Ethan

SAND79-2330
Unlimited Release
UC-60, 63a, 94c

SOLSTOR Description and User's Guide

Eugene A. Aronson, David L. Caskey, Bill C. Caskey

Prepared by Sandia National Laboratories, Albuquerque, New Mexico 87185
and Livermore, California 94550 for the United States Department
of Energy under Contract DE-AC04-76DP00789

Printed March 1981

Sandia National Laboratories

SF 2900-Q(3-80)

Issued by Sandia National Laboratories, operated for the United States Department of Energy by Sandia Corporation

---

NOTICE

Printed in the United States of America

Available from
National Technical Information Service
U.S. Department of Commerce
5285 Port Royal Road
Springfield, VA 22161

Price: Printed Copy $; Microfiche $3

SAND79-2330
Unlimited Release
Printed March 1981

SOLSTOR DESCRIPTION AND USER'S GUIDE

E. A. Aronson
Applied Mathematics Division, 2646

D. L. Caskey
Systems Analysis Division, 4723

B. C. Caskey
Geo Energy Systems Analysis Division, 4744

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.

Contents

Page

Page

LIST OF FIGURES

LIST OF TABLES

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

Sandia

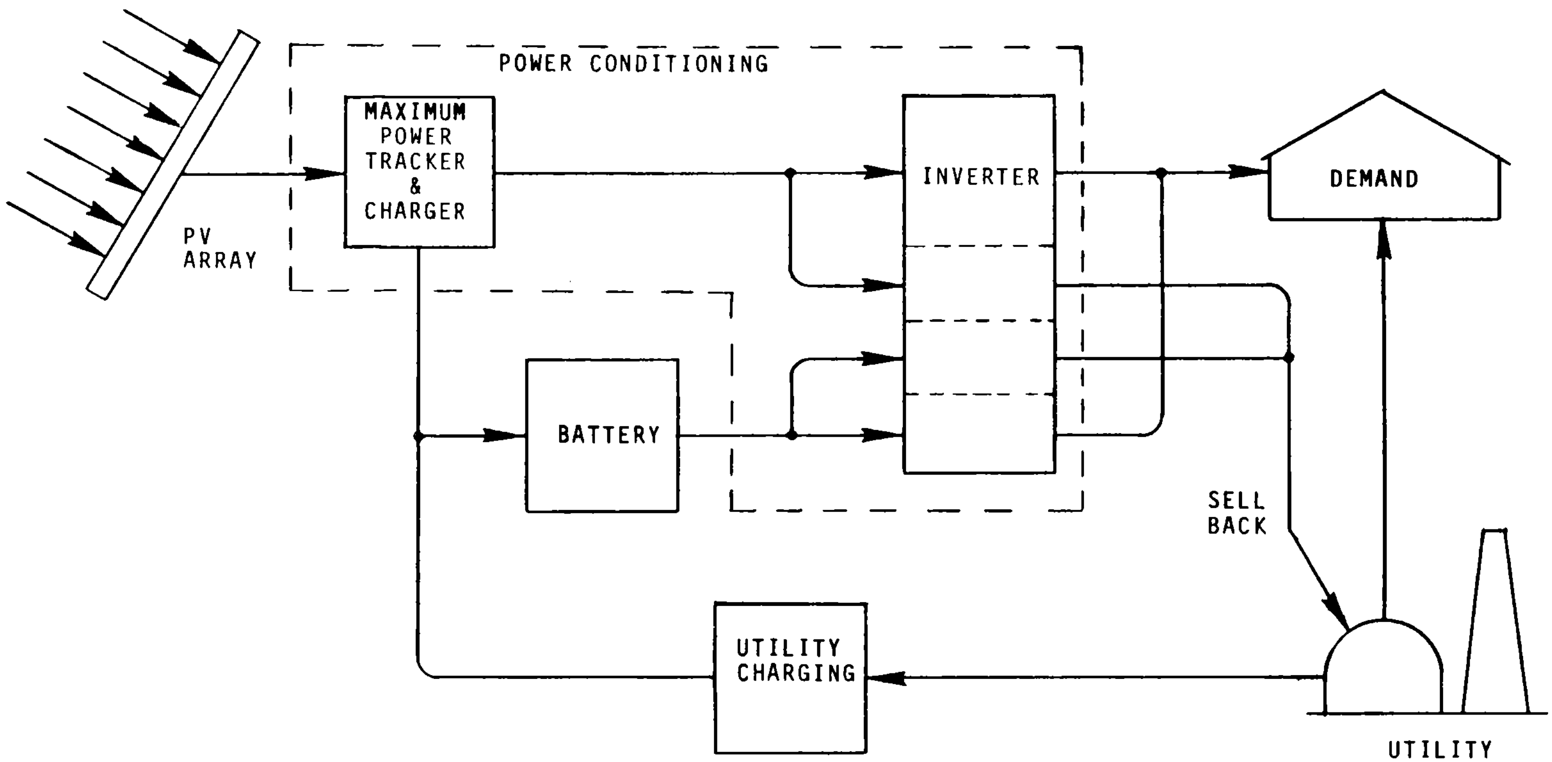

Figure 1.1 SOLSTOR Model

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 <u>all</u> 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 $\text{life} < 3$, 1/3 for $3 \leq \text{life} < 5$, 2/3 for $5 \leq \text{life} < 7$, and 1.0 for $7 \leq \text{life}$. 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.

<u>Price-Year Present-Value Computation</u>

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 initial 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

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

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

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

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

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

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

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

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

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

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

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

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

and the total AC of capital is

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

The total AC of OM is

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

The annualized fuel cost in the base year is

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

The total system AC is

$$\text{ACSYS} = \text{ACC} + \text{ACOM} + \text{ACF} \quad .$$

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

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

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

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

Wind Turbines

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:

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

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

For $V_i < V \le V_r$, 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 (^{o}F)

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

$T_E(t)$ = effective outside air temperature (Sol-Air temp) at time t (^{o}F)

$T_E(t-\delta)$ = T_E at time $(t-\delta)$ (^{o}F)

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)	$0.225 \frac{h - ft^2 - {}^{o}F}{Btu}$
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 - ^{o}F
Conductance of Floor (Constant built into SOLSTOR)	one-half of U_w
Air Infiltration, (ρ_{vcp})	0.032 kW/^{o}F (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 - ^{o}F

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.

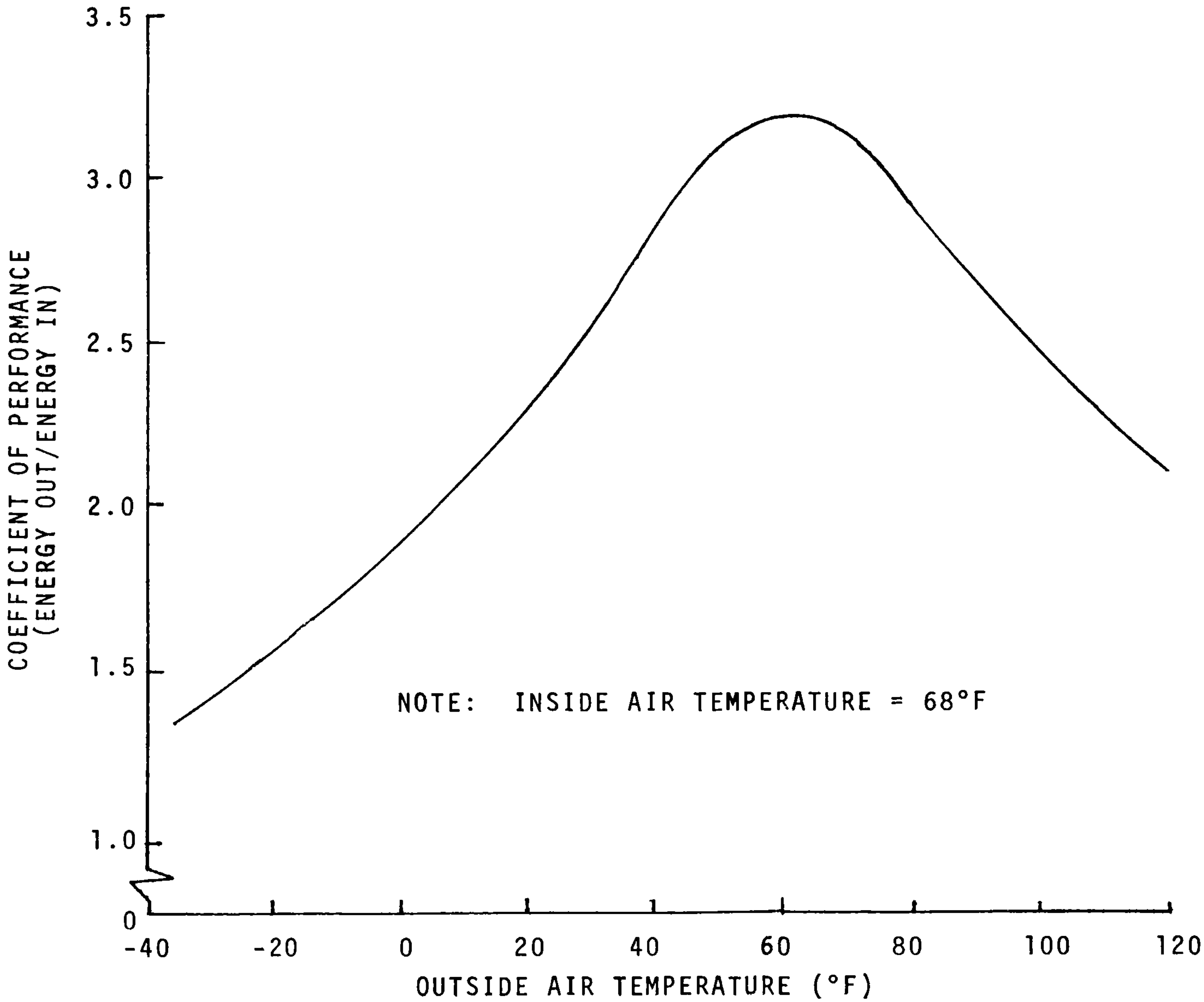

Figure 4.1 Air-to-Air Heat Pump Coefficient of Performance Vs. Temperature

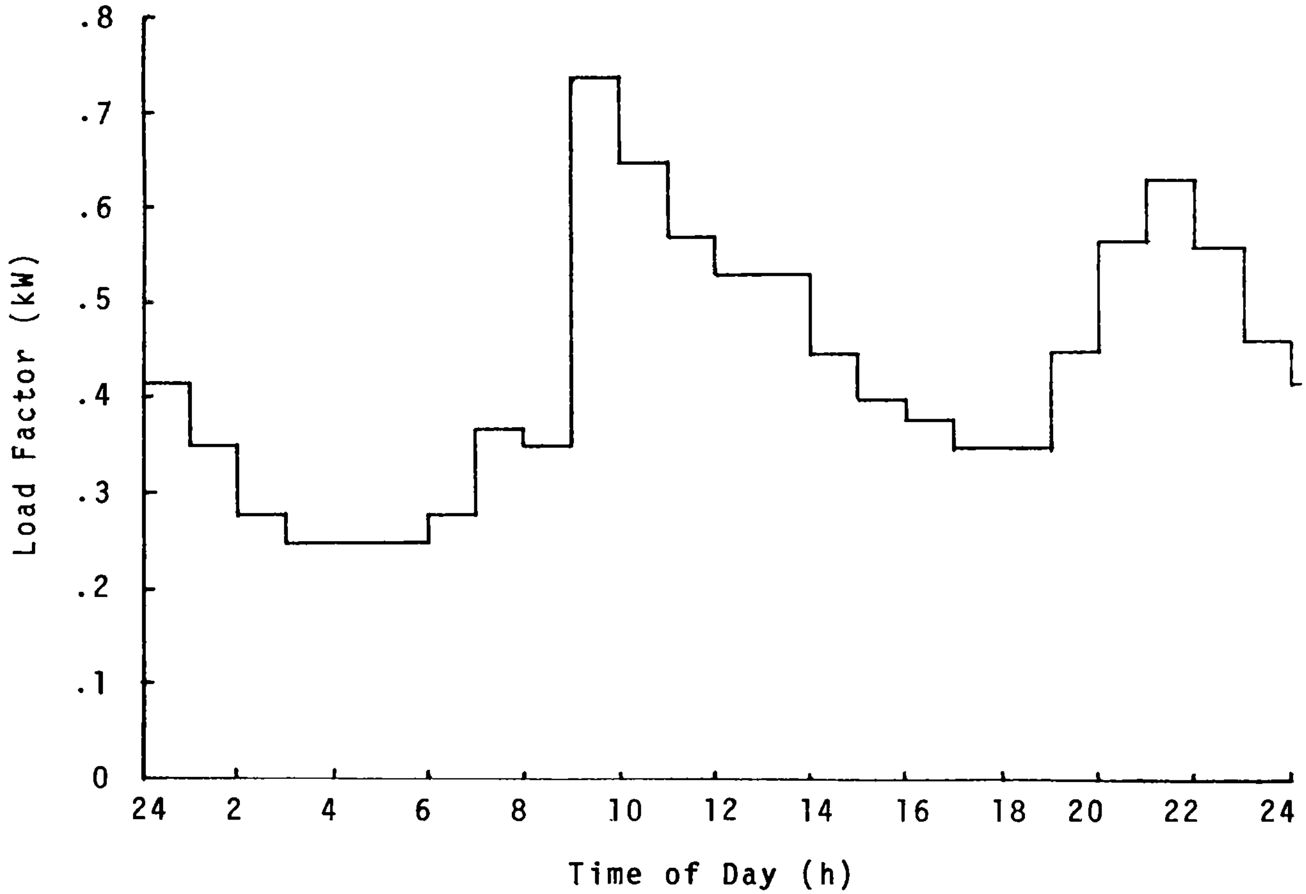

Figure 4.2 Default Hot Water Load Profile

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.

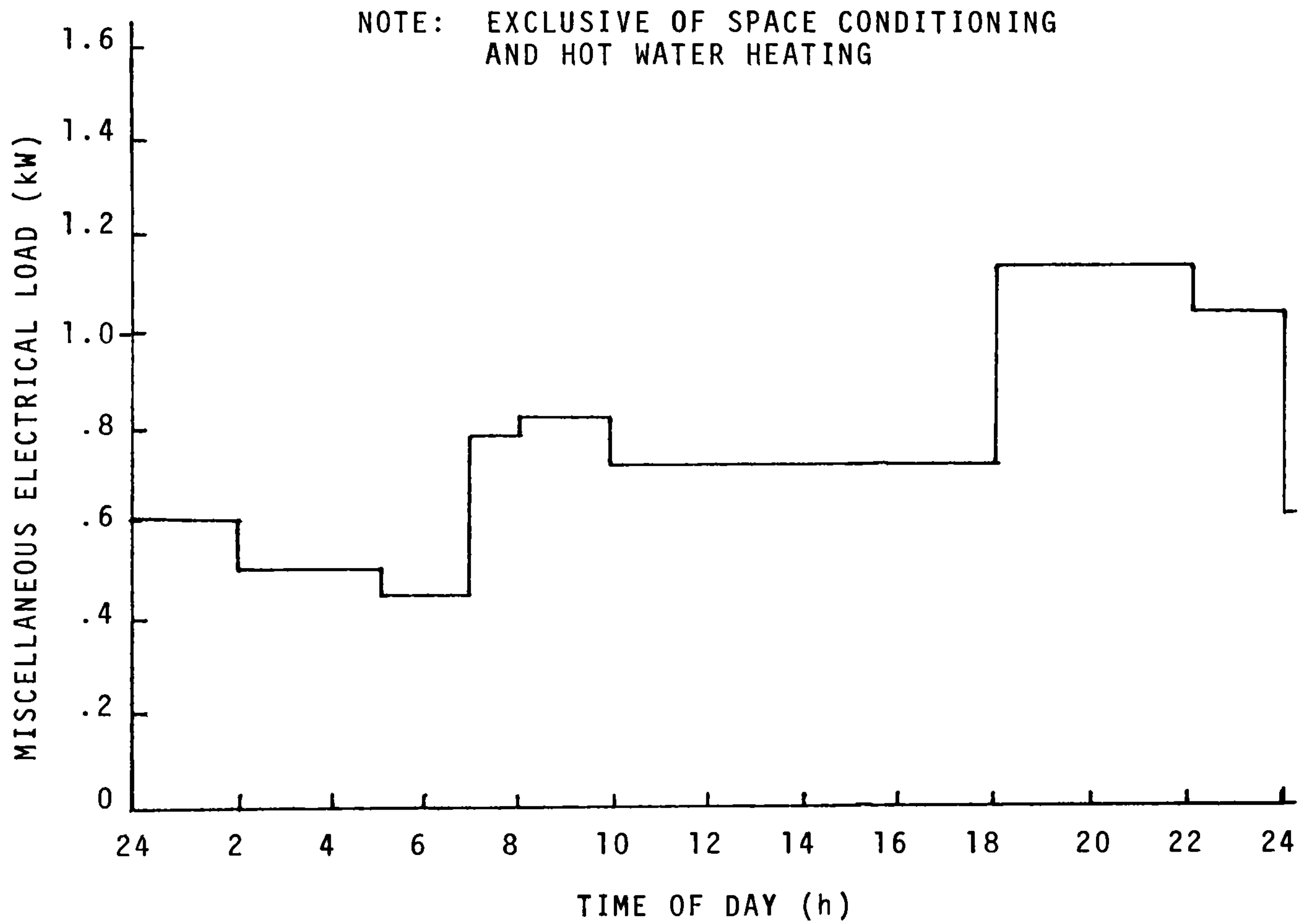

Figure 4.3 Default Miscellaneous Electrical Load Profile

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 <u>to</u> 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 <u>by</u> 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.

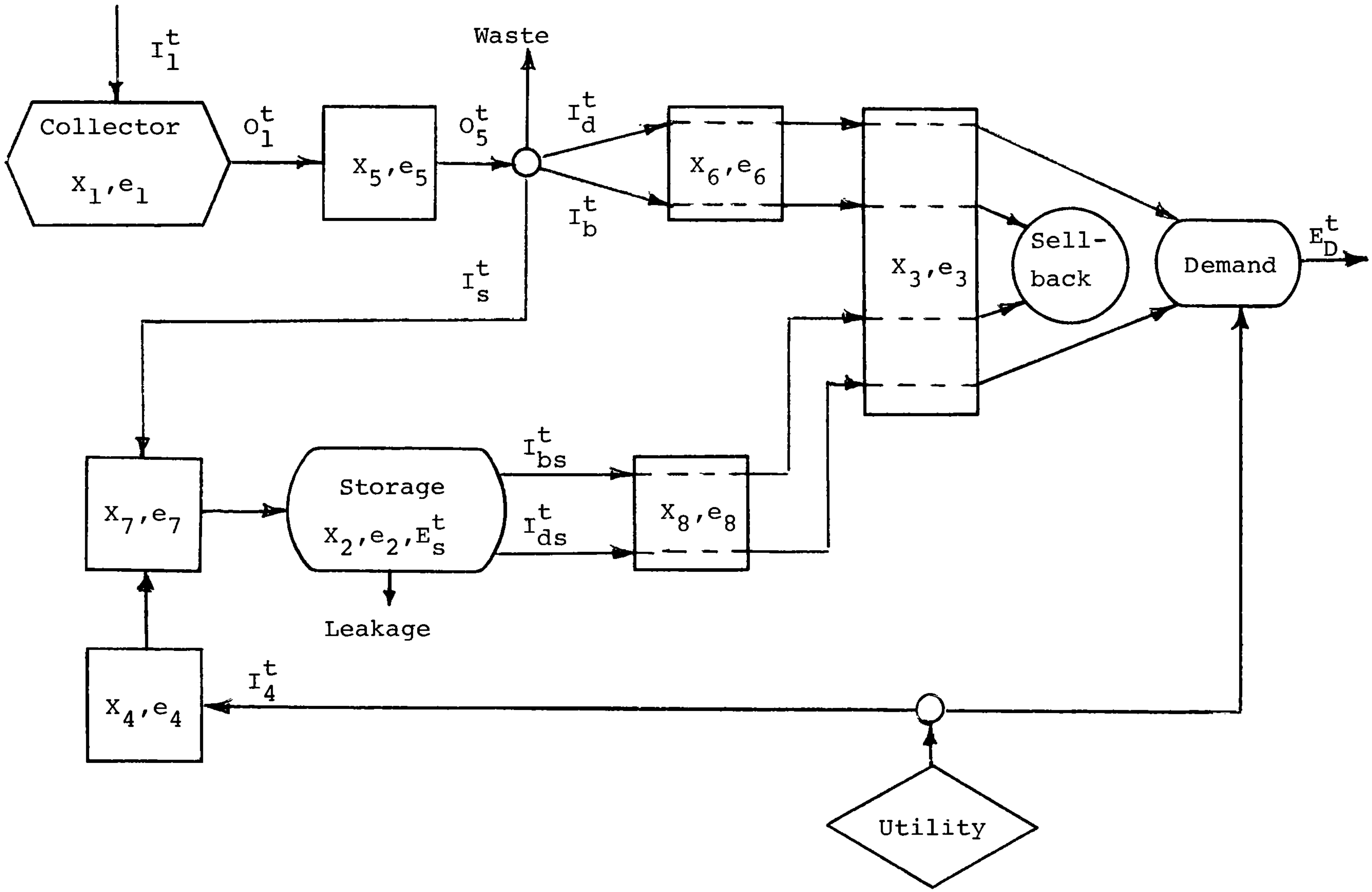

FIGURE 6.1 Block Diagram of UE11 System.

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 $X_7=r_7X_2$ and $X_8=r_8X_2$. 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

$$O_5^t = e_5e_1X_1I_1^t \quad . \tag{6-4}$$

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

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

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"

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

Equation "B"

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

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

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

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

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

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

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

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

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

For each t we get

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

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

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

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

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

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

3. $e_7 e_8 \max\left(1,\ e_2^m P_u/P\right) > e_6 \geq Re_6 \rightarrow$ 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. $q = \max\left(e_2,\ e_2^mP_u/P\right)$

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

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

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

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

7. $q_3 = e_2E_s^{t-1}+e_7I_s$. (6-21f)

   If $e_3e_4e_7e_8e_2^mP_u/P > 1$ and

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

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

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

$$\min \sum_{t=t_o+1}^{t_o+T} P^t \left(E_D^t - e_3 e_6 I_d^t - R e_3 e_6 I_b^t - e_3 e_8 I_{ds}^t - R e_3 e_8 I_{bs}^t + I_4^t \right) , \qquad (6\text{-}22)$$

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

$$E_s^t + I_{ds}^t + I_{bs}^t - e_4 e_7 I_4^t - e_7 I_s - e_2 E_s^{t-1} = 0 \qquad (6\text{-}23a)$$

$$I_{ds}^t + I_{bs}^t + I_d^t e_6/e_8 + I_b^t e_6/e_8 \leq X_3/e_8 \qquad (6\text{-}23b)$$

$$I_{ds}^t + I_{bs}^t \leq X_8 \qquad (6\text{-}23c)$$

$$e_4 I_4^t + I_s^t \leq X_7 \qquad (6\text{-}23d)$$

$$I_{ds}^t + I_d^t e_6/e_8 \leq E_D^t/e_3 e_8 \qquad (6\text{-}23e)$$

$$I_d^t + I_b^t + I_s^t \leq O_5^t \qquad (6\text{-}23f)$$

$$I_4^t \leq X_4 \qquad (6\text{-}23g)$$

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

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

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

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 $2 \le t \le T$. The LP is solved for $1 \le t \le T$, 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."

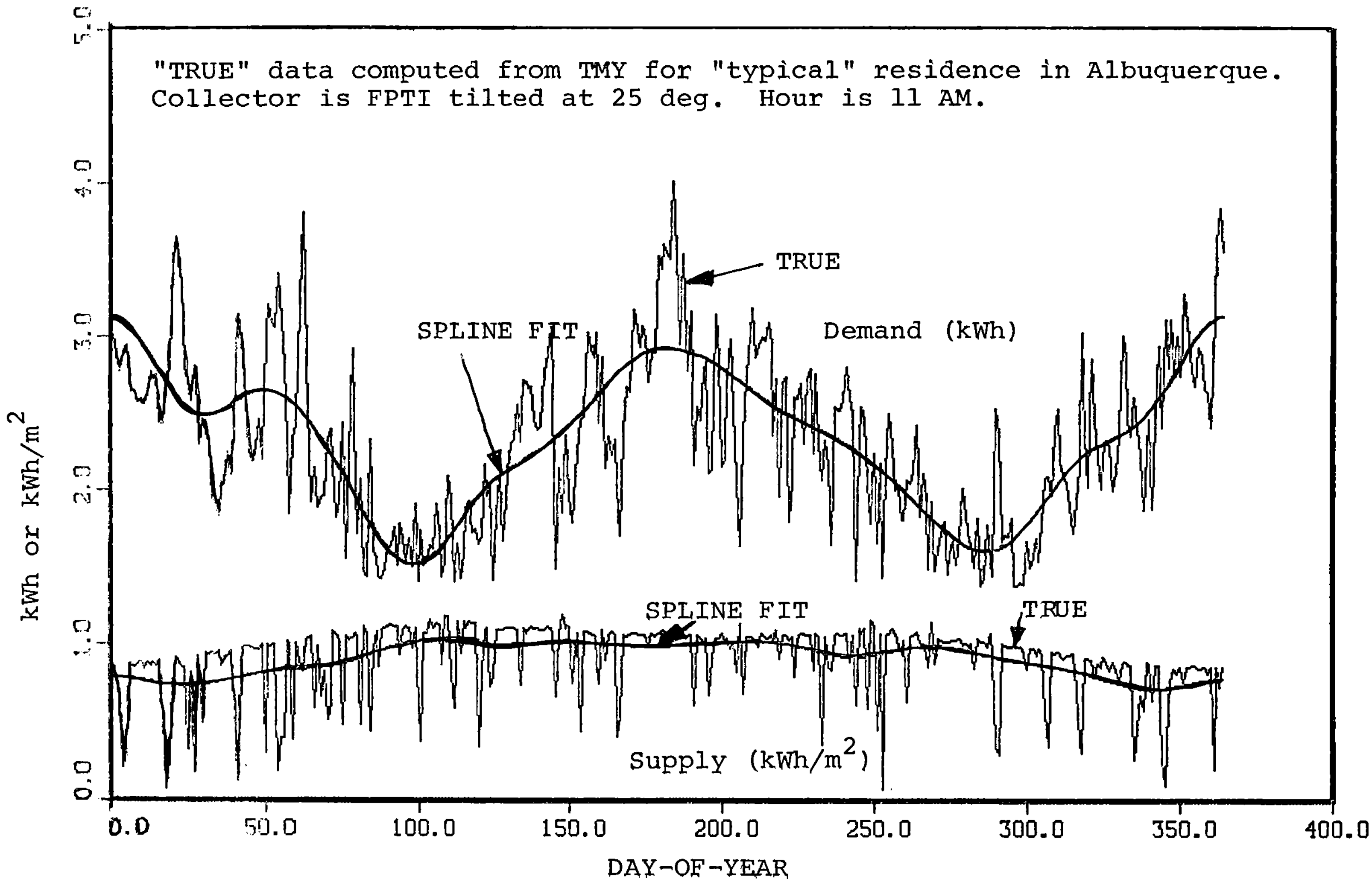

FIGURE 6.2 Sample Spline Fit to TMY Data.

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

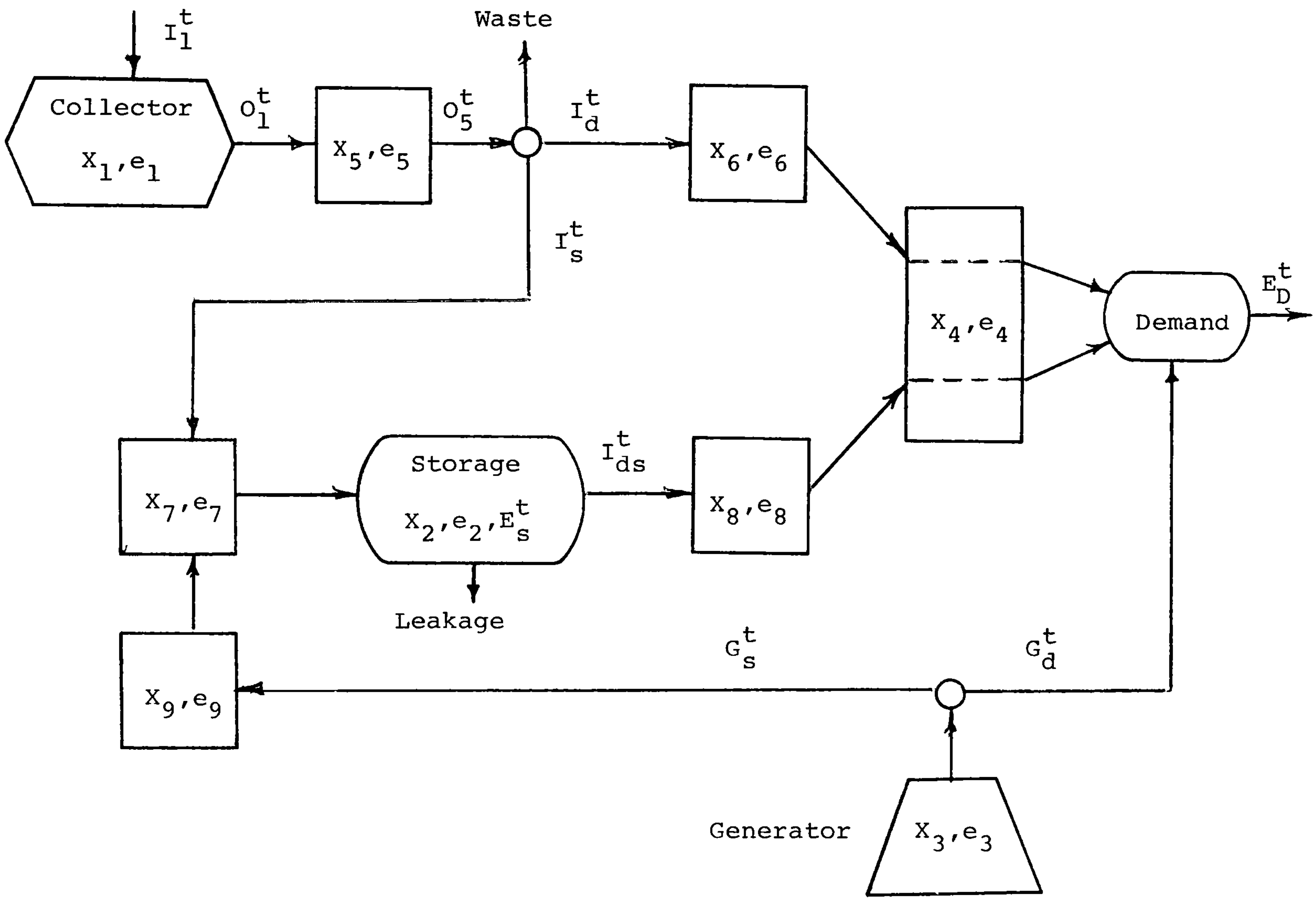

FIGURE 7.1 Block Diagram of GE11 System.

not be run at full throttle when it first starts. The parameter $0<g_b\le 1$ 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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

$$\lambda >>> 1 \quad . \tag{7-12}$$

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 dependently 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.

Generator Operation and Sizing

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

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

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

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

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

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

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

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

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 $X_3=x_3 X_{M3}$ and $X_4=x_4 X_{M4}$. 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 both 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 GEll

Optimization is carried out for up to five variables, X_1, X_2, X_3, X_L, and X_U. As with UEll, 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 $\phi_1 \leq X_1 \leq U_1$, $X_2 = 0$, $X_3 = 0$
   c. then $\phi_1 \leq X_1 \leq U_1$, $X_2 = 0$, $\phi_3 \leq X_3 \leq U_3$
   d. then $\phi_1 \leq X_1 \leq U_1$, $\phi_2 \leq X_2 \leq U_2$, $X_3 = 0$
   e. then $\phi_1 \leq X_1 \leq U_1$, $\phi_2 \leq X_2 \leq U_2$, $\phi_3 \leq X_3 \leq U_3$

   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 $a \sim b \rightarrow c = d$ means that if a is related to b by $\sim$ in the input, then c is set to d. The notation Error = (a b, etc.) means that if a is related to b by $\sim$ 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 job must be an ID card. If two or more cards appear in a run 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 "EØ." 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 "EØ." 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

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

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

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

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

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

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

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

*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

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

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

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 = ($w_0 \le 0$, $w_0 > 48$, $w_{i-1} \ge w_i$, $p_{1i} \le 0$, $p_{2i} \le 0$, $p_{1i} < p_{2i}$, $q_i < 0$, $h_{1i} < 1$, $h_{2i} > 24$, $h_{2i} < h_{1i}$, 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 GE11Aƀƀƀƀƀƀƀƀƀƀƀƀƀƀƀƀƀƀƀƀƀƀƀƀƀƀƀƀƀƀƀƀƀƀ 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--GASƀ, 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,

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

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

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

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 = $(0_5 - I_d - I_b - I_s)$

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  67.8  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      127128133785017D
 (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 48 46 45 60 75 80 75 70 70 70 70 70 70 70 9811011011010510080)
 (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/FPTI/         /.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       50.008        377.          1.170        1.137        5.325
 GE/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         .080                      .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

     PDO    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         6061436540753D
(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 90110110110105100 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. /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    /.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).

Distribution:
DOE/TIC-4500-R67
UC-60, 63a, 94c (596)

U. S. Department of Energy
600 E. Street, N. W.
Washington, D. C. 20545
Attn: A. R. Landgrebe (50)
P. D. Maycock
J. W. Mayo
V. Rabl
A. S. Clorfeine

U. S. Department of Energy
P. O. Box 5400
Albuquerque, New Mexico 87115
Attn: D. L. Plymale

The Aerospace Corporation
20030 Century Blvd.
Germantown, MD 20767
Attn: T. Blanchard, Jr.
D. Edwards

Argonne National Laboratory
9700 South Cass Avenue
Argonne, IL 60439
Attn: J. G. Asbury
D. L. Barney

Bechtel National, Inc.
P. O. Box 3965
San Francisco, CA 94119
Attn: D. J. Rosen
W. J. Stolte

Bell Laboratories
600 Mountain Avenue
Murray Hill, NJ 07974
Attn: D. O. Feder

Best Battery Co.
4015 Fleet St.
Baltimore, MD 21224
Attn: A. R. Best

F. Biondi, Consultant
74 Ridge Drive
Livingston, NJ 07039

Dr. Per Bro, Consultant
Rt. 7 Hyde Park Estates
Santa Fe, NM 87501

Brookhaven National Laboratory
Upton, NY 11973
Attn: J. McBreen

C & D Batteries
3043 Walton Road
Plymouth Meeting, PA 19462
Attn: D. D. Delans

Brooklyn College
Dept. of Physics
Brooklyn, NY 11210
Attn: Prof. Misha Tomkiewicz

C. H. Guernsey Co.
3555 NW 58th St.
Oklahoma City, OK 73112
Attn: S. Collier

Dow Chemical Company
2800 Mitchell Road
Walnut Creek, CA 94598
Attn: C. A. Levine

Eagle Pitcher
P. O. Box 47
Joplin, MO 64801
Attn: E. Carr

Energy Development Associates
1100 Whitcomb Avenue
Madison Heights, MI 48701
Attn: B. D. Brummet

ESB Incorporated
19 W. College Avenue
Yardley, PA 19067
Attn: D. T. Ferrell, Jr.
F. P. Malaspina

EPRI
3412 Hillview Avenue
P. O. Box 10412
Palo Alto, CA 94303
Attn: T. M. Lechner

Exxon Research & Engineering Co.
P. O. Box 8
Linden, NJ 07036
Attn: P. Grimes

GEL Incorporated
1511 Peace Street
Durham, NC 27701
Attn: R. Zito, Jr.

General Electric Co.
P. O. Box 8661
Philadelphia, PA 19101
Attn: R. L. McCarthy
E. Mehalick

Gilbert Associates
P. O. Box 1498
Reading, PA 19603
Attn: A. J. Sattolo

Globe-Union, Inc.
5757 Green Bay Avenue
Milwaukee, WI 53201
Attn: C. K. Morehouse

Gould Laboratories
40 Gould Center
Rolling Meadows, IL 60008
Attn: B. W. Burrows
J. Oxley
P. Thomas, Jr.

Grumman Aerospace
MSB-29-35
Bethpage, NY 11714
Attn: Mike Malison

Hittman Associates, Inc.
9190 Red Branch Road
Columbia, MD 21045
Attn: L. D. Carter

Intertechnology Corporation
100 Main Street
Warrenton, VA 22186
Attn: D. G. Edelman

JBF Scientific Corporation
2 Jewel Drive
Wilmington, MA 01887
Attn: J. E. Soden

Jet Propulsion Laboratory
4800 Oak Grove Drive
Pasadena, CA 91103
Attn: R. G. Forney

Lawrence Berkeley Laboratory
University of California
Berkeley, CA 94720
Attn: E. J. Cairns
F. McLarnon

Lawrence Livermore Laboratory
P. O. Box 808
Livermore, CA 94550
Attn: D. King (L-3888)

Martin Marietta Corporation
P. O. Box 179
Denver, CO 80201
Attn: R. L. Donovan

Massachusetts Institute of Tech.
Energy Laboratory
E38-400
Cambridge, MA 02139
Attn: R. Tabors

Massachusetts Institute of Tech.
Lincoln Laboratory
P. O. Box 73
Lexington, MA 02173
Attn: M. D. Pope

Mobile Tyco Solar Energy Corp.
16 Hickory Drive
Waltham, MA 02154
Attn: J. R. Wood

Motorola Semiconductor Products, Inc.
Solar Operations Division
P. O. Box 2953
Phoenix, AZ 85062
Attn: W. Bailey

NASA Industrial Application Ctr.
University of Southern Calif.
Denney Research Bldg., 3rd Floor
Los Angeles, CA 90007
Attn: D. Maund

NASA/Lewis Research Center
21000 Brookpart Road
Cleveland, OH 44135
Attn: R. S. Palmer
A. W. Nice

New York State Energy Research
and Development Authority
Rockefeller Plaza
Albany, NY 12223
Attn: R. S. Morette

Pennsylvania Power & Light Co.
2 N. Ninth Street
Allentown, PA 18101
Attn: H. G. Pfeiffer

Research Triangle Institute
P. O. Box 12194
Research Triangle Park, NC 27709
Attn: R. Burger
R. A. Whisnant

Rocky Flats Plant
Energy Systems Group
P. O. Box 464
Golden, CO 80401
Attn: R. P. Cingo

Solar Energy Research
Institute
1536 Cole Boulevard
Golden, CO 80401
Attn: F. Baylin
J. L. Watkins

Solar Power Corporation
5 Executive Park Drive
North Billerica, MA 01862
Attn: E. Wald

Stonehart Associates, Inc.
34 Five Fields Road
Madison, CT 06443
Attn: T. B. Reddy

Dr. Philip C. Symons, Consultant
4544 Ottawa Lane
Birmingham, MI 48010

Team, Inc.
P. O. Box 672
Springfield, VA 22150
Attn: E. M. Henry

Texas Tech University
P. O. Box 4200
Lubbock, TX 79409
Attn: W. M. Marey

Tideland Signal Corporation
P. O. Box 52430
Houston, TX 77052
Attn: C. Kotilla

U. S. Army/MERADCOM
DRDME-E
Fort Belvoir, VA 22060
Attn: D. D. Faehn

U. S. Navy/Naval Sea System
Command
Code 543
Washington, DC 20362
Attn: A. Himy

University of Houston
College of Engineering
Houston, TX 77004
Attn: E. C. Tacker

Westinghouse Electric Corp.
1310 Beulak Road
Pittsburgh, PA 15235
Attn: R. Rosey

Westinghouse Electric Corp.
Power Systems, AST
East Pittsburgh, PA 15112
Attn: J. T. Day

Yardney Electric Corp.
82 Mechanic St.
Pawcatuck, CN 02891

2000 E. D. Reed
2500 J. C. Crawford
2520 H. J. Saxton
2525 R. P. Clark
2525 J. L. Chamberlin
2525 J. D. Sealey (50)
2533 A. E. Verardo
2640 J. L. Tischhauser
2646 M. R. Scott
2646 E. A. Aronson (8)
4000 A. Narath
4700 J. H. Scott
4710 G. E. Brandvold
4719 D. G. Schueler
4719 G. J. Jones
4719 D. C. Browne
4720 V. L. Dugan
4723 W. P. Schimmel (5)

4723 D. L. Caskey (10)
4723 M. W. Edenburn
4740 R. K. Traeger
4744 H. M. Dodd
4744 B. C. Caskey (3)
3141 T. L. Werner (5)
3151 W. L. Garner (3)
8266 E. A. Aas
8452 A. C. Skinrood
8452 C. E. Hackett
For DOE/TIC (Unlimited Release)

☆U.S. GOVERNMENT PRINTING OFFICE: 1981-0-777-023/519

```
C               **************************
C              SOLSTOR - UE11 - SOLLIB1, SOLLIB2, SOLLIB3  LIBRARIES.
C                EUGENE ARONSON
C                2646 SANDIA LABORATORIES
C                ALBUQUERQUE, NEW MEXICO  87185
C                505 - 844-4348                    11/28/80
C
C                 *************************
C                 *       ISSUED BY       *
C                 *  SANDIA LABORATORIES, *
C                 *   A PRIME CONTRACTOR  *
C                 ********     TO THE     *
C                        *  UNITED STATES *
C                        *   DEPARTMENT   *
C                        *       OF       *
C                        *     ENERGY     *
C      ********************  ---NOTICE---  ********************
C      *THIS REPORT WAS PREPARED AS AN ACCOUNT OF WORK SPONSORED*
C      *  BY THE UNITED STATES GOVERNMENT.  NEITHER THE UNITED  *
C      *   STATES NOR THE UNITED STATES DEPARTMENT OF ENERGY,   *
C      *            NOR ANY OF THEIR EMPLOYEES,                 *
C      * NOR ANY OF THEIR CONTRACTORS, SUBCONTRACTORS, OR THEIR *
C      * EMPLOYEES, MAKES ANY WARRANTY, EXPRESS OR IMPLIED, OR  *
C      * ASSUMES ANY LEGAL LIABILITY OR RESPONSIBILITY FOR THE  *
C      *         *********     ACCURACY,     *********          *
C      *         *       *   COMPLETENESS *         *           *
C      *         *       *   OR USEFULNESS *        *           *
C      *         *       *      OF ANY     *        *           *
C      *         *       *   INFORMATION,  *        *           *
C      *         *       *    APPARATUS,   *        *           *
C      *      ****       *     PRODUCT     *        ****        *
C      *      *          *    OR PROCESS   *           *        *
C      *      *          *    DISCLOSED,   *           *        *
C      *      *          *   OR REPRESENTS *           *        *
C      *      *         **     THAT ITS    **          *        *
C      *      *         **   USE WOULD NOT **          *        *
C      ********         **     INFRINGE    **          *********
C                       **     PRIVATELY   **
C                       **       OWNED     **
C                       **      RIGHTS.    **
C                       **                 **
C                       **                 **
C                       **                 **
C                       *********************
```

```
C
C
C              SOLSTOR - UE11 - SOLLIB1 LIBRARY.
C
```

```
      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
```

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

  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

```
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)=CLV(J)/[illegible]
       PRINT9,CLV(1),CLV(2),CLV(4)
      JM=1HM
       IF(ISBIG.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						

```
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	

```
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                 0            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
```

```
1          SUBROUTINE STORI
            DIMENSION P(11)
           COMMON /COMMAIN/ NV,NCV,NCCOL,NCSTO,NCTRA,NOVAR,NCOTH,ISTH,ISBIG,
          1ITIT,IRUN,LCO(30),LCR(9,30),NTYPE
5          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
10         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.
15          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)
20         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)
25          XM(L,2)=P(8)
           CC(L)=P(9)
            CC(L,2)=P(10)
            CC(L,3)=P(11)
     20    NC=NC+1
30          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					

```
      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
    175          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
```

```
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.0..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	

```
       SUBROUTINE TODUP        74/74    OPT=2                          FTN 4.8+518         80/11/28. 10.23.01         PAGE      4

  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 E'OS    (11)
                                           43 ITOD    (26)                69 PCOS    (10)                79 PUCO    (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         10
     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                      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)=X0(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
       MIN0         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
```

```
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
```

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

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[illegible]   83    86        95       104       141
                                                   142   [illegible]            153     2*158   DEFINED      2*72      2*73
                                                    74   [illegible]            [illegible]0
```

```
        FUNCTION UE11DF      74/74    OPT=2                              FTN 4.8+518        80/11/28. 10.23.01       PAGE      5

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
```

```
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
      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     COMIN11      REFS        4       11      2*37      61      103      114
                                                     DEFINED      19       36        42      61       86
  4732  A2           REAL       ARRAY     COMIN11      REFS        4       12        62     103      114
                                                     DEFINED      23       25        39      43       45       62       87
                                                        95
  5042  A3           REAL       ARRAY     COMIN11      REFS        4       13        63     103  DEFINED       20       38
                                                        43        63       88
  4541  B            REAL       ARRAY     COMIN11      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
             JXOL(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
```

```
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
```

```
        FUNCTION UE11BF      74/74    OPT=2                          FTN 4.8+518          80/11/28. 10.23.01        PAGE       8

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 [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
```

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

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						

```
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						

```
          FUNCTION UE11CF      74/74   OPT=2                            FTN 4.8+518        80/11/28. 10.23.01       PAGE      8

 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
```

```
      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        74/74    OPT=2                          FTN 4.8+518        80/11/28. 10.23.01        PAGE      1


   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   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.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
  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
```

```
 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
```

```
      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 [illegible] 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
```

```
  1            SUBROUTINE SMOLS3(ISW,LHOL,INX)
               DIMENSION LHOL(5)
               LOGICALPS,TS
               DATA NP/10/,PS/.TRUE./,TS/.FALSE./
  5            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
 10            IF(TS)CALLEXIT
               RETURN
             2 PS=.FALSE.
               RETURN
             3 PS=.TRUE.
 15            NP=INX
               RETURN
             4 TS=.TRUE.
               RETURN
             5 TS=.FALSE.
 20            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		

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

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
```

```
C              *************************
C             SOLSTOR - GE11 - GENLIB1, GENLIB2, GENLIB3  LIBRARIES.
C               EUGENE ARONSON
C               2646 SANDIA LABORATORIES
C               ALBUQUERQUE, NEW MEXICO  87185
C               505 - 844-4348                     11/28/80
C
C               *************************
C               *       ISSUED BY       *
C               *  SANDIA LABORATORIES, *
C               *   A PRIME CONTRACTOR  *
C               ********     TO THE     *
C                      *  UNITED STATES *
C                      *   DEPARTMENT   *
C                      *       OF       *
C                      *     ENERGY     *
C      ********************  ---NOTICE---  ********************
C      *THIS REPORT WAS PREPARED AS AN ACCOUNT OF WORK SPONSORED*
C      *  BY THE UNITED STATES GOVERNMENT.  NEITHER THE UNITED  *
C      *    STATES NOR THE UNITED STATES DEPARTMENT OF ENERGY,   *
C      *             NOR ANY OF THEIR EMPLOYEES,                *
C      * NOR ANY OF THEIR CONTRACTORS, SUBCONTRACTORS, OR THEIR *
C      * EMPLOYEES, MAKES ANY WARRANTY, EXPRESS OR IMPLIED, OR  *
C      * ASSUMES ANY LEGAL LIABILITY OR RESPONSIBILITY FOR THE  *
C      *         **********     ACCURACY,    **********         *
C      *         *         *  COMPLETENESS *         *          *
C      *         *         *  OR USEFULNESS *        *          *
C      *         *         *     OF ANY    *         *          *
C      *         *         *  INFORMATION, *         *          *
C      *         *         *   APPARATUS,  *         *          *
C      *      ****         *     PRODUCT   *         ****       *
C      *      *            *   OR PROCESS  *            *       *
C      *      *            *   DISCLOSED,  *            *       *
C      *      *            *  OR REPRESENTS *           *       *
C      *      *           **    THAT ITS   **           *       *
C      *      *           **  USE WOULD NOT **          *       *
C      *********          **    INFRINGE   **           *********
C                         **    PRIVATELY  **
C                         **      OWNED    **
C                         **     RIGHTS.   **
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
```

```
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
```

```
115                 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)
120                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
125         C      FPNS
            28     Q1=SLA*CTL+STL*CLA
                    Q2=CLA*CTL-SLA*STL
                    Q3=.75+.25*Q2
                   DO 29 J=1,364
130                 SDL=SDF(J)
                    Z1=CDF(SDL)*CLA
                    Z2=SLA*SDL
                   DO 29 I=1,24
                    Z3=Z1*CH(I)+Z2
135                 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
140                 GO TO 40
            C      HAWT
            30     DO 31 J=1,364
                    DO 31 I=1,24
                    J1=ESD(1,I,J).A.7777B
145                 Z1=.1*J1
            31     ESD(K,I,J)=Z1.A.MU
                    GO TO 40
            C      VAWT
            32     PRINT33
150                 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 *)
155         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
```

```
      SUBROUTINE SUPPLY     74/74    OPT=2                         FTN 4.8+518         80/11/28. 10.01.44        PAGE      5

 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
```

```
      SUBROUTINE DEMAND     74/74   OPT=2                            FTN 4.8+518        80/11/28. 10.01.44      PAGE     5

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		

```
  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
  5             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
 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)
 15             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)
 20             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
 25       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,
 30            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
```

```
C
C
C                 SOLSTOR - GE11 - GENLIB2 LIBRARY.
C
```

```
          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
```

```
                 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
```

```
      SUBROUTINE PROUT       74/74   OPT=2                        FTN 4.8+518          80/11/28. 10.01.44        PAGE      3

 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.[illegible].2)GO TO 80 $ PRINT1 $ CALL EXIT
    1 FORMAT(* PREDICTION NOT ALLOWED WITH WIND*)
   80 DIA=SQRT(25[illegible].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([illegible]) $ 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(11)/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
  1 20  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
```

```
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
```

```
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=MIN0(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
```

```
VARIABLES      SN  TYPE            RELOCATION
     0  XO         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
        APS        REAL         1  INTRIN                  59
        AMAX1      REAL         0  INTRIN                  19       43
        AMIN1      REAL         0  INTRIN                  14       48
        MINO       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

```
      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 /
      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
      MFLAG = 1
      M = INT((ALOG(FLOAT(N)))/B)
      I=2**M
      K=I
   10 K=K/2
      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
   12 I = I+K
   13 IF (I.LE.N) GO TO 10
      I = I-1
      GO TO 13
   14 MFLAG=0
      RETURN
   15 CALL SMOLS3(1,COM3,1)
      RETURN
   16 CALL SMOLS3(1,COM1,1)
      RETURN
   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
```

```
       SUBROUTINE SMOLS1      74/74    OPT=2                          FTN 4.8+518         80/11/28. 10.01.44        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
       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
```

```
    1          SUBROUTINE SMOLS3(ISW,LHOL,INX)
               DIMENSION LHOL(5)
               LOGICALPS,TS
               DATA NP/10/,PS/.TRUE./,TS/.FALSE./
    5          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
   10          IF(TS)CALLEXIT
               RETURN
             2 PS=.FALSE.
               RETURN
             3 PS=.TRUE.
   15          NP=INX
               RETURN
             4 TS=.TRUE.
               RETURN
             5 TS=.FALSE.
   20          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) 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(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
```

```
      SUBROUTINE STAGET     74/74   OPT=2                           FTN 4.8+518        80/11/28. 10.01.44       PAGE      2

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
```