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SOLSTOR Description and User's Guide

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ABSTRACT

This report describes the computer simulation code SOLSTOR. The code simulates energy systems in which electricity is generated by either a photovoltaic (PV) system or a wind turbine generator (WTG). Storage may or may not be present. Backup electricity, if needed, is provided either from a utility grid or from a fuel-burning generator. SOLSTOR minimizes the life cycle cost of providing energy by choosing the optimal solar or wind system component sizes. Rates for electricity purchased from the grid can include time-of-day (TOD) energy charges as well as time-of-day peak demand changes. Sell-back to the grid of excess collected energy is also considered.

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Chapter I. Introduction

Several computer simulation codes exist which simulate or analyze photovoltaic (PV) and/or wind energy conversion systems (WECS) (Refs. 1, 2). In general, they accept as input a specified system configuration and analyze it using detailed performance simulation of the system components. SOLSTOR, on the other hand, uses fairly simple models of the components and is intended to generate the most economical system configuration, which can then be analyzed in detail by these other codes. SOLSTOR, then, is an effective tool for analyzing the economics of solar systems and for studying the effect of various economic parameters, including electricity rate structures (see Ref. 3). Electricity rates may include fixed service charges, time-of-day pricing, demand charges, and seasonal adjustments.

This document describes SOLSTOR as it is in late 1980. We intend the code to evolve as new problems arise, therefore, changes and improvements in SOLSTOR are expected in the future. A listing of current version of the SOLSTOR FORTRAN source code is in microfiche form at the end of this report.

SOLSTOR models a generalized solar system which can include wind turbines or PV arrays as energy sources and batteries or flywheels as system storage. Backup and/or storage charging power may be either purchased from the utility grid or obtained from an on-site fossil-fueled generator. A typical system configuration for the grid-connected case is shown in Figure 1.1 There are four major components (collector, storage, power conditioning, and utility-powered battery charger), each characterized by a "size" (physical or electrical), an efficiency, and a cost equation. In addition, the storage has a self-discharge rate parameter (leakage), and parameters limiting the rate of charge/discharge. As may be seen in Figure 1.1, all possible paths for energy flows are allowed. That is to say, array energy may flow to any or all of three destinations: (1) to the load (demand), (2) to storage, or (3) to the utility (sell-back mode). Likewise, stored energy may be (1) left in storage, (2) sent

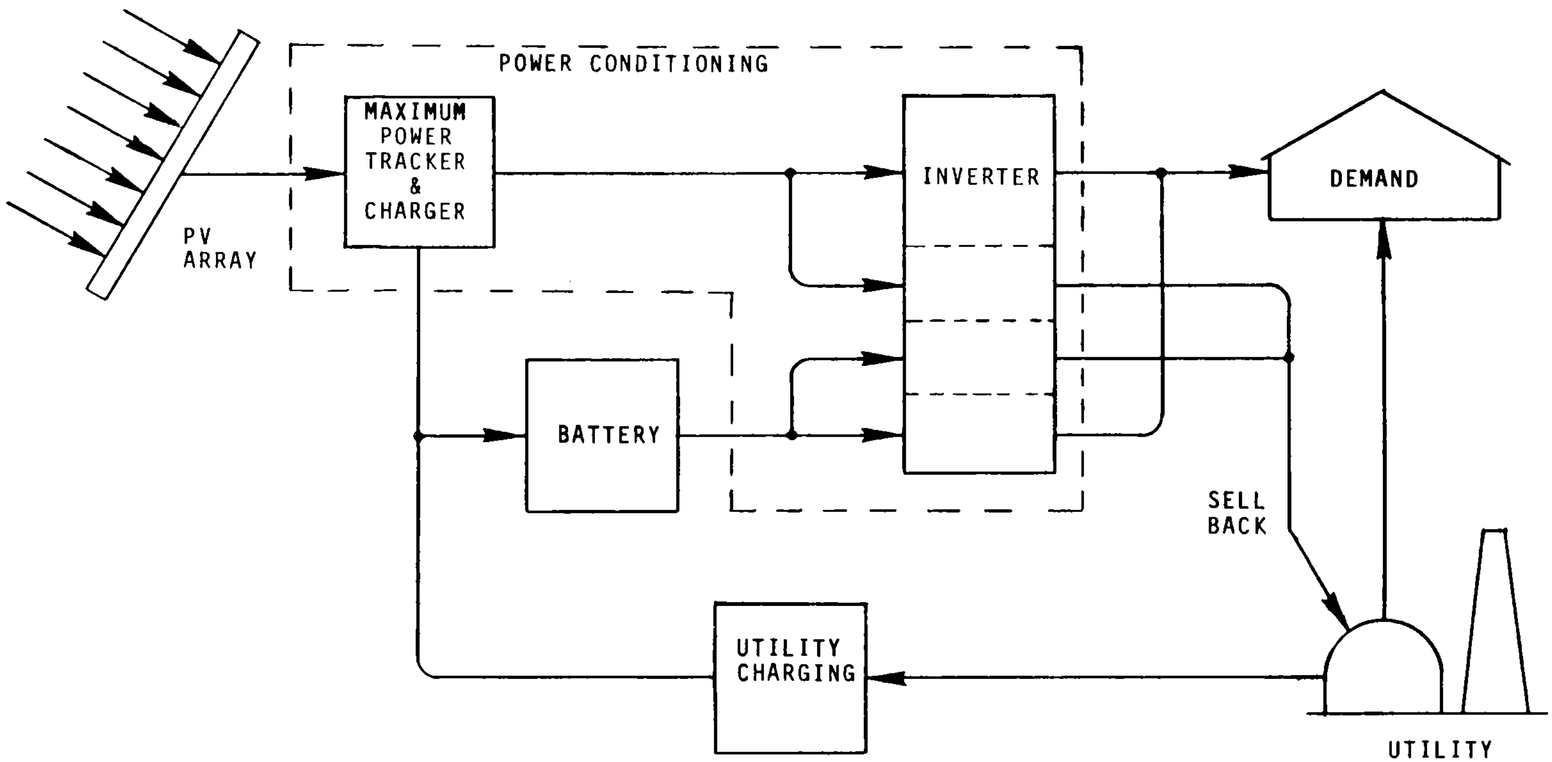

Figure 1.1 SOLSTOR Model

to the load, or (3) sold to the utility; and finally, the battery may be charged from either the utility or the array. Decisions on all of these possibilities are made hourly, with a typical simulation run covering one year. Strategy algorithms, including predictive ones, for determining the choices are discussed later.

The version which provides backup energy from an on-site generator is somewhat simpler than the utility version since there is no "sell-back" option. The generator may be powered by gasoline, coal, natural gas, or diesel fuel. The generator model is discussed later in detail; the major parameters are the fuel cost, generator efficiency versus load, and start-up efficiency. The generator version of SOLSTOR has the capability of meeting only a user-specified fraction of the "desired" yearly demand. This allows the user to determine the cost effectiveness of insisting on meeting only 90 percent of the load versus 100 percent, for example.

The utility-connected model is referred to as the "UE" version (Utility Electric), while the generator version is known as "GE" (Generator Electric). A brief table of SOLSTOR options is given in Table 1.1.

TABLE 1.1 SOLSTOR Options

Utility Connector, 1 Collector, 1 Storage Device

Identification	Energy Allocation Strategy
UE11A	Simple, based on storage level.
UE11B	Simple, based on timing of price changes.
UE11C	Complex, linear programming technique, assumes perfect knowledge of future supply and demand.
UE11D	Complex, moving linear programming technique, predicts future supply and demand. Spline and global average schemes implemented.

Stand-Alone, 1 Collector, 1 Storage Device

Identification	Generator Control Strategy
GE11A, Q = 0	Simple, based on storage level and fixed times.
GE11A, Q = 1	Simple, based on present supply, demand, and storage level.
GE11A, Q > 1	Moderately complex, based on predictions of supply and demand for Q hours. Spline, global averages and perfect knowledge schemes implemented.

Chapter II. Economic Analysis

SOLSTOR economic analysis is based on the concept of life cycle cost, with methodologies appropriate to either personal (homeowner) or corporate (commercial, factory, etc.) entities. This chapter details the methodology.

Assumptions

The figure of merit for a system is the annualized cost for the life of the system referred to the base year. Cost is divided into capital cost, operation-maintenance cost (OM), and energy purchase cost. Increased property-tax costs, if any, due to capital investment are assigned to capital cost. It is possible that certain major system components require replacement during the system life. These items require depreciation rather than expensing, and their replacement cost is part of capital cost, not OM cost. For UE (Utility-Electric) systems, only the storage device may be replaced. For GE (Generator-Electric), only the storage device and back-up generator may be replaced. Also, the generator may require periodic overhauling, the cost of which is expensed as OM.

The economic computation considers events in whole year increments. These economics assume the following rules:

1. Initial capital investment is at the beginning of the first year of operation and includes all capital items, including items which may require replacement. Operation commences at the beginning of this year.

2. A loan, if any, is for the total initial investment only. All subsequent expenses and capital replacements are paid for in cash. The life of the loan is not greater than the life of the system. Principal plus interest on the unpaid balance are paid in equal yearly installments at the end of each year.

3. All costs are constant over a year. Any cost escalation takes place as a step function at the beginning of each year. Escalation is absolute; i.e., not relative to inflation.

4. All OM, property tax, purchased energy, and overhaul expenses are priced at the beginning of the year and paid for and tax expensed at the end of the year.

5. Replacement items are purchased in cash at the beginning of the year in which they are required.

6. All capital items are depreciated at the end of the year in which they are purchased and subsequent years. Depreciation method is sum-of-years digits (SOYD).

7. The "true" life of nonreplaceable components is the system life. The "true" life of a replaceable component is the lesser of the life computed by the simulation and the system life. Depreciation life of each item is the lesser of its true life and the specified maximum allowed depreciation life. Replaceables with true life less than one year are expensed as capital items.

8. Investment tax credit is claimed at the end of the year of purchase, not carried forward or backward. The tax credit schedule is zero for life < 3, 1/3 for $3 \leq$ life < 5, 2/3 for $5 \leq$ life < 7, and 1.0 for $7 \leq$ life. Here, life is depreciation life.

9. The effective tax rate is not affected by tax writeoffs.

10. Salvage value of components is constant (excluding escalation) after depreciation life. Income from salvaged items has no tax consequences.

11. When a component is replaced, its out-of-pocket cost is escalated cost less escalated salvage. Both cost and salvage escalate at the same rate.

12. Generator overhaul costs escalate at the same rate as OM costs.

13. Escalation of OM and property tax is considered only over the system life; that is, the ratio of OM and property-tax annual cost to initial capital cost for the first year of operation is independent of the year specified.

Economic Parameters

y_p = Price year. All input costs are quoted in this year.

y_o = Year of first operation.

y_b = Base year. All output costs are in base-year dollars.

R = Discount rate

i = Loan interest rate

D = Ratio of down payment to loan

τ = Effective income tax rate (federal plus state plus local marginal rate)

f_{om} = Ratio of annual OM cost to initial capital cost, assumed same for all components

f_{pt} = Ratio of increased annual property tax to initial capital cost

g = General inflation rate

g_{om} = Escalation rate of OM

g_{pt} = Escalation rate of property tax

g_f = Escalation rate of purchased energy--fuel for generator or electrical energy from utility

N = Life of system in years (integer)

L = Life of loan in years (integer), $L \leq N$

K_0 = Maximum depreciation life of nonreplaceables, years (integer), $K_0 \leq N$

S_0 = Ratio of salvage value to initial cost of nonreplaceables

T_0 = Ratio of maximum investment tax credit to initial cost of nonreplaceables

g_0 = Escalation rate of nonreplaceables

K_r = Maximum depreciation life of r-th replaceable item in years (integer); r=1,2,...

S_r = Ratio of salvage value to initial cost of r-th replaceable

T_r = Ratio of maximum investment tax credit to initial cost of r-th replaceable

g_r = Escalation rate of r-th replaceable

f_{or} = Ratio of overhaul cost to initial capital cost for r-th component--used only for generators

A dependent variable is $\hat{\tau}$, defined as

$\hat{\tau} = 0$ if system is personal,

$\hat{\tau} = \tau$ if system is business-owned.

If the system is business owned, depreciation and certain expense items are tax deductable which are not tax deductable if personally owned.

Price-Year Present-Value Computation

Most of the formulas presented here are from References 4 and 5. The annualized system cost is computed by summing the present value, PV, referenced to the base year, of all economic terms and finding the annualized cost, AC, from the PV over the system life. The PV of an annual one dollar payment discounted at rate R and escalating at rate g for N years is

$$p(R,g,N) = \frac{\left[1-\left(\frac{1+g}{1+R}\right)^N\right]}{R-g} \quad ,$$

$$p(R,g{=}R,N) = N/(1+R) \quad .$$

The assumption here is that cost is determined at the beginning of each year and paid at the end of the year; or, equivalently, there is no escalation in the first year--consistent with the rules above.

Let C_r be the capital cost in price year dollars of the r-th component; where r=0 refers to the total of all nonreplaceables. The present-value capital cost associated with the initial investment in the r-th component in the price year is

$$\frac{PVI_r}{C_r} = D \qquad \text{down payment}$$

$$+ (1-D)p(R,0,L)/p(i,0,L) \qquad \text{loan payment}$$

$$- \tau(1-D)\left\{p(R,i,L)\left[i - \frac{1}{p(i,0,L)}\right] + \frac{p(R,0,L)}{p(i,0,L)}\right\} \qquad \text{interest tax deduction}$$

$$+ (1-\tau)f_{pt}p(R,g_{pt},N) \qquad \text{property tax}$$

$$- S_r\left(\frac{1+g_r}{1+R}\right)^N \qquad \text{salvage}$$

$$- \theta(k_r)T_r/(1+R) \qquad \text{investment tax credit}$$

$$- 2\,\hat{\tau}\,\frac{(1-S_r)\left[k_r - p(R,0,k_r)\right]}{Rk_r(k_r+1)} \quad , \qquad \text{depreciation}$$

where

$$k_r = \max\left[1, \min\left(K_r, \text{ integer part of true life of r-th item}\right)\right] ,$$

and

$\theta(k_r)$ = 0, 1/3, 2/3, or 1 depending on k_r, according to the investment tax credit schedule.

The OM present value associated with the r-th component is

$$PVOM_r = C_r(1-\hat{\tau})f_{om}p(R,g_{om},N) \quad .$$

Note that OM cost is associated only with <u>initial</u> capital cost.

Let t_{rj} be the year in which the r-th replaceable is replaced for the j-th time. Let this component be replaced exactly J_r times during the system life such that the true life of the component is $N/(J_r+1)$, then

$$t_{rj} = y_o + \text{integer part of } \left[jN/(J_r + 1)\right] \quad .$$

Now, the price-year present value of all replacements (not initial purchase) of this item is

$$PVR_r(J_r) = C_r(1-S_r)\left\{1 - \frac{\theta(k_r)T_r}{1+R} - \frac{2\hat{\tau}\left[k_r - p(R,0,k_r)\right]}{Rk_r(k_r+1)}\right\} \sum_{j=1}^{J_r} \left(\frac{1+g_r}{1+R}\right)^{t_{rj}-y_o}$$

$$= 0 \text{ if } J_r = 0 \quad (\text{Note } PVR_0=0)$$

Let t_{rh} be the integer part of the years in which the r-th component is overhauled. For H_r overhauls, the price-year present value of the overhauls is

$$PVOH_r(H_r) = \frac{C_r f_{or}(1-\hat{\tau})}{1+R} \sum_{h=1}^{H_r} \left(\frac{1+g_{om}}{1+R}\right)^{t_{rh}-y_o}$$

$$= 0 \text{ if } H_r = 0 \quad .$$

If C_f is the annual cost of purchased energy in price-year dollars, the price-year present value of purchased fuel for the system life is

$$PVF = C_f \ (1-\hat{\tau})p(R,g_f,N) \quad .$$

All present value formulae given in this section are in price-year dollars.

Cost and Timing of Replacements and Overhauls

For simplicity we temporarily drop the r subscript. Let Y N be the true life in years of a replaceable component, as computed by the simulation. If Y = N, the number of replacements, J, is zero, and there are no replacements. Let Y be less than N. The life Y is not necessarily an integer, and the number of replacements

$$J = N/(Y+1)$$

is also not necessarily an integer. Our economics now has the problem of coping with a partial life, with the attendant problem of defining salvage value for a life less than the depreciation life.

To circumvent these difficulties, the following approximation is used: Define

$$J_1 = \text{integer part of } [N/(Y+1)] \geq 1$$

$$J_2 = J_1 + 1$$

We compute the replacement present value for $J = J_1$ and $J = J_2$ and estimate the PV for J replacements by linear interpolation;

$$PVR(J) = \left[PVR(J_2) - PVR(J_1)\right](J - J_1) + PVR(J_1) \quad .$$

The replacement times are

$$t_{ij} = y_o + \text{integer part of } \left[jN/(J_i+1)\right] \quad .$$

$$i = 1,2 \quad .$$

The criterion for overhaul is that an item is overhauled Q times before it is replaced. We assume the overhauls are equispaced in time. For J (integer) replacements, the overhaul times are

$$t_{jh} = y_o + \text{integer part of } \left[\frac{N}{J+1}\ j + \frac{hN}{Q+1}\right] ,$$

$$j = 0,1,\ldots,J ,$$

$$h = 1,\ldots,Q .$$

Note that overhaul of the initial purchase, j=0, is included.

Implicit in these schemes is that each replacement of a component has the identical life; and, if life depends on usage, wear occurs in a uniform way throughout each year.

System Annualized Cost in Base Year

The annualized costs in the base year for each economic term may now be computed. The annualized capital cost of the r-th component in the base year is

$$ACC_r = (1+g)^{y_b - y_o}(1+g_r)^{y_o - y_p}(PVI_r + PVR_r)/p(R,0,N) ,$$

and the total AC of capital is

$$ACC = \sum_{r=0,1,\ldots} ACC_r .$$

The total AC of OM is

$$ACOM = \frac{(1+g)^{y_b - y_o}}{p(R,0,N)} \sum_{r=0,1,\ldots} (1+g_r)^{y_o - y_p} (PVOM_r + PVOH_r) \quad .$$

The annualized fuel cost in the base year is

$$ACF = (1+g)^{y_b - y_o} (1+g_f)^{y_o - y_p} PVF/p(R,0,N) \quad .$$

The total system AC is

$$ACSYS = ACC + ACOM + ACF \quad .$$

If required rate of revenue (see Ref. 6) is desired, the relationship is simply

$$\text{Required rate of revenue} = \frac{ACSYS}{1-\tau} \quad .$$

Chapter III. Supply

SOLSTOR requires as supply inputs, hourly weather data for a year. Parameters required are: insolation (for calculating both PV output and heating or cooling loads), wind speed (required only for wind energy systems), and ambient temperatures (for heating and cooling load calculations). The file format required for this data is given in Chapter IX. While any hourly data can be used, we prefer to use TMY (Typical Meteorological Year) data (Ref. 7), since it is specifically designed to provide "typical" or average year data. There would be little advantage in using SOLMET data for different years, since SOLSTOR simulates only one year of operation and extrapolates that performance to arrive at life cycle costs. It would, of course, be possible to run simulations on the same system using different year data in order to estimate the yearly performance variations to be expected in practice.

PV Arrays

Hourly output of a flat plate PV array is calculated from the hourly insolation by computing the flux density on the array (assumed to be oriented due south, but at a user specified tilt angle) from the geometry of the sun's position relative to the array. A simple temperature-invariant overall array efficiency then is used to translate insolation to electrical output.

Let I^t in kWh/m^2 be the total solar supply energy density at hour-of-the-year t. We assume this quantity is constant during each hour. The solar data for the chosen site contains the direct normal insolation D_N^t and the total horizontal insolation D_H^t for all t, t=1,...,8760. The insolation for the various collectors are

1. Total tracking (two-axis) focused - CTTC

$$I^t = D_N^t \quad .$$

2. Flat plate total tracking--FPTT

$$I^t = D_N^t + (.75 + .25 \sin E^t)\left(D_H^t - D_N^t \sin E^t\right) ,$$

where E^t is the local elevation angle of the sun at time t.

3. Flat plate tilted--FPTI

$$I^t = (\sin A_t \cos E^t \cos A^t + \cos A_t \sin E^t)\ D_N^t$$

$$+ \left(D_H^t - D_N^t \sin E^t\right)(.75 + .25 \cos A_t)$$

The tilt angle from the local horizon, positive southward, is A_t. The angle A^t is the local azimuth of the sun measured positive westward from due south.

4. Flat plate tracking on east-west axis--FPEW

$$I^t = q^t D_N^t + \left[.75 + .25\left(\frac{\sin E^t}{q^t}\right)\right] \left(D_H^t - D_N^t \sin E^t\right) ,$$

$$q^t = \left(1 - \cos^2 E^t \sin^2 A^t\right)^{1/2}$$

5. Flat plate tracking on a north-south axis--FPNS

$$I^t = \sin (E^t + L + A_t)\ D_N^t +$$

$$\left[.75 + .23 \cos (L + A_t)\right]\left(D_H^t - D_N^t \sin E^t\right) ,$$

where L is the latitude of the site, positive in the northern hemisphere.

The E^t and A^t are computed from the hour angle h^t and declination d^t of the sun. For our purposes, a simple sinusoidal sun motion is suitable. The declination is taken as constant for each day. We use

$$\sin d^t = 0.410 \cos [0.01720 (I-172)]$$

where I is the day of the year. The hour angle in radians is approximated by

$$h^t = 0.2618 (J-13)$$

where J is the hour of the day, J=13 at noon. The formulas are then

$$\sin A^t \cos E^t = \sin h^t \cos d^t$$

$$\cos A^t \cos E^t = \sin L \cos d^t \cos h^t - \cos L \sin d^t$$

$$\sin E^t = \cos L \cos d^t \cos h^t + \sin L \sin d^t$$

With X_1 as the area of the collector and e_1 as its efficiency, then the output of the collector in hour t is

$$O_1^t = e_1 X_1 I^t \quad , \quad \text{kWh} \quad .$$

<u>Wind Turbines</u>

Wind turbines are necessarily more complex to describe. Only horizontal axis models (HAWT) are modeled currently. Factors in the function translating wind speed to electrical output are:

V_i, the "cut-in" wind speed of the turbine (i.e., output power is zero below V_i)

V_c, the "cut-out" wind speed of the turbine

V_r, the reference wind speed at which rated power is obtained. Power out is constant at wind speeds from V_r up to V_c.

$(0 < V_i < V_r < V_c)$

X_1, the desired rated power output of the wind turbine(s)

N_T, the number of turbines at the site

In addition, there are several parameters describing the site that must be read from the TMY data tapes. The most important is the height of the sensor where the data was read. This is used to obtain a "corrected" wind speed for the turbine at hub height. If

Z_r = 15.2+D/2 = hub height (D is diameter of turbine in meters)

Z_o = reference data height, and

V_d^t = wind speed at reference height as a function of time, then

$$V^t = \left(\frac{Z_r}{Z_o}\right)^{\frac{1}{7}} V_d^t$$ is the corrected wind speed function.

The average air density at the reference site, ρ, is also on the data tape. The wind power available to the turbine is:

$$I_1 = 0.001226\ N_T(V^t)^3\ D^2 \text{ in kW.}$$

If the turbine efficiency is e_1 (typically e_1 = 1.0), then output power is:

$$O_1^t = 0 \qquad 0 \leq V < V_i \text{ and } V_c < V$$

$$O_1^t = X_1 e_1 \qquad V_r < V \leq V_c$$

For $V_i < V \leq V_r$, O_1^t varies linearly from 0 to $X_1 e_1$. SOLSTOR uses as the input parameter the desired power output, X_1. Thus the necessary diameter, D, is solved for by the following relation:

$$D = \left(\frac{259.7}{\rho V_r^3} X_1\right)^{\frac{1}{2}} .$$

But note that D need not be the diameter of a single machine needed to achieve the desired power. Since N_T turbines are permitted, D is the diameter for each of the N_T turbines.

Chapter IV. Demand

Electrical loads in SOLSTOR may be inputted in tabular form or computed from the TMY data. The computed residential electrical load is from three sources. These are (1) domestic hot water, (2) miscellaneous lighting and appliance loads (also called "diversified" loads), and (3) building heating and cooling, as supplied by an electric heat pump. The first two are input to SOLSTOR as separate schedules of 24 hourly values each. The same schedule, then, is used every day of the year. However, seasonal variations can be accommodated with a separate input parameter which applies various seasonal multipliers to the basic schedules. The heating and cooling loads are calculated by SOLSTOR, and some discussion of these procedures and assumptions is given next.

Heating and Cooling Loads

The driving force for calculating heating and cooling loads is weather data. Of course, any weather data could be used, but we have chosen to use the TMY (Typical Meteorological Year) derived from SOLMET data by Sandia (Ref. 7). These data have the advantage, compared to long-term-averaged data, of reflecting real weather. The TMYs are comprised of actual monthly data, with each month's data selected from the year that has the appropriate average statistics for insolation, degree days, runs of cloudy days, etc.

The insolation and temperature data then determine the calculated hourly heating or cooling load for the building. The heat loss/gain calculations follow the method outlined in the ASHRAE Handbook of Fundamentals, 1972 and updated in 1973 (Ref. 8). This method is intended for a dynamic hourly simulation such as this and is adequate for the needs of SOLSTOR. Heat flow totals in the ASHRAE model include the contributions due to conduction, air infiltration, gains due to appliances and lights, and gains due to occupants (we neglect the last in SOLSTOR). The conduction calculations use the "Sol-Air" temperature method of ASHRAE, which provides realistic outside surface temperatures by accounting for solar insolation.

The residence simulated, for simplicity in calculation, was assumed to be a square, flat-roof, slab floor, windowless cubicle oriented east-west and north-south. The lack of windows eliminated the requirement for detailed calculations of direct solar gain. This "error" can be compensated for by using a composite wall conductance typical of a real wall with windows, and by appropriate solar absorptivity and thermal time lag for the walls.

Table 4.1 lists all of the input parameters pertinent to the heating and cooling load calculations. The parameters λ and δ, which vary with wall construction, have been empirically determined for many wall types. The 1972 ASHRAE Handbook of Fundamentals lists several. These parameters are used in the equation for the effective temperature difference between the inside and outside wall or roof surfaces as follows:

$$\Delta T \text{ effective}(t) = \left[T_I - T_{EA}\right] + \left[T_{EA} - T_E(t-\delta)\right]$$

where:

T_I = indoor air temperature (^oF)

T_{EA} = 24-hour average of $T_E(t)$ for the given day, location and surface (^oF), see Ref. 8

$T_E(t)$ = effective outside air temperature (Sol-Air temp) at time t (^oF)

$T_E(t-\delta)$ = T_E at time $(t-\delta)$ (^oF)

δ = time lag between a peak in the Sol-Air temperature cycle and the corresponding peak of the inside wall surface temperature (hours)

λ = an empirically determined constant known as the "decrement factor"

Table 4.1

DEFAULT PARAMETERS USED IN HEATING/COOLING LOAD CALCULATIONS

Inside Air Temperature, heating (T_{HI})	$65^{o}F$
Inside Air Temperature, cooling (T_{LO})	$75^{o}F$
Underground Temperature and Cold Water Inlet Temperature (T_{DE})	$55^{o}F$
Absorptivity/Film Coefficient on Outside Surfaces (R-value) (α/h_o)	$0.225 \dfrac{h - ft^2 - {}^oF}{Btu}$
Time Lag for Sol-Air Temperature (δ)	4 h
Decrement Factor (λ)	0.45
Conductance of Walls and Roof (U_w)	$58.6 \; mW/ft^2 - {}^oF$
Conductance of Floor (Constant built into SOLSTOR)	one-half of U_w
Air Infiltration, (ρ_{vcp})	$0.032 \; kW/{}^oF$ (0.5 air changes per hour)
Hours Size:	
Roof and Floor (A_r)	$1520 \; ft^2$
Walls, 4 each (A_w)	$312 \; ft^2$ (8 ft by 39 ft)
Hot Water Peak Load Multiplier	1.2
Heat Capacity of the House per square foot of floor area (c_p)	$3.52 \; Wh/ft^2 - {}^oF$

A typical choice of 0.45 and 4 hours for λ and δ, respectively, is appropriate for a masonry wall consisting of 4-inch face brick over 4-inch concrete block and 1 inch of insulation.

Once the heating or cooling load has been determined for a particular hour, the electrical input energy required is obtained by dividing by the Coefficient of Performance (COP) of the heat pump. The curve of heat pump COP versus ambient temperature is built into SOLSTOR and is shown in Figure 4.1.

The building size and loss factors are entered by the user, although default values are available. Maximum summer and minimum winter interior temperatures are also specified. If the two differ, a "dead band" is created in which neither heating nor cooling is needed. The heat capacity of the building, per square foot of floor area, is used to determine the interior temperature changes in this dead band.

Hot Water Loads

A typical hot water load profile shown in Figure 4.2 represents an average based on metered tests of typical apartment buildings in Albuquerque, New Mexico, and is the default schedule used by SOLSTOR. The curve as shown is a normalized "load factor" curve. The actual consumption for an hour is given by the product of the load factor for that hour from Figure 4.2 and the "peak load multiplier." As shown in Table 4.1, the peak load multiplier used is 1.2. For example, the peak load between 9 a.m. and 10 a.m. would be 0.74 x 1.2 = 0.89 kW and used for one hour in our simulations. A value of 1.522 was the peak load multiplier found in metered tests of electric hot water heaters in Albuquerque, but we have reduced this 20 percent to simulate some projected conservation efforts. The resulting daily load is about 12.5 kWh/day, or 4.6 MWh/year. We assume that this profile is invariant with respect to residence type, geographic location, and time of year. The typical hot water load profile and multiplier are stored in the code, but the user may use his own values.

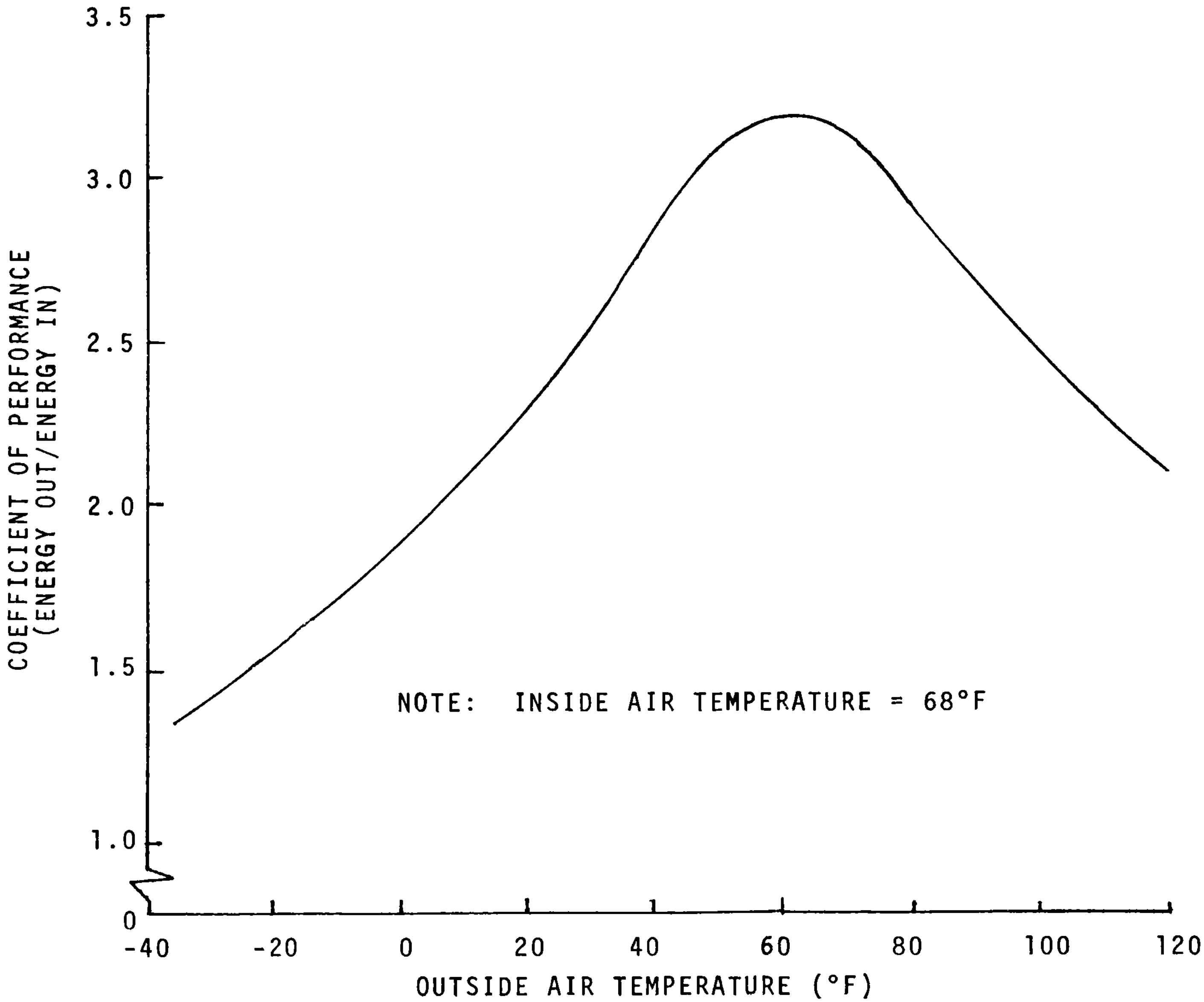

Figure 4.1 Air-to-Air Heat Pump Coefficient of Performance Vs. Temperature

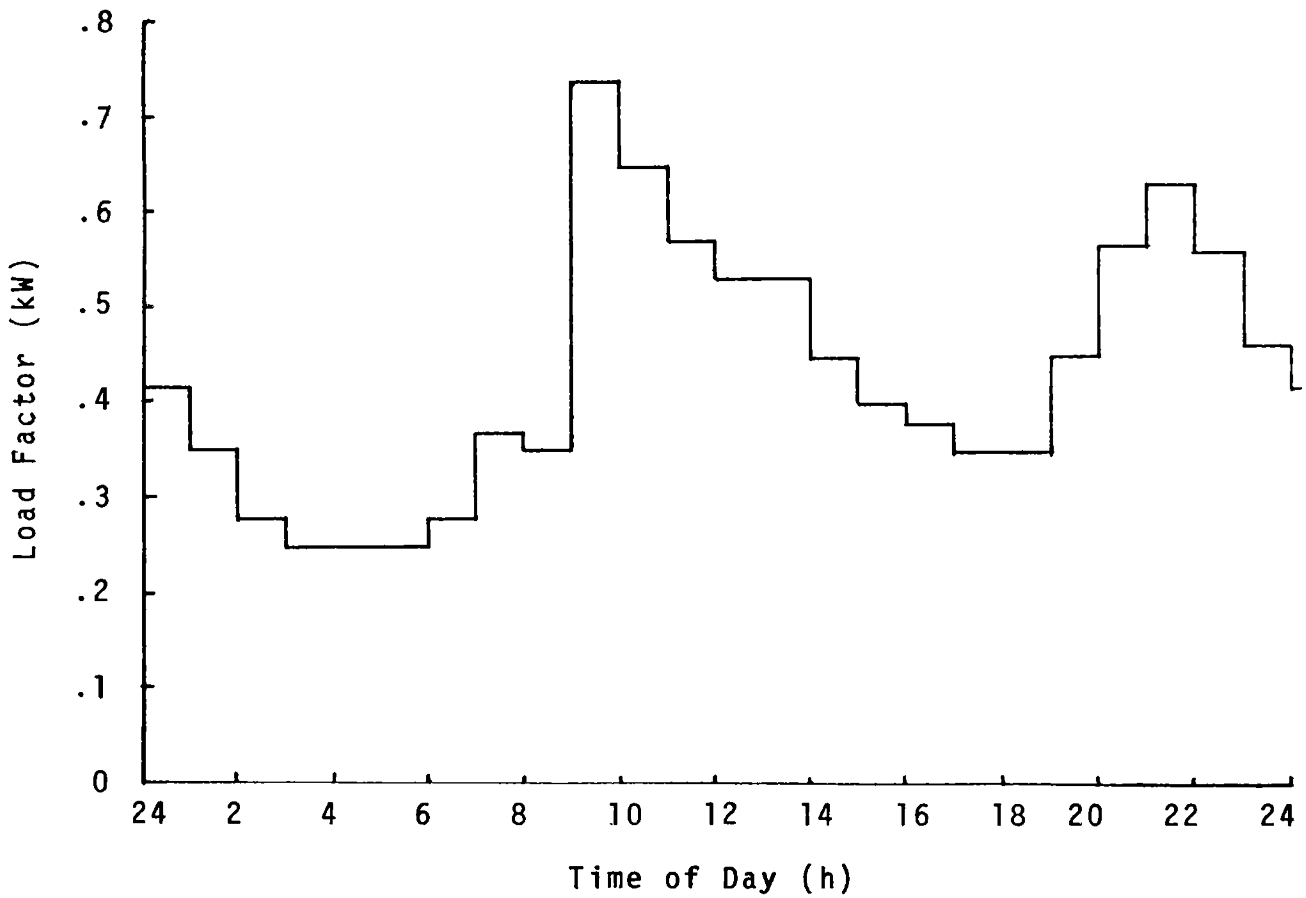

Figure 4.2 Default Hot Water Load Profile

Lighting and Appliance (Miscellaneous) Load

The final contribution to the electrical load is that provided by appliances and lighting. Again, we use the same profile every day of the year and in all locations. The profile used, seen in Figure 4.3, was collected by the Public Service Company of New Mexico over the period November 1973 through January 1974. The data was from 127 individually monitored residential customers within the City of Albuquerque, New Mexico. The data in Figure 4.3 is a composite of those residences.

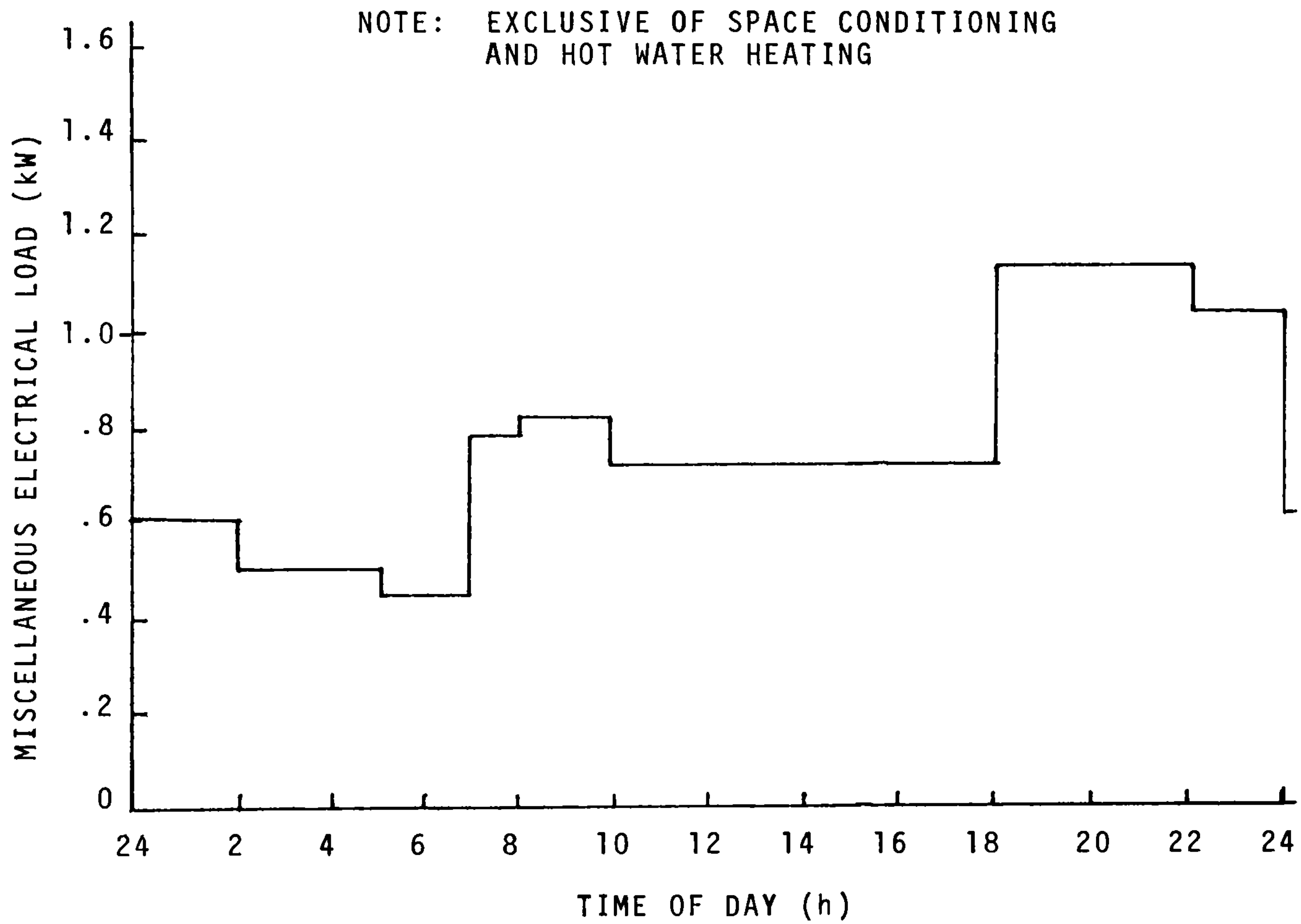

Figure 4.3 Default Miscellaneous Electrical Load Profile

Chapter V. Backup Energy

Utility Supplied

Assumptions about utility rates and policies are of critical importance in grid-connected systems since utility energy is used whenever there is an economic advantage in doing so. Moreover, there is the possibility of the system selling excess energy _to_ the utility. SOLSTOR permits a large number of possible economic interfaces to be simulated. We permit any combination of the following rate attributes:

1. A fixed yearly "service" or "meter" charge.

2. Seasonal rates, with up to four seasons allowed.

3. Time-of-Day (TOD) energy charges with two rates in which the time period for the two rates is user specified.

4. Time-of-Day (TOD) peak demand charges. The specified demand charge is applicable for any period of the day, from 0 to 24 hours in length. The charge is applied to the highest hour demand in each month.

5. A "sell-back ratio" which specifies the rate paid _by_ the utility for energy sold to them, as a fraction of the currently effective price of electricity.

6. A "sell-back limit" which specifies the maximum the utility will pay a customer in a year, expressed as a ratio of the amount sold to the total yearly bill for purchased electricity.

In the utility-backed model, the demand profile is always satisfied. Thus the utility is used either when the PV and/or battery cannot supply the full load, or when the allocation algorithms determine that utility energy is the least expensive alternative.

Generator Supplied

The generator model has two major differences from the utility model. First, there is no "sellback" to consider, and second, the generator has a finite output power. That is, it may be sized such that at rated output, it cannot meet the peak demand. The latter characteristic means that we can either permit peak demand to go unsatisfied, or we must ensure that storage, if present, is charged sufficiently to meet the peak demand. This second alternative implies some sort of prediction, i.e., the generator must be operated such that the battery is able to meet demand. We accomplish this in any of several ways. One is to specify a fixed number of hours of daily generator operation for seasons of low insolation and/or high demand. This optional scheduled charging is in addition to other demand-sensitive charging schemes. The other major alternative is to use storage level as the determinant of generator operation. When storage declines to some lower bound, the generator is started and remains on until an upper bound is reached. We can prevent "oscillation", or one hour on, one hour off cycles by providing an optional "first hour penalty function" in which the generator operates at less than full output for the first hour of operation. These options and algorithms are discussed more fully in Chapter VII.

The generator model is quite different from the utility model in another way as well. Whereas the utility has only an operating cost, the generator has both operating costs and capital costs associated with its limited lifetime. We provide, as input data, information as to the total lifetime of the generator (in hours of operation) and number of overhauls allowed before replacement. These factors are also discussed more fully in Chapter VII.

Chapter VI. Energy Allocation Logic for Utility-Connected Simulation--UE

The UE11 System

The present SOLSTOR code can consider one solar or wind collector, one storage device, and associated components. Only electrical energy is considered. The energy user may be a residence, community (a group of more than one identical residences), or a large structure such as a factory or utility. The user may be connected to a utility or stand alone. We consider stand-alone systems in the next chapter.

The system described in this chapter is designated UE11. This acronym stands for Utility-connected, all-Electric, 1-collector, 1 storage-device system. Within the UE11 scheme we have studied four different energy-distribution strategies, denoted UE11A, UE11B, UE11C, and UE11D. These are described in detail below.

For simulation purposes UE11 consists of eight components--see Figure 6.1. Component 1 is the collector, component 2 is the storage device, and the remaining six components are transducers. Each component is characterized by its size or capacity, whichever is appropriate, and its efficiency. We define $X_i \geq 0$ to be the size (or capacity) of the i-th component, and $0 \leq e_i \leq 1$ to be its efficiency. The collector area is X_1. The storage capacity is X_2. For the transducers X_i, $3 \leq i \leq 8$, is the maximum power allowed at input; i.e., the input saturation level. The component efficiencies, except for e_2, specify that part of the input energy or power that appears at the output. The storage efficiency e_2 is the complement of hourly storage leakage; that is, if E_s^t is the amount of energy in storage at the end of hour t, the amount of energy in storage at the end of hour t+1 is $e_2 E_s^t$, provided no energy has been put into or drawn out of storage. In addition to X_1 and e_1, the collector is described by its type (concentrating, flat plate, etc.) and any additional associated parameters (tilt angle, etc.) required to determine the energy density on the collector, as described in Chapter III.

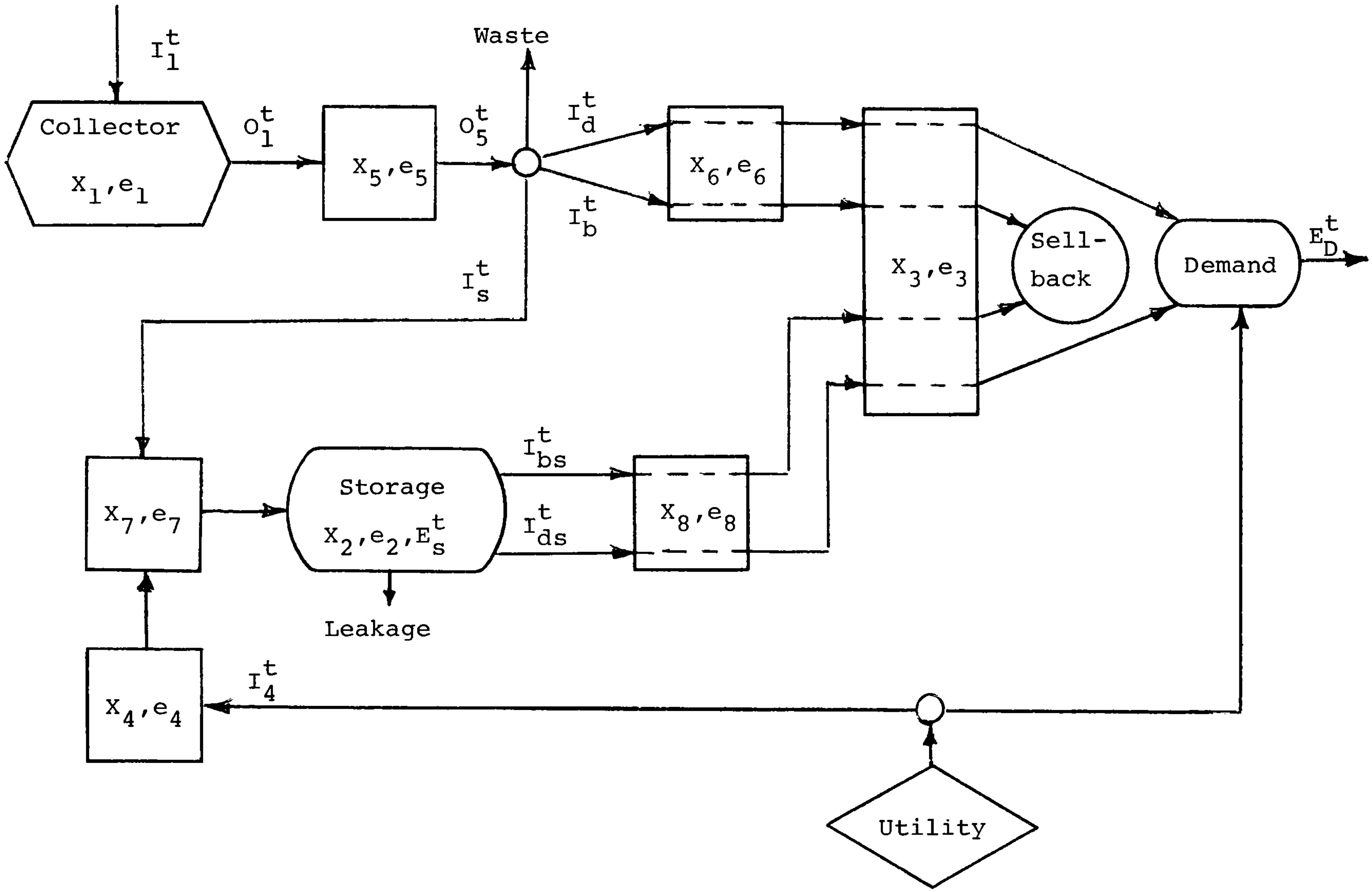

FIGURE 6.1 Block Diagram of UE11 System.

The simulation step is one hour. We assume that energy supply (insolation or wind velocity), demand, and prices are constant over each hour and that all changes occur instantaneously. For convenience we use a 364-day year with exactly 52 weeks and 8,736 hours. The basic problem time unit is hour-of-the-year. The year starts on January 1. There is no February 29 or December 31 considered. The time-of-day pricing structure, TOD, assumes that high-low pricing occurs on Monday through Friday, with only low pricing on Saturday and Sunday. We uniformly assume January 1 is a Saturday.

The insolation and ambient temperature information (as well as wind data, if needed) are given by the TMY (Typical Metrological Year) data. Having data for only one typical year for each site, we assume that each year in the life of a system is the same. Hence only 1 year need be simulated--at a great saving of computer-run time. The extension of the TMY results to include the total system life is achieved by proper use of the economic factors. For simplicity, storage is taken as empty at the beginning of the year. The cost anomaly due to storage not necessarily being empty at the end of the year is a trivial effect and is ignored. Given the system site and collection characteristics--excluding size and efficiency--the collector input energy density per unit area or wind turbine characteristics (supply) is determined for every hour of the year. The site and characteristics of the building(s) in which the system is used determine the energy demand. It is also possible to specify demand by an input file table (see Chapter III).

The essence of the UEII simulation is that the hourly demand must be satisfied. If the collector/storage configuration cannot satisfy the demand, then the unsatisfied portion of the demand must be purchased from the utility at whatever rate exists at that hour. Energy may also be purchased for storage and use at a later time, and energy may be sold back to the utility. With supply, demand, economics, energy-pricing structure, and component efficiencies given, the code chooses a set of component sizes and runs a simulation to determine the net amount and cost of purchased energy. By net purchased energy, we mean energy purchased to satisfy demand and increase storage levels less energy sold back. With these results, the annualized system cost is computed. This cost consists of annualized capital cost, annualized operation-maintenance cost, and annualized net purchase cost, all of which depend only on component sizes and efficiencies, and the omnipresent economics, of course. That set of component sizes which minimizes the annualized system cost is taken as optimal. If purchase costs are cheap and component costs are expensive, the optimum solution may be $X_i=0$; that is, no system at all. We will describe the procedure for choosing component sizes in Chapter VIII.

Let superscript t refer to the hour of the year. We use I_i^t and O_i^t to denote, respectively, the input and output of the i-th component at time (hour) t. Refer to Figure 6.1. The collector output is

$$O_1^t = e_1 X_1 I_1^t \quad , \tag{6-1}$$

where I_1^t is the energy density supply to the collector at time t. Let E_s^t be the energy level of storage at the end of time t. The storage balance is

$$E_s^t = \min X_2, \max(0, e_2 E_s^{t-1} + I_2^t - O_2^t) \quad . \tag{6-2}$$

This equation states that we cannot deplete storage below zero nor can we store more than X_2. The input-output relation for the transducers is

$$O_i^t = e_i \min(I_i^t, X_i) \quad ; \quad 3 \le i \le 8 \quad . \tag{6-3}$$

If a particular component does not exist in the sense that a path is not allowed, set the associated X_i to zero. If a transducer does not exist in the sense that the path is nonsaturable and lossless, set $e_i=1$ and $X_i=\infty$.

At each hour the simulation must decide how to allocate available energies. The available collected energy is the output of transducer #5, O_5^t. This energy can be allocated to satisfy demand I_d^t, to be sold back I_b^t, or to charge storage I_s^t, in any combination. Also, stored energy can be used to satisfy demand I_{ds}^t or to be sold back I_{bs}^t. At the same time energy may be purchased to charge storage I_4^t. The total input to a component is the sum of all its inputs; i.e., $I_6^t = I_d^t + I_b^t$.

To simplify the computation and avoid excessive computer time usage, the number of variable component sizes has been reduced to four, without loss of generality. The size of components 5 and 6 is taken as infinity; i.e., $X_5 = X_6 = \infty$ (see Figure 6.1). These components may exist in the sense that they can have efficiency losses, but they do not saturate. This approximation is justified because these components are relatively inexpensive compared to the other components and because their outputs still can saturate due to finite X_7 and X_3. The cost of components 5 and 6 can be included in the collector or transducer costs in some fashion. Sizing of components 7 and 8 is accomplished by relating their sizes to the storage size X_2. We define parameters r_7 and r_8 as $X_7 = r_7 X_2$ and $X_8 = r_8 X_2$. The r_7 and r_8 parameters specify the rate at which storage can be charged and discharged, respectively. The cost of X_7 and X_8 is easily included in the storage component cost. Only four independent component sizes X_1, X_2, X_3, and X_4, are searched for the optimum configuration.

With $X_5 = \infty$, the available collected energy is

$$O_5^t = e_5 e_1 X_1 I_1^t \quad . \tag{6-4}$$

The constraint on collected energy allocation is

$$I_d^t + I_b^t + I_s^t \leq O_5^t \quad . \tag{6-5}$$

If E_D^t is the demand at time t, the demand constraint is

$$e_3 e_6 I_d^t + e_3 e_8 I_{ds}^t \leq E_D^t \quad . \tag{6-6}$$

The storage balance and constraint equations are

$$E_s^t = e_2 E_s^{t-1} + e_4 e_7 I_4^t + e_7 I_s^t - I_{ds}^t - I_{bs}^t \quad , \tag{6-7}$$

$$E_s^t \leq X_2 \quad . \tag{6-8}$$

The component saturation constraints are

$$e_6 I_d^t + e_6 I_b^t + e_8 I_{ds}^t + e_8 I_{bs}^t \leq X_3 \quad , \tag{6-9}$$

$$I_4^t \leq X_4 \quad , \tag{6-10}$$

$$I_s^t + e_4 I_4^t \leq X_7 \quad , \text{ and} \tag{6-11}$$

$$I_{ds}^t + I_{bs}^t \leq X_8 \quad . \tag{6-12}$$

In addition, all quantities are nonnegative; i.e.,

$$O_5^t, E_s^t, I_d^t, I_b^t, I_s^t, I_{ds}^t, I_{bs}^t, I_4^t \geq 0 \quad . \tag{6-13}$$

The quantities I_1^t and E_D^t are a fortiori nonnegative. Whatever distribution strategy is used, equations (6-1) to (6-13) must be satisfied.

At this time it is convenient to define P^t as the annualized unit price of purchased energy and 0 R 1 as the sell-back ratio; that is, if at time t the unit cost of energy is P^t, energy may be sold back for a dollar credit of RP^t per unit. (Note: The sell-back ratio R is not to be confused with the discount rate of the same symbol.)

Peak Pricing and Sell-back Limits

In addition to time-of-day pricing, peak demand usage pricing may also be considered (often called "demand" charge). Let $E_P(t_m)$ be the maximum energy purchased in month m. Let this purchase be at time (hour) t_m. If the peak usage cost at time t_m is $P_P(t_m)$, then in addition to the fixed purchase cost (service charges) and costs associated with the amount of energy purchased, a premium cost of

$$\sum_{m=1}^{12} P_P(t_m) E_P(t_m)$$

is assumed. Here a year consists of four identical quarters of 3 months each of 31, 30, and 30 days.

Sell-back limitation is based on energy purchased costs. Let $c_P(t)$ be the total purchased energy cost for the year up to time t, less fixed or peak costs; that is, only the purchase cost associated with the hourly quantities purchased. Let $c_S(t)$ be the total dollar credit that the user has amassed up to time t due to sell-back. Note that

$$c_P(0) = c_S(0) = 0 \quad .$$

Let S_L be a given constant, then sell-back is allowed at time t+1 if

$$S_L c_P(t) - c_S(t) > 0. \tag{6-14}$$

Thus if $S_L \leq 0$, sell-back is never allowed, and if S_L is very large, sell-back is essentially unlimited. For each hour in which sell-back is allowed, the amount is unlimited. Thus at each hour I_b^t and I_{bs}^t are either forced to zero or explicitly unlimited.

Strategies

The essential problem of distribution strategy is with the storage. Without storage, the best strategy is simple: at each hour use all available energy to satisfy demand, and if any is left over, sell back all you can. Since R 1, sell-back never has a higher priority than demand. It is the storage linkage balance in time that requires strategical considerations.

Strategies can broadly be divided into two classes. A nonpredictive strategy assumes that all component characteristics and sizes are known, as well as the future price structure. It also "knows" the current available collected energy, demand, and storage level. However, the future supply and demand are not considered. A predictive strategy knows as much as a nonpredictive one, but also considers estimates of future supply and demand. Strategies UE11A and UE11B are nonpredictive. Strategies UE11C and UE11D are predictive. None of these strategies explicitly use peak demand pricing in their decisions. The sell-back limitation is used only in a go-no-go fashion at each hour.

Strategy UE11A

In addition to the four optimizing size variables, this scheme uses a fifth optimizing variable, $0 \leq X_L \leq 1$. This new variable is the (relative) storage decision level. If the relative storage level, defined as $L^t = E_S^{t-1}/X_2$, is greater than or equal to X_L, the system tends to deplete storage, if $L^t < X_L$, the system tends to fill storage. For each simulation pass, X_L is constant, like the sizes, however, no cost is associated with X_L.

UE11A makes decisions based on priorities having to do with the price structure, sell-back ratio R, component efficiencies and X_L. The TOD energy pricing structure is always such that for each week there is at most one high price and one low price for the whole week. Of course, these prices may be equal. Such a flat or average rate structure is typical today. Let P^t be the price at time t and P_M^t be the "high" price for the week in which t occurs.

For simplicity, we drop the t in the following equations when not needed for clarity. The priorities are demand D, utility sell-back B, and storage S. They are ordered by (see Figure 6.1):

A. If $L^t \geq X_L$, and

1. $e_6 \geq Re_6 \geq e_2e_7e_8 \rightarrow$ DBS priority.
   (<u>D</u>emand, Sell<u>B</u>ack, <u>S</u>torage)

2. $e_6 \geq e_2e_7e_8 > Re_6 \rightarrow$ DSB priority.

3. $e_2e_7e_8 > e_6 \geq Re_6 \rightarrow$ SDB priority.

B. If $L^t < X_L$ and

1. $e_6 \geq Re_6 \geq e_2e_7e_8P_M^t/P^t \rightarrow$ DBS

2. $e_6 \geq e_2e_7e_8P_M^t/P^t > Re_6 \rightarrow$ DSB

3. $e_2e_7e_8P_M^t/P^t > e_6 \geq Re_6 \rightarrow$ SDB

At each hour the quantities I_d, I_b, I_s, I_{ds}, I_{bs}, and I_4 are initially set to zero. The following equations are then solved in the order indicated by the priorities of the hour; i.e., if DSB, first solve equation "D", then equations "S", and finally equation "B". Let variable B^t be the sell-back limit at time t. If sell-back is allowed at this time, $B^t=\infty$, otherwise $B^t=0$.

Equation "D"

$$I_d = \min\left[\frac{E_D - e_3 e_8 I_{ds}}{e_3 e_6},\ O_5 - I_s,\ \frac{X_3 - e_8(I_{ds}+I_{bs})}{e_6}\right] \quad (6\text{-}15)$$

Equation "B"

$$I_b = \min\left[\frac{B - e_3 e_8 I_{bs}}{e_3 e_6},\ O_5 - I_d - I_s,\ \frac{X_3 - e_8(I_{ds}+I_{bs})}{e_6} - I_d\right] \quad (6\text{-}16)$$

Equations "S"

1. $q_7 = \min(X_7,\ O_5 - I_d - I_b)$ (6-17a)

2. $q_2 = e_2 E_s^{t-1} + e_7 q_7$ (6-17b)

3a. $L \geq X_L$;

(1) $P = P_M$; solve 4 (equation 6-17c); then, if $q_7 = 0$ or $e_7 e_8 \geq e_6$ solve 5; then solve 6.

(2) $P/P_M \geq R$; solve 4, then 6.

(3) $P/P_M < R$; solve 6.

3b. $L < X_L$;

(1) $P = P_M$; solve 4, then 6.

(2) $P \neq P_M$; solve 6.

4. $$I_{ds} = \min\left[\frac{E_D - e_3 e_6 I_d}{e_3 e_8},\ X_8,\ q_2,\ \frac{X_3 - e_6(I_d+I_b)}{e_8}\right] \quad (6\text{-}17c)$$

5. $$I_{bs} = \min\left[\frac{B-e_3e_6I_b}{e_3e_8},\ X_8-I_{ds},\ q_2-I_{ds},\ \frac{X_3-e_6(I_d+I_b)}{e_8} - I_{ds}\right] \tag{6-17d}$$

6. $$I_s = q_7 - \max(0,\ q_2-I_{ds}-I_{bs}-X_2)/e_7 \tag{6-17e}$$

After the three-step priorities are satisfied, the decision is made whether to buy for storage. If

$L < X_L$ and $e_2e_3e_4e_7e_8P_M > P$, then

$$I_4 = \min\left(e_4X_4,\ X_7-I_s,\ \frac{X_2-e_2E_s^{t-1}}{e_7} - I_s\right)/e_4 \tag{6-18}$$

Note that in order to buy for storage, $P \neq P_M$ and $I_{ds}=I_{bs}=0$.

The system is now updated for the next step. The new storage level is

$$E_s^t = e_2E_s^{t-1} + e_7\left(e_4I_4^t+I_s^t - I_{ds}^t - I_{bs}^t\right) . \tag{6-19}$$

For each t we get

$$\text{Purchase energy} = E_D^t - e_3e_6I_d^t - e_3e_8I_{ds}^t + I_4^t \tag{6-20a}$$

$$\text{Sell-back energy} = e_3e_6I_b^t + e_3e_8I_{bs}^t \tag{6-20b}$$

$$\text{Leakage} = (1-e_2)E_s^{t-1} \tag{6-20c}$$

$$\text{Waste} = O_5^t - I_d^t - I_b^t - I_s^t \tag{6-20d}$$

The maximum sell-back, B^t, is also updated at the end of each time step by the algorithm described above.

Note that UE11A uses price information in the sense that it knows the high and low price for the week, but it ignores the timing of the price changes.

Strategy UE11B

This strategy does not use X_L. Only the four size variables are used as optimizing variables. In UE11B the price change timing is used. Priorities are established by considering the value in cost savings of energy used for demand, for sell-back, for increasing storage, and for retaining in storage.

Define m=m(t) to be the number of hours in the future when the purchase energy price next up-tics; i.e., the least number of hours we must wait, from time t, for the price to pass from a "low" to a "high" value. If the yearly price is constant, $m=\infty$. Let P_u^t be the "high" price when the next up-tic occurs. Note, P_u^t need not be the "high" price for the week in which t occurs since the next up-tic may be in the next season.

The priorities are:

1. $e_6 \geq Re_6 \geq e_7 e_8 \max\left(1,\ e_2^m P_u/P\right) \rightarrow \text{DBS}$ (Demand, SellBack, Storage

2. $e_6 \geq e_7 e_8 \max\left(1,\ e_2^m P_u/P\right) > Re_6 \rightarrow \text{DSB}$

3. $e_7 e_8 \max\left(1,\ e_2^m P_u/P\right) > e_6 \geq Re_6 \rightarrow \text{SDB}$

Again, at each hour the priorities are established, I_d, I_b, I_s, I_{ds}, I_{bs}, and I_4 are initially set to zero and the following equations are evaluated according to the priorities.

Equation "D"--same as (6-15)

$$I_d = \min\left[\frac{E_D - e_3 e_8 I_{ds}}{e_3 e_6},\ O_5 - I_s,\ \frac{X_3 - e_8(I_{ds} + I_{bs})}{e_6}\right] .$$

Equation "B"--same as (6-16)

$$I_b = \min \left[\frac{B-e_3e_8I_{bs}}{e_3e_6},\ O_5-I_d-I_s,\ X_3- \frac{e_8(I_{ds}+I_{bs})}{e_6} - I_d \right]$$

Equations "S"

1. $q_7 = \min(X_7,\ O_5-I_d-I_b)$ (6-21a)

2. $q_2 = e_2E_s^{t-1} + e_7q_7$ (6-21b)

3. $q = \max \left(e_2,\ e_2^m P_u/P\right)$

   (a) $1 \geq R \geq q \rightarrow$ solve 4, then 5, then 6.

   (b) $1 \geq q > R \rightarrow$ solve 4, then 6.

   (c) $q > 1 \geq R \rightarrow$ solve 6, then equations 7.

4. $$I_{ds} = \min \left[\frac{E_D-e_3e_6I_d}{e_{38}},\ X_8,\ q_2,\ \frac{X_3-e_6(I_d+I_b)}{e_8} \right] \tag{6-21c}$$

5. If $q_7 > 0$ <u>and</u> $e_7e_8 \leq e_6$, $I_{bs}=0$; otherwise

$$I_{bs} = \min \left[\frac{B-e_3e_6I_b}{e_{38}},\ X_8-I_{ds},\ q_2-I_{ds},\ \frac{X_3-e_6(I_d+I_b)}{e_8} - I_{ds} \right] \tag{6-21d}$$

6. $$I_s = q_7 - \max(0,\ q_2-I_{ds}-I_{bs}-X_2)/e_7 \tag{6-21e}$$

7. $$q_3 = e_2E_s^{t-1}+e_7I_s \quad . \tag{6-21f}$$

   If $e_3e_4e_7e_8e_2^mP_u/P > 1$ <u>and</u>

$$m \le \frac{X_2 - q_3 e_2^m}{e_7 \min(X_7, e_4 X_4)} \quad , \text{ then} \tag{6-21g}$$

$$I_4 = \min\left(e_4 X_4,\ X_7 - I_s,\ \frac{X_2 - q_3}{e_7}\right) / e_4 \tag{6-21h}$$

The system state is then updated as in equations (6-20a) through (6-20d), and the next hour is computed, etc.

Strategy UE11C

This strategy utilizes ideal prediction of supply and demand; that is, the future supply and demand is known exactly for as far in the future as desired. Obviously it is not possible to implement such a scheme at any installation. However, UE11C is of great theoretical value for two reasons. First, the study of an ideal predictive scheme gives great heuristic insight into the development of truly predictive schemes. Second, the ideal scheme is a bound on how well any scheme can do; that is, we can measure how sub-optimal any scheme may be.

It turns out that the ideal predictive scheme is the solution of a linear program, LP. Given all system parameters, all system sizes, the initial storage condition, supply, demand, and purchase price structure, we desire to find I_d, I_b, I_s, I_{ds}, I_{bs}, and I_4 so as to minimize the net purchase cost over some period of time--hopefully over the whole TMY year. Attempting solution for the whole year creates an LP of hopelessly large size, so we must settle for some slightly sub-optimal scheme which pieces together a solution from smaller LP solutions in some fashion.

It should be pointed out here that if the capital costs of the variable components is directly proportional to their size--ignoring fixed costs associated with these components--then the optimal strategy <u>and</u> the optimal sizing is the solution of an LP. However, the LP must be solved over the whole year--an impossible task with today's computing technology. Therefore, we assume that for each simulation pass the sizes are given.

We wish to find the optimal energy allocations for a period of T hours, starting at $t=t_o+1$; i.e., $t_o+1 \leq t \leq t_o+T$. We assume the storage level at time t_o, $E_s^{t_o}$, is known. The optimal allocations minimize the net purchased cost for the period. We wish to find

$$\min \sum_{t=t_o+1}^{t_o+T} P^t\left(E_D^t - e_3e_6I_d^t - Re_3e_6I_b^t - e_3e_8I_{ds}^t - Re_3e_8I_{bs}^t + I_4^t\right) , \tag{6-22}$$

subject to certain constraints. These constraints are equations (6-5) through (6-13) written in a slightly different form which is convenient to our purpose here. We have

$$E_s^t + I_{ds}^t + I_{bs}^t - e_4e_7I_4^t - e_7I_s - e_2E_s^{t-1} = 0 \tag{6-23a}$$

$$I_{ds}^t + I_{bs}^t + I_d^te_6/e_8 + I_b^te_6/e_8 \leq X_3/e_8 \tag{6-23b}$$

$$I_{ds}^t + I_{bs}^t \leq X_8 \tag{6-23c}$$

$$e_4I_4^t + I_s^t \leq X_7 \tag{6-23d}$$

$$I_{ds}^t + I_d^te_6/e_8 \leq E_D^t/e_3e_8 \tag{6-23e}$$

$$I_d^t + I_b^t + I_s^t \leq O_5^t \tag{6-23f}$$

$$I_4^t \leq X_4 \tag{6-23g}$$

$$E_s^t \leq X_2 \tag{6-23h}$$

$$I_d^t, I_b^t, I_s^t, I_{ds}^t, I_{bs}^t, I_4^t, E_s^t \geq 0 \tag{6-23i}$$

$$t = t_o+1, \ldots, t_o+T$$

We see that this is an LP of 7 unknowns--the variables of equations (6-23i)--and 8 constraints for <u>every</u> t; i.e., 7T variables and 8T constraints. The nonnegativity constraints of equations (6-23i) are automatically satisfied by the LP. Even for a period of one week, T=168, solution is virtually impossible.

In actuality, the LP is not quite as large as it seems. The constraints (6-23g) and (6-23h) are simple upper bounds and can be implemented in the LP in such a way as to not be considered as explicit constraints (see Ref. 9). Also, if $O_5^t=0$, true for solar collectors at nighttime, then $I_d^t=I_b^t+I_s^t=0$, and only four variables need be considered. If $O_5^t=0$, the constraints are

$$E_s^t + I_{ds}^t + I_{bs}^t - e_4 e_7 I_4^t - e_2 E_s^{t-1} = 0 \quad , \tag{6-24a}$$

$$I_{ds}^t + I_{bs}^t \leq \min(X_3/e_8,\ X_8) \quad , \tag{6-24b}$$

$$I_4^t \leq \min(X_4,\ X_7/e_4) \quad , \tag{6-24c}$$

$$I_{ds}^t \leq E_D^t/e_3 e_8 \quad , \tag{6-24d}$$

$$E_s^t \leq X_2 \quad \text{, and} \tag{6-24e}$$

$$I_{bs}^t \leq B^t \quad . \tag{6-24f}$$

Thus for each hour when there is no sunshine there are only four variables, two constraints, and at most four simple upper bounds. However, even with this problem-size reduction, solution of the LP over one week is still essentially prohibitive. The same thinking applies to wind systems. If sell-back is allowed, there is no explicit constraint on I_b^t and I_{bs}^t. If sell-back is not allowed, $I_b^t=I_{bs}^t=0$.

Since solution of the LP for the whole year is impractical, we adopt the following sub-optimal scheme. Choose the integers T_1 and T so that $1 \leq T_1 < T$. Starting at t=0, with $E_s^0=0$, solve the LP for T hours. Implement the LP solution for T_1 hours. Using the storage level of the solution at $t=T_1$ as an initial condition, solve a new LP over $T_1+1 \leq t \leq T_1+T$. Then, implement the solution up to time $2T_1$. Solve the next LP over $2T_1+1 \leq t \leq 2T_1+T$, etc. Hopefully, solutions very near optimal can be achieved for T of the order of about half a day to a few days.

In this method, if sell-back is allowed at the first time step of an LP, it is allowed over that whole T interval. If sell-back is not allowed at the first step, it is not allowed over that whole T interval.

To save computer time, we would like to choose $T_1=T$ and thus solve the least number of LPs per pass for any given T. Unfortunately this choice of T_1 yields a very poor solution. When any LP is solved, the optimum solution does not consider the future beyond $t=nT_1+T$. Hence, since there is no reason to retain energy in storage for the future, the optimum solution dumps storage and $E_s^{nT_1+T}=0$. Actually, in some cases the optimum solution is not unique, but driving storage to zero at the end is always one of the optimal solutions. Indeed it is intuitively evident the $T_1=1$ is the best choice for any T.

We have conducted some preliminary studies concerning the choice of T. It appears that T of about 12 to 24 hours gives good solutions. The implication here is that the system is loosely coupled from day to day, but quite tightly coupled on an intraday basis. This phenomenon is due to the diurnal nature of the supply, demand, and prices.

In the initial coding of UE11C, a packaged LP routine was used. A specialized LP tailored to this problem cut the computer running time by about one-third. Because the LP is "block-angular," a Dantzig-Wolfe decomposition was then employed (see Ref. 9). This innovation further cut running time by one-half. For T=16 hours and T_1=8 hours, the CDC 7600 runs one pass (one set of sizes) in about 26 seconds. While this is excellent speed considering the computation involved, a full-blown optimization on four variables can be very time-consuming. The bag of LP tricks has not yet been exhausted, and we hope to achieve additional speed improvement in the future. In contrast, the computer time per pass for UE11A and UE11B is only about a half second. In general, a few hundred pases may be required per optimization.

Strategy UE11D and Predictive Methods

This scheme is a truly predictive strategy. A sliding LP is used as in UE11C with T_1=1 and T chosen by the user.

Suppose the system is at t=1. It knows the state of the system, the current supply and demand (at t=1), the future price structure, the time of day, and the day of the year. With these data, a prediction is made of supply and demand for times $2 \leq t \leq T$. The LP is solved for $1 \leq t \leq T$, and the solution is implemented at t=1. Since supply and demand are known at t=1, the allocation chosen by the LP solution can be directly implemented for t=1. The scheme now steps to t=2, measures the new actual supply and demand, generates new predictions of future supply and demand to time T+1, and then implements its results for t=2, and so on.

The supply-and-demand-prediction method has not yet been studied per se. We envision eventually using something like a Box-Jenkins technique (see Ref. 10) with diurnal, and perhaps seasonal correlations. In an actual field implementation, it may be possible to include weather reports in some fashion. Additional control techniques such as load-leveling would aid the prediction of future demand.

For the present, three prediction schemes have been implemented in UE11D. None of these methods are truly predictive in the Box-Jenkins sense, but are essentially global averaging techniques on the existing data.

The first method is merely ideal prediction. In this case UE11D is identical to UE11C with $T_1=1$.

In the second method, both supply and demand are predicted by a spline fit to the data. Let V_{dh} be the "true" computed supply or demand at day-of-the-year d and hour-of-the-day h. For each hour h, a least-squares cubic C2 spline is fit to the daily data (see Ref. 11). That is, 24 spline fits for supply and 24 spline fits for demand, each fitting 364 points. Each spline fit uses 16 equispaced knots, including the ends at d=1 and d=364. The only constraint imposed is that the endpoint values of the fit must be the same; that is, each fit must have yearly periodicity. Let the fitted data be U_{dh}. To account for the fact that we really know when the sun sets and rises and that the data cannot be negative, we adjust the fits so that

If $V_{dh} = 0$, set U_{dh} to zero,

If $V_{dh} > 0$ and $U_{dh} \leq 0$, set $U_{dh} = 0.001$.

A value of 0.001 is negligibly positive for any supply or demand. A sample for a "typical" residence in Albuquerque at mid-day is shown in Figure 6-2. The collector is a "FPTI" tilted at 25°. We see that the basic seasonal character of the data is preserved, but daily variations are heavily smoothed. For later reference we denote this scheme as "spline prediction."

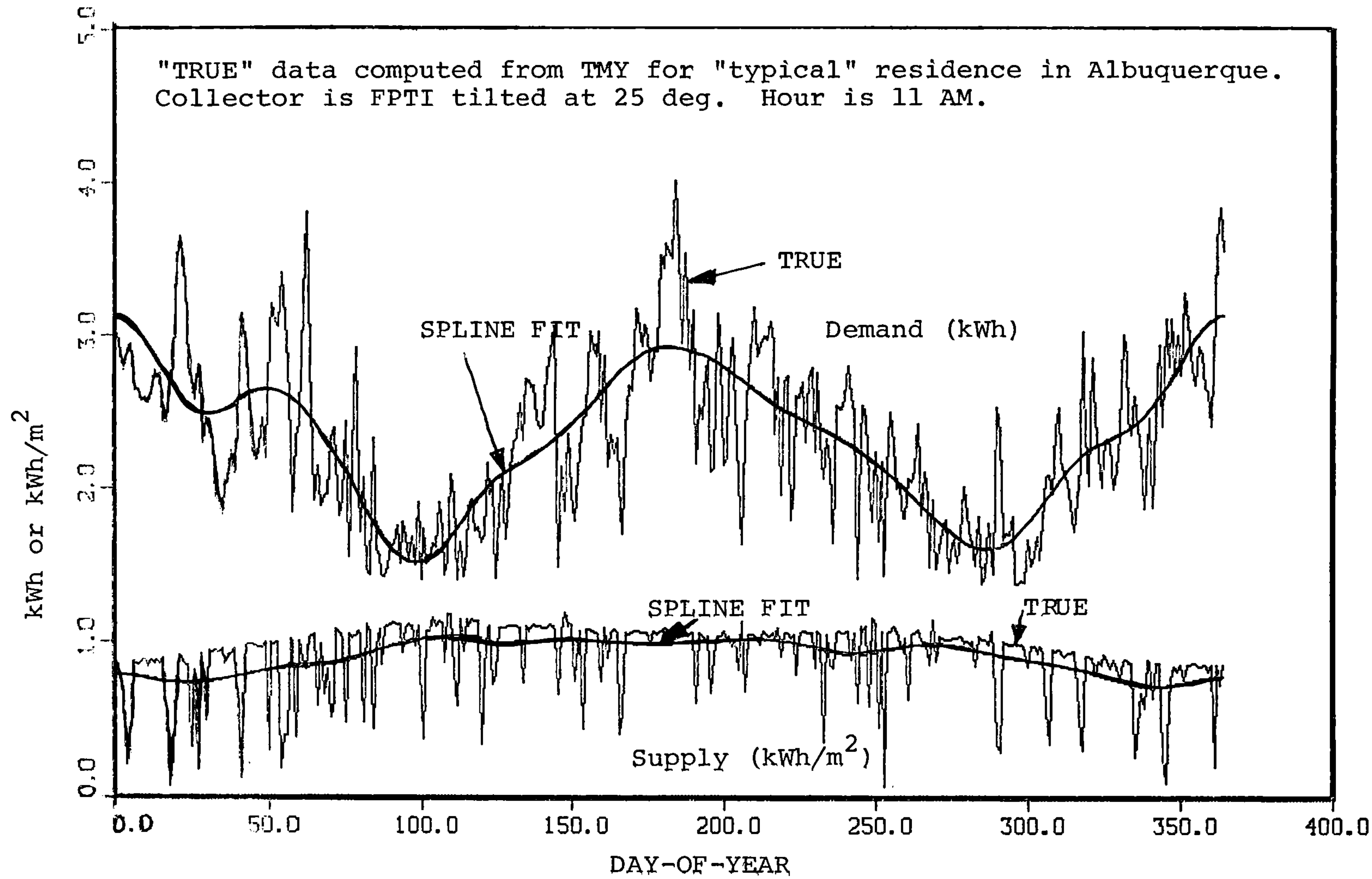

FIGURE 6.2 Sample Spline Fit to TMY Data.

The third scheme is even cruder. For each h we take

$$U_{dh} = \sum_{d=1}^{364} V_{dh}/N_h \quad ,$$

where N_h is the number of nonzero values of V_{dh} for each h. The equation above is used for all U_{dh} such that $V_{dh}>0$, and U_{dh} is set to zero if $V_{dh}=0$. This scheme is denoted "global average prediction."

The latter two predictive methods are obviously inferior to Box-Jenkins type schemes, which weight recently measured data more heavily than data acquired far in the past. Also, they are extremely poor predictors for wind supply. For this reason, wind systems are not allowed in UE11D. However, wind can be used in UE11C.

Storage Replacement

In all UE11 simulations, only the storage device, usually a battery, may require replacement. There are no overhauls. Replacement is based on the number of "storage cycles" experienced in the year. This quantity is computed as

$$S_{cy} = \sum_{t=1}^{8736} (I_{bs}^{t}+I_{ds}^{t})/X_2 \quad ,$$

$$= 0 \text{ if } X_2 = 0 \quad ;$$

that is, the total yearly output of the device divided by its size. The cycle life, L_{cy}, is an input parameter. The storage device life is then

$$Y_2 = \min(N, L_{cy}/S_{cy}) \quad .$$

where N is the system life. Of course, Y_2 is only a first order approximation to the characteristics of actual components.

Price-Year and Replacement Costs

The price-year cost of each component is described by the triplet $(\alpha_i, \beta_i, \gamma_i)$, where i refers to the component. Given the price-year costs of components, the ACSYS, annualized cost of system, is computed as described in Chapter II. For a solar collector, the price-year cost is

$$c_1 = \alpha_1 X_1^{\beta_1} + \gamma_1 \quad .$$

For a wind collector, the cost of N_T turbines each with diameter D is (see Chapter III),

$$c_1 = N_T\left(\alpha_1 D^{\beta_1} + \gamma_1\right)$$

The costs of the other components are

$$c_i = \alpha_i (e_i X_i)^{\beta_i} + \gamma_i, \quad i = 2,3,4 \quad .$$

In all cases $c_i=0$ if $X_i=0$. Since only the storage device is replaceable, the cost of the nonreplaceables is

$$C_0 = c_1 c_3 + c_4,$$

$C_1 = c_2$ for the initial storage cost, and

$C_1 = c_2 - \gamma_2$ for storage replacement,
since the fixed cost is not repeated for replacement.

The β_i parameter offer economies of scale, $\beta_i<1$, or diseconomies of scale, $\beta_i>1$, as the user may choose. The γ_i parameter represents fixed costs of purchase and installation.

The annual purchase energy cost is the total of the fixed purchase cost, the price per unit energy times the amount purchased totaled over the year, and the total monthly peak costs.

Chapter VII. Energy Allocation Logic for Stand Alone Simulation--GE

The GE11 System

The acronym GE11 stands for Generator-connected, all-Electric, 1 collector, 1 storage-device system. Only one strategy has been devised for GE11--called GE11A. For the most part, GE11 has the same component configuration as UE11 (see Fig. 7.1), except that energy not supplied by a solar or wind collector is supplied by a fuel-burning, on-site generator. Since a utility is not involved, sell-back and time-of-day pricing are not considered. The rate of purchased energy costs in UE11 is replaced by generator fuel costs. The time step is also 1 hour.

The GE11 system consists of nine components--a collector, storage device, generator, and six transducers. For convenience, the notation has been changed somewhat. The generator size (maximum allowed power output) is denoted X_3. The transducer that feeds demand is X_4, and the transducer that feeds generator output into the storage charger is X_9. The respective efficiencies are e_3, e_4, and e_9. As in UE11, all efficiencies are constant, except for the generator efficiency e_3, which depends on the type of fuel and power output versus rating (size) of the particular generator used. As before, we assume that certain transducers are inexpensive enough so that their size can be ignored and that the storage charge and discharge transducers depend on the storage size, viz,

$$X_5 = X_6 = X_9 = \infty \quad ,$$

$$X_7 = r_7 X_2, \; X_8 = r_7 X_2 \quad .$$

Additional quantities are the generator output to demand G_d, the generator output to storage G_s, and the generator starting level g_b, which allows for the fact that, in general, a generator should

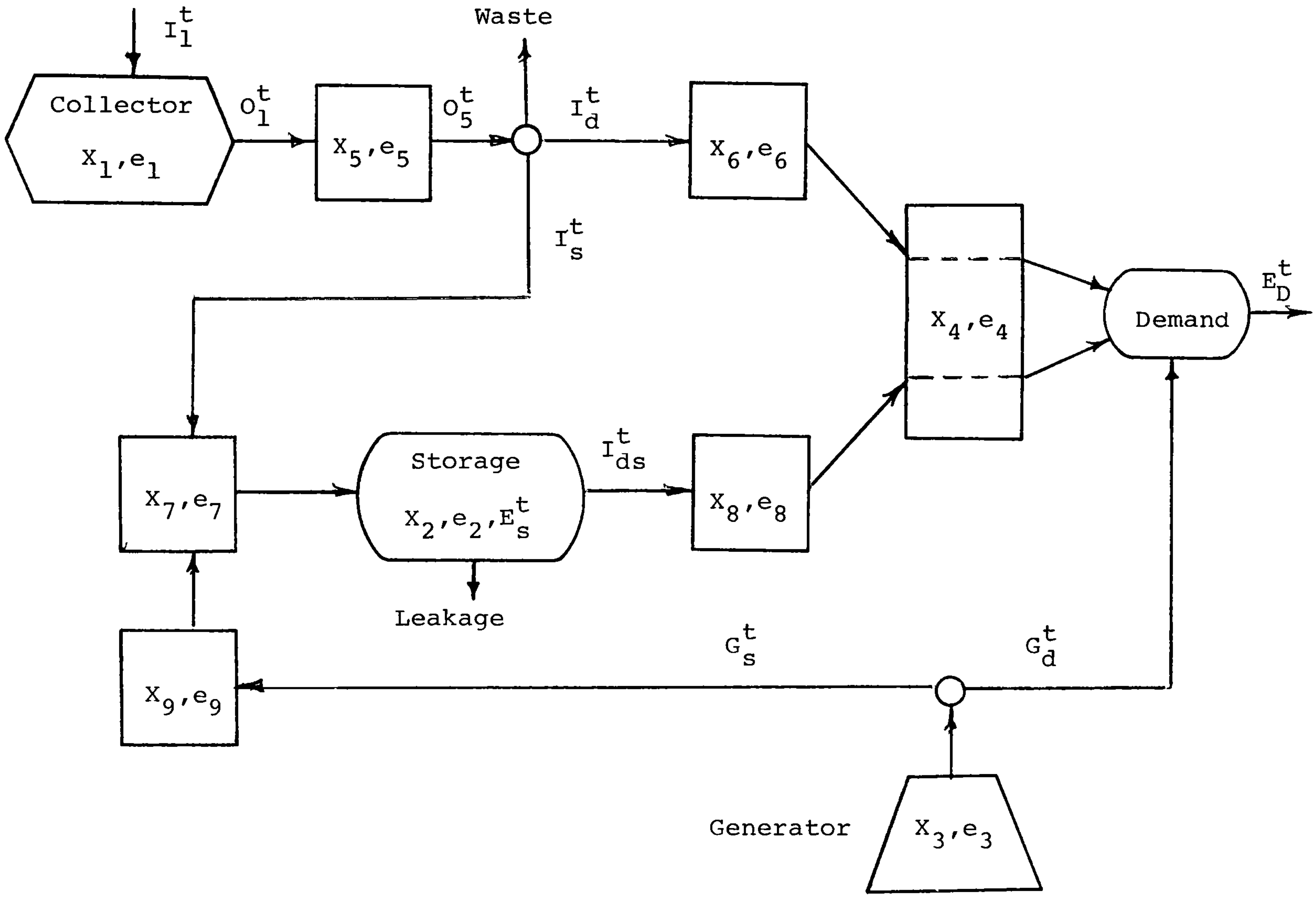

FIGURE 7.1 Block Diagram of GE11 System.

not be run at full throttle when it first starts. The parameter $0<g_b \leq 1$ is chosen by the user. The maximum generator output at time t is $g_b^t X_3$ where $g_b^t=g_b$ if the generator was off at time t-1, and $g_b^t=1$ if the generator was on at time t-1.

The system equations are

$$O_1^t = e_1 X_1 I_1^t \tag{7-1}$$

$$O_5^t = e_5 O_1^t \tag{7-2}$$

$$I_d^t + I_s^t \leq O_5^t \tag{7-3}$$

$$e_4 e_6 I_d^t + e_4 e_8 I_{ds}^t + G_d^t \leq E_D^t \tag{7-4}$$

$$e_2 E_s^{t-1} - I_{ds}^t + e_7 I_s^t + e_7 e_9 G_s^t = E_s^t \tag{7-5}$$

$$E_s^t \leq X_2 \tag{7-6}$$

$$I_s^t + e_9 G_s^t \leq X_7 \tag{7-7}$$

$$I_{ds}^t \leq X_8 \tag{7-8}$$

$$G_d^t + G_s^t \leq g_b^t X_3 \tag{7-9}$$

$$I_1^t,\ E_s^t,\ I_d^t,\ I_{ds}^t,\ I_s^t,\ G_d^t,\ G_s^t \geq 0 \tag{7-10}$$

These equations indicate two important distinctions between UE11 and GE11. In GE11 it is not necessarily required that all the demand be satisfied and there is no constraint on X_4 (called X_3 in UE11). Because GE11 is a stand-alone system, it cannot be assumed that an inexhaustible, unbounded source of energy like the utility exists at the site. While a suitably large generator could be used to meet all demand, such a value of X_3 may be impractical. We therefore permit the system to satisfy a demand goal which is some part of the total yearly demand. Let the unsatisfied demand at hour t be

$$D_u^t = E_D^t - e_4 e_6 I_d^t - e_4 e_8 I_{ds}^t - G_d^t \quad ,$$

then the system is required to satisfy the condition

$$\sum_{t=1}^{8736} D_u^t \leq (1-d_g) \cdot \sum_{t=1}^{8736} E_D^t \quad , \qquad (7\text{-}11)$$

where $0<d_g\leq 1$ is the input demand-goal parameter. If $d_g=1$, all demand must be satisfied. The simulation imposes this requirement by attempting to find X_1, X_2, and X_3 so as to minimize

$$\text{ACSYS} + \lambda \min\left\{0, \sum_{t=1}^{8736} \left[D_u^t - (1-d_g) E_D^t\right]\right\} \quad ,$$

$$\lambda >>> 1 \quad . \qquad (7\text{-}12)$$

The term involving λ in equation (7-12) is a penalty for not meeting the demand goal. As before, ACSYS is the annualized cost of the system.

Since the system must be allowed to satisfy equation (7-11) if it can, the second distinction is that no constraint is imposed on X_4. However, X_4 is <u>dependently</u> sized as

$$X_4 = \max_t \left(e_6 I_d^t + e_8 I_{ds}^t \right) \quad , \tag{7-13}$$

and its cost is included in ACSYS as a capital item. Thus only X_1, X_2, and X_3 are independent variable sizes.

<u>Generator Operation and Sizing</u>

An important factor in generator operation is its fuel consumption versus power output. We call this relationship the generator consumption function, which depends on generator size, type of fuel, and instantaneous output relative to rated output X_3.

Define G_o^t as the total generator output at time t,

$$0 \leq G_o^t = G_d^t + G_s^t \leq g_b^t \, X_3 \quad .$$

The consumption function is of the form

$$e_3^t = \left(e_{31}+e_{32}X_3\right) \left[e_{33}+e_{34} \left(\frac{G_o^t}{X_3}\right) +e_{35} \left(\frac{G_o^t}{X_3}\right)^2 \right] \tag{7-14}$$

The units of e_3 are kWh output per unit fuel consumed. The e_{3i} are constant input parameters. The term $e_{31} + e_{31}X_3$ in (7-14) is an approximation to the economy of scale in that larger generators tend to be more efficient than smaller ones. We require

$$e_{31} > 0 \text{ and } e_{32} \geq 0 \quad .$$

The second term in (7-14) is the relative efficiency which depends on the ratio of instantaneous output to rating. It is required that this term be a strictly positive nondecreasing function for $0 \leq G_o^t \leq X_3$.

In particular

$$0 < e_{33} \leq 1 \text{ and } e_{33} + e_{34} + e_{35} = 1 \quad .$$

are required.

The fuel consumed at time t is then

$$F^t = G_o^t / e_3^t \tag{7-15}$$

The parameters chosen for the e_{3i} and the unit price of fuel depend on the type of generator used. In particular, we allow gasoline, diesel fuel, coal, and natural gas with price units of dollars per gallon, gallon, ton, and MCF, respectively. A cursory, informal study indicates "typical" values of

$$e_{31} = 0.0836,\ e_{33} = 0.327,\ e_{34} = 1.293,\ e_{35} = -0.62$$

for diesel and

$$e_{31} = 0.1495,\ e_{33} = 0.136,\ e_{34} = 1.664,\ e_{35} = -0.80$$

for gasoline for generators of $X_3 \leq 15$ kW. For both, $e_{32}=0$.

Because of the demand goal requirement, it is not possible to know what size generator will satisfy the demand goal in the absence of a collector and battery unless detailed knowledge of the demand profile is available. Therefore, generator size is specified on input as $0 \leq Z_3 \leq 1$, which is the ratio of total yearly demand satisfied by a generator-only system. The simulation finds the value of X_3 associated with the demand profile for any value of Z_3. Of course, in the case where $Z_3=1$,

$$X_3 = \max_t E_D^t \quad .$$

The constraint

$$Z_3 \leq d_g$$

is always imposed on the generator size.

Strategy GE11A

In the absence of sell-back and time-of-day pricing, the distribution of collected energy is quite simple; namely, satisfy as much demand as possible and use any excess to increase storage. Also, use stored energy to help satisfy demand only if insufficient collected energy is available. Given that a solar or wind system has been built, the only strategical question is whether or not to have the generator running. If it is decided to turn on the generator, its fuel consumption function always indicates that it is best to run it at full output power if possible. In all cases we use the expression generator "ON" to mean turn it on if it is off, or leave it on if it is on. Generator "OFF" means to shut it off if it is on, or leave it off if it is off. If the generator is ON, its first priority is to help the collected energy satisfy demand before any stored energy is used. Excessive generator output can then be put to storage.

In addition to optimizing the sizes X_1, X_2, and X_3, this strategy uses two auxiliary optimizing variables X_L and X_U, constrained by

$$0 < X_L \leq X_U < 1 \quad .$$

These variables represent, respectively, the lower and upper relative-storage decision levels. They are used only when $X_2 > 0$. If $E_s^{t-1}/X_2 < X_L$, the generator will always be ON at time t. If $E_s^{t-1}/X_2 > X_U$, the generator will always be OFF at time t. As usual, X_L and/or X_U may be fixed by the user or allowed to vary so as to optimize the system. The initial storage level is set to $(X_L + X_U)/2$, at no cost.

The user may also specify that the generator be ON for certain hours in certain weeks of the year. For example, in the dark, early morning hours of winter, a solar installation may arbitrarily turn on its generator to pump up storage because of the long absence of sunshine. The user can input a table of these "arbitrary ON" times. We define the input values

$$g_o^t = 0, \text{ generator not necessarily ON at time } t$$

$$g_o^t = 1, \text{ generator arbitrarily ON at time } t.$$

The $g_o^t=1$ condition is overridden if the relative storage level exceeds X_U.

There are three substrategies in GE11A depending on the degree of prediction and whether the values of supply and demand at the current time are used. In all cases the storage level is monitored. The strategies are defined by the value of the input parameter Q:

$Q = 0$, current time values not used, no prediction,

$Q = 1$, current time values used, no prediction,

$Q > 1$, current time values used, prediction for Q-1 hours ahead.

Whatever the value of Q used, the following strategy and operating equations always hold:

1. If $E_s^{t-1}/X_2 < X_L$, generator is ON.

2. If $E_s^{t-1}/X_2 \leq X_U$ and $g_o^t = 1$, generator is ON.

3. If $E_s^{t-1}/X_2 > X_U$, generator is OFF.

If the generator is OFF, the operation equations are

$$G_s^t + G_d^t = 0 \quad . \tag{7-16}$$

$$I_d^t = \min\left(E_D^t/e_4e_6, O_5^t\right) \quad . \tag{7-17}$$

If $O_5^t \neq I_d^t$, then

$$I_{ds}^t = 0 \quad \text{, and} \tag{7-18a}$$

$$I_s^t = \min\left[O_5^t - I_d^t, X_7, \left(X_2 - e_2E_s^{t-1}\right)/e_7\right] \quad . \tag{7-18b}$$

If $O_5^t = I_d^t$, then

$$I_s^t = 0\text{, and} \tag{7-19a}$$

$$I_{ds}^t = \min\left[\ E_D^t - e_4e_6I_d^t\ /e_4e_8, X_8, e_2E_s^{t-1}\right] \quad . \tag{7-19b}$$

For the generator ON,

$$I_d^t = \min\left(E_D^t/e_4e_6, O_5^t\right) \quad . \tag{7-20}$$

If $O_5^t > I_d^t$, then

$$I_{ds}^t = G_d^t = 0 \quad , \tag{7-21a}$$

$$I_s^t = \min\left[O_5^t - I_d^t, X_7, \left(X_2 - e_2E_s^{t-1}\right)/e_7\right] \quad , \tag{7-21b}$$

$$G_s^t = \min\left[g_b^tX_3, \ \frac{X_7 - I_s^t}{e_9}\ , \ \frac{X_2 - e_2E_s^{t-1} - e_7I_s^t}{e_7e_9}\right] . \tag{7-21c}$$

If $O_5^t = I_d^t$, then

$$I_s^t = 0 \quad , \tag{7-22a}$$

$$G_d^t = \min\left(g_b^t X_3,\ E_D^t - e_4 e_6 I_d^t\right) \tag{7-22b}$$

If $O_5^t = I_d^t$ and $G_d^t = g_b^t X_3$, then

$$G_s^t = 0 \quad , \tag{7-22c}$$

$$I_{ds}^t = \min\left[\frac{E_D^t - e_4 e_6 I_d^t - G_d^t}{e_4 e_8}\ ,\ X_8, e_2 E_s^{t-1}\right] \quad . \tag{7-22d}$$

If $O_5^t = I_d^t$ and $G_d^t < g_b^t X_3$, then

$$I_{ds}^t = 0 \quad , \tag{7-22e}$$

$$G_s^t = \min\left[g_b^t X_3 - G_d^t, X_7/e_7,\ \frac{X_2 - e_2 E_s^{t-1}}{e_7 e_9}\right] \quad . \tag{7-22f}$$

The following equations apply whether the generator is ON or OFF.

$$E_s^t = e_2 E_s^{t-1} + e_7 I_s^t + e_7 e_9 G_s^t - I_{ds}^t \tag{7-23}$$

$$D_u^t = E_D^t - e_4 e_6 I_d^t - e_4 e_8 I_{ds}^t - G_d^t \tag{7-24}$$

$$G_o^t = G_d^t + G_s^t \tag{7-25}$$

$$\text{Waste} = O_5^t - I_d^t - I_s^t \tag{7-26}$$

$$\text{Leakage} = e_2 E_s^{t-1} \tag{7-27}$$

GE11A with Q = 0

This strategy does not use current time values of supply and demand, nor does it predict. Its decision is:

> If $X_L \leq E_s^{t-1}/X_2 \leq X_U$ and $g_o^t = 0$, then leave generator ON if it is on, leave it OFF if it is off.

GE11A with Q = 1

This strategy does not predict, but it monitors the current supply and demand. As usual we assume exact measurement of these quantities. The strategy is:

> If $X_L \leq E_s^{t-1}/X_2 \leq X_U$ and $g_o^t = 0$, then turn ON the generator if the demand for this hour cannot be satisfied by the collector and battery. Otherwise, turn it OFF.

GE11A with Q > 1

This strategy monitors the current demand and supply and also predicts them for Q-1 hours in the future. The strategy is:

> If $X_L \leq E_s^{t-1}/X_2 \leq X_u$ and $g_o^t = 0$, turn the generator ON if the current demand or future demand, based on predicted supply and demand, is not satisfied in the present hour in any of the Q-1 hours in the future. Otherwise turn it OFF.

The implemented predictors are the same as described in Chapter VI for UE11D.

Storage and Generator Replacement and Overhaul

In GE11, the storage may be replaced as described in Chapter VI. Also, the generator may be replaced according to its hours of operation. The generator life in hours, $0<L_g$, is an input parameter that specifies the number of hours the generator may be ON before it is replaced. If H_y is the computed number of hours per year that the generator is ON, then the generator life in years of service is

$$Y_3 = \min(N, NH_y/L_g) \quad .$$

The generator may also require overhauls. The input parameter N_{og} 0 specifies the number of overhauls per generator life. If a generator is purchased at time (years) Y_p, it is overhauled every

$$Y_p + jY_3/(N_{og}+1);\ j=1,2,\ldots,N_{og}$$

years.

Price Year and Replacement Costs

As with UE11, the cost of each component is described by the triplet $(\alpha_i, \beta_i, \gamma_i)$. The collector, storage, and transducer #4 costs, (c_1, c_2, c_4), are as in Chapter VI. The generator price-year cost is

$$c_3 = \alpha_3 X_3^{\beta_3} + \gamma_3;\ c_3 = 0 \text{ if } X_3 = 0 \quad .$$

The nonreplaceables are the collector and transducer, thus

$$C_0 = c_1 + c_4 \quad ,$$

$C_1 = c_2$ and $C_2 = c_3$ for initial storage and generator cost, and

$C_1 = c_2 - \gamma_2$ and $C_2 = c_3 - \gamma_3$ for replacement, since the fixed costs are not included for replacements.

Generator overhaul costs are imbedded in OM costs on output.

The annual energy purchase cost in UE11 is replaced by the generator fuel cost. The yearly fuel consumed is, from Equation (7-15),

$$\sum_{t=1}^{8736} F^t = \sum_{t=1}^{8736} G_o^t/e_3^t \quad ,$$

and its price year cost depends on the price per unit, which is an input parameter.

Optimization of UE11

For given strategy, site, parameters, etc., the optimum system is that which minimizes the annualized cost of satisfying demand for the life of the system. For all UE11 strategies there are up to four sizes to choose; X_1, X_2, X_3, $X_4 \geq 0$. For UE11A, the additional variable $0 \leq X_L \leq 1$ must be found. Any or all of these variables may be held constant at the whim of the user.

Optimal sizing of the variables is accomplished by a pattern search procedure. Associated with each variable is a lower and upper bound, $0 \leq L_i \leq U_i$ specified by the code user. The upper bound of X_L cannot exceed unity. If the specified upper and lower bounds are the same for a component, its size is fixed at that value.

Associated with the optimization is a relative mesh size and an iteration number. Let $0 \leq m_k \leq 0.333$ be the mesh size associated with the k-th iteration, k=0, 1, ..., K, where $K \geq 0$ is the index of the final iteration. The m_k are interrelated by

$$m_{k+1} = m_k/10 \tag{8-1}$$

The quantities m_0 and K can be specified by the user or left to the code as a default. The absolute mesh size associated with the i-th variable at the k-th iteration is

$$d_{ik} = m_k(U_i - L_i) \tag{8-2}$$

Let G_{ik} be the estimate of the optimal value of the i-th variable at the beginning of the k-th iteration--here we view X_L as a fifth variable. During the k-th iteration, the optimal value of X_i will be selected from the monotonically nondecreasing set of points

$$L_i, \ldots, G_{ik}-d_{ik}, G_{ik}, G_{ik}+d_{ik}, \ldots, U_i \quad .$$

Because of the pattern search algorithm, not all grid points will necessarily be examined. The optimal value found at the end of the k-th iteration is the estimate for the k+1 iteration. The set of G_{iK} at the end of the K-th iteration is taken as the optimal system size.

We will not discuss the pattern search algorithm here (see Ref. 12). Because of the special nature of our optimization, the algorithm has been somewhat modified. This modification was necessitated by the fact that the fixed cost terms in the components cause severe discontinuities in the capital cost as a size nears zero, because the collector and storage device, X_1 and X_2, are generally more expensive than the two variable-sized transducers X_3 and X_4--X_L is free, of course--and because each value of X_1 and X_2 imposes an effective bound on X_3 and X_4.

If X_1 and X_2 are not both fixed, then sets of searches are performed, depending on the lower bounds. Assume $U_1>0$ and $U_2>0$ and let $\xi>0$ be an arbitrarily small number, if

1. $L_1=0$, $L_2=0$;

   Evaluate $X_1=0$, $X_2=0$
   Search $X_1=0$, $\xi\leq X_2\leq U_2$,
   then $\xi\leq X_1\leq U_1$, $X_2=0$,
   then $\xi\leq X_1\leq U_1$, $\xi\leq X_2\leq U_2$.

2. $L_1>0$, $L_2=0$;

   Search $L_1\leq X_1\leq U_1$, $X_2=0$,
   then $L_1\leq X_1\leq U_1$, $\xi\leq X_2\leq U_2$.

3. $L_1=0$, $L_2>0$;

   Search $X_1=0$, $L_2\leq X_2\leq U_2$,
   then $\xi\leq X_1\leq U_1$, $L_2\leq X_2\leq U_2$.

4. $L_1>0$, $L_2>0$;

Search $L_1 \le X_1 \le U_1$, $L_2 \le X_2 \le U_2$.

Whatever the procedures, the optimum of the optimum of each search is retained as the solution. For each search $m_0=0.1$ and $K=1$ are the default values. The user can specify $0<m_0\le 0.333$ and $0\le K\le 9$.

The quantities X_3, X_4, and X_L (if it exists) may be fixed or variable. If the input lower bound of any of these variables is equal to the input upper bound, that variable is fixed at its bound. If X_3 or X_4 are variable, then their search ranges depend on the values of X_1 and X_2 for any particular pass, and the actual input bounds are not used. Let X_{M3} and X_{M4} be upper bounds defined as

$$X_{M3} = e_1 e_5 e_6 X_1 + e_8 r_8 X_2 \quad , \tag{8-3}$$

$$X_{M4} = r_7 X_2 / e_4 \quad .$$

Here we assume the maximum value of I_1^t is 1.0 kWh/m^2, which is nearly true. If X_3 or X_4 are variable, then the searched variables associated with these quantities have range $0.05\le x_3\le 1.0$ and $0\le x_4\le 1.0$. The values used in the simulation pass are $X_3=x_3X_{M3}$ and $X_4=x_4X_{M4}$. If X_2 is zero, then x_4 is fixed at zero. Note that no search on X_1 or X_2 includes zero in its range. Also, if X_2 is zero, X_L is fixed at zero for that search.

To initialize the search estimates, a Latin hypercube random start is used if <u>both</u> X_1 and X_2 are allowed to vary during the search (see Ref. 13). If one of these variables is fixed, then the other variable is initialized at 20 percent of its range. For example, if X_1 is fixed (on a particular search, not necessarily for the whole optimization) and $L_2\le X_2\le U_2$, then

$$G_{20} = 0.2(U_2-L_2) + L_2 \quad .$$

If both variables are allowed to vary, each range is broken into 15 equi-sized segments. A point is uniformly and randomly chosen within each segment. The points are randomly shuffled so that each point in the range of X_1 is randomly paired with a point in X_2 (no point is used twice). We now have 15 pairs of candidate sizes. An annualized cost is computed by a pass for each of the 15 pairs of X_1, X_2. At this stage X_3 and X_4 are set to their fixed values or effective maximums as in equations (8-3), and the cost of X_3 and X_4 is taken to be zero. The "best" pair is used to initialize the outer search. The uniform random number generator seed can be chosen by the user, or left to a "random" choice by the computer.

The cost of satisfying demand with no system is always computed. If all components are allowed to be zero; i.e., $L_i=0$ for all i, then the nonsystem is a candidate for the optimum configuration. If, however, a nonsystem is not allowed, the nonsystem is not allowed to compete.

Optimization of GE11

Optimization is carried out for up to five variables, X_1, X_2, X_3, X_L, and X_U. As with UE11, any or all of these may be held constant if so desired. Optimization is achieved by a pattern search as above, with the modifications described below.

The "nonsystem"--no collector, storage, or transducers--must have a generator to satisfy the demand goal. Let $X_3(Z)$ denote the kW size of the generator for the satisfied demand ratio Z (see Chapter VII). Then the stand-alone nonsystem generator is sized at

$$X_3 = X_3(Z=d_g).$$

Let the input bounds on X_3 be Z_L and Z_U, then if $Z_U=d_g$ and $L_1=L_2=0$, the nonsystem is a candidate for optimization. If it is not a candidate but is less expensive than the optimal system allowed under the input constraints, this fact is noted in the output of the code.

In the input we do not allow $Z_U > d_g$, nor do we allow the generator size to be fixed at zero; i.e., $Z_L = Z_U = 0$. If $Z_U < d_g$, then the generator alone cannot satisfy demand, and some collector-storage system must be built.

If X_1 or X_2 are not fixed, then sets of searches are performed, depending on their lower bounds. Assume U_1, U_2, and $U_3 > 0$ and $\xi > 0$ is an arbitrary small number, where

$$U_3 = X_3(Z_U) \text{ and } L_3 = X_3(Z_L),$$

that is, generator size in power units. Define

$$\phi_i = \min(\xi, L_i),$$

then the optimization candidates are:

1. $L_1 = 0,\ L_2 = 0,\ L_3 = 0$

   a. Evaluate $X_1 = X_2 = 0$ and $X_3 = U_3$
   b. Search $\phi_1 \le X_1 \le U_1,\ X_2 = 0,\ X_3 = 0$
   c. then $\phi_1 \le X_1 \le U_1,\ X_2 = 0,\ \phi_3 \le X_3 \le U_3$
   d. then $\phi_1 \le X_1 \le U_1,\ \phi_2 \le X_2 \le U_2,\ X_3 = 0$
   e. then $\phi_1 \le X_1 \le U_1,\ \phi_2 \le X_2 \le U_2,\ \phi_3 \le X_3 \le U_3$

   In all these cases, X_L and X_U are also searched unless they are fixed on input or $X_2=0$.

2. $L_1 = 0,\ L_2 = 0,\ L_3 > 0$, do 1a, 1c, and 1e.

3. $L_1 = 0,\ L_2 > 0,\ L_3 = 0$, do 1d and 1e.

4. $L_1 = 0,\ L_2 > 0,\ L_3 > 0$, do 1e.

5. $L_1 > 0,\ L_2 = 0,\ L_3 = 0$, do 1b, 1c, 1d, and 1e.

6. $L_1 > 0$, $L_2 = 0$, $L_3 > 0$, do 1c.

7. $L_1 > 0$, $L_2 > 0$, $L_3 = 0$, do 1d and 1e.

8. $L_1 > 0$, $L_2 > 0$, $L_3 > 0$, do 1e.

In all cases where $X_2=0$, we set $X_L=X_U=0$, and these variables are not searched. The mesh sizes and iteration numbers are used exactly as in UE11 above.

A problem arises in the bounding of X_U. Let X_L be bound by $0 \le L_L \le X_L \le L_U < 1$. We always require that $X_L \le X_U < 1$. Suppose, for example, $L_L=0.1$ and $L_U=0.6$. We are forced to use 0.6 X_U to avoid X_U becoming less than X_L in the search. Now suppose the solution is $X_L=0.2$ and $X_U=0.6$. We cannot know if X_U less than 0.6 would improve the solution unless we set up another optimization.

To avoid this difficulty while maintaining $X_U \ge X_L$, we use the bounds (U_L, U_U) to denote the relative range above X_L that X_U is allowed, where $0 < U_L \le U_U < 1$. Given a candidate value X_L, $L_L \le X_L \le L_U$, and a candidate value X_U^1, $U_L \le X_U^1 \le U_U$, the value of X_U used is

$$X_U = X_L + (1-X_L)X_U^1 \tag{8-4}$$

Thus the bounds (U_L, U_U) are bounds relative to X_L.

For each optimization search, for example 1e above, from one to five of the "variables" may be fixed. If all are fixed, the optimum cost is merely the cost associated with this fixed vector. If four are fixed, the search is initialized with the midpoint of the range of the variable one. If fewer than four are fixed, then the Latin hypercube random start technique described earlier is used on the variable quantities. In GE11, each range is broken into 20 segments instead of the 15 segments used in UE11.

Optimization of UE11 and GE11 is a difficult procedure because the surface to be minimized is exceedingly complicated. The pattern search method was chosen because of its simplicity and since analytic derivatives are not available, and numerical derivatives are expensive to compute. Our experience indicates that the mimimums are quite broad in many cases, and thus moderate variations in sizes about the computed mimimum do not drastically change the annualized cost. As usual in these kinds of problems, the possibility of finding a local rather than global minimum always exists.

Chapter IX. SOLSTOR Input/Output

Introduction

At this juncture, it is convenient to define some terms. By a "pass" we mean the simulation of one year's data for a fixed set of component sizes. By a "run" we mean a set of one or more passes resulting in the optimization of a particular configuration. By a "job" we mean a set of one or more runs presented to the computer to be processed at one time, i.e., with one object program loading.

Input data consists of an input card deck or 80-character coded records, TMY data for the various sets and the ASHRAE data. If the demand data is presented in tabular form rather than being internally computed, an additional input file is needed. In addition to the output listing, an output file is generated which gives detailed data about the system state for each hour of the year for each run, i.e., the detailed data for each optimal configuration. The TMY, ASHRAE, and demand data input files are identical for both UE11 and GE11. The input card decks and output are somewhat dissimilar.

In the following, the symbol ߸ means blank. The default and override notation a∿b→c=d means that if a is related to b by ∿ in the input, then c is set to d. The notation Error = (a b, etc.) means that if a is related to b by ∿ or input, a fatal input error has occurred.

Each type of card is identified by a code in columns 1 and 2. Blank cards are used to separate runs within a job. Two successive blank cards terminate a job. Cards within a run may be in any order, except that the first card of a <u>job</u> must be an ID card. If two or more cards appear in a <u>run</u> with the same identification, the last card read is used. The first run deck of a job must contain at least one of each necessary type of card. Subsequent run decks require only those cards which are different from preceding cards of the same type. The configuration strategy field--UE11A, UE11B, etc.--of the first ID card of a job defines the configuration for the whole job. If subsequent ID cards appear in the job deck, their configuration field is ignored.

Both UE11 and GE11 require 13 cards per run. Many input cards are the same for both programs. These two simulations are actually in separate libraries. Their job control streams for the CDC 7600 are described below.

For residences, all component sizes are in m^2, kW, or kWh, and all costs are in dollars. For communities (multiple residences) and utilities as users, components sizes are $k(m^2)$, MW, and MWh, and costs in $K. The electrical purchase prices per unit energy are in cents/kWh in UE11. Fuel purchase prices in GE11 are in dollars per unit. Size and cost scaling is described in the "DH" card section.

UE11 and GE11 Job Control Streams

The UE11 job control stream is shown here. The small driver program is in FORTRAN. The symbol O means the letter "O."

```
 UE11, etc. (JOB Card)
 ACCOUNT Card
 ATTACH (SOLLIB1,SOLLIB1)
 ATTACH (SOLLIB2,SOLLIB2)
 ATTACH (SOLLIB3,SOLLIB3)
 LIBRARY (SOLLIB1,SOLLIB2,SOLLIB3)
 FILE,TAPE1,RT=S.
 ATTACH (TAPE1,PVBAT,CY=3)
 FILE,TAPE2,RT=S.
 ATTACH (TAPE2,PVBAT,CY=2)
*FILE,TAPE3,RT=S.
*ATTACH (TAPE3,...)
 FTN(L=0,OPT=2)
```

```
**STAGE(TAPE9,POST,HY,VSN=.....)
  LGO.
  End of Record
       PROGRAM UE1RUN(INPUT,OUTPUT,TAPE1,TAPE2,TAPE3,TAPE9)
       COMMON /COMSXOL/ ISXOL
  C    ISXOL=0, NO PRINT OF EACH PASS.
       ISXOL=0
       CALL RANSTA(J)
       CALL UDSET(J)
       CALL SETUP
       END
  End of Record
  Data Cards
  End of File
 *--Required only if demand data is an input file
**--Required only if detailed output data is to be saved
```

The GE11 job control stream is very similar

```
  GE11, ... (JOB Card)
  ACCOUNT Card
  ATTACH (GENLIB1,GENLIB1)
  ATTACH (GENLIB2,GENLIB2)
  ATTACH (GENLIB3,GENLIB3)
  LIBRARY (GENLIB1, GENLIB2, GENLIB3)
  FILE,TAPE1,RT=S.
  ATTACH (TAPE1,PVBAT,CY=3)
  FILE,TAPE2,RT=S.
  ATTACH (TAPE2,PVBAT,CY=2)
 *FILE,TAPE3,RT=S.
 *ATTACH (TAPE3,...)
  FTN(L=0,OPT=2)
**STAGE(TAPE9,POST,HY,VSN=.....)
```

```
LGO.
End of Record
     PROGRAM GE1RUN(INPUT,OUTPUT,TAPE1,TAPE2,TAPE3,TAPE9)
     COMMON /COMSXOL/ ISXOL
C    ISXOL=0, NO PRINT OF EACH PASS.
     ISXOL=0
     CALL RANSTA(J)
     CALL UDSET(J)
     CALL GSETUP
     END
End of Record
Data Cards
End of File
```

The TMY data is on TAPE1. The ASHRAE data is on TAPE2. The file of demand data, if desired, is on TAPE3. The detailed output is written to TAPE9.

TMY Data Input--TAPE 1

The data on TAPE 1 contains the TMY information. These data are in binary (unformatted) mode. An END-OF-FILE mark separates data for various sites. Data for each site consists of 13 logical records.

First record - 7 words.

Word 1 Site Code (A10).
Word 2 Not used.
Word 3 Latitude of site in degrees (real).
Word 4 Median wind velocity in m/s (real).
Word 5 Recording station height in m (real).
Word 6 Average air density in kg-s^2/m^4 (real).
Word 7 Not used.

Words 4, 5, and 6 are used only in wind systems.

Second through thirteenth records contain data for each month, January to December.

Word 1 Number of days in month, N (integer). February always has 28 days.

Word 2 Not used.

Words 3 through 24N + 2 contain packed data at 60 bits/word. Each word is data for each hour of the month in hour order. The unpacked data is integer mode. Let b_i, i=0, ..., 59 be the i-th bit, with b_0 as the most significant (left-most) bit.

b_0-b_{11}	Not used.
b_{12}-b_{23}	Ambient temperature, Kelvin.
b_{24}-b_{35}	Direct horizontal solar radiation (kW/m^2) times 100.
b_{36}-b_{47}	Direct normal solar radiation (kW/m^2) times 100.
b_{48}-b_{59}	Wind velocity (m/s) times 10.

The last file on TAPE 1 is a terminator consisting of one record of 7 words. The first word is TRAILERØØØ.

ASHRAE Data Tables--TAPE 2

This file contains the ASHRAE data for solar intensity and heat gain factors. The file has six logical records in binary (unformatted) mode. The first record is the one-word identifier "ASHRAETABL." The next five records each contain data for 24°, 32°, 40°, 48°, and 56° north latitude in that order.

The first word of each data record is the latitude in degrees (real mode). The second word is the associated day-of-the-year (real mode). The next 9x12=72 words contain packed data for hours 5 through 13 (9 hours) and the twenty-first day of each month, January to December. The data for hours 1 through 4 is always zero at these latitudes. Hour 14 data is the same as hour 12 data, hour 15 the same as hour 11, etc. The data word is integer mode when unpacked.

b_0-b_{19} Maximum direct normal radiation, BTUh/ft^2.

b_{20}-b_{39} Sum of N, E, S, and W solar heat gain factors, BTUh/ft^2. Only the sum is required, since for residential demands the house is square, of homogeneous wall, and oriented north-south.

b_{40}-b_{59} Horizontal solar heat gain factor, BTUh/ft^2.

Linear interpolation is used between latitudes and between days of the year.

Demand Data--TAPE 3 (optional)

If the demand is not residential (or community), the demand can be inputted as a table on TAPE 3. This file contains one logical record for each demand table in binary (unformatted) mode. There are 8739 words per record.

Word 1 Data identifier (A10). The file is searched until a record whose first word agrees with column 3-12 of the DH card.

Word 2 Indicator of data types, left justified: "T" = thermal only; "E" = electrical only, "ET" = both. For both UE11 and GE11, only "E" is allowed. The demand mix in the record must correspond to the demand mix indicated in columns 13-14 of the "DH" card.

Word 3 For input sites in m^2 and kW, use zero; for input sites in k(m^2) and MW, use one (integer mode).

Words 4 through 8739 give the demand for each hour of the 364-day year. When unpacked, the data is real mode.

b_0-b_{29} Electrical demand, kWh
b_{30}-b_{59} Thermal demand, kWh--not used in UE11 and GE11

UE11 Input Cards

1. IDENT Card (A2,8X,2A10,1X,I1,F3.0)

The first card of a job must be an ID card. The system configuration (strategy) is defined in this card along with other items. Subsequent ID cards may appear in a job deck, but their configuration field will be ignored.

Column	Symb.	
1-2	--	"ID"
3-10	--	Not used
11-20	--	Site code--T-ALBUQ, etc., left-justified
21-30	--	Configuration--UE11A, UE11B, UE11C, or UE11D, left-justified
31	--	Not used
32	K	Index of final iteration for search, K=b̸ K=1.
33-35	M_0	Initial relative mesh size for search, $M_0 \leq 0 \rightarrow M_0 = 0.1$, $M_0 > 0.333 \rightarrow M_0 = 0.333$.
36-80	--	Not used

Error = (K<0, K>9, unacceptable site or configuration code)

T-MADISON	Madison, Wisconsin
T-BISMAR	Bismarck, North Dakota
T-APALACH	Apalachicola, Florida
T-SEATTLE	Seattle, Washington
T-ELØPASO	El Paso, Texas
T-FØWORTH	Fort Worth, Texas
T-GØFALLS	Great Falls, Montana
T-FRESNO	Fresno, California
T-WASHØDC	Washington, D. C.
T-OMAHA	Omaha, Nebraska
T-ELY	Ely, Nevada
T-MEDFORD	Medford, Oregon
T-ALBUQ	Albuquerque, New Mexico
T-BOSTON	Boston, Massachusetts
T-BROWNSV	Brownsville, Texas
T-CARIBOU	Caribou, Maine
T-LØCHARL	Lake Charles, Louisiana
T-CØHATT	Cape Hatteras, North Carolina
T-NØYORK	New York, New York
T-CHARLES	Charleston, South Carolina
T-COLUMB	Columbia, Missouri
T-DODGE	Dodge City, Kansas
T-MIAMI	Miami, Florida
T-NASHV	Nashville, Tennessee
T-PHOENIX	Phoenix, Arizona
T-SØMARIA	Santa Maria, California

Table 9-1 Site Codes

2. Demand Heat Card (A2,A10,A2,F6.0,4X,I2,F6.0,3F2.0,6F6.0)

This card specifies parameters to compute residential electrical heat demand. If the demand is not residential, the identification code for the demand input on TAPE3 is given. The scaling parameter f determines whether residential demand is a single residence or a community and also denotes the sale of component input sizes and certain fixed costs.

Column	Symb.	
1-2	--	"DH"
3-12	--	Identifier code of input demand file, if desired. If column 3 is "R," the demand is internally computed as residential
13-14	--	"EQ" or "Eƀ." For residential, "EQ" generates demand which is the sum of electrical heating and cooling, hot water, and miscellaneous. The heating term is not used for "Eƀ." For input demand, this symbol must agree with the symbol on the TAPE3 file, see above.
15-20	f	Multiplicative factor of demand. All demand, whether internally computed residential or externally given, is in kWh. The demand used is f times the demand computed, with seasonal adjustments (see DS card), or given in a table. If f 1.0 with residential, then community demand is assumed. If demand is residential, then input component sizes are m^2, kW, and kWh, and fixed costs are in dollars. If community demand is used, the component sizes are in $k(m^2)$, MW, and MWh; fixed costs are in $K. For input demand, sizes are specified on the input file--see TAPE 3 above. For residential only, $f<1.0 \rightarrow f=1.0$.

Columns 21 through 74 give parameters for computing residential heating demand. If columns 21 through 30 are blank, "typical" residential default values are used for all these parameters. See Chapter IV for definition of these parameters.

			Default Values
21-24	--	Not used	
25-26	δ	Hours	4
27-32	c_p	Wh/ft^2-deg. F	3.52
33-34	T_{HI}	Deg. F	75
35-36	T_{LO}	Deg. F	65
37-38	T_{DE}	Deg. F	55
39-44	λ	--	0.45
45-50	α/h_o	Hours-ft^2-deg. F/Btu	0.225
51-56	U_w	Milliwatts/ft^2-deg.F	58.6
57-62	A_r	ft^2	1520
63-68	A_w	ft^2	312
69-74	ρ_{vcp}	kW/deg. F (air infiltration rate)	0.032
75-80	--	Not used	

3. Demand Hot Water Card (A2,F6.0,24F3.2)

This card specifies the electrical hot water demand on an hour-of-the-day basis. Except for seasonal scaling, this demand is the same at the same hour of every day. The factor f in the DH card also scales this demand. Although this card is not decoded if the demand is an input file, it must appear in the input deck. The hot water demand at hour-of-the-day h is

$$D_{Wh} = Q_W W_h (\mathrm{kWh}),\ h = 1, \ldots, 24$$

where Q_W is the input hot water scale factor and the W_h are from the input table on the card. A default which represents a "typical" residence is shown in Figure 4-2 and tabulated below.

Column	Symb.	
1-2	--	"DH"
3-8	Q_W	Hot water scale. If this field is blank, the default values are used.
9-11	W_1	Hot water entry for first hour
12-15	W_2	Hot water entry for second hour
.	.	.
.	.	.
.	.	.
78-80	W_{24}	Hot water entry for twenty-fourth hour.

Default values are $Q_W = 1.2$

$W_h =$ 0.42, 0.35, 0.28, 0.25, 0.26, 0.25, 0.28, 0.37, 0.35, 0.74, 0.65, 0.57, 0.53, 0.53, 0.45, 0.40, 0.38, 0.35, 0.35, 0.35, 0.45, 0.57, 0.63, 0.56, 0.46.

Errors = (Q_W<0 but not blank, W_h<0)

4. Demand Miscellaneous Card (A2,F6.0,24F3.2)

This card specifies the miscellaneous electrical demand on an hour-of-the-day basis. Except for seasonal scaling, this demand is the same at the same hour of every day. The factor f in the DH card also scales this demand. Although this card is not decoded if the demand is an input file, it must appear in the input deck. The miscellaneous electrical demand at hour-of-the-day h is

$$D_{Mh} = Q_M M_h \text{(kWh)}, \ h = 1, 2, \ldots, 24$$

where Q_M is the input miscellaneous scale factor and the M_h are an input table. A default which represents a "typical" residence is shown in Figure 4-3 and tabulated below.

Column	Symb.	
1-2	--	"DM"
3-8	Q_M	Miscellaneous scale. If this field is blank, the default values are used.
9-11	M_1	Miscellaneous entry for first hour
.	.	.
.	.	.
.	.	.
78-80	M_{24}	Miscellaneous entry for twenty-fourth hour.

Default values are $Q_M = 1.0$

M_h = 0.60, 0.55, 0.50, 0.48, 0.46, 0.45, 0.60, 0.75, 0.80, 0.75, 0.70, 0.70, 0.70, 0.70, 0.70, 0.70, 0.70, 0.90, 1.10, 1.10, 1.10, 1.05, 1.00, 0.80.

Error = ($Q_M \leq 0$ but not blank, $M_h < 0$)

5. Demand Seasonal Card (A2,I2,4(F4.0,I2))

This card allows "seasonal" scaling of total demand by week-of-the year (the first week starts January 1). By "season," we mean some set of contiguous weeks; for example, a season may be the whole year. The identification of weeks is sort of modulo 52 in that week 53 is week 1, etc. If the second field of the card, w_0, is blank, the rest of the card is ignored and no seasonal scaling occurs. From one to four seasons can be scaled. The weeks given must span the year; that is, the last given week must be the initial given week plus 51.

Column	Symb.	
1-2	--	"DS"
3-4	w_0	Initial week. If blank, the card is ignored.
5-8	f_1	Scale for first season
9-10	w_1	End week of first season
11-14	f_2	Scale for second season, if needed.
15-16	w_2	End week for second season, if needed.
17-20	f_3	Etc.
21-22	w_3	Etc.
23-26	f_4	Etc.
27-28	w_4	End week for fourth season, if needed.
29-80	--	Not used

The total demand--heating/cooling (if used), plus hot water, plus miscellaneous for residential and input file otherwise--is scaled by f_i, depending on the week in which the demand occurs. Let w be any week, then for

$$w_0 \le w \le w_1; \text{ use } f_1$$

$$w_{i-1} < w \le w_i; \text{ use } f_i,\ i = 2, 3, 4 \quad .$$

The number of seasons terminates whenever $w_i - w_0 = 51$; for example, if $w_0 = 5$ and $w_2 = 56$, seasons three and four are not considered.

Error = ($w_0 \leq 0$ but not blank, $w_0 > 48$, $w_i \leq w_{i-1}$, $f_i \leq 0$, no w_i such that $w_i - w_0 = 51$)

6. COLLECTOR Card (A2,A4,A8,11F6.0)

Column	Symb.	
1-2	--	"CO"
3-6	--	Collector type code. The codes are CTTC = total tracking focused, (two-axis), solar FPTT = flat plate total tracking, solar FPTI = flat plate, tilted, solar FPEW = flat plate tracking about east/west axis, solar FPNS = flat plate tracking about north/south axis, solar HAWT = horizontal axis wind turbine
7-14	--	English description of collector, if desired
15-20	e_1	Efficiency of collector (usually $e_1 = 1.0$ for HAWT).
21-26	A_t	For FPTI or FPNS, A_t = tilt angle in degrees
	v_c	For HAWT, cutoff velocity, m/s
27-32	N_T	For HAWT, N_T = number of turbines. Only integer part is taken, $N_T<1 \rightarrow N_T=1$.
33-38	v_i	For HAWT, v_i = initial velocity, m/s; $v_i \leq 0 \rightarrow v_i = 0.454\ v_m$, where v_m is the median velocity from the TMY data.
39-44	v_r	For HAWT, v_r = rated velocity, m/s; $v_r \leq 0 \rightarrow v_r = 2.225\ v_m - 0.0761 v_m^2$.
45-50	--	Not used
51-56	L_1	*Minimum collector size--m^2 or $k(m^2)$
57-62	U_1	*Maximum collector size. If $L_1=U_1$, collector size is fixed at L_1.
63-68	α_1	Collector cost "α" parameter in $\$/m^2$ ($/kW for HAWT).
69-74	β_1	Collector cost "β" parameter.
75-80	γ_1	*Collector fixed cost--$ or K$.

Errors = (Unacceptable collector type, $e_1 \leq 0$, $e_1 > 1$, $A_t < 0$, $A_t \geq 90$, $v_c \leq v_r \leq v_i$, $L_1 < 0$, $U_1 < L_1$, $\alpha_1 < 0$, $\beta_1 \leq 0$, $\gamma_1 < 0$)

*See DH card for scale.

7. STORAGE Card (A2,A4,A8,11F6.0)

Column	Symb.	
1-2	--	"ST"
3-6	--	Storage code, not used.
7-14	--	English description of storage device, if desired
15-20	e_2	Storage efficiency (one minus leakage per hour)
21-26	e_7	Efficiency of transducer 7
27-32	e_8	Efficiency of transducer 8
33-38	r_7	Relative size of transducer 7
39-44	r_8	Relative size of transducer 8
45-50	L_{cy}	Storage cycles/life. To avoid storage replacement set L_{cy} = 999999.
51-56	L_2	*Minimum storage size--kWh or MWh
57-62	U_2	*Maximum storage size. If $L_2=U_2$, the storage size is fixed at L_2.
63-68	α_2	Storage cost "α" parameter in $/kWh.
69-74	β_2	Storage cost "β" parameter.
75-80	γ_2	*Storage fixed cost--$ or K$.

Errors = ($e_2 \leq 0$, $e_2 > 1$, $e_7 \leq 0$, $e_7 > 1$, $e_8 \leq 0$, $e_8 > 1$, $r_7 \leq 0$, $r_7 > 1$, $r_8 \leq 0$, $r_8 > 1$, $L_{cy} \leq 0$, $L_2 < 0$, $U_2 < L_2$, $\alpha_2 < 0$, $\beta_2 \leq 0$, $\gamma_2 < 0$)

*See DH card for scale.

8. Transducer 3 Card (A2,A4,A8,11F6.0)

Column	Symb.	
1-2	--	"T3"
3-6	--	Transducer code, not used.
7-14	--	English description of transducer, if desired
15-20	e_3	Transducer 3 efficiency
21-26	e_5	Transducer 5 efficiency
27-32	e_6	Transducer 6 efficiency
33-50	--	Not used
51-56	L_3	*Minimum transducer size--kW or MW
57-62	U_3	*Maximum transducer size. If $L_3=U_3$, the transducer is fixed at L_3.
63-68	α_3	Transducer cost "α" parameter in $/kW.
69-74	β_3	Transducer cost "β" parameter.
75-80	γ_3	*Transducer fixed cost--$ or K$.

Errors = ($e_3 \leq 0$, $e_3 > 1$, $e_5 \leq 0$, $e_5 > 1$, $e_6 \leq 0$, $e_6 > 1$, $L_3 < 0$, $U_3 < L_3$, $\alpha_3 < 0$, $\beta_3 \leq 0$, $\gamma_3 < 0$)

*See DH card for scale. These fields are enforced only if $L_3=U_3$, see Chapter VIII.

9. Transducer 4 Card (A2,A4,A8,11F6.0)

Column	Symb.	
1-2	--	"T4"
3-6	--	Transducer code, not used.
7-14	--	English description of transducer, if desired
15-20	e_4	Transducer 4 efficiency
21-50	--	Not used
51-56	L_4	*Minimum transducer size--kW or MW
57-62	U_4	*Maximum transducer size. If $L_4=U_4$, the transducer is fixed at L_4.
63-68	α_4	Transducer cost "α" parameter in $/kW.
69-74	β_4	Transducer cost "β" parameter.
75-80	γ_4	*Transducer fixed cost--$ or K$.

Errors = ($e_4 \leq 0$, $e_4 > 1$, $L_4 < 0$, $U_4 < L_4$, $\alpha_4 < 0$, $\beta_4 \leq 0$, $\alpha_4 < 0$)

*See DH card for scale. These fields are enforced only if $L_4=U_4$, see Chapter VIII.

10. YEARS Card (A2,3(2X,I4),10F6.0)

The YEARS and AMORT card give the economic parameters (see Chapter II).

Column	Symb.	
1-2	--	"YR"
3-4	--	Not used
5-8	y_p	Price year
9-10	--	Not used
11-14	y_o	Year of first operation
15-16	--	Not used
17-20	y_b	Base year
21-26	R	Discount rate
27-32	i	Loan interest rate
33-38	D	Ratio down payment
39-44	τ	Effective income tax rate
45-50	f_{om}	Ratio OM cost to capital cost
51-56	f_{pt}	Ratio property tax to capital cost
57-62	g	General inflation rate
63-68	g_{om}	OM escalation rate
69-74	g_{pt}	Property tax escalation rate
75-80	g_f	Purchase energy escalation rate

Errors = ($R \leq 0$, $D<0$, $D>1$, $\tau<0$, $\tau \geq 1$, $f_{om}<0$, $f_{pt}<0$, $i \leq 0$ and $D \neq 1$)

11. AMORT Card (A2,A1,I2,1X,I2,2(I6,3F6.0))

Column	Symb.	
1-2	--	"AM"
3	--	If "P," economics are personal, otherwise business.
4-5	N	System life
6	--	Not used
7-8	L	Life of loan
9-14	K_0	Maximum depreciation life of nonreplaceables
15-20	S_0	Ratio salvage to cost of nonreplaceables
21-26	T_0	Maximum investment tax credit for nonreplaceables
27-32	g_0	Escalation rate of nonreplaceables
33-38	K_1	Maximum depreciation life of storage
39-44	S_1	Ratio salvage to cost of storage
45-50	T_1	Maximum investment tax credit of storage
51-56	g_1	Escalation rate of storage
57-80	--	Not used

For personal economics, depreciation lives are used to compute investment-tax credits as usual--see Chapter II.

Errors = ($N \leq 0$, $L>N$, $L \leq 0$, and $D \neq 1$ (see YR Card), $K_0 \leq 0$, $K_0>N$, $S_0<0$, $S_0 \geq 1$, $T_0<0$, $T_0 \geq 1$, $K_1 \leq 0$, $K_1>N$, $S_1<0$, $S_1 \geq 1$, $T_1<0$, $T_1 \geq 1$)

12. Price of Energy Card (A2,F4.0,I2,4(3F4.0,3I2))

This card describes the time-of-day pricing structure and the peak pricing structure "seasonally" by week-of-the-year. The basic format concept is like the DS card, except that at least one season must appear. If only one season, it must be the whole year. The purchase prices, p_{ij}, are in cents per kWh. Again, weeks are defined by a quasi-modulo 52 method (see 5. Demand Seasonal Card).

Column	Symb.	
1-2	--	"PE"
3-6	p_f	*Fixed yearly cost of purchased energy--$ or $ K
7-8	w_0	Initial week
9-12	p_{11}	"High" price of purchased energy--cents/kWh, for first season
13-16	p_{21}	"Low" price of purchased energy--cents/kWh, for first season
17-20	q_1	Monthly peak demand charge--$/kW, for first season
21-22	h_{11}	Start hour for first season
23-24	h_{21}	End hour for first season
25-26	w_1	End week of first season
27-30	p_{12}	"High" price of purchased energy for second season, if needed.
31-34	p_{22}	Etc.
35-38	q_2	Etc.
39-40	h_{12}	Etc.
41-42	h_{22}	Etc.
43-44	w_2	Etc.
45-48	p_{13}	Etc.
49-52	p_{23}	Etc.
53-56	q_3	Etc.
57-58	h_{13}	Etc.
59-60	h_{23}	Etc.
61-62	w_3	Etc.

63-66	p_{14}	Etc.
67-70	p_{24}	Etc.
71-74	q_4	Etc.
75-76	h_{14}	Etc.
77-78	h_{24}	Etc.
79-80	w_4	End week of fourth season, if needed.

The seasons terminate whenever $w_i - w_0 = 51$. Let w be any week, then

$$w_0 \leq w \leq w_1 \quad \text{use } p_{11},\ p_{21},\ q_1,\ h_{11}, \text{ and } h_{21}$$

$$w_{i-1} < w \leq w_i \quad \text{use } p_{1i},\ p_{2i},\ q_i,\ h_{1i}, \text{ and } h_{2i};\ i = 2,3,4$$

For the i-th season, the low price p_{2i} applies for the first 2 days of the week (weekends). For the remaining five "working" days, the high price applies for hours-of-the-day h_{1i} through h_{2i}, inclusive, and the low price applies for the remaining hours, if any. If the high price and low price are not the same in any season, the peak price applies only at the same hours and days that the high price applies; that is, peaking is only measured during these hours. If the high price equals the low price, the peak demand charge applies at all hours and days in the season.

Errors = ($w_0 \leq 0$, $w_0 > 48$, $w_{i-1} \geq w_i$, $p_{1i} \leq 0$, $p_{2i} \leq 0$, $p_{1i} < p_{2i}$, $q_i < 0$,
$h_{1i} < 1$, $h_{2i} > 24$, $h_{2i} < h_{1i}$, no w_i such that $w_i - w_0 = 51$, $p_f < 0$)

13. LOGIC Card

This LOGIC card depends on the strategy chosen.

Column	Symb.	
1-2	--	"LO"
3-8	R	Sell-back ratio
9-14	S_L	Sell-back limit factor-see Chapter VI.
	UE11A	(A2,4F6.0)
15-20	L_L	Lower limit of decision variable X_L
21-26	U_L	Upper limit of decision variable X_L. If $L_L=U_L$, X_L is set equal to L_L.
27-80	--	Not used
	UE11B	(A2,2F6.0)
15-80	--	Not used
	UE11C	(A2,2F6.0,2I3)
15-17	T_1	LP step size
18-20	T	LP time span
21-80	--	Not used
	UE11D	(A2,2F6.0,2I3)
15-17	Q_P	Prediction indicator; $Q_P=0$, ideal prediction; $Q_P=1$, spline prediction; $Q_P=2$, average prediction--see Chapter VI
18-20	T	LP time span
21-80	--	Not used

Errors = ($R<0$, $R\geq 1$, $L_L\leq 0$, $U_L\geq 1.0$, $U_L<L_L$, $T_1\leq 0$, $T_1\geq T$, $T<4$, $T>24$, $Q_P<0$, $Q_P>2$)

GE11 Input Cards

Many of the GE11 cards are identical to the UE11 cards. There is no "T3," "T4," or "PE" card.

1. IDENT Card (A2,F8.0,2A10,1X,I1,F3.0)

   This card is the same as the ID card in UE11, except:

   The demand goal ratio parameter d_g is in columns 3-10.

   Only GE11Aþþþþþ may appear in columns 21-30.

   Errors = ($d_g \leq 0$, $d_g > 1$)

2. DH Card--identical to UE11.

3. DW Card--identical to UE11.

4. DM Card--identical to UELL.

5. DS Card--identical to UE11.

6. CO Card--identical to UE11.

7. ST Card--identical to UE11.

8. YR Card--identical to UE11.

9. AMORT Card (A2,A1,I2,1X,I2,3(I6,3F6.0))

   This card is the same as the AM card in UE11 except that the following additional data must be provided.

Column	Symb.	
57-62	K_2	Maximum depreciation life of generator
63-68	S_2	Ratio salvage to cost of generator
69-74	T_2	Maximum investment tax credit of generator
75-80	g_2	Escalation rate of generator

Errors = ($K_2 \leq 0$, $K_2 > N$, $S_2 < 0$, $S_2 \geq 1$, $T_2 < 0$, $T_2 \geq 1$)

10. GENERATOR Card (A2,A4,A8,4F6.0,4X,I2,6F6.0)

Column	Symb.	
1-2	--	"GE"
3-6	--	Fuel type--GASb̸, DIES, COAL, or NGAS
7-14	--	English description of generator, if desired
15-20	e_9	Efficiency of transducer 9
21-26	g_b	Generator turn-on loss factor
27-32	p_f	Generator fuel cost, \$/unit fuel
33-38	f_{or}	Ratio overhaul cost to capital cost
39-42	--	Not used
43-44	N_{og}	Number of overhauls per life
45-50	L_g	Life of generator--hours. If it is desired to never replace the generator, use L_g=999999
51-56	Z_L	Minimum size of generator in demand goal units
57-62	Z_U	Maximum size of generator in demand goal units
63-68	α_3	Generator cost "α" parameter--\$/kW
69-74	β_3	Generator cost "β" parameter
75-80	γ_3	*Generator fixed cost--\$ or K\$

Errors = ($e_9 \leq 0$, $e_9 > 1$, $g_b \leq 0$, $g_b > 1$, $p_f \leq 0$, $f_{or} < 0$, $N_{og} < 0$, $L_g \leq 0$, $Z_L < 0$, $Z_U < d_g$, $Z_U < Z_L$, $\alpha_3 < 0$, $\beta_3 \leq 0$, $\alpha_3 < 0$)

*See DH card for scale.

11. Generator Season Card (A2,I2,4(I4,I2),4X,5F6.0)

This card serves a dual function. It contains the seasonal data for arbitrary timing on the generator; that is, for producing the g_o^t table. The card also gives the parameters to compute the generator fuel consumption function. The seasonal part of the card is just like the DS card. However, instead of giving a seasonal scaling, the GS card gives the number of hours daily that the generator is ON for the season.

Column	Symb.	
1-2	--	"GS"
3-4	w_0	Initial week. If blank, the rest of the card is ignored up to column 33. In this case, g_o^t is set to zero for all t.
5-8	H_1	Number of daily ON hours for first season, if needed
9-10	w_1	End week of first season, if needed
11-14	H_2	Etc.
15-16	w_2	Etc.
17-20	H_3	Etc.
21-22	w_3	Etc.
23-26	H_4	Number of ON hours for fourth season, if needed
27-28	w_4	End week of fourth season, if needed
29-32	--	Not used
33-38	e_{31}	Coefficient of generator fuel consumption function--see Chapter VII
39-44	e_{32}	"
45-50	e_{33}	"
51-56	e_{34}	"
57-62	e_{35}	"
63-80	--	Not used

The same conventions concerning the w_i are used as in the "DS" card. For any week w,

$w_0 \leq w \leq w_1$, set g_o^t to one for the first H_1 hours of every day in all weeks w.

$w_{i-1} < w \leq w_i$, set g_o^t to one for the first H_i hours of every day in all weeks w.

A value of $H_i=0$ is valid and merely means that $g_o^t=0$ for all weeks in the i-th season.

Errors = ($w_0 \leq 0$ but not blank, $w_0>48$, $w_i \leq w_{i-1}$, $H_i<0$, $H_i>24$, no w_i such that $w_i-w_0=51$, $e_{31} \leq 0$, $e_{32}<0$, $e_{33} \leq 0$, $e_{33}>1$, $e_{33}+e_{34}+e_{35}$ 1; for any $0 \leq x<1$ max $(e_{33}+e_{34}x+e_{35}x^2)>1$)

12. Power Conditioning Card (A2,A4,A8,3F6.0,30X,3F6.0)

This card is like the "T3" card in UE11, except that the component size is dependent, and hence size limits are not used.

Column	Symb.	
1-2	--	"PC"
3-6	--	Not used.
7-14	--	English description of power conditioner--if desired
15-20	e_4	Efficiency of transducer 4
21-26	e_5	Efficiency of transducer 5
27-32	e_6	Efficiency of transducer 6
33-62	--	Not used
63-68	α_4	Transducer 4 cost "α" parameter--$/kW
69-74	β_4	Transducer 4 cost "β" parameter
75-80	γ_4	*Transducer 4 fixed cost--$ or $ K

Errors = ($e_4 \leq 0$, $e_4 > 1$, $e_5 \leq 0$, $e_5 > 1$, $e_6 \leq 0$, $e_6 > 1$, $\alpha_4 < 0$, $\beta_4 \leq 0$, $\gamma_4 < 0$)

*See DH card for scale.

13. LOGIC Card (A2,2(1X,I2),4F6.0)

Column	Symb.	
1-2	--	"LO"
3	--	Not used.
4-5	Q_P	Prediction indicator; $Q_P=0$, ideal prediction; $Q_P=1$, spline prediction; $Q_P=2$, average prediction--see Chapter VII
6	--	Not used
7-8	Q	Substrategy indicator; Q=0, no current measurement and no prediction; Q=1, current measurement but no prediction; Q 1, current measurement and prediction for Q-1 hours in the future--see Chapter VII
9-14	L_L	Lower limit of X_L
15-20	U_L	Upper limit of X_L. If $L_L=U_L$, X_L is set to L_L.
21-26	L_U	Lower limit of X_U relative to X_L
27-32	U_U	Upper limit of X_U. If $L_U=U_U$, X_U is set to L_U.
33-80	--	Not used

Errors = ($Q_P < 0$, $Q_P > 2$, $Q < 0$, $Q > 24$, $L_L \leq 0$, $L_L > U_L$, $U_L \geq 1$, $L_U \leq 0$, $L_U > U_U$, $U_U \geq 1$)

UE11 Output Listing Description and Samples

The output for each run consists of two files, the OUTPUT listing and a detailed output written to TAPE 9 for further reference, if so desired. We discuss the TAPE 9 output later.

The OUTPUT listing consists of two pages (see Chapter X). The first page shows the input deck and certain quantities associated with the demand and optimization. The run identifier, run number, and random seed (in decimal) for the Latin hypercube are printed first. This identifier is the hour, minute, second, month, and day the job entered the computer. The run number is a counter of runs in the job. Each input card image is enclosed in parentheses and has slashes printed to separate fields. If a card has been changed from the previous run, an asterisk is printed to the right of the card image. A listing is also presented of the seasonal distribution of energy and costs for time-of-day prices and demand charges for the nonsystem--no collector, storage, or transducer. After the message "XMIN," the number of passes in the run, K, and m_0 are listed.

The second output page gives the results. Fixed "optimal" sizes are denoted "F," variable ones by "V." The chosen size is under "SIZE." All costs are annualized unless otherwise noted. Under "PTC" is percent total capital cost. Percent capital cost assigned to variables is "PVC."

Let D_T be the total yearly demand, then

$$\text{TOTAL LEVEL COST} = (\text{TOTAL COST})/D_T,$$

$$\text{CAPITAL LEVEL COST} = \frac{\text{CAPITAL plus OM COST}}{D_T \text{ less NET E-PUR ENERGY}}$$

$$\text{NET E-PUR LEVEL COST} = \frac{\text{NET E-PUR COST}}{\text{NET E-PUR ENERGY}}$$

INIT LEV COST (all) = (LEVEL COST)/p(R,0,N)/p(R,g,N),

where p is the PV function, R is the discount rate, N is the system life, and g is the general inflation rate (see Chapter II).

The quantity BOD is an estimate of barrels of oil displaced by the system. We assume electrical energy provided by the system displaces oil consumption only during the "high-price" times. Thus

BOD = 0.001667 times (Demand plus total sold back less total purchased energy, all in kWh and at high price time only).

The storage cycle estimate is

$$\text{STO CYCLES/YR} \quad \frac{8736 \text{ (Average hourly storage output)}}{\text{storage capacity}}$$

The "LIFE CYCLE COST RATIO" is the ratio of the optimal ACSYS to the annualized cost of the nonsystem (or "ZERO" system).

In the following equations, all sums are on t from 1 to 8736. Other output quantities are:

PFD = percent fossil fuel displaced

$$= 100 \left[e_3 e_6 \sum \left(I_d + I_b\right) + e_3 e_8 e_7 \sum I_s - \frac{(1-e_2)\Sigma E_s \Sigma I_s}{\Sigma I_s + e_4 \Sigma I_4} \right] / D_T$$

PFP = percent fossil fuel purchased = 100 - PFD

PSE = percent system efficiency

$$= 100 e_3 \; e_6 \quad (I_d + I_b) + e_8 \quad (I_{ds} + I_{bs}) \; / (X_1 \; I_1 + I_4)$$

PDC = percent demand from collector and storage

$= 100e_3\ (e_6 I_d + e_8 I_{ds})/D_T$

PDS = percent demand from storage

$= 100e_3 e_8\ I_{ds}/D_T$

E-WASTE = total waste = $(O_5 - I_d - I_b - I_s)$

AES = average percent efficiency of storage

$= 100e_8\ (I_{ds} + I_{bs})/(\ I_s + I_4)$

AVG STO = average storage level = $E_s/8736$

LEAK = total leakage = $(1-e_2)\ E_s$

The "SELECTED CUMULANTS" give the percent of time that a particular component is at a certain level. For UE11, we only show storage cumulants. There are 20 numbers listed across the page. The i-th number shows the percent of time that the storage level, E_s^t, is at or below the level $iX_2/20$.

```
ENERGY OPTIMUM   RUN(0803021028-  1)  364    71437688227633DEC
(ID        /T-ALBUQ   /UE11A     /         /         /         /         /          )*
(CO/FPTI/         /.11   /25.    /      /      /      /      /00.00 /150.0 /117.  /1.     /1047. )*
(ST/    / BATT   /.999  /.85    /.89   /.3    /.3    /2000. /00.   /50.000/ 50.  /.98    /850.  )*
(T3/    / INV    /.90   /.90    /.99   /      /      /      /0.000 /10.00 /140.  /1.     /200.  )*
(T4/    / RECT   /.95   /       /      /      /      /      /0.    /10.   / 30.  /1.     /50.   )*
(YR/  1980/  1986/  1980/ .10  /.085  /.20   /.35   /.015  /.00   /.06   /.06   /.06    /.09   )*
(AM/P20 20/     6/ .11  /.13    /.065  /      3/.16  /.09   /.060  /      /      /       /      )*
(DH/RESID      /EQ/ 1.   /      4/ 3.52 /78/68/55/.4    /.225  /58.6  /1520. /312.  /.032  /      )*
(DW/ 1.2  / 42 35 28 25 26 25 28 37 35 74 65 57 53 53 45 40 38 35 35 45 57 63 56 46)*
(DM/ 1.0  / 60 55 50 48 46 45 60 75 80 75 70 70 70 70 70 70 70 90110110110105100 80)*
(DS/  /    /  /    /  /    /  /    /                                                   )*
(PE/ 0. /16/12. /6.0 /0.   /0921/44/12. /6.0 /0.   /0820/67/   /    /     /    /  /    /    /    /    /  )*
(LO/ .25   / 1.   /.01   /.90    /      /      /      /      /      /      /      /      /       )*
-DEMAND-RESIDENCE MAX=          4.465KW  TOTAL=        16.285MWH AT DAY 184, HOUR 19
-RSLB=  .25 RESB= 1.00

                 PURCHASE COST WITHOUT SYSTEM   TOTAL EL=      3218.
PRICE CENTS/KWH        12.000      6.000      12.000      6.000       0.000      0.000      0.000      0.000
AMT EL PURCH            3710.      4242.       3137.      5196.          0.         0.         0.         0.
COST OF EL PURCH       1032.1      590.0       872.6      722.8         0.0        0.0        0.0        0.0
(LESS FIXED COST)

            PEAK DEMAND PRICING
PRICE $/PEAK-KW          0.00       0.00        0.00       0.00        0.00       0.00       0.00       0.00

    -MONTH-                 1          2          3          4          5          6          7          8          9         10         11         12
HOUR OF YEAR              490       1282       1474       2626       3427       4363       4411       5131       5827       6958       7618       8698
PEAK PURCHASED            4.2        3.9        4.2        2.5        3.4        4.1        4.5        3.6        3.1        2.8        3.5        4.4
PEAK PURCHASED COST       0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0
FIXED PURCHASED COST=            .0, PURCHASED ENERGY COST=      3217.6,  PEAK PURCHASED COST        0.0
XMIN      133       1      .100000
-NOTE.   SIZES IN KWH, KW, OR  (M-SQ).  ENERGY IN KWH EXCEPT AS NOTED.
        COST IN  DOLLARS.
```

Figure 9.1 Sample Chart   UE11 with Collector   page 1

```
ENERGY OPTIMUM   RUN(0803021028-  1)
(ID        /T-ALBUQ   /UE11A     /          /          /          /          /
-NOTE.  SIZES IN KWH, KW, OR  (M-SQ).  ENERGY IN KWH EXCEPT AS NOTED.
        COST IN  DOLLARS.

                                                                  ELECTRICAL
                         SIZE     MAX SIZE      COST    PTC    PVC       AVG IN     AVG OUT
CO/FPTI/          -V   124.728    150.000      1179.   78.4   78.4      33.785       3.716
ST/     / BATT    -V    11.630     50.000       186.   12.4   12.4        .415        .410
                                                                         AVG IN     MAX IN
T3/     / INV     -V    13.000     15.330       139.    9.2    9.2       3.182      13.000
T4/     / RECT    -V     0.000      3.672         0.    0.0    0.0       0.000       0.000

 1                -V      .452

                    TOTAL     CAPITAL        OM  NET E-PUR TOT E-PUR    E-SLB
ANNUAL COST          2102.     1504.        447.     151.     1114.      963.
LEVEL COST           .1291     .0780               -.0173
INIT LEV COST        .1984     .1199               -.0267
ENERGY MWH                                         -8.726     7.432    16.158
BOD=             29.7 STO CYCLES/YR=    307.813 NO. PURCH.=    3.08 EVERY    6.5 YEARS
LIFE CYCLE COST RATIO= .6534

   PFD     PFP     PSE     PDC     PDS   E-WASTE   TOT DEM MWH  AES    AVG STO    LEAK
   153.5   -53.5    8.5    54.4    13.3     100.      16.285    74.8    5.407      47.

         TIME OF DAY ELECTRIC PRICING  RSLB=     .250    1.000
PRICE CENTS/KWH      12.000      6.000     12.000      6.000     0.000     0.000     0.000     0.000
TOTAL PURCHASED        254.      2732.       324.      4122.        0.        0.        0.        0.
      SOLD BACK       7633.      3007.      3902.      1616.        0.        0.        0.        0.
  NET PURCHASED      -7379.      -275.     -3578.      2506.        0.        0.        0.        0.
ANN NET COST PUR     -460.1      275.4     -181.1      517.2       0.0       0.0       0.0       0.0
 (LESS FIXED COST)

         PEAK DEMAND PRICING
PRICE $/PEAK-KW        0.00       0.00       0.00       0.00      0.00      0.00      0.00      0.00

  -MONTH-               1          2          3          4          5          6          7          8          9         10         11         12
HOUR OF YEAR           478       1279       1487       2624       3405       4366       4413       5397       5901       6958       7928       8695
PEAK PURCHASED         4.1        3.7        4.1        2.2        3.1        3.3        4.0        3.0        2.8        2.8        3.3        4.0
PEAK PURCHASED COST    0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0
FIXED PURCHASED COST=          .0,  PURCHASED ENERGY COST=        151.3,  PEAK PURCHASED COST=          0.0

                                 SELECTED CUMULANTS    100=FULL SCALE
ST   23.8  25.8  27.9  32.6  41.8  44.2  47.9  54.9  58.9  60.2  61.3  62.2  63.4  67.6  68.7  69.8  70.7  71.9  73.3 100.0
```

Figure 9.1 Sample Output UE11 with Collector   page 2

```
ENERGY OPTIMUM    RUN(0803021028-  2)  364  280127345961197DEC
(ID         /T-ALBUQ   /UE11A     /          /          /          /          /          )
(CO/MAWT/             /1.0    /15.    /1.     /5.      /10.     /         /00.    /20.    /100.0 /2.2    /2000. )*
(ST/     / BATT    /.999  /.85    /.89    /.3      /.3      /2000.  /00.    /50.000/ 50.  /.98    /850.  )
(T3/     / INV     /.90   /.90    /.99    /        /        /         /0.000 /10.00 /140.  /1.     /200.  )
(T4/     / RECT    /.95   /       /       /        /        /         /0.     /10.    / 30.  /1.     /50.   )
(YR/  1980/  1986/  1980/ .10  /.085   /.20     /.35     /.015   /.00    /.06    /.06   /.06    /.09   )
(AM/P20 20/      6/ .11  /.13   /.065   /        3/.16    /.09    /.060   /       /      /       /      )
(DH/RESID      /EQ/ 1.    /       4/ 3.52 /78/68/55/.4     /.225   /58.6   /1520. /312.  /.032   /      )
(DW/ 1.2   / 42 35 28 25 26 25 28 37 35 74 65 57 53 53 45 40 38 35 35 45 57 63 56 46)
(DM/ 1.0   / 60 55 50 48 46 45 60 75 80 75 70 70 70 70 70 70 70 90110110110105100 80)
(DS/  /     /  /     /  /     /  /     /                                             )
(PE/ 0. /16/12. /6.0 /0.   /0921/44/12. /6.0 /0.   /0820/67/     /      /     /     /    /     /     /     /  )
(LO/ .25   / 1.   /.01   /.90   /       /        /        /         /       /       /      /       /      )
-DEMAND-RESIDENCE MAX=            4.465KW  TOTAL=        16.285MWH AT DAY 184, HOUR 19
-VI=     5.00 VR=   10.00 VC=    15.00 NTUR=      1.0
-RSLB=   .25 RESB= 1.00

                  PURCHASE COST WITHOUT SYSTEM    TOTAL EL=       3218.
PRICE CENTS/KWH       12.000      6.000     12.000      6.000      0.000      0.000      0.000      0.000
AMT EL PURCH           3710.      4242.      3137.      5196.         0.         0.         0.         0.
COST OF EL PURCH      1032.1      590.0      872.6      722.8        0.0        0.0        0.0        0.0
(LESS FIXED COST)

             PEAK DEMAND PRICING
PRICE $/PEAK-KW         0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00

   -MONTH-                 1         2         3         4         5         6         7         8         9        10        11        12
HOUR OF YEAR             490      1282      1474      2626      3427      4363      4411      5131      5827      6958      7618      8698
PEAK PURCHASED           4.2       3.9       4.2       2.5       3.4       4.1       4.5       3.6       3.1       2.8       3.5       4.4
PEAK PURCHASED COST      0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0
FIXED PURCHASED COST=          .0, PURCHASED ENERGY COST=      3217.6,  PEAK PURCHASED COST         0.0
XMIN        98       1       .100000
-NOTE.  SIZES IN KWH, KW, OR  (M-SQ).  ENERGY IN KWH EXCEPT AS NOTED.
        COST IN  DOLLARS.
```

Figure 9.2 Sample Output UE11 with Wind Turbine   page 1

```
ENERGY OPTIMUM   RUN(0803021028-  2)
(ID         /T-ALBUQ   /UE11A     /          /          /          /          )
-NOTE.  SIZES IN KWH, KW, OR  (M-SQ).  ENERGY IN KWH EXCEPT AS NOTED.
        COST IN  DOLLARS.
--DIAMETER=      7.06 METERS.  SIZE OF THE WIND TURBINE IS FOR A SINGLE TURBINE.
                                COSTS AND I-O RESULTS ARE FOR  1 IDENTICAL TURBINES.

                                                                     ELECTRICAL
                       SIZE     MAX SIZE      COST     PTC    PVC       AVG IN     AVG OUT
CO/HAWT/         -V    20.000     20.000       706.    61.3   61.3       4.137      2.723
ST/     / BATT   -V    50.000     50.000       279.    24.2   24.2        .726       .705
                                                                        AVG IN     MAX IN
T3/     / INV    -V    16.068     31.170       168.    14.5   14.5       2.169     16.068
T4/     / RECT   -V     0.000     15.789         0.     0.0    0.0       -.000      0.000

 1               -V      .900

                   TOTAL    CAPITAL         OM  NET E-PUR TOT E-PUR    E-SLB
ANNUAL COST         2393.     1153.        348.      892.     1361.      468.
LEVEL COST          .1470     .0886               -1.3611
INIT LEV COST       .2258     .1362               -2.0914
ENERGY MWH                                          -.656     8.645     9.300
BOD=           16.5 STO CYCLES/YR=    123.097 NO. PURCH.=    1.23 EVERY  16.2 YEARS
LIFE CYCLE COST RATIO= .7439

   PFD     PFP     PSE     PDC     PDS   E-WASTE   TOT DEM MWH  AES    AVG STO    LEAK
  103.8    -3.8    47.0    47.2    25.0     421.       16.285   73.4    26.475     231.

             TIME OF DAY ELECTRIC PRICING  RSLB=    .250   1.000
PRICE CENTS/KWH      12.000     6.000    12.000     6.000     0.000     0.000     0.000     0.000
TOTAL PURCHASED        466.     3268.      672.     4238.        0.        0.        0.        0.
      SOLD BACK       2552.     3165.     1620.     1964.        0.        0.        0.        0.
  NET PURCHASED      -2086.      103.     -947.     2274.        0.        0.        0.        0.
ANN NET COST PUR      -47.8     344.5      74.4     521.2       0.0       0.0       0.0       0.0
  (LESS FIXED COST)

             PEAK DEMAND PRICING
PRICE $/PEAK-KW         0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00

   -MONTH-              1        2        3        4        5        6        7        8        9       10       11       12
HOUR OF YEAR          490     1282     1487     2624     3404     4363     4411     5755     5899     6958     7930     8722
PEAK PURCHASED        4.2      3.9      4.1      2.2      3.2      4.1      4.5      3.2      3.1      2.8      3.5      4.1
PEAK PURCHASED COST   0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0
FIXED PURCHASED COST=          .0,  PURCHASED ENERGY COST=       892.4,  PEAK PURCHASED COST=          0.0

                                 SELECTED CUMULANTS   100=FULL SCALE
ST   16.7  19.7  22.5  25.2  28.3  31.7  35.4  38.4  41.3  44.3  48.1  51.6  56.0  60.7  64.7  67.0  71.4  82.3  85.5 100.0
```

Figure 9.2 Sample Output UE11 with Wind Turbine   page 2

GE11 Output Listing Description and Samples

The GE11 output listing is much like the UE11 listing. In addition to showing the input cards, data is given for the generator only system; that is, no collector, storage, or transducers. The generator size is that size which satisfies the demand goal, whether or not such a generator size is allowed by the limits on the GE card. Due to minor numerical errors, the actual demand goal satisfied may not be "exactly" the requested value of d_g; hence the "ACTUAL DEMAND SATISFACTION GOAL" printing. The "DEMAND NOT SATISFIED IN...HOURS" indicates how many hours in the year that the demand is not satisfied. The "GENERATOR CUMULANTS" show the percent of time that the generator output is at or below the level $iX_3/20$, for the i-th number.

Most of the answer page is self-explanatory. Let D_S be the total demand satisfied by the optimal system, then

TOTAL LEVEL COST = (TOTAL COST)/D_S

CAPITAL LEVEL COST = (CAPITAL + OM COST)/(D_S - ΣG_d)

FUEL LEVEL COST = (FUEL COST)/(ΣG_d + ΣG_s)

INIT LEV COST (all) = (LEVEL COST)p(R,0,N)/p(R,g,N)

GENERATOR NO OVH = Number of overhauls

GENERATOR HOURS/YR = Number of hours generator is ON per year

GENERATOR DSIZE = Size of generator in ratio total-demand-satisfied units.

PDD = percent demand displaced

$$= 100\ (D_S-\Sigma G_d-\Sigma G_s)/D_S$$

PDG = percent demanded generated = 100-PDD

PSE = percent system efficiency

$$= \frac{100(D_S - \Sigma G_d - \Sigma G_s)}{\text{TOTAL COLLECTOR INPUT}}$$

PDC = percent demand from collector

$$= 100\ (1 - \Sigma G_d / D_S)\ -\ \text{PDS}$$

PDS = percent demand from storage

$$= 100\ e_4 e_8 \Sigma I_{ds} / D_S$$

AES = average efficiency of storage

$$= 100\ e_8 \Sigma I_{ds} / (\Sigma I_s + \Sigma G_s)$$

All sums are on t from 1 to 8736.

The "ST" and "GE" CUMULANTS are respectively the storage and generator cumulants as explained above.

Detailed Output--TAPE 9 (Optional)

For each run a file is written in binary (unformatted) mode to TAPE 9. Successive runs in a job are separated by END-OF-FILE marks. The file from each run consists of 366 records.

```
GE11 OPTIMIZATION (0803001028- 2) DSPLR=  .999     1271281337050170
(ID .999   /T-ALBUQ   /GE11A     /          /          /          /          /          )
(DM/RESID      /EQ/ 1.0  /      4/ 3.52 /786855/ .40  /.225  /58.6  /1520. /312.  /.032  /      )
(DW/ 1.2  / 42 35 28 25 26 25 28 37 35 74 65 57 53 53 45 40 38 35 35 45 57 63 56 46)
(DM/ 1.0  / 60 55 50 48 46 45 60 75 80 75 70 70 70 70 70 70 70 98110110110105100 80)
(DS/  /    / /    / /    / /    / /                                              )
--DEMAND=RESIDENCE   TOTAL=      16.285MWH  MAX=      4.465KWH AT DAY 184, HOUR 19
--SIZES IN KWH, KW, OR M-SQ.  ENERGY IN KWH, EXCEPT AS NOTED.  COSTS IN DOLLARS.
(CO/PPTI/        /.11   /25.    /       /       /       /       /00.   /150.  /117.  /1.    /1047. )
(ST/    / BATT   /.999  /.85    /.89    /.3     /.3     /2000. /00.000/50.000/ 50.  /.98    /850.  )
(GE/GAS /        /.97   /.86    /1.30   /.085   /      3/ 25000/ .0    /.999  /200.  /1.     /100.  )
--GENERATOR FUEL IS GASOLINE IN GALLONS
(GS/  /    / /    / /    / /    / /    /5.     /.3      /.1365 /1.664 /-.801 /       /       /      )
--ACTUAL DEMAND SATISFACTION GOAL IS   .9990
(PC/     /        /.90   /.90   /.99   /                                          /140.  /1.    /200.  )
(YR/  1980/  1986/  1980/ .10  /.085  /.20   /.35   /.015  /.00   /.06   /.06   /.06   /.89   )
(AM/P20/ 20/      6/ .11  /.20   /.060  /      3/ .16  / .20  /.060  /      3/ .15  /.20   /.06   )

--GENERATOR ONLY...SIZE=      3.739 USES          3475. UNITS FUEL/YR TO SATISFY DEMAND GOAL
--ANNUAL COST...TOTAL=   10998. CAP=    389. OM=    136. FUEL=  10473.  NO. USED=  7.0 EVERY  2.86 YEARS
--DEMAND NOT SATISFIED IN     76. HOURS

                              GENERATOR CUMULANTS   100=FULL SCALE
--   0.0   0.0   0.0   0.0   8.7  15.4  26.0  38.8  48.7  56.8  62.5  68.7  74.9  80.8  86.6  91.4  94.8  96.9  98.3 100.0

(LO/  0  0/.010  /.700  /.100  /.900  /      /      /      /      /      /      /      /      )
--MIN     169      1    .1000
```

Figure 9.3 Sample Output GE11 with Collector   page 1

```
STAND-ALONE OPTIMUM  RUN(0803001028-  2)  DEMAND SATISFACTION GOAL IS  .9990 OF TOTAL.
(ID .999    /T-ALBUQ    /GE11A      /          /          /          /          /          )
--SIZES IN KWH, KW, OR  (M-SQ).  ENERGY IN KWH, EXCEPT AS NOTED.  COSTS IN   DOLLARS.
--GENERATOR FUEL IS GASOLINE IN GALLONS .  ANNUAL FUEL USED IS            368.
--TOTAL DEMAND =        16.285MWH.  PEAK DEMAND SATISFIED=         4.465.  SATISFIED DEMAND IS  .9990 OF TOTAL.
--DEMAND IS NOT SATISFIED IN     23. HOURS OF YEAR

                                SIZE      MAX SIZE      COST        AVG IN      AVG OUT     MAX OUT
CO/FPTI/            / -V      125.849     150.000      1087.        34.088       3.750      16.489
ST/     / BATT      / -V       50.000      50.000       377.         1.170       1.137       5.325
BE/GAS /            / -V        2.446       3.739        39.         0.000        .241       2.446
PC/     /           /           4.961       4.961        57.         1.921       1.729       4.465
 1                    -V         .187        .780 MIN=        .010
 2                    -V         .370        .900 MIN=        .100

LIFE CYCLE COST RATIO=   .286

                         TOTAL      CAPITAL        OM        FUEL
ANNUAL COST              3150.       1561.        480.       1110.
LEVEL COST               .194        .135                    .527
INIT LEV COST            .126        .088                    .343

TOTAL MWH     NET OUTPUT   TO DEMAND    TO STORE      WASTE
COLLECTOR       29481.8      8019.3      11116.7     10345.8
STORAGE          9935.5      9935.5          0.0       298.2
GENERATOR        2105.8      1165.8        940.0         0.0

                NO. PURCH  INTERVAL(YR)  STO CYC/YR  AVG LEVEL
STORAGE            1.99       10.06       198.71      34.14
                                         NO. OVH    NO. STARTS   HOURS/YR DSIZE
GENERATOR          1.00       20.00        3.0         78.          872.  .9375

    PDD    PDG    PSE    PDC    PDS    AES
   87.06  12.94   4.76  43.92  48.92  73.34

                          CUMULANTS  100=FULL SCALE
ST       .6    1.3    3.7    6.2    8.3   10.5   12.9   15.4   18.9   23.8   29.3   35.5   43.8   50.8   56.7   62.1   66.7   71.2   76.2 100.0
GE     90.0   90.0   90.0   90.0   90.0   90.0   90.0   90.0   90.0   90.0   90.0   90.0   90.0   90.0   90.0   90.0   90.0   90.9   90.9 100.0
```

Figure 9.3   Sample Output   GE11 with Collector   page 2

```
GE11 OPTIMIZATION  (0803001028-  1) DSPLR=  .999        6061436548007530
(ID .999    /T-ALBUQ    /GE11A     /            /            /            /            /            )*
(DH/RESID         /EQ/ 1.0  /        4/ 3.52 /786855/ .40  /.225  /58.6  /1520. /312.  /.032  /        )*
(DW/ 1.2  / 42 35 28 25 26 25 28 37 35 74 65 57 53 53 45 40 38 35 35 45 57 63 56 46)*
(DM/ 1.0  / 60 55 50 40 46 45 60 75 80 75 70 70 70 70 70 70 70 9011011011010510080 80)*
(DS/  /     /  /     /  /     /  /     /  /                                                    )*
--DEMAND=RESIDENCE    TOTAL=         16.285MWH   MAX=          4.465KWH AT DAY 184, HOUR 19
--SIZES IN KWH, KW, OR M-SQ.  ENERGY IN KWH, EXCEPT AS NOTED.  COSTS IN DOLLARS.
(CO/HAWT/            /1.0   /15.    /1.     /5.     /10.    /          /00.00 /50.00 /100.0 /2.2    /2000. )*
-VI=    5.00 VR=    10.00 VC=    15.00 NTUR=      1.0
(ST/     / BATT     /.999  /.85    /.89    /.3     /.3      /2000. /80.008/50.008/ 50.   /.98    /850.   )*
(GE/GAS /           /.97   /.86    /1.30  /.085  /       3/ 25000/ .0    /.999  /200.  /1.     /100.   )*
--GENERATOR FUEL IS GASOLINE IN GALLONS
(GS/  /     /  /     /  /     /  /     /  /      /5.     /.3     /.1365 /1.664 /-.801 /        /        /        )*
--ACTUAL DEMAND SATISFACTION GOAL IS    .9990
(PC/     /           /.90   /.90   /.99   /                                          /140.  /1.     /280.  )*
(YR/  1980/  1986/  1980/ .10  /.085  /.20    /.35    /.015  /.00   /.06    /.06   /.06   /.09    )*
(AM/P20/ 20/       6/ .11  /.20    /.060  /       3/ .16  / .20  /.060  /        5/ .15  /.20    /.06    )*

--GENERATOR ONLY...SIZE=        3.739 USES          3475. UNITS FUEL/YR TO SATISFY DEMAND GOAL
--ANNUAL COST...TOTAL=    10998. CAP=      389. OM=      136. FUEL=   10473.   NO. USED=  7.0 EVERY  2.86 YEARS
--DEMAND NOT SATISFIED IN     76. HOURS

--                                   GENERATOR CUMULANTS    100=FULL SCALE
--      0.0    0.0    0.0    0.0    8.7   15.4   26.0   38.8   48.7   56.8   62.5   68.7   74.9   80.8   86.6   91.4   94.8   96.9   98.3  100.0

(LO/   0   0/.010  /.700  /.100  /.900  /        /        /        /        /        /        /        /        )*
--MIN      175         1    .1000
```

Figure 9.4 Sample Output GE11 with Wind Turbine   page 1

```
STAND-ALONE OPTIMUM  RUN(0803001028-  1)  DEMAND SATISFACTION GOAL IS  .9990 OF TOTAL.
--DIAMETER=     10.02 METERS.  SIZE OF THE WIND TURBINE IS FOR A SINGLE TURBINE.
                                COSTS AND I-O RESULTS ARE FOR  1 SETS OF IDENTICAL TURBINES.
(ID .999   /T-ALBUQ   /GE11A      /          /          /          /          /          )*
--SIZES IN KWH, KW, OR  (M-SQ).  ENERGY IN KWH, EXCEPT AS NOTED.  COSTS IN   DOLLARS.
--GENERATOR FUEL IS GASOLINE IN GALLONS .  ANNUAL FUEL USED IS          1114.
--TOTAL DEMAND =       16.285MWH.  PEAK DEMAND SATISFIED=        4.465.  SATISFIED DEMAND IS  .9990 OF TOTAL.
--DEMAND IS NOT SATISFIED IN     25. HOURS OF YEAR

                              SIZE      MAX SIZE      COST         AVG IN       AVG OUT      MAX OUT
CO/HAWT/         / -V        40.291      50.000       1235.         8.611        5.596       40.291
ST/    / BATT    / -V        50.000      50.000        346.         1.043        1.016        5.248
GE/GAS /         / -V         2.948       3.739         76.         0.000         .747        2.948
PC/    /         /            4.841       4.841         56.         1.521        1.369        4.357
 1                 -V          .239        .700 MIN=          .010
 2                 -V          .116        .900 MIN=          .100

LIFE CYCLE COST RATIO=   .511

                     TOTAL      CAPITAL        OM         FUEL
ANNUAL COST          5616.       1713.         545.       3357.
LEVEL COST           .345        .189                      .514
INIT LEV COST        .225        .123                      .335

TOTAL-MWH    NET OUTPUT  TO DEMAND     TO STORE       WASTE
COLLECTOR       43994.3      5443.6       8568.2      29982.5
STORAGE          8879.4      8879.4          0.0        251.9
.GENERATOR       6526.8      4306.5       2220.2          0.0

             NO. PURCH INTERVAL(YR) STO CYC/YR  AVG LEVEL
STORAGE          1.78       11.26      177.59      28.84
                                      NO. OVH     NO. STARTS    HOURS/YR DSIZE
GENERATOR        1.84       10.86         5.5        325.        2302.  .9825

   PDD    PDG    PSE    PDC    PDS    AES
  59.88  40.12  12.95  29.81  43.72  73.25

                     CUMULANTS  100=FULL SCALE
ST      .6    1.0    1.9    4.9   16.2   29.1   38.5   41.7   44.6   47.4   50.6   53.8   56.9   60.1   63.5   67.4   71.3   75.3   79.8  100.0
GE    74.1   74.1   74.1   74.1   74.1   74.1   74.1   74.1   74.1   74.1   74.1   74.2   74.2   74.2   74.2   74.2   74.2   77.9   77.9  100.0
```

Figure 9.4 Sample Output GE11 with Wind Turbine   page 2

The first record gives the run identifier, run number, and input card images. It may be read by

```
READ(.)ID,IR,((C(I,J),I=1,9),J=1,30).
```

ID = Run identifier (A10)

IR = Run number, integer mode

Word C(I,J), I=1,8 is the 10 character field of the J-th input card, ordered as in the OUTPUT listing. If C(9,J) is an asterisk, the card is "new."

The second record contains 10 words; vis,

```
READ(.)(X(I), I=1,10).
```

The mode is real. The value of X(I) is the optimum value of the I-th size. In UE11, only I=1,4 is meaningful, except for UE11A, where X(5) is the value of X_L. In GE11, X(4)=0, X(5) gives the optimal value of X_L, and X(6) gives the optimal value of X_U.

The next 364 records contain detailed real-mode data for each of the 364 days. There are 240 words/record. Each record is read by

```
READ(.)((A(I,J), I=1,10), J=1,24).
```

Index J is the hour of the day.

	UE11	GE11
A(1,J) =	I_d	I_d
A(2,J) =	I_b	G_d
A(3,J) =	I_s	I_{ds}
A(4,J) =	I_{ds}	I_s
A(5,J) =	I_{bs}	G_s
A(6,J) =	I_4	E_s
A(7,J) =	E_s	0_5
A(8,J) =	O_5	E_D
A(9,J) =	E_D	Zero
A(10,J) =	P (price)	Zero

EAA:pml:4632A:02/28/81

References

1. Hoover, E. R., "SOLCEL-II: An Improved Photovoltaic System Analysis Program," Sandia National Laboratories, Albuquerque, New Mexico, SAND79-1785, February 1980.

2. Burroughs, J. D., Warren, A. W., and Edsinger, R. W., "SIMWEST: A Simulation Model for Wind and Solar Photovoltaic Energy Storage Systems," Boeing Computer Services Company, NASA/LRC BCS-40262-1, May 1979.

3. Caskey, D. L., Caskey, B. C., and Aronson, E. A., "Parametric Analysis of Residential Grid-Connected Photovoltaic Systems with Storage," Sandia National Laboratories, Albuquerque, New Mexico, SAND 79-2331, March 1980.

4. Perino, Audrey, "A Methodology for Determining the Economic Feasibility of Residential or Commercial Solar Energy Systems," Sandia National Laboratories, Albuquerque, NM, SAND78-0931, January 1979.

5. Stermole, F. J., Economic Evaluation and Investment Decision Methods, Investment Evaluations Corporation, Golden Colorado, 1974.

6. Dickinson, W. C. and Brown, K. C., "Economic Analysis of Solar Industrial Process Heat Systems," Lawrence Livermore Laboratory, Livermore, CA, August 1979.

7. Hall, I. J., Prairie, R. R., Anderson, H. E., and Boes, E. C., Generation of TMY for 26 SOLMET Stations, Sandia National Laboratories, Albuquerque, NM, SAND78-1601, August 1978.

8. Hill, James, E., and Furlong, Richard R., "ASHRAE Cooling Load Calculation," ASHRAE Journal, May 1973.

9. Lasdon, L. S., Optimization Theory for Large Systems, (New York, MacMillan Publishing Company, Inc., 1970).

10. Box, G. E. P. and Jenkins, G. M., Time Series Analysis: Forecasting and Control, (San Francisco, CA, Holden-Day, 1976).

11. Hanson, R. J., "Constrained Least Squares Curve Fitting to Discrete Data Using B-Splines--A User's Guide," Sandia National Laboratories, Albuquerque, NM, SAND78-1291, February 1979.

12. Haskell, K. H. and Jones R. E., "Brief Instructions for Using the Sandia Mathematical Subroutine Library (Version 7.2)," Sandia National Laboratories, Albuquerque, NM, SAND77-1441, June 1978 (see subroutine MINA).

13. McKay, M. D., Beckman, R. J., and Conover, W. J., "A Comparison of Three Methods for Selecting Values of Input Variables in the Analysis of Output from a Computer Code," TECHNOMETRICS, Vol 21, No. 2, pp 239-245 (May 1979).

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```
      FUNCTION COST(ZZZZZ)
C ....   NOTE. VALID ONLY IF X(2) IS BATTERY AND THERE IS ONLY ONE.
      COMMON /COMMAIN/ NV,NCV,NCCOL,NCSTO,NCTRA,NOVAR,NCOTH,ISTH,ISBIG,
     1ITIT,IRUN,LCO(30),LCR(9,30),NTYPE
      COMMON /COMAMOB/ CZSYS,LIFE,AMOB,AMOP
      COMMON /COMWIND/ W(8),ISWND(2)
      COMMON /COMSUDE/ SE1(24),SE2(24),ST1(24),ST2(24),DEE(24),DET(24)
      COMMON /COMCOMP/ EFF(22),XM(20,2),CC(20,3),RSLB,RESB,DETOT,DTTOT
      COMMON /COMPURC/ EPUR(11,2),ESLB(10),ECOS(11),ITOD(26),
     A PCOS(10),PDCO(12,2),MHPK(12),MHOUR(12)
     B ,RLCCR
      COMMON /COMANSW/ X(20),XCO(20),MXX(20),CTOT(7,2)
C     CTOT(1,1)=CTOT, (2)=CCAP, 3=CCOM, 4=CTPU, 5=NET CEPU, 6=CEPU, 7=SL
C     CTOT(4,2)=AMOUNT TPU, ETC.
      DO 9 J=1,14
    9 CTOT(J)=0. $ IF(X(2).LE.0.)EFF(22)=0.
      DO 10 J=1,NCV $ XCO(J)=0. $ IF(X(J).LE.0.)GO TO 10
      Z1=CC(J)*(X(J)**CC(J,2))+CC(J,3)
      CALL AMORT(Z1,0,LIFE,J,XCO(J),Z2) $ CTOT(3)=CTOT(3)+Z2
      IF(J.NE.2)GO TO 10 $ P=AMAX1(1.,EFF(22)*LIFE/EFF(21)/X(2))
      EFF(22)=P $ IF(P.LE.1.)GO TO 10 $ M1=P $ M2=M1+1 $ DO 14 M=M1,M2
      Z8=Z1
      Z3=0. $ Z4=M $ XNR=LIFE/Z4 $ NR=MAX0(1,INT(XNR)) $ DO 13 K=1,M
      CALL AMORT(Z8,INT((K-1)*XNR),NR,2,Z4,Z5) $ Z8=Z1-CC(2,3)
   13 Z3=Z3+Z4 $ IF(M.EQ.M1)Z6=Z3
   14 CONTINUE $ XCO(2)=(Z3-Z6)*(P-M1)+Z6
   10 CTOT(2)=CTOT(2)+XCO(J)
      CTOT(4)=AMOP*(FCTP+.01*ECOS(11)*EPUR(11))
       CTOT(4,2)=EPUR(11)
      DO 11 J=1,10
       CTOT(6,2)=CTOT(6,2)+EPUR(J)
      CTOT(7,2)=CTOT(7,2)+ESLB(J)
       CTOT(6)=CTOT(6)+ECOS(J)*EPUR(J)
   11 CTOT(7)=CTOT(7)+ESLB(J)*ECOS(J)
      DO 12 J=1,12
   12 CTOT(6)=CTOT(6)+PDCO(J,1)*100.
       CTOT(6)=AMOP*(FCEP+.01*CTOT(6))
      CTOT(7)=RSLB*.01*AMOP*CTOT(7)
       CTOT(5,2)=CTOT(6,2)-CTOT(7,2)
      CTOT(5)=CTOT(6)-CTOT(7)
      COST=CTOT(1)=CTOT(2)+CTOT(3)+CTOT(4)+CTOT(5)
      RETURN
      ENTRY COSTI
      N1=NCV+2
       N2=N1+NCOTH-1
       DO 16 J=1,11
   16 ECOS(J)=0.
       FCTP=FCEP=0.
       IF(ISTH) 17,20,20
C      THERMAL - PT CARD.
   17 DO 18 N=N1,N2
       DECODE(2,1,LCR(1,N))J1
       IF(J1.EQ.2HPT)GO TO 19
    1 FORMAT(A2,13F6.0)
   18 CONTINUE
       CALL EXIT
   19 DECODE(80,1,LCR(1,N))J1,FCTP,ECOS(11)
```

```
      GO TO 23
C     ELECTRIC - PE CARD.
   20 DO 21 N=N1,N2
      DECODE(2,1,LCR(1,N))J1
      IF(J1.EQ.2HPE)GOTO 22
   21 CONTINUE
      CALL EXIT
   22 DECODE(80,1,LCR(1,N))J1,FCEP
      CALL TODPRI(N)
      IF(ISTH.LE.0)GOTO17
   23 IF(ISBIG.EQ.0)GO TO 24
      FCTP=1000.*FCTP
      FCEP=1000.*FCEP
   24 IF(FCEP.LT.0..O.FCTP.LT.0.)GO TO 99
      DO 25 J=1,11
      IF(ECOS(J).LT.0.) GO TO 99
   25 CONTINUE
C     LOGIC CARD.
      DO 26 N=N1,N2
      DECODE(2,1,LCR(1,N))J1
      IF(J1.EQ.2HLO)GOTO27
   26 CONTINUE
      CALL EXIT
   27 DECODE(80,1,LCR(1,N))J1,RSLB,RESB
      IF(RESB.LT.0..O.RSLB.LT.0..O.RSLB.GT.1.)GOTO99
      IF(RSLB.LE.0.)RESB=0.
      CALL AMORTI(Z1,Z1,Z1,Z1,Z1,Z1)
      DO 36 J=1,NCV
      IF(ISBIG.LE.0)GO TO 34
      XM(J)=1000.*XM(J)
      XM(J,2)=1000.*XM(J,2)
      CC(J,3)=1000.*CC(J,3)
   34 IF(J.GT.NCCOL)GO TO 35
      IF(ISWND(J).LE.0)GO TO 36
      CC(J,3)=CC(J,3)*W(7)
      CC(J,2)=CC(J,2)/2.
      CC(J)=CC(J)*W(7)*((259.7/W(3)/(W(5)+W(4))**3)**CC(J,2))
      GO TO 36
   35 CC(J)=CC(J)*(EFF(J)**CC(J,2))
   36 CONTINUE
C ....
      DO 38 J=1,NCV
      MXX(J)=1HV
   38 IF(XM(J,2).EQ.XM(J))MXX(J)=1HF
      J1=0
C  .....
      PRINT 3,RSLB,RESB
    3 FORMAT(* -RSLB=*F5.2,* RESB=*F5.2)
      CALL TODUDI(1)
      Z2=AMOP*(FCTP+.01*ECOS(11)*EPUR(11))
      Z3=Z4=0.
      DO 40 J=1,12
      PDCO(J,1)=PDCO(J,1)*AMOP
   40 Z3=Z3+PDCO(J,1)
      Z5=AMOP*FCEP
      DO 42 J=1,10
      ESLB(J)=.01*AMOP*ECOS(J)*EPUR(J)
```

```
      42  Z4=Z4+ESLB(J)
          Z1=Z3+Z4+Z5
          CZSYS=Z1+Z2
           IF(ISBIG.LE.0)GO TO 44
           Z1=Z1/1000.
          Z2=Z2/1000.
          Z3=Z3/1000.
          Z4=Z4/1000.
          Z5=Z5/1000.
          DO 41 J=1,12
          DO 41 K=1,2
     41   PDCO(J,K)=PDCO(J,K)/1000.
           DO 43 J=1,10
           EPUR(J)=EPUR(J)/1000.
      43  ESLB(J)=ESLB(J)/1000.
      44  PRINT4,Z1,   (ECOS(J),J=1,8),(EPUR(J),J=1,8),(ESLB(J),J=1,8)
     C    SUM COST OF SYSTEM WITHOUT SOLAR ARRAYS
          RLCCR = CZSYS
      4   FORMAT(/18X,*PURCHASE COST WITHOUT SYSTEM   TOTAL EL=*F10.0,
         1                  /* PRICE CENTS/KWH  *8F10.3/* AMT EL PURCH*
         25X,8F10.0/* COST OF EL PURCH *8F10.1/* (LESS FIXED COST)*)
          PRINT 90,(PCOS(I),I=1,8),(I,I=1,12),(MHPK(I),I=1,12),
         A (PDCO(I,2),I=1,12),(PDCO(I,1),I=1,12)
     90   FORMAT(/12X,*PEAK DEMAND PRICING*/* PRICE $/PEAK-KW   *8F10.2,//
         A 4X,*-MONTH-*,8X,12I9,/* HOUR OF YEAR*7X,12I9,/
         B * PEAK PURCHASED*5X,12F9.1,/* PEAK PURCHASED COST*12F9.1)
          PRINT 91,Z5,Z4,Z3
     91   FORMAT(* FIXED PURCHASED COST=*,F12.1,
         A *, PURCHASED ENERGY COST=*,F12.1,
         B *,  PEAK PURCHASED COST*,F12.1)
          RETURN
      98  FORMAT(* ERROR FROM COST*/1X,8A10)
      99  PRINT98,(LCR(J,N),J=1,8)
           CALL EXIT
           END
```

SYMBOLIC REFERENCE MAP (R=3)

```
ENTRY POINTS      DEF LINE      REFERENCES
    4   COST          1           42
  156   COSTI        43          145        149

VARIABLES      SN  TYPE          RELOCATION
    2   AMOB        REAL                 COMAMOB     REFS        5
    3   AMOP        REAL                 COMAMOB     REFS        5       28      37      38     107     110     112
                                                            114
   76   CC          REAL         ARRAY   COMCOMP     REFS        8     3*18      24      89      92      93    2*94
                                                            2*96  DEFINED      89      92      93      94      96
  736   COST        REAL                             DEFINED    41
   74   CTOT        REAL         ARRAY   COMANSW     REFS       12       19      27      31      32      33      34
                                                             36       37      38    2*39    2*40    4*41
                                                     DEFINED    16       19      27      28      29      31      32
                                                             33       34      36      37      38      39      40      41
```

VARIABLES	SN	TYPE		RELOCATION								
0	CZSYS	REAL		COMAMOB	REFS	5	132	DEFINED	117			
140	DEE	REAL	ARRAY	COMSUDE	REFS	7						
170	DET	REAL	ARRAY	COMSUDE	REFS	7						
174	DETOT	REAL		COMCOMP	REFS	8						
175	DTTOT	REAL		COMCOMP	REFS	8						
40	ECOS	REAL	ARRAY	COMPURC	REFS	9	28	33	34	73	107	114
					130	DEFINED	47	57				
0	EFF	REAL	ARRAY	COMCOMP	REFS	8	2*20	96	DEFINED	16	21	
0	EPUR	REAL	ARRAY	COMPURC	REFS	9	28	29	31	33	107	114
					128	130	DEFINED	128				
26	ESLB	REAL	ARRAY	COMPURC	REFS	9	32	34	115	129	130	
					DEFINED	114	129					
757	FCEP	REAL			REFS	37	70	71	112	DEFINED	48	65
					70							
756	FCTP	REAL			REFS	28	69	71	107	DEFINED	48	57
					69							
764	I	INTEGER			REFS	5*136	DEFINED	5*136				
12	IRUN	INTEGER		COMMAIN	REFS	3						
10	ISBIG	INTEGER		COMMAIN	REFS	3	68	86	118			
7	ISTH	INTEGER		COMMAIN	REFS	3	49	67				
10	ISWND	INTEGER	ARRAY	COMWIND	REFS	6	91					
11	ITIT	INTEGER		COMMAIN	REFS	3						
53	ITOD	INTEGER	ARRAY	COMPURC	REFS	9						
737	J	INTEGER			REFS	16	2*17	4*18	2*19	20	27	31
					32	2*33	2*34	36	47	73	2*87	2*88
					2*89	90	91	2*92	2*93	3*94	4*96	100
					3*101	2*110	111	3*114	115	2*126	2*128	2*129
					3*130	147	DEFINED	15	17	30	35	46
					72	85	99	109	113	124	127	3*130
					147							
763	J1	INTEGER			REFS	53	62	78	DEFINED	52	57	61
					65	77	81	102				
753	K	INTEGER			REFS	24	2*126	DEFINED	23	125		
13	LCO	INTEGER	ARRAY	COMMAIN	REFS	3						
51	LCR	INTEGER	ARRAY	COMMAIN	REFS	3	52	57	61	65	77	81
					147							
1	LIFE	INTEGER		COMAMOB	REFS	5	19	20	23			
745	M	INTEGER			REFS	2*23	25	DEFINED	21			
163	MHOUR	INTEGER	ARRAY	COMPURC	REFS	9						
147	MHPK	INTEGER	ARRAY	COMPURC	REFS	9	136					
50	MXX	INTEGER	ARRAY	COMANSW	REFS	12	DEFINED	100	101			
743	M1	INTEGER			REFS	2*21	25	26	DEFINED	21		
744	M2	INTEGER			REFS	21	DEFINED	21				
762	N	INTEGER			REFS	52	57	61	65	66	77	81
					147	DEFINED	51	60	76			
2	NCCOL	INTEGER		COMMAIN	REFS	3	90					
6	NCOTH	INTEGER		COMMAIN	REFS	3	45					
3	NCSTO	INTEGER		COMMAIN	REFS	3						
4	NCTRA	INTEGER		COMMAIN	REFS	3						
1	NCV	INTEGER		COMMAIN	REFS	3	17	44	85	99		
5	NOVAR	INTEGER		COMMAIN	REFS	3						
752	NR	INTEGER			REFS	24	DEFINED	23				
467	NTYPE	INTEGER		COMMAIN	REFS	3						
0	NV	INTEGER		COMMAIN	REFS	3						
760	N1	INTEGER			REFS	45	51	60	76	DEFINED	44	
761	N2	INTEGER			REFS	51	60	76	DEFINED	45		
742	P	REAL			REFS	3*21	26	DEFINED	20			

```
VARIABLES      SN  TYPE            RELOCATION
  105  PCOS        REAL      ARRAY     COMPURC     REFS        9        136
  117  PDCO        REAL      ARRAY     COMPURC     REFS        9         36       110       111       126      2*136
                                                 DEFINED     110        126
  173  RESB        REAL                COMCOMP     REFS        8         82       104     DEFINED      81        83
  177  RLCCR       REAL                COMPURC     REFS        9     DEFINED      132
  172  RSLB        REAL                COMCOMP     REFS        8         38      2*82        83       104
                                                 DEFINED      81
    0  SE1         REAL      ARRAY     COMSUDE     REFS        7
   30  SE2         REAL      ARRAY     COMSUDE     REFS        7
   60  ST1         REAL      ARRAY     COMSUDE     REFS        7
  110  ST2         REAL      ARRAY     COMSUDE     REFS        7
    0  W           REAL      ARRAY     COMWIND     REFS        6         92      4*94
    0  X           REAL      ARRAY     COMANSW     REFS       12         16        17        18        20
   24  XCO         REAL      ARRAY     COMANSW     REFS       12         19        27     DEFINED      17        26
   26  XM          REAL      ARRAY     COMCOMP     REFS        8         87        88     2*101     DEFINED      87        88
  751  XNR         REAL                            REFS       23         24     DEFINED      23
    0  ZZZZZ       REAL     *UNUSED     F.P.     DEFINED       1
  740  Z1          REAL                            REFS       19         22        24      6*84       117       119       130
                                                 DEFINED      18        116       119
  741  Z2          REAL                            REFS     2*19        117       120     DEFINED     107       120
  747  Z3          REAL                            REFS     2*25         26       111       116       121       141
                                                 DEFINED      23         25       108       111       121
  750  Z4          REAL                            REFS       23         24        25       115       116       122       141
                                                 DEFINED      23        108       115       122
  754  Z5          REAL                            REFS       24        116       123       141     DEFINED     112       123
  755  Z6          REAL                            REFS     2*26     DEFINED       25
  746  Z8          REAL                            REFS       24     DEFINED       22        24

FILE NAMES       MODE
       OUTPUT    FMT                    WRITES    104       130       136       141       147

EXTERNALS            TYPE     ARGS        REFERENCES
       AMORT                   6             19        24
       AMORTI                  6             84
       EXIT                    0             56        64        80       148
       TODPRI                  1             66
       TODUDI                  1            106

INLINE FUNCTIONS     TYPE     ARGS         DEF LINE  REFERENCES
       AMAX1       REAL        0  INTRIN               20
       INT         INTEGER     1  INTRIN               23        24
       MAXO        INTEGER     0  INTRIN               23

STATEMENT LABELS              DEF LINE    REFERENCES
  525  1         FMT              54          52        57        61        65        77        81
  573  3         FMT             105         104
  607  4         FMT             133         130
    0  9                          16          15
  106  10                         27        2*17        20        21
    0  11                         34          30
    0  12                         36          35
    0  13                         25          23
    0  14                         26          21
    0  16                         47          46
  202  17                         51          49        67
    0  18                         55          51
  217  19                         57          53
```

```
 STATEMENT LABELS               DEF LINE   REFERENCES
   224  20                         60        2*49
     0  21                         63          60
   241  22                         65          62
   251  23                         68          58
   255  24                         71          68
     0  25                         74          72
     0  26                         79          76
   301  27                         81          78
   324  34                         90          86
   343  35                         96          90
   347  36                         97          85       91        95
     0  38                        101          99
     0  40                        111         109
     0  41                        126         124      125
     0  42                        115         113
     0  43                        129         127
   436  44                        130         118
   643  90       FMT              138         136
   673  91       FMT              142         141
   706  98       FMT              146         147
   454  99                        147          71       73        82

 LOOPS  LABEL     INDEX      FROM-TO    LENGTH    PROPERTIES
    10  9         J           15  16       2B      INSTACK
    15  10        J           17  27      76B               EXT REFS  NOT INNER
    45  14        M           21  26      34B               EXT REFS  NOT INNER
    57  13        K           23  25      14B               EXT REFS
   126  11        J           30  34       4B      INSTACK
   137  12        J           35  36       2B      INSTACK
   175  16        J           46  47       2B      INSTACK
   205  18        N           51  55      11B               EXT REFS    EXITS
   227  21        N           60  63      11B               EXT REFS    EXITS
   262  25        J           72  74       2B      INSTACK    EXITS
   267  26        N           76  79      11B               EXT REFS    EXITS
   317  36        J           85  97      33B               EXT REFS
   356  38        J           99 101       4B      INSTACK
   375  40        J          109 111       3B      INSTACK
   406  42        J          113 115       3B      INSTACK
   424  41        J          124 126       4B               NOT INNER
   425  41        K          125 126       2B      INSTACK
   433  43        J          127 129       3B      INSTACK
   444            I          136 136       4B               EXT REFS

 COMMON BLOCKS   LENGTH     MEMBERS - BIAS NAME(LENGTH)
        COMMAIN     312              0 NV      (1)           1 NCV     (1)            2 NCCOL  (1)
                                     3 NCSTO   (1)           4 NCTRA   (1)            5 NOVAR  (1)
                                     6 NCOTH   (1)           7 ISTH    (1)            8 ISBIG  (1)
                                     9 ITIT    (1)          10 IRUN    (1)           11 LCO    (30)
                                    41 LCR     (270)       311 NTYPE   (1)
        COMAMOB       4              0 CZSYS   (1)           1 LIFE    (1)            2 AMOB   (1)
                                     3 AMOP    (1)
        COMWIND      10              0 W       (8)           8 ISWND   (2)
        COMSUDE     144              0 SE1     (24)         24 SE2     (24)          48 ST1    (24)
                                    72 ST2     (24)         96 DEE     (24)         120 DET    (24)
        COMCOMP     126              0 EFF     (22)         22 XM      (40)          62 CC     (60)
                                   122 RSLB    (1)         123 RESB    (1)          124 DETOT  (1)
                                   125 DTTOT   (1)
```

```
COMMON BLOCKS   LENGTH     MEMBERS - BIAS NAME(LENGTH)
     COMPURC       128           0 EPUR    (22)           22 ESLB    (10)           32 ECOS    (11)
                                43 ITOD    (26)           69 PCOS    (10)           79 PDCO    (24)
                               103 MHPK    (12)          115 MHOUR   (12)          127 RLCCR   (1)
     COMANSW        74           0 X       (20)           20 XCO     (20)           40 MXX     (20)
                                60 CTOT    (14)

STATISTICS
  PROGRAM LENGTH                765B      501
  CM LABELED COMMON LENGTH     1436B      798
       60000B CM USED
```

```
          SUBROUTINE AMORT(CR,ML,LR,IND,CAP,COM)
C ...     CR=COST,  ML=YEAR OF PURCHASE , LR=LIFE.
          DIMENSION AC(2),AO(2),KM(2),S(2),G(2),TC(2),DP(2),CV(2)
          COMMON /COMMAIN/ NV,NCV,NCCOL,NCSTO,NCTRA,NOVAR,NCOTH,ISTH,ISBIG,
         1 ITIT,IRUN,LCO(30),LCR(9,30),NTYPE
          COMMON /COMAMOB/ CZSYS,LIFE,AMOB,AMOP
          I=IND $ IF(I.NE.2)I=1
          C=CV(I)*CR $ K=MAX0(1,MIN0(LR,KM(I))) $ Z1=1.
          IF(K.LT.7)Z1=2./3. $ IF(K.LT.5)Z1=1./3. $ IF(K.LT.3)Z1=0.
          IF(ML.NE.0)GO TO 11 $ COM=C*AO(I)
          CAP=C*(AC(I)-Z1*TC(I)-DP(I)*S(I)*(K-ZMF(R,0.,K))/K/(K+1))
          RETURN
   11     C=C*S(I)*(G(I)**ML) $ COM=0.
          CAP=C*(1.-Z1*TC(I)-DP(I)*(K-ZMF(R,0.,K))/K/(K+1.))
          RETURN
          ENTRY AMORTI
          DO 20 J=1,30 $ DECODE(10,1,LCR(1,J))J1 $ IF(J1.EQ.2HYR)GO TO 21
   20     CONTINUE $ GO TO 99
    1      FORMAT(A2,8X)
   21     DECODE(80,3,LCR(1,J))IP,IO,IB,R,RI,D,T,FOM,FPT,GO,GOM,GPT,GF
    3     FORMAT(2X,3(2X,I4),10F6.0)
          IF(R.LE.0..O.D.LT.0..O.D.GT.1..O.T.LT.0..O.T.GE.1.
         1 .O.FOM.LT.0..O.FPT.LT.0.)GO TO 99
          IF(D.NE.1..A.RI.LE.0.)GO TO 99 $ R1=R+1.
          DO 22 K=1,30 $ DECODE(10,1,LCR(1,K))J1 $ IF(J1.EQ.2HAM)GO TO 23
   22     CONTINUE $ GO TO 99
   23     DECODE(80,6,LCR(1,K))JP,N,L,(KM(J),S(J),TC(J),G(J),J=1,2)
    6     FORMAT(2X,A1,I2,1X,I2,3(4X,I2,3F6.0))
          LIFE=N $ IF(N.LE.0)GO TO 99
          IF(D.NE.1..A.(L.LE.0.O.L.GT.N))GO TO 99
          DO 60 J=1,2 $ IF(JP.NE.1HP.A.(KM(J).LE.0.O.KM(J).GT.N))GOTO99
          IF(S(J).LT.0..O.S(J).GE.1..O.TC(J).LT.0..O.TC(J).GE.1.)GOTO99
   60     CONTINUE $ THT=0. $ IF(JP.NE.1HP)THT=T
          AMOB=ZMF(R,0,N)/ZMF(R,GO,N)
          Z1=D+(1.-T)*FPT*ZMF(R,GPT,N)
          IF(D.NE.1.)Z1=Z1+(1.-D)*((1.-T)*ZMF(R,0.,L)/ZMF(RI,0.,L)-
         1 T*ZMF(R,RI,L)*(RI-1./ZMF(RI,0.,L)))
          AC(1)=AC(2)=Z1 $ DO 61 J=1,2 $ KM(J)=MAX0(1,KM(J))
          TC(J)=TC(J)/R1 $ AC(J)=AC(J)-S(J)*(((1.+G(J))/R1)**N)
          DP(J)=2.*THT/R $ S(J)=1.-S(J)
   61     CONTINUE
          AO(1)=AO(2)=(1.-THT)*FOM*ZMF(R,GOM,N)
          Z1=((1.+GO)**(IB-IO))/ZMF(R,0.,N) $ DO 62 J=1,2
          G(J)=1.+G(J) $ CV(J)=Z1*(G(J)**(IO-IP))
   62     G(J)=G(J)/R1
          AMOP=Z1*((1.+GF)**(IO-IP))*(1.-THT)*ZMF(R,GF,N) $ RETURN
   98     FORMAT(* ERROR IN AM OR YR CARD *)
   99     PRINT98 $ CALL EXIT $ END
```

SYMBOLIC REFERENCE MAP (R=3)

```
ENTRY POINTS        DEF LINE      REFERENCES
     3  AMORT              1          12         15
    76  AMORTI            16          46         48

VARIABLES       SN  TYPE             RELOCATION
   566  AC          REAL       ARRAY                     REFS          3          11          39     DEFINED       2*38        39
     2  AMOB        REAL                   COMAMOB       REFS          6     DEFINED          34
     3  AMOP        REAL                   COMAMOB       REFS          6     DEFINED          46
   570  AO          REAL       ARRAY                     REFS          3          10     DEFINED        2*42
   537  C           REAL                                 REFS         10          11          13          14     DEFINED         8          13
     0  CAP         REAL                     F.P.      DEFINED         1          11          14
     0  COM         REAL                     F.P.      DEFINED         1          10          13
     0  CR          REAL                     F.P.        REFS          8     DEFINED           1
   604  CV          REAL       ARRAY                     REFS          3           8     DEFINED          44
     0  CZSYS       REAL                   COMAMOB       REFS          6
   551  D           REAL                                 REFS       2*22          24          30          35        2*36
                                                       DEFINED        20
   602  DP          REAL       ARRAY                     REFS          3          11          14     DEFINED          40
   553  FOM         REAL                                 REFS         22          42     DEFINED          20
   554  FPT         REAL                                 REFS         22          35     DEFINED          20
   576  G           REAL       ARRAY                     REFS          3          13          39        2*44          45
                                                       DEFINED        27          44          45
   560  GF          REAL                                 REFS       2*46     DEFINED          20
   555  GO          REAL                                 REFS         34          43     DEFINED          20
   556  GOM         REAL                                 REFS         42     DEFINED          20
   557  GPT         REAL                                 REFS         35     DEFINED          20
   536  I           INTEGER                              REFS          7         2*8          10        4*11        2*13        2*14
                                                       DEFINED       2*7
   547  IB          INTEGER                              REFS         43     DEFINED          20
     0  IND         INTEGER                  F.P.        REFS          7     DEFINED           1
   546  IO          INTEGER                              REFS         43          44          46     DEFINED          20
   545  IP          INTEGER                              REFS         44          46     DEFINED          20
    12  IRUN        INTEGER                COMMAIN       REFS          4
    10  ISBIG       INTEGER                COMMAIN       REFS          4
     7  ISTH        INTEGER                COMMAIN       REFS          4
    11  ITIT        INTEGER                COMMAIN       REFS          4
   543  J           INTEGER                              REFS         17          20        4*27        2*31        4*32        2*38        6*39
                                                         3*40       4*44        2*45     DEFINED          17          27          31          38
                                                           43
   562  JP          INTEGER                              REFS         31          33     DEFINED          27
   544  J1          INTEGER                              REFS         17          25     DEFINED          17          25
   540  K           INTEGER                              REFS        3*9        4*11        4*14          25          27
                                                       DEFINED         8          25
   572  KM          INTEGER    ARRAY                     REFS          3           8        2*31          38     DEFINED        27          38
   564  L           INTEGER                              REFS       2*30        4*36     DEFINED          27
    13  LCO         INTEGER    ARRAY       COMMAIN       REFS          4
    51  LCR         INTEGER    ARRAY       COMMAIN       REFS          4          17          20          25          27
     1  LIFE        INTEGER                COMAMOB       REFS          6     DEFINED          29
     0  LR          INTEGER                  F.P.        REFS          8     DEFINED           1
     0  ML          INTEGER                  F.P.        REFS         10          13     DEFINED           1
   563  N           INTEGER                              REFS       2*29          30          31        2*34          35          39          42
                                                           43         46     DEFINED          27
     2  NCCOL       INTEGER                COMMAIN       REFS          4
     6  NCOTH       INTEGER                COMMAIN       REFS          4
     3  NCSTO       INTEGER                COMMAIN       REFS          4
     4  NCTRA       INTEGER                COMMAIN       REFS          4
     1  NCV         INTEGER                COMMAIN       REFS          4
```

```
VARIABLES      SN  TYPE               RELOCATION
    5  NOVAR     INTEGER                COMMAIN      REFS        4
  467  NTYPE     INTEGER                COMMAIN      REFS        4
    0  NV        INTEGER                COMMAIN      REFS        4
  542  R         REAL                                REFS       11      14      22      24     2*34     35    2*36
                                                      40        42      43      46  DEFINED    20
  550  RI        REAL                                REFS       24    4*36  DEFINED    20
  561  R1        REAL                                REFS     2*39      45  DEFINED    24
  574  S         REAL       ARRAY                    REFS        3      11      13    2*32      39       40
                                                  DEFINED       27      40
  552  T         REAL                                REFS     2*22      33      35    2*36  DEFINED      20
  600  TC        REAL       ARRAY                    REFS        3      11      14    2*32      39
                                                  DEFINED       27      39
  565  THT       REAL                                REFS       40      42      46  DEFINED    2*33
  541  Z1        REAL                                REFS       11      14      36      38      44       46
                                                  DEFINED        8     3*9      35      36      43

FILE NAMES         MODE
       OUTPUT    FMT                      WRITES      48

EXTERNALS           TYPE    ARGS          REFERENCES
       EXIT                   0               48
       ZMF       REAL         3               11      14    2*34      35    4*36      42      43      46

INLINE FUNCTIONS    TYPE    ARGS          DEF LINE  REFERENCES
       MAXO      INTEGER      0  INTRIN                  8      38
       MINO      INTEGER      0  INTRIN                  8

STATEMENT LABELS                 DEF LINE    REFERENCES
  440  1       FMT                  19          17      25
  463  3       FMT                  21          20
  510  6       FMT                  28          27
   55  11                           13          10
    0  20                           18          17
  123  21                           20          17
    0  22                           26          25
  156  23                           27          25
    0  60                           33          31
    0  61                           41          38
    0  62                           45          43
  514  98      FMT                  47          48
  355  99                           48          18      22      24      26      29      30      31      32

LOOPS  LABEL    INDEX     FROM-TO     LENGTH     PROPERTIES
  112  20       J          17 18        11B                EXT REFS    EXITS
  145  22       K          25 26        11B                EXT REFS    EXITS
  166           J          27 27        13B                EXT REFS
  216  60       J          31 33         7B      INSTACK     EXITS
  273  61       J          38 41        17B                EXT REFS
  331  62       J          43 45        12B                EXT REFS

COMMON BLOCKS    LENGTH      MEMBERS - BIAS NAME(LENGTH)
       COMMAIN     312                 0 NV      (1)               1 NCV     (1)               2 NCCOL  (1)
                                       3 NCSTO   (1)               4 NCTRA   (1)               5 NOVAR  (1)
                                       6 NCOTH   (1)               7 ISTH    (1)               8 ISBIG  (1)
                                       9 ITIT    (1)              10 IRUN    (1)              11 LCO    (30)
                                      41 LCR     (270)           311 NTYPE   (1)
       COMAMOB       4                 0 CZSYS   (1)               1 LIFE    (1)               2 AMOB   (1)
```

```
COMMON BLOCKS   LENGTH     MEMBERS - BIAS NAME(LENGTH)
                                     3 AMOP    (1)

STATISTICS
  PROGRAM LENGTH                 606B      390
  CM LABELED COMMON LENGTH       474B      316
          60000B CM USED
```

```
       SUBROUTINE GETSD(N)
        DIMENSION SD(3,24)
       COMMON /COMMAIN/ NV,NCV,NCCOL,NCSTO,NCTRA,NOVAR,NCOTH,ISTH,ISBIG,
      1ITIT,IRUN,LCO(30),LCR(9,30),NTYPE
       COMMON /COMLEV2/ ESD(72,364)
        LEVEL2,ESD
       COMMON /COMSUDE/ SE(24,2),ST(24,2),DEE(24),DET(24)
C      N=DAY.  SE(.,1)=SE1,  SE(.,2)=SE2,  ETC.
       DATA MU/77777777770000000000B/
        NN=N
16     IF(NN.GT.0)GO TO 17
        NN=NN+364
        GO TO 16
17     IF(NN.LE.364)GO TO 18
        NN=NN-364
        GO TO 17
18     CALL MOVLEV(ESD(1,NN),SD,72)
        IF(ISTH) 10,12,14
10     DO 11 I=1,24
        DET(I)=SHIFT(SD(3,I),30).A.MU
        DO 11 J=1,NCCOL
11     ST(I,J)=SHIFT(SD(J,I),30).A.MU
        RETURN
12     DO 13 I=1,24
        DET(I)=SHIFT(SD(3,I),30).A.MU
       DEE(I)=SD(3,I).A.MU
        DO 13 J=1,NCCOL
        SE(I,J)=SD(J,I).A.MU
13     ST(I,J)=SHIFT(SD(J,I),30).A.MU
        RETURN
14     DO 15 I=1,24
        DEE(I)=SD(3,I).A.MU
        DO 15 J=1,NCCOL
15     SE(I,J)=SD(J,I).A.MU
        RETURN
        END
```

SYMBOLIC REFERENCE MAP (R=3)

```
ENTRY POINTS      DEF LINE      REFERENCES
  3  GETSD            1           23          30          35

VARIABLES      SN   TYPE            RELOCATION
  140  DEE          REAL        ARRAY    COMSUDE     REFS         7   DEFINED      26       32
  170  DET          REAL        ARRAY    COMSUDE     REFS         7   DEFINED      20       25
    0  ESD          REAL        ARRAY    COMLEV2     REFS         5         6      17
  103  I            INTEGER                          REFS      2*20      2*22    2*25     2*26     2*28     2*29     2*32
                                                     2*34   DEFINED        19      24       31
   12  IRUN         INTEGER              COMMAIN     REFS         3
   10  ISBIG        INTEGER              COMMAIN     REFS         3
    7  ISTH         INTEGER              COMMAIN     REFS         3        18
   11  ITIT         INTEGER              COMMAIN     REFS         3
  104  J            INTEGER                          REFS      2*22      2*28    2*29     2*34   DEFINED       21       27
```

```
     SJBROUTINE GETSD        74/74    OPT=2                          FTN 4.8+518        80/11/28. 10.23.01        PAGE      2

VARIABLES       SN   TYPE            RELOCATION
                                                    33
   13  LCO         INTEGER     ARRAY     COMMAIN      REFS          3
   51  LCR         INTEGER     ARRAY     COMMAIN      REFS          3
  100  MU          INTEGER                            REFS         20          22          25          26          28          29          32
                                                    34     DEFINED           9
    0  N           INTEGER                 F.P.       REFS         10     DEFINED           1
    2  NCCOL       INTEGER               COMMAIN      REFS          3          21          27          33
    6  NCOTH       INTEGER               COMMAIN      REFS          3
    3  NCSTO       INTEGER               COMMAIN      REFS          3
    4  NCTRA       INTEGER               COMMAIN      REFS          3
    1  NCV         INTEGER               COMMAIN      REFS          3
  102  NN          INTEGER                            REFS         11          12          14          15          17
                                                    DEFINED        10          12          15
    5  NOVAR       INTEGER               COMMAIN      REFS          3
  467  NTYPE       INTEGER               COMMAIN      REFS          3
    0  NV          INTEGER               COMMAIN      REFS          3
  105  SD          REAL        ARRAY                  REFS          2          17          20          22          25          26          28
                                                    29         32          34
    0  SE          REAL        ARRAY     COMSUDE      REFS          7     DEFINED          28          34
   60  ST          REAL        ARRAY     COMSUDE      REFS          7     DEFINED          22          29

EXTERNALS              TYPE    ARGS          REFERENCES
       MOVLEV                   3                 17

INLINE FUNCTIONS       TYPE    ARGS          DEF LINE  REFERENCES
       SHIFT         NO TYPE    2  INTRIN                   20          22          25          29

STATEMENT LABELS                     DEF LINE     REFERENCES
    0  10             INACTIVE          19           18
    0  11                               22           19          21
   37  12                               24           18
    0  13                               29           24          27
   57  14                               31           18
    0  15                               34           31          33
    6  16                               11           13
   11  17                               14           11          16
   14  18                               17           14

LOOPS  LABEL        INDEX         FROM-TO       LENGTH      PROPERTIES
   27  11           I              19 22          7B                   NOT INNER
   32  11           J              21 22          3B         INSTACK
   45  13           I              24 29         12B                   NOT INNER
   52  13           J              27 29          3B         INSTACK
   64  15           I              31 34          7B                   NOT INNER
   67  15           J              33 34          2B         INSTACK

COMMON BLOCKS      LENGTH       MEMBERS - BIAS NAME(LENGTH)
       COMMAIN      312                    0 NV       (1)                        1 NCV      (1)                          2 NCCOL    (1)
                                           3 NCSTO    (1)                        4 NCTRA    (1)                          5 NOVAR    (1)
                                           6 NCOTH    (1)                        7 ISTH     (1)                          8 ISBIG    (1)
                                           9 ITIT     (1)                       10 IRUN     (1)                         11 LCO      (30)
                                          41 LCR      (270)                    311 NTYPE    (1)
       COMLEV2    26208                    0 ESD      (26208)
       COMSUDE      144                    0 SE       (48)                      48 ST       (48)                        96 DEE      (24)
                                         120 DET      (24)
```

```
STATISTICS
  PROGRAM LENGTH                 215B      141
  CM LABELED COMMON LENGTH     64050B    26664
          60000B CM USED
```

```
      SUBROUTINE OVER
      DIMENSION LCUE(13),LIUE(4)
      COMMON /COMMAIN/ NV,NCV,NCCOL,NCSTO,NCTRA,NOVAR,NCOTH,ISTH,ISBIG,
     1ITIT,IRUN,LCO(30),LCR(9,30),NTYPE
      DATA LIUE/5HUE11A,5HUE11B,5HUE11C,5HUE11D/
      DATA LCUE/2HID,2HCO,2HST,2HT3,2HT4,2HYR,2HAM,2HDH,2HDW,2HDM,
     1 2HDS,2HPE,2HLO/
      DO 10 J=1,30
   10 LCO(J)=1H
      READ 2,(LCR(J),J=1,8)
      IF(LCR(1).EQ.2HID)GO TO 12
   11 PRINT 1,(LCR(J),J=1,8)
      CALL EXIT
   12 DO 13 I=1,4
      IF(LCR(3).EQ.LIUE(I))GO TO 14
   13 CONTINUE
      GO TO 11
    1 FORMAT(* ID CARD ERROR (*8A10,*)*)
    2 FORMAT(8A10)
   14 NTYPE=I
      DO 15 J=1,13
   15 LCO(J)=LCUE(J)
      NV=NCV=4
      NCCOL=NCSTO=ISTH=1
      NCTRA=2
      NOVAR=0
      NCOTH=8
      IF(I.NE.1)GO TO 16
      NV=5
      NOVAR=1
   16 CONTINUE
      RETURN
      END
```

SYMBOLIC REFERENCE MAP (R=3)

```
ENTRY POINTS      DEF LINE     REFERENCES
   1  OVER            1            32

VARIABLES      SN  TYPE              RELOCATION
   65  I           INTEGER                          REFS      15       20       28   DEFINED      14
   12  IRUN        INTEGER                COMMAIN   REFS       3
   10  ISBIG       INTEGER                COMMAIN   REFS       3
    7  ISTH        INTEGER                COMMAIN   REFS       3   DEFINED      24
   11  ITIT        INTEGER                COMMAIN   REFS       3
   64  J           INTEGER                          REFS       9       10       12     2*22   DEFINED    8     10
                                                          12      21
   13  LCO         INTEGER   ARRAY        COMMAIN   REFS       3   DEFINED       9       22
   51  LCR         INTEGER   ARRAY        COMMAIN   REFS       3       11       12       15   DEFINED   10
   66  LCUE        INTEGER   ARRAY                  REFS       2       22  DEFINED        6
  103  LIUE        INTEGER   ARRAY                  REFS       2       15  DEFINED        5
    2  NCCOL       INTEGER                COMMAIN   REFS       3   DEFINED      24
    6  NCOTH       INTEGER                COMMAIN   REFS       3   DEFINED      27
```

```
VARIABLES      SN  TYPE          RELOCATION
     3 NCSTO     INTEGER              COMMAIN     REFS          3    DEFINED     24
     4 NCTRA     INTEGER              COMMAIN     REFS          3    DEFINED     25
     1 NCV       INTEGER              COMMAIN     REFS          3    DEFINED     23
     5 NOVAR     INTEGER              COMMAIN     REFS          3    DEFINED     26          30
   467 NTYPE     INTEGER              COMMAIN     REFS          3    DEFINED     20
     0 NV        INTEGER              COMMAIN     REFS          3    DEFINED     23          29

FILE NAMES         MODE
       INPUT     FMT                        READS      10
       OUTPUT    FMT                       WRITES      12

EXTERNALS            TYPE    ARGS         REFERENCES
       EXIT                    0               13

STATEMENT LABELS                  DEF LINE    REFERENCES
    53   1         FMT               18          12
    60   2         FMT               19          10
     0  10                            9           8
    11  11                           12          17
    14  12                           14          11
     0  13                           16          14
    22  14                           20          15
     0  15                           22          21
    41  16                           31          28

LOOPS  LABEL     INDEX        FROM-TO      LENGTH     PROPERTIES
    4   10         J            8 9           2B        INSTACK
   17   13         I           14 16          2B        INSTACK      EXITS
   25   15         J           21 22          3B        INSTACK

COMMON BLOCKS    LENGTH      MEMBERS - BIAS NAME(LENGTH)
       COMMAIN      312                   0 NV      (1)                  1 NCV     (1)                  2 NCCOL   (1)
                                          3 NCSTO   (1)                  4 NCTRA   (1)                  5 NOVAR   (1)
                                          6 NCOTH   (1)                  7 ISTH    (1)                  8 ISBIG   (1)
                                          9 ITIT    (1)                 10 IRUN    (1)                 11 LCO     (30)
                                         41 LCR     (270)              311 NTYPE   (1)

STATISTICS
  PROGRAM LENGTH                  107B        71
  CM LABELED COMMON LENGTH        470B       312
        60000B CM USED
```

```
      SUBROUTINE PROUT(FCT)
      DIMENSION WK(20,2),XP(20),XMP(20)
      COMMON /COMCUMU/ NAMCU(3),CU(20,3),R(20)
      COMMON /COMMAIN/ NV,NCV,NCCOL,NCSTO,NCTRA,NOVAR,NCOTH,ISTH,ISBIG,
     1ITIT,IRUN,LCO(30),LCR(9,30),NTYPE
      COMMON /COMANSW/ X(20),XCO(20),MXX(20),CTOT(7,2)
      COMMON /COMCOMP/ EFF(22),XM(20,2),CC(20,3),RSLB,RESB,DETOT,DTTOT
      COMMON /COMWIND/ W(8),ISWND(2)
      COMMON /COMPURC/ EPUR(11,2),ESLB(10),ECOS(11),ITOD(26),
     A PCOS(10),PDCO(12,2),MHPK(12),MHOUR(12)
     B ,RLCCR
      COMMON /COMAMOB/ CZSYS,LIFE,AMOB,AMOP
      COMMON /COMPRNS/ TA(20,2),TB(20,2),FFD(6,2),AES(6,2),CLV(4),
     1WRS(10,24)
      EXTERNAL FCT
      DETO=DETOT
       DTTO=DTTOT
       DO 30 J=1,NV
       XP(J)=X(J)
   30 XMP(J)=XM(J,2)
       ZTOT=CTOT(1,1)
      J1=1H
       J2=1HK
       IF(ISBIG.EQ.0)GO TO 15
      CZSYS=CZSYS/1000.
      J1=1HK
       J2=1HM
       DETO=DETO/1000.
       DO 10 J=1,NCV
      XP(J)=XP(J)/1000.
       XMP(J)=XMP(J)/1000.
       XCO(J)=XCO(J)/1000.
      DO 10 I=1,2
       TA(J,I)=TA(J,I)/1000.
       TB(J,I)=TB(J,I)/1000.
   10 CONTINUE
       DTTO=DTTO/1000.
       DO 12 I=1,2
       DO 11 J=1,7
   11 CTOT(J,I)=CTOT(J,I)/1000.
       FFD(6,I)=FFD(6,I)/1000.
      DO 12 J=2,3
      AES(J+3,I)=AES(J+3,I)/1000.
       AES(J,I)=AES(J,I)/1000.
   12 CONTINUE
       DO 13 J=1,10
       EPUR(J)=EPUR(J)/1000.
   13 ESLB(J)=ESLB(J)/1000.
       EPUR(11)=EPUR(11)/1000.
      DO 100 J=1,12
      DO 100 K=1,2
  100 PDCO(J,K)=PDCO(J,K)/1000.
   15 PRINT2,J2,J2,J1,J2,J1
      PRINT1,ITIT,IRUN,(LCR(J),J=1,9)
      PRINT2,J2,J2,J1,J2,J1
      J=W(7) $ IF(ISWND(1).NE.0)PRINT92,W(8),J
   92 FORMAT(* --DIAMETER=*F9.2,* METERS.  SIZE OF THE WIND TURBINE *
```

```
     1*IS FOR A SINGLE TURBINE.*/31X,*COSTS AND I-O RESULTS ARE FOR *
     2I2,* IDENTICAL TURBINES.*)
      IF(CZSYS.LE.CTOT(1))PRINT 89
89    FORMAT(* NOTE...ZERO SYSTEM BETTER.*)
     Z1=Z2=1.E-30
      DO 16 J=1,NCV
     Z1=Z1+XCO(J)
     WK(J)=WK(J,2)=0.
      IF(MXX(J).EQ.1HV)Z2=Z2+XCO(J)
16    CONTINUE
      Z1=.01*Z1
      Z2=.01*Z2
      DO 17 J=1,NCV
      IF(MXX(J).EQ.1HV)WK(J,2)=XCO(J)/Z2
17   WK(J)=XCO(J)/Z1
      PRINT3
      N1=NCCOL+NCSTO
      DO 18 N=1,N1
      DECODE(20,4,LCR(1,N+1))J1,J2,J3
4     FORMAT(A2,A4,A8)
18    PRINT5,J1,J2,J3,MXX(N),XP(N),XMP(N),XCO(N),WK(N),WK(N,2),
     1 TA(N,1),TB(N,1)
      PRINT6
      N1=N1+1
      DO 19 N=N1,NCV
      DECODE(20,4,LCR(1,N+1))J1,J2,J3
19    PRINT5,J1,J2,J3,MXX(N),XP(N),XMP(N),XCO(N),WK(N),WK(N,2),
     1 TA(N,1),TB(N,1)
      N1=NCV+1
      IF(N1.GT.NV)GO TO 34
      DO 20 N=N1,NV
      J=N-NCV
20    PRINT7,J,MXX(N),XP(N)
1     FORMAT(*1ENERGY OPTIMUM   RUN(*A10,*-*I3,*)*/* (*7(A10,*/*),
     1A10,*)*A1)
2     FORMAT(* -NOTE.  SIZES IN *A1,*WH, *A1,*W, OR *A1,*(M-SQ).  *
     1*ENERGY IN *A1,*WH EXCEPT AS NOTED.*/9X,*COST IN *A1,*DOLLARS.*)
3     FORMAT(/72X,*ELECTRICAL*15X,        /24X,*SIZE    MAX SIZE*6X,
     1*COST      PTC   PVC  *  5X,*AVG IN     AVG OUT * )
5     FORMAT(1X,A2,*/*A4,*/*A8,*-*A1,2(1X,F10.3),1X,F10.0,2F7.1,
     1  2X,F10.3,1X,F10.3 )
6     FORMAT(66X,5X,*AVG IN      MAX IN *)
7     FORMAT(/1X,I2,14X,*-*A1,1X,F10.3)
8     FORMAT(/19X,*TOTAL     CAPITAL*8X,*OM   NET E-PUR*
     1* TOT E-PUR     E-SLB*/* ANNUAL COST     *6F10.0/* LEVEL COST      *
     22F10.4,10X,F10.4)
9     FORMAT(* INIT LEV COST  *2F10.4,10X,F10.4)
80    FORMAT(* ENERGY *A1,*WH*35X,3F10.3)
81    FORMAT(/4X,*PFD    PFP    PSE    PDC    PDS    E-WASTE    TOT DEM *
     1A1,*WH  AES    AVG STO    LEAK*/1X,5F7.1,1X,F10.0,F12.3,
     2F7.1,F10.3,F10.0)
83    FORMAT(/12X*TIME OF DAY ELECTRIC PRICING  RSLB=*2F8.3/
     1* PRICE CENTS/KWH  *8F10.3/* TOTAL PURCHASED  *8F10.0/
     2*         SOLD BACK  *8F10.0/*    NET PURCHASED  *8F10.0/
     3* ANN NET COST PUR *8F10.1/*  (LESS FIXED COST)*)
34    PRINT8,(CTOT(J),J=1,3),(CTOT(J),J=5,7),CLV(1),CLV(2),CLV(4)
      DO 21 J=1,4
```

```
  21  CLV(J)= LV(J)/  9
       PRINT9, LV(1 ,CLV(2),CLV(4)
      JM=1HM
       IF(ISIG.NE.0)JM=1HG
       DO 22 J=4,7
  22  CTOT(J,2)=CTOT(J,2)/1000.
       DETO=DETO/1000.
       DTTO=DTTO/1000.
      PRINT80,JM,(CTOT(J,2),J=5,7)
      Z1=0.
       Z2=1.
       IF(ISBIG.NE.0)Z2=1000.
      DO 14 J=1,10,2
       I=J
       IF(ECOS(J+1).GT.ECOS(J))I=J+1
  14  Z1=EPUR(I,2)+Z2*(ESLB(I)-EPUR(I))+Z1
      Z1=.00166667*Z1
      WK(1)=WK(2)=0. $ DO 35 J=1,NCSTO
      IF(XP(J+NCCOL).GT.0.)WK(J)=8736.*TB(J+NCCOL,J)/XP(J+NCCOL)
  35  CONTINUE $ Z2=0. $ IF(EFF(22).GT.0.)Z2=LIFE/EFF(22)
       PRINT88,Z1,WK(1),EFF(22),Z2
  88  FORMAT(* BOD=*F16.1,* STO CYCLES/YR=*F10.3,* NO. PURCH.=*F7.2,
     1 * EVERY *F5.1,* YEARS*)
C     CALCULATE THE LIFE CYCLE COST RATIO OF SOLAR OVER NONSOLAR
      RLCCR=CTOT(1,1)/RLCCR
      PRINT 220,RLCCR
 220  FORMAT(* LIFE CYCLE COST RATIO=*,G10.4)
      PRINT81,JM,(FFD(J),J=1,6),DETO,(AES(J,1),J=1,3)
       IF(ISTH.LE.0)PRINT84,ECOS(11)
      IF(ISTH.LT.0)GO TO 29
  84  FORMAT(/* THERMAL PURCHASED AT *F8.3,* CENTS/KWH.*)
      DO 23 J=1,10
       WK(J,2)=.01*AMOP*ECOS(J)*(EPUR(J)-RSLB*ESLB(J))
  23  WK(J)=EPUR(J)-ESLB(J)
      PRINT83,RSLB,RESB,(ECOS(J),J=1,8),(EPUR(J),J=1,8),
     1(ESLB(J),J=1,8),((WK(I,J),I=1,8),J=1,2)
C     SUM NET COST OF PURCHASED ENERGY
      SNEC=0.
      DO 200 I=1,10
 200  SNEC=SNEC+WK(I,2)
C     SUM PEAK DEMAND COST
      SPDC=0.
      DO 210 I=1,12
      PDCO(I,1)=PDCO(I,1)*AMOP
 210  SPDC=SPDC+PDCO(I,1)
C     GET FIXED COST
      FC=CTOT(5,1)-(SNEC+SPDC)
C     PRINT PEAK DEMAND PRICE, ENERGY, AND COST
      PRINT 90,(PCOS(I),I=1,8),(I,I=1,12),(MHPK(I),I=1,12),
     A (PDCO(I,2),I=1,12),(PDCO(I,1),I=1,12)
  90  FORMAT(/12X,*PEAK DEMAND PRICING*/* PRICE $/PEAK-KW   *8F10.2,//
     A 4X,*-MONTH-*8X,12I9,/* HOUR OF YEAR*7X,12I9,/
     B * PEAK PURCHASED*5X,12F9.1,/* PEAK PURCHASED COST*12F9.1)
C     PRINT THE SUMS OF ENERGY COST, PEAK DEMAND COST AND FIXED COST
      PRINT91,FC,SNEC,SPDC
  91  FORMAT(* FIXED PURCHASED COST=*,F12.1,
     A *,  PURCHASED ENERGY COST=*,F12.1,
```

```
     B *,  PEAK PURCHASED COST=*,F12.1)
  85  FORMAT(/40X,*SELECTED CUMULANTS   100=FULL SCALE*)
C ....   CUMULANTS
  29  DO 24 J=1,3
      IF(NAMCU(J).NE.1H )GO TO 25
  24  CONTINUE
      GO TO 31
  25  PRINT85
      DO 28 J=1,3
      IF(NAMCU(J).EQ.1H )GO TO 28
      DO 26 I=2,20
  26  CU(I,J)=CU(I,J)+CU(I-1,J)
      IF(CU(20,J).LE.0.)GO TO 28
      DO 27 I=1,20
  27  CU(I,J)=CU(I,J)/.01/CU(20,J)
      PRINT86,NAMCU(J),(CU(I,J),I=1,20)
  28  CONTINUE
  86  FORMAT(1X,A3,20F6.1)
C ....
  31  CONTINUE
C     DO 32 J=1,NV
C32   XP(J)=X(J)
C     DO 33 I=1,NV $ CU(I,1)=CU(I,2)=0. $ IF(R(I).LE.0.)GO TO 33
C     R IS RANGE OF X,    FROM MIN.
C     Z2=XP(I) $ XP(I)=.99*Z2
C     IF(XP(I).GE.XM(I))CU(I)=100.*(FCT(XP)-ZTOT)/ZTOT
C     XP(I)=1.01*Z2
C     IF(XP(I).LE.XM(I,2))CU(I,2)=100.*(FCT(XP)-ZTOT)/ZTOT
C     XP(I)=Z2
C33   CONTINUE $ PRINT87,(I,CU(I),CU(I,2),I=1,NV)
C87   FORMAT(/40X,*PERCENT SENSITIVITY*/(4(I3,2F14.5)))
      RETURN
       END
```

SYMBOLIC REFERENCE MAP (R=3)

```
ENTRY POINTS      DEF LINE      REFERENCES
   3  PROUT           1           203

VARIABLES      SN  TYPE            RELOCATION
  134  AES         REAL       ARRAY   COMPRNS     REFS       13       43      44      142   DEFINED     43      44
    2  AMOB        REAL               COMAMOB     REFS       12      115
    3  AMOP        REAL               COMAMOB     REFS       12      147     158
   76  CC          REAL       ARRAY   COMCOMP     REFS        7
  150  CLV         REAL       ARRAY   COMPRNS     REFS       13    3*113     115    3*116   DEFINED    115
   74  CTOT        REAL       ARRAY   COMANSW     REFS        6       21      40       60    2*113    120     123
                                                   139      161  DEFINED      40      120
    3  CU          REAL       ARRAY   COMCUMU     REFS        3    2*183     184    2*186      187
                                                DEFINED     183      186
    0  CZSYS       REAL               COMAMOB     REFS       12       25      60  DEFINED       25
 1272  DETO        REAL                           REFS       28      121     142  DEFINED       16      28     121
  174  DETOT       REAL               COMCOMP     REFS        7       16
 1273  DTTO        REAL                           REFS       37      122  DEFINED       17       37     122
```

VARIABLES		SN TYPE		RELOCATION								
175	DTTOT	REAL		COMCOMP	REFS	7	17					
40	ECOS	REAL	ARRAY	COMPURC	REFS	9	2*129	143	147	149		
0	EFF	REAL	ARRAY	COMCOMP	REFS	7	2*134	135				
0	EPUR	REAL	ARRAY	COMPURC	REFS	9	47	49	2*130	147	148	149
					DEFINED	47	49					
26	ESLB	REAL	ARRAY	COMPURC	REFS	9	48	130	147	148	149	
					DEFINED	48						
1312	FC	REAL			REFS	169	DEFINED	161				
120	FFD	REAL	ARRAY	COMPRNS	REFS	13	41	142	DEFINED	41		
1300	I	INTEGER			REFS	2*34	2*35	2*40	2*41	2*43	2*44	3*130
					149	154	2*158	159	5*163	3*183	2*186	187
					DEFINED	33	38	128	129	149	153	157
					5*163	182	185	187				
12	IRUN	INTEGER		COMMAIN	REFS	4	54					
10	ISBIG	INTEGER		COMMAIN	REFS	4	24	118	126			
7	ISTH	INTEGER		COMMAIN	REFS	4	143	144				
10	ISWND	INTEGER	ARRAY	COMWIND	REFS	8	56					
11	ITIT	INTEGER		COMMAIN	REFS	4	54					
53	ITOD	INTEGER	ARRAY	COMPURC	REFS	9						
1274	J	INTEGER			REFS	2*19	2*20	2*30	2*31	2*32	2*34	2*35
					2*40	2*43	2*44	2*47	2*48	2*52	54	56
					64	2*65	2*66	3*71	2*72	90	2*113	2*115
					2*120	123	128	3*129	5*133	2*142	4*147	3*148
					4*149	176	181	3*183	184	3*186	2*187	
					DEFINED	18	29	39	42	46	50	54
					56	63	70	89	2*113	114	119	123
					127	132	2*142	146	4*149	175	180	
1307	JM	INTEGER			REFS	123	142	DEFINED	117	118		
1276	J1	INTEGER			REFS	2*53	2*55	78	84	DEFINED	22	26
					76	83						
1277	J2	INTEGER			REFS	3*53	3*55	78	84	DEFINED	23	27
					76	83						
1306	J3	INTEGER			REFS	78	84	DEFINED	76	83		
1301	K	INTEGER			REFS	2*52	DEFINED	51				
13	LCO	INTEGER	ARRAY	COMMAIN	REFS	4						
51	LCR	INTEGER	ARRAY	COMMAIN	REFS	4	54	76	83			
1	LIFE	INTEGER		COMAMOB	REFS	12	134					
163	MHOUR	INTEGER	ARRAY	COMPURC	REFS	9						
147	MHPK	INTEGER	ARRAY	COMPURC	REFS	9	163					
50	MXX	INTEGER	ARRAY	COMANSW	REFS	6	66	71	78	84	90	
1305	N	INTEGER			REFS	76	8*78	83	8*84	89	2*90	
					DEFINED	75	82	88				
0	NAMCU	INTEGER	ARRAY	COMCUMU	REFS	3	176	181	187			
2	NCCOL	INTEGER		COMMAIN	REFS	4	74	3*133				
6	NCOTH	INTEGER		COMMAIN	REFS	4						
3	NCSTO	INTEGER		COMMAIN	REFS	4	74	132				
4	NCTRA	INTEGER		COMMAIN	REFS	4						
1	NCV	INTEGER		COMMAIN	REFS	4	29	63	70	82	86	89
5	NOVAR	INTEGER		COMMAIN	REFS	4						
467	NTYPE	INTEGER		COMMAIN	REFS	4						
0	NV	INTEGER		COMMAIN	REFS	4	18	87	88			
1304	N1	INTEGER			REFS	75	81	82	87	88		
					DEFINED	74	81	86				
105	PCOS	REAL	ARRAY	COMPURC	REFS	9	163					
117	PDCO	REAL	ARRAY	COMPURC	REFS	9	52	158	159	2*163		
					DEFINED	52	158					
77	R	REAL	ARRAY	COMCUMU	REFS	3						

```
      SUBROUTINE PROUT       74/74    OPT=2                            FTN 4.8+518          80/11/28. 10.23.01        PAGE      6

 VARIABLES      SN  TYPE            RELOCATION
    173  RESB        REAL                COMCOMP     REFS         7         149
    177  RLCCR       REAL                COMPURC     REFS         9         139        140    DEFINED       139
    172  RSLB        REAL                COMCOMP     REFS         7         147        149
   1310  SNEC        REAL                            REFS       154         161        169    DEFINED       152        154
   1311  SPDC        REAL                            REFS       159         161        169    DEFINED       156        159
      0  TA          REAL      ARRAY     COMPRNS     REFS        13          34         78         84    DEFINED         34
     50  TB          REAL      ARRAY     COMPRNS     REFS        13          35         78         84       133
                                                  DEFINED        35
      0  W           REAL      ARRAY     COMWIND     REFS         8        2*56
   1313  WK          REAL      ARRAY                 REFS         2        2*78       2*84        135       149        154
                                                  DEFINED      2*65          71         72      2*132       133        147        148
    154  WRS         REAL      ARRAY     COMPRNS     REFS        13
      0  X           REAL      ARRAY     COMANSW     REFS         6          19
     24  XCO         REAL      ARRAY     COMANSW     REFS         6          32         64         66        71         72         78
                                                        84   DEFINED         32
     26  XM          REAL      ARRAY     COMCOMP     REFS         7          20
   1407  XMP         REAL      ARRAY                 REFS         2          31         78         84    DEFINED         20         31
   1363  XP          REAL      ARRAY                 REFS         2          30         78         84        90      2*133
                                                  DEFINED        19          30
   1275  ZTOT      * REAL                         DEFINED        21
   1302  Z1          REAL                            REFS        64          68         72        130       131        135
                                                  DEFINED        62          64         68        124       130        131
   1303  Z2          REAL                            REFS        66          69         71        130       135
                                                  DEFINED        62          66         69        125       126      2*134

 FILE NAMES        MODE
         OUTPUT    FMT                       WRITES        53         54         55         56         60         73         78         80
                                                 84        90        113        116        123        135        140        142        143
                                                149       163        169        179        187

 EXTERNALS             TYPE    ARGS         REFERENCES
         FCT                      0   F.P.         15

 STATEMENT LABELS                  DEF LINE   REFERENCES
    664  1        FMT                    91         54
    675  2        FMT                    93         53         55
    714  3        FMT                    95         73
    606  4        FMT                    77         76         83
    727  5        FMT                    97         78         84
    737  6        FMT                    99         80
    743  7        FMT                   100         90
    747  8        FMT                   101        113
    766  9        FMT                   104        116
      0  10                              36         29         33
      0  11                              40         39
      0  12                              45         38         42
      0  13                              48         46
      0  14                             130        127
     72  15                              53         24
      0  16                              67         63
      0  17                              72         70
      0  18                              78         75
      0  19                              84         82
      0  20                              90         88
      0  21                             115        114
      0  22                             120        119
      0  23                             148        146
```

STATEMENT LABELS			DEF LINE	REFERENCES		
0	24		177	175		
444	25		179	176		
0	26		183	182		
0	27		186	185		
500	28		188	180	181	184
436	29		175	144		
0	30		20	18		
504	31		191	178		
254	34		113	87		
0	35		134	132		
773	80	FMT	105	123		
1000	81	FMT	106	142		
1017	83	FMT	109	149		
1136	84	FMT	145	143		
1235	85	FMT	173	179		
1253	86	FMT	189	187		
1100	88	FMT	136	135		
567	89	FMT	61	60		
1171	90	FMT	165	163		
1221	91	FMT	170	169		
543	92	FMT	57	56		
0	100		52	50	51	
0	200		154	153		
0	210		159	157		
1116	220	FMT	141	140		

LOOPS	LABEL	INDEX	FROM-TO	LENGTH	PROPERTIES		
11	30	J	18 20	4B	INSTACK		
30	10	J	29 36	10B		NOT INNER	
34	10	I	33 36	3B	INSTACK		
43	12	I	38 45	13B		NOT INNER	
45	11	J	39 40	2B	INSTACK		
52	12	J	42 45	3B	INSTACK		
61	13	J	46 48	3B	INSTACK		
66	100	J	50 52	4B		NOT INNER	
67	100	K	51 52	2B	INSTACK		
115	16	J	63 67	5B	INSTACK		
130	17	J	70 72	4B	INSTACK		
145	18	N	75 78	26B		EXT REFS	
204	19	N	82 84	26B		EXT REFS	
242	20	N	88 90	12B		EXT REFS	
260	21	J	114 115	2B	INSTACK		
272	22	J	119 120	2B	INSTACK		
312	14	J	127 130	11B	OPT		
333	35	J	132 134	4B	INSTACK		
364	23	J	146 148	4B	INSTACK		
377		J	149 149	10B		EXT REFS	
413	200	I	153 154	2B	INSTACK		
417	210	I	157 159	3B	INSTACK		
427		I	163 163	4B		EXT REFS	
441	24	J	175 177	2B	INSTACK	EXITS	
454	28	J	180 188	30B		EXT REFS	NOT INNER
461	26	I	182 183	2B	INSTACK		
470	27	I	185 186	2B	INSTACK		

```
COMMON BLOCKS   LENGTH      MEMBERS - BIAS NAME(LENGTH)
      COMCUMU       83               0 NAMCU   (3)            3 CU      (60)           63 R       (20)
      COMMAIN      312               0 NV      (1)            1 NCV     (1)             2 NCCOL   (1)
                                     3 NCSTO   (1)            4 NCTRA   (1)             5 NOVAR   (1)
                                     6 NCOTH   (1)            7 ISTH    (1)             8 ISBIG   (1)
                                     9 ITIT    (1)           10 IRUN    (1)            11 LCO     (30)
                                    41 LCR     (270)        311 NTYPE   (1)
      COMANSW       74               0 X       (20)          20 XCO     (20)           40 MXX     (20)
                                    60 CTOT    (14)
      COMCOMP      126               0 EFF     (22)          22 XM      (40)           62 CC      (60)
                                   122 RSLB    (1)          123 RESB    (1)           124 DETOT   (1)
                                   125 DTTOT   (1)
      COMWIND       10               0 W       (8)            8 ISWND   (2)
      COMPURC      128               0 EPUR    (22)          22 ESLB    (10)           32 ECOS    (11)
                                    43 ITOD    (26)          69 PCOS    (10)           79 PDCO    (24)
                                   103 MHPK    (12)         115 MHOUR   (12)          127 RLCCR   (1)
      COMAMOB        4               0 CZSYS   (1)            1 LIFE    (1)             2 AMOB    (1)
                                     3 AMOP    (1)
      COMPRNS      348               0 TA      (40)          40 TB      (40)           80 FFD     (12)
                                    92 AES     (12)         104 CLV     (4)           108 WRS     (240)

STATISTICS
  PROGRAM LENGTH               1433B      795
  CM LABELED COMMON LENGTH     2075B      1085
       60000B CM USED
```

```
      SUBROUTINE SETUP
      COMMON /COMMAIN/ NV,NCV,NCCOL,NCSTO,NCTRA,NOVAR,NCOTH,ISTH,ISBIG,
     1ITIT,IRUN,LCO(30),LCR(9,30),NTYPE
      EXTERNAL UE11AF,UE11BF,UE11CF,UE11DF
      DATA JBL/1H /,NDAY/364/
      CALL HOROLOG(J1,LCR(1),LCR(2))
       DECODE(20,1,LCR)(LCO(J),J=1,5)
    1 FORMAT(3(1X,A2),1X,2(1X,A2))
      ENCODE(10,2,ITIT)(LCO(J),J=1,5)
       IRUN=0
    2 FORMAT(5A2)
      CALL OVER
      NC=NCV+NCOTH+1
   10 IRUN=IRUN+1
       CALL RDINP(NDAY)
      WRITE(9)ITIT,IRUN,((LCR(I,J),I=1,9),J=1,30)
      CALL STAGET(LCR(2),XLAT)
      CALL DEMAND(XLAT)
      CALL SUPPLY(XLAT,0)
   13 CALL STORI
        CALL TRANSI
       Z1=COSTI(Z2)
      GO TO (21,22,23,24),NTYPE
   21 CALL UE11MN(UE11AF)
       GO TO 80
   22 CALL UE11MN(UE11BF)
       GO TO 80
   23 CALL UE11MN(UE11CF)
       GO TO 80
   24 DO 25 J=2,30 $ DECODE(10,2,LCR(1,J))J1 $ IF(J1.EQ.2HLO)GO TO 26
   25 CONTINUE $ CALL EXIT
   26 CALL PREDIC(LCR(1,J))
      CALL UE11MN(UE11DF)
      GO TO 80
   80 CONTINUE
      ENDFILE 9
   98 DO 99 J=1,NC
   99 LCR(9,J)=JBL
       GO TO 10
       END
```

SYMBOLIC REFERENCE MAP (R=3)

ENTRY POINTS		DEF LINE	REFERENCES
1	SETUP	1	

VARIABLES		SN	TYPE	RELOCATION							
205	I		INTEGER		REFS	16	DEFINED	16			
12	IRUN		INTEGER	COMMAIN	REFS	2	14	16	DEFINED	10	14
10	ISBIG		INTEGER	COMMAIN	REFS	2					
7	ISTH		INTEGER	COMMAIN	REFS	2					
11	ITIT		INTEGER	COMMAIN	REFS	2	16	DEFINED	9		
203	J		INTEGER		REFS	7	9	16	30	32	38

```
      SUBROUTINE SETUP       74/74   OPT=2                            FTN 4.8+518        80/11/28. 10.23.01       PAGE      2

 VARIABLES      SN  TYPE            RELOCATION
                                                  DEFINED      7          9         16        30        37
     142  JBL          INTEGER                      REFS      38     DEFINED         5
     202  J1           INTEGER                      REFS       6         30    DEFINED        30
      13  LCO          INTEGER   ARRAY    COMMAIN   REFS       2          9    DEFINED         7
      51  LCR          INTEGER   ARRAY    COMMAIN   REFS       2        2*6          7        16        17        30        32
                                                  DEFINED     38
     204  NC           INTEGER                      REFS      37     DEFINED        13
       2  NCCOL        INTEGER            COMMAIN   REFS       2
       6  NCOTH        INTEGER            COMMAIN   REFS       2         13
       3  NCSTO        INTEGER            COMMAIN   REFS       2
       4  NCTRA        INTEGER            COMMAIN   REFS       2
       1  NCV          INTEGER            COMMAIN   REFS       2         13
     143  NDAY         INTEGER                      REFS      15     DEFINED         5
       5  NOVAR        INTEGER            COMMAIN   REFS       2
     467  NTYPE        INTEGER            COMMAIN   REFS       2         23
       0  NV           INTEGER            COMMAIN   REFS       2
     206  XLAT         REAL                         REFS      17         18         19
     207  Z1        *  REAL                       DEFINED     22
     210  Z2        *  REAL                         REFS      22

 FILE NAMES        MODE
          TAPE9        UNFMT                WRITES      16      MOTION        36

 EXTERNALS           TYPE    ARGS        REFERENCES
          COSTI        REAL       1             22
          DEMAND                  1             18
          EXIT                    0             31
          HOROLOG                 3              6
          OVER                    0             12
          PREDIC                  1             32
          RDINP                   1             15
          STAGET                  2             17
          STORI                   C             20
          SUPPLY                  2             19
          TRANSI                  0             21
          UE11AF                  0              4         24
          UE11BF                  0              4         26
          UE11CF                  0              4         28
          UE11DF                  0              4         33
          UE11MN                  1             24         26        28        33

 STATEMENT LABELS              DEF LINE   REFERENCES
     151  1           FMT            8          7
     161  2           FMT           11          9         30
      16  10                        14         39
       0  13            INACTIVE    20
      46  21                        24         23
      51  22                        26         23
      54  23                        28         23
      57  24                        30         23
       0  25                        31         30
      73  26                        32         30
     101  80                        35         25         27        29        34
       0  98            INACTIVE    37
       0  99                        38         37
```

```
LOOPS  LABEL     INDEX       FROM-TO      LENGTH     PROPERTIES
   61  25        J             30 31         11B                EXT REFS     EXITS
  106  99        J             37 38          2B      INSTACK

COMMON BLOCKS    LENGTH      MEMBERS - BIAS NAME(LENGTH)
       COMMAIN      312                   0 NV       (1)                1 NCV      (1)                2 NCCOL   (1)
                                          3 NCSTO    (1)                4 NCTRA    (1)                5 NOVAR   (1)
                                          6 NCOTH    (1)                7 ISTH     (1)                8 ISBIG   (1)
                                          9 ITIT     (1)               10 IRUN     (1)               11 LCO     (30)
                                         41 LCR      (270)            311 NTYPE    (1)

STATISTICS
  PROGRAM LENGTH                     211B       137
  CM LABELED COMMON LENGTH           470B       312
        60000B CM USED
```

```
          SUBROUTINE STORI
           DIMENSION P(11)
          COMMON /COMMAIN/ NV,NCV,NCCOL,NCSTO,NCTRA,NOVAR,NCOTH,ISTH,ISBIG,
         1ITIT,IRUN,LCO(30),LCR(9,30),NTYPE
          COMMON /COMCOMP/ EFF(22),XM(20,2),CC(20,3),RSLB,RESB,DETOT,DTTOT
          COMMON /COMUE11/ IND,NITER,E5,E6,E7,E8,RX7,RX8,LPNS,LPNH
          NC=NCCOL+2
           DO 20 N=1,NCSTO
           L=NC-1
          DECODE(80,1,LCR(1,NC))(P(J),J=1,11)
     1    FORMAT(14X,11F6.0)
          IF(P(1).NE.0.)GO TO 10
           P(1)=P(10)=1.
          P(7)=P(8)=P(9)=P(11)=0.
           GO TO 11
     10   IF(P(1).LE.0..O.P(1).GT.1..O.
         1P(7).LT.0..O.P(8).LT.0..O.P(9).LE.0..O.P(10).LE.0..O.
         2P(11).LT.0..O.P(7).GT.P(8))GO TO 99
     11   IF(N.NE.1)GO TO 12 $ E7=P(2) $ E8=P(3) $ RX7=P(4) $ RX8=P(5)
          IF(E7.LE.0..O.E8.LE.0..O.RX7.LE.0..O.RX8.LE.0..O.
         1 E7.GT.1..O.E8.GT.1..O.RX7.GT.1..O.RX8.GT.1.)GO TO 99
          IF(P(6).LE.0.)GO TO 99 $ EFF(21)=P(6)
     12   EFF(L)=P(1)
           XM(L)=P(7)
           XM(L,2)=P(8)
          CC(L)=P(9)
           CC(L,2)=P(10)
           CC(L,3)=P(11)
     20   NC=NC+1
           RETURN
     98   FORMAT(* STORAGE CARD ERROR *8A10)
     99   PRINT98,(LCR(J,NC),J=1,8)
           CALL EXIT
           END
```

SYMBOLIC REFERENCE MAP (R=3)

ENTRY POINTS		DEF LINE	REFERENCES	
1	STORI	1	30	34

VARIABLES		SN	TYPE		RELOCATION						
76	CC		REAL	ARRAY	COMCOMP	REFS	5	DEFINED	26	27	28
174	DETOT		REAL		COMCOMP	REFS	5				
175	DTTOT		REAL		COMCOMP	REFS	5				
0	EFF		REAL	ARRAY	COMCOMP	REFS	5	DEFINED	22	23	
2	E5		REAL		COMUE11	REFS	6				
3	E6		REAL		COMUE11	REFS	6				
4	E7		REAL		COMUE11	REFS	6	2*20	DEFINED	19	
5	E8		REAL		COMUE11	REFS	6	2*20	DEFINED	19	
0	IND		INTEGER		COMUE11	REFS	6				
12	IRUN		INTEGER		COMMAIN	REFS	3				
10	ISBIG		INTEGER		COMMAIN	REFS	3				
7	ISTH		INTEGER		COMMAIN	REFS	3				

A 03

```
        SUBROUTINE STORI       74/74    OPT=2                          FTN 4.8+518        80/11/28. 10.23.01       PAGE      2

 VARIABLES       SN  TYPE             RELOCATION
     11  ITIT        INTEGER                COMMAIN      REFS          3
    131  J           INTEGER                             REFS         10         32    DEFINED        10         32
    130  L           INTEGER                             REFS         23         24         25        26         27        28
                                                     DEFINED           9
     13  LCO         INTEGER       ARRAY    COMMAIN      REFS          3
     51  LCR         INTEGER       ARRAY    COMMAIN      REFS          3         10         32
     11  LPNH        INTEGER                COMUE11      REFS          6
     10  LPNS        INTEGER                COMUE11      REFS          6
    127  N           INTEGER                             REFS         19    DEFINED          8
    126  NC          INTEGER                             REFS          9         10         29        32    DEFINED          7        29
      2  NCCOL       INTEGER                COMMAIN      REFS          3          7
      6  NCOTH       INTEGER                COMMAIN      REFS          3
      3  NCSTO       INTEGER                COMMAIN      REFS          3          8
      4  NCTRA       INTEGER                COMMAIN      REFS          3
      1  NCV         INTEGER                COMMAIN      REFS          3
      1  NITER       INTEGER                COMUE11      REFS          6
      5  NOVAR       INTEGER                COMMAIN      REFS          3
    467  NTYPE       INTEGER                COMMAIN      REFS          3
      0  NV          INTEGER                COMMAIN      REFS          3
    132  P           REAL          ARRAY                 REFS          2         12       9*16      4*19       2*22        23        24
                                                           25         26         27         28   DEFINED         10       2*13      4*14
    173  RESB        REAL                   COMCOMP      REFS          5
    172  RSLB        REAL                   COMCOMP      REFS          5
      6  RX7         REAL                   COMUE11      REFS          6       2*20    DEFINED        19
      7  RX8         REAL                   COMUE11      REFS          6       2*20    DEFINED        19
     26  XM          REAL          ARRAY    COMCOMP      REFS          5    DEFINED         24        25

 FILE NAMES         MODE
        OUTPUT      FMT                       WRITES          32

 EXTERNALS             TYPE    ARGS          REFERENCES
        EXIT                      0                  33

 STATEMENT LABELS               DEF LINE      REFERENCES
    111  1         FMT               11             10
     21  10                          16             12
     32  11                          19             15
     53  12                          23             19
      0  20                          29              8
    114  98        FMT               31             32
     73  99                          32             16          20          22

 LOOPS   LABEL      INDEX     FROM-TO     LENGTH     PROPERTIES
     6   20         N           8 29        64B                   EXT REFS     EXITS

 COMMON BLOCKS    LENGTH     MEMBERS - BIAS NAME(LENGTH)
        COMMAIN      312                  0 NV        (1)                  1 NCV       (1)                 2 NCCOL    (1)
                                          3 NCSTO     (1)                  4 NCTRA     (1)                 5 NOVAR    (1)
                                          6 NCOTH     (1)                  7 ISTH      (1)                 8 ISBIG    (1)
                                          9 ITIT      (1)                 10 IRUN      (1)                11 LCO      (30)
                                         41 LCR       (270)              311 NTYPE     (1)
        COMCOMP      126                  0 EFF       (22)                22 XM        (40)               62 CC       (60)
                                        122 RSLB      (1)                123 RESB      (1)               124 DETOT    (1)
                                        125 DTTOT     (1)
        COMUE11       10                  0 IND       (1)                  1 NITER     (1)                 2 E5       (1)
                                          3 E6        (1)                  4 E7        (1)                 5 E8       (1)
                                          6 RX7       (1)                  7 RX8       (1)                 8 LPNS     (1)
```

```
COMMON BLOCKS   LENGTH     MEMBERS - BIAS NAME(LENGTH)
                                     9 LPNH    (1)

STATISTICS
   PROGRAM LENGTH                145B      101
   CM LABELED COMMON LENGTH      700B      448
        60000B CM USED
```

```
      SUBROUTINE SUPPLY(XL,IND)
C      DEMAND MUST BE CALLED BEFORE SUPPLY. IND=0, NEW DATA
      DIMENSION CH(24),SH2(24),LTY(7),P(11),DSV(2,5)
      COMMON /COMMAIN/ NV,NCV,NCCOL,NCSTO,NCTRA,NOVAR,NCOTH,ISTH,ISBIG,
     1ITIT,IRUN,LCO(30),LCR(9,30),NTYPE
      COMMON /COMLEV2/ ESD(3,24,364)
       LEVEL2,ESD
      COMMON /COMWIND/ W(8),ISWND(2)
      COMMON /COMCOMP/ EFF(22),XM(20,2),CC(20,3),RSLB,RESB,DETOT,DTTOT
      DATA LTY/4HCTTC,4HFPTT,4HFPTI,4HFPEW,4HFPNS,4HHAWT,4HVAWT/
      DATA NTY/7/,JBL/1H /,CAV/57.29577951/
      DATA MU/77777777770000000000B/, ML/7777777777B/
      KH(I)=SHIFT(ESD(2,I,J),-24).A.7777B
      KN(I)=SHIFT(ESD(2,I,J),-12).A.7777B
      SDF(J)=.410*COS(.01720*(J-172))
      CDF(X)=SQRT(1.-X*X)
      IF(IND.LE.0)GO TO 9
       DO 19 K=1,NCCOL
       XM(K)=DSV(K)
      XM(K,2)=DSV(K,2)
       CC(K)=DSV(K,3)
       CC(K,2)=DSV(K,4)
   19 CC(K,3)=DSV(K,5)
       RETURN
    9 W(7)=1.
       ISWND(1)=ISWND(2)=0
      DO 10 J=1,24
       CH(J)=COS(15.*(J-13)/CAV)
   10 SH2(J)=1.-CH(J)**2
       CLA=COS(XL/CAV)
       SLA=SIN(XL/CAV)
      DO 60 K=1,NCCOL
       DECODE(80,1,LCR(1,K+1))IC,(P(J),J=1,11)
    1 FORMAT(2X,A4,8X,11F6.0)
      IF(IC.NE.JBL.A.P(1).NE.0.)GO TO 17
       EFF(K)=CC(K,2)=DSV(K,4)=1.
C     ZERO SUPPLY
      XM(K)=XM(K,2)=CC(K)=CC(K,3)=DSV(K)=DSV(K,2)=DSV(K,3)=DSV(K,5)=0
      DO 11 I=1,24
       DO 11 J=1,364
   11 ESD(K,I,J)=0
       GO TO 40
C     TEST COLLECTOR CARDS
   17 IF(P(1).GT.1..O.P(1).LE.0.)GOTO99
      IF(P(9).LE.0..O.P(10).LE.0..O.P(11).LT.0.O.P(8).LT.P(7))GOTO99
      IF(P(7).LT.0..O.P(8).LT.0.)GO TO 99
      DO 12 KK=1,NTY
       IF(IC.EQ.LTY(KK))GO TO 13
   12 CONTINUE
       GO TO 99
   13 EFF(K)=P(1)
       XM(K)=P(7)
       XM(K,2)=P(8)
      CC(K)=P(9)
       CC(K,2)=P(10)
       CC(K,3)=P(11)
       DSV(K,5)=P(11)
```

```
      DSV(K)=P(7)
       DSV(K,2)=P(8)
       DSV(K,3)=P(9)
       DSV(K,4)=P(10)
      GO TO (16,16,14,16,14,15,32),KK
   14 CTL=COS(P(2)/CAV)
       STL=SIN(P(2)/CAV)
      IF(P(2).GE.0..A.P(2).LT.90.)GO TO 16
       PRINT2
       GO TO 99
    2 FORMAT(* TILT ANGLE ERROR*)
   15 IF(K.EQ.1)GO TO 18
       IF(ISWND(1).EQ.0)GO TO 18
      PRINT4
       GO TO 99
    4 FORMAT(* ONLY ONE WIND TURBINE ALLOWED*)
   18 IF(P(5).LE.0.)P(5)=W(1)*(2.225-.0761*W(1))
       W(5)=P(5)
      IF(P(4).LE.0.)P(4)=.454*W(5)
       W(4)=P(4)
       W(6)=P(2)
      W(7)=MAX0(INT(P(3)),1)
       ISWND(K)=1
      PRINT3,(W(J),J=4,7)
       IF(W(4).GE.W(5).O.W(5).GE.W(6))GOTO99
      W(5)=W(5)-W(4)
       W(6)=W(6)-W(4)
    3 FORMAT(* -VI=*F8.2,* VR=*F8.2,* VC=*F8.2,* NTUR=*F8.1)
   16 GO TO (20,22,24,26,28,30,32),KK
C     CTTC
   20 DO 21 I=1,24
       DO 21 J=1,364
       J1=KN(I)
       Z1=.01*J1
   21 ESD(K,I,J)=Z1.A.MU
       GO TO 40
C     FPTT
   22 DO 23 J=1,364
       SDL=SDF(J)
       CDL=CLA*CDF(SDL)
       SDL=SLA*SDL
      DO 23 I=1,24
       Z1=CH(I)*CDL+SDL
       Z2=.75+.25*Z1
      J1=KH(I)
       J2=KN(I)
       Z3=.01*AMAX1(0.,J2+Z2*(J1-J2*Z1))
   23 ESD(K,I,J)=Z3.A.MU
       GO TO 40
C     FPTI
   24 Q1=STL*SLA
       Q2=STL*CLA
       Q3=.75+.25*CTL
       DO 25 J=1,364
      SDL=SDF(J)
       CDL=CDF(SDL)
       Z1=Q1*CDL
```

```
             Z2=Q2*SDL
            Z3=CLA*CDL
             Z4=SLA*SDL
             DO 25 I=1,24
             Z5=Z3*CH(I)+Z4
            Z6=Z1*CH(I)-Z2+CTL*Z5
             J1=KH(I)
             J2=KN(I)
            Z7=.01*AMAX1(0.,Z6*J2+Q3*(J1-J2*Z5))
      25    ESD(K,I,J)=Z7.A.MU
             GO TO 40
C           FPEW
      26    DO 27 J=1,364
             SDL=SDF(J)
             CDL=CDF(SDL)
             CD2=CDL**2
            Z1=CLA*CDL
             Z2=SLA*SDL
             DO 27 I=1,24
             Z3=Z1*CH(I)+Z2
            Z4=SQRT(1.-SH2(I)*CD2)
             Z5=.75+.25*COS(Z3/Z4)
            J1=KH(I)
             J2=KN(I)
             Z6=.01*AMAX1(0.,Z4*J2+Z5*(J1-J2*Z3))
      27    ESD(K,I,J)=Z6.A.MU
             GO TO 40
C           FPNS
      28    Q1=SLA*CTL+STL*CLA
             Q2=CLA*CTL-SLA*STL
             Q3=.75+.25*Q2
            DO 29 J=1,364
             SDL=SDF(J)
             Z1=CDF(SDL)*CLA
             Z2=SLA*SDL
            DO 29 I=1,24
             Z3=Z1*CH(I)+Z2
             Z4=Q1*CDF(Z3)+Q2*Z3
            J1=KH(I)
             J2=KN(I)
             Z5=.01*AMAX1(0.,Z4*J2+Q3*(J1-J2*Z3))
      29    ESD(K,I,J)=Z5.A.MU
             GO TO 40
C           HAWT
      30    DO 31 J=1,364
             DO 31 I=1,24
             J1=ESD(2,I,J).A.7777B
             Z1=.1*J1
      31    ESD(K,I,J)=Z1.A.MU
             GO TO 40
C           VAWT
      32    PRINT33
             GO TO 99
      33    FORMAT(* NO VAWT YET*)
      40    CONTINUE
             GO TO (41,41,41,41,41,60,60),KK
C           COMPUTE THERMAL
```

```
                 41    CONTINUE
                 60    CONTINUE
                        RETURN
                 98    FORMAT(* COLLECTOR CARD ERROR */1X,8A10)
                 99    PRINT98,(LCR(J,K+1),J=1,8)
                        CALL EXIT
                        END
```

SYMBOLIC REFERENCE MAP (R=3)

```
ENTRY POINTS     DEF LINE      REFERENCES
    3  SUPPLY           1          24       174        178

VARIABLES      SN  TYPE             RELOCATION
  617  CAV         REAL                              REFS        28       30       31       63       64
                                                  DEFINED        11
   76  CC          REAL        ARRAY    COMCOMP      REFS         9  DEFINED       21       22       23       36     2*38
                                                       54        55       56
  737  CDL         REAL                              REFS       100      114      116      130      131
                                                  DEFINED        97      113      129
  752  CD2         REAL                              REFS       135  DEFINED      130
  753  CH          REAL        ARRAY                 REFS         3       29      100      119      120      134      151
                                                  DEFINED        28
  725  CLA         REAL                              REFS        97      109      116      131      143      144      148
                                                  DEFINED        30
  732  CTL         REAL                              REFS       110      120      143      144  DEFINED       63
  174  DETOT       REAL                 COMCOMP      REFS         9
 1055  DSV         REAL        ARRAY                 REFS         3       19       20       21       22       23
                                                  DEFINED        36     4*38       57       58       59       60       61
  175  DTTOT       REAL                 COMCOMP      REFS         9
    0  EFF         REAL        ARRAY    COMCOMP      REFS         9  DEFINED       36       51
    0  ESD         REAL        ARRAY    COMLEV2      REFS         6        7       90      102      103      121      122
                                                      137       138      153      154      161  DEFINED       41       92
                                                      105       124      140      156      163
  730  I           INTEGER                           REFS        41       90       92      100      102      103      105
                                                      119       120      121      122      124      134      135      137
                                                      138       140      151      153      154      156      161      163
                                                  DEFINED        39       88       99      118      133      150      160
  727  IC          INTEGER                           REFS        35       48  DEFINED       33
    0  IND         INTEGER                F.P.       REFS        17  DEFINED        1
   12  IRUN        INTEGER              COMMAIN      REFS         4
   10  ISBIG       INTEGER              COMMAIN      REFS         4
    7  ISTH        INTEGER              COMMAIN      REFS         4
   10  ISWND       INTEGER     ARRAY  - COMWIND      REFS         8       70  DEFINED     2*26       80
   11  ITIT        INTEGER              COMMAIN      REFS         4
  724  J           INTEGER                           REFS      2*28     2*29       33       41       81       90       92
                                                       96       102      103      105      112      121      122      124
                                                      128       137      138      140      147      153      154      156
                                                      161       163      176  DEFINED       27       33       40       81
                                                       89        95      111      127      146      159      176
  616  JBL         INTEGER                           REFS        35  DEFINED       11
  734  J1          INTEGER                           REFS        91      104      123      139      155      162
                                                  DEFINED        90      102      121      137      153      161
```

```
      SUBROUTINE SUPPLY      74/74    OPT=2                              FTN 4.8+518         80/11/28. 10.23.01        PAGE      5

VARIABLES       SN  TYPE             RELOCATION
   741  J2          INTEGER                               REFS     2*104     2*123     2*139     2*155   DEFINED      103      122
                                                          138       154
   723  K           INTEGER                               REFS      2*19      2*20      2*21      2*22      2*23       33     3*36
                                                         8*38        41        51        52        53        54       55       56
                                                           57        58        59        60        61        69       80       92
                                                          105       124       140       156       163       176
                                                       DEFINED       18        32
   731  KK          INTEGER                               REFS       48        62        86       170   DEFINED       47
    13  LCO         INTEGER     ARRAY    COMMAIN          REFS        4
    51  LCR         INTEGER     ARRAY    COMMAIN          REFS        4        33       176
  1033  LTY         INTEGER     ARRAY                     REFS        3        48   DEFINED        10
   621  ML        * INTEGER                            DEFINED       12
   620  MU          INTEGER                               REFS       92       105       124       140       156      163
                                                       DEFINED       12
     2  NCCOL       INTEGER              COMMAIN          REFS        4        18        32
     6  NCOTH       INTEGER              COMMAIN          REFS        4
     3  NCSTO       INTEGER              COMMAIN          REFS        4
     4  NCTRA       INTEGER              COMMAIN          REFS        4
     1  NCV         INTEGER              COMMAIN          REFS        4
     5  NOVAR       INTEGER              COMMAIN          REFS        4
   615  NTY         INTEGER                               REFS       47   DEFINED        11
   467  NTYPE       INTEGER              COMMAIN          REFS        4
     0  NV          INTEGER              COMMAIN          REFS        4
  1042  P           REAL        ARRAY                     REFS        3        35      2*44      5*45      2*46       51       52
                                                           53        54        55        56        57        58       59       60
                                                           61        63        64      2*65        74        75       76       77
                                                           78        79   DEFINED        33        74        76
   743  Q1          REAL                                  REFS      114       152   DEFINED       108       143
   744  Q2          REAL                                  REFS      115       145       152   DEFINED       109      144
   745  Q3          REAL                                  REFS      123       155   DEFINED       110       145
   173  RESB        REAL                 COMCOMP          REFS        9
   172  RSLB        REAL                 COMCOMP          REFS        9
   736  SDL         REAL                                  REFS     2*97        98       100     2*113       115      117    2*129
                                                          132     2*148       149   DEFINED        96        98      112      128
                                                          147
  1003  SH2         REAL        ARRAY                     REFS        3       135   DEFINED        29
   726  SLA         REAL                                  REFS       98       108       117       132       143      144      149
                                                       DEFINED       31
   733  STL         REAL                                  REFS      108       109       143       144   DEFINED       64
     0  W           REAL        ARRAY    COMWIND          REFS        8      2*74        76        81      4*82     2*83     2*84
                                                       DEFINED       25        75        77        78        79       83       84
     0  XL          REAL                  F.P.            REFS       30        31   DEFINED         1
    26  XM          REAL        ARRAY    COMCOMP          REFS        9   DEFINED        19        20      2*38       52       53
   735  Z1          REAL                                  REFS       92       101       104       120       134      151      163
                                                       DEFINED       91       100       114       131       148      162
   740  Z2          REAL                                  REFS      104       120       134       151   DEFINED      101      115
                                                          132       149
   742  Z3          REAL                                  REFS      105       119       136       139     3*152      155
                                                       DEFINED      104       116       134       151
   746  Z4          REAL                                  REFS      119       136       139       155   DEFINED      117      135
                                                          152
   747  Z5          REAL                                  REFS      120       123       139       156   DEFINED      119      136
                                                          155
   750  Z6          REAL                                  REFS      123       140   DEFINED       120       139
   751  Z7          REAL                                  REFS      124   DEFINED       123
```

FILE NAMES	MODE						
OUTPUT	FMT	WRITES	66	71	81	166	176

EXTERNALS	TYPE	ARGS		REFERENCES							
COS	REAL	1	LIBRARY	28	30	63	96	112	128	136	147
EXIT		0		177							
SIN	REAL	1	LIBRARY	31	64						
SQRT	REAL	1	LIBRARY	97	113	129	135	148	152		

INLINE FUNCTIONS	TYPE	ARGS		DEF LINE	REFERENCES							
AMAX1	REAL	0	INTRIN		104	123	139	155				
CDF	REAL	1	SF	16	97	113	129	148	152			
INT	INTEGER	1	INTRIN		79							
KH	INTEGER	1	SF	13	102	121	137	153				
KN	INTEGER	1	SF	14	90	103	122	138	154			
MAX0	INTEGER	0	INTRIN		79							
SDF	REAL	1	SF	15	96	112	128	147				
SHIFT	NO TYPE	2	INTRIN		90	102	103	121	122	137	138	153
					154							

STATEMENT LABELS			DEF LINE	REFERENCES								
630	1	FMT	34	33								
636	2	FMT	68	66								
656	3	FMT	85	81								
645	4	FMT	73	71								
26	9		25	17								
0	10		29	27								
0	11		41	39	40							
0	12		49	47								
121	13		51	48								
150	14		63	2*62								
163	15		69	62								
221	16		86	3*62	65							
101	17		44	35								
171	18		74	69	70							
0	19		23	18								
235	20		88	86								
0	21		92	88	89							
247	22		95	86								
0	23		105	95	99							
310	24		108	86								
0	25		124	111	118							
364	26		127	86								
0	27		140	127	133							
445	28		143	86								
0	29		156	146	150							
530	30		159	86								
0	31		163	159	160							
542	32		166	62	86							
670	33	FMT	168	166								
545	40		169	42	93	106	125	141	157	164		
561	41		172	5*170								
561	60		173	32	2*170							
673	98	FMT	175	176								
566	99		176	44	45	46	50	67	72	82	167	

LOOPS	LABEL	INDEX	FROM-TO	LENGTH	PROPERTIES
17	19	K	18 23	6B	INSTACK
32	10	J	27 29	11B	EXT REFS
53	60	K	32 173	512B	EXT REFS EXITS NOT INNER
75	11	I	39 41	4B	NOT INNER
76	11	J	40 41	2B	INSTACK
116	12	KK	47 49	2B	INSTACK EXITS
241	21	I	88 92	6B	NOT INNER
242	21	J	89 92	4B	INSTACK
251	23	J	95 105	37B	EXT REFS NOT INNER
271	23	I	99 105	13B	OPT
320	25	J	111 124	44B	EXT REFS NOT INNER
343	25	I	118 124	15B	OPT
370	27	J	127 140	55B	EXT REFS NOT INNER
406	27	I	133 140	31B	EXT REFS
460	29	J	146 156	50B	EXT REFS NOT INNER
475	29	I	150 156	26B	EXT REFS
534	31	J	159 163	5B	NOT INNER
535	31	I	160 163	3B	INSTACK
575		J	176 176	10B	EXT REFS

COMMON BLOCKS	LENGTH	MEMBERS - BIAS NAME(LENGTH)		
COMMAIN	312	0 NV (1)	1 NCV (1)	2 NCCOL (1)
		3 NCSTO (1)	4 NCTRA (1)	5 NOVAR (1)
		6 NCOTH (1)	7 ISTH (1)	8 ISBIG (1)
		9 ITIT (1)	10 IRUN (1)	11 LCO (30)
		41 LCR (270)	311 NTYPE (1)	
COMLEV2	26208	0 ESD (26208)		
COMWIND	10	0 W (8)	8 ISWND (2)	
COMCOMP	126	0 EFF (22)	22 XM (40)	62 CC (60)
		122 RSLB (1)	123 RESB (1)	124 DETOT (1)
		125 DTTOT (1)		

STATISTICS		
PROGRAM LENGTH	1067B	567
CM LABELED COMMON LENGTH	64040B	26656
60000B CM USED		

```
              SUBROUTINE TODPRI(KK)
              DIMENSION IW(5),IH(4,2),ZP(4,3),ITOL(364),MHC(12)
              COMMON /COMMAIN/ NV,NCV,NCCOL,NCSTO,NCTRA,NOVAR,NCOTH,ISTH,ISBIG,
             1ITIT,IRUN,LCO(30),LCR(9,30),NTYPE
              COMMON /COMPURC/ EPUR(11,2),ESLB(10),ECOS(11),ITOD(26),
             A PCOS(10),PDCO(12,2),MHPK(12),MHOUR(12)
             B ,RLCCR
              DATA MHC/744,1464,2184,2928,3648,4368,5102,5822,6542,7286,
             A 8006,9000/
        C     AT THIS ENTRY KK IS THE PE CARD.
              DO 11 I=1,12
         11   MHOUR(I)=MHC(I)
               DO 12 J=1,364
         12   ITOL(J)=0
               DO 13 J=1,10
              PCOS(J)=0
         13   ECOS(J)=0
              DECODE(80,2,LCR(1,KK))(IW(J),ZP(J),ZP(J,2),ZP(J,3),IH(J),IH(J,2),
             1J=1,4),IW(5)
          2   FORMAT(6X,I2,4(3F4.0,3I2))
        C     TEST CARD
              IF(IW(1).LE.0.O.IW(1).GT.48)GO TO 99
               DO 16 J=1,4
              IF(IH(J).LE.0.O.IH(J,2).LE.0.O.IH(J).GT.24.O.IH(J,2).GT.24
             1.O.IH(J).GT.IH(J,2).O.ZP(J).LE.0..O.ZP(J,2).LE.0.O.
             2ZP(J,2).GT.ZP(J).O.IW(J+1).LE.IW(J))GO TO 99
              IF(IW(J+1)-IW(1)-51) 16,17,99
         16   CONTINUE
               GO TO 99
         17   K1=J
               JW=IW(1)
               JD=7*JW-6
               DO 21 K=1,K1
               K2=2*K-1
              ECOS(K2)=ZP(K)
               ECOS(K2+1)=ZP(K,2)
              PCOS(K2)=ZP(K,3)
              PCOS(K2+1)=0.
              IF(ZP(K).EQ.ZP(K,2))PCOS(K2+1)=ZP(K,3)
              IF(IH(K).NE.1.O.IH(K,2).NE.24)GO TO 24
              K2=K2+16*K2+256*K2
              GO TO 25
        24    K2=K2+16*(K2+1)+256*K2
         25   K2=SHIFT(K2,24)
               K3=K2.O.77777777B
               DO 18 I=1,24
              IF(I.GE.IH(K).A.I.LE.IH(K,2))GO TO 18
               K2=K2.O.SHIFT(1,I-1)
         18   CONTINUE
         19   IF(JD.GT.364)JD=JD-364
               ITOL(JD)=ITOL(JD+1)=K3
               DO 20 J=2,6
         20   ITOL(JD+J)=K2
               JD=JD+7
               JW=JW+1
               IF(JW.LE.IW(K+1))GO TO 19
         21   CONTINUE
```

```
                 RETURN
      C         BITS. 1=HOUR1, ETC.  25-28=K. 29-32=LO. 33-36=HI. ITOD(25)=HI
      C         GETS PRICE LIST FOR KK-TH DAY.
                ENTRY TODPR
                 KKK=KK
       26       IF(KKK.GT.0)GO TO 27
                 KKK=KKK+364
                 GO TO 26
       27       IF(KKK.LE.364)GO TO 28
                 KKK=KKK-364
                 GO TO 27
       28       J1=ITOL(KKK)
                 K1=SHIFT(J1,-24).A.17B
                 K2=K1+1
                ITOD(25)=SHIFT(J1,-32).A.17B
                 ITOD(26)=SHIFT(J1,-28).A.17B
                DO 30 I=1,24
                 ITOD(I)=K1
                IF((SHIFT(J1,1-I).A.1).NE.0)ITOD(I)=K2
       30       CONTINUE
                 RETURN
       98       FORMAT(* PE CARD ERROR *8A10)
       99       PRINT98,(LCR(J,KK),J=1,8)
                 CALL EXIT
                 END
```

SYMBOLIC REFERENCE MAP (R=3)

```
ENTRY POINTS     DEF LINE      REFERENCES
  166  TODPR          61           78         82
    3  TODPRI          1           58

VARIABLES       SN  TYPE             RELOCATION
   40  ECOS         REAL         ARRAY    COMPURC      REFS          5    DEFINED      17        35        36
    0  EPUR         REAL         ARRAY    COMPURC      REFS          5
   26  ESLB         REAL         ARRAY    COMPURC      REFS          5
  272  I            INTEGER                            REFS       2*12       2*47      48        75      2*76
                                                    DEFINED         11         46      74
  311  IH           INTEGER      ARRAY                 REFS          2       6*24    2*40      2*47   DEFINED     2*18
   12  IRUN         INTEGER               COMMAIN      REFS          3
   10  ISBIG        INTEGER               COMMAIN      REFS          3
    7  ISTH         INTEGER               COMMAIN      REFS          3
   11  ITIT         INTEGER               COMMAIN      REFS          3
   53  ITOD         INTEGER      ARRAY    COMPURC      REFS          5    DEFINED      72        73        75        76
  335  ITOL         INTEGER      ARRAY                 REFS          2         69 DEFINED        14      2*51        53
  304  IW           INTEGER      ARRAY                 REFS          2       2*22    2*24      2*27        31        56
                                                    DEFINED       2*18
  273  J            INTEGER                            REFS         14         16      17      6*18     12*24        27        30
                                                         53         80    DEFINED      13        15        18        23        52
                                                         80
  276  JD           INTEGER                            REFS       2*50       2*51      53        54   DEFINED        32        50
                                                         54
  275  JW           INTEGER                            REFS         32         55      56   DEFINED        31        55
```

```
VARIABLES        SN  TYPE            RELOCATION
   303  J1          INTEGER                               REFS       70        72        73        76   DEFINED      69
   277  K           INTEGER                               REFS       34        35        36        37      3*39      2*40      2*47
                                                           56   DEFINED        33
     0  KK          INTEGER                  F.P.         REFS       18        62        80   DEFINED         1
   302  KKK         INTEGER                               REFS       63        64        66        67        69
                                                      DEFINED       62        64        67
   274  K1          INTEGER                               REFS       33        71        75   DEFINED        30        70
   300  K2          INTEGER                               REFS       35        36        37        38        39      3*41      3*43
                                                           44        45        48        53        76   DE INED        34        41
                                                           43        44        48        71
   301  K3          INTEGER                               REFS       51   DEFINED        45
    13  LCO         INTEGER    ARRAY      COMMAIN         REFS        3
    51  LCR         INTEGER    ARRAY      COMMAIN         REFS        3        18        80
  1111  MHC         INTEGER    ARRAY                      REFS        2        12   DEFINED         8
   163  MHOUR       INTEGER    ARRAY      COMPURC         REFS        5   DEFINED        12
   147  MHPK        INTEGER    ARRAY      COMPURC         REFS        5
     2  NCCOL       INTEGER               COMMAIN         REFS        3
     6  NCOTH       INTEGER               COMMAIN         REFS        3
     3  NCSTO       INTEGER               COMMAIN         REFS        3
     4  NCTRA       INTEGER               COMMAIN         REFS        3
     1  NCV         INTEGER               COMMAIN         REFS        3
     5  NOVAR       INTEGER               COMMAIN         REFS        3
   467  NTYPE       INTEGER               COMMAIN         REFS        3
     0  NV          INTEGER               COMMAIN         REFS        3
   105  PCOS        REAL       ARRAY      COMPURC         REFS        5   DEFINED        16        37        38        39
   117  PDCO        REAL       ARRAY      COMPURC         REFS        5
   177  RLCCR       REAL                  COMPURC         REFS        5
   321  ZP          REAL       ARRAY                      REFS        2      4*24        35        36        37      3*39
                                                      DEFINED     3*18

FILE NAMES        MODE
       OUTPUT     FMT                      WRITES         80

EXTERNALS             TYPE    ARGS          REFERENCES
       EXIT                    0                 81

INLINE FUNCTIONS      TYPE    ARGS        DEF LINE   REFERENCES
       SHIFT       NO TYPE     2  INTRIN                  44        48        70        72        73        76

STATEMENT LABELS                 DEF LINE    REFERENCES
   254  2       FMT                 20          18
     0  11                          12          11
     0  12                          14          13
     0  13                          17          15
     0  16                          28          23        27
    74  17                          30          27
   140  18                          49          46        47
   146  19                          50          56
     0  20                          53          52
     0  21                          57          33
   123  24                          43          40
   126  25                          44          42
   201  26                          63          65
   204  27                          66          63        68
   207  28                          69          66
     0  30                          77          74
   260  98      FMT                 79          80
```

STATEMENT LABELS		DEF LINE	REFERENCES			
223	99	80	22	24	27	29

LOOPS	LABEL	INDEX	FROM-TO	LENGTH	PROPERTIES		
7	11	I	11 12	3B	INSTACK		
13	12	J	13 14	2B	INSTACK		
16	13	J	15 17	3B	INSTACK		
31		J	18 18	16B			EXT REFS
56	16	J	23 28	15B		OPT	EXITS
103	21	K	33 57	62B			NOT INNER
134	18	I	46 49	5B	INSTACK		
153	20	J	52 53	2B	INSTACK		
216	30	I	74 77	4B	INSTACK		

COMMON BLOCKS	LENGTH	MEMBERS - BIAS NAME(LENGTH)							
COMMAIN	312	0	NV	(1)	1	NCV	(1)	2 NCCOL	(1)
		3	NCSTO	(1)	4	NCTRA	(1)	5 NOVAR	(1)
		6	NCOTH	(1)	7	ISTH	(1)	8 ISBIG	(1)
		9	ITIT	(1)	10	IRUN	(1)	11 LCO	(30)
		41	LCR	(270)	311	NTYPE	(1)		
COMPURC	128	0	EPUR	(22)	22	ESLB	(10)	32 ECOS	(11)
		43	ITOD	(26)	69	PCOS	(10)	79 PDCO	(24)
		103	MHPK	(12)	115	MHOUR	(12)	127 RLCCR	(1)

STATISTICS

PROGRAM LENGTH	1125B	597
CM LABELED COMMON LENGTH	670B	440
60000B CM USED		

```
      SUBROUTINE TODUP(NHR)
       DIMENSION JUPT(365)
      COMMON /COMPURC/ EPUR(11,2),ESLB(10),ECOS(11),ITOD(26),
     A PCOS(10),PDCO(12,2),MHPK(12),MHOUR(12)
     B ,RLCCR
      COMMON /COMUPDN/ IHUP,PRUP,IHDN,PRDN
      COMMON /COMSUDE/ SE1(24),SE2(24),ST1(24),ST2(24),DEE(24),DET(24)
      IF(NHR.LT.NHRU)LU=1
       NHRU=NHR
   10 J=JUPT(LU).A.M5
       IF(J.GT.NHRU)GO TO 11
       LU=LU+1
       GO TO 10
   11 IHUP=J
       J=SHIFT(JUPT(LU),-15).A.17B
       PRUP=ECOS(J)
       RETURN
      ENTRY TODDN
      IF(NHR.LT.NHRD)LD=1
       NHRD=NHR
   12 J=SHIFT(JUPT(LD),-21).A.M5
       IF(J.GT.NHRD)GO TO 13
      LD=LD+1
       GO TO 13
   13 IHDN=J
       J=SHIFT(JUPT(LD),-36).A.17B
       PRDN=ECOS(J)
       RETURN
      ENTRY TODUDI
       M5=77777B
      LU=LD=1
       NHRU=NHRD=M5
       CALL TODPR(1)
       J=ITOD(1)
      Z1=ECOS(J)
       NH=0
      MO=1
      DO 19 J=1,11
   19 EPUR(J)=0.
      DO 20 J=1,12
      MHPK(J)=0.
      DO 20 K=1,2
   20 PDCO(J,K)=0.
       DO 23 ND=1,364
       CALL GETSD(ND)
       CALL TODPR(ND)
      DO 23 I=1,24
       EPUR(11)=EPUR(11)+DET(I)
       J=ITOD(I)
      EPUR(J)=EPUR(J)+DEE(I)
       NH=NH+1
C     CHECK MONTH
      IF(NH.GT.MHOUR(MO))MO=MO+1
      Z2=DEE(I)*PCOS(J)
C     FIND PEAK COST FOR EACH MONTH
      IF(Z2.LE.PDCO(MO,1))GO TO 18
      PDCO(MO,1)=Z2
```

```
                     MHPK(MO)=NH
                     PDCO(MO,2)=DEE(I)
                18   CONTINUE
               C     FIND PEAK DEMAND FOR EACH MONTH IF PEAK DEMAND PRICE IS ZERO
                     IF(PDCO(MO,1).NE.O..O.DEE(I).LE.PDCO(MO,2))GO TO 24
                     PDCO(MO,2)=DEE(I)
                     MHPK(MO)=NH
                24   CONTINUE
                     IF(ECOS(J)-Z1)21,23,22
               C       THE EPUR RESULTS ARE USED IN COSTI.
                21   JUPT(LD)=(JUPT(LD).A.7777777B).O.SHIFT(SHIFT(J,15).O.NH,21)
                     LD=LD+1
                      GO TO 23
                22   JUPT(LU)=(JUPT(LU).A.77777770000000B).O.SHIFT(J,15).O.NH
                     LU=LU+1
                23   Z1=ECOS(J)
                       J=JUPT(1).A.7777777B
                      IF(LU.EQ.1)J=150000B
                     J=J+8736
                      JUPT(LU)=J.O.(JUPT(LU).A.77777770000000B)
                     J=SHIFT(JUPT(1),-21).A.7777777B
                      IF(LD.EQ.1)J=150000B
                     J=J+8736
                      JUPT(LD)=(JUPT(LD).A.7777777B).O.SHIFT(J,21)
                      DO 26 J=1,11
                26   EPUR(J,2)=EPUR(J)
                      RETURN
                      END
```

```
        SYMBOLIC REFERENCE MAP (R=3)

ENTRY POINTS       DEF LINE      REFERENCES
   26  TODDN          18            28
   60  TODUDI         29            84
    3  TODUP           1            17

VARIABLES       SN  TYPE              RELOCATION
  140  DEE          REAL       ARRAY    COMSUDE     REFS        7       50       54       59       62       63
  170  DET          REAL       ARRAY    COMSUDE     REFS        7       48
   40  ECOS         REAL       ARRAY    COMPURC     REFS        3       16       27       35       66       73
    0  EPUR         REAL       ARRAY    COMPURC     REFS        3       48       50       83  DEFINED       39       48
                                                      50       83
   26  ESLB         REAL       ARRAY    COMPURC     REFS        3
  246  I            INTEGER                         REFS       48       49       50       54       59       62       63
                                                 DEFINED       47
    2  IHDN         INTEGER             COMUPDN     REFS        6  DEFINED       25
    0  IHUP         INTEGER             COMUPDN     REFS        6  DEFINED       14
   53  ITOD         INTEGER    ARRAY    COMPURC     REFS        3       34       49
  235  J            INTEGER                         REFS       11       14       16       22       25       27       35
                                                      39       41       43     2*50       54       66       68       71
                                                      73       76       77       80       81     2*83
                                                 DEFINED       10       15       21       26       34       38       40
                                                      49       74       75       76       78       79       80       82
```

```
VARIABLES      SN  TYPE              RELOCATION
  250  JUPT        INTEGER   ARRAY                    REFS       2      10      15      21      26      68      71
                                                        74      77      78      81  DEFINED      68      71      77
                                                        81
  244  K           INTEGER                            REFS      43  DEFINED      42
  240  LD          INTEGER                            REFS      21      23      26    2*68      69      79    2*81
                                                   DEFINED      19      23      31      69
  234  LU          INTEGER                            REFS      10      12      15    2*71      72      75    2*77
                                                   DEFINED       8      12      31      72
  163  MHOUR       INTEGER   ARRAY     COMPURC        REFS       3      53
  147  MHPK        INTEGER   ARRAY     COMPURC        REFS       3  DEFINED      41      58      64
  243  MO          INTEGER                            REFS    2*53      56      57      58      59    2*62      63
                                                        64 DEFINED      37      53
  236  M5          INTEGER                            REFS      10      21      32  DEFINED      30
  245  ND          INTEGER                            REFS      45      46  DEFINED      44
  242  NH          INTEGER                            REFS      51      53      58      64      68      71
                                                   DEFINED      36      51
    0  NHR         INTEGER             F.P.           REFS       8       9      19      20  DEFINED       1
  237  NHRD        INTEGER                            REFS      19      22  DEFINED      20      32
  233  NHRU        INTEGER                            REFS       8      11  DEFINED       9      32
  105  PCOS        REAL      ARRAY     COMPURC        REFS       3      54
  117  PDCO        REAL      ARRAY     COMPURC        REFS       3      56    2*62  DEFINED      43      57      59
                                                        63
    3  PRDN        REAL                COMUPDN        REFS       6  DEFINED      27
    1  PRUP        REAL                COMUPDN        REFS       6  DEFINED      16
  177  RLCCR       REAL                COMPURC        REFS       3
    0  SE1         REAL      ARRAY     COMSUDE        REFS       7
   30  SE2         REAL      ARRAY     COMSUDE        REFS       7
   60  ST1         REAL      ARRAY     COMSUDE        REFS       7
  110  ST2         REAL      ARRAY     COMSUDE        REFS       7
  241  Z1          REAL                               REFS      66  DEFINED      35      73
  247  Z2          REAL                               REFS      56      57  DEFINED      54

EXTERNALS             TYPE   ARGS        REFERENCES
       GETSD                   1            45
       TODPR                   1            33      46

INLINE FUNCTIONS      TYPE   ARGS        DEF LINE   REFERENCES
       SHIFT       NO TYPE     2  INTRIN              15      21      26    2*68      71      78      81

STATEMENT LABELS               DEF LINE    REFERENCES
   16  10                          10          13
   21  11                          14          11
    0  12           INACTIVE       21
   53  13                          25          22      24
  145  18                          60          56
    0  19                          39          38
    0  20                          43          40      42
    0  21           INACTIVE       68          66
  161  22                          71          66
  164  23                          73          44      47      66      70
  152  24                          65          62
    0  26                          83          82

LOOPS  LABEL    INDEX       FROM-TO     LENGTH    PROPERTIES
  104  19       J           38 39         2B      INSTACK
  107  20       J           40 43         5B                NOT INNER
  111  20       K           42 43         2B      INSTACK
```

```
LOOPS  LABEL    INDEX    FROM-TO    LENGTH    PROPERTIES
 115   23       ND        44 73       60B               EXT REFS  NOT INNER
 127   23       I         47 73       40B        OPT
 220   26       J         82 83        2B      INSTACK

COMMON BLOCKS   LENGTH    MEMBERS - BIAS NAME(LENGTH)
       COMPURC     128             0 EPUR    (22)             22 ESLB    (10)             32 ECOS    (11)
                                  43 ITOD    (26)             69 PCOS    (10)             79 PHCO    (24)
                                 103 MHPK    (12)            115 MHOUR   (12)            127 RLCCR   (1)
       COMUPDN       4             0 IHUP    (1)               1 PRUP    (1)               2 IHDN    (1)
                                   3 PRDN    (1)
       COMSUDE     144             0 SE1     (24)             24 SE2     (24)             48 ST1     (24)
                                  72 ST2     (24)             96 DEE     (24)            120 DET     (24)

STATISTICS
  PROGRAM LENGTH                  1025B     533
  CM LABELED COMMON LENGTH         424B     276
        60000B CM USED
```

```
      SUBROUTINE TRANSI
      DIMENSION P(11)
      COMMON /COMMAIN/ NV,NCV,NCCOL,NCSTO,NCTRA,NOVAL,NCOTH,ISTH,ISBIG,
     1ITIT,IRUN,LCO(30),LCR(9,30),NTYPE
      COMMON /COMCOMP/ EFF(22),XM(20,2),CC(20,3),RSLB,RESB,DETOT,DTTOT
      COMMON /COMUE11/ IND,NITER,E5,E6,E7,E8,RX7,RX8,LPNS,LPNH
      NC=NCCOL+NCSTO+2
      DO 20 N=1,NCTRA
      L=NC-1
      DECODE(80,1,LCR(1,NC))(P(J),J=1,11)
    1 FORMAT(14X,11F6.0)
      IF(P(1).NE.0.)GO TO 10
      P(1)=P(10)=1.
      P(7)=P(8)=P(9)=P(11)=0.
      GO TO 12
   10 IF(P(1).NE.1.)GO TO 11
      P(1)=P(10)=1.
      P(7)=P(8)=1.E30
      P(9)=P(11)=0.
      GO TO 12
   11 IF(P(9).EQ.0.)P(10)=1.
      IF(P(1).LE.0..O.P(1).GT.1..O.P(7).LT.0..O.P(8).LT.0..O.
     1P(9).LT.0..O.P(10).LE.0..O.P(11).LT.0..O.P(8).LT.P(7))GOTO99
   12 IF(N.NE.1)GO TO 13 $ E5=P(2) $ E6=P(3)
      IF(E5.LE.0..O.E6.LE.0..O.E5.GT.1..O.E6.GT.1.)GO TO 99
   13 EFF(L)=P(1)
      XM(L)=P(7)
      XM(L,2)=P(8)
      CC(L)=P(9)
      CC(L,2)=P(10)
      CC(L,3)=P(11)
   20 NC=NC+1
      RETURN
   98 FORMAT(* TRANSDUCER CARD ERROR *8A10)
   99 PRINT98,(LCR(J,NC),J=1,8)
      CALL EXIT
      END
```

SYMBOLIC REFERENCE MAP (R=3)

```
ENTRY POINTS    DEF LINE     REFERENCES
   1 TRANSI         1          33         37

VARIABLES      SN  TYPE              RELOCATION
  76 CC            REAL      ARRAY   COMCOMP     REFS        5   DEFINED      29      30      31
 174 DETOT         REAL              COMCOMP     REFS        5
 175 DTTOT         REAL              COMCOMP     REFS        5
   0 EFF           REAL      ARRAY   COMCOMP     REFS        5   DEFINED      26
   2 E5            REAL              COMUE11     REFS        6      2*25   DEFINED      24
   3 E6            REAL              COMUE11     REFS        6      2*25   DEFINED      24
   4 E7            REAL              COMUE11     REFS        6
   5 E8            REAL              COMUE11     REFS        6
   0 IND           INTEGER           COMUE11     REFS        6
```

```
VARIABLES         SN   TYPE             RELOCATION
    12  IRUN      INTEGER              COMMAIN       REFS        3
    10  ISBIG     INTEGER              COMMAIN       REFS        3
     7  ISTH      INTEGER              COMMAIN       REFS        3
    11  ITIT      INTEGER              COMMAIN       REFS        3
   136  J         INTEGER                            REFS       10        35    DEFINED      10        35
   135  L         INTEGER                            REFS       26        27         28      29        30        31
                                                  DEFINED        9
    13  LCO       INTEGER    ARRAY     COMMAIN       REFS        3
    51  LCR       INTEGER    ARRAY     COMMAIN       REFS        3        10         35
    11  LPNH      INTEGER              COMUE11       REFS        6
    10  LPNS      INTEGER              COMUE11       REFS        6
   134  N         INTEGER                            REFS       24   DEFINED          8
   133  NC        INTEGER                            REFS        9        10         32      35   DEFINED         7        32
     2  NCCOL     INTEGER              COMMAIN       REFS        3         7
     6  NCOTH     INTEGER              COMMAIN       REFS        3
     3  NCSTO     INTEGER              COMMAIN       REFS        3         7
     4  NCTRA     INTEGER              COMMAIN       REFS        3         8
     1  NCV       INTEGER              COMMAIN       REFS        3
     1  NITER     INTEGER              COMUE11       REFS        6
     5  NOVAR     INTEGER              COMMAIN       REFS        3
   467  NTYPE     INTEGER              COMMAIN       REFS        3
     0  NV        INTEGER              COMMAIN       REFS        3
   137  P         REAL       ARRAY                   REFS        2        12         16      21      9*22      2*24        26
                                                      27        28        29         30      31   DEFINED        10      2*13
                                                     4*14      2*17      2*18       2*19     21
   173  RESB      REAL                 COMCOMP       REFS        5
   172  RSLB      REAL                 COMCOMP       REFS        5
     6  RX7       REAL                 COMUE11       REFS        6
     7  RX8       REAL                 COMUE11       REFS        6
    26  XM        REAL       ARRAY     COMCOMP       REFS        5   DEFINED         27      28

FILE NAMES        MODE
        OUTPUT    FMT                     WRITES        35

EXTERNALS              TYPE    ARGS        REFERENCES
        EXIT                    0              36

STATEMENT LABELS                DEF LINE    REFERENCES
   114  1          FMT              11         10
    22  10                          16         12
    31  11                          21         16
    45  12                          24         15
    56  13                          26         24
     0  20                          32          8
   117  98         FMT              34         35
    76  99                          35         22         25

LOOPS  LABEL     INDEX        FROM-TO      LENGTH     PROPERTIES
    7  20        N              8 32        66B                  EXT REFS     EXITS

COMMON BLOCKS    LENGTH      MEMBERS - BIAS NAME(LENGTH)
        COMMAIN     312                 0 NV      (1)                    1 NCV     (1)                   2 NCCOL  (1)
                                        3 NCSTO   (1)                    4 NCTRA   (1)                   5 NOVAR  (1)
                                        6 NCOTH   (1)                    7 ISTH    (1)                   8 ISBIG  (1)
                                        9 ITIT    (1)                   10 IRUN    (1)                  11 LCO    (30)
                                       41 LCR     (270)                311 NTYPE   (1)
        COMCOMP     126                 0 EFF     (22)                  22 XM      (40)                 62 CC     (60)
```

```
COMMON BLOCKS   LENGTH     MEMBERS - BIAS NAME(LENGTH)
                              122 RSLB    (1)        123 RESB    (1)        124 DETOT   (1)
                              125 DTTOT   (1)
     COMUE11       10           0 IND     (1)          1 NITER   (1)          2 E5      (1)
                                3 E6      (1)          4 E7      (1)          5 E8      (1)
                                6 RX7     (1)          7 RX8     (1)          8 LPNS    (1)
                                9 LPNH    (1)

STATISTICS
  PROGRAM LENGTH                  152B      106
  CM LABELED COMMON LENGTH        700B      448
        60000B CM USED
```

```
      SUBROUTINE UE11MN(FCT)
       EXTERNAL FCT
      DIMENSION XL(5),XU(5),XB(6)
      COMMON /COMMAIN/ NV,NCV,NCCOL,NCSTO,NCTRA,NOVAR,NCOTH,ISTH,ISBIG,
     1ITIT,IRUN,LCO(30),LCR(9,30),NTYPE
      COMMON /COMCOMP/ EFF(22),XM(20,2),CC(20,3),RSLB,RESB,DETOT,DTTOT
      COMMON /COMAMOB/ CZSYS,LIFE,AMOB,AMOP
      COMMON /COMUE11/ IND,NITER,E5,E6,E7,E8,RX7,RX8,LPNS,LPNH
C .... NOTE. E5,E6 DECODED IN TRANSI,  E7,E8 RX7,RX8 DECODED IN STORI.
      COMMON /COMCUMU/ NAMCU(3),CU(20,3),R(20)
      COMMON /COMANSW/ X(20),XCO(20),MXX(20),CTOT(7,2)
      IND=NITER=JSRAN=0
       XM(5)=XM(5,2)=0.
      DO 30 K=2,30 $ DECODE(10,7,LCR(1,K))J1 $ IF(J1.EQ.2HLO)GO TO 31
   30 CONTINUE $ CALL EXIT
    7 FORMAT(A2,8X)
   31 GO TO (27,25,26,28),NTYPE
   28 DECODE(20,5,LCR(1,K))LPNS,LPNH
      IF(LPNS.LT.0 .O. LPNS.GT.5 .O. LPNH.LT.4 .O.LPNH.GT.24)GO TO 24
      JSRAN=1 $ GO TO 25
   26 DECODE(20,5,LCR(1,K))LPNS,LPNH
    5 FORMAT(14X,2(1X,I2))
      IF(LPNS.LT.1.O.LPNS.GT.48.O.LPNH.GT.72.O.LPNH.LT.LPNS)GOTO24
      J1=8736/LPNS
       IF(LPNS*J1.NE.8736)GO TO 24
       JSRAN=1 $ GO TO 25
   27 DECODE(30,3,LCR(1,K))XM(5),XM(5,2)
      IF(XM(2,2).LE.0.)XM(5)=XM(5,2)=0.
      MXX(5)=1HV
       IF(XM(5).EQ.XM(5,2))MXX(5)=1HF
      IF(XM(5).GE.0..A.XM(5).LE.1..A.XM(5,2).GE.0..A.XM(5,2).LE.1.
     1.A.XM(5).LE.XM(5,2))GO TO 25
   24 PRINT4,(LCR(L,K),L=1,8)
       CALL EXIT
   25 N=1
      V3L=.05 $ DECODE(10,6,LCR(1,4))J $ IF(J.EQ.1HF)V3L=1.
      V4L=0.  $ DECODE(10,6,LCR(1,5))J $ IF(J.EQ.1HF)V4L=1.
    6 FORMAT(2X,A1,7X)
       DECODE(10,1,LCR(4))J,D
       IF(D.LE.0.)D=.1
      D=AMIN1(.3333333,D)
       IF(J.NE.1H )DECODE(10,2,J)N
    1 FORMAT(1X,A1,F3.0)
    2 FORMAT(I1)
    3 FORMAT(14X,11F6.0)
    4 FORMAT(* LO CARD ERROR-STORAGE*/* (*8A10,*)*)
       XB(6)=CZSYS
       Z1=0.
       DO 11 J=1,NV
      R(J)=XM(J,2)-XM(J)
       Z1=Z1+R(J)
       XB(J)=0.
   11 CONTINUE
       IF(XM(1).GT.0..O.XM(2).GT.0.)XB(6)=1.E80
      IF(Z1.GT.0.)GO TO 13
       DO 12 J=1,NV
   12 XB(J)=XM(J)
```

```
      GO TO 52
C      NOT ALL VARIABLES FIXED.
   13 XU(1)=XL(1)=XM(1)
      XU(2)=XL(2)=XM(2)
      IF(R(1).GT.0..O.R(2).GT.0.)GO TO 20
      CALL XMINOU(FCT,NV,N,D,XL,XU,V3L,V4L,JSRAN,XB)
      GO TO 52
C .... NOT BOTH FIXED.
   20 IF(R(1).GT.0.)GO TO 15
C .... X1 FIXED.
      IF(XL(2).GT.0.)GO TO 14
      IF(XL(1).LE.0.)GO TO 14
      XU(2)=XL(2)=0.
      CALL XMINOU(FCT,NV,N,D,XL,XU,V3L,V4L,JSRAN,XB)
   14 XU(2)=XM(2,2)
      XL(2)=AMAX1(XM(2),1.E-3)
      CALL XMINOU(FCT,NV,N,D,XL,XU,V3L,V4L,JSRAN,XB)
      GO TO 52
C .... X1 NOT FIXED.
   15 IF(R(2).GT.0.)GO TO 17
C .... X2 FIXED.
      IF(XL(1).GT.0.)GO TO 16
      IF(XL(2).LE.0.)GO TO 16
      XU(1)=XL(1)=0.
      CALL XMINOU(FCT,NV,N,D,XL,XU,V3L,V4L,JSRAN,XB)
   16 XU(1)=XM(1,2)
      XL(1)=AMAX1(XM(1),1.E-3)
      CALL XMINOU(FCT,NV,N,D,XL,XU,V3L,V4L,JSRAN,XB)
      GO TO 52
C .... BOTH VARIABLE.
   17 IF(XM(1).GT.0.)GO TO 18
      XU(1)=XL(1)=0.
      XU(2)=XM(2,2)
      XL(2)=AMAX1(XM(2),1.E-3)
      CALL XMINOU(FCT,NV,N,D,XL,XU,V3L,V4L,JSRAN,XB)
   18 IF(XM(2).GT.0.)GO TO 19
      XU(2)=XL(2)=0.
      XU(1)=XM(1,2)
      XL(1)=AMAX1(XM(1),1.E-3)
      CALL XMINOU(FCT,NV,N,D,XL,XU,V3L,V4L,JSRAN,XB)
   19 XU(1)=XM(1,2)
      XL(1)=AMAX1(XM(1),1.E-3)
      XU(2)=XM(2,2)
      XL(2)=AMAX1(XM(2),1.E-3)
      CALL XMINOU(FCT,NV,N,D,XL,XU,V3L,V4L,JSRAN,XB)
C ....    SOLUTION IN XB
   52 IF(R(3).EQ.0.)GO TO 53
      XM(3,2)=EFF(1)*E5*E6*XB(1)+E8*RX8*XB(2)
      R(3)=(1.-V3L)*XM(3,2)
   53 IF(R(4).EQ.0.)GO TO 54
      XM(4,2)=XB(2)*RX7/EFF(4)
      R(4)=(1.-V4L)*XM(4,2)
   54 IND=1
      Z1=FCT(XB)
      PRINT55,NITER,N,D
      IND=0
      CALL PROUT(FCT)
```

```
   115         55  FORMAT(* XMIN *2I8,F12.6)
                   RETURN
                    END
```

SYMBOLIC REFERENCE MAP (R=3)

```
ENTRY POINTS     DEF LINE      REFERENCES
   3  UE11MN         3           116

VARIABLES      SN  TYPE               RELOCATION
    2  AMOB        REAL                 COMAMOB     REFS        7
    3  AMOP        REAL                 COMAMOB     REFS        7
   76  CC          REAL       ARRAY     COMCOMP     REFS        6
   74  CTOT        REAL       ARRAY     COMANSW     REFS       11
    3  CU          REAL       ARRAY     COMCUMU     REFS       10
    0  CZSYS       REAL                 COMAMOB     REFS        7      47
  513  D           REAL                             REFS       40      41      63      71      74      82      85
                                                      92       97     102     112  DEFINED    39      40      41
  174  DETOT       REAL                 COMCOMP     REFS        6
  175  DTTOT       REAL                 COMCOMP     REFS        6
    0  EFF         REAL       ARRAY     COMCOMP     REFS        6     105     108
    2  E5          REAL                 COMUE11     REFS        8     105
    3  E6          REAL                 COMUE11     REFS        8     105
    4  E7          REAL                 COMUE11     REFS        8
    5  E8          REAL                 COMUE11     REFS        8     105
    0  IND         INTEGER              COMUE11     REFS        8  DEFINED     12     110     113
   12  IRUN        INTEGER              COMMAIN     REFS        4
   10  ISBIG       INTEGER              COMMAIN     REFS        4
    7  ISTH        INTEGER              COMMAIN     REFS        4
   11  ITIT        INTEGER              COMMAIN     REFS        4
  511  J           INTEGER                          REFS       36      37    2*42    3*50      51      52    2*57
                                                 DEFINED       36      37      39      49      56
  503  JSRAN       INTEGER                          REFS       63      71      74      82      85      92      97
                                                     102  DEFINED      12      20      26
  505  J1          INTEGER                          REFS       14      25  DEFINED      14      24
  504  K           INTEGER                          REFS       14      18      21      27      33
                                                 DEFINED       14
  506  L           INTEGER                          REFS       33  DEFINED      33
   13  LCO         INTEGER    ARRAY     COMMAIN     REFS        4
   51  LCR         INTEGER    ARRAY     COMMAIN     REFS        4      14      18      21      27      33      36
                                                      37       39
    1  LIFE        INTEGER              COMAMOB     REFS        7
   11  LPNH        INTEGER              COMUE11     REFS        8    2*19    2*23  DEFINED      18      21
   10  LPNS        INTEGER              COMUE11     REFS        8    2*19    3*23      24      25
                                                 DEFINED       18      21
   50  MXX         INTEGER    ARRAY     COMANSW     REFS       11  DEFINED      29      30
  507  N           INTEGER                          REFS       63      71      74      82      85      92      97
                                                     102      112  DEFINED      35      42
    0  NAMCU       INTEGER    ARRAY     COMCUMU     REFS       10
    2  NCCOL       INTEGER              COMMAIN     REFS        4
    6  NCOTH       INTEGER              COMMAIN     REFS        4
    3  NCSTO       INTEGER              COMMAIN     REFS        4
    4  NCTRA       INTEGER              COMMAIN     REFS        4
```

```
VARIABLES       SN  TYPE            RELOCATION
     1  NCV         INTEGER                 COMMAIN      REFS         4
     1  NITER       INTEGER                 COMUE11      REFS         8          112     DEFINED      12
     5  NOVAR       INTEGER                 COMMAIN      REFS         4
   467  NTYPE       INTEGER                 COMMAIN      REFS         4           17
     0  NV          INTEGER                 COMMAIN      REFS         4           49        56        63        71        74        82
                                                             85      92           97       102
    77  R           REAL        ARRAY       COMCUMU      REFS        10           51      2*62        66        77       104       107
                                                         DEFINED     50          106       109
   173  RESB        REAL                    COMCOMP      REFS         6
   172  RSLB        REAL                    COMCOMP      REFS         6
     6  RX7         REAL                    COMUE11      REFS         8          108
     7  RX8         REAL                    COMUE11      REFS         8          105
   510  V3L         REAL                                 REFS        63           71        74        82        85        92        97
                                                            102     106      DEFINED      2*36
   512  V4L         REAL                                 REFS        63           71        74        82        85        92        97
                                                            102     109      DEFINED      2*37
     0  X           REAL        ARRAY       COMANSW      REFS        11
   527  XB          REAL        ARRAY                    REFS         3           63        71        74        82        85        92
                                                             97     102        2*105       108       111   DEFINED        47        52
                                                             54      57
    24  XCO         REAL        ARRAY       COMANSW      REFS        11
   515  XL          REAL        ARRAY                    REFS         3           63        68        69        71        74        79
                                                             80      82           85        92        97       102
                                                         DEFINED     60           61        70        73        81        84        89
                                                             91      94           96        99       101
    26  XM          REAL        ARRAY       COMCOMP      REFS         6           28      2*30      6*31      2*50      2*54        57
                                                             60      61           72        73        83        84        88        90
                                                             91      93           95        96        98        99       100       101
                                                            106     109      DEFINED      2*13      2*27      2*28       105       108
   522  XU          REAL        ARRAY                    REFS         3           63        71        74        82        85        92
                                                             97     102      DEFINED        60        61        70        72        81
                                                             83      89           90        94        95        98       100
   514  Z1          REAL                                 REFS        51           55     DEFINED      48        51       111

FILE NAMES       MODE
        OUTPUT      FMT                       WRITES         33     112

EXTERNALS             TYPE     ARGS          REFERENCES
        EXIT                      0                 15       34
        FCT           REAL        1     F.P.         2       63      71           74        82        85        92        97       102
                                                   111      114
        PROUT                     1                114
        XMINOU                   10                 63       71      74           82        85        92        97       102

INLINE FUNCTIONS      TYPE     ARGS           DEF LINE   REFERENCES
        AMAX1         REAL        0   INTRIN                 73      84           91        96        99       101
        AMIN1         REAL        0   INTRIN                 41

STATEMENT LABELS                DEF LINE    REFERENCES
   436  1           FMT               43          39
   441  2           FMT               44          42
   443  3           FMT               45          27
   446  4           FMT               46          33
   372  5           FMT               22          18       21
   421  6           FMT               38          36       37
   354  7           FMT               16          14
     0  11                            53          49
```

```
STATEMENT LABELS                  DEF LINE   REFERENCES
    0  12                            57         56
  176  13                            60         55
  217  14                            72         68        69
  226  15                            77         66
  236  16                            83         79        80
  245  17                            88         77
  256  18                            93         88
  267  19                            98         93
  207  20                            66         62
  111  24                            33         19        23        25
  120  25                            35         17        20        26        31
   51  26                            21         17
   67  27                            27         17
   36  28                            18         17
    0  30                            15         14
   25  31                            17         14
  301  52                           104         58        64        75        86
  312  53                           107        104
  320  54                           110        107
  462  55        FMT                115        112

LOOPS  LABEL    INDEX     FROM-TO     LENGTH    PROPERTIES
   13  30       K          14 15        11B                EXT REFS    EXITS
  157  11       J          49 53         4B       INSTACK
  173  12       J          56 57         3B       INSTACK

COMMON BLOCKS   LENGTH    MEMBERS - BIAS NAME(LENGTH)
       COMMAIN     312           0 NV      (1)                1 NCV    (1)                 2 NCCOL  (1)
                                 3 NCSTO   (1)                4 NCTRA  (1)                 5 NOVAR  (1)
                                 6 NCOTH   (1)                7 ISTH   (1)                 8 ISBIG  (1)
                                 9 ITIT    (1)               10 IRUN   (1)                11 LCO    (30)
                                41 LCR     (270)            311 NTYPE  (1)
       COMCOMP     126           0 EFF     (22)              22 XM     (40)               62 CC     (60)
                               122 RSLB    (1)              123 RESB   (1)               124 DETOT  (1)
                               125 DTTOT   (1)
       COMAMOB       4           0 CZSYS   (1)                1 LIFE   (1)                 2 AMOB   (1)
                                 3 AMOP    (1)
       COMUE11      10           0 IND     (1)                1 NITER  (1)                 2 E5     (1)
                                 3 E6      (1)                4 E7     (1)                 5 E8     (1)
                                 6 RX7     (1)                7 RX8    (1)                 8 LPNS   (1)
                                 9 LPNH    (1)
       COMCUMU      83           0 NAMCU   (3)                3 CU     (60)               63 R      (20)
       COMANSW      74           0 X       (20)              20 XCO    (20)               40 MXX    (20)
                                60 CTOT    (14)

STATISTICS
  PROGRAM LENGTH                  541B       353
  CM LABELED COMMON LENGTH       1141B       609
       60000B CM USED
```

```
          SUBROUTINE XMINOU(FCT,NV,ND,DD,XL,XU,V3L,V4L,JSRAN,XB)
          DIMENSION XL(5),XU(5),XO(5),RR(5),XN(5),VS(6,15),XX(5),XB(6)
C ....     BEST  ANSWER IN XB.
          COMMON /COMCOMP/ EFF(22),XM(20,2),CC(20,3),RSLB,RESB,DETOT,DTTOT
          COMMON /COMUE11/ IND,NITER,E5,E6,E7,E8,RX7,RX8,LPNS,LPNH
          EXTERNAL FCT
          DATA  DVJ/10./,NSM/15/,XGU/.2/
          Q3(X)=EFF(1)*E5*E6*X(1)+E8*RX8*X(2)
           Q4(X)=RX7*X(2)/EFF(4)
          XU(5)=XM(5,2)
           XL(5)=XM(5)
          JV3=JV4=0
           IF(XU(2).LE.0.)XU(5)=XL(5)=0.
          RR(1)=XU(1)-XL(1)
           RR(2)=XU(2)-XL(2)
           RR(5)=XU(5)-XL(5)
          XU(3)=XU(4)=XL(3)=XL(4)=1.
           XF3=XM(3)
           XF4=XM(4)
          IF(XM(3,2)-XM(3).LE.0.)GO TO 40
           XF3=Q3(XU)
          IF(XF3.LE.0.)GO TO 40 $ XL(3)=V3L $ JV3=1
   40     IF(XM(4,2)-XM(4).LE.0.)GO TO 41
           XF4=Q4(XU)
          IF(XF4.LE.0.)GO TO 41 $ XL(4)=V4L $ JV4=1
   41     RR(3)=XU(3)-XL(3)
           RR(4)=XU(4)-XL(4)
          IF(RR(1)+RR(2)+RR(3)+RR(4)+RR(5).GT.0.)GO TO 42
          VS(1)=XL(1)
           VS(2)=XL(2)
           VS(5)=XL(5)
           VS(3)=XF3
          VS(4)=XF4
           VS(6)=FCT(VS)
           K=1
           GO TO 51
   42     NS=NR=1
           D=DD
           ID=0
           DO 43 J=1,NV
   43     XX(J)=XO(J)=XGU*(XU(J)-XL(J))+XL(J)
          IF(RR(1).LE.0..O.JSRAN.NE.0.O.RR(2).LE.0.)GO TO 27
C ....      BOTH X1 AND X2 VARIABLE - RANDOM START.
          SC3=CC(3)
           SC4=CC(4)
           CC(3)=CC(4)=0.
          DO 44 J=1,NV
           Z2=RR(J)/NSM
           DO 44 I=1,NSM
   44     VS(J,I)=Z2*(UDGEN(0)+I-1)+XL(J)
           DO 45 J=2,NV
           J1=NSM
          DO 45 I=2,NSM
           J2=J1*UDGEN(0)+1.
           Z3=VS(J,J1)
          VS(J,J1)=VS(J,J2)
           VS(J,J2)=Z3
```

```
   45 J1=J1-1
      K=1
      DO 46 I=1,NSM
      XN(1)=VS(1,I)
      XN(2)=VS(2,I)
      XN(5)=VS(5,I)
      XN(3)=XF3
      IF(JV3.GT.0)XN(3)=Q3(XN)
      XN(4)=XF4
      IF(JV4.GT.0)XN(4)=Q4(XN)
      VS(6,I)=FCT(XN)
      IF(VS(6,I).LT.VS(6,K))K=I
   46 CONTINUE
      CC(3)=SC3
      CC(4)=SC4
      XX(1)=XO(1)=VS(1,K)
      XX(2)=XO(2)=VS(2,K)
      XX(5)=XO(5)=VS(5,K)
   27 XX(3)=XO(3)*XF3
      IF(JV3.GT.0)XX(3)=Q3(XX)*XO(3)
      XX(4)=XO(4)*XF4
      IF(JV4.GT.0)XX(4)=Q4(XX)*XO(4)
      VS(1)=XX(1)
      VS(2)=XX(2)
      VS(5)=XX(5)
      VS(4)=XX(4)
      VS(3)=XX(3)
      F2=VS(6)=FCT(XX)
C ...   MIN LOOP
   11 DO 12 J=1,NV
   12 XN(J)=XO(J)
      F1=F2
   13 DO 17 J=1,NV
      IF(XO(J).GE.XU(J))GO TO 14
      XN(J)=AMIN1(XO(J)+D*RR(J),XU(J))
      JUMP=-1
      GO TO 30
   24 IF(F3.LT.F2)GO TO 16
   14 IF(XO(J).LE.XL(J))GO TO 15
      XN(J)=AMAX1(XO(J)-D*RR(J),XL(J))
      JUMP=0
      GO TO 30
   25 IF(F3.LT.F2)GO TO 16
   15 XN(J)=XO(J)
      GO TO 17
   16 F2=F3
   17 CONTINUE
      IS=1
      IF(F2.LT.F1)GO TO 18
      IF(ID.GE.ND)GO TO 37
      D=D/DVJ
      ID=ID+1
      GO TO 13
   18 IC=0
      FAC=1.
      IF(IS.LT.10)GO TO 19
      FAC=2.*FAC
```

```
      IS=0
   19 IS=IS+1
      DO 23 J=1,NV
      DX=(XN(J)-XO(J))*FAC
      XO(J)=XN(J)
      IF(DX) 20,21,22
   20 XN(J)=AMAX1(XO(J)+DX,XL(J))
      IF(XN(J).LT.XO(J))IC=1
      GO TO 23
   21 XN(J)=XO(J)
      GO TO 23
   22 XN(J)=AMIN1(XO(J)+DX,XU(J))
      IF(XN(J).GT.XO(J))IC=1
   23 CONTINUE
      IF(IC.EQ.0)GO TO 11
      JUMP=1
      GO TO 30
   26 IF(F3.GE.F2)GO TO 11
      F2=F3
      GO TO 18
C ...  TEST LOOP
   30 XX(1)=XN(1)
      XX(2)=XN(2)
      XX(5)=XN(5)
      XX(3)=XN(3)*XF3
      IF(JV3.GT.0)XX(3)=XN(3)*Q3(XX)
      XX(4)=XN(4)*XF4
      IF(JV4.GT.0)XX(4)=XN(4)*Q4(XX)
      DO 33 K=1,NS
      Z1=0.
      DO 32 L=1,NV
   32 Z1=Z1+ABS(XX(L)-VS(L,K))
      IF(Z1.LT.1.E-5)GO TO 35
   33 CONTINUE
      F3=FCT(XX)
      NS=MIN0(NS+1,NSM)
      NR=NR+1
      IF(NR.GT.NSM)NR=1
      VS(6,NR)=F3
      DO 34 L=1,NV
   34 VS(L,NR)=XX(L)
      GO TO 36
   35 F3=VS(6,K)
   36 IF(JUMP) 24,25,26
C ....  SOLUTION IN XO
   37 Z1=XO(3)*XF3
      IF(JV3.GT.0)Z1=XO(3)*Q3(XO)
      XO(3)=Z1
      Z1=XO(4)*XF4
      IF(JV4.GT.0)Z1=XO(4)*Q4(XO)
      XO(4)=Z1
      DO 39 K=1,NS
      DO 38 J=1,NV
      IF(ABS(XO(J)-VS(J,K)).GT.1.E-5)GO TO 39
   38 CONTINUE
      GO TO 51
   39 CONTINUE
```

```
          K=1
          DO 50 J=1,NV
    50  VS(J)=XO(J)
          VS(6)=FCT(VS)
    51  IF(VS(6,K).GE.XB(6))RETURN
          DO 52 J=1,6
    52  XB(J)=VS(J,K)
          RETURN
          END
```

SYMBOLIC REFERENCE MAP (R=3)

```
ENTRY POINTS      DEF LINE      REFERENCES
   3  XMINOU           1         176        179

VARIABLES        SN   TYPE              RELOCATION
  76  CC              REAL      ARRAY   COMCOMP     REFS        4        44        45   DEFINED     2*46        71        72
 632  D               REAL                          REFS       92        97       108   DEFINED       38       108
   0  DD              REAL                F.P.      REFS       38   DEFINED         1
 174  DETOT           REAL              COMCOMP     REFS        4
 175  DTTOT           REAL              COMCOMP     REFS        4
 614  DVJ             REAL                          REFS      108   DEFINED         7
 653  DX              REAL                          REFS      120       121       126   DEFINED      118
   0  EFF             REAL      ARRAY   COMCOMP     REFS        4        21        24        65        67        77        79
                                                     140      142       161       164
   2  E5              REAL              COMUE11     REFS        5        21        65        77       140       161
   3  E6              REAL              COMUE11     REFS        5        21        65        77       140       161
   4  E7              REAL              COMUE11     REFS        5
   5  E8              REAL              COMUE11     REFS        5        21        65        77       140       161
 652  FAC             REAL                          REFS      114       118   DEFINED       112       114
 645  F1              REAL                          REFS      106   DEFINED        89
 644  F2              REAL                          REFS       89        95       100       106       132
                                                 DEFINED       85       103       133
 647  F3              REAL                          REFS       95       100       103       132       133       153
                                                 DEFINED      149       157
 640  I               INTEGER                       REFS     2*50        61        62        63        68      2*69
                                                 DEFINED       49        53        60
 651  IC              INTEGER                       REFS      129   DEFINED       111       122       127
 633  ID              INTEGER                       REFS      107       109   DEFINED        39       109
   0  IND             INTEGER           COMUE11     REFS        5
 650  IS              INTEGER                       REFS      113       116   DEFINED       105       115       116
 634  J               INTEGER                       REFS     5*41        48      2*50        55      2*56        57      2*88
                                                    2*91     4*92      2*96      4*97     2*101     2*118     2*119     3*121
                                                   2*122    2*124     3*126     2*127     2*168     2*174     2*178
                                                 DEFINED       40        47        51        87        90       117       167
                                                     173      177
   0  JSRAN           INTEGER             F.P.      REFS       42   DEFINED         1
 646  JUMP            INTEGER                       REFS      158   DEFINED        93        98       130
 623  JV3             INTEGER                       REFS       65        77       140       161   DEFINED        12        22
 624  JV4             INTEGER                       REFS       67        79       142       164   DEFINED        12        25
 641  J1              INTEGER                       REFS       54        55        56        58   DEFINED        52        58
 642  J2              INTEGER                       REFS       56        57   DEFINED        54
 627  K               INTEGER                       REFS       69        73        74        75       146       157       168
```

VARIABLES	SN	TYPE		RELOCATION								
					176	178	DEFINED	35	59	69	143	166
					172							
655	L	INTEGER			REFS	2*146	2*155	DEFINED	145	154		
11	LPNH	INTEGER		COMUE11	REFS	5						
10	LPNS	INTEGER		COMUE11	REFS	5						
0	ND	INTEGER		F.P.	REFS	107	DEFINED	1				
1	NITER	INTEGER		COMUE11	REFS	5						
631	NR	INTEGER			REFS	151	152	153	155	DEFINED	37	151
					152							
630	NS	INTEGER			REFS	143	150	166	DEFINED	37	150	
615	NSM	INTEGER			REFS	48	49	52	53	60	150	152
					DEFINED	7						
0	NV	INTEGER		F.P.	REFS	40	47	51	87	90	117	145
					154	167	173	DEFINED	1			
173	RESB	REAL		COMCOMP	REFS	4						
663	RR	REAL	ARRAY		REFS	2	5*28	2*42	48	92	97	
					DEFINED	14	15	16	26	27		
172	RSLB	REAL		COMCOMP	REFS	4						
6	RX7	REAL		COMUE11	REFS	5	24	67	79	142	164	
7	RX8	REAL		COMUE11	REFS	5	21	65	77	140	161	
635	SC3	REAL			REFS	71	DEFINED	44				
636	SC4	REAL			REFS	72	DEFINED	45				
675	VS	REAL	ARRAY		REFS	2	34	55	56	61	62	63
					2*69	73	74	75	146	157	168	175
					176	178	DEFINED	29	30	31	32	33
					34	50	56	57	68	80	81	82
					83	84	85	153	155	174	175	
0	V3L	REAL		F.P.	REFS	22	DEFINED	1				
0	V4L	REAL		F.P.	REFS	25	DEFINED	1				
0	XB	REAL	ARRAY	F.P.	REFS	2	176	DEFINED	1	178		
625	XF3	REAL			REFS	22	32	64	76	139	160	
					DEFINED	18	21					
626	XF4	REAL			REFS	25	33	66	78	141	163	
					DEFINED	19	24					
616	XGU	REAL			REFS	41	DEFINED	7				
0	XL	REAL	ARRAY	F.P.	REFS	2	14	15	16	26	27	29
					30	31	2*41	50	96	97	121	
					DEFINED	1	11	13	2*17	22	25	
26	XM	REAL	ARRAY	COMCOMP	REFS	4	10	11	18	19	2*20	2*23
670	XN	REAL	ARRAY		REFS	2	2*65	67	68	118	119	122
					127	136	137	138	139	140	141	142
					DEFINED	61	62	63	64	65	66	67
					88	92	97	101	121	124	126	
656	XO	REAL	ARRAY		REFS	2	76	77	78	79	88	91
					92	96	97	101	118	121	122	124
					126	127	160	3*161	163	2*164	168	174
					DEFINED	41	73	74	75	119	162	165
0	XU	REAL	ARRAY	F.P.	REFS	2	13	14	15	16	2*21	24
					26	27	41	91	92	126		
					DEFINED	1	10	13	2*17			
1027	XX	REAL	ARRAY		REFS	2	2*77	79	80	81	82	83
					84	85	2*140	142	146	149	155	
					DEFINED	41	73	74	75	76	77	78
					79	136	137	138	139	140	141	142
654	Z1	REAL			REFS	146	147	162	165	DEFINED	144	146
					160	161	163	164				
637	Z2	REAL			REFS	50	DEFINED	48				

```
VARIABLES       SN  TYPE            RELOCATION
  643  Z3           REAL                                REFS        57    DEFINED       55

EXTERNALS               TYPE    ARGS         REFERENCES
       FCT          REAL       1   F.P.         6         34        68         85        149        175
       UDGEN        REAL       1               50         54

INLINE FUNCTIONS    TYPE    ARGS          DEF LINE  REFERENCES
       ABS          REAL       1  INTRIN                 146        168
       AMAX1        REAL       0  INTRIN                  97        121
       AMIN1        REAL       0  INTRIN                  92        126
       MINO         INTEGER    0  INTRIN                 150
       Q3           REAL       1    SF          8         21         65         77        140        161
       Q4           REAL       1    SF          9         24         67         79        142        164

STATEMENT LABELS                DEF LINE   REFERENCES
  315  11                          87       129        132
    0  12                          88        87
  323  13                          90       110
  337  14                          96        91
  352  15                         101        96
  355  16                         103        95        100
  357  17                         104        90        102
  372  18                         111       106        134
  377  19                         116       113
    0  20           INACTIVE      121       120
  417  21                         124       120
  421  22                         126       120
  425  23                         128       117        123        125
  335  24                          95       158
  350  25                         100       158
  431  26                         132       158
  263  27                          76        42
  434  30                         136        94         99        131
    0  32                         146       145
    0  33                         148       143
    0  34                         155       154
  514  35                         157       147
  517  36                         158       156
  521  37                         160       107
    0  38                         169       167
  557  39                         171       166        168
   46  40                          23        20         22
   60  41                          26        23         25
  104  42                          37        28
    0  43                          41        40
    0  44                          50        47         49
    0  45                          58        51         53
    0  46                          70        60
    0  50                         174       173
  570  51                         176        36        170
    0  52                         178       177

LOOPS  LABEL     INDEX      FROM-TO    LENGTH    PROPERTIES
  114  43         J           40 41       4B       INSTACK
  132  44         J           47 50      23B                EXT REFS   NOT INNER
  137  44         I           49 50      13B                EXT REFS
  160  45         J           51 58      26B                EXT REFS   NOT INNER
```

LOOPS	LABEL	INDEX	FROM-TO	LENGTH	PROPERTIES
164	45	I	53 58	16B	EXT REFS
214	46	I	60 70	35B	EXT REFS
317	12	J	87 88	3B	INSTACK
324	17	J	90 104	36B	ENTRIES EXITS
407	23	J	117 128	17B	OPT
463	33	K	143 148	10B	EXITS NOT INNER
465	32	L	145 146	3B	INSTACK
511	34	L	154 155	2B	INSTACK
550	39	K	156 171	11B	EXITS NOT INNER
552	38	J	167 169	4B	INSTACK EXITS
563	50	J	173 174	3B	INSTACK
576	52	J	177 178	2B	INSTACK

COMMON BLOCKS	LENGTH	MEMBERS - BIAS NAME(LENGTH)		
COMCOMP	126	0 EFF (22)	22 XM (40)	62 CC (60)
		122 RSLB (1)	123 RESB (1)	124 DETOT (1)
		125 DTTOT (1)		
COMUE11	10	0 IND (1)	1 NITER (1)	2 E5 (1)
		3 E6 (1)	4 E7 (1)	5 E8 (1)
		6 RX7 (1)	7 RX8 (1)	8 LPNS (1)
		9 LPNH (1)		

STATISTICS

PROGRAM LENGTH	1045B	549
CM LABELED COMMON LENGTH	210B	136

60000B CM USED

```
      SUBROUTINE DEMAND(XL)
      DIMENSION QHM(24,2),DME(24),DMT(24),TR(24,2),TW(24,2),TO(24)
C     DEMAND MUST BE CALLED BEFORE SUPPLY
      COMMON /COMMAIN/ NV,NCV,NCCOL,NCSTO,NCTRA,NOVAR,NCOTH,ISTH,ISBIG,
     1ITIT,IRUN,LCO(30),LCR(9,30),NTYPE
      COMMON /COMLEV2/ ESD(3,24,364)
       LEVEL2,ESD
      COMMON /COMPIHI/ SD(24,2)
      COMMON /COMCOMP/ EFF(22),XM(20,2),CC(20,3),RSLB,RESB,DETOT,DTTOT
      COMMON /COMSUDE/ SE1(24),SE2(24),ST1(24),ST2(24),DEE(24),DET(24)
      DATA MU/77777777770000000000B/ ,ML/7777777777B/
      COPEV(X)=((((4.698*X-7.508)*X-1.137)*X+2.529)*X+2.029)*X+1.872
      DO 13 J=1,24
   13 SE1(J)=SE2(J)=ST1(J)=ST2(J)=DEE(J)=DET(J)=0.
      DO 10 KK=2,30
       DECODE(12,1,LCR(1,KK)) J1,J2
      IF(J1.EQ.2HDH) GO TO 11
    1 FORMAT(A2,A1,9X,A2,F6.0,4X,I2,F6.0,3F2.0,7F6.0)
   10 CONTINUE
       CALL EXIT
   11 ISBIG=JSS=0
       IPR=9HRESIDENCE
       IF(J2.EQ.1HR)GO TO 20
C     UTILITY DEMAND
      DECODE(20,7,LCR(1,KK))IPR,JSW,FC
    7 FORMAT(2X,A10,A2,F6.0)
      CALL DEMGET(IPR,ISTH,ISBIG,FC,ESD)
       GO TO 40
C     RESIDENCE OR COMMUNITY
   20 DECODE(80,1,LCR(1,KK)) J1,J2,JSW,FC,LD,CP,THI,TLO,TDE,ZL,AL,UW,AR,
     1AW,RVCP
      IF(ISTH)43,45,44
   43 IF(JSW.NE.1HT) GO TO 99
       GO TO 45
   44 IF(JSW.EQ.1HT.O.JSW.EQ.2HET) GO TO 99
   45 FC=AMAX1(1.,FC)
       IF(FC.LE.1.)GO TO 29
      ISBIG=1
       IPR=9HCOMMUNITY
   29 DO 50 I=1,2 $ KK=KK+1
      DECODE(80,8,LCR(1,KK))Z1,(QHM(J,I),J=1,24) $ IF(Z1.LE.0.)GO TO 99
    8 FORMAT(2X,F6.0,24F3.2)
      DO 50 J=1,24 $ IF(QHM(J,I).LT.0.)GO TO 99
   50 QHM(J,I)=Z1*QHM(J,I)
      DO 21 J=1,24
       DME(J)=(QHM(J,1)+QHM(J,2))*FC
   21 DME(J)=DME(J).A.MU
       IF(JSW.NE.1HE) GO TO 23
C     ELECTRIC ONLY,  NO THERMAL OR THERMAL EQUIVALENT.
      DO 22 I=1,24
       DO 22 J=1,364
   22 ESD(3,I,J)=DME(I)
       GO TO 40
   23 IF(JSW.NE.1HT) GO TO 25
       DO 24 I=1,24
C     THERMAL ONLY.
   24 DME(I)=0.
```

```
       GO TO 27
 25   IF(JSW.EQ.2HEQ)GO TO 26
       IF(JSW.EQ.2HET)GO TO 27
      PRINT3,JSW
       GO TO 99
 3    FORMAT(* ELECTRIC-THERMAL DEMAND MIX ERROR *A10)
 26    JSS=1
C     COMPUTE THERMAL.
 27   IF(LD.GE.0.A.LD.LE.24)GO TO 28
       PRINT4,LD
       GO TO 99
 4    FORMAT(* DELTA OUT OF RANGE *I6)
 28   SD(1)=XL
       CALL PIHI
       UW=1.E-6*UW
       LD=25-LD
      AL=1.15*.01*317.11*AL
       TIN=TLO
      CP=CP*AR/1000.
       DO 35 J=1,364
      CALL PIH
       Z1=Z2=0.
       DO 30 I=1,24
      J1=SHIFT(ESD(2,I,J),-36).A.7777B
       TO(I)=1.8*(J1-273)+32.
      J2=SHIFT(ESD(2,I,J),-12).A.7777B
       Z4=AL*J2
      TR(I,2)=TO(I)+Z4*SD(I,2)
       TW(I,2)=TO(I)+Z4*SD(I)
      Z1=Z1+TW(I,2)
       Z2=Z2+TR(I,2)
 30   CONTINUE
       Z1=Z1/24.
       Z2=Z2/24.
       IF(J.NE.1)GOTO 32
      DO 31 I=1,24
       TR(I)=TR(I,2)
 31   TW(I)=TW(I,2)
 32   J2=LD
       DO 33 I=1,24
      Z6=FC*(UW*AW*((TIN-Z1)+ZL*(Z1-TW(J2)))+UW*AR*((TIN-Z2)+
     1 .5*(TIN-TDE)+ZL*(Z2-TR(J2)))+RVCP*(TIN-TO(I))-QHM(I,2))
      TW(I)=TW(I,2)
       TR(I)=TR(I,2)
       J2=J2+1
      Z7=TIN-Z6/CP
      IF(Z7.LE.THI)GO TO 46
      Z6=(THI-Z7)*Z6/(Z7-TIN)
      TIN=THI
      GO TO 48
 46   IF(Z7.GE.TLO)GO TO 47
      Z6=(TLO-Z7)*Z6/(TIN-Z7)
      TIN=TLO
      GO TO 48
 47   Z6=0.
      TIN=Z7
 48   DMT(I)=Z6
```

```
       33   CONTINUE
             IF(JSS.EQ.0)GO TO 37
            DO 36 I=1,24
             Z5=DME(I)+DMT(I)/COPEV(.01*TO(I))
       36   ESD(3,I,J)=Z5.A.MU
             GO TO 35
       37   DO 38 I=1,24
       38   ESD(3,I,J)=SHIFT(DMT(I),-30.A.ML).O.DME(I)
       35   CONTINUE
       40   CALL DECSEA(LCR(1,KK+1)) $ Z1=Z2=DETOT=DTTOT=0. $ J1=J2=0
             DO 41 I=1,24
             DO 41 J=1,364
            Z3=ESD(3,I,J).A.MU
             DETOT=DETOT+Z3
            Z4=SHIFT(ESD(3,I,J),30).A.MU
             Z2=AMAX1(Z4,Z2)
             DTTOT=DTTOT+Z4
            IF(Z3.LE.Z1)GO TO 41 $ Z1=Z3 $ J1=J $ J2=I
       41   CONTINUE
             Z3=DETOT/1000.
             Z4=DTTOT/1000.
            IF(ISBIG.NE.0)GO TO 42
             PRINT5,IPR,Z1,Z3,J1,J2
             RETURN
        5   FORMAT(* -DEMAND-*A10,  *MAX=*F13.3,*KW  TOTAL=*F13.3,*MWH*
           1* AT DAY *I3,*, HOUR *I2)
       42   Z1=Z1/1000.
             Z2=Z2/1000.
             Z3=Z3/1000.
             Z4=Z4/1000.
        6   FORMAT(* -DEMAND-*A10,  *MAX=*F13.3,*MW  TOTAL=*F13.3,*GWH*
           1* AT DAY *I3,*,,HOUR *I2)
            PRINT6,IPR,Z1,Z3,J1,J2
             RETURN
       98   FORMAT(* DEMAND CARD ERROR *8A10)
       99   PRINT98,(LCR(J,KK),J=1,8)
             CALL EXIT
             END
```

CARD NR.	SEVERITY	DETAILS	DIAGNOSIS OF PROBLEM
42	I	27 CD 42	FIELD WIDTH OF A CONVERSION DESCRIPTOR SHOULD BE AS LARGE AS THE MINIMUM SPECIFIED FOR THAT DESCRIPTOR.

SYMBOLIC REFERENCE MAP (R=3)

ENTRY POINTS	DEF LINE	REFERENCES		
3 DEMAND	1	138	148	152

```
VARIABLES      SN  TYPE           RELOCATION
   672  AL        REAL                             REFS        74       84   DEFINED      30       74
   674  AR        REAL                             REFS        76       98   DEFINED      30
   675  AW        REAL                             REFS        98  DEFINED       30
    76  CC        REAL       ARRAY     COMCOMP     REFS         9
   665  CP        REAL                             REFS        76      103   DEFINED      30       76
   140  DEE       REAL       ARRAY     COMSUDE     REFS        10  DEFINED       14
   170  DET       REAL       ARRAY     COMSUDE     REFS        10  DEFINED       14
   174  DETOT     REAL                 COMCOMP     REFS         9      128      134  DEFINED      124      128
   770  DME       REAL       ARRAY                 REFS         2       47       52      118      122
                                                DEFINED        46       47       57
  1020  DMT       REAL       ARRAY                 REFS         2      118      122  DEFINED      114
   175  DTTOT     REAL                 COMCOMP     REFS         9      131      135  DEFINED      124      131
     0  EFF       REAL       ARRAY     COMCOMP     REFS         9
     0  ESD       REAL       ARRAY     COMLEV2     REFS         6        7       27       81       83      127      129
                                                DEFINED        52      119      122
   663  FC        REAL                             REFS        27       36       37       46       98
                                                DEFINED        25       30       36
   677  I         INTEGER                          REFS        41       43     2*44     2*52       57       81       82
                                                      83     3*85     3*86       87       88     2*94     2*95     2*98
                                                   2*100    2*101      114    7*118      119    3*122      127      129
                                                     132  DEFINED       40       50       55       80       93       97
                                                     117      121      125
   661  IPR       INTEGER                          REFS        27      137      147  DEFINED       22       25       39
    12  IRUN      INTEGER              COMMAIN     REFS         4
    10  ISBIG     INTEGER              COMMAIN     REFS         4       27      136  DEFINED       21       38
     7  ISTH      INTEGER              COMMAIN     REFS         4       27       32
    11  ITIT      INTEGER              COMMAIN     REFS         4
   654  J         INTEGER                          REFS      6*14       41       43     2*44     3*46     2*47       52
                                                      81       83       92      119      122      127      129      132
                                                     150  DEFINED       13       41       43       45       51       77
                                                     126      150
   660  JSS       INTEGER                          REFS       116  DEFINED       21       64
   662  JSW       INTEGER                          REFS        33     2*35       48       54       59       60       61
                                                DEFINED        25       30
   656  J1        INTEGER                          REFS        17       82      137      147  DEFINED       16       30
                                                      81      124      132
   657  J2        INTEGER                          REFS        23       84     2*98      102      137      147
                                                DEFINED        16       30       83       96      102      124      132
   655  KK        INTEGER                          REFS        16       25       30       40       41      124      150
                                                DEFINED        15       40
    13  LCO       INTEGER    ARRAY     COMMAIN     REFS         4
    51  LCR       INTEGER    ARRAY     COMMAIN     REFS         4       16       25       30       41      124      150
   664  LD        INTEGER                          REFS      2*66       67       73       96  DEFINED       30       73
   440  ML        INTEGER                          REFS       122  DEFINED       11
   437  MU        INTEGER                          REFS        47      119      127      129  DEFINED       11
     2  NCCOL     INTEGER              COMMAIN     REFS         4
     6  NCOTH     INTEGER              COMMAIN     REFS         4
     3  NCSTO     INTEGER              COMMAIN     REFS         4
     4  NCTRA     INTEGER              COMMAIN     REFS         4
     1  NCV       INTEGER              COMMAIN     REFS         4
     5  NOVAR     INTEGER              COMMAIN     REFS         4
   467  NTYPE     INTEGER              COMMAIN     REFS         4
     0  NV        INTEGER              COMMAIN     REFS         4
   710  QHM       REAL       ARRAY                 REFS         2       43       44     2*46       98
                                                DEFINED        41       44
   173  RESB      REAL                 COMCOMP     REFS         9
```

```
VARIABLES      SN   TYPE              RELOCATION
    172  RSLB      REAL                      COMCOMP    REFS          9
    676  RVCP      REAL                                 REFS         98      DEFINED        30
      0  SD        REAL         ARRAY        COMPIHI    REFS          8          85         86    DEFINED       70
      0  SE1       REAL         ARRAY        COMSUDE    REFS         10      DEFINED        14
     30  SE2       REAL         ARRAY        COMSUDE    REFS         10      DEFINED        14
     60  ST1       REAL         ARRAY        COMSUDE    REFS         10      DEFINED        14
    110  ST2       REAL         ARRAY        COMSUDE    REFS         10      DEFINED        14
    670  TDE       REAL                                 REFS         98      DEFINED        30
    666  THI       REAL                                 REFS        104         105        106    DEFINED       30
    701  TIN       REAL                                 REFS       4*98         103        105        109   DEFINED        75        106
                                                         110        113
    667  TLO       REAL                                 REFS         75         108        109        110   DEFINED        30
   1210  TO        REAL         ARRAY                   REFS          2          85         86         98     5*118
                                                     DEFINED         82
   1050  TR        REAL         ARRAY                   REFS          2          88         94         98       101
                                                     DEFINED         85          94        101
   1130  TW        REAL         ARRAY                   REFS          2          87         95         98       100
                                                     DEFINED         86          95        100
    673  UW        REAL                                 REFS         72        2*98    DEFINED         30        72
      0  XL        REAL                      F.P.       REFS         70      DEFINED         1
     26  XM        REAL         ARRAY        COMCOMP    REFS          9
    671  ZL        REAL                                 REFS       2*98      DEFINED        30
    700  Z1        REAL                                 REFS         41          44         87         90      2*98       132        137
                                                         141        147      DEFINED        41         79        87        90        124
                                                         132        141
    702  Z2        REAL                                 REFS         88          91       2*98        130       142
                                                     DEFINED         79          88         91        124       130       142
    707  Z3        REAL                                 REFS        128       2*132        137        143       147
                                                     DEFINED        127         134        143
    703  Z4        REAL                                 REFS         85          86        130        131       144
                                                     DEFINED         84         129        135        144
    706  Z5        REAL                                 REFS        119      DEFINED       118
    704  Z6        REAL                                 REFS        103         105        109        114   DEFINED        98        105
                                                         109        112
    705  Z7        REAL                                 REFS        104       2*105        108      2*109       113
                                                     DEFINED        103

FILE NAMES          MODE
       OUTPUT       FMT                    WRITES       61          67         137        147        150

EXTERNALS               TYPE    ARGS          REFERENCES
       DECSEA                     1              124
       DEMGET                     5               27
       EXIT                       0               20      151
       PIH                        0               78
       PIHI                       0               71

INLINE FUNCTIONS        TYPE    ARGS         DEF LINE   REFERENCES
       AMAX1        REAL          0  INTRIN                  36         130
       COPEV        REAL          1    SF        12         118
       SHIFT        NO TYPE       2  INTRIN                  81          83         122        129

STATEMENT LABELS                 DEF LINE     REFERENCES
    447  1           FMT             18           16         30
    526  3           FMT             63           61
    540  4           FMT             69           67
    554  5           FMT            139          137
```

STATEMENT LABELS			DEF LINE	REFERENCES					
566	6	FMT	145	147					
463	7	FMT	26	25					
517	8	FMT	42	41					
0	10		19	15					
27	11		21	17					
0	13		14	13					
43	20		30	23					
0	21		47	45					
0	22		52	50	51				
136	23		54	48					
0	24		57	55					
143	25		59	54					
151	26		64	59					
152	27		66	58	60				
160	28		70	66					
66	29		40	37					
0	30		89	80					
0	31		95	93					
243	32		96	92					
0	33		115	97					
337	35		123	77	120				
0	36		119	117					
327	37		121	116					
0	38		122	121					
343	40		124	28	53				
365	41		133	125	126	132			
402	42		141	136					
0	43	INACTIVE	33	32					
53	44		35	32					
60	45		36	32	34				
276	46		108	104					
302	47		112	108					
303	48		114	107	111				
0	50		44	40	43				
610	98	FMT	149	150					
411	99		150	33	35	41	43	62	68

LOOPS	LABEL	INDEX	FROM-TO	LENGTH	PROPERTIES			
6	13	J	13 14	5B	INSTACK			
15	10	KK	15 19	11B		EXT REFS	EXITS	
74	50	I	40 44	23B		EXT REFS	EXITS	NOT INNER
110	50	J	43 44	3B	INSTACK	EXITS		
122	21	J	45 47	3B	INSTACK			
130	22	I	50 52	5B		NOT INNER		
132	22	J	51 52	2B	INSTACK			
141	24	I	55 57	2B	INSTACK			
207	35	J	77 123	134B		EXT REFS	NOT INNER	
217	30	I	80 89	13B	OPT			
240	31	I	93 95	3B	INSTACK			
246	33	I	97 115	37B	OPT			
313	36	I	117 119	13B	OPT			
334	38	I	121 122	3B	INSTACK			
354	41	I	125 133	16B		NOT INNER		
355	41	J	126 133	12B	OPT			

```
COMMON BLOCKS   LENGTH    MEMBERS - BIAS NAME(LENGTH)
    COMMAIN      312             0 NV      (1)               1 NCV     (1)             2 NCCOL  (1)
                                 3 NCSTO   (1)               4 NCTRA   (1)             5 NOVAR  (1)
                                 6 NCOTH   (1)               7 ISTH    (1)             8 ISBIG  (1)
                                 9 ITIT    (1)              10 IRUN    (1)            11 LCO    (30)
                                41 LCR     (270)           311 NTYPE   (1)
    COMLEV2    26208             0 ESD     (26208)
    COMPIHI       48             0 SD      (48)
    COMCOMP      126             0 EFF     (22)             22 XM      (40)           62 CC     (60)
                               122 RSLB    (1)             123 RESB    (1)           124 DETOT  (1)
                               125 DTTOT   (1)
    COMSUDE      144             0 SE1     (24)             24 SE2     (24)           48 ST1    (24)
                                72 ST2     (24)             96 DEE     (24)          120 DET    (24)

STATISTICS
  PROGRAM LENGTH                 1240B      672
  CM LABELED COMMON LENGTH      64326B    26838
      60000B CM USED
```

```
      SUBROUTINE RDINP(NDAY)
      DIMENSION LTYC(9),JWK(30),LDO(6),LDW(8),LDM(8)
      COMMON /COMMAIN/ NV,NCV,NCCOL,NCSTO,NCTRA,NOVAR,NCOTH,ISTH,ISBIG,
     1ITIT,IRUN,LCO(30),LCR(9,30),NTYPE
      DATA ISW/0/,JBL/1H /,JST/1H*/,NTYC/9/
      DATA LTYC/2HDH,2HYR,2HAM,2HPE,2HPT,2HLO,2HDW,2HDM,2HCS/
      DATA LDO/10H     4 3.5,10H2 756555.4,10H5    .225  ,10H58.6  1520,
     110H. 312.  .0,10H32        /
      DATA(LDW(J),J=1,4)/40HDW 1.2   42 35 28 25 26 25 28 37 35 74 6/
      DATA(LDW(J),J=5,8)/40H5 57 53 53 45 40 38 35 35 45 57 63 56 46/
      DATA(LDM(J),J=1,4)/40HDM 1.0   60 55 50 48 46 45 60 75 80 75 7/
      DATA(LDM(J),J=5,8)/40H0 70 70 70 70 70 70 90110110110105100 80/
      DO 17 J=1,30
   17 LCR(9,J)=JBL
      IF(ISW.GT.0)GO TO 11
       JSW=ISW=1
       DO 10 J=1,9
       DO 10  I=2,30
   10 LCR(J,I)=JBL
       NC=NCV+NCOTH+1
       LCR(9,1)=JST
   11 READ1,J1,(JWK(J),J=1,8)
       IF(J1.EQ.JBL) GO TO 16
       JSW=JSW+1
    1 FORMAT(A2,A8,7A10)
      IF(J1.NE.2HID) GO TO 12
       JWK(3)=LCR(3)
       J=1
       GO TO 15
   12 DO 13 J=2,NC
       IF(J1.EQ.LCO(J))GO TO 15
   13 CONTINUE
       PRINT14,J1,(JWK(J),J=1,8)
       CALL EXIT
   14 FORMAT(* INVALID INPUT CARD*/1X,A2,A8,7A10)
   15 ENCODE(80,1,LCR(1,J)) J1,(JWK(I),I=1,8)
      LCR(9,J)=JST
       GO TO 11
   16 IF(JSW.EQ.1) CALL EXIT
       JSW=1
       CALL UDGET(I1)
C     PRINT CARDS.
      PRINT2,ITIT,IRUN,NDAY,I1,(LCR(J),J=1,9)
    2 FORMAT(*1ENERGY OPTIMUM    RUN(*A10,*-*I3,*)  *I3,I17,*DEC*/
     1* (*7(A10,*/*),A10,*)*A1)
      I1=NC-NCOTH
C      CHECK THAT ALL CARDS ARE THERE.
      DO 18 J=1,NC $ DECODE(10,1,LCR(1,J))J1
      IF(J1.EQ.LCO(J))GO TO 18 $ PRINT22 $ CALL EXIT
   18 CONTINUE $ DO 20 I=2,I1
      DECODE(80,3,LCR(1,I))(JWK(J),J=1,14)
    3 FORMAT(A2,A4,A8,11A6)
   20 PRINT4,(JWK(J),J=1,14),LCR(9,I)
       I1=I1+1
    4 FORMAT(* (*A2,*/*A4,*/*A8,11(*/*A6,),*)*A1)
      DO 50 I=I1,NC
       DECODE(10,1,LCR(1,I))J1
```

```
      DO 21 K=1,NTYC
       IF(J1.EQ.LTYC(K)) GO TO 23
   21 CONTINUE
      CALLEXIT
   22 FORMAT(* CARD MISSING */(* (*8A10,*)*A1))
   23 GO TO (24,32,32,35,35,38,39,44,47),K
C     DEMAND CARD
   24 DECODE(30,25,LCR(1,I))J2,J3
       IF(J2.NE.1HR)GO TO 29
   25 FORMAT(2X,A1,17X,A6)
      IF(J3.NE.JBL)GO TO 29
      DO 28 J=3,8
   28 LCR(J,I)=LDO(J-2)
   29 DECODE(80,30,LCR(1,I))(JWK(J),J=1,16)
   30 FORMAT(A2,A10,A2,3A6,3A2,7A6)
      PRINT 31,(JWK(J),J=1,16),LCR(9,I)
       GO TO 50
   31 FORMAT(* (*A2,*/*A10,*/*A2,3(*/*A6),3(*/*A2),7(*/*A6),*)*A1)
C     YR OR AM CARD
   32 DECODE(80,33,LCR(1,I))(JWK(J),J=1,14)
   33 FORMAT(A2,13A6)
      PRINT34,(JWK(J),J=1,14),LCR(9,I)
       GO TO 50
   34 FORMAT(* (*A2,13(*/*A6,)*)*A1)
C     PE OR PT CARD
   35 DECODE(80,36,LCR(1,I))(JWK(J),J=1,23)
   36 FORMAT(A2,A4,4(A2,4A4),A2)
      PRINT37,(JWK(J),J=1,23),LCR(9,I)
       GO TO 50
   37 FORMAT(* (*A2,*/*A4,4(*/*A2,4(*/*A4))*/*A2,*)*A1)
C     LO CARD
   38 DECODE(80,33,LCR(1,I))(JWK(J),J=1,14)
      PRINT34,(JWK(J),J=1,14),LCR(9,I)
       GO TO 50
C     DW CARD
   39 DECODE(10,40,LCR(1,I))J1,J2 $ IF(J2.NE.JBL)GO TO 42 $ DO 41 J=1,8
   40 FORMAT(A2,A6,A2,7A10)
   41 LCR(J,I)=LDW(J)
   42 DECODE(80,40,LCR(1,I))(JWK(J),J=1,10)
      PRINT43,(JWK(J),J=1,10),LCR(9,I) $ GO TO 50
   43 FORMAT(* (*A2,*/*A6,*/*A2,7A10,*)*A1)
C     DM CARD
   44 DECODE(10,40,LCR(1,I))J1,J2 $ IF(J2.NE.JBL)GO TO 46 $ DO 45 J=1,8
   45 LCR(J,I)=LDM(J)
   46 DECODE(80,40,LCR(1,I))(JWK(J),J=1,10)
      PRINT43,(JWK(J),J=1,10),LCR(9,I) $ GO TO 50
C     DS CARD
   47 DECODE(80,48,LCR(1,I))(JWK(J),J=1,16)
   48 FORMAT(2A2,4(A4,A2),A2,5A10)
      PRINT49,(JWK(J),J=1,16),LCR(9,I) $ GO TO 50
   49 FORMAT(* (*A2,*/*A2,4(*/*A4,*/*A2),A2,5A10,*)*A1)
   50 CONTINUE
       RETURN
       END
```

```
      SUBROUTINE RDINP        74/74    OPT=2                           FTN 4.8+518         80/11/28. 10.23.01        PAGE      3

CARD NR. SEVERITY  DETAILS      DIAGNOSIS OF PROBLEM

      9      I        DW 1.2       HOLLERITH CONSTANT .GT. 10 CHARACTERS, EXCESS CHARACTERS INITIALIZED INTO SUCCEEDING WORDS.
     10      I        5 57 53      HOLLERITH CONSTANT .GT. 10 CHARACTERS, EXCESS CHARACTERS INITIALIZED INTO SUCCEEDING WORDS.
     11      I        DM 1.0       HOLLERITH CONSTANT .GT. 10 CHARACTERS, EXCESS CHARACTERS INITIALIZED INTO SUCCEEDING WORDS.
     12      I        0 70 70      HOLLERITH CONSTANT .GT. 10 CHARACTERS, EXCESS CHARACTERS INITIALIZED INTO SUCCEEDING WORDS.


      SYMBOLIC REFERENCE MAP (R=3)

 ENTRY POINTS      DEF LINE        REFERENCES
     3  RDINP            1           110

 VARIABLES       SN  TYPE               RELOCATION
   674  I             INTEGER                              REFS          19         36         51         53         57         65         70
                                                              71          73         77         79         83         85         89         90
                                                              93          95         96         97        100        101        102        103
                                                             105         107    DEFINED         18         36         50         56
    12  IRUN          INTEGER                  COMMAIN     REFS           3         43
    10  ISBIG         INTEGER                  COMMAIN     REFS           3
     7  ISTH          INTEGER                  COMMAIN     REFS           3
   325  ISW           INTEGER                              REFS          15    DEFINED          5         16
    11  ITIT          INTEGER                  COMMAIN     REFS           3         43
   677  I1            INTEGER                              REFS          41         43         50         54         56
                                                         DEFINED          46         54
   672  J             INTEGER                              REFS          14         19         22         31         33         36         37
                                                              43          48         49         51         53       2*70         71         73
                                                              77          79         83         85         89         90       2*95         96
                                                              97       2*101        102        103        105        107
                                                         DEFINED          13         17         22         28         30         33         43
                                                              48          51         53         69         71         73         77         79
                                                              83          85         89         90         93         96         97        100
                                                             102         103        105        107
   326  JBL           INTEGER                              REFS          14         19         23         68         93        100
                                                         DEFINED           5
   327  JST           INTEGER                              REFS          21         37    DEFINED          5
   673  JSW           INTEGER                              REFS          24         39    DEFINED         16         24         40
   714  JWK           INTEGER        ARRAY                 REFS           2         33         36         53         73         79         85
                                                              90          97        103        107    DEFINED         22         27         51
                                                              71          77         83         89         96        102        105
   676  J1            INTEGER                              REFS          23         26         31         33         36         49         59
                                                         DEFINED          22         48         57         93        100
   701  J2            INTEGER                              REFS          66         93        100    DEFINED         65         93        100
   702  J3            INTEGER                              REFS          68    DEFINED         65
   700  K             INTEGER                              REFS          59         63    DEFINED         58
    13  LCO           INTEGER        ARRAY     COMMAIN     REFS           3         31         49
    51  LCR           INTEGER        ARRAY     COMMAIN     REFS           3         27         43         48         51         53         57
                                                              65          71         73         77         79         83         85         89
                                                              90          93         96         97        100        102        103        105
                                                             107     DEFINED         14         19         21         36         37         70
                                                              95         101
   770  LDM           INTEGER        ARRAY                 REFS           2        101    DEFINED         11         12
   752  LDO           INTEGER        ARRAY                 REFS           2         70    DEFINED          7
   760  LDW           INTEGER        ARRAY                 REFS           2         95    DEFINED          9         10
```

```
VARIABLES       SN  TYPE              RELOCATION
   703  LTYC        INTEGER    ARRAY               REFS         2        59    DEFINED        6
   675  NC          INTEGER                        REFS        30        46       48         56    DEFINED       20
     2  NCCOL       INTEGER             COMMAIN    REFS         3
     6  NCOTH       INTEGER             COMMAIN    REFS         3        20       46
     3  NCSTO       INTEGER             COMMAIN    REFS         3
     4  NCTRA       INTEGER             COMMAIN    REFS         3
     1  NCV         INTEGER             COMMAIN    REFS         3        20
     0  NDAY        INTEGER              F.P.      REFS        43    DEFINED        1
     5  NOVAR       INTEGER             COMMAIN    REFS         3
   330  NTYC        INTEGER                        REFS        58    DEFINED        5
   467  NTYPE       INTEGER             COMMAIN    REFS         3
     0  NV          INTEGER             COMMAIN    REFS         3

FILE NAMES         MODE
        INPUT      FMT                     READS       22
        OUTPUT     FMT                    WRITES       33        43        49        53        73        79        85        90
                                              97      103       107

EXTERNALS             TYPE   ARGS        REFERENCES
        EXIT                   0              34       39        49        61
        UDGET                  1              41

STATEMENT LABELS                    DEF LINE    REFERENCES
   337  1         FMT                  25          22       36        48        57
   372  2         FMT                  44          43
   422  3         FMT                  52          51
   432  4         FMT                  55          53
     0  10                             19          17       18
    25  11                             22          15       38
    37  12                             30          26
     0  13                             32          30
   347  14        FMT                  35          33
    50  15                             36          29       31
    57  16                             39          23
     0  17                             14          13
   103  18                             50          48       49
     0  20                             53          50
     0  21                             60          58
   445  22        FMT                  62          49
   146  23                             63          59
   164  24                             65          63
   461  25        FMT                  67          65
     0  28                             70          69
   200  29                             71          66       68
   471  30        FMT                  72          71
   502  31        FMT                  75          73
   210  32                             77        2*63
   517  33        FMT                  78          77       89
   526  34        FMT                  81          79       90
   220  35                             83        2*63
   537  36        FMT                  84          83
   547  37        FMT                  87          85
   230  38                             89          63
   240  39                             93          63
   576  40        FMT                  94          93       96       100       102
     0  41                             95          93
   252  42                             96          93
```

```
STATEMENT LABELS                DEF LINE   REFERENCES
   613  43       FMT                98         97        103
   262  44                         100         63
     0  45                         101        100
   274  46                         102        100
   304  47                         105         63
   645  48       FMT               106        105
   656  49       FMT               108        107
   314  50                         109         56         74        80        86        91        97       103       107

LOOPS  LABEL     INDEX       FROM-TO      LENGTH    PROPERTIES
    7   17         J           13 14         2B      INSTACK
   15   10         J           17 19         4B                 NOT INNER
   16   10         I           18 19         2B      INSTACK
   43   13         J           30 32         3B      INSTACK      EXITS
   73   18         J           48 50        14B                 EXT REFS
  113   20         I           50 53        13B                 EXT REFS
  133   50         I           56 109      165B                 EXT REFS  NOT INNER
  142   21         K           58 60         3B      INSTACK      EXITS
  176   28         J           69 70         2B      INSTACK
  250   41         J           93 95         2B      INSTACK
  272   45         J          100 101        2B      INSTACK

COMMON BLOCKS   LENGTH      MEMBERS - BIAS NAME(LENGTH)
        COMMAIN    312               0 NV      (1)                1 NCV     (1)                2 NCCOL  (1)
                                     3 NCSTO   (1)                4 NCTRA   (1)                5 NOVAR  (1)
                                     6 NCOTH   (1)                7 ISTH    (1)                8 ISBIG  (1)
                                     9 ITIT    (1)               10 IRUN    (1)               11 LCO    (30)
                                    41 LCR     (270)            311 NTYPE   (1)

STATISTICS
  PROGRAM LENGTH                 1000B      512
  CM LABELED COMMON LENGTH        470B      312
          60000B CM USED
```

```
C
C
C            SOLSTOR - UE11 - SOLLIB2 LIBRARY.
C
C
```

```
          FUNCTION UE11DF(XXXX)
          DIMENSION XXXX(20),XOL(5),JXOL(5),B5(5,48)
          COMMON /COMCUMU/ NAMCU(3),CU(20,3),R(20)
          COMMON /COMWIND/ W(8),ISWND(2)
          COMMON /COMCOMP/ EFF(22),XM(20,2),CC(20,3),RSLB,RESB,DETOT,DTTOT
          COMMON /COMPURC/ EPUR(11,2),ESLB(10),ECOS(11),ITOD(26),
         A PCOS(10),PDCO(12,2),MHPK(12),MHOUR(12)
         B ,RLCCR
          COMMON /COMANSW/ X(20),XCO(20),MXX(20),CTOT(7,2)
          COMMON /COMSUDE/ SE1(24),SE2(24),ST1(24),ST2(24),DEE(24),DET(24)
          COMMON /COMPRNS/ TA(20,2),TB(20,2),FFD(6,2),AES(6,2),CLV(4),
         1WRS(10,24)
          COMMON /COMUE11/ IND,NITER,E5,E6,E7,E8,RX7,RX8,NSNS,NHNH
          COMMON /COMLPRO/ NH,NS,SU(24),DE(24),CTB(7,24),XTB(13),KSBW
          COMMON /COMSXOL/ ISXOL
           DATA XOL/5(-1.)/
          IF(ISWND(1).EQ.0)GO TO 22 $ PRINT2 $ CALL EXIT
    2     FORMAT(* WIND NOT ALLOWED IN UE11D*)
    22    NH=NHNH
          DO 200 J=1,12
          MHPK(J)=0
    200   PDCO(J)=PDCO(J,2)=0
          MO=1
          NHR=0
           EPUR(11)=EFF(22)=0.
           DO 10 J=1,10
    10    EPUR(J)=ESLB(J)=0.
           NITER=NITER+1
           DO 11 J=1,4
    11    X(J)=XXXX(J)
           X7=RX7*X(2)
           X8=RX8*X(2)
           E15X=EFF(1)*E5*X(1)
          E36=EFF(3)*E6
           R36=RSLB*E36
           E38=EFF(3)*E8
           R38=RSLB*E38
          E47=E7*EFF(4)
           EST=EBM=0.
          XTB(2)=X(2)
           XTB(3)=X(3)/E8
           XTB(4)=X(4)
           XTB(5)=E7
          XTB(6)=AMIN1(XTB(3),X8)
           XTB(7)=X7
           XTB(8)=X8
           XTB(9)=EFF(4)
          XTB(10)=EFF(2)
           XTB(11)=E47
           XTB(12)=E6/E8
           XTB(13)=EFF(4)*X(4)
    12    IF(IND.LE.0)GO TO 17
          NW=0
           DO 13 I=1,20
           DO 13 J=1,3
    13    CU(I,J)=0.
           NAMCU(1)=2HST
```

```
          NAMCU(2)=2H
          NAMCU(3)=1H
           DO15I=1,2
          DO14J=1,20
   14     TA(J,I)=TB(J,I)=0.
           DO 15 J=1,6
   15     FFD(J,I)=AES(J,I)=0.
          DCU2=0.
          E15=EFF(1)*E5 $ IF(E15.LE.0.)E15=1.
           IF(X(2).GE..1)GO TO 16 $ PRINT1 $ CALL EXIT
    1      FORMAT(* LESS THAN 0.1KW STORAGE NOT ALLOWED IN UE11D*)
   16      DCU2=19.9999/X(2)
           WRITE(9)(X(J),J=1,10)
   17     CALL TODPR(1) $ CALL DGETSD(1) $ DO 18 K=1,24
          B5(1,K)=SE1(K)*E15X $ B5(4,K)=SE2(K)*E15X $ JP=ITOD(K)
          B5(3,K)=(ECOS(JP).A.(-17B)).O.JP $ B5(2,K)=DEE(K)
   18     B5(5,K)=DET(K)
C ....     SE1=TRUE SU, SE2=SU PRED.  DEE=TRUE DE, DET=DE PRED.
C ....     BEGIN LOOP
          DO 59 ND=1,364 $ CALL TODPR(ND+1) $ CALL DGETSD(ND+1)
          DO 19 K=1,24 $ L=K+24 $ B5(1,L)=SE1(K)*E15X $ B5(2,L)=DEE(K)
          B5(4,L)=SE2(K)*E15X $ B5(5,L)=DET(K) $ JP=ITOD(K)
   19     B5(3,L)=(ECOS(JP).A.(-17B)).O.JP
          DO 58 NHOU=1,24 $ KSBW=1 $ IF(EBM.LE.0.)KSBW=0
          SU(1)=B5(1) $ DE(1)=B5(2)/E38 $ DO 21 K=2,NH $ SU(K)=B5(4,K)
   21     DE(K)=B5(5,K)/E38
          XTB(1)=EFF(2)*EST
           DO 20 K=1,NH
           Z1=CTB(1,K)=B5(3,K)
           CTB(2,K)=-Z1*E38
          CTB(3,K)=-Z1*R38
           CTB(4,K)=-Z1*E36
           CTB(5,K)=-Z1*R36
          CTB(6,K)=AMIN1(DE(K),XTB(6))
           CTB(7,K)=XTB(6)-CTB(6,K)
   20     CONTINUE
          CALL LPOUTR
           JP=B5(3).A.17B
           A4=CTB(1)
           ADS=CTB(2)
          ABSS=CTB(3)
           AD=CTB(4)
           AB=CTB(5)
           AS=CTB(6)
          EST=CTB(7)
          EFF(22)=EFF(22)+ADS+ABSS
          Z6=A4+B5(2)-E36*AD-E38*ADS
           EPUR(JP)=EPUR(JP)+Z6
          NHR=NHR+1
C         CHECK MONTH OF YEAR
          IF(NHR.GT.MHOUR(MO))MO=MO+1
C         FIND MAXIMUM PEAK DEMAND COST FOR EACH MONTH
          Z7=Z6*PCOS(JP)
          IF(Z7.LE.PDCO(MO))GO TO 205
          PDCO(MO)=Z7
          MHPK(MO)=NHR
          PDCO(MO,2)=Z6
```

```
  205 CONTINUE
C     FIND PEAK DEMAND FOR EACH MONTH IF PEAK DEMAND PRICE IS ZERO
      IF(PDCO(MO,1).NE.0. .O. Z6.LE.PDCO(MO,2))GO TO 210
      PDCO(MO,2)=Z6
      MHPK(MO)=NHR
  210 CONTINUE
      Z5=E36*AB+E38*ABSS
      EBM=EBM+ECOS(JP)*(RESB*Z6-RSLB*Z5)
       ESLB(JP)=ESLB(JP)+Z5
      IF(IND.EQ.0)GO TO 57
       AMS=ADS+ABSS
       AES(1)=AES(1)+AMS
      AES(2)=AES(2)+EST
       FFD(1)=FFD(1)+AD+AB
       FFD(5)=FFD(5)+ADS
      Z1=AS+A4*EFF(4)
      TA(2)=TA(2)+Z1
      L=EST*DCU2+1.
       CU(L)=CU(L)+1.
       FFD(2)=FFD(2)+AS
      TB(2)=TB(2)+AMS
      Z1=E6*(AD+AB)+E8*AMS
       TA(3)=TA(3)+Z1
       TB(3)=AMAX1(TB(3),Z1)
      TA(4)=TA(4)+A4
       TB(4)=AMAX1(TB(4),A4)
      TA(1)=TA(1)+B5(1)/E15
       TB(1)=TB(1)+B5(1)
      NW=NW+1
       WRS(1,NW)=AD
       WRS(2,NW)=AB
       WRS(3,NW)=AS
      WRS(4,NW)=ADS
       WRS(5,NW)=ABSS
       WRS(6,NW)=A4
       WRS(7,NW)=EST
      WRS(8,NW)=B5(1)
       WRS(9,NW)=B5(2)
       WRS(10,NW)=B5(3)
      IF(NW.LT.24)GO TO 57
       NW=0
       WRITE(9)((WRS(I,J),I=1,10),J=1,24)
   57 CONTINUE
      CALL MOVLEV(B5(6),B5,235)
   58 CONTINUE
   59 CONTINUE
       UE11DF=COST(ZZZZZ)
      IF(ISXOL.EQ.0)GO TO 122
       DO 120 J=1,4
       JXOL(J)=1H
      IF(X(J).EQ.XOL(J))GO TO 120
       JXOL(J)=1H*
       XOL(J)=X(J)
  120 CONTINUE
       PRINT121,UE11DF,(XOL(J),JXOL(J),J=1,4)
  121 FORMAT(1X,F15.3,5(F16.4,A1))
  122 IF(IND.EQ.0)RETURN
```

```
          Z1=1.E-30
           DO 61  J=1,10
   61     Z1=Z1+EPUR(J)-ESLB(J)
           CLV(1)=CTOT(1)/DETOT
          CLV(2)=0.
           Z2=DETOT-Z1
          IF(Z2.NE.0.)CLV(2)=(CTOT(2)+CTOT(3))/Z2
          CLV(3)=CLV(4)=0.
           IF(Z1.NE.0.)CLV(4)=CTOT(5)/Z1
          Z1=FFD(2)+TA(4)
           IF(Z1.GT.0.)AES(1)=100.*E8*AES(1)/Z1
          IF(Z1.LE.0.)AES(1)=0.
          AES(3)=(1.-EFF(2))*AES(2)
           FFD(6)=TB(1)-FFD(1)-FFD(2)
          IF(TA(2).GT.0.)FFD(1)=100.*(E36*FFD(1)+E38*E7*FFD(2)-
         1FFD(2)*AES(3)/TA(2))/DETOT
          IF(TA(2).LE.0.)FFD(1)=100.*E36*FFD(1)/DETOT
          Z1=TA(1)+TA(4)
           IF(Z1.GT.0.)FFD(3)=100.*EFF(3)*TA(3)/Z1
          FFD(4)=100.*(EFF(3)*TA(3)-CTOT(7,2))/DETOT
          FFD(5)=100.*E38*FFD(5)/DETOT
           FFD(2)=100.-FFD(1)
          TB(1)=TB(1)/E5
           TA(2)=TA(2)*E7
          Z1=24.*364.
           AES(2)=AES(2)/Z1
          TB(1)=TB(1)/Z1
           TB(2)=TB(2)/Z1
           DO 62  J=1,4
   62     TA(J)=TA(J)/Z1
           RETURN
          END
```

SYMBOLIC REFERENCE MAP (R=3)

```
ENTRY POINTS     DEF LINE      REFERENCES
   4  UE11DF         1           171        202

VARIABLES       SN  TYPE           RELOCATION
  713  AB           REAL                           REFS       121      128      136      145    DEFINED   100
  711  ABSS         REAL                           REFS       103      121      125      148    DEFINED    98
  712  AD           REAL                           REFS       104      128      136      144    DEFINED    99
  710  ADS          REAL                           REFS       103      104      125      129      147
                                                DEFINED        97
  134  AES          REAL        ARRAY    COMPRNS   REFS        11      126      127      182      184      186      197
                                                DEFINED        64      126      127      182      183      184      197
  720  AMS          REAL                           REFS       126      135      136  DEFINED      125
  714  AS           REAL                           REFS       130      134      146  DEFINED      101
  707  A4           REAL                           REFS       104      130      139      140      149
                                                DEFINED        96
  735  B5           REAL        ARRAY              REFS         2      3*8?      83       86       95      104      141
                                                      142       [illegible]       153    2*158  DEFINED   2*72     2*73
                                                       74       [illegible]       ?0
```

```
VARIABLES       SN  TYPE               RELOCATION
   76  CC          REAL      ARRAY    COMCOMP    REFS       5
  150  CLV         REAL      ARRAY    COMPRNS    REFS      11   DEFINED     175      176      178    2*179      180
   62  CTB         REAL      ARRAY    COMLPRO    REFS      14        92      96       97       98       99      100
                                                 101      102   DEFINED      86       87       88       89       90
                                                  91       92
   74  CTOT        REAL      ARRAY    COMANSW    REFS       9       175   2*178      180      191
    3  CU          REAL      ARRAY    COMCUMU    REFS       3       133  DEFINED      56      133
  677  DCU2        REAL                          REFS     132   DEFINED      65       69
   32  DE          REAL      ARRAY    COMLPRO    REFS      14        91  DEFINED      82       83
  140  DEE         REAL      ARRAY    COMSUDE    REFS      10        73      78
  170  DET         REAL      ARRAY    COMSUDE    REFS      10        74      79
  174  DETOT       REAL               COMCOMP    REFS       5       175     177      186      188      191      192
  175  DTTOT       REAL               COMCOMP    REFS       5
  674  EBM         REAL                          REFS      81       122  DEFINED      39      122
   40  ECOS        REAL      ARRAY    COMPURC    REFS       6        73      80      122
    0  EFF         REAL      ARRAY    COMCOMP    REFS       5        33      34       36       38       47       48
                                                  51       66        84     103      130      184      190      191
                                              DEFINED      25       103
    0  EPUR        REAL      ARRAY    COMPURC    REFS       6       105     174  DEFINED       25       27      105
   26  ESLB        REAL      ARRAY    COMPURC    REFS       6       123     174  DEFINED       27      123
  673  EST         REAL                          REFS      84       127     132      150  DEFINED       39      102
  700  E15         REAL                          REFS      66       141  DEFINED    2*66
  665  E15X        REAL                          REFS    2*72        78      79  DEFINED       33
  666  E36         REAL                          REFS      35        89     104      121      186      188
                                              DEFINED      34
  670  E38         REAL                          REFS      37        82      83       87      104      121      186
                                                 192  DEFINED        36
  672  E47         REAL                          REFS      49   DEFINED      38
    2  E5          REAL               COMUE11    REFS      13        33      66      194
    3  E6          REAL               COMUE11    REFS      13        34      50      136
    4  E7          REAL               COMUE11    REFS      13        38      43      186      195
    5  E8          REAL               COMUE11    REFS      13        36      41       50      136      182
  120  FFD         REAL      ARRAY    COMPRNS    REFS      11       128     129      134      181    2*185    3*186
                                                 188      192       193  DEFINED       64      128      129      134
                                                 185      186       188     190      191      192      193
  676  I           INTEGER                       REFS      56      2*62    2*64      156  DEFINED       54       60
                                                 156
    0  IND         INTEGER            COMUE11    REFS      13        52     124      171
   10  ISWND       INTEGER   ARRAY    COMWIND    REFS       4        17
    0  ISXOL       INTEGER            COMSXOL    REFS      15       162
   53  ITOD        INTEGER   ARRAY    COMPURC    REFS       6        72      79
  660  J           INTEGER                       REFS      21      2*22    2*27     2*30       56     2*62     2*64
                                                  70      156       164   2*165      166    2*167    2*169    2*174
                                               2*201  DEFINED        20      26       29       55       61       63
                                                  70      156       163     169      173      200
  702  JP          INTEGER                       REFS    2*73      2*80   2*105      110      122    2*123
                                              DEFINED      72        79      95
  730  JXOL        INTEGER   ARRAY               REFS       2       169  DEFINED      164      166
  701  K           INTEGER                       REFS    5*72      3*73    2*74     3*78     3*79     2*82     2*83
                                                2*86       87        88      89       90     2*91     2*92
                                              DEFINED      71        78      82       85
  347  KSBW        INTEGER            COMLPRO    REFS      14   DEFINED    2*81
  704  L           INTEGER                       REFS    2*78      2*79      80    2*133  DEFINED       78      132
  163  MHOUR       INTEGER   ARRAY    COMPURC    REFS       6       108
  147  MHPK        INTEGER   ARRAY    COMPURC    REFS       6   DEFINED      21      113      119
  661  MO          INTEGER                       REFS   2*108       111     112      113      114    2*117      118
                                                 119  DEFINED        23     108
```

VARIABLES		SN	TYPE		RELOCATION								
50	MXX		INTEGER	ARRAY	COMANSW	REFS	9						
0	NAMCU		INTEGER	ARRAY	COMCUMU	REFS	3	DEFINED	57	58	59		
703	ND		INTEGER			REFS	2*77	DEFINED	77				
0	NH		INTEGER		COMLPRO	REFS	14	82	85	DEFINED	19		
11	NHNH		INTEGER		COMUE11	REFS	13	19					
705	NHOU	*	INTEGER			DEFINED	81						
662	NHR		INTEGER			REFS	106	108	113	119	DEFINED	24	106
1	NITER		INTEGER		COMUE11	REFS	13	28	DEFINED	28			
1	NS		INTEGER		COMLPRO	REFS	14						
10	NSNS		INTEGER		COMUE11	REFS	13						
675	NW		INTEGER			REFS	143	144	145	146	147	148	149
						150	151	152	153	154	DEFINED	53	143
						155							
105	PCOS		REAL	ARRAY	COMPURC	REFS	6	110					
117	PDCO		REAL	ARRAY	COMPURC	REFS	6	111	2*117	DEFINED	2*22	112	114
						118							
77	R		REAL	ARRAY	COMCUMU	REFS	3						
173	RESB		REAL		COMCOMP	REFS	5	122					
177	RLCCR		REAL		COMPURC	REFS	6						
172	RSLB		REAL		COMCOMP	REFS	5	35	37	122			
6	RX7		REAL		COMUE11	REFS	13	31					
7	RX8		REAL		COMUE11	REFS	13	32					
667	R36		REAL			REFS	90	DEFINED	35				
671	R38		REAL			REFS	88	DEFINED	37				
0	SE1		REAL	ARRAY	COMSUDE	REFS	10	72	78				
30	SE2		REAL	ARRAY	COMSUDE	REFS	10	72	79				
60	ST1		REAL	ARRAY	COMSUDE	REFS	10						
110	ST2		REAL	ARRAY	COMSUDE	REFS	10						
2	SU		REAL	ARRAY	COMLPRO	REFS	14	DEFINED	2*82				
0	TA		REAL	ARRAY	COMPRNS	REFS	11	131	137	139	141	181	2*186
						188	2*189	190	191	195	201		
						DEFINED	62	131	137	139	141	195	201
50	TB		REAL	ARRAY	COMPRNS	REFS	11	135	138	140	142	185	194
						198	199	DEFINED	62	135	138	140	142
						194	198	199					
657	UE11DF		REAL			REFS	169	DEFINED	161				
0	W		REAL	ARRAY	COMWIND	REFS	4						
154	WRS		REAL	ARRAY	COMPRNS	REFS	11	156	DEFINED	144	145	146	147
						148	149	150	151	152	153		
0	X		REAL	ARRAY	COMANSW	REFS	9	31	32	33	40	41	42
						51	67	69	70	165	167		
						DEFINED	30						
24	XCO		REAL	ARRAY	COMANSW	REFS	9						
26	XM		REAL	ARRAY	COMCOMP	REFS	5						
723	XOL		REAL	ARRAY		REFS	2	165	169	DEFINED	16	167	
332	XTB		REAL	ARRAY	COMLPRO	REFS	14	44	91	92	DEFINED	40	41
						42	43	44	45	46	47	48	49
						50	51	84					
0	XXXX		REAL	ARRAY	F.P.	REFS	2	30	DEFINED	1			
663	X7		REAL			REFS	45	DEFINED	31				
664	X8		REAL			REFS	44	46	DEFINED	32			
721	ZZZZZ	*	REAL			REFS	161						
706	Z1		REAL			REFS	87	88	89	90	131	137	138
						174	177	2*180	2*182	183	2*190	197	198
						199	201	DEFINED	86	130	136	172	174
						181	189	196					
722	Z2		REAL			REFS	2*178	DEFINED	177				

```
VARIABLES       SN  TYPE            RELOCATION
  717  Z5           REAL                              REFS         122        123    DEFINED        121
  715  Z6           REAL                              REFS         105        110       114         117        118        122
                                                   DEFINED         104
  716  Z7           REAL                              REFS         111        112    DEFINED        110

FILE NAMES          MODE
       OUTPUT       FMT                     WRITES          17          67        169
       TAPE9        UNFMT                   WRITES          70         156

EXTERNALS              TYPE    ARGS          REFERENCES
       COST         REAL        1                161
       DGETSD                   1                 71        77
       EXIT                     0                 17        67
       LPOUTR                   0                 94
       MOVLEV                   3                158
       TODPR                    1                 71        77

INLINE FUNCTIONS       TYPE    ARGS         DEF LINE  REFERENCES
       AMAX1        REAL        0  INTRIN                  138        140
       AMIN1        REAL        0  INTRIN                   44         91

STATEMENT LABELS                 DEF LINE    REFERENCES
  611  1           FMT               68         67
  601  2           FMT               18         17
    0  10                            27         26
    0  11                            30         29
    0  12              INACTIVE      52
    0  13                            56         54         55
    0  14                            62         61
    0  15                            64         60         63
  127  16                            69         67
  133  17                            71         52
    0  18                            74         71
    0  19                            80         78
    0  20                            93         85
    0  21                            83         82
   12  22                            19         17
  404  57                           157        124        154
    0  58                           159         81
    0  59                           160         77
    0  61                           174        173
    0  62                           201        200
  426  120                          168        163        165
  636  121         FMT              170        169
  446  122                          171        162
    0  200                           22         20
  274  205                          115        111
  303  210                          120        117

LOOPS  LABEL      INDEX        FROM-TO     LENGTH     PROPERTIES
   15  200        J             20 22         3B        INSTACK
   24  10         J             26 27         3B        INSTACK
   32  11         J             29 30         2B        INSTACK
   72  13         I             54 56         4B                  NOT INNER
   73  13         J             55 56         2B        INSTACK
  102  15         I             60 64        14B                  NOT INNER
  105  14         J             61 62         3B        INSTACK
```

LOOPS	LABEL	INDEX	FROM-TO	LENGTH	PROPERTIES	
112	15	J	63 64	3B	INSTACK	
143	18	K	71 74	7B	INSTACK	
153	59	ND	77 160	240B		EXT REFS NOT INNER
166	19	K	78 80	10B	OPT	
177	58	NHOU	81 159	212B		EXT REFS NOT INNER
210	21	K	82 83	3B	INSTACK	
223	20	K	85 93	11B	OPT	
423	120	J	163 168	4B	INSTACK	
435		J	169 169	10B		EXT REFS
453	61	J	173 174	3B	INSTACK	
556	62	J	200 201	2B	INSTACK	

COMMON BLOCKS	LENGTH	MEMBERS - BIAS NAME(LENGTH)		
COMCUMU	83	0 NAMCU (3)	3 CU (60)	63 R (20)
COMWIND	10	0 W (8)	8 ISWND (2)	
COMCOMP	126	0 EFF (22)	22 XM (40)	62 CC (60)
		122 RSLB (1)	123 RESB (1)	124 DETOT (1)
		125 DTTOT (1)		
COMPURC	128	0 EPUR (22)	22 ESLB (10)	32 ECOS (11)
		43 ITOD (26)	69 PCOS (10)	79 PDCO (24)
		103 MHPK (12)	115 MHOUR (12)	127 RLCCR (1)
COMANSW	74	0 X (20)	20 XCO (20)	40 MXX (20)
		60 CTOT (14)		
COMSUDE	144	0 SE1 (24)	24 SE2 (24)	48 ST1 (24)
		72 ST2 (24)	96 DEE (24)	120 DET (24)
COMPRNS	348	0 TA (40)	40 TB (40)	80 FFD (12)
		92 AES (12)	104 CLV (4)	108 WRS (240)
COMUE11	10	0 IND (1)	1 NITER (1)	2 E5 (1)
		3 E6 (1)	4 E7 (1)	5 E8 (1)
		6 RX7 (1)	7 RX8 (1)	8 NSNS (1)
		9 NHNH (1)		
COMLPRO	232	0 NH (1)	1 NS (1)	2 SU (24)
		26 DE (24)	50 CTB (168)	218 XTB (13)
		231 KSBW (1)		
COMSXOL	1	0 ISXOL (1)		

STATISTICS

PROGRAM LENGTH	1315B	717
CM LABELED COMMON LENGTH	2204B	1156

60000B CM USED

```
                SUBROUTINE PREDIC(LCRD) $ DIMENSION LCRD(9),IOP(2)
                COMMON /COMINI1/ T(365),Y(365),X(16),F(32),WK(1888)
                COMMON /COMLEV2/ ESD(3,24,364) $ LEVEL2,ESD
                DATA MU/77777777770000000000B/, ML/7777777777B/
                DATA IOP/4,4/, NK/16/
                DECODE(20,1,LCRD)J1 $ IF(J1-1)10,15,22
         1      FORMAT(15X,I2,1X,I2)
        C ....    NO PREDICTION
         10     DO 11 K=1,364 $ DO 11 J=1,24 $ DO 11 I=1,3,2
         11     ESD(I,J,K)=(ESD(I,J,K).A.MU).O.(SHIFT(ESD(I,J,K),-30).A.ML)
                RETURN
        C ...     SPLINE PREDICTION.
         15     DL=364./(NK-1) $ X(1)=.9999 $ DO 16 J=2,NK
         16     X(J)=(J-1)*DL+1. $ X(NK)=365. $ DO 17 J=1,365
         17     T(J)=J $ DO 21 I=1,3,2 $ DO 21 J=1,24 $ DO 18 K=1,364
         18     Y(K)=ESD(I,J,K).A.MU $ Y(365)=Y(1)
                CALL SMOLSW(365,2*NK,IOP,T,X,Y,F,WK)
                L=1 $ X1=X(1) $ F1=F(NK+1) $ F21=F(1) $ DO 21 K=1,364
         19     IF(T(K).LE.X1)GO TO 20 $ X0=X1 $ F0=F1 $ F20=F21 $ L=L+1
                X1=X(L) $ F1=F(NK+L) $ F21=F(L) $ A2=F20/2.
                A3=(F21-F20)/6./(X1-X0)
                A1=(F1-F0)/(X1-X0)-(X1-X0)*(A2+A3*(X1-X0)) $ GO TO 19
         20     Z1=T(K)-X0 $ Z1=AMAX1(.001,((A3*Z1+A2)*Z1+A1)*Z1+F0)
                IF(Y(K).LE.0.)Z1=0.
                ESD(I,J,K)=(Y(K).A.MU).O.(SHIFT(Z1,-30).A.ML)
         21     CONTINUE $ RETURN
        C ....    OTHER PREDICTIONS.
        C22     PRINT2,J1 $ CALL EXIT
         2      FORMAT(* DISALLOWED PREDICTION *I4)
        C ....    AVERAGE AT EACH HOUR.
         22     DO 24 J=1,24 $ DO 24 I=1,3,2 $ Z2=Z3=0. $ DO 23 K=1,364
                Z1=ESD(I,J,K).A.MU $ IF(Z1.LE.0.)GO TO 23 $ Z2=Z2+Z1 $ Z3=Z3+1.
         23     CONTINUE $ Z2=AMAX1(.001,Z2/AMAX1(Z3,1.)) $ PRINT3,J,I,Z2
         3      FORMAT(1X,2I4,F10.5)
                DO 24 K=1,24 $ Z1=ESD(I,J,K).A.MU $ Z3=Z2
                IF(Z1.LE.0.)Z3=0. $ ESD(I,J,K)=Z1.O.SHIFT(Z3.A.MU,-30)
         24     CONTINUE $ RETURN
                END
```

SYMBOLIC REFERENCE MAP (R=3)

ENTRY POINTS	DEF LINE	REFERENCES		
3 PREDIC	1	11	26	37

VARIABLES	SN	TYPE	RELOCATION							
337 A1		REAL			REFS	23	DEFINED	22		
335 A2		REAL			REFS	22	23	DEFINED	20	
336 A3		REAL			REFS	22	23	DEFINED	21	
325 DL		REAL			REFS	14	DEFINED	13		
0 ESD		REAL	ARRAY	COMLEV2	REFS	2*3	2*10	16	32	35
					DEFINED	10	25	36		
1352 F		REAL	ARRAY	COMINI1	REFS	2	17	2*18	2*20	
333 F0		REAL			REFS	22	23	DEFINED	19	

```
VARIABLES      SN  TYPE            RELOCATION
   330  F1         REAL                                   REFS        19        22    DEFINED       18        20
   334  F20        REAL                                   REFS        20        21    DEFINED       19
   331  F21        REAL                                   REFS        19        21    DEFINED       18        20
   324  I          INTEGER                                REFS      3*10        16        25        32        33        35        36
                                                       DEFINED         9        15        31
   343  IOP        INTEGER     ARRAY                      REFS         1        17    DEFINED        5
   323  J          INTEGER                                REFS      3*10      2*14      2*15        16        25        32        33
                                                            35        36   DEFINED         9        13        14        15        31
   321  J1         INTEGER                                REFS         6   DEFINED         6
   322  K          INTEGER                                REFS      3*10      2*16        19        23        24      2*25        32
                                                            35        36   DEFINED         9        15        18        31        35
   326  L          INTEGER                                REFS        19      3*20    DEFINED
     0  LCRD       INTEGER     ARRAY       F.P.           REFS         1         6    DEFINED
   257  ML         INTEGER                                REFS        10        25    DEFINED        4
   256  MU         INTEGER                                REFS        10        16        25        32        35        36
                                                       DEFINED         4
   260  NK         INTEGER                                REFS      2*13        14        17        18        20
                                                       DEFINED         5
     0  T          REAL        ARRAY      COMINI1         REFS         2        17        19        23   DEFINED        15
  1412  WK         REAL        ARRAY      COMINI1         REFS         2        17
  1332  X          REAL        ARRAY      COMINI1         REFS         2        17        18        20   DEFINED        13      2*14
   332  X0         REAL                                   REFS        21      3*22        23   DEFINED        19
   327  X1         REAL                                   REFS      2*19        21      3*22   DEFINED        18        20
   555  Y          REAL        ARRAY      COMINI1         REFS         2        16        17        24        25
                                                       DEFINED      2*16
   340  Z1         REAL                                   REFS      3*23        25      2*32      2*36   DEFINED      2*23        24
                                                            32        35
   341  Z2         REAL                                   REFS        32      2*33        35   DEFINED        31        32        33
   342  Z3         REAL                                   REFS        32        33        36   DEFINED        31        32        35
                                                            36

FILE NAMES       MODE
       OUTPUT    FMT                     WRITES       33

EXTERNALS           TYPE    ARGS         REFERENCES
       SMOLSW                 8              17

INLINE FUNCTIONS    TYPE    ARGS         DEF LINE  REFERENCES
       AMAX1     REAL         0  INTRIN              23        2*33
       SHIFT     NO TYPE      2  INTRIN              10          25        36

STATEMENT LABELS                DEF LINE   REFERENCES
   266  1         FMT                  7          6
   271  2         FMT  NO REFS        29
   304  3         FMT                 34         33
    12  10                             9          6
     0  11                            10        3*9
    37  15                            13          6
     0  16                            14         13
     0  17                            15         14
     0  18                            16         15
   112  19                            19         22
   132  20                            23         19
     0  21                            26       2*15        18
   160  22                            31          6
   200  23                            33         31        32
     0  24                            37       2*31        35
```

LOOPS	LABEL	INDEX	FROM-TO	LENGTH	PROPERTIES	
20	11	K	9 10	17B		NOT INNER
23	11	J	9 10	5B		NOT INNER
24	11	I	9 10	3B	INSTACK	
45	16	J	13 14	4B	INSTACK	
54	17	J	14 15	3B	INSTACK	
61	21	I	15 26	76B		EXT REFS NOT INNER
64	21	J	15 26	71B		EXT REFS NOT INNER
67	18	K	15 16	3B	INSTACK	
107	21	K	18 26	42B	OPT	
164	24	J	31 37	52B		EXT REFS NOT INNER
171	24	I	31 37	36B		EXT REFS NOT INNER
175	23	K	31 33	4B	INSTACK	
214	24	K	35 37	4B	INSTACK	

COMMON BLOCKS	LENGTH	MEMBERS - BIAS NAME(LENGTH)		
COMINI1	2666	0 T (365)	365 Y (365)	730 X (16)
		746 F (32)	778 WK (1888)	
COMLEV2	26208	0 ESD (26208)		

STATISTICS

PROGRAM LENGTH	345B	229
CM LABELED COMMON LENGTH	70312B	28874

60000B CM USED

```
      1             SUBROUTINE DGETSD(ND) $ DIMENSION SD(3,24)
                    COMMON /COMSUDE/ SE(24,2),ST(24,2),DEE(24),DET(24)
                    COMMON /COMLEV2/ ESD(72,364) $ LEVEL2,ESD
                    DATA MU/77777777770000000000B/,ML/7777777777B/
      5             N=ND
                10  IF(N.GT.0)GO TO 11 $ N=N+364 $ GO TO 10
                11  IF(N.LE.364)GO TO 12 $ N=N-364 $ GO TO 11
                12  CALL MOVLEV(ESD(1,N),SD,72) $ DO 13 J=1,24
                    SE(J)=SD(1,J).A.MU $ DEE(J)=SD(3,J).A.MU
     10             SE(J,2)=SHIFT(SD(1,J).A.ML,30)
                13  DET(J)=SHIFT(SD(3,J).A.ML,30) $ RETURN $ END
```

```
      SYMBOLIC REFERENCE MAP (R=3)

ENTRY POINTS      DEF LINE      REFERENCES
    3  DGETSD         1            11

VARIABLES       SN  TYPE              RELOCATION
   140  DEE         REAL        ARRAY    COMSUDE      REFS          2     DEFINED        9
   170  DET         REAL        ARRAY    COMSUDE      REFS          2     DEFINED       11
     0  ESD         REAL        ARRAY    COMLEV2      REFS        2*3          8
    42  J           INTEGER                           REFS        4*9       2*10       2*11     DEFINED        8
    37  ML          INTEGER                           REFS         10         11    DEFINED        4
    36  MU          INTEGER                           REFS        2*9     DEFINED        4
    41  N           INTEGER                           REFS        2*6        2*7          8     DEFINED        5        6        7
     0  ND          INTEGER               F.P.        REFS          5     DEFINED        1
    43  SD          REAL        ARRAY                 REFS          1          8        2*9         10       11
     0  SE          REAL        ARRAY    COMSUDE      REFS          2     DEFINED        9         10
    60  ST          REAL        ARRAY    COMSUDE      REFS          2

EXTERNALS           TYPE    ARGS         REFERENCES
       MOVLEV                 3              8

INLINE FUNCTIONS    TYPE    ARGS       DEF LINE   REFERENCES
       SHIFT      NO TYPE     2  INTRIN        10         11

STATEMENT LABELS            DEF LINE    REFERENCES
    6  10                      6           6
   11  11                      7           6         7
   14  12                      8           7
    0  13                     11           8

LOOPS  LABEL     INDEX     FROM-TO     LENGTH     PROPERTIES
   24  13         J         8 11          6B      INSTACK

COMMON BLOCKS    LENGTH      MEMBERS - BIAS NAME(LENGTH)
       COMSUDE     144                 0 SE       (48)             48 ST      (48)               96 DEE     (24)
                                     120 DET      (24)
       COMLEV2   26208                 0 ESD      (26208)

STATISTICS
  PROGRAM LENGTH                  153B      107
  CM LABELED COMMON LENGTH      63360B    26352
```

STATISTICS

60000B CM USED

```
          SUBROUTINE DWINIT(NH,U,KB)
    C ....INITIALIZE.   NOTE 24*49=1176.
          DIMENSION U(2401),KB(193),KK(193)
          COMMON/COMINI2/Z(1176)
          COMMON/COMLPIN/MC,MC1,MR,LPO,LPI,NH1,NH3,NH7,MR71,MCNH,TH,
         1 V(7,72),Z00(24),B2X(48),CAD6,CAD7
          DATA IS/0/, NHO/-1/
          IF(IS.NE.0)GO TO 12
           IS=1
           DO 10  J=1,1176
     10   Z(J)=0.
           DO 11  J=1,49
     11   KK(J)=J
           TH=1.E-7
          CAD6=-.0001
          CAD7=-.0001
     12   IF(NH.EQ.NHO)GO TO 14
           NHO=NH
          CALL MOVLEV(Z,KK(50),144)
           MR=2*NH
          NH1=NH+1
           MC=MR+1
           MCNH=MC*NH
           LPO=2*MCNH+1
          NH3=3*NH
           NH7=7*NH
           MR71=2*NH7+1
           MC1=MC+1
           L=1
          DO 13  J=1,NH
           KK(J+49)=KK(J+49+NH)=1
          KK(J+121)=KK(J+121+NH)=KK(J+121+MR)=J
     13   L=L+MC1
           LPI=LPO+NH
    C ....SET U   AND KB.
     14   L=MCNH
           CALL MOVLEV(Z,U,L)
          CALL MOVLEV(Z,U(L+1),L)
           CALL MOVLEV(Z,U(L+L+1),MC)
          CALL MOVLEV(KK,KB,193)
           U(LPI+NH)=1.
          RETURN
           END
```

SYMBOLIC REFERENCE MAP (R=3)

```
ENTRY POINTS     DEF LINE      REFERENCES
   3  DWINIT         1            42

VARIABLES      SN   TYPE              RELOCATION
  1033  B2X         REAL        ARRAY    COMLPIN      REFS         5
  1113  CAD6        REAL                 COMLPIN      REFS         5   DEFINED        15
  1114  CAD7        REAL                 COMLPIN      REFS         5   DEFINED        16
```

```
      SUBROUTINE DWINIT      74/74    OPT=2                          FTN 4.8+518         80/11/28. 10.23.01        PAGE      2

VARIABLES      SN   TYPE            RELOCATION
   112  IS          INTEGER                           REFS          8    DEFINED        7        9
   122  J           INTEGER                           REFS         11       2*13     2*31     4*32   DEFINED       10        12
                                                        30
     0  KB          INTEGER    ARRAY     F.P.         REFS          3         40   DEFINED        1
   124  KK          INTEGER    ARRAY                  REFS          3         19       40   DEFINED       13      2*31      3*32
   123  L           INTEGER                           REFS         33         37     2*38     2*39   DEFINED       29        33
                                                        36
     4  LPI         INTEGER             COMLPIN       REFS          5         41   DEFINED       34
     3  LPO         INTEGER             COMLPIN       REFS          5         34   DEFINED       24
     0  MC          INTEGER             COMLPIN       REFS          5         23       28       39   DEFINED       22
    11  MCNH        INTEGER             COMLPIN       REFS          5         24       36   DEFINED       23
     1  MC1         INTEGER             COMLPIN       REFS          5         33   DEFINED       28
     2  MR          INTEGER             COMLPIN       REFS          5         22       32   DEFINED       20
    10  MR71        INTEGER             COMLPIN       REFS          5    DEFINED       27
     0  NH          INTEGER              F.P.         REFS         17         18       20       21       23       25        26
                                                        30         31         32       34       41   DEFINED        1
   113  NHO         INTEGER                           REFS         17    DEFINED        7       18
     5  NH1         INTEGER             COMLPIN       REFS          5    DEFINED       21
     6  NH3         INTEGER             COMLPIN       REFS          5    DEFINED       25
     7  NH7         INTEGER             COMLPIN       REFS          5         27   DEFINED       26
    12  TH          REAL                COMLPIN       REFS          5    DEFINED       14
     0  U           REAL       ARRAY     F.P.         REFS          3         37       38       39   DEFINED        1        41
    13  V           REAL       ARRAY    COMLPIN       REFS          5
     0  Z           REAL       ARRAY    COMINI2       REFS          4         19       37       38       39
                                                    DEFINED        11
  1003  ZOO         REAL       ARRAY    COMLPIN       REFS          5

EXTERNALS          TYPE    ARGS       REFERENCES
        MOVLEV               3              19          37          38          39          40

STATEMENT LABELS                   DEF LINE   REFERENCES
     0  10                            11         10
     0  11                            13         12
    20  12                            17          8
     0  13                            33         30
    47  14                            36         17

LOOPS   LABEL       INDEX       FROM-TO       LENGTH      PROPERTIES
   10   10          J            10 11           2B         INSTACK
   13   11          J            12 13           2B         INSTACK
   41   13          J            30 33           4B         INSTACK

COMMON BLOCKS     LENGTH      MEMBERS - BIAS NAME(LENGTH)
        COMINI2     1176                   0 Z          (1176)
        COMLPIN      589                   0 MC         (1)                  1 MC1        (1)                  2 MR         (1)
                                           3 LPO        (1)                  4 LPI        (1)                  5 NH1        (1)
                                           6 NH3        (1)                  7 NH7        (1)                  8 MR71       (1)
                                           9 MCNH       (1)                 10 TH         (1)                 11 V          (504)
                                         515 ZOO        (24)               539 B2X        (48)               587 CAD6       (1)
                                         588 CAD7       (1)

STATISTICS
  PROGRAM LENGTH                   425B        277
  CM LABELED COMMON LENGTH        3345B       1765
        60000B CM USED
```

```
      SUBROUTINE LPINNR(PII)
      DIMENSION C(5),KB(5),PII(24)
      COMMON /COMLPRO/NH,NS,SU(24),DE(24),CTB(7,24),XTB(13),KSBW
C ....XTB  1=E0. 2=X2. 3=X3/E8. 4=X4. 5=E7. 6=MIN(X3/E8,X8). 7=X7.
C ....       8=X8. 9=E4. 10=E2. 11=E47. 12=E6/E8.  13=E4*X4.
C ....CTB(6,K)=MIN(XTB(6),DE(K)).   CTB(7,K)=XTB(6)-CTB(6,K)
      COMMON/COMLPIN/MC,MC1,MR,LPO,LPI,NH1,NH3,NH7,MR71,MCNH,TH,
     1 V(7,72),Z00(24),B2X(48),CAD6,CAD7
      KS=MR71
       KC=1
      DO 70 K=1,NH
       C1=CTB(KC)-PII(K)*XTB(11)
       V(KS+6)=B2X(K+NH)
      C2=PII(K)+CTB(KC+1)
       KC=KC+7
      C7=PII(K)+CAD7
       IF(K.LT.NH)C7=C7-XTB(10)*PII(K+1)
       Z00(K)=0.
      IF(C7.GT.0.)V(KS+6)=B2X(K)
      IF(SU(K).GT.0.)GO TO 14
       IF(C1.LT.0.)V(KS)=XTB(4)
      IF(C2.GE.0.)GO TO 69
       V(KS+1)=CTB(KC-2)
      Z00(K)=C2*V(KS+1)
      IF(KSBW.EQ.0)GO TO 69
      C3=PII(K)+CTB(KC-5)
       IF(C3.GE.0.)GO TO 69
      V(KS+2)=CTB(KC-1)
       Z00(K)=Z00(K)+C3*V(KS+2)
       GO TO 69
C ....FULL INNER LOOP.
   14 B1=XTB(3)
       B3=XTB(7)
       B4=DE(K)
       B5=SU(K)
       C(1)=C4=CTB(KC-4)
      C6=-PII(K)*XTB(5)+CAD6
      IF(KSBW.NE.0)GO TO 34
      KB(1)=1
      C(2)=1.
      KB(2)=KB(3)=4
      IF(C2.GE.0.)GO TO 40
      C(2)=C2
      KB(2)=2
      IF(C(2).GE.C(1))GO TO 40
      C(1)=C2
      C(2)=C4
      KB(1)=2
      KB(2)=1
   40 IF(C6.GT.0.)GO TO 42
      KB(3)=3
      IF(C6.GE.C(1))GO TO 41
      KB(3)=KB(2)
      KB(2)=KB(1)
      KB(1)=3
      GO TO 42
   41 IF(C6.GE.C(2))GO TO 42
```

```
      KB(3)=KB(2)
      KB(2)=3
   42 DO 46 J=1,3
      GO TO (43,44,45,33),KB(J)
   43 Z1=V(KS+3)=AMIN1(B1/XTB(12),B4/XTB(12),B5)
      B5=B5-Z1
      B1=B1-(Z1*XTB(12))
      B4=B4-(Z1*XTB(12))
      Z00(K)=Z00(K)+C4*Z1
      GO TO 46
   44 Z1=V(KS+1)=AMIN1(B1,XTB(8),B4)
      B1=B1-Z1
      B4=B4-Z1
      Z00(K)=Z00(K)+C2*Z1
      GO TO 46
   45 Z1=V(KS+5)=AMIN1(B3,B5)
      B3=B3-Z1
      B5=B5-Z1
      Z00(K)=Z00(K)+C6*Z1
   46 CONTINUE
      GO TO 33
   34 C(2)=C5=CTB(KC-3)
       KB(1)=3
       KB(2)=4
       KB(3)=KB(4)=KB(5)=6
      IF(C2.GE.0.)GO TO 20
       B2=XTB(8)
       IF(C2.GE.C4)GO TO 15
      KB(3)=4
       KB(2)=3
       KB(1)=1
       C(3)=C5
       C(2)=C4
       C(1)=C2
      GO TO 17
   15 IF(C2.GE.C5)GO TO 16
       KB(2)=1
       KB(3)=4
      C(2)=C2
       C(3)=C5
       GO TO 17
   16 KB(3)=1
       C(3)=C2
   17 C3=PII(K)+CTB(KC-5)
      IF(C3.GE.0.)GO TO 20
       IF(C3.GE.C(2))GO TO 18
      KB(4)=KB(3)
       KB(3)=KB(2)
       KB(2)=2
       C(4)=C(3)
       C(3)=C(2)
      C(2)=C3
       GO TO 20
   18 IF(C3.GE.C(3))GO TO 19
       KB(4)=KB(3)
       C(4)=C(3)
      KB(3)=2
```

```
       C(3)=C3
       GO TO 20
 19    KB(4)=2
       C(4)=C3
 20    CONTINUE
       IF(C6.GT.0.)GO TO 26
       IF(C6.GE.C(1))GO TO 22
       KB(5)=KB(4)
       KB(4)=KB(3)
       KB(3)=KB(2)
       KB(2)=KB(1)
       KB(1)=5
       GO TO 26
 22    IF(C6.GE.C(2))GO TO 23
       KB(5)=KB(4)
       KB(4)=KB(3)
       KB(3)=KB(2)
       KB(2)=5
       GO TO 26
 23    IF(C6.GE.C(3))GO TO 24
       KB(5)=KB(4)
       KB(4)=KB(3)
       KB(3)=5
       GO TO 26
 24    IF(C6.GE.C(4))GO TO 25
       KB(5)=KB(4)
       KB(4)=5
       GO TO 26
 25    KB(5)=5
 26    DO 32 J=1,5
       GO TO (27,28,29,30,31,33),KB(J)
 27    Z1=V(KS+1)=AMIN1(B1,B2,B4)
       B1=B1-Z1
       B2=B2-Z1
       B4=B4-Z1
       Z00(K)=Z00(K)+C2*Z1
       GO TO 32
 28    Z1=V(KS+2)=AMIN1(B1,B2)
       B1=B1-Z1
       B2=B2-Z1
       Z00(K)=Z00(K)+C3*Z1
       GO TO 32
 29    Z1=V(KS+3)=AMIN1(B1/XTB(12),B4/XTB(12),B5)
       B5=B5-Z1
       B1=B1-Z1*XTB(12)
       B4=B4-Z1*XTB(12)
       Z00(K)=Z00(K)+C4*Z1
       GO TO 32
 30    Z1=V(KS+4)=AMIN1(B1/XTB(12),B5)
       B1=B1-Z1*XTB(12)
       B5=B5-Z1
       Z00(K)=Z00(K)+C5*Z1
       GO TO 32
 31    Z1=V(KS+5)=AMIN1(B3,B5)
       B3=B3-Z1
       B5=B5-Z1
       Z00(K)=Z00(K)+C6*Z1
```

```
                32    CONTINUE
                33    IF(C1.LE.0.)V(KS)=AMIN1(XTB(4),B3/XTB(9))
                69    ZOO(K)=ZOO(K)+V(KS+6)*C7+V(KS)*C1
   175          70    KS=KS+7
                       RETURN
                       END
```

SYMBOLIC REFERENCE MAP (R=3)

```
ENTRY POINTS      DEF LINE      REFERENCES
   3  LPINNR          1          176

VARIABLES       SN   TYPE            RELOCATION
  432   B1           REAL                                REFS       62       64       68       69      146      147      152
                                                          153      157      159      163      164  DEFINED       32       64
                                                           69      147      153      159      164
  443   B2           REAL                                REFS      146      148      152      154  DEFINED       84      148
                                                          154
 1033   B2X          REAL       ARRAY     COMLPIN        REFS        7       13       19
  433   B3           REAL                                REFS       73       74      168      169      173
                                                      DEFINED       33       74      169
  434   B4           REAL                                REFS       62       65       68       70      146      149      157
                                                          160  DEFINED       34       65       70      149      160
  435   B5           REAL                                REFS       62       63       73       75      157      158      163
                                                          165      168      170  DEFINED       35       63       75      158
                                                          165      170
  444   C            REAL       ARRAY                    REFS        2     2*45       52       57      103      107      108
                                                          111      113      121      128      134      139
                                                      DEFINED       36       40       43       46       47       79       89
                                                           90       91       96       97      100      107      108      109
                                                          113      115      118
 1113   CAD6         REAL                 COMLPIN        REFS        7       37
 1114   CAD7         REAL                 COMLPIN        REFS        7       16
   62   CTB          REAL       ARRAY     COMLPRO        REFS        3       12       14       23       26       28       36
                                                           79      101
  426   C1           REAL                                REFS       21      173      174  DEFINED       12
  427   C2           REAL                                REFS       22       24       42       43       46       71       83
                                                           85       91       93       96      100      150
                                                      DEFINED       14
  431   C3           REAL                                REFS       27       29      102      103      109      111      115
                                                          118      155  DEFINED       26      101
  436   C4           REAL                                REFS       47       66       85       90      161
                                                      DEFINED       36
  442   C5           REAL                                REFS       89       93       97      166  DEFINED       79
  437   C6           REAL                                REFS       50       52       57       76      120      121      128
                                                          134      139      171  DEFINED       37
  430   C7           REAL                                REFS       17       19      174  DEFINED       16       17
   32   DE           REAL       ARRAY     COMLPRO        REFS        3       34
  440   J            INTEGER                             REFS       61      145  DEFINED       60      144
  425   K            INTEGER                             REFS       12       13       14       16     2*17       18       19
                                                           20       24       26     2*29       34       35       37     2*66
                                                         2*71     2*76      101    2*150    2*155    2*161    2*166    2*171
                                                        2*174  DEFINED       11
```

```
VARIABLES       SN  TYPE               RELOCATION
  451  KB           INTEGER     ARRAY                  REFS        2       53       54       58       61      104      105
                                                        112      122      123      124      125      129      130      131
                                                        135      136      140      145  DEFINED       39     2*41       44
                                                         48       49       51       53       54       55       58       59
                                                         80       81     3*82       86       87       88       94       95
                                                         99      104      105      106      112      114      117      122
                                                        123      124      125      126      129      130      131      132
                                                        135      136      137      140      141      143
  424  KC           INTEGER                            REFS       12       14       15       23       26       28       36
                                                         79      101  DEFINED       10       15
  423  KS           INTEGER                            REFS       13       19       21       23       24       28       29
                                                         62       68       73      146      152      157      163      168
                                                        173    2*174      175  DEFINED        9      175
  347  KSBW         INTEGER               COMLPRO      REFS        3       25       38
    4  LPI          INTEGER               COMLPIN      REFS        7
    3  LPO          INTEGER               COMLPIN      REFS        7
    0  MC           INTEGER               COMLPIN      REFS        7
   11  MCNH         INTEGER               COMLPIN      REFS        7
    1  MC1          INTEGER               COMLPIN      REFS        7
    2  MR           INTEGER               COMLPIN      REFS        7
   10  MR71         INTEGER               COMLPIN      REFS        7        9
    0  NH           INTEGER               COMLPRO      REFS        3       11       13       17
    5  NH1          INTEGER               COMLPIN      REFS        7
    6  NH3          INTEGER               COMLPIN      REFS        7
    7  NH7          INTEGER               COMLPIN      REFS        7
    1  NS           INTEGER               COMLPRO      REFS        3
    0  PII          REAL        ARRAY     F.P.         REFS        2       12       14       16       17       26       37
                                                        101  DEFINED        1
    2  SU           REAL        ARRAY     COMLPRO      REFS        3       20       35
   12  TH           REAL                  COMLPIN      REFS        7
   13  V            REAL        ARRAY     COMLPIN      REFS        7       24       29    2*174  DEFINED       13       19
                                                         21       23       28       62       68       73      146      152
                                                        157      163      168      173
  332  XTB          REAL        ARRAY     COMLPRO      REFS        3       12       17       21       32       33       37
                                                       2*62       64       65       68       84    2*157      159      160
                                                        163      164    2*173
 1003  ZOO          REAL        ARRAY     COMLPIN      REFS        7       29       66       71       76      150      155
                                                        161      166      171      174  DEFINED       18       24       29
                                                         66       71       76      150      155      161      166      171
                                                        174
  441  Z1           REAL                               REFS       63       64       65       66       69       70       71
                                                         74       75       76      147      148      149      150      153
                                                        154      155      158      159      160      161      164      165
                                                        166      169      170      171  DEFINED       62       68       73
                                                        146      152      157      163      168

INLINE FUNCTIONS    TYPE    ARGS       DEF LINE  REFERENCES
       AMIN1        REAL      0  INTRIN             62       68       73      146      152      157      163      168
                                                   173

STATEMENT LABELS                 DEF LINE    REFERENCES
   62  14                            32         20
  217  15                            93         85
  225  16                            99         93
  230  17                           101         92       98
  243  18                           111        103
  251  19                           117        111
```

```
STATEMENT LABELS                 DEF LINE   REFERENCES
   254  20                          119        83       102       110       116
   265  22                          128       121
   274  23                          134       128
   302  24                          139       134
   307  25                          143       139
   310  26                          144       130       127       133       138       142
   326  27                          146       [illegible]
   337  28                          152       14[illegible]
   346  29                          157       145
   361  30                          163       145
   371  31                          168       145
   377  32                          172       144       151       156       162       167
   400  33                          173        61        78       145
   176  34                           79        38
   113  40                           50        42        45
   122  41                           57        52
   126  42                           60        50        56        57
   142  43                           62        61
   155  44                           68        61
   166  45                           73        61
   174  46                           77        60        67        72
   406  69                          174        22        25        27        30
     0  70                          175        11

LOOPS  LABEL     INDEX     FROM-TO     LENGTH      PROPERTIES
   13  70        K           11 175     405B                NOT INNER
  132  46        J           60 77       43B          OPT      EXITS
  314  32        J          144 172      64B          OPT      EXITS

COMMON BLOCKS    LENGTH       MEMBERS - BIAS NAME(LENGTH)
       COMLPRO      232                 0 NH      (1)                 1 NS      (1)                 2 SU      (24)
                                       26 DE      (24)               50 CTB     (168)             218 XTB     (13)
                                      231 KSBW    (1)
       COMLPIN      589                 0 MC      (1)                 1 MC1     (1)                 2 MR      (1)
                                        3 LPO     (1)                 4 LPI     (1)                 5 NH1     (1)
                                        6 NH3     (1)                 7 NH7     (1)                 8 MR71    (1)
                                        9 MCNH    (1)                10 TH      (1)                11 V       (504)
                                      515 ZOO     (24)              539 B2X     (48)              587 CAD6    (1)
                                      588 CAD7    (1)

STATISTICS
  PROGRAM LENGTH                     463B      307
  CM LABELED COMMON LENGTH          1465B      821
        60000B CM USED
```

```
      SUBROUTINE LPOUTR
C ....NOTE,   3528=49*72.   2401=49*49.
      DIMENSION KT(72),KP(72),KB(193),W(49)
      COMMON/COMINI1/U(2401),B(49),A1(72),A2(72),A3(72)
      COMMON /COMLPRO/NH,NS,SU(24),DE(24),CTB(7,24),XTB(13),KSBW
      COMMON/COMLPIN/MC,MC1,MR,LPO,LPI,NH1,NH3,NH7,MR71,MCNH,TH,
     1 V(7,72),Z00(24),B2X(48),CAD6,CAD7
      COMMON/COMINI2/ZERO(1176)
      EQUIVALENCE (KT,KB(50)),(KP,KB(122))
      CALL DWINIT(NH,U,KB)
      CALL MOVLEV(ZERO,A1,NH3)
       CALL MOVLEV(ZERO,A2,NH3)
      CALL MOVLEV(ZERO,A3,NH3)
       CALL MOVLEV(ZERO,V,3*NH7)
      Z1=Z2=XTB(1)
       L2=7
       DO 18  K=1,NH
      B2X(K+NH)=AMIN1(XTB(2),Z2+XTB(5)*AMIN1(XTB(7),SU(K)+XTB(13)))
      V(L2)=A1(K)=B2X(K)=AMAX1(0.,Z1-XTB(6))
      A3(K)=CAD7*V(L2)
      Z1=B2X(K)*XTB(10)
       Z2=B2X(K+NH)*XTB(10)
       A2(K)=-Z1
   18 L2=L2+7
       A2(NH)=0.
      L1=MR
       Z1=0.
   19 B2X(L1)=Z1
       L1=L1-1
       Z1=(Z1+XTB(6))/XTB(10)
      IF(L1.GT.NH1.A.Z1.LT.B2X(L1))GO TO 19
      CALL LPINNR(U)
       L1=NH7+1
      CALL MOVLEV(V(MR71),V(L1),NH7)
       DO 13  I=NH1,MR
      A1(I)=V(L1+1)+V(L1+2)+V(L1+6)-XTB(5)*V(L1+5)
      IF(ABS(A1(I)-A1(I-NH)).LE..001)GO TO 14
      A3(I)=Z00(I-NH)
       A2(I)=-XTB(10)*V(L1+6)
   13 L1=L1+7 $ GO TO 16
   14 DO 15 I=NH1,MR $ V(1,I)=V(3,I)=V(4,I)=V(5,I)=V(6,I)=0.
      V(2,I)=CTB(6,I-NH) $ V(7,I)=B2X(I) $ A1(I)=V(2,I)+V(7,I)
      A3(I)=V(2,I)*CTB(2,I-NH)+V(7,I)*CAD7 $ A2(I)=-XTB(10)*V(7,I)
   15 CONTINUE
   16  A2(MR)=0.
      CALL UINV
       GO TO 29
C ....LOOP
C .... INTERCHANGE SOLUTIONS.
   20 L=1
       DO 23  I=1,MR
       IF(KB(I).LE.MR)GO TO 23
       J=KB(I)
   21 IF(KT(L).EQ.0)GO TO 22
       L=L+1
       GO TO 21
   22 KT(L)=1
```

```
       KT(J)=0
       KP(L)=KP(J)
       KB(I)=L
      A1(L)=A1(J)
       A2(L)=A2(J)
       A3(L)=A3(J)
      CALL MOVLEV(V(7*J-6),V(7*L-6),7)
   23 CONTINUE
   29 CALL MOVLEV(ZERO,V(MR71),NH7)
       CALL LPINNR(U(LPI))
C ...   TEST FOR TERMINATION.
      L=LPO
       DO 24 K=1,NH
       IF(ZOO(K)+U(L).LT.-1.E-5)GO TO 27
   24 L=L+1
       CALL MOVLEV(ZERO,CTB,168)
       DO 26 K=1,MR
      I=KB(K)
       L=KP(I)
       DO 25 J=1,7
   25 CTB(J,L)=CTB(J,L)+B(K)*V(J,I)
   26 CONTINUE
       RETURN
C ....DO LOOP AGAIN.
   27 L1=MC
       L3=MR71
       L4=1
       DO 28 K=1,NH
      A1(L1)=V(L3+1)+V(L3+2)-V(L3)*XTB(11)-V(L3+5)*XTB(5)+V(L3+6)
      A2(L1)=-XTB(10)*V(L3+6)
      A3(L1)=CTB(L4)*V(L3)+CTB(L4+1)*V(L3+1)+CTB(L4+2)*V(L3+2)+
     1 CTB(L4+3)*V(L3+3)+CTB(L4+4)*V(L3+4)
     2 +CAD6*V(L3+5)+CAD7*V(L3+6)
      L1=L1+1
       L3=L3+7
       L4=L4+7
   28 CONTINUE
       A2(NH3)=0.
C ...   SOLVE MASTER LP.
   30 CONTINUE
      Z1=0.
       L2=LPO-1
       DO 32 K=1,NH3
       IF(KT(K).NE.0)GO TO 32
      J1=KP(K)+L2
      Z2=U(J1)+U(J1+NH)*A1(K)+U((J1+NH)+1)*A2(K)+A3(K)
      IF(Z2.GE.Z1)GO TO 32
       JP=K
       Z1=Z2
   32 CONTINUE
       IF(Z1.GT.-TH)GO TO 20
       W(MC)=Z1
       Z1=1.E50
       IP=0
      J1=KP(JP)
       DO 35 K=1,MR
      Z2=U(J1)+U(J1+NH)*A1(JP)+U((J1+NH)+1)*A2(JP)
```

```
          J1=J1+MC
         IF(Z2.LT.TH)GO TO 34
          Z3=B(K)/Z2
         IF(Z3.GE.Z1)GO TO 35
          IP=K
          Z1=Z3
          GO TO 35
      34 IF(Z2.GT.-TH)Z2=0.
      35 W(K)=Z2
          IF(IP.GT.0)GO TO 37
          PRINT1
          CALL EXIT
       1 FORMAT(* DW UNBOUNDED *)
      37 Z1=1./W(IP)
          W(IP)=0.
          B(IP)=B(IP)*Z1
         CALL SAXPY(MC,-B(IP),W,1,B,1)
         L1=MC*IP-MR
          CALL SSCAL(MR,Z1,U(L1),1)
          L2=1
         KT(JP)=1
          J=KB(IP)
          KT(J)=0
          KB(IP)=JP
         DO 40 K=1,MC
         IF(W(K).NE.0.)CALL SAXPY(MC,-W(K),U(L1),1,U(L2),1)
      40 L2=L2+MC
          GO TO 30
         END
```

SYMBOLIC REFERENCE MAP (R=3)

```
ENTRY POINTS      DEF LINE     REFERENCES
   1  LPOUTR          1          80

VARIABLES       SN  TYPE            RELOCATION
 4622  A1           REAL      ARRAY    COMINI1      REFS        4       11     2*37      61     103     114
                                                 DEFINED       19       36       42      61      86
 4732  A2           REAL      ARRAY    COMINI1      REFS        4       12       62     103     114
                                                 DEFINED       23       25       39      43      45      62      87
                                                      95
 5042  A3           REAL      ARRAY    COMINI1      REFS        4       13       63     103  DEFINED      20      38
                                                      43       63       88
 4541  B            REAL      ARRAY    COMINI1      REFS        4       78      117     130   2*131
                                                 DEFINED      130
 1033  B2X          REAL      ARRAY    COMLPIN      REFS        6       21       22      31      42
                                                 DEFINED       18       19       28
 1113  CAD6         REAL               COMLPIN      REFS        6       88
 1114  CAD7         REAL               COMLPIN      REFS        6       20       43      88
   62  CTB          REAL      ARRAY    COMLPRO      REFS        5       42       43      73      78    5*88
                                                 DEFINED       78
   32  DE           REAL      ARRAY    COMLPRO      REFS        5
  504  I            INTEGER                         REFS       36     2*37     2*38      39    5*41    7*42    6*43
```

```
VARIABLES       SN  TYPE            RELOCATION
                                                    52       53       60       76       78  DEFINED       35       41
                                                    51       75
  513  IP          INTEGER                        REFS      124      128      129    2*130      131      132      136
                                                   138  DEFINED      111      119
  506  J           INTEGER                        REFS       58       59       61       62       63       64     3*78
                                                   137  DEFINED       53       77      136
  512  JP          INTEGER                        REFS      112    2*114      135      138  DEFINED      105
  511  J1          INTEGER                        REFS    3*103    3*114      115  DEFINED      102      112      115
  502  K           INTEGER                        REFS     2*18     2*19       20       21       22       23       71
                                                    75       78      101      102    3*103      105      117      119
                                                   123    2*140  DEFINED       17       70       74       85      100
                                                   113      139
  515  KB          INTEGER    ARRAY               REFS        3      2*9       10       52       53       75      136
                                               DEFINED       60      138
  706  KP          INTEGER    ARRAY               REFS        3        9       59       76      102      112
                                               DEFINED       59
  347  KSBW        INTEGER             COMLPRO    REFS        5
  576  KT          INTEGER    ARRAY               REFS        3        9       54      101  DEFINED       57       58
                                                   135      137
  505  L           INTEGER                        REFS       54       55       57       59       60       61       62
                                                    63       64       71       72     2*78  DEFINED       50       55
                                                    69       72       76
    4  LPI         INTEGER             COMLPIN    REFS        6       67
    3  LPO         INTEGER             COMLPIN    REFS        6       69       99
  503  L1          INTEGER                        REFS       28       29     2*31       34     4*36       39       40
                                                    86       87       88       91      133      140
                                               DEFINED       26       29       33       40       82       91      132
  501  L2          INTEGER                        REFS       19       20       24      102      140      141
                                               DEFINED       16       24       99      134      141
  507  L3          INTEGER                        REFS     5*86       87     7*88       92  DEFINED       83       92
  510  L4          INTEGER                        REFS     5*88       93  DEFINED       84       93
    0  MC          INTEGER             COMLPIN    REFS        6       82      109      115      131      132      139
                                                   140      141
   11  MCNH        INTEGER             COMLPIN    REFS        6
    1  MC1         INTEGER             COMLPIN    REFS        6
    2  MR          INTEGER             COMLPIN    REFS        6       26       35       41       45       51       52
                                                    74      113      132      133
   10  MR71        INTEGER             COMLPIN    REFS        6       34       66       83
    0  NH          INTEGER             COMLPRO    REFS        5       10       17       18       22       25       37
                                                    38       42       43       70       85    2*103    2*114
    5  NH1         INTEGER             COMLPIN    REFS        6       31       35       41
    6  NH3         INTEGER             COMLPIN    REFS        6       11       12       13       95      100
    7  NH7         INTEGER             COMLPIN    REFS        6       14       33       34       66
    1  NS          INTEGER             COMLPRO    REFS        5
    2  SU          REAL       ARRAY    COMLPRO    REFS        5       18
   12  TH          REAL                COMLPIN    REFS        6      108      116      122
    0  U           REAL       ARRAY    COMINI1    REFS        4       10       32       67       71    3*103    3*114
                                                   133    2*140
   13  V           REAL       ARRAY    COMLPIN    REFS        6       14       20     2*34     4*36       39     2*42
                                                  3*43     2*64       66       78     5*86       87     7*88
                                               DEFINED       19     5*41     2*42
 1016  W           REAL       ARRAY               REFS        3      128      131    2*140  DEFINED      109      123
                                                   129
  332  XTB         REAL       ARRAY    COMLPRO    REFS        5       15     4*18       19       21       22     2*30
                                                    36       39       43     2*86       87
    0  ZERO        REAL       ARRAY    COMINI2    REFS        8       11       12       13       14       66       73
 1003  ZOO         REAL       ARRAY    COMLPIN    REFS        6       38       71
```

```
VARIABLES       SN  TYPE            RELOCATION
  477  Z1           REAL                              REFS      19      23      28      30      31     104     108
                                                       109     118     130     133  DEFINED     15      21      27
                                                        30      98     106     110     120     128
  500  Z2           REAL                              REFS      18     104     106     116     117     122     123
                                                   DEFINED      15      22     103     114     122
  514  Z3           REAL                              REFS     118     120  DEFINED     117

FILE NAMES         MODE
       OUTPUT      FMT                  WRITES     125

EXTERNALS           TYPE    ARGS        REFERENCES
       DWINIT                3              10
       EXIT                  0             126
       LPINNR                1              32      67
       MOVLEV                3              11      12      13      14      34      64      66      73
       SAXPY                 6             131     140
       SSCAL                 4             133
       UINV                  0              46

INLINE FUNCTIONS    TYPE    ARGS          DEF LINE   REFERENCES
       ABS         REAL      1   INTRIN                  37
       AMAX1       REAL      0   INTRIN                  19
       AMIN1       REAL      0   INTRIN                 2*18

STATEMENT LABELS                DEF LINE    REFERENCES
  464  1         FMT               127         125
    0  13                           40          35
  105  14                           41          37
    0  15                           44          41
  127  16                           45          40
    0  18                           24          17
   50  19                           28          31
  133  20                           50         108
  142  21                           54          56
  144  22                           57          54
  163  23                           65          51      52
    0  24                           72          70
    0  25                           78          77
    0  26                           79          74
  221  27                           82          71
    0  28                           94          85
  166  29                           66          47
  252  30                           97         142
  271  32                          107         100     101     104
  316  34                          122         116
  320  35                          123         113     118     121
  326  37                          128         124
    0  40                          141         139

LOOPS  LABEL     INDEX      FROM-TO     LENGTH     PROPERTIES
  24   18        K           17  24        17B        OPT
  72   13        I           35  40        13B        OPT      EXITS
 115   15        I           41  44        12B        OPT
 135   23        I           51  65        31B                EXT REFS
 200   24        K           70  72         3B    INSTACK      EXITS
 210   26        K           74  79        11B                NOT INNER
 215   25        J           77  78         3B    INSTACK
```

LOOPS	LABEL	INDEX	FROM-TO	LENGTH	PROPERTIES
227	28	K	85 94	22B	OPT
257	32	K	100 107	13B	OPT
306	35	K	113 123	14B	OPT
351	40	K	139 141	13B	EXT REFS

COMMON BLOCKS	LENGTH	MEMBERS - BIAS NAME(LENGTH)							
COMINI1	2666	0	U	(2401)	2401	B	(49)	2450 A1	(72)
		2522	A2	(72)	2594	A3	(72)		
COMLPRO	232	0	NH	(1)	1	NS	(1)	2 SU	(24)
		26	DE	(24)	50	CTB	(168)	218 XTB	(13)
		231	KSBW	(1)					
COMLPIN	589	0	MC	(1)	1	MC1	(1)	2 MR	(1)
		3	LPO	(1)	4	LPI	(1)	5 NH1	(1)
		6	NH3	(1)	7	NH7	(1)	8 MR71	(1)
		9	MCNH	(1)	10	TH	(1)	11 V	(504)
		515	Z00	(24)	539	B2X	(48)	587 CAD6	(1)
		588	CAD7	(1)					
COMINI2	1176	0	ZERO	(1176)					

EQUIV CLASSES	LENGTH	MEMBERS - BIAS NAME(LENGTH)					
KB	193	49	KT	(72)	121	KP	(72)

STATISTICS

PROGRAM LENGTH	1077B	575
CM LABELED COMMON LENGTH	11067B	4663

60000B CM USED

```
      FUNCTION UE11AF(XXXX)
      DIMENSION XXXX(20),B5(24),XOL(5),JXOL(5)
      COMMON /COMCUMU/ NAMCU(3),CU(20,3),R(20)
      COMMON /COMWIND/ W(8),ISWND(2)
      COMMON /COMCOMP/ EFF(22),XM(20,2),CC(20,3),RSLB,RESB,DETOT,DTTOT
      COMMON /COMPURC/ EPUR(11,2),ESLB(10),ECOS(11),ITOD(26),
     A PCOS(10),PDCO(12,2),MHPK(12),MHOUR(12)
     B ,RLCCR
      COMMON /COMANSW/ X(20),XCO(20),MXX(20),CTOT(7,2)
      COMMON /COMSUDE/ SE1(24),SE2(24),ST1(24),ST2(24),DEE(24),DET(24)
      COMMON /COMPRNS/ TA(20,2),TB(20,2),FFD(6,2),AES(6,2),CLV(4),
     1WRS(10,24)
      COMMON /COMUE11/ IND,NITER,E5,E6,E7,E8,RX7,RX8,LPNS,LPNH
      COMMON /COMSXOL/ ISXOL
      DATA XOL/5(-1.)/, BIGW/1E30/
      ADF(I)=AMIN1((DEE(I)-E38*ADS)/E36,B5(I)-AS,(X(3)-E8*AMS)/E6)
      ABF(I)=AMIN1((EBM-E38*ABSS)/E36,B5(I)-AS-AD,(X(3)-E8*AMS)/E6-AD)
      ADSF(I)=AMIN1((DEE(I)-E36*AD)/E38,X8,Q2,(X(3)-E6*(AD+AB))/E8)
      ABSSF(I)=AMIN1((EBM-E36*AB)/E38,AMIN1(X8,Q2,(X(3)-E6*(AD+AB))/E8
     1)-ADS)
      EPUR(11)=EFF(22)=0.
      AD=AB=AS=ADS=ABSS=AMS=B4=0.
      DO 10 J=1,10
   10 EPUR(J)=ESLB(J)=0.
C     INITIALIZE FOR PEAK DEMAND PRICING
      DO 205 J=1,12
      MHPK(J)=0
  205 PDCO(J)=PDCO(J,2)=0.
      MO=1
      NH=0
      NITER=NITER+1
      DO 11 J=1,5
   11 X(J)=XXXX(J)
      X7=RX7*X(2)
      X8=RX8*X(2)
      X3E6=X(3)/E6
      E38=EFF(3)*E8
      R38=RSLB*E38
      E36=EFF(3)*E6
      R36=RSLB*E36
      E78=E7*E8
      E278=EFF(2)*E78
      E23478=EFF(3)*EFF(4)*E278
      RE6=RSLB*E6
      E4X4=EFF(4)*X(4)
      E4X4X7 =AMIN1(E4X4,X7)
      X8X38=AMIN1(X8,X(3)/E8)
      E15X=EFF(1)*E5*X(1)
      JUMP=1
      IF(ISWND(1).LE.0)GO TO 12
      W(8)=DIA=SQRT(259.7*X(1)/W(3)/(W(5)+W(4))**3)
      E15X=E15X*W(7)
      JUMP=2
      QHT=((15.2+.5*DIA)/W(2))**.142857
   12 IS1=-1
      IF(RE6.LT.E278)IS1=0
      IF(E278.GT.E6)IS1=1
```

```
      E2=X(5)*X(2)
       EC=EFF(2)*E2
      CALL TODPR(1)
       JP1=ITOD(1)
       EPUR(JP1)=E2
      EBMT=RESB*EPUR(JP1)*ECOS(JP1)
      EBM=BIGW
      IF(EBMT.LE.0.)EBM=0.
      IF(IND.EQ.0)GO TO 17
       JUMP=JUMP+2
       DO 13 I=1,20
       DO 13 J=1,3
   13 CU(I,J)=0.
       NAMCU(1)=2HST
       NAMCU(2)=2H
      NAMCU(3)=1H
       DO15I=1,2
      DO14J=1,20
   14 TA(J,I)=TB(J,I)=0.
       DO 15 J=1,6
   15 FFD(J,I)=AES(J,I)=0.
      DO 51 I=1,10
       DO 51 J=1,24
   51 WRS(I,J)=0.
       WRITE(9)(X(J),J=1,10)
      DCU2=0.
       IF(X(2).LE.0.)GO TO 16
       DCU2=19.9999/X(2)
   16 IF(JUMP.NE.4)GO TO 17
       QW1=0.00385159*W(7)*W(3)*DIA*DIA
   17 IF(X(1).GT.0.)GO TO 19
       JUMP=5
       DO 18 I=1,24
   18 B5(I)=0.
       IF(IND.NE.0)JUMP=6
   19 DO 60 ND=1,364
       CALL GETSD(ND)
       CALL TODPR(ND)
      PM=ECOS(ITOD(25))
       GO TO (20,22,24,26,74,70),JUMP
   20 DO 21 I=1,24
   21 B5(I)=E15X*SE1(I)
       GO TO 28
   22 DO 23 I=1,24
       B5(I)=0.
       Z1=QHT*SE1(I)-W(4)
      IF(Z1.GT.0..A.Z1.LE.W(6)) B5(I)=E15X*AMIN1(1.,Z1/W(5))
   23 CONTINUE
       GO TO 28
   24 DO 25 I=1,24
       B5(I)=E15X*SE1(I)
       TB(1)=TB(1)+B5(I)
   25 TA(1)=TA(1)+X(1)*SE1(I)
       GO TO 28
   26 DO 27 I=1,24
       Z1=QHT*SE1(I)
       TA(1)=TA(1)+QW1*(Z1**3)
```

```
            B5(I)=0.
             Z1=Z1-W(4)
             IF(Z1.LE.0..O.Z1.GT.W(6))GO TO 27
            B5(I)=E15X*AMIN1(1.,Z1/W(5))
             TB(1)=TB(1)+B5(I)
      27    CONTINUE
             GO TO 28
      28    CONTINUE
            IF(X(2))71,71,70
C             X(2)=0.
      71    DO 73 I=1,24
            NH=NH+1
             JP=ITOD(I)
             IF(B5(I).GT.0.)GO TO 72
            EPUR(JP)=EPUR(JP)+DEE(I)
C           CHECK MONTH
            IF(NH.GT.MHOUR(MO))MO=MO+1
C           FIND PEAK DEMAND PURCHASED FOR EACH MONTH (MAX COST NOT MAX ENERGY)
            Z7=DEE(I)*PCOS(JP)
            IF(Z7.LE.PDCO(MO))GO TO 200
            PDCO(MO)=Z7
            MHPK(MO)=NH
            PDCO(MO,2)=DEE(I)
     200    CONTINUE
C           FIND PEAK ENERGY FOR EACH MONTH IF PEAK DEMAND COST IS ZERO
            IF(PDCO(MO,1).NE.0. .O. DEE(I).LE.PDCO(MO,2))GO TO 206
            PDCO(MO,2)=DEE(I)
            MHPK(MO)=NH
     206    CONTINUE
             IF(IND.EQ.0)GO TO 73
            WRS(1,I)=WRS(2,I)=WRS(8,I)=0.
             WRS(9,I)=DEE(I)
            WRS(10,I)=ECOS(JP)
             GO TO 73
      72    AD=AMIN1(DEE(I)/E36,X3E6,B5(I))
            AB=AMIN1(EBM/E36,X3E6-AD,B5(I)-AD)
            EPUR(JP)=EPUR(JP)+DEE(I)-E36*AD
            ESLB(JP)=ESLB(JP)+E36*AB
            EBMT=EBMT+ECOS(JP)*(RESB*(DEE(I)-E36*AD)-R36*AB)
            EBM=BIGW
            IF(EBMT.LE.0.)EBM=0.
             IF(IND.EQ.0)GO TO 73
             Z1=AD+AB
            FFD(1)=FFD(1)+Z1
            Z1=Z1*E6
            TA(3)=TA(3)+Z1
            TB(3)=AMAX1(TB(3),Z1)
            WRS(1,I)=AD
             WRS(2,I)=AB
             WRS(8,I)=B5(I)
             WRS(9,I)=DEE(I)
            WRS(10,I)=ECOS(JP)
      73    CONTINUE
             GO TO 59
C           X1=0.  AND  IND=0
      74    DO 78 I=1,24
            NH=NH+1
```

```
       E2=EFF(2)*E2
       JP=ITOD(I)
       RPM=ECOS(JP)/PM
      ADS=ABSS=B4=0.
       IF(E2.LT.EC)GO TO 75
       IF(RPM.LT.RSLB)GOTO 77
      ADS=AMIN1(DEE(I)/E38,X8X38,E2)
      IF(RPM.EQ.1.)ABSS=AMIN1(EBM/E38,X8X38-ADS,E2-ADS)
       GO TO 77
   75 IF(RPM.NE.1.)GO TO 76
       ADS=AMIN1(DEE(I)/E38,X8X38,E2)
       GO TO 77
   76 IF(E23478.GT.RPM)B4=AMIN1(E4X4X7,(X(2)-E2)/E7)
   77 Z6=DEE(I)-E38*ADS+B4/EFF(4)
      EFF(22)=EFF(22)+ADS+ABSS
      EPUR(JP)=EPUR(JP)+Z6
C     CHECK MONTH
      IF(NH.GT.MHOUR(MO))MO=MO+1
C     FIND MAX PEAK DEMAND COST FOR EACH MONTH
      Z7=Z6*PCOS(JP)
      IF(Z7.LE.PDCO(MO))GO TO 210
      PDCO(MO)=Z7
      MHPK(MO)=NH
      PDCO(MO,2)=Z6
  210 CONTINUE
C     FIND PEAK DEMAND FOR EACH MONTH IF PEAK DEMAND COST IS ZERO
      IF(PDCO(MO,1).NE.0. .O. Z6.LE.PDCO(MO,2))GO TO 215
      PDCO(MO,2)=Z6
      MHPK(MO)=NH
  215 CONTINUE
      ESLB(JP)=ESLB(JP)+E38*ABSS
      EBMT=EBMT+ECOS(JP)*(RESB*Z6-R38*ABSS)
      EBM=BIGW
      IF(EBMT.LE.0.)EBM=0.
       E2=E2+E7*B4-ADS-ABSS
   78 CONTINUE
       GO TO 59
C          ------------
   70 DO 57 I=1,24
      NH=NH+1
       E2=EFF(2)*E2
       JP=ITOD(I)
       RPM=ECOS(JP)/PM
      AD=AB=AS=ADS=ABSS=B4=AMS=0.
       IF(B5(I).GT.0.)GO TO 31
C     B5=0.
      IF(E2.LT.EC) GO TO 29
       IF(RPM.LT.RSLB) GO TO 50
      ADS=AMS=AMIN1(DEE(I)/E38,X8X38,E2)
      IF(RPM.NE.1.)GO TO 50
       ABSS=AMIN1(EBM/E38,X8X38-ADS,E2-ADS)
      AMS=AMS+ABSS
       GO TO 50
   29 IF(RPM.NE.1.)GO TO 30
       ADS=AMS=AMIN1(DEE(I)/E38,X8X38,E2)
      GO TO 50
   30 IF(E23478.GT.RPM)B4=AMIN1(E4X4X7,(X(2)-E2)/E7)
```

```
         GO TO 50
C       B5.GT.0
   31   IF(E2.LT.EC)GO TO 37
         IF(IS1)32,33,35
   32   AD=ADF(I)
         AB=ABF(I)
         JUMG=-1
         GO TO 46
   33   AD=ADF(I)
         JUMG=0
         GO TO 46
   34   AB=ABF(I)
         GO TO 50
   35   JUMG=1
         GO TO 46
   36   AD=ADF(I)
         AB=ABF(I)
         GO TO 50
C       E2.LT.EC
   37   Z1=E278/RPM
         IF(Z1.GT.RE6)GO TO 38
         JUMG=-1
        AD=ADF(I)
         AB=ABF(I)
         GO TO 49
   38   IF(Z1.GT.E6)GO TO 40
         AD=ADF(I)
         JUMG=0
         GO TO 49
   39   AB=ABF(I)
         GO TO 50
   40   JUMG=1
         GO TO 49
   41   AD=ADF(I)
         AB=ABF(I)
         GO TO 50
C        STORAGE LOOP    E2.GE.EC
   46   Q7=AMIN1(X7,B5(I)-AD-AB)
         Q2=E2+Q7*E7
        IF(RPM.NE.1.)GO TO 47
         ADS=ADSF(I)
        IF(Q7.LE.0..O.E78.GE.E6) ABSS=ABSSF(I)
         GO TO 48
   47   IF(RPM.GE.RSLB) ADS=ADSF(I)
   48   AMS=ADS+ABSS
         AS=Q7-AMAX1(0.,Q2-X(2)-AMS)/E7
         IF(JUMG)50,34,36
C        STORAGE     E2.LT.EC
   49   Q7=AMIN1(X7,B5(I)-AD-AB)
         Q2=E2+Q7*E7
        IF(RPM.EQ.1.) AMS=ADS=ADSF(I)
         AS=Q7-AMAX1(0.,Q2-AMS-X(2))/E7
        IF(E23478.GT.RPM) B4=AMIN1(E4X4,X7-AS,(X(2)-E2)/E7-AS)
        IF(JUMG) 50,39,41
   50   CONTINUE
        Z6=B4/EFF(4)+DEE(I)-E36*AD-E38*ADS
         EPUR(JP)=EPUR(JP)+Z6
```

```
      EFF(22)=EFF(22)+AMS
C     CHECK MONTH
      IF(NH.GT.MHOUR(MO))MO=MO+1
C     FIND PEAK COST FOR EACH MONTH
      Z7=Z6*PCOS(JP)
      IF(Z7.LE.PDCO(MO))GO TO 220
      PDCO(MO)=Z7
      MHPK(MO)=NH
      PDCO(MO,2)=Z6
  220 CONTINUE
C     FIND PEAK DEMAND FOR EACH MONTH IF THE PEAK COST IS ZERO
      IF(PDCO(MO,1).NE.0. .O. Z6.LE.PDCO(MO,2))GO TO 225
      PDCO(MO,2)=Z6
      MHPK(MO)=NH
  225 CONTINUE
      Z5=E36*AB+E38*ABSS
      EBMT=EBMT+ECOS(JP)*(RESB*Z6-RSLB*Z5)
      EBM=BIGW
      IF(EBMT.LE.0.)EBM=0.
       ESLB(JP)=ESLB(JP)+Z5
      E2=E2+E7*(AS+B4)-AMS
       IF(IND.EQ.0)GO TO 57
       AES(1)=AES(1)+AMS
      AES(2)=AES(2)+E2
       FFD(1)=FFD(1)+AD+AB
       FFD(5)=FFD(5)+ADS
      Z1=AS+B4
       TA(2)=TA(2)+Z1
      L=E2*DCU2+1.
       CU(L)=CU(L)+1.
       FFD(2)=FFD(2)+AS
      TB(2)=TB(2)+AMS
      Z1=E6*(AD+AB)+E8*AMS
       TA(3)=TA(3)+Z1
       TB(3)=AMAX1(TB(3),Z1)
      Z1=B4/EFF(4)
       TA(4)=TA(4)+Z1
       TB(4)=AMAX1(TB(4),Z1)
      WRS(1,I)=AD
       WRS(2,I)=AB
       WRS(3,I)=AS
       WRS(4,I)=ADS
      WRS(5,I)=ABSS
       WRS(6,I)=Z1
       WRS(7,I)=E2
      WRS(8,I)=B5(I)
       WRS(9,I)=DEE(I)
       WRS(10,I)=ECOS(JP)
   57 CONTINUE
   59 IF(IND.NE.0)WRITE(9)((WRS(I,J),I=1,10),J=1,24)
   60 CONTINUE
       EPUR(JP1)=EPUR(JP1)-E2
       UE11AF=COST(ZZZZZ)
      IF(ISXOL.EQ.0)GO TO 102
       DO 100 J=1,5
       XOL(J)=1H
      IF(X(J).EQ.XOL(J))GO TO 100
```

```
          JXOL(J)=1H*
          XOL(J)=X(J)
  100   CONTINUE
          PRINT101,UE11AF,(XOL(J),JXOL(J),J=1,5)
  101   FORMAT(1X,F15.3,5(F16.4,A1))
  102   IF(IND.EQ.0)RETURN
        Z1=1.E-30
          DO 61  J=1,10
  61    Z1=Z1+EPUR(J)-ESLB(J)
          CLV(1)=CTOT(1)/DETOT
        CLV(2)=0.
          Z2=DETOT-Z1
        IF(Z2.NE.0.)CLV(2)=(CTOT(2)+CTOT(3))/Z2
        CLV(3)=CLV(4)=0.
          IF(Z1.NE.0.)CLV(4)=CTOT(5)/Z1
        Z1=FFD(2)+TA(4)
          IF(Z1.GT.0.)AES(1)=100.*E8*AES(1)/Z1
        IF(Z1.LE.0.)AES(1)=0.
        AES(3)=(1.-EFF(2))*AES(2)
          FFD(6)=TB(1)-FFD(1)-FFD(2)
        IF(TA(2).GT.0.)FFD(1)=100.*(E36*FFD(1)+E38*E7*FFD(2)-
       1FFD(2)*AES(3)/TA(2))/DETOT
        IF(TA(2).LE.0.)FFD(1)=100.*E36*FFD(1)/DETOT
        Z1=TA(1)+TA(4)
          IF(Z1.GT.0.)FFD(3)=100.*EFF(3)*TA(3)/Z1
        FFD(4)=100.*(EFF(3)*TA(3)-CTOT(7,2))/DETOT
        FFD(5)=100.*E38*FFD(5)/DETOT
          FFD(2)=100.-FFD(1)
        TB(1)=TB(1)/E5
          TA(2)=TA(2)*E7
        Z1=24.*364.
          AES(2)=AES(2)/Z1
        TB(1)=TB(1)/Z1
          TB(2)=TB(2)/Z1
          DO 62  J=1,4
  62    TA(J)=TA(J)/Z1
        RETURN
          END
```

SYMBOLIC REFERENCE MAP (R=3)

ENTRY POINTS	DEF LINE	REFERENCES	
4 UE11AF	1	348	379

VARIABLES	SN	TYPE	RELOCATION								
1537 AB		REAL		REFS	152	153	157	163	266	269	2*270
				272	277	279	301	310	318	325	
				DEFINED	22	150	215	234	240	245	252
				258	263						
1542 ABSS		REAL		REFS	186	202	203	206	223	234	240
				245	252	258	263	273	301	328	
				DEFINED	22	175	179	215	222	270	
1536 AD		REAL		REFS	2*150	151	153	157	162	2*234	2*240

```
VARIABLES          SN  TYPE          RELOCATION
                                                2*245   2*252   2*258   2*263    266    2*269    270    2*272
                                                  277   2*279     284     310    318      324
                                              DEFINED      22     149     215    233      237    244      251
                                                  255     262
 1541  ADS        REAL                           REFS   2*179     185     186    206    2*222    233      237
                                                  244     251     255     262    270      273    284      311
                                                  327 DEFINED      22     175    178      182    215      220
                                                  226     269     272     279
  134  AES        REAL       ARRAY   COMPRNS     REFS      11     308     309    359      361    363      374
                                              DEFINED      78     308     309    359      360    361      374
 1543  AMS        REAL                           REFS     223     233     234    237      240    244      245
                                                  251     252     255     258    262      263    274      280
                                                  286     306     308     317    318  DEFINED     22      215
                                                  220     223     226     273    279
 1540  AS         REAL                           REFS     233     234     237    240      244    245      251
                                                  252     255     258     262    263    2*281    306      312
                                                  316     326 DEFINED      22    215      274    280
 1472  BIGW       REAL                           REFS      64     154     204    303  DEFINED     15
 1544  B4         REAL                           REFS     185     206     284    306      312    321
                                              DEFINED      22     175     184    215      228    281
 1621  B5         REAL       ARRAY               REFS       2     109     119    128      149    150      164
                                                  216     233     234     237    240      244    245      251
                                                  252     255     258     262    263      266    277      331
                                              DEFINED      91      99     102    104      108    115      118
   76  CC         REAL       ARRAY   COMCOMP     REFS       5
  150  CLV        REAL       ARRAY   COMPRNS     REFS      11 DEFINED     352    353      355  2*356      357
   74  CTOT       REAL       ARRAY   COMANSW     REFS       9     352   2*355    357      368
    3  CU         REAL       ARRAY   COMCUMU     REFS       3     315 DEFINED     70      315
 1601  DCU2       REAL                           REFS     314 DEFINED      83     85
  140  DEE        REAL       ARRAY   COMSUDE     REFS      10     129     133    137      140    141      146
                                                  149     151     153     165    178      182    185      220
                                                  226     233     237     244    251      255    262      269
                                                  272     279     284     332
  170  DET        REAL       ARRAY   COMSUDE     REFS      10
  174  DETOT      REAL               COMCOMP     REFS       5     352     354    363      365    368      369
 1570  DIA        REAL                           REFS      54    2*87 DEFINED     51
  175  DTTOT      REAL               COMCOMP     REFS       5
 1577  EBM        REAL                           REFS     150     179     222    234      240    245      252
                                                  258     263     270 DEFINED     64       65    154      155
                                                  204     205     303     304
 1576  EBMT       REAL                           REFS      65     153     155    203      205    302      304
                                              DEFINED      63     153     203    302
 1574  EC         REAL                           REFS     176     218     231 DEFINED      59
   40  ECOS       REAL       ARRAY   COMPURC     REFS       6      63      96    147      153    166      174
                                                  203     214     302     333
    0  EFF        REAL       ARRAY   COMCOMP     REFS       5      37      39     42     2*43     45       48
                                                   59     172     185     186    212      284    286      321
                                                  361     367     368 DEFINED     21      186    286
    0  EPUR       REAL       ARRAY   COMPURC     REFS       6      63     129    151      187    285      337
                                                  351 DEFINED      21      24     62      129    151      187
                                                  285     337
   26  ESLB       REAL       ARRAY   COMPURC     REFS       6     152     202    305      351
                                              DEFINED      24     152     202    305
 1566  E15X       REAL                           REFS      52      99     104    108      118
                                              DEFINED      48      52
 1573  E2         REAL                           REFS      59      62     172    176      178    179      182
                                                  184     206     212     218    220      222    226      228
```

VARIABLES	SN	TYPE		RELOCATION								
					231	267	278	281	306	309	314	330
					337	DEFINED	58	172	206	212	306	
1561	E23478	REAL			REFS	184	228	281	DEFINED	43		
1560	E278	REAL			REFS	43	56	57	248	DEFINED	42	
1555	E36	REAL			REFS	40	149	150	151	152	153	233
					234	237	240	244	245	251	252	255
					258	262	263	269	270	272	279	284
					301	363	365	DEFINED	39			
1553	E38	REAL			REFS	38	178	179	182	185	202	220
					222	226	233	234	237	240	244	245
					251	252	255	258	262	263	269	270
					272	279	284	301	363	369		
					DEFINED	37						
1563	E4X4	REAL			REFS	46	281	DEFINED	45			
1564	E4X4X7	REAL			REFS	184	228	DEFINED	46			
2	E5	REAL		COMUE11	REFS	13	48	371				
3	E6	REAL		COMUE11	REFS	13	36	39	44	57	159	233
					234	237	240	244	245	251	252	254
					255	258	262	263	269	2*270	272	279
					318							
4	E7	REAL		COMUE11	REFS	13	41	184	206	228	267	274
					278	280	281	306	363	372		
1557	E78	REAL			REFS	42	270	DEFINED	41			
5	E8	REAL		COMUE11	REFS	13	37	41	47	233	234	237
					240	244	245	251	252	255	258	262
					263	269	270	272	279	318	359	
120	FFD	REAL	ARRAY	COMPRNS	REFS	11	158	310	311	316	358	2*362
					3*363	365	369	370	DEFINED	78	158	310
					311	316	362	363	365	367	368	369
					370							
1600	I	INTEGER			REFS	70	2*76	2*78	81	91	2*99	102
					103	104	2*108	109	110	113	115	118
					119	127	128	129	133	137	140	141
					3*145	2*146	147	2*149	150	151	153	162
					163	2*164	2*165	166	173	178	182	185
					213	216	220	226	2*233	234	2*237	240
					2*244	245	2*251	252	2*255	258	2*262	263
					266	269	272	277	279	284	324	325
					326	327	328	329	330	2*331	2*332	333
					335	DEFINED	68	74	79	90	98	101
					107	112	125	170	210	335		
0	IND	INTEGER		COMUE11	REFS	13	66	92	144	156	307	335
					348							
10	ISWND	INTEGER	ARRAY	COMWIND	REFS	4	50					
0	ISXOL	INTEGER		COMSXOL	REFS	14	339					
1572	IS1	INTEGER			REFS	232	DEFINED	55	56	57		
53	ITOD	INTEGER	ARRAY	COMPURC	REFS	6	61	96	127	173	213	
1545	J	INTEGER			REFS	2*24	27	2*28	2*33	70	2*76	2*78
					81	82	335	341	2*342	343	2*344	2*346
					2*351	2*378	DEFINED	23	26	32	69	75
					77	80	82	335	340	346	350	377
1606	JP	INTEGER			REFS	2*129	133	147	2*151	2*152	153	166
					174	2*187	191	2*202	203	214	2*285	290
					302	2*305	333	DEFINED	127	173	213	
1575	JP1	INTEGER			REFS	62	2*63	2*337	DEFINED	61		
1612	JUMG	INTEGER			REFS	275	282	DEFINED	235	238	242	250
					256	260						

```
VARIABLES      SN  TYPE             RELOCATION
  1567  JUMP     INTEGER                          REFS        67       86       97  DEFINED     49       53       67
                                                    89        92
  1656  JXOL     INTEGER    ARRAY                 REFS         2      346  DEFINED      341      343
  1616  L        INTEGER                          REFS     2*315  DEFINED      314
    11  LPNH     INTEGER             COMUE11      REFS        13
    10  LPNS     INTEGER             COMUE11      REFS        13
   163  MHOUR    INTEGER    ARRAY    COMPURC      REFS         6      131      189      288
   147  MHPK     INTEGER    ARRAY    COMPURC      REFS         6  DEFINED       27      136      142      194      200
                                                   293       299
  1546  MO       INTEGER                          REFS     2*131      134      135      136      137    2*140      141
                                                   142     2*189      192      193      194      195    2*198      199
                                                   200     2*288      291      292      293      294    2*297      298
                                                   299   DEFINED       29      131      189      288
    50  MXX      INTEGER    ARRAY    COMANSW      REFS         9
     0  NAMCU    INTEGER    ARRAY    COMCUMU      REFS         3  DEFINED       71       72       73
  1603  ND       INTEGER                          REFS        94       95  DEFINED       93
  1547  NH       INTEGER                          REFS       126      131      136      142      171      189      194
                                                   200       211      288      293      299  DEFINED       30      126
                                                   171       211
     1  NITER    INTEGER             COMUE11      REFS        13       31  DEFINED       31
   105  PCOS     REAL       ARRAY    COMPURC      REFS         6      133      191      290
   117  PDCO     REAL       ARRAY    COMPURC      REFS         6      134    2*140      192    2*198      291    2*297
                                               DEFINED      2*28      135      137      141      193      195      199
                                                   292       294      298
  1604  PM       REAL                             REFS       174      214  DEFINED       96
  1571  QHT      REAL                             REFS       103      113  DEFINED       54
  1602  QW1      REAL                             REFS       114  DEFINED       87
  1614  Q2       REAL                             REFS       269      270      272      274      279      280
                                               DEFINED       267      278
  1613  Q7       REAL                             REFS       267      270      274      278      280
                                               DEFINED       266      277
    77  R        REAL       ARRAY    COMCUMU      REFS         3
   173  RESB     REAL                COMCOMP      REFS         5       63      153      203      302
  1562  RE6      REAL                             REFS        56      249  DEFINED       44
   177  RLCCR    REAL                COMPURC      REFS         6
  1610  RPM      REAL                             REFS       177      179      181      184      219      221      225
                                                   228       248      268      272      279      281
                                               DEFINED       174      214
   172  RSLB     REAL                COMCOMP      REFS         5       38       40       44      177      219      272
                                                   302
     6  RX7      REAL                COMUE11      REFS        13       34
     7  RX8      REAL                COMUE11      REFS        13       35
  1556  R36      REAL                             REFS       153  DEFINED       40
  1554  R38      REAL                             REFS       203  DEFINED       38
     0  SE1      REAL       ARRAY    COMSUDE      REFS        10       99      103      108      110      113
    30  SE2      REAL       ARRAY    COMSUDE      REFS        10
    60  ST1      REAL       ARRAY    COMSUDE      REFS        10
   110  ST2      REAL       ARRAY    COMSUDE      REFS        10
     0  TA       REAL       ARRAY    COMPRNS      REFS        11      110      114      160      313      319      322
                                                   358     2*363      365    2*366      367      368      372      378
                                               DEFINED        76      110      114      160      313      319      322
                                                   372       378
    50  TB       REAL       ARRAY    COMPRNS      REFS        11      109      119      161      317      320      323
                                                   362       371      375      376  DEFINED       76      109      119
                                                   161       317      320      323      371      375      376
  1535  UE11AF   REAL                             REFS       346  DEFINED      338
     0  W        REAL       ARRAY    COMWIND      REFS         4     3*51       52       54     2*87      103    2*104
```

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VARIABLES       SN  TYPE            RELOCATION
                                                 116      117      118   DEFINED     51
  154  WRS          REAL     ARRAY     COMPRNS   REFS      11      335   DEFINED     81     3*145     146     147
                                                 162      163      164      165     166      324     325     326
                                                 327      328      329      330     331      332     333
    0  X            REAL     ARRAY     COMANSW   REFS       9       34       35      36       45      47      48
                                                  51     2*58       82       84      85       88     110     123
                                                 184      228      233      234     237      240     244     245
                                                 251      252      255      258     262      263     269     270
                                                 272      274      279      280     281      342     344
                                             DEFINED       33
   24  XCO          REAL     ARRAY     COMANSW   REFS       9
   26  XM           REAL     ARRAY     COMCOMP   REFS       5
 1651  XOL          REAL     ARRAY               REFS       2      342      346  DEFINED      15      344
    0  XXXX         REAL     ARRAY      F.P.     REFS       2       33  DEFINED       1
 1552  X3E6         REAL                         REFS     149      150  DEFINED      36
 1550  X7           REAL                         REFS      46      266      277     281  DEFINED      34
 1551  X8           REAL                         REFS      47      269      270     272      279
                                             DEFINED       35
 1565  X8X38        REAL                         REFS     178      179      182     220      222     226
                                             DEFINED       47
 1617  ZZZZZ     *  REAL                         REFS     338
 1605  Z1           REAL                         REFS   3*104      114      116   2*117      118     158     159
                                                 160      161      249      254     313      319     320     322
                                                 323      329      351      354   2*357    2*359     360   2*367
                                                 374      375      376      378  DEFINED     103     113     116
                                                 157      159      248      312     318      321     349     351
                                                 358      366      373
 1620  Z2           REAL                         REFS   2*355  DEFINED      354
 1615  Z5           REAL                         REFS     302      305  DEFINED     301
 1611  Z6           REAL                         REFS     187      191      195     198      199     203     285
                                                 290      294      297      298     302  DEFINED     185     284
 1607  Z7           REAL                         REFS     134      135      192     193      291     292
                                             DEFINED      133      191      290

FILE NAMES        MODE
       OUTPUT     FMT                 WRITES     346
       TAPE9      UNFMT               WRITES      82      335

EXTERNALS             TYPE   ARGS         REFERENCES
       COST       REAL        1                338
       GETSD                  1                 94
       SQRT       REAL        1 LIBRARY         51
       TODPR                  1                 60       95

INLINE FUNCTIONS      TYPE   ARGS        DEF LINE  REFERENCES
       ABF        REAL        1     SF        17     234      240      245     252      258     263
       ABSSF      REAL        1     SF        19     270
       ADF        REAL        1     SF        16     233      237      244     251      255     262
       ADSF       REAL        1     SF        18     269      272      279
       AMAX1      REAL        0   INTRIN             161      274      280     320      323
       AMIN1      REAL        0   INTRIN              46       47      104     118      149     150     178     179
                                                     182      184      220     222      226     228     233     234
                                                     237      240      244     245      251     252     255     258
                                                     262      263      266     269    2*270     272     277     279
                                                     281
```

STATEMENT LABELS			DEF LINE	REFERENCES								
0	10		24	23								
0	11		33	32								
75	12		55	50								
0	13		70	68	69							
0	14		76	75								
0	15		78	74	77							
163	16		86	84								
171	17		88	66	86							
0	18		91	90								
201	19		93	88								
223	20		98	97								
0	21		99	98								
230	22		101	97								
0	23		105	101								
245	24		107	97								
0	25		110	107								
257	26		112	97								
275	27		120	112	117							
300	28		122	100	106	111	121					
566	29		225	218								
577	30		228	225								
607	31		231	216								
0	32	INACTIVE	233	232								
635	33		237	232								
651	34		240	275								
666	35		242	232								
670	36		244	275								
712	37		248	231								
740	38		254	249								
756	39		258	282								
773	40		260	254								
775	41		262	282								
1017	46		266	236	239	243						
1057	47		272	268								
1075	48		273	271								
1107	49		277	253	257	261						
1154	50		283	219	221	224	227	229	241	246	259	264
				275	282							
0	51		81	79	80							
1300	57		334	210	307							
1303	59		335	168	208							
0	60		336	93								
0	61		351	350								
0	62		378	377								
525	70		210	97	123							
0	71	INACTIVE	125	2*123								
337	72		149	128								
404	73		167	125	144	148	156					
407	74		170	97								
441	75		181	176								
450	76		184	181								
456	77		185	177	180	183						
0	78		207	170								
1326	100		345	340	342							
1511	101	FMT	347	346								
1346	102		348	339								

STATEMENT LABELS		DEF LINE	REFERENCES
323	200	138	134
0	205	28	26
330	206	143	140
477	210	196	192
504	215	201	198
1177	220	295	291
1204	225	300	297

LOOPS	LABEL	INDEX	FROM-TO	LENGTH	PROPERTIES	
11	10	J	23 24	3B	INSTACK	
15	205	J	26 28	3B	INSTACK	
25	11	J	32 33	2B	INSTACK	
125	13	I	68 70	4B		NOT INNER
126	13	J	69 70	2B	INSTACK	
135	15	I	74 78	14B		NOT INNER
140	14	J	75 76	3B	INSTACK	
145	15	J	77 78	3B	INSTACK	
152	51	I	79 81	4B		NOT INNER
153	51	J	80 81	2B	INSTACK	
175	18	I	90 91	2B	INSTACK	
205	60	ND	93 336	1104B		EXT REFS NOT INNER
226	21	I	98 99	2B	INSTACK	
235	23	I	101 105	7B	INSTACK	
252	25	I	107 110	3B	INSTACK	
263	27	I	112 120	13B	OPT	
306	73	I	125 167	100B	OPT	
414	78	I	170 207	107B	OPT	
531	57	I	210 334	551B	OPT	
1323	100	J	340 345	4B	INSTACK	
1335		J	346 346	10B		EXT REFS
1353	61	J	350 351	3B	INSTACK	
1456	62	J	377 378	2B	INSTACK	

COMMON BLOCKS	LENGTH	MEMBERS - BIAS NAME(LENGTH)								
COMCUMU	83	0	NAMCU	(3)	3	CU	(60)	63	R	(20)
COMWIND	10	0	W	(8)	8	ISWND	(2)			
COMCOMP	126	0	EFF	(22)	22	XM	(40)	62	CC	(60)
		122	RSLB	(1)	123	RESB	(1)	124	DETOT	(1)
		125	DTTOT	(1)						
COMPURC	128	0	EPUR	(22)	22	ESLB	(10)	32	ECOS	(11)
		43	ITOD	(26)	69	PCOS	(10)	79	PDCO	(24)
		103	MHPK	(12)	115	MHOUR	(12)	127	RLCCR	(1)
COMANSW	74	0	X	(20)	20	XCO	(20)	40	MXX	(20)
		60	CTOT	(14)						
COMSUDE	144	0	SE1	(24)	24	SE2	(24)	48	ST1	(24)
		72	ST2	(24)	96	DEE	(24)	120	DET	(24)
COMPRNS	348	0	TA	(40)	40	TB	(40)	80	FFD	(12)
		92	AES	(12)	104	CLV	(4)	108	WRS	(240)
COMUE11	10	0	IND	(1)	1	NITER	(1)	2	E5	(1)
		3	E6	(1)	4	E7	(1)	5	E8	(1)
		6	RX7	(1)	7	RX8	(1)	8	LPNS	(1)
		9	LPNH	(1)						
COMSXOL	1	0	ISXOL	(1)						

STATISTICS		
PROGRAM LENGTH	1663B	947
CM LABELED COMMON LENGTH	1634B	924

STATISTICS
66500B CM USED

```
      FUNCTION UE11BF(XXXX)
      DIMENSION XXXX(20),B5(24),XOL(5),JXOL(5)
      COMMON /COMUPDN/ IHUP,PRUP,IHDN,PRDN
      COMMON /COMCUMU/ NAMCU(3),CU(20,3),R(20)
      COMMON /COMWIND/ W(8),ISWND(2)
      COMMON /COMCOMP/ EFF(22),XM(20,2),CC(20,3),RSLB,RESB,DETOT,DTTOT
      COMMON /COMPURC/ EPUR(11,2),ESLB(10),ECOS(11),ITOD(26),
     A PCOS(10),PDCO(12,2),MHPK(12),MHOUR(12)
     B ,RLCCR
      COMMON /COMANSW/ X(20),XCO(20),MXX(20),CTOT(7,2)
      COMMON /COMSUDE/ SE1(24),SE2(24),ST1(24),ST2(24),DEE(24),DET(24)
      COMMON /COMPRNS/ TA(20,2),TB(20,2),FFD(6,2),AES(6,2),CLV(4),
     1WRS(10,24)
      COMMON /COMUE11/ IND,NITER,E5,E6,E7,E8,RX7,RX8,LPNS,LPNH
      COMMON /COMSXOL/ ISXOL
       DATA XOL/5(-1.)/
      DATA BIGW/1E30/
      ADF(I)=AMIN1((DEE(I)-E38*ADS)/E36,B5(I)-AS,(X(3)-E8*AMS)/E6)
      ABF(I)=AMIN1((EBM-E38*ABSS)/E36,B5(I)-AS-AD,(X(3)-E8*AMS)/E6-AD)
      ADSF(I)=AMIN1((DEE(I)-E36*AD)/E38,X8,Q2,(X(3)-E6*(AD+AB))/E8)
      ABSSF(I)=AMIN1((EBM-E36*AB)/E38,AMIN1(X8,Q2,(X(3)-E6*(AD+AB))/E8
     1)-ADS)
      EPUR(11)=EFF(22)=0.
       AD=AB=AS=ADS=ABSS=AMS=B4=0.
       DO 10 J=1,10
   10 EPUR(J)=ESLB(J)=0.
      DO 200 J=1,12
      MHPK(J)=0
  200 PDCO(J,1)=PDCO(J,2)=0.
      NH=0
      MO=1
       NITER=NITER+1
       DO 11 J=1,4
   11 X(J)=XXXX(J)
       X7=RX7*X(2)
       X8=RX8*X(2)
       X3E6=X(3)/E6
      E15X=EFF(1)*E5*X(1)
       JUMP=1
       IF(ISWND(1).LE.0)GO TO 12
      W(8)=DIA=SQRT(259.7*X(1)/W(3)/(W(5)+W(4))**3)
       E15X=E15X*W(7)
      JUMP=2
       QHT=((15.2+.5*DIA)/W(2))**.142857
   12 E2=0.
      EBMT=EBM=0.
       NH=IHUP=0
      CALL TODPR(1)
       JP1=ITOD(1)
      E36=EFF(3)*E6
      R36=RSLB*E36
       E38=EFF(3)*E8
      R38=RSLB*E38
       E4X4=EFF(4)*X(4)
      E7X7E4=E7*AMIN1(X7,E4X4)
       X8X38=AMIN1(X8,X(3)/E8)
      IF(E7X7E4.LE.0.)E7X7E4=-1.E30
```

```
      E78=E7*E8
       E3478=EFF(3)*EFF(4)*E78
       RE6=RSLB*E6
      IF(IND.EQ.0)GO TO 17
       JUMP=JUMP+2
       DO 13 I=1,20
       DO 13 J=1,3
13    CU(I,J)=0.
       NAMCU(1)=2HST
       NAMCU(2)=2H
      NAMCU(3)=1H
       DO15I=1,2
      DO14J=1,20
14    TA(J,I)=TB(J,I)=0.
       DO 15 J=1,6
15    FFD(J,I)=AES(J,I)=0.
      DO 51 I=1,10
       DO 51 J=1,24
51    WRS(I,J)=0.
       WRITE(9)(X(J),J=1,10)
      DCU2=0.
       IF(X(2).LE.0.)GO TO 16
       DCU2=19.9999/X(2)
16    IF(JUMP.NE.4)GO TO 17
       QW1=0.00385159*W(7)*W(3)*DIA*DIA
17    IF(X(1).GT.0.)GO TO 19
       JUMP=5
       DO 18 I=1,24
18    B5(I)=0.
       IF(IND.NE.0)JUMP=6
19    DO 60 ND=1,364
       CALL GETSD(ND)
       CALL TODPR(ND)
      GO TO (20,22,24,26,74,70),JUMP
20    DO 21 I=1,24
21    B5(I)=E15X*SE1(I)
       GO TO 28
22    DO 23 I=1,24
       B5(I)=0.
       Z1=QHT*SE1(I)-W(4)
      IF(Z1.GT.0..A.Z1.LE.W(6))B5(I)=E15X*AMIN1(1.,Z1/W(5))
23    CONTINUE
       GO TO 28
24    DO 25 I=1,24
       B5(I)=E15X*SE1(I)
       TB(1)=TB(1)+B5(I)
25    TA(1)=TA(1)+X(1)*SE1(I)
       GO TO 28
26    DO 27 I=1,24
       Z1=QHT*SE1(I)
       TA(1)=TA(1)+QW1*(Z1**3)
      B5(I)=0.
       Z1=Z1-W(4)
       IF(Z1.LE.0..O.Z1.GT.W(6))GO TO 27
      B5(I)=E15X*AMIN1(1.,Z1/W(5))
       TB(1)=TB(1)+B5(I)
27    CONTINUE
```

```
                GO TO 28
         28    CONTINUE
               IF(X(2))71,71,70
      C        X2=0.
         71    DO 73 I=1,24
               NH=NH+1
                JP=ITOD(I)
                IF(B5(I).GT.0.)GO TO 72
               EPUR(JP)=EPUR(JP)+DEE(I)
      C        CHECK MONTH
               IF(NH.GT.MHOUR(MO))MO=MO+1
      C        FIND MAXIMUM PEAK DEMAND COST FOR EACH MONTH
               Z7=DEE(I)*PCOS(JP)
               IF(Z7.LE.PDCO(MO,1))GO TO 300
               PDCO(MO)=Z7
               MHPK(MO)=NH
               PDCO(MO,2)=DEE(I)
        300    CONTINUE
      C        FIND PEAK POWER FOR MONTH IF PEAK DEMAND PRICE IS ZERO
               IF(PDCO(MO,1).NE.0..O.DEE(I).LE.PDCO(MO,2))GO TO 310
               PDCO(MO,2)=DEE(I)
               MHPK(MO)=NH
         310   CONTINUE
                IF(IND.EQ.0)GO TO 73
               WRS(1,I)=WRS(2,I)=WRS(8,I)=0.
                WRS(9,I)=DEE(I)
               WRS(10,I)=ECOS(JP)
                GO TO 73
         72    AD=AMIN1(DEE(I)/E36,X3E6,B5(I))
               AB=AMIN1(EBM/E36,X3E6-AD,B5(I)-AD)
               EPUR(JP)=EPUR(JP)+DEE(I)-E36*AD
               EBMT=EBMT+ECOS(JP)*(RESB*(DEE(I)-E36*AD)-R36*AB)
               EBM=BIGW
               IF(EBMT.LE.0.)EBM=0.
               ESLB(JP)=ESLB(JP)+E36*AB
                IF(IND.EQ.0)GO TO 73
                Z1=AD+AB
               FFD(1)=FFD(1)+Z1
               Z1=Z1*E6
               TA(3)=TA(3)+Z1
               TB(3)=AMAX1(TB(3),Z1)
               WRS(1,I)=AD
                WRS(2,I)=AB
                WRS(8,I)=B5(I)
                WRS(9,I)=DEE(I)
               WRS(10,I)=ECOS(JP)
         73    CONTINUE
                GO TO 59
      C        X1=0.  AND  IND=0
         74    DO 79 I=1,24
                NH=NH+1
                E2=E2*EFF(2)
                IF(NH.LT.IHUP)GO TO 75
               CALL TODUP(NH)
                M=IHUP-NH
                E2M=EFF(2)**M
         75    JP=ITOD(I)
```

```
       E2MP=E2M*PRUP/ECOS(JP)
       ADS=ABSS=B4=0.
      E2MPM=AMAX1(EFF(2),E2MP)
      IF(RSLB.GE.E2MPM)GO TO 77
       IF(1..GE.E2MPM)GO TO 76
      IF(E2MP*E3478.LE.1.)GOTO 78
      IF(INT((X(2)-E2*E2M)/E7X7E4).LT.M)GO TO 78
      B4=AMIN1((X(2)-E2)/E7,X7,E4X4)
       GO TO 78
   76 ADS=AMIN1(DEE(I)/E38,E2,X8X38)
       GO TO 78
   77 ADS=AMIN1(DEE(I)/E38,E2,X8X38)
      ABSS=AMIN1(EBM/E38,E2-ADS,X8X38-ADS)
   78 Z6=DEE(I)-E38*ADS+B4/EFF(4)
      EFF(22)=EFF(22)+ADS+ABSS
      EPUR(JP)=EPUR(JP)+Z6
C     CHECK MONTH
      IF(NH.GT.MHOUR(MO))MO=MO+1
C     FIND MAXIMUM PEAK DEMAND COST FOR EACH MONTH
      Z7=Z6*PCOS(JP)
      IF(Z7.LE.PDCO(MO,1))GO TO 210
      PDCO(MO,1)=Z7
      MHPK(MO)=NH
      PDCO(MO,2)=Z6
  210 CONTINUE
C     FIND PEAK POWER FOR MONTH IF PEAK DEMAND PRICE IS ZERO
      IF(PDCO(MO,1).NE.0..O.Z6.LE.PDCO(MO,2))GO TO 230
      PDCO(MO,2)=Z6
      MHPK(MO)=NH
  230 CONTINUE
      ESLB(JP)=ESLB(JP)+E38*ABSS
      EBMT=EBMT+ECOS(JP)*(RESB*Z6-R38*ABSS)
      EBM=BIGW
      IF(EBMT.LE.0.)EBM=0.
       E2=E2+E7*B4-ADS-ABSS
       M=M-1
       E2M=E2M/EFF(2)
   79 CONTINUE
       GO TO 59
C       ---------------
   70 DO 57 I=1,24
       NH=NH+1
       E2=E2*EFF(2)
       IF(NH.LT.IHUP)GO TO 29
      CALL TODUP(NH)
       M=IHUP-NH
       E2M=EFF(2)**M
   29 JP=ITOD(I)
       E2MP=E2M*PRUP/ECOS(JP)
       E2MPM=AMAX1(EFF(2),E2MP)
      AD=AB=AS=ADS=ABSS=B4=AMS=0.
       IF(B5(I).GT.0.)GO TO 32
C     B5=0.
      IF(RSLB.GE.E2MPM)GO TO 31
       IF(1..GE.E2MPM) GO TO 30
      IF(E2MP*E3478.LE.1.)GO TO 50
      IF(INT((X(2)-E2*E2M)/E7X7E4).LT.M)GO TO 50
```

```
      B4=AMIN1((X(2)-E2)/E7,X7,E4X4)
       GO TO 50
   30 ADS=AMS=AMIN1(DEE(I)/E38,E2,X8X38)
       GO TO 50
   31 ADS=AMIN1(DEE(I)/E38,E2,X8X38)
      ABSS=AMIN1(EBM/E38,E2-ADS,X8X38-ADS)
      AMS=ADS+ABSS
       GO TO 50
C     B5.GT.0
   32 Z1=E78*AMAX1(1.,E2MP)
       IF(Z1.GT.RE6)GO TO 33
      AD=ADF(I)
       AB=ABF(I)
       JUMG=-1
       GO TO 40
   33 IF(Z1.GT.E6)GO TO 35
       AD=ADF(I)
       JUMG=0
       GO TO 40
   34 AB=ABF(I)
       GO TO 50
   35 JUMG=1
       GO TO 40
   36 AD=ADF(I)
       AB=ABF(I)
       GO TO 50
C      STORAGE LOOP
   40 Q7=AMIN1(X7,B5(I)-AD-AB)
       Q2=E2+E7*Q7
      IF(RSLB.GE.E2MPM)GO TO 42
       IF(1..GE.E2MPM)GO TO 41
      AS=Q7-AMAX1(0.,Q2-X(2))/E7
      IF(E3478*E2MP.LE.1.)GO TO 43
       Q3=E2+E7*AS
      IF(INT((X(2)-Q3*E2M)/E7X7E4).LT.M)GO TO 43
      B4=AMIN1((X(2)-Q3)/E7,X7-AS,E4X4)
       GO TO 43
   41 ADS=AMS=ADSF(I)
       AS=Q7-AMAX1(0.,Q2-AMS-X(2))/E7
       GO TO 43
   42 ADS=ADSF(I)
       IF(Q7.LE.0..O.E78.GT.E6)ABSS=ABSSF(I)
      AMS=ADS+ABSS
       AS=Q7-AMAX1(0.,Q2-AMS-X(2))/E7
   43 IF(JUMG)50,34,36
   50 CONTINUE
      M=M-1
       E2M=E2M/EFF(2)
      Z6=B4/EFF(4)+DEE(I)-E36*AD-E38*ADS
       EPUR(JP)=EPUR(JP)+Z6
      EFF(22)=EFF(22)+AMS
C     CHECK MONTH
      IF(NH.GT.MHOUR(MO))MO=MO+1
C     FIND MAXIMUM PEAK DEMAND COST FOR EACH MONTH
      Z7=Z6*PCOS(JP)
      IF(Z7.LE.PDCO(MO,1))GO TO 220
      PDCO(MO,1)=Z7
```

```
      MHPK(MO)=NH
      PDCO(MO,2)=Z6
  220 CONTINUE
C     FIND PEAK POWER FOR MONTH IF PEAK DEMAND PRICE IS ZERO
      IF(PDCO(MO,1).NE.0..O.Z6.LE.PDCO(MO,2))GO TO 240
      PDCO(MO,2)=Z6
      MHPK(MO)=NH
  240 CONTINUE
      Z5=E36*AB+E38*ABSS
      EBMT=EBMT+ECOS(JP)*(RESB*Z6-RSLB*Z5)
      EBM=BIGW
      IF(EBMT.LE.0.)EBM=0.
       ESLB(JP)=ESLB(JP)+Z5
      E2=E2+E7*(AS+B4)-AMS
       IF(IND.EQ.0)GO TO 57
       AES(1)=AES(1)+AMS
      AES(2)=AES(2)+E2
       FFD(1)=FFD(1)+AD+AB
       FFD(5)=FFD(5)+ADS
      Z1=AS+B4
       TA(2)=TA(2)+Z1
      L=E2*DCU2+1.
       CU(L)=CU(L)+1.
       FFD(2)=FFD(2)+AS
      TB(2)=TB(2)+AMS
      Z1=E6*(AD+AB)+E8*AMS
       TA(3)=TA(3)+Z1
       TB(3)=AMAX1(TB(3),Z1)
      Z1=B4/EFF(4)
       TA(4)=TA(4)+Z1
       TB(4)=AMAX1(TB(4),Z1)
      WRS(1,I)=AD
       WRS(2,I)=AB
       WRS(3,I)=AS
       WRS(4,I)=ADS
      WRS(5,I)=ABSS
       WRS(6,I)=Z1
       WRS(7,I)=E2
      WRS(8,I)=B5(I)
       WRS(9,I)=DEE(I)
       WRS(10,I)=ECOS(JP)
   57 CONTINUE
   59 IF(IND.NE.0)WRITE(9)((WRS(I,J),I=1,10),J=1,24)
   60 CONTINUE
       EPUR(JP1)=EPUR(JP1)-E2
       UE11BF=COST(ZZZZZ)
      IF(ISXOL.EQ.0)GO TO 102
       DO 100 J=1,4
       JXOL(J)=1H
      IF(X(J).EQ.XOL(J))GO TO 100
       JXOL(J)=1H*
       XOL(J)=X(J)
  100 CONTINUE
       PRINT101,UE11BF,(XOL(J),JXOL(J),J=1,4)
  101 FORMAT(1X,F15.3,5(F16.4,A1))
  102 IF(IND.EQ.0)RETURN
      Z1=1.E-30
```

```
          DO 61  J=1,10
    61   Z1=Z1+EPUR(J)-ESLB(J)
          CLV(1)=CTOT(1)/DETOT
         CLV(2)=0.
          Z2=DETOT-Z1
         IF(Z2.NE.0.)CLV(2)=(CTOT(2)+CTOT(3))/Z2
         CLV(3)=CLV(4)=0.
          IF(Z1.NE.0.)CLV(4)=CTOT(5)/Z1
         Z1=FFD(2)+TA(4)
          IF(Z1.GT.0.)AES(1)=100.*E8*AES(1)/Z1
         IF(Z1.LE.0.)AES(1)=0.
         AES(3)=(1.-EFF(2))*AES(2)
          FFD(6)=TB(1)-FFD(1)-FFD(2)
         IF(TA(2).GT.0.)FFD(1)=100.*(E36*FFD(1)+E38*E7*FFD(2)-
        1FFD(2)*AES(3)/TA(2))/DETOT
         IF(TA(2).LE.0.)FFD(1)=100.*E36*FFD(1)/DETOT
         Z1=TA(1)+TA(4)
          IF(Z1.GT.0.)FFD(3)=100.*EFF(3)*TA(3)/Z1
         FFD(4)=100.*(EFF(3)*TA(3)-CTOT(7,2))/DETOT
         FFD(5)=100.*E38*FFD(5)/DETOT
          FFD(2)=100.-FFD(1)
         TB(1)=TB(1)/E5
          TA(2)=TA(2)*E7
         Z1=24.*364.
          AES(2)=AES(2)/Z1
         TB(1)=TB(1)/Z1
          TB(2)=TB(2)/Z1
          DO 62  J=1,4
    62   TA(J)=TA(J)/Z1
         RETURN
          END
```

SYMBOLIC REFERENCE MAP (R=3)

```
ENTRY POINTS      DEF LINE      REFERENCES
   4  UE11BF          1           341          372

VARIABLES        SN  TYPE                RELOCATION
 1475  AB             REAL                              REFS       146     149     151     157      256     266     269
                                                        2*270      294     303     311     318  DEFINED      24     144
                                                         222       241     248     253
 1500  ABSS           REAL                              REFS       186     202     203     206      235     241     248
                                                         253       271     294     321  DEFINED       24     173     184
                                                         222       234     270
 1474  AD             REAL                              REFS      2*14,    145     146     151      156   2*241   2*248
                                                        2*253      256   2*266   2*269     270      277     303     311
                                                         317   DEFINED      24     143     222      240     245     252
 1477  ADS            REAL                              REFS      2*134    185     186     206    2*234     235     240
                                                         245       252     270     271     277      304     320
                                                      DEFINED       24     173     181     183      222     231     233
                                                         266       269
  134  AES            REAL       ARRAY     COMPRNS      REFS        12     301     302     352      354     356     367
                                                      DEFINED       73     301     302     352      353     354     367
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VARIABLES      SN  TYPE            RELOCATION
  1501  AMS        REAL                                  REFS      240      241      245      248      252      253      267
                                                          272      279      299      301      310      311
                                                      DEFINED       24      222      231      235      266      271
  1476  AS         REAL                                  REFS      240      241      245      248      252      253      262
                                                          264      299      305      309      319  DEFINED       24      222
                                                          260      267      272
  1425  BIGW       REAL                                  REFS      147      204      296  DEFINED       17
  1502  B4         REAL                                  REFS      185      206      277      299      305      314
                                                      DEFINED       24      173      179      222      229      264
  1557  B5         REAL        ARRAY                     REFS        2      103      113      122      143      144      158
                                                          223      240      241      245      248      252      253      256
                                                          324  DEFINED       86       93       96       98      102      109
                                                          112
    76  CC         REAL        ARRAY     COMCOMP         REFS        6
   150  CLV        REAL        ARRAY     COMPRNS         REFS       12  DEFINED      345      346      348    2*349      350
    74  CTOT       REAL        ARRAY     COMANSW         REFS       10      345    2*348      350      361
     3  CU         REAL        ARRAY     COMCUMU         REFS        4      308  DEFINED       65      308
  1534  DCU2       REAL                                  REFS      307  DEFINED       78       80
   140  DEE        REAL        ARRAY     COMSUDE         REFS       11      123      127      131      134      135      140
                                                          143      145      146      159      181      183      185      231
                                                          233      240      245      252      266      269      277      325
   170  DET        REAL        ARRAY     COMSUDE         REFS       11
   174  DETOT      REAL                  COMCOMP         REFS        6      345      347      356      358      361      362
  1513  DIA        REAL                                  REFS       44     2*82  DEFINED       41
   175  DTTOT      REAL                  COMCOMP         REFS        6
  1517  EBM        REAL                                  REFS      144      184      234      241      248      253      270
                                                      DEFINED       46      147      148      204      205      296      297
  1516  EBMT       REAL                                  REFS      146      148      203      205      295      297
                                                      DEFINED       46      146      203      295
    40  ECOS       REAL        ARRAY     COMPURC         REFS        7      141      146      160      172      203      220
                                                          295      326
     0  EFF        REAL        ARRAY     COMCOMP         REFS        6       38       50       52       54     2*59      166
                                                          170      174      185      186      208      214      218      221
                                                          276      277      279      314      354      360      361
                                                      DEFINED       23      186      279
     0  EPUR       REAL        ARRAY     COMPURC         REFS        7      123      145      187      278      330      344
                                                      DEFINED       23       26      123      145      187      278      330
    26  ESLB       REAL        ARRAY     COMPURC         REFS        7      149      202      298      344
                                                      DEFINED       26      149      202      298
  1511  E15X       REAL                                  REFS       42       93       98      102      112
                                                      DEFINED       38       42
  1515  E2         REAL                                  REFS      166      178      179      181      183      184      206
                                                          214      228      229      231      233      234      257      262
                                                          299      302      307      323      330  DEFINED       45      166
                                                          206      214      299
  1543  E2M        REAL                                  REFS      172      178      208      220  2[illegible]     263      276
                                                      DEFINED      170      208      218      276
  1544  E2MP       REAL                                  REFS      174      177      221      227      238      261
                                                      DEFINED      172      220
  1545  E2MPM      REAL                                  REFS      175      176      225      226      258      259
                                                      DEFINED      174      221
  1531  E3478      REAL                                  REFS      177      227      261  DEFINED       59
  1521  E36        REAL                                  REFS       51      143      144      145      146      149      240
                                                          241      245      248      252      253      266      269      270
                                                          277      294      356      358  DEFINED       50
  1523  E38        REAL                                  REFS       53      181      183      184      185      202      231
                                                          233      234      240      241      245      248      252      253
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VARIABLES      SN  TYPE            RELOCATION
                                                266      269      270      277      294      356      362
                                            DEFINED       52
 1525  E4X4          REAL                       REFS      55      179      229      264  DEFINED       54
    2  E5            REAL              COMUE11  REFS      14       38      364
    3  E6            REAL              COMUE11  REFS      14       37       50       60      153      240      241
                                                244      245      248      252      253      266      269    2*270
                                                311
    4  E7            REAL              COMUE11  REFS      14       55       58      179      206      229      257
                                                260      262      264      267      272      299      356      365
 1526  E7X7E4        REAL                       REFS      57      178      228      263  DEFINED       55       57
 1530  E78           REAL                       REFS      59      238      270  DEFINED       58
    5  E8            REAL              COMUE11  REFS      14       52       56       58      240      241      245
                                                248      252      253      266      269      270      311      352
  120  FFD           REAL      ARRAY   COMPRNS  REFS      12      152      303      304      309      351    2*355
                                              3*356      358      362      363  DEFINED       73      152      303
                                                304      309      355      356      358      360      361      362
                                                363
 1533  I             INTEGER                    REFS      65     2*71     2*73       76       86     2*93       96
                                                 97       98    2*102      103      104      107      109      112
                                                113      121      122      123      127      131      134      135
                                              3*139    2*140      141    2*143      144      145      146      156
                                                157    2*158    2*159      160      171      181      183      185
                                                219      223      231      233    2*240      241    2*245      248
                                              2*252      253      256      266      269      277      317      318
                                                319      320      321      322      323    2*324    2*325      326
                                                328  DEFINED       63       69       74       85       92       95
                                                101      106      119      164      212      328
    2  IHDN          INTEGER           COMUPDN  REFS       3
    0  IHUP          INTEGER           COMUPDN  REFS       3      167      169      215      217
                                            DEFINED       47
    0  IND           INTEGER           COMUE11  REFS      14       61       87      138      150      300      328
                                                341
   10  ISWND         INTEGER   ARRAY   COMWIND  REFS       5       40
    0  ISXOL         INTEGER           COMSXOL  REFS      15      332
   53  ITOD          INTEGER   ARRAY   COMPURC  REFS       7       49      121      171      219
 1503  J             INTEGER                    REFS    2*26       28     2*29     2*34       65     2*71     2*73
                                                 76       77      328      334    2*335      336    2*337    2*339
                                              2*344    2*371  DEFINED       25       27       33       64       70
                                                 72       75       77      328      333      339      343      370
 1540  JP            INTEGER                    REFS   2*123      127      141    2*145      146    2*149      160
                                                172    2*187      191    2*202      203      220    2*278      283
                                                295    2*298      326  DEFINED      121      171      219
 1520  JP1           INTEGER                    REFS   2*330  DEFINED       49
 1547  JUMG          INTEGER                    REFS     273  DEFINED      242      246      250
 1512  JUMP          INTEGER                    REFS      62       81       91  DEFINED       39       43       62
                                                 84       87
 1614  JXOL          INTEGER   ARRAY            REFS       2      339  DEFINED      334      336
 1554  L             INTEGER                    REFS   2*308  DEFINED      307
   11  LPNH          INTEGER           COMUE11  REFS      14
   10  LPNS          INTEGER           COMUE11  REFS      14
 1542  M             INTEGER                    REFS     170      178      207      218      228      263      275
                                            DEFINED      169      207      217      275
  163  MHOUR         INTEGER   ARRAY   COMPURC  REFS       7      125      189      281
  147  MHPK          INTEGER   ARRAY   COMPURC  REFS       7  DEFINED       28      130      136      194      200
                                                286      292
 1505  MO            INTEGER                    REFS   2*125      128      129      130      131    2*134      135
                                                136    2*189      192      193      194      195    2*198      199
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VARIABLES	SN	TYPE		RELOCATION								
					200	2*281	284	285	286	287	2*290	291
					292	DEFINED	31	125	189	281		
50	MXX	INTEGER	ARRAY	COMANSW	REFS	10						
0	NAMCU	INTEGER	ARRAY	COMCUMU	REFS	4	DEFINED	66	67	68		
1536	ND	INTEGER			REFS	89	90	DEFINED	88			
1504	NH	INTEGER			REFS	120	125	130	136	165	167	168
					169	189	194	200	213	215	216	217
					281	286	292	DEFINED	30	47	120	165
					213							
1	NITER	INTEGER		COMUE11	REFS	14	32	DEFINED	32			
105	PCOS	REAL	ARRAY	COMPURC	REFS	7	127	191	283			
117	PDCO	REAL	ARRAY	COMPURC	REFS	7	128	2*134	192	2*198	284	2*290
					DEFINED	2*29	129	131	135	193	195	199
					285	287	291					
3	PRDN	REAL		COMUPDN	REFS	3						
1	PRUP	REAL		COMUPDN	REFS	3	172	220				
1514	QHT	REAL			REFS	97	107	DEFINED	44			
1535	QW1	REAL			REFS	108	DEFINED	82				
1551	Q2	REAL			REFS	260	266	267	269	270	272	
					DEFINED	257						
1552	Q3	REAL			REFS	263	264	DEFINED	262			
1550	Q7	REAL			REFS	257	260	267	270	272		
					DEFINED	256						
77	R	REAL	ARRAY	COMCUMU	REFS	4						
173	RESB	REAL		COMCOMP	REFS	6	146	203	295			
1532	RE6	REAL			REFS	239	DEFINED	60				
177	RLCCR	REAL		COMPURC	REFS	7						
172	RSLB	REAL		COMCOMP	REFS	6	51	53	60	175	225	258
					295							
6	RX7	REAL		COMUE11	REFS	14	35					
7	RX8	REAL		COMUE11	REFS	14	36					
1522	R36	REAL			REFS	146	DEFINED	51				
1524	R38	REAL			REFS	203	DEFINED	53				
0	SE1	REAL	ARRAY	COMSUDE	REFS	11	93	97	102	104	107	
30	SE2	REAL	ARRAY	COMSUDE	REFS	11						
60	ST1	REAL	ARRAY	COMSUDE	REFS	11						
110	ST2	REAL	ARRAY	COMSUDE	REFS	11						
0	TA	REAL	ARRAY	COMPRNS	REFS	12	104	108	154	306	312	315
					351	2*356	358	2*359	360	361	365	371
					DEFINED	71	104	108	154	306	312	315
					365	371						
50	TB	REAL	ARRAY	COMPRNS	REFS	12	103	113	155	310	313	316
					355	364	368	369	DEFINED	71	103	113
					155	310	313	316	364	368	369	
1473	UE11BF	REAL			REFS	339	DEFINED	331				
0	W	REAL	ARRAY	COMWIND	REFS	5	3*41	42	44	2*82	97	2*98
					110	111	112	DEFINED	41			
154	WRS	REAL	ARRAY	COMPRNS	REFS	12	328	DEFINED	76	3*139	140	141
					156	157	158	159	160	317	318	319
					320	321	322	323	324	325	326	
0	X	REAL	ARRAY	COMANSW	REFS	10	35	36	37	38	41	54
					56	77	79	80	83	104	117	178
					179	228	229	240	241	245	248	252
					253	260	263	264	266	267	269	270
					272	335	337	DEFINED	34			
24	XCO	REAL	ARRAY	COMANSW	REFS	10						
26	XM	REAL	ARRAY	COMCOMP	REFS	6						

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VARIABLES      SN  TYPE            RELOCATION
  1607  XOL         REAL        ARRAY                   REFS          2        335       339   DEFINED       16       337
     0  XXXX        REAL        ARRAY       F.P.        REFS          2         34   DEFINED         1
  1510  X3E6        REAL                                REFS        143        144   DEFINED        37
  1506  X7          REAL                                REFS         55        179       229       256      264
                                                     DEFINED         35
  1507  X8          REAL                                REFS         56        266       269       270  DEFINED        36
  1527  X8X38       REAL                                REFS        181        183       184       231      233       234
                                                     DEFINED         56
  1555  ZZZZZ    *  REAL                                REFS        331
  1537  Z1          REAL                                REFS       3*98        108       110     2*111      112       152       153
                                                         154        155        239       244       306      312       313       315
                                                         316        322        344       347     2*350    2*352       353     2*360
                                                         367        368        369       371   DEFINED       97       107       110
                                                         151        153        238       305       311      314       342       344
                                                         351        359        366
  1556  Z2          REAL                                REFS      2*348    DEFINED       347
  1553  Z5          REAL                                REFS        295        298   DEFINED       294
  1546  Z6          REAL                                REFS        187        191       195       198      199       203       278
                                                         283        287        290       291       295  DEFINED       185       277
  1541  Z7          REAL                                REFS        128        129       192       193      284       285
                                                     DEFINED        127        191       283

FILE NAMES         MODE
        OUTPUT     FMT                      WRITES        339
        TAPE9      UNFMT                    WRITES         77        328

EXTERNALS            TYPE    ARGS         REFERENCES
        COST       REAL        1              331
        GETSD                  1               89
        SQRT       REAL        1  LIBRARY      41
        TODPR                  1               48         90
        TODUP                  1              168        216

INLINE FUNCTIONS     TYPE    ARGS          DEF LINE   REFERENCES
        ABF        REAL        1     SF         19        241        248        253
        ABSSF      REAL        1     SF         21        270
        ADF        REAL        1     SF         18        240        245        252
        ADSF       REAL        1     SF         20        266        269
        AMAX1      REAL        0   INTRIN                 155        174        221       238       260      267       272       313
                                                          316
        AMIN1      REAL        0   INTRIN                  55         56         98       112       143      144       179       181
                                                          183        184        229       231       233      234       240       241
                                                          245        248        252       253       256      264       266       269
                                                        2*270
        INT        INTEGER     1   INTRIN                 178        228        263

STATEMENT LABELS              DEF LINE   REFERENCES
     0  10                       26          25
     0  11                       34          33
    56  12                       45          40
     0  13                       65          63          64
     0  14                       71          70
     0  15                       73          69          72
   153  16                       81          79
   161  17                       83          61          81
     0  18                       86          85
   171  19                       88          83
```

STATEMENT LABELS			DEF LINE	REFERENCES							
212	20		92	91							
0	21		93	92							
217	22		95	91							
0	23		99	95							
234	24		101	91							
0	25		104	101							
246	26		106	91							
264	27		114	106	111						
267	28		116	94	100	105	115				
563	29		219	215							
617	30		231	226							
626	31		233	225							
642	32		238	223							
672	33		244	239							
710	34		248	273							
725	35		250	244							
727	36		252	273							
751	40		256	243	247	251					
1006	41		266	259							
1031	42		269	258							
1067	43		273	261	263	265	268				
1071	50		274	227	228	230	232	236	249	254	273
0	51		76	74	75						
1231	57		327	212	300						
1235	59		328	162	210						
0	60		329	88							
0	61		344	343							
0	62		371	370							
547	70		212	91	117						
0	71	INACTIVE	119	2*117							
325	72		143	122							
373	73		161	119	138	142	150				
377	74		164	91							
412	75		171	167							
443	76		181	176							
452	77		183	175							
465	78		185	177	178	180	182				
0	79		209	164							
1260	100		338	333	335						
1445	101	FMT	340	339							
1300	102		341	332							
0	200		29	27							
512	210		196	192							
1122	220		288	284							
521	230		201	198							
1131	240		293	290							
311	300		132	128							
316	310		137	134							

LOOPS	LABEL	INDEX	FROM-TO	LENGTH	PROPERTIES	
11	10	J	25 26	3B	INSTACK	
15	200	J	27 29	3B	INSTACK	
24	11	J	33 34	2B	INSTACK	
115	13	I	63 65	4B		NOT INNER
116	13	J	64 65	2B	INSTACK	
125	15	I	69 73	14B		NOT INNER
130	14	J	70 71	3B	INSTACK	

LOOPS	LABEL	INDEX	FROM-TO	LENGTH	PROPERTIES	
135	15	J	72 73	3B	INSTACK	
142	51	I	74 76	4B		NOT INNER
143	51	J	75 76	2B	INSTACK	
165	18	I	85 86	2B	INSTACK	
175	60	ND	88 329	1046B		EXT REFS NOT INNER
215	21	I	92 93	2B	INSTACK	
224	23	I	95 99	7B	INSTACK	
241	25	I	101 104	3B	INSTACK	
252	27	I	106 114	13B	OPT	
275	73	I	119 161	100B	OPT	
400	79	I	164 209	147B		EXT REFS
551	57	I	212 327	464B		EXT REFS
1255	100	J	333 338	4B	INSTACK	
1267		J	339 339	10B		EXT REFS
1305	61	J	343 344	3B	INSTACK	
1410	62	J	370 371	2B	INSTACK	

COMMON BLOCKS	LENGTH	MEMBERS - BIAS NAME(LENGTH)		
COMUPDN	4	0 IHUP (1)	1 PRUP (1)	2 IHDN (1)
		3 PRDN (1)		
COMCUMU	83	0 NAMCU (3)	3 CU (60)	63 R (20)
COMWIND	10	0 W (8)	8 ISWND (2)	
COMCOMP	126	0 EFF (22)	22 XM (40)	62 CC (60)
		122 RSLB (1)	123 RESB (1)	124 DETOT (1)
		125 DTTOT (1)		
COMPURC	128	0 EPUR (22)	22 ESLB (10)	32 ECOS (11)
		43 ITOD (26)	69 PCOS (10)	79 PDCO (24)
		103 MHPK (12)	115 MHOUR (12)	127 RLCCR (1)
COMANSW	74	0 X (20)	20 XCO (20)	40 MXX (20)
		60 CTOT (14)		
COMSUDE	144	0 SE1 (24)	24 SE2 (24)	48 ST1 (24)
		72 ST2 (24)	96 DEE (24)	120 DET (24)
COMPRNS	348	0 TA (40)	40 TB (40)	80 FFD (12)
		92 AES (12)	104 CLV (4)	108 WRS (240)
COMUE11	10	0 IND (1)	1 NITER (1)	2 E5 (1)
		3 E6 (1)	4 E7 (1)	5 E8 (1)
		6 RX7 (1)	7 RX8 (1)	8 LPNS (1)
		9 LPNH (1)		
COMSXOL	1	0 ISXOL (1)		

STATISTICS

PROGRAM LENGTH	1621B	913
CM LABELED COMMON LENGTH	1640B	928

64600B CM USED

```
      FUNCTION UE11CF(XXXX)
      DIMENSION XXXX(20),XOL(5),JXOL(5),B5(4,72)
      COMMON /COMCUMU/ NAMCU(3),CU(20,3),R(20)
      COMMON /COMWIND/ W(8),ISWND(2)
      COMMON /COMCOMP/ EFF(22),XM(20,2),CC(20,3),RSLB,RESB,DETOT,DTTOT
      COMMON /COMPURC/ EPUR(11,2),ESLB(10),ECOS(11),ITOD(26),
     A PCOS(10),PDCO(12,2),MHPK(12),MHOUR(12)
     B ,RLCCR
      COMMON /COMANSW/ X(20),XCO(20),MXX(20),CTOT(7,2)
      COMMON /COMSUDE/ SE1(24),SE2(24),ST1(24),ST2(24),DEE(24),DET(24)
      COMMON /COMPRNS/ TA(20,2),TB(20,2),FFD(6,2),AES(6,2),CLV(4),
     1WRS(10,24)
      COMMON /COMUE11/ IND,NITER,E5,E6,E7,E8,RX7,RX8,NSNS,NHNH
      COMMON /COMLPRO/NH,NS,SU(24),DE(24),CTB(7,24),XTB(13),KSBW
      COMMON /COMSXOL/ ISXOL
       DATA XOL/5(-1.)/
      NH=NHNH
       NS=NSNS
      DO 200 J=1,12
      MHPK(J)=0
  200 PDCO(J)=PDCO(J,2)=0
      MO=1
      NHR=0
       EPUR(11)=EFF(22)=0.
       NW=0
       DO 10 J=1,10
   10 EPUR(J)=ESLB(J)=0.
       NITER=NITER+1
       DO 11 J=1,4
   11 X(J)=XXXX(J)
       X7=RX7*X(2)
       X8=RX8*X(2)
       E15X=EFF(1)*E5*X(1)
      ND=0
       NS41=4*NS+1
       NS42=289-NS41
      E36=EFF(3)*E6
       R36=RSLB*E36
       E38=EFF(3)*E8
       R38=RSLB*E38
      E47=E7*EFF(4)
       EST=0.
      EBM=0.
      XTB(2)=X(2)
       XTB(3)=X(3)/E8
       XTB(4)=X(4)
       XTB(5)=E7
      XTB(6)=AMIN1(XTB(3),X8)
       XTB(7)=X7
       XTB(8)=X8
       XTB(9)=EFF(4)
      XTB(10)=EFF(2)
       XTB(11)=E47
       XTB(12)=E6/E8
       XTB(13)=EFF(4)*X(4)
      CALL TODPR(1)
       JP1=ITOD(1)
```

```
       EPUR(JP1)=EST
       NHOUR=0
      JUMP=1
       IF(ISWND(1).LE.0)GO TO 12
      W(8)=DIA=SQRT(259.7*X(1)/W(3)/(W(5)+W(4))**3)
       E15X=E15X*W(7)
      JUMP=2
       QHT=((15.2+.5*DIA)/W(2))**.142857
   12 IF(IND.LE.0)GO TO 17
       JUMP=JUMP+2
       DO 13 I=1,20
       DO 13 J=1,3
   13 CU(I,J)=0.
       NAMCU(1)=2HST
       NAMCU(2)=2H
      NAMCU(3)=1H
       DO15I=1,2
      DO14J=1,20
   14 TA(J,I)=TB(J,I)=0.
       DO 15 J=1,6
   15 FFD(J,I)=AES(J,I)=0.
      DCU2=0.
       IF(X(2).LE.0.)GO TO 16
       DCU2=19.9999/X(2)
       WRITE(9)(X(J),J=1,10)
   16 IF(JUMP.NE.4)GO TO 17
       QW1=0.00385159*W(7)*W(3)*DIA*DIA
   17 NDN=1
       JUMG=0
       DO 18 K=1,3
       GO TO 101
   18 CONTINUE
       JUMG=1
C ....  BEGIN LOOP
   19 CONTINUE
      XTB(1)=EFF(2)*EST
       DO 20 K=1,NH
       SU(K)=B5(1,K)
      DE(K)=B5(2,K)/E38
       Z1=CTB(1,K)=B5(3,K)
       CTB(2,K)=-Z1*E38
      CTB(3,K)=-Z1*R38
       CTB(4,K)=-Z1*E36
       CTB(5,K)=-Z1*R36
      CTB(6,K)=AMIN1(DE(K),XTB(6))
       CTB(7,K)=XTB(6)-CTB(6,K)
   20 CONTINUE
      KSBW=1
      IF(EBM.LE.0.)KSBW=0
      CALL LPOUTR
      DO 57 K=1,NS
       JP=B5(3,K).A.17B
       A4=CTB(1,K)
       ADS=CTB(2,K)
      ABSS=CTB(3,K)
       AD=CTB(4,K)
       AB=CTB(5,K)
```

```
            AS=CTB(6,K)
           EST=CTB(7,K)
           EFF(22)=EFF(22)+ADS+ABSS
           Z6=A4+B5(2,K)-E36*AD-E38*ADS
            EPUR(JP)=EPUR(JP)+Z6
           NHR=NHR+1
C          CHECK MONTH OF YEAR
           IF(NHR.GT.MHOUR(MO))MO=MO+1
C          FIND MAXIMUM PEAK DEMAND COST FOR EACH MONTH
           Z7=Z6*PCOS(JP)
           IF(Z7.LE.PDCO(MO))GO TO 205
           PDCO(MO)=Z7
           MHPK(MO)=NHR
           PDCO(MO,2)=Z6
     205   CONTINUE
C          FIND PEAK DEMAND FOR EACH MONTH IF PEAK DEMAND PRICE IS ZERO
           IF(PDCO(MO,1).NE.0. .O. Z6.LE.PDCO(MO,2))GO TO 210
           PDCO(MO,2)=Z6
           MHPK(MO)=NHR
     210   CONTINUE
           Z5=E36*AB+E38*ABSS
           EBM=EBM+ECOS(JP)*(RESB*Z6-RSLB*Z5)
            ESLB(JP)=ESLB(JP)+Z5
           IF(IND.EQ.0)GO TO 57
            AMS=ADS+ABSS
            AES(1)=AES(1)+AMS
           AES(2)=AES(2)+EST
            FFD(1)=FFD(1)+AD+AB
            FFD(5)=FFD(5)+ADS
           Z1=AS+A4*EFF(4)
           TA(2)=TA(2)+Z1
           L=EST*DCU2+1.
            CU(L)=CU(L)+1.
            FFD(2)=FFD(2)+AS
           TB(2)=TB(2)+AMS
           Z1=E6*(AD+AB)+E8*AMS
            TA(3)=TA(3)+Z1
            TB(3)=AMAX1(TB(3),Z1)
           TA(4)=TA(4)+A4
            TB(4)=AMAX1(TB(4),A4)
           TA(1)=TA(1)+B5(4,K)
            TB(1)=TB(1)+B5(1,K)
           NW=NW+1
            WRS(1,NW)=AD
            WRS(2,NW)=AB
            WRS(3,NW)=AS
           WRS(4,NW)=ADS
            WRS(5,NW)=ABSS
            WRS(6,NW)=A4
            WRS(7,NW)=EST
           WRS(8,NW)=B5(1,K)
            WRS(9,NW)=B5(2,K)
            WRS(10,NW)=B5(3,K)
           IF(NW.LT.24)GO TO 57
            NW=0
            WRITE(9)((WRS(I,J),I=1,10),J=1,24)
      57   CONTINUE
```

```
      NHOUR=NHOUR+NS
       IF(NHOUR.LT.8736)GO TO 100
      EPUR(JP1)=EPUR(JP1)-EST
       UE11CF=COST(ZZZZZ)
      IF(ISXOL.EQ.0)GO TO 122
       DO 120 J=1,4
       JXOL(J)=1H
      IF(X(J).EQ.XOL(J))GO TO 120
       JXOL(J)=1H*
       XOL(J)=X(J)
  120 CONTINUE
       PRINT121,UE11CF,(XOL(J),JXOL(J),J=1,4)
  121 FORMAT(1X,F15.3,5(F16.4,A1))
  122 IF(IND.EQ.0)RETURN
      Z1=1.E-30
       DO 61  J=1,10
   61 Z1=Z1+EPUR(J)-ESLB(J)
       CLV(1)=CTOT(1)/DETOT
      CLV(2)=0.
       Z2=DETOT-Z1
      IF(Z2.NE.0.)CLV(2)=(CTOT(2)+CTOT(3))/Z2
      CLV(3)=CLV(4)=0.
       IF(Z1.NE.0.)CLV(4)=CTOT(5)/Z1
      Z1=FFD(2)+TA(4)
       IF(Z1.GT.0.)AES(1)=100.*E8*AES(1)/Z1
      IF(Z1.LE.0.)AES(1)=0.
      AES(3)=(1.-EFF(2))*AES(2)
       FFD(6)=TB(1)-FFD(1)-FFD(2)
      IF(TA(2).GT.0.)FFD(1)=100.*(E36*FFD(1)+E38*E7*FFD(2)-
     1FFD(2)*AES(3)/TA(2))/DETOT
      IF(TA(2).LE.0.)FFD(1)=100.*E36*FFD(1)/DETOT
      Z1=TA(1)+TA(4)
       IF(Z1.GT.0.)FFD(3)=100.*EFF(3)*TA(3)/Z1
      FFD(4)=100.*(EFF(3)*TA(3)-CTOT(7,2))/DETOT
      FFD(5)=100.*E38*FFD(5)/DETOT
       FFD(2)=100.-FFD(1)
      TB(1)=TB(1)/E5
       TA(2)=TA(2)*E7
      Z1=24.*364.
       AES(2)=AES(2)/Z1
      TB(1)=TB(1)/Z1
       TB(2)=TB(2)/Z1
       DO 62  J=1,4
   62 TA(J)=TA(J)/Z1
       RETURN
C ....  DATA GETTER.
  100 CALL MOVLEV(B5(NS41),B5,NS42)
       NDN=NDN-NS
  101 IF(NDN.GT.49)GO TO 111
       ND=ND+1
       CALL GETSD(ND)
       CALL TODPR(ND)
      DO 102 I=1,24
       B5(2,NDN)=DEE(I)
       JP=ITOD(I)
      B5(3,NDN)=(ECOS(JP).A.77777777777777777740B).O.JP
  102 NDN=NDN+1
```

```
                   J=NDN-24
                   GO TO (103,105,107,109),JUMP
           103    DO 104 I=1,24
                   B5(1,J)=E15X*SE1(I)
           104    J=J+1
                   GO TO 101
           105    DO 106 I=1,24
                   B5(1,J)=0.
                   Z1=QHT*SE1(I)-W(4)
                  IF(Z1.GT.0..A.Z1.LE.W(6))B5(1,J)=E15X*AMIN1(1.,Z1/W(5))
           106    J=J+1
                   GO TO 101
           107    DO 108 I=1,24
                   B5(1,J)=E15X*SE1(I)
                   B5(4,J)=X(1)*SE1(I)
           108    J=J+1
                   GO TO 101
           109    DO 110 I=1,24
                   Z1=QHT*SE1(I)
                   B5(4,J)=QW1*(Z1**3)
                  B5(1,J)=0.
                   Z1=Z1-W(4)
                  IF(Z1.GT.0..A.Z1.LE.W(6))B5(1,J)=E15X*AMIN1(1.,Z1/W(5))
           110    J=J+1
                   GO TO 101
           111    IF(JUMG.EQ.0)GO TO 18
                   GO TO 19
                  END
```

```
     SYMBOLIC REFERENCE MAP (R=3)

ENTRY POINTS      DEF LINE      REFERENCES
    4  UE11CF            1       185        216

VARIABLES       SN  TYPE            RELOCATION
 1023  AB           REAL                            REFS      135     142     150     159  DEFINED     114
 1021  ABSS         REAL                            REFS      117     135     139     162  DEFINED     112
 1022  AD           REAL                            REFS      118     142     150     158  DEFINED     113
 1020  ADS          REAL                            REFS      117     118     139     143     161
                                                 DEFINED      111
  134  AES          REAL     ARRAY    COMPRNS       REFS       11     140     141     196     198     200     211
                                                 DEFINED       78     140     141     196     197     198     211
 1030  AMS          REAL                            REFS      140     149     150  DEFINED     139
 1024  AS           REAL                            REFS      144     148     160  DEFINED     115
 1017  A4           REAL                            REFS      118     144     153     154     163
                                                 DEFINED      110
 1046  B5           REAL     ARRAY                  REFS        2      95      96      97     109     118     155
                                                     156      165     166     167   2*218  DEFINED     225     227
                                                     232      236     238     242     243     248     249     251
   76  CC           REAL     ARRAY    COMCOMP       REFS        5
  150  CLV          REAL     ARRAY    COMPRNS       REFS       11  DEFINED     189     190     192   2*193     194
   62  CTB          REAL     ARRAY    COMLPRO       REFS       14     103     110     111     112     113     114
                                                     115      116  DEFINED      97      98      99     100     101
```

VARIABLES	SN	TYPE		RELOCATION								
					102	103						
74	CTOT	REAL	ARRAY	COMANSW	REFS	9	189	2*192	194	205		
3	CU	REAL	ARRAY	COMCUMU	REFS	3	147	DEFINED	70	147		
1010	DCU2	REAL			REFS	146	DEFINED	79	81			
32	DE	REAL	ARRAY	COMLPRO	REFS	14	102	DEFINED	96			
140	DEE	REAL	ARRAY	COMSUDE	REFS	10	225					
170	DET	REAL	ARRAY	COMSUDE	REFS	10						
174	DETOT	REAL		COMCOMP	REFS	5	189	191	200	202	205	206
1005	DIA	REAL			REFS	65	2*84	DEFINED	62			
175	DTTOT	REAL		COMCOMP	REFS	5						
1001	EBM	REAL			REFS	106	136	DEFINED	43	136		
40	ECOS	REAL	ARRAY	COMPURC	REFS	6	136	227				
0	EFF	REAL	ARRAY	COMCOMP	REFS	5	33	37	39	41	51	52
					55	93	117	144	198	204	205	
					DEFINED	24	117					
0	EPUR	REAL	ARRAY	COMPURC	REFS	6	119	174	188	DEFINED	24	27
					58	119	174					
26	ESLB	REAL	ARRAY	COMPURC	REFS	6	137	188	DEFINED	27	137	
1000	EST	REAL			REFS	58	93	141	146	164	174	
					DEFINED	42	116					
767	E15X	REAL			REFS	63	232	238	242	251		
					DEFINED	33	63					
773	E36	REAL			REFS	38	100	118	135	200	202	
					DEFINED	37						
775	E38	REAL			REFS	40	96	98	118	135	200	206
					DEFINED	39						
777	E47	REAL			REFS	53	DEFINED	41				
2	E5	REAL		COMUE11	REFS	13	33	208				
3	E6	REAL		COMUE11	REFS	13	37	54	150			
4	E7	REAL		COMUE11	REFS	13	41	47	200	209		
5	E8	REAL		COMUE11	REFS	13	39	45	54	150	196	
120	FFD	REAL	ARRAY	COMPRNS	REFS	11	142	143	148	195	2*199	3*200
					202	206	207	DEFINED	78	142	143	148
					199	200	202	204	205	206	207	
1007	I	INTEGER			REFS	70	2*76	2*78	170	225	226	232
					237	242	243	247	DEFINED	68	74	170
					224	231	235	241	246			
0	IND	INTEGER		COMUE11	REFS	13	66	138	185			
10	ISWND	INTEGER	ARRAY	COMWIND	REFS	4	61					
0	ISXOL	INTEGER		COMSXOL	REFS	15	176					
53	ITOD	INTEGER	ARRAY	COMPURC	REFS	6	57	226				
761	J	INTEGER			REFS	20	2*21	2*27	2*30	70	2*76	2*78
					82	170	178	2*179	180	2*181	2*183	2*188
					2*215	232	233	236	238	239	242	243
					244	248	249	251	252	DEFINED	19	26
					29	69	75	77	82	170	177	183
					187	214	229	233	239	244	252	
1016	JP	INTEGER			REFS	2*119	124	136	2*137	2*227		
					DEFINED	109	226					
1002	JP1	INTEGER			REFS	58	2*174	DEFINED	57			
1013	JUMG	INTEGER			REFS	254	DEFINED	86	90			
1004	JUMP	INTEGER			REFS	67	83	230	DEFINED	60	64	67
1041	JXOL	INTEGER	ARRAY		REFS	2	183	DEFINED	178	180		
1014	K	INTEGER			REFS	2*95	2*96	2*97	98	99	100	101
					2*102	2*103	109	110	111	112	113	114
					115	116	118	155	156	165	166	167
					DEFINED	87	94	108				

```
        FUNCTION UE11CF      74/74    OPT=2                          FTN 4.8+518        80/11/28. 10.23.01        PAGE      7

VARIABLES       SN  TYPE            RELOCATION
   347  KSBW        INTEGER                COMLPRO     REFS        14    DEFINED       105       106
  1031  L           INTEGER                            REFS     2*147    DEFINED       146
   163  MHOUR       INTEGER       ARRAY    COMPURC     REFS         6        122
   147  MHPK        INTEGER       ARRAY    COMPURC     REFS         6    DEFINED        20       127       133
   762  MO          INTEGER                            REFS     2*122        125       126       127       128     2*131      132
                                                       133    DEFINED         22       122
    50  MXX         INTEGER       ARRAY    COMANSW     REFS         9
     0  NAMCU       INTEGER       ARRAY    COMCUMU     REFS         3    DEFINED        71        72        73
   770  ND          INTEGER                            REFS       221        222       223   DEFINED        34       221
  1012  NDN         INTEGER                            REFS       219        220       225       227       228       229
                                                    DEFINED        85        219       228
     0  NH          INTEGER                COMLPRO     REFS        14         94   DEFINED        17
    11  NHNH        INTEGER                COMUE11     REFS        13         17
  1003  NHOUR       INTEGER                            REFS       172        173   DEFINED        59       172
   763  NHR         INTEGER                            REFS       120        122       127       133   DEFINED        23      120
     1  NITER       INTEGER                COMUE11     REFS        13         28   DEFINED        28
     1  NS          INTEGER                COMLPRO     REFS        14         35       108       172       219
                                                    DEFINED        18
    10  NSNS        INTEGER                COMUE11     REFS        13         18
   771  NS41        INTEGER                            REFS        36        218   DEFINED        35
   772  NS42        INTEGER                            REFS       218    DEFINED        36
   764  NW          INTEGER                            REFS       157        158       159       160       161       162      163
                                                       164        165        166       167       168   DEFINED        25      157
                                                       169
   105  PCOS        REAL          ARRAY    COMPURC     REFS         6        124
   117  PDCO        REAL          ARRAY    COMPURC     REFS         6        125     2*131   DEFINED      2*21       126      128
                                                       132
  1006  QHT         REAL                               REFS       237        247   DEFINED        65
  1011  QW1         REAL                               REFS       248    DEFINED        84
    77  R           REAL          ARRAY    COMCUMU     REFS         3
   173  RESB        REAL                   COMCOMP     REFS         5        136
   177  RLCCR       REAL                   COMPURC     REFS         6
   172  RSLB        REAL                   COMCOMP     REFS         5         38        40       136
     6  RX7         REAL                   COMUE11     REFS        13         31
     7  RX8         REAL                   COMUE11     REFS        13         32
   774  R36         REAL                               REFS       101    DEFINED        38
   776  R38         REAL                               REFS        99    DEFINED        40
     0  SE1         REAL          ARRAY    COMSUDE     REFS        10        232       237       242       243       247
    30  SE2         REAL          ARRAY    COMSUDE     REFS        10
    60  ST1         REAL          ARRAY    COMSUDE     REFS        10
   110  ST2         REAL          ARRAY    COMSUDE     REFS        10
     2  SU          REAL          ARRAY    COMLPRO     REFS        14    DEFINED        95
     0  TA          REAL          ARRAY    COMPRNS     REFS        11        145       151       153       155       195    2*200
                                                       202      2*203        204       205       209       215
                                                    DEFINED        76        145       151       153       155       209      215
    50  TB          REAL          ARRAY    COMPRNS     REFS        11        149       152       154       156       199      208
                                                       212        213    DEFINED        76       149       152       154      156
                                                       208        212        213
   760  UE11CF      REAL                               REFS       183    DEFINED       175
     0  W           REAL          ARRAY    COMWIND     REFS         4       3*62        63        65      2*84       237    2*238
                                                       250      2*251    DEFINED        62
   154  WRS         REAL          ARRAY    COMPRNS     REFS        11        170   DEFINED       158       159       160      161
                                                       162        163        164       165       166       167
     0  X           REAL          ARRAY    COMANSW     REFS         9         31        32        33        44        45       46
                                                        55         62         80        81        82       179       181      243
                                                    DEFINED        30
    24  XCO         REAL          ARRAY    COMANSW     REFS         9
```

```
VARIABLES       SN  TYPE          RELOCATION
   26  XM           REAL      ARRAY    COMCOMP     REFS         5
 1034  XOL          REAL      ARRAY                REFS         2       179       183    DEFINED        16       181
  332  XTB          REAL      ARRAY    COMLPRO     REFS        14        48       102       103    DEFINED        44        45
                                                     46        47        48        49        50        51        52        53
                                                     54        55        93
    0  XXXX         REAL      ARRAY       F.P.     REFS         2        30    DEFINED         1
  765  X7           REAL                           REFS        49   DEFINED        31
  766  X8           REAL                           REFS        48        50    DEFINED        32
 1032  ZZZZZ     *  REAL                           REFS       175
 1015  Z1           REAL                           REFS        98        99       100       101       145       151       152
                                                    188       191     2*194     2*196       197     2*204       211       212
                                                    213       215     3*238       248       250     3*251
                                                DEFINED        97       144       150       186       188       195       203
                                                    210       237       247       250
 1033  Z2           REAL                           REFS     2*192   DEFINED       191
 1027  Z5           REAL                           REFS       136       137    DEFINED       135
 1025  Z6           REAL                           REFS       119       124       128       131       132       136
                                                DEFINED       118
 1026  Z7           REAL                           REFS       125       126    DEFINED       124

FILE NAMES          MODE
       OUTPUT       FMT                  WRITES     183
       TAPE9        UNFMT                WRITES      82       170

EXTERNALS              TYPE   ARGS         REFERENCES
       COST         REAL        1             175
       GETSD                    1             222
       LPOUTR                   0             107
       MOVLEV                   3             218
       SQRT         REAL        1  LIBRARY     62
       TODPR                    1              56       223

INLINE FUNCTIONS     TYPE   ARGS         DEF LINE  REFERENCES
       AMAX1        REAL        0  INTRIN               152       154
       AMIN1        REAL        0  INTRIN                48       102       238       251

STATEMENT LABELS              DEF LINE   REFERENCES
    0  10                        27         26
    0  11                        30         29
  116  12                        66         61
    0  13                        70         68        69
    0  14                        76         75
    0  15                        78         74        77
  153  16                        83         80
  161  17                        85         66        83
  171  18                        89         87       254
  175  19                        92        255
    0  20                       104         94
  402  57                       171        108       138       168
    0  61                       188        187
    0  62                       215        214
  561  100                      218        173
  566  101                      220         88       234       240       245       253
    0  102                      228        224
  620  103                      231        230
    0  104                      233        231
  627  105                      235        230
```

STATEMENT LABELS			DEF LINE	REFERENCES	
0	106		239	235	
645	107		241	230	
0	108		244	241	
656	109		246	230	
0	110		252	246	
676	111		254	220	
426	120		182	177	179
733	121	FMT	184	183	
446	122		185	176	
0	200		21	19	
270	205		129	125	
277	210		134	131	

LOOPS	LABEL	INDEX	FROM-TO	LENGTH	PROPERTIES		
12	200	J	19 21	3B	INSTACK		
21	10	J	26 27	3B	INSTACK		
27	11	J	29 30	2B	INSTACK		
122	13	I	68 70	4B		NOT INNER	
123	13	J	69 70	2B	INSTACK		
132	15	I	74 78	14B		NOT INNER	
135	14	J	75 76	3B	INSTACK		
142	15	J	77 78	3B	INSTACK		
170	18	K	87 89	4B		ENTRIES	EXITS
205	20	K	94 104	13B	OPT		
226	57	K	108 171	160B		EXT REFS	
423	120	J	177 182	4B	INSTACK		
435		J	183 183	10B		EXT REFS	
453	61	J	187 188	3B	INSTACK		
556	62	J	214 215	2B	INSTACK		
603	102	I	224 228	5B	INSTACK		
624	104	I	231 233	2B	INSTACK		
635	106	I	235 239	10B	OPT		
652	108	I	241 244	3B	INSTACK		
663	110	I	246 252	13B	OPT		

COMMON BLOCKS	LENGTH	MEMBERS - BIAS NAME(LENGTH)							
COMCUMU	83	0	NAMCU	(3)	3	CU	(60)	63	R	(20)
COMWIND	10	0	W	(8)	8	ISWND	(2)			
COMCOMP	126	0	EFF	(22)	22	XM	(40)	62	CC	(60)
		122	RSLB	(1)	123	RESB	(1)	124	DETOT	(1)
		125	DTTOT	(1)						
COMPURC	128	0	EPUR	(22)	22	ESLB	(10)	32	ECOS	(11)
		43	ITOD	(26)	69	PCOS	(10)	79	PDCO	(24)
		103	MHPK	(12)	115	MHOUR	(12)	127	RLCCR	(1)
COMANSW	74	0	X	(20)	20	XCO	(20)	40	MXX	(20)
		60	CTOT	(14)						
COMSUDE	144	0	SE1	(24)	24	SE2	(24)	48	ST1	(24)
		72	ST2	(24)	96	DEE	(24)	120	DET	(24)
COMPRNS	348	0	TA	(40)	40	TB	(40)	80	FFD	(12)
		92	AES	(12)	104	CLV	(4)	108	WRS	(240)
COMUE11	10	0	IND	(1)	1	NITER	(1)	2	E5	(1)
		3	E6	(1)	4	E7	(1)	5	E8	(1)
		6	RX7	(1)	7	RX8	(1)	8	NSNS	(1)
		9	NHNH	(1)						
COMLPRO	232	0	NH	(1)	1	NS	(1)	2	SU	(24)
		26	DE	(24)	50	CTB	(168)	218	XTB	(13)
		231	KSBW	(1)						

COMMON BLOCKS	LENGTH	MEMBERS - BIAS NAME(LENGTH)
COMSXOL	1	0 ISXOL (1)

STATISTICS

PROGRAM LENGTH	1506B	838
CM LABELED COMMON LENGTH	2204B	1156

60000B CM USED

```
      SUBROUTINE UINV
      COMMON/COMLPIN/MC,MC1,MR,LPO,LPI,NH1,NH3,NH7,MR71,MCNH,TH,
     1 V(7,72),ZOO(24),B2X(48),CAD6,CAD7
      COMMON/COMINI1/U(2401),B(49),A1(72),A2(72),A3(72)
      COMMON  COMLPRO/NH,NS,SU(24),DE(24),CTB(7,24),XTB(13),KSBW
      L1=NH1
       DO 10 I=1,NH
       U(L1)=1./(A1(I)-A1(I+NH))
      U(L1+MCNH)=-U(L1)
       L1=L1+MC1
   10 CONTINUE
       L1=NH1
      DO 11 I=2,NH
       I2=I-1
       Z1=-(A2(NH+I2)-A2(I2))*U(L1+MC+I2)
      L3=L1=L1+MC
       DO 11 J=1,I2
       U(L3)=-Z1*U(L3-MC)
      U(L3+MCNH)=-U(L3)
       L3=L3+1
   11 CONTINUE
       L4=1
      DO 13 I=1,NH
       L1=L4+NH
       L2=L4+MCNH
      DO 12 J=I,NH
      U(L2)=U(L1)*A1(I)+U(L1+1)*A2(I)
       U(L2-MCNH)=-U(L2)
      L1=L1+MC
       L2=L2+MC
   12 CONTINUE
       U(L4)=U(L4)+1.
       L4=L4+MC1
   13 CONTINUE
C....   FIND PI↑S.
      L1=LPO-1
       DO 14 I=1,MR
   14 U(L1+I)=-SDOT(MR,U(I),MC,A3,1)
C....   FIND B.
      L1=0
       DO 16 I=1,NH
       Z1=XTB(1)*U(L1+NH1)
       DO 15 J=1,I
   15 Z1=Z1+U(L1+J)
       B(I)=Z1
       B(I+NH)=1.-Z1
       L1=L1+MC
   16 CONTINUE
       B(MC)=-SDOT(MR,B,1,A3,1)
      RETURN
       END
```

```
      SUBROUTINE UINV          74/74    OPT=2                               FTN 4.8+518         80/11/28. 10.23.01        PAGE      2

      SYMBOLIC REFERENCE MAP (R=3)

ENTRY POINTS        DEF LINE       REFERENCES
    1 UINV                 1          50

VARIABLES        SN  TYPE                RELOCATION
 4622   A1           REAL          ARRAY    COMINI1        REFS          4        2*8       27
 4732   A2           REAL          ARRAY    COMINI1        REFS          4        2*15      27
 5042   A3           REAL          ARRAY    COMINI1        REFS          4        38        49
 4541   B            REAL          ARRAY    COMINI1        REFS          4        49     DEFINED       45        46        49
 1033   B2X          REAL          ARRAY    COMLPIN        REFS          2
 1113   CAD6         REAL                   COMLPIN        REFS          2
 1114   CAD7         REAL                   COMLPIN        REFS          2
   62   CTB          REAL          ARRAY    COMLPRO        REFS          5
   32   DE           REAL          ARRAY    COMLPRO        REFS          5
  144   I            INTEGER                               REFS        2*8       14        26       2*27      2*38       43        45
                                                             46    DEFINED        7        13        23        37        41
  145   I2           INTEGER                               REFS       3*15       17     DEFINED       14
  150   J            INTEGER                               REFS         44    DEFINED       17        26        43
  347   KSBW         INTEGER                COMLPRO        REFS          5
    4   LPI          INTEGER                COMLPIN        REFS          2
    3   LPO          INTEGER                COMLPIN        REFS          2        36
  143   L1           INTEGER                               REFS          8        2*9       10        15        16       2*27       29
                                                             38         42        44        47     DEFINED        6        10        12
                                                             16         24        29        36        40        47
  152   L2           INTEGER                               REFS         27       2*28       30     DEFINED       25        30
  147   L3           INTEGER                               REFS       2*18       2*19       20     DEFINED       16        20
  151   L4           INTEGER                               REFS         24        25       2*32       33     DEFINED       22        33
    0   MC           INTEGER                COMLPIN        REFS          2        15        16        18        29        30        38
                                                             47         49
   11   MCNH         INTEGER                COMLPIN        REFS          2         9        19        25        28
    1   MC1          INTEGER                COMLPIN        REFS          2        10        33
    2   MR           INTEGER                COMLPIN        REFS          2        37        38        49
   10   MR71         INTEGER                COMLPIN        REFS          2
    0   NH           INTEGER                COMLPRO        REFS          5         7         8        13        15        23        24
                                                             26         41        46
    5   NH1          INTEGER                COMLPIN        REFS          2         6        12        42
    6   NH3          INTEGER                COMLPIN        REFS          2
    7   NH7          INTEGER                COMLPIN        REFS          2
    1   NS           INTEGER                COMLPRO        REFS          5
    2   SU           REAL          ARRAY    COMLPRO        REFS          5
   12   TH           REAL                   COMLPIN        REFS          2
    0   U            REAL          ARRAY    COMINI1        REFS          4         9        15        18        19       2*27       28
                                                             32         38        42        44     DEFINED        8         9        18
                                                             19         27        28        32        38
   13   V            REAL          ARRAY    COMLPIN        REFS          2
  332   XTB          REAL          ARRAY    COMLPRO        REFS          5        42
 1003   ZOO          REAL          ARRAY    COMLPIN        REFS          2
  146   Z1           REAL                                  REFS         18        44        45        46     DEFINED       15        42
                                                             44

EXTERNALS           TYPE    ARGS         REFERENCES
      SDOT          REAL     5                38         49
```

STATEMENT LABELS		DEF LINE	REFERENCES	
0	10	11	7	
0	11	21	13	17
0	12	31	26	
0	13	34	23	
0	14	38	37	
0	15	44	43	
0	16	48	41	

LOOPS	LABEL	INDEX	FROM-TO	LENGTH	PROPERTIES	
11	10	I	7 11	4B	INSTACK	
22	11	I	13 21	17B		NOT INNER
33	11	J	17 21	3B	INSTACK	
46	13	I	23 34	22B		NOT INNER
54	12	J	26 31	4B	INSTACK	
73	14	I	37 38	10B		EXT REFS
107	16	I	41 48	11B		NOT INNER
112	15	J	43 44	2B	INSTACK	

COMMON BLOCKS	LENGTH	MEMBERS - BIAS NAME(LENGTH)								
COMLPIN	589	0	MC	(1)	1	MC1	(1)	2	MR	(1)
		3	LPO	(1)	4	LPI	(1)	5	NH1	(1)
		6	NH3	(1)	7	NH7	(1)	8	MR71	(1)
		9	MCNH	(1)	10	TH	(1)	11	V	(504)
		515	ZOO	(24)	539	B2X	(48)	587	CAD6	(1)
		588	CAD7	(1)						
COMINI1	2666	0	U	(2401)	2401	B	(49)	2450	A1	(72)
		2522	A2	(72)	2594	A3	(72)			
COMLPRO	232	0	NH	(1)	1	NS	(1)	2	SU	(24)
		26	DE	(24)	50	CTB	(168)	218	XTB	(13)
		231	KSBW	(1)						

STATISTICS		
PROGRAM LENGTH	153B	107
CM LABELED COMMON LENGTH	6637B	3487
60000B CM USED		

```
C
C
C              SOLSTOR - UE11 - SOLLIB3 LIBRARY.
C
C
```

```
      FUNCTION ZMF(A,B,N)
       ZMF=N/(1.+A)
       IF(ABS(A-B).LT..000001)RETURN
      ZMF=(1.-((1.+B)/(1.+A))**N)/(A-B)
       RETURN
       END
```

```
     SYMBOLIC REFERENCE MAP (R=3)

ENTRY POINTS     DEF LINE      REFERENCES
    4  ZMF              1           3          5

VARIABLES      SN  TYPE             RELOCATION
    0  A            REAL                 F.P.        REFS          2          3          2*4   DEFINED         1
    0  B            REAL                 F.P.        REFS          3        2*4   DEFINED         1
    0  N            INTEGER              F.P.        REFS          2          4   DEFINED         1
   25  ZMF          REAL                           DEFINED         2          4

INLINE FUNCTIONS    TYPE    ARGS         DEF LINE   REFERENCES
       ABS          REAL       1  INTRIN                    3

STATISTICS
  PROGRAM LENGTH                 26B       22
       60000B CM USED
```

```
      SUBROUTINE DEMGET(IPR,ISTH,ISBIG,FC,ESD)
      DIMENSION ESD(3,8736),J2C(3)
       LEVEL2,ESD
      DATA ISS/0/,MU/77777777770000000000B/,J2C/1HT,2HET,1HE/
      IF(FC.LE.0.)GO TO 20
      IF(IPR.EQ.8HFLATD-KW.O.IPR.EQ.8HFLATD-MW)GO TO 21
      IF(ISS.EQ.0)REWIND 3
       ISS=2
   10 READ(3)J1,J2,ISBIG,(ESD(3,J),J=1,8736)
       IF(EOF(3))11,13,11
   11 IF(ISS.EQ.1)GO TO 12
       REWIND 3
       ISS=1
       GO TO 10
   12 PRINT1,IPR
       CALL EXIT
    1   FORMAT(* CANNOT FIND DEMAND (*A10,*)*)
   13 IF(J1.NE.IPR)GO TO 10
       BACKSPACE 3 $ IF(ISBIG.NE.0)ISBIG=1
       IF(J2.NE.J2C(ISTH+2))GOTO20
   24 IF(ISTH)14,16,18
C     THERMAL ONLY.
   14 DO 15 J=1,8736
       Z1=SHIFT(ESD(3,J),30).A.MU
       Z1=FC*Z1
   15 ESD(3,J)=SHIFT(Z1.A.MU,-30)
       RETURN
C     BOTH
   16 DO 17 J=1,8736
       Z1=ESD(3,J).A.MU
       Z1=Z1*FC
      Z2=SHIFT(ESD(3,J),30).A.MU
       Z2=Z2*FC
   17 ESD(3,J)=SHIFT(Z2.A.MU,-30).O.(Z1.A.MU)
       RETURN
C     ELECTRICAL ONLY
   18 DO 19 J=1,8736
       Z1=ESD(3,J).A.MU
       Z1=Z1*FC
   19 ESD(3,J)=Z1.A.MU
       RETURN
   20 PRINT2,IPR,ISTH,J2,FC
       CALL EXIT
    2 FORMAT(* FC OR ET MATCH ERROR *A10,I2,1X,A10,1X,E10.2)
   21 Z1=1000. $ ISBIG=1
       IF(IPR.EQ.8HFLATD-MW)GO TO 22
       ISBIG=0
       Z1=1.
   22 Z2=SHIFT(Z1.A.MU,-30).O.(Z1.A.MU)
       DO 23 J=1,8736
   23 ESD(3,J)=Z2
       J2=J2C(ISTH+2)
       GO TO 24
       END
```

```
         SUBROUTINE DEMGET     74/74   OPT=2                          FTN 4.8+518        80/11/28. 10.23.01      PAGE     2

         SYMBOLIC REFERENCE MAP (R=3)

  ENTRY POINTS      DEF LINE     REFERENCES
      3  DEMGET            1          27         35         41

  VARIABLES        SN  TYPE              RELOCATION
      0  ESD           REAL       ARRAY      F.P.        REFS          2          3         24         30         32         38
                                                      DEFINED          1          9         26         34         40         51
      0  FC            REAL                  F.P.        REFS          5         25         31         33         39         42
                                                      DEFINED          1
      0  IPR           INTEGER               F.P.        REFS        2*6         15         18         42         46
                                                      DEFINED          1
      0  ISBIG         INTEGER               F.P.        REFS         19    DEFINED          1          9         19         45         47
    143  ISS           INTEGER                           REFS          7         11    DEFINED          4          8         13
      0  ISTH          INTEGER               F.P.        REFS         20         21         42         52    DEFINED          1
    216  J             INTEGER                           REFS          9         24         26         30         32         34         38
                                                          40          51    DEFINED          9         23         29         37         50
    214  J1            INTEGER                           REFS         18    DEFINED          9
    215  J2            INTEGER                           REFS [illegible]        42    DEFINED          9         52
    221  J2C           INTEGER    ARRAY                  REFS          2         20         52    DEFINED          4
    144  MU            INTEGER                           REFS         24         26         30         32       2*34         38         40
                                                        2*49    DEFINED          4
    217  Z1            REAL                              REFS         25         26         31         34         39         40       2*49
                                                      DEFINED         24         25         30         31         38         39         45
                                                          48
    220  Z2            REAL                              REFS         33         34         51    DEFINED         32         33         49

  FILE NAMES          MODE
         OUTPUT        FMT                   WRITES       15         42
         TAPE3         UNFMT                  READS        9     MOTION          7         12         19

  EXTERNALS             TYPE     ARGS          REFERENCES
         EOF           REAL         1               10
         EXIT                       0               16         43

  INLINE FUNCTIONS      TYPE     ARGS        DEF LINE   REFERENCES
         SHIFT         NO TYPE      2  INTRIN                  24         26         32         34         49

  STATEMENT LABELS                  DEF LINE    REFERENCES
    164  1            FMT                 17          15
    201  2            FMT                 44          42
     22  10                                9          14         18
      0  11             INACTIVE          11        2*10
     47  12                               15          11
     52  13                               18          10
      0  14             INACTIVE          23          21
      0  15                               26          23
     76  16                               29          21
      0  17                               34          29
    107  18                               37          21
      0  19                               40          37
    115  20                               42           5         20
    120  21                               45           6
    127  22                               49          46
      0  23                               51          50
     64  24                               21          53
```

LOOPS	LABEL	INDEX	FROM-TO	LENGTH	PROPERTIES
26		J	9 9	10B	EXT REFS
72	15	J	23 26	3B	INSTACK
102	17	J	29 34	4B	INSTACK
112	19	J	37 40	3B	INSTACK
133	23	J	50 51	2B	INSTACK

STATISTICS
PROGRAM LENGTH 227B 151
60000B CM USED

```
      SUBROUTINE PIHI
      DIMENSION R(2,24,14),D(14),KF(9,14),KE(9,14)
      COMMON /COMPIHI/ SD(24,2)
      KA(I)=SHIFT(J1,I).A.37777777B
       KB(I)=SHIFT(J2,I).A.37777777B
      REWIND 2
       READ(2)J1
       IF(J1.EQ.10HASHRAETABL)GO TO 13
      PRINT1,J1
       CALL EXIT
    1 FORMAT(* NO ASHRAE DATA *A10)
   13 READ(2)X2,(D(J),(KE(I,J),I=1,9),J=2,13)
      IF(SD(1).LT.X2) GO TO 20
   10 X1=X2
       DO 11 I=1,9
       DO 11 J=2,13
   11 KF(I,J)=KE(I,J)
      READ(2)X2,(D(J),(KE(I,J),I=1,9),J=2,13)
       IF(EOF(2))20,12,20
   20 PRINT2,SD(1)
       CALL EXIT
    2 FORMAT(* ASHRAE TABLE ERROR *F8.2)
   12 IF(SD(1).GT.X2)GO TO 10
       D(1)=-10.
       D(14)=386.
       DO 14 J=1,9
      KF(J,1)=KF(J,13)
       KF(J,14)=KF(J,2)
      KE(J,1)=KE(J,13)
   14 KE(J,14)=KE(J,2)
       Z1=X2-X1
       X2=(SD(1)-X1)/Z1
       X1=1.-X2
      DO 23 K=1,14
       DO 21 I=1,2
       DO 21 J=1,24
   21 R(I,J,K)=0.
       N1=5
       N2=21
       DO 23 J=1,9
      J1=KF(J,K)
       J2=KE(J,K)
       K1=KA(-40)
       K2=KB(-40)
      Z1=X1*K1+X2*K2
       IF(Z1.LE.0.)GO TO 22
      K1=KA(-20)
       K2=KB(-20)
       R(1,N1,K)=R(1,N2,K)=(X1*K1+X2*K2)/Z1
      K1=KA(  0)
       K2=KB(  0)
       R(2,N1,K)=R(2,N2,K)=(X1*K1+X2*K2)/Z1
   22 N1=N1+1
       N2=N2-1
   23 CONTINUE
       X=1.
       K1=1
```

```
                 K2=2
                 DD=D(2)-D(1)
                 RETURN
                ENTRY PIH
                IF(X.LE.D(K2))GO TO 26
                 K1=K2
                K2=K2+1
                 DD=D(K2)-D(K1)
          26    X2=(X-D(K1))/DD
                 X1=1.-X2
                 DO 27 I=1,2
                 DO 27 J=1,24
          27    SD(J,I)=X1*R(I,J,K1)+X2*R(I,J,K2)
                 X=X+1.
                 RETURN
                END
```

SYMBOLIC REFERENCE MAP (R=3)

```
ENTRY POINTS      DEF LINE     REFERENCES
  200  PIH            61          72
    1  PIHI            1          60

VARIABLES       SN  TYPE             RELOCATION
 1577  D            REAL      ARRAY                 REFS        2      2*59     62     2*65      66
                                                 DEFINED       12       18      24      25
  336  DD           REAL                            REFS       66   DEFINED     59      65
  324  I            INTEGER                         REFS       12     2*17      18      37      3*70
                                                 DEFINED       12       15      18      35       68
  323  J            INTEGER                         REFS     2*12     2*17    2*18    2*27     2*28     2*29     2*30
                                                              37       41      42     3*70  DEFINED      12       16       18
                                                              26       36      40      69
  321  J1           INTEGER                         REFS        8        9      43      47       50
                                                 DEFINED        7       41
  332  J2           INTEGER                         REFS       44       48      51   DEFINED      42
  327  K            INTEGER                         REFS       37       41      42    2*49     2*52
                                                 DEFINED       34
 2013  KE           INTEGER   ARRAY                 REFS        2       17      29      30       42
                                                 DEFINED       12       18      29      30
 1615  KF           INTEGER   ARRAY                 REFS        2       27      28      41   DEFINED      17       27
                                                              28
  333  K1           INTEGER                         REFS       45       49      52      65       66       70
                                                 DEFINED       43       47      50      57       63
  334  K2           INTEGER                         REFS       45       49      52      62       63       64       65
                                                              70  DEFINED      44      48      51       58       64
  330  N1           INTEGER                         REFS       49       52      53   DEFINED      38       53
  331  N2           INTEGER                         REFS       49       52      54   DEFINED      39       54
  337  R            REAL      ARRAY                 REFS        2     2*70  DEFINED     37     2*49     2*52
    0  SD           REAL      ARRAY    COMPIHI      REFS        3       13      20      23       32
                                                 DEFINED       70
  335  X            REAL                            REFS       62       66      71   DEFINED      56       71
  325  X1           REAL                            REFS       31       32      45      49       52       70
                                                 DEFINED       14       33      67
```

```
VARIABLES      SN  TYPE           RELOCATION
   322  X2         REAL                          REFS        13        14        23        31        33        45        49
                                                   52        67        70   DEFINED        12        18        32        66
   326  Z1         REAL                          REFS        32        46        49        52   DEFINED        31        45

FILE NAMES          MODE
       OUTPUT      FMT                 WRITES        9        20
       TAPE2       UNFMT                READS        7        12        18    MOTION         6

EXTERNALS           TYPE   ARGS        REFERENCES
       EOF         REAL      1              19
       EXIT                  0              10        21

INLINE FUNCTIONS    TYPE   ARGS         DEF LINE  REFERENCES
       KA          INTEGER   1    SF          4        43        47        50
       KB          INTEGER   1    SF          5        44        48        51
       SHIFT       NO TYPE   2  INTRIN                 43        44        47        48        50        51

STATEMENT LABELS              DEF LINE   REFERENCES
   256  1        FMT              11          9
   306  2        FMT              22         20
    40  10                        14         23
     0  11                        17         15        16
   100  12                        23         19
    13  13                        12          8
     0  14                        30         26
    75  20                        20         13       2*19
     0  21                        37         35        36
   161  22                        53         46
     0  23                        55         34        40
   212  26                        66         62
     0  27                        70         68        69

LOOPS   LABEL     INDEX      FROM-TO     LENGTH     PROPERTIES
   23             J           12 12        12B                EXT REFS
   43   11        I           15 17         5B                NOT INNER
   44   11        J           16 17         3B      INSTACK
   57             J           18 18        12B                EXT REFS
  110   14        J           26 30         6B      INSTACK
  126   23        K           34 55        44B                NOT INNER
  132   21        I           35 37         4B                NOT INNER
  133   21        J           36 37         2B      INSTACK
  145   23        J           40 55        16B        OPT
  225   27        I           68 70        10B                NOT INNER
  230   27        J           69 70         3B      INSTACK

COMMON BLOCKS    LENGTH      MEMBERS - BIAS NAME(LENGTH)
       COMPIHI      48               0 SD      (48)

STATISTICS
  PROGRAM LENGTH                 2211B     1161
  CM LABELED COMMON LENGTH         60B       48
         60000B CM USED
```

```
      SUBROUTINE RANSTA (M)
C     RANDOM STARTER FOR ANDGEN,UDGEN, AND RAYGEN
C     USER MUST CALL ---SET(M) TO SET DESIRED ROUTINE
C     CDC-6600 WITH HOROLOG ONLY
      CALL HOROLOG(I,J,K)
       DECODE(10,1,J)J3,J2,J1
       DECODE(10,2,K)J4
    1 FORMAT(1X,I2,1X,I2,1X,I2)
    2 FORMAT(4X,I2)
      L=(40320*J1+672*J2*28*J3+J4)
       L=L.AND.7777777B
      M=L*1000000100B+61B
       RETURN
      END
```

```
      SYMBOLIC REFERENCE MAP (R=3)

ENTRY POINTS       DEF LINE       REFERENCES
    3  RANSTA          1             13

VARIABLES        SN  TYPE              RELOCATION
   54  I          *  INTEGER                            REFS        5
   55  J             INTEGER                            REFS        5          6
   61  J1            INTEGER                            REFS       10     DEFINED         6
   60  J2            INTEGER                            REFS       10     DEFINED         6
   57  J3            INTEGER                            REFS       10     DEFINED         6
   62  J4            INTEGER                            REFS       10     DEFINED         7
   56  K             INTEGER                            REFS        5          7
   63  L             INTEGER                            REFS       11         12     DEFINED       10       11
    0  M             INTEGER                 F.P.     DEFINED       1         12

EXTERNALS              TYPE    ARGS          REFERENCES
       HOROLOG                  3                 5

STATEMENT LABELS                DEF LINE    REFERENCES
   44  1         FMT                8           6
   47  2         FMT                9           7

STATISTICS
  PROGRAM LENGTH                   64B        52
         60000B CM USED
```

```
      SUBROUTINE SMOLSW(J1,N2,IOP,T,X,Y,F,A)
C     WHERE J1=NUMBER OF DATA POINTS
C           N2=TWICE THE NUMBER OF KNOTS
C           IOP=ARRAY OF DIMENSION 2 CONTAINING COMBINATIONS OF THE
C               INTEGERS 1 THRU 5 FOR SPECIFYING THE BOUNDARY CONDITIONS
C           T=TABLE OF ABSCISSAS OF DATA POINTS
C           X=TABLE OF KNOTS
C           Y=TABLE OF ORDINATES OF DATA POINTS
C           W=  WEIGHTS ARE REMOVED.......
C           F=ARRAY OF DIMENSION N2 CONTAINING SECOND DERIVATIVES AND
C             FUNCTION VALUES UPON RETURN
C           A=ARRAY OF DIMENSION .GE. N2**2 USED FOR TEMPORARY STORAGE
C
      DIMENSION IOP(2),T(2),X(2),Y(2),F(2),A(N2,N2),W(2)
      N=N2/2
      KK=N-1
      F1=F(1)
      FN=F(N)
      DO 100 I=1,N
  100 F(I)=0.
      M1=2*N
      M2=M1-1
      M3=N+1
      M4=KK-1
      DO 20 I=2,KK
      FL1=X(I+1)-X(I)
      FL2=X(I)-X(I-1)
      DO 20 J=1,N
      M=N+J
      IF (J-(I-1))70,40,30
   30 IF (J-I)50,60,50
   50 IF (J-(I+1))70,80,70
   70 A(I,J)=0.
      A(I,M)=0.
      GO TO 20
   40 A(I,J)=FL2/6.
      A(I,M)=-1./FL2
      GO TO 20
   60 A(I,J)=(X(I+1)-X(I-1))/3.
      A(I,M)=(FL1+FL2)/(FL1*FL2)
      GO TO 20
   80 A(I,J)=FL1/6.
      A(I,M)=-1./FL1
   20 CONTINUE
      IF (N-3)111,112,111
  111 DO 110 I=3,KK
      A(I,I)=A(I,I)-A(I,I-1)*A(I-1,I)/A(I-1,I-1)
      A(I,1)=-A(I,I-1)*A(I-1,1)/A(I-1,I-1)
      DO 110 J=M3,M2
  110 A(I,J)=A(I,J)-A(I,I-1)*A(I-1,J)/A(I-1,I-1)
  112 A(N-1,1)=A(N-1,1)/A(N-1,N-1)
      DO 130 I=N,M1
  130 A(N-1,I)=A(N-1,I)/A(N-1,N-1)
      IF (N-3)113,114,113
  113 DO 140 I=2,M4
      J=N-I
      A(J,1)=(A(J,1)-A(J,J+1)*A(J+1,1))/A(J,J)
```

```
          DO 140 K=N,M1
      140 A(J,K)=(A(J,K)-A(J,J+1)*A(J+1,K))/A(J,J)
      114 DO 141 I=2,KK
          DO 141 J=2,KK
          IF (I-J) 142,143,142
      143 A(I,J)=1.
          GO TO 141
      142 A(I,J)=0.
      141 CONTINUE
          DO 150 I=M3,M1
          F(I)=0.
          DO 150 J=1,M1
      150 A(I,J)=0.
          IF (IOP(1)-5) 151,152,151
      152 DO 153 I=1,M1
      153 A(1,I)=0.
          GO TO 200
      151 DO 149 I=N,M1
      149 A(1,I)=0.
          DO 154 I=1,KK
      160 MK=IOP(1)
          GO TO (220,230,240,250),MK
      220 IF (I-1) 221,222,221
      222 A(1,1)=1.
          F(1)=F1
          GO TO 155
      221 BOB=0.
          GO TO 155
      230 IF (I-1) 231,232,231
      232 A(1,1)=1.
          GO TO 155
      231 IF (I-2) 233,233,234
      233 BOB=-F1
          GO TO 155
      234 BOB=0.
          GO TO 155
      240 IF (I-1) 241,242,241
      242 A(1,1)=(X(2)-X(1))/3.
          A(1,N+1)=1./(X(2)-X(1))
          A(1,N+2)=-A(1,N+1)
          F(1)=-F1
          GO TO 155
      241 IF (I-2) 243,243,244
      243 BOB=(X(2)-X(1))/6.
          GO TO 155
      244 BOB=0.
          GO TO 155
      250 IF (I-1) 251,252,251
      252 A(1,1)=1.
          A(1,N)=-1.
          GO TO 155
      251 BOB=0.
          GO TO 155
      155 IF (I-1) 156,154,156
      156 A(1,1)=A(1,1)-BOB*A(I,1)
          DO 157 J=N,M1
      157 A(1,J)=A(1,J)-BOB*A(I,J)
```

```
  154 CONTINUE
      DO 158 I=N,M1
  158 A(1,I)=A(1,I)/A(1,1)
      F(1)=F(1)/A(1,1)
      DO 159 I=2,KK
      F(I)=F(I)-A(I,1)*F(1)
      DO 159 J=N,M1
  159 A(I,J)=A(I,J)-A(I,1)*A(1,J)
      A(1,1)=1.
      DO 161 I=2,KK
      A(1,I)=0.
  161 A(I,1)=0.
  200 IF (IOP(2)-5)201,202,201
  202 DO 203 I=1,M1
  203 A(N,I)=0.
      GO TO 300
  201 DO 204 I=N,M1
  204 A(N,I)=0.
      A(N,1)=0.
      DO 205 I=1,KK
  260 MK=IOP(2)
      GO TO (310,320,330,340),MK
  310 IF (I-1)311,312,311
  312 A(N,N)=1.
      F(N)=FN
      GO TO 206
  311 BOB=0.
      GO TO 206
  320 IF (I-1)321,322,321
  322 A(N,N)=1.
      GO TO 206
  321 IF (I-(N-1))323,324,323
  324 BOB=-FN
      GO TO 206
  323 BOB=0.
      GO TO 206
  330 IF (I-1)331,332,331
  332 A(N,N)=(X(N)-X(N-1))/3.
      A(N,M2)=-1./(X(N)-X(N-1))
      A(N,M1)=-A(N,M2)
      F(N)=FN
      GO TO 206
  331 IF (I-(N-1))333,334,333
  334 BOB=(X(N)-X(N-1))/6.
      GO TO 206
  333 BOB=0.
      GO TO 206
  340 IF (I-1)341,342,341
  342 A(N,N)=(X(2)-X(1)+X(N)-X(N-1))/3.
      A(N,N+1)=1./(X(2)-X(1))
      A(N,N+2)=-A(N,N+1)
      A(N,M2)=-1./(X(N)-X(N-1))
      A(N,M1)=-A(N,M2)
      GO TO 206
  341 IF (I-2)343,344,343
  343 IF (I-(N-1))345,346,345
  344 BOB=(X(2)-X(1))/6.
```

```
      GO TO 206
  346 BOB=(X(N)-X(N-1))/6.
      GO TO 206
  345 BOB=0.
      GO TO 206
  206 IF (I-1)207,205,207
  207 F(N)=F(N)-BOB*F(I)
      A(N,1)=A(N,1)-BOB*A(I,1)
      DO 208 J=N,M1
  208 A(N,J)=A(N,J)-BOB*A(I,J)
  205 CONTINUE
      DO 210 I=M3,M1
  210 A(N,I)=A(N,I)/A(N,N)
      F(N)=F(N)/A(N,N)
      A(N,1)=A(N,1)/A(N,N)
      DO 211 I=1,KK
      F(I)=F(I)-A(I,N)*F(N)
      A(I,1)=A(I,1)-A(I,N)*A(N,1)
      DO 211 J=M3,M1
  211 A(I,J)=A(I,J)-A(I,N)*A(N,J)
      A(N,N)=1.
      DO 239 I=2,KK
      A(N,I)=0.
  239 A(I,N)=0.
      A(1,N)=0.
  300 GO TO 400
  400 A1N=A(1,N)
      AN1=A(N,1)
      DO 1000 J=1,J1
      IF(T(J)-X(1))77,77,66
   66 IF(T(J)-X(N))68,69,69
   69 I=N-1
      GO TO 212
   68 CALL SMOLS2(T(J),X,N,M,MFLAG)
      IF (M-1)76,77,76
   77 I=1
      GO TO 212
   76 IF (MFLAG)78,79,78
   79 I=M-1
      GO TO 212
   78 I=M
  212 A1=X(I+1)-T(J)
      FLI=X(I+1)-X(I)
      MB=N+I
      A2=T(J)-X(I)
      AIJ=-((A1**3)/(6.*FLI)-FLI*A1/6.)
      BIJ=-((A2**3)/(6.*FLI)-FLI*A2/6.)
      CIJ=A1/FLI
      DIJ=A2/FLI
      IF (IOP(1)-5)401,402,401
  402 IF (I-1)403,404,403
  403 IF (I-(N-1))405,406,405
  404 EIJ=-AIJ+A(2,1)*BIJ
      GO TO 410
  406 EIJ=A(N-1,1)*AIJ+AN1*BIJ
      GO TO 410
  405 EIJ=A(I,1)*AIJ+A(I+1,1)*BIJ
```

```
  410 A(1,I)=A(1,I)-EIJ*AIJ
      A(1,I+1)=A(1,I+1)-EIJ*BIJ
      A(1,MB)=A(1,MB)+EIJ*CIJ
      A(1,MB+1)=A(1,MB+1)+EIJ*DIJ
      F(1)=F(1)+EIJ*Y(J)
  401 IF (IOP(2)-5)411,412,411
  412 IF (I-1)413,414,413
  413 IF (I-(N-1))415,416,415
  414 GIJ=A1N*AIJ+A(2,N)*BIJ
      GO TO 420
  416 GIJ=A(N-1,N)*AIJ-BIJ
      GO TO 420
  415 GIJ=A(I,N)*AIJ+A(I+1,N)*BIJ
  420 A(N,I)=A(N,I)-GIJ*AIJ
      A(N,I+1)=A(N,I+1)-GIJ*BIJ
      A(N,MB)=A(N,MB)+GIJ*CIJ
      A(N,MB+1)=A(N,MB+1)+GIJ*DIJ
      F(N)=F(N)+GIJ*Y(J)
  411 DO 1000 K=1,N
      K1=N+K
      IF (I-1)430,431,430
  430 IF (I-(N-1))432,433,432
  431 IF (IOP(1)-5)432,435,432
  435 PKJI=A(2,K1)*BIJ
      GO TO 450
  433 IF (IOP(2)-5)432,436,432
  436 PKJI=A(N-1,K1)*AIJ
      GO TO 450
  432 PKJI=A(I,K1)*AIJ+A(I+1,K1)*BIJ
  450 IF (K-I)451,452,453
  453 IF (K-(I+1))451,454,451
  452 PKJI=PKJI+A1/FLI
      GO TO 451
  454 PKJI=PKJI+A2/FLI
  451 A(K1,I)=A(K1,I)-PKJI*AIJ
      A(K1,I+1)=A(K1,I+1)-PKJI*BIJ
      A(K1,MB)=A(K1,MB)+PKJI*CIJ
      A(K1,MB+1)=A(K1,MB+1)+PKJI*DIJ
 1000 F(K1)=F(K1)+PKJI*Y(J)
      IF (IOP(1)-4)601,602,601
  602 DO 604 I=1,M1
  604 A(N+1,I)=0.
      A(N+1,N+1)=1.
      A(N+1,M1)=-1.
      F(N+1)=0.
  601 CALL SMOLS1(N2,1,N2,A,F,DET)
      RETURN
      END
```

SYMBOLIC REFERENCE MAP (R=3)

```
ENTRY POINTS      DEF LINE     REFERENCES
   3  SMOLSW          1        275

VARIABLES       SN  TYPE            RELOCATION
    0  A            REAL         ARRAY      F.P.     REFS       14     4*47     3*48     4*50     2*51     2*53     4*57
                                                     4*59       97    2*112    2*114    2*117      118      120    3*122
                                                      154      165      167    2*179    2*181    2*184      185    2*186
                                                      188    3*189    3*191      198      199      224      226    2*228
                                                      229      230      231      232      237      239    2*241      242
                                                      243      244      245      252      255    2*257      263      264
                                                      265      266      274  DEFINED        1       33       34       36
                                                       37       39       40       42       43       47       48       50
                                                       51       53       57       59       63       65       70       73
                                                       76       81       87       95       96       97      106      107
                                                      112      114      117      122      123      125      126      129
                                                      132      133      138      144      152      153      154      163
                                                      164      165      166      167      179      181      184      186
                                                      189      191      192      194      195      196      229      230
                                                      231      232      242      243      244      245      263      264
                                                      265      266      270      271      272
 1324  AIJ          REAL                             REFS      224      226      228      229      237      239      241
                                                      242      255      257      263  DEFINED      217
 1316  AN1          REAL                             REFS      226  DEFINED      199
 1320  A1           REAL                             REFS    2*217      219      260  DEFINED      213
 1315  A1N          REAL                             REFS      237  DEFINED      198
 1323  A2           REAL                             REFS    2*218      220      262  DEFINED      216
 1325  BIJ          REAL                             REFS      224      226      228      230      237      239      241
                                                      243      252      257      264  DEFINED      218
 1314  BOB          REAL                             REFS      112      114      178      179      181
                                                  DEFINED       84       90       92      101      103      109      141
                                                      147      149      158      160      171      173      175
 1326  CIJ          REAL                             REFS      231      244      265  DEFINED      219
 1334  DET        * REAL                             REFS      274
 1327  DIJ          REAL                             REFS      232      245      266  DEFINED      220
 1330  EIJ          REAL                             REFS      229      230      231      232      233
                                                  DEFINED      224      226      228
    0  F            REAL         ARRAY      F.P.     REFS       14       17       18      118    2*120    2*178      185
                                                    2*188      233      246      267      274  DEFINED        1       20
                                                       68       82       98      118      120      139      155      178
                                                      185      188      233      246      267      273
 1321  FLI          REAL                             REFS    2*217    2*218      219      220      260      262
                                                  DEFINED      214
 1306  FL1          REAL                             REFS     2*40       42       43  DEFINED       26
 1307  FL2          REAL                             REFS       36       37     2*40  DEFINED       27
 1300  FN           REAL                             REFS      139      147      155  DEFINED       18
 1277  F1           REAL                             REFS       82       90       98  DEFINED       17
 1331  GIJ          REAL                             REFS      242      243      244      245      246
                                                  DEFINED      237      239      241
 1301  I            INTEGER                          REFS       20     2*26     2*27       30       31       32       33
                                                       34       36       37     3*39       40       42       43    10*47
                                                     6*48     7*50     2*53       56       62       63       65       68
                                                       70       73       76       80       86       89       94      100
                                                      105      111      112      114    2*117    3*120    3*122      125
                                                      126      129      132      137      143      146      151      157
                                                      162      169      170      177      178      179      181    2*184
                                                    3*188    3*189    3*191      194      195      213    2*214      215
                                                      216      222      223    2*228    2*229    2*230      235      236
```

```
VARIABLES       SN  TYPE            RELOCATION
                                                    2*241    2*242    2*243      249      250    2*257      258      259
                                                    2*263    2*264      270  DEFINED       19       25       46       52
                                                       55       60       67       72       75       77      116      119
                                                      124      128      131      134      183      187      193      203
                                                      207      210      212      269
     0  IOP         INTEGER   ARRAY     F.P.         REFS       14       71       78      127      135      221      234
                                                      251      254      268  DEFINED        1
  1310  J           INTEGER                          REFS       29       30       31       32       33       36       39
                                                       42     3*50     7*57     7*59       62       63       65       70
                                                    3*114    3*122    3*181    3*191      201      202      205      213
                                                      216      233      246      267  DEFINED       28       49       56
                                                       61       69      113      121      180      190      200
     0  J1          INTEGER             F.P.         REFS      200  DEFINED        1
  1312  K           INTEGER                          REFS     3*59      248      258      259  DEFINED       58      247
  1276  KK          INTEGER                          REFS       24       25       46       60       61       77      119
                                                      124      134      187      193  DEFINED       16
  1332  K1          INTEGER                          REFS      252      255    2*257    2*263    2*264    2*265    2*266
                                                    2*267  DEFINED      248
  1311  M           INTEGER                          REFS       34       37       40       43      205      206      210
                                                      212  DEFINED       29
  1322  MB          INTEGER                          REFS    2*231    2*232    2*244    2*245    2*265    2*266
                                                  DEFINED      215
  1317  MFLAG       INTEGER                          REFS      205      209
  1313  MK          INTEGER                          REFS       79      136  DEFINED       78      135
  1302  M1          INTEGER                          REFS       22       52       58       67       69       72       75
                                                      113      116      121      128      131      154      167      180
                                                      183      190      269      272  DEFINED       21
  1303  M2          INTEGER                          REFS       49      153      154      166      167
                                                  DEFINED       22
  1304  M3          INTEGER                          REFS       49       67      183      190  DEFINED       23
  1305  M4          INTEGER                          REFS       55  DEFINED       24
  1275  N           INTEGER                          REFS       16       18       19       21       23       28       29
                                                       45     4*51       52     4*53       54       56       58       75
                                                       96     2*97      107      113      116      121      129      131
                                                      132      133    2*138      139    2*144      146    4*152    3*153
                                                    2*154      155      157    2*158    4*163    2*164    4*165    3*166
                                                    2*167      170    2*173    2*178    2*179      180    2*181    4*184
                                                    4*185    4*186    2*188    2*189    2*191    2*192      194      195
                                                      196      198      199      202      203      205      215      223
                                                      226      236      237    2*239    2*241    2*242    2*243    2*244
                                                    2*245    2*246      247      248      250      255      270    2*271
                                                      272      273  DEFINED       15
     0  N2          INTEGER             F.P.         REFS     2*14       15    2*274  DEFINED        1
  1333  PKJI        REAL                             REFS      260      262      263      264      265      266      267
                                                  DEFINED      252      255      257      260      262
     0  T           REAL      ARRAY     F.P.         REFS       14      201      202      205      213      216
                                                  DEFINED        1
  1335  W           REAL     *UNDEF                  REFS       14
     0  X           REAL      ARRAY     F.P.         REFS       14     2*26     2*27     2*39     2*95     2*96    2*101
                                                    2*152    2*153    2*158    4*163    2*164    2*166    2*171    2*173
                                                      201      202      205      213    2*214      216
                                                  DEFINED        1
     0  Y           REAL      ARRAY     F.P.         REFS       14      233      246      267  DEFINED        1

EXTERNALS          TYPE    ARGS        REFERENCES
        SMOLS1               6            274
        SMOLS2               5            205
```

STATEMENT LABELS			DEF LINE	REFERENCES								
77	20		44	25	28	35	38	41				
0	30	INACTIVE	31	30								
56	40		36	30								
0	50	INACTIVE	32	2*31								
63	60		39	31								
0	66	INACTIVE	202	201								
740	68		205	202								
0	69	INACTIVE	203	2*202								
53	70		33	30	2*32							
751	76		209	2*206								
747	77		207	2*201	206							
755	78		212	2*209								
0	79	INACTIVE	210	209								
72	80		42	32								
0	100		20	19								
0	110		50	46	49							
0	111	INACTIVE	46	2*45								
142	112		51	45								
0	113	INACTIVE	55	2*54								
215	114		60	54								
0	130		53	52								
0	140		59	55	58							
230	141		66	60	61	64						
227	142		65	2*62								
0	143	INACTIVE	63	62								
0	149		76	75								
0	150		70	67	69							
256	151		75	2*71								
0	152	INACTIVE	72	71								
0	153		73	72								
365	154		115	77	111							
353	155		111	83	85	88	91	93	99	102	104	108
				110								
0	156	INACTIVE	112	2*111								
0	157		114	113								
0	158		117	116								
0	159		122	119	121							
0	160	INACTIVE	78									
0	161		126	124								
425	200		127	74								
437	201		131	2*127								
0	202	INACTIVE	128	127								
0	203		129	128								
0	204		132	131								
624	205		182	134	177							
606	206		177	140	142	145	148	150	156	159	161	168
				172	174	176						
0	207	INACTIVE	178	2*177								
0	208		181	180								
0	210		184	183								
0	211		191	187	190							
757	212		213	204	208	211						
307	220		80	79								
314	221		84	2*80								
0	222	INACTIVE	81	80								
315	230		86	79								

STATEMENT LABELS			DEF LINE	REFERENCES		
321	231		89	2*86		
0	232	INACTIVE	87	86		
0	233	INACTIVE	90	2*89		
324	234		92	89		
0	239		195	193		
325	240		94	79		
337	241		100	2*94		
0	242	INACTIVE	95	94		
0	243	INACTIVE	101	2*100		
344	244		103	100		
345	250		105	79		
352	251		109	2*105		
0	252	INACTIVE	106	105		
0	260	INACTIVE	135			
722	300		197	130		
504	310		137	136		
513	311		141	2*137		
0	312	INACTIVE	138	137		
515	320		143	136		
522	321		146	2*143		
0	322	INACTIVE	144	143		
526	323		149	2*146		
0	324	INACTIVE	147	146		
530	330		151	136		
544	331		157	2*151		
0	332	INACTIVE	152	151		
551	333		160	2*157		
0	334	INACTIVE	158	157		
553	340		162	136		
571	341		169	2*162		
0	342	INACTIVE	163	162		
0	343	INACTIVE	170	2*169		
575	344		171	169		
605	345		175	2*170		
601	346		173	170		
0	400	INACTIVE	198	197		
1040	401		234	2*221		
0	402	INACTIVE	222	221		
0	403	INACTIVE	223	2*222		
1004	404		224	222		
1015	405		228	2*223		
1010	406		226	223		
1021	410		229	225	227	
1112	411		247	2*234		
0	412	INACTIVE	235	234		
0	413	INACTIVE	236	2*235		
1046	414		237	235		
1062	415		241	2*236		
1054	416		239	236		
1070	420		242	238	240	
0	430	INACTIVE	250	2*249		
1140	431		251	249		
1151	432		257	2*250	2*251	2*254
1144	433		254	250		
0	435	INACTIVE	252	251		
0	436	INACTIVE	255	254		
1156	450		258	253	256	

```
 STATEMENT LABELS                   DEF LINE   REFERENCES
  1167  451                          263        258       2*259       261
  1162  452                          260        258
     0  453          INACTIVE        259        258
  1165  454                          262        259
  1230  601                          274        2*268
     0  602          INACTIVE        269        268
     0  604                          270        269
     0  1000                         267        200        247

 LOOPS  LABEL     INDEX       FROM-TO     LENGTH     PROPERTIES
    17  100       I             19  20       2B        INSTACK
    34  20        I             25  44      50B                  NOT INNER
    46  20        J             28  44      33B          OPT
   120  110       I             46  50      22B                  NOT INNER
   132  110       J             49  50       4B        INSTACK
   153  130       I             52  53       3B        INSTACK
   170  140       I             55  59      25B                  NOT INNER
   202  140       K             58  59       4B        INSTACK
   223  141       I             60  66      11B                  NOT INNER
   225  141       J             61  66       5B        INSTACK
   240  150       I             67  70       6B                  NOT INNER
   243  150       J             69  70       2B        INSTACK
   253  153       I             72  73       2B        INSTACK
   262  149       I             75  76       2B        INSTACK
   300  154       I             77 115      66B                  NOT INNER
   362  157       J            113 114       3B        INSTACK
   373  158       I            116 117       3B        INSTACK
   405  159       I            119 122      11B                  NOT INNER
   412  159       J            121 122       3B        INSTACK
   423  161       I            124 126       2B        INSTACK
   434  203       I            128 129       2B        INSTACK
   444  204       I            131 132       2B        INSTACK
   475  205       I            134 182     132B                  NOT INNER
   621  208       J            180 181       3B        INSTACK
   636  210       I            183 184       3B        INSTACK
   661  211       I            187 191      22B                  NOT INNER
   674  211       J            190 191       3B        INSTACK
   715  239       I            193 195       2B        INSTACK
   731  1000      J            200 267     257B                  EXT REFS   NOT INNER
  1134  1000      K            247 267      52B          OPT
  1216  604       I            269 270       2B        INSTACK

 STATISTICS
   PROGRAM LENGTH                    1461B      817
           60000B CM USED
```

```
  1         SUBROUTINE SMOLS2(XBAR,X,N,I,MFLAG)
            DIMENSION X(N),COM1(5),COM2(5),COM3(5)
            DATAB/.6931471800/
            DATA COM1/10HSRRRCH XBA,10HAR IS OUTS,9HIDE RANGE,8HOF TABLE,1H /
  5         DATA COM2/10HSRRRCH N I,10HS LESS THA,10HN 2       ,1H ,1H /
            DATA COM3/10HSRRRCH TAB,10HLE IS NOT ,10HINCREASING,6H ORDER,1H /
            IF (N.LT.2) GO TO 17
            IF(X(1).GT.X(2)) GO TO 15
            IF (XBAR.LT.X(1).OR.XBAR.GT.X(N))GO TO 16
 10         MFLAG = 1
            M = INT((ALOG(FLOAT(N)))/B)
            I=2**M
            K=I
         10 K=K/2
 15         IF (XBAR.EQ.X(I)) GO TO 14
            IF (XBAR.GT.X(I).AND.XBAR.LT.X(I+1))RETURN
            IF (XBAR.GT.X(I)) GO TO 12
            I = I-K
            GO TO 10
 20      12 I = I+K
         13 IF (I.LE.N) GO TO 10
            I = I-1
            GO TO 13
         14 MFLAG=0
 25         RETURN
         15 CALL SMOLS3(1,COM3,1)
            RETURN
         16 CALL SMOLS3(1,COM1,1)
            RETURN
 30      17 CALL SMOLS3(1,COM2,2)
            RETURN
            END
```

SYMBOLIC REFERENCE MAP (R=3)

ENTRY POINTS		DEF LINE	REFERENCES				
3	SMOLS2	1	16	25	27	29	31

VARIABLES		SN TYPE	RELOCATION									
73	B	REAL			REFS	11	DEFINED	3				
100	COM1	REAL	ARRAY		REFS	2	28	DEFINED	4			
105	COM2	REAL	ARRAY		REFS	2	30	DEFINED	5			
112	COM3	REAL	ARRAY		REFS	2	26	DEFINED	6			
0	I	INTEGER		F.P.	REFS	13	15	2*16	17	18	20	21
					22	DEFINED	1	12	18	20	22	
77	K	INTEGER			REFS	14	18	20	DEFINED	13	14	
76	M	INTEGER			REFS	12	DEFINED	11				
0	MFLAG	INTEGER		F.P.	DEFINED	1	10	24				
0	N	INTEGER		F.P.	REFS	2	7	9	11	21		
					DEFINED	1						
0	X	REAL	ARRAY	F.P.	REFS	2	2*8	2*9	15	2*16	17	
					DEFINED	1						
0	XBAR	REAL		F.P.	REFS	2*9	15	2*16	17	DEFINED	1	

```
EXTERNALS            TYPE   ARGS       REFERENCES
       ALOG      REAL         1 LIBRARY      11
       SMOLS3                 3              26          28          30

INLINE FUNCTIONS     TYPE   ARGS          DEF LINE  REFERENCES
       FLOAT     REAL         1  INTRIN                    11
       INT       INTEGER      1  INTRIN                    11

STATEMENT LABELS                DEF LINE    REFERENCES
   26  10                          14          19          21
   36  12                          20          17
   40  13                          21          23
   44  14                          24          15
   46  15                          26           8
   51  16                          28           9
   54  17                          30           7

STATISTICS
  PROGRAM LENGTH                   124B        84
         60000B CM USED
```

```
      SUBROUTINE SMOLS1(N,M,I,A,B,  DET)
      DIMENSION A(I,N),B(I,M),COM1(5),COM2(5),COM3(5)
      DOUBLE PRECISION S1,S2,DSDOT
      DATA COM1/10HLSS NEAR S,10HINGULAR SY,10HSTEM. CALC,10HULATION CO,
     110HNTINUED    /
      DATA COM2/10HLSS SINGUL,10HAR SYSTEM.,10H NO RESULT,10H. INPUT DE,
     110HSTROYED    /
      DATA COM3/10HLSS N IS Z,10HERO. NO IN,10HPUT DATA H,10HAS BEEN DE,
     110HSTROYED    /
      NN = N
      IF (NN.EQ.0) GO TO 20
      MM = M
      X = 0.
      DO 1 J = 1,NN
      DO 1 K = 1,NN
      T = ABS(A(K,J))
      IF (T.GT.X) X = T
    1 CONTINUE
      IF (X.EQ.0.) GO TO 19
      IF (X.GT.1.E-15) GO TO 2
      CALL SMOLS3(1,COM1,1)
    2 SN = 1.
      DO 14 J = 1,NN
      L = J - 1
      IF (J.EQ.NN) GO TO 11
      T = ABS(A(J,J))
      M1 = J
      M2 = J + 1
      DO 3 K =M2,NN
      X = ABS(A(K,J))
      IF (X.LE.T) GO TO 3
      T = X
      M1 = K
    3 CONTINUE
      IF (M1.EQ.J) GO TO 6
      DO 4 K = 1,NN
      T = A(J,K)
      A(J,K) = A(M1,K)
    4 A(M1,K) = T
      DO 5 K = 1,MM
      T = B(J,K)
      B(J,K) = B(M1,K)
    5 B(M1,K) = T
      SN = -SN
    6 IF (A(J,J).EQ.0.) GO TO 19
      DO 10 K = M2,NN
      S1 = 0.
      S2 = 0.
      IF (L.EQ.0) GO TO 8
      S1=DSDOT(L,A(J,1),I,A(1,K),1)
    8 A(J,K) =(A(J,K) - S1)/A(J,J)
      S2=DSDOT(J,A(K,1),I,A(1,M2),1)
   10 A(K,M2) = A(K,M2) - S2
   11 DO 13 K = 1,MM
      S1 = 0.
      IF (L.EQ.0) GO TO 13
      S1=DSDOT(L,A(J,1),I,B(1,K),1)
```

```
   13 B(J,K) = (B(J,K) - S1)/A(J,J)
   14 CONTINUE
      DET = A(1,1)*SN
      IF (DET.EQ.0.) GO TO 19
      IF (N.EQ.1) GO TO 21
      DO 15 J = 2,NN
   15 DET = DET*A(J,J)
      IF (DET.EQ.0.) GO TO 19
      IF (MM.EQ.0) GO TO 21
      M3 = NN-1
      DO 18 J = 1,MM
      DO 17 L = 1,M3
      M1 = NN - L
      S1 = 0.
      M2 = M1 + 1
      K=NN-M2+1
      S1=DSDOT(K,A(M1,M2),I,B(M2,J),1)
   17 B(M1,J) = B(M1,J) - S1
   18 CONTINUE
      GO TO 21
   19 CALL SMOLS3(1,COM2,2)
      GO TO 21
   20 CALL SMOLS3(1,COM3,3)
   21 RETURN   $END
```

SYMBOLIC REFERENCE MAP (R=3)

```
ENTRY POINTS     DEF LINE      REFERENCES
  3  SMOLS1         1            81

VARIABLES       SN  TYPE           RELOCATION
  0  A              REAL      ARRAY    F.P.      REFS        2       16       26       30       37       38       45
                                                 2*50     2*51     2*52       53       57       58       60       64
                                                   74  DEFINED        1       38       39       51       53
  0  B              REAL      ARRAY    F.P.      REFS        2       41       42       57       58       74       75
                                              DEFINED        1       42       43       58       75
413  COM1           REAL      ARRAY              REFS        2       21  DEFINED        4
420  COM2           REAL      ARRAY              REFS        2       78  DEFINED        6
425  COM3           REAL      ARRAY              REFS        2       80  DEFINED        8
  0  DET            REAL               F.P.      REFS       61       64       65  DEFINED        1       60       64
  0  I              INTEGER            F.P.      REFS      2*2       50       52       57       74
                                              DEFINED        1
403  J              INTEGER                      REFS       16       24       25     2*26       27       28       30
                                                   35       37       38       41       42     2*45       50     4*51
                                                   52       57     4*58     2*64       74     2*75
                                              DEFINED       14       23       63       68
404  K              INTEGER                      REFS       16       30       33       37     2*38       39       41
                                                 2*42       43       50     2*51       52     2*53       57     2*58
                                                   74  DEFINED       15       29       36       40       46       54
                                                   73
407  L              INTEGER                      REFS       49       50       56       57       70
                                              DEFINED       24       69
  0  M              INTEGER            F.P.      REFS        2       12  DEFINED        1
```

```
       SUBROUTINE SMOLS1      74/74    OPT=2                              FTN 4.8+518          80/11/28. 10.23.01         PAGE      3

 VARIABLES        SN  TYPE              RELOCATION
   401  MM        INTEGER                           REFS         40         54         66         68    DEFINED         12
   410  M1        INTEGER                           REFS         35         38         39         42         43         72         74
                                                    2*75    DEFINED         27         33         70
   411  M2        INTEGER                           REFS         29         46         52       2*53         73       2*74
                                                  DEFINED        28         72
   412  M3        INTEGER                           REFS         69    DEFINED         67
     0  N         INTEGER              F.P.         REFS          2         10         62    DEFINED          1
   400  NN        INTEGER                           REFS         11         14         15         23         25         29         36
                                                      46         63         67         70         73    DEFINED         10
   406  SN        REAL                              REFS         44         60    DEFINED         22         44
   374  S1        DOUBLE                            REFS          3         51         58         75    DEFINED         47         50
                                                      55         57         71         74
   376  S2        DOUBLE                            REFS          3         53    DEFINED         48         52
   405  T         REAL                              REFS       2*17         31         39         43    DEFINED         16         26
                                                      32         37         41
   402  X         REAL                              REFS         17         19         20         31         32
                                                  DEFINED        13         17         30

 EXTERNALS          TYPE    ARGS        REFERENCES
        DSDOT     DOUBLE     5                 3          50         52         57         74
        SMOLS3               3                21          78         80

 INLINE FUNCTIONS   TYPE    ARGS       DEF LINE  REFERENCES
        ABS       REAL       1  INTRIN                    16         26         30

 STATEMENT LABELS                  DEF LINE   REFERENCES
     0  1                             18         14         15
    31  2                             22         20
    56  3                             34         29         31
     0  4                             39         36
     0  5                             43         40
   100  6                             45         35
   123  8                             51         49
     0  10                            53         46
   152  11                            54         25
   172  13                            58         54         56
     0  14                            59         23
     0  15                            64         63
     0  17                            75         69
     0  18                            76         68
   303  19                            78         19         45         61         65
   306  20                            80         11
   310  21                            81         62         66         77         79

 LOOPS  LABEL      INDEX       FROM-TO     LENGTH     PROPERTIES
    20  1          J            14  18        5B                NOT INNER
    21  1          K            15  18        3B       INSTACK
    41  14         J            23  59      152B                EXT REFS     EXITS    NOT INNER
    54  3          K            29  34        3B       INSTACK
    64  4          K            36  39        3B       INSTACK
    74  5          K            40  43        3B       INSTACK
   112  10         K            46  53       40B                EXT REFS
   161  13         K            54  58       27B                EXT REFS
   224  15         J            63  64        2B       INSTACK
   241  18         J            68  76       42B                EXT REFS  NOT INNER
   251  17         L            69  75       27B                EXT REFS
```

```
STATISTICS
  PROGRAM LENGTH                    456B      302
          60000B CM USED
```

```
      SUBROUTINE SMOLS3(ISW,LHOL,INX)
      DIMENSION LHOL(5)
      LOGICALPS,TS
      DATA NP/10/,PS/.TRUE./,TS/.FALSE./
      IF((ISW.EQ.0).OR.(ISW.GT.5))RETURN
      GOTO(1,2,3,4,5),ISW
    1 IF(PS.AND.(NP.GT.0)) PRINT 27,LHOL,INX
   27 FORMAT(1H0,9X,5A10,3X,O6)
      NP=NP-1
      IF(TS)CALLEXIT
      RETURN
    2 PS=.FALSE.
      RETURN
    3 PS=.TRUE.
      NP=INX
      RETURN
    4 TS=.TRUE.
      RETURN
    5 TS=.FALSE.
      RETURN    $ END
```

SYMBOLIC REFERENCE MAP (R=3)

```
ENTRY POINTS      DEF LINE      REFERENCES
    3  SMOLS3         1            5       11       13       16       18       20

VARIABLES        SN  TYPE              RELOCATION
    0  INX           INTEGER                F.P.      REFS       7       15   DEFINED     1
    0  ISW           INTEGER                F.P.      REFS     2*5        6   DEFINED     1
    0  LHOL          INTEGER      ARRAY     F.P.      REFS       2        7   DEFINED     1
   44  NP            INTEGER                          REFS       7        9   DEFINED     4      9     15
   45  PS            LOGICAL                          REFS       3        7   DEFINED     4     12     14
   46  TS            LOGICAL                          REFS       3       10   DEFINED     4     17     19

FILE NAMES         MODE
    OUTPUT         FMT                       WRITES        7

EXTERNALS               TYPE    ARGS        REFERENCES
    EXIT                          0             10

STATEMENT LABELS                    DEF LINE   REFERENCES
   22  1                                 7           6
   33  2                                12           6
   35  3                                14           6
   40  4                                17           6
   42  5                                19           6
   54  27        FMT                     8           7

STATISTICS
  PROGRAM LENGTH                     57B       47
      60000B CM USED
```

```
          SUBROUTINE STAGET(IC,XL)
           DIMENSION NDT(12)
          COMMON /COMWIND/ W(8),ISWND(2)
C         FINDS SITE, RAW DATA INTO ESD(2,I,J).
          COMMON /COMLEV2/ ESD(3,24,364)
           LEVEL2,ESD
          DATA NDT/31,28,31,30,31,30,31,31,30,31,30,31/,JTW/7HTRAILER/
          J3=2
   10     READ(1)J1,J2,XL,(W(J),J=1,3)
           IF(J1.EQ.JTW)GO TO 12
          IF(J1.EQ.IC) GO TO 14
   11     READ(1)
           IF(EOF(1)) 10,11,10
   12     IF(J3.NE.2)GO TO 13
           J3=0
           REWIND 1
           GO TO 10
   13     PRINT1,IC
           CALL EXIT
    1     FORMAT(* CANNOT FIND SITE (*A10,*)*)
   14     N2=0
           DO 16 JM=1,12
           N1=N2+1
           N2=N2+NDT(JM)
          IF(JM.EQ.12)N2=N2-1
           READ(1)N,J1,((ESD(2,I,J),I=1,24),J=N1,N2)
          IF(N.EQ.NDT(JM))GO TO 16
           PRINT2,IC,N,JM
           CALL EXIT
    2     FORMAT(* DAYS OF MONTH ERROR *A10,2I8)
   16     CONTINUE
           DO 17 J=1,13
   17     BACKSPACE 1
           RETURN
           END
```

SYMBOLIC REFERENCE MAP (R=3)

```
ENTRY POINTS     DEF LINE      REFERENCES
   3  STAGET         1            34

VARIABLES      SN  TYPE            RELOCATION
    0  ESD          REAL        ARRAY   COMLEV2    REFS        5        6   DEFINED     26
  176  I            INTEGER                        REFS       26  DEFINED       26
    0  IC           INTEGER             F.P.       REFS       11       18       28   DEFINED      1
   10  ISWND        INTEGER     ARRAY   COMWIND    REFS        3
  171  J            INTEGER                        REFS        9       26   DEFINED      9       26       32
  173  JM           INTEGER                        REFS       24       25       27       28   DEFINED     22
  114  JTW          INTEGER                        REFS       10  DEFINED        7
  167  J1           INTEGER                        REFS       10       11   DEFINED      9       26
  170  J2        *  INTEGER                     DEFINED        9
  166  J3           INTEGER                        REFS       14  DEFINED        8       15
  175  N            INTEGER                        REFS       27       28   DEFINED     26
```

```
VARIABLES      SN  TYPE          RELOCATION
   177  NDT       INTEGER     ARRAY                 REFS         2      24       27    DEFINED        7
   174  N1        INTEGER                           REFS        26   DEFINED     23
   172  N2        INTEGER                           REFS        23      24       25       26   DEFINED       21       24
                                                     25
     0  W         REAL        ARRAY     COMWIND     REFS         3   DEFINED      9
     0  XL        REAL                   F.P.     DEFINED        1       9

FILE NAMES        MODE
       OUTPUT     FMT                     WRITES       18       28
       TAPE1      UNFMT                    READS        9       12       26   MOTION      16       33

EXTERNALS          TYPE   ARGS        REFERENCES
       EOF        REAL      1             13
       EXIT                 0             19       29

STATEMENT LABELS             DEF LINE    REFERENCES
   134  1        FMT            20          18
   157  2        FMT            30          28
     7  10                       9         2*13      17
    15  11                      12          13
    22  12                      14          10
    27  13                      18          14
    32  14                      21          11
    76  16                      31          22       27
     0  17                      33          32

LOOPS  LABEL     INDEX      FROM-TO     LENGTH     PROPERTIES
   36  16        JM           22 31       43B                EXT REFS  NOT INNER
   51            J            26 26       17B                EXT REFS  NOT INNER
   54            I            26 26       10B                EXT REFS
  102  17        J            32 33        5B                EXT REFS

COMMON BLOCKS    LENGTH     MEMBERS - BIAS NAME(LENGTH)
       COMWIND       10                 0 W        (8)                        8 ISWND   (2)
       COMLEV2    26208                 0 ESD      (26208)

STATISTICS
  PROGRAM LENGTH                 215B      141
  CM LABELED COMMON LENGTH     63152B    26218
       60000B CM USED
```

```
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C                          **                **
C                          **                **
C                          **                **
C                          ********************
```

```
C
C
C                 SOLSTOR - GE11 - GENLIB1 LIBRARY.
C
```

```
      SUBROUTINE GSETUP
      DIMENSION LID(13),LC(8),LTY(2)
      COMMON /COMCARD/ ITIT,IRUN,ISBIG,NOVAR,NTYPE,JGCO(2),DSPLR,
     1 LCR(9,13)
      EXTERNAL GE11AF
      DATA NID/13/, NTY/2/, LTY/5HGE11A,5HGE11B/, LCR/117(1H )/
      DATA LID/2HID,2HDH,2HDW,2HDM,2HDS,2HCO,2HST,2HGE,2HGS,2HPC,
     1 2HYR,2HAM,2HLO/
      CALL HOROLOG(Z1,LC(1),LC(2)) $ DECODE(20,1,LC)(LC(J),J=3,7)
    1 FORMAT(3(1X,A2),1X,2(1X,A2))
      ENCODE(10,2,ITIT)(LC(J),J=3,7) $ IRUN=0
    2 FORMAT(5A2)
    6 FORMAT(*1 GE11 OPTIMIZATION  (*A10,*-*I3,*) DSPLR=*F6.3,I20,*D*)
   10 IRUN=IRUN+1 $ DO 11 J=1,NID
   11 LCR(9,J)=1H  $ READ3,(LC(J),J=1,8) $ DECODE(10,4,LC)JC
    3 FORMAT(8A10)
    4 FORMAT(A2,8X)
      IF(JC.EQ.1H )CALL EXIT $ GO TO 13
   12 READ3,(LC(J),J=1,8) $ DECODE(10,4,LC)JC $ IF(JC.EQ.1H )GO TO 20
   13 DO 14 J=1,NID $ IF(JC.EQ.LID(J))GO TO 15
   14 CONTINUE $ PRINT5,(LC(J),J=1,8) $ CALL EXIT
    5 FORMAT(* UNIDENTIFIED CARD *8A10)
   15 LCR(9,J)=1H* $ DO 16 K=1,8
   16 LCR(K,J)=LC(K) $ GO TO 12
C ....   HAVE CARDS.
   20 DECODE(10,25,LCR)DSPLR $ IF(DSPLR.LE.0.)DSPLR=1.
   25 FORMAT(2X,F8.0)
      DSPLR=AMIN1(1.,DSPLR) $ CALL UDGET(J) $ PRINT6,ITIT,IRUN,DSPLR,J
      IF(IRUN.GT.1)GO TO 22 $ DO 21 J=1,NID
      IF(LCR(9,J).EQ.1H*)GO TO 21
      PRINT7,((LCR(K,L),K=1,8),L=1,NID) $ CALL EXIT
    7 FORMAT(* CARDS MISSING*/(* (*8A10,*)*))
   21 CONTINUE
   22 PRINT8,(LCR(I,1),I=1,9) $ DO 23 J=1,NTY
    8 FORMAT(* (*A10,7(*/*A10),*)*A1)
      IF(LCR(3).EQ.LTY(J))GO TO 24
   23 CONTINUE $ PRINT9 $ CALL EXIT
    9 FORMAT(* IMPROPER SYSTEM TYPE*)
C ....  ID IS OK.
   24 NTYPE=J $ CALL STAGET(LCR(2),XLAT)
C ....  DEMAND MUST BE CALLED BEFORE SUPPLY.
      CALL DEMAND(XLAT)
      CALL SUPPLY(XLAT)
      CALL STORI
      CALL GENERI
      CALL POWCI
      CALL AMORTI(Z1,J,J,J,Z1,Z1)
      CALL GEONLY
      WRITE(9)ITIT,IRUN,((LCR(J,K),J=1,9),K=1,NID)
      GO TO (31,32),NTYPE
   31 CALL GE11MN(GE11AF) $ GO TO 40
C32   CALL GE11MN(GE11BF) $ GO TO 40
   32 PRINT17 $ CALL EXIT
   17 FORMAT(* GE11B NOT CREATED*)
   40 ENDFILE9 $ GO TO 10 $ END
```

```
      SUBROUTINE GSETUP      74/74    OPT=2                         FTN 4.8+518        80/11/28. 10.01.44       PAGE      2

CARD NR. SEVERITY  DETAILS     DIAGNOSIS OF PROBLEM

    50     I                 AN IF STATEMENT MAY BE MORE EFFICIENT THAN A 2 OR 3 BRANCH COMPUTED GO TO STATEMENT.


      SYMBOLIC REFERENCE MAP (R=3)

 ENTRY POINTS      DEF LINE      REFERENCES
    1  GSETUP         1

 VARIABLES      SN  TYPE              RELOCATION
     7  DSPLR       REAL                  COMCARD      REFS        3        26       2*28    DEFINED      2*26      28
   421  I           INTEGER                            REFS       34    DEFINED      34
     1  IRUN        INTEGER               COMCARD      REFS        3        14        28        29        49
                                                    DEFINED       11        14
     2  ISBIG       INTEGER               COMCARD      REFS        3
     0  ITIT        INTEGER               COMCARD      REFS        3        28        49    DEFINED       11
   415  J           INTEGER                            REFS        9        11       2*15       19        20        21        23
                                                          24      2*28       30        36        40      3*47       49
                                                    DEFINED        9        11        14        15        19        20        21
                                                          29        34       49
   416  JC          INTEGER                            REFS       18        19        20    DEFINED       15        19
     5  JGCO        INTEGER     ARRAY     COMCARD      REFS        3
   417  K           INTEGER                            REFS     2*24        31        49    DEFINED       23        31        49
   420  L           INTEGER                            REFS       31    DEFINED       31
   440  LC          INTEGER     ARRAY                  REFS        2       3*9        11        15        19        21        24
                                                    DEFINED        9        15        19
    10  LCR         INTEGER     ARRAY     COMCARD      REFS        3        26        30        31        34        36        40
                                                          49  DEFINED        6        15        23        24
   423  LID         INTEGER     ARRAY                  REFS        2        20   DEFINED         7
   450  LTY         INTEGER     ARRAY                  REFS        2        36   DEFINED         6
   231  NID         INTEGER                            REFS       14        20        29        31        49
                                                    DEFINED        6
     3  NOVAR       INTEGER               COMCARD      REFS        3
   232  NTY         INTEGER                            REFS       34    DEFINED         6
     4  NTYPE       INTEGER               COMCARD      REFS        3        50   DEFINED        40
   422  XLAT        REAL                               REFS       40        42        43
   414  Z1          REAL                               REFS        9      3*47

 FILE NAMES        MODE
        INPUT      FMT                       READS        15        19
        OUTPUT     FMT                      WRITES        21        28        31        34        37        53
        TAPE9      UNFMT                    WRITES        49    MOTION        55

 EXTERNALS              TYPE    ARGS         REFERENCES
        AMORTI                    6              47
        DEMAND                    1              42
        EXIT                      0              18        21        31        37        53
        GENERI                    0              45
        GEONLY                    0              48
        GE11AF                    0               5        51
        GE11MN                    1              51
        HOROLOG                   3               9
        POWCI                     0              46
```

```
EXTERNALS           TYPE   ARGS        REFERENCES
         STAGET             2             40
         STORI              0             44
         SUPPLY             1             43
         UDGET              1             28

INLINE FUNCTIONS    TYPE   ARGS          DEF LINE  REFERENCES
         AMIN1    REAL      0  INTRIN                   28

STATEMENT LABELS                 DEF LINE    REFERENCES
    240  1        FMT              10           9
    250  2        FMT              12          11
    274  3        FMT              16          15          19
    276  4        FMT              17          15          19
    316  5        FMT              22          21
    252  6        FMT              13          28
    346  7        FMT              32          31
    357  8        FMT              35          34
    366  9        FMT              38          37
     20  10                        14          55
      0  11                        15          14
     35  12                        19          24
     43  13                        20          18
      0  14                        21          20
     54  15                        23          20
      0  16                        24          23
    402  17       FMT              54          53
     64  20                        26          19
    123  21                        33          29          30
    127  22                        34          29
      0  23                        37          34
    142  24                        40          36
    327  25       FMT              27          26
    171  31                        51          50
    174  32                        53          50
    177  40                        55          51

LOOPS   LABEL    INDEX      FROM-TO      LENGTH    PROPERTIES
   24   11        J          14 15          2B      INSTACK
   47   14        J          20 21          3B      INSTACK     EXITS
   61   16        K          23 24          2B      INSTACK
  103   21        J          29 33         24B                 EXT REFS   NOT INNER
  111             L          31 31         10B                 EXT REFS
  135   23        J          34 37          3B      INSTACK     EXITS

COMMON BLOCKS    LENGTH      MEMBERS - BIAS NAME(LENGTH)
       COMCARD      125                 0 ITIT    (1)                 1 IRUN    (1)                2 ISBIG   (1)
                                        3 NOVAR   (1)                 4 NTYPE   (1)                5 JGCO    (2)
                                        7 DSPLR   (1)                 8 LCR     (117)

STATISTICS
  PROGRAM LENGTH                   452B       298
  CM LABELED COMMON LENGTH         175B       125
        60000B CM USED
```

```
      SUBROUTINE SUPPLY(XL)
C ...  DEMAND MUST BE CALLED BEFORE SUPPLY.
      DIMENSION CH(24),SH2(24),LTY(7),P(11)
      COMMON /COMCARD/ ITIT,IRUN,ISBIG,NOVAR,NTYPE,JGCO(2),DSPLR,
     1 LCR(9,13)
      COMMON /COMLEV2/ ESD(2,24,364)
      COMMON /COMWIND/ W(8),ISWND
      COMMON /COMCOMP/ EF(20),XM(10,2),CC(10,3),DETOT(2),XRS(3),GEC(20)
      DATA LTY/4HCTTC,4HFPTT,4HFPTI,4HFPEW,4HFPNS,4HHAWT,4HVAWT/
      DATA NTY/7/,JBL/1H /,CAV/57.29577951/
      DATA MU/77777777770000000000B/
      KH(I)=SHIFT(ESD(1,I,J),-24).A.7777B
      KN(I)=SHIFT(ESD(1,I,J),-12).A.7777B
      SDF(J)=.410*COS(.01720*(J-172))
      CDF(X)=SQRT(1.-X*X)
      K=1 $ DECODE(80,5,LCR(1,6))(CH(J),J=1,14)
      PRINT6,(CH(J),J=1,14),LCR(9,6)
    5 FORMAT(A2,A4,A8,11A6)
    6 FORMAT(* (*A2,*/*A4,*/*A8,11(*/*A6,),*)*A1)
      W(7)=1.
       ISWND=0
      DO 10 J=1,24
       CH(J)=COS(15.*(J-13)/CAV)
   10 SH2(J)=1.-CH(J)**2
       CLA=COS(XL/CAV)
       SLA=SIN(XL/CAV)
       DECODE(80,1,LCR(1,6))IC,(P(J),J=1,11)
    1 FORMAT(2X,A4,8X,11F6.0)
      IF(IC.NE.JBL.A.P(1).NE.0.)GO TO 17
C     ZERO SUPPLY
      XM(K)=XM(K,2)=CC(K)=CC(K,3)=0. $ EF(K)=CC(K,2)=1.
      DO 11 I=1,24
       DO 11 J=1,364
   11 ESD(K,I,J)=0.
       GO TO 40
C     TEST COLLECTOR CARD
   17 IF(P(1).GT.1..O.P(1).LE.0.)GO TO 99
      IF(P(9).LE.0..O.P(10).LE.0..O.P(11).LT.0.O.P(8).LT.P(7))GOTO99
      IF(P(7).LT.0..O.P(8).LT.0.)GO TO 99
      DO 12 KK=1,NTY
       IF(IC.EQ.LTY(KK))GO TO 13
   12 CONTINUE
       GO TO 99
   13 EF(K)=P(1)
       XM(K)=P(7)
       XM(K,2)=P(8)
      CC(K)=P(9)
       CC(K,2)=P(10)
       CC(K,3)=P(11)
      GO TO (16,16,14,16,14,15,32),KK
   14 CTL=COS(P(2)/CAV)
       STL=SIN(P(2)/CAV)
      IF(P(2).GE.0..A.P(2).LT.90.)GO TO 16
       PRINT2
       GO TO 99
    2 FORMAT(* TILT ANGLE ERROR*)
   15 IF(P(5).LE.0.)P(5)=W(1)*(2.225-.0761*W(1))
```

```
             W(5)=P(5)
            IF(P(4).LE.0.)P(4)=.454*W(5)
             W(4)=P(4)
             W(6)=P(2)
            W(7)=MAXO(INT(P(3)),1)
             ISWND=1
            PRINT3,(W(J),J=4,7)
             IF(W(4).GE.W(5).O.W(5).GE.W(6))GOTO99
            W(5)=W(5)-W(4)
             W(6)=W(6)-W(4)
      3     FORMAT(* -VI=*F8.2,* VR=*F8.2,* VC=*F8.2,* NTUR=*F8.1)
     16     GO TO (20,22,24,26,28,30,32),KK
     C      CTTC
     20     DO 21 I=1,24
             DO 21 J=1,364
             J1=KN(I)
             Z1=.01*J1
     21     ESD(K,I,J)=Z1.A.MU
             GO TO 40
     C      FPTT
     22     DO 23 J=1,364
             SDL=SDF(J)
             CDL=CLA*CDF(SDL)
             SDL=SLA*SDL
            DO 23 I=1,24
             Z1=CH(I)*CDL+SDL
             Z2=.75+.25*Z1
            J1=KH(I)
             J2=KN(I)
             Z3=.01*AMAX1(0.,J2+Z2*(J1-J2*Z1))
     23     ESD(K,I,J)=Z3.A.MU
             GO TO 40
     C      FPTI
     24     Q1=STL*SLA
             Q2=STL*CLA
             Q3=.75+.25*CTL
             DO 25 J=1,364
            SDL=SDF(J)
             CDL=CDF(SDL)
             Z1=Q1*CDL
             Z2=Q2*SDL
            Z3=CLA*CDL
             Z4=SLA*SDL
             DO 25 I=1,24
             Z5=Z3*CH(I)+Z4
            Z6=Z1*CH(I)-Z2+CTL*Z5
             J1=KH(I)
             J2=KN(I)
            Z7=.01*AMAX1(0.,Z6*J2+Q3*(J1-J2*Z5))
     25     ESD(K,I,J)=Z7.A.MU
             GO TO 40
     C      FPEW
     26     DO 27 J=1,364
             SDL=SDF(J)
             CDL=CDF(SDL)
             CD2=CDL**2
            Z1=CLA*CDL
```

```
               Z2=SLA*SDL
               DO 27 I=1,24
               Z3=Z1*CH(I)+Z2
              Z4=SQRT(1.-SH2(I)*CD2)
               Z5=.75+.25*COS(Z3/Z4)
              J1=KH(I)
               J2=KN(I)
               Z6=.01*AMAX1(0.,Z4*J2+Z5*(J1-J2*Z3))
       27     ESD(K,I,J)=Z6.A.MU
               GO TO 40
      C       FPNS
       28     Q1=SLA*CTL+STL*CLA
               Q2=CLA*CTL-SLA*STL
               Q3=.75+.25*Q2
              DO 29 J=1,364
               SDL=SDF(J)
               Z1=CDF(SDL)*CLA
               Z2=SLA*SDL
              DO 29 I=1,24
               Z3=Z1*CH(I)+Z2
               Z4=Q1*CDF(Z3)+Q2*Z3
              J1=KH(I)
               J2=KN(I)
               Z5=.01*AMAX1(0.,Z4*J2+Q3*(J1-J2*Z3))
       29     ESD(K,I,J)=Z5.A.MU
               GO TO 40
      C       HAWT
       30     DO 31 J=1,364
               DO 31 I=1,24
               J1=ESD(1,I,J).A.7777B
               Z1=.1*J1
       31     ESD(K,I,J)=Z1.A.MU
               GO TO 40
      C       VAWT
       32     PRINT33
               GO TO 99
       33     FORMAT(* NO VAWT YET*)
       40     CONTINUE $ IF(ISBIG.EQ.0)RETURN $ XM(1,1)=1000.*XM(1,1)
              XM(1,2)=1000.*XM(1,2) $ CC(1,3)=1000.*CC(1,3) $ RETURN
       98     FORMAT(* COLLECTOR CARD ERROR *)
       99     PRINT98
               CALL EXIT
               END
```

SYMBOLIC REFERENCE MAP (R=3)

```
ENTRY POINTS      DEF LINE      REFERENCES
   3 SUPPLY           1           152        153        157

VARIABLES      SN  TYPE            RELOCATION
  530  CAV         REAL                           REFS        23        25        26        51        52
                                                 DEFINED      10
   50  CC          REAL        ARRAY    COMCOMP   REFS         8       153   DEFINED   3*31        47        48        49
```

```
VARIABLES      SN  TYPE            RELOCATION
                                                 153
   657  CDL         REAL                        REFS         83        97        99       113       114
                                             DEFINED         80        96       112
   672  CD2         REAL                        REFS        118   DEFINED       113
   673  CH          REAL         ARRAY          REFS          3        17        24        83       102       103       117
                                                 134    DEFINED        16        23
   645  CLA         REAL                        REFS         80        92        99       114       126       127       131
                                             DEFINED         25
   652  CTL         REAL                        REFS         93       103       126       127   DEFINED        51
   106  DETOT       REAL         ARRAY  COMCOMP REFS          8
     7  DSPLR       REAL                COMCARD REFS          4
     0  EF          REAL         ARRAY  COMCOMP REFS          8   DEFINED        31        44
     0  ESD         REAL         ARRAY  COMLEV2 REFS          6        73        85        86       104       105       120
                                                 121        136       137       144   DEFINED        34        75        88
                                                 107        123       139       146
   113  GEC         REAL         ARRAY  COMCOMP REFS          8
   650  I           INTEGER                     REFS         34        73        75        83        85        86        88
                                                 102        103       104       105       107       117       118       120
                                                 121        123       134       136       137       139       144       146
                                             DEFINED         32        71        82       101       116       133       143
   647  IC          INTEGER                     REFS         29        41   DEFINED        27
     1  IRUN        INTEGER             COMCARD REFS          4
     2  ISBIG       INTEGER             COMCARD REFS          4       152
    10  ISWND       INTEGER             COMWIND REFS          7   DEFINED        21        63
     0  ITIT        INTEGER             COMCARD REFS          4
   644  J           INTEGER                     REFS         16        17      2*23      2*24        27        34        64
                                                  73         75        79        85        86        88        95       104
                                                 105        107       111       120       121       123       130       136
                                                 137        139       144       146   DEFINED        16        17        22
                                                  27         33        64        72        78        94       110       129
                                                 142
   527  JBL         INTEGER                     REFS         29   DEFINED        10
     5  JGCO        INTEGER      ARRAY  COMCARD REFS          4
   654  J1          INTEGER                     REFS         74        87       106       122       138       145
                                             DEFINED         73        85       104       120       136       144
   661  J2          INTEGER                     REFS       2*87     2*106     2*122     2*138   DEFINED        86       105
                                                 121        137
   643  K           INTEGER                     REFS       6*31        34        44        45        46        47        48
                                                  49         75        88       107       123       139       146
                                             DEFINED         16
   651  KK          INTEGER                     REFS         41        50        69   DEFINED        40
    10  LCR         INTEGER      ARRAY  COMCARD REFS          4        16        17        27
   753  LTY         INTEGER      ARRAY          REFS          3        41   DEFINED         9
   531  MU          INTEGER                     REFS         75        88       107       123       139       146
                                             DEFINED         11
     3  NOVAR       INTEGER             COMCARD REFS          4
   526  NTY         INTEGER                     REFS         40   DEFINED        10
     4  NTYPE       INTEGER             COMCARD REFS          4
   762  P           REAL         ARRAY          REFS          3        29      2*37      5*38      2*39        44        45
                                                  46         47        48        49        51        52      2*53        57
                                                  58         59        60        61        62   DEFINED        27        57
                                                  59
   663  Q1          REAL                        REFS         97       135   DEFINED        91       126
   664  Q2          REAL                        REFS         98       128       135   DEFINED        92       127
   665  Q3          REAL                        REFS        106       138   DEFINED        93       128
   656  SDL         REAL                        REFS       2*80        81        83      2*96        98       100     2*112
                                                 115      2*131       132   DEFINED        79        81        95       111
```

```
VARIABLES      SN   TYPE            RELOCATION
                                              130
   723  SH2        REAL       ARRAY                  REFS          3        118     DEFINED       24
   646  SLA        REAL                              REFS         81         91        100       115        126        127        132
                                                  DEFINED         26
   653  STL        REAL                              REFS         91         92        126       127    DEFINED         52
     0  W          REAL       ARRAY     COMWIND      REFS          7       2*57         59        64       4*65       2*66       2*67
                                                  DEFINED         20         58         60        61         62         66         67
     0  XL         REAL                   F.P.       REFS         25         26     DEFINED        1
    24  XM         REAL       ARRAY     COMCOMP      REFS          8        152        153   DEFINED       2*31         45         46
                                              152        153
   110  XRS        REAL       ARRAY     COMCOMP      REFS          8
   655  Z1         REAL                              REFS         75         84         87       103        117        134        146
                                                  DEFINED         74         83         97       114        131        145
   660  Z2         REAL                              REFS         87        103        117       134    DEFINED         84         98
                                              115        132
   662  Z3         REAL                              REFS         88        102        119       122      3*135        138
                                                  DEFINED         87         99        117       134
   666  Z4         REAL                              REFS        102        119        122       138    DEFINED        100        118
                                              135
   667  Z5         REAL                              REFS        103        106        122       139    DEFINED        102        119
                                              138
   670  Z6         REAL                              REFS        106        123     DEFINED       103        122
   671  Z7         REAL                              REFS        107    DEFINED        106

FILE NAMES       MODE
        OUTPUT     FMT                     WRITES       17         54         64        149       155

EXTERNALS          TYPE    ARGS         REFERENCES
        COS        REAL       1 LIBRARY     23          25         51         79         95       111        119        130
        EXIT                  0            156
        SIN        REAL       1 LIBRARY     26          52
        SQRT       REAL       1 LIBRARY     80          96        112        118        131       135

INLINE FUNCTIONS   TYPE    ARGS          DEF LINE   REFERENCES
        AMAX1      REAL       0  INTRIN                 87        106        122        138
        CDF        REAL       1    SF          15       80         96        112        131       135
        INT        INTEGER    1  INTRIN                 62
        KH         INTEGER    1    SF          12       85        104        120        136
        KN         INTEGER    1    SF          13       73         86        105        121       137
        MAX0       INTEGER    0  INTRIN                 62
        SDF        REAL       1    SF          14       79         95        111        130
        SHIFT      NO TYPE    2  INTRIN                 73         85         86        104       105        120        121        136
                                                       137

STATEMENT LABELS               DEF LINE   REFERENCES
   563  1        FMT              28         27
   571  2        FMT              56         54
   601  3        FMT              68         64
   544  5        FMT              18         16
   547  6        FMT              19         17
     0  10                        24         22
     0  11                        34         32         33
     0  12                        42         40
    76  13                        44         41
   122  14                        51       2*50
   135  15                        57         50
   165  16                        69       3*50         53
```

STATEMENT LABELS

			DEF LINE	REFERENCES						
56	17		37	29						
201	20		71	69						
0	21		75	71	72					
213	22		78	69						
0	23		88	78	82					
254	24		91	69						
0	25		107	94	101					
330	26		110	69						
0	27		123	110	116					
411	28		126	69						
0	29		139	129	133					
474	30		142	69						
0	31		146	142	143					
506	32		149	50	69					
613	33	FMT	151	149						
511	40		152	35	76	89	108	124	140	147
616	98	FMT	154	155						
516	99		155	37	38	39	43	55	65	150

LOOPS	LABEL	INDEX	FROM-TO	LENGTH	PROPERTIES
15	10	J	22 24	11B	EXT REFS
52	11	I	32 34	4B	NOT INNER
53	11	J	33 34	2B	INSTACK
73	12	KK	40 42	2B	INSTACK EXITS
205	21	I	71 75	6B	NOT INNER
206	21	J	72 75	4B	INSTACK
215	23	J	78 88	37B	EXT REFS NOT INNER
235	23	I	82 88	13B	OPT
264	25	J	94 107	44B	EXT REFS NOT INNER
307	25	I	101 107	15B	OPT
334	27	J	110 123	55B	EXT REFS NOT INNER
352	27	I	116 123	31B	EXT REFS
424	29	J	129 139	50B	EXT REFS NOT INNER
441	29	I	133 139	26B	EXT REFS
500	31	J	142 146	5B	NOT INNER
501	31	I	143 146	3B	INSTACK

COMMON BLOCKS	LENGTH	MEMBERS - BIAS NAME(LENGTH)		
COMCARD	125	0 ITIT (1)	1 IRUN (1)	2 ISBIG (1)
		3 NOVAR (1)	4 NTYPE (1)	5 JGCO (2)
		7 DSPLR (1)	8 LCR (117)	
COMLEV2	17472	0 ESD (17472)		
COMWIND	9	0 W (8)	8 ISWND (1)	
COMCOMP	95	0 EF (20)	20 XM (20)	40 CC (30)
		70 DETOT (2)	72 XRS (3)	75 GEC (20)

STATISTICS

PROGRAM LENGTH	775B	509
CM LABELED COMMON LENGTH	42445B	17701

60000B CM USED

```
              SUBROUTINE DEMAND(XL)
      C ....    DEMAND MUST BE CALLED BEFORE SUPPLY.
              DIMENSION LHM(8,2),LHH(8),QHM(26,2),DME(24),TR(24,2),TW(24,2),
             1 TO(24),WKF(52),SD(24,2),IW(48)
              EQUIVALENCE (IW,SD),(WKF,QHM)
              COMMON /COMCARD/ ITIT,IRUN,ISBIG,NOVAR,NTYPE,JGCO(2),DSPLR,
             1 LCR(9,13)
              COMMON /COMLEV2/ ESD(2,24,364)
              COMMON /COMCOMP/ EF(20),XM(10,2),CC(10,3),DETOT(2),XRS(3),GEC(20)
              DATA(LHM(J,1),J=1,4)/40HDW 1.2   42 35 28 25 26 25 28 37 35 74 6/
              DATA(LHM(J,1),J=5,8)/40H5 57 53 53 45 40 38 35 35 45 57 63 56 46/
              DATA(LHM(J,2),J=1,4)/40HDM 1.0   60 55 50 48 46 45 60 75 80 75 7/
              DATA(LHM(J,2),J=5,8)/40H0 70 70 70 70 70 70 90110110110105100 80/
              DATA(LHH(J),J=1,4)  /40HDH                       4 3.52 756555   /
              DATA(LHH(J),J=5,8)  /40H.45 .225  58.6  1520. 312.  .032         /
              DATA MU/77777777770000000000B/
              COPEV(X)=((((4.698*X-7.508)*X-1.137)*X+2.529)*X+2.029)*X+1.872
           50 DECODE(80,51,LCR(1,2))(IW(J),J=1,14) $ IF(IW(5).NE.1H )GO TO 53
           51 FORMAT(A2,A10,A2,11A6)
              DO 52 J=3,8
           52 LCR(J,2)=LHH(J) $ GO TO 50
           53 PRINT54,(IW(J),J=1,14),LCR(9,2) $ DO 58 K=1,2
           54 FORMAT(* (*A2,*/*A10,*/*A2,11(*/*A6),*)*A1)
           55 DECODE(80,56,LCR(1,K+2))(IW(J),J=1,10)
              IF(IW(2).NE.1H )GO TO 58 $ DO 57 J=1,8
           56 FORMAT(A2,A6,7A10,A2)
           57 LCR(J,K+2)=LHM(J,K) $ GO TO 55
           58 PRINT59,(IW(J),J=1,10),LCR(9,K+2)
           59 FORMAT(* (*A2,*/*A6,*/*7A10,A2,*)*A1)
              DO 49 J=1,8 $ LHM(J,1)=LCR(J,3) $ LHM(J,2)=LCR(J,4)
           49 LHH(J)=LCR(J,2) $ ISBIG=0
               IPR=9HRESIDENCE $ DECODE(12,1,LCR(1,2))J2
            1 FORMAT(2X,A1,9X,A2,F6.0,4X,I2,F6.0,3F2.0,7F6.0)
               IF(J2.EQ.1HR)GO TO 20
      C       UTILITY DEMAND
              DECODE(20,7,LCR(1,2))IPR,JSW,FC
            7 FORMAT(2X,A10,A2,F6.0)
              CALL DEMGET(IPR,ISBIG,FC,ESD)
               GO TO 41
      C       RESIDENCE OR COMMUNITY
           20 DECODE(80,1,LCR(1,2))J2,JSW,FC,LD,CP,THI,TLO,TDE,ZL,AL,UW,AR,
             1AW,RVCP
              DECODE(80,60,LCR(1,5))(IW(J),J=1,16)
              PRINT61,(IW(J),J=1,16),LCR(9,5) $ IWO=IW(2)
           60 FORMAT(2A2,4(A4,A2),A2,5A10)
           61 FORMAT(* (*A2,*/*A2,4(*/*A4,*/*A2),*/*A2,5A10,*)*A1)
              DO 69 K=1,2 $ DECODE(80,65,LCR(1,K+2))Z1,(QHM(J,K),J=1,24)
           65 FORMAT(2X,F6.0,24F3.2)
              IF(Z1.GT.0.)GO TO 68
           66 PRINT67 $ CALL EXIT
           67 FORMAT(* NON-POSITIVE HW OR MISC. DEMAND VALUES*)
           68 DO 69 J=1,24 $ IF(QHM(J,K).LT.0.)GO TO 66 $ QHM(J,K)=Z1*QHM(J,K)
           69 CONTINUE $ FC=AMAX1(1.,FC)
               IF(FC.LE.1.)GO TO 29
              ISBIG=1
               IPR=9HCOMMUNITY
           29 DO 21 J=1,24
```

```
       DME(J)=(QHM(J,1)+QHM(J,2))*FC
21    DME(J)=DME(J).A.MU
       IF(JSW.NE.1HE) GO TO 23
C     ELECTRIC ONLY,  NO THERMAL  EQUIVALENT.
      DO 22 I=1,24
       DO 22 J=1,364
22    ESD(2,I,J)=DME(I)
       GO TO 40
23    IF(JSW.EQ.2HEQ)GO TO 27
      PRINT3 $ CALL EXIT
3     FORMAT(* ELECTRIC-THERMAL DEMAND MIX ERROR *A10)
27    IF(LD.GE.0.A.LD.LE.24)GO TO 28
       PRINT4,LD
       CALL EXIT
4     FORMAT(* DELTA OUT OF RANGE *I6)
28    SD(1)=XL
       CALL PIHI(SD)
       UW=1.E-6*UW
       LD=25-LD
      AL=1.15*.01*317.11*AL
       TIN=TLO
      CP=CP*AR/1000.
       DO 35 J=1,364
      CALL PIH(SD)
       Z1=Z2=0.
       DO 30 I=1,24
      J1=SHIFT(ESD(1,I,J),-36).A.7777B
       TO(I)=1.8*(J1-273)+32.
      J2=SHIFT(ESD(1,I,J),-12).A.7777B
       Z4=AL*J2
      TR(I,2)=TO(I)+Z4*SD(I,2)
       TW(I,2)=TO(I)+Z4*SD(I)
      Z1=Z1+TW(I,2)
       Z2=Z2+TR(I,2)
30    CONTINUE
       Z1=Z1/24.
       Z2=Z2/24.
       IF(J.NE.1)GOTO 32
      DO 31 I=1,24
       TR(I)=TR(I,2)
31    TW(I)=TW(I,2)
32    J2=LD
       DO 33 I=1,24
      Z6=FC*(UW*AW*((TIN-Z1)+ZL*(Z1-TW(J2)))+UW*AR*((TIN-Z2)+
     1 .5*(TIN-TDE)+ZL*(Z2-TR(J2)))+RVCP*(TIN-TO(I))-QHM(I,2))
      TW(I)=TW(I,2)
       TR(I)=TR(I,2)
       J2=J2+1
      Z7=TIN-Z6/CP
      IF(Z7.LE.THI)GO TO 46
      Z6=(THI-Z7)*Z6/(Z7-TIN)
      TIN=THI
      GO TO 48
46    IF(Z7.GE.TLO)GO TO 47
      Z6=(TLO-Z7)*Z6/(TIN-Z7)
      TIN=TLO
      GO TO 48
```

```
 47   Z6=0.
      TIN=Z7
 48   Z5=DME(I)+Z6/COPEV(.01*TO(I)) $ ESD(2,I,J)=Z5.A.MU
 33   CONTINUE
 35   CONTINUE
 40   IF(IWO.EQ.1H )GO TO 41
      DECODE(80,5,LCR(1,5))(IW(J),TO(J),J=1,4),IW(5)
  5   FORMAT(2X,4(I2,F4.0),I2)
      CALL DECSEA(4,IW,TO,WKF) $ L=0 $ DO 64 I=1,364,7 $ L=L+1
      I1=I+6 $ IF(WKF(L).GT.0.)GO TO 63 $ PRINT62,L $ CALL EXIT
 62   FORMAT(* NON-POSITIVE SEASONAL DEMAND FACTOR *I3)
 63   DO 64 J=1,24 $ DO 64 K=I,I1
 64   ESD(2,J,K)=WKF(L)*ESD(2,J,K)
C ....  DEMAND IN KWH IN ESD(2,...,...)
 41   Z1=Z2=0. $ I1=J1=0 $  $ DO 42 I=1,24 $ DO 42 J=1,364
      Z4=ESD(2,I,J) $ IF(Z4.LE.Z2)GO TO 42 $ Z2=Z4 $ I1=I $ J1=J
 42   Z1=Z1+Z4 $ DETOT(1)=Z1 $ DETOT(2)=Z2 $ Z1=Z1/1000.
      K1=1HM $ K2=1HK $ IF(ISBIG.EQ.0)GO TO 43
      Z1=Z1/1000. $ Z2=Z2/1000. $ K1=1HG $ K2=1HM
 43   PRINT44,IPR,Z1,K1,Z2,K2,J1,I1
 44   FORMAT(* --DEMAND=*A10*  TOTAL=*F12.3,A1*WH  MAX=*F12.3,A1,*WH*
     1 * AT DAY *I3,*, HOUR *I2)
      IF(ISBIG.NE.0)GO TO 45 $ PRINT2 $ RETURN
  2   FORMAT(* --SIZES IN KWH, KW, OR M-SQ.  ENERGY IN KWH, EXCEPT AS*
     1 * NOTED.  COSTS IN DOLLARS.*)
 45   PRINT6
  6   FORMAT(* --SIZES IN MWH, MW, OR K(M-SQ).  ENERGY IN MWH, EXCEPT*
     1 * AS NOTED.  COSTS IN K-DOLLARS.*)
      RETURN $ END
```

CARD NR.	SEVERITY	DETAILS	DIAGNOSIS OF PROBLEM
12	I	DW 1.2	HOLLERITH CONSTANT .GT. 10 CHARACTERS, EXCESS CHARACTERS INITIALIZED INTO SUCCEEDING WORDS.
11	I	5 57 53	HOLLERITH CONSTANT .GT. 10 CHARACTERS, EXCESS CHARACTERS INITIALIZED INTO SUCCEEDING WORDS.
12	I	DM 1.0	HOLLERITH CONSTANT .GT. 10 CHARACTERS, EXCESS CHARACTERS INITIALIZED INTO SUCCEEDING WORDS.
13	I	0 70 70	HOLLERITH CONSTANT .GT. 10 CHARACTERS, EXCESS CHARACTERS INITIALIZED INTO SUCCEEDING WORDS.
14	I	DH	HOLLERITH CONSTANT .GT. 10 CHARACTERS, EXCESS CHARACTERS INITIALIZED INTO SUCCEEDING WORDS.
15	I	.45 .225	HOLLERITH CONSTANT .GT. 10 CHARACTERS, EXCESS CHARACTERS INITIALIZED INTO SUCCEEDING WORDS.
48	I	27 CD 48	FIELD WIDTH OF A CONVERSION DESCRIPTOR SHOULD BE AS LARGE AS THE MINIMUM SPECIFIED FOR THAT DESCRIPTOR.

SYMBOLIC REFERENCE MAP (R=3)

```
ENTRY POINTS    DEF LINE    REFERENCES
   3  DEMAND        1          137        143

VARIABLES       SN  TYPE            RELOCATION
 1100  AL           REAL                                REFS      77       87   DEFINED      41       77
 1102  AR           REAL                                REFS      79      101   DEFINED      41
 1103  AW           REAL                                REFS     101   DEFINED       41
   50  CC           REAL         ARRAY    COMCOMP       REFS       9
```

```
VARIABLES      SN   TYPE             RELOCATION
  1073  CP           REAL                                 REFS        79       106    DEFINED      41       79
   106  DETOT        REAL        ARRAY    COMCOMP         REFS         9    DEFINED     2*131
  1317  DME          REAL        ARRAY                    REFS         3        59       64       117    DEFINED       58       59
     7  DSPLR        REAL                 COMCARD         REFS         6
     0  EF           REAL        ARRAY    COMCOMP         REFS         9
     0  ESD          REAL        ARRAY    COMLEV2         REFS         8        38       84        86      127      130
                                                       DEFINED        64       117      127
  1071  FC           REAL                                 REFS        38        53       54        58      101
                                                       DEFINED        36        41       53
   113  GEC          REAL        ARRAY    COMCOMP         REFS         9
  1107  I            INTEGER                              REFS      2*64        84       85        86     3*88     3*89       90
                                                            91      2*97      2*98    2*101     2*103    2*104    7*117      124
                                                           126     2*130   DEFINED       62        83       96      100      123
                                                           129
  1066  IPR          INTEGER                              REFS        38       134    DEFINED      32       36       56
     1  IRUN         INTEGER              COMCARD         REFS         6
     2  ISBIG        INTEGER              COMCARD         REFS         6        38      132       137    DEFINED       31       55
     0  ITIT         INTEGER              COMCARD         REFS         6
  1123  IW           INTEGER     ARRAY                    REFS         3         5       18        22       25       28     2*44
                                                           123   DEFINED        18       24        43    2*121
  1105  IWO          INTEGER                              REFS       120   DEFINED       44
  1120  I1           INTEGER                              REFS       126       134    DEFINED     124      129      130
  1064  J            INTEGER                              REFS        18      2*21       22        24     2*27       28     4*30
                                                          2*31        43        44       47      3*52     3*58     2*59       64
                                                            84        86        95      117     2*121    2*127    2*130
                                                       DEFINED        18        20       22        24       25       28       30
                                                            43        44        47       52        57       63       80      121
                                                           126       129
     5  JGCO         INTEGER     ARRAY    COMCARD         REFS         6
  1070  JSW          INTEGER                              REFS        60        66    DEFINED      36       41
  1112  J1           INTEGER                              REFS        85       134    DEFINED      84      129      130
  1067  J2           INTEGER                              REFS        34        87    2*101       105    DEFINED       32       41
                                                            86        99       105
  1065  K            INTEGER                              REFS        24      2*27       28      2*47     3*52    2*127
                                                       DEFINED        22        47      126
  1121  K1           INTEGER                              REFS       134   DEFINED      132       133
  1122  K2           INTEGER                              REFS       134   DEFINED      132       133
  1117  L            INTEGER                              REFS       123     2*124      127   DEFINED    2*123
    10  LCR          INTEGER     ARRAY    COMCARD         REFS         6        18       22        24       28     2*30       31
                                                            32        36        41       43        44       47      121
                                                       DEFINED        21        27
  1072  LD           INTEGER                              REFS      2*69        70       76        99    DEFINED       41       76
  1307  LHH          INTEGER     ARRAY                    REFS         3        21    DEFINED      14       15       31
  1267  LHM          INTEGER     ARRAY                    REFS         3        27    DEFINED      10       11       12       13
                                                          2*30
   513  MU           INTEGER                              REFS        59       117    DEFINED      16
     3  NOVAR        INTEGER              COMCARD         REFS         6
     4  NTYPE        INTEGER              COMCARD         REFS         6
  1203  QHM          REAL        ARRAY                    REFS         3         5     2*52      2*58      101
                                                       DEFINED        47        52
  1104  RVCP         REAL                                 REFS       101   DEFINED       41
  1123  SD           REAL        ARRAY                    REFS         3         5       74        81       88       89
                                                       DEFINED        73
  1076  TDE          REAL                                 REFS       101   DEFINED       41
  1074  THI          REAL                                 REFS       107       108      109   DEFINED       41
  1110  TIN          REAL                                 REFS     4*101       106      108       112    DEFINED       78      109
                                                           113       116
```

```
VARIABLES      SN  TYPE           RELOCATION
  1075  TLO        REAL                            REFS       78      111      112      113    DEFINED     41
  1507  TO         REAL      ARRAY                 REFS        3       88       89      101      5*117    123
                                                DEFINED       85      121
  1347  TR         REAL      ARRAY                 REFS        3       91       97      101      104
                                                DEFINED       88       97      104
  1427  TW         REAL      ARRAY                 REFS        3       90       98      101      103
                                                DEFINED       89       98      103
  1101  UW         REAL                            REFS       75    2*101  DEFINED       41       75
  1203  WKF        REAL      ARRAY                 REFS        3        5      123      124      127
     0  XL         REAL              F.P.          REFS       73  DEFINED        1
    24  XM         REAL      ARRAY   COMCOMP       REFS        9
   110  XRS        REAL      ARRAY   COMCOMP       REFS        9
  1077  ZL         REAL                            REFS    2*101  DEFINED       41
  1106  Z1         REAL                            REFS       49       52       90       93    2*101    3*131      133
                                                    134  DEFINED       47       82       90       93      129    2*131
                                                    133
  1111  Z2         REAL                            REFS       91       94    2*101      130      131      133      134
                                                DEFINED       82       91       94      129      130      133
  1113  Z4         REAL                            REFS       88       89    2*130      131    DEFINED     87      130
  1116  Z5         REAL                            REFS      117  DEFINED      117
  1114  Z6         REAL                            REFS      106      108      112      117    DEFINED    101      108
                                                    112      115
  1115  Z7         REAL                            REFS      107    2*108      111    2*112      116
                                                DEFINED      106

FILE NAMES        MODE
       OUTPUT     FMT                    WRITES      22       28       44       50       67       70      124      134
                                           137      140

EXTERNALS              TYPE   ARGS         REFERENCES
       DECSEA                   4             123
       DEMGET                   4              38
       EXIT                     0              50       67       71      124
       PIH                      1              81
       PIHI                     1              74

INLINE FUNCTIONS       TYPE   ARGS        DEF LINE   REFERENCES
       AMAX1      REAL          0  INTRIN                 53
       COPEV      REAL          1    SF         17       117
       SHIFT      NO TYPE       2  INTRIN                 84       86

STATEMENT LABELS              DEF LINE   REFERENCES
   566  1        FMT              33        32       41
   775  2        FMT             138       137
   701  3        FMT              68        67
   713  4        FMT              72        70
   730  5        FMT             122       121
  1013  6        FMT             141       140
   602  7        FMT              37        36
   106  20                        41        34
     0  21                        59        57
     0  22                        64        62       63
   173  23                        66        60
   200  27                        69        66
   206  28                        73        69
   153  29                        57        54
     0  30                        92        83
```

STATEMENT LABELS			DEF LINE	REFERENCES	
0	31		98	96	
262	32		99	95	
0	33		118	100	
0	35		119	80	
346	40		120	65	
426	41		129	39	120
437	42		131	2*129	130
456	43		134	132	
757	44	FMT	135	134	
464	45		140	137	
317	46		111	107	
324	47		115	111	
325	48		117	110	114
0	49		31	30	
5	50		18	21	
521	51	FMT	19	18	
0	52		21	20	
15	53		22	18	
531	54	FMT	23	22	
35	55		24	27	
544	56	FMT	26	24	
0	57		27	25	
46	58		28	22	25
554	59	FMT	29	28	
641	60	FMT	45	43	
645	61	FMT	46	44	
737	62	FMT	125	124	
405	63		126	124	
0	64		127	123	2*126
662	65	FMT	48	47	
131	66		50	52	
670	67	FMT	51	50	
134	68		52	49	
0	69		53	47	52

LOOPS	LABEL	INDEX	FROM-TO	LENGTH	PROPERTIES	
12	52	J	20 21	3B	INSTACK	
27	58	K	22 28	34B		EXT REFS NOT INNER
44	57	J	25 27	2B	INSTACK	
70	49	J	30 31	4B	INSTACK	
117	69	K	47 53	26B		EXT REFS NOT INNER
140	69	J	52 53	3B	INSTACK	EXITS
157	21	J	57 59	3B	INSTACK	
165	22	I	62 64	5B		NOT INNER
167	22	J	63 64	2B	INSTACK	
226	35	J	80 119	120B		EXT REFS NOT INNER
236	30	I	83 92	13B	OPT	
257	31	I	96 98	3B	INSTACK	
267	33	I	100 118	52B	OPT	
356		J	121 121	10B		EXT REFS
375	64	I	123 127	31B		EXT REFS NOT INNER
414	64	J	126 127	4B		NOT INNER
415	64	K	126 127	2B	INSTACK	
432	42	I	129 131	11B		NOT INNER
433	42	J	129 131	6B	INSTACK	

COMMON BLOCKS	LENGTH	MEMBERS - BIAS NAME(LENGTH)		
COMCARD	125	0 ITIT (1)	1 IRUN (1)	2 ISBIG (1)
		3 NOVAR (1)	4 NTYPE (1)	5 JGCO (2)
		7 DSPLR (1)	8 LCR (117)	
COMLEV2	17472	0 ESD (17472)		
COMCOMP	95	0 EF (20)	20 XM (20)	40 CC (30)
		70 DETOT (2)	72 XRS (3)	75 GEC (20)

EQUIV CLASSES	LENGTH	MEMBERS - BIAS NAME(LENGTH)
IW	48	0 SD (48)
WKF	52	0 QHM (52)

STATISTICS		
PROGRAM LENGTH	1537B	863
CM LABELED COMMON LENGTH	42434B	17692
60000B CM USED		

```
      SUBROUTINE STORI $ DIMENSION P(14)
      COMMON /COMCARD/ ITIT,IRUN,ISBIG,NOVAR,NTYPE,JGCO(2),DSPLR,
     1 LCR(9,13)
      COMMON /COMCOMP/ EF(20),XM(10,2),CC(10,3),DETOT(2),XRS(3),GEC(20)
      DECODE(80,1,LCR(1,7))(P(J),J=1,14)
    1 FORMAT(A2,A4,A8,11A6)
      PRINT2,(P(J),J=1,14),LCR(9,7)
    2 FORMAT(* (*A2,*/*A4,*/*A8,11(*/*A6),*)*A1)
      DECODE(80,3,LCR(1,7))EF(2),EF(7),EF(8),(XRS(J),J=1,3),XM(2,1),
     1 XM(2,2),(CC(2,J),J=1,3)
    3 FORMAT(14X,11F6.0)
      IF(CC(2,1).EQ.0.)CC(2,2)=1.
      IF(EF(2).LE.0..O.EF(2).GT.1..O.EF(7).LE.0..O.EF(7).GT.1.
     1 .O.EF(8).LE.0..O.EF(8).GT.1..O.XRS(1).LE.0..O.XRS(1).GT.1.
     2 .O.XRS(2).LE.0..O.XRS(2).GT.1..O.XM(2,1).LT.0..O.XM(2,2).LT.0.
     3 .O.XM(2,1).GT.XM(2,2).O.CC(2,1).LT.0..O.CC(2,2).LE.0.
     4 .O.CC(2,3).LT.0..O.XRS(3).LE.0.)GO TO 99
      IF(ISBIG.EQ.0)RETURN $ XM(2,1)=1000.*XM(2,1)
      XM(2,2)=1000.*XM(2,2) $ CC(2,3)=1000.*CC(2,3) $ RETURN
   98 FORMAT(* STORAGE CARD ERROR *)
   99 PRINT98 $ CALL EXIT $ END
```

SYMBOLIC REFERENCE MAP (R=3)

```
ENTRY POINTS      DEF LINE      REFERENCES
  1  STORI            1            18          19          21

VARIABLES       SN   TYPE              RELOCATION
   50  CC            REAL        ARRAY    COMCOMP     REFS      4      12      3*13      19    DEFINED      9      12
                                                         19
  106  DETOT         REAL        ARRAY    COMCOMP     REFS      4
    7  DSPLR         REAL                 COMCARD     REFS      2
    0  EF            REAL        ARRAY    COMCOMP     REFS      4     6*13   DEFINED    3*9
  113  GEC           REAL        ARRAY    COMCOMP     REFS      4
    1  IRUN          INTEGER              COMCARD     REFS      2
    2  ISBIG         INTEGER              COMCARD     REFS      2      18
    0  ITIT          INTEGER              COMCARD     REFS      2
  142  J             INTEGER                          REFS      5       7      2*9   DEFINED      5       7     2*9
    5  JGCO          INTEGER     ARRAY    COMCARD     REFS      2
   10  LCR           INTEGER     ARRAY    COMCARD     REFS      2       5       7        9
    3  NOVAR         INTEGER              COMCARD     REFS      2
    4  NTYPE         INTEGER              COMCARD     REFS      2
  143  P             REAL        ARRAY                REFS      1       7    DEFINED     5
   24  XM            REAL        ARRAY    COMCOMP     REFS      4     4*13     18       19    DEFINED    2*9      18
                                                         19
  110  XRS           REAL        ARRAY    COMCOMP     REFS      4     5*13   DEFINED     9

FILE NAMES         MODE
      OUTPUT       FMT                 WRITES       7        21

EXTERNALS           TYPE    ARGS         REFERENCES
      EXIT                    0             21
```

```
STATEMENT LABELS                 DEF LINE   REFERENCES
    72  1           FMT              6           5
   102  2           FMT              8           7
   125  3           FMT             11           9
   130  98          FMT             20          21
    57  99                          21          13

LOOPS  LABEL    INDEX      FROM-TO     LENGTH     PROPERTIES
   14           J           9 9         10B                  EXT REFS

COMMON BLOCKS   LENGTH     MEMBERS - BIAS NAME(LENGTH)
       COMCARD     125            0 ITIT    (1)            1 IRUN    (1)            2 ISBIG  (1)
                                  3 NOVAR   (1)            4 NTYPE   (1)            5 JGCO   (2)
                                  7 DSPLR   (1)            8 LCR     (117)
       COMCOMP      95            0 EF      (20)          20 XM      (20)          40 CC     (30)
                                 70 DETOT   (2)           72 XRS     (3)           75 GEC    (20)

STATISTICS
  PROGRAM LENGTH                    161B      113
  CM LABELED COMMON LENGTH          334B      220
          60000B CM USED
```

```
 1                  SUBROUTINE POWCI $ DIMENSION PP(12)
                    COMMON /COMCARD/ ITIT,IRUN,ISBIG,NOVAR,NTYPE,JGCO(2),DSPLR,
                   1 LCR(9,13)
                    COMMON /COMCOMP/ EF(20),XM(10,2),CC(10,3),DETOT(2),XRS(3),GEC(20)
 5                  DECODE(80,1,LCR(1,10))(PP(J),J=1,12)
              1     FORMAT(A2,A4,A8,3A6,3A10,3A6)
                    PRINT2,(PP(J),J=1,12),LCR(9,10)
              2     FORMAT(* (*A2,*/*A4,*/*A8,3(*/*A6),*/*3A10,3(*/*A6),*)*A1)
                    DECODE(80,3,LCR(1,10))EF(4),EF(5),EF(6),CC(4,1),CC(4,2),CC(4,3)
10            3     FORMAT(14X,3F6.0,30X,3F6.0)
                    IF(CC(4,1).EQ.0.)CC(4,2)=1.
                    IF(EF(4).LE.0..O.EF(4).GT.1..O.EF(5).LE.0..O.EF(5).GT.1.
                   1 .O.EF(6).LE.0..O.EF(6).GT.1..O.CC(4,1).LT.0..O.CC(4,2).LE.0.
                   2 .O.CC(4,3).LT.0.)GO TO 99
15                  IF(ISBIG.NE.0)CC(4,3)=1000.*CC(4,3) $ RETURN
             98     FORMAT(* POWER CONDITIONING CARD ERROR *)
             99     PRINT98 $ CALL EXIT $ END
```

SYMBOLIC REFERENCE MAP (R=3)

ENTRY POINTS		DEF LINE	REFERENCES	
1	POWCI	1	15	17

VARIABLES		SN TYPE		RELOCATION								
50	CC	REAL	ARRAY	COMCOMP	REFS	4	11	3*12	15	DEFINED	3*9	11
					15							
106	DETOT	REAL	ARRAY	COMCOMP	REFS	4						
7	DSPLR	REAL		COMCARD	REFS	2						
0	EF	REAL	ARRAY	COMCOMP	REFS	4	6*12	DEFINED	3*9			
113	GEC	REAL	ARRAY	COMCOMP	REFS	4						
1	IRUN	INTEGER		COMCARD	REFS	2						
2	ISBIG	INTEGER		COMCARD	REFS	2	15					
0	ITIT	INTEGER		COMCARD	REFS	2						
113	J	INTEGER			REFS	5	7	DEFINED	5	7		
5	JGCO	INTEGER	ARRAY	COMCARD	REFS	2						
10	LCR	INTEGER	ARRAY	COMCARD	REFS	2	5	7	9			
3	NOVAR	INTEGER		COMCARD	REFS	2						
4	NTYPE	INTEGER		COMCARD	REFS	2						
114	PP	REAL	ARRAY		REFS	1	7	DEFINED	5			
24	XM	REAL	ARRAY	COMCOMP	REFS	4						
110	XRS	REAL	ARRAY	COMCOMP	REFS	4						

FILE NAMES	MODE			
OUTPUT	FMT	WRITES	7	17

EXTERNALS	TYPE	ARGS	REFERENCES
EXIT		0	17

STATEMENT LABELS			DEF LINE	REFERENCES
42	1	FMT	6	5
53	2	FMT	8	7
75	3	FMT	10	9
100	98	FMT	16	17

```
STATEMENT LABELS                DEF LINE   REFERENCES
   31  99                          17          12

COMMON BLOCKS   LENGTH       MEMBERS - BIAS NAME(LENGTH)
       COMCARD      125               0 ITIT    (1)              1 IRUN    (1)              2 ISBIG  (1)
                                      3 NOVAR   (1)              4 NTYPE   (1)              5 JGCO   (2)
                                      7 DSPLR   (1)              8 LCR     (117)
       COMCOMP       95               0 EF      (20)            20 XM      (20)            40 CC     (30)
                                     70 DETOT   (2)             72 XRS     (3)             75 GEC    (20)

STATISTICS
  PROGRAM LENGTH                  130B        88
  CM LABELED COMMON LENGTH        334B       220
         60000B CM USED
```

```
      SUBROUTINE AMORT(CR,ML,LR,IND,CAP,COM)
C ... CR=COST,  ML=YEAR OF PURCHASE (OR OVH), LR=LIFE, IND=0 IS OVH.
C ... OVH ONLY ON I=3 ITEM (GENERATOR).
      DIMENSION P(20),AC(3),AO(3),KM(3),S(3),G(3),TC(3),DP(3),CV(3)
      COMMON /COMCARD/ ITIT,IRUN,ISBIG,NOVAR,NTYPE,JGCO(2),DSPLR,
     1 LCR(9,13)
      COMMON /COMCOMP/ EF(20),XM(10,2),CC(10,3),DETOT(2),XRS(3),GEC(20)
      COMMON /COMAMOR/ LIFE,AMP,AMB
      COMMON /COMWIND/ W(8),ISWND
      I=IND $ IF(I.GT.0)GO TO 10 $ CAP=0.
      COM=ACOH*CR*(GOMR**ML) $ RETURN
   10 C=CV(I)*CR $ K=MAX0(1,MIN0(LR,KM(I))) $ Z1=1.
      IF(K.LT.7)Z1=2./3. $ IF(K.LT.5)Z1=1./3. $ IF(K.LT.3)Z1=0.
      IF(ML.NE.0)GO TO 11 $ COM=C*AO(I)
      CAP=C*(AC(I)-Z1*TC(I)-DP(I)*S(I)*(K-ZMF(R,0.,K))/K/(K+1))
      RETURN
   11 C=C*S(I)*(G(I)**ML) $ COM=0.
      CAP=C*(1.-Z1*TC(I)-DP(I)*(K-ZMF(R,0.,K))/K/(K+1.))
      RETURN
      ENTRY AMORTI
      DECODE(80,1,LCR(1,11))(P(J),J=1,14)
    1 FORMAT(A2,13A6)
      PRINT2,(P(J),J=1,14),LCR(9,11)
    2 FORMAT(* (*A2,13(*/*A6),*)*A1)
      DECODE(80,3,LCR(1,11))IP,IO,IB,R,RI,D,T,FOM,FPT,GO,GOM,GPT,GF
    3 FORMAT(2X,3(2X,I4),10F6.0)
      IF(R.LE.0..O.D.LT.0..O.D.GT.1..O.T.LT.0..O.T.GE.1.
     1 .O.FOM.LT.0..O.FPT.LT.0.)GO TO 99
      IF(D.NE.1..A.RI.LE.0.)GO TO 99 $ R1=R+1. $ GOMR=(1.+GOM)/R1
      DECODE(80,4,LCR(1,12))(P(J),J=1,15)
    4 FORMAT(A2,2A3,12A6)
      PRINT5,(P(J),J=1,15),LCR(9,12)
    5 FORMAT(* (*A2,*/*A3,*/*A3,12(*/*A6),*)*A1)
      DECODE(80,6,LCR(1,12))JP,N,L,(KM(J),S(J),TC(J),G(J),J=1,3)
    6 FORMAT(2X,A1,I2,1X,I2,3(4X,I2,3F6.0))
      LIFE=N $ IF(N.LE.0)GO TO 99
      IF(D.NE.1..A.(L.LE.0.O.L.GT.N))GO TO 99
      DO 60 J=1,3 $ IF(JP.NE.1HP.A.(KM(J).LE.0.O.KM(J).GT.N))GOTO99
      IF(S(J).LT.0..O.S(J).GE.1..O.TC(J).LT.0..O.TC(J).GE.1.)GOTO99
   60 CONTINUE $ THT=0. $ IF(JP.NE.1HP)THT=T
      AMB=ZMF(R,0,N)/ZMF(R,GO,N)
      Z1=D+(1.-T)*FPT*ZMF(R,GPT,N)
      IF(D.NE.1.)Z1=Z1+(1.-D)*((1.-T)*ZMF(R,0.,L)/ZMF(RI,0.,L)-
     1 T*ZMF(R,RI,L)*(RI-1./ZMF(RI,0.,L)))
      AC(1)=AC(2)=AC(3)=Z1 $ DO 61 J=1,3 $ KM(J)=MAX0(1,KM(J))
      TC(J)=TC(J)/R1 $ AC(J)=AC(J)-S(J)*(((1.+G(J))/R1)**N)
      DP(J)=2.*THT/R $ S(J)=1.-S(J)
   61 CONTINUE
      AO(1)=AO(2)=AO(3)=(1.-THT)*FOM*ZMF(R,GOM,N)
      Z1=((1.+GO)**(IB-IO))/ZMF(R,0.,N) $ DO 62 J=1,3
      G(J)=1.+G(J) $ CV(J)=Z1*(G(J)**(IO-IP))
   62 G(J)=G(J)/R1 $ ACOH=CV(3)*GEC(3)*(1.-THT)/R1
      AMP=Z1*((1.+GF)**(IO-IP))*(1.-THT)*ZMF(R,GF,N)
      IF(ISWND.EQ.0)RETURN $ CC(1,2)=CC(1,2)/2.
      CC(1,1)=CC(1,1)*W(7)*((259.7/W(3)/(W(5)+W(4))**3)**CC(1,2))
      CC(1,3)=W(7)*CC(1,3) $ RETURN
   98 FORMAT(* ERROR IN AM OR YR CARD *)
```

```
            99    PRINT98 $ CALL EXIT $ END


      SYMBOLIC REFERENCE MAP (R=3)

ENTRY POINTS      DEF LINE      REFERENCES
    3  AMORT           1           11          16          19
  102  AMORTI         20           54          56          58

VARIABLES       SN  TYPE             RELOCATION
  643  AC           REAL       ARRAY                   REFS          4          15          46    DEFINED      3*45        46
  567  ACOH         REAL                               REFS         11     DEFINED          52
    2  AMB          REAL                COMAMOR        REFS          8     DEFINED          41
    1  AMP          REAL                COMAMOR        REFS          8     DEFINED          53
  646  AO           REAL       ARRAY                   REFS          4          14     DEFINED        3*49
  571  C            REAL                               REFS         14          15          17          18    DEFINED        12          17
    0  CAP          REAL                  F.P.      DEFINED          1          10          15          18
   50  CC           REAL       ARRAY    COMCOMP        REFS          7          54        2*55          56    DEFINED        54          55
                                                         56
    0  COM          REAL                  F.P.      DEFINED          1          11          14          17
    0  CR           REAL                  F.P.         REFS         11          12     DEFINED           1
  670  CV           REAL       ARRAY                   REFS          4          12          52    DEFINED        51
  602  D            REAL                               REFS       2*27          29          37          42      2*43
                                                    DEFINED         25
  106  DETOT        REAL       ARRAY    COMCOMP        REFS          7
  665  DP           REAL       ARRAY                   REFS          4          15          18    DEFINED        47
    7  DSPLR        REAL                COMCARD        REFS          5
    0  EF           REAL       ARRAY    COMCOMP        REFS          7
  604  FOM          REAL                               REFS         27          49     DEFINED          25
  605  FPT          REAL                               REFS         27          42     DEFINED          25
  657  G            REAL       ARRAY                   REFS          4          17          46        2*51        52
                                                    DEFINED         34          51          52
  113  GEC          REAL       ARRAY    COMCOMP        REFS          7          52
  611  GF           REAL                               REFS       2*53     DEFINED          25
  606  GO           REAL                               REFS         41          50     DEFINED          25
  607  GOM          REAL                               REFS         29          49     DEFINED          25
  570  GOMR         REAL                               REFS         11     DEFINED          29
  610  GPT          REAL                               REFS         42     DEFINED          25
  566  I            INTEGER                            REFS         10        2*12          14        4*15      2*17      2*18
                                                    DEFINED         10
  600  IB           INTEGER                            REFS         50     DEFINED          25
    0  IND          INTEGER               F.P.         REFS         10     DEFINED           1
  577  IO           INTEGER                            REFS         50          51          53    DEFINED        25
  576  IP           INTEGER                            REFS         51          53     DEFINED          25
    1  IRUN         INTEGER             COMCARD        REFS          5
    2  ISBIG        INTEGER             COMCARD        REFS          5
   10  ISWND        INTEGER             COMWIND        REFS          9          54
    0  ITIT         INTEGER             COMCARD        REFS          5
  575  J            INTEGER                            REFS         21          23          30          32      4*34      2*38      4*39
                                                       2*45       6*46        3*47        4*51        2*52    DEFINED        21          23
                                                         30         32          34          38          45        50
    5  JGCO         INTEGER    ARRAY    COMCARD        REFS          5
  613  JP           INTEGER                            REFS         38          40     DEFINED          34
  572  K            INTEGER                            REFS       3*13        4*15        4*18    DEFINED        12
```

```
VARIABLES       SN  TYPE              RELOCATION
   651  KM          INTEGER    ARRAY                    REFS          4         12      2*38         45    DEFINED        34        45
   615  L           INTEGER                             REFS       2*37       4*43   DEFINED         34
    10  LCR         INTEGER    ARRAY    COMCARD         REFS          5         21        23         25         30        32        34
     0  LIFE        INTEGER             COMAMOR         REFS          8    DEFINED        36
     0  LR          INTEGER               F.P.          REFS         12    DEFINED         1
     0  ML          INTEGER               F.P.          REFS         11         14        17    DEFINED          1
   614  N           INTEGER                             REFS       2*36         37        38       2*41         42        46        49
                                                          50         53    DEFINED        34
     3  NOVAR       INTEGER             COMCARD         REFS          5
     4  NTYPE       INTEGER             COMCARD         REFS          5
   617  P           REAL       ARRAY                    REFS          4         23        32    DEFINED         21        30
   574  R           REAL                                REFS         15         18        27         29       2*41        42      2*43
                                                          47         49         50        53    DEFINED         25
   601  RI          REAL                                REFS         29       4*43   DEFINED         25
   612  R1          REAL                                REFS         29       2*46      2*52    DEFINED         29
   654  S           REAL       ARRAY                    REFS          4         15        17       2*39         46        47
                                                     DEFINED         34         47
   603  T           REAL                                REFS       2*27         40        42       2*43    DEFINED        25
   662  TC          REAL       ARRAY                    REFS          4         15        18       2*39         46
                                                     DEFINED         34         46
   616  THT         REAL                                REFS         47         49        52         53    DEFINED      2*40
     0  W           REAL       ARRAY    COMWIND         REFS          9       4*55        56
    24  XM          REAL       ARRAY    COMCOMP         REFS          7
   110  XRS         REAL       ARRAY    COMCOMP         REFS          7
   573  Z1          REAL                                REFS         15         18        43         45         51        53
                                                     DEFINED         12       3*13        42         43         50

FILE NAMES         MODE
        OUTPUT     FMT                    WRITES      23         32         58

EXTERNALS            TYPE    ARGS         REFERENCES
        EXIT                   0                58
        ZMF          REAL      3                15        18       2*41         42       4*43         49         50        53

INLINE FUNCTIONS     TYPE    ARGS         DEF LINE   REFERENCES
        MAXO       INTEGER     0  INTRIN                    12        45
        MINO       INTEGER     0  INTRIN                    12

STATEMENT LABELS                DEF LINE    REFERENCES
   442  1          FMT              22         21
   451  2          FMT              24         23
   476  3          FMT              26         25
   506  4          FMT              31         30
   516  5          FMT              33         32
   541  6          FMT              35         34
    16  10                          12         10
    61  11                          17         14
     0  60                          40         38
     0  61                          48         45
     0  62                          52         50
   545  98         FMT              57         58
   357  99                          58         27         29         36         37         38         39

LOOPS   LABEL      INDEX       FROM-TO      LENGTH     PROPERTIES
   151                J         34 34         13B                EXT REFS
   201  60            J         38 40          7B      INSTACK     EXITS
   257  61            J         45 48         17B                EXT REFS
```

LOOPS	LABEL	INDEX	FROM-TO	LENGTH	PROPERTIES
315	62	J	50 52	12B	EXT REFS

COMMON BLOCKS	LENGTH	MEMBERS - BIAS NAME(LENGTH)		
COMCARD	125	0 ITIT (1)	1 IRUN (1)	2 ISBIG (1)
		3 NOVAR (1)	4 NTYPE (1)	5 JGCO (2)
		7 DSPLR (1)	8 LCR (117)	
COMCOMP	95	0 EF (20)	20 XM (20)	40 CC (30)
		70 DETOT (2)	72 XRS (3)	75 GEC (20)
COMAMOR	3	0 LIFE (1)	1 AMP (1)	2 AMB (1)
COMWIND	9	0 W (8)	8 ISWND (1)	

STATISTICS		
PROGRAM LENGTH	673B	443
CM LABELED COMMON LENGTH	350B	232
60000B CM USED		

```
      SUBROUTINE GENERI $ DIMENSION IP(401),P(401),JG(3,4),SZ(3)
      COMMON /COMCARD/ ITIT,IRUN,ISBIG,NOVAR,NTYPE,JGCO(2),DSPLR,
     1 LCR(9,13)
      COMMON /COMCOMP/ EF(20),XM(10,2),CC(10,3),DETOT(2),XRS(3),GEC(20)
      COMMON /COMGEON/ LGON(52)
      COMMON /COMLEV2/ ESD(2,24,364)
      EQUIVALENCE (IP,P)
      DATA JG/4HNGAS,10HNAT. GAS I,5HN MCF,3HGAS,10HGASOLINE I,
     1 9HN GALLONS,3HDIE,9HDIESEL IN,7HGALLONS,4HCOAL,10HCOAL IN TO,
     2 2HNS/
      DECODE(80,1,LCR(1,8))(IP(J),J=1,14)
    1 FORMAT(A2,A4,A8,11A6)
      PRINT2,(IP(J),J=1,14),LCR(9,8) $ DO 30 I=1,4
      IF(IP(2).EQ.JG(1,I))GO TO 31
   30 CONTINUE $ GO TO 99
   31 JGCO(1)=JG(2,I) $ JGCO(2)=JG(3,I) $ PRINT7,JGCO(1),JGCO(2)
    7 FORMAT(* --GENERATOR FUEL IS *2A10)
    2 FORMAT(* (*A2*/*A4*/*A8,11(*/*A6),*)*A1)
      DECODE(80,3,LCR(1,8))EF(3),(GEC(J),J=1,3),K,GEC(5),XM(3,1),
     1 XM(3,2),(CC(3,J),J=1,3)
    3 FORMAT(14X,4F6.0,4X,I2,6F6.0)
      GEC(4)=K $ IF(CC(3,1).EQ.0.)CC(3,2)=1.
      IF(EF(3).LE.0..O.EF(3).GT.1..O.GEC(1).LE.0..O.GEC(1).GT.1.
     1 .O.GEC(2).LE.0..O.GEC(3).LE.0..O.GEC(4).LT.0.
     2 .O.GEC(5).LT.0..O.XM(3,1).LT.0..O.XM(3,2).GT.1.
     3 .O.XM(3,2).LT.XM(3,1).O.CC(3,1).LT.0..O.CC(3,2).LE.0.
     4 .O.CC(3,3).LT.0..O.XM(3,2).LE.0..O.XM(3,2).GT.DSPLR)GO TO 99
      DECODE(80,4,LCR(1,9))(IP(J),J=1,19)
    4 FORMAT(2A2,4(A4,A2),A4,8A6)
      IPO=IP(2) $ PRINT5,(IP(J),J=1,19),LCR(9,9)
    5 FORMAT(* (*A2,5(*/*A2,*/*A4),8(*/*A6),*)*A1)
      DECODE(80,6,LCR(1,9))(IP(J),IP(J+9),J=1,4),IP(5),(GEC(J),J=6,10)
    6 FORMAT(2X,4(I2,I4),I2,4X,8F6.0)
      DO 10 J=1,52
   10 LGON(J)=0 $ IF(IPO.EQ.1H )GO TO 12
      CALL DECSEA(4,IP,IP(10),LGON) $ DO 11 J=1,52
   11 LGON(J)=MAX0(24,MIN0(0,LGON(J)))
   12 Z1=GEC(8)+GEC(9)+GEC(10)
      IF(GEC(8).LE.0..O.Z1.LT.GEC(8).O.Z1.GT.1.001.O.GEC(6).LE.0.
     1 .O.GEC(7).LT.0.)GO TO 99
      Z1=-GEC(9) $ IF(GEC(10).NE.0.)Z1=Z1/2./GEC(10)
      IF(Z1.GT.0..A.Z1.LT.1.)GO TO 99 $ SZ(1)=XM(3,1) $ SZ(2)=XM(3,2)
C ....  FIND HI-LO GENERATOR VALUES.
      SZ(3)=DSPLR $ Z1=400./DETOT(2) $ DO 20 J=1,401
   20 P(J)=0. $ DO 21 I=1,24 $ DO 21 J=1,364
      K=Z1*ESD(2,I,J)+2. $ K=MIN0(401,MAX0(2,K))
   21 P(K)=P(K)+1. $ DO 22 J=1,399
   22 P(401-J)=P(401-J)+P(402-J) $ DO 23 J=3,401
   23 P(J)=P(J)+P(J-1) $ DO 27 K=1,3 $ Z2=P(401)*SZ(K)
      DO 25 J=2,401 $ IF(Z2.LT.P(J))GO TO 26
   25 CONTINUE $ SZ(K)=1.000000001*DETOT(2) $ GO TO 27
   26 Z3=(Z2-P(J-1))/(P(J)-P(J-1)) $ SZ(K)=(J-2+Z3)/Z1
   27 CONTINUE $ XM(3,1)=SZ(1) $ XM(3,2)=SZ(2) $ GEC(11)=SZ(3)
      Z1=0. $ DO 28 J=1,24 $ DO 28 K=1,364
   28 Z1=Z1+AMIN1(SZ(3),ESD(2,J,K)) $ DSPLR=Z1/DETOT(1)
      PRINT8,DSPLR $ RETURN
    8 FORMAT(* --ACTUAL DEMAND SATISFACTION GOAL IS *F7.4)
```

```
                 98    FORMAT(* GENERATOR CARD ERROR*)
                 99    PRINT98 $ CALL EXIT $ END



      SYMBOLIC REFERENCE MAP (R=3)

 ENTRY POINTS       DEF LINE       REFERENCES
    1  GENERI           1            56         59

 VARIABLES        SN  TYPE            RELOCATION
    50  CC            REAL      ARRAY     COMCOMP     REFS         4       22      3*23   DEFINED      19      22
   106  DETOT         REAL      ARRAY     COMCOMP     REFS         4       44        51       55
     7  DSPLR         REAL                COMCARD     REFS         2       23        44       56    DEFINED     55
     0  EF            REAL      ARRAY     COMCOMP     REFS         4     2*23   DEFINED       19
     0  ESD           REAL      ARRAY     COMLEV2     REFS         6       46        55
   113  GEC           REAL      ARRAY     COMCOMP     REFS         4     6*23      3*38     4*39    3*41
                                                    DEFINED      2*19       22        32       53
   426  I             INTEGER                         REFS        14     2*16        46   DEFINED      13      45
   434  IP            INTEGER   ARRAY                 REFS         1        7        13       14    2*30    2*36
                                                    DEFINED        11       28      3*32
   430  IPO           INTEGER                         REFS        35   DEFINED       30
     1  IRUN          INTEGER             COMCARD     REFS         2
     2  ISBIG         INTEGER             COMCARD     REFS         2
     0  ITIT          INTEGER             COMCARD     REFS         2
   425  J             INTEGER                         REFS        11       13      2*19       28      30    3*32     35
                                                      2*37        45       46      3*48     3*49      50    4*52     55
                                                    DEFINED        11       13      2*19       28      30    2*32     34
                                                        36        44       45        47       48      50      54
  1255  JG            INTEGER   ARRAY                 REFS         1       14      2*16   DEFINED       8
     5  JGCO          INTEGER   ARRAY     COMCARD     REFS         2     2*16   DEFINED     2*16
   427  K             INTEGER                         REFS        22       46      2*47       49      51      52     55
                                                    DEFINED        19     2*46        49       54
    10  LCR           INTEGER   ARRAY     COMCARD     REFS         2       11        13       19      28      30     32
     0  LGON          INTEGER   ARRAY     COMGEON     REFS         5       36        37   DEFINED      35      37
     3  NOVAR         INTEGER             COMCARD     REFS         2
     4  NTYPE         INTEGER             COMCARD     REFS         2
   434  P             REAL      ARRAY                 REFS         1        7        47     2*48    3*49      50   3*52
                                                    DEFINED        45       47        48       49
  1271  SZ            REAL      ARRAY                 REFS         1       49      3*53       55   DEFINED    2*42     44
                                                        51        52
    24  XM            REAL      ARRAY     COMCOMP     REFS         4     6*23      2*42   DEFINED    2*19    2*53
   110  XRS           REAL      ARRAY     COMCOMP     REFS         4
   431  Z1            REAL                            REFS      2*39       41      2*42       46      52    2*55
                                                    DEFINED        38     2*41        44       54      55
   432  Z2            REAL                            REFS        50       52   DEFINED       49
   433  Z3            REAL                            REFS        52   DEFINED       52

 FILE NAMES         MODE
      OUTPUT        FMT                     WRITES    13        16       30        56       59

 EXTERNALS              TYPE    ARGS         REFERENCES
      DECSEA                      4              36
      EXIT                        0              59
```

INLINE FUNCTIONS	TYPE	ARGS		DEF LINE	REFERENCES	
AMIN1	REAL	0	INTRIN		55	
MAX0	INTEGER	0	INTRIN		37	46
MIN0	INTEGER	0	INTRIN		37	46

STATEMENT LABELS			DEF LINE	REFERENCES			
262	1	FMT	12	11			
304	2	FMT	18	13			
327	3	FMT	21	19			
340	4	FMT	29	28			
350	5	FMT	31	30			
370	6	FMT	33	32			
277	7	FMT	17	16			
400	8	FMT	57	56			
0	10		35	34			
0	11		37	36			
126	12		38	35			
0	20		45	44			
0	21		47	2*45			
0	22		48	47			
0	23		49	48			
0	25		51	50			
213	26		52	50			
221	27		53	49	51		
0	28		55	2*54			
0	30		15	13			
14	31		16	14			
406	98	FMT	58	59			
242	99		59	15	23	39	42

LOOPS	LABEL	INDEX	FROM-TO	LENGTH	PROPERTIES	
11	30	I	13 15	2B	INSTACK	EXITS
30		J	19 19	10B		EXT REFS
100		J	32 32	10B		EXT REFS
112	10	J	34 35	2B	INSTACK	
121	11	J	36 37	5B	INSTACK	
153	20	J	44 45	2B	INSTACK	
161	21	I	45 47	12B		NOT INNER
162	21	J	45 47	10B	OPT	
174	22	J	47 48	2B	INSTACK	
200	23	J	48 49	2B	INSTACK	
204	27	K	49 53	16B		NOT INNER
207	25	J	50 51	2B	INSTACK	EXITS
230	28	J	54 55	5B		NOT INNER
231	28	K	54 55	3B	INSTACK	

COMMON BLOCKS	LENGTH	MEMBERS - BIAS NAME(LENGTH)							
COMCARD	125	0	ITIT	(1)	1	IRUN	(1)	2	ISBIG (1)
		3	NOVAR	(1)	4	NTYPE	(1)	5	JGCO (2)
		7	DSPLR	(1)	8	LCR	(117)		
COMCOMP	95	0	EF	(20)	20	XM	(20)	40	CC (30)
		70	DETOT	(2)	72	XRS	(3)	75	GEC (20)
COMGEON	52	0	LGON	(52)					
COMLEV2	17472	0	ESD	(17472)					

```
EQUIV CLASSES   LENGTH      MEMBERS - BIAS NAME(LENGTH)
    IP            401                0 P      (401)

STATISTICS
  PROGRAM LENGTH                1274B     700
  CM LABELED COMMON LENGTH     42520B   17744
        60000B CM USED
```

SUBROUTINE GEONLY 74/74 OPT=2 FTN 4.8+518 80/11/28. 10.01.44 PAGE 1

```
              SUBROUTINE GEONLY $ DIMENSION CUMU(20)
              COMMON /COMCARD/ ITIT,IRUN,ISBIG,NOVAR,NTYPE,JGCO(2),DSPLR,
             1 LCR(9,13)
              COMMON /COMAMOR/ LIFE,AMP,AMB
              COMMON /COMCOMP/ EF(20),XM(10,2),CC(10,3),DETOT(2),XRS(3),GEC(20)
              COMMON /COMLEV2/ ESD(2,8736)
              COMMON /COMANSW/ X(10),ANS(21),CTOT(5),CCM(6)
C ...          COMPUTER GENERATOR ONLY SYSTEM.
              GEC(14)=0. $ DO 16 J=1,10
   16         X(J)=0. $ DO 17 J=1,20 $ CUMU(J)=0.
   17         ANS(J)=0. $ ANS(3)=8736.
              X(3)=GEC(11) $ Z1=GEC(6)+X(3)*GEC(7) $ EFG0=Z1*GEC(8)
              EFG1=Z1*GEC(9)/X(3) $ EFG2=Z1*GEC(10)/X(3)/X(3)
              Z2=19.9999/X(3)
              DO 14 J=1,8736 $ Z1=ESD(2,J)-X(3) $ IF(Z1)12,11,10
   10         ANS(5)=ANS(5)+Z1 $ GEC(14)=GEC(14)+1.
   11         GL=X(3) $ GO TO 13
   12         GL=ESD(2,J)
   13         ANS(1)=ANS(1)+GL/((EFG2*GL+EFG1)*GL+EFG0)
              K=Z2*GL+1. $ CUMU(K)=CUMU(K)+1.
   14         CONTINUE $ GEC(12)=ANS(1) $ DO 20 J=2,20
   20         CUMU(J)=CUMU(J)+CUMU(J-1) $ Z1=100./CUMU(20) $ DO 21 J=1,20
   21         CUMU(J)=Z1*CUMU(J) $ GEC(13)=COST(Z1) $ Z2=LIFE/ANS(8)
              IF(ISBIG.EQ.0)GO TO 22 $ X(3)=X(3)/1000. $ DO 23 J=1,4
   23         CTOT(J)=CTOT(J)/1000.
   22         PRINT1,X(3),ANS(1),(CTOT(J),J=1,4),ANS(8),Z2,GEC(14),
             1 (CUMU(J),J=1,20)
    1         FORMAT(/* --GENERATOR ONLY...SIZE=*F11.3,* USES*F13.0,* UNITS FU*
             1 *EL/YR TO SATISFY DEMAND GOAL*/* --ANNUAL COST...TOTAL=*F9.0,
             2 * CAP=*F8.0,* OM=*F8.0,* FUEL=*F8.0,*  NO. USED=*F5.1,* EVERY *
             3 F5.2,* YEARS*/* --DEMAND NOT SATISFIED IN *F6.0,* HOURS*/
             4 /* --*30X,*GENERATOR CUMULANTS   100=FULL SCALE*/* --*20F6.1/)
              RETURN $ END
```

SYMBOLIC REFERENCE MAP (R=3)

ENTRY POINTS		DEF LINE	REFERENCES
1	GEONLY	1	33

VARIABLES		SN	TYPE		RELOCATION							
2	AMB		REAL		COMAMOR	REFS	4					
1	AMP		REAL		COMAMOR	REFS	4					
12	ANS		REAL	ARRAY	COMANSW	REFS	7	16	19	21	23	2*26
						DEFINED	2*11	16	19			
50	CC		REAL	ARRAY	COMCOMP	REFS	5					
44	CCM		REAL	ARRAY	COMANSW	REFS	7					
37	CTOT		REAL	ARRAY	COMANSW	REFS	7	25	26	DEFINED	25	
175	CUMU		REAL	ARRAY		REFS	1	20	3*22	23	26	
						DEFINED	10	20	22	23		
106	DETOT		REAL	ARRAY	COMCOMP	REFS	5					
7	DSPLR		REAL		COMCARD	REFS	2					
0	EF		REAL	ARRAY	COMCOMP	REFS	5					
167	EFG0		REAL			REFS	19	DEFINED	12			

```
       SUBROUTINE GEONLY      74/74    OPT=2                            FTN 4.8+518         80/11/28. 10.01.44       PAGE      2

  VARIABLES      SN  TYPE            RELOCATION
     170  EFG1       REAL                                 REFS         19     DEFINED       13
     171  EFG2       REAL                                 REFS         19     DEFINED       13
       0  ESD        REAL        ARRAY    COMLEV2         REFS          6         15        18
     113  GEC        REAL        ARRAY    COMCOMP         REFS          5       4*12      2*13        16        26
                                                       DEFINED          9         16        21        23
     173  GL         REAL                                 REFS       3*19         20   DEFINED        17        18
       1  IRUN       INTEGER              COMCARD         REFS          2
       2  ISBIG      INTEGER              COMCARD         REFS          2         24
       0  ITIT       INTEGER              COMCARD         REFS          2
     165  J          INTEGER                              REFS       2*10         11        15        18      3*22      2*23      2*25
                                                          2*26    DEFINED          9        10        15        21        22        24
                                                          2*26
       5  JGCO       INTEGER     ARRAY    COMCARD         REFS          2
     174  K          INTEGER                              REFS       2*20    DEFINED        20
      10  LCR        INTEGER     ARRAY    COMCARD         REFS          2
       0  LIFE       INTEGER              COMAMOR         REFS          4         23
       3  NOVAR      INTEGER              COMCARD         REFS          2
       4  NTYPE      INTEGER              COMCARD         REFS          2
       0  X          REAL        ARRAY    COMANSW         REFS          7         12      3*13        14        15        17        24
                                                            26    DEFINED         10        12        24
      24  XM         REAL        ARRAY    COMCOMP         REFS          5
     110  XRS        REAL        ARRAY    COMCOMP         REFS          5
     166  Z1         REAL                                 REFS         12       2*13        15        16      2*23
                                                       DEFINED         12         15        22
     172  Z2         REAL                                 REFS         20         26   DEFINED        14        23

  FILE NAMES          MODE
          OUTPUT     FMT                    WRITES        26

  EXTERNALS            TYPE    ARGS         REFERENCES
          COST       REAL        1              23

  STATEMENT LABELS                DEF LINE    REFERENCES
     115  1       FMT                28          26
       0  10          INACTIVE       16          15
      34  11                         17          15
      36  12                         18          15
      37  13                         19          17
       0  14                         21          15
       0  16                         10           9
       0  17                         11          10
       0  20                         22          21
       0  21                         23          22
      76  22                         26          24
       0  23                         25          24

  LOOPS   LABEL      INDEX       FROM-TO      LENGTH     PROPERTIES
      4   16         J             9 10          2B       INSTACK
      7   17         J            10 11          3B       INSTACK
     30   14         J            15 21         17B         OPT
     54   20         J            21 22          2B       INSTACK
     61   21         J            22 23          2B       INSTACK
     74   23         J            24 25          2B       INSTACK

  COMMON BLOCKS    LENGTH       MEMBERS - BIAS NAME(LENGTH)
          COMCARD     125                 0 ITIT     (1)                 1 IRUN    (1)                2 ISBIG   (1)
                                          3 NOVAR    (1)                 4 NTYPE   (1)                5 JGCO    (2)
```

```
COMMON BLOCKS  LENGTH     MEMBERS - BIAS NAME(LENGTH)
                              7 DSPLR  (1)          8 LCR   (117)
    COMAMOR        3          0 LIFE   (1)          1 AMP   (1)          2 AMB   (1)
    COMCOMP       95          0 EF     (20)        20 XM    (20)        40 CC    (30)
                             70 DETOT  (2)         72 XRS   (3)         75 GEC   (20)
    COMLEV2    17472          0 ESD    (17472)
    COMANSW       42          0 X      (10)        10 ANS   (21)        31 CTOT  (5)
                             36 CCM    (6)

STATISTICS
  PROGRAM LENGTH                 221B      145
  CM LABELED COMMON LENGTH     42511B    17737
       60000B CM USED
```

```
                 FUNCTION  COST(ZZZZZ)
      C .... CTOT(1)=TOTAL COST, 2=CAP COST, 3=OM COST, 4=FUEL COST
      C ....  5=EXCESS UNSATISFIED DEMAND.
      C .... CCM(1)=CAP COST COLL, 2=CAP COST STO, 3=CAP COST GEN,
      C ....  4=CAP COST POWC, 5=OVERHAUL COST, 6=TOTAL SATISFIED DEM.
             COMMON /COMCARD/ ITIT,IRUN,ISBIG,NOVAR,NTYPE,JGCO(2),DSPLR,
            1 LCR(9,13)
             COMMON /COMCOMP/ EF(20),XM(10,2),CC(10,3),DETOT(2),XRS(3),GEC(20)
             COMMON /COMAMOR/ LIFE,AMP,AMB
             COMMON /COMANSW/ X(10),ANS(21),CTOT(5),CCM(6)
             CCM(6)=0. $ DO 10 J=1,5
         10  CTOT(J)=CCM(J)=0. $ CTOT(4)=ANS(1)*GEC(2)*AMP
             IF(X(1).LE.0.)GO TO 11 $ Z1=CC(1,1)*(X(1)**CC(1,2))+CC(1,3)
             CALL AMORT(Z1,0,LIFE,1,CCM(1),CTOT(3))
         11  IF(X(4).LE.0.)GO TO 12
             Z1=CC(4,1)*((X(4)*EF(4))**CC(4,2))+CC(4,3)
             CALL AMORT(Z1,0,LIFE,1,CCM(4),Z2) $ CTOT(3)=CTOT(3)+Z2
      C .... BATTERY COST
         12  ANS(7)=0. $ IF(X(2).LE.0.)GO TO 20 $ P=ANS(2)*LIFE/XRS(3)
             Z1=CC(2,1)*((X(2)*EF(2))**CC(2,2))+CC(2,3) $ ANS(7)=1.
             CALL AMORT(Z1,0,LIFE,2,CCM(2),Z2) $ CTOT(3)=CTOT(3)+Z2
             IF(P.LE.1.)GO TO 20 $ ANS(7)=P $ M1=P $ M2=M1+1
             DO 14 M=M1,M2 $ Z3=0. $ Z4=M $ XNR=LIFE/Z4 $ Z8=Z1
             NR=MAX0(1,INT(XNR)) $ DO 13 J=1,M
             CALL AMORT(Z8,INT((J-1)*XNR),NR,2,Z4,Z5) $ Z8=Z1-CC(2,3)
         13  Z3=Z3+Z4 $ IF(M.EQ.M1)Z6=Z3
         14  CONTINUE $ CCM(2)=(Z3-Z6)*(P-M1)+Z6
      C ....  GENERATOR COST
         20  ANS(8)=ANS(9)=0. $ IF(X(3).LE.0.)GO TO 21
             P=AMAX1(1.,ANS(3)*LIFE/GEC(5)) $ ANS(8)=P $ ANS(9)=P*GEC(4)
             Z1=CC(3,1)*(X(3)*CC(3,2))+CC(3,3) $ NOV=GEC(4)
             CALL AMORT(Z1,0,LIFE,3,Z2,Z3) $ CTOT(3)=CTOT(3)+Z3
             M1=P $ Z2=M1 $ XNR=LIFE/Z2 $ NR=MAX0(1,INT(XNR))
             Z8=Z1 $ Z4=Z6=TM=0. $ DO 16 M=1,M1
             CALL AMORT(Z8,INT(TM),NR,3,Z2,Z7) $ Z4=Z4+Z2 $ Z8=Z1-CC(3,3)
             IF(NOV.LE.0)GO TO 16 $ DO 15 J=1,NOV $ TQ=TM+J*XNR/(NOV+1)
             CALL AMORT(Z1,INT(TQ),NR,0,Z2,Z7) $ Z6=Z6+Z7
         15  CONTINUE
         16  TM=TM+XNR $ Z5=Z6 $ Z3=Z4 $ IF(P.LE.1.)GO TO 19
             M2=M1+1 $ Z2=M2 $ XNR=LIFE/Z2 $ NR=MAX0(1,INT(XNR))
             Z8=Z1 $ Z3=Z5=TM=0. $ DO 18 M=1,M2
             CALL AMORT(Z8,INT(TM),NR,3,Z2,Z7) $ Z3=Z3+Z2 $ Z8=Z1-CC(3,3)
             IF(NOV.LE.0)GO TO 18 $ DO 17 J=1,NOV $ TQ=TM+J*XNR/(NOV+1)
             CALL AMORT(Z1,INT(TQ),NR,0,Z2,Z7) $ Z5=Z5+Z7
         17  CONTINUE
         18  TM=TM+XNR
         19  CCM(3)=(Z3-Z4)*(P-M1)+Z4 $ CCM(5)=(Z5-Z6)*(P-M1)+Z6
         21  CTOT(3)=CTOT(3)+CCM(5) $ CTOT(2)=CCM(1)+CCM(2)+CCM(3)+CCM(4)
             CTOT(1)=CTOT(2)+CTOT(3)+CTOT(4)
             CCM(6)=1.-ANS(5)/DETOT(1)
             CTOT(5)=1E6*DETOT(1)*AMAX1(0.,DSPLR-CCM(6))
             COST=CTOT(1)+CTOT(5) $ RETURN $ END
```

```
      SYMBOLIC REFERENCE MAP (R=3)

ENTRY POINTS      DEF LINE      REFERENCES
    4  COST              1         52

VARIABLES      SN  TYPE              RELOCATION
     2  AMB         REAL                      COMAMOR      REFS         9
     1  AMP         REAL                      COMAMOR      REFS         9         12
    12  ANS         REAL          ARRAY       COMANSW      REFS        10         12        19        30        50
                                                       DEFINED        19         20        22      2*29      2*30
    50  CC          REAL          ARRAY       COMCOMP      REFS         8       3*13      3*16      3*20        25      3*31        35
                                                             42
    44  CCM         REAL          ARRAY       COMANSW      REFS        10         14        17        21      5*48        51
                                                       DEFINED        11         12        27      2*47        50
   415  COST        REAL                               DEFINED        52
    37  CTOT        REAL          ARRAY       COMANSW      REFS        10         14        17        21        32        48      3*49
                                                           2*52  DEFINED       2*12        17        21        32      2*48        49
                                                             51
   106  DETOT       REAL          ARRAY       COMCOMP      REFS         8         50        51
     7  DSPLR       REAL                      COMCARD      REFS         6         51
     0  EF          REAL          ARRAY       COMCOMP      REFS         8         16        20
   113  GEC         REAL          ARRAY       COMCOMP      REFS         8         12      2*30        31
     1  IRUN        INTEGER                   COMCARD      REFS         6
     2  ISBIG       INTEGER                   COMCARD      REFS         6
     0  ITIT        INTEGER                   COMCARD      REFS         6
   416  J           INTEGER                                REFS      2*12         25        36        43   DEFINED        11        24
                                                             36        43
     5  JGCO        INTEGER       ARRAY       COMCARD      REFS         6
    10  LCR         INTEGER       ARRAY       COMCARD      REFS         6
     0  LIFE        INTEGER                   COMAMOR      REFS         9         14        17        19        21        23        30
                                                             32        33        40
   424  M           INTEGER                                REFS        23         24        26   DEFINED        23        34        41
   422  M1          INTEGER                                REFS        22         23        26        27        33        34        40
                                                           2*47  DEFINED         22        33
   423  M2          INTEGER                                REFS        23         40        41   DEFINED        22        40
   434  NOV         INTEGER                                REFS      3*36       3*43   DEFINED        31
     3  NOVAR       INTEGER                   COMCARD      REFS         6
   431  NR          INTEGER                                REFS        25         35        37        42        44
                                                       DEFINED        24         33        40
     4  NTYPE       INTEGER                   COMCARD      REFS         6
   421  P           REAL                                   REFS      3*22         27      2*30        33        39      2*47
                                                       DEFINED        19         30
   435  TM          REAL                                   REFS        35         36        39        42        43        46
                                                       DEFINED        34         39        41        46
   437  TQ          REAL                                   REFS        37         44   DEFINED        36        43
     0  X           REAL          ARRAY       COMANSW      REFS        10       2*13        15        16        19        20        29
                                                             31
    24  XM          REAL          ARRAY       COMCOMP      REFS         8
   427  XNR         REAL                                   REFS        24         25        33        36        39        40        43
                                                             46  DEFINED         23        33        40
   110  XRS         REAL          ARRAY       COMCOMP      REFS         8         19
     0  ZZZZZ       REAL         *UNUSED      F.P.     DEFINED         1
   417  Z1          REAL                                   REFS        14         17        21        23        25        32        34
                                                             35        37         41        42        44   DEFINED        13        16
                                                             20        31
   420  Z2          REAL                                   REFS      2*17       2*21        32        33      2*35        37        40
```

```
        FUNCTION COST       74/74   OPT=2                          FTN 4.8+518        80/11/28. 10.01.44      PAGE      3

 VARIABLES     SN  TYPE            RELOCATION
                                                   2*42       44    DEFINED       33        40
   425  Z3          REAL                           REFS       2*26        27      2*32        42        47
                                                DEFINED       23          26        39        41        42
   426  Z4          REAL                           REFS       23          25        26        35        39      2*47
                                                DEFINED       23          34        35
   432  Z5          REAL                           REFS       25          44        47   DEFINED        39        41        44
   433  Z6          REAL                           REFS       2*27        37        39      2*47   DEFINED        26        34
                                                     37
   436  Z7          REAL                           REFS       35        2*37        42      2*44
   430  Z8          REAL                           REFS       25          35        42   DEFINED        23        25        34
                                                     35       41          42

 EXTERNALS          TYPE    ARGS         REFERENCES
        AMORT                6                   14         17         21        25        32        35        37        42        44

 INLINE FUNCTIONS   TYPE    ARGS          DEF LINE  REFERENCES
        AMAX1       REAL      0  INTRIN                    30         51
        INT         INTEGER   1  INTRIN                    24         25         33        35        37        40        42        44
        MAXO        INTEGER   0  INTRIN                    24         33         40

 STATEMENT LABELS              DEF LINE    REFERENCES
     0  10                         12         11
    24  11                         15         13
    36  12                         19         15
     0  13                         26         24
     0  14                         27         23
     0  15                         38         36
   211  16                         39         34         36
     0  17                         45         43
   265  18                         46         41         43
   272  19                         47         39
   125  20                         29         19         22
   302  21                         48         29

 LOOPS  LABEL    INDEX       FROM-TO     LENGTH    PROPERTIES
    10  10       J            11 12         3B      INSTACK
    64  14       M            23 27        34B               EXT REFS  NOT INNER
    76  13       J            24 26        14B               EXT REFS
   163  16       M            34 39        33B               EXT REFS  NOT INNER
   176  15       J            36 38        13B               EXT REFS
   237  18       M            41 46        33B               EXT REFS  NOT INNER
   252  17       J            43 45        13B               EXT REFS

 COMMON BLOCKS   LENGTH      MEMBERS - BIAS NAME(LENGTH)
        COMCARD     125                    0 ITIT    (1)                  1 IRUN    (1)                  2 ISBIG  (1)
                                           3 NOVAR   (1)                  4 NTYPE   (1)                  5 JGCO   (2)
                                           7 DSPLR   (1)                  8 LCR     (117)
        COMCOMP      95                    0 EF      (20)                20 XM      (20)                40 CC     (30)
                                          70 DETOT   (2)                 72 XRS     (3)                 75 GEC    (20)
        COMAMOR       3                    0 LIFE    (1)                  1 AMP     (1)                  2 AMB    (1)
        COMANSW      42                    0 X       (10)                10 ANS     (21)                31 CTOT   (5)
                                          36 CCM     (6)

 STATISTICS
   PROGRAM LENGTH                  440B       288
   CM LABELED COMMON LENGTH        411B       265
          60000B CM USED
```

```
                 SUBROUTINE PREDIC(J1)
                 DIMENSION IOP(2),T(365),Y(365),X(16),F(32),WK(1888)
                 COMMON /COMLEV2/ ESD(2,24,364)
                 DATA MU/77777777770000000000B/, ML/7777777777B/
                 DATA IOP/4,4/, NK/16/
                 IF(J1-1)10,15,22
       C ....      NO PREDICTION
        10       DO 11 K=1,364 $ DO 11 J=1,24 $ DO 11 I=1,2
        11       ESD(I,J,K)=(ESD(I,J,K).A.MU).O.(SHIFT(ESD(I,J,K),-30).A.ML)
                 RETURN
       C ...       SPLINE PREDICTION.
        15       DL=364./(NK-1) $ X(1)=.9999 $ DO 16 J=2,NK
        16       X(J)=(J-1)*DL+1. $ X(NK)=365. $ DO 17 J=1,365
        17       T(J)=J $ DO 21 I=1,2 $ DO 21 J=1,24 $ DO 18 K=1,364
        18       Y(K)=ESD(I,J,K).A.MU $ Y(365)=Y(1)
                 CALL SMOLSW(365,2*NK,IOP,T,X,Y,F,WK)
                 L=1 $ X1=X(1) $ F1=F(NK+1) $ F21=F(1) $ DO 21 K=1,364
        19       IF(T(K).LE.X1)GO TO 20 $ X0=X1 $ F0=F1 $ F20=F21 $ L=L+1
                 X1=X(L) $ F1=F(NK+L) $ F21=F(L) $ A2=F20/2.
                 A3=(F21-F20)/6./(X1-X0)
                 A1=(F1-F0)/(X1-X0)-(X1-X0)*(A2+A3*(X1-X0)) $ GO TO 19
        20       Z1=T(K)-X0 $ Z1=AMAX1(.001,((A3*Z1+A2)*Z1+A1)*Z1+F0)
                 IF(Y(K).LE.0.)Z1=0.
                 ESD(I,J,K)=(Y(K).A.MU).O.(SHIFT(Z1,-30).A.ML)
        21       CONTINUE $ RETURN
       C ....      OTHER PREDICTIONS.
       C22       PRINT2,J1 $ CALL EXIT
         2       FORMAT(* DISALLOWED PREDICTION *I4)
       C ....      AVERAGE AT EACH HOUR.
        22       DO 24 J=1,24 $ DO 24 I=1,2 $ Z2=Z3=0. $ DO 23 K=1,364
                 Z1=ESD(I,J,K).A.MU $ IF(Z1.LE.0.)GO TO 23 $ Z2=Z2+Z1 $ Z3=Z3+1.
        23       CONTINUE $ Z2=AMAX1(.001,Z2/AMAX1(Z3,1.)) $ PRINT3,J,I,Z2
         3       FORMAT(1X,2I4,F10.5)
                 DO 24 K=1,24 $ Z1=ESD(I,J,K).A.MU $ Z3=Z2
                 IF(Z1.LE.0.)Z3=0. $ ESD(I,J,K)=Z1.O.SHIFT(Z3.A.MU,-30)
        24       CONTINUE $ RETURN
                 END
```

SYMBOLIC REFERENCE MAP (R=3)

ENTRY POINTS		DEF LINE	REFERENCES		
3	PREDIC	1	10	25	36

VARIABLES		SN	TYPE	RELOCATION							
311	A1		REAL			REFS	22	DEFINED	21		
307	A2		REAL			REFS	21	22	DEFINED	19	
310	A3		REAL			REFS	21	22	DEFINED	20	
277	DL		REAL			REFS	13	DEFINED	12		
0	ESD		REAL	ARRAY	COMLEV2	REFS	3	2*9	15	31	34
						DEFINED	9	24	35		
1671	F		REAL	ARRAY		REFS	2	16	2*17	2*19	
305	F0		REAL			REFS	21	22	DEFINED	18	
302	F1		REAL			REFS	18	21	DEFINED	17	19

```
VARIABLES       SN  TYPE            RELOCATION
    306  F20        REAL                              REFS       19        20    DEFINED     18
    303  F21        REAL                              REFS       18        20    DEFINED     17        19
    276  I          INTEGER                           REFS       3*9       15       24       31        32        34        35
                                                   DEFINED        8        14       30
    315  IOP        INTEGER    ARRAY                  REFS        2        16    DEFINED      5
    275  J          INTEGER                           REFS       3*9      2*13     2*14      15        24        31        32
                                                        34       35    DEFINED      8        12        13        14        30
      0  J1         INTEGER             F.P.          REFS        6    DEFINED      1
    274  K          INTEGER                           REFS       3*9      2*15      18       22        23       2*24       31
                                                        34       35    DEFINED      8        14        17        30        34
    300  L          INTEGER                           REFS       18       3*19   DEFINED     17        18
    243  ML         INTEGER                           REFS        9        24    DEFINED      4
    242  MU         INTEGER                           REFS        9        15       24       31        34        35
                                                   DEFINED        4
    244  NK         INTEGER                           REFS      2*12       13       16       17        19
                                                   DEFINED        5
    317  T          REAL       ARRAY                  REFS        2        16       18       22    DEFINED       14
   1731  WK         REAL       ARRAY                  REFS        2        16
   1651  X          REAL       ARRAY                  REFS        2        16       17       19    DEFINED       12       2*13
    304  X0         REAL                              REFS       20       3*21      22    DEFINED     18
    301  X1         REAL                              REFS      2*18       20     3*21   DEFINED     17        19
   1074  Y          REAL       ARRAY                  REFS        2        15       16       23        24
                                                   DEFINED      2*15
    312  Z1         REAL                              REFS      3*22       24     2*31     2*35    DEFINED      2*22       23
                                                        31       34
    313  Z2         REAL                              REFS       31       2*32      34    DEFINED     30        31        32
    314  Z3         REAL                              REFS       31        32       35    DEFINED     30        31        34
                                                        35

FILE NAMES        MODE
         OUTPUT   FMT                       WRITES     32

EXTERNALS            TYPE    ARGS        REFERENCES
         SMOLSW                8             16

INLINE FUNCTIONS     TYPE    ARGS        DEF LINE  REFERENCES
         AMAX1    REAL         0  INTRIN              22        2*32
         SHIFT    NO TYPE      2  INTRIN               9         24        35

STATEMENT LABELS              DEF LINE   REFERENCES
    245  2          FMT  NO REFS    28
    260  3          FMT             33        32
      0  10             INACTIVE     8         6
      0  11                          9        3*8
     33  15                         12         6
      0  16                         13        12
      0  17                         14        13
      0  18                         15        14
    105  19                         18        21
    125  20                         22        18
      0  21                         25       2*14       17
    153  22                         30         6
    171  23                         32        30        31
      0  24                         36       2*30       34
```

LOOPS	LABEL	INDEX	FROM-TO	LENGTH	PROPERTIES	
15	11	K	8 9	16B		NOT INNER
20	11	J	8 9	5B		NOT INNER
21	11	I	8 9	3B	INSTACK	
41	16	J	12 13	4B	INSTACK	
50	17	J	13 14	3B	INSTACK	
55	21	I	14 25	75B		EXT REFS NOT INNER
60	21	J	14 25	70B		EXT REFS NOT INNER
63	18	K	14 15	2B	INSTACK	
102	21	K	17 25	42B	OPT	
156	24	J	30 36	46B		EXT REFS NOT INNER
162	24	I	30 36	35B		EXT REFS NOT INNER
166	23	K	30 32	5B	INSTACK	
205	24	K	34 36	4B	INSTACK	

COMMON BLOCKS	LENGTH	MEMBERS - BIAS	NAME(LENGTH)
COMLEV2	17472	0	ESD (17472)

STATISTICS

PROGRAM LENGTH	5471B	2873
CM LABELED COMMON LENGTH	42100B	17472
60000B CM USED		

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C
C
C                 SOLSTOR - GE11 - GENLIB2 LIBRARY.
C
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```
      SUBROUTINE PROUT $ DIMENSION P(20)
      COMMON /COMOCUM/ OCU(20,4)
      COMMON /COMCARD/ ITIT,IRUN,ISBIG,NOVAR,NTYPE,JGCO(2),DSPLR,
     1 LCR(9,13)
      COMMON /COMCOMP/ EF(20),XM(10,2),CC(10,3),DETOT(2),XRS(3),GEC(20)
      COMMON /COMANSW/ X(10),ANS(21),CTOT(5),CCM(6)
      COMMON /COMAMOR/ LIFE,AMP,AMB
      COMMON /COMLEV2/ ESD(2,8736)
      COMMON /COMWIND/ W(8),ISWND
      PRINT1,ITIT,IRUN,DSPLR $ IF(CCM(6).LT.DSPLR)PRINT2
      J=W(7) $ IF(ISWND.NE.0)PRINT16,W(8),J
   16 FORMAT(* --DIAMETER=*F9.2,* METERS.  SIZE OF THE WIND TURBINE *
     1*IS FOR A SINGLE TURBINE.*/31X,*COSTS AND I-O RESULTS ARE FOR *
     2I2,* SETS OF IDENTICAL TURBINES.*)
    1 FORMAT(*1STAND-ALONE OPTIMUM  RUN(*A10,*-*I3*)  DEMAND SATISFAC*
     1 *TION GOAL IS *F6.4,* OF TOTAL.*)
    2 FORMAT(8H ********GOAL IS NOT SATISFIED*7H*******)
      PRINT3,(LCR(J,1),J=1,9)
    3 FORMAT(* (*7(A10,*/*),A10,*)*A1)
      Z1=DETOT(1)/1000. $ J1=1HK $ J2=J3=1H  $ J4=1HM $ Z2=ANS(6)
      IF(ISBIG.EQ.0)GO TO 30 $ Z1=Z1/1000. $ Z2=Z2/1000.
      J1=1HM $ J2=1HK $ J3=2HK- $ J4=1HG
   30 PRINT4,J1,J1,J2,J1,J3,JGCO(1),JGCO(2),ANS(1),Z1,J4,Z2,CCM(6),
     1 ANS(10)
    4 FORMAT(* --SIZES IN *A1,*WH, *A1,*W, OR *A1,*(M-SQ).  ENERGY IN *
     1 A1,*WH, EXCEPT AS NOTED.  COSTS IN *A2,*DOLLARS.*/
     2 * --GENERATOR FUEL IS *2A10,*.  ANNUAL FUEL USED IS *F14.0/
     3 * --TOTAL DEMAND =*F12.3,A1,*WH.  PEAK DEMAND SATISFIED=*F12.3,
     4 *.  SATISFIED DEMAND IS *F6.4,* OF TOTAL.*/
     5 * --DEMAND IS NOT SATISFIED IN *F6.0,* HOURS OF YEAR*)
      PRINT5 $ DO 36 I=1,4 $ JF=2H-V $ IF(XM(I,1).EQ.XM(I,2))JF=2H-F
    5 FORMAT(/26X,*SIZE       MAX SIZE      COST*8X,*AVG IN       AVG *
     1 *OUT      MAX OUT*)
      Z1=X(I) $ Z2=XM(I,2) $ Z3=CCM(I) $ L=I+5 $ GO TO (31,32,33,34),I
   31 Z4=ANS(21)/8736 $ Z5=ANS(11)/EF(5)/8736
      Z6=ANS(17)/EF(5) $ GO TO 35
   32 Z4=EF(7)*(ANS(13)+EF(3)*ANS(14))/8736 $ Z5=ANS(20)/8736
      Z6=ANS(18) $ GO TO 35
   33 Z4=0. $ Z5=(ANS(14)+ANS(15))/8736 $ Z6=ANS(19) $ GO TO 35
   34 L=10 $ Z2=X(4) $ Z4=(EF(6)*ANS(12)+EF(8)*ANS(20))/8736
      Z5=EF(4)*Z4 $ Z6=EF(4)*Z2 $ JF=1H
   35 DECODE(20,6,LCR(1,L))(P(J),J=1,3) $ IF(ISBIG.EQ.0)GO TO 36
      Z1=Z1/1000. $ Z2=Z2/1000. $ Z3=Z3/1000.
      Z4=Z4/1000. $ Z5=Z5/1000. $ Z6=Z6/1000.
   36 PRINT7,(P(J),J=1,3),JF,Z1,Z2,Z3,Z4,Z5,Z6
    6 FORMAT(A2,A4,A8,6X)
    7 FORMAT(1X,A2,*/*A4,*/*A8,*/ *A2,2F12.3,F12.0,3F12.3)
      IF(NOVAR.LE.0)GO TO 38 $ DO 37 J=1,NOVAR $ L=J+4
      JF=2H-V $ IF(XM(L,1).EQ.XM(L,2))JF=2H-F
   37 PRINT13,J,JF,X(L),XM(L,2),XM(L,1)
   13 FORMAT(1X,I2,16X,A2,2F12.3,* MIN=*F12.3)
   38 Z1=CTOT(1)/GEC(13) $ PRINT14,Z1
   14 FORMAT(/* LIFE CYCLE COST RATIO=*F7.3)
      DS=CCM(6)*DETOT(1) $ DO 39 J=1,4
   39 P(J)=CTOT(J) $ P(5)=P(1)/DS
      P(6)=0. $ Z1=DS-ANS(15) $ IF(Z1.GT.0.)P(6)=(P(2)+P(3))/Z1
      P(7)=0. $ Z1=ANS(14)+ANS(15) $ IF(Z1.GT.0.)P(7)=P(4)/Z1
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              P(8)=P(5)*AMB $ P(9)=P(6)*AMB $ P(10)=P(7)*AMB
              IF(ISBIG.EQ.0)GO TO 41 $ DO 40 J=1,4
        40    P(J)=P(J)/1000.
        41    PRINT8,(P(J),J=1,10) $ J1=1HM $ Z1=1000.
        8     FORMAT(/19X,*TOTAL*5X,*CAPITAL*8X,*OM*8X,*FUEL*/* ANNUAL COST   *
             1 4F12.0/* LEVEL COST    *2F12.3,12X,F12.3/* INIT LEV COST *
             2 2F12.3,12X,F12.3)
              P(1)=ANS(11) $ P(2)=ANS(12) $ P(3)=ANS(13) $ P(4)=P(1)-P(2)-P(3)
              P(5)=P(6)=ANS(20) $ P(7)=P(12)=0. $ P(8)=(1.-EF(2))*ANS(16)
              P(9)=ANS(14)+ANS(15) $ P(10)=ANS(15) $ P(11)=ANS(14)
              IF(ISBIG.EQ.0)GO TO 43 $ J1=1HG $ Z1=1000000. $ DO 42 J=1,12
        42    P(J)=P(J)/Z1
        43    PRINT9,J1,(P(J),J=1,12)
        9     FORMAT(/* TOTAL-*A1,*WH   NET OUTPUT  TO DEMAND    TO STORE  *
             1 *     WASTE*/* COLLECTOR  *4F12.1/* STORAGE    *4F12.1/
             2 * GENERATOR  *4F12.1)
              Z1=Z3=Z4=0. $ IF(ANS(7).GT.0.)Z1=LIFE/ANS(7) $ Z2=ANS(16)/8736
              DO 15 J=1,8736 $ Z5=ESD(2,J).A.77777777770000000000B
        15    Z4=Z4+AMIN1(Z5,X(3)) $ Z4=Z4/DETOT(1)
              IF(ANS(8).GT.0.)Z3=LIFE/ANS(8) $ IF(ISBIG.NE.0)Z2=Z2/1000.
              PRINT10,ANS(7),Z1,ANS(2),Z2,ANS(8),Z3,ANS(9),ANS(4),ANS(3),Z4
        10    FORMAT(/12X,*NO. PURCH INTERVAL(YR) STO CYC/YR  AVG LEVEL*/
             1 * STORAGE   *F9.2,F13.2,2F12.2/36X,* NO. OVH    NO. STARTS  *
             3 * HOURS/YR DSIZE*/* GENERATOR *F9.2,F13.2,F12.1,2F12.0,F7.4)
              Z1=100.*(DS-ANS(15)-ANS(14))/DS $ Z2=100.-Z1 $ Z3=0.
              IF(ANS(21).GT.0.)Z3=Z1*DS/ANS(21)
              Z5=100.*EF(4)*EF(8)*ANS(20)/DS
              Z4=100.*(1.-ANS(15)/DS)-Z5
              Z6=100.*EF(8)*ANS(20)/(ANS(13)+ANS(14))
              PRINT11,Z1,Z2,Z3,Z4,Z5,Z6
        11    FORMAT(/4X,*PDD    PDG    PSE    PDC    PDS    AES*/1X,6F7.2)
              PRINT12,((OCU(I,J),I=1,20),J=1,2)
        12    FORMAT(/20X,*CUMULANTS  100=FULL SCALE*/* ST *20F6.1/* GE *
             1 20F6.1)
              RETURN $ END
```

SYMBOLIC REFERENCE MAP (R=3)

```
ENTRY POINTS      DEF LINE      REFERENCES
   1  PROUT           1             92

VARIABLES      SN  TYPE             RELOCATION
    2  AMB         REAL                   COMAMOR     REFS       7      3*58
    1  AMP         REAL                   COMAMOR     REFS       7
   12  ANS         REAL         ARRAY     COMANSW     REFS       6        20      2*23      2*35       36      3*37      38
                                                          3*39    2*40        56      2*57      3*65     2*66      4*67    3*74
                                                          2*77    6*78      2*82      2*83        84       85      3*86
   50  CC          REAL         ARRAY     COMCOMP     REFS       5
   44  CCM         REAL         ARRAY     COMANSW     REFS       6        10        23        34       54
   37  CTOT        REAL         ARRAY     COMANSW     REFS       6        52        55
  106  DETOT       REAL         ARRAY     COMCOMP     REFS       5        20        54        76
 1025  DS          REAL                               REFS      55        56      2*82        83       84        85
                                                       DEFINED  54
```

```
 VARIABLES       SN  TYPE           RELOCATION
      7  DSPLR       REAL              COMCARD     REFS          3          2*10
      0  EF          REAL      ARRAY   COMCOMP     REFS          5            35         36         2*37       2*40       2*41         66
                                                   2*84         86
      0  ESD         REAL      ARRAY   COMLEV2     REFS          8            75
    113  GEC         REAL      ARRAY   COMCOMP     REFS          5            52
   1016  I           INTEGER                       REFS       2*31          5*34         89      DEFINED         31         89
      1  IRUN        INTEGER           COMCARD     REFS          3            10
      2  ISBIG       INTEGER           COMCARD     REFS          3            21         42           59         68         77
     10  ISWND       INTEGER           COMWIND     REFS          9            11
      0  ITIT        INTEGER           COMCARD     REFS          3            10
   1007  J           INTEGER                       REFS         11            18         42           45         48         50       2*55
                                                   2*60         61          2*69         70           75         89
                                                 DEFINED        11            18         42           45         48         54         59
                                                     61         68            70         75           89
   1017  JF          INTEGER                       REFS         45            50    DEFINED         2*31         41       2*49
      5  JGCO        INTEGER   ARRAY   COMCARD     REFS          3          2*23
   1011  J1          INTEGER                       REFS       3*23            70    DEFINED           20         22         61         68
   1012  J2          INTEGER                       REFS         23       DEFINED         20           22
   1013  J3          INTEGER                       REFS         23       DEFINED         20           22
   1014  J4          INTEGER                       REFS         23       DEFINED         20           22
   1021  L           INTEGER                       REFS         42          2*49       3*50      DEFINED         34         40         48
     10  LCR         INTEGER   ARRAY   COMCARD     REFS          3            18         42
      0  LIFE        INTEGER           COMAMOR     REFS          7            74         77
      3  NOVAR       INTEGER           COMCARD     REFS          3          2*48
      4  NTYPE       INTEGER           COMCARD     REFS          3
      0  OCU         REAL      ARRAY   COMOCUM     REFS          2            89
   1026  P           REAL      ARRAY               REFS          1            45         55         2*56         57       3*58         60
                                                     61       3*65            69         70      DEFINED         42       2*55       2*56
                                                   2*57       3*58            60       4*65         5*66       3*67         69
      0  W           REAL      ARRAY   COMWIND     REFS          9          2*11
      0  X           REAL      ARRAY   COMANSW     REFS          6            34         40           50         76
     24  XM          REAL      ARRAY   COMCOMP     REFS          5          2*31         34         2*49       2*50
    110  XRS         REAL      ARRAY   COMCOMP     REFS          5
   1010  Z1          REAL                          REFS         21            23         43           45         52       2*56       2*57
                                                     69         78            82         83           87    DEFINED         20         21
                                                     34         43            52         56           57         61         68       2*74
                                                     82
   1015  Z2          REAL                          REFS         21            23         41           43         45         77         78
                                                     87    DEFINED            20         21           34         40         43         74
                                                     77         82
   1020  Z3          REAL                          REFS         43            45         78           87    DEFINED         34         43
                                                     74         77            82         83
   1022  Z4          REAL                          REFS         41            44         45         2*76         78         87
                                                 DEFINED        35            37         39           40         44         74       2*76
                                                     85
   1023  Z5          REAL                          REFS         44            45         76           85         87
                                                 DEFINED        35            37         39           41         44         75         84
   1024  Z6          REAL                          REFS         44            45         87      DEFINED         36         38         39
                                                     41         44            86

 FILE NAMES         MODE
       OUTPUT       FMT                     WRITES       2*10         11            18         23           31         45         50         52
                                                61         70         78            87         89

 INLINE FUNCTIONS    TYPE    ARGS         DEF LINE   REFERENCES
       AMIN1         REAL      0   INTRIN               76
```

```
STATEMENT LABELS                 DEF LINE   REFERENCES
   407  1        FMT                15         10
   423  2        FMT                17         10
   435  3        FMT                19         18
   462  4        FMT                25         23
   532  5        FMT                32         31
   563  6        FMT                46         42
   566  7        FMT                47         45
   627  8        FMT                62         61
   654  9        FMT                71         70
   711  10       FMT                79         78
   746  11       FMT                88         87
   761  12       FMT                90         89
   605  13       FMT                51         50
   616  14       FMT                53         52
     0  15                          76         75
   365  16       FMT                12         11
    36  30                          23         21
    66  31                          35         34
    74  32                          37         34
   104  33                          39         34
   112  34                          40         34
   124  35                          42         36         38         39
   141  36                          45         31         42
     0  37                          50         48
   172  38                          52         48
     0  39                          55         54
     0  40                          60         59
   232  41                          61         59
     0  42                          69         68
   263  43                          70         68

LOOPS  LABEL    INDEX      FROM-TO      LENGTH     PROPERTIES
   43  36       I           31 45        103B                EXT REFS
  152  37       J           48 50         20B                EXT REFS
  201  39       J           54 55          3B       INSTACK
  230  40       J           59 60          2B       INSTACK
  261  42       J           68 69          2B       INSTACK
  300  15       J           75 76          4B       INSTACK

COMMON BLOCKS   LENGTH      MEMBERS - BIAS NAME(LENGTH)
       COMOCUM     80                 0 OCU     (80)
       COMCARD    125                 0 ITIT    (1)             1 IRUN    (1)             2 ISBI[illegible]  (1)
                                      3 NOVAR   (1)             4 NTYPE   (1)             5 JGCO    (2)
                                      7 DSPLR   (1)             8 LCR     (117)
       COMCOMP     95                 0 EF      (20)           20 XM      (20)           40 CC      (30)
                                     70 DETOT   (2)            72 XRS     (3)            75 GEC     (20)
       COMANSW     42                 0 X       (10)           10 ANS     (21)           31 CTOT    (5)
                                     36 CCM     (6)
       COMAMOR      3                 0 LIFE    (1)             1 AMP     (1)             2 AMB     (1)
       COMLEV2  17472                 0 ESD     (17472)
       COMWIND      9                 0 W       (8)             8 ISWND   (1)

STATISTICS
  PROGRAM LENGTH                  1052B       554
  CM LABELED COMMON LENGTH       42642B     17826
        60000B CM USED
```

```
      FUNCTION  GE11AF(XXXX)
      DIMENSION XXXX(10),SAV(8,24),B5(4,48),XOL(10),JXOL(10)
      COMMON /COMWIND/ W(8),ISWND
      COMMON /COMGE11/ NITER,NH,IND
      COMMON /COMOCUM/ OCU(20,4)
      COMMON /COMCOMP/ EF(20),XM(10,2),CC(10,3),DETOT(2),XRS(3),GEC(20)
      COMMON /COMANSW/ X(10),ANS(21),CTOT(5),CCM(6)
      COMMON /COMGEON/ LGON(52)
      COMMON /COMSUDE/ SUDE(24,4)
      COMMON /COMSXOL/ ISXOL
      DATA XOL/10(-1.)/, ZERO/0./
      NITER=NITER+1 $ DO 10 J=1,21
   10 ANS(J)=0. $ DO 11 J=1,10
   11 X(J)=XXXX(J) $ KGG=0 $ X2L=X(5)*X(2)
      X2U=(X(5)+X(6)-X(5)*X(6))*X(2)
      EST=.5*X(2) $ X7=XRS(1)*X(2) $ X8=XRS(2)*X(2)
      E46=EF(4)*EF(6) $ E48=EF(4)*EF(8) $ E37=EF(3)*EF(7)
      X7E3=X7/EF(3) $ E15X=EF(1)*EF(5)*X(1) $ E7X7=EF(7)*X7
      IF(X(3).GT.0.)GO TO 13 $ X2U=-999999. $ GO TO 14
   13 Z1=GEC(6)+X(3)*GEC(7) $ EFG0=Z1*GEC(8)
      EFG1=Z1*GEC(9)/X(3) $ EFG2=Z1*GEC(10)/X(3)/X(3)
   14 CALL GETSD(1) $ IF(ISWND.EQ.0)GO TO 16
      IF(NH.' '.2)GO TO 80 $ PRINT1 $ CALL EXIT
    1 FORMAT(* PREDICTION NOT ALLOWED WITH WIND*)
   80 DIA=SQRT(25?.7*X(1)/W(3)/(W(5)+W(4))**3) $ E15X=W(7)*E15X
      QHT=((15.2+.5*DIA)/W(2))**0.142857 $ DO 81 J=1,24
      B5(3,J)=SUDE(J,3) $ B5(1,J)=0. $ Z3=QHT*SUDE(J)-W(4)
      IF(Z3.LT.W(6))B5(1,J)=E15X*AMAX1(0.,AMIN1(1.,Z3/W(5)))
   81 CONTINUE $ W(8)=DIA $ GO TO 17
   16 DO 12 J=1,24 $ DO 12 I=3,4
      B5(I-2,J)=E15X*SUDE(J,I-2)
   12 B5(I,J)=SUDE(J,I) $ X(4)=0.
   17 IF(IND.EQ.0)GO TO 20 $ WRITE(9)(X(J),J=1,10) $ CU1=CU2=0.
      IF(X(2).GT.0.)CU1=19.9999/X(2) $ IF(X(3).GT.0.)CU2=19.999/X(3)
      DO 15 J=1,2 $ DO 15 I=1,20
   15 OCU(I,J)=0.
      IF(ISWND.NE.0)QW1=0.00385159*W(7)*W(3)*DIA*DIA*(QHT**3)
C ....  MAIN LOOP.
   20 DO 60 NWK=1,52 $ LGO=LGON(NWK) $ ND2=7*NWK $ ND1=ND2-6
      DO 59 ND=ND1,ND2 $ CALL GETSD(ND+1) $ IF(ISWND.EQ.0)GO TO 18
      DO 82 J=1,24 $ B5(3,J+24)=SUDE(J,3) $ B5(1,J+24)=0.
      IF(IND.EQ.1)ANS(21)=ANS(21)+QW1*(SUDE(J)**3)
      Z3=QHT*SUDE(J)-W(4)
      IF(Z3.LT.W(6))B5(1,J+24)=E15X*AMAX1(0.,AMIN1(1.,Z3/W(5)))
   82 CONTINUE $ GO TO 19
   18 DO 21 I=1,24 $ DO 21 J=1,2 $ B5(J+2,I+24)=SUDE(I,J+2)
   21 B5(J,I+24)=SUDE(I,J)*E15X
   19 DO 50 I=1,24 $ B5(2)=B5(1) $ B5(4)=B5(3)
      EES=EF(2)*EST $ IF(EES.GT.X2U)GO TO 37
      IF(EES.LT.X2L.O.I.LE.LGO)GO TO 33 $ IF(NH.GT.0)GO TO 22
      IF(X(2).LE.0.)GO TO 22
C ....  MAINTAIN STATUS.
      IF(KGG.EQ.0)GO TO 37 $ GRM=X(3) $ GO TO 34
C ....  TEST FOR NH=1
   22 AD=AMIN1(B5(3)/E46,B5(1)) $ DUNS=B5(3)-E46*AD
      Z1=B5(1)-AD $ IF(Z1.GT.0.)GO TO 23 $ ADS=AMIN1(DUNS/E48,X8,EES)
      AS=0. $ EST=EES-ADS $ DUNS=DUNS-E48*ADS $ GO TO 24
```

```
   23   ADS=0. $ AS=AMIN1(Z1,X7,(X(2)-EES)/EF(7)) $ EST=EES+EF(7)*AS
   24   IF(DUNS.GT..0001)GO TO 33 $ IF(NH.GT.1)GO TO 26
C .... SHUT OFF (OR LEAVE OFF)
   25   KGG=0 $ GS=GD=GDS=0. $ GO TO 40
C .... TEST FOR NH .GT. 1
   26   TST=EST $ DO 29 K=2,NH $ TES=EF(2)*TST
        TD=AMIN1(B5(4,K)/E46,B5(2,K)) $ TUNS=B5(4,K)-E46*TD
        Z1=B5(2,K)-TD $ IF(Z1.GT.0.)GO TO 27 $ TDS=AMIN1(TUNS/E48,X8,TES)
        TST=TES-TDS $ TUNS=TUNS-E48*TDS $ GO TO 28
   27   TST=TES+AMIN1(EF(7)*Z1,E7X7,X(2)-TES)
   28   IF(TUNS.GT..0001)GO TO 33
   29   CONTINUE $ GO TO 25
C ....  TURN ON (OR LEAVE ON) GENERATOR.
   33   GRM=X(3) $ IF(KGG.EQ.1)GO TO 34
        GRM=GRM*GEC(1) $ ANS(4)=ANS(4)+1. $ KGG=1
   34   ANS(3)=ANS(3)+1. $ AD=AMIN1(B5(3)/E46,B5(1)) $ DUNS=B5(3)-E46*AD
        Z1=B5(1)-AD $ IF(Z1.GT.0.)GO TO 35 $ GD=AMIN1(GRM,DUNS)
        DUNS=DUNS-GD $ AS=ADS=GS=0. $ Z2=GRM-GD $ IF(Z2.LE.0.)GO TO 41
        GS=AMIN1(Z2,X7E3,(X(2)-EES)/E37) $ EST=EES+E37*GS $ GO TO 36
   41   ADS=AMIN1(DUNS/E48,EES) $ DUNS=DUNS-E48*ADS
        EST=EES-ADS $ GO TO 36
   35   ADS=GD=0. $ AS=AMIN1(Z1,X7,(X(2)-EES)/EF(7))
        GS=AMIN1(GRM,(X7-AS)/EF(3),(X(2)-(EES+EF(7)*AS))/E37)
        EST=(EES+EF(7)*AS)+E37*GS
   36   GDS=GD+GS
        ANS(1)=ANS(1)+GDS/((EFG2*GDS+EFG1)*GDS+EFG0)
        GO TO 40
C ....  GENERATOR OFF.
   37   KGG=0 $ GS=GD=GDS=0. $ AD=AMIN1(B5(3)/E46,B5(1))
        DUNS=B5(3)-E46*AD $ Z1=B5(1)-AD $ IF(Z1.GT.0.)GO TO 38
        ADS=AMIN1(DUNS/E48,X8,EES) $ AS=0. $ EST=EES-ADS
        DUNS=DUNS-E48*ADS $ GO TO 40
   38   ADS=0. $ AS=AMIN1(Z1,X7,(X(2)-EES)/EF(7)) $ EST=EES+EF(7)*AS
C ....  STATUS COMPLETE.
   40   ANS(2)=ANS(2)+ADS $ ANS(5)=ANS(5)+DUNS
        X(4)=AMAX1(X(4),EF(6)*AD+EF(8)*ADS)
        IF(IND.EQ.0)GO TO 50 $ SAV(1,I)=AD $ SAV(5,I)=GS $ SAV(3,I)=ADS
        SAV(4,I)=AS $ SAV(6,I)=EST $ SAV(2,I)=(GD.A.(-1)).O.KGG
        SAV(7,I)=B5(1) $ SAV(8,I)=B5(3)
        ANS(6)=AMAX1(ANS(6),B5(3)-DUNS)
        ANS(11)=ANS(11)+B5(1) $ ANS(12)=ANS(12)+AD $ ANS(13)=ANS(13)+AS
        ANS(14)=ANS(14)+GS $ ANS(15)=ANS(15)+GD $ ANS(16)=ANS(16)+EST
        ANS(17)=AMAX1(ANS(17),B5(1)) $ ANS(18)=AMAX1(ANS(18),ADS)
        ANS(19)=AMAX1(ANS(19),GDS) $ IF(DUNS.GT..0001) ANS(10)=ANS(10)+1.
        L1=CU1*EST+1. $ OCU(L1,1)=OCU(L1,1)+1.
        L1=CU2*GDS+1. $ OCU(L1,2)=OCU(L1,2)+1.
   50   CALL MOVLEV(B5(5),B5,188)
        IF(IND.EQ.0)GO TO 59
        WRITE(9)((SAV(J,I),J=1,8),ZERO,ZERO,I=1,24)
   59   CONTINUE
   60   CONTINUE
        ANS(20)=ANS(2) $ IF(X(2).GT.0.)ANS(2)=ANS(2)/X(2)
        GE11AF=COST(Z1) $ IF(IND.EQ.0)GO TO 69
        DO 62 I=1,2 $ DO 61 J=2,20
   61   OCU(J,I)=OCU(J,I)+OCU(J-1,I) $ DO 62 J=1,20
   62   OCU(J,I)=100.*OCU(J,I)/OCU(20,I) $ IF(ISWND.NE.0)GO TO 69
        Z3=EF(1)*EF(5) $ ANS(21)=0. $ IF(Z3.GT.0.)ANS(21)=ANS(21)/Z3
```

```
     115            69    IF(ISXOL.EQ.0)RETURN
                          DO 70 J=1,6 $ JXOL(J)=1H  $ IF(X(J).NE.XOL(J))JXOL(J)=1H*
                    70    XOL(J)=X(J) $ PRINT71,GE11AF,CCM(6),(XOL(J),JXOL(J),J=1,6)
                    71    FORMAT(1X,F14.2,F9.6,4(F15.3,A1),2(F9.6,A1))
                          RETURN $ END
```

SYMBOLIC REFERENCE MAP (R=3)

```
ENTRY POINTS     DEF LINE      REFERENCES
   4  GE11AF          1         115        119

VARIABLES        SN  TYPE             RELOCATION
 1044  AD            REAL                                REFS        55       56       73       74     2*87       93       94
                                                           98   DEFINED       55       73       86
 1046  ADS           REAL                                REFS      2*57       77       78       88       89       92       93
                                                           94      100   DEFINED       56       58       75       77       79
                                                           88       90
   12  ANS           REAL        ARRAY    COMANSW        REFS         7       42       72       73       83     2*92       97
                                                         3*98     3*99    2*100    2*101    2*109      114
                                                      DEFINED        13       42       72       73       83     2*92       97
                                                         3*98     3*99    2*100    2*101    2*109    2*114
 1047  AS            REAL                                REFS        58     2*80       81       90       95       98
                                                      DEFINED        57       58       75       79       88       90
 1363  B5            REAL        ARRAY                   REFS         2     2*48     3*55       56     3*64       65     3*73
                                                           74     2*86     2*87     2*96       97       98      100    2*104
                                                      DEFINED      2*27       28       31       32     2*41       44       46
                                                           47     2*48
   50  CC            REAL        ARRAY    COMCOMP        REFS         6
   44  CCM           REAL        ARRAY    COMANSW        REFS         7      117
   37  CTOT          REAL        ARRAY    COMANSW        REFS         7
 1032  CU1           REAL                                REFS       102   DEFINED       33       34
 1033  CU2           REAL                                REFS       103   DEFINED       33       34
  106  DETOT         REAL        ARRAY    COMCOMP        REFS         6
 1026  DIA           REAL                                REFS        26       29     2*37  DEFINED       25
 1045  DUNS          REAL                                REFS        56       57       59       74       75     2*77       88
                                                           89       92       97      101  DEFINED       55       57       73
                                                           75       77       87       89
 1042  EES           REAL                                REFS        49       50       56       57     2*58     2*76       77
                                                           78       79       80       81     2*88     2*90
                                                      DEFINED        49
    0  EF            REAL        ARRAY    COMCOMP        REFS         6     6*17     4*18       49     2*58       63       67
                                                           79     2*80       81     2*90     2*93    2*114
 1023  EFG0          REAL                                REFS        83   DEFINED       20
 1024  EFG1          REAL                                REFS        83   DEFINED       21
 1025  EFG2          REAL                                REFS        83   DEFINED       21
 1011  EST           REAL                                REFS        49       63       95       99      102
                                                      DEFINED        16       57       58       76       78       81       88
                                                           90
 1020  E15X          REAL                                REFS        25       28       31       44       47
                                                      DEFINED        18       25
 1016  E37           REAL                                REFS      2*76       80       81  DEFINED       17
 1014  E46           REAL                                REFS      2*55     2*64     2*73       86       87
                                                      DEFINED        17
```

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VARIABLES       SN  TYPE              RELOCATION
  1015   E48        REAL                              REFS        56       57       65       66     2*77       88       89
                                                   DEFINED        17
  1021   E7X7       REAL                              REFS        67  DEFINED       18
  1051   GD         REAL                              REFS      2*75       82       95       99  DEFINED       61       74
                                                                79        86
  1052   GDS        REAL                              REFS      3*83      101      103  DEFINED       61       82       86
   113   GEC        REAL       ARRAY    COMCOMP       REFS         6     3*20     2*21       72
  1004   GE11AF     REAL                              REFS       117  DEFINED      110
  1043   GRM        REAL                              REFS        72       74       75       80  DEFINED       53       71
                                                                72
  1050   GS         REAL                              REFS        76       81       82       94       99
                                                   DEFINED        61       75       76       80       86
  1031   I          INTEGER                           REFS      2*31     2*32       36     2*46     2*47       50     3*94
                                                              3*95      2*96      106    3*112    3*113  DEFINED       30       35
                                                                46        48      106      111
     2   IND        INTEGER             COMGE11       REFS         4       33       42       94      105      110
    10   ISWND      INTEGER             COMWIND       REFS         3       22       37       40      113
     0   ISXOL      INTEGER             COMSXOL       REFS        10      115
  1005   J          INTEGER                           REFS        13     2*14     4*27       28     2*31     2*32       33
                                                                36      3*41       42       43       44     2*46     2*47      106
                                                             3*112     2*113    4*116    4*117  DEFINED       12       13       26
                                                                30        33       35       41       46      106      111      112
                                                               116       117
  1675   JXOL       INTEGER    ARRAY                  REFS         2      117  DEFINED    2*116
  1054   K          INTEGER                           REFS      3*64       65  DEFINED       63
  1006   KGG        INTEGER                           REFS        53       71       95  DEFINED       14       61       72
                                                                86
  1036   LGO        INTEGER                           REFS        50  DEFINED       39
     0   LGON       INTEGER    ARRAY    COMGEON       REFS         8       39
  1062   L1         INTEGER                           REFS     2*102    2*103  DEFINED      102      103
  1041   ND         INTEGER                           REFS        40  DEFINED       40
  1040   ND1        INTEGER                           REFS        40  DEFINED       39
  1037   ND2        INTEGER                           REFS        39       40  DEFINED       39
     1   NH         INTEGER             COMGE11       REFS         4       23       50       59       63
     0   NITER      INTEGER             COMGE11       REFS         4       12  DEFINED       12
  1035   NWK        INTEGER                           REFS      2*39  DEFINED       39
     0   OCU        REAL       ARRAY    COMOCUM       REFS         5      102      103    2*112    2*113
                                                   DEFINED        36      102      103      112      113
  1027   QHT        REAL                              REFS        27       37       43  DEFINED       26
  1034   QW1        REAL                              REFS        42  DEFINED       37
  1063   SAV        REAL       ARRAY                  REFS         2      106  DEFINED     3*94     3*95     2*96
     0   SUDE       REAL       ARRAY    COMSUDE       REFS         9     2*27       31       32       41       42       43
                                                                46        47
  1056   TD         REAL                              REFS        64       65  DEFINED       64
  1060   TDS        REAL                              REFS      2*66  DEFINED       65
  1055   TES        REAL                              REFS        65       66     2*67  DEFINED       63
  1053   TST        REAL                              REFS        63  DEFINED       63       66       67
  1057   TUNS       REAL                              REFS        65       66       68  DEFINED       64       66
     0   W          REAL       ARRAY    COMWIND       REFS         3     4*25       26       27     2*28     2*37       43
                                                              2*44   DEFINED       29
     0   X          REAL       ARRAY    COMANSW       REFS         7     2*14     5*15     3*16       18       19       20
                                                              3*21        25       33     4*34       51       53       58       67
                                                                71        76       79       80       90       93    2*109      116
                                                               117   DEFINED       14       32       93
    24   XM         REAL       ARRAY    COMCOMP       REFS         6
  1663   XOL        REAL       ARRAY                  REFS         2      116      117  DEFINED       11      117
   110   XRS        REAL       ARRAY    COMCOMP       REFS         6     2*16
```

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VARIABLES       SN  TYPE            RELOCATION
     0  XXXX        REAL        ARRAY     F.P.      REFS        2        14     DEFINED       1
  1007  X2L         REAL                            REFS       50     DEFINED       14
  1010  X2U         REAL                            REFS       49     DEFINED       15        19
  1012  X7          REAL                            REFS     2*18        58        79        80        90
                                                 DEFINED       16
  1017  X7E3        REAL                            REFS       76     DEFINED       18
  1013  X8          REAL                            REFS       56        65        88    DEFINED       16
   722  ZERO        REAL                            REFS    2*106     DEFINED       11
  1022  Z1          REAL                            REFS       20      2*21        56        58        65        67        74
                                                      79       87        90       110    DEFINED       20        56        65
                                                      74       87
  1061  Z2          REAL                            REFS       75        76     DEFINED       75
  1030  Z3          REAL                            REFS     2*28      2*44     2*114    DEFINED       27        43       114

FILE NAMES          MODE
        OUTPUT      FMT                   WRITES      23      117
        TAPE9       UNFMT                 WRITES      33      106

EXTERNALS             TYPE    ARGS         REFERENCES
        COST        REAL        1             110
        EXIT                    0              23
        GETSD                   1              22      40
        MOVLEV                  3             104
        SQRT        REAL        1  LIBRARY     25

INLINE FUNCTIONS      TYPE    ARGS        DEF LINE  REFERENCES
        AMAX1       REAL        0  INTRIN             28       44        93        97     2*100       101
        AMIN1       REAL        0  INTRIN             28       44        55        56        58        64        65        67
                                                      73       74        76        77        79        80        86        88
                                                      90

STATEMENT LABELS                    DEF LINE   REFERENCES
   726  1          FMT                  24         23
     0  10                              13         12
     0  11                              14         13
     0  12                              32       2*30
    46  13                              20         19
    55  14                              22         19
     0  15                              36       2*35
   121  16                              30         22
   133  17                              33         29
   222  18                              46         40
   233  19                              48         45
   161  20                              39         33
     0  21                              47       2*46
   254  22                              55         50      51
   273  23                              58         56
   304  24                              59         57
   311  25                              61         69
   314  26                              63         59
   333  27                              67         65
   341  28                              68         66
     0  29                              69         63
   3[illegible]  33                     71         50      59        68
   35[illegible]  34                    73         53      71
   411  35                              79         74
   431  36                              82         76      78
```

STATEMENT LABELS			DEF LINE	REFERENCES		
440	37		86	49	53	
462	38		90	87		
473	40		92	61	84	89
403	41		77	75		
564	50		104	48	94	
616	59		107	40	105	
0	60		108	39		
0	61		112	111		
0	62		113	111	112	
652	69		115	110	113	
0	70		117	116		
757	71	FMT	118	117		
65	80		25	23		
0	81		29	26		
0	82		45	41		

LOOPS	LABEL	INDEX	FROM-TO	LENGTH	PROPERTIES	
11	10	J	12 13	2B	INSTACK	
15	11	J	13 14	2B	INSTACK	
105	81	J	26 29	12B	OPT	
124	12	J	30 32	6B		NOT INNER
126	12	I	30 32	3B	INSTACK	
147	15	J	35 36	4B		NOT INNER
150	15	I	35 36	2B	INSTACK	
164	60	NWK	39 108	437B		EXT REFS NOT INNER
171	59	ND	40 107	430B		EXT REFS NOT INNER
203	82	J	41 45	16B	OPT	
225	21	I	46 47	6B		NOT INNER
227	21	J	46 47	3B	INSTACK	
234	50	I	48 104	335B		EXT REFS NOT INNER
317	29	K	63 69	25B	OPT	EXITS
575		I	106 106	20B		EXT REFS NOT INNER
600		J	106 106	10B		EXT REFS
634	62	I	111 113	10B		NOT INNER
635	61	J	111 112	2B	INSTACK	
641	62	J	112 113	2B	INSTACK	
657	70	J	116 117	5B	INSTACK	
672		J	117 117	10B		EXT REFS

COMMON BLOCKS	LENGTH	MEMBERS - BIAS NAME(LENGTH)							
COMWIND	9	0	W	(8)	8	ISWND	(1)			
COMGE11	3	0	NITER	(1)	1	NH	(1)	2	IND	(1)
COMOCUM	80	0	OCU	(80)						
COMCOMP	95	0	EF	(20)	20	XM	(20)	40	CC	(30)
		70	DETOT	(2)	72	XRS	(3)	75	GEC	(20)
COMANSW	42	0	X	(10)	10	ANS	(21)	31	CTOT	(5)
		36	CCM	(6)						
COMGEON	52	0	LGON	(52)						
COMSUDE	96	0	SUDE	(96)						
COMSXOL	1	0	ISXOL	(1)						

STATISTICS

PROGRAM LENGTH	1707B	967
CM LABELED COMMON LENGTH	572B	378

61100B CM USED

```
      SUBROUTINE SMIN6(FCT,XO,FV)
      DIMENSION XO(6),XN(6),SV(6,10),FF(10)
      COMMON /COMMINN/ NMIN,DMIN,XL(10),XU(10),RR(10),XLU(10,2)
      EXTERNAL FCT
      DATA NV/6/, DVJ/10./, NSM/10/
      D=DMIN $ NS=NR=ID=1 $ DO 10 J=1,NV $ IF(RR(J).GT.0.)ID=0
   10 SV(J,1)=XO(J) $ FV=FF(1)=F2=FCT(XO) $ IF(ID.NE.0)RETURN
C ...    MIN LOOP
   11 DO 12 J=1,NV
   12 XN(J)=XO(J)
       F1=F2
   13 DO 17 J=1,NV
       IF(XO(J).GE.XU(J))GO TO 14
      XN(J)=AMIN1(XO(J)+D*RR(J),XU(J))
       JUMP=-1
       GO TO 30
   24 IF(F3.LT.F2)GO TO 16
   14 IF(XO(J).LE.XL(J))GO TO 15
       XN(J)=AMAX1(XO(J)-D*RR(J),XL(J))
      JUMP=0
       GO TO 30
   25 IF(F3.LT.F2)GO TO 16
   15 XN(J)=XO(J)
       GO TO 17
   16 F2=F3
   17 CONTINUE
       IS=1
       IF(F2.LT.F1)GO TO 18
       IF(ID.GE.NMIN)GO TO 35
      D=D/DVJ
       ID=ID+1
       GO TO 13
   18 IC=0
       FAC=1.
       IF(IS.LT.10)GO TO 19
       FAC=2.*FAC
       IS=0
   19 IS=IS+1
       DO 23 J=1,NV
       DX=(XN(J)-XO(J))*FAC
      XO(J)=XN(J)
       IF(DX) 20,21,22
   20 XN(J)=AMAX1(XO(J)+DX,XL(J))
       IF(XN(J).LT.XO(J))IC=1
       GO TO 23
   21 XN(J)=XO(J)
       GO TO 23
   22 XN(J)=AMIN1(XO(J)+DX,XU(J))
       IF(XN(J).GT.XO(J))IC=1
   23 CONTINUE
       IF(IC.EQ.0)GO TO 11
       JUMP=1
       GO TO 30
   26 IF(F3.GE.F2)GO TO 11
       F2=F3
       GO TO 18
C ...     TEST LOOP
```

```
      30   DO 32 I=1,NS $ DO 31 K=1,NV
           IF(ABS(XN(K)-SV(K,I)).GT..00001)GO TO 32
      31   CONTINUE $ F3=FF(I) $ GO TO 34
      32   CONTINUE $ F3=FCT(XN) $ NS=MINO(NSM,NS+1)
           NR=NR+1 $ IF(NR.GT.NSM)NR=1 $ DO 33 K=1,NV
      33   SV(K,NR)=XN(K) $ FF(NR)=F3
      34   IF(JUMP) 24,25,26
     C ....   SOLUTION IN XO
      35   I=1 $ DO 36 K=1,NS $ IF(FF(K).LE.FF(I))I=K
      36   CONTINUE $ FV=FF(I) $ DO 37 J=1,NV
      37   XO(J)=SV(J,I) $ RETURN $ END
```

SYMBOLIC REFERENCE MAP (R=3)

```
ENTRY POINTS      DEF LINE      REFERENCES
   3  SMIN6           1            7         68

VARIABLES      SN  TYPE             RELOCATION
  242  D           REAL                               REFS        14        19        30   DEFINED         6        30
    1  DMIN        REAL                     COMMINN   REFS         3         6
  235  DVJ         REAL                               REFS        30   DEFINED         5
  256  DX          REAL                               REFS        42        43        48   DEFINED        40
  255  FAC         REAL                               REFS        36        40   DEFINED        34        36
  363  FF          REAL        ARRAY                  REFS         2        60      2*66        67   DEFINED         7        63
    0  FV          REAL                       F.P. DEFINED         1         7        67
  250  F1          REAL                               REFS        28   DEFINED        11
  247  F2          REAL                               REFS        11        17        22        28        54
                                                   DEFINED         7        25        55
  252  F3          REAL                               REFS        17        22        25        54        55        63
                                                   DEFINED        60        61
  257  I           INTEGER                            REFS        59        60        66        67        68
                                                   DEFINED        58      2*66
  254  IC          INTEGER                            REFS        51   DEFINED        33        44        49
  245  ID          INTEGER                            REFS         7        29        31   DEFINED       2*6        31
  253  IS          INTEGER                            REFS        35        38   DEFINED        27        37        38
  246  J           INTEGER                            REFS         6       2*7      2*10      2*13      4*14      2*18      4*19
                                                      2*23      2*40      2*41      3*43      2*44      2*46      3*48      2*49
                                                      2*68   DEFINED         6         9        12        39        67
  251  JUMP        INTEGER                            REFS        64   DEFINED        15        20        52
  260  K           INTEGER                            REFS      2*59      2*63      2*66   DEFINED        58        62        66
    0  NMIN        INTEGER                  COMMINN   REFS         3        29
  244  NR          INTEGER                            REFS      2*62      2*63   DEFINED         6      2*62
  243  NS          INTEGER                            REFS        58        61        66   DEFINED         6        61
  236  NSM         INTEGER                            REFS        61        62   DEFINED         5
  234  NV          INTEGER                            REFS         6         9        12        39        58        62        67
                                                   DEFINED         5
   26  RR          REAL        ARRAY        COMMINN   REFS         3         6        14        19
  267  SV          REAL        ARRAY                  REFS         2        59        68   DEFINED         7        63
    2  XL          REAL        ARRAY        COMMINN   REFS         3        18        19        43
   40  XLU         REAL        ARRAY        COMMINN   REFS         3
  261  XN          REAL        ARRAY                  REFS         2        40        41        44        49        59        61
                                                        63   DEFINED        10        14        19        23        43        46
                                                        48
```

```
      SUBROUTINE SMIN6        74/74    OPT=2                             FTN 4.8+518         80/11/28. 10.01.44        PAGE      3

VARIABLES       SN  TYPE              RELOCATION
     0  X0            REAL         ARRAY      F.P.          REFS           2            2*7          10           13           14           18           19
                                                               23           40           43           44           46           48           49
                                                          DEFINED          1            41           68
    14  XU            REAL         ARRAY     COMMINN        REFS           3            13           14           48

EXTERNALS               TYPE     ARGS         REFERENCES
        FCT           REAL          1   F.P.         4            7           61

INLINE FUNCTIONS        TYPE     ARGS              DEF LINE    REFERENCES
        ABS           REAL          1   INTRIN                       59
        AMAX1         REAL          0   INTRIN                       19           43
        AMIN1         REAL          0   INTRIN                       14           48
        MIN0          INTEGER       0   INTRIN                       61

STATEMENT LABELS                       DEF LINE     REFERENCES
     0  10                                   7            6
    30  11                                   9           51           54
     0  12                                  10            9
    37  13                                  12           32
    53  14                                  18           13
    66  15                                  23           18
    71  16                                  25           17           22
    73  17                                  26           12           24
   106  18                                  33           28           56
   113  19                                  38           35
     0  20          INACTIVE                43           42
   132  21                                  46           42
   134  22                                  48           42
   140  23                                  50           39           45           47
    51  24                                  17           64
    64  25                                  22           64
   144  26                                  54           64
   147  30                                  58           16           21           53
     0  31                                  60           58
   163  32                                  61           58           59
     0  33                                  63           62
   205  34                                  64           60
   207  35                                  66           29
     0  36                                  67           66
     0  37                                  68           67

LOOPS   LABEL     INDEX       FROM-TO      LENGTH      PROPERTIES
    15  10         J             6  7          4B      INSTACK
    33  12         J             9 10          2B      INSTACK
    40  17         J            12 26         36B                    ENTRIES      EXITS
   122  23         J            39 50         17B        OPT
   153  32         I            58 61         12B                     EXITS     NOT INNER
   155  31         K            58 60          4B      INSTACK        EXITS
   201  33         K            62 63          2B      INSTACK
   213  36         K            66 67          4B      INSTACK
   225  37         J            67 68          2B      INSTACK

COMMON BLOCKS     LENGTH       MEMBERS - BIAS NAME(LENGTH)
        COMMINN      52                   0 NMIN     (1)                          1 DMIN     (1)                          2 XL       (10)
                                         12 XU       (10)                        22 RR       (10)                        32 XLU      (20)
```

```
STATISTICS
  PROGRAM LENGTH                400B      256
  CM LABELED COMMON LENGTH       64B       52
        60000B CM USED
```

```
      SUBROUTINE MINOU(FCT,XB,VAL)
      DIMENSION XB(6),XS(6,20)
      COMMON /COMSXOL/ ISXOL
      COMMON /COMMINN/ NMIN,DMIN,XL(10),XU(10),RR(10),XLU(10,2)
      EXTERNAL FCT
      DATA NV/6/, MRA/20/
       IF(XU(2).LE.0..O.XU(3).LE.0.)XL(5)=XU(5)=XL(6)=XU(6)=0.
      I=0 $ DO 10 J=1,NV $ RR(J)=XU(J)-XL(J) $ IF(RR(J).GT.0.)I=I+1
   10 XS(J)=.5*(XU(J)+XL(J)) $ IF(I.LT.2)GO TO 18
C ....  RANDOM START
      DO 15 J=1,NV $ IF(RR(J).GT.0.)GO TO 12 $ DO 11 I=2,MRA
   11 XS(J,I)=XS(J,1) $ GO TO 15
   12 Z1=RR(J)/MRA $ DO 13 I=1,MRA
   13 XS(J,I)=Z1*(UDGEN(0)+I-1)+XL(J) $ IF(J.EQ.1)GO TO 15
      J1=MRA $ DO 14 I=2,MRA $ J2=J1*UDGEN(0)+1.
      Z1=XS(J,J1) $ XS(J,J1)=XS(J,J2) $ XS(J,J2)=Z1
   14 J1=J1-1
   15 CONTINUE $ Z1=FCT(XS) $ DO 17 I=2,MRA $ Z2=FCT(XS(1,I))
      IF(Z2.GE.Z1)GO TO 17 $ DO 16 J=1,NV
   16 XS(J,1)=XS(J,I) $ Z1=Z2
   17 CONTINUE
   18 CALL SMIN6(FCT,XS,Z1)
    1 FORMAT(* --M-*F14.2,4F15.3,2F9.6)
      IF(ISXOL.NE.0)PRINT1,Z1,(XS(J),J=1,NV)
      IF(Z1.GE.VAL)GO TO 20 $ DO 19 J=1,NV
   19 XB(J)=XS(J) $ VAL=Z1
   20 DO 21 J=1,NV $ XL(J)=XLU(J,1)
   21 XU(J)=XLU(J,2) $ RETURN $ END
```

```
     SYMBOLIC REFERENCE MAP (R=3)

ENTRY POINTS    DEF LINE    REFERENCES
   3 MINOU          1          28

VARIABLES      SN  TYPE            RELOCATION
    1 DMIN         REAL                COMMINN     REFS       4
  223 I            INTEGER                         REFS       8         9        12      2*14        18        20
                                               DEFINED     2*8        11        13        15        18
    0 ISXOL        INTEGER             COMSXOL     REFS       3        24
  224 J            INTEGER                         REFS     4*8       3*9        11      2*12        13      3*14      4*16
                                                    2*20     24      2*26      2*27      2*28   DEFINED         8        11
                                                      19     24        25        27
  226 J1           INTEGER                         REFS      15      2*16        17   DEFINED        15        17
  227 J2           INTEGER                         REFS    2*16   DEFINED        15
  206 MRA          INTEGER                         REFS      11      2*13      2*15        18   DEFINED         6
    0 NMIN         INTEGER             COMMINN     REFS       4
  205 NV           INTEGER                         REFS       8        11        19        24        25        27
                                               DEFINED       6
   26 RR           REAL       ARRAY    COMMINN     REFS       4         8        11        13   DEFINED         8
    0 VAL          REAL                F.P.        REFS      25   DEFINED         1        26
    0 XB           REAL       ARRAY    F.P.        REFS       2   DEFINED         1        26
    2 XL           REAL       ARRAY    COMMINN     REFS       4         8         9        14   DEFINED       2*7        27
   40 XLU          REAL       ARRAY    COMMINN     REFS       4        27        28
```

```
VARIABLES       SN  TYPE              RELOCATION
  231  XS           REAL       ARRAY                      REFS        2        12       2*16      2*18       20        22        24
                                                            26   DEFINED        9        12        14      2*16        20
   14  XU           REAL       ARRAY      COMMINN         REFS        4       2*7         8         9   DEFINED       2*7        28
  225  Z1           REAL                                  REFS       14        16        19        22        24        25        26
                                                       DEFINED       13        16        18        20
  230  Z2           REAL                                  REFS       19        20   DEFINED        18

FILE NAMES          MODE
     OUTPUT         FMT                       WRITES         24

EXTERNALS                TYPE     ARGS            REFERENCES
     FCT            REAL          1     F.P.          5         2*18          22
     SMIN6                        3                  22
     UDGEN          REAL          1                  14          15

STATEMENT LABELS                  DEF LINE    REFERENCES
  207  1           FMT               23          24
    0  10                             9           8
    0  11                            12          11
   42  12                            13          11
    0  13                            14          13
    0  14                            17          15
  106  15                            18          11          12          14
    0  16                            20          19
  133  17                            21          18          19
  137  18                            22           9
    0  19                            26          25
  161  20                            27          25
    0  21                            28          27

LOOPS  LABEL      INDEX      FROM-TO      LENGTH     PROPERTIES
   20  10          J            8  9          6B      INSTACK
   33  15          J           11  18        57B                EXT REFS   NOT INNER
   37  11          I           11  12         2B      INSTACK
   47  13          I           13  14        13B                EXT REFS
   70  14          I           15  17        16B                EXT REFS
  117  17          I           18  21        20B                EXT REFS   NOT INNER
  127  16          J           19  20         2B      INSTACK
  155  19          J           25  26         2B      INSTACK
  164  21          J           27  28         3B      INSTACK

COMMON BLOCKS    LENGTH      MEMBERS - BIAS NAME(LENGTH)
     COMSXOL          1                  0 ISXOL    (1)
     COMMINN         52                  0 NMIN     (1)                  1 DMIN     (1)                  2 XL       (10)
                                        12 XU       (10)                22 RR       (10)                32 XLU      (20)

STATISTICS
  PROGRAM LENGTH                      425B      277
  CM LABELED COMMON LENGTH             65B       53
        60000B CM USED
```

```
      SUBROUTINE GE11MN(FCT)
      DIMENSION P(14)
      COMMON /COMMINN/ NMIN,DMIN,XL(10),XU(10),RR(10),XLU(10,2)
      COMMON /COMGE11/ NITER,NH,IND
      COMMON /COMCARD/ ITIT,IRUN,ISBIG,NOVAR,NTYPE,JGCO(2),DSPLR,
     1 LCR(9,13)
      COMMON /COMCOMP/ EF(20),XM(10,2),CC(10,3),DETOT(2),XRS(3),GEC(20)
      EXTERNAL FCT
      FUNL(J)=AMAX1(.0001*XM(J,2),XM(J,1))
      NITER=IND=0 $ NOVAR=2 $ XM(4,1)=XM(4,2)=0.
      DECODE(80,1,LCR(1,13))(P(J),J=1,14)
    1 FORMAT(A2,13A6)
      PRINT2,(P(J),J=1,14),LCR(9,13)
    2 FORMAT(* (*A2,13(*/*A6),*)*A1)
      DECODE(80,3,LCR(1,13))J1,NH,XM(5,1),XM(5,2),XM(6,1),XM(6,2)
    3 FORMAT(2X,2(1X,I2),12F6.0)
      IF(NH.LT.0.O.NH.GT.24.O.XM(5,1).LE.0..O.XM(6,1).LE.0.
     1 .O.XM(5,2).GE.1..O.XM(6,2).GE.1..O.XM(5,1).GT.XM(5,2)
     2 .O.XM(6,1).GT.XM(6,2))GO TO 99
      IF(XM(2,2).LE.0.)XM(5,1)=XM(5,2)=XM(6,1)=XM(6,2)=0.
      CALL PREDIC(J1) $ NMIN=1 $ DECODE(10,4,LCR(4))J,DMIN
    4 FORMAT(1X,A1,F3.0,5X)
      IF(J.NE.1H )DECODE(10,5,J)NMIN $ VAL=1.E90 $ I=0
    5 FORMAT(I1,9X)
      DMIN=AMIN1(DMIN,1./3.) $ IF(DMIN.LE.0.)DMIN=0.1
      DO 11 J=1,6 $ XLU(J,1)=XL(J)=P(J)=XM(J,1)
      IF(XM(J,1).NE.XM(J,2))I=I+1
   11 XLU(J,2)=XU(J)=XM(J,2) $ IF(I.EQ.0)GO TO 30
C .... NOT ALL FIXED
      IF(XL(1).GT.0..O.XL(2).GT.0.)GO TO 12 $ P(3)=XL(3)=XU(3)
      IF(XU(1).LE.0..A.XU(2).GT.0.)GO TO 97
C .... COL EQ 0, STO EQ 0, GEN NE 0
      XL(1)=XU(1)=XL(2)=XU(2)=0. $ CALL MINOU(FCT,P,VAL)
      IF(XU(1).LE.0.)GO TO 30
   12 IF(XL(2).GT.0.)GO TO 14 $ IF(XL(3).GT.0.)GO TO 13
C .... COL NE 0, STO EQ 0, GEN EQ 0
      XL(1)=FUNL(1) $ XL(2)=XU(2)=XL(3)=XU(3)=0.
      CALL MINOU(FCT,P,VAL)
C ....  COL NE 0, STO EQ 0,  GEN NE 0.
   13 XL(1)=FUNL(1) $ XL(2)=XU(2)=0. $ XL(3)=FUNL(3)
      CALL MINOU(FCT,P,VAL) $ IF(XU(2).LE.0.)GO TO 30
   14 IF(XL(3).GT.0.)GO TO 15
C .... COL NE 0, STO NE 0, GEN EQ 0
      XL(1)=FUNL(1) $ XL(2)=FUNL(2) $ XL(3)=XU(3)=0.
      CALL MINOU(FCT,P,VAL)
C .... ALL GT 0
   15 XL(1)=FUNL(1) $ XL(2)=FUNL(2) $ XL(3)=FUNL(3)
      CALL MINOU(FCT,P,VAL)
   30 IND=1 $ VAL=FCT(P) $ PRINT6,NITER,NMIN,DMIN $ CALL PROUT(VAL,P)
    6 FORMAT(* --MIN *2I7,F8.4)
      RETURN
   96 FORMAT(* ZERO COLLECTOR AND NONZERO STORAGE NOT ALLOWED*)
   97 PRINT96 $ CALL EXIT
   98 FORMAT(* LOGIC CARD ERROR *)
   99 PRINT98 $ CALL EXIT $ END
```

```
      SUBROUTINE GE11MN      74/74    OPT=2                         FTN 4.8+518        80/11/28. 10.01.44        PAGE      2


      SYMBOLIC REFERENCE MAP (R=3)

ENTRY POINTS     DEF LINE      REFERENCES
    3 GE11MN           1        51         55

VARIABLES      SN  TYPE            RELOCATION
   50  CC          REAL        ARRAY    COMCOMP       REFS         7
  106  DETOT       REAL        ARRAY    COMCOMP       REFS         7
    1  DMIN        REAL                 COMMINN       REFS         3         2*25        49   DEFINED        21         2*25
    7  DSPLR       REAL                 COMCARD       REFS         5
    0  EF          REAL        ARRAY    COMCOMP       REFS         7
  113  GEC         REAL        ARRAY    COMCOMP       REFS         7
  335  I           INTEGER                            REFS        27          28   DEFINED         23         27
    2  IND         INTEGER              COMGE11       REFS         4   DEFINED          10         49
    1  IRUN        INTEGER              COMCARD       REFS         5
    2  ISBIG       INTEGER              COMCARD       REFS         5
    0  ITIT        INTEGER              COMCARD       REFS         5
  332  J           INTEGER                            REFS        11          13        2*23       4*26       2*27       3*28
                                                   DEFINED        11          13          21         26
    5  JGCO        INTEGER     ARRAY    COMCARD       REFS         5
  333  J1          INTEGER                            REFS        21   DEFINED          15
   10  LCR         INTEGER     ARRAY    COMCARD       REFS         5          11          13         15         21
    1  NH          INTEGER              COMGE11       REFS         4        2*17     DEFINED         15
    0  NITER       INTEGER              COMGE11       REFS         4          49     DEFINED         10
    0  NMIN        INTEGER              COMMINN       REFS         3          49     DEFINED         21         23
    3  NOVAR       INTEGER              COMCARD       REFS         5   DEFINED          10
    4  NTYPE       INTEGER              COMCARD       REFS         5
  336  P           REAL        ARRAY                  REFS         2          13          33         38         41         45         48
                                                      2*49   DEFINED          11          26         30
   26  RR          REAL        ARRAY    COMMINN       REFS         3
  334  VAL         REAL                               REFS        33          38          41         45         48         49
                                                   DEFINED        23          49
    2  XL          REAL        ARRAY    COMMINN       REFS         3        2*30        2*35         42   DEFINED         26         30
                                                      2*33      3*37        3*40        3*44       3*47
   40  XLU         REAL        ARRAY    COMMINN       REFS         3   DEFINED          26         28
   24  XM          REAL        ARRAY    COMCOMP       REFS         7        8*17          20         26       2*27         28       2*37
                                                      4*40      4*44        6*47     DEFINED       2*10       4*15       4*20
  110  XRS         REAL        ARRAY    COMCOMP       REFS         7
   14  XU          REAL        ARRAY    COMMINN       REFS         3          30        2*31         34         41
                                                   DEFINED        28        2*33        2*37         40         44

FILE NAMES       MODE
      OUTPUT     FMT                     WRITES        13         49          53          55

EXTERNALS            TYPE    ARGS           REFERENCES
      EXIT                     0              53        55
      FCT            REAL      1    F.P.       8        33         38          41          45         48         49
      MINOU                    3              33        38         41          45          48
      PREDIC                   1              21
      PROUT                    2              49

INLINE FUNCTIONS     TYPE    ARGS          DEF LINE  REFERENCES
      AMAX1          REAL      0  INTRIN               37       2*40        2*44        3*47
      AMIN1          REAL      0  INTRIN               25
      FUNL           REAL      1    SF         9       37       2*40        2*44        3*47
```

STATEMENT LABELS			DEF LINE	REFERENCES		
216	1	FMT	12	11		
225	2	FMT	14	13		
243	3	FMT	16	15		
254	4	FMT	22	21		
264	5	FMT	24	23		
274	6	FMT	50	49		
0	11		28	26		
104	12		35	30		
117	13		40	35		
133	14		42	35		
146	15		47	42		
161	30		49	28	34	41
300	96	FMT	52	53		
171	97		53	31		
312	98	FMT	54	55		
174	99		55	17		

LOOPS	LABEL	INDEX	FROM-TO	LENGTH	PROPERTIES
57	11	J	26 28	7B	INSTACK

COMMON BLOCKS	LENGTH	MEMBERS - BIAS NAME(LENGTH)							
COMMINN	52	0	NMIN	(1)	1	DMIN	(1)	2	XL (10)
		12	XU	(10)	22	RR	(10)	32	XLU (20)
COMGE11	3	0	NITER	(1)	1	NH	(1)	2	IND (1)
COMCARD	125	0	ITIT	(1)	1	IRUN	(1)	2	ISBIG (1)
		3	NOVAR	(1)	4	NTYPE	(1)	5	JGCO (2)
		7	DSPLR	(1)	8	LCR	(117)		
COMCOMP	95	0	EF	(20)	20	XM	(20)	40	CC (30)
		70	DETOT	(2)	72	XRS	(3)	75	GEC (20)

STATISTICS

PROGRAM LENGTH	357B	239
CM LABELED COMMON LENGTH	423B	275

60000B CM USED

```
C
C
C                SOLSTOR - GE11 - GENLIB3 LIBRARY.
C
```

```
      SUBROUTINE SMOLSW(J1,N2,IOP,T,X,Y,F,A)
C     WHERE J1=NUMBER OF DATA POINTS
C           N2=TWICE THE NUMBER OF KNOTS
C           IOP=ARRAY OF DIMENSION 2 CONTAINING COMBINATIONS OF THE
C               INTEGERS 1 THRU 5 FOR SPECIFYING THE BOUNDARY CONDITIONS
C           T=TABLE OF ABSCISSAS OF DATA POINTS
C           X=TABLE OF KNOTS
C           Y=TABLE OF ORDINATES OF DATA POINTS
C           W=  WEIGHTS ARE REMOVED.......
C           F=ARRAY OF DIMENSION N2 CONTAINING SECOND DERIVATIVES AND
C             FUNCTION VALUES UPON RETURN
C           A=ARRAY OF DIMENSION .GE. N2**2 USED FOR TEMPORARY STORAGE
C
      DIMENSION IOP(2),T(2),X(2),Y(2),F(2),A(N2,N2),W(2)
      N=N2/2
      KK=N-1
      F1=F(1)
      FN=F(N)
      DO 100 I=1,N
  100 F(I)=0.
      M1=2*N
      M2=M1-1
      M3=N+1
      M4=KK-1
      DO 20 I=2,KK
      FL1=X(I+1)-X(I)
      FL2=X(I)-X(I-1)
      DO 20 J=1,N
      M=N+J
      IF (J-(I-1))70,40,30
   30 IF (J-I)50,60,50
   50 IF (J-(I+1))70,80,70
   70 A(I,J)=0.
      A(I,M)=0.
      GO TO 20
   40 A(I,J)=FL2/6.
      A(I,M)=-1./FL2
      GO TO 20
   60 A(I,J)=(X(I+1)-X(I-1))/3.
      A(I,M)=(FL1+FL2)/(FL1*FL2)
      GO TO 20
   80 A(I,J)=FL1/6.
      A(I,M)=-1./FL1
   20 CONTINUE
      IF (N-3)111,112,111
  111 DO 110 I=3,KK
      A(I,I)=A(I,I)-A(I,I-1)*A(I-1,I)/A(I-1,I-1)
      A(I,1)=-A(I,I-1)*A(I-1,1)/A(I-1,I-1)
      DO 110 J=M3,M2
  110 A(I,J)=A(I,J)-A(I,I-1)*A(I-1,J)/A(I-1,I-1)
  112 A(N-1,1)=A(N-1,1)/A(N-1,N-1)
      DO 130 I=N,M1
  130 A(N-1,I)=A(N-1,I)/A(N-1,N-1)
      IF (N-3)113,114,113
  113 DO 140 I=2,M4
      J=N-I
      A(J,1)=(A(J,1)-A(J,J+1)*A(J+1,1))/A(J,J)
```

```
          DO 140 K=N,M1
      140 A(J,K)=(A(J,K)-A(J,J+1)*A(J+1,K))/A(J,J)
      114 DO 141 I=2,KK
          DO 141 J=2,KK
          IF (I-J)142,143,142
      143 A(I,J)=1.
          GO TO 141
      142 A(I,J)=0.
      141 CONTINUE
          DO 150 I=M3,M1
          F(I)=0.
          DO 150 J=1,M1
      150 A(I,J)=0.
          IF (IOP(1)-5)151,152,151
      152 DO 153 I=1,M1
      153 A(1,I)=0.
          GO TO 200
      151 DO 149 I=N,M1
      149 A(1,I)=0.
          DO 154 I=1,KK
      160 MK=IOP(1)
          GO TO (220,230,240,250),MK
      220 IF (I-1)221,222,221
      222 A(1,1)=1.
          F(1)=F1
          GO TO 155
      221 BOB=0.
          GO TO 155
      230 IF (I-1)231,232,231
      232 A(1,1)=1.
          GO TO 155
      231 IF (I-2)233,233,234
      233 BOB=-F1
          GO TO 155
      234 BOB=0.
          GO TO 155
      240 IF (I-1)241,242,241
      242 A(1,1)=(X(2)-X(1))/3.
          A(1,N+1)=1./(X(2)-X(1))
          A(1,N+2)=-A(1,N+1)
          F(1)=-F1
          GO TO 155
      241 IF (I-2)243,243,244
      243 BOB=(X(2)-X(1))/6.
          GO TO 155
      244 BOB=0.
          GO TO 155
      250 IF (I-1)251,252,251
      252 A(1,1)=1.
          A(1,N)=-1.
          GO TO 155
      251 BOB=0.
          GO TO 155
      155 IF (I-1)156,154,156
      156 A(1,1)=A(1,1)-BOB*A(I,1)
          DO 157 J=N,M1
      157 A(1,J)=A(1,J)-BOB*A(I,J)
```

```
  154 CONTINUE
      DO 158 I=N,M1
  158 A(1,I)=A(1,I)/A(1,1)
      F(1)=F(1)/A(1,1)
      DO 159 I=2,KK
      F(I)=F(I)-A(I,1)*F(1)
      DO 159 J=N,M1
  159 A(I,J)=A(I,J)-A(I,1)*A(1,J)
      A(1,1)=1.
      DO 161 I=2,KK
      A(1,I)=0.
  161 A(I,1)=0.
  200 IF (IOP(2)-5)201,202,201
  202 DO 203 I=1,M1
  203 A(N,I)=0.
      GO TO 300
  201 DO 204 I=N,M1
  204 A(N,I)=0.
      A(N,1)=0.
      DO 205 I=1,KK
  260 MK=IOP(2)
      GO TO (310,320,330,340),MK
  310 IF (I-1)311,312,311
  312 A(N,N)=1.
      F(N)=FN
      GO TO 206
  311 BOB=0.
      GO TO 206
  320 IF (I-1)321,322,321
  322 A(N,N)=1.
      GO TO 206
  321 IF (I-(N-1))323,324,323
  324 BOB=-FN
      GO TO 206
  323 BOB=0.
      GO TO 206
  330 IF (I-1)331,332,331
  332 A(N,N)=(X(N)-X(N-1))/3.
      A(N,M2)=-1./(X(N)-X(N-1))
      A(N,M1)=-A(N,M2)
      F(N)=FN
      GO TO 206
  331 IF (I-(N-1))333,334,333
  334 BOB=(X(N)-X(N-1))/6.
      GO TO 206
  333 BOB=0.
      GO TO 206
  340 IF (I-1)341,342,341
  342 A(N,N)=(X(2)-X(1)+X(N)-X(N-1))/3.
      A(N,N+1)=1./(X(2)-X(1))
      A(N,N+2)=-A(N,N+1)
      A(N,M2)=-1./(X(N)-X(N-1))
      A(N,M1)=-A(N,M2)
      GO TO 206
  341 IF (I-2)343,344,343
  343 IF (I-(N-1))345,346,345
  344 BOB=(X(2)-X(1))/6.
```

```
      GO TO 206
  346 BOB=(X(N)-X(N-1))/6.
      GO TO 206
  345 BOB=0.
      GO TO 206
  206 IF (I-1)207,205,207
  207 F(N)=F(N)-BOB*F(I)
      A(N,1)=A(N,1)-BOB*A(I,1)
      DO 208 J=N,M1
  208 A(N,J)=A(N,J)-BOB*A(I,J)
  205 CONTINUE
      DO 210 I=M3,M1
  210 A(N,I)=A(N,I)/A(N,N)
      F(N)=F(N)/A(N,N)
      A(N,1)=A(N,1)/A(N,N)
      DO 211 I=1,KK
      F(I)=F(I)-A(I,N)*F(N)
      A(I,1)=A(I,1)-A(I,N)*A(N,1)
      DO 211 J=M3,M1
  211 A(I,J)=A(I,J)-A(I,N)*A(N,J)
      A(N,N)=1.
      DO 239 I=2,KK
      A(N,I)=0.
  239 A(I,N)=0.
      A(1,N)=0.
  300 GO TO 400
  400 A1N=A(1,N)
      AN1=A(N,1)
      DO 1000 J=1,J1
      IF(T(J)-X(1))77,77,66
   66 IF(T(J)-X(N))68,69,69
   69 I=N-1
      GO TO 212
   68 CALL SMOLS2(T(J),X,N,M,MFLAG)
      IF (M-1)76,77,76
   77 I=1
      GO TO 212
   76 IF (MFLAG)78,79,78
   79 I=M-1
      GO TO 212
   78 I=M
  212 A1=X(I+1)-T(J)
      FLI=X(I+1)-X(I)
      MB=N+I
      A2=T(J)-X(I)
      AIJ=-((A1**3)/(6.*FLI)-FLI*A1/6.)
      BIJ=-((A2**3)/(6.*FLI)-FLI*A2/6.)
      CIJ=A1/FLI
      DIJ=A2/FLI
      IF (IOP(1)-5)401,402,401
  402 IF (I-1)403,404,403
  403 IF (I-(N-1))405,406,405
  404 EIJ=-AIJ+A(2,1)*BIJ
      GO TO 410
  406 EIJ=A(N-1,1)*AIJ+AN1*BIJ
      GO TO 410
  405 EIJ=A(I,1)*AIJ+A(I+1,1)*BIJ
```

```
  410 A(1,I)=A(1,I)-EIJ*AIJ
      A(1,I+1)=A(1,I+1)-EIJ*BIJ
      A(1,MB)=A(1,MB)+EIJ*CIJ
      A(1,MB+1)=A(1,MB+1)+EIJ*DIJ
      F(1)=F(1)+EIJ*Y(J)
  401 IF (IOP(2)-5)411,412,411
  412 IF (I-1)413,414,413
  413 IF (I-(N-1))415,416,415
  414 GIJ=A1N*AIJ+A(2,N)*BIJ
      GO TO 420
  416 GIJ=A(N-1,N)*AIJ-BIJ
      GO TO 420
  415 GIJ=A(I,N)*AIJ+A(I+1,N)*BIJ
  420 A(N,I)=A(N,I)-GIJ*AIJ
      A(N,I+1)=A(N,I+1)-GIJ*BIJ
      A(N,MB)=A(N,MB)+GIJ*CIJ
      A(N,MB+1)=A(N,MB+1)+GIJ*DIJ
      F(N)=F(N)+GIJ*Y(J)
  411 DO 1000 K=1,N
      K1=N+K
      IF (I-1)430,431,430
  430 IF (I-(N-1))432,433,432
  431 IF (IOP(1)-5)432,435,432
  435 PKJI=A(2,K1)*BIJ
      GO TO 450
  433 IF (IOP(2)-5)432,436,432
  436 PKJI=A(N-1,K1)*AIJ
      GO TO 450
  432 PKJI=A(I,K1)*AIJ+A(I+1,K1)*BIJ
  450 IF (K-I)451,452,453
  453 IF (K-(I+1))451,454,451
  452 PKJI=PKJI+A1/FLI
      GO TO 451
  454 PKJI=PKJI+A2/FLI
  451 A(K1,I)=A(K1,I)-PKJI*AIJ
      A(K1,I+1)=A(K1,I+1)-PKJI*BIJ
      A(K1,MB)=A(K1,MB)+PKJI*CIJ
      A(K1,MB+1)=A(K1,MB+1)+PKJI*DIJ
 1000 F(K1)=F(K1)+PKJI*Y(J)
      IF (IOP(1)-4)601,602,601
  602 DO 604 I=1,M1
  604 A(N+1,I)=0.
      A(N+1,N+1)=1.
      A(N+1,M1)=-1.
      F(N+1)=0.
  601 CALL SMOLS1(N2,1,N2,A,F,DET)
      RETURN
      END
```

SYMBOLIC REFERENCE MAP (R=3)

```
ENTRY POINTS      DEF LINE      REFERENCES
   3  SMOLSW           1           275

VARIABLES        SN  TYPE             RELOCATION
    0  A              REAL       ARRAY      F.P.      REFS        14      4*47      3*48      4*50      2*51      2*53      4*57
                                                       4*59        97     2*112     2*114     2*117       118       120     3*122
                                                        154       165       167     2*179     2*181     2*184       185     2*186
                                                        188     3*189     3*191       198       199       224       226     2*228
                                                        229       230       231       232       237       239     2*241       242
                                                        243       244       245       252       255     2*257       263       264
                                                        265       266       274   DEFINED         1        33        34        36
                                                         37        39        40        42        43        47        48        50
                                                         51        53        57        59        63        65        70        73
                                                         76        81        87        95        96        97       106       107
                                                        112       114       117       122       123       125       126       129
                                                        132       133       138       144       152       153       154       163
                                                        164       165       166       167       179       181       184       186
                                                        189       191       192       194       195       196       229       230
                                                        231       232       242       243       244       245       263       264
                                                        265       266       270       271       272
 1324  AIJ            REAL                             REFS       224       226       228       229       237       239       241
                                                        242       255       257       263   DEFINED       217
 1316  AN1            REAL                             REFS       226   DEFINED       199
 1320  A1             REAL                             REFS     2*217       219       260   DEFINED       213
 1315  A1N            REAL                             REFS       237   DEFINED       198
 1323  A2             REAL                             REFS     2*218       220       262   DEFINED       216
 1325  BIJ            REAL                             REFS       224       226       228       230       237       239       241
                                                        243       252       257       264   DEFINED       218
 1314  BOB            REAL                             REFS       112       114       178       179       181
                                                     DEFINED        84        90        92       101       103       109       141
                                                        147       149       158       160       171       173       175
 1326  CIJ            REAL                             REFS       231       244       265   DEFINED       219
 1334  DET         *  REAL                             REFS       274
 1327  DIJ            REAL                             REFS       232       245       266   DEFINED       220
 1330  EIJ            REAL                             REFS       229       230       231       232       233
                                                     DEFINED       224       226       228
    0  F              REAL       ARRAY      F.P.      REFS        14        17        18       118     2*120     2*178       185
                                                      2*188       233       246       267       274   DEFINED         1        20
                                                         68        82        98       118       120       139       155       178
                                                        185       188       233       246       267       273
 1321  FLI            REAL                             REFS     2*217     2*218       219       220       260       262
                                                     DEFINED       214
 1306  FL1            REAL                             REFS      2*40        42        43   DEFINED        26
 1307  FL2            REAL                             REFS        36        37      2*40   DEFINED        27
 1300  FN             REAL                             REFS       139       147       155   DEFINED        18
 1277  F1             REAL                             REFS        82        90        98   DEFINED        17
 1331  GIJ            REAL                             REFS       242       243       244       245       246
                                                     DEFINED       237       239       241
 1301  I              INTEGER                          REFS        20      2*26      2*27        30        31        32        33
                                                         34        36        37      3*39        40        42        43     10*47
                                                       6*48      7*50      2*53        56        62        63        65        68
                                                         70        73        76        80        86        89        94       100
                                                        105       111       112       114     2*117     3*120     3*122       125
                                                        126       129       132       137       143       146       151       157
                                                        162       169       170       177       178       179       181     2*184
                                                      3*188     3*189     3*191       194       195       213     2*214       215
                                                        216       222       223     2*228     2*229     2*230       235       236
```

```
VARIABLES       SN  TYPE          RELOCATION
                                                  2*241    2*242    2*243     249      250    2*257     258      259
                                                  2*263    2*264     270    DEFINED     19      25       46       52
                                                    55       60       67       72       75      77      116      119
                                                   124      128      131      134      183     187      193      203
                                                   207      210      212      269
       0  IOP        INTEGER    ARRAY     F.P.    REFS       14       71       78      127     135      221      234
                                                   251      254      268    DEFINED      1
    1310  J          INTEGER                      REFS       29       30       31       32      33       36       39
                                                    42     3*50     7*57     7*59       62      63       65       70
                                                 3*114    3*122    3*181    3*191      201     202      205      213
                                                   216      233      246      267   DEFINED     28       49       56
                                                    61       69      113      121      180     190      200
       0  J1         INTEGER              F.P.    REFS      200   DEFINED       1
    1312  K          INTEGER                      REFS     3*59      248      258      259   DEFINED     58      247
    1276  KK         INTEGER                      REFS       24       25       46       60      61       77      119
                                                   124      134      187      193   DEFINED     16
    1332  K1         INTEGER                      REFS      252      255    2*257    2*263   2*264    2*265    2*266
                                                 2*267  DEFINED      248
    1311  M          INTEGER                      REFS       34       37       40       43     205      206      210
                                                   212  DEFINED       29
    1322  MB         INTEGER                      REFS    2*231    2*232    2*244    2*245   2*265    2*266
                                               DEFINED      215
    1317  MFLAG      INTEGER                      REFS      205      209
    1313  MK         INTEGER                      REFS       79      136   DEFINED       78     135
    1302  M1         INTEGER                      REFS       22       52       58       67      69       72       75
                                                   113      116      121      128      131     154      167      180
                                                   183      190      269      272   DEFINED     21
    1303  M2         INTEGER                      REFS       49      153      154      166     167
                                               DEFINED       22
    1304  M3         INTEGER                      REFS       49       67      183      190  DEFINED      23
    1305  M4         INTEGER                      REFS       55   DEFINED      24
    1275  N          INTEGER                      REFS       16       18       19       21      23       28       29
                                                    45     4*51       52     4*53       54      56       58       75
                                                    96     2*97      107      113      116     121      129      131
                                                   132      133    2*138      139    2*144     146    4*152    3*153
                                                 2*154      155      157    2*158    4*163   2*164    4*165    3*166
                                                 2*167      170    2*173    2*178    2*179     180    2*181    4*184
                                                 4*185    4*186    2*188    2*189    2*191   2*192      194      195
                                                   196      198      199      202      203     205      215      223
                                                   226      236      237    2*239    2*241   2*242    2*243    2*244
                                                 2*245    2*246      247      248      250     255      270    2*271
                                                   272      273   DEFINED      15
       0  N2         INTEGER              F.P.    REFS     2*14       15    2*274   DEFINED      1
    1333  PKJI       REAL                         REFS      260      262      263      264     265      266      267
                                               DEFINED      252      255      257      260     262
       0  T          REAL       ARRAY     F.P.    REFS       14      201      202      205     213      216
                                               DEFINED        1
    1335  W          REAL      *UNDEF             REFS       14
       0  X          REAL       ARRAY     F.P.    REFS       14     2*26     2*27     2*39    2*95     2*96    2*101
                                                 2*152    2*153    2*158    4*163    2*164   2*166    2*171    2*173
                                                   201      202      205      213    2*214     216
                                               DEFINED        1
       0  Y          REAL       ARRAY     F.P.    REFS       14      233      246      267  DEFINED       1

EXTERNALS         TYPE    ARGS        REFERENCES
       SMOLS1               6             274
       SMOLS2               5             205
```

STATEMENT LABELS			DEF LINE	REFERENCES								
77	20		44	25	28	35	38	41				
0	30	INACTIVE	31	30								
56	40		36	30								
0	50	INACTIVE	32	2*31								
63	60		39	31								
0	66	INACTIVE	202	201								
740	68		205	202								
0	69	INACTIVE	203	2*202								
53	70		33	30	2*32							
751	76		209	2*206								
747	77		207	2*201	206							
755	78		212	2*209								
0	79	INACTIVE	210	209								
72	80		42	32								
0	100		20	19								
0	110		50	46	49							
0	111	INACTIVE	46	2*45								
142	112		51	45								
0	113	INACTIVE	55	2*54								
215	114		60	54								
0	130		53	52								
0	140		59	55	58							
230	141		66	60	61	64						
227	142		65	2*62								
0	143	INACTIVE	63	62								
0	149		76	75								
0	150		70	67	69							
256	151		75	2*71								
0	152	INACTIVE	72	71								
0	153		73	72								
365	154		115	77	111							
353	155		111	83	85	88	91	93	99	102	104	108
				110								
0	156	INACTIVE	112	2*111								
0	157		114	113								
0	158		117	116								
0	159		122	119	121							
0	160	INACTIVE	78									
0	161		126	124								
425	200		127	74								
437	201		131	2*127								
0	202	INACTIVE	128	127								
0	203		129	128								
0	204		132	131								
624	205		182	134	177							
606	206		177	140	142	145	148	150	156	159	161	168
				172	174	176						
0	207	INACTIVE	178	2*177								
0	208		181	180								
0	210		184	183								
0	211		191	187	190							
757	212		213	204	208	211						
307	220		80	79								
314	221		84	2*80								
0	222	INACTIVE	81	80								
315	230		86	79								

STATEMENT LABELS			DEF LINE	REFERENCES		
321	231		89	2*86		
0	232	INACTIVE	87	86		
0	233	INACTIVE	90	2*89		
324	234		92	89		
0	239		195	193		
325	240		94	79		
337	241		100	2*94		
0	242	INACTIVE	95	94		
0	243	INACTIVE	101	2*100		
344	244		103	100		
345	250		105	79		
352	251		109	2*105		
0	252	INACTIVE	106	105		
0	260	INACTIVE	135			
722	300		197	130		
504	310		137	136		
513	311		141	2*137		
0	312	INACTIVE	138	137		
515	320		143	136		
522	321		146	2*143		
0	322	INACTIVE	144	143		
526	323		149	2*146		
0	324	INACTIVE	147	146		
530	330		151	136		
544	331		157	2*151		
0	332	INACTIVE	152	151		
551	333		160	2*157		
0	334	INACTIVE	158	157		
553	340		162	136		
571	341		169	2*162		
0	342	INACTIVE	163	162		
0	343	INACTIVE	170	2*169		
575	344		171	169		
605	345		175	2*170		
601	346		173	170		
0	400	INACTIVE	198	197		
1040	401		234	2*221		
0	402	INACTIVE	222	221		
0	403	INACTIVE	223	2*222		
1004	404		224	222		
1015	405		228	2*223		
1010	406		226	223		
1021	410		229	225	227	
1112	411		247	2*234		
0	412	INACTIVE	235	234		
0	413	INACTIVE	236	2*235		
1046	414		237	235		
1062	415		241	2*236		
1054	416		239	236		
1070	420		242	238	240	
0	430	INACTIVE	250	2*249		
1140	431		251	249		
1151	432		257	2*250	2*251	2*254
1144	433		254	250		
0	435	INACTIVE	252	251		
0	436	INACTIVE	255	254		
1156	450		258	253	256	

STATEMENT LABELS			DEF LINE	REFERENCES		
1167	451		263	258	2*259	261
1162	452		260	258		
0	453	INACTIVE	259	258		
1165	454		262	259		
1230	601		274	2*268		
0	602	INACTIVE	269	268		
0	604		270	269		
0	1000		267	200	247	

LOOPS	LABEL	INDEX	FROM-TO	LENGTH	PROPERTIES	
17	100	I	19 20	2B	INSTACK	
34	20	I	25 44	50B		NOT INNER
46	20	J	28 44	33B	OPT	
120	110	I	46 50	22B		NOT INNER
132	110	J	49 50	4B	INSTACK	
153	130	I	52 53	3B	INSTACK	
170	140	I	55 59	25B		NOT INNER
202	140	K	58 59	4B	INSTACK	
223	141	I	60 66	11B		NOT INNER
225	141	J	61 66	5B	INSTACK	
240	150	I	67 70	6B		NOT INNER
243	150	J	69 70	2B	INSTACK	
253	153	I	72 73	2B	INSTACK	
262	149	I	75 76	2B	INSTACK	
300	154	I	77 115	66B		NOT INNER
362	157	J	113 114	3B	INSTACK	
373	158	I	116 117	3B	INSTACK	
405	159	I	119 122	11B		NOT INNER
412	159	J	121 122	3B	INSTACK	
423	161	I	124 126	2B	INSTACK	
434	203	I	128 129	2B	INSTACK	
444	204	I	131 132	2B	INSTACK	
475	205	I	134 182	132B		NOT INNER
621	208	J	180 181	3B	INSTACK	
636	210	I	183 184	3B	INSTACK	
661	211	I	187 191	22B		NOT INNER
674	211	J	190 191	3B	INSTACK	
715	239	I	193 195	2B	INSTACK	
731	1000	J	200 267	257B		EXT REFS NOT INNER
1134	1000	K	247 267	52B	OPT	
1216	604	I	269 270	2B	INSTACK	

STATISTICS
PROGRAM LENGTH 1461B 817
60000B CM USED

```
    1                SUBROUTINE SMOLS2(XBAR,X,N,I,MFLAG)
                     DIMENSION X(N),COM1(5),COM2(5),COM3(5)
                     DATAB/.6931471800/
                     DATA COM1/10HSRRRCH XBA,10HAR IS OUTS,9HIDE RANGE,8HOF TABLE,1H /
    5                DATA COM2/10HSRRRCH N I,10HS LESS THA,10HN 2       ,1H ,1H /
                     DATA COM3/10HSRRRCH TAB,10HLE IS NOT ,10HINCREASING,6H ORDER,1H /
                     IF (N.LT.2) GO TO 17
                     IF(X(1).GT.X(2)) GO TO 15
                     IF (XBAR.LT.X(1).OR.XBAR.GT.X(N))GO TO 16
   10                MFLAG = 1
                     M = INT((ALOG(FLOAT(N)))/B)
                     I=2**M
                     K=I
                  10 K=K/2
   15                IF (XBAR.EQ.X(I)) GO TO 14
                     IF (XBAR.GT.X(I).AND.XBAR.LT.X(I+1))RETURN
                     IF (XBAR.GT.X(I)) GO TO 12
                     I = I-K
                     GO TO 10
   20             12 I = I+K
                  13 IF (I.LE.N) GO TO 10
                     I = I-1
                     GO TO 13
                  14 MFLAG=0
   25                RETURN
                  15 CALL SMOLS3(1,COM3,1)
                     RETURN
                  16 CALL SMOLS3(1,COM1,1)
                     RETURN
   30             17 CALL SMOLS3(1,COM2,2)
                     RETURN
                     END
```

SYMBOLIC REFERENCE MAP (R=3)

```
ENTRY POINTS     DEF LINE      REFERENCES
    3  SMOLS2           1        16         25         27         29         31

VARIABLES        SN  TYPE            RELOCATION
   73  B              REAL                                 REFS        11    DEFINED       3
  100  COM1           REAL       ARRAY                     REFS         2         28    DEFINED       4
  105  COM2           REAL       ARRAY                     REFS         2         30    DEFINED       5
  112  COM3           REAL       ARRAY                     REFS         2         26    DEFINED       6
    0  I              INTEGER                 F.P.         REFS        13         15       2*16        17        18        20        21
                                                              22  DEFINED          1         12        18        20        22
   77  K              INTEGER                              REFS        14         18         20   DEFINED        13        14
   76  M              INTEGER                              REFS        12    DEFINED         11
    0  MFLAG          INTEGER                 F.P.      DEFINED         1         10         24
    0  N              INTEGER                 F.P.         REFS         2          7          9        11        21
                                                        DEFINED         1
    0  X              REAL       ARRAY        F.P.         REFS         2        2*8        2*9        15      2*16        17
                                                        DEFINED         1
    0  XBAR           REAL                    F.P.         REFS       2*9         15       2*16        17   DEFINED         1
```

```
EXTERNALS              TYPE    ARGS        REFERENCES
       ALOG      REAL         1 LIBRARY       11
       SMOLS3                 3               26         28          30

INLINE FUNCTIONS       TYPE    ARGS         DEF LINE   REFERENCES
       FLOAT     REAL         1  INTRIN                   11
       INT       INTEGER      1  INTRIN                   11

STATEMENT LABELS                  DEF LINE    REFERENCES
   26   10                           14          19          21
   36   12                           20          17
   40   13                           21          23
   44   14                           24          15
   46   15                           26           8
   51   16                           28           9
   54   17                           30           7

STATISTICS
  PROGRAM LENGTH                     124B        84
           60000B CM USED
```

```
      SUBROUTINE SMOLS1(N,M,I,A,B,  DET)
      DIMENSION A(I,N),B(I,M),COM1(5),COM2(5),COM3(5)
      DOUBLE PRECISION S1,S2,SMOLS4
      DATA COM1/10HLSS NEAR S,10HINGULAR SY,10HSTEM. CALC,10HULATION CO,
     110HNTINUED    /
      DATA COM2/10HLSS SINGUL,10HAR SYSTEM.,10H NO RESULT,10H. INPUT DE,
     110HSTROYED      /
      DATA COM3/10HLSS N IS Z,10HERO. NO IN,10HPUT DATA H,10HAS BEEN DE,
     110HSTROYED      /
      NN = N
      IF (NN.EQ.0) GO TO 20
      MM = M
      X = 0.
      DO 1 J = 1,NN
      DO 1 K = 1,NN
      T = ABS(A(K,J))
      IF (T.GT.X) X = T
    1 CONTINUE
      IF (X.EQ.0.) GO TO 19
      IF (X.GT.1.E-15) GO TO 2
      CALL SMOLS3(1,COM1,1)
    2 SN = 1.
      DO 14 J = 1,NN
      L = J - 1
      IF (J.EQ.NN) GO TO 11
      T = ABS(A(J,J))
      M1 = J
      M2 = J + 1
      DO 3 K =M2,NN
      X = ABS(A(K,J))
      IF (X.LE.T) GO TO 3
      T = X
      M1 = K
    3 CONTINUE
      IF (M1.EQ.J) GO TO 6
      DO 4 K = 1,NN
      T = A(J,K)
      A(J,K) = A(M1,K)
    4 A(M1,K) = T
      DO 5 K = 1,MM
      T = B(J,K)
      B(J,K) = B(M1,K)
    5 B(M1,K) = T
      SN = -SN
    6 IF (A(J,J).EQ.0.) GO TO 19
      DO 10 K = M2,NN
      S1 = 0.
      S2 = 0.
      IF (L.EQ.0) GO TO 8
      S1=SMOLS4(L,A(J,1),I,A(1,K),1)
    8 A(J,K) =(A(J,K) - S1)/A(J,J)
      S2=SMOLS4(J,A(K,1),I,A(1,M2),1)
   10 A(K,M2) = A(K,M2) - S2
   11 DO 13 K = 1,MM
      S1 = 0.
      IF (L.EQ.0) GO TO 13
      S1=SMOLS4(L,A(J,1),I,B(1,K),1)
```

```
   13 B(J,K) = (B(J,K) - S1)/A(J,J)
   14 CONTINUE
      DET = A(1,1)*SN
      IF (DET.EQ.0.) GO TO 19
      IF (N.EQ.1) GO TO 21
      DO 15 J = 2,NN
   15 DET = DET*A(J,J)
      IF (DET.EQ.0.) GO TO 19
      IF (MM.EQ.0) GO TO 21
      M3 = NN-1
      DO 18 J = 1,MM
      DO 17 L = 1,M3
      M1 = NN - L
      S1 = 0.
      M2 = M1 + 1
      K=NN-M2+1
      S1=SMOLS4(K,A(M1,M2),I,B(M2,J),1)
   17 B(M1,J) = B(M1,J) - S1
   18 CONTINUE
      GO TO 21
   19 CALL SMOLS3(1,COM2,2)
      GO TO 21
   20 CALL SMOLS3(1,COM3,3)
   21 RETURN   $END
```

SYMBOLIC REFERENCE MAP (R=3)

```
ENTRY POINTS     DEF LINE      REFERENCES
  3  SMOLS1          1            81

VARIABLES       SN  TYPE              RELOCATION
   0  A             REAL       ARRAY      F.P.       REFS        2       16       26       30       37       38       45
                                                        2*50     2*51     2*52       53       57       58       60       64
                                                          74  DEFINED        1       38       39       51       53
   0  B             REAL       ARRAY      F.P.       REFS        2       41       42       57       58       74       75
                                                     DEFINED        1       42       43       58       75
 413  COM1          REAL       ARRAY                 REFS        2       21  DEFINED        4
 420  COM2          REAL       ARRAY                 REFS        2       78  DEFINED        6
 425  COM3          REAL       ARRAY                 REFS        2       80  DEFINED        8
   0  DET           REAL                  F.P.       REFS       61       64       65  DEFINED        1       60       64
   0  I             INTEGER               F.P.       REFS      2*2       50       52       57       74
                                                     DEFINED        1
 403  J             INTEGER                          REFS       16       24       25     2*26       27       28       30
                                                          35       37       38       41       42     2*45       50     4*51
                                                          52       57     4*58     2*64       74     2*75
                                                     DEFINED       14       23       63       68
 404  K             INTEGER                          REFS       16       30       33       37     2*38       39       41
                                                        2*42       43       50     2*51       52     2*53       57     2*58
                                                          74  DEFINED       15       29       36       40       46       54
                                                          73
 407  L             INTEGER                          REFS       49       50       56       57       70
                                                     DEFINED       24       69
   0  M             INTEGER               F.P.       REFS        2       12  DEFINED        1
```

```
VARIABLES      SN  TYPE            RELOCATION
   401  MM         INTEGER                            REFS        40        54        66        68   DEFINED        12
   410  M1         INTEGER                            REFS        35        38        39        42        43        72        74
                                                       2*75   DEFINED        27        33        70
   411  M2         INTEGER                            REFS        29        46        52      2*53        73      2*74
                                                    DEFINED       28        72
   412  M3         INTEGER                            REFS        69   DEFINED        67
     0  N          INTEGER               F.P.         REFS         2        10        62   DEFINED         1
   400  NN         INTEGER                            REFS        11        14        15        23        25        29        36
                                                         46        63        67        70        73   DEFINED        10
   406  SN         REAL                               REFS        44        60   DEFINED        22        44
   374  S1         DOUBLE                             REFS         3        51        58        75   DEFINED        47        50
                                                         55        57        71        74
   376  S2         DOUBLE                             REFS         3        53   DEFINED        48        52
   405  T          REAL                               REFS      2*17        31        39        43   DEFINED        16        26
                                                         32        37        41
   402  X          REAL                               REFS        17        19        20        31        32
                                                    DEFINED       13        17        30

EXTERNALS              TYPE     ARGS         REFERENCES
       SMOLS3                    3                   21        78        80
       SMOLS4          DOUBLE    5                    3        50        52        57        74

INLINE FUNCTIONS       TYPE     ARGS        DEF LINE  REFERENCES
       ABS             REAL      1  INTRIN                   16        26        30

STATEMENT LABELS                      DEF LINE    REFERENCES
     0  1                                   18          14        15
    31  2                                   22          20
    56  3                                   34          29        31
     0  4                                   39          36
     0  5                                   43          40
   100  6                                   45          35
   123  8                                   51          49
     0  10                                  53          46
   152  11                                  54          25
   172  13                                  58          54        56
     0  14                                  59          23
     0  15                                  64          63
     0  17                                  75          69
     0  18                                  76          68
   303  19                                  78          19        45        61        65
   306  20                                  80          11
   310  21                                  81          62        66        77        79

LOOPS   LABEL      INDEX     FROM-TO      LENGTH     PROPERTIES
    20  1            J         14 18          5B               NOT INNER
    21  1            K         15 18          3B       INSTACK
    41  14           J         23 59        152B               EXT REFS      EXITS    NOT INNER
    54  3            K         29 34          3B       INSTACK
    64  4            K         36 39          3B       INSTACK
    74  5            K         40 43          3B       INSTACK
   112  10           K         46 53         40B               EXT REFS
   161  13           K         54 58         27B               EXT REFS
   224  15           J         63 64          2B       INSTACK
   241  18           J         68 76         42B               EXT REFS  NOT INNER
   251  17           L         69 75         27B               EXT REFS
```

```
STATISTICS
  PROGRAM LENGTH              456B      302
        60000B CM USED
```

```
      SUBROUTINE SMOLS3(ISW,LHOL,INX)
      DIMENSION LHOL(5)
      LOGICALPS,TS
      DATA NP/10/,PS/.TRUE./,TS/.FALSE./
      IF((ISW.EQ.0).OR.(ISW.GT.5))RETURN
      GOTO(1,2,3,4,5),ISW
    1 IF(PS.AND.(NP.GT.0)) PRINT 27,LHOL,INX
   27 FORMAT(1H0,9X,5A10,3X,06)
      NP=NP-1
      IF(TS)CALLEXIT
      RETURN
    2 PS=.FALSE.
      RETURN
    3 PS=.TRUE.
      NP=INX
      RETURN
    4 TS=.TRUE.
      RETURN
    5 TS=.FALSE.
      RETURN   $ END
```

SYMBOLIC REFERENCE MAP (R=3)

```
ENTRY POINTS      DEF LINE      REFERENCES
    3 SMOLS3          1           5        11        13        16        18        20

VARIABLES       SN  TYPE              RELOCATION
    0 INX           INTEGER                F.P.        REFS       7        15    DEFINED      1
    0 ISW           INTEGER                F.P.        REFS     2*5         6    DEFINED      1
    0 LHOL          INTEGER    ARRAY       F.P.        REFS       2         7    DEFINED      1
   44 NP            INTEGER                            REFS       7         9    DEFINED      4        9        15
   45 PS            LOGICAL                            REFS       3         7    DEFINED      4       12        14
   46 TS            LOGICAL                            REFS       3        10    DEFINED      4       17        19

FILE NAMES          MODE
       OUTPUT       FMT                    WRITES        7

EXTERNALS             TYPE   ARGS          REFERENCES
       EXIT                   0                10

STATEMENT LABELS                 DEF LINE   REFERENCES
   22  1                            7          6
   33  2                           12          6
   35  3                           14          6
   40  4                           17          6
   42  5                           19          6
   54  27       FMT                 8          7

STATISTICS
  PROGRAM LENGTH                   57B       47
      60000B CM USED
```

```
     1                DOUBLE PRECISION FUNCTION SMOLS4(K,A,N,B,M)
                      DIMENSION A(99),B(99) $ I=J=1 $ SMOLS4=0.D0
                      DO 10 L=1,K $ SMOLS4=SMOLS4+DBLE(A(I))*DBLE(B(J)) $ I=I+N
                10    J=J+M $ RETURN $ END
```

```
    SYMBOLIC REFERENCE MAP (R=3)

ENTRY POINTS      DEF LINE      REFERENCES
   5  SMOLS4          1             4

VARIABLES       SN  TYPE              RELOCATION
   0  A             REAL        ARRAY      F.P.       REFS        2          3    DEFINED        1
   0  B             REAL        ARRAY      F.P.       REFS        2          3    DEFINED        1
  26  I             INTEGER                           REFS        2*3   DEFINED        2         3
  27  J             INTEGER                           REFS        3          4    DEFINED        2          4
   0  K             INTEGER                F.P.       REFS        3     DEFINED        1
  30  L           * INTEGER                         DEFINED       3
   0  M             INTEGER                F.P.       REFS        4     DEFINED        1
   0  N             INTEGER                F.P.       REFS        3     DEFINED        1
  24  SMOLS4        DOUBLE                            REFS        3     DEFINED        2         3

INLINE FUNCTIONS    TYPE    ARGS         DEF LINE  REFERENCES
      DBLE          DOUBLE    1  INTRIN                  2*3

STATEMENT LABELS                DEF LINE    REFERENCES
   0  10                            4            3

LOOPS  LABEL    INDEX      FROM-TO     LENGTH     PROPERTIES
  15   10       L            3 4          6B        INSTACK

STATISTICS
  PROGRAM LENGTH                   31B        25
       60000B CM USED
```

```
          SUBROUTINE STAGET(IC,XL)
           DIMENSION NDT(12)
          COMMON /COMWIND/ W(8),ISWND
C         FINDS SITE, RAW DATA INTO ESD(1,I,J).
          COMMON /COMLEV2/ ESD(2,24,364)
          DATA NDT/31,28,31,30,31,30,31,31,30,31,30,31/,JTW/7HTRAILER/
          J3=2
     10   READ(1)J1,J2,XL,(W(J),J=1,3)
           IF(J1.EQ.JTW)GO TO 12
          IF(J1.EQ.IC) GC TO 14
     11   READ(1)
           IF(EOF(1)) 10,11,10
     12   IF(J3.NE.2)GO TO 13
           J3=0
           REWIND 1
           GO TO 10
     13   PRINT1,IC
           CALL EXIT
      1   FORMAT(* CANNOT FIND SITE (*A10,*)*)
     14   N2=0
           DO 16 JM=1,12
           N1=N2+1
           N2=N2+NDT(JM)
          IF(JM.EQ.12)N2=N2-1
           READ(1)N,J1,((ESD(1,I,J),I=1,24),J=N1,N2)
          IF(N.EQ.NDT(JM))GO TO 16
           PRINT2,IC,N,JM
           CALL EXIT
      2   FORMAT(* DAYS OF MONTH ERROR *A10,2I8)
     16   CONTINUE
           DO 17 J=1,13
     17   BACKSPACE 1
           RETURN
           END
```

SYMBOLIC REFERENCE MAP (R=3)

```
ENTRY POINTS      DEF LINE      REFERENCES
    3  STAGET          1            33

VARIABLES       SN  TYPE             RELOCATION
     0  ESD         REAL      ARRAY   COMLEV2     REFS      5   DEFINED    25
   176  I           INTEGER                       REFS     25   DEFINED    25
     0  IC          INTEGER           F.P.        REFS     10       17     27   DEFINED     1
    10  ISWND       INTEGER           COMWIND     REFS      3
   171  J           INTEGER                       REFS      8       25   DEFINED     8     25     31
   173  JM          INTEGER                       REFS     23       24     26       27   DEFINED     21
   114  JTW         INTEGER                       REFS      9   DEFINED     6
   167  J1          INTEGER                       REFS      9       10   DEFINED     8     25
   170  J2       *  INTEGER                    DEFINED      8
   166  J3          INTEGER                       REFS     13   DEFINED     7       14
   175  N           INTEGER                       REFS     26       27   DEFINED    25
   177  NDT         INTEGER   ARRAY               REFS      2       23     26   DEFINED     6
```

```
VARIABLES      SN  TYPE            RELOCATION
    174  N1        INTEGER                           REFS        25     DEFINED       22
    172  N2        INTEGER                           REFS        22        23         24         25     DEFINED      20         23
                                                        24
      0  W         REAL        ARRAY     COMWIND     REFS         3     DEFINED        8
      0  XL        REAL                   F.P.     DEFINED        1         8

FILE NAMES         MODE
         OUTPUT    FMT                      WRITES       17         27
         TAPE1     UNFMT                     READS        8         11         25    MOTION      15         32

EXTERNALS            TYPE    ARGS        REFERENCES
         EOF       REAL        1             12
         EXIT                  0             18         28

STATEMENT LABELS               DEF LINE   REFERENCES
    134  1          FMT            19         17
    157  2          FMT            29         27
      7  10                         8       2*12        16
     15  11                        11         12
     22  12                        13          9
     27  13                        17         13
     32  14                        20         10
     76  16                        30         21         26
      0  17                        32         31

LOOPS   LABEL      INDEX       FROM-TO     LENGTH     PROPERTIES
    36  16         JM           21 30        43B                 EXT REFS   NOT INNER
    51             J            25 25        17B                 EXT REFS   NOT INNER
    54             I            25 25        10B                 EXT REFS
   102  17         J            31 32         5B                 EXT REFS

COMMON BLOCKS    LENGTH      MEMBERS - BIAS NAME(LENGTH)
         COMWIND      9                 0 W       (8)                    8 ISWND  (1)
         COMLEV2  17472                 0 ESD     (17472)

STATISTICS
  PROGRAM LENGTH                  215B      141
  CM LABELED COMMON LENGTH      42111B    17481
       60000B CM USED
```

```
      SUBROUTINE PIHI(SD)
      DIMENSION R(2,24,14),D(14),KF(9,14),KE(9,14),SD(24,2)
      KA(I)=SHIFT(J1,I).A.3777777B
      KB(I)=SHIFT(J2,I).A.3777777B
      REWIND 2
       READ(2)J1
       IF(J1.EQ.10HASHRAETABL)GO TO 13
      PRINT1,J1
       CALL EXIT
    1 FORMAT(* NO ASHRAE DATA *A10)
   13 READ(2)X2,(D(J),(KE(I,J),I=1,9),J=2,13)
      IF(SD(1).LT.X2) GO TO 20
   10 X1=X2
       DO 11 I=1,9
       DO 11 J=2,13
   11 KF(I,J)=KE(I,J)
      READ(2)X2,(D(J),(KE(I,J),I=1,9),J=2,13)
       IF(EOF(2))20,12,20
   20 PRINT2,SD(1)
       CALL EXIT
    2 FORMAT(* ASHRAE TABLE ERROR *F8.2)
   12 IF(SD(1).GT.X2)GO TO 10
       D(1)=-10.
       D(14)=386.
       DO 14 J=1,9
      KF(J,1)=KF(J,13)
       KF(J,14)=KF(J,2)
      KE(J,1)=KE(J,13)
   14 KE(J,14)=KE(J,2)
       Z1=X2-X1
       X2=(SD(1)-X1)/Z1
       X1=1.-X2
      DO 23 K=1,14
       DO 21 I=1,2
       DO 21 J=1,24
   21 R(I,J,K)=0.
       N1=5
       N2=21
       DO 23 J=1,9
      J1=KF(J,K)
       J2=KE(J,K)
       K1=KA(-40)
       K2=KB(-40)
      Z1=X1*K1+X2*K2
       IF(Z1.LE.0.)GO TO 22
      K1=KA(-20)
       K2=KB(-20)
       R(1,N1,K)=R(1,N2,K)=(X1*K1+X2*K2)/Z1
      K1=KA(  0)
       K2=KB(  0)
       R(2,N1,K)=R(2,N2,K)=(X1*K1+X2*K2)/Z1
   22 N1=N1+1
       N2=N2-1
   23 CONTINUE
       X=1.
       K1=1
       K2=2
```

```
            DD=D(2)-D(1)
            RETURN
           ENTRY PIH
           IF(X.LE.D(K2))GO TO 26
            K1=K2
           K2=K2+1
            DD=D(K2)-D(K1)
      26   X2=(X-D(K1))/DD
            X1=1.-X2
            DO 27 I=1,2
            DO 27 J=1,24
      27   SD(J,I)=X1*R(I,J,K1)+X2*R(I,J,K2)
            X=X+1.
            RETURN
           END
```

```
   SYMBOLIC REFERENCE MAP (R=3)

ENTRY POINTS      DEF LINE      REFERENCES
  204  PIH           60           71
    3  PIHI           1           59

VARIABLES       SN  TYPE             RELOCATION
  1613  D           REAL      ARRAY                 REFS        2      2*58       61      2*64      65
                                                 DEFINED       11        17       23        24
   352  DD          REAL                            REFS       65   DEFINED       58        64
   340  I           INTEGER                         REFS       11      2*16       17        36     3*69
                                                 DEFINED       11        14       17        34       67
   337  J           INTEGER                         REFS     2*11      2*16     2*17      2*26     2*27     2*28     2*29
                                                      36       40        41     3*69   DEFINED       11       15       17
                                                      25       35        39       68
   335  J1          INTEGER                         REFS        7         8       42        46       49
                                                 DEFINED        6        40
   346  J2          INTEGER                         REFS       43        47       50   DEFINED       41
   343  K           INTEGER                         REFS       36        40       41      2*48     2*51
                                                 DEFINED       33
  2027  KE          INTEGER   ARRAY                 REFS        2        16       28        29       41
                                                 DEFINED       11        17       28        29
  1631  KF          INTEGER   ARRAY                 REFS        2        26       27        40  DEFINED       16       26
                                                      27
   347  K1          INTEGER                         REFS       44        48       51        64       65       69
                                                 DEFINED       42        46       49        56       62
   350  K2          INTEGER                         REFS       44        48       51        61       62       63       64
                                                      69  DEFINED        43       47        50       57       63
   344  N1          INTEGER                         REFS       48        51       52   DEFINED       37       52
   345  N2          INTEGER                         REFS       48        51       53   DEFINED       38       53
   353  R           REAL      ARRAY                 REFS        2      2*69  DEFINED        36     2*48     2*51
     0  SD          REAL      ARRAY      F.P.       REFS        2        12       19        22       31
                                                 DEFINED        1        69
   351  X           REAL                            REFS       61        65       70   DEFINED       55       70
   341  X1          REAL                            REFS       30        31       44        48       51       69
                                                 DEFINED       13        32       66
   336  X2          REAL                            REFS       12        13       22        30       32       44       48
```

```
 VARIABLES      SN  TYPE            RELOCATION
                                                                51          66          69    DEFINED        11          17          31          65
   342  Z1          REAL                                     REFS           31          45          48          51    DEFINED        30          44

 FILE NAMES         MODE
        OUTPUT      FMT                          WRITES          8          19
        TAPE2       UNFMT                         READS          6          11          17     MOTION         5

 EXTERNALS            TYPE    ARGS         REFERENCES
        EOF         REAL       1               18
        EXIT                   0                9         20

 INLINE FUNCTIONS     TYPE    ARGS          DEF LINE  REFERENCES
        KA          INTEGER    1     SF          3        42          46          49
        KB          INTEGER    1     SF          4        43          47          50
        SHIFT       NO TYPE    2  INTRIN                  42          43          46          47          49          50

 STATEMENT LABELS                  DEF LINE   REFERENCES
   271  1          FMT                10         8
   321  2          FMT                21        19
    44  10                            13        22
     0  11                            16        14         15
   104  12                            22        18
    17  13                            11         7
     0  14                            29        25
   101  20                            19        12        2*18
     0  21                            36        34         35
   165  22                            52        45
     0  23                            54        33         39
   224  26                            65        61
     0  27                            69        67         68

 LOOPS  LABEL       INDEX        FROM-TO      LENGTH     PROPERTIES
    27              J             11  11        12B                 EXT REFS
    47  11          I             14  16         5B                 NOT INNER
    50  11          J             15  16         3B       INSTACK
    63              J             17  17        12B                 EXT REFS
   114  14          J             25  29         6B       INSTACK
   132  23          K             33  54        44B                 NOT INNER
   136  21          I             34  36         4B                 NOT INNER
   137  21          J             35  36         2B       INSTACK
   151  23          J             39  54        16B         OPT
   240  27          I             67  69        10B                 NOT INNER
   243  27          J             68  69         3B       INSTACK

 STATISTICS
   PROGRAM LENGTH                   2225B      1173
          60000B CM USED
```

```
      1              SUBROUTINE DECSEA(N,IW,F,W) $ DIMENSION IW(99),F(99),W(52)
              C ....   DECODES SEASONAL INPUT.
                     IF(IW(1).LE.0.O.IW(1).GT.48)GO TO 99
                     DO 10 K=1,N $ IF(IW(K+1).LE.IW(K))GO TO 99
      5              IF(IW(K+1)-IW(1)-51) 10,11,99
                10   CONTINUE
                98   FORMAT(* SEASONAL DECODE ERROR*)
                99   PRINT98 $ CALL EXIT
                11   JW=IW(1) $ DO 13 J=1,K
     10         12   LW=JW $ IF(LW.GT.52)LW=LW-52 $ W(LW)=F(J)
                     JW=JW+1 $ IF(JW.LE.IW(J+1))GO TO 12
                13   CONTINUE $ RETURN $ END
```

```
      SYMBOLIC REFERENCE MAP (R=3)

ENTRY POINTS      DEF LINE      REFERENCES
   3  DECSEA         1             12

VARIABLES     SN  TYPE             RELOCATION
   0  F           REAL      ARRAY     F.P.      REFS        1       10    DEFINED      1
   0  IW          INTEGER   ARRAY     F.P.      REFS        1      2*3       2*4      2*5      9      11
                                              DEFINED       1
  54  J           INTEGER                       REFS       10       11    DEFINED      9
  53  JW          INTEGER                       REFS       10     2*11    DEFINED      9      11
  52  K           INTEGER                       REFS      2*4        5         9   DEFINED    4
  55  LW          INTEGER                       REFS     3*10  DEFINED      2*10
   0  N           INTEGER             F.P.      REFS        4  DEFINED         1
   0  W           REAL      ARRAY     F.P.      REFS        1  DEFINED         1       10

FILE NAMES        MODE
      OUTPUT      FMT                 WRITES        8

EXTERNALS           TYPE    ARGS          REFERENCES
      EXIT                    0               8

STATEMENT LABELS                DEF LINE    REFERENCES
   0  10                            6           4          5
  25  11                            9           5
  33  12                           10          11
   0  13                           12           9
  43  98        FMT                 7           8
  22  99                            8           3          4          5

LOOPS  LABEL    INDEX     FROM-TO    LENGTH    PROPERTIES
  14   10       K           4 6        6B       INSTACK     EXITS
  32   13       J           9 12      10B         OPT

STATISTICS
  PROGRAM LENGTH              56B       46
        60000B CM USED
```

```
1        FUNCTION ZMF(A,B,N)
          ZMF=N/(1.+A)
          IF(ABS(A-B).LT..000001)RETURN
         ZMF=(1.-((1.+B)/(1.+A))**N)/(A-B)
5         RETURN
          END
```

```
      SYMBOLIC REFERENCE MAP (R=3)

ENTRY POINTS      DEF LINE      REFERENCES
    4  ZMF               1             3          5

VARIABLES      SN  TYPE            RELOCATION
    0  A           REAL                 F.P.        REFS       2         3        2*4  DEFINED        1
    0  B           REAL                 F.P.        REFS       3       2*4   DEFINED       1
    0  N           INTEGER              F.P.        REFS       2         4   DEFINED       1
   25  ZMF         REAL                          DEFINED       2         4

INLINE FUNCTIONS    TYPE    ARGS         DEF LINE  REFERENCES
       ABS         REAL       1                         3

STATISTICS
  PROGRAM LENGTH                   26B       22
       60000B CM USED
```

```
     1          SUBROUTINE GETSD(ND)
          C ....  GETS SUPPLY AND DEMAND FOR ND DAY
          C ....  TRUE VALUES IN UPPER HALF, PREDICTED IN LOWER HALF OF ESD.
                COMMON /COMSUDE/ SUDE(24,4)
     5          COMMON /COMLEV2/ ESD(2,24,364)
                DATA MU/77777777770000000000B/ $ N=ND
             10 IF(N.GT.0)GO TO 11 $ N=N+364 $ GO TO 10
             11 IF(N.LE.364)GO TO 12 $ N=N-364 $ GO TO 11
             12 DO 13 I=1,24 $ SUDE(I,1)=ESD(1,I,N).A.MU
    10          SUDE(I,3)=ESD(2,I,N).A.MU $ SUDE(I,2)=SHIFT(ESD(1,I,N),30).A.MU
             13 SUDE(I,4)=SHIFT(ESD(2,I,N),30).A.MU $ RETURN $ END
```

```
SYMBOLIC REFERENCE MAP (R=3)

ENTRY POINTS     DEF LINE      REFERENCES
   3  GETSD         1            11

VARIABLES      SN  TYPE            RELOCATION
   0  ESD          REAL        ARRAY    COMLEV2      REFS       5         9        2*10       11
  30  I            INTEGER                           REFS     2*9      4*10       2*11   DEFINED       9
  26  MU           INTEGER                           REFS       9      2*10         11   DEFINED       6
  27  N            INTEGER                           REFS     2*7       2*8          9      2*10      11
                                                  DEFINED       6         7          8
   0  ND           INTEGER                F.P.       REFS       6   DEFINED          1
   0  SUDE         REAL        ARRAY    COMSUDE      REFS       4   DEFINED          9      2*10      11

INLINE FUNCTIONS    TYPE    ARGS       DEF LINE  REFERENCES
      SHIFT       NO TYPE    2  INTRIN               10          11

STATEMENT LABELS                 DEF LINE   REFERENCES
   6  10                            7          7
  11  11                            8          7          8
  14  12                            9          8
   0  13                           11          9

LOOPS  LABEL      INDEX       FROM-TO      LENGTH      PROPERTIES
  21   13         I              9 11         5B        INSTACK

COMMON BLOCKS   LENGTH       MEMBERS - BIAS NAME(LENGTH)
      COMSUDE      96                  0 SUDE     (96)
      COMLEV2   17472                  0 ESD      (17472)

STATISTICS
  PROGRAM LENGTH                    31B       25
  CM LABELED COMMON LENGTH       42240B    17568
        60000B CM USED
```

```
      SUBROUTINE DEMGET(IPR,ISBIG,FC,ESD)
      DIMENSION ESD(2,8736)
      DATA ISS/0/,MU/77777777770000000000B/
      IF(FC.LE.0.)GO TO 20
      IF(IPR.EQ.8HFLATD-KW.O.IPR.EQ.8HFLATD-MW)GO TO 21
      IF(ISS.EQ.0)REWIND 3
       ISS=2
10    READ(3)J1,J2,ISBIG,(ESD(2,J),J=1,8736)
       IF(EOF(3))11,13,11
11    IF(ISS.EQ.1)GO TO 12
       REWIND 3
       ISS=1
       GO TO 10
12    PRINT1,IPR
       CALL EXIT
1       FORMAT(* CANNOT FIND DEMAND (*A10,*)*)
13    IF(J1.NE.IPR)GO TO 10
       BACKSPACE 3 $ IF(ISBIG.NE.0)ISBIG=1
       IF(J2.NE.1HE.A.J2.NE.2HEQ)GO TO 20
C     ELECTRICAL ONLY
      DO 19 J=1,8736
       Z1=ESD(2,J).A.MU
       Z1=Z1*FC
19    ESD(2,J)=Z1.A.MU
       RETURN
20    PRINT2,IPR,J2,FC
       CALL EXIT
2     FORMAT(* FC OR E,EQ  ERROR *A10,1X,A10,1X,E10.2)
21    Z1=1000. $ ISBIG=1
       IF(IPR.EQ.8HFLATD-MW)GO TO 22
       ISBIG=0
       Z1=1.
22     Z2=Z1.A.MU $ DO 23 J=1,8736
23    ESD(2,J)=Z2
      RETURN
       END
```

SYMBOLIC REFERENCE MAP (R=3)

```
ENTRY POINTS     DEF LINE      REFERENCES
  3  DEMGET         1            25          35

VARIABLES        SN  TYPE              RELOCATION
  0  ESD             REAL        ARRAY      F.P.       REFS        2        22   DEFINED       1         8        24        34
  0  FC              REAL                   F.P.       REFS        4        23        26   DEFINED         1
  0  IPR             INTEGER                F.P.       REFS      2*5        14        17        26        30
                                                    DEFINED        1
  0  ISBIG           INTEGER                F.P.       REFS       18   DEFINED         1         8        18        29        31
114  ISS             INTEGER                           REFS        6        10   DEFINED         3         7        12
170  J               INTEGER                           REFS        8        22        24        34   DEFINED         8        21
                                                         33
166  J1              INTEGER                           REFS       17   DEFINED         8
167  J2              INTEGER                           REFS     2*19        26   DEFINED         8
```

```
VARIABLES      SN   TYPE           RELOCATION
   115  MU          INTEGER                            REFS         22        24        33   DEFINED         3
   171  Z1          REAL                               REFS         23        24        33   DEFINED        22         23         29
                                                         32
   172  Z2          REAL                               REFS         34    DEFINED           33

FILE NAMES          MODE
        OUTPUT      FMT                    WRITES        14        26
        TAPE3       UNFMT                   READS         8    MOTION         6        11         18

EXTERNALS             TYPE    ARGS          REFERENCES
        EOF         REAL       1                9
        EXIT                   0               15        27

STATEMENT LABELS                  DEF LINE     REFERENCES
   135  1          FMT                16          14
   151  2          FMT                28          26
    22  10                             8          13        17
     0  11              INACTIVE      10          2*9
    45  12                            14          10
    50  13                            17           9
     0  19                            24          21
    72  20                            26           4        19
    75  21                            29           5
   104  22                            33          30
     0  23                            34          33

LOOPS   LABEL     INDEX        FROM-TO      LENGTH     PROPERTIES
    25              J             8 8          7B                 EXT REFS
    67  19          J            21 24         3B        INSTACK
   107  23          J            33 34         2B        INSTACK

STATISTICS
  PROGRAM LENGTH                      176B      126
         60000B CM USED
```

```
  1                 SUBROUTINE RANSTA (M)
              C     RANDOM STARTER FOR ANDGEN,UDGEN, AND RAYGEN
              C     USER MUST CALL ---SET(M) TO SET DESIRED ROUTINE
              C     CDC-6600 WITH HOROLOG ONLY
  5                 CALL HOROLOG(I,J,K)
                     DECODE(10,1,J) J3,J2,J1
                     DECODE(10,2,K) J4
                  1 FORMAT(1X,I2,1X,I2,1X,I2)
                  2 FORMAT(4X,I2)
 10                 L=(40320*J1+672*J2*28*J3+J4)
                     L=L.AND.7777777B
                    M=L*1000000100B+61B
                     RETURN
                    END
```

```
      SYMBOLIC REFERENCE MAP (R=3)

ENTRY POINTS      DEF LINE      REFERENCES
    3  RANSTA          1           13

VARIABLES      SN  TYPE            RELOCATION
   54  I        *  INTEGER                        REFS        5
   55  J           INTEGER                        REFS        5          6
   61  J1          INTEGER                        REFS       10   DEFINED        6
   60  J2          INTEGER                        REFS       10   DEFINED        6
   57  J3          INTEGER                        REFS       10   DEFINED        6
   62  J4          INTEGER                        REFS       10   DEFINED        7
   56  K           INTEGER                        REFS        5          7
   63  L           INTEGER                        REFS       11         12   DEFINED      10      11
    0  M           INTEGER               F.P.  DEFINED        1         12

EXTERNALS             TYPE    ARGS         REFERENCES
       HOROLOG                  3               5

STATEMENT LABELS               DEF LINE   REFERENCES
   44  1       FMT                 8           6
   47  2       FMT                 9           7

STATISTICS
  PROGRAM LENGTH                  64B        52
         60000B CM USED
```