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COST FUNCTION STUDIES FOR POWER REACTORS

by

J. Heestand and L. T. Wos

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Applied Mathematics Division

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ABSTRACT

A function to evaluate the cost of electricity produced by a nuclear power reactor is developed. The basic equation, revenue = capital charges + profit + operating expenses, is expanded in terms of various cost parameters to enable analysis of multiregion nuclear reactors with uranium and/or plutonium for fuel. A corresponding IBM 704 computer program, which will compute either the price of electricity or the value of plutonium, is presented in detail in the appendices.

I. INTRODUCTION

The industrial application of any large engineering system requires a critical examination of the economic factors involved in its use. Following the suggestion of the use of nuclear reactors for the generation of electric power, there has arisen an interest in examining the economic aspects of the operation of such a reactor power station. For this purpose a program directed toward carrying out a rather thorough analysis of reactor power stations has been initiated, the first step of which is the development of an appropriate cost function for the system. The purpose of this paper is to discuss the development of the cost function, which in this case gives the cost in mills per kilowatt hour of generated electricity as a function of the various cost parameters. The cost function contains minor simplifications whose effect on mills per kilowatt hour is insignificant; it is not intended to serve as an accounting technique. This work bears a close resemblance to that of J. M. McCampbell,[a] with revisions to incorporate recent changes in insurance laws, elaboration of the treatment of fuel cycle cost, and refinements to give access to more detailed information and to permit further studies which are contemplated.

II. DEVELOPMENT OF COST FUNCTION

The basis for the analysis is contained in the equation

$$\text{revenue} = \text{capital charges} + \text{profit} + \text{operating expenses}, \qquad (1)$$

which is assumed to hold true for each period of time (one year in this program) in which the reactor is operated to produce electricity.

A. Revenue

There are two sources of revenue, the sale of electricity and the sale of plutonium (or U^{233}). We ignore all other fission byproducts as sources of revenue.

$$\text{Annual electric revenue (\$)} = 8.76 \times 10^3 P\eta\epsilon m \quad , \tag{2}$$

where P is the thermal power rating of the reactor in megawatts, η is the net thermal efficiency, ϵ is the plant factor, and m is the cost of electricity to the user in mills per kilowatt hour.

$$\text{Annual revenue (\$) from sale of plutonium} = 10^3 Av/\tau \quad , \tag{3}$$

where A is the amount in kilograms of plutonium produced by one fuel charge in exposure time τ years and v is the value in dollars of one gram of plutonium.

B. Capital Charges

Capital charges are just those charges needed to redeem capital spent on construction, research and development, the corresponding interest, and the interest on capital spent for land. We wish to redeem interest on the various sums involved, whether it occurs as a result of actually borrowing capital or as a result of interest lost by utilizing available funds in these connections instead of investing them. We make the assumptions that the value of land is a constant and that available interest on sinking funds is equal percentagewise to those interests referred to above. We then have

$$(\text{capital charges})\left(\frac{(1+i)^n-1}{i}\right) + I_\ell = \frac{1}{\beta} I_d (1+i)^{n_d+n} + (I_c + I_\ell)(1+i)^{n_c+n} \quad , \tag{4}$$

where, remembering that the assumption with sinking funds is that the payment is made at the end of each period, $[(1+i)^n - 1]/i$ is the sinking fund factor which gives the value of a sinking fund consisting of n equal payments at interest i, n is the life of the plant in years, β is the number of plants over which research and development costs are distributed, I_d is the research and development cost, n_d is the average lead time in years for research and development, I_c and I_ℓ are the respective costs for construction and land, and n_c is the number of years capital is tied up in land and construction prior to startup. By transposing the cost of land and dividing by $(1+i)^n$, we have an equation stating that the present value of the sinking fund resulting from annual capital charges is equal to the present net value of the capital transaction. In other words, capital charges refer to that amount of money deposited in equal payments at the

end of each operating year in a sinking fund such that the value of that fund when the plant has zero salvage value is precisely the difference between the value of the invested capital at that time and the value of land; the value of invested capital at the end of the life of the plant is expressed by the right side of Equation (4).

C. Profit

The profit parameter ω is given as a percentage of the value of invested capital at startup, and is not to be confused with the present value of all capital transactions. The value of ω is obtained by levelizing the desired profit over the lifetime of the plant. The profit in dollars is thus $\omega\left[\frac{1}{\beta} I_d(1+i)^{n_d} + (I_c + I_\ell)(1+i)^{n_c}\right]$. At present, the value of ω is supplied to, rather than computed by, the program.

D. Operating Expenses

Operating expenses consist of: ad valorem charges, operation and maintenance, fuel-cycle costs, and insurance and taxes not proportional to the value of the plant.

1. Ad valorem Charges. Ad valorem charges (plant insurance, property damage insurance, and property taxes) are assessed against the appraised value of the property. The sum of these charges is given by

$$(\phi + \chi + \psi)\ \delta(I_c + I_\ell) \quad ,$$

where ϕ, χ, and ψ are the respective rates, and δ is the ratio of appraised value to actual.

2. Operation and Maintenance Costs. Operation and maintenance costs are estimated by the user of the program. They include salaries, equipment, supplies, and overhead.

3. Fuel-cycle Cost. Fuel-cycle cost is computed from supplied cost parameters; there is no attempt at this time to include any core design study or any technique for minimization of this cost. We are able to consider a multiregion core, a multiregion blanket, and, as fuel, enriched uranium, plutonium, or some combination of these fuels restricted to separate regions. The fuel-cycle cost is, therefore, the sum of the costs for the various regions. Any credit for plutonium production is added as revenue and not placed against fuel-cycle cost directly. For any one region, the fuel-cycle cost has four components: first, the product of the throughput of fuel, adjusted to compensate for various losses, and the sum of the unit costs for conversion, fabrication, reprocessing, shipping, and

waste disposal; second, a use-charge proportional to the use-charge rate, value of fuel at the appropriate enrichment, and the time in which the fuel is not in AEC possession; third, a burnup charge from the loss in value of the fuel; fourth, the cost of reducing produced plutonium to metal buttons. Since annual loading equals initial loading divided by residence time, fuel-cycle cost is given by the equation

$$fc = \sum_k \Bigg[uL_{3k}V(e_1)_k + \frac{1}{\tau_k}\Bigg\{\Big[c_{ck}(1+\ell_{ck}+\ell_{fk}) + c_{fk}(1+\ell_{fk}) + c_{rk} + c_{sk} + c_{s'k} + c_{wk}\ell_{wk}\Big]L_{1k}$$

$$+\Big[(t_{ck}+t_{fk}+t_{sk})V(e_1)_k + \tau_k\left(\frac{V(e_1)_k + V(e_2)_k}{2}\right) + (t_{dk}+t_{rk}+t_{s'k})V(e_2)_k\Big]uL_{1k}\,(1+\ell_{ck}+\ell_{fk}) \quad (5)$$

$$+\Big[V(e_1)_k\,L_{1k}(1+\ell_{ck}+\ell_{fk}) - V(e_2)_k\,L_{2k}\Big] + A_k c_{pk}\,10^3\Bigg\}\Bigg] \quad ,$$

(the subscript k designates the region)

where: c_c, c_f, c_r, c_s, c_s', and c_w are unit costs per kilogram of conversion, fabrication, reprocessing, shipping of new and irradiated fuel, and radioactive waste disposal, respectively; t_c, t_f, t_r, t_s and t_s' are the corresponding times required for the processes; t_d is the time necessary for radioactive decay of spent fuel before reprocessing; τ is the residence time; u is the use-charge rate; $V(e_1)$ denotes the value at initial enrichment e_1, and $V(e_2)$ the value at enrichment e_2 at discharge; L_1, L_2, and L_3 are the weights of fuel at initial loading, after reprocessing and for the inventory; ℓ_c and ℓ_f are those percentages by which L_1 must be increased to compensate for losses in conversion and fabrication, respectively*; ℓ_w is the percentage of L_1 to be disposed of as radioactive waste; A is the amount of plutonium produced by one loading; and c_p is the cost per gram of reducing plutonium to metal buttons.

4. Liability Insurance. According to the latest law on liability insurance for power reactors, the required coverage is determined in the following manner. If the maximum allowable power does not exceed 10 kw(thermal), the required coverage is 1 million dollars; if greater than 10 kw(t) but does not exceed 1 mw(t), 1.5 million; if greater than 1 mw(t) but does not exceed 10 mw(t), 2.5 million. If the power rating in mw(electrical) exceeds 100, the required coverage is 60 million. For those reactors not yet covered, apply the formula x = Bp, where x is coverage in dollars rounded up to the nearest hundred thousand, B is the base amount of financial protection, and p is the population factor. The coverage x must be between 3.5 and 60 million; B equals 150 dollars times maximum allowable power in kw(t); p is between 1 and 1.5 and is determined by the magnitude of the nearby population.

*To avoid confusion it should be understood that ℓ_c equals 0.15 if, for example, the loss from conversion is 15%.

The parameter of interest, however, is the amount of premium. Not allowing a premium rate to be less than 1,000 dollars per million of coverage, the premium schedule is: the base premium for the first million, 0.5 of base for each of the next 4 million, 0.2 of base for each of next 5, 0.1 for each of next 10, 0.05 for each of next 20, and 0.025 for each million of coverage above 40 million. Annual cost of liability insurance $P\ell$ is given by

$$P\ell = a_1 \kappa + 0.5\, a_1 \lambda + 0.2\, a_1 \mu + 0.1\, a_1 \nu + 0.05\, a_1 \xi + 0.025\, a_1 \zeta \,, \quad (6)$$

where a_1 is the base premium and κ, λ, μ, ν, ξ, and ζ are the number of millions at the corresponding premium.

5. Taxes. The taxes are of two kinds: state income and federal income. State tax S is assessed at the rate j_S on the difference between gross revenue and the tax deductibles. The tax deductibles consist of ad valorem charges, operation and maintenance cost, fuel-cycle cost, liability insurance, interest on the bonded fraction of invested capital at startup, and depreciation. For the tax calculation the shortest allowable time for straight-line depreciation is taken. The federal income tax F is obtained by taking that revenue taxable by the state, subtracting from it the money paid as state income tax, and taxing this modified revenue at the rate j_F. With b the bonded fraction of capitalization, $\underline{i}$ the interest rate on the bonds, and n' the depreciation time, the tax equations are

$$S = j_S \left(8.76 \times 10^3 P \eta \epsilon m + 10^3 (Av/\tau) - (\phi + \psi + \chi)(I_c + I_\ell)\delta - OM - fc - P_\ell \right.$$
$$\left. - \frac{1}{n'} \left[\frac{1}{\beta} I_d + I_c \right] - b_{\underline{i}} \left[\frac{1}{\beta} I_d (1+i)^{n_d} + (I_c + I_\ell)(1+i)^{n_c} \right] \right) \quad (7)$$

and

$$F = j_F (1 - j_S)\, S / j_S \quad . \quad (8)$$

If the reactor power station is part of a larger complex and, therefore, its taxes are not computed separately but are instead assigned as a fraction g of the revenue dollar; its reduced revenue, 1-g times gross revenue, must equal the sum of capital charges and operating expenses exclusive of taxes. By using the selector α, which takes on the value 0 or 1, we can handle either tax situation. This is accomplished by replacing revenue in Equation (1) by $(1 - \alpha g)$ revenue and by replacing the tax contribution in Equation (1) by $(1 - \alpha)(F + S)$. Thus, when α is 0, we are in the first case; and when α is 1, the tax contribution is nullified and the gross revenue reduced accordingly, and we are in the second.

Using Equations (1) and (2) and letting I be the present value of all capital transactions and $a_{n\rceil} = [1 - (1 + i)^{-n}]/i$, we have

$$a_{n\rceil} \text{ revenue} = I + a_{n\rceil} \text{ profit} + a_{n\rceil} \text{ operating expenses} \quad , \tag{9}$$

which says that the present value of annual revenue equals the present value of annual capital charges plus the present value of annual profit plus the present annual operating expenses all taken over the life of the plant. By expanding Equation (9) in the parameters discussed above, we can solve for m, obtaining

$$\begin{aligned} m = {} & \frac{1}{8.76 \times 10^3 \, P \eta \epsilon [(1 - \alpha g) - (1 - \alpha) j]} \times \\ & \Big\{ I/a_{n\rceil} + [1 - (1 - \alpha) j][\phi + \chi + \psi) \delta (I_c + I_\ell) + OM + fc + P_\ell] \\ & + [\tfrac{1}{\beta} I_d (1 + i)^{n_d} + (I_c + I_\ell)(1 + i)^{n_c}][\omega - (1 - \alpha) j \, b_i] \\ & - (1 - \alpha) j \tfrac{1}{n'} \left[\tfrac{1}{\beta} I_d + I_c \right] + [(1 - \alpha) j - (1 - \alpha g)][10^3 \, Av/\tau] \Big\} \quad , \end{aligned} \tag{10}$$

where $j = j_S + j_F - j_S j_F$. Thus, if we are given average values for the parameters involved, we can determine the average price to be charged for the electricity produced by the power reactor in order to cover the various costs and still yield the desired average profit. For the public power station operating on a nonprofit basis, we just set the profit parameter ω to 0 and follow our usual procedure. The question of a year with unusual operating conditions may be of interest to the utility - for example, the first year with its attendant startup problems and, therefore, costs. To compute the corresponding charge for electricity necessary to maintain the desired revenue cost balance when viewed as a one-year problem, we need only adjust the affected cost parameters accordingly, since the value of fixed charges is not changed by such considerations.

III. CONCLUDING REMARKS

Since the selling price of electricity produced by power reactors may be very dependent on the value placed on the simultaneously produced plutonium, the pricing of plutonium is a very relevant consideration. We have applied the analysis above to this problem, interchanging the roles of electricity cost and plutonium value, and thus developed an IBM 704 program to yield the value of plutonium when assigning a selling price for electricity therein produced.

By use of the cost function discussed in this paper, or the corresponding IBM 704 program, one can gain information about the economic competitiveness of a given reactor with other means of producing electricity. By a differential analysis of such cost functions, the importance of the various cost parameters can be seen. Thus, for example, the effect of a small change in use-charge rate or a change in tax rate can easily be assessed. Differentiating with respect to u, the use-charge, we have

$$\frac{\partial m}{\partial u} = \frac{[(1 - \alpha g) - (1 - \alpha)j]^{-1}}{8.76 \times 10^3 P\eta\epsilon} \times$$

$$\sum_k \left\{ L_{3k} V(e_1)_k + \frac{1}{\tau_k} \left[(t_{ck} + t_{fk} + t_{sk}) V(e_1)_k + \tau_k \left(\frac{V(e_1)_k + V(e_2)_k}{2} \right) \right.\right.$$

$$\left.\left. + (t_{dk} + t_{rk} + t_{s'k}) V(e_2)_k \right] L_{1k} (1 + \ell_{ck} + \ell_{fk}) \right\} \quad , \qquad (11)$$

which shows that a doubling of the use-charge would cause the cost in mills per kilowatt hour to increase by

$$\frac{u[(1 - \alpha g) - (1 - \alpha)j]^{-1}}{8.76 \times 10^3 P\eta\epsilon} \times$$

$$\sum_k \left\{ L_{3k} V(e_1)_k + \frac{1}{\tau_k} \left[(t_{ck} + t_{fk} + t_{sk}) V(e_1)_k + \tau_k \left(\frac{V(e_1)_k + V(e_2)_k}{2} \right) \right.\right.$$

$$\left.\left. + (t_{dk} + t_{rk} + t_{s'k}) V(e_2)_k \right] L_{1k} (1 + \ell_{ck} + \ell_{fk}) \right\} \quad .$$

Another partial, perhaps of equal interest, is that with respect to j, the tax rate:

$$\frac{\partial m}{\partial j} = (1 - \alpha) \left\{ I/a_{\overline{n}|} + [1 - (1 - \alpha g)][(\phi + \psi + \chi)\delta (I_c + I\ell) + OM + fc + P\ell] \right.$$

$$+ [\omega - (1 - \alpha g) b\underline{i}][\frac{1}{\beta} I_d (1 + i)^{n_d} + (I_c + I\ell)(1 + i)^{n_c}] \qquad (12)$$

$$\left. - (1 - \alpha g) \frac{1}{n'} \left[\frac{1}{\beta} I_d + I_c \right] \right\} \div \left\{ 8.76 \times 10^3 P\eta\epsilon [(1 - \alpha g) - (1 - \alpha)j]^2 \right\} \quad .$$

Such an analysis can indicate those areas in which, from an economic viewpoint, technological progress is needed.

APPENDIX A

DESCRIPTION OF THE IBM 704 PROGRAM 0908/RE224

STATEMENT OF THE PROBLEM: RE224 is a program for the IBM 704 that will evaluate m, the cost of electricity (mills/kwhr), or v, the value of plutonium ($/gm), for a nuclear power plant, given various cost parameters as input.

The cost of electricity, m, can be evaluated for either a nuclear power plant or a fossil-fueled power plant by the following equation:

$$m = \frac{1}{8.76 \times 10^3 P\eta\epsilon\,[(1-\alpha g) - (1-\alpha)j]} \times \left\{(1/a_{\overline{n}|}) + [1-(1-\alpha)j][(\phi + \chi + \psi)\ \delta(I_c + I_\ell) + OM + P_\ell + fc_t] + [I + I_\ell(1+i)^{-n}][\omega - (1-\alpha)j\ b_{\overline{i}|}] - (1-\alpha)j\,\frac{1}{n'}\left(\frac{1}{\beta} I_d + I_c\right) + [(1-\alpha)j - (1-\alpha g)][10^3\ Av/\tau]\right\} ,$$

where

$$I = \frac{1}{\beta} I_d (1+i)^{n_d} + (I_c + I_\ell)(1+i)^{n_c} - I_\ell (1+i)^{-n} ,$$

$$j = j_S + j_F - j_S j_F ,$$

$$a_{\overline{n}|} = \frac{1 - (1+i)^{-n}}{i} ,$$

$$P_\ell = \begin{cases} 0 \text{ for fossil-fueled plant} \\ \kappa a_1 + \lambda 0.5\, a_1 + \mu 0.2\, a_1 + \nu 0.1\, a_1 + \xi 0.05\, a_1 + \zeta 0.025\, a_1 \text{ for nuclear power plant,} \end{cases}^{(1)*}$$

$$\tau_k = \begin{cases} \text{assumed one year for fossil-fueled plant} \\ \dfrac{2.7397 \times 10^{-3}\, E_{tk}}{\epsilon P} \text{ for nuclear power plant}^{(2)} \end{cases} = \text{residence time,}$$

$$Av/\tau = \begin{cases} 0 \text{ for fossil-fueled plant} \\ \nu \sum_{k=1}^{NFCB+NFCC} A_k/\tau_k \text{ for nuclear power plant, and} \end{cases}$$

---

* See notes at end of Appendix A

$$fc_t = \begin{cases} \text{input for fossil-fueled plant} \\ Q_1 + Q_2 + Q_3 \text{ v } 10^3 \text{ for nuclear power plant} \end{cases}$$

In the equation for fc_t,

$$Q_1 = \sum_{k=1}^{NFCB+NFCC} 1/\tau_k \left\{\left[c_{ck}(1+\ell_{ck}+\ell_{fk}) + c_{fk}(1+\ell_{fk}) + c_{rk} + c_{sk} + c_{s'k} + c_{wk}\ell_{wk}\right] \quad L_{1k} + A_k c_{pk} 10^3\right\}$$

$$Q_2 = \sum_{k=1}^{NFCB} u_k L_{3k} V(e_1)_k + \frac{1}{\tau_k} \left\{\left[\left(t_{ck} + t_{fk} + t_{sk}\right) \quad V(e_1)_k + \tau_k \left(\frac{V(e_1)_k + V(e_2)_k}{2}\right)\right.\right.$$

$$\left.\left. + \left(t_{dk} + t_{rk} + t_{s'k}\right) \quad V(e_2)_k\right] \quad u_k L_{1k}(1+\ell_{ck}+\ell_{fk}) + \left[V(e_1)_k L_{1k}(1+\ell_{ck}+\ell_{fk}) - V(e_2)_k L_{2k}\right]\right\} ,$$

and

$$Q_3 = \sum_{k\,=\,NFCB+1}^{NFCB+NFCC} u_k L_{3k} + 1/\tau_k \left\{\left[(t_{ck} + t_{fk} + \tau_k + t_{dk} + t_{rk} + t_{sk} + t_{s'k}) u_k + 1\right] \quad L_{1k}(1+\ell_{ck}+\ell_{fk}) - L_{2k}\right\} ,$$

with

$$V(e_p) = \left\{C_F\left(\frac{e_p - e_w}{e_F - e_w}\right) + C_\Delta \left[V_p + \left(\frac{e_p - e_F}{e_F - e_w}\right) V_w - \left(\frac{e_p - e_w}{e_F - e_w}\right) V_F\right]\right\}$$

defined as the value of the product fuel at enrichment e_p, p = 1,2, and

$$V_\zeta = (2e_\zeta - 1)\, \ell n \left(\frac{e_\zeta}{1 - e_\zeta}\right)$$

defined as the separation potential of the ζ^{th} stream, $\zeta = p, w, F^{(c)}$

The parameter NFCB designates the number of uranium fuel regions in the reactor and NFCC, the number of plutonium fuel regions.

The value of plutonium, v, can be evaluated for a uranium- or a plutonium-fueled plant by the following equation:

$$v = \frac{1}{[(1-\alpha g) - (1-\alpha)_J]\, 10^3 (A/\tau) - [1 - (1-\alpha)_J]\, Q_3 \times 10^3}$$

$$\times \left\{(I/a_n) - 8.76 \times 10^3 \, P \eta \epsilon m [(1-\alpha g) - (1-\alpha)_J]\right.$$

$$+ [\omega - (1-\alpha)_J \, b_1][I + I_\ell (1+i)^{-n}] - (1-\alpha)_J \frac{1}{n'} \left(\frac{1}{\beta} I_d + I_c\right)$$

$$\left. + [1 - (1-\alpha)_J][(\phi + \psi + \chi) \quad \delta(I_c + I_\ell) + OM + P_\ell + Q_1 + Q_2]\right\} ,$$

where I, J, a_n, P_ℓ, τ, Q_1, Q_2, and Q_3 are as defined above for uranium-fueled plants

and

$$A/\tau = \sum_{k\,=\,1}^{NFCB+NFCC} A_k/\tau_k$$

Further analysis of the fuel cycle cost equation can be found in Appendix B.

MACHINE: This program is written in FORTRAN for an IBM 704 with core storage of at least 8K, an on-line card reader, and an on-line printer or one magnetic tape unit.

RUNNING TIME: A problem takes less than one-minute running time with tape output.

INPUT INFORMATION REQUIRED: The input parameters, together with the values of the associated index J (to be explained later), are as follows:

J	Parameter	Description
1	MCALC	0 - v-calculation 1 - m-calculation
2	NFCB	number of uranium regions; $0 \leq NFCB \leq 10$
3	NFCC	number of plutonium regions; $0 \leq NFCC \leq 10$; $0 \leq NFCB + NFCC \leq 10$ (both 0 for fossil-fuel case)
4	β	number of plants over which design and development costs are distributed
5	i	interest rate (% x 10^{-2})
6	I_c	investment in construction ($)
7	I_d	investment in design and development ($)
8	I_ℓ	investment in land ($)
9	n	plant life (yr)
10	n_c	average lead time for construction (yr)
11	n_d	average lead time for design (yr)
12	ϵ	plant factor (% x 10^{-2})
13	η	plant net thermal efficiency (% x 10^{-2})
14	P	thermal power rating of reactor (TMW)
15	v	value of plutonium as metal buttons ($/gm)
16	m	cost of generating electric power (mills/kwhr)
17	OM	operating and maintenance cost ($/yr)
18	ω	annual levelized return on investment (% x 10^{-2})

J	Parameter	Description
19	χ	ad valorem rate for property taxes (% x 10^{-2})
20	δ	appraisal fraction (% x 10^{-2})
21	ϕ	ad valorem rate for plant insurance (% x 10^{-2})
22	ψ	ad valrem rate for property damage insurance (% x 10^{-2})
23	a_1	base rate of premium on liability insurance ($ per $ million)
24	PF	population factor
25	α	{0 - calculation for individual plant 1 - calculation for company as a whole
26	b	fraction of capitalization by bonds (% x 10^{-2})
27	$\underline{i}$	interest on bonds (% x 10^{-2})
28	j_F	federal income tax rate (% x 10^{-2})
29	j_S	state income tax rate (% x 10^{-2})
30	n'	shortest period allowed for straight line depreciation for tax deduction (yr)
31	g	average ratio of annual income tax payments to annual gross revenue (% x 10^{-2})
32	fc_t	{0 for nuclear power case "fuel cycle cost" for fossil-fueled case ($/yr)
33-42	L_1	initial fuel loading (kg)
43-52	L_2	amount of fuel after reprocessing (kg)
53-62	L_3	amount of inventory fuel (kg)
63-72	ℓ_c	percent by which L_1 must be increased to compensate for loss due to conversion (% x 10^{-2})
73-82	ℓ_F	percent by which L_1 must be increased to compensate for loss due to fabrication (% x 10^{-2})
83-92	ℓ_w	percent of L_1 to be disposed of as radioactive waste (% x 10^{-2})
93-102	c_c	cost of conversion to fuel meat material ($/kg)
103-112	c_f	cost of fabricating fuel elements ($/kg)
113-122	c_r	cost of reprocessing fuel ($/kg)

J	Parameter	Description
123-132	c_w	cost of radioactive waste disposal ($/kg)
133-142	c_s	cost of shipping new fuel ($/kg)
143-152	$c_{s'}$	cost of shipping irradiated fuel ($/kg)
153-162	t_c	conversion time (yr)
163-172	t_f	fabrication time (yr)
173-182	t_r	reprocessing time (yr)
183-192	t_d	radioactive decay time for "cooling" (yr)
193-202	t_s	shipping time for new fuel (yr)
203-212	$t_{s'}$	shipping time for irradiated fuel (yr)
213-222	e_1*(3)	initial uranium fuel enrichment (wt % x 10^{-2})
223-232	e_2*	discharge uranium fuel enrichment (wt % x 10^{-2})
233-242	C_Δ*	cost of separative work ($/kg)
243-252	C_F*	cost of feed material ($/kg)
253-262	e_F*	feed stream enrichment in separation plant (wt % x 10^{-2})
263-272	e_w*	waste stream enrichment in separation plant (wt % x 10^{-2})
273-282	A	amount of plutonium produced with one fuel charge (kg)
283-292	c_p	cost of reducing plutonium nitrate to metal buttons ($/gm)
293-302	E_t	integrated fission energy (TMW day)
303-312	u	use charge rate (% x 10^{-2}/yr).

The input format is as follows:

Card 1	title card of up to 72 Hollerith characters including a 1 in column 1	
Card 2	3I12(4)	MCALC, NFCB, NFCC
Card 3	6E12.5	β, i, I_c, I_d, I_ℓ, n
Card 4	2E12.5	n_c, n_d
Card 5	5E12.5	ϵ, η, p, v, m

Card 6	1E12.5	OM
Card 7	1E12.5	ω
Card 8	4E12.5	χ, δ, ϕ, ψ
Card 9	2E12.5	a_1, PF
Card 10	6E12.5	α, b, $\underline{i}$, j_F, j_S, n'
Card 11	1E12.5	g
Card 12	1E12.5	fc_t
Card 13	6E12.5	L_1, L_2, L_3, ℓ_c, ℓ_f, ℓ_w
Card 14	6E12.5	c_c, c_f, c_r, c_w, c_s, $c_{s'}$
Card 15	6E12.5	t_c, t_f, t_r, t_d, t_s, $t_{s'}$
Card 16	6E12.5	e_1, e_2, C_Δ, C_F, e_F, e_w
Card 17	4E12.5	A, c_p, E_t, u.

There must be NFCB+NFCC sets of cards number 13 through 17, and the data for all the uranium regions (NFCB sets) must precede the data for the plutonium regions (NFCC sets).

To facilitate parameter studies, as many sets of the following NPC+1 cards as desired (including 0) may follow the above data:

Card "1"	I12	NPC -	the number of parameter changes in the next case
Card "2"	I12,E12.5	J_1,PA(J_1) -	the index of the parameter to be changed and the new value of that parameter
.	.	.	
.	.	.	
.	.	.	
Card "NPC+1"	I12,E12.5	J_{NPC},PA(J_{NPC}).	

A blank card must be the last card for each problem.

Any desired number of problems can be run consecutively.

POSSIBLE OUTPUT: Output from an m-calculation consists of:

m (mills-kwhr)

Capital charges = I ($/yr)

Ad valorem charges = $(\phi + \psi + \chi)\,\delta\,(I_c + I_\ell)$ ($/yr)

Liability insurance premium = P_ℓ ($/yr)

Total revenue = $8.76 \times 10^3 \, P\eta\epsilon m + 10^3 \, Av/\tau$ ($/yr)

Electric revenue = $8.76 \times 10^3 \, P\eta\epsilon m$ ($/yr)

Plutonium revenue = $10^3 \, Av/\tau$ ($/yr)

Operating expenses = ad valorem + OM + P_ℓ + fc_t + taxes ($/yr)

Profit = $\omega \, [I + I_\ell (1+i)^{-n}]$ ($/yr)

State income tax = $j_S N_S$ ($/yr)

Federal income tax = $j_F (1 - j_S) N_S$ ($/yr)

Total fuel cycle costs = fc_t ($/yr)

Value of fuel at initial and final enrichment = $V(e_1)$ and $V(e_2)$ ($/kg) (for uranium regions of nuclear power plant only),

where

Taxes = federal income tax + state income tax

and

$$N_S = \text{revenue} - fc_t - \text{OM} - \text{ad valorem charges} - P_\ell - \frac{1}{n'}\left[\frac{1}{\beta} I_d + I_c\right] - bi\left[\frac{1}{\beta} I_d (1+i)^{n_d} + (I_c + I_\ell)(1+i)^{n_c}\right]$$

Output from a v-calculation is the same as that for an m-calculation except that m is replaced by v.

SPECIAL FEATURES, RESTRICTIONS, AND PROGRAM LIMITATIONS:

1. In computing federal and state taxes, a negative result is possible if tax deductibe expenses exceed the revenue. In this case the taxes are set equal to 0 and m or v appropriately adjusted.

2. Liability insurance coverage required is rounded up to the nearest $100,000.

3. Parameter studies are possible without rereading the entire data deck, as is apparent from the description of the input format. To facilitate storage of the new values of changed parameters, an index J has been assigned to each parameter (see list of input parameters). The index J associated with a fuel-cycle-cost parameter has 10 possible values, one for each possible fuel cycle. For example, the value of A in the third fuel cycle would have index J = 275. The values of NFCB and NFCC may be changed to 0 and later restored to their original values to enable a comparison with fossil-fueled plants. No other changes in NFCB and NFCC are permitted. Any parameter changes made will remain in effect in succeeding cases until changed.

4. Depressing Sense Switch 1 will produce additional output (labelled) for use in debugging. This output consists of: $a_{\overline{n}|}$, Q_1, Q_2, and Q_3, which have been defined previously; $I_p = I - I\ell(1 + i)^{-n}$; and T_1, T_2, T_3, and T_4 which are intermediate terms defined in the flowchart in boxes 402 and 404 for an m calculation and in box 401 for a v calculation.

NOTES:

(1) See reference (b), table on page 5 of reference (a), and Section II.D.4 of this report for details on liability insurance premiums.

(2) For theoretical physics purposes, τ, the residence time, may be defined as $y\theta/\phi_{100}\epsilon$, where

θ = integrated flux time (cm^{-2}),

ϕ_{100} = spatial average of neutron flux at 100% power ($cm^{-2}sec^{-1}$),

ϵ = plant factor (% x 10^{-2}), and

y = number of years per second = 3.1709 x 10^{-8}.

(3) Starred parameters are defined for uranium regions only. They should be set equal to zero for plutonium regions.

(4) MCALC, NFCB, NFCC, NPC, and J must be written as integers (no decimal point) and right adjusted in their respective card fields. For example, if NFCC = 4, the 4 goes in column 36 of card 2 and columns 25-35 must be blank. All other parameters must be written as floating point numbers with format E12.5. For example, the number -0.035 would be written as -3.50000E-02.

704 INPUT DATA
FORM I

PROBLEM SAMPLE INPUT FORM ORIGINATOR PROGRAM 0908/RE 224 DATE PAGE OF

1 Title							TITLE 1
MCALC	NFCB	NFCC					PARAMS 2
β	i	I_c	I_d	I_ℓ	n		FIXED 3
n_c	n_d						CHARGES 4
ϵ	η	P	μ	m			REVENUE 5
OM							OM 6
ω							PROFIT 7
χ	δ	ϕ	ψ				ADVAL 8
a_1	PF						INSUR 9
α	b	i	j_F	j_S	n'		TAXES 10
$\$$							11
fc_t							FC 12
L_1	L_2	L_3	ℓ_c	ℓ_f	ℓ_w		FUEL 13
c_c	c_f	c_r	c_w	c_s	c_s'		CYCLE 14
t_c	t_f	t_r	t_d	t_s	t_s'		PARAM- 15
e_1	e_2	C_Δ	C_F	e_F	e_w		ETER 16
A	cp	E_t	u				SET 17
NPC							NPC-MOD 1
J(1)	Parameter(1)						PC(1)
⋮ J(NPC)	⋮ Parameter(NPC)						PC(NPC)
blank card							

AMD-8 (5-58)

APPENDIX B

FAST REACTOR FUEL CYCLE COST ANALYSIS

Consider the reactor divided into up to ten fuel regions of two types - uranium regions and plutonium regions.

The fuel-cycle-cost equation for a uranium region is of the form

$$fc_U = uL_3V(e_1) + \frac{1}{\tau}\left\{\left[c_c(1 + \ell_c + \ell_f) + c_f(1 + \ell_f) + c_r + c_s + c_{s'} + c_w\ell_w\right] L_1 \right.$$
$$+ \left[(t_c + t_f + t_s)\, V(e_1) + \tau\left(\frac{V(e_1) + V(e_2)}{2}\right)\right.$$
$$\left. + (t_d + t_r + t_{s'})V(e_2)\right] uL_1(1 + \ell_c + \ell_f)$$
$$\left. + [V(e_1)\, L_1\, (1 + \ell_c + \ell_f) - V(e_2)L_2] + A\, c_p\, 10^3\right\} \quad , \qquad (1)$$

where all cost and weight variables and the use-charge rate are in terms of uranium.

For plutonium regions we assume that the cost of non-plutonium core materials is negligible and that all isotopes of plutonium are of equal value. Hence all costs and weights are in terms of plutonium only. In equation (1), replace $V(e_1)$ and $V(e_2)$ by $v \cdot 10^3$, the value of a kilogram of plutonium, and redefine all cost and weight variables and the use-charge rate in terms of plutonium. This yields

$$fc_{Pu} = uL_3v \cdot 10^3 + \frac{1}{\tau}\left\{[c_c(1 + \ell_c + \ell_f) + c_f(1 + \ell_f) + c_r + c_s + c_{s'} + c_w\ell_w]\, L_1\right.$$
$$+ [(t_c + t_f + t_r + t_s + t_{s'} + t_d + \tau)\, v \cdot 10^3\, uL_1\, (1 + \ell_c + \ell_f)]$$
$$\left. + [L_1\, (1 + \ell_c + \ell_f) - L_2]v \cdot 10^3 + A\, c_p 10^3\right\} \quad .$$

The total fuel-cycle cost, fc_t, is the sum of all uranium and plutonium region costs.

APPENDIX C

GENERAL OPERATING INSTRUCTIONS

704 PROGRAM 0908/RE224

	USED	NOT USED
DRUM:	[ ]	[X]
UF SWITCH:	[ ]	[X]

READER: 72 x 72 board PUNCH: not used

PRINTER: SHARE board #2 if SS #2 is down, not used otherwise

SENSE SWITCH SETTINGS:

#1 - up #2 - up - output on tape #1
down - output on line
#3,4,5,6 - not used

TAPES: Tape #1 for output if SS #2 is up
None used if SS #2 is down

TIME BEFORE OUTPUT: negligible

RUNNING TIME: about 1 minute/problem with off-line output

OFF-LINE PRINTING: Print tape #1 (if used) off-line under program control.

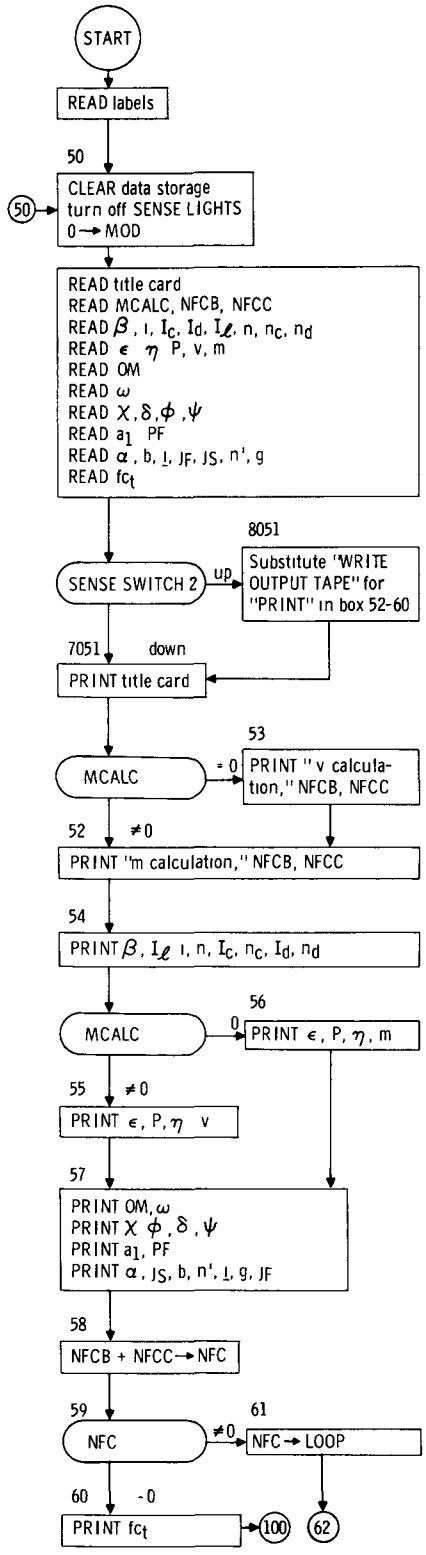
RUNNING PROCEDURE:

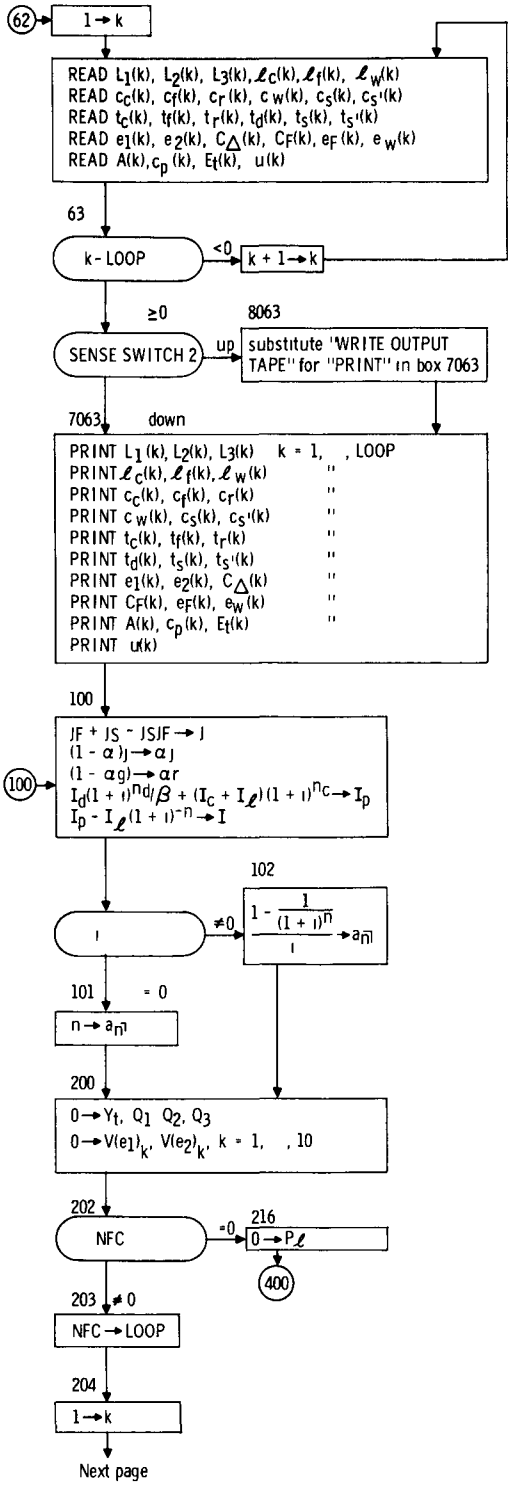
1. READY tape #1 or printer.
2. Set sense switches.
3. READY binary program deck followed by data input (a blank card must separate problems) in reader.
4. CLEAR and LOAD CARDS.

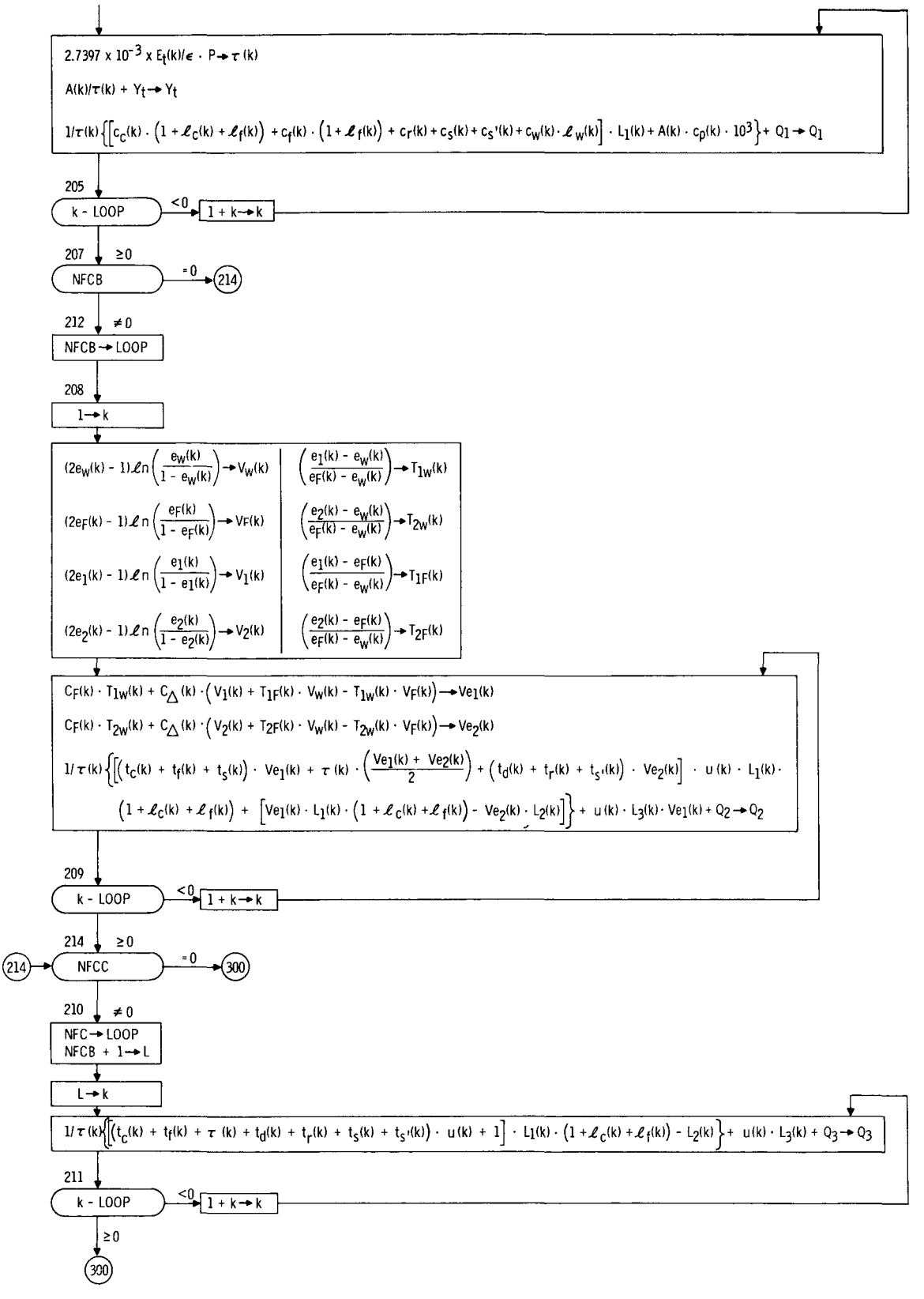
STOPS (OCTAL): Final stop: HPR 0,1
FORTRAN ERROR STOPS

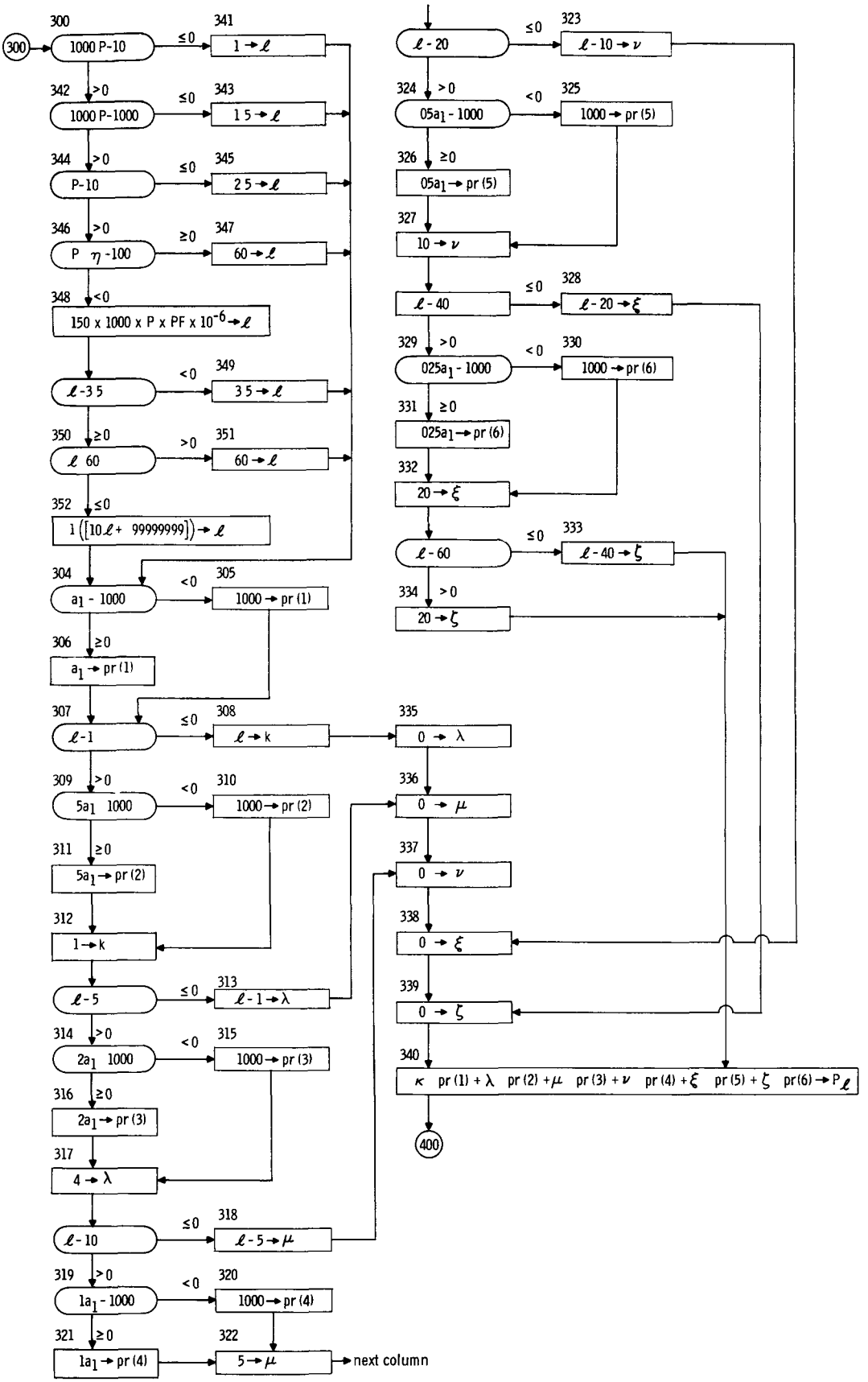
APPENDIX D

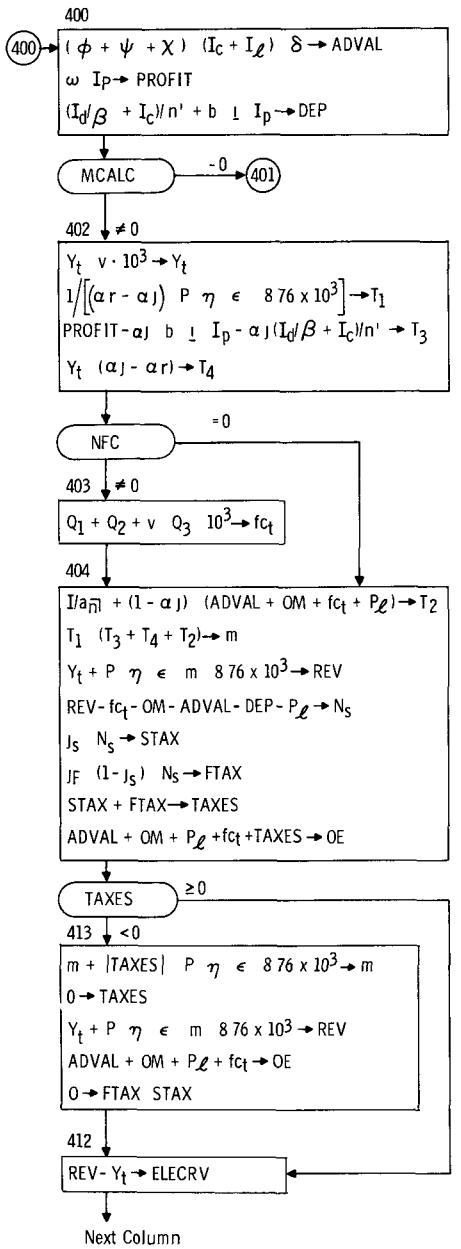
FLOWCHART

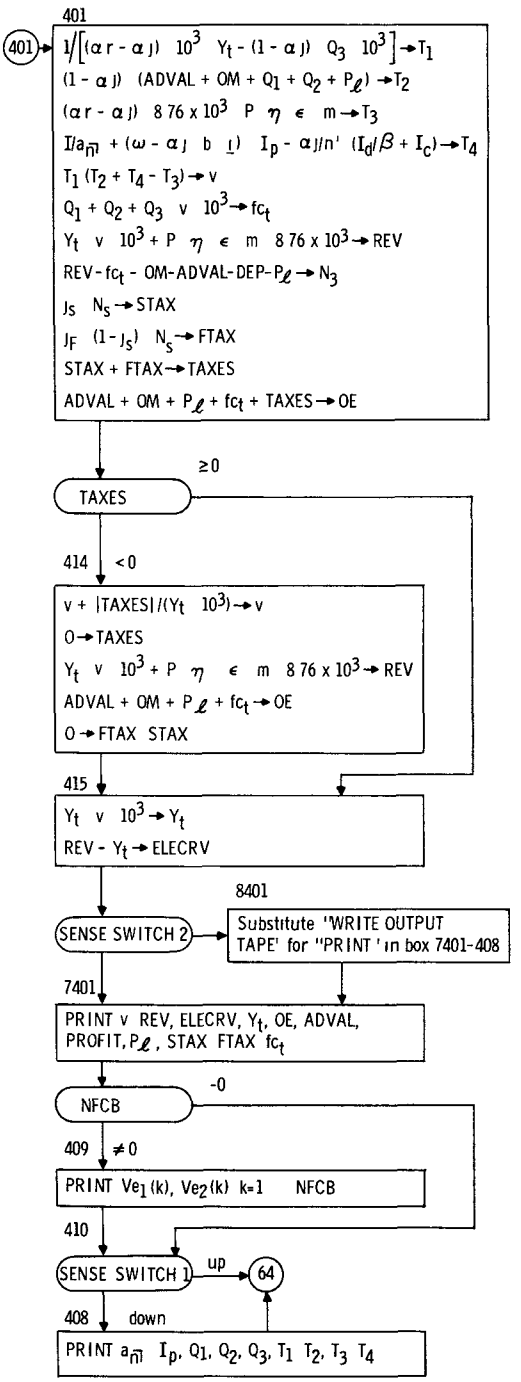





$2.7397 \times 10^{-3} \times E_t(k)/\epsilon \cdot P \rightarrow \tau(k)$
$A(k)/\tau(k) + Y_t \rightarrow Y_t$
$1/\tau(k)\left\{\left[c_c(k)\cdot\left(1+\ell_c(k)+\ell_f(k)\right)+c_f(k)\cdot\left(1+\ell_f(k)\right)+c_r(k)+c_s(k)+c_s'(k)+c_w(k)\cdot\ell_w(k)\right]\cdot L_1(k)+A(k)\cdot c_p(k)\cdot 10^3\right\}+Q_1\rightarrow Q_1$
205
k - LOOP
<0
1 + k→k
207
≥0
NFCB
=0
214
212
≠0
NFCB→LOOP
208
1→k
$(2e_w(k)-1)\ell n\left(\frac{e_w(k)}{1-e_w(k)}\right)\rightarrow V_w(k)$
$\left(\frac{e_1(k)-e_w(k)}{e_F(k)-e_w(k)}\right)\rightarrow T_{1w}(k)$
$(2e_F(k)-1)\ell n\left(\frac{e_F(k)}{1-e_F(k)}\right)\rightarrow V_F(k)$
$\left(\frac{e_2(k)-e_w(k)}{e_F(k)-e_w(k)}\right)\rightarrow T_{2w}(k)$
$(2e_1(k)-1)\ell n\left(\frac{e_1(k)}{1-e_1(k)}\right)\rightarrow V_1(k)$
$\left(\frac{e_1(k)-e_F(k)}{e_F(k)-e_w(k)}\right)\rightarrow T_{1F}(k)$
$(2e_2(k)-1)\ell n\left(\frac{e_2(k)}{1-e_2(k)}\right)\rightarrow V_2(k)$
$\left(\frac{e_2(k)-e_F(k)}{e_F(k)-e_w(k)}\right)\rightarrow T_{2F}(k)$
$C_F(k)\cdot T_{1w}(k)+C_\Delta(k)\cdot\left(V_1(k)+T_{1F}(k)\cdot V_w(k)-T_{1w}(k)\cdot V_F(k)\right)\rightarrow Ve_1(k)$
$C_F(k)\cdot T_{2w}(k)+C_\Delta(k)\cdot\left(V_2(k)+T_{2F}(k)\cdot V_w(k)-T_{2w}(k)\cdot V_F(k)\right)\rightarrow Ve_2(k)$
$1/\tau(k)\left\{\left[\left(t_c(k)+t_f(k)+t_s(k)\right)\cdot Ve_1(k)+\tau(k)\cdot\left(\frac{Ve_1(k)+Ve_2(k)}{2}\right)+\left(t_d(k)+t_r(k)+t_s'(k)\right)\cdot Ve_2(k)\right]\cdot u(k)\cdot L_1(k)\cdot\left(1+\ell_c(k)+\ell_f(k)\right)+\left[Ve_1(k)\cdot L_1(k)\cdot\left(1+\ell_c(k)+\ell_f(k)\right)-Ve_2(k)\cdot L_2(k)\right]\right\}+u(k)\cdot L_3(k)\cdot Ve_1(k)+Q_2\rightarrow Q_2$
209
k - LOOP
<0
1 + k→k
214
≥0
214
NFCC
=0
300
210
≠0
NFC→LOOP
NFCB + 1→L
L→k
$1/\tau(k)\left\{\left[\left(t_c(k)+t_f(k)+\tau(k)+t_d(k)+t_r(k)+t_s(k)+t_s'(k)\right)\cdot u(k)+1\right]\cdot L_1(k)\cdot\left(1+\ell_c(k)+\ell_f(k)\right)-L_2(k)\right\}+u(k)\cdot L_3(k)+Q_3\rightarrow Q_3$
211
k - LOOP
<0
1 + k→k
≥0
300


300
1000 P-10
≤0
341
1 → ℓ
342
>0
1000 P-1000
≤0
343
15 → ℓ
344
>0
P-10
≤0
345
25 → ℓ
346
>0
P η -100
≥0
347
60 → ℓ
348
<0
150 x 1000 x P x PF x 10^-6 → ℓ
ℓ -35
<0
349
35 → ℓ
350
≥0
ℓ 60
>0
351
60 → ℓ
352
≤0
1 ([10ℓ + 99999999]) → ℓ
304
a1 - 1000
<0
305
1000 → pr (1)
306
≥0
a1 → pr (1)
307
ℓ -1
≤0
308
ℓ → k
309
>0
5a1 1000
<0
310
1000 → pr (2)
311
≥0
5a1 → pr (2)
312
1 → k
ℓ -5
≤0
313
ℓ -1 → λ
314
>0
2a1 1000
<0
315
1000 → pr (3)
316
≥0
2a1 → pr (3)
317
4 → λ
ℓ -10
≤0
318
ℓ -5 → μ
319
>0
1a1 - 1000
<0
320
1000 → pr (4)
321
≥0
1a1 → pr (4)
322
5 → μ
next column
ℓ - 20
≤0
323
ℓ -10 → ν
324
>0
05a1 - 1000
<0
325
1000 → pr (5)
326
≥0
05a1 → pr (5)
327
10 → ν
ℓ - 40
≤0
328
ℓ -20 → ξ
329
>0
025a1 - 1000
<0
330
1000 → pr (6)
331
≥0
025a1 → pr (6)
332
20 → ξ
ℓ - 60
≤0
333
ℓ -40 → ζ
334
>0
20 → ζ
335
0 → λ
336
0 → μ
337
0 → ν
338
0 → ξ
339
0 → ζ
340
κ pr (1) + λ pr (2) + μ pr (3) + ν pr (4) + ξ pr (5) + ζ pr (6) → Pℓ
400


400
(400)
$(\phi + \psi + \chi)\ (I_c + I_\ell)\ \delta \rightarrow$ ADVAL
$\omega\ I_P \rightarrow$ PROFIT
$(I_d/\beta + I_c)/n' + b \perp I_p \rightarrow$ DEP
MCALC
-0
(401)
402
≠0
$Y_t\ v \cdot 10^3 \rightarrow Y_t$
$1/\left[(\alpha r - \alpha J)\ P\ \eta\ \epsilon\ 8\,76 \times 10^3\right] \rightarrow T_1$
PROFIT - $\alpha J\ b \perp I_p - \alpha J (I_d/\beta + I_c)/n' \rightarrow T_3$
$Y_t\ (\alpha J - \alpha r) \rightarrow T_4$
NFC
=0
403
≠0
$Q_1 + Q_2 + v\ Q_3\ 10^3 \rightarrow fc_t$
404
$I/a_{\overline{n}|} + (1 - \alpha J)\ (ADVAL + OM + fc_t + P_\ell) \rightarrow T_2$
$T_1\ (T_3 + T_4 + T_2) \rightarrow m$
$Y_t + P\ \eta\ \epsilon\ m\ 8\,76 \times 10^3 \rightarrow REV$
REV - fc_t - OM - ADVAL - DEP - $P_\ell \rightarrow N_S$
$J_S\ N_S \rightarrow$ STAX
$J_F\ (1 - J_S)\ N_S \rightarrow$ FTAX
STAX + FTAX → TAXES
ADVAL + OM + P_ℓ + fc_t + TAXES → OE
TAXES
≥0
413
<0
$m + |TAXES|\ P\ \eta\ \epsilon\ 8\,76 \times 10^3 \rightarrow m$
0 → TAXES
$Y_t + P\ \eta\ \epsilon\ m\ 8\,76 \times 10^3 \rightarrow REV$
ADVAL + OM + P_ℓ + $fc_t \rightarrow$ OE
0 → FTAX STAX
412
REV - $Y_t \rightarrow$ ELECRV
Next Column
SENSE SWITCH 2
up
8404
substitute "WRITE OUTPUT TAPE" for "PRINT" in box 7404-407
7404
down
PRINT m, REV, ELECRV Y_t, I OE, ADVAL, PROFIT, P_ℓ, STAX, FTAX, fc_t
NFCB
=0
405
≠0
PRINT $Ve_1(k)$, $Ve_2(k)$, k = 1 NFCB
406
SENSE SWITCH 1
up
407
down
PRINT $a_{\overline{n}|}$, I_p Q_1 Q_2, Q_3, T_1, T_2, T_3 T_4
64
(64)
turn off SENSE LIGHTS
READ NPC
NPC
0
(50)
65
≠0
MOD + 1 → MOD
SENSE SWITCH 2
up
8065
WRITE OUTPUT TAPE MOD
7065
down
PRINT MOD
70
1 → k
READ J, PA(J)
SENSE SWITCH 2
up
8070
WRITE OUTPUT TAPE LABEL (J), PA(J)
7070
down
PRINT LABEL(J), PA(J)
71
J-3
≤0
66
"fix" PA(J)
69
>0
<0
k - NPC
k + 1 → k
≥0
(100)


401
401
$1/\left[(\alpha r - \alpha j)\ 10^3\ Y_t - (1 - \alpha j)\ Q_3\ 10^3\right] \rightarrow T_1$
$(1 - \alpha j)$ (ADVAL + OM + Q_1 + Q_2 + P_ℓ) $\rightarrow T_2$
$(\alpha r - \alpha j)$ 8 76 x 10^3 P η ϵ m $\rightarrow T_3$
$I/a_{\overline{n}|} + (\omega - \alpha j\ b\ \underline{1})\ I_p - \alpha j/n'\ (I_d/\beta + I_c) \rightarrow T_4$
$T_1\ (T_2 + T_4 - T_3) \rightarrow v$
$Q_1 + Q_2 + Q_3\ v\ 10^3 \rightarrow fc_t$
$Y_t\ v\ 10^3 + P\ \eta\ \epsilon\ m\ 8\ 76 \times 10^3 \rightarrow REV$
$REV - fc_t$ - OM-ADVAL-DEP-$P_\ell \rightarrow N_3$
$J_S\ N_S \rightarrow STAX$
$J_F\ (1 - J_S)\ N_S \rightarrow FTAX$
STAX + FTAX $\rightarrow$ TAXES
ADVAL + OM + P_ℓ + fc_t + TAXES $\rightarrow$ OE
≥0
TAXES
414
<0
v + |TAXES| / (Y_t 10^3) $\rightarrow$ v
0 $\rightarrow$ TAXES
Y_t v 10^3 + P η ϵ m 8 76 x $10^3 \rightarrow$ REV
ADVAL + OM + P_ℓ + $fc_t \rightarrow$ OE
0 $\rightarrow$ FTAX STAX
415
Y_t v $10^3 \rightarrow Y_t$
REV - $Y_t \rightarrow$ ELECRV
8401
SENSE SWITCH 2
Substitute "WRITE OUTPUT TAPE" for "PRINT" in box 7401-408
7401
PRINT v REV, ELECRV, Y_t, OE, ADVAL, PROFIT, P_ℓ, STAX FTAX fc_t
-0
NFCB
409
≠0
PRINT $Ve_1(k)$, $Ve_2(k)$ k=1 NFCB
410
SENSE SWITCH 1
up
64
408
down
PRINT $a_{\overline{n}|}$ I_p, Q_1, Q_2, Q_3, T_1 T_2, T_3 T_4

APPENDIX E

CODE LISTING

```
C      0908/RE224 REACTOR ECONOMICS CALCULATIONS   J HEESTAND   7/5/61
       DIMENSION LABEL(350),PA(350),JPA(350),EL1(10),EL2(10),EL3(10),
      1          ELC(10),ELF(10),ELWD(10),CU(10),F(10),RPU(10),
      2          CWD(10),S1(10),S2(10),TC(10),TF(10),TRP(10),
      3          TD(10),TS1(10),TS2(10),E1(10),E2(10),CDELTA(10),
      4          CF(10),EF(10),EW(10),A(10),CP(10),ET(10),U(10),
      5          VW(10),VF(10),V1(10),V2(10),T1W(10),T2W(10),
      6          T1F(10),T2F(10),VE1(10),VE2(10),TAU(10),PR(6)
       EQUIVALENCE (PA(  1),MCALC ),(PA(  2),NFCB  ),(PA(  3),NFCC  ),
      1            (PA(  4),BETA  ),(PA(  5),EYE   ),(PA(  6),EYEC  ),
      2            (PA(  7),EYED  ),(PA(  8),EYEL  ),(PA(  9),EN    ),
      3            (PA( 10),ENC   ),(PA( 11),END   ),(PA( 12),EPSLON),
      4            (PA( 13),ETA   ),(PA( 14),P     ),(PA( 15),V     ),
      5            (PA( 16),EM    ),(PA( 17),OM    ),(PA( 18),OMEGA ),
      6            (PA( 19),CHI   ),(PA( 20),DELTA ),(PA( 21),PHI   ),
      7            (PA( 22),PSI   ),(PA( 23),A1    ),(PA( 24),PF    ),
      8            (PA( 25),ALPHA ),(PA( 26),B     ),(PA( 27),EYEBAR),
      9            (PA( 28),AJF   ),(PA( 29),AJS   ),(PA( 30),ENPRIM)
       EQUIVALENCE (PA( 31),R     ),(PA( 32),FCT   ),(PA( 33),EL1(1)),
      1            (PA( 43),EL2(1)),(PA( 53),EL3(1)),(PA( 63),ELC(1)),
      2            (PA( 73),ELF(1)),(PA( 83),ELWD(1)),(PA( 93),CU(1) ),
      3            (PA(103),F(1)  ),(PA(113),RPU(1)),(PA(123),CWD(1)),
      4            (PA(133),S1(1) ),(PA(143),S2(1) ),(PA(153),TC(1) ),
      5            (PA(163),TF(1) ),(PA(173),TRP(1)),(PA(183),TD(1) ),
      6            (PA(193),TS1(1)),(PA(203),TS2(1)),(PA(213),E1(1) ),
      7            (PA(223),E2(1) ),(PA(233),CDELTA(1)),(PA(243),CF(1) ),
      8            (PA(253),EF(1) ),(PA(263),EW(1) ),(PA(273),A(1) ),
      9            (PA(283),CP(1) ),(PA(293),ET(1) ),(PA(303),U(1) )
       EQUIVALENCE (PA(  1),JPA(1))
       COMMON LABEL,PA,AJ,ALPHAJ,ALPHAR,CAPIP,CAPI,AN,YT,PL,CAPPA,ELAMDA,
      1       EMU,ENU,XI,ZETA,T1,T2,T3,T4,EL,VW,VF,V1,V2,T1W,T2W,T1F,T2F,
      2       VE1,VE2,TAU,P3,Q1,Q2,Q3,J,K,L,LOOP,NPC,
      3       MOD,ADVAL,PROFIT,DEP,REV,ENS,STAX,FTAX,TAXES,OE,ELECRV,NFC
     1 FORMAT(72H
      1                )
     2 FORMAT(6E12.5)
     3 FORMAT(/7H0 INPUT/16H0  FIXED CHARGES/8H     BETA1PE17.6,18H
      1       I(L)E17.6/8H     I   E17.6,18H                N   E17.6/8H
      2I(C)E17.6,18H              N(C)E17.6/8H     I(D)E17.6,18H
      3    N(D)E17.6)
     4 FORMAT(10H0  REVENUE/11H     EPSILON1PE14.6,18H                P   E1
      17.6/8H     ETA E17.6,18H                V   E17.6)
     5 FORMAT(34H0  OPERATING AND MAINTENANCE COSTS/6H     OM1PE19.6/9H0
      1PROFIT/9H     OMEGAE16.6)
     6 FORMAT(21H0  AD VALOREM CHARGES/9H     CHI   1PE16.6,18H
      1  PHI E17.6/9H     DELTAE16.6,18H                PSI E17.6)
     7 FORMAT(20H0  INSURANCE CHARGES/8H     A(1)1PE17.6,18H
      1PF  E17.6)
     8 FORMAT(8H0  TAXES/9H     ALPHA1PE16.6,18H                J(S)E17.6/8H
      1    B    E17.6,20H                NPRIMEE15.6/8H     IBARE17.6,18H
      2          G    E17.6/8H     J(F)E17.6)
     9 FORMAT(20H0  FUEL CYCLE COST =1PE13.6)
    10 FORMAT(19H0  FUEL CYCLE COSTS/7X,4HL(1)18X,4HL(2)19X,4HL(3)/(1PE15
      1.6,E22.6,E23.6))
    11 FORMAT(7X,4HL(C)18X,4HL(F)19X,5HL(W) /(1PE15.6,E22.6,E23.6))
    12 FORMAT(7X,4HC(C)18X,4HC(F)19X,4HC(R)/(1PE15.6,E22.6,E23.6))
    13 FORMAT(7X,4HC(W)18X,4HC(S)16X,10HC(S PRIME)/(1PE15.6,E22.6,E23.6))
    14 FORMAT(7X,4HT(C)18X,4HT(F)19X,5HT(R) /(1PE15.6,E22.6,E23.6))
    15 FORMAT(7X,4HT(D)18X,4HT(S)16X,10HT(S PRIME)/(1PE15.6,E22.6,E23.6))
    16 FORMAT(7X,4HE(1)18X,4HE(2)17X,8HC(DELTA)/(1PE15.6,E22.6,E23.6))
    17 FORMAT(/8H0 OUTPUT/4X,1HM8X,1PE14.6,13X,9HTOTAL REVE14.6/4X,9HELEC
      1T REVE14.6,13X,9HPU REV   E14.6/4X,1HI8X,E14.6,13X,4HO.E.5X,E14.6/
      24X,9HAD VAL   E14.6,13X,9HPROFIT   E14.6/4X,2HPL7X,E14.6,13X,9HS T
      3AX    E14.6/4X,9HF TAX    E14.6,13X,9HTOTAL FC E14.6)
    19 FORMAT(I12,E12.5)
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```
   20 FORMAT(12A6)
   21 FORMAT(4H     1A6,1PE12.5)
   22 FORMAT(6I12)
   23 FORMAT(17H M CALCULATION   I2,19H URANIUM REGIONS   I2,18H PLUTONI
     1UM REGIONS)
   24 FORMAT(17H V CALCULATION   I2,19H URANIUM REGIONS   I2,18H PLUTONI
     1UM REGIONS)
   25 FORMAT(10H0  REVENUE/11H     EPSILON1PE14.6,18H                P   E1
     17.6/8H     ETA E17.6,18H                M   E17.6)
   26 FORMAT(7X,4HC(F)18X,4HE(F)19X,4HE(W)/(1PE15.6,E22.6,E23.6))
   27 FORMAT(/8H0 OUTPUT/4X,1HV8X,1PE14.6,13X,9HTOTAL REVE14.6/4X,9HELEC
     1T REVE14.6,13X,9HPU REV   E14.6/4X,1HI8X,E14.6,13X,4HO.E.5X,E14.6/
     24X,9HAD VAL   E14.6,13X,9HPROFIT   E14.6/4X,2HPL7X,E14.6,13X,9HS T
     3AX    E14.6/4X,9HF TAX    E14.6,13X,9HTOTAL FC E14.6)
   28 FORMAT(//13H0MODIFICATIONI6)
   29 FORMAT(4X,5HV(E1)31X,5HV(E2)/(13X,1PE14.6,22X,E14.6))
   31 FORMAT(8H     AN  1PE17.6,18H                IP  E17.6/8H     Q1  E17.
     16,18H                Q2  E17.6/8H     Q3  E17.6,18H                T1
     2E17.6/8H     T2  E17.6,18H                T3  E17.6/8H     T4  E17.6)
   32 FORMAT(9X,1HA19X,4HC(P)19X,4HE(T)/(1PE15.6,E22.6,E23.6))
   33 FORMAT(9X,1HU/(1PE15.6))
      READ 20,(LABEL(K),K=1,312)
   50 DO 51 K=1,350
   51 PA(K)=0.
      SENSE LIGHT 0
      MOD=0
      READ 1
      READ 22,MCALC,NFCB,NFCC
      READ 2,BETA,EYE,EYEC,EYED,EYEL,EN,ENC,END
      READ 2,EPSLON,ETA,P,V,EM
      READ 2,OM
      READ 2,OMEGA
      READ 2,CHI,DELTA,PHI,PSI
      READ 2,A1,PF
      READ 2,ALPHA,B,EYEBAR,AJF,AJS,ENPRIM,R
      READ 2,FCT
      IF (SENSE SWITCH 2) 7051,8051
 7051 PRINT 1
      IF (MCALC) 52,53,52
   52 PRINT 23,NFCB,NFCC
      GO TO 54
   53 PRINT 24,NFCB,NFCC
   54 PRINT 3,BETA,EYEL,EYE,EN,EYEC,ENC,EYED,END
      IF (MCALC) 55,56,55
   55 PRINT 4,EPSLON,P,ETA,V
      GO TO 57
   56 PRINT 25,EPSLON,P,ETA,EM
   57 PRINT 5,OM,OMEGA
      PRINT 6,CHI,PHI,DELTA,PSI
      PRINT 7,A1,PF
      PRINT 8,ALPHA,AJS,B,ENPRIM,EYEBAR,R,AJF
   58 NFC=NFCB+NFCC
   59 IF (NFC) 61,60,61
   60 PRINT 9,FCT
      GO TC 100
   61 LOOP=NFC
   62 DO 63 K=1,LOOP
      READ 2,EL1(K),EL2(K),EL3(K),ELC(K),ELF(K),ELWD(K)
      READ 2,CU(K),F(K),RPU(K),CWD(K),S1(K),S2(K)
      READ 2,TC(K),TF(K),TRP(K),TD(K),TS1(K),TS2(K)
      READ 2,E1(K),E2(K),CDELTA(K),CF(K),EF(K),EW(K)
   63 READ 2,A(K),CP(K),ET(K),U(K)
      IF (SENSE SWITCH 2) 7063,8063
 7063 PRINT 10,(EL1(K),EL2(K),EL3(K),K=1,LOOP)
      PRINT 11,(ELC(K),ELF(K),ELWD(K),K=1,LOOP)
      PRINT 12,(CU(K),F(K),RPU(K),K=1,LOOP)
```

```
      PRINT 13,(CWD(K),S1(K),S2(K),K=1,LOOP)
      PRINT 14,(TC(K),TF(K),TRP(K),K=1,LOOP)
      PRINT 15,(TD(K),TS1(K),TS2(K),K=1,LOOP)
      PRINT 16,(E1(K),E2(K),CDELTA(K),K=1,LOOP)
      PRINT 26,(CF(K),EF(K),EW(K),K=1,LOOP)
      PRINT 32,(A(K),CP(K),ET(K),K=1,LOOP)
      PRINT 33,(U(K),K=1,LOOP)
  100 AJ=AJF+AJS-AJF*AJS
      ALPHA J=(1.-ALPHA)*AJ
      ALPHA R=1.-ALPHA*R
      CAP I P=(EYED*(1.+EYE)**END)/BETA+(EYEC+EYEL)*(1.+EYE)**ENC
      CAP I=CAPIP-EYEL*(1.+EYE)**(-EN)
      IF(EYE)102,101,102
  101 AN=EN
      GO TO 200
  102 AN=(1.-1./(1.+EYE)**EN)/EYE
  200 YT=0.
      Q1=0.
      Q2=0.
      Q3=0.
      DO 217 K=1,10
      VE1(K)=0.
  217 VE2(K)=0.
  202 IF (NFC) 203,216,203
  216 PL=0.0
      GO TO 400
  203 LOOP=NFC
  204 DO 205 K=1,LOOP
      TAU(K)=(2.7397E-3*ET(K))/(EPSLON*P)
      YT=YT+A(K)/TAU(K)
  205 Q1=Q1+((CU(K)*(1.0+ELC(K)+ELF(K))+F(K)*(1.0+ELF(K))+RPU(K)+S1(K)+
     1S2(K)+CWD(K)*ELWD(K))*EL1(K)+A(K)*CP(K)*1E+3)/TAU(K)
  207 IF (NFCB) 212,214,212
  212 LOOP=NFCB
  208 DO 209 K=1,LOOP
      VW(K)=(2.*EW(K)-1.)*LOGF(EW(K)/(1.-EW(K)))
      VF(K)=(2.*EF(K)-1.)*LOGF(EF(K)/(1.-EF(K)))
      V1(K)=(2.*E1(K)-1.)*LOGF(E1(K)/(1.-E1(K)))
      V2(K)=(2.*E2(K)-1.)*LOGF(E2(K)/(1.-E2(K)))
      T1W(K)=(E1(K)-EW(K))/(EF(K)-EW(K))
      T2W(K)=(E2(K)-EW(K))/(EF(K)-EW(K))
      T1F(K)=(E1(K)-EF(K))/(EF(K)-EW(K))
      T2F(K)=(E2(K)-EF(K))/(EF(K)-EW(K))
      VE1(K)=(CF(K)*T1W(K)+CDELTA(K)*(V1(K)+T1F(K)*VW(K)-T1W(K)*VF(K)))
      VE2(K)=(CF(K)*T2W(K)+CDELTA(K)*(V2(K)+T2F(K)*VW(K)-T2W(K)*VF(K)))
  209 Q2=Q2+U(K)*EL3(K)*VE1(K)+(((TC(K)+TF(K)+TS1(K))*VE1(K)+TAU(K)*
     1(VE1(K)+VE2(K))/2.0+(TD(K)+TRP(K)+TS2(K))*VE2(K))*U(K)*EL1(K)*
     2(1.0+ELC(K)+ELF(K))+VE1(K)*EL1(K)*(1.0+ELC(K)+ELF(K))-
     3VE2(K)*EL2(K))/TAU(K)
  214 IF (NFCC) 210,300,210
  210 LOOP=NFC
      L=NFCB+1
      DO 211 K=L,LOOP
  211 Q3=Q3+U(K)*EL3(K)+(TC(K)+TF(K)+TRP(K)+TS1(K)+TS2(K)+TD(K)+TAU(K))*
     1U(K)*EL1(K)*(1.0+ELC(K)+ELF(K))/TAU(K)+
     2(EL1(K)*(1.0+ELC(K)+ELF(K))-EL2(K))/TAU(K)
  300 IF (1000.*P-10.) 341,341,342
  341 EL=1.0
      GO TO 304
  342 IF (1000.*P-1000.) 343,343,344
  343 EL=1.5
      GO TO 304
  344 IF (P-10.) 345,345,346
  345 EL=2.5
      GO TO 304
  346 IF (P*ETA-100.) 348,347,347
```

```
347 EL=60.
    GO TO 304
348 EL=(150.*1000.*P*PF)/1000000.
    IF (EL-3.5) 349,350,350
349 EL=3.5
    GO TO 304
350 IF (EL-60.) 352,352,351
351 EL=60.
    GO TO 304
352 EL=.1*INTF(10.*EL+.99999999)
304 IF(A1-1000.)305,306,306
305 PR(1)=1000.
    GO TO 307
306 PR(1)=A1
307 IF(EL-1.)308,308,309
308 CAPPA=EL
    GO TO 335
309 IF(.5*A1-1000.)310,311,311
310 PR(2)=1000.
    GO TO 312
311 PR(2)=.5*A1
312 CAPPA=1.
    IF(EL-5.)313,313,314
313 ELAMDA=EL-1.
    GO TO 336
314 IF(.2*A1-1000.)315,316,316
315 PR(3)=1000.
    GO TO 317
316 PR(3)=.2*A1
317 ELAMDA=4.
    IF(EL-10.)318,318,319
318 EMU=EL-5.
    GO TO 337
319 IF(.1*A1-1000.)320,321,321
320 PR(4)=1000.
    GO TO 322
321 PR(4)=.1*A1
322 EMU=5.
    IF(EL-20.)323,323,324
323 ENU=EL-10.
    GO TO 338
324 IF(.05*A1-1000.)325,326,326
325 PR(5)=1000.
    GO TO 327
326 PR(5)=.05*A1
327 ENU=10.
    IF(EL-40.)328,328,329
328 XI=EL-20.
    GO TO 339
329 IF(.025*A1-1000.)330,331,331
330 PR(6)=1000.
    GO TO 332
331 PR(6)=.025*A1
332 XI=20.
    IF(EL-60.)333,333,334
333 ZETA=EL-40.
    GO TO 340
334 ZETA=20.0
    GO TO 340
335 ELAMDA=0.
336 EMU=0.
337 ENU=0.
338 XI=0.
339 ZETA=0.
340 PL=CAPPA*PR(1)+ELAMDA*PR(2)+EMU*PR(3)+ENU*PR(4)+XI*PR(5)+ZETA*PR(6
   1    )
```

```
  400 ADVAL=(PHI+CHI+PSI)*(EYEC+EYEL)*DELTA
      PROFIT=OMEGA*CAPIP
      DEP=1.0/ENPRIM*(1.0/BETA*EYED+EYEC)+B*EYEBAR*CAPIP
      IF (MCALC) 402,401,402
  401 T1=1.0/((ALPHAR-ALPHAJ)*1E+3*YT-(1.0-ALPHAJ)*Q3*1E+3)
      T2=(1.-ALPHAJ)*(ADVAL+OM+Q1+Q2+PL)
      T3=(ALPHAR-ALPHAJ)*8.76E+3*P*ETA*EPSLON*EM
      T4=CAPI/AN+(OMEGA-ALPHAJ*B*EYEBAR)*CAPIP-
     1ALPHAJ*(1.0/BETA*EYED+EYEC)/ENPRIM
      V=T1*(T2+T4-T3)
      FCT=Q1+Q2+Q3*V*1E+3
      REV=YT*V*1E3+P*ETA*EPSLON*EM*8.76E+3
      ENS=REV-FCT-OM-ADVAL-DEP-PL
      STAX=AJS*ENS
      FTAX=AJF*(1.-AJS)*ENS
      TAXES=STAX+FTAX
      OE=ADVAL+OM+PL+FCT+TAXES
      IF(TAXES)414,415,415
  414 V=V+ABSF(TAXES)/(YT*1E+3)
      TAXES=0.0
      REV=YT*V*1E3+P+ETA*EPSLON*EM*8.76E+3
      OE=ADVAL+OM+PL+FCT
      FTAX=0.0
      STAX=0.0
  415 YT=YT*V*1E+3
      ELECRV=REV-YT
      IF (SENSE SWITCH 2) 7401,8401
 7401 PRINT 27,V,REV,ELECRV,YT,CAPI,OE,ADVAL,PROFIT,PL,STAX,FTAX,FCT
      IF (NFCB) 409,410,409
  409 PRINT 29,(VE1(K),VE2(K),K=1,NFCB)
  410 IF (SENSE SWITCH 1) 408,64
  408 PRINT 31,AN,CAPIP,Q1,Q2,Q3,T1,T2,T3,T4
      GO TO 64
  402 YT=YT*V*1E3
  411 T1=1./((ALPHAR-ALPHAJ)*P*ETA*EPSLON*8.76E+3)
      T3=PROFIT-ALPHAJ*B*EYEBAR*CAPIP-ALPHAJ*(1.0/BETA*EYED+EYEC)/ENPRIM
      T4=YT*(ALPHAJ-ALPHAR)
      IF(NFC)403,404,403
  403 FCT=Q1+Q2+Q3*V*1E3
  404 T2=CAPI/AN+(1.-ALPHAJ)*(ADVAL+OM+FCT+PL)
      EM=T1*(T3+T4+T2)
      REV=YT+P*ETA*EPSLON*EM*8.76E+3
      ENS=REV-FCT-OM-ADVAL-DEP-PL
      STAX=AJS*ENS
      FTAX=AJF*(1.-AJS)*ENS
      TAXES=STAX+FTAX
      OE=ADVAL+OM+PL+FCT+TAXES
      IF(TAXES)413,412,412
  413 EM=EM+ABSF(TAXES)/(P*ETA*EPSLON*8.76E+3)
      TAXES=0.0
      REV=YT+P*ETA*EPSLON*EM*8.76E+3
      OE=ADVAL+OM+PL+FCT
      FTAX=0.0
      STAX=0.0
  412 ELECRV=REV-YT
      IF (SENSE SWITCH 2) 7404,8404
 7404 PRINT 17,EM,REV,ELECRV,YT,CAPI,OE,ADVAL,PROFIT,PL,STAX,FTAX,FCT
      IF (NFCB) 405,406,405
  405 PRINT 29,(VE1(K),VE2(K),K=1,NFCB)
  406 IF (SENSE SWITCH 1) 407,64
  407 PRINT 31,AN,CAPIP,Q1,Q2,Q3,T1,T2,T3,T4
   64 SENSE LIGHT 0
      READ19,NPC
      IF (NPC) 65,50,65
   65 MOD=MOD+1
      IF (SENSE SWITCH 2) 7065,8065
```

```
7065 PRINT 28,MOD
  70 DO 69 K=1,NPC
     READ 19,J,(PA(J))
     IF (SENSE SWITCH 2) 7070,8070
7070 PRINT 21,LABEL(J),PA(J)
  71 IF (J-3) 66,66,69
  66 JPA(J)=PA(J)
  69 CONTINUE
     GO TO 100
8051 WRITE OUTPUT TAPE 1,1
     IF (MCALC) 8052,8053,8052
8052 WRITE OUTPUT TAPE 1,23,NFCB,NFCC
     GO TO 8054
8053 WRITE OUTPUT TAPE 1,24,NFCB,NFCC
8054 WRITE OUTPUT TAPE 1,3,BETA,EYEL,EYE,EN,EYEC,ENC,EYED,END
     IF (MCALC) 8055,8056,8055
8055 WRITE OUTPUT TAPE 1,4,EPSLON,P,ETA,V
     GO TO 8057
8056 WRITE OUTPUT TAPE 1,25,EPSLON,P,ETA,EM
8057 WRITE OUTPUT TAPE 1,5,OM,OMEGA
     WRITE OUTPUT TAPE 1,6,CHI,PHI,DELTA,PSI
     WRITE OUTPUT TAPE 1,7,A1,PF
     WRITE OUTPUT TAPE 1,8,ALPHA,AJS,B,ENPRIM,EYEBAR,R,AJF
8058 NFC=NFCB+NFCC
8059 IF (NFC) 61,8060,61
8060 WRITE OUTPUT TAPE 1,9,FCT
     GO TO 100
8063 WRITE OUTPUT TAPE 1,10,(EL1(K),EL2(K),EL3(K),K=1,LOOP)
     WRITE OUTPUT TAPE 1,11,(ELC(K),ELF(K),ELWD(K),K=1,LOOP)
     WRITE OUTPUT TAPE 1,12,(CU(K),F(K),RPU(K),K=1,LOOP)
     WRITE OUTPUT TAPE 1,13,(CWD(K),S1(K),S2(K),K=1,LOOP)
     WRITE OUTPUT TAPE 1,14,(TC(K),TF(K),TRP(K),K=1,LOOP)
     WRITE OUTPUT TAPE 1,15,(TD(K),TS1(K),TS2(K),K=1,LOOP)
     WRITE OUTPUT TAPE 1,16,(E1(K),E2(K),CDELTA(K),K=1,LOOP)
     WRITE OUTPUT TAPE 1,26,(CF(K),EF(K),EW(K),K=1,LOOP)
     WRITE OUTPUT TAPE 1,32,(A(K),CP(K),ET(K),K=1,LOOP)
     WRITE OUTPUT TAPE 1,33,(U(K),K=1,LOOP)
     GO TO 100
8401 WRITE OUTPUT TAPE 1,27,V,REV,ELECRV,YT,CAPI,OE,ADVAL,PROFIT,PL,
    1                        STAX,FTAX,FCT
     IF (NFCB) 8409,8410,8409
8409 WRITE OUTPUT TAPE 1,29,(VE1(K),VE2(K),K=1,NFCB)
8410 IF (SENSE SWITCH 1) 8408,64
8408 WRITE OUTPUT TAPE 1,31,AN,CAPIP,Q1,Q2,Q3,T1,T2,T3,T4
     GO TO 64
8404 WRITE OUTPUT TAPE 1,17,EM,REV,ELECRV,YT,CAPI,OE,ADVAL,PROFIT,PL,
    1                        STAX,FTAX,FCT
     IF (NFCB) 8405,8406,8405
8405 WRITE OUTPUT TAPE 1,29,(VE1(K),VE2(K),K=1,NFCB)
8406 IF (SENSE SWITCH 1) 8407,64
8407 WRITE OUTPUT TAPE 1,31,AN,CAPIP,Q1,Q2,Q3,T1,T2,T3,T4
     GO TO 64
8065 WRITE OUTPUT TAPE 1,28,MOD
     GO TO 70
8070 WRITE OUTPUT TAPE 1,21,LABEL(J),PA(J)
     GO TO 71
     END (0,1,0,1,1)
```

STORAGE FOR VARIABLES APPEARING IN COMMON SENTENCES

	DEC	OCT
ETAX	31712	75740
EYED	32556	77454
ETA	32550	77446
ENPRIM	32533	77425
ELWD	32480	77340
ELAMDA	31953	76155
F2	32340	77124
CU	32470	77326
CAPPA	31854	76156
A	32290	77042
AJS	32534	77426
JPA	32562	77462
L	31722	75752
NFC	31708	75734
PA	32562	77462
PR	31733	75765
Q3	31725	75755
Q2	32420	77244
T2F	31773	76035
TAU	31743	75777
TRP	32390	77206
V2	31813	76105
VW	31843	76143

	DEC	OCT
F	32460	77314
EYEC	32557	77455
EPSLON	32551	77447
END	32552	77450
EL	31844	76144
EL3	32510	77376
E1	32350	77136
CP	32280	77030
CAPI	31858	76162
AN	31857	76161
AJ	31862	76166
J	31724	75754
NCALC	32562	77462
NPC	31720	75750
PF	32532	77433
P	32549	77445
REV	31715	75743
STAX	31713	75741
T2	31847	76147
TAXES	31711	75737
TS1	32370	77162
VE1	31763	76023
XI	31850	76152

	DEC	OCT
FCT	32531	77423
EYEBAR	32536	77430
ENU	31851	76153
ENC	32553	77451
ELF	32420	77352
EL2	32520	77410
DEP	31716	75744
CHI	32544	77440
CAPIP	31859	76163
ALPHA	32538	77432
AJF	32535	77427
K	31723	75753
MOD	31719	75747
OE	31710	75736
PHI	32542	77436
PSI	32541	77435
RPU	32450	77302
T1F	31783	76047
T2W	31793	76061
TC	32410	77232
TS2	32360	77150
VE2	31753	76011
YT	31856	76160

	DEC	OCT
EYE	32558	77456
EW	32300	77054
FNS	31714	75742
EMU	31852	76154
ELECRV	31709	75735
EL1	32530	77422
DELTA	32543	77437
CF	32320	77100
B	32537	77431
ALPHAR	31860	76164
ADVAL	31718	75746
LAREL	32212	76724
NFCR	32561	77461
OMEGA	32545	77441
PL	31855	76157
Q1	31727	75757
R	32532	77424
T1	31848	76150
T3	31846	76146
TD	32380	77174
U	32260	77004
VF	31833	76131
ZETA	31849	76151

	DEC	OCT
EYEL	32555	77453
ET	32270	77016
EN	32554	77452
FM	32547	77443
ELC	32500	77364
EF	32310	77066
CWD	32440	77270
CDELTA	32330	77112
BETA	32559	77457
ALPHAJ	31861	76165
A1	32540	77434
LOOP	31721	75751
NFCC	32560	77460
OM	32546	77442
PROFIT	31717	75745
Q2	31726	75756
S1	32430	77256
T1W	31803	76073
T4	31845	76145
TF	32400	77220
V1	31823	76117
V	32548	77444

EXTERNAL FORMULA NUMBERS WITH CORRESPONDING INTERNAL FORMULA NUMBERS AND OCTAL LOCATIONS

EFN	IFN	LOC
1	6	00000
6	11	00000
11	16	00000
16	21	00000
22	26	00000
27	31	00000
33	36	00000
52	80	00274
54	89	00350
57	98	00413
60	114	00527
7063	134	00666
200	203	01314
204	214	01345
209	231	01653
341	238	02023
346	246	02045
351	254	02104
307	261	02131
312	268	02153
317	276	02200
322	284	02225
327	292	02252
332	300	02277
337	308	02320
401	316	02421
409	342	02751
402	353	03023
412	374	03272
406	386	03353
7065	397	03425
71	410	03510
8052	417	03544
8054	426	03620

EFN	IFN	LOC
2	7	00000
7	12	00000
12	17	00000
17	22	00000
23	27	00000
28	32	00000
50	43	00033
52	82	00307
55	91	00354
57	100	00426
61	116	00532
7063	139	00710
217	209	01327
205	217	01365
214	232	01743
342	240	02026
347	247	02053
352	256	02107
308	262	02135
313	270	02161
318	278	02206
323	286	02233
328	294	02260
333	302	02305
338	309	02322
414	329	02637
409	347	02772
411	354	03031
7404	376	03277
407	387	03355
7065	399	03437
66	411	03514
8052	419	03557
8055	428	03624

EFN	IFN	LOC
3	8	00000
8	13	00000
13	18	00000
19	23	00000
24	28	00000
29	33	00000
51	44	00034
53	84	00312
55	93	00371
58	110	00506
62	117	00534
100	194	01175
202	210	01333
207	218	01432
210	233	01745
343	241	02033
348	249	02056
304	257	02120
309	264	02140
314	272	02165
319	280	02212
324	288	02237
329	296	02264
334	304	02311
339	310	02324
415	335	02705
410	348	02774
403	358	03106
7404	378	03324
407	389	03377
70	400	03441
69	412	03525
8053	421	03562
8055	430	03641

EFN	IFN	LOC
4	9	00000
9	14	00000
14	19	00000
20	24	00000
25	29	00000
31	34	00000
7051	77	00261
53	86	00325
56	95	00374
59	111	00511
63	130	00643
101	200	01273
216	211	01337
212	219	01434
211	236	01755
344	243	02036
349	251	02074
305	258	02124
310	265	02145
315	273	02172
320	281	02217
325	289	02244
330	297	02271
335	306	02314
340	311	02326
7401	338	02720
408	349	02776
404	359	03116
405	380	03330
64	390	03401
7070	407	03473
8051	414	03531
8053	423	03575
8056	432	03644

EFN	IFN	LOC
5	10	00000
10	15	00000
15	20	00000
21	25	00000
26	30	00000
32	35	00000
7051	78	00270
54	87	00327
56	97	00411
60	112	00515
63	132	00660
102	202	01276
203	213	01343
208	220	01436
300	237	02016
345	244	02042
350	253	02077
306	260	02127
311	267	02150
316	275	02175
321	283	02222
326	291	02247
331	299	02274
336	307	02316
400	312	02357
7401	340	02745
408	351	03020
413	368	03222
405	385	03351
65	395	03420
7070	409	03506
8051	415	03540
8054	424	03577
8056	434	03661

8057	435	03663	8057	437	03676	8058	447	03756	8059	448	03761	8060	449	03765
8060	451	03777	8063	453	04002	8063	458	04024	8401	514	04311	8401	516	04336
8409	518	04342	8409	523	04363	8410	524	04365	8408	525	04367	8408	527	04411
8404	529	04414	8404	531	04441	8405	533	04445	8405	538	04466	8406	539	04470
8407	540	04472	8407	542	04514	8065	544	04517	8065	546	04531	8070	548	04534
8070	550	04547												

STORAGE NOT USED BY PROGRAM

DEC	OCT	DEC	OCT
2868	05464	31707	75733

LOCATIONS OF NAMES IN TRANSFER VECTOR

	DEC	OCT		DEC	OCT		DEC	OCT		DEC	OCT		DEC	OCT
EXP(3	2	00002	LOG	1	00001	(CSH)	7	00007	(FIL)	3	00003	(IOH)I	8	00010
(IOH)O	5	00005	(LEV)	9	00011	(RTN)	6	00006	(SPH)	4	00004	(STH)	0	00000

STORAGE LOCATIONS FOR SYMBOLS NOT APPEARING IN SOURCE PROGRAM

	DEC	OCT		DEC	OCT		DEC	OCT		DEC	OCT		DEC	OCT
E)48	1879	03527	E)47	1876	03524	E)43	1847	03467	D)439	1262	02356	D)41D	738	01342
D)403	26	00032	D)116	636	01174	C)G2	2867	05463	8)11	2444	04614	8)10	2453	04625
8)V	2485	04665	8)T	2493	04675	8)S	2497	04701	8)R	2538	04752	8)Q	2547	04763
8)P	2565	05005	8)O	2577	05021	8)N	2589	05035	8)M	2590	05036	8)L	2594	05042
8)K	2595	05043	8)J	2597	05045	8)H	2638	05116	8)G	2648	05130	8)F	2658	05142
8)E	2667	05153	8)D	2677	05165	8)C	2686	05176	8)B	2695	05207	8)A	2708	05224
8)9	2714	05232	8)8	2741	05265	8)7	2753	05301	8)6	2773	05325	8)5	2787	05343
8)4	2805	05365	8)3	2840	05430	8)2	2842	05432	8)1	2855	05447	1)	2857	05451
2)	2410	04552	3)	2413	04555	6)	2437	04605	7)	2856	05450			

SUBROUTINES PUNCHED FROM LIBRARY

LOG	EXP	EXP(3	(RTN)	(LEV)	(STH)	(SPH)	(CSH)	(FIL)	(BDC)
(DBC)	(IOH)O	(IOH)I							

```
00000 (STH)    BCD 1(STH)
00001 LOG      BCD 1LOG
00002 EXP(3    BCD 1EXP(3
00003 (FIL)    BCD 1(FIL)
00004 (SPH)    BCD 1(SPH)
00005 (IOH)O   BCD 1(IOH)O
00006 (RTN)    BCD 1(RTN)
00007 (CSH)    BCD 1(CSH)
00010 (IOH)I   BCD 1(IOH)I
00011 (LEV)    BCD 1(LEV)
00012 37A      CAL *
00013          XIT (LEV)
00014          ETM
00015          CAL (IOH)I
00016          SLW 1
00017          CAL (CSH)
00020 37D1     NTR 8)K,0,81
00021 38A      LXD 2)+1,1
00022 39A      ETM
00023          NTR LABEL+1,1
00024          LTM
00025 39A1     TXI *+1,1,1
00026 39A2     TXL 39A,1,312
00027 41A      LTM
00030 42A      CAL *
00031          XIT (RTN)
00032 D)1403   LXD C)G2,4
00033 43A      LXD 2)+1,2
00034 44A      CLA 3)
00035          STO PA+1,2
00036 44A1     TXI *+1,2,1
00037 44A2     TXL 44A,2,350
00040 45A      PSE 96
00041 46A      CLA 2)
00042          STO MOD
00043 47A      CAL *
00044          XIT (LEV)
00045          ETM
00046          CAL (IOH)I
00047          SLW 1
00050          CAL (CSH)
00051 47D1     NTR 8)1,0,81
00052 48A      CAL *
00053          XIT (RTN)
00054 49A      CAL *
00055          XIT (LEV)
00056          ETM
00057          CAL (IOH)I
00060          SLW 1
00061          CAL (CSH)
00062 49D1     NTR 8)M,0,81
00063 50A      ETM
00064          NTR MCALC
00065          NTR NFCB
00066          NTR NFCC
00067          LTM
00070 51A      CAL *
00071          XIT (RTN)
00072 52A      CAL *
00073          XIT (LEV)
00074          ETM
00075          CAL (IOH)I
00076          SLW 1
00077          CAL (CSH)
00100 52D1     NTR 8)2,0,81
00101 53A      ETM
00102          NTR BETA
00103          NTR EYE
00104          NTR EYEC
00105          NTR EYED
00106          NTR EYEL
00107          NTR EN
00110          NTR ENC
00111          NTR END
00112          LTM
00113 54A      CAL *
00114          XIT (RTN)
00115 55A      CAL *
00116          XIT (LEV)
00117          ETM
00120          CAL (IOH)I
00121          SLW 1
00122          CAL (CSH)
00123 55D1     NTR 8)2,0,81
00124 56A      ETM
00125          NTR EPSLON
00126          NTR ETA
00127          NTR P
00130          NTR V
00131          NTR EM
00132          LTM
00133 57A      CAL *
00134          XIT (RTN)
00135 58A      CAL *
00136          XIT (LEV)
00137          ETM
00140          CAL (IOH)I
00141          SLW 1
00142          CAL (CSH)
00143 58D1     NTR 8)2,0,81
00144 59A      ETM
00145          NTR OM
00146          LTM
00147 60A      CAL *
00150          XIT (RTN)
00151 61A      CAL *
00152          XIT (LEV)
00153          ETM
00154          CAL (IOH)I
00155          SLW 1
00156          CAL (CSH)
00157 61D1     NTR 8)2,0,81
00160 62A      ETM
00161          NTR OMEGA
00162          LTM
00163 63A      CAL *
00164          XIT (RTN)
00165 64A      CAL *
00166          XIT (LEV)
00167          ETM
00170          CAL (IOH)I
00171          SLW 1
00172          CAL (CSH)
00173 64D1     NTR 8)2,0,81
00174 65A      ETM
00175          NTR CHI
00176          NTR DELTA
00177          NTR PHI
00200          NTR PSI
00201          LTM
00202 66A      CAL *
00203          XIT (RTN)
00204 67A      CAL *
00205          XIT (LEV)
00206          ETM
00207          CAL (IOH)I
00210          SLW 1
00211          CAL (CSH)
00212 67D1     NTR 8)2,0,81
00213 68A      ETM
00214          NTR A1
00215          NTR PF
00216          LTM
00217 69A      CAL *
00220          XIT (RTN)
00221 70A      CAL *
00222          XIT (LEV)
00223          ETM
00224          CAL (IOH)I
00225          SLW 1
00226          CAL (CSH)
00227 70D1     NTR 8)2,0,81
00230 71A      ETM
00231          NTR ALPHA
00232          NTR B
00233          NTR EYEBAR
00234          NTR AJF
00235          NTR AJS
00236          NTR ENPRIM
00237          NTR R
00240          LTM
00241 72A      CAL *
00242          XIT (RTN)
00243 73A      CAL *
00244          XIT (LEV)
00245          ETM
00246          CAL (IOH)I
00247          SLW 1
00250          CAL (CSH)
00251 73D1     NTR 8)2,0,81
00252 74A      ETM
00253          NTR FCT
00254          LTM
00255 75A      CAL *
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00256          XIT  (RTN)
00257  76A     PSE  114
00260          TRA  414A
00261  77A     CAL  *
00262          XIT  (LEV)
00263          ETM
00264          CAL  (IOH)0
00265          SLW  1
00266          CAL  (SPH)
00267  77D1    NTR  8)1
00270  78A     CAL  *
00271          XIT  (FIL)
00272  79A     CLA  MCALC
00273  79A1    TZE  84A
00274  80A     CAL  *
00275          XIT  (LEV)
00276          ETM
00277          CAL  (IOH)0
00300          SLW  1
00301          CAL  (SPH)
00302  80D1    NTR  8)N
00303  81A     ETM
00304          NTR  NFCB
00305          NTR  NFCC
00306          LTM
00307  82A     CAL  *
00310          XIT  (FIL)
00311  83A     TRA  87A
00312  84A     CAL  *
00313          XIT  (LEV)
00314          ETM
00315          CAL  (IOH)0
00316          SLW  1
00317          CAL  (SPH)
00320  84D1    NTR  8)O
00321  85A     ETM
00322          NTR  NFCB
00323          NTR  NFCC
00324          LTM
00325  86A     CAL  *
00326          XIT  (FIL)
00327  87A     CAL  *
00330          XIT  (LEV)
00331          ETM
00332          CAL  (IOH)0
00333          SLW  1
00334          CAL  (SPH)
00335  87D1    NTR  8)3
00336  88A     ETM
00337          NTR  BETA
00340          NTR  EYEL
00341          NTR  EYE
00342          NTR  EN
00343          NTR  EYEC
00344          NTR  ENC
00345          NTR  EYED
00346          NTR  END
00347          LTM

00350  89A     CAL  *
00351          XIT  (FIL)
00352  90A     CLA  MCALC
00353  90A1    TZE  95A
00354  91A     CAL  *
00355          XIT  (LEV)
00356          ETM
00357          CAL  (IOH)0
00360          SLW  1
00361          CAL  (SPH)
00362  91D1    NTR  8)4
00363  92A     ETM
00364          NTR  EPSLON
00365          NTR  P
00366          NTR  ETA
00367          NTR  V
00370          LTM
00371  93A     CAL  *
00372          XIT  (FIL)
00373  94A     TRA  98A
00374  95A     CAL  *
00375          XIT  (LEV)
00376          ETM
00377          CAL  (IOH)0
00400          SLW  1
00401          CAL  (SPH)
00402  95D1    NTR  8)P
00403  96A     ETM
00404          NTR  EPSLON
00405          NTR  P
00406          NTR  ETA
00407          NTR  EM
00410          LTM
00411  97A     CAL  *
00412          XIT  (FIL)
00413  98A     CAL  *
00414          XIT  (LEV)
00415          ETM
00416          CAL  (IOH)0
00417          SLW  1
00420          CAL  (SPH)
00421  98D1    NTR  8)5
00422  99A     ETM
00423          NTR  OM
00424          NTR  OMEGA
00425          LTM
00426  100A    CAL  *
00427          XIT  (FIL)
00430  101A    CAL  *
00431          XIT  (LEV)
00432          ETM
00433          CAL  (IOH)0
00434          SLW  1
00435          CAL  (SPH)
00436  101D1   NTR  8)6
00437  102A    ETM
00440          NTR  CHI
00441          NTR  PHI

00442          NTR  DELTA
00443          NTR  PSI
00444          LTM
00445  103A    CAL  *
00446          XIT  (FIL)
00447  104A    CAL  *
00450          XIT  (LEV)
00451          ETM
00452          CAL  (IOH)0
00453          SLW  1
00454          CAL  (SPH)
00455  104D1   NTR  8)7
00456  105A    ETM
00457          NTR  A1
00460          NTR  PF
00461          LTM
00462  106A    CAL  *
00463          XIT  (FIL)
00464  107A    CAL  *
00465          XIT  (LEV)
00466          ETM
00467          CAL  (IOH)0
00470          SLW  1
00471          CAL  (SPH)
00472  107D1   NTR  8)8
00473  108A    ETM
00474          NTR  ALPHA
00475          NTR  AJS
00476          NTR  B
00477          NTR  ENPRIM
00500          NTR  EYEBAR
00501          NTR  R
00502          NTR  AJF
00503          LTM
00504  109A    CAL  *
00505          XIT  (FIL)
00506  110A    CLA  NFCB
00507          ADD  NFCC
00510          STO  NFC
00511  111A    CLA  NFC
00512  111A1   TZE  112A
00513          TPL  116A
00514          TRA  116A
00515  112A    CAL  *
00516          XIT  (LEV)
00517          ETM
00520          CAL  (IOH)0
00521          SLW  1
00522          CAL  (SPH)
00523  112D1   NTR  8)9
00524  113A    ETM
00525          NTR  FCT
00526          LTM
00527  114A    CAL  *
00530          XIT  (FIL)
00531  115A    TRA  D)116
00532  116A    CLA  NFC
00533          STO  LOOP
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00534 117A    LXD 2)+1,2
00535         CLA LOOP
00536         STD 132A2
00537 118A    CAL *
00540         XIT (LEV)
00541         ETM
00542         CAL (IOH)I
00543         SLW 1
00544         CAL (CSH)
00545 118D1   NTR 8)2,0,81
00546 119A    ETM
00547         NTR EL1+1,2
00550         NTR EL2+1,2
00551         NTR EL3+1,2
00552         NTR ELC+1,2
00553         NTR ELF+1,2
00554         NTR ELWD+1,2
00555         LTM
00556 120A    CAL *
00557         XIT (RTN)
00560 121A    CAL *
00561         XIT (LEV)
00562         ETM
00563         CAL (IOH)I
00564         SLW 1
00565         CAL (CSH)
00566 121D1   NTR 8)2,0,81
00567 122A    ETM
00570         NTR CU+1,2
00571         NTR F+1,2
00572         NTR RPU+1,2
00573         NTR CWD+1,2
00574         NTR S1+1,2
00575         NTR S2+1,2
00576         LTM
00577 123A    CAL *
00600         XIT (RTN)
00601 124A    CAL *
00602         XIT (LEV)
00603         ETM
00604         CAL (IOH)I
00605         SLW 1
00606         CAL (CSH)
00607 124D1   NTR 8)2,0,81
00610 125A    ETM
00611         NTR TC+1,2
00612         NTR TF+1,2
00613         NTR TRP+1,2
00614         NTR TD+1,2
00615         NTR TS1+1,2
00616         NTR TS2+1,2
00617         LTM
00620 126A    CAL *
00621         XIT (RTN)
00622 127A    CAL *
00623         XIT (LEV)
00624         ETM
00625         CAL (IOH)I
00626         SLW 1
00627         CAL (CSH)
00630 127D1   NTR 8)2,0,81
00631 128A    ETM
00632         NTR E1+1,2
00633         NTR E2+1,2
00634         NTR CDELTA+1,2
00635         NTR CF+1,2
00636         NTR EF+1,2
00637         NTR EW+1,2
00640         LTM
00641 129A    CAL *
00642         XIT (RTN)
00643 130A    CAL *
00644         XIT (LEV)
00645         ETM
00646         CAL (IOH)I
00647         SLW 1
00650         CAL (CSH)
00651 130D1   NTR 8)2,0,81
00652 131A    ETM
00653         NTR A+1,2
00654         NTR CP+1,2
00655         NTR ET+1,2
00656         NTR U+1,2
00657         LTM
00660 132A    CAL *
00661         XIT (RTN)
00662 132A1   TXI *+1,2,1
00663 132A2   TXL 118A,2
00664 133A    PSE 114
00665         TRA 453A
00666 134A    CAL *
00667         XIT (LEV)
00670         ETM
00671         CAL (IOH)O
00672         SLW 1
00673         CAL (SPH)
00674 134D1   NTR 8)A
00675 135A    LXD 2)+1,2
00676         CLA LOOP
00677         STD 136A2
00700 136A    ETM
00701         NTR EL1+1,2
00702         NTR EL2+1,2
00703         NTR EL3+1,2
00704         LTM
00705 136A1   TXI *+1,2,1
00706 136A2   TXL 136A,2
00707 138A    LTM
00710 139A    CAL *
00711         XIT (FIL)
00712 140A    CAL *
00713         XIT (LEV)
00714         ETM
00715         CAL (IOH)O
00716         SLW 1
00717         CAL (SPH)
00720 140D1   NTR 8)B
00721 141A    LXD 2)+1,2
00722         CLA LOOP
00723         STD 142A2
00724 142A    ETM
00725         NTR ELC+1,2
00726         NTR ELF+1,2
00727         NTR ELWD+1,2
00730         LTM
00731 142A1   TXI *+1,2,1
00732 142A2   TXL 142A,2
00733 144A    LTM
00734 145A    CAL *
00735         XIT (FIL)
00736 146A    CAL *
00737         XIT (LEV)
00740         ETM
00741         CAL (IOH)O
00742         SLW 1
00743         CAL (SPH)
00744 146D1   NTR 8)C
00745 147A    LXD 2)+1,2
00746         CLA LOOP
00747         STD 148A2
00750 148A    ETM
00751         NTR CU+1,2
00752         NTR F+1,2
00753         NTR RPU+1,2
00754         LTM
00755 148A1   TXI *+1,2,1
00756 148A2   TXL 148A,2
00757 150A    LTM
00760 151A    CAL *
00761         XIT (FIL)
00762 152A    CAL *
00763         XIT (LEV)
00764         ETM
00765         CAL (IOH)O
00766         SLW 1
00767         CAL (SPH)
00770 152D1   NTR 8)D
00771 153A    LXD 2)+1,2
00772         CLA LOOP
00773         STD 154A2
00774 154A    ETM
00775         NTR CWD+1,2
00776         NTR S1+1,2
00777         NTR S2+1,2
01000         LTM
01001 154A1   TXI *+1,2,1
01002 154A2   TXL 154A,2
01003 156A    LTM
01004 157A    CAL *
01005         XIT (FIL)
01006 158A    CAL *
01007         XIT (LEV)
01010         ETM
01011         CAL (IOH)O
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```
01012          SLW  1
01013          CAL  (SPH)
01014  158D1   NTR  8)E
01015  159A    LXD  2)+1,2
01016          CLA  LOOP
01017          STD  160A2
01020  160A    ETM
01021          NTR  TC+1,2
01022          NTR  TF+1,2
01023          NTR  TRP+1,2
01024          LTM
01025  160A1   TXI  *+1,2,1
01026  160A2   TXL  160A,2
01027  162A    LTM
01030  163A    CAL  *
01031          XIT  (FIL)
01032  164A    CAL  *
01033          XIT  (LEV)
01034          ETM
01035          CAL  (IOH)0
01036          SLW  1
01037          CAL  (SPH)
01040  164D1   NTR  8)F
01041  165A    LXD  2)+1,2
01042          CLA  LOOP
01043          STD  166A2
01044  166A    ETM
01045          NTR  TD+1,2
01046          NTR  TS1+1,2
01047          NTR  TS2+1,2
01050          LTM
01051  166A1   TXI  *+1,2,1
01052  166A2   TXL  166A,2
01053  168A    LTM
01054  169A    CAL  *
01055          XIT  (FIL)
01056  170A    CAL  *
01057          XIT  (LEV)
01060          ETM
01061          CAL  (IOH)0
01062          SLW  1
01063          CAL  (SPH)
01064  170D1   NTR  8)G
01065  171A    LXD  2)+1,2
01066          CLA  LOOP
01067          STD  172A2
01070  172A    ETM
01071          NTR  E1+1,2
01072          NTR  E2+1,2
01073          NTR  CDELTA+1,2
01074          LTM
01075  172A1   TXI  *+1,2,1
01076  172A2   TXL  172A,2
01077  174A    LTM
01100  175A    CAL  *
01101          XIT  (FIL)
01102  176A    CAL  *
01103          XIT  (LEV)
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01104          ETM
01105          CAL  (IOH)0
01106          SLW  1
01107          CAL  (SPH)
01110  176D1   NTR  8)Q
01111  177A    LXD  2)+1,2
01112          CLA  LOOP
01113          STD  178A2
01114  178A    ETM
01115          NTR  CF+1,2
01116          NTR  EF+1,2
01117          NTR  EW+1,2
01120          LTM
01121  178A1   TXI  *+1,2,1
01122  178A2   TXL  178A,2
01123  180A    LTM
01124  181A    CAL  *
01125          XIT  (FIL)
01126  182A    CAL  *
01127          XIT  (LEV)
01130          ETM
01131          CAL  (IOH)0
01132          SLW  1
01133          CAL  (SPH)
01134  182D1   NTR  8)10
01135  183A    LXD  2)+1,2
01136          CLA  LOOP
01137          STD  184A2
01140  184A    ETM
01141          NTR  A+1,2
01142          NTR  CP+1,2
01143          NTR  ET+1,2
01144          LTM
01145  184A1   TXI  *+1,2,1
01146  184A2   TXL  184A,2
01147  186A    LTM
01150  187A    CAL  *
01151          XIT  (FIL)
01152  188A    CAL  *
01153          XIT  (LEV)
01154          ETM
01155          CAL  (IOH)0
01156          SLW  1
01157          CAL  (SPH)
01160  188D1   NTR  8)11
01161  189A    LXD  2)+1,2
01162          CLA  LOOP
01163          STD  190A2
01164  190A    ETM
01165          NTR  U+1,2
01166          LTM
01167  190A1   TXI  *+1,2,1
01170  190A2   TXL  190A,2
01171  192A    LTM
01172  193A    CAL  *
01173          XIT  (FIL)
01174  D)116   LXD  C)G2,1
01175  194A    LDQ  AJF
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01176          FMP  AJS
01177          CHS
01200          FAD  AJS
01201          FAD  AJF
01202          STO  AJ
01203  195A    CLA  3)+1
01204          FSB  ALPHA
01205          STO  1)+1
01206          LDQ  1)+1
01207          FMP  AJ
01210          STO  ALPHAJ
01211  196A    LDQ  ALPHA
01212          FMP  R
01213          CHS
01214          FAD  3)+1
01215          STO  ALPHAR
01216  197A    CLA  3)+1
01217          FAD  EYE
01220          STO  1)+1
01221          LDQ  ENC
               BSS
01222          TSX  EXP(3,4
01223          NTR  *+2,0,100
01224          PZE  0,0,197
01225          STO  1)+2
01226          CLA  EYEC
01227          FAD  EYEL
01230          STO  1)+3
01231          LDQ  1)+3
01232          FMP  1)+2
01233          STO  1)+4
01234          CLA  1)+1
01235          LDQ  END
               BSS
01236          TSX  EXP(3,4
01237          NTR  *+2,0,100
01240          PZE  0,0,197
01241          STO  1)+5
01242          LDQ  EYEC
01243          FMP  1)+5
01244          FDP  BETA
01245          STO  1)+6
01246          CLA  1)+6
01247          FAD  1)+4
01250          STO  CAPIP
01251  198A    CLS  EN
01252          STO  1)+1
01253          CLA  3)+1
01254          FAD  EYE
01255          LDQ  1)+1
               BSS
01256          TSX  EXP(3,4
01257          NTR  *+2,0,100
01260          PZE  0,0,198
01261          STO  1)+2
01262          LDQ  EYEL
01263          FMP  1)+2
01264          CHS
```

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01265          FAD  CAPIP
01266          STO  CAPI
01267  199A    CLA  EYE
01270  199A1   TZE  200A
01271          TPL  202A
01272          TRA  202A
01273  200A    CLA  EN
01274          STO  AN
01275  201A    TRA  203A
01276  202A    CLA  3)+1
01277          FAD  EYE
01300          LDQ  EN
               BSS
01301          TSX  EXP(3,4
01302          NTR  *+2,0,102
01303          PZE  0,0,202
01304          STO  1)+1
01305          CLA  3)+1
01306          FDP  1)+1
01307          STQ  1)+2
01310          CLA  3)+1
01311          FSB  1)+2
01312          FDP  EYE
01313          STQ  AN
01314  203A    CLA  3)
01315          STO  YT
01316  204A    CLA  3)
01317          STO  Q1
01320  205A    CLA  3)
01321          STO  Q2
01322  206A    CLA  3)
01323          STO  Q3
01324  207A    LXD  2)+1,2
01325  208A    CLA  3)
01326          STO  VE1+1,2
01327  209A    CLA  3)
01330          STO  VE2+1,2
01331  209A1   TXI  *+1,2,1
01332  209A2   TXL  208A,2,10
01333  210A    CLA  NFC
01334  210A1   TZE  211A
01335          TPL  D)41D
01336          TRA  D)41D
01337  211A    CLA  3)
01340          STO  PL
01341  212A    TRA  D)439
01342  D)41D   LXD  C)G2,4
01343  213A    CLA  NFC
01344          STO  LOOP
01345  214A    LXD  2)+1,2
01346          CLA  LOOP
01347          STD  217A2
01350  215A    LDQ  EPSLON
01351          FMP  P
01352          STO  1)+1
01353          LDQ  3)+2
01354          FMP  ET+1,2
01355          FDP  1)+1
01356          STQ  TAU+1,2
01357  216A    CLA  A+1,2
01360          FDP  TAU+1,2
01361          STQ  1)+1
01362          CLA  YT
01363          FAD  1)+1
01364          STO  YT
01365  217A    LDQ  3)+3
01366          FMP  A+1,2
01367          STO  7)
01370          LDQ  7)
01371          FMP  CP+1,2
01372          STO  1)+1
01373          LDQ  CWD+1,2
01374          FMP  ELWD+1,2
01375          STO  1)+2
01376          CLA  3)+1
01377          FAD  ELF+1,2
01400          STO  1)+3
01401          LDQ  F+1,2
01402          FMP  1)+3
01403          STO  1)+4
01404          CLA  3)+1
01405          FAD  ELC+1,2
01406          FAD  ELF+1,2
01407          STO  1)+5
01410          LDQ  CU+1,2
01411          FMP  1)+5
01412          FAD  1)+4
01413          FAD  RPU+1,2
01414          FAD  S1+1,2
01415          FAD  S2+1,2
01416          FAD  1)+2
01417          STO  1)+6
01420          LDQ  1)+6
01421          FMP  EL1+1,2
01422          FAD  1)+1
01423          FDP  TAU+1,2
01424          STQ  1)+7
01425          CLA  Q1
01426          FAD  1)+7
01427          STO  Q1
01430  217A1   TXI  *+1,2,1
01431  217A2   TXL  215A,2
01432  218A    CLA  NFCB
01433  218A1   TZE  232A
01434  219A    CLA  NFCB
01435          STO  LOOP
01436  220A    LXD  2)+1,2
01437          CLA  LOOP
01440          STD  231A2
01441  221A    CLA  3)+1
01442          FSB  EW+1,2
01443          STO  1)+1
01444          CLA  EW+1,2
01445          FDP  1)+1
01446          STQ  1)+2
01447          CLA  1)+2
01450          SXD  6)+4,4
01451          TSX  LOG,4
01452          NTR  *+2,0,208
01453          PZE  0,0,221
01454          LXD  6)+4,4
01455          STO  1)+3
01456          LDQ  3)+4
01457          FMP  EW+1,2
01460          FSB  3)+1
01461          STO  1)+4
01462          LDQ  1)+4
01463          FMP  1)+3
01464          STO  VW+1,2
01465  222A    CLA  3)+1
01466          FSB  EF+1,2
01467          STO  1)+1
01470          CLA  EF+1,2
01471          FDP  1)+1
01472          STQ  1)+2
01473          CLA  1)+2
01474          SXD  6)+4,4
01475          TSX  LOG,4
01476          NTR  *+2,0,208
01477          PZE  0,0,222
01500          LXD  6)+4,4
01501          STO  1)+3
01502          LDQ  3)+4
01503          FMP  EF+1,2
01504          FSB  3)+1
01505          STO  1)+4
01506          LDQ  1)+4
01507          FMP  1)+3
01510          STO  VF+1,2
01511  223A    CLA  3)+1
01512          FSB  E1+1,2
01513          STO  1)+1
01514          CLA  E1+1,2
01515          FDP  1)+1
01516          STQ  1)+2
01517          CLA  1)+2
01520          SXD  6)+4,4
01521          TSX  LOG,4
01522          NTR  *+2,0,208
01523          PZE  0,0,223
01524          LXD  6)+4,4
01525          STO  1)+3
01526          LDQ  3)+4
01527          FMP  E1+1,2
01530          FSB  3)+1
01531          STO  1)+4
01532          LDQ  1)+4
01533          FMP  1)+3
01534          STO  V1+1,2
01535  224A    CLA  3)+1
01536          FSB  E2+1,2
01537          STO  1)+1
01540          CLA  E2+1,2
01541          FDP  1)+1
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01542           STQ  1)+2
01543           CLA  1)+2
01544           SXD  6)+4,4
01545           TSX  LOG,4
01546           NTR  *+2,0,208
01547           PZE  0,0,224
01550           LXD  6)+4,4
01551           STO  1)+3
01552           LDQ  3)+4
01553           FMP  E2+1,2
01554           FSB  3)+1
01555           STO  1)+4
01556           LDQ  1)+4
01557           FMP  1)+3
01560           STO  V2+1,2
01561 225A      CLA  EF+1,2
01562           FSB  EW+1,2
01563           STO  1)+1
01564           CLA  E1+1,2
01565           FSB  EW+1,2
01566           FDP  1)+1
01567           STQ  T1W+1,2
01570 226A      CLA  EF+1,2
01571           FSB  EW+1,2
01572           STO  1)+1
01573           CLA  E2+1,2
01574           FSB  EW+1,2
01575           FDP  1)+1
01576           STQ  T2W+1,2
01577 227A      CLA  EF+1,2
01600           FSB  EW+1,2
01601           STO  1)+1
01602           CLA  E1+1,2
01603           FSB  EF+1,2
01604           FDP  1)+1
01605           STQ  T1F+1,2
01606 228A      CLA  EF+1,2
01607           FSB  EW+1,2
01610           STO  1)+1
01611           CLA  E2+1,2
01612           FSB  EF+1,2
01613           FDP  1)+1
01614           STQ  T2F+1,2
01615 229A      LDQ  T1W+1,2
01616           FMP  VF+1,2
01617           STO  1)+1
01620           LDQ  T1F+1,2
01621           FMP  VW+1,2
01622           FAD  V1+1,2
01623           FSB  1)+1
01624           STO  1)+2
01625           LDQ  CDELTA+1,2
01626           FMP  1)+2
01627           STO  1)+3
01630           LDQ  CF+1,2
01631           FMP  T1W+1,2
01632           FAD  1)+3
01633           STO  VE1+1,2
01634 230A      LDQ  T2W+1,2
01635           FMP  VF+1,2
01636           STO  1)+1
01637           LDQ  T2F+1,2
01640           FMP  VW+1,2
01641           FAD  V2+1,2
01642           FSB  1)+1
01643           STO  1)+2
01644           LDQ  CDELTA+1,2
01645           FMP  1)+2
01646           STO  1)+3
01647           LDQ  CF+1,2
01650           FMP  T2W+1,2
01651           FAD  1)+3
01652           STO  VE2+1,2
01653 231A      LDQ  VE2+1,2
01654           FMP  EL2+1,2
01655           STO  1)+1
01656           CLA  3)+1
01657           FAD  ELC+1,2
01660           FAD  ELF+1,2
01661           STO  1)+2
01662           LDQ  1)+2
01663           FMP  VE1+1,2
01664           STO  7)
01665           LDQ  7)
01666           FMP  EL1+1,2
01667           STO  1)+3
01670           CLA  TD+1,2
01671           FAD  TRP+1,2
01672           FAD  TS2+1,2
01673           STO  1)+4
01674           LDQ  1)+4
01675           FMP  VE2+1,2
01676           STO  1)+5
01677           CLA  VE1+1,2
01700           FAD  VE2+1,2
01701           FDP  3)+4
01702           FMP  TAU+1,2
01703           STO  1)+6
01704           CLA  TC+1,2
01705           FAD  TF+1,2
01706           FAD  TS1+1,2
01707           STO  1)+7
01710           LDQ  1)+7
01711           FMP  VE1+1,2
01712           FAD  1)+6
01713           FAD  1)+5
01714           STO  1)+8
01715           LDQ  1)+2
01716           FMP  1)+8
01717           STO  7)
01720           LDQ  7)
01721           FMP  U+1,2
01722           STO  7)
01723           LDQ  7)
01724           FMP  EL1+1,2
01725           FAD  1)+3
01726           FSB  1)+1
01727           FDP  TAU+1,2
01730           STQ  1)+9
01731           LDQ  VE1+1,2
01732           FMP  U+1,2
01733           STO  7)
01734           LDQ  7)
01735           FMP  EL3+1,2
01736           FAD  Q2
01737           FAD  1)+9
01740           STQ  Q2
01741 231A1     TXI  *+1,2,1
01742 231A2     TXL  221A,2
01743 232A      CLA  NFCC
01744 232A1     TZE  237A
01745 233A      CLA  NFC
01746           STO  LOOP
01747 234A      CLA  NFCB
01750           ADD  2)+1
01751           STO  L
01752 235A      LXD  L,2
01753           CLA  LOOP
01754           STD  236A2
01755 236A      CLA  3)+1
01756           FAD  ELC+1,2
01757           FAD  ELF+1,2
01760           STO  1)+1
01761           LDQ  EL1+1,2
01762           FMP  1)+1
01763           FSB  EL2+1,2
01764           FDP  TAU+1,2
01765           STQ  1)+2
01766           CLA  TC+1,2
01767           FAD  TF+1,2
01770           FAD  TRP+1,2
01771           FAD  TS1+1,2
01772           FAD  TS2+1,2
01773           FAD  TD+1,2
01774           FAD  TAU+1,2
01775           STO  1)+3
01776           LDQ  U+1,2
01777           FMP  1)+3
02000           FDP  TAU+1,2
02001           FMP  EL1+1,2
02002           STO  7)
02003           LDQ  7)
02004           FMP  1)+1
02005           STO  1)+4
02006           LDQ  U+1,2
02007           FMP  EL3+1,2
02010           FAD  Q3
02011           FAD  1)+4
02012           FAD  1)+2
02013           STO  Q3
02014 236A1     TXI  *+1,2,1
02015 236A2     TXL  236A,2
02016 237A      LDQ  3)+3
02017           FMP  P
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02020          FSB  3)+5
02021 237A1    TZE  238A
02022          TPL  240A
02023 238A     CLA  3)+1
02024          STO  EL
02025 239A     TRA  257A
02026 240A     LDQ  3)+3
02027          FMP  P
02030          FSB  3)+3
02031 240A1    TZE  241A
02032          TPL  243A
02033 241A     CLA  3)+6
02034          STO  EL
02035 242A     TRA  257A
02036 243A     CLA  P
02037          FSB  3)+5
02040 243A1    TZE  244A
02041          TPL  246A
02042 244A     CLA  3)+7
02043          STO  EL
02044 245A     TRA  257A
02045 246A     LDQ  P
02046          FMP  ETA
02047          FSB  3)+8
02050 246A1    TZE  247A
02051          TPL  247A
02052          TRA  249A
02053 247A     CLA  3)+9
02054          STO  EL
02055 248A     TRA  257A
02056 249A     LDQ  PF
02057          FMP  3)+10
02060          STO  7)
02061          LDQ  7)
02062          FMP  3)+3
02063          STO  7)
02064          LDQ  7)
02065          FMP  P
02066          FDP  3)+11
02067          STQ  EL
02070 250A     CLA  EL
02071          FSB  3)+12
02072 250A1    TZE  253A
02073          TPL  253A
02074 251A     CLA  3)+12
02075          STO  EL
02076 252A     TRA  257A
02077 253A     CLA  EL
02100          FSB  3)+9
02101 253A1    TZE  256A
02102          TPL  254A
02103          TRA  256A
02104 254A     CLA  3)+9
02105          STO  EL
02106 255A     TRA  257A
02107 256A     LDQ  3)+5
02110          FMP  EL
02111          FAD  3)+14
02112          UFA  6)
02113          FAD  6)
02114          STO  1)+1
02115          LDQ  3)+13
02116          FMP  1)+1
02117          STO  EL
02120 257A     CLA  A1
02121          FSB  3)+3
02122 257A1    TZE  260A
02123          TPL  260A
02124 258A     CLA  3)+3
02125          STO  PR
02126 259A     TRA  261A
02127 260A     CLA  A1
02130          STO  PR
02131 261A     CLA  EL
02132          FSB  3)+1
02133 261A1    TZE  262A
02134          TPL  264A
02135 262A     CLA  EL
02136          STO  CAPPA
02137 263A     TRA  306A
02140 264A     LDQ  3)+15
02141          FMP  A1
02142          FSB  3)+3
02143 264A1    TZE  267A
02144          TPL  267A
02145 265A     CLA  3)+3
02146          STO  PR-1
02147 266A     TRA  268A
02150 267A     LDQ  3)+15
02151          FMP  A1
02152          STO  PR-1
02153 268A     CLA  3)+1
02154          STO  CAPPA
02155 269A     CLA  EL
02156          FSB  3)+16
02157 269A1    TZE  270A
02160          TPL  272A
02161 270A     CLA  EL
02162          FSB  3)+1
02163          STO  ELAMDA
02164 271A     TRA  307A
02165 272A     LDQ  3)+17
02166          FMP  A1
02167          FSB  3)+3
02170 272A1    TZE  275A
02171          TPL  275A
02172 273A     CLA  3)+3
02173          STO  PR-2
02174 274A     TRA  276A
02175 275A     LDQ  3)+17
02176          FMP  A1
02177          STO  PR-2
02200 276A     CLA  3)+18
02201          STO  ELAMDA
02202 277A     CLA  EL
02203          FSB  3)+5
02204 277A1    TZE  278A
02205          TPL  280A
02206 278A     CLA  EL
02207          FSB  3)+16
02210          STO  ENU
02211 279A     TRA  308A
02212 280A     LDQ  3)+13
02213          FMP  A1
02214          FSB  3)+3
02215 280A1    TZE  283A
02216          TPL  283A
02217 281A     CLA  3)+3
02220          STO  PR-3
02221 282A     TRA  284A
02222 283A     LDQ  3)+13
02223          FMP  A1
02224          STO  PR-3
02225 284A     CLA  3)+16
02226          STO  ENU
02227 285A     CLA  EL
02230          FSB  3)+19
02231 285A1    TZE  286A
02232          TPL  288A
02233 286A     CLA  EL
02234          FSB  3)+5
02235          STO  ENU
02236 287A     TRA  309A
02237 288A     LDQ  3)+20
02240          FMP  A1
02241          FSB  3)+3
02242 288A1    TZE  291A
02243          TPL  291A
02244 289A     CLA  3)+3
02245          STO  PR-4
02246 290A     TRA  292A
02247 291A     LDQ  3)+20
02250          FMP  A1
02251          STO  PR-4
02252 292A     CLA  3)+5
02253          STO  ENU
02254 293A     CLA  EL
02255          FSB  3)+21
02256 293A1    TZE  294A
02257          TPL  296A
02260 294A     CLA  EL
02261          FSB  3)+19
02262          STO  XI
02263 295A     TRA  310A
02264 296A     LDQ  3)+22
02265          FMP  A1
02266          FSB  3)+3
02267 296A1    TZE  299A
02270          TPL  299A
02271 297A     CLA  3)+3
02272          STO  PR-5
02273 298A     TRA  300A
02274 299A     LDQ  3)+22
02275          FMP  A1
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```
02276          STO  PR-5
02277  300A    CLA  3)+19
02300          STO  XI
02301  301A    CLA  EL
02302          FSB  3)+9
02303  301A1   TZE  302A
02304          TPL  304A
02305  302A    CLA  EL
02306          FSB  3)+21
02307          STO  ZETA
02310  303A    TRA  311A
02311  304A    CLA  3)+19
02312          STO  ZETA
02313  305A    TRA  311A
02314  306A    CLA  3)
02315          STO  ELAMDA
02316  307A    CLA  3)
02317          STO  EMU
02320  308A    CLA  3)
02321          STO  ENU
02322  309A    CLA  3)
02323          STO  XI
02324  310A    CLA  3)
02325          STO  ZETA
02326  311A    LDQ  ZETA
02327          FMP  PR-5
02330          STO  1)+1
02331          LDQ  XI
02332          FMP  PR-4
02333          STO  1)+2
02334          LDQ  ENU
02335          FMP  PR-3
02336          STO  1)+3
02337          LDQ  EMU
02340          FMP  PR-2
02341          STO  1)+4
02342          LDQ  ELAMDA
02343          FMP  PR-1
02344          STO  1)+5
02345          LDQ  CAPPA
02346          FMP  PR
02347          FAD  1)+5
02350          FAD  1)+4
02351          FAD  1)+3
02352          FAD  1)+2
02353          FAD  1)+1
02354          STO  PL
02355          TTR  312A
02356  D)439   LXD  C)G2,4
02357  312A    CLA  EYEC
02360          FAD  EYEL
02361          STO  1)+1
02362          CLA  PHI
02363          FAD  CHI
02364          FAD  PSI
02365          STO  1)+2
02366          LDQ  DELTA
02367          FMP  1)+2
02370          STO  7)
02371          LDQ  7)
02372          FMP  1)+1
02373          STO  ADVAL
02374  313A    LDQ  OMEGA
02375          FMP  CAPIP
02376          STO  PROFIT
02377  314A    LDQ  CAPIP
02400          FMP  B
02401          STO  7)
02402          LDQ  7)
02403          FMP  EYEBAR
02404          STO  1)+1
02405          CLA  3)+1
02406          FDP  BETA
02407          FMP  EYED
02410          FAD  EYEC
02411          FDP  ENPRIM
02412          FMP  3)+1
02413          FAD  1)+1
02414          STO  DEP
02415  315A    CLA  MCALC
02416  315A1   TZE  316A
02417          TPL  353A
02420          TRA  353A
02421  316A    CLA  3)+1
02422          FSB  ALPHAJ
02423          STO  1)+1
02424          LDQ  3)+3
02425          FMP  1)+1
02426          STO  7)
02427          LDQ  7)
02430          FMP  Q3
02431          STO  1)+2
02432          CLA  ALPHAR
02433          FSB  ALPHAJ
02434          STO  1)+3
02435          LDQ  YT
02436          FMP  1)+3
02437          STO  7)
02440          LDQ  7)
02441          FMP  3)+3
02442          FSB  1)+2
02443          STO  1)+4
02444          CLA  3)+1
02445          FDP  1)+4
02446          STQ  T1
02447  317A    CLA  ADVAL
02450          FAD  OM
02451          FAD  Q1
02452          FAD  Q2
02453          FAD  PL
02454          STO  1)+1
02455          CLA  3)+1
02456          FSB  ALPHAJ
02457          STO  1)+2
02460          LDQ  1)+2
02461          FMP  1)+1
02462          STO  T2
02463  318A    CLA  ALPHAR
02464          FSB  ALPHAJ
02465          STO  1)+1
02466          LDQ  EM
02467          FMP  1)+1
02470          STO  7)
02471          LDQ  7)
02472          FMP  3)+23
02473          STO  7)
02474          LDQ  7)
02475          FMP  P
02476          STO  7)
02477          LDQ  7)
02500          FMP  ETA
02501          STO  7)
02502          LDQ  7)
02503          FMP  EPSLON
02504          STO  T3
02505  319A    CLA  3)+1
02506          FDP  BETA
02507          FMP  EYED
02510          FAD  EYEC
02511          FDP  ENPRIM
02512          FMP  ALPHAJ
02513          STO  1)+1
02514          LDQ  EYEBAR
02515          FMP  ALPHAJ
02516          STO  7)
02517          LDQ  7)
02520          FMP  B
02521          CHS
02522          FAD  OMEGA
02523          STO  1)+2
02524          LDQ  1)+2
02525          FMP  CAPIP
02526          STO  1)+3
02527          CLA  CAPI
02530          FDP  AN
02531          STO  1)+4
02532          CLA  1)+4
02533          FAD  1)+3
02534          FSB  1)+1
02535          STO  T4
02536  320A    CLA  T2
02537          FAD  T4
02540          FSB  T3
02541          STO  1)+1
02542          LDQ  T1
02543          FMP  1)+1
02544          STO  V
02545  321A    LDQ  3)+3
02546          FMP  Q3
02547          STO  7)
02550          LDQ  7)
02551          FMP  V
02552          FAD  Q2
02553          FAD  Q1
```

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02554          STO  FCT
02555  322A    LDQ  3)+23
02556          FMP  P
02557          STO  7)
02560          LDQ  7)
02561          FMP  ETA
02562          STO  7)
02563          LDQ  7)
02564          FMP  EPSLON
02565          STO  7)
02566          LDQ  7)
02567          FMP  EM
02570          STO  1)+1
02571          LDQ  3)+3
02572          FMP  YT
02573          STO  7)
02574          LDQ  7)
02575          FMP  V
02576          FAD  1)+1
02577          STO  REV
02600  323A    CLA  REV
02601          FSB  FCT
02602          FSB  OM
02603          FSB  ADVAL
02604          FSB  DEP
02605          FSB  PL
02606          STO  ENS
02607  324A    LDQ  AJS
02610          FMP  ENS
02611          STO  STAX
02612  325A    CLA  3)+1
02613          FSB  AJS
02614          STO  1)+1
02615          LDQ  ENS
02616          FMP  AJF
02617          STO  7)
02620          LDQ  7)
02621          FMP  1)+1
02622          STO  FTAX
02623  326A    CLA  STAX
02624          FAD  FTAX
02625          STO  TAXES
02626  327A    CLA  ADVAL
02627          FAD  OM
02630          FAD  PL
02631          FAD  FCT
02632          FAD  TAXES
02633          STO  OE
02634  328A    CLA  TAXES
02635  328A1   TZE  335A
02636          TPL  335A
02637  329A    LDQ  YT
02640          FMP  3)+3
02641          STO  1)+1
02642          CLA  TAXES
02643          SSP
02644          FDP  1)+1
02645          STQ  1)+2
02646          CLA  V
02647          FAD  1)+2
02650          STO  V
02651  330A    CLA  3)
02652          STO  TAXES
02653  331A    LDQ  3)+23
02654          FMP  ETA
02655          STO  7)
02656          LDQ  7)
02657          FMP  EPSLON
02660          STO  7)
02661          LDQ  7)
02662          FMP  EM
02663          STO  1)+1
02664          LDQ  3)+3
02665          FMP  YT
02666          STO  7)
02667          LDQ  7)
02670          FMP  V
02671          FAD  P
02672          FAD  1)+1
02673          STO  REV
02674  332A    CLA  ADVAL
02675          FAD  OM
02676          FAD  PL
02677          FAD  FCT
02700          STO  OE
02701  333A    CLA  3)
02702          STO  FTAX
02703  334A    CLA  3)
02704          STO  STAX
02705  335A    LDQ  3)+3
02706          FMP  YT
02707          STO  7)
02710          LDQ  7)
02711          FMP  V
02712          STO  YT
02713  336A    CLA  REV
02714          FSB  YT
02715          STO  ELECRV
02716  337A    PSE  114
02717          TRA  514A
02720  338A    CAL  *
02721          XIT  (LEV)
02722          ETM
02723          CAL  (IOH)O
02724          SLW  1
02725          CAL  (SPH)
02726  338D1   NTR  8)R
02727  339A    ETM
02730          NTR  V
02731          NTR  REV
02732          NTR  ELECRV
02733          NTR  YT
02734          NTR  CAPI
02735          NTR  OE
02736          NTR  ADVAL
02737          NTR  PROFIT
02740          NTR  PL
02741          NTR  STAX
02742          NTR  FTAX
02743          NTR  FCT
02744          LTM
02745  340A    CAL  *
02746          XIT  (FIL)
02747  341A    CLA  NFCP
02750  341A1   TZE  348A
02751  342A    CAL  *
02752          XIT  (LEV)
02753          ETM
02754          CAL  (IOH)O
02755          SLW  1
02756          CAL  (SPH)
02757  342D1   NTR  8)T
02760  343A    LXD  2)+1,2
02761          CLA  NFCP
02762          STD  344A2
02763  344A    ETM
02764          NTR  VE1+1,2
02765          NTR  VE2+1,2
02766          LTM
02767  344A1   TXI  *+1,2,1
02770  344A2   TXL  344A,2
02771  346A    LTM
02772  347A    CAL  *
02773          XIT  (FIL)
02774  348A    PSE  113
02775          TRA  390A
02776  349A    CAL  *
02777          XIT  (LEV)
03000          ETM
03001          CAL  (IOH)O
03002          SLW  1
03003          CAL  (SPH)
03004  349D1   NTR  8)V
03005  350A    ETM
03006          NTR  AN
03007          NTR  CAPIP
03010          NTR  Q1
03011          NTR  Q2
03012          NTR  Q3
03013          NTR  T1
03014          NTR  T2
03015          NTR  T3
03016          NTR  T4
03017          LTM
03020  351A    CAL  *
03021          XIT  (FIL)
03022  352A    TRA  390A
03023  353A    LDQ  3)+3
03024          FMP  YT
03025          STO  7)
03026          LDQ  7)
03027          FMP  V
03030          STO  YT
03031  354A    CLA  ALPHAR
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03032          FSB  ALPHAJ
03033          STO  1)+1
03034          LDQ  3)+23
03035          FMP  1)+1
03036          STO  7)
03037          LDQ  7)
03040          FMP  P
03041          STO  7)
03042          LDQ  7)
03043          FMP  ETA
03044          STO  7)
03045          LDQ  7)
03046          FMP  EPSLON
03047          STO  1)+2
03050          CLA  3)+1
03051          FDP  1)+2
03052          STQ  T1
03053  355A    CLA  3)+1
03054          FDP  BETA
03055          FMP  EYED
03056          FAD  EYEC
03057          FDP  ENPRIM
03060          FMP  ALPHAJ
03061          STO  1)+1
03062          LDQ  CAPIP
03063          FMP  ALPHAJ
03064          STO  7)
03065          LDQ  7)
03066          FMP  B
03067          STO  7)
03070          LDQ  7)
03071          FMP  EYEBAR
03072          CHS
03073          FAD  PROFIT
03074          FSB  1)+1
03075          STO  T3
03076  356A    CLA  ALPHAJ
03077          FSB  ALPHAR
03100          STO  1)+1
03101          LDQ  YT
03102          FMP  1)+1
03103          STO  T4
03104  357A    CLA  NFC
03105  357A1   TZE  359A
03106  358A    LDQ  3)+3
03107          FMP  Q3
03110          STO  7)
03111          LDQ  7)
03112          FMP  V
03113          FAD  Q2
03114          FAD  Q1
03115          STO  FCT
03116  359A    CLA  ADVAL
03117          FAD  OM
03120          FAD  FCT
03121          FAD  PL
03122          STO  1)+1
03123          CLA  3)+1
03124          FSB  ALPHAJ
03125          STO  1)+2
03126          LDQ  1)+2
03127          FMP  1)+1
03130          STO  1)+3
03131          CLA  CAPI
03132          FDP  AN
03133          STQ  1)+4
03134          CLA  1)+4
03135          FAD  1)+3
03136          STO  T2
03137  360A    CLA  T3
03140          FAD  T4
03141          FAD  T2
03142          STO  1)+1
03143          LDQ  T1
03144          FMP  1)+1
03145          STO  EM
03146  361A    LDQ  3)+23
03147          FMP  P
03150          STO  7)
03151          LDQ  7)
03152          FMP  ETA
03153          STO  7)
03154          LDQ  7)
03155          FMP  EPSLON
03156          STO  7)
03157          LDQ  7)
03160          FMP  EM
03161          FAD  YT
03162          STO  REV
03163  362A    CLA  REV
03164          FSB  FCT
03165          FSB  OM
03166          FSB  ADVAL
03167          FSB  DEP
03170          FSB  PL
03171          STO  ENS
03172  363A    LDQ  AJS
03173          FMP  ENS
03174          STO  STAX
03175  364A    CLA  3)+1
03176          FSB  AJS
03177          STO  1)+1
03200          LDQ  ENS
03201          FMP  AJF
03202          STO  7)
03203          LDQ  7)
03204          FMP  1)+1
03205          STO  FTAX
03206  365A    CLA  STAX
03207          FAD  FTAX
03210          STO  TAXES
03211  366A    CLA  ADVAL
03212          FAD  OM
03213          FAD  PL
03214          FAD  FCT
03215          FAD  TAXES
03216          STO  OE
03217  367A    CLA  TAXES
03220  367A1   TZE  374A
03221          TPL  374A
03222  368A    LDQ  3)+23
03223          FMP  P
03224          STO  7)
03225          LDQ  7)
03226          FMP  ETA
03227          STO  7)
03230          LDQ  7)
03231          FMP  EPSLON
03232          STO  1)+1
03233          CLA  TAXES
03234          SSP
03235          FDP  1)+1
03236          STQ  1)+2
03237          CLA  EM
03240          FAD  1)+2
03241          STO  EM
03242  369A    CLA  3)
03243          STO  TAXES
03244  370A    LDQ  3)+23
03245          FMP  P
03246          STO  7)
03247          LDQ  7)
03250          FMP  ETA
03251          STO  7)
03252          LDQ  7)
03253          FMP  EPSLON
03254          STO  7)
03255          LDQ  7)
03256          FMP  EM
03257          FAD  YT
03260          STO  REV
03261  371A    CLA  ADVAL
03262          FAD  OM
03263          FAD  PL
03264          FAD  FCT
03265          STO  OE
03266  372A    CLA  3)
03267          STO  FTAX
03270  373A    CLA  3)
03271          STO  STAX
03272  374A    CLA  REV
03273          FSP  YT
03274          STO  ELECRV
03275  375A    PSE  11|4
03276          TRA  529A
03277  376A    CAL  *
03300          XIT  (LEV)
03301          ETM
03302          CAL  (IOH)0
03303          SLW  1
03304          CAL  (SPH)
03305  376D1   NTR  8)H
03306  377A    ETM
03307          NTR  EM
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03310          NTR  REV
03311          NTR  ELECRV
03312          NTR  YT
03313          NTR  CAPI
03314          NTR  OE
03315          NTR  ADVAL
03316          NTR  PROFIT
03317          NTR  PL
03320          NTR  STAX
03321          NTR  FTAX
03322          NTR  FCT
03323          LTM
03324  378A    CAL  *
03325          XIT  (FIL)
03326  379A    CLA  NFCB
03327  379A1   TZE  386A
03330  380A    CAL  *
03331          XIT  (LEV)
03332          ETM
03333          CAL  (IOH)0
03334          SLW  1
03335          CAL  (SPH)
03336  380D1   NTR  8)T
03337  381A    LXD  2)+1,2
03340          CLA  NFCB
03341          STD  382A2
03342  382A    ETM
03343          NTR  VE1+1,2
03344          NTR  VE2+1,2
03345          LTM
03346  382A1   TXI  *+1,2,1
03347  382A2   TXL  382A,2
03350  384A    LTM
03351  385A    CAL  *
03352          XIT  (FIL)
03353  386A    PSE  113
03354          TRA  390A
03355  387A    CAL  *
03356          XIT  (LEV)
03357          ETM
03360          CAL  (IOH)0
03361          SLW  1
03362          CAL  (SPH)
03363  387D1   NTR  8)V
03364  388A    ETM
03365          NTR  AN
03366          NTR  CAPIP
03367          NTR  Q1
03370          NTR  Q2
03371          NTR  Q3
03372          NTR  T1
03373          NTR  T2
03374          NTR  T3
03375          NTR  T4
03376          LTM
03377  389A    CAL  *
03400          XIT  (FIL)
03401  390A    PSE  96
03402  391A    CAL  *
03403          XIT  (LEV)
03404          ETM
03405          CAL  (IOH)I
03406          SLW  1
03407          CAL  (CSH)
03410  391D1   NTR  8)J,0,81
03411  392A    ETM
03412          NTR  NPC
03413          LTM
03414  393A    CAL  *
03415          XIT  (RTN)
03416  394A    CLA  NPC
03417  394A1   TZE  43A
03420  395A    CLA  MOD
03421          ADD  2)+1
03422          STO  MOD
03423  396A    PSE  114
03424          TRA  544A
03425  397A    CAL  *
03426          XIT  (LEV)
03427          ETM
03430          CAL  (IOH)0
03431          SLW  1
03432          CAL  (SPH)
03433  397D1   NTR  8)S
03434  398A    ETM
03435          NTR  MOD
03436          LTM
03437  399A    CAL  *
03440          XIT  (FIL)
03441  400A    LXD  2)+1,2
03442          CLA  NPC
03443          STD  412A2
03444  401A    CAL  *
03445          XIT  (LEV)
03446          ETM
03447          CAL  (IOH)I
03450          SLW  1
03451          CAL  (CSH)
03452  401D1   NTR  8)J,0,81
03453  402A    ETM
03454          NTR  J
03455          LTM
03456          LXD  J,1
03457  404A    ETM
03460          NTR  PA+1,1
03461          LTM
03462  405A    CAL  *
03463          XIT  (RTN)
03464  406A    PSE  114
03465          TRA  E)43
03466          TRA  407A
03467  E)43    SXD  C)G2,1
03470  406A1   PXD  0,2
03471          STO  K
03472          TRA  548A
03473  407A    CAL  *
03474          XIT  (LEV)
03475          ETM
03476          CAL  (IOH)0
03477          SLW  1
03500          CAL  (SPH)
03501  407D1   NTR  8)L
03502  408A    ETM
03503          NTR  LABEL+1,1
03504          NTR  PA+1,1
03505          LTM
03506  409A    CAL  *
03507          XIT  (FIL)
03510  410A    CLA  J
03511          SUB  2)+2
03512  410A1   TZE  411A
03513          TPL  E)47
03514  411A    CLA  PA+1,1
03515          UFA  6)
03516          LRS
03517          ANA  6)+1
03520          LLS
03521          ALS  18
03522          STO  JPA+1,1
03523          TTR  412A
03524  E)47    SXD  C)G2,1
       412A    BSS
03525  412A1   TXI  *+1,2,1
03526  412A2   TXL  401A,2
03527  E)48    SXD  C)G2,1
03530  413A    TRA  194A
03531  414A    CAL  *
03532          XIT  (LEV)
03533          ETM
03534          CAL  (IOH)0
03535          SLW  1
03536          CAL  (STH)
03537  414D1   NTR  8)1,0,1
03540  415A    CAL  *
03541          XIT  (FIL)
03542  416A    CLA  MCALC
03543  416A1   TZE  421A
03544  417A    CAL  *
03545          XIT  (LEV)
03546          ETM
03547          CAL  (IOH)0
03550          SLW  1
03551          CAL  (STH)
03552  417D1   NTR  8)N,0,1
03553  418A    ETM
03554          NTR  NFCP
03555          NTR  NFCC
03556          LTM
03557  419A    CAL  *
03560          XIT  (FIL)
03561  420A    TRA  424A
03562  421A    CAL  *
03563          XIT  (LEV)
03564          ETM
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03565          CAL  (IOH)O
03566          SLW  1
03567          CAL  (STH)
03570  421D1   NTR  8)O,0,1
03571  422A    ETM
03572          NTR  NFCB
03573          NTR  NFCC
03574          LTM
03575  423A    CAL  *
03576          XIT  (FIL)
03577  424A    CAL  *
03600          XIT  (LEV)
03601          ETM
03602          CAL  (IOH)O
03603          SLW  1
03604          CAL  (STH)
03605  424D1   NTR  8)3,0,1
03606  425A    ETM
03607          NTR  BETA
03610          NTR  EYEL
03611          NTR  EYE
03612          NTR  EN
03613          NTR  EYEC
03614          NTR  ENC
03615          NTR  EYED
03616          NTR  END
03617          LTM
03620  426A    CAL  *
03621          XIT  (FIL)
03622  427A    CLA  MCALC
03623  427A1   TZE  432A
03624  428A    CAL  *
03625          XIT  (LEV)
03626          ETM
03627          CAL  (IOH)O
03630          SLW  1
03631          CAL  (STH)
03632  428D1   NTR  8)4,0,1
03633  429A    ETM
03634          NTR  EPSLON
03635          NTR  P
03636          NTR  ETA
03637          NTR  V
03640          LTM
03641  430A    CAL  *
03642          XIT  (FIL)
03643  431A    TRA  435A
03644  432A    CAL  *
03645          XIT  (LEV)
03646          ETM
03647          CAL  (IOH)O
03650          SLW  1
03651          CAL  (STH)
03652  432D1   NTR  8)P,0,1
03653  433A    ETM
03654          NTR  EPSLON
03655          NTR  P
03656          NTR  ETA
03657          NTR  EM
03660          LTM
03661  434A    CAL  *
03662          XIT  (FIL)
03663  435A    CAL  *
03664          XIT  (LEV)
03665          ETM
03666          CAL  (IOH)O
03667          SLW  1
03670          CAL  (STH)
03671  435D1   NTR  8)5,0,1
03672  436A    ETM
03673          NTR  OM
03674          NTR  OMEGA
03675          LTM
03676  437A    CAL  *
03677          XIT  (FIL)
03700  438A    CAL  *
03701          XIT  (LEV)
03702          ETM
03703          CAL  (IOH)O
03704          SLW  1
03705          CAL  (STH)
03706  438D1   NTR  8)6,0,1
03707  439A    ETM
03710          NTR  CHI
03711          NTR  PHI
03712          NTR  DELTA
03713          NTR  PSI
03714          LTM
03715  440A    CAL  *
03716          XIT  (FIL)
03717  441A    CAL  *
03720          XIT  (LEV)
03721          ETM
03722          CAL  (IOH)O
03723          SLW  1
03724          CAL  (STH)
03725  441D1   NTR  8)7,0,1
03726  442A    ETM
03727          NTR  AI
03730          NTR  PF
03731          LTM
03732  443A    CAL  *
03733          XIT  (FIL)
03734  444A    CAL  *
03735          XIT  (LEV)
03736          ETM
03737          CAL  (IOH)O
03740          SLW  1
03741          CAL  (STH)
03742  444D1   NTR  8)8,0,1
03743  445A    ETM
03744          NTR  ALPHA
03745          NTR  AJS
03746          NTR  B
03747          NTR  ENPRIM
03750          NTR  EYEBAR
03751          NTR  R
03752          NTR  AJF
03753          LTM
03754  446A    CAL  *
03755          XIT  (FIL)
03756  447A    CLA  NFCC
03757          ADD  NFCC
03760          STO  NFC
03761  448A    CLA  NFC
03762  448A1   TZE  449A
03763          TPL  116A
03764          TRA  116A
03765  449A    CAL  *
03766          XIT  (LEV)
03767          ETM
03770          CAL  (IOH)O
03771          SLW  1
03772          CAL  (STH)
03773  449D1   NTR  8)9,0,1
03774  450A    ETM
03775          NTR  FCT
03776          LTM
03777  451A    CAL  *
04000          XIT  (FIL)
04001  452A    TRA  D)116
04002  453A    CAL  *
04003          XIT  (LEV)
04004          ETM
04005          CAL  (IOH)O
04006          SLW  1
04007          CAL  (STH)
04010  453D1   NTR  8)A,0,1
04011  454A    LXD  2)+1,2
04012          CLA  LOOP
04013          STD  455A2
04014  455A    ETM
04015          NTR  EL1+1,2
04016          NTR  EL2+1,2
04017          NTR  EL3+1,2
04020          LTM
04021  455A1   TXI  *+1,2,1
04022  455A2   TXL  455A,2
04023  457A    LTM
04024  458A    CAL  *
04025          XIT  (FIL)
04026  459A    CAL  *
04027          XIT  (LEV)
04030          ETM
04031          CAL  (IOH)O
04032          SLW  1
04033          CAL  (STH)
04034  459D1   NTR  8)B,0,1
04035  460A    LXD  2)+1,2
04036          CLA  LOOP
04037          STD  461A2
04040  461A    ETM
04041          NTR  ELC+1,2
04042          NTR  ELF+1,2
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04043          NTR  ELWD+1,2
04044          LTM
04045  461A1   TXI  *+1,2,1
04046  461A2   TXL  461A,2
04047  463A    LTM
04050  464A    CAL  *
04051          XIT  (FIL)
04052  465A    CAL  *
04053          XIT  (LEV)
04054          ETM
04055          CAL  (IOH)O
04056          SLW  1
04057          CAL  (STH)
04060  465D1   NTR  8)C,0,1
04061  466A    LXD  2)+1,2
04062          CLA  LOOP
04063          STD  467A2
04064  467A    ETM
04065          NTR  CU+1,2
04066          NTR  F+1,2
04067          NTR  RPU+1,2
04070          LTM
04071  467A1   TXI  *+1,2,1
04072  467A2   TXL  467A,2
04073  469A    LTM
04074  470A    CAL  *
04075          XIT  (FIL)
04076  471A    CAL  *
04077          XIT  (LEV)
04100          ETM
04101          CAL  (IOH)O
04102          SLW  1
04103          CAL  (STH)
04104  471D1   NTR  8)D,0,1
04105  472A    LXD  2)+1,2
04106          CLA  LOOP
04107          STD  473A2
04110  473A    ETM
04111          NTR  CWD+1,2
04112          NTR  S1+1,2
04113          NTR  S2+1,2
04114          LTM
04115  473A1   TXI  *+1,2,1
04116  473A2   TXL  473A,2
04117  475A    LTM
04120  476A    CAL  *
04121          XIT  (FIL)
04122  477A    CAL  *
04123          XIT  (LEV)
04124          ETM
04125          CAL  (IOH)O
04126          SLW  1
04127          CAL  (STH)
04130  477D1   NTR  8)E,0,1
04131  478A    LXD  2)+1,2
04132          CLA  LOOP
04133          STD  479A2
04134  479A    ETM
04135          NTR  TC+1,2
04136          NTR  TF+1,2
04137          NTR  TRP+1,2
04140          LTM
04141  479A1   TXI  *+1,2,1
04142  479A2   TXL  479A,2
04143  481A    LTM
04144  482A    CAL  *
04145          XIT  (FIL)
04146  483A    CAL  *
04147          XIT  (LEV)
04150          ETM
04151          CAL  (IOH)O
04152          SLW  1
04153          CAL  (STH)
04154  483D1   NTR  8)F,0,1
04155  484A    LXD  2)+1,2
04156          CLA  LOOP
04157          STD  485A2
04160  485A    ETM
04161          NTR  TD+1,2
04162          NTR  TS1+1,2
04163          NTR  TS2+1,2
04164          LTM
04165  485A1   TXI  *+1,2,1
04166  485A2   TXL  485A,2
04167  487A    LTM
04170  488A    CAL  *
04171          XIT  (FIL)
04172  489A    CAL  *
04173          XIT  (LEV)
04174          ETM
04175          CAL  (IOH)O
04176          SLW  1
04177          CAL  (STH)
04200  489D1   NTR  8)G,0,1
04201  490A    LXD  2)+1,2
04202          CLA  LOOP
04203          STD  491A2
04204  491A    ETM
04205          NTR  E1+1,2
04206          NTR  E2+1,2
04207          NTR  CDELTA+1,2
04210          LTM
04211  491A1   TXI  *+1,2,1
04212  491A2   TXL  491A,2
04213  493A    LTM
04214  494A    CAL  *
04215          XIT  (FIL)
04216  495A    CAL  *
04217          XIT  (LEV)
04220          ETM
04221          CAL  (IOH)O
04222          SLW  1
04223          CAL  (STH)
04224  495D1   NTR  8)Q,0,1
04225  496A    LXD  2)+1,2
04226          CLA  LOOP
04227          STD  497A2
04230  497A    ETM
04231          NTR  CF+1,2
04232          NTR  EF+1,2
04233          NTR  EW+1,2
04234          LTM
04235  497A1   TXI  *+1,2,1
04236  497A2   TXL  497A,2
04237  499A    LTM
04240  500A    CAL  *
04241          XIT  (FIL)
04242  501A    CAL  *
04243          XIT  (LEV)
04244          ETM
04245          CAL  (IOH)O
04246          SLW  1
04247          CAL  (STH)
04250  501D1   NTR  8)10,0,1
04251  502A    LXD  2)+1,2
04252          CLA  LOOP
04253          STD  503A2
04254  503A    ETM
04255          NTR  A+1,2
04256          NTR  CP+1,2
04257          NTR  ET+1,2
04260          LTM
04261  503A1   TXI  *+1,2,1
04262  503A2   TXL  503A,2
04263  505A    LTM
04264  506A    CAL  *
04265          XIT  (FIL)
04266  507A    CAL  *
04267          XIT  (LEV)
04270          ETM
04271          CAL  (IOH)O
04272          SLW  1
04273          CAL  (STH)
04274  507D1   NTR  8)11,0,1
04275  508A    LXD  2)+1,2
04276          CLA  LOOP
04277          STD  509A2
04300  509A    ETM
04301          NTR  U+1,2
04302          LTM
04303  509A1   TXI  *+1,2,1
04304  509A2   TXL  509A,2
04305  511A    LTM
04306  512A    CAL  *
04307          XIT  (FIL)
04310  513A    TRA  D)116
04311  514A    CAL  *
04312          XIT  (LEV)
04313          ETM
04314          CAL  (IOH)O
04315          SLW  1
04316          CAL  (STH)
04317  514D1   NTR  8)R,0,1
04320  515A    ETM
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04321          NTR V
04322          NTR REV
04323          NTR ELECRV
04324          NTR YT
04325          NTR CAPI
04326          NTR OE
04327          NTR ADVAL
04330          NTR PROFIT
04331          NTR PL
04332          NTR STAX
04333          NTR FTAX
04334          NTR FCT
04335          LTM
04336 516A     CAL *
04337          XIT (FIL)
04340 517A     CLA NFCB
04341 517A1    TZE 524A
04342 518A     CAL *
04343          XIT (LEV)
04344          ETM
04345          CAL (IOH)O
04346          SLW 1
04347          CAL (STH)
04350 518D1    NTR 8)T,0,1
04351 519A     LXD 2)+1,2
04352          CLA NFCB
04353          STD 520A2
04354 520A     ETM
04355          NTR VE1+1,2
04356          NTR VE2+1,2
04357          LTM
04360 520A1    TXI *+1,2,1
04361 520A2    TXL 520A,2
04362 522A     LTM
04363 523A     CAL *
04364          XIT (FIL)
04365 524A     PSE 113
04366          TRA 390A
04367 525A     CAL *
04370          XIT (LEV)
04371          ETM
04372          CAL (IOH)O
04373          SLW 1
04374          CAL (STH)
04375 525D1    NTR 8)V,0,1
04376 526A     ETM
04377          NTR AN
04400          NTR CAPIP
04401          NTR Q1
04402          NTR Q2
04403          NTR Q3
04404          NTR T1
04405          NTR T2
04406          NTR T3
04407          NTR T4
04410          LTM
04411 527A     CAL *
04412          XIT (FIL)
04413 528A     TRA 390A
04414 529A     CAL *
04415          XIT (LEV)
04416          ETM
04417          CAL (IOH)O
04420          SLW 1
04421          CAL (STH)
04422 529D1    NTR 8)H,0,1
04423 530A     ETM
04424          NTR EM
04425          NTR REV
04426          NTR ELECRV
04427          NTR YT
04430          NTR CAPI
04431          NTR OE
04432          NTR ADVAL
04433          NTR PROFIT
04434          NTR PL
04435          NTR STAX
04436          NTR FTAX
04437          NTR FCT
04440          LTM
04441 531A     CAL *
04442          XIT (FIL)
04443 532A     CLA NFCB
04444 532A1    TZE 539A
04445 533A     CAL *
04446          XIT (LEV)
04447          ETM
04450          CAL (IOH)O
04451          SLW 1
04452          CAL (STH)
04453 533D1    NTR 8)T,0,1
04454 534A     LXD 2)+1,2
04455          CLA NFCB
04456          STD 535A2
04457 535A     ETM
04460          NTR VE1+1,2
04461          NTR VE2+1,2
04462          LTM
04463 535A1    TXI *+1,2,1
04464 535A2    TXL 535A,2
04465 537A     LTM
04466 538A     CAL *
04467          XIT (FIL)
04470 539A     PSE 113
04471          TRA 390A
04472 540A     CAL *
04473          XIT (LEV)
04474          ETM
04475          CAL (IOH)O
04476          SLW 1
04477          CAL (STH)
04500 540D1    NTR 8)V,0,1
04501 541A     ETM
04502          NTR AN
04503          NTR CAPIP
04504          NTR Q1
04505          NTR Q2
04506          NTR Q3
04507          NTR T1
04510          NTR T2
04511          NTR T3
04512          NTR T4
04513          LTM
04514 542A     CAL *
04515          XIT (FIL)
04516 543A     TRA 390A
04517 544A     CAL *
04520          XIT (LEV)
04521          ETM
04522          CAL (IOH)O
04523          SLW 1
04524          CAL (STH)
04525 544D1    NTR 8)S,0,1
04526 545A     ETM
04527          NTR MOD
04530          LTM
04531 546A     CAL *
04532          XIT (FIL)
04533 547A     TRA 400A
04534 548A     CAL *
04535          XIT (LEV)
04536          ETM
04537          CAL (IOH)O
04540          SLW 1
04541          CAL (STH)
04542 548D1    NTR 8)L,0,1
04543 549A     ETM
04544          NTR LABEL+1,1
04545          NTR PA+1,1
04546          LTM
04547 550A     CAL *
04550          XIT (FIL)
04551 551A     TRA 410A
04552 2)       OCT +000000000000
04553          OCT +000001000000
04554          OCT +000003000000
04555 3)       OCT +000000000000
04556          OCT +201400000000
04557          OCT +170547062117
04560          OCT +212764000000
04561          OCT +202400000000
04562          OCT +204500000000
04563          OCT +201600000000
04564          OCT +202500000000
04565          OCT +207620000000
04566          OCT +206740000000
04567          OCT +210454000000
04570          OCT +224750220000
04571          OCT +202700000000
04572          OCT +175631463146
04573          OCT +200777777776
04574          OCT +200400000000
04575          OCT +203500000000
04576          OCT +176631463146
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04577          OCT +2034000000000
04600          OCT +2055000000000
04601          OCT +1746314631460
04602          OCT +2065000000000
04603          OCT +1736314631460
04604          OCT +2164216000000
04605 6)       OCT +2330000000000
04606          OCT +0000000777777
04607          OCT +0000000000000
04610          OCT +0000010000000
04611          OCT +0000000000000
04612          BCD 115.6))
04613          BCD 1U/(1PE
04614 8)11     BCD 1(9X,1H
04615          BCD 1))
04616          BCD 1,E23.6
04617          BCD 1,E22.6
04620          BCD 1PE15.6
04621          BCD 1(T)/(1
04622          BCD 19X,4HE
04623          BCD 1HC(P)1
04624          BCD 1A19X,4
04625 8)10     BCD 1(9X,1H
04626          BCD 117.6)
04627          BCD 1 T4   E
04630          BCD 1/8H
04631          BCD 1 E17.6
04632          BCD 1    T3
04633          BCD 1
04634          BCD 1H
04635          BCD 17.6,18
04636          BCD 1T2   E1
04637          BCD 18H
04640          BCD 1E17.6/
04641          BCD 1   T1
04642          BCD 1
04643          BCD 1
04644          BCD 1.6,18H
04645          BCD 13   E17
04646          BCD 1H     Q
04647          BCD 117.6/8
04650          BCD 1 Q2   E
04651          BCD 1
04652          BCD 1
04653          BCD 16,18H
04654          BCD 1   E17.
04655          BCD 1     Q1
04656          BCD 17.6/8H
04657          BCD 1IP   E1
04660          BCD 1
04661          BCD 1
04662          BCD 1,18H
04663          BCD 1PE17.6
04664          BCD 1 AN   1
04665 8)V      BCD 1(8H
04666          BCD 14.6))
04667          BCD 122X,E1
04670          BCD 1E14.6,
04671          BCD 113X,1P
04672          BCD 1(E2)/(
04673          BCD 11X,5HV
04674          BCD 1V(E1)3
04675 8)T      BCD 1(4X,5H
04676          BCD 1NI6)
04677          BCD 1ICATIO
04700          BCD 10MODIF
04701 8)S      BCD 1(//13H
04702          BCD 114.6)
04703          BCD 1L FC E
04704          BCD 19HTOTA
04705          BCD 16,13X,
04706          BCD 1   E14.
04707          BCD 1 TAX
04710          BCD 14X,9HF
04711          BCD 1E14.6/
04712          BCD 1AX
04713          BCD 1,9HS T
04714          BCD 1.6,13X
04715          BCD 17X,E14
04716          BCD 1X,2HPL
04717          BCD 114.6/4
04720          BCD 1IT    E
04721          BCD 19HPROF
04722          BCD 16,13X,
04723          BCD 1   E14.
04724          BCD 1D VAL
04725          BCD 14X,9HA
04726          BCD 1E14.6/
04727          BCD 1.E.5X,
04730          BCD 13X,4HO
04731          BCD 114.6,1
04732          BCD 1HI8X,E
04733          BCD 16/4X,1
04734          BCD 1   E14.
04735          BCD 1U REV
04736          BCD 13X,9HP
04737          BCD 114.6,1
04740          BCD 1T REVE
04741          BCD 19HELEC
04742          BCD 1.6/4X,
04743          BCD 1REVE14
04744          BCD 1TOTAL
04745          BCD 113X,9H
04746          BCD 1E14.6,
04747          BCD 1V8X,1P
04750          BCD 1/4X,1H
04751          BCD 1OUTPUT
04752 8)R      BCD 1(/8H0
04753          BCD 13.6))
04754          BCD 12.6,E2
04755          BCD 15.6,E2
04756          BCD 1/(1PE1
04757          BCD 14HE(W)
04760          BCD 1F)19X,
04761          BCD 1X,4HE(
04762          BCD 1C(F)18
04763 8)Q      BCD 1(7X,4H
04764          BCD 117.6)
04765          BCD 1 M    E
04766          BCD 1
04767          BCD 1
04770          BCD 16,18H
04771          BCD 1A E17.
04772          BCD 1     ET
04773          BCD 17.6/8H
04774          BCD 1P    E1
04775          BCD 1
04776          BCD 1
04777          BCD 1,18H
05000          BCD 1PE14.6
05001          BCD 1SILONI
05002          BCD 1     EP
05003          BCD 1UE/11H
05004          BCD 1 REVEN
05005 8)P      BCD 1(10H0
05006          BCD 1IONS)
05007          BCD 1UM REG
05010          BCD 1LUTONI
05011          BCD 1,18H P
05012          BCD 1S    I2
05013          BCD 1REGION
05014          BCD 1ANIUM
05015          BCD 119H UR
05016          BCD 1    I2,
05017          BCD 1LATION
05020          BCD 1 CALCU
05021 8)O      BCD 1(17H V
05022          BCD 1IONS)
05023          BCD 1UM REG
05024          BCD 1LUTONI
05025          BCD 1,18H P
05026          BCD 1S    I2
05027          BCD 1REGION
05030          BCD 1ANIUM
05031          BCD 119H UR
05032          BCD 1    I2,
05033          BCD 1LATION
05034          BCD 1 CALCU
05035 8)N      BCD 1(17H M
05036 8)M      BCD 1(6I12)
05037          BCD 1)
05040          BCD 1PE12.5
05041          BCD 1 1A6,1
05042 8)L      BCD 1(4H
05043 8)K      BCD 1(12A6)
05044          BCD 112.5)
05045 8)J      BCD 1(I12,E
05046          BCD 114.6)
05047          BCD 1L FC E
05050          BCD 19HTOTA
05051          BCD 16,13X,
05052          BCD 1   E14.
05053          BCD 1 TAX
05054          BCD 14X,9HF
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05055          BCD  1E14.6/
05056          BCD  1AX
05057          BCD  1,9HS T
05060          BCD  1.6,13X
05061          BCD  17X,E14
05062          BCD  1X,2HPL
05063          BCD  114.6/4
05064          BCD  1IT   E
05065          BCD  19HPROF
05066          BCD  16,13X,
05067          BCD  1  E14.
05070          BCD  1D VAL
05071          BCD  14X,9HA
05072          BCD  1E14.6/
05073          BCD  1.E.5X,
05074          BCD  13X,4HO
05075          BCD  114.6,1
05076          BCD  1HI8X,E
05077          BCD  16/4X,1
05100          BCD  1  E14.
05101          BCD  1U REV
05102          BCD  13X,9HP
05103          BCD  114.6,1
05104          BCD  1T REVE
05105          BCD  19HELEC
05106          BCD  1.6/4X,
05107          BCD  1REVE14
05110          BCD  1TOTAL
05111          BCD  113X,9H
05112          BCD  1E14.6,
05113          BCD  1M8X,1P
05114          BCD  1/4X,1H
05115          BCD  1OUTPUT
05116  8)H     BCD  1(/8HO
05117          BCD  16))
05120          BCD  16,E23.
05121          BCD  16,E22.
05122          BCD  11PE15.
05123          BCD  1LTA)/(
05124          BCD  18HC(DE
05125          BCD  12)17X,
05126          BCD  1X,4HE(
05127          BCD  1E(1)18
05130  8)G     BCD  1(7X,4H
05131          BCD  123.6))
05132          BCD  122.6,E
05133          BCD  115.6,E
05134          BCD  1)/(1PE
05135          BCD  1 PRIME
05136          BCD  110HT(S
05137          BCD  1S)16X,
05140          BCD  1X,4HT(
05141          BCD  1T(D)18
05142  8)F     BCD  1(7X,4H
05143          BCD  123.6))
05144          BCD  122.6,E
05145          BCD  115.6,E
05146          BCD  1 /(1PE
05147          BCD  15HT(R)
05150          BCD  1F)19X,
05151          BCD  1X,4HT(
05152          BCD  1T(C)18
05153  8)E     BCD  1(7X,4H
05154          BCD  123.6))
05155          BCD  122.6,E
05156          BCD  115.6,E
05157          BCD  1)/(1PE
05160          BCD  1 PRIME
05161          BCD  110HC(S
05162          BCD  1S)16X,
05163          BCD  1X,4HC(
05164          BCD  1C(W)18
05165  8)D     BCD  1(7X,4H
05166          BCD  13.6))
05167          BCD  12.6,E2
05170          BCD  15.6,E2
05171          BCD  1/(1PE1
05172          BCD  14HC(R)
05173          BCD  1F)19X,
05174          BCD  1X,4HC(
05175          BCD  1C(C)18
05176  8)C     BCD  1(7X,4H
05177          BCD  123.6))
05200          BCD  122.6,E
05201          BCD  115.6,E
05202          BCD  1 /(1PE
05203          BCD  15HL(W)
05204          BCD  1F)19X,
05205          BCD  1X,4HL(
05206          BCD  1L(C)18
05207  8)B     BCD  1(7X,4H
05210          BCD  1.6))
05211          BCD  1.6,E23
05212          BCD  1.6,E22
05213          BCD  1(1PE15
05214          BCD  1HL(3)/
05215          BCD  1)19X,4
05216          BCD  1,4HL(2
05217          BCD  1(1)18X
05220          BCD  17X,4HL
05221          BCD  1COSTS/
05222          BCD  1CYCLE
05223          BCD  1 FUEL
05224  8)A     BCD  1(19H0
05225          BCD  16)
05226          BCD  11PE13.
05227          BCD  1COST =
05230          BCD  1CYCLE
05231          BCD  1 FUEL
05232  8)9     BCD  1(20H0
05233          BCD  1E17.6)
05234          BCD  1  J(F)
05235          BCD  16/8H
05236          BCD  1  E17.
05237          BCD  1    G
05240          BCD  1
05241          BCD  18H
05242          BCD  117.6,1
05243          BCD  1 IPARE
05244          BCD  1/8H
05245          BCD  1EE15.6
05246          BCD  1 NPRIM
05247          BCD  1
05250          BCD  1
05251          BCD  16,20H
05252          BCD  1  E17.
05253          BCD  1    P
05254          BCD  17.6/8H
05255          BCD  1J(S)E1
05256          BCD  1
05257          BCD  1
05260          BCD  1,18H
05261          BCD  1PE16.6
05262          BCD  1ALPHA1
05263          BCD  19H
05264          BCD  1TAXES/
05265  8)8     BCD  1(8HO
05266          BCD  17.6)
05267          BCD  1PF  F1
05270          BCD  1
05271          BCD  1
05272          BCD  1,18H
05273          BCD  1PE17.6
05274          BCD  1 A(1)1
05275          BCD  1/8H
05276          BCD  1HARGES
05277          BCD  1ANCE C
05300          BCD  1 INSUR
05301  8)7     BCD  1(20HO
05302          BCD  16)
05303          BCD  1I F17.
05304          BCD  1    PS
05305          BCD  1
05306          BCD  18H
05307          BCD  116.6,1
05310          BCD  1DELTAE
05311          BCD  19H
05312          BCD  1E17.6/
05313          BCD  1  PHI
05314          BCD  1
05315          BCD  1
05316          BCD  1.6,18H
05317          BCD  1 1PE16
05320          BCD  1  CHI
05321          BCD  1S/9H
05322          BCD  1CHARGE
05323          BCD  1LOREM
05324          BCD  1 AD VA
05325  8)6     BCD  1(21HO
05326          BCD  1E16.6)
05327          BCD  1 OMEGA
05330          BCD  1/9H
05331          BCD  1PROFIT
05332          BCD  1/9HO
```

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05333          BCD 1PE19.6
05334          BCD 1    OM1
05335          BCD 1TS/6H
05336          BCD 1CE COS
05337          BCD 1NTENAN
05340          BCD 1ND MAI
05341          BCD 1TING A
05342          BCD 1 OPERA
05343 8)5      BCD 1(34H0
05344          BCD 117.6)
05345          BCD 1 V    E
05346          BCD 1
05347          BCD 1
05350          BCD 16,18H
05351          BCD 1A E17.
05352          BCD 1    ET
05353          BCD 17.6/8H
05354          BCD 1P    E1
05355          BCD 1
05356          BCD 1
05357          BCD 1,18H
05360          BCD 1PE14.6
05361          BCD 1SILON1
05362          BCD 1     EP
05363          BCD 1UE/11H
05364          BCD 1 REVEN
05365 8)4      BCD 1(10H0
05366          BCD 16)
05367          BCD 1D)E17.
05370          BCD 1     N(
05371          BCD 1
05372          BCD 18H
05373          BCD 117.6,1
05374          BCD 1 I(D)E
05375          BCD 1/8H
05376          BCD 1)E17.6
05377          BCD 1    N(C
05400          BCD 1
05401          BCD 1H
05402          BCD 17.6,18
05403          BCD 1I(C)E1
05404          BCD 18H
05405          BCD 1E17.6/
05406          BCD 1   N
05407          BCD 1
05410          BCD 1
05411          BCD 1.6,18H
05412          BCD 1    E17
05413          BCD 1H     I
05414          BCD 117.6/8
05415          BCD 1 I(L)E
05416          BCD 1
05417          BCD 1
05420          BCD 16,18H
05421          BCD 11PE17.
05422          BCD 1  BETA
05423          BCD 1S/8H
05424          BCD 1CHARGE
05425          BCD 1FIXED
05426          BCD 116H0
05427          BCD 1INPUT/
05430 8)3      BCD 1(/7H0
05431          BCD 15)
05432 8)2      BCD 1(6E12.
05433          BCD 1     )
05434          BCD 1
05435          BCD 1
05436          BCD 1
05437          BCD 1
05440          BCD 1
05441          BCD 1
05442          BCD 1
05443          BCD 1
05444          BCD 1
05445          BCD 1
05446          BCD 1
05447 8)1      BCD 1(72H
```

APPENDIX F

SAMPLE PROBLEM INPUT AND OUTPUT

704 INPUT DATA
FORM I

PROBLEM SAMPLE PROBLEM ORIGINATOR J. HEESTAND PROGRAM 0908/RE224 DATE 2/24/61 PAGE 1 OF 3

1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0
1	2	3	4	5	6	7 8
0908/RE224	SAMPLE PROBLEM	2/24/61				TITLE 1
1	3	3				PARAMS 2
1.0	.0635	1.05 E+08	1.5 E+07	3.6 E+05	25.0	FIXED 3
1.5	1.0					CHARGES 4
.8	.3	1000.0	12.0	0.0		REVENUE 5
2.0 E+06						OM 6
.0444						PROFIT 7
.05	1.0	.00225	.00133			AD VAL 8
4.0 E+04	1.0					INSUR 9
0.0	.5	.045	.52	.27	25.0	TAXES 10
0.0						11
0.0						FC 12
5.0 E+04	4.9 E+04	0.0	.01	.01	0.0	FUEL 13
15.0	85.0	25.0	0.0	3.0	16.0	CYCLE 14
.0111	.25	.2	.33	.111	.0555	PARAM- 15
.03	.02	37.29	39.27	.00714	.00221	ETER 16
3430	1.5	5.2 E+05	.04			SET 17
1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0	1 2 3 4 5 6 7 8 9 0
1	2	3	4	5	6	7 8

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704 INPUT DATA
FORM I

PROBLEM | ORIGINATOR | PROGRAM | DATE | PAGE 2 OF 3

1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0
	1	2	3	4	5	6	7	8
.5.0 E+04	4.8 E+04	1.0 E+04	.01	.01	.05	2	13
15.0	100.0	25.0	100.0	3.0	16.0	2	14
.011	.25	.2	.5	.11	.055	2	15
.03	.025	37.29	39.27	.007142	.002211	2	16
300.0	1.5	5.0 E+05	.04			2	17
4.0 E+04	3.5 E+04	1.0 E+04	.01	.01	.05	3	13
15.0	75.0	25.0	100.0	3.0	16.0	3	14
.011	.25	.2	.25	.11	.055	3	15
.025	.02	37.29	39.27	.007142	.002211	3	16
400.0	1.5	4.0 E+05	.04			3	17
5.0 E+04	4.9 E+04	1.0 E+04	.01	.01	.05	4	13
10.0	70.0	30.0	100.0	3.0	16.0	4	14
.01	.2	.3	.4	.1	.05	4	15
0.0	0.0	0.0	0.0	0.0	0.0	4	16
0.0	1.5	5.0 E+05	.05			4	17
5.1 E+04	5.0 E+04	1.0 E+04	.01	.01	.05	5	13
15.0	80.0	20.0	100.0	3.0	16.0	5	14
.01	.2	.3	.4	.1	.05	5	15
0.0	0.0	0.0	0.0	0.0	0.0	5	16
1.0	1.5	5.0 E+05	.05			5	17
1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0
	1	2	3	4	5	6	7	8

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704 INPUT DATA
FORM I

PROBLEM | ORIGINATOR | PROGRAM | DATE | PAGE 3 OF 3

1	2	3	4	5	6	7
4.9E+04	4.8E+04	1.0E+04	.01	.01	.05	6 13
20.0	90.0	10.0	100.0	3.0	16.0	6 14
.01	.2	.3	.4	.1	.05	6 15
0.0	0.9	0.0	0.0	0.0	0.0	6 16
0.0	1.5	5.0E+05	.05			6 17
			.05			

AMD-8 (5-58)

0908/RE224 SAMPLE PROBLEM 2/24/61
M CALCULATION 3 URANIUM REGIONS 3 PLUTONIUM REGIONS

INPUT

FIXED CHARGES

BETA	1.000000E 00	I(L)	3.600000E 05
I	6.350000E-02	N	2.500000E 01
I(C)	1.050000E 08	N(C)	1.500000E 00
I(D)	1.500000E 07	N(D)	1.000000E 00

REVENUE

EPSILON	8.000000E-01	P	1.000000E 03
ETA	3.000000E-01	V	1.200000E 01

OPERATING AND MAINTENANCE COSTS

OM	2.000000E 06

PROFIT

OMEGA	4.400000E-02

AD VALOREM CHARGES

CHI	5.000000E-02	PHI	2.500000E-03
DELTA	1.000000E 00	PSI	1.300000E-03

INSURANCE CHARGES

A(1)	4.000000E 04	PF	1.000000E 00

TAXES

ALPHA	0.	J(S)	2.700000E-01
B	5.000000E-01	NPRIME	2.500000E 01
IBAR	4.500000E-02	G	0.
J(F)	5.200000E-01		

FUEL CYCLE COSTS

L(1)	L(2)	L(3)
5.000000E 04	4.900000E 04	0.
5.000000E 04	4.800000E 04	1.000000E 04
4.000000E 04	3.500000E 04	1.000000E 04
5.000000E 04	4.900000E 04	1.000000E 04
5.100000E 04	5.000000E 04	1.000000E 04
4.900000E 04	4.800000E 04	1.000000E 04

L(C)	L(F)	L(W)
10.000000E-03	10.000000E-03	0.
10.000000E-03	10.000000E-03	5.000000E-02
10.000000E-03	10.000000E-03	5.000000E-02
10.000000E-03	10.000000E-03	5.000000E-02
10.000000E-03	10.000000E-03	5.000000E-02
10.000000E-03	10.000000E-03	5.000000E-02

C(C)	C(F)	C(R)
1.500000E 01	8.500000E 01	2.500000E 01
1.500000E 01	1.000000E 02	2.500000E 01
1.500000E 01	7.500000E 01	2.500000E 01

1.000000E 01	7.000000E 01	3.000000E 01
1.500000E 01	8.000000E 01	2.000000E 01
2.000000E 01	9.000000E 01	1.000000E 01
C(W)	C(S)	C(S PRIME)
0.	3.000000E 00	1.600000E 01
1.000000E 02	3.000000E 00	1.600000E 01
1.000000E 02	3.000000E 00	1.600000E 01
1.000000E 02	3.000000E 00	1.600000E 01
1.000000E 02	3.000000E 00	1.600000E 01
1.000000E 02	3.000000E 00	1.600000E 01
T(C)	T(F)	T(R)
1.100000E-02	2.500000E-01	2.000000E-01
1.100000E-02	2.500000E-01	2.000000E-01
1.100000E-02	2.500000E-01	2.000000E-01
10.000000E-03	2.000000E-01	3.000000E-01
10.000000E-03	2.000000E-01	3.000000E-01
10.000000E-03	2.000000E-01	3.000000E-01
T(D)	T(S)	T(S PRIME)
3.300000E-01	1.100000E-01	5.500000E-02
5.000000E-01	1.100000E-01	5.500000E-02
2.500000E-01	1.100000E-01	5.500000E-02
4.000000E-01	10.000000E-02	5.000000E-02
4.000000E-01	10.000000E-02	5.000000E-02
4.000000E-01	10.000000E-02	5.000000E-02
E(1)	E(2)	C(DELTA)
3.000000E-02	2.000000E-02	3.729000E 01
3.000000E-02	2.500000E-02	3.729000E 01
2.500000E-02	2.000000E-02	3.729000E 01
0.	0.	0.
0.	0.	0.
0.	0.	0.
C(F)	E(F)	E(W)
3.927000E 01	7.140000E-03	2.210000E-03
3.927000E 01	7.140000E-03	2.210000E-03
3.927000E 01	7.140000E-03	2.210000E-03
0.	0.	0.
0.	0.	0.
0.	0.	0.
A	C(P)	E(T)
3.430000E 02	1.500000E 00	5.200000E 05
3.000000E 02	1.500000E 00	5.000000E 05
4.000000E 02	1.500000E 00	4.000000E 05
0.	1.500000E 00	5.000000E 05
1.000000E 00	1.500000E 00	5.000000E 05
0.	1.500000E 00	5.000000E 05
U		
4.000000E-02		
4.000000E-02		
4.000000E-02		
5.000000E-02		
5.000000E-02		
5.000000E-02		

OUTPUT

M	1.336895E 02	TOTAL REV	2.889936E 08
ELECT REV	2.810688E 08	PU REV	7.924775E 06
I	1.314285E 08	O.E.	2.725817E 08
AD VAL	5.668368E 06	PROFIT	5.786251E 06
PL	2.600000E 05	S TAX	6.667537E 06
F TAX	9.374063E 06	TOTAL FC	2.486118E 08
V(E1)		V(E2)	
	3.729599E 02		2.184147E 02
	3.729599E 02		2.948872E 02
	2.948872E 02		2.184147E 02

APPENDIX G

SAMPLE WORK SHEET

The following is a sample work sheet proposed by T. Heckman of the AEC, to be of aid to the problem originator.

0908/RE224 REACTOR ECONOMICS WORK SHEET

ORIGINATOR _____ DATE _____

PARAMETER	(J) INDEX	UNITS	PLANT_____ PROBLEM NO. _____			PLANT _____ PROBLEM NO. _____		
			VALUE	REFERENCE (AUTHOR AND/OR DOCUMENT)	ACCURACY G GOOD F FAIR P POOR	VALUE	REFERENCE (AUTHOR AND/OR DOCUMENT)	ACCURACY G GOOD F FAIR P POOR
MCALC	1	-						
NFCB	2	-						
NFCC	3	-						
β	4	-						
$\imath$	5	% x 10^{-2}						
I_c	6	$						
I_d	7	$						
I_ℓ	8	$						
n	9	yr						
n_c	10	yr						
n_d	11	yr						
ϵ	12	% x 10^{-2}						
η	13	% x 10^{-2}						
P	14	TMW						
v	15	$/gm						
m	16	mills/kwh						
OM	17	$/yr						
ω	18	% x 10^{-2}						
χ	19	% x 10^{-2}						
δ	20	% x 10^{-2}						
ϕ	21	% x 10^{-2}						
ψ	22	% x 10^{-2}						
a_1	23	per million						

ORIGINATOR _____ DATE _____

PARAMETER	(J) INDEX	UNITS	PLANT_____ PROBLEM NO._____			PLANT_____ PROBLEM NO._____		
			VALUE	REFERENCE (AUTHOR AND/OR DOCUMENT)	ACCURACY G GOOD F FAIR P POOR	VALUE	REFERENCE (AUTHOR AND/OR DOCUMENT)	ACCURACY G GOOD F FAIR P POOR
PF	24	-						
α	25	-						
b	26	% x 10^{-2}						
$\underline{1}$ '	27	% x 10^{-2}						
JF	28	% x 10^{-2}						
JS	29	% x 10^{-2}						
n'	30	yr						
g	31	% x 10^{-2}						
fc_t	32	\$/yr						
L_1	33-42	kg						
L_2	43-52	kg						
L_3	53-62	kg						
ℓ_c	63-72	% x 10^{-2}						
ℓ_f	73-82	% x 10^{-2}						
ℓ_w	83-92	% x 10^{-2}						
c_c	93-102	\$/kg						
c_f	103-112	\$/kg						
c_r	113-122	\$/kg						
c_w	123-132	\$/kg						
c_s	133-142	\$/kg						
$c_{s'}$	143-152	\$/kg						
t_c	153-162	yr						
t_f	163-172	yr						

ORIGINATOR _____ DATE _____

PARAMETER	(J) INDEX	UNITS	PLANT_____ PROBLEM NO. _____			PLANT_____ PROBLEM NO._____		
			VALUE	REFERENCE (AUTHOR AND/OR DOCUMENT)	ACCURACY G GOOD F FAIR P POOR	VALUE	REFERENCE (AUTHOR AND/OR DOCUMENT)	ACCURACY G GOOD F FAIR P POOR
t_r	173-182	yr						
t_d	183-192	yr						
t_s	193-202	yr						
$t_{s'}$	203-212	yr						
e_1	213-222	wt % x 10^{-2}						
e_2	223-232	wt % x 10^{-2}						
C_Δ	233-242	\$/kg						
C_F	243-252	\$/kg						
e_F	253-262	wt % x 10^{-2}						
e_w	263-272	wt % x 10^{-2}						
A	273-282	kg						
c_p	283-292	\$/gm						
E_t	293-302	TMW day						
u	303-312	% x 10^{-2}/yr						
fc_{core}		\$/yr						
fc_{AB}		\$/yr						
fc_{IB}		\$/yr						
fc_{OB}		\$/yr						

REFERENCES

(a) J. M. McCampbell, Paper 16-6, Analytical Treatment of Power Reactor Economics, presented at the American Nuclear Society meeting in December, 1958.

(b) Indemnity regulations, 10 CFR 140, Federal Register, April 7, 1960.

(c) H. L. Hollister, and A. J. Burington, Pricing Enriched Uranium, Nucleonics, 16 (January 1958).

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