020E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	2014
39 2015	.6280E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	2015
40 2016	.6280E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	2016
41 2017	.6280E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	2017

COST REPORT FOR FCT RECYCLE SCENARIO - 300 GW BY 2000 - RECYCLE STARTING IN 1985

TABLE 7A PROJECTED UNIT COSTS

MODE: REPROCESSING AND RECYCLE

DATE: 04/27/79 TIME: TODAY

YEAR	U308 \$/LB	UF6 CONVERSION \$/KG-U	--ENRICHMENT-- DIFFUSION \$/SWU	----FABRICATION----	U FUEL \$/KG	MOX FUEL \$/KG-MM	-----REACTOR----- PWR MILL/KWH	BWR MILL/KWH	YEAR
----	-----	-----	-----	-----	-----	-----	-----	-----	----
42	2018	.6280E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	2018
43	2019	.6280E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	2019
44	2020	.7020E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	2020
45	2021	.7020E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	2021
46	2022	.7020E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	2022
47	2023	.7020E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	2023
48	2024	.7020E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	2024
49	2025	.7020E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	2025
50	2026	.7020E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	2026
51	2027	.7020E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	2027
52	2028	.7020E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	2028
53	2029	.7020E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	2029
54	2030	.7020E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	2030
55	2031	.7020E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	2031
56	2032	.7020E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	2032
57	2033	.7020E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	2033
58	2034	.7020E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	2034
59	2035	.7020E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	2035
60	2036	.7020E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	2036
61	2037	.7020E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	2037
62	2038	.7020E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	2038
63	2039	.7020E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	2039
64	2040	.7020E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	2040
65	2041	.7020E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	2041
66	2042	.7020E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	2042
67	2043	.7020E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	2043
68	2044	.7020E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	2044
69	2045	.7370E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	2045
70	2046	.7370E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	2046
71	2047	.7370E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	2047
72	2048	.7370E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	2048
73	2049	.7370E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	2049
74	2050	.7370E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	2050
75	2051	.7370E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	2051
76	2052	.7370E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	2052
77	2053	.7370E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	2053
78	2054	.7370E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	2054
79	2055	.7370E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	2055
80	2056	.7370E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	2056
81	2057	.7370E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	2057
82	2058	.7370E+02	.5460E+01	.1000E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02	2058

COST REPORT FOR PCT RECYCLE SCENARIO - 380 GW BY 2000 - RECYCLE STARTING IN 1985

TABLE 7A PROJECTED UNIT COSTS

MODE1 REPROCESSING AND RECYCLE

DATE: 04/27/79 TIME: TODAY

		U16		--ENRICHMENT--		---FABRICATION---		-----REACTOR-----		
YEAR	U308	CONVERSION	DIFFUSION	U FUEL	MOX FUEL	PWR	BWR			YEAR
----	\$/LB	\$/KG-U	\$/SWU	\$/KG	\$/KG-MM	MILL/KWH	MILL/KWH	-----	-----	----
83	2059	.7370E+02	.5460E+01	.1070E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02		2059
84	2060	.7370E+02	.5460E+01	.1070E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02		2060
85	2061	.7370E+02	.5460E+01	.1070E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02		2061
86	2062	.7370E+02	.5460E+01	.1070E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02		2062
87	2063	.7370E+02	.5460E+01	.1070E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02		2063
88	2064	.7370E+02	.5460E+01	.1070E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02		2064
89	2065	.7370E+02	.5460E+01	.1070E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02		2065
90	2066	.7370E+02	.5460E+01	.1070E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02		2066
91	2067	.7370E+02	.5460E+01	.1070E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02		2067
92	2068	.7370E+02	.5460E+01	.1070E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02		2068
93	2069	.7370E+02	.5460E+01	.1070E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02		2069
94	2070	.7370E+02	.5460E+01	.1070E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02		2070
95	2071	.7370E+02	.5460E+01	.1070E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02		2071
96	2072	.7370E+02	.5460E+01	.1070E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02		2072
97	2073	.8070E+02	.5460E+01	.1070E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02		2073
98	2074	.8070E+02	.5460E+01	.1070E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02		2074
99	2075	.8070E+02	.5460E+01	.1070E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02		2075
100	2076	.8070E+02	.5460E+01	.1070E+03	.9390E+02	.2685E+03	.2440E+02	.2440E+02		2076

COST REPORT FOR FCT RECYCLE SCENARIO - 3A0 GW BY 2000 - RECYCLE STARTING IN 1985

TABLE 7A PROJECTED UNIT COSTS (CENTS)

MODE: REPROCESSING AND RECYCLE

DATE: 04/27/79 TIME: TODAY

YEAR	STORAGE		TRANSPORTATION		REPROCESSING		TRANSPORTATION		WASTE DISPOSAL \$/KG-HM	PU SALES \$/KG-FISS-PU	YEAR
	SPENT FUEL \$/KG-HM	PU \$/GH-TOT	SPENT FUEL \$/KG-HM-YR	MT	SPENT FUEL MT	PII \$/GH-TOT	PII \$/GH-TOT	PII \$/GH-TOT			
1 1977	0.	0.	.3000E+02	.2364E+03	.4000E-01	0.	.3266E+02	1977			
2 1978	0.	0.	.3000E+02	.2364E+03	.4000E-01	0.	.3266E+02	1978			
3 1979	0.	0.	.3000E+02	.2364E+03	.4000E-01	0.	.3266E+02	1979			
4 1980	0.	0.	.3000E+02	.2364E+03	.4000E-01	0.	.4401E+02	1980			
5 1981	0.	0.	.3000E+02	.2364E+03	.4000E-01	0.	.4401E+02	1981			
6 1982	0.	0.	.3000E+02	.2364E+03	.4000E-01	0.	.4401E+02	1982			
7 1983	0.	0.	.3000E+02	.2364E+03	.4000E-01	0.	.4401E+02	1983			
8 1984	0.	0.	.3000E+02	.2364E+03	.4000E-01	0.	.4401E+02	1984			
9 1985	0.	0.	.3000E+02	.2364E+03	.4000E-01	0.	.4401E+02	1985			
10 1986	0.	0.	.3000E+02	.2364E+03	.4000E-01	0.	.4401E+02	1986			
11 1987	0.	0.	.3000E+02	.2364E+03	.4000E-01	0.	.4401E+02	1987			
12 1988	0.	0.	.3000E+02	.2364E+03	.4000E-01	0.	.4401E+02	1988			
13 1989	0.	0.	.3000E+02	.2364E+03	.4000E-01	0.	.4401E+02	1989			
14 1990	0.	0.	.3000E+02	.2364E+03	.4000E-01	0.	.4401E+02	1990			
15 1991	0.	0.	.3000E+02	.2364E+03	.4000E-01	0.	.4401E+02	1991			
16 1992	0.	0.	.3000E+02	.2364E+03	.4000E-01	0.	.4818E+02	1992			
17 1993	0.	0.	.3000E+02	.2364E+03	.4000E-01	0.	.5235E+02	1993			
18 1994	0.	0.	.3000E+02	.2364E+03	.4000E-01	0.	.5235E+02	1994			
19 1995	0.	0.	.3000E+02	.2364E+03	.4000E-01	0.	.5235E+02	1995			
20 1996	0.	0.	.3000E+02	.2364E+03	.4000E-01	0.	.5235E+02	1996			
21 1997	0.	0.	.3000E+02	.2364E+03	.4000E-01	0.	.5235E+02	1997			
22 1998	0.	0.	.3000E+02	.2364E+03	.4000E-01	0.	.5235E+02	1998			
23 1999	0.	0.	.3000E+02	.2364E+03	.4000E-01	0.	.5235E+02	1999			
24 2000	0.	0.	.3000E+02	.2364E+03	.4000E-01	0.	.5235E+02	2000			
25 2001	0.	0.	.3000E+02	.2364E+03	.4000E-01	0.	.5235E+02	2001			
26 2002	0.	0.	.3000E+02	.2364E+03	.4000E-01	0.	.5235E+02	2002			
27 2003	0.	0.	.3000E+02	.2364E+03	.4000E-01	0.	.5235E+02	2003			
28 2004	0.	0.	.3000E+02	.2364E+03	.4000E-01	0.	.5235E+02	2004			
29 2005	0.	0.	.3000E+02	.2364E+03	.4000E-01	0.	.5235E+02	2005			
30 2006	0.	0.	.3000E+02	.2364E+03	.4000E-01	0.	.5235E+02	2006			
31 2007	0.	0.	.3000E+02	.2364E+03	.4000E-01	0.	.5235E+02	2007			
32 2008	0.	0.	.3000E+02	.2364E+03	.4000E-01	0.	.5122E+02	2008			
33 2009	0.	0.	.3000E+02	.2364E+03	.4000E-01	0.	.5122E+02	2009			
34 2010	0.	0.	.3000E+02	.2364E+03	.4000E-01	0.	.5122E+02	2010			
35 2011	0.	0.	.3000E+02	.2364E+03	.4000E-01	0.	.5122E+02	2011			
36 2012	0.	0.	.3000E+02	.2364E+03	.4000E-01	0.	.5122E+02	2012			
37 2013	0.	0.	.3000E+02	.2364E+03	.4000E-01	0.	.5122E+02	2013			
38 2014	0.	0.	.3000E+02	.2364E+03	.4000E-01	0.	.5518E+02	2014			
39 2015	0.	0.	.3000E+02	.2364E+03	.4000E-01	0.	.5122E+02	2015			
40 2016	0.	0.	.3000E+02	.2364E+03	.4000E-01	0.	.5122E+02	2016			
41 2017	0.	0.	.3000E+02	.2364E+03	.4000E-01	0.	.5122E+02	2017			

COST REPORT FOR FCT RECYCLE SCENARIO - 340 GW BY 2000 - RECYCLE STARTING IN 1985

TABLE 7A PROJECTED UNIT COSTS (CNTD)

MODE: REPROCESSING AND RECYCLE

DATE: 04/27/79 TIME: TODAY

		-----STORAGE-----		--TRANSPORTATION--		--REPROCESSING--		--TRANSPORTATION--		WASTE	PU	
YEAR		SPENT FUEL	PU	SPENT FUEL	SPENT FUEL	MT	PU	DISPOSAL	SALES			YEAR
----		\$/KG-HM	\$/GM-TDT	\$/KG-HM-YR			\$/GM-TDT	\$/KG-HM	\$/KG-FISS-PU			----
42	2018	0.	0.	.3000E+02	.2364E+03		.4000E-01	0.	.5122E+02			2018
43	2019	0.	0.	.3000E+02	.2364E+03		.4000E-01	0.	.5122E+02			2019
44	2020	0.	0.	.3000E+02	.2364E+03		.4000E-01	0.	.5518E+02			2020
45	2021	0.	0.	.3000E+02	.2364E+03		.4000E-01	0.	.5518E+02			2021
46	2022	0.	0.	.3000E+02	.2364E+03		.4000E-01	0.	.5518E+02			2022
47	2023	0.	0.	.3000E+02	.2364E+03		.4000E-01	0.	.5518E+02			2023
48	2024	0.	0.	.3000E+02	.2364E+03		.4000E-01	0.	.5518E+02			2024
49	2025	0.	0.	.3000E+02	.2364E+03		.4000E-01	0.	.5518E+02			2025
50	2026	0.	0.	.3000E+02	.2364E+03		.4000E-01	0.	.5518E+02			2026
51	2027	0.	0.	.3000E+02	.2364E+03		.4000E-01	0.	.5518E+02			2027
52	2028	0.	0.	.3000E+02	.2364E+03		.4000E-01	0.	.5518E+02			2028
53	2029	0.	0.	.3000E+02	.2364E+03		.4000E-01	0.	.5518E+02			2029
54	2030	0.	0.	.3000E+02	.2364E+03		.4000E-01	0.	.5518E+02			2030
55	2031	0.	0.	.3000E+02	.2364E+03		.4000E-01	0.	.5518E+02			2031
56	2032	0.	0.	.3000E+02	.2364E+03		.4000E-01	0.	.5518E+02			2032
57	2033	0.	0.	.3000E+02	.2364E+03		.4000E-01	0.	.5518E+02			2033
58	2034	0.	0.	.3000E+02	.2364E+03		.4000E-01	0.	.5518E+02			2034
59	2035	0.	0.	.3000E+02	.2364E+03		.4000E-01	0.	.5518E+02			2035
60	2036	0.	0.	.3000E+02	.2364E+03		.4000E-01	0.	.5518E+02			2036
61	2037	0.	0.	.3000E+02	.2364E+03		.4000E-01	0.	.5518E+02			2037
62	2038	0.	0.	.3000E+02	.2364E+03		.4000E-01	0.	.5518E+02			2038
63	2039	0.	0.	.3000E+02	.2364E+03		.4000E-01	0.	.5518E+02			2039
64	2040	0.	0.	.3000E+02	.2364E+03		.4000E-01	0.	.5518E+02			2040
65	2041	0.	0.	.3000E+02	.2364E+03		.4000E-01	0.	.5518E+02			2041
66	2042	0.	0.	.3000E+02	.2364E+03		.4000E-01	0.	.5518E+02			2042
67	2043	0.	0.	.3000E+02	.2364E+03		.4000E-01	0.	.5518E+02			2043
68	2044	0.	0.	.3000E+02	.2364E+03		.4000E-01	0.	.5518E+02			2044
69	2045	0.	0.	.3000E+02	.2364E+03		.4000E-01	0.	.5705E+02			2045
70	2046	0.	0.	.3000E+02	.2364E+03		.4000E-01	0.	.5705E+02			2046
71	2047	0.	0.	.3000E+02	.2364E+03		.4000E-01	0.	.5705E+02			2047
72	2048	0.	0.	.3000E+02	.2364E+03		.4000E-01	0.	.5705E+02			2048
73	2049	0.	0.	.3000E+02	.2364E+03		.4000E-01	0.	.5705E+02			2049
74	2050	0.	0.	.3000E+02	.2364E+03		.4000E-01	0.	.5705E+02			2050
75	2051	0.	0.	.3000E+02	.2364E+03		.4000E-01	0.	.5705E+02			2051
76	2052	0.	0.	.3000E+02	.2364E+03		.4000E-01	0.	.5705E+02			2052
77	2053	0.	0.	.3000E+02	.2364E+03		.4000E-01	0.	.5705E+02			2053
78	2054	0.	0.	.3000E+02	.2364E+03		.4000E-01	0.	.5705E+02			2054
79	2055	0.	0.	.3000E+02	.2364E+03		.4000E-01	0.	.5705E+02			2055
80	2056	0.	0.	.3000E+02	.2364E+03		.4000E-01	0.	.5705E+02			2056
81	2057	0.	0.	.3000E+02	.2364E+03		.4000E-01	0.	.5705E+02			2057
82	2058	0.	0.	.3000E+02	.2364E+03		.4000E-01	0.	.5705E+02			2058

COST REPORT FOR FCT RECYCLE SCENARIO - 340 GW BY 2000 - RECYCLE STARTING IN 1985

TABLE 7A PROJECTED UNIT COSTS (CMTD)

MODEL: REPROCESSING AND RECYCLE

DATE: 04/27/79 TIME: TODAY

YEAR	STORAGE-----		TRANSPORTATION--		REPROCESSING--		TRANSPORTATION--		WASTE DISPOSAL \$/KG-HM	PU SALES	
	SPENT FUEL \$/KG-HM	PU \$/GM-TOT	SPENT FUEL \$/KG-HM-YR		SPENT FUEL MT	PU \$/GM-TOT		\$/KG-FISS-PU		YEAR	
83	2059	0.	0.	.3000E+02	.2364E+03	.4000E-01	0.	.5705E+02	2059		
84	2060	0.	0.	.3000E+02	.2364E+03	.4000E-01	0.	.5705E+02	2060		
85	2061	0.	0.	.3000E+02	.2364E+03	.4000E-01	0.	.5705E+02	2061		
86	2062	0.	0.	.3000E+02	.2364E+03	.4000E-01	0.	.5705E+02	2062		
87	2063	0.	0.	.3000E+02	.2364E+03	.4000E-01	0.	.5705E+02	2063		
88	2064	0.	0.	.3000E+02	.2364E+03	.4000E-01	0.	.5705E+02	2064		
89	2065	0.	0.	.3000E+02	.2364E+03	.4000E-01	0.	.5705E+02	2065		
90	2066	0.	0.	.3000E+02	.2364E+03	.4000E-01	0.	.5705E+02	2066		
91	2067	0.	0.	.3000E+02	.2364E+03	.4000E-01	0.	.5705E+02	2067		
92	2068	0.	0.	.3000E+02	.2364E+03	.4000E-01	0.	.5705E+02	2068		
93	2069	0.	0.	.3000E+02	.2364E+03	.4000E-01	0.	.5705E+02	2069		
94	2070	0.	0.	.3000E+02	.2364E+03	.4000E-01	0.	.5705E+02	2070		
95	2071	0.	0.	.3000E+02	.2364E+03	.4000E-01	0.	.5705E+02	2071		
96	2072	0.	0.	.3000E+02	.2364E+03	.4000E-01	0.	.5705E+02	2072		
97	2073	0.	0.	.3000E+02	.2364E+03	.4000E-01	0.	.6078E+02	2073		
98	2074	0.	0.	.3000E+02	.2364E+03	.4000E-01	0.	.6078E+02	2074		
99	2075	0.	0.	.3000E+02	.2364E+03	.4000E-01	0.	.6078E+02	2075		
100	2076	0.	0.	.3000E+02	.2364E+03	.4000E-01	0.	.6078E+02	2076		

COST REPORT FOR FCT RECYCLE SCENARIO - 340 GW BY 2000 - RECYCLE STARTING IN 1985

TABLE 8A PROJECTED COSTS (MILLIONS OF DISCOUNTED 1977 DOLLARS)

MODEL REPROCESSING AND RECYCLE

DATE: 04/27/79 TIME: TODAY

YEAR	U308	UF6 CONVERSION	--ENRICHMENT-- DIFFUSION	----FABRICATION----- U FUEL MOX FUEL	-----REACTOR----- PWR BWR	YEAR
----	-----	-----	-----	-----	-----	----
1 1977	.5071E+03	.3766E-01	.4818E+03	.1207E+00 0.	.3228E+07 .2053E+07	1977
2 1978	.5352E+03	.3692E-01	.4631E+03	.1133E+00 0.	.3815E+07 .2123E+07	1978
3 1979	.6056E+03	.4516E-01	.4783E+03	.1073E+00 0.	.4077E+07 .2083E+07	1979
4 1980	.1260E+04	.4911E-01	.5361E+03	.1213E+00 0.	.4169E+07 .2007E+07	1980
5 1981	.1285E+04	.5276E-01	.5696E+03	.1499E+00 0.	.4286E+07 .2070E+07	1981
6 1982	.1522E+04	.5836E-01	.6179E+03	.1572E+00 0.	.4529E+07 .2277E+07	1982
7 1983	.1577E+04	.6335E-01	.6942E+03	.1649E+00 0.	.4845E+07 .2457E+07	1983
8 1984	.1479E+04	.6294E-01	.6973E+03	.1882E+00 0.	.5323E+07 .2569E+07	1984
9 1985	.1449E+04	.6126E-01	.6670E+03	.1909E+00 .7178E-02	.5845E+07 .2747E+07	1985
10 1986	.1338E+04	.5944E-01	.6751E+03	.1764E+00 .2040E-01	.6208E+07 .2950E+07	1986
11 1987	.1251E+04	.5718E-01	.6370E+03	.1740E+00 .4113E-01	.6431E+07 .3072E+07	1987
12 1988	.1183E+04	.5389E-01	.6214E+03	.1626E+00 .6315E-01	.6567E+07 .3145E+07	1988
13 1989	.1176E+04	.5646E-01	.6375E+03	.1562E+00 .8412E-01	.6647E+07 .3199E+07	1989
14 1990	.1132E+04	.5583E-01	.6492E+03	.1575E+00 .1007E+00	.6722E+07 .3244E+07	1990
15 1991	.1124E+04	.5544E-01	.6510E+03	.1599E+00 .1088E+00	.6819E+07 .3301E+07	1991
16 1992	.1137E+04	.5761E-01	.6691E+03	.1591E+00 .1096E+00	.6933E+07 .3365E+07	1992
17 1993	.1601E+04	.5824E-01	.6814E+03	.1619E+00 .1057E+00	.7031E+07 .3420E+07	1993
18 1994	.1599E+04	.5893E-01	.6933E+03	.1655E+00 .1056E+00	.7116E+07 .3469E+07	1994
19 1995	.1656E+04	.5876E-01	.6953E+03	.1663E+00 .1034E+00	.7194E+07 .3514E+07	1995
20 1996	.1662E+04	.5999E-01	.7217E+03	.1633E+00 .1028E+00	.7246E+07 .3545E+07	1996
21 1997	.1650E+04	.5982E-01	.7248E+03	.1647E+00 .9771E-01	.7265E+07 .3559E+07	1997
22 1998	.1606E+04	.5781E-01	.7095E+03	.1627E+00 .9302E-01	.7249E+07 .3554E+07	1998
23 1999	.1521E+04	.5584E-01	.6944E+03	.1563E+00 .9139E-01	.7201E+07 .3534E+07	1999
24 2000	.1365E+04	.5251E-01	.6641E+03	.1514E+00 .9402E-01	.7113E+07 .3494E+07	2000
25 2001	.1283E+04	.4881E-01	.6295E+03	.1396E+00 .9670E-01	.6979E+07 .3425E+07	2001
26 2002	.1199E+04	.4657E-01	.6014E+03	.1275E+00 .9840E-01	.6769E+07 .3324E+07	2002
27 2003	.1134E+04	.4446E-01	.5720E+03	.1211E+00 .9979E-01	.6506E+07 .3202E+07	2003
28 2004	.1062E+04	.4149E-01	.5425E+03	.1136E+00 .1002E+00	.6233E+07 .3066E+07	2004
29 2005	.1057E+04	.4081E-01	.5240E+03	.1086E+00 .9658E-01	.5963E+07 .2931E+07	2005
30 2006	.9985E+03	.3924E-01	.5102E+03	.1046E+00 .9130E-01	.5704E+07 .2804E+07	2006
31 2007	.9140E+03	.3662E-01	.4745E+03	.1022E+00 .8595E-01	.5458E+07 .2681E+07	2007
32 2008	.8385E+03	.3396E-01	.4440E+03	.9436E-01 .8083E-01	.5212E+07 .2554E+07	2008
33 2009	.7647E+03	.3185E-01	.4274E+03	.8651E-01 .7594E-01	.4924E+07 .2420E+07	2009
34 2010	.6977E+03	.2907E-01	.3876E+03	.8072E-01 .7091E-01	.4613E+07 .2273E+07	2010
35 2011	.6571E+03	.2668E-01	.3548E+03	.7347E-01 .6627E-01	.4296E+07 .2126E+07	2011
36 2012	.6070E+03	.2545E-01	.3402E+03	.6708E-01 .6167E-01	.3982E+07 .1989E+07	2012
37 2013	.5446E+03	.2318E-01	.3134E+03	.6394E-01 .5738E-01	.3698E+07 .1844E+07	2013
38 2014	.5372E+03	.2070E-01	.2822E+03	.5889E-01 .5344E-01	.3431E+07 .1718E+07	2014
39 2015	.4289E+03	.1858E-01	.2540E+03	.5201E-01 .5157E-01	.3165E+07 .1597E+07	2015
40 2016	.3833E+03	.1728E-01	.2359E+03	.4595E-01 .5133E-01	.2917E+07 .1470E+07	2016
41 2017	.3394E+03	.1567E-01	.2194E+03	.4229E-01 .5103E-01	.2655E+07 .1352E+07	2017

COST REPORT FOR FCT RECYCLE SCENARIO - 300 GW BY 2000 - RECYCLE STARTING IN 1995

TABLE AA PROJECTED COSTS (MILLIONS OF DISCOUNTED 1977 DOLLARS)

MODE: REPROCESSING AND RECYCLE

DATE: 04/27/79 TIME: TODAY

YEAR	U308	UFG	CONVERSION	ENRICHMENT	FABRICATION		REACTOR		YEAR
				DIFFUSION	U FUEL	MOX FUEL	PWR	BWR	
42	2018	.3218E+03	.1435E-01	.2001E+03	.3819E-01	.4903E-01	.2424E+07	.1245E+07	2018
43	2019	.2843E+03	.1360E-01	.1918E+03	.3492E-01	.4617E-01	.2220E+07	.1148E+07	2019
44	2020	.2694E+03	.1184E-01	.1719E+03	.3330E-01	.4338E-01	.2032E+07	.1055E+07	2020
45	2021	.2349E+03	.1043E-01	.1515E+03	.2867E-01	.4093E-01	.1851E+07	.9598E+06	2021
46	2022	.2032E+03	.9263E-02	.1373E+03	.2480E-01	.3854E-01	.1676E+07	.8661E+06	2022
47	2023	.1765E+03	.8240E-02	.1243E+03	.2175E-01	.3661E-01	.1511E+07	.7826E+06	2023
48	2024	.1593E+03	.7511E-02	.1145E+03	.1908E-01	.3420E-01	.1347E+07	.7074E+06	2024
49	2025	.1462E+03	.6689E-02	.1075E+03	.1709E-01	.2977E-01	.1198E+07	.6319E+06	2025
50	2026	.1317E+03	.6269E-02	.9324E+02	.1571E-01	.2705E-01	.1067E+07	.5628E+06	2026
51	2027	.1173E+03	.5412E-02	.8544E+02	.1450E-01	.2419E-01	.9511E+06	.5027E+06	2027
52	2028	.1153E+03	.5117E-02	.7590E+02	.1278E-01	.2161E-01	.8465E+06	.4485E+06	2028
53	2029	.1123E+03	.4886E-02	.7515E+02	.1194E-01	.1930E-01	.7513E+06	.3989E+06	2029
54	2030	.1042E+03	.4381E-02	.6478E+02	.1163E-01	.1630E-01	.6692E+06	.3531E+06	2030
55	2031	.1006E+03	.4156E-02	.6023E+02	.1070E-01	.1472E-01	.6003E+06	.3102E+06	2031
56	2032	.9146E+02	.3856E-02	.4677E+02	.1016E-01	.1312E-01	.5410E+06	.2732E+06	2032
57	2033	.8251E+02	.3550E-02	.5274E+02	.9722E-02	.1178E-01	.4890E+06	.2440E+06	2033
58	2034	.7187E+02	.3205E-02	.4798E+02	.9055E-02	.1074E-01	.4430E+06	.2201E+06	2034
59	2035	.6678E+02	.2913E-02	.4331E+02	.8311E-02	.9437E-02	.4030E+06	.1998E+06	2035
60	2036	.5826E+02	.2683E-02	.4090E+02	.7623E-02	.8698E-02	.3680E+06	.1823E+06	2036
61	2037	.4902E+02	.2281E-02	.3433E+02	.7235E-02	.8007E-02	.3372E+06	.1679E+06	2037
62	2038	.4835E+02	.2168E-02	.3143E+02	.6279E-02	.7174E-02	.3117E+06	.1533E+06	2038
63	2039	.4970E+02	.2007E-02	.2947E+02	.5733E-02	.6800E-02	.2892E+06	.1431E+06	2039
64	2040	.4117E+02	.1827E-02	.2521E+02	.5617E-02	.5760E-02	.2693E+06	.1328E+06	2040
65	2041	.4197E+02	.1724E-02	.2355E+02	.5100E-02	.5769E-02	.2527E+06	.1243E+06	2041
66	2042	.3817E+02	.1609E-02	.2344E+02	.4489E-02	.5302E-02	.2373E+06	.1164E+06	2042
67	2043	.3595E+02	.1517E-02	.2077E+02	.4462E-02	.4677E-02	.2224E+06	.1090E+06	2043
68	2044	.3325E+02	.1322E-02	.1871E+02	.4019E-02	.4405E-02	.2091E+06	.1024E+06	2044
69	2045	.3184E+02	.1263E-02	.1798E+02	.3627E-02	.4136E-02	.1970E+06	.9613E+05	2045
70	2046	.3158E+02	.1233E-02	.1747E+02	.3404E-02	.4022E-02	.1866E+06	.9079E+05	2046
71	2047	.2820E+02	.1099E-02	.1618E+02	.3096E-02	.3734E-02	.1763E+06	.8560E+05	2047
72	2048	.2674E+02	.1085E-02	.1576E+02	.2830E-02	.3567E-02	.1670E+06	.8077E+05	2048
73	2049	.2401E+02	.9512E-03	.1400E+02	.2672E-02	.3424E-02	.1599E+06	.7652E+05	2049
74	2050	.2043E+02	.8649E-03	.1245E+02	.2370E-02	.3177E-02	.1501E+06	.7238E+05	2050
75	2051	.1874E+02	.7708E-03	.1149E+02	.2168E-02	.2642E-02	.1412E+06	.6740E+05	2051
76	2052	.1818E+02	.7163E-03	.1068E+02	.1882E-02	.2485E-02	.1320E+06	.6209E+05	2052
77	2053	.1726E+02	.6915E-03	.1040E+02	.1705E-02	.2383E-02	.1218E+06	.5767E+05	2053
78	2054	.1817E+02	.6783E-03	.9944E+01	.1617E-02	.2263E-02	.1123E+06	.5305E+05	2054
79	2055	.1804E+02	.6489E-03	.9782E+01	.1556E-02	.1805E-02	.1042E+06	.4857E+05	2055
80	2056	.1703E+02	.6073E-03	.8298E+01	.1571E-02	.1366E-02	.9710E+05	.4509E+05	2056
81	2057	.1529E+02	.5411E-03	.7544E+01	.1476E-02	.1288E-02	.9049E+05	.4212E+05	2057
82	2058	.1350E+02	.4889E-03	.6775E+01	.1351E-02	.1209E-02	.8421E+05	.3929E+05	2058

COST REPORT FOR FCT RECYCLE SCENARIO - 330 GW BY 2000 - RECYCLE STARTING IN 1985

TABLE AA PROJECTED COSTS (MILLIONS OF DISCOUNTED 1977 DOLLARS)

MODE: REPROCESSING AND RECYCLE

DATE: 04/27/79 TIME: TODAY

YEAR	U308	UF6 CONVERSION	--ENRICHMENT-- DIFFUSION	---FABRICATION--- U FUEL MOX FUEL	-----REACTOR----- PWR BWR	YEAR
----	-----	-----	-----	-----	-----	----
83 2059	.1208E+02	.4510E-03	.6176E+01	.1210E-02 .1244E-02	.7826E+05 .3660E+05	2059
84 2060	.9937E+01	.3998E-03	.5890E+01	.1086E-02 .1309E-02	.7260E+05 .3403E+05	2060
85 2061	.8739E+01	.3661E-03	.5546E+01	.9436E-03 .1374E-02	.6724E+05 .3158E+05	2061
86 2062	.8496E+01	.3405E-03	.5241E+01	.8122E-03 .1394E-02	.6215E+05 .2924E+05	2062
87 2063	.7314E+01	.3193E-03	.4976E+01	.7496E-03 .1255E-02	.5733E+05 .2701E+05	2063
88 2064	.7359E+01	.2873E-03	.4345E+01	.7309E-03 .1131E-02	.5277E+05 .2490E+05	2064
89 2065	.7964E+01	.2992E-03	.4249E+01	.6493E-03 .1037E-02	.4845E+05 .2291E+05	2065
90 2066	.8163E+01	.2955E-03	.4249E+01	.6786E-03 .8394E-03	.4439E+05 .2102E+05	2066
91 2067	.7430E+01	.2627E-03	.3546E+01	.7151E-03 .6325E-03	.4059E+05 .1925E+05	2067
92 2068	.6800E+01	.2423E-03	.3278E+01	.6613E-03 .5986E-03	.3705E+05 .1760E+05	2068
93 2069	.6093E+01	.2216E-03	.3039E+01	.5932E-03 .5637E-03	.3372E+05 .1606E+05	2069
94 2070	.5270E+01	.1942E-03	.2779E+01	.5401E-03 .5250E-03	.3026E+05 .1462E+05	2070
95 2071	.4641E+01	.1768E-03	.2447E+01	.4813E-03 .4924E-03	.2674E+05 .1327E+05	2071
96 2072	.4237E+01	.1547E-03	.2223E+01	.4214E-03 .4622E-03	.2341E+05 .1185E+05	2072
97 2073	.4454E+01	.1487E-03	.2117E+01	.3733E-03 .4353E-03	.2037E+05 .1037E+05	2073
98 2074	.3991E+01	.1383E-03	.1977E+01	.3522E-03 .3860E-03	.1755E+05 .8947E+04	2074
99 2075	.3492E+01	.1235E-03	.1745E+01	.3374E-03 .3477E-03	.1496E+05 .7632E+04	2075
100 2076	.2872E+01	.1099E-03	.1546E+01	.3094E-03 .3418E-03	.1266E+05 .6459E+04	2076
TOTALS	.4131E+06	.1687E+02	.2297E+06	.4602E+02 .4584E+02	.2520E+10 .1249E+10	
LEVELIZED FUEL CYCLE COSTS, MILL/KWH	.3141E+01	.1309E-03	.1602E+01	.3658E-03 .2077E-03	.1632E+05 .8076E+04	

COST REPORT FOR FCT RECYCLE SCENARIO - 380 GW BY 2000 - RECYCLE STARTING IN 1985

TABLE 8A PROJECTED COSTS (MILLIONS OF DISCOUNTED 1977 DOLLARS) (CNTD)

MODE: REPROCESSING AND RECYCLE

DATE: 04/27/79 TIME: TODAY

YEAR	STORAGE SPENT FUEL	PU	TRANSPORTATION SPENT FUEL	REPROCESSING SPENT FUEL	TRANSPORTATION PU	WASTE DISPOSAL	PU SALES	YEAR
1 1977	0.	0.	.5503E+02	0.	0.	0.	0.	1977
2 1978	0.	0.	.2276E+02	0.	0.	0.	0.	1978
3 1979	0.	0.	.2459E+02	0.	0.	0.	0.	1979
4 1980	0.	0.	.2576E+02	0.	0.	0.	0.	1980
5 1981	0.	0.	.2577E+02	0.	0.	0.	0.	1981
6 1982	0.	0.	.2587E+02	0.	0.	0.	0.	1982
7 1983	0.	0.	.2581E+02	0.	0.	0.	0.	1983
8 1984	0.	0.	.2796E+02	0.	0.	0.	0.	1984
9 1985	0.	0.	.3107E+02	.6429E+02	.7479E+01	0.	0.	1985
10 1986	0.	0.	.3723E+02	.1202E+03	.1429E+00	0.	0.	1986
11 1987	0.	0.	.3532E+02	.2437E+03	.3046E+00	0.	0.	1987
12 1988	0.	0.	.3844E+02	.2974E+03	.3914E+00	0.	0.	1988
13 1989	0.	0.	.4016E+02	.4087E+03	.5459E+00	0.	0.	1989
14 1990	0.	0.	.4024E+02	.4431E+03	.5861E+00	0.	0.	1990
15 1991	0.	0.	.4011E+02	.4717E+03	.6276E+00	0.	0.	1991
16 1992	0.	0.	.4152E+02	.4404E+03	.6053E+00	0.	0.	1992
17 1993	0.	0.	.4188E+02	.4116E+03	.6070E+00	0.	0.	1993
18 1994	0.	0.	.4182E+02	.3847E+03	.6366E+00	0.	0.	1994
19 1995	0.	0.	.4348E+02	.3595E+03	.6653E+00	0.	0.	1995
20 1996	0.	0.	.4367E+02	.3360E+03	.6581E+00	0.	0.	1996
21 1997	0.	0.	.4427E+02	.3140E+03	.6425E+00	0.	0.	1997
22 1998	0.	0.	.4442E+02	.2935E+03	.6039E+00	0.	0.	1998
23 1999	0.	0.	.4494E+02	.3075E+03	.6337E+00	0.	0.	1999
24 2000	0.	0.	.4454E+02	.3185E+03	.6571E+00	0.	0.	2000
25 2001	0.	0.	.4422E+02	.3267E+03	.6792E+00	0.	0.	2001
26 2002	0.	0.	.4414E+02	.3324E+03	.6988E+00	0.	0.	2002
27 2003	0.	0.	.4423E+02	.3361E+03	.7077E+00	0.	0.	2003
28 2004	0.	0.	.4117E+02	.3378E+03	.7064E+00	0.	0.	2004
29 2005	0.	0.	.4019E+02	.3157E+03	.6649E+00	0.	0.	2005
30 2006	0.	0.	.3824E+02	.2950E+03	.6350E+00	0.	0.	2006
31 2007	0.	0.	.3627E+02	.2757E+03	.6119E+00	0.	0.	2007
32 2008	0.	0.	.3503E+02	.2577E+03	.5922E+00	0.	0.	2008
33 2009	0.	0.	.3385E+02	.2408E+03	.5657E+00	0.	0.	2009
34 2010	0.	0.	.3217E+02	.2251E+03	.5392E+00	0.	0.	2010
35 2011	0.	0.	.3066E+02	.2103E+03	.5096E+00	0.	0.	2011
36 2012	0.	0.	.2923E+02	.1966E+03	.4812E+00	0.	0.	2012
37 2013	0.	0.	.2754E+02	.1837E+03	.4490E+00	0.	0.	2013
38 2014	0.	0.	.2546E+02	.1717E+03	.4183E+00	0.	0.	2014
39 2015	0.	0.	.2442E+02	.1717E+03	.4141E+00	0.	0.	2015
40 2016	0.	0.	.2281E+02	.1710E+03	.4183E+00	0.	0.	2016
41 2017	0.	0.	.2021E+02	.1697E+03	.4086E+00	0.	0.	2017

COST REPORT FOR FCT RECYCLE SCENARIO - 3A0 GW BY 2000 - RECYCLE STARTING IN 1985

TABLE 8A PROJECTED COSTS (MILLIONS OF DISCOUNTED 1977 DOLLARS) (CNT0)

MODE: REPROCESSING AND RECYCLE

DATE: 04/27/79 TIME: TODAY

YEAR	STORAGE SPENT FUEL	PU	TRANSPORTATION SPENT FUEL	REPROCESSING SPENT FUEL	TRANSPORTATION PU	WASTE DISPOSAL	PU SALES	YEAR
----	-----	-----	-----	-----	-----	-----	-----	----
42 2018	0.	0.	.1489E+02	.1586E+03	.3862E+00	0.	0.	2018
43 2019	0.	0.	.1739E+02	.1482E+03	.3677E+00	0.	0.	2019
44 2020	0.	0.	.1567E+02	.1355E+03	.3447E+00	0.	0.	2020
45 2021	0.	0.	.1440E+02	.1294E+03	.3260E+00	0.	0.	2021
46 2022	0.	0.	.1396E+02	.1210E+03	.3134E+00	0.	0.	2022
47 2023	0.	0.	.1305E+02	.1131E+03	.3027E+00	0.	0.	2023
48 2024	0.	0.	.1177E+02	.1057E+03	.2839E+00	0.	0.	2024
49 2025	0.	0.	.1111E+02	.8587E+02	.2397E+00	0.	0.	2025
50 2026	0.	0.	.1017E+02	.8560E+02	.2405E+00	0.	0.	2026
51 2027	0.	0.	.8893E+01	.7000E+02	.1979E+00	0.	0.	2027
52 2028	0.	0.	.7937E+01	.7010E+02	.2035E+00	0.	0.	2028
53 2029	0.	0.	.7149E+01	.5241E+02	.1594E+00	0.	0.	2029
54 2030	0.	0.	.6387E+01	.4898E+02	.1532E+00	0.	0.	2030
55 2031	0.	0.	.5860E+01	.4578E+02	.1466E+00	0.	0.	2031
56 2032	0.	0.	.5409E+01	.4278E+02	.1330E+00	0.	0.	2032
57 2033	0.	0.	.4856E+01	.3998E+02	.1271E+00	0.	0.	2033
58 2034	0.	0.	.4477E+01	.3737E+02	.1147E+00	0.	0.	2034
59 2035	0.	0.	.4155E+01	.3492E+02	.1045E+00	0.	0.	2035
60 2036	0.	0.	.3814E+01	.3264E+02	.9702E-01	0.	0.	2036
61 2037	0.	0.	.3465E+01	.3050E+02	.8945E-01	0.	0.	2037
62 2038	0.	0.	.3224E+01	.2851E+02	.8365E-01	0.	0.	2038
63 2039	0.	0.	.2967E+01	.1998E+02	.5735E-01	0.	0.	2039
64 2040	0.	0.	.2706E+01	.2075E+02	.6045E-01	0.	0.	2040
65 2041	0.	0.	.2478E+01	.2133E+02	.6035E-01	0.	0.	2041
66 2042	0.	0.	.2272E+01	.1631E+02	.4637E-01	0.	0.	2042
67 2043	0.	0.	.1952E+01	.1524E+02	.4263E-01	0.	0.	2043
68 2044	0.	0.	.1814E+01	.1425E+02	.3997E-01	0.	0.	2044
69 2045	0.	0.	.1651E+01	.1331E+02	.3863E-01	0.	0.	2045
70 2046	0.	0.	.1574E+01	.1244E+02	.3459E-01	0.	0.	2046
71 2047	0.	0.	.1476E+01	.1163E+02	.3232E-01	0.	0.	2047
72 2048	0.	0.	.1408E+01	.1087E+02	.3037E-01	0.	0.	2048
73 2049	0.	0.	.1306E+01	.1016E+02	.2696E-01	0.	0.	2049
74 2050	0.	0.	.1100E+01	.9493E+01	.2479E-01	0.	0.	2050
75 2051	0.	0.	.1031E+01	.8872E+01	.2361E-01	0.	0.	2051
76 2052	0.	0.	.9766E+00	.8291E+01	.2313E-01	0.	0.	2052
77 2053	0.	0.	.8898E+00	.7749E+01	.2178E-01	0.	0.	2053
78 2054	0.	0.	.8510E+00	.7242E+01	.2028E-01	0.	0.	2054
79 2055	0.	0.	.7881E+00	.4512E+01	.1299E-01	0.	0.	2055
80 2056	0.	0.	.7240E+00	.4217E+01	.1173E-01	0.	0.	2056
81 2057	0.	0.	.6204E+00	.3941E+01	.1095E-01	0.	0.	2057
82 2058	0.	0.	.5699E+00	.3683E+01	.1035E-01	0.	0.	2058

COST REPORT FOR FCT RECYCLE SCENARIO - 380 GW BY 2000 - RECYCLE STARTING IN 1985

TABLE 8A PROJECTED COSTS (MILLIONS OF DISCOUNTED 1977 DOLLARS) (CMTD)

MODE: REPROCESSING AND RECYCLE

DATE: 04/27/79 TIME: TODAY

YEAR	STORAGE SPENT FUEL	PU	TRANSPORTATION SPENT FUEL	REPROCESSING SPENT FUEL	TRANSPORTATION PU	WASTE DISPOSAL	PU SALES	YEAR
----	-----	-----	-----	-----	-----	-----	-----	----
83 2059	0.	0.	.5453E+00	.4016E+01	.1182E-01	0.	0.	2059
84 2060	0.	0.	.4984E+00	.4290E+01	.1228E-01	0.	0.	2060
85 2061	0.	0.	.4685E+00	.4510E+01	.1336E-01	0.	0.	2061
86 2062	0.	0.	.4417E+00	.4215E+01	.1199E-01	0.	0.	2062
87 2063	0.	0.	.4070E+00	.3939E+01	.1040E-01	0.	0.	2063
88 2064	0.	0.	.3758E+00	.3682E+01	.9207E-02	0.	0.	2064
89 2065	0.	0.	.3518E+00	.3441E+01	.8A62E-02	0.	0.	2065
90 2066	0.	0.	.3287E+00	.2144E+01	.5792E-02	0.	0.	2066
91 2067	0.	0.	.2975E+00	.2003E+01	.5818E-02	0.	0.	2067
92 2068	0.	0.	.2723E+00	.1872E+01	.5740E-02	0.	0.	2068
93 2069	0.	0.	.2582E+00	.1750E+01	.5580E-02	0.	0.	2069
94 2070	0.	0.	.2427E+00	.1635E+01	.5151E-02	0.	0.	2070
95 2071	0.	0.	.2249E+00	.1528E+01	.4A38E-02	0.	0.	2071
96 2072	0.	0.	.2141E+00	.1428E+01	.4541E-02	0.	0.	2072
97 2073	0.	0.	.2015E+00	.1335E+01	.3998E-02	0.	0.	2073
98 2074	0.	0.	.1872E+00	.1248E+01	.3388E-02	0.	0.	2074
99 2075	0.	0.	.1715E+00	.1166E+01	.3061E-02	0.	0.	2075
100 2076	0.	0.	.1541E+00	.1271E+01	.3191E-02	0.	0.	2076
TOTALS	0.	0.	.1935E+09	.1497E+06	.3823E+03	0.	0.	
LEVELIZED AND DISCOUNTED(1977) FUEL CYCLE COSTS, MILLS/KWH	0.	0.	.1084E+00	.7318E+00	.1491E-02	0.	0.	

COST REPORT FOR FCT RECYCLE SCENARIO - 340 GW BY 2000 - RECYCLE STARTING IN 1985

TABLE 9 SUMMARY OF POWER COSTS (DISCOUNTED)

MODE: REPROCESSING AND RECYCLE

DATE: 04/27/79 TIME: TODAY

YEAR	-- FUEL CYCLE COSTS --		--- POWER GENERATION ---		-- POWER COST WITH REACTOR --		-- POWER COST W/O REACTOR --		YEAR
	ANNUAL (MILLION 1977 DOLLARS)	CUMMULATIVE	ANNUAL KWHR	CUMMULATIVE KWHR	ANNUAL MILLS/KWHR	LEVELIZED MILLS/KWHR	ANNUAL MILLS/KWHR	LEVELIZED MILLS/KWHR	
1 1977	.5282E+07	.5282E+07	.2023E+12	.2023E+12	.2612E+05	.2612E+05	.7545E+01	.7545E+01	1977
2 1978	.5939E+07	.1122E+08	.2125E+12	.4148E+12	.2794E+05	.2705E+05	.6983E+01	.1177E+04	1978
3 1979	.6162E+07	.1738E+08	.2061E+12	.6209E+12	.2990E+05	.2800E+05	.8088E+01	.1768E+04	1979
4 1980	.6178E+07	.2356E+08	.1931E+12	.8140E+12	.3200E+05	.2895E+05	.1222E+02	.1402E+04	1980
5 1981	.6359E+07	.2992E+08	.1857E+12	.9997E+12	.3424E+05	.2993E+05	.1318E+02	.1861E+04	1981
6 1982	.6809E+07	.3673E+08	.1859E+12	.1186E+13	.3663E+05	.3098E+05	.1498E+02	.3464E+04	1982
7 1983	.7305E+07	.4403E+08	.1864E+12	.1372E+13	.3920E+05	.3210E+05	.1609E+02	.5140E+04	1983
8 1984	.7895E+07	.5193E+08	.1867E+12	.1560E+13	.4194E+05	.3324E+05	.1541E+02	.7184E+04	1984
9 1985	.8595E+07	.6052E+08	.1915E+12	.1752E+13	.4487E+05	.3455E+05	.1503E+02	.9595E+04	1985
10 1986	.9161E+07	.6968E+08	.1908E+12	.1943E+13	.4801E+05	.3587E+05	.1489E+02	.1127E+05	1986
11 1987	.9506E+07	.7919E+08	.1850E+12	.2128E+13	.5137E+05	.3722E+05	.1515E+02	.1191E+05	1987
12 1988	.9711E+07	.8890E+08	.1747E+12	.2304E+13	.5497E+05	.3858E+05	.1564E+02	.1198E+05	1988
13 1989	.9848E+07	.9875E+08	.1674E+12	.2472E+13	.5882E+05	.3995E+05	.1733E+02	.1183E+05	1989
14 1990	.9969E+07	.1087E+09	.1544E+12	.2630E+13	.6293E+05	.4134E+05	.1839E+02	.1171E+05	1990
15 1991	.1012E+08	.1188E+09	.1503E+12	.2780E+13	.6734E+05	.4274E+05	.1954E+02	.1186E+05	1991
16 1992	.1030E+08	.1291E+09	.1430E+12	.2923E+13	.7206E+05	.4418E+05	.2236E+02	.1219E+05	1992
17 1993	.1045E+08	.1396E+09	.1356E+12	.3059E+13	.7710E+05	.4564E+05	.2524E+02	.1244E+05	1993
18 1994	.1059E+08	.1502E+09	.1283E+12	.3187E+13	.8250E+05	.4712E+05	.2659E+02	.1265E+05	1994
19 1995	.1071E+08	.1609E+09	.1213E+12	.3309E+13	.8827E+05	.4863E+05	.2944E+02	.1286E+05	1995
20 1996	.1080E+08	.1717E+09	.1143E+12	.3423E+13	.9445E+05	.5016E+05	.3050E+02	.1290E+05	1996
21 1997	.1083E+08	.1825E+09	.1071E+12	.3530E+13	.1011E+06	.5170E+05	.3232E+02	.1288E+05	1997
22 1998	.1081E+08	.1933E+09	.9993E+11	.3630E+13	.1081E+06	.5326E+05	.3366E+02	.1222E+05	1998
23 1999	.1074E+08	.2041E+09	.9281E+11	.3723E+13	.1157E+06	.5481E+05	.3521E+02	.1151E+05	1999
24 2000	.1061E+08	.2147E+09	.8571E+11	.3809E+13	.1238E+06	.5637E+05	.3567E+02	.1048E+05	2000
25 2001	.1041E+08	.2251E+09	.7847E+11	.3887E+13	.1325E+06	.5790E+05	.3699E+02	.9013E+04	2001
26 2002	.1010E+08	.2352E+09	.7123E+11	.3958E+13	.1417E+06	.5941E+05	.3902E+02	.6880E+04	2002
27 2003	.9711E+07	.2449E+09	.6403E+11	.4022E+13	.1517E+06	.6088E+05	.4152E+02	.4292E+04	2003
28 2004	.9302E+07	.2542E+09	.5732E+11	.4080E+13	.1623E+06	.6231E+05	.4409E+02	.1518E+04	2004
29 2005	.8897E+07	.2631E+09	.5124E+11	.4131E+13	.1736E+06	.6369E+05	.4806E+02	.1249E+04	2005
30 2006	.8510E+07	.2716E+09	.4580E+11	.4177E+13	.1856E+06	.6503E+05	.5137E+02	.3918E+04	2006
31 2007	.8141E+07	.2797E+09	.4095E+11	.4218E+13	.1988E+06	.6633E+05	.5323E+02	.6507E+04	2007
32 2008	.7768E+07	.2875E+09	.3652E+11	.4254E+13	.2127E+06	.6758E+05	.5532E+02	.9168E+04	2008
33 2009	.7346E+07	.2949E+09	.3228E+11	.4286E+13	.2276E+06	.6879E+05	.5828E+02	.1225E+05	2009
34 2010	.6888E+07	.3017E+09	.2828E+11	.4315E+13	.2435E+06	.6993E+05	.6120E+02	.1567E+05	2010
35 2011	.6424E+07	.3082E+09	.2465E+11	.4339E+13	.2606E+06	.7102E+05	.6541E+02	.1822E+05	2011
36 2012	.5972E+07	.3141E+09	.2142E+11	.4361E+13	.2786E+06	.7204E+05	.7068E+02	.2275E+05	2012
37 2013	.5544E+07	.3197E+09	.1858E+11	.4379E+13	.2983E+06	.7300E+05	.7444E+02	.2617E+05	2013
38 2014	.5150E+07	.3248E+09	.1617E+11	.4396E+13	.3192E+06	.7390E+05	.8053E+02	.2934E+05	2014
39 2015	.4763E+07	.3296E+09	.1394E+11	.4409E+13	.3416E+06	.7475E+05	.8130E+02	.3263E+05	2015
40 2016	.4383E+07	.3340E+09	.1199E+11	.4421E+13	.3655E+06	.7553E+05	.8749E+02	.3589E+05	2016
41 2017	.4008E+07	.3380E+09	.1025E+11	.4432E+13	.3910E+06	.7626E+05	.9450E+02	.3919E+05	2017

COST REPORT FOR FCT RECYCLE SCENARIO - 340 GW BY 2000 - RECYCLE STARTING IN 1985

TABLE 9 SUMMARY OF POWER COSTS (DISCOUNTED)

MODE: REPROCESSING AND RECYCLE

DATE: 04/27/79 TIME: TODAY

YEAR	-- FUEL CYCLE COSTS --		--- POWER GENERATION ---		-- POWER COST WITH REACTOR --		-- POWER COST W/O REACTOR --		YEAR
	ANNUAL (MILLION 1977 DOLLARS)	CUMMULATIVE	ANNUAL KWHR	CUMMULATIVE KWHR	ANNUAL MILLS/KWHR	LEVELIZED MILLS/KWHR	ANNUAL MILLS/KWHR	LEVELIZED MILLS/KWHR	
42 2018	.3671F+07	.3417E+09	.4777E+10	.4440E+13	.4184E+06	.7694E+05	.1026E+03	.4223E+05	2018
43 2019	.3368F+07	.3450E+09	.7524E+10	.4448E+13	.4477E+06	.7757E+05	.1109E+03	.4501E+05	2019
44 2020	.3088F+07	.3481E+09	.4447E+10	.4454E+13	.4791E+06	.7815E+05	.1191E+03	.4785E+05	2020
45 2021	.2812F+07	.3509E+09	.9486E+10	.4460E+13	.5126E+06	.7868E+05	.1244E+03	.5032E+05	2021
46 2022	.2543F+07	.3535E+09	.4476E+10	.4465E+13	.5485E+06	.7917E+05	.1322E+03	.5298E+05	2022
47 2023	.2294F+07	.3558E+09	.4909E+10	.4468E+13	.5869E+06	.7961E+05	.1416E+03	.5549E+05	2023
48 2024	.2055F+07	.3578E+09	.4277E+10	.4472E+13	.6279E+06	.8002E+05	.1540E+03	.5796E+05	2024
49 2025	.1830F+07	.3596E+09	.2724E+10	.4474E+13	.6719E+06	.8038E+05	.1654E+03	.6034E+05	2025
50 2026	.1630F+07	.3613E+09	.2266E+10	.4477E+13	.7189E+06	.8070E+05	.1727E+03	.6249E+05	2026
51 2027	.1454F+07	.3627E+09	.1899E+10	.4479E+13	.7693E+06	.8099E+05	.1793E+03	.6444E+05	2027
52 2028	.1295F+07	.3640E+09	.1574E+10	.4480E+13	.8231E+06	.8125E+05	.2193E+03	.6622E+05	2028
53 2029	.1151F+07	.3652E+09	.1306E+10	.4482E+13	.8807E+06	.8148E+05	.2467E+03	.6788E+05	2029
54 2030	.1023F+07	.3662E+09	.1085E+10	.4483E+13	.9424E+06	.8169E+05	.2667E+03	.6938E+05	2030
55 2031	.9107E+06	.3671E+09	.9032E+09	.4484E+13	.1008E+07	.8188E+05	.3021E+03	.7071E+05	2031
56 2032	.8144F+06	.3679E+09	.7544E+09	.4484E+13	.1079E+07	.8205E+05	.3356E+03	.7188E+05	2032
57 2033	.7332F+06	.3687E+09	.4351E+09	.4485E+13	.1155E+07	.8220E+05	.3646E+03	.7288E+05	2033
58 2034	.6634F+06	.3693E+09	.4377E+09	.4485E+13	.1235E+07	.8234E+05	.3907E+03	.7376E+05	2034
59 2035	.6030F+06	.3699E+09	.4562E+09	.4486E+13	.1322E+07	.8246E+05	.4222E+03	.7454E+05	2035
60 2036	.5505F+06	.3705E+09	.4892E+09	.4486E+13	.1414E+07	.8258E+05	.4518E+03	.7522E+05	2036
61 2037	.5052F+06	.3710E+09	.4337E+09	.4487E+13	.1513E+07	.8269E+05	.4858E+03	.7582E+05	2037
62 2038	.4671F+06	.3714E+09	.4844E+09	.4487E+13	.1619E+07	.8278E+05	.4951E+03	.7633E+05	2038
63 2039	.4325F+06	.3719E+09	.4494E+09	.4487E+13	.1733E+07	.8288E+05	.5275E+03	.7681E+05	2039
64 2040	.4022F+06	.3723E+09	.4217E+09	.4487E+13	.1854E+07	.8296E+05	.5306E+03	.7723E+05	2040
65 2041	.3771F+06	.3727E+09	.1901E+09	.4488E+13	.1984E+07	.8304E+05	.591E+03	.7758E+05	2041
66 2042	.3539F+06	.3730E+09	.1667E+09	.4488E+13	.2122E+07	.8312E+05	.6231E+03	.7792E+05	2042
67 2043	.3315F+06	.3733E+09	.1466E+09	.4488E+13	.2271E+07	.8319E+05	.6491E+03	.7824E+05	2043
68 2044	.3116F+06	.3737E+09	.1282E+09	.4488E+13	.2430E+07	.8326E+05	.6767E+03	.7854E+05	2044
69 2045	.2932F+06	.3739E+09	.1124E+09	.4488E+13	.2600E+07	.8332E+05	.7343E+03	.7881E+05	2045
70 2046	.2774F+06	.3742E+09	.9972E+08	.4488E+13	.2782E+07	.8334E+05	.8101E+03	.7905E+05	2046
71 2047	.2620F+06	.3745E+09	.4802E+08	.4488E+13	.2977E+07	.8344E+05	.8374E+03	.7929E+05	2047
72 2048	.2479F+06	.3747E+09	.7782E+08	.4488E+13	.3185E+07	.8349E+05	.9049E+03	.7951E+05	2048
73 2049	.2355F+06	.3750E+09	.4910E+08	.4488E+13	.3408E+07	.8354E+05	.9191E+03	.7971E+05	2049
74 2050	.2226F+06	.3752E+09	.4107E+08	.4488E+13	.3647E+07	.8359E+05	.9300E+03	.7992E+05	2050
75 2051	.2086F+06	.3754E+09	.4347E+08	.4489E+13	.3902E+07	.8363E+05	.9622E+03	.8015E+05	2051
76 2052	.1942F+06	.3756E+09	.4655E+08	.4489E+13	.4175E+07	.8368E+05	.1050E+04	.8039E+05	2052
77 2053	.1795F+06	.3758E+09	.4011E+08	.4489E+13	.4467E+07	.8372E+05	.1168E+04	.8064E+05	2053
78 2054	.1654F+06	.3759E+09	.4466E+08	.4489E+13	.4780E+07	.8375E+05	.1335E+04	.8088E+05	2054
79 2055	.1528F+06	.3761E+09	.4944E+08	.4489E+13	.5115E+07	.8379E+05	.1436E+04	.8110E+05	2055
80 2056	.1422F+06	.3762E+09	.4594E+08	.4489E+13	.5473E+07	.8382E+05	.1485E+04	.8128E+05	2056
81 2057	.1326F+06	.3764E+09	.4264E+08	.4489E+13	.5856E+07	.8385E+05	.1544E+04	.8145E+05	2057
82 2058	.1235F+06	.3765E+09	.1972E+08	.4489E+13	.6266E+07	.8387E+05	.1588E+04	.8162E+05	2058

COST REPORT FOR FCT RECYCLE SCENARIO - 340 GW BY 2000 - RECYCLE STARTING IN 1985

TABLE 9 SUMMARY OF POWER COSTS (DISCOUNTED)

MODE1 REPROCESSING AND RECYCLE

DATE: 04/27/79 TIME: TODAY

YEAR	-- FUEL CYCLE COSTS --		--- POWER GENERATION ---		-- POWER COST WITH REACTOR --		-- POWER COST W/O REACTOR --		YEAR
	ANNUAL (MILLION 1977 DOLLARS)	CUMMULATIVE	ANNUAL KWHR	CUMMULATIVE KWHR	ANNUAL MILLS/KWHR	LEVELIZED MILLS/KWHR	ANNUAL MILLS/KWHR	LEVELIZED MILLS/KWHR	
83 2059	.1149E+06	.3766E+09	.1714E+08	.4489E+13	.6704E+07	.8390E+05	.1693E+04	.8178E+05	2059
84 2060	.1067E+06	.3767E+09	.1487E+08	.4489E+13	.7174E+07	.8392E+05	.1784E+04	.8193E+05	2060
85 2061	.9880E+05	.3768E+09	.1288E+08	.4489E+13	.7676E+07	.8394E+05	.1928E+04	.8207E+05	2061
86 2062	.9141E+05	.3769E+09	.1113E+08	.4489E+13	.8213E+07	.8396E+05	.2132E+04	.8221E+05	2062
87 2063	.8436E+05	.3770E+09	.9600E+07	.4489E+13	.8788E+07	.8398E+05	.2252E+04	.8235E+05	2063
88 2064	.7769E+05	.3771E+09	.8262E+07	.4489E+13	.9403E+07	.8400E+05	.2435E+04	.8248E+05	2064
89 2065	.7138E+05	.3771E+09	.7094E+07	.4489E+13	.1006E+08	.8402E+05	.2662E+04	.8260E+05	2065
90 2066	.6543E+05	.3772E+09	.6077E+07	.4489E+13	.1077E+08	.8403E+05	.3156E+04	.8272E+05	2066
91 2067	.5986E+05	.3773E+09	.5197E+07	.4489E+13	.1152E+08	.8404E+05	.3246E+04	.8283E+05	2067
92 2068	.5467E+05	.3773E+09	.4435E+07	.4489E+13	.1233E+08	.8406E+05	.3497E+04	.8294E+05	2068
93 2069	.4979E+05	.3774E+09	.3775E+07	.4489E+13	.1319E+08	.8407E+05	.3758E+04	.8304E+05	2069
94 2070	.4488E+05	.3774E+09	.3181E+07	.4489E+13	.1411E+08	.8408E+05	.3994E+04	.8314E+05	2070
95 2071	.4002E+05	.3775E+09	.2650E+07	.4489E+13	.1510E+08	.8409E+05	.4292E+04	.8324E+05	2071
96 2072	.3527E+05	.3775E+09	.2183E+07	.4489E+13	.1616E+08	.8409E+05	.4733E+04	.8334E+05	2072
97 2073	.3073E+05	.3775E+09	.1779E+07	.4489E+13	.1729E+08	.8410E+05	.5752E+04	.8344E+05	2073
98 2074	.2651E+05	.3775E+09	.1433E+07	.4489E+13	.1850E+08	.8411E+05	.6550E+04	.8353E+05	2074
99 2075	.2260E+05	.3776E+09	.1142E+07	.4489E+13	.1979E+08	.8411E+05	.7325E+04	.8361E+05	2075
100 2076	.1912E+05	.3776E+09	.9028E+06	.4489E+13	.2118E+08	.8412E+05	.8190E+04	.8369E+05	2076

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