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Electric Utility Value Determination for Wind Energy

Volume II: A User's Guide

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SERI

Solar Energy Research Institute

A Division of Midwest Research Institute

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MASTER

**ELECTRIC-UTILITY VALUE
DETERMINATION FOR WIND
ENERGY**

VOLUME II: A USER'S GUIDE

**DAVID PERCIVAL
JAMES HARPER**

FEBRUARY 1981

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Solar Energy Research Institute

A Division of Midwest Research Institute

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Golden, Colorado 80401**

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PREFACE

This report, the second of two volumes prepared within the Utility Applications and Policy Branch of SERI for the Department of Energy's Wind Energy Systems Division under Subtask 3532.15, is a user's guide to the computer programs used to determine the value of wind energy conversion systems to electric utilities. Volume I describes the value determination methodology and gives detailed discussion on each computer program available from SERI.

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SUMMARY

Objective:

The objective of this two-volume report is to describe a method developed by the Solar Energy Research Institute (Seri) for determining the value of Wind Energy Conversion Systems (WECS) to electric utilities. The method involves using a package of computer models available from Seri. These models vary in sophistication and may be used with most utility planning models. Only minimal effort should be required to make the programs operational on hardware other than the Control Data Corporation CDC hardware on which the programs were developed and used.

Discussion:

The first volume of this report describes the value determination method and gives detailed discussion on each computer program available from Seri. The second volume is a user's guide for these computer programs.

The value determination process begins with the processing of weather data by computer programs WTP or WEIBUL to produce hourly wind speed data or wind probability distributions, respectively. These data are then provided as input to the program ROSEW, which estimates wind-derived electricity production.

The results from ROSEW, which can provide probabilities of certain WECS power levels being produced, are next input to the program ULMOD so that the utility load forecast may be modified to incorporate the WECS generation. These results, which are for as many years as desired, are provided to the utility planning models. The expansion planning model develops an optimal scenario of conventional generating unit additions. This number of conventional units is given to a production cost model to develop a more accurate estimate of the variable operating costs needed for the conventional generating system. This cost information and the conventional capacity information from the expansion model for the base case (zero WECS) and for all the change cases (varying WECS capacity) are provided to FINAM. This final routine determines the break-even cost of each WECS penetration (\$/rated kW) and the WECS marginal value (\$/rated kW), where value is the utility's present worth savings of reduced operating costs and modified capital additions. These values may be combined with total WECS cost to determine the maximum amount of WECS capacity that can be economically justified for addition to the utility system.

If the WECS value obtained exceeds the amount for which WECS may be purchased, the utility planner might next perform a financial analysis by the utility's corporate model to determine effects on cash flow, debt requirements, etc.

While the analysis was primarily developed for utility-owned and controlled WECS, it easily could be applied to nonutility-owned WECS with proper treatment of WECS availability.

Conclusions and Recommendations:

A planning group interested in this wind value determination method should obtain copies of the SERI-developed computer programs (WTP, WEIBUL, ROSEW, ULMOD, and FINAM) along with Volumes I and II of this report. The utility expansion planning and production cost models are currently used by many utilities and are not available through SERI. The utility may also prefer to use its own financial model instead of FINAM in the last step of the method.

This group of programs and associated materials are identified by the name WECS. The SERI codes are available through two sources. Qualifying organizations may use the SERI Solar Energy Information Data Bank (SEIDB) network, which houses these computer models. To determine qualification status, contact: Rafael Ubico, SEIDB Coordinator, SERI, 1617 Cole Blvd., Golden, CO 80401; 303-231-1032 (FTS-327-1032). These models are also available through National Energy Software Center, Argonne National Laboratory, 9700 S. Cass Ave., Argonne, IL 60439.

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SERIO

SECTION 1.0

INTRODUCTION

This volume is intended for those who will be utilizing the computer programs available from SERI to determine the value of intermittent power generation sources, specifically Wind Energy Conversion Systems (WECS). Reference should be made to Volume I: A Methodology for a complete description of how the various routines may be used together and how each routine performs its tasks. All programs are written in the FORTRAN IV language and are presently installed on Control Data Corporation (CDC) hardware. The CDC compiler currently in use is the FTN compiler. Some knowledge of the FORTRAN will be needed to use this guide. There is a separate section for each computer program (WTP, WEIBUL, ROSEW, ULMOD, and FINAM). Each section includes, where appropriate, a description of: (1) features and peculiarities required for installation at SERI, (2) all manually created (or card-type) input data required, (3) computer data file inputs, (4) printed results, and (5) program-created data file results. Samples are provided for inputs, outputs, and a CDC runstream for each routine.

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SECTION 2.0

WTP - WEATHER TAPE PREPROCESSOR

As explained in Vol. I, WTP is the starting point in the analysis if the Weibull option is not chosen. WTP's basic job is to process any one of four types of raw weather data. WTP reads only the necessary data, replaces missing or faulty data by interpolation, converts to the proper units, and finally outputs the data in an acceptable format. This output proceeds to ROSEW for hourly power or typical day operation. Volume I, Sec. 3.0, provides much more detail on WTP.

2.1 FACILITY SPECIFICS

Since WTP was designed to run on a CDC system, two program specifics may cause problems on other systems. First, a PROGRAM card is required at the beginning of the code on the CDC system and may not be required for other systems. Second, two hexadecimal constants, 000072B and 000066B, exist at the end of subroutine BLOCK DATA. For normal CDC systems, these represent a zero overstruck with a plus and a zero overstruck with a minus. When using other systems, these must be changed to the proper representation for the overstrike characters.

2.2 WTP INPUT DATA

WTP requires a small amount of manually created input data for execution. Each input type is identified in the first two columns of the card; with the types as follow:

- WA--Header card
- WB--Title cards
- WC--Weather card

2.2.1 WA--Header Card

One card is required, placed first in the input deck.

FORMAT (A2,2X,10A4,3I2)

- CRDTYP -- WA
- USER -- Name of user, 40 characters
- IMONTH -- Month of run
- IDAY -- Day of run
- IYEAR -- Year of run

2.2.2 WB--Title Cards

Three cards are required, placed after the WA card. Each has a 40-character title.

FORMAT (A2,2X,10A4)

CRDTYP -- WB

TITLE -- 40-character title

2.2.3 WC--Weather Cards

One card is required, placed after the third WB card.

FORMAT (A2,3X,I1,I5,I4,2F5.1,I2,F4.1,5A4)

CRDTYP -- WC

ISOURC -- Weather data source:

1 = TDF-14

2 = Aerospace

3 = SOLMET

4 = TMY

NWSTAT -- National Climatic Center weather station number;
Must match number on weather tape

NWYEAR -- Weather year desired;
Must be four digits and match year on weather tape

WSLAT -- Latitude of station, degrees;
North is positive, south is negative

WSLONG -- Longitude of station, degrees;
West is positive, no negatives allowed

NTZWS -- Time zone of weather station:
5 = Eastern
6 = Central
7 = Mountain
8 = Pacific

HTWIND -- Height of wind recorder (m)

WSNAME -- Weather station name;
20-character identification

This completes the card input data requirements. These data are expected on "TAPE5" as shown in the sample control card sequence of Sec. 2.6. Figure 2-1 gives a data sample.

2.3 WTP INPUT WEATHER DATA

As described previously, one year of any of four types of weather data can be selected for WTP input: TDF-14, Aerospace, SOLMET, or TMY. One of these tapes must be provided to WTP as "TAPE10," as shown in the sample runstream in Sec. 2.6.

2.4 WTP PRINTED OUTPUT

For visual inspection, WTP outputs a file containing the input data and a missing data summary. A sample of this output is given in Fig. 2-2. This file is output on "TAPE6" of the sample control card deck of Sec. 2.6.

2.5 WTP OUTPUT FILE

The WTP output file for use by ROSEW contains a header line followed by 8760 (365 × 24) lines of hourly weather data (8784 in leap year).

2.5.1 Header

```
FORMAT (I5,1X,I2,1X,I1,1X,F5.1,1X,F5.1,1X,I2,1X,5A4,  
        6X,I1,1X,F4.1,1X,F4.2,1X,F5.3,1X,7I1)
```

<u>Column</u>	<u>Variable</u>
1-5	Weather station number
7-8	Weather year, 2 digit
10	Leap year; 1 = yes, 0 = no
12-16	Weather station latitude; degrees
18-22	Weather station longitude; degrees
24-25	Weather station time zone: 05 = Eastern 06 = Central 07 = Mountain 08 = Pacific
27-46	Weather station name
53	Weather data source 1 = TDF-14 2 = Aerospace 3 = SOLMET 4 = TMY
55-58	Height of wind speed recorder (m)
60-63	Ground reflectivity at station; Fractional

65-69	Terrain factor at station; Range: 0-1.
71	Dry-bulb temperature code
72	Barometric pressure code
73	Relative humidity code
74	Wind speed code
75	Opaque sky cover code
76	Direct insolation code
77	Total insolation code

(Codes are 0 = not provided, 1 = provided)

2.5.2 Weather Data

FORMAT (I4,1X,I2,1X,I2,1X,I2,2X,F5.1,1X,F6.4,1X,F5.3,
1X,F5.1,1X,F5.3,1X,F5.3,1X,F5.3)

<u>Column</u>	<u>Variable</u>
1-4	Hour of year
6-7	Month of year
9-10	Day of month
12-13	Hour of day
16-20	Dry-bulb temperature ('C)
22-27	Barometric pressure; bars
29-33	Relative humidity; fractional
35-39	Wind speed (m/s)
41-45	Opaque sky cover; fractional
47-51	Direct insolation; kW/m ²
53-57	Total insolation; kW/m ²

A sample of this output file is given in Fig. 2-3. The file is represented by "TAPE11" in the sample runstream in Sec. 6.0.

2.6 WTP SAMPLE CONTROL CARD SEQUENCE

A sample control card sequence for a standard CDC-SCOPE system is shown in Fig. 2-4.

```
WA  SAMPLE PROBLEM - ALBUQUERQUE, N.M.      120180
WB  ***  ALBUQUERQUE, N.M. - TMY TAPE
WB  ***  TAPE OBTAINED FROM NCC
WB  ***  TAPE ALSO RESIDES ON SERI DISKPACK
WC  4230501999 35.0107.0 711.9 ALBUQUERQUE, N.M.
```

Figure 2-1. WTP Manually Created Input Data

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12/ 1/80

WTP - WEATHER TAPE PREPROCESSOR

---SAMPLE PROBLEM - ALBUQUERQUE, N.M.---

PAGE 1

```

CCCCC  000000  RRRRRR  EEEEEEE  LL      AA      TTTTTTT  EEEEEEE
CCCCCCC 00000000 RRRRRRR  EEEEEEE  LL      AAAA   TTTTTTT  EEEEEEE
CC  CC  00  00  RR  PR  EE      LL      AA  AA  T1      EE
CC      00  00  RR  PR  EEEEE  LL      AA  AA  T1      EEEEE
CC      00  00  PRRRRR  EEEEE  LL      AAAAAAA  T1      EEEEE
CC  CC  00  00  RRRRRR  EE      LL      AAAAAAA  T1      EE
CCCCCCC 00000000 RR  RR  EEEEEEE LLLLLLL  AA  AA  T1      EEEEEEE
CCCCC  00000  RR  RR  EEEEEEE  LLLLLLL  AA  AA  T1      EEEEEEE

```

```

*** ALBUQUERQUE, N.M.- THY TAPE
*** TAPE OBTAINED FROM MCC
*** TAPE ALSO RESIDES ON SERI DISKPACK

```

Figure 2-2. WTP Printed Output

INPUT DATA

SOURCE DATA FORMAT - 4 - NATIONAL CLIMATIC CENTER - TMY TAPE FORMAT

WEATHER STATION NO. 23050 - ALBUQUERQUE, N.M.

WEATHER YEAR - TYPICAL

LOCATION

LATITUDE - 35.0 DEGREES
LONGITUDE - 107.0 DEGREES
TIME ZONE - 7 (MOUNTAIN)

HEIGHT OF WIND SPEED RECORDER - 11.9 METERS

MISSING DATA SUMMARY

<u>PARAMETER</u>	<u>NUMBER OF HOURS DATA WAS MISSING</u>
DRY BULB TEMPERATURE	0
BAROMETRIC PRESSURE	0
WIND SPEED	0
PERCENT OPAQUE SKY COVER	2432
DIRECT INSOLATION	0
TOTAL INSOLATION	0

Figure 2-2. WTP Printed Output (Concluded)

```
23050 99 0 35.0 107.0 7 ALBUQUERQUE,N.M. 4 11.9 0.00 .143 1101111
 1 1 1 1 -3.3 .8459 0.000 2.1 0.000 0.000 0.000
 2 1 1 2 -4.4 .8459 0.000 0.0 0.000 0.000 0.000
 3 1 1 3 -5.0 .8459 0.000 0.0 0.000 0.000 0.000
 4 1 1 4 -4.4 .8456 0.000 3.1 0.000 0.000 0.000
 5 1 1 5 -5.6 .8456 0.000 3.6 0.000 0.000 0.000
 6 1 1 6 -6.7 .8459 0.000 3.7 0.000 0.000 0.000
 7 1 1 7 -7.8 .8463 0.000 3.1 0.000 0.000 0.000
 8 1 1 8 -6.1 .8469 0.000 3.1 0.000 .215 .043
 9 1 1 9 -5.6 .8473 0.000 0.0 .100 .491 .182
10 1 1 10 -3.3 .8473 0.000 2.1 .100 .838 .354
11 1 1 11 -1.1 .8473 0.000 0.0 .100 .970 .499

      ↑↓
8759 12 31 23 0.0 .8358 0.000 1.5 .300 0.000 0.000
8760 12 31 24 0.0 .8358 0.000 1.5 .300 0.000 0.000
```

Figure 2-3. WTP Output File

```
WTP,T100,YD1.
COMMENT. FILE,TAPE10,RT=F,FL=163,BT=K,RB=24,MBL=3912,CM=YES.
COMMENT. ABOVE FOR SOLMET. BELOW FOR TMY.
FILE,TAPE10,RT=F,FL=132,BT=K,RB=24,MBL=3168,CM=YES.
FILE,TAPE11.
FILE,TAPES,FL=80.
FILE,TAPE6,FL=80.
FILE,WTP,FL=80.
GETPF,WTP,ID=UID.
GETPF,TAPES,ID=UID.
COMMENT. REQUEST,WTPX,*PF.
FTN,I=WTP,B=WTPX,R=0,L=0,ER.
COMMENT. CATALOG,WTPX,ID=UID.
COMMENT. VSN-S00183=TMY, VSN-S00035=ALBQ SOLMET.
STAGE,TAPE10,PRE,VSN=S00183,PE,NT,EB.
LDSET,FILES=TAPE10.
WTPX.
REWIND,TAPES.
COPYSBF,TAPES,OUTPUT.
REWIND,TAPE6.
COPYSBF,TAPE6,OUTPUT.
REWIND,TAPE11.
SAVEPF,TAPE11,SAVEF,ID=UID.
EXIT.
```

(Lines beginning in "COMMENT." are inactive, but removing the "COMMENT." will activate the command.)

Figure 2-4. WTP Sample Runstream

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SECTION 3.0

WEIBUL WIND DISTRIBUTION

WEIBUL's objective is to create Weibull wind speed probability distributions, given weather data as input. Multiyear data from any of the four weather-data types previously discussed can be used. A Weibull distribution is created for each hour of a monthly typical day, with these 288 distributions available to ROSEW for Weibull option execution. In Vol. I, Sec. 4.0, the WEIBUL methodology is discussed.

3.1 FACILITY SPECIFICS

Since WEIBUL was created by strongly modifying WTP, the two specifics mentioned for WTP also apply. These give consideration of the PROGRAM statement and the code required to represent the overstruck characters at the end of subroutine BLOCK DATA.

3.2 WEIBUL INPUT DATA

Like WTP, the manually created input data required by WEIBUL are identified by the card's first two columns. The types are:

- WA--Header Card
- WB--Title Cards
- WC--Weather Card
- WD--Curve Parameter Card

3.2.1 WA--Header Card

One card is required at the beginning of the data.

FORMAT (A2,2X,10A4,3I2)

- CRDTYP -- WA
- USER -- Name of user; 40 characters
- IMONTH -- Month of run
- IDAY -- Day of run
- IYEAR -- Year of run

3.2.2 WB--Title Cards

Three cards are required, placed after the WA card. Each is a 40-character title.

FORMAT (A2,2X,10A4)

CRDTYP -- WB

TITLE -- 40-character title

3.2.3 WC--Weather Card

One card is required, placed after the third WB card.

FORMAT (A2,1X,I1,1X,I5,1X,I4,1X,I4,1X,F4.1,1X,5A4)

CRDTYP -- WC

ISOURCE -- Weather data source:

1 = TDF-14

2 = Aerospace

3 = SOLMET

4 = TMY

NWSTAT -- National Climatic Center weather station number;
Must match number on weather tape

NWYEAR -- First weather year desired in the wind speed probability
distribution development;
Must be four digits and match year on weather tape

LASTYR -- Last weather year desired;
If only 1 year of data desired, enter same year as NWYEAR

HTWIND -- Height of wind recorder (m)

WSNAME -- Weather station name;
20-character identification

3.2.4 WD--Curve Parameter Card

One card is required, placed after the WC card.

FORMAT (A2,1X,I1,1X,I3,1X,F5.2,1X,F5.2)

CRDTYP -- WD

IOPT -- Calculation option, (see Vol. I, Sec. 4.0):

0 = maximum likelihood technique

1 = ordinary least squares technique

IBINS -- Number of wind bins (divisions between cut-in and maximum wind
speed) for calculation purposes;

Range: 1-100

Recommendation: As large as possible for accuracy's sake--
tradeoff with CPU time (see Vol. I, Sec. 4.0)

WSMAX -- Maximum wind speed expected [m/s (see Vol. 1, Sec. 4.0)]

WSCUTIN -- Wind machine cut-in wind speed (m/s) at height of wind data recordings. The following hand calculation is required to determine the proper input value:

$$WSCUTIN = W_{CI}(H_a/H_h)^\alpha$$

where:

W_{CI} = wind machine cut-in wind speed at machine hub height (m/s). If more than one wind machine is to be analyzed, then the smallest cut-in value of all the wind machines should be entered (see Vol. I, Sec. 4.0).

H_a = height of wind-speed recorder used to collect data (m).

H_h = hub height of wind machine (m). The machine with the smallest cut-in velocity should again be used.

α = terrain factor to be input to ROSEW (see Sec. 4.2.5).

Only wind speeds above this value are used to create a Weibull distribution.

This completes the card input requirements. This data is to be input on "TAPE5" in the sample runstream in Sec. 6.0. A sample of this data is given in Fig. 3-1.

3.3 WEIBUL INPUT WEATHER DATA

Multiyear weather data from TDF-14, Aerospace, SOLMET, or TMY must be made available to WEIBUL. The sample control card sequence of Sec. 3.6 shows this data entering as "TAPE10."

3.4 WEIBUL PRINTED OUTPUT

WEIBUL outputs a file for visual inspection on "TAPE6" of the sample runstream. This file includes input data, a missing data summary, and some interesting Weibull output parameters for each hour of the month's typical days. A sample of this output, shown in Fig. 3-2, is generally printed on paper.

3.5 WEIBUL OUTPUT FILE

Important results are output to a file identified for later input to ROSEW. These results contain one line of header information and 288 (24 × 12) lines of Weibull information--each line describing one hour of a monthly typical day.

3.5.1 Header

FORMAT (I5,1X,I4,1X,I4,1X,I1,16X,5A4,1X,I1,
1X,F5.2,1X,I3,1X,F5.2,1X,F5.2)

<u>Column</u>	<u>Variable</u>
1-5	Weather station number
7-10	First weather year; 2 digits
12-15	Last weather year; 2 digits
17	Leap year; 1 = yes, 0 = no
34-53	Weather station name
55	Weather data source 1 = TDF-14 2 = Aerospace 3 = SOLMET 4 = TMY
57-61	Height of wind speed recorder (m)
63-65	Number of calculation bins
67-71	Maximum expected wind speed
73-77	Cut-in wind speed input on WD card

3.5.2 Results

FORMAT (2I2,2F5.2,4F7.3,2X,F6.4)

<u>Column</u>	<u>Description</u>
1-2	Month
3-4	Hour of monthly typical day
5-9	K - Weibull shape parameter
10-14	C - Weibull scale parameter
15-21	Average pressure; bars
22-28	Average temperature (°C)
29-35	Average relative humidity; fractional
36-42	Average wind speed (m/s)
45-50	Probability of the wind being below cut-in wind speed

A sample of this output file is shown in Fig. 3-3. The file is identified as "TAPE11" in the following sample runstream.

3.6 WEIBUL SAMPLE CONTROL CARD SEQUENCE

Figure 3-4 gives a sample control card sequence for a normal CDC-SCOPE operating system.

```
WA TEST RUN FOR CALCULATION COMPARISON      120480
WB TMY - ALBUQUERQUE,NM
WB MAXIMUM LIKELIHOOD TECHNIQUE
WB
WC 4 23050 1999 1999 11.9 TMY ALBUQUERQUE
WD 0 100 40.      0.00
```

Figure 3-1. WEIBUL Manually Created Input Data

INPUT DATA

SOURCE DATA FORMAT - 4 - NATIONAL CLIMATIC CENTER - THY TAPE FORMAT

WEATHER STATION NO. 23050 - THY ALBUQUERQUE

A TYPICAL METEOROLOGICAL YEAR IS USED - THY

** THE MAXIMUM LIVLIMOOD TECHNIQUE HAS BEEN CHOSEN TO CALCULATE THE WEIBULL PARAMETERS

HEIGHT OF WIND SPEED RECORDER - 11.6 METERS

NUMBER OF DAYS OF DATA USED IN WEIBUL CALCULATION - 365

WSMAX = 40.000 METERS/SEC TOTAL BINS = 100 WSDIVB = .40000

CUTIN WIND SPEED AT ANEMOMETER HEIGHT = 5.030 METERS/SEC

NUMBER OF ITERATIONS-	8					
1 1	1.211	1.931	.838	-.781	0.000	3.077
NUMBER OF ITERATIONS-	6					
1 2	.940	1.242	.838	-1.161	0.000	2.839
NUMBER OF ITERATIONS-	3					
1 3	1.026	1.406	.838	-1.645	0.000	3.068
NUMBER OF ITERATIONS-	4					
1 4	1.200	1.770	.838	-1.777	0.000	2.945
NUMBER OF ITERATIONS-	10					
1 5	.941	.859	.838	-2.281	0.000	2.832
NUMBER OF ITERATIONS-	7					
1 6	1.493	.667	.838	-2.719	0.000	2.742
NUMBER OF ITERATIONS-	4					
1 7	1.274	1.781	.839	-3.006	0.000	2.577
NUMBER OF ITERATIONS-	2					
1 8	.500	1.800	.839	-2.919	0.000	2.361
NUMBER OF ITERATIONS-	7					
1 9	1.675	2.902	.840	-1.445	0.000	2.310
NUMBER OF ITERATIONS-	4					
1 10	1.278	1.647	.840	.735	0.000	2.742
NUMBER OF ITERATIONS-	9					
1 11	1.162	1.556	.840	2.258	0.000	2.632
NUMBER OF ITERATIONS-	4					
1 12	1.029	1.170	.839	4.394	0.000	2.868

Figure 3-2. WEIBUL Printed Output

• • • SOLAR ENERGY RESEARCH INSTITUTE • • • 12/ 4/80
WEIBUL -WEIBULL WIND DISTRIBUTION ---TEST RUN FOR CALCULATION COMPARISON --- PAGE 2
.....

MISSING DATA SUMMARY

<u>PARAMETER</u>	<u>NUMBER OF HOURS DATA WAS MISSING</u>
DRY BULB TEMPERATURE	0
BAROMETRIC PRESSURE	0
WIND SPEED	0

Figure 3-2. WEIBUL Printed Output (Concluded)

23050 1999 1999				TMY ALBUQUERQUE				4 11.90 100 40.00 5.03			
1 1	1.21	1.93	.838	-.781	0.000	3.077	.8065				
1 2	.94	1.24	.838	-1.161	0.000	2.839	.7742				
1 3	1.03	1.41	.838	-1.645	0.000	3.068	.8387				
1 4	1.20	1.77	.838	-1.777	0.000	2.945	.9032				
1 5	.94	.87	.838	-2.281	0.000	2.832	.8710				
1 6	1.49	.67	.838	-2.719	0.000	2.742	.9355				
1 7	1.27	1.78	.839	-3.006	0.000	2.577	.9032				
1 8	.50	1.80	.839	-2.919	0.000	2.361	.9355				
1 9	1.67	2.90	.840	-1.445	0.000	2.310	.9355				
110	1.28	1.65	.840	.735	0.000	2.742	.9032				
111	1.16	1.56	.840	2.258	0.000	2.632	.8387				
112	1.03	1.17	.839	4.394	0.000	2.868	.7419				
113	1.02	2.14	.838	5.539	0.000	3.200	.8065				
114	3.18	2.58	.837	6.503	0.000	3.435	.7742				
115	1.32	3.18	.837	7.090	0.000	4.071	.7097				
116	1.34	2.78	.837	6.935	0.000	4.429	.6129				
117	1.53	1.55	.837	5.739	0.000	4.384	.5484				
118	1.02	1.32	.837	4.103	0.000	3.700	.6774				
119	1.05	1.82	.838	3.029	0.000	3.929	.7419				
120	1.39	2.44	.838	2.268	0.000	3.532	.7419				
121	1.04	1.90	.838	1.742	0.000	3.748	.7097				
122	1.49	2.19	.838	1.116	0.000	2.816	.8065				
123	2.54	3.72	.838	.455	0.000	3.084	.8710				
124	1.68	3.10	.838	-.258	0.000	3.287	.8387				
2 1	.62	1.47	.838	1.004	0.000	2.846	.8929				
2 2	.74	1.82	.838	.200	0.000	3.257	.8571				
2 3	.67	.92	.838	-.407	0.000	3.179	.8571				
↓						↓					
1224	1.92	.68	.841	1.210	0.000	2.810	.9032				

Figure 3-3. WEIBUL Output File

```
WEB,YD1,YL1.
COMMENT. FILE,TAPE10,RT=F,FL=163,BT=K,RB=24,MBL=3912,CM=YES.
COMMENT. ABOVE FOR SOLMET. BELOW FOR TMY.
FILE,TAPE10,RT=F,FL=132,BT=K,RB=24,MBL=3168,CM=YES.
FILE,TAPE11,FL=80.
FILE,TAPES,FL=80.
GETPF,TAPES,WEBDAT,ID=UID.
COMMENT. PURGE,WEIBX,ID=UID.
COMMENT. REQUEST,WEIBX,*PF.
FILE,WEIBUL,FL=80.
GETPF,WEIBUL,TY=G,ST=CNS.
FTN,I=WEIBUL,B=WEIBX,R=0,L=0,ER.
COMMENT. CATALOG,WEIBX,ID=UID,XR=UID.
COMMENT. VSN-S00183=TMY, VSN-S00035=ALBQ SOLMET.
STAGE,TAPE10,PRE,VSN=S00183,PE,NT,EB,ST=CNS.
LDSET,FILES=TAPE10.
WEIBX.
REWIND,TAPES.
COPYSBF,TAPES,OUTPUT.
REWIND,TAPE6.
COPYSBF,TAPE6,OUTPUT.
REWIND,TAPE11.
SAVEPF,TAPE11,SAVEF,ID=UID.
EXIT.
```

(Lines beginning in "COMMENT." are inactive, but removing the "COMMENT." will activate the command.)

Figure 3-4. WEIBUL Sample Runstream

SECTION 4.0

ROSEW-REPRESENTATION OF SOLAR ELECTRIC-WIND

As Vol. I, Sec. 5.0 indicates, ROSEW's basic responsibility is to calculate the amount of wind-derived electric power available. Input to ROSEW includes a data set to describe the wind machines, plus an output file from either WTP or WEIBUL. WTP's results are to be used if the hourly power option or typical day option are chosen, and WEIBUL's results are used with the Weibull option (see Vol. I, Sec. 5.0). ROSEW's output varies with the type of option chosen; each type is treated in this section. This output is sent to ULMOD for utility load modification.

4.1 FACILITY SPECIFICS

Since ROSEW was designed to run on a CDC system, two characteristics of the program may require modification for use on other systems. First, the PROGRAM card required at the beginning of the code for CDC systems may not be needed for other systems. The second problem concerns the free-formatted inputs that are used, with only a comma or space needed to separate the user input data. If another system does not recognize a statement of the form READ (5,*) as a free format, then the appropriate corrections must be made to each READ statement of this kind. Corresponding formatted read statements for each instance have been left in the code but commented out. Thus, the user may comment out the free-formatted READ statements and remove the comment from the formatted READs (and associated FORMATS) if this trouble arises.

4.2 ROSEW INPUT DATA

ROSEW requires user selected values to control certain execution options and to describe the wind machines. Each manually created input data card type is identified in the first two or three columns as:

- RA--Header Card
- RB--Title Card
- RC--Control Card
- RD--Time Period Card
- RF--Wind Enhancements Card
- RJA--Design Label Card
- RJB--Design Parameters Card
- RJC--Gear Box Efficiency Table
- RJD--Generator Efficiency Table
- RJE--Transformer Efficiency Table
- RJF--Aerodynamic Efficiency Table

4.2.1 RA--Header Card

One card is required, placed first in the input deck.

FORMAT (A2,2X,10A4,3I2)

CRDTYP -- RA
USER -- Name of user
IMONTH -- Month of run
IDAY -- Day of run
IYEAR -- Year of run

4.2.2 RB--Title Cards

Three cards are required, placed after the RA card. Each contains a 40-character title.

FORMAT (A2,2X,10A4)

CRDTYP -- RB
TITLE -- 40-character title

4.2.3 RC--Control Card

One card is required, placed after the last RB card.

FORMAT (FREE)

This free format means that only a space or comma is necessary to separate the data. Zeros must be included if the value is zero (i.e., no blanks). Alpha-numeric (A) format data must be enclosed in quotes. See previous section on facility specifics for possible problems if used on a non-CDC system.

CRDTYP -- RC
IWBLOP -- Weibull option; 1 = on, 0 = off
IFOROP -- Forced outage rate option;
 0 = WECS power outputs modified by the forced outage rate,
 1 = The probabilities (of certain power outputs) are modified
 by the forced outage rate;
 This must be zero if IWBLOP equals zero since probability
 information exists only with the Weibull option.
NPER -- Number of time periods;
 Range: 1-52, but normally 12;
 Can be input as zero if IWBLOP = 1
NDESIN -- Total number of wind-machine designs;
 Range: 1-9

- RAIR -- Gas constant for dry air; $\text{bar m}^3/\text{kg}^\circ\text{K}$;
If zero is input, the program defaults to the value 0.00287
- RVAP -- Gas constant for water vapor; $\text{bar m}^3/\text{kg}^\circ\text{K}$;
If zero is input, the program defaults to the value 0.0046
- INTER -- Number of intervals between VCUTIN and VRATED for Weibull computation purposes;
Enter a zero if IWBLOP = 0;
Range: 1-25, default = 5 if 0 entered and IWBLOP = 1;
Will be the same for all wind-machine designs
See Vol. I, Sec. 5.2.1.2 for more details.
- NSLOTS -- Number of divisions for each interval above;
Enter a zero if IWBLOP = 0;
Range: 1-10, default = 5 if 0 entered and IWBLOP = 1
See Vol. I, Sec. 5.2.1.2 for more details.

4.2.4 RD--Time Period Card

One card is required for each time period (see NPER on RC card); all placed in sequence after the RC card. These cards are not to be input if IWBLOP = 1.

FORMAT (FREE)

- CRDTYP -- RD
- IP -- Time period index,
Range: 1-52, usually 1-12;
RD cards must be in order according to this field
- JTPER -- Time period (month) label;
Any four-character description to describe the month;
Must have characters inside quotation marks
- IUBEG -- First time unit (hour of the year) for this month;
Range: 1-8784
- IUEND -- Last time unit (hour of the year) for this month;
Range: 1-8784
- NUPF -- Number of time units (hours) per frame (day);
Usually 24
- NTDAY -- Number of typical days;
Range: 0-3;
If 0, then straight hourly powers are output
- NFDAY1 -- Number of values to make up first typical day's averages
(see Vol. I, Sec. 5.0);
Zero if IWBLOP = 1 or NTDAY = 0
- NFDAY2 -- Number of values to make up second typical day's averages;
Zero if IWBLOP = 1 or NTDAY = 0
- NFDAY3 -- Number of values to make up third typical day's averages;
Zero if IWBLOP = 1 or NTDAY = 0

4.2.5 RE--Weather Station Card

One card is required, following RD card (or RC if no RD)

FORMAT (FREE)

CRDTYP -- RE
MWSTAT -- Desired weather station number;
 Must match number on weather or WEIBUL input
MWYEAR -- Desired weather year, four digits;
 Must match year on weather or WEIBUL input file
STTERR -- Terrain factor (power law exponent for vertical projection);
 Range: 0-0.7
 Note: This value should be 0.0 if IALOPT on RF card is 1

4.2.6 RF--Wind Enhancements Card

One card is required; placed after RE card. See Vol. I, Sec. 5.0 for details on each variable.

FORMAT (FREE)

CRDTYP -- RF
IALOPT -- Alpha (terrain factor) calculation option;
 0 = off, 1 = on
IWOPT -- Enhancements option;
 0 = off, 1 = on;
 If 0, all following values on this card should be zeros
SIGS -- Gust-power correction factor;
 Generally ≈ 0.2
SIGTHE -- Anemometer theta correction factor;
 Generally ≈ 0.2
SIGW -- Anemometer vertical gust correction factor;
 Generally ≈ 0.2
SIGU -- Anemometer longitude gust factor;
 Generally ≈ 0.2
ISHROPT -- Shear correction option;
 0 = off, 1 = on

4.2.7 RJA--Design Label Card

One card is required for each wind-machine design and follows the RF card. This RJA card should be followed by RJB-RJH cards for the specific design, with this package followed by another wind-machine design package if more than one design is considered.

FORMAT (A3,1X,I1,1X,I1,1X,5A4)

CRDTYP -- RJA
JDESIN -- Design number of this specific wind-machine design;
Range: 1--NDESIN on RC card
INNOV(D) -- Innovative design flag for design D;
If 1, then a velocity-power table is used for power
calculations;
If 0, then the standard power calculations are used
PLNTLB -- Wind-machine label;
20-character description of wind-machine design

4.2.8 RJB--Design Parameters Card

One card required for each design, placed behind RJA card.

FORMAT (FREE)

If INNOV(D) on the RJA card is zero (no power table), then the input is:

CRDTYP -- RJB
DROTOR -- Wind-turbine rotor diameter (m);
Range: 1-200.0
FORWGU -- Forced outage rate of a single unit, fractional;
Range: 0-0.9999
HUBHT -- Hub height (m);
Range: 1.0-100.0
RPMROT -- RPM of rotor;
Range: 1.0-500.0
VCUTIN -- Cut-in velocity at hub height, (m/s);
Range: 0-20.0
VRATED -- Rated velocity at hub height, (m/s);
Range: 0-30.0
VCUTUT -- Cut-out velocity at hub height, (m/s);
Range: 0-50.0

If INNOV(D) on RJA card is one (power table desired), then the following is input instead of the previously mentioned parameters:

FORMAT (FREE)

CRDTYP -- RJB
FORWGU -- Forced outage rate of a single unit, fractional;
Range: 0-0.9999
HUBHT -- Representative centerline height of wind turbine for power
calculations, meters;
Range: 0-100.0

VCUTIN -- Cut-in velocity at hub height, (m/s);
Range: 0-20.0

VRATED -- Rated velocity at hub height, (m/s);
Range: 0-30.0

VCUTUT -- Cut-out velocity at hub height, (m/s);
Range: 0-50.0

HGTINN -- Wind-speed recorder height that velocity values in the velocity-power table are based upon, meters;
Range: 0-200.0

4.2.9 RJC--Number of Generators Card

One card is required for each design, placed behind RJB card.

FORMAT (FREE)

CRDTYP -- RJC

NWGU(M) -- Number of wind generators of this design for month M;
Range: 0-999

NWGU(M+1) -- Same for next month, continue until all months are represented

4.2.10 RJD-RJH--Tabular Input Cards

If INNOV on the RJA card is zero, then the RJD card is not needed and the RJE-RJH cards enter gearbox, generator, transformer, and aerodynamic efficiencies as functions of an independent variable. If INNOV is one, the RJD card inputs the wind-generator power output as a function of wind velocity at a certain height, and the RJE-RJH cards are not needed. Either way, the program takes this set of independent variables (range: 2-25 points) and an equal number of dependent variables and, in effect, plots a curve of one variable versus the other. Linear interpolation between these known points determines intermediate values, and points outside the range are assigned the value of the closest known point (first or last). Values of the independent variable must be input in ascending order with no two values the same. The table is input in free format as follows:

- o The initial input on the first card indicates the number of points, followed by the first 10 values of the independent variable. If less than 10 points are to be input, zeros should be input in order to have 10 values on the card. If more than 10 points are needed, a second card should be used. For 21 to 25 points, a third card is required.
- o After the entire independent array has been input, the dependent array is similarly input on one, two, or three cards. The number of points is not to be input on the first dependent variable card.

If a constant dependent variable value is desired, only two points of that value need to be input.

RJD--Power Table Cards (INNOV = 1). Two to six cards are required, as described, placed after the RJC card. If INNOV = 1, then the RJD cards replace the RJE-RJH cards. If INNOV = 0, no RJD cards are included.

FORMAT (FREE)

CRDTYP -- RJD
NVELP -- Number of points;
Range: 2-25
XVEL -- Independent variable, wind velocity (m/s);
Range: 0-100.
XPOW -- Dependent variable, wind-turbine power output, MW;
Range: 0-10.

RJE--Gearbox Efficiency Table Cards (INNOV = 0). Two to six cards are required, as described, and are placed after the RJC card. If INNOV = 0, then the RJE-RJH cards are required.

FORMAT (FREE)

CRDTYP -- RJE
NEFFGB -- Number of points;
Range: 2-25
EFFGBX -- Independent variable, power input to gearbox, MW;
Range: 0.0-999.9
EFFGB -- Dependent variable, gearbox efficiency;
Range: 0-1.0

RJF--Generator Efficiency Table Cards. Two to six cards are required, placed after the last RJF card. These are needed only if INNOV = 0.

FORMAT (FREE)

CRDTYP -- RJF
NEFFGN -- Number of points;
Range: 2-25
EFFGNX -- Power input to generator, MW;
Range: 0-999.9
EFFGN -- Generator efficiency;
Range: 0-1.0

RJG--Transformer Efficiency Table Cards. Two to six cards are required, placed after the last RJF card. These are needed only if INNOV = 0.

FORMAT (FREE)

CRDTYP -- RJG
NEFFTN -- Number of points;
Range: 2-25
EFFTFX -- Power input to transformer, MW;
Range: 0-999.9
EFFTF -- Transformer efficiency;
Range: 0-1.00

RJH--Aerodynamic Efficiency Table Cards. Two to six cards are required, placed after the last RJG card. These are needed only if INNOV = 0.

FORMAT (FREE)

CRDTYP -- RJH
NEFFAD -- Number of points;
Range: 2-25
EFFADX -- Tip speed ratio;
Range: 0-999.9
EFFAD -- Aerodynamic efficiency;
Range: 0-1.00

That completes the input requirements for ROSEW. Recall that if more than one wind-generator design is used, the second design deck of RJA-RJF cards is placed at the end, followed by a third design, etc.

For clarification, several examples of ROSEW input data are presented. Figure 4-1 gives data for a Weibull option with two wind-machine designs and no wind enhancements. Figure 4-2 supplies data for hourly power outputs with one wind-machine design and wind enhancements.

4.3 ROSEW FILE INPUTS

If the Weibull option is chosen, then the WEIBUL-created output file must be provided as input to ROSEW. The hourly power and typical day options require WTP's output file as input. These two files have been previously discussed and are identified as "TAPE10" in the sample control card sequence of Sec. 4.6.

4.4 ROSEW PRINTED OUTPUT

For visual inspection and easy reference, ROSEW creates a file for printed output. In a convenient format, this file exhibits input data, execution options, and useful calculation values. A sample portion of this output is given in Fig. 4-3. This output is identified as "TAPE6" in the sample runstream.

4.5 ROSEW OUTPUT FILE

ROSEW's main output file is saved for input to ULMOD. The file's contents will be different for each of the three execution options (Weibull, hourly power, or typical day).

4.5.1 Weibull Option

This option's output file contains a header card, a comment card, and power-probability results for each hour of the monthly typical day.

4.5.1.1 Header Card

```
FORMAT("PP", 1X,I5,1X,I4,1X,I4,1X,5A4,1X,I1,1X,  
       I2,1X,F5.2,1X,I2,1X,I2,1X,I1,1X,I1,1X,I1,1X,I1)
```

<u>Column</u>	<u>Variable</u>
1-2	"PP"
4-8	Weather station number
10-13	First weather year
15-18	Last weather year
20-39	Weather station name
41	Weather data source; 1 = TDF-14 2 = Aerospace 3 = SOLMET 4 = TMY
43-44	Number of bins in Weibull calculation
46-50	Maximum wind speed expected in Weibull calculation
52-53	Number of intervals between VCUTIN and VRATED for calculation purposes
55-56	Number of slots in each interval
58	Height projection calculation option; 1 = on, 0 = off
60	Wind enhancements option, 1 = on, 0 = off
62	Forced outage option; 1 = on, 0 = off
64	Number of wind-machine designs considered

4.5.1.2 Comment Card

One 20-character plant description (PLNTLB variable) is included for each wind-machine design.

4.5.1.3 Results

For each hour of the month's typical day, general results, along with results for each interval between cut-in and rated wind speeds, are given for each design.

General Results

FORMAT (3I2,2X,F10.4,2X,F10.4,2X,F10.4)

<u>Column</u>	<u>Variable</u>
1-2	Number of wind-machine designs; Range: 1-9
3-4	Month
5-6	Hour of month's typical day
9-18	Probability of zero power output from wind machine; Range: 0-1.0
21-30	Rated power output of this design, MW
33-42	Probability of rated power being produced; Range: 0-1

Interval Results

For each interval between VCUTIN and VRATED, the output is:

FORMAT (I2,2X,F10.4,2X,F10.4)

<u>Column</u>	<u>Variable</u>
1-2	Interval number
5-14	Representative power of this wind-speed interval, MW
17-26	Probability of the wind being in this wind-speed interval; Range: 0-1.0

A sample of this output file is shown in Fig. 4-4.

4.5.2 Hourly Power Option

This type of output file contains a header card, a comment card, and output results.

4.5.2.1 Header Card

```
FORMAT ("HR",1X,I5,1X,I4,1X,I4,1X,5A4,1X,I1,16X,I1,  
1X,I1,3X,I1)
```

<u>Column</u>	<u>Variable</u>
1-2	"HR"
4-8	Weather station number
10-13	Weather year
15-18	Weather year repeated
20-39	Weather station name; 20 characters
41	Weather data source: 1 = TDF-14 2 = Aerospace 3 = SOLMET 4 = TMY
58	Height projection calculation option; 1 = on, 0 = off
60	Wind enhancements option; 1 = on, 0 = off
64	Number of wind-machine designs considered;

4.5.2.2 Comment Card

One 20-character plant description (PLNTLB variable) is included for each wind-machine design.

4.5.2.3 Results

Hourly average power values are output on two lines for each day of the year:

```
FORMAT (3I2, "1X ", I1, " HR ENGY ", 12F5.1,/,3I2, "2 ", I1,  
" HR ENGY ", 12F5.1)
```

<u>Column</u>	<u>Variable</u>
1-2	Month
3-4	Day

5-6	Weather year
10	Machine design number; Range: 1-9
21-80	First 12 hourly average powers, MW

The above procedure is repeated once more for the second 12 hourly average powers of the day.

An example of this output is shown in Fig. 4-5.

4.5.3 Typical Days Option

As described in Vol. I, either one, two, or three "typical days" can be selected. All choices have output containing a header card, a comment card, and the typical day results.

4.5.3.1 Header Card

```
FORMAT ("T",I1,1X,I5,1X,I4,1X,I4,1X,5A4,1X,I1,16X,I1,1X  
I1,3X,I1)
```

<u>Column</u>	<u>Variable</u>
1	"T"
2	Number of typical days; Range: 1-3
4-8	Weather station number
10-13	Weather year
15-18	Weather year repeated
20-39	Weather station name
41	Weather data source; 1 = TDF-14 2 = Aerospace 3 = SOLMET 4 = TMY
58	Height projection calculation option; 1 = on, 0 = off
60	Number of wind-machine designs considered

4.5.3.2 Comment Card

One 20-character plant description (PLNTLB variable) is included for each wind-machine design.

4.5.3.3 Results

As discussed, the typical day results are average hourly power values for one, two, or three monthly typical days.

```
FORMAT (I2,2X,I2,"1  ",I1,' T1 ',I2,2X,12F5.1,/,  
        I2,2X,I2,"  ",I1'2  T1 ',I2,X2X,12F5.1)
```

<u>Column</u>	<u>Variable</u>
1-2	Month
5-6	Year
10	Machine design number; Range: 1-9
17-18	Number of days used for typical day 1. (If only 1 typical day is selected, this will equal days in month)
21-80	First 12 hourly powers, MW

The above procedure is repeated once more for the second 12 hourly average powers for the first typical day.

If two typical days are selected, the same results will be output for day two; T1 in the above FORMAT will change to T2. If three typical days are selected, all three days will have the same type output. The third typical day will be identified by a T3 in the FORMAT statement. Sample output for all three typical day cases is shown in Fig. 4-6.

4.6 SAMPLE CONTROL CARD SEQUENCE

A sample control card sequence for each of the three options is given in Fig. 4-7. These runstreams utilize the CDC-SCOPE operating system.

```

RA  SAMPLE PROBLEM - ALBUQUERQUE, N.M.          120180
RB  * TMY DATA - ALBUQUERQUE, N.M.
RB  * 25 MOD-2 AND 50 MOD-1 WIND TURBINES
RB  * WEIBUL PROBABILITY EXECUTION
"RC" 1 1 12 2      0 0 5 5
"RE" 23050 1999      0.143
"RF" 0 0 0. 0. 0. 0. 0
RJA 1 1 MOD-2 WIND GENERATOR
"RJB"      0.08 60.96 6.355 12.52 20.52 60.96
"RJC" 25 25 25 25 25 25 25 25 25 25 25 25
"RJD" 16 6.35 6.7 7.15 7.6 8.05 8.5 8.9 9.4 9.84 10.3
"RJE"      10.7 11.2 11.6 12.1 12.5 20.5
"RJD"      .119 .261 .39 .528 .665 .812 1.016 1.203 1.395 1.582
"RJD"      1.776 1.974 2.155 2.339 2.5 2.5
RJA 2 0 MOD-1 WIND GENERATOR
"RJB" 60.0 .1 40. 35. 7. 15. 20.
"RJC" 50 50 50 50 50 50 50 50 50 50 50 50
"RJE" 12      0.0 .084 .117 .151 .201 .302 .436 .620 .824 1.038
"RJE"      1.390 1.675
"RJE"      0.0 .456 .565 .639 .713 .787 .849 .893 .918 .935
"RJE"      .951 .960
"RJE" 11      0.0 .064 .096 .113 .161 .257 .434 .563 .965 1.318
"RJE"      1.608
"RJE"      0.0 .571 .717 .785 .838 .885 .920 .930 .945 .948
"RJE"      .947
"RJE" 11      0.0 .062 .092 .108 .153 .245 .413 .536 .914 1.249
"RJE"      1.523
"RJE"      0.0 .975 .975 .975 .980 .980 .980 .980 .985 .985
"RJE"      .985
"RJE" 12      0.0 1.0 4.0 6.0 8.0 9.0 10.0 12.0 14.0 16.0
"RJE"      18.0 20.0
"RJE"      .019 .020 .133 .324 .424 .448 .455 .440 .397 .320
"RJE"      .210 0.0

```

**Figure 4-1. ROSEW Manually Created Input Data
Weibull Option — 2 Designs**

```
RA  SAMPLE PROBLEM - ALBUQUERQUE, N.M.          120180
RB  * TMY DATA - ALBUQUERQUE, N.M.
RB  * 25 MOD-2 WIND TURBINES - POWER TABLE
RB  * HOURLY POWER OPTION
"RC" 0 0 12 1      0 0 0 0
"RD" 1 "JAN"          1 744 24 0 0 0 0
"RD" 2 "FEB"          745 1416 24 0 0 0 0
"RD" 3 "MAR"          1417 2160 24 0 0 0 0
"RD" 4 "APR"          2161 2880 24 0 0 0 0
"RD" 5 "MAY"          2881 3624 24 0 0 0 0
"RD" 6 "JUNE"         3625 4344 24 0 0 0 0
"RD" 7 "JULY"         4345 5088 24 0 0 0 0
"RD" 8 "AUG"          5089 5832 24 0 0 0 0
"RD" 9 "SEPT"         5833 6552 24 0 0 0 0
"RD" 10 "OCT"         6553 7296 24 0 0 0 0
"RD" 11 "NOV"         7297 8016 24 0 0 0 0
"RD" 12 "DEC"         8017 8760 24 0 0 0 0
"RE" 23050 1999 0.143
"RF" 1 1 .2 .2 .2 .2 1
RJA 1 1 MOD-2 WIND GENERATOR
"RJB"      0.08 60.96 6.35 12.52 20.52 60.96
"RJC" 25 25 25 25 25 25 25 25 25 25 25
"RJD" 18 6.349 6.35 6.7 7.15 7.6 8.05 8.5 8.94 9.39 9.84
"RJD" 10.28 10.73 11.18 11.63 12.07 12.52 20.52 20.521
"RJD" 0.119 .261 .39 .528 .665 .812 1.016 1.203 1.395
"RJD" 1.582 1.776 1.974 2.155 2.339 2.5 2.5 0.
```

**Figure 4-2. ROSEW Manually Created Input Data
Hourly Option — 1 Design**

REPRESENTATION OF SOLAR ELECTRIC--WIND

* * * SOLAR ENERGY RESEARCH INSTITUTE * * *

12/ 1/80

---SAMPLE PROBLEM - ALBUQUERQUE, N.M.---

PAGE 1

* TMY DATA - ALBUQUERQUE, N.M.
* 25 MOD-2 AND 50 MOD-1 WIND TURBINES
* WEIBUL PROBABILITY EXECUTION

REPRESENTATION OF SOLAR ELECTRIC--WIND

* * * SOLAR ENERGY RESEARCH INSTITUTE * * *

12/ 1/80

---SAMPLE PROBLEM - ALBUQUERQUE, N.M.---

PAGE 2

INPUT DATA

THIS RUN ENCOMPASSES

12 TIME PERIODS 2 WGEN DESIGNS

WEIBUL OPTION - 1

GAS CONSTANTS

DRY AIR - .002E70 BAP ***3/(KG K)
WATER VAPOR - .004E00 BAP ***3/(KG K)

FORCED OUTAGE OPTION - 1

WEIBUL INTERVALS = 5

WEIBUL SLOTS PER INTERVAL = 5

SITE AND PLANT PARAMETERS

DATA FROM WEATHER STATION 23050

WEATHER YEAR - 1999

SITE TERRAIN FACTOR = .1430

** MODIFICATIONS FOR GUST, ANEMOMETER READINGS, AND SHEAR EFFECT NOT UTILIZED **

Figure 4-3. ROSEW Printed Output

REPRESENTATION OF SOLAR ELECTRIC--WIND

* * * SOLAR ENERGY RESEARCH INSTITUTE * * *

12/ 1/80

---SAMPLE PROBLEM - ALBUQUERQUE, N.M.---

PAGE 3

PLANT DESIGN 1 - MOD-2 WIND GENERATOR

THIS DESIGN USES AN INPUT TABLE OF VELOCITY VS. POWER FOR ITS CALCULATIONS

FORCED OUTAGE RATE - .080
 CUT IN VELOCITY (M/S) - 6.355
 RATED VELOCITY (M/S) - 12.520
 CUT OUT VELOCITY (M/S) - 20.520

RECORDER HEIGHT WIND SPEED TABLE IS BASED ON - 60.960 M

NUMBER OF WIND MACHINES OF THIS DESIGN FOR EACH TIME PERIOD:

25	25	25	25	25	25	25	25	25
25	25							

POWER OUTPUT

TABLE

WIND VELOCITY	6.355	6.730	7.150	7.600	8.050	8.500	8.900	9.400	9.840	10.300
	10.790	11.200	11.600	12.100	12.500	20.500				
POWER OUTPUT	.119	.261	.390	.528	.665	.812	1.016	1.203	1.395	1.582
	1.775	1.974	2.155	2.339	2.500	2.500				

Figure 4-3. ROSEW Printed Output (Continued)

PLANT DESIGN 2 - MCD-1 WIND GENERATOR

DIAMETER OF ROTOR (M) 60.000 CUT IN VELOCITY (M/S) 7.000
 FORCED OUTAGE RATE .100 RATED VELOCITY (M/S) 15.000
 HUB HEIGHT (M) 40.000 CUT-OUT VELOCITY (M/S) 20.000
 RPM OF ROTORS 35.000
 NUMBER OF WIND MACHINES OF THIS DESIGN FOR EACH TIME PERIOD:
 50 50 50 50 50 50 50 50 50
 50 50

GEAR BOX EFFICIENCY TABLE

POWER TO GEAR BOX (MW)	0.000	.084	.117	.151	.201	.302	.436	.620	.824	1.038
	1.390	1.675								
GEAR BOX EFFICIENCY	0.000	.456	.565	.639	.713	.787	.849	.893	.918	.935
	.951	.960								

GENERATOR EFFICIENCY TABLE

POWER TO GENERATOR (MW)	0.000	.054	.096	.113	.161	.257	.434	.563	.965	1.318
	1.608									
GENERATOR EFFICIENCY	0.000	.571	.717	.785	.838	.885	.920	.930	.945	.948
	.947									

TRANSFORMER EFFICIENCY TABLE

POWER TO TRANSFORMER (MW)	0.000	.062	.092	.108	.153	.245	.413	.536	.914	1.249
	1.523									
TRANSFORMER EFFICIENCY	0.000	.985	.975	.975	.980	.980	.980	.930	.985	.985
	.985									

AERODYNAMIC EFFICIENCY TABLE

TIP SPEED RATIO	0.000	1.000	4.000	6.000	8.000	9.000	10.000	12.000	14.000	16.000
	18.000	20.000								
AERODYNAMIC EFFICIENCY	.019	.020	.133	.324	.424	.446	.455	.440	.397	.320
	.210	0.000								

DESIGN- 1 MON- 1 HR- 1 HOURLY CF- .0657
 DESIGN- 2 MON- 1 HR- 2 HOURLY CF- .0252
 DESIGN- 1 MON- 1 HR- 2 HOURLY CF- .0567
 DESIGN- 2 MON- 1 HR- 2 HOURLY CF- .0177
 DESIGN- 1 MON- 1 HR- 3 HOURLY CF- .0436
 DESIGN- 2 MON- 1 HR- 3 HOURLY CF- .0143
 DESIGN- 1 MON- 1 HR- 4 HOURLY CF- .0306
 DESIGN- 2 MON- 1 HR- 4 HOURLY CF- .0111
 DESIGN- 1 MON- 1 HR- 5 HOURLY CF- .0251
 DESIGN- 2 MON- 1 HR- 5 HOURLY CF- .0056
 DESIGN- 1 MON- 1 HR- 6 HOURLY CF- .0098
 DESIGN- 2 MON- 1 HR- 6 HOURLY CF- .0010
 DESIGN- 1 MON- 1 HR- 7 HOURLY CF- .0304
 DESIGN- 2 MON- 1 HR- 7 HOURLY CF- .0110
 DESIGN- 1 MON- 1 HR- 8 HOURLY CF- .0202
 DESIGN- 2 MON- 1 HR- 8 HOURLY CF- .0098

Figure 4-3. ROSEW Printed Output (Concluded)


```

PP 23050 1999 1999 TMY ALBUQUERQUE      4 100 40.0  5  5 0 0 1 2
C   MOD-2 WIND GENERATOR
C   MOD-1 WIND GENERATOR
  1 1 1      .8220      62.5000      .0043
  1      9.9039      .0564
  2     18.1497      .0572
  3     30.2638      .0351
  4     43.4551      .0175
  5     56.0463      .0075
  2 1 1      .8750      89.4320      .0003
  1      9.6198      .0723
  2     21.6469      .0349
  3     38.0196      .0127
  4     57.5897      .0038
  5     78.1249      .0010
  1 1 2      .7924      62.5000      .0023
  1      9.3322      .1114
  2     17.7940      .0563
  3     29.9958      .0241
  ↑↓
21224      .9831      89.1009      .0000
  1      6.0564      .0169
  2     18.4731      .0000
  3     33.1265      .0000
  4     51.3888      .0000
  5     70.9209      .0000

```

Figure 4-4. ROSEW Output File — Weibull

HR 23050	1999	1999	ALBUQUERQUE, N.M.	4						1	1			
C	MOD-2	WIND GENERATOR												
1	1991	1 HR ENGY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	1992	1 HR ENGY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	2991	1 HR ENGY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	2992	1 HR ENGY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	3991	1 HR ENGY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.3	.3	0.0
1	3992	1 HR ENGY	0.0	0.0	0.0	0.0	.5	1.3	2.3	2.5	2.5	2.5	2.5	2.5
1	4991	1 HR ENGY	2.5	1.8	2.1	2.3	2.1	0.0	0.0	0.0	0.0	0.0	0.0	2.1
1	4992	1 HR ENGY	2.1	2.1	2.1	1.8	2.1	2.5	2.1	1.8	1.6	1.8	2.5	2.1
1	5991	1 HR ENGY	2.5	2.5	2.3	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	5992	1 HR ENGY	0.0	0.0	1.8	2.1	1.8	1.6	0.0	.3	.7	0.0	0.0	0.0
1	6991	1 HR ENGY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.3	.7	.7
1	6992	1 HR ENGY	.5	0.0	0.0	0.0	.5	.3	.3	0.0	0.0	0.0	0.0	0.0
1230992	1 HR ENGY		0.0	0.0	.5	.5	.3	.3	.5	0.0	.3	.3	0.0	0.0
1231991	1 HR ENGY		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1231992	1 HR ENGY		0.0	0.0	0.0	0.0	0.0	0.0	0.0	.5	0.0	0.0	0.0	0.0

Figure 4-5. ROSEW Output File — Hourly

T3 23050 1999 1999 ALBUQUERQUE, N.M. 4 1 1 1																
C MOD-2 WIND GENERATOR																
1	991	1	T1	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	992	1	T1	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	991	1	T2	21	.1	.1	.0	.0	.0	0.0	0.0	0.0	.0	.1	.1	.1
1	992	1	T2	21	.2	.3	.6	.6	.2	.2	.2	.2	.1	.1	.1	.1
1	991	1	T3	5	1.5	1.4	1.1	1.0	.6	.9	.7	.8	1.0	1.4	1.6	1.8
1	992	1	T3	5	2.1	2.3	2.3	1.9	1.9	2.1	2.1	2.1	1.9	1.8	1.9	1.8
2	991	1	T1	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	992	1	T1	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	991	1	T2	18	.1	.1	.1	0.0	.2	.1	.1	.1	.0	.2	.4	.5
2	991	1	T2	18	.1	.1	.1	0.0	.2	.1	.1	.1	.0	.2	.4	.5
2	992	1	T2	18	.5	.7	.8	1.2	.9	.7	.8	.4	.3	.4	.1	.0
2	991	1	T3	5	1.3	1.0	2.1	1.7	2.2	1.3	1.4	2.0	2.0	2.3	2.5	2.5
12	992	1	T3	5	1.8	1.6	2.5	2.3	2.0	1.9	1.7	1.2	1.6	1.0	.8	1.6

Figure 4-6. ROSEW Output File — 3 Typical Days

```
SUBSG,TS0.
REQUEST,ROSEWX,*PF.
FILE,TAPE7,RT=Z.
FILE,TAPE5,FL=80.
FILE,TAPE16,FL=80.
COMMENT. FILE,TAPE10,FL=80.
ATTACH,ROSEWX,ID=UID.
GETPF,TAPE5,ROSDAT,ID=UID.
GETPF,TAPE16,WTHRDAT,ID=UID.
COMMENT. TAPE16-WEIBULL, TAPE10-CORELATE FROM WTP
COMMENT. GETPF,TAPE10,WTHRDAT,ID=UID.
COMMENT. PURGE,ROSEWX,ID=UID.
COMMENT. REQUEST,ROSEWX,*PF.
COMMENT. FILE,ROSEW,FL=80.
COMMENT. GETPF,ROSEW,ID=UID.
COMMENT. FTN,I=ROSEW,B=ROSEWX,R=0,L=0,ER.
COMMENT. CATALOG,ROSEWX,ID=UID.
ROSEWX.
REWIND,TAPE6.
COPY,TAPE6,OUTPUT.
REWIND,TAPE7.
SAVEPF,TAPE7,SAVEF,ID=UID.
EXIT.
```

Figure 4-7. ROSEW Sample Runstream

SECTION 5.0

ULMOD - UTILITY-LOAD MODIFICATION

The purpose of ULMOD is to subtract the estimated electrical output of alternative generation sources, such as WECS, from forecasted utility loads and to model the variability in utility load forecasting. Refer to Vol. I, Sec. 6.0 for a description of the specific calculations performed in ULMOD.

5.1 FACILITY SPECIFICS

ULMOD utilizes the CDC Sort/Merge package for the development of all load duration curves. The necessary CDC calls are contained in the subroutine CDCSRT. Any other sort routine could be utilized by the replacement of CDCSRT. The comments within CDCSRT should assist making the substitution.

ULMOD uses a LEVEL 2 statement within several of the routines. This command designates that specific data are to reside in the large central memory of a CDC 7600 computer. For use on other computers, delete all the LEVEL 2 commands and the preceding comment cards. Also, CDC equipment requires a PROGRAM card before the main routine. If you are not using CDC hardware, this card may not be needed.

Like most of the other routines, ULMOD uses a free format or list-directed input data. Most versions of FORTRAN have an equivalent input capability. The CDC version uses an * in place of a format number in the READ command. This means that the data do not have to reside in specific fields on the cards but that each value needs to be separated by only a space or comma. Each free formatted data card type is usually preceded by a single, user-provided comment card that has no operational effect. Its purpose is to assist the user in making modifications to a data set.

5.2 ULMOD INPUT DATA

Figure 5-1 is a listing of a sample set of manually created card type data required by ULMOD.

5.2.1 Title (Card Type A)

FORMAT (20A4)

The title of this ULMOD execution has a maximum of 80 characters. This card is always required.

5.2.2 Options (Card Type B)

FORMAT (FREE)

Must be preceded by a comment card.

- IULFG -- Flag on what amount of hourly utility loads is to be input:
1 = A typical week per month
2 = A whole month
Note: Utility loads should be in local Standard Time and not shifted for Daylight Savings Time.
- ISOLFG -- Flag what type of alternative generation is to be input:
0 = None
1 = Power-probability sets for a monthly typical day
2 = A whole month of hourly values
3 = A typical day per month
4 = 2 typical days per month
5 = 3 typical days per month
- IVARFG -- Flag whether to incorporate the variability in utility-load forecasting:
< 0 = Do not consider variability
> 1 = Consider variability
- NSECTM -- Number of large sections to divide the final monthly load duration curves into. A legal value less than or equal to 15 must be entered.
- NSECTA -- Number of large sections to divide the final annual load duration curves into. A legal value less than or equal to 15 must be entered.
- IDESGN -- Specific alternative generation design to be used in this execution;
Must be consistent with ROSEW design numbering

5.2.3 Print Flags 1-6 (Card Type C)

FORMAT (FREE)

These flags, which must be preceded by a comment card, indicate whether or not the specified input data or results are to be printed:

Print if > 1

Do not print if < 0

- IP1 -- Input utility loads
- IP2 -- Input alternative generation
- IP3 -- Resulting residual loads; probabilities if appropriate
- IP4 -- Load duration curve of residuals; probabilities if appropriate
- IP5 -- Sectionalized LDC; both monthly and annual
- IP6 -- Annual LDC

5.2.4 Print Flags 7-10 (Card Type D)

FORMAT (FREE)

These flags, which must be preceded by a comment card, indicate whether or not the specified input data or results are to be printed:

Print if > 1

Do not print if ≤ 0

IP7 -- Expected value of chronological loads

IP8 -- Load duration curve made from these expected values

IP9 -- Accumulated load duration curve made from the power-probability data

IP10 -- Estimated chronological loads made from the accumulated load duration curve

5.2.5 File Output Flags 1-6 (Card Type E)

FORMAT (FREE)

These flags, which must be preceded by a comment card, indicate whether or not the specified input data or results are to be sent to a computer data file (TAPE11) for possible use by other routines such as utility expansion or production cost models:

Write if flag > 1

Do not write if flag ≤ 0

I01 -- Input utility loads

I02 -- Input alternative generation

I03 -- Resulting residual loads; probabilities if appropriate

I04 -- Load duration curve of the residuals; probabilities if appropriate

I05 -- Sectionalized load duration curve; both monthly and annual

I06 -- Annual LDC

5.2.6 File Output Flags 7-10 (Card Type F)

FORMAT (FREE)

These flags, which must be preceded by a comment card, indicate whether or not the specified input data or results are to be sent to a computer data file (TAPE11) for possible use by other routines such as utility expansion or production cost models:

Write if flag > 1

Do not write if flag ≤ 0

- I07 -- Expected-value chronological loads
- I08 -- LDC made from these expected values
- I09 -- Accumulated LDC made from the power-probability data
- I010 -- Estimated chronological loads made from the accumulated LDC

5.2.7 Monthly Sectionalized LDC (Card Type G)

FORMAT (FREE)

One comment card must precede this group of data cards. One data card is required for each LDC section indicated by NSECTM on the type B card. If sectioning is not desired (both IP5 and IO5 < 0), do not provide any type G cards or the preceding comment card.

- PSECM(I) -- Percentage of the monthly load duration curve that Section I will cover; I=1,NSECTM;
Assumes data are provided from top of LDC down. If the sum of all PSECM does not equal 100, a message will be printed and all PSECM will be scaled as needed to yield 100.
- NPIECM(I) -- The number of smaller and equally spaced segments this section will be divided into

5.2.8 Annual Sectionalized LDC (Card Type H)

FORMAT (FREE)

One comment card must precede this group of cards. One data card is required for each LDC section indicated by NSECTA on the type B card. If sectioning is not desired (both IP5 and IO5 < 0), do not provide any type H cards or the preceding comment card.

- PSECA(I) -- Percentage of the monthly load duration curve that Section I will cover; I=1,NSECTA;
Assumes data are provided from top of LDC. If the sum of all PSECA does not equal 100, a message will be printed and all PSECA will be scaled as needed to yield 100.
- NPIECA(I) -- The number of smaller and equally spaced segments this section will be divided into

5.2.9 Load Forecast Uncertainty Data (Card Type I)

One comment card must precede this group of data cards. Two or three data cards (I1,I2,I3) are required as a group for each month (I=1,12). If no uncertainty analysis is desired (IVARFG < 0 on the type B card), then no type I cards or the preceding comment should be provided. If the desired uncertainty analysis is to apply the same uncertainty to all portions of the LDC, then only card types I1 and I2 may be provided by the user. If the

uncertainty is to be different for the upper and lower portions of the LDC, then a group of I1, I2, and I3 cards is required for each month. If uncertainty is being investigated, either flags I09, I010, IP9, or IP10 should be activated in order to get results.

I1. Month, Split Top to Bottom, and Taper Option

FORMAT (FREE)

Required for all months

IMO -- Current input data month
VARTOP(I,1) -- Percent of time for Month I that uncertainty will be applied to the top of the load duration
IVARTF(I) -- A flag on whether the MW modification amounts are to be applied to all parts of the LDC ("F") or taper from the input maximums to near zero ("T"). Flag "N" indicates uncertainty analysis not desired this month.
NT -- Desired number of uncertainty intervals for top portion of LDC (< 5)
NB -- Desired number of uncertainty intervals for bottom portion of LDC (< 5)

I2. Top of LDC Uncertainty

FORMAT (FREE)

VARTOP(I,2) -- MW variation from the forecast mean points for the first uncertainty interval applied to top portion of LDC. Positive value for increase above mean points; negative value for below mean points
VARTOP(I,3) -- Probability, represented as a percent, of actual load occurring within the first interval
VARTOP(I,J) -- Same descriptions as J = 2 and 3 for the second, third, fourth, and, fifth intervals (up to NT); J = 4 to 11 in pairs. May input zero MW variation and/or probability for any interval

I3. Bottom of LDC Uncertainty

FORMAT (FREE)

Card type I3 must not be given for any month where VARTOP(I,1) is greater than or equal to 100. I3 cards immediately follow I2 cards.

VARBOT(I,1) -- Percent of time for month I that uncertainty will be applied to the bottom of the load duration curve.

VARBOT(I,2) -- MW variation from the forecast mean points for the first uncertainty interval applied to the bottom portion of LDC. Positive value for increase above mean points, negative value for below mean points

VARBOT(I,3) -- Probability, represented as a percent, of actual load occurring within the first interval

VARBOT(I,J) -- Same descriptions as J = 2 and 3 for the second, third, fourth, and fifth intervals (up to NB); J = 4 to 11 in pairs. May input zero MW variation and/or probability for any interval

5.3 DATA FILE INPUTS

5.3.1 Intermittent Generation

These program-created data will be read from "TAPE9" or unit number 9. A complete description of this file for wind generation is provided in Sec. 4.0 under the ROSEW output file subheading.

5.3.2 Utility Load Data

These data will be read from "TAPE10" or unit number 10. Note that all utility-load data should be in accordance with local Standard Time and not shifted for Daylight Savings Time.

FORMAT (3I2,I1,13X,12I5)

Each column includes:

<u>Column</u>	<u>Variable</u>
1-2	Month (e.g., November = 11)
3-4	Day of month
5-6	Year (e.g., 1977 = 77)
7	Sequence--one for hours 1 through 12; two for hours 13 through 24
8-20	Not used
21-80	Twelve hourly MW load values with 5 positions/values

Using this format, two cards are required for each day of utility loads.

There are two possible groupings of these data, and the program knows which to expect by the initial input variable IULFG (Card Type B). Both input possibilities utilize the standard EEI format for utility-load data. The difference between the two is the number of days of hourly data provided each

month. If IULFG = 1, then a typical week (seven days) of hourly loads is provided per month. If IULFG = 2, then each month will include as many days of hourly loads as exist in the month. Unlike the data read from "TAPE5," none of the utility-load data is preceded by a comment card.

5.4 PRINTED OUTPUTS

ULMOD printed outputs begin with two pages that report all the data input via cards types (Fig. 5-2). There can be up to ten additional types of printed output generated. These outputs correspond to the print flags given on input card types C and D. Since probability information is needed to perform certain calculations, not all of these outputs are available if the particular execution data do not contain power-probability, if two or three typical days of intermittent generation have been chosen, or if variability is not needed. An example of each possible output is presented in a separate figure. These are discussed briefly below and correspond to the print flags IP1 through IP10:

- IP1 Figure 5-3 -- The utility-load data as echoed by ULMOD;
 Always available;
 Example shows 31 days, could be 7 if IULFG = 1
- IP2 Figure 5-4 -- The intermittent generation data as echoed by ULMOD;
 Available if ISOLFG ≠ 0;
 Appropriate probability information included if needed
- IP3 Figure 5-5 -- Calculated residual loads;
 Available if ISOLFG ≠ 0;
 Appropriate probability information included if needed
- IP4 Figure 5-6 -- Load duration curve developed from the residuals;
 Available if ISOLFG ≠ 0;
 Probability or duration of each point is included if appropriate
- IP5 Figure 5-7 -- Monthly sectionalized LDC made from the residual loads
 if ISOLFG = 0, 2, or 3 and variability not desired;
 Made from accumulated LDC for all other conditions;
 Always available
- IP6 Figure 5-8 -- Annual LDC;
 Made from all residual loads if ISOLFG = 0, 2, or 3 and
 variability not desired;
 Made from accumulated whole hour points for all other
 conditions;
 Always available
- IP7 Figure 5-9 -- Expected chronological residual loads;
 Available if ISOLFG = 1, 4, or 5, or if variability
 desired for any ISOLFG
- IP8 Figure 5-10 -- LDC made from the expected chronological residual loads;
 Available if ISOLFG = 1, 4, or 5, or if variability
 desired for any ISOLFG

- IP9 Figure 5-11 -- Accumulated whole hour LDC made from the full power-probability data;
Available if ISOLFG = 1, 4, or 5, or if variability desired for any ISOLFG
- IP10 Figure 5-12-- Estimated chronological order created from the accumulated residuals;
Available if ISOLFG = 1, 4, or 5, or if variability desired for any ISOLFG

5.5 DATA FILE OUTPUTS

The data file written to by ULMOD is "TAPE11" or unit 11. The first record is the input TITLE written in FORMAT (5X, 20A4). Since this file might be used as direct input to a utility model, the output file is in EEI format, where possible, but preceded by a single line title the same as those printed and shown in the previous subheading's figures. The standard EEI format is:

EEI FORMAT (3I2,I1,13X,12I5)

Each column includes:

<u>Column</u>	<u>Variable</u>
1-2	Month
3-4	Day of month
5-6	Year
7	Sequence - 1 for hours 1-12, 2 for hours 13-24
8-20	Not used
21-80	12 hourly MW values

Where EEI format is the output, this will be merely mentioned. If this is not the format, the exact format will be given. In the non-EEI format case, this output will look exactly like the printed examples already provided. These outputs will be described in the order corresponding to the output flags I01 through I010.

EEI FORMAT

I01--Utility-load data

EEI FORMAT

I02--Intermittent generation

If ISOLFG = 2 or 3, EEI FORMAT

If ISOLFG = 4 or 5, EEI FORMAT but preceded by a line containing the probability of each typical day type;
FORMAT (5X, "***** PROBABILITY OF EACH TYPICAL
DAY = ",2X,3F8.4)

If ISOLFG = 1, write both powers in groups of 12 followed by corresponding probabilities;
Powers;
FORMAT (2X,"HOUR ",I2,5X,"POWERS",5X,12F8.4)
Probabilities;
FORMAT (14X,"PROBS ",5X,12F8.4)

I03--Residual loads

If ISOLFG = 2 or 3, EEI FORMAT

If ISOLFG = 1, 4 or 5, write residuals in groups of 12 followed by corresponding probabilities;
Powers;
FORMAT (1X,"DAY ",I2," HOUR ",I2," POWERS ",12F8.1)
Probabilities;
FORMAT (15X," PROBS. ",12F8.4)

I04--Residual LDC

If ISOLFG = 2 or 3 and no variability;
FORMAT (27X,12F8.1)

If ISOLFG = 1, 4, or 5, or if variability desired, write residuals in groups of 12 followed by corresponding probabilities
Residuals;
FORMAT(12X,"POWERS",7X,12F8.1)
Probabilities;
FORMAT (17X,"PROBS.",2X,12F8.4)

I05--Segmented LDC

2 formats for each large section;
FORMAT (1X,"SECTION ",I2," = ", F7.4,"FRACTION OF TIME,
PIECES = ",12F7.1)
FORMAT (1X,"EACH PIECE = ",F7.0, " HOURS LONG",T48,12F7.1)

I06--Annual LDC

If ISOLFG = 2, FORMAT (9X,"RESIDUAL LOADS",2X,12F8.1)

If ISOLFG = 1, write out residuals in groups of 12 followed by corresponding duration;
Residuals;
FORMAT (1X,"ACCUMULATED RESID. LOADS",2X,12F8.1)
Durations;
FORMAT (16X,"DURATIONS",2X,12F8.4)

I07--Expected chronological residuals

Only if ISOLFG = 1, 4, or 5, or if variability desired for any ISOLFG;
EEI FORMAT

I08--Expected residuals LDC

Only if ISOLFG = 1, 4 or, 5, or if variability desired for any ISOLFG;
FORMAT (27X,12F8.1)

I09--Accumulated LDC

Only if ISOLFG = 1, 4, or 5, or if variability desired for any ISOLFG;
FORMAT (27X,12F8.1)

I010--Estimated chronological of accumulated residuals

Only if ISOLFG = 1, 4, or 5, or if variability desired for any ISOLFG;
EEI FORMAT

5.6 SAMPLE CONTROL CARD SEQUENCE

A sample control card sequence necessary to run ULMOD is given as Fig. 5-13. This runstream uses the CDC-SCOPE operating system.

```
** TEST ULMOD DATA; 25 MOD2'S, ALBO. N.M. SOLAR DATA
IULFG,ISOLFG,IVARFG, LDC. SECTIONS- MONTHLY THEN ANNUAL,DESIGN
2 1 1 5 7 1
PRNT 1-6: LOADS,ALT GEN.,RESIDS.,LDC.,SECT LDC.,ANNUAL LDC.
0 0 0 0 1 1
PRNT 7-10: EXPECTEDS CHRON.,LDC. OF EXPECT.,ACCUM.,EST. CHRON.
0 0 0 1
KOUT 1-6: LOADS,ALT GEN.,RESIDS.,LDC.,SECT LDC.,ANNUAL LDC.
0 0 0 0 0 0
KOUT 7-10: EXPECTEDS CHRON.,LDC. OF EXPECT.,ACCUM.,EST. CHRON.
0 0 0 1
MONTHLY % OF SECTION, NUMBER OF PIECES IN THIS SECTION.
5 2
5 2
20 2
50 2
20 2
ANNUAL % OF SECTION, NUMBER OF PIECES IN THIS SECTION.
5 2
5 2
10 2
20 2
20 2
20 2
20 2
20 2
UNCERTAINTY DATA
1 100 "F" 5 0
000.00 38.3 179.80 24.2 -179.80 24.2 378.92 6.65 -378.92 6.65
2 100 "F" 5 0
000.00 38.3 171.78 24.2 -171.78 24.2 361.85 6.65 -361.85 6.65
3 100 "F" 5 0
000.00 38.3 165.76 24.2 -165.76 24.2 349.16 6.65 -349.16 6.65
4 100 "F" 5 0
000.00 38.3 163.68 24.2 -163.68 24.2 344.78 6.65 -344.78 6.65
5 100 "F" 5 0
000.00 38.3 186.01 24.2 -186.01 24.2 396.03 6.65 -396.03 6.65
6 100 "F" 5 0
000.00 38.3 229.00 24.2 -229.00 24.2 482.36 6.65 -482.36 6.65
7 100 "F" 5 0
000.00 38.3 217.80 24.2 -217.80 24.2 458.77 6.65 -458.77 6.65
8 100 "F" 5 0
000.00 38.3 216.40 24.2 -216.40 24.2 455.82 6.65 -455.82 6.65
9 100 "F" 5 0
000.00 38.3 233.57 24.2 -233.57 24.2 491.98 6.65 -491.98 6.65
10 100 "F" 5 0
000.00 38.3 193.23 24.2 -193.23 24.2 407.01 6.65 -407.01 6.65
11 100 "F" 5 0
000.00 38.3 174.03 24.2 -174.03 24.2 366.58 6.65 -366.58 6.65
12 100 "F" 5 0
000.00 38.3 173.48 24.2 -173.48 24.2 365.42 6.65 -365.42 6.65
```

Figure 5-1. ULMOD Manually Created Input Data

DESIGNED OPTIONS

UTILITY LOADS - INPUT A WHOLE MONTH OF DATA.
ALTERNATIVE GENERATION - INPUT POWER-PROBABILITY DATA.

SOLAR DESIGN NUMBER 1 TO BE USED.

OPTIONS ON PRINTING AND OUTPUT TO TAPE	PRINT	TAPE
LOADS	1	0
ALT. GENERATION	1	0
RESIDUALS	1	0
RESIDUALS L.D.C.	1	0
SECTIONALIZED L.D.C.	1	0
ANNUAL L.D.C.	1	0
EXPECTED CHRONOLOGICAL	1	0
EXPECTED L.D.C.	1	0
ACCUMULATED PROP-PROPS.	1	0
ESTIMATED CHRONOLOGICAL	1	1

Figure 5-2. ULMOD Echo of Input Data

 ***** TEST ULMOD DATA; 25 MOD2'S; ALRO. N.M. SOLAR DATA *****

MONTHLY L.D.C.'S WILL BE DIVIDED INTO 5 LARGE SECTIONS.

SECTION	FRACTION OF TIME	SMALLER PIECES
1	.0500	2
2	.0500	2
3	.2000	2
4	.5000	2
5	.2000	2

ANNUAL L.D.C.'S WILL BE DIVIDED INTO 7 LARGE SECTIONS.

SECTION	FRACTION OF TIME	SMALLER PIECES
1	.0500	2
2	.0500	2
3	.1000	2
4	.2000	2
5	.2000	2
6	.2000	2
7	.2000	2

UNCERTAINTY IN UTILITY LOADS IS DESIRED.

MONTH	T	OP	3	% OF TIME	MW	Z	**	MW	Z	**	MW	Z	**	MW	Z	**	MW	Z	**TAPER**
1	*	TOP	*	100.00	0.0	38.30	**	179.8	24.20	**	-179.8	24.20	**	378.9	6.65	**	-378.9	6.65	** F **
2	*	TOP	*	100.00	0.0	38.30	**	171.8	24.20	**	-171.8	24.20	**	361.9	6.65	**	-361.9	6.65	** F **
3	*	TOP	*	100.00	0.0	38.30	**	165.8	24.20	**	-165.8	24.20	**	349.2	6.65	**	-349.2	6.65	** F **
4	*	TOP	*	100.00	0.0	38.30	**	163.7	24.20	**	-163.7	24.20	**	344.8	6.65	**	-344.8	6.65	** F **
5	*	TOP	*	100.00	0.0	38.30	**	188.0	24.20	**	-188.0	24.20	**	396.0	6.65	**	-396.0	6.65	** F **
6	*	TOP	*	100.00	0.0	38.30	**	229.0	24.20	**	-229.0	24.20	**	482.4	6.65	**	-482.4	6.65	** F **
7	*	TOP	*	100.00	0.0	38.30	**	217.8	24.20	**	-217.8	24.20	**	458.8	6.65	**	-458.8	6.65	** F **
8	*	TOP	*	100.00	0.0	38.30	**	216.4	24.20	**	-216.4	24.20	**	455.8	6.65	**	-455.8	6.65	** F **
9	*	TOP	*	100.00	0.0	38.30	**	233.6	24.20	**	-233.6	24.20	**	492.0	6.65	**	-492.0	6.65	** F **
10	*	TOP	*	100.00	0.0	38.30	**	193.2	24.20	**	-193.2	24.20	**	407.0	6.65	**	-407.0	6.65	** F **
11	*	TOP	*	100.00	0.0	38.30	**	174.0	24.20	**	-174.0	24.20	**	366.6	6.65	**	-366.6	6.65	** F **
12	*	TOP	*	100.00	0.0	38.30	**	173.5	24.20	**	-173.5	24.20	**	365.4	6.65	**	-365.4	6.65	** F **

Figure 5-2. ULMOD Echo of Input Data (Concluded)

***** FOR THE MONTH 1 INPUT HOURLY UTILITY LOADS.												
DAY 1	5697.	5439.	5252.	5151.	5167.	5248.	5224.	5554.	5775.	5907.	5966.	5933.
DAY 2	5894.	5764.	5687.	5819.	6603.	7250.	7227.	7092.	6940.	6403.	5876.	5414.
DAY 3	5302.	5224.	5199.	5274.	5483.	6327.	7352.	8145.	9081.	8520.	8227.	8315.
DAY 4	8276.	8189.	8227.	8211.	6775.	9328.	9095.	9793.	8472.	7529.	6923.	6120.
DAY 5	5814.	5629.	5600.	5586.	5624.	6426.	7575.	8341.	8649.	8606.	8458.	8316.
DAY 6	8288.	8202.	8157.	7984.	8502.	9205.	6975.	8743.	8419.	7698.	6989.	6163.
DAY 7	5842.	5637.	5594.	5568.	5818.	6447.	7519.	8226.	9470.	8472.	8449.	8226.
DAY 8	8210.	8181.	8087.	7979.	8757.	9111.	8994.	8666.	8281.	7543.	6856.	6170.
DAY 9	5770.	5608.	5550.	5519.	5791.	6489.	7532.	8404.	8673.	8772.	8792.	8657.
DAY 10	8668.	8600.	8519.	8499.	8936.	9208.	8931.	8561.	8165.	7498.	6966.	6305.
DAY 11	5586.	5561.	5424.	5385.	5416.	5685.	5947.	6532.	6869.	7176.	7129.	7042.
DAY 12	6910.	6789.	6658.	6695.	7511.	7938.	7766.	7521.	7128.	6793.	6212.	5658.
DAY 13	5367.	5122.	5055.	5004.	5015.	5103.	5189.	5590.	5974.	6352.	6413.	6439.
DAY 14	6343.	6311.	6195.	6323.	6935.	7598.	7468.	7257.	6997.	6526.	5918.	5465.
DAY 15	5309.	5174.	5226.	5220.	5501.	6166.	7202.	8053.	8387.	8440.	6380.	8203.
DAY 16	5207.	5176.	5181.	8189.	8731.	9225.	9099.	8788.	8337.	7582.	6866.	6254.
DAY 17	5403.	5409.	5457.	5368.	5614.	6287.	7272.	8130.	8139.	8499.	8443.	8174.
DAY 18	8155.	8121.	8051.	7904.	8376.	9045.	8951.	8674.	8259.	7506.	6758.	6062.
DAY 19	5729.	5148.	5454.	5472.	5739.	6393.	7339.	8139.	8331.	8429.	8344.	8137.
DAY 20	4178.	8088.	8047.	7873.	8335.	9182.	8939.	8590.	8208.	7514.	6725.	6047.
DAY 21	5460.	5569.	5480.	5478.	5667.	6380.	7318.	8133.	8357.	8352.	8376.	8180.
DAY 22	8230.	8182.	8073.	7865.	8344.	9059.	8832.	8557.	8176.	7399.	6635.	5956.
DAY 23	9726.	9515.	9422.	9422.	9615.	6120.	7306.	7866.	8344.	8441.	8421.	8171.
DAY 24	8202.	8092.	7944.	7773.	8330.	8740.	8621.	8271.	7909.	7349.	6758.	6085.
DAY 25	5605.	5407.	5367.	5302.	5419.	5561.	5875.	6505.	6898.	7142.	7026.	6877.
DAY 26	6685.	6648.	6596.	6578.	7306.	7797.	7597.	7328.	7023.	6535.	6126.	5586.
DAY 27	9277.	9079.	4963.	4922.	4898.	5043.	5142.	5539.	5997.	6230.	6372.	6487.
DAY 28	6617.	6672.	6670.	6627.	7353.	7694.	7611.	7378.	7046.	6603.	6009.	5468.
DAY 29	5323.	5226.	5130.	5201.	5421.	6131.	7342.	8186.	8503.	8744.	8965.	8669.
DAY 30	8693.	8705.	8694.	8606.	8998.	9385.	9062.	8829.	8395.	7573.	6824.	6062.
DAY 31	5724.	5557.	5455.	5454.	5644.	6286.	7470.	8257.	8517.	8470.	8302.	8211.
DAY 32	8244.	8435.	8298.	8159.	8635.	9189.	8952.	8630.	8279.	7516.	6790.	6127.
DAY 33	5755.	5534.	5413.	5402.	5554.	6270.	7408.	8116.	8362.	8392.	8350.	8080.
DAY 34	8103.	8079.	8019.	7894.	8232.	9068.	8908.	8633.	8233.	7586.	6710.	5995.
DAY 35	5627.	5504.	5423.	5425.	5580.	6243.	7381.	8096.	8425.	8476.	8469.	8354.
DAY 36	8442.	8364.	8221.	8154.	8429.	9254.	9135.	8855.	8426.	7707.	6912.	6245.
DAY 37	5956.	5769.	5639.	5700.	5901.	6563.	7679.	8338.	8459.	8505.	8327.	8138.
DAY 38	8129.	8074.	7922.	7663.	7984.	8860.	8704.	8420.	8082.	7534.	6893.	6132.
DAY 39	5797.	5585.	5518.	5428.	5528.	5807.	6047.	6535.	6955.	7076.	7023.	6913.
DAY 40	6743.	5550.	6474.	6495.	7088.	7867.	7703.	7436.	7033.	6649.	6140.	5615.
DAY 41	5289.	5093.	4987.	4943.	4914.	5027.	5156.	5602.	6065.	6303.	6356.	6358.
DAY 42	6257.	6090.	6112.	6206.	6735.	7484.	7340.	7228.	6878.	6413.	5931.	5428.
DAY 43	5152.	5097.	5100.	5144.	5354.	6131.	7217.	8030.	8330.	8367.	8335.	8071.
DAY 44	8182.	8182.	8023.	7949.	8355.	9051.	8830.	8609.	8179.	7408.	6711.	6009.
DAY 45	5550.	5494.	5412.	5430.	5686.	6393.	7425.	8146.	8403.	8422.	8306.	8051.
DAY 46	8062.	8054.	7941.	7828.	8265.	9033.	8959.	8602.	8190.	7409.	6623.	5980.
DAY 47	5568.	5403.	5323.	5347.	5589.	6210.	7401.	9141.	8426.	8502.	8452.	8209.
DAY 48	8241.	8186.	8016.	7953.	8225.	9073.	8913.	8601.	8192.	7462.	6712.	6039.
DAY 49	5657.	5476.	5451.	5464.	5670.	6342.	7490.	9264.	8493.	8526.	8466.	8322.
DAY 50	8284.	8225.	8129.	8079.	9338.	9274.	9130.	9865.	8473.	7717.	6891.	6246.
DAY 51	5892.	5755.	5710.	5760.	6008.	6706.	7787.	8461.	8585.	8498.	8547.	8265.
DAY 52	8225.	8145.	7983.	7717.	7969.	8927.	8789.	8336.	8242.	7603.	7020.	6305.
DAY 53	5957.	5781.	5662.	5657.	5737.	6001.	6360.	6828.	7134.	7198.	7142.	6903.
DAY 54	6717.	6541.	6426.	6393.	6815.	7854.	7668.	7326.	7140.	6714.	6234.	5702.
DAY 55	5381.	5256.	5118.	5148.	5155.	5262.	5384.	5850.	6173.	6421.	6383.	6441.
DAY 56	6426.	6340.	6463.	6621.	7000.	7819.	7792.	7679.	7445.	6929.	6363.	5768.
DAY 57	5624.	5555.	5559.	5638.	5886.	6668.	7824.	8594.	8753.	8760.	8646.	8310.
DAY 58	8315.	8177.	8047.	7916.	8318.	9180.	9069.	8945.	8552.	7981.	7108.	6356.
DAY 59	6017.	5855.	5713.	5731.	5921.	6630.	7783.	8577.	8817.	8931.	8876.	8772.
DAY 60	8901.	8951.	8912.	8880.	9253.	9766.	9540.	9166.	8714.	7940.	7089.	6387.
DAY 61	6125.	5851.	5776.	5717.	5904.	6555.	7622.	8359.	8617.	8573.	8678.	8465.
DAY 62	8524.	8608.	8659.	8579.	8717.	9336.	9188.	8856.	8428.	7691.	6907.	6209.

Figure 5-3. ULMOD Echo of Provided Load Data

***** FOR MONTH 1		INPUT TYPICAL DAY OF HOURLY ALTERNATIVE GENERATION POWER-PROBABILITY DATA.						
HOURL		POWERS	PROBS.	POWERS	PROBS.	POWERS	PROBS.	POWERS
1	POWERS	0.0000	18.1497	30.7638	43.4551	56.0463	62.5000	9.9039
	PROBS.	.8220	.0572	.0351	.0175	.0075	.0043	.0564
2	POWERS	0.0000	17.7940	29.9958	43.2881	56.0049	62.5000	9.3322
	PROBS.	.7974	.0563	.0241	.0097	.0038	.0023	.1114
3	POWERS	0.0000	17.8816	30.0285	43.2750	55.9838	62.5000	9.5316
	PROBS.	.8516	.0443	.0205	.0084	.0032	.0017	.0703
4	POWERS	0.0000	18.0828	30.1616	43.3322	55.9476	62.5000	9.8630
	PROBS.	.9109	.0295	.0165	.0074	.0029	.0014	.0314
5	POWERS	0.0000	17.4694	29.6037	42.7659	55.6013	62.5000	9.1285
	PROBS.	.8815	.0277	.0077	.0020	.0005	.0001	.0805
6	POWERS	0.0000	15.8544	26.9237	51.1034	62.5000	62.5000	9.4205
	PROBS.	.9407	.0085	.0001	0.0000	0.0000	0.0000	.0507
7	POWERS	0.0000	18.1071	30.1252	43.2345	55.8376	62.5000	9.9598
	PROBS.	.9109	.0309	.0173	.0074	.0026	.0010	.0299
8	POWERS	0.0000	17.9349	30.4468	43.9570	56.5856	62.5000	8.5307
	PROBS.	.9446	.0087	.0051	.0034	.0024	.0067	.0291
9	POWERS	0.0000	18.6454	30.7367	43.8014	56.1814	62.5000	10.4939
	PROBS.	.9407	.0153	.0160	.0115	.0062	.0037	.0067
10	POWERS	0.0000	18.6410	30.6390	43.0621	55.6880	62.5000	9.9467
	PROBS.	.9109	.0319	.0162	.0060	.0018	.0006	.0326
11	POWERS	0.0000	17.9708	30.0286	43.1846	55.8416	62.5000	9.7598
	PROBS.	.8517	.0492	.0241	.0095	.0032	.0013	.0610
12	POWERS	0.0000	17.7172	29.8180	42.9848	55.7340	62.5000	9.4440
	PROBS.	.7626	.0691	.0256	.0082	.0024	.0009	.1312
13	POWERS	0.0000	18.1357	30.4126	43.7462	56.3411	62.5000	9.6517
	PROBS.	.8220	.0477	.0311	.0187	.0107	.0121	.0577
14	POWERS	0.0000	19.4391	30.7656	41.9856	53.4260	62.5000	11.3084
	PROBS.	.7924	.0565	.1039	.0398	.0019	0.0000	.0055
15	POWERS	0.0000	18.4455	30.7197	43.9883	56.4668	62.5000	10.1461
	PROBS.	.7331	.0605	.0561	.0431	.0242	.0382	.0398
16	POWERS	0.0000	18.4240	30.6230	43.8472	56.3381	62.5000	10.1508
	PROBS.	.6439	.0929	.0802	.0555	.0331	.0316	.0628
17	POWERS	0.0000	18.0062	29.6467	42.2574	54.8685	62.5000	10.2174
	PROBS.	.5845	.1768	.0733	.0160	.0020	.0002	.1472
18	POWERS	0.0000	17.8290	29.9700	43.2010	55.9088	62.5000	9.4877
	PROBS.	.7033	.0875	.0379	.0145	.0052	.0025	.1491
19	POWERS	0.0000	18.0602	30.2726	43.5633	56.1873	62.5000	9.6532
	PROBS.	.7627	.0693	.0403	.0210	.0102	.0082	.0883
20	POWERS	0.0000	18.3850	30.5004	43.6497	56.1483	62.5000	10.1868
	PROBS.	.7625	.0712	.0566	.0341	.0169	.0108	.0479
21	POWERS	0.0000	18.0821	30.3148	43.6193	56.2350	62.5000	9.6507
	PROBS.	.7330	.0762	.0459	.0250	.0127	.0113	.0959
22	POWERS	0.0000	18.3651	30.3484	43.3652	55.8551	62.5000	10.2757
	PROBS.	.8220	.0609	.0447	.0224	.0083	.0031	.0386
23	POWERS	0.0000	19.2665	31.3802	44.2704	56.2911	62.5000	11.0644
	PROBS.	.8814	.0140	.0298	.0352	.0248	.0126	.0022
24	POWERS	0.0000	18.6830	30.8118	43.9103	56.2819	62.5000	10.5093
	PROBS.	.8517	.0347	.0385	.0299	.0178	.0129	.0145

Figure 5-4. ULMOD Echo of Intermittent Generation Data Provided from ROSEW

***** FOR MONTH 1			RESIDUAL LOADS AND PROBABILITIES.							
DAY	1 HOUR	1	POWERS	5697.0	5687.1	5678.9	5666.7	5653.5	5641.0	5634.5
			PROBS.	.8220	.0564	.0572	.0351	.0175	.0075	.0043
DAY	1 HOUR	2	POWERS	5439.0	5429.7	5421.2	5409.0	5395.7	5383.0	5376.5
			PROBS.	.7924	.1114	.0563	.0241	.0097	.0038	.0023
DAY	1 HOUR	3	POWERS	5252.0	5242.5	5234.1	5222.0	5208.7	5196.0	5189.5
			PROBS.	.8516	.0703	.0443	.0205	.0084	.0032	.0017
DAY	1 HOUR	4	POWERS	5151.0	5141.1	5132.9	5120.8	5107.7	5095.1	5088.5
			PROBS.	.9109	.0314	.0295	.0165	.0074	.0029	.0014
DAY	1 HOUR	5	POWERS	5167.0	5157.9	5149.5	5137.4	5124.2	5111.4	5104.5
			PROBS.	.8815	.0805	.0277	.0077	.0020	.0005	.0001
DAY	1 HOUR	6	POWERS	5248.0	5238.6	5232.1	5221.1	5196.9	5185.5	5185.5
			PROBS.	.9407	.0507	.0085	.0001	0.0000	0.0000	0.0000
DAY	1 HOUR	7	POWERS	5224.0	5214.0	5205.9	5193.9	5180.8	5168.2	5161.5
			PROBS.	.9109	.0299	.0309	.0173	.0074	.0026	.0010
DAY	1 HOUR	8	POWERS	5554.0	5545.5	5536.1	5523.6	5510.0	5497.4	5491.5
			PROBS.	.9446	.0291	.0087	.0051	.0034	.0024	.0007
DAY	1 HOUR	9	POWERS	5775.0	5765.5	5756.4	5744.3	5731.2	5717.8	5712.5
			PROBS.	.9406	.0067	.0153	.0160	.0115	.0062	.0037
DAY	1 HOUR	10	POWERS	5907.0	5897.1	5889.0	5877.0	5863.9	5851.3	5844.5
			PROBS.	.9109	.0326	.0319	.0162	.0060	.0018	.0006
DAY	1 HOUR	11	POWERS	5768.0	5758.2	5748.0	5736.0	5722.8	5710.2	5703.5
			PROBS.	.8517	.0610	.0492	.0241	.0095	.0032	.0013
DAY	1 HOUR	12	POWERS	5933.0	5923.6	5915.3	5903.2	5890.0	5877.3	5870.5
			PROBS.	.7476	.1312	.0691	.0256	.0082	.0024	.0009
DAY	1 HOUR	13	POWERS	5884.0	5874.3	5865.9	5853.6	5840.3	5827.7	5821.5
			PROBS.	.8220	.0577	.0477	.0311	.0187	.0107	.0051
DAY	1 HOUR	14	POWERS	5744.0	5732.7	5744.6	5733.2	5722.0	5710.6	5701.5
			PROBS.	.7476	.0055	.0565	.0339	.0398	.0019	0.0000
DAY	1 HOUR	15	POWERS	5687.0	5676.9	5668.5	5656.3	5643.0	5630.5	5624.5
			PROBS.	.7331	.0398	.0505	.0561	.0431	.0292	.0082
DAY	1 HOUR	16	POWERS	5819.0	5808.8	5800.6	5788.4	5775.2	5762.7	5756.5
			PROBS.	.6439	.0628	.0929	.0802	.0555	.0331	.0036
DAY	1 HOUR	17	POWERS	6603.0	6592.8	6585.0	6573.4	6560.7	6548.8	6540.5
			PROBS.	.5845	.1472	.1768	.0733	.0160	.0020	.0002
DAY	1 HOUR	18	POWERS	7250.0	7240.5	7232.2	7220.0	7206.8	7194.1	7187.5
			PROBS.	.7033	.1491	.0875	.0379	.0145	.0052	.0025
DAY	1 HOUR	19	POWERS	7227.0	7217.3	7208.9	7196.7	7183.4	7170.8	7164.5
			PROBS.	.7627	.0883	.0693	.0403	.0210	.0102	.0082
DAY	1 HOUR	20	POWERS	7092.0	7081.8	7073.6	7061.5	7048.4	7035.9	7029.5
			PROBS.	.7625	.0479	.0712	.0566	.0341	.0169	.0108
DAY	1 HOUR	21	POWERS	6940.0	6930.3	6921.9	6909.7	6896.4	6883.8	6877.5
			PROBS.	.7330	.0959	.0762	.0459	.0250	.0127	.0113
DAY	1 HOUR	22	POWERS	6403.0	6392.7	6384.6	6372.7	6359.6	6347.1	6340.5
			PROBS.	.8220	.0386	.0609	.0447	.0224	.0083	.0031
DAY	1 HOUR	23	POWERS	5876.0	5864.4	5856.7	5844.6	5831.7	5819.7	5813.5
			PROBS.	.8814	.0022	.0140	.0298	.0352	.0248	.0126
DAY	1 HOUR	24	POWERS	5414.0	5403.5	5395.3	5383.2	5370.1	5357.7	5351.5
			PROBS.	.8517	.0145	.0347	.0385	.0259	.0178	.0129
DAY	2 HOUR	1	POWERS	5302.0	5292.1	5283.9	5271.7	5258.5	5246.0	5239.5
			PROBS.	.8220	.0564	.0572	.0351	.0175	.0075	.0043
DAY	2 HOUR	2	POWERS	5224.0	5214.0	5206.2	5194.0	5180.7	5168.0	5161.5
			PROBS.	.7924	.1114	.0563	.0241	.0097	.0038	.0023
DAY	2 HOUR	3	POWERS	5199.0	5189.5	5181.1	5169.0	5155.7	5143.0	5136.5
			PROBS.	.8516	.0703	.0443	.0205	.0084	.0032	.0017
DAY	2 HOUR	4	POWERS	5274.0	5264.1	5255.9	5243.8	5230.7	5218.1	5211.5
			PROBS.	.9109	.0314	.0295	.0165	.0074	.0029	.0014
DAY	2 HOUR	5	POWERS	5483.0	5473.9	5464.5	5453.4	5440.2	5427.4	5420.8
			PROBS.	.8815	.0805	.0277	.0077	.0020	.0005	.0001
DAY	2 HOUR	6	POWERS	6327.0	6317.6	6311.1	6300.1	6275.9	6264.5	6264.5
			PROBS.	.9407	.0507	.0085	.0001	0.0000	0.0000	0.0000
DAY	2 HOUR	7	POWERS	7352.0	7342.0	7333.9	7321.9	7308.8	7296.2	7289.5
			PROBS.	.9109	.0299	.0309	.0173	.0074	.0026	.0010
DAY	2 HOUR	8	POWERS	8145.0	8136.5	8127.1	8114.6	8101.0	8088.4	8082.5

Figure 5-5. ULMOD Residual Loads

Figure 5-6. ULMOD Residual Load Duration Curve

***** MONTH 1 SEGMENTED LOAD DURATION CURVE.

SECTION 1	=	.0500 FRACTION OF TIME, PIECES = 9348.7 9062.5
EACH PIECE	=	18.6 HOURS LONG
SECTION 2	=	.0500 FRACTION OF TIME, PIECES = 0907.8 0700.1
EACH PIECE	=	18.6 HOURS LONG
SECTION 3	=	.2000 FRACTION OF TIME, PIECES = 8571.2 8309.2
EACH PIECE	=	74.4 HOURS LONG
SECTION 4	=	.5000 FRACTION OF TIME, PIECES = 7681.2 6301.2
EACH PIECE	=	186.0 HOURS LONG
SECTION 5	=	.2000 FRACTION OF TIME, PIECES = 5581.5 5183.1
EACH PIECE	=	74.4 HOURS LONG

Figure 5-7. ULMOD Sectionalized Residual LDC

***** ANNUAL LOAD DISSIPATION CURVE															
RESIDUAL LOADS	12969.8	12900.2	12729.6	12686.9	12664.4	12599.6	12553.7	12535.6	12512.2	12490.5	12477.8	12452.9			
RESIDUAL LOADS	12411.7	12398.4	12376.1	12339.5	12338.3	12319.6	12301.0	12285.1	12266.5	12253.8	12248.3	12234.8			
RESIDUAL LOADS	12211.4	12203.3	12176.7	12161.9	12158.9	12119.1	12115.4	12111.2	12096.3	12071.7	12050.7	12050.5			
RESIDUAL LOADS	12038.6	12027.4	12025.2	12019.2	12003.9	11987.6	11986.0	11959.8	11959.2	11942.8	11940.7	11917.3			
RESIDUAL LOADS	11895.2	11878.4	11874.1	11858.9	11854.1	11840.2	11824.4	11810.5	11803.0	11800.2	11784.2	11781.3			
RESIDUAL LOADS	11772.9	11760.2	11755.3	11753.0	11742.8	11725.1	11718.7	11715.3	11702.7	11701.1	11672.7	11668.8			
RESIDUAL LOADS	11667.1	11662.7	11650.4	11633.9	11624.4	11623.1	11602.5	11594.0	11593.3	11586.4	11582.4	11567.8			
RESIDUAL LOADS	11561.8	11554.2	11552.8	11539.8	11531.6	11530.6	11524.2	11515.6	11503.3	11499.2	11493.5	11486.4			
RESIDUAL LOADS	11475.9	11472.5	11463.0	11458.4	11455.4	11438.7	11433.1	11421.1	11419.1	11417.5	11412.3	11400.5			
RESIDUAL LOADS	11345.8	11335.5	11376.0	11373.2	11368.3	11363.8	11358.1	11356.5	11346.4	11342.9	11340.7	11338.5			
RESIDUAL LOADS	11321.7	11316.7	11314.0	11307.6	11304.9	11297.7	11291.7	11285.5	11278.3	11277.6	11268.8	11261.5			
RESIDUAL LOADS	11258.7	11255.2	11249.5	11234.0	11233.2	11232.2	11230.3	11223.4	11207.9	11206.4	11206.3	11196.2			
RESIDUAL LOADS	11193.6	11187.2	11186.7	11180.7	11172.6	11166.2	11158.0	11157.5	11152.5	11144.7	11141.5	11139.3			
RESIDUAL LOADS	11133.8	11128.0	11123.9	11120.7	11118.2	11116.3	11116.2	11107.5	11100.5	11095.1	11094.9	11091.1			
RESIDUAL LOADS	11082.4	11079.9	11079.3	11073.6	11069.2	11066.5	11066.3	11059.8	11049.0	11048.7	11046.2	11037.7			
RESIDUAL LOADS	11033.3	11029.8	11025.9	11019.9	11017.8	11014.9	11006.9	10999.2	10997.5	10994.1	10991.6	10982.1			
RESIDUAL LOADS	10977.1	10976.2	10973.8	10965.1	10959.5	10952.4	10947.9	10947.8	10939.0	10937.9	10937.9	10926.2			
RESIDUAL LOADS	10924.9	10924.5	10923.4	10917.1	10907.8	10906.6	10904.4	10903.9	10897.6	10896.6	10890.8	10885.8			
RESIDUAL LOADS	10894.7	10883.4	10881.6	10868.2	10865.6	10864.3	10863.0	10861.9	10858.9	10850.2	10846.4	10843.0			
RESIDUAL LOADS	10840.0	10839.2	10834.4	10829.9	10822.8	10822.8	10813.9	10812.5	10809.2	10803.2	10801.8	10796.5			
RESIDUAL LOADS	10792.1	10787.1	10783.5	10774.5	10773.2	10767.9	10765.8	10764.3	10751.6	10750.4	10748.1	10740.5			
RESIDUAL LOADS	10736.8	10735.6	10729.2	10727.6	10726.0	10717.1	10715.8	10714.1	10711.7	10705.7	10703.0	10699.9			
RESIDUAL LOADS	10694.2	10690.7	10687.3	10687.1	10682.1	10680.7	10680.6	10677.7	10669.5	10667.0	10665.9	10664.9			
RESIDUAL LOADS	10660.2	10650.3	10649.3	10644.9	10642.4	10641.7	10635.9	10629.2	10624.8	10624.4	10623.4	10619.2			
RESIDUAL LOADS	10611.1	10606.7	10604.6	10601.2	10597.9	10592.7	10584.5	10584.5	10580.8	10574.8	10574.8	10567.0			
RESIDUAL LOADS	10563.0	10556.3	10555.0	10551.0	10547.8	10545.7	10539.8	10537.8	10533.1	10531.3	10529.4	10522.4			
RESIDUAL LOADS	10520.8	10519.9	10517.1	10515.8	10506.9	10504.7	10497.9	10494.1	10493.9	10491.2	10489.0	10483.8			
RESIDUAL LOADS	10480.7	10480.0	10474.3	10473.6	10468.6	10465.3	10464.9	10463.3	10459.1	10458.5	10449.8	10448.5			
RESIDUAL LOADS	10446.6	10436.7	10435.4	10432.9	10431.9	10427.8	10414.3	10412.8	10411.6	10411.2	10403.2	10403.2			
RESIDUAL LOADS	10401.2	10393.2	10390.7	10386.9	10382.3	10380.7	10376.0	10371.4	10368.9	10367.0	10364.5	10362.5			
RESIDUAL LOADS	10356.8	10351.1	10348.6	10347.0	10342.9	10342.4	10339.1	10331.4	10331.3	10330.0	10326.2	10322.3			
RESIDUAL LOADS	10318.9	10318.1	10312.6	10306.4	10306.1	10304.5	10300.4	10300.0	10295.5	10291.8	10287.5	10285.9			
RESIDUAL LOADS	10279.8	10279.5	10276.4	10270.8	10270.4	10269.8	10265.2	10265.1	10259.2	10255.6	10252.6	10250.4			
RESIDUAL LOADS	10245.0	10244.8	10244.0	10243.5	10238.3	10236.9	10232.4	10230.3	10227.2	10226.8	10219.6	10216.9			
RESIDUAL LOADS	10210.2	10209.6	10208.8	10204.7	10195.4	10188.7	10186.1	10184.8	10178.1	10174.9	10174.6	10173.8			
RESIDUAL LOADS	10171.4	10168.0	10167.3	10158.3	10157.8	10155.3	10149.1	10146.8	10145.2	10145.2	10143.0	10137.6			
RESIDUAL LOADS	10137.2	10136.6	10136.5	10132.0	10124.3	10123.7	10122.3	10121.3	10120.7	10114.0	10109.6	10109.3			
RESIDUAL LOADS	10108.0	10105.2	10098.3	10094.0	10093.7	10092.0	10086.6	10084.0	10082.4	10080.4	10074.5	10073.3			
RESIDUAL LOADS	10072.9	10065.8	10063.5	10062.9	10059.0	10057.7	10056.8	10052.3	10050.8	10049.8	10047.7	10046.9			
RESIDUAL LOADS	10043.0	10040.6	10037.5	10034.0	10030.4	10027.3	10025.0	10024.7	10021.1	10016.1	10015.8	10014.1			
RESIDUAL LOADS	10008.1	10004.4	10003.4	10003.1	10001.3	9999.3	9999.0	9997.1	9990.8	9990.0	9988.1	9983.5			
RESIDUAL LOADS	9978.8	9974.2	9970.3	9968.9	9968.0	9965.6	9960.8	9959.4	9956.9	9952.5	9950.4	9947.0			
RESIDUAL LOADS	9946.9	9946.9	9941.4	9940.1	9938.1	9935.4	9931.7	9929.8	9924.1	9922.0	9920.7	9920.2			
RESIDUAL LOADS	9913.0	9911.6	9911.2	9910.8	9908.4	9905.4	9903.7	9899.6	9898.0	9897.1	9896.8	9895.9			
RESIDUAL LOADS	9890.6	9887.7	9885.5	9882.5	9876.6	9876.3	9875.2	9868.5	9867.6	9867.5	9862.9	9862.1			
RESIDUAL LOADS	9861.2	9855.6	9851.2	9849.9	9846.4	9846.5	9841.0	9840.4	9837.8	9834.4	9834.3	9832.1			
RESIDUAL LOADS	9831.3	9829.2	9826.7	9826.4	9824.5	9823.8	9821.8	9818.5	9818.2	9817.6	9815.0	9814.7			
RESIDUAL LOADS	9811.6	9808.6	9805.6	9802.4	9802.2	9801.0	9799.3	9790.8	9790.6	9786.2	9785.9	9784.2			
RESIDUAL LOADS	9781.3	9779.8	9779.8	9775.5	9774.7	9771.7	9770.1	9769.5	9765.5	9763.9	9761.3	9758.7			
RESIDUAL LOADS	9758.6	9754.9	9748.7	9747.9	9742.0	9740.5	9740.0	9739.7	9736.2	9733.0	9730.5	9727.8			
RESIDUAL LOADS	9724.9	9722.8	9722.5	9720.7	9716.5	9716.0	9712.2	9710.0	9707.7	9703.3	9702.8	9700.9			
RESIDUAL LOADS	9699.6	9698.5	9695.0	9691.2	9691.0	9690.9	9686.3	9685.4	9682.0	9679.7	9677.6	9675.1			
RESIDUAL LOADS	9674.6	9673.6	9669.9	9668.4	9665.1	9664.4	9664.1	9662.0	9656.3	9656.1	9655.5	9653.4			
RESIDUAL LOADS	9652.5	9647.5	9647.1	9647.0	9639.8	9639.7	9639.0	9634.4	9634.0	9631.6	9630.2	9624.0			
RESIDUAL LOADS	9622.1	9620.1	9618.8	9617.6	9616.6	9615.3	9615.2	9612.3	9611.3	9607.6	9607.2	9605.2			
RESIDUAL LOADS	9603.8	9601.0	9600.2	9599.9	9599.6	9599.0	9593.7	9593.3	9592.2	9589.8	9588.7	9585.9			
RESIDUAL LOADS	9585.1	9584.2	9584.0	9583.4	9579.6	9577.8	9576.5	9575.0	9572.7	9571.2	9567.7	9567.3			
RESIDUAL LOADS	9564.9	9564.7	9564.2	9561.8	9561.4	9557.7	9556.5	9552.2	9551.7	9550.8	9550.7	9542.7			
RESIDUAL LOADS	9540.5	9538.6	9537.8	9537.4	9534.4	9533.5	9532.6	9527.3	9524.8	9523.6	9523.0	9521.7			
RESIDUAL LOADS	9518.5	9517.7	9517.6	9515.7	9509.8	9507.1	9506.1	9504.6	9504.1	9502.6	9500.9	9499.1			
RESIDUAL LOADS	9496.4	9492.2	9490.6	9489.5	9489.2	9486.0	9484.5	9484.1	9481.2	9480.1	9478.3	9477.9			
RESIDUAL LOADS	9476.5	9475.7	9474.6	9471.8	9467.0	9466.3	9464.7	9464.7	9464.4	9457.3	9456.6	9455.7			
RESIDUAL LOADS	9455.2	9453.6	9452.7	9450.1	9449.1	9447.9	9445.3	9441.7	9439.9	9439.5	9437.8	9437.5			

Figure 5-8. ULMOD Annual LDC

***** FOR MONTH 1		EXPECTED CHRONOLOGICAL HOURLY RESIDUAL LOADS FROM PROBABILITY DATA.												
DAY		1	2	3	4	5	6	7	8	9	10	11	12	13
DAY 1	5692.9	5435.5	5249.3	5149.1	5165.4	5247.4	5222.1	5552.7	5773.1	5905.2	5963.1	5929.2	5905.2	5963.1
DAY 2	5879.5	5757.9	5677.8	5807.9	6595.3	7244.8	7221.7	7085.4	6933.8	6398.5	5871.0	5408.9	6398.5	5871.0
DAY 3	5297.9	5220.5	5196.3	5272.1	5481.4	6326.4	7350.1	8143.7	9079.1	8518.2	8224.1	8311.2	8518.2	8224.1
DAY 4	8271.5	6182.9	8217.8	9199.9	8767.3	9322.8	9089.7	8786.4	8465.8	7624.5	6918.0	6114.9	7624.5	6918.0
DAY 5	5809.9	5625.5	5597.3	5584.1	5822.4	6425.4	7573.1	8339.7	8647.1	8604.2	8455.1	8312.2	8604.2	8455.1
DAY 6	9283.5	8195.9	8147.8	7972.9	8494.3	9199.8	8969.7	8736.4	8412.8	7693.5	6984.0	6157.9	7693.5	6984.0
DAY 7	5837.9	5635.5	5591.3	5566.1	5816.4	6446.4	7517.1	8224.7	8468.1	8470.2	8446.1	8222.2	8470.2	8446.1
DAY 8	8205.5	8174.9	8077.8	7967.9	8749.3	9105.8	8788.7	8659.4	8274.8	7538.5	6851.0	6164.9	7538.5	6851.0
DAY 9	5765.9	5604.5	5547.3	5517.1	5789.4	6488.4	7530.1	8402.7	8671.1	8770.2	8789.1	8653.2	8770.2	8789.1
DAY 10	8663.5	8593.9	8509.6	8487.9	8928.3	9202.8	8925.7	8554.4	8158.8	7493.5	6961.0	6299.9	7493.5	6961.0
DAY 11	5581.9	5557.5	5421.3	5383.1	5414.4	5684.4	5945.1	6530.7	6867.1	7174.2	7126.1	7038.2	7174.2	7126.1
DAY 12	6905.5	6782.9	6648.8	6683.9	7503.3	7932.8	7760.7	7514.4	7121.8	6788.5	6207.0	5652.9	6788.5	6207.0
DAY 13	5362.9	5118.5	5052.3	5002.1	5013.4	5102.4	5187.1	5588.7	5972.1	6350.2	6410.1	6435.2	6350.2	6410.1
DAY 14	6338.5	6304.9	6185.8	6311.9	6927.3	7592.8	7462.7	7250.4	6990.8	6521.5	5913.0	5459.9	6521.5	5913.0
DAY 15	5304.9	5170.5	5223.3	5218.1	5499.4	6165.4	7200.1	8051.7	8385.1	8438.2	8377.1	8199.2	8438.2	8377.1
DAY 16	8202.5	8169.9	8171.8	8177.9	8273.3	9219.8	9093.7	8781.4	8330.8	7577.5	6981.0	6248.9	7577.5	6981.0
DAY 17	5798.9	5605.5	5454.3	5369.1	5612.4	6281.4	7270.1	8128.7	8377.1	8497.7	8440.1	8177.7	8497.7	8440.1
DAY 18	8180.5	8114.9	8041.8	7892.9	8568.3	9079.8	8949.7	8667.4	8252.8	7501.5	6753.0	6056.9	7501.5	6753.0
DAY 19	5774.9	5544.5	5451.3	5470.1	5727.4	6392.4	7337.1	8137.7	8329.1	8426.2	8341.1	8131.2	8426.2	8341.1
DAY 20	8173.5	8081.4	8037.8	7861.4	8320.3	9170.8	8453.7	8783.4	8201.8	7511.5	6720.0	6041.9	8453.7	8201.8
DAY 21	5655.9	5565.5	5477.3	5476.1	5668.4	6370.4	7316.1	8121.7	8355.1	8350.8	8275.1	8176.2	8350.8	8275.1
DAY 22	8225.5	8175.9	8013.8	7853.9	8336.3	9053.8	8826.7	8550.4	8159.8	7393.5	6630.0	5950.9	8826.7	8550.4
DAY 23	5721.7	5511.5	5425.3	5420.1	5613.4	6119.4	7304.1	7864.7	8342.1	8439.2	8418.1	8167.2	8439.2	8418.1
DAY 24	9147.5	8085.9	7954.8	7761.9	8222.3	8734.8	8615.7	8284.4	7902.8	7343.5	6753.0	6079.9	7343.5	6753.0
DAY 25	5600.9	5403.5	5364.3	5300.1	5417.4	5660.4	5873.1	6503.7	6896.1	7140.2	7023.1	6873.2	7140.2	7023.1
DAY 26	6880.5	6641.9	6594.8	6566.3	7258.3	7791.8	7591.7	7321.4	7016.8	6630.5	6121.0	5574.9	6630.5	6121.0
DAY 27	5272.9	5075.5	4960.3	4920.1	4896.4	5042.4	5140.1	5537.7	5995.1	6228.2	6369.1	6483.2	6228.2	6369.1
DAY 28	6612.5	6665.4	6560.8	6815.9	7345.3	7688.8	7505.7	7371.4	7039.8	6596.5	6004.0	5462.9	6596.5	6004.0
DAY 29	5318.9	5222.5	5127.3	5199.1	5419.4	6130.4	7346.1	8187.7	8601.1	8742.2	8682.1	8665.2	8742.2	8682.1
DAY 30	8688.5	8698.9	8684.8	8594.9	8990.3	9379.8	9056.7	8822.4	8388.8	7568.5	6819.0	6056.9	8822.4	8388.8
DAY 31	5719.9	5553.5	5452.1	5452.1	5642.4	6287.4	7468.1	8255.7	8515.1	8468.2	8299.1	8207.2	8468.2	8299.1
DAY 1	8239.5	8428.9	8288.8	8147.9	8627.3	9183.8	8946.7	8673.4	8272.8	7511.5	6785.0	6121.9	8946.7	8673.4
DAY 2	5750.9	5530.5	5410.3	5400.1	5552.4	6269.4	7406.1	8114.7	8360.1	8380.2	8347.1	8076.2	8380.2	8347.1
DAY 3	8098.5	8072.9	8009.9	7882.9	8224.3	9062.8	8902.7	8626.4	8226.8	7581.5	6705.0	5989.9	8902.7	8626.4
DAY 4	5622.9	5500.5	5420.3	5425.1	5578.4	6242.4	7379.1	8094.7	8423.1	8474.2	8466.1	8350.2	8474.2	8466.1
DAY 5	8437.5	8357.9	8211.8	8142.9	8421.3	9248.8	9129.7	8848.4	8419.8	7702.5	6907.0	6239.9	8848.4	8419.8
DAY 6	5951.9	5765.5	5636.3	5698.1	5899.4	6562.4	7677.1	8336.7	8457.1	8503.2	8324.1	8134.2	8503.2	8324.1
DAY 7	8124.5	8067.9	7912.8	7651.9	7976.3	8854.8	8698.7	8413.4	8075.8	7529.5	6888.0	6126.9	8698.7	8413.4
DAY 8	5792.9	5581.5	5515.3	5426.1	5526.4	5806.4	6045.1	6533.7	6953.1	7074.2	7020.1	6909.2	6953.1	6953.1
DAY 9	6738.5	6543.9	6464.8	6483.9	7080.3	7861.8	7697.7	7431.4	7026.8	6644.5	6135.0	5609.9	7697.7	7431.4
DAY 10	5284.9	5089.5	4984.3	4941.1	4912.4	5026.4	5154.1	5600.7	6063.1	6301.2	6353.1	6354.2	6063.1	6301.2
DAY 11	6252.5	6083.9	6102.8	6194.9	6727.3	7478.8	7334.7	7221.4	6871.8	6408.5	5926.0	5422.9	7334.7	7221.4
DAY 12	5147.9	5093.5	5097.3	5142.1	5352.4	6130.4	7215.1	8028.7	8328.1	8365.2	8332.1	8067.2	8028.7	8328.1
DAY 13	8177.5	8175.9	8013.8	7937.9	8347.3	9045.8	8824.7	8602.4	8172.8	7403.5	6706.0	6003.9	8824.7	8602.4
DAY 14	5645.9	5490.5	5409.3	5426.1	5684.4	6392.4	7423.1	8144.7	8401.1	8420.2	8303.1	8047.2	8420.2	8401.1
DAY 15	8057.5	8047.9	7931.8	7816.9	8257.3	9027.8	8853.7	8595.4	8183.8	7404.5	6618.0	5974.9	8853.7	8595.4
DAY 16	5563.9	5399.5	5320.3	5345.1	5587.4	6209.4	7399.1	8139.7	8424.1	8500.2	8449.1	8205.2	8139.7	8424.1
DAY 17	8236.5	8179.9	8006.8	7941.9	8217.3	9067.8	8907.7	8594.4	8185.8	7457.5	6707.0	6033.9	8907.7	8594.4
DAY 18	5652.9	5472.5	5448.3	5462.1	5668.4	6341.4	7488.1	8262.7	8491.1	8524.2	8463.1	8318.2	8491.1	8262.7
DAY 19	8279.5	8218.9	8119.8	8067.9	8330.3	9268.8	9124.7	8858.4	8466.8	7712.5	6886.0	6240.9	8858.4	8466.8
DAY 20	5887.9	5751.5	5707.3	5758.1	6006.4	6705.4	7785.1	8459.7	8583.1	8496.2	8544.1	8261.2	8459.7	8583.1
DAY 21	8220.5	8138.4	7973.8	7705.9	7961.3	8421.8	8783.7	8329.4	8235.8	7598.5	7015.0	6299.9	8783.7	8329.4
DAY 22	5952.9	5777.5	5659.3	5655.1	5735.4	6000.4	6398.1	6826.7	7132.1	7196.2	7139.1	6899.2	6398.1	6826.7
DAY 23	8712.5	8534.9	8416.8	8381.9	8807.3	9848.8	7662.7	7319.4	7133.8	6709.5	6229.0	5696.0	7662.7	7319.4
DAY 24	5376.9	5252.5	5115.3	5146.1	5153.4	5261.4	5382.1	5848.7	6171.1	6419.2	6380.1	6437.2	5848.7	6171.1
DAY 25	6421.5	6333.9	6453.0	6609.9	6992.3	7813.8	7786.7	7672.4	7438.8	6923.5	6358.0	5762.9	7786.7	7672.4
DAY 26	5610.9	5551.5	5556.3	5636.1	5884.4	6667.4	7822.1	8592.7	8731.1	8758.2	8643.1	8306.2	8592.7	8731.1
DAY 27	8310.5	8170.9	8037.8	7904.9	8310.3	9174.8	9063.7	8938.4	8545.8	7976.5	7103.0	6350.9	8938.4	8545.8
DAY 28	6012.9	5851.5	5710.3	5729.1	5919.4	6629.4	7781.1	8575.7	8815.1	8929.2	8873.1	8768.2	8575.7	8815.1
DAY 29	8996.5	8944.9	8902.8	8868.9	9245.3	9760.8	9534.7	9159.4	8707.8	7935.5	7084.0	6381.9	9534.7	9159.4
DAY 30	6120.9	5847.5	5773.3	5715.1	5902.4	6554.4	7620.1	8357.7	8615.1	8571.2	8475.1	8461.2	8357.7	8615.1
DAY 31	8519.5	8601.9	8649.8	8567.9	8709.3	9330.8	9182.7	8849.4	8421.8	7676.5	6902.0	6203.9	8849.4	8421.8

Figure 5-9. ULMOD Expected Chronological Residuals

***** FOR MONTH 1

LOAD DURATION CURVE OF EXPECTED	HOURLY RESIDUAL	LOADS FROM PROBABILITY DATA		
9760.8	9534.7	9379.8	9330.8	9322.8
9182.7	9176.8	9174.8	9159.4	9129.7
9063.7	9062.8	9056.7	9053.8	9045.8
8938.4	8933.7	8929.2	8928.3	8925.7
8868.9	8858.4	8854.8	8853.7	8849.4
8783.7	8781.4	8770.2	8768.2	8767.3
8709.3	8707.8	8698.9	8698.7	8688.5
8653.2	8649.8	8647.1	8643.1	8627.3
8601.1	8595.4	8594.9	8594.4	8593.9
8550.4	8545.8	8544.1	8524.2	8519.5
8494.3	8491.1	8487.9	8474.2	8470.2
8460.1	8459.7	8457.1	8455.1	8446.1
8423.1	8421.8	8421.3	8420.2	8419.8
8380.2	8377.1	8373.1	8368.3	8365.2
8347.1	8342.1	8341.1	8339.7	8337.1
8284.4	8283.5	8279.5	8274.8	8272.8
8236.5	8235.6	8226.8	8225.5	8224.7
8211.8	8207.2	8205.5	8205.2	8202.5
8183.8	8182.9	8180.5	8177.9	8177.9
8172.2	8171.8	8170.9	8159.9	8149.8
8139.7	8139.9	8137.7	8134.2	8131.7
8094.7	8085.9	8081.9	8077.8	8076.2
8047.9	8047.2	8041.8	8037.8	8037.8
7976.3	7973.8	7972.9	7967.9	7961.9
7904.9	7902.8	7892.9	7882.9	7864.7
7791.8	7786.7	7785.1	7781.1	7761.9
7677.1	7676.5	7672.4	7662.7	7651.9
7577.5	7573.1	7568.5	7538.5	7530.1
7493.5	7488.1	7478.8	7468.1	7462.7
7399.1	7393.5	7379.1	7371.4	7350.1
7316.1	7304.1	7298.3	7270.1	7250.4
7140.2	7139.1	7133.8	7132.1	7126.1
7038.2	7026.8	7023.1	7020.1	7016.8
6927.3	6923.5	6918.0	6909.2	6907.0
6873.2	6871.8	6867.1	6851.0	6826.7
6753.0	6738.5	6727.3	6720.0	6712.5
6667.4	6665.9	6660.8	6648.8	6644.5
6598.5	6595.3	6588.8	6566.9	6562.4
6483.9	6483.2	6464.8	6453.8	6446.4
6408.5	6398.5	6392.4	6392.4	6381.9
6353.1	6350.9	6350.2	6341.4	6338.5
6287.4	6281.4	6269.4	6252.5	6248.9
6203.9	6194.9	6185.8	6171.1	6165.4
6121.0	6120.9	6119.4	6114.9	6102.8
6033.9	6012.9	6006.4	6004.0	6003.9
5951.9	5950.9	5945.1	5929.2	5926.0
5879.5	5873.1	5871.0	5851.5	5848.7
5798.9	5792.9	5789.4	5777.5	5773.3
5750.9	5737.4	5735.4	5729.1	5724.9
5692.9	5684.4	5684.4	5677.8	5668.4
5645.9	5642.4	5636.3	5636.1	5633.5
5604.5	5600.9	5600.7	5597.3	5591.3
5566.1	5565.5	5563.9	5557.5	5556.3
5537.7	5530.5	5526.4	5517.1	5513.3
5472.5	5470.1	5462.9	5462.1	5459.9
5426.1	5425.3	5423.1	5422.9	5421.3
5408.9	5403.5	5400.1	5399.5	5383.1
5320.3	5318.9	5304.9	5300.1	5297.9
5223.3	5222.5	5222.1	5220.5	5218.1
5149.1	5147.9	5146.1	5142.1	5140.1
5075.5	5052.3	5042.4	5026.4	5013.4
				5002.1
				4984.3
				4960.3
				4941.1
				4920.1
				4912.4
				4896.4

Figure 5-10. ULMOD LDC from Chronological Residuals

***** FOR MONTH 1

THE ACCUMULATED LOAD DURATION CURVE CREATED FROM THE FULL POWER-PROBABILITY DATA.

9832.1	9613.2	9538.6	9478.3	9427.4	9386.0	9364.8	9344.4	9321.6	9296.8	9272.2	9256.3
9246.6	9233.5	9214.7	9200.9	9185.3	9174.2	9160.4	9142.2	9131.5	9119.8	9109.6	9097.4
9090.3	9082.1	9073.3	9066.5	9059.4	9051.2	9042.0	9034.0	9022.6	9009.6	9000.7	8992.6
8980.3	8970.6	8957.5	8942.2	8947.6	8938.6	8932.7	8928.5	8921.4	8913.9	8907.7	8900.4
8892.9	8885.4	8880.7	8875.4	8868.3	8859.2	8854.8	8850.8	8845.0	8836.0	8829.6	8823.5
8815.6	8808.4	8799.3	8792.9	8788.4	8784.2	8778.5	8773.0	8770.0	8762.6	8757.9	8754.2
8749.7	8743.4	8739.1	8732.6	8727.8	8719.9	8713.8	8705.8	8702.7	8697.8	8693.6	8689.6
8680.5	8677.9	8674.2	8670.6	8665.6	8657.8	8652.9	8649.9	8647.9	8644.0	8638.8	8634.5
8629.2	8621.2	8617.4	8611.7	8608.4	8606.6	8605.2	8602.4	8600.5	8596.7	8591.8	8587.3
8582.7	8578.3	8574.4	8569.3	8563.5	8560.4	8557.1	8552.7	8546.9	8541.2	8535.8	8531.5
8525.3	8523.9	8520.4	8518.1	8516.3	8513.2	8508.0	8503.5	8500.1	8498.0	8494.8	8491.8
8487.1	8481.1	8476.5	8472.3	8470.3	8468.6	8465.6	8462.4	8459.4	8456.5	8452.0	8447.7
8442.5	8440.2	8436.5	8430.8	8427.8	8426.1	8424.2	8421.7	8420.5	8416.2	8410.9	8407.1
8405.0	8403.2	8398.5	8393.7	8389.5	8385.8	8381.8	8378.9	8374.5	8369.6	8366.7	8363.7
8361.7	8359.8	8357.7	8355.8	8352.4	8348.4	8344.3	8342.7	8339.5	8338.0	8336.6	8334.8
8330.6	8326.7	8324.8	8321.5	8318.9	8317.2	8314.9	8311.8	8308.3	8303.7	8298.7	8294.1
8281.0	8289.8	8289.1	8281.4	8278.1	8274.4	8270.1	8266.0	8261.7	8257.1	8252.6	8250.0
8246.4	8243.1	8241.2	8236.7	8232.3	8229.6	8226.9	8225.0	8224.5	8221.5	8218.5	8210.3
8208.2	8205.1	8202.3	8200.3	8195.9	8190.9	8188.7	8185.4	8182.3	8181.4	8179.6	8177.6
8175.1	8172.9	8169.0	8164.5	8162.5	8159.5	8157.7	8155.4	8151.2	8146.9	8145.2	8142.2
8138.9	8136.2	8133.6	8129.7	8127.7	8122.2	8119.2	8114.3	8105.6	8100.0	8095.4	8090.3
8076.5	8073.2	8070.9	8066.9	8062.7	8059.4	8053.3	8051.3	8048.0	8046.7	8045.4	8044.5
8041.7	8033.2	8029.9	8026.4	8021.7	8018.7	8012.1	8008.1	8003.5	8001.3	7998.3	7994.5
7986.7	7982.8	7979.2	7975.1	7968.9	7965.5	7962.8	7959.0	7954.2	7951.0	7947.5	7940.9
7934.9	7925.7	7918.1	7910.2	7904.3	7898.6	7894.2	7886.6	7879.3	7873.5	7868.8	7865.6
7860.1	7852.9	7847.7	7842.2	7833.4	7824.9	7814.7	7805.4	7801.3	7795.5	7788.8	7784.1
7778.6	7771.3	7764.7	7759.5	7752.7	7738.9	7724.5	7716.3	7709.9	7702.1	7697.2	7692.2
7685.6	7680.1	7675.9	7668.3	7658.7	7647.4	7637.9	7624.8	7614.1	7605.4	7600.2	7591.8
7586.3	7580.0	7573.2	7558.7	7539.9	7532.6	7525.4	7520.2	7517.5	7513.1	7508.0	7499.4
7493.5	7486.5	7478.1	7467.4	7454.2	7441.9	7430.8	7420.8	7409.4	7407.1	7401.2	7395.9
7383.7	7374.5	7356.1	7349.7	7341.0	7337.7	7329.4	7323.1	7317.9	7310.4	7305.6	7294.7
7285.9	7272.8	7263.3	7253.5	7238.6	7227.8	7222.0	7214.0	7203.7	7200.1	7190.3	7174.4
7166.3	7155.1	7143.6	7139.2	7132.8	7126.7	7114.5	7104.4	7092.5	7089.5	7083.8	7075.6
7068.1	7054.2	7046.3	7037.4	7028.6	7022.6	7016.9	7004.9	6997.1	6985.4	6970.1	6962.8
6954.5	6943.7	6934.7	6925.6	6915.9	6911.0	6906.4	6899.3	6894.2	6890.9	6884.7	6875.6
6866.6	6857.0	6849.1	6842.1	6830.8	6825.3	6817.0	6810.2	6800.6	6792.2	6785.7	6774.6
6760.2	6755.5	6744.5	6737.2	6730.9	6724.0	6717.4	6711.1	6702.6	6700.5	6689.6	6680.9
6680.9	6671.0	6666.1	6654.1	6647.9	6640.6	6633.3	6625.6	6619.7	6613.2	6606.7	6601.9
6593.5	6582.3	6575.3	6566.8	6560.2	6552.2	6543.0	6537.5	6534.4	6531.7	6526.9	6520.3
6509.7	6503.8	6493.9	6488.9	6484.5	6474.2	6465.8	6456.1	6448.0	6441.6	6436.4	6426.7
6424.9	6421.0	6413.7	6407.7	6395.4	6391.8	6386.8	6381.8	6375.6	6366.0	6358.8	6355.3
6351.7	6345.1	6341.5	6332.2	6324.1	6313.5	6309.6	6305.7	6303.1	6296.0	6284.8	6277.2
6268.0	6259.9	6251.8	6245.7	6243.5	6238.3	6231.7	6222.3	6215.1	6210.6	6205.7	6197.5
6190.1	6183.2	6177.4	6173.9	6168.2	6162.4	6156.4	6146.4	6138.4	6132.7	6129.7	6126.0
6123.2	6117.3	6110.2	6102.0	6092.3	6085.3	6077.4	6067.3	6064.3	6060.8	6053.0	6046.7
6038.2	6031.5	6026.1	6016.5	6009.1	6004.5	5998.5	5994.4	5988.7	5982.6	5976.9	5969.5
5962.1	5956.6	5953.8	5949.6	5946.9	5942.7	5937.2	5932.4	5926.0	5918.5	5911.5	5906.3
5902.7	5894.8	5888.3	5883.4	5879.0	5873.7	5868.4	5859.1	5851.4	5846.1	5840.5	5836.3
5830.1	5823.1	5819.3	5817.1	5811.6	5806.1	5801.5	5794.7	5792.6	5787.6	5782.4	5777.2
5774.9	5769.7	5767.5	5764.5	5759.9	5754.9	5750.0	5745.1	5739.5	5736.6	5732.6	5729.2
5726.0	5721.4	5715.0	5710.1	5704.0	5699.3	5695.9	5687.4	5683.3	5674.3	5668.8	5662.9
5660.2	5657.5	5654.2	5647.2	5642.6	5638.4	5635.8	5632.1	5627.9	5623.4	5616.6	5613.4
5608.7	5606.6	5603.5	5601.4	5598.5	5594.8	5591.8	5589.3	5586.5	5584.2	5580.4	5577.2
5569.9	5566.2	5560.5	5557.4	5554.2	5550.7	5548.5	5545.9	5539.0	5533.9	5528.9	5523.0
5518.4	5511.4	5504.5	5500.1	5491.0	5483.3	5480.9	5478.0	5474.7	5469.6	5464.8	5459.4
5455.9	5453.5	5448.1	5440.6	5435.1	5430.3	5428.0	5426.4	5423.4	5421.4	5418.0	5413.8
5410.9	5406.6	5404.8	5402.1	5398.0	5389.3	5384.4	5380.7	5376.6	5371.4	5367.9	5363.3
5354.3	5347.7	5339.8	5333.8	5326.1	5322.5	5314.8	5305.2	5301.2	5295.4	5288.0	5282.0
5277.1	5274.2	5268.0	5259.1	5252.0	5248.1	5244.1	5238.7	5233.5	5226.8	5224.1	5221.5
5210.6	5203.0	5197.0	5188.3	5180.2	5170.7	5162.2	5153.4	5147.2	5142.7	5132.5	5122.5
5114.6	5101.8	5096.6	5090.4	5079.0	5070.9	5051.5	5044.3	5037.8	5023.5	5010.2	4993.5
4978.6	4967.6	4954.8	4937.5	4921.0	4909.6	4888.5	4852.9	4817.0	4771.2	4732.2	4627.6

Figure 5-11. ULMOD Accumulated LDC from Power-Probability Data

***** FOR MONTH 1		THE CHRONOLOGICAL ESTIMATE MADE FROM THE ACCUMULATED FULL POWER-PROBABILITY DATA.										
DAY	1	2	3	4	5	6	7	8	9	10	11	12
DAY 1	5726.0	5418.0	5224.1	5114.6	5142.7	5221.5	5197.0	5548.5	5806.1	5932.4	5976.9	5949.6
DAY 2	5902.7	5782.4	5710.1	5840.5	6582.3	7227.8	7222.0	7104.4	6962.8	6421.0	5888.3	5354.8
DAY 3	5252.0	5188.3	5162.2	5238.7	5469.6	6309.6	7341.0	8095.4	9109.6	8560.4	8226.9	8317.2
DAY 4	8274.3	8172.9	8213.5	8188.7	8788.4	9427.4	9131.5	8823.5	8498.0	7647.4	6934.7	6102.0
DAY 5	5846.1	5638.4	5601.4	5589.3	5859.1	6456.1	7580.0	8355.8	8674.2	8644.0	8472.3	8318.9
DAY 6	8288.5	8181.4	8105.6	7918.1	8525.3	9272.2	9022.6	8762.6	8421.7	7697.2	6997.1	6156.4
DAY 7	5866.4	5642.6	5598.5	5569.9	5851.4	5484.5	7525.4	8232.3	8508.0	8516.3	8468.6	8225.6
DAY 8	8202.3	8146.9	8026.4	7910.2	8773.0	9160.4	9034.0	8685.6	8281.4	7558.7	6842.1	6162.4
DAY 9	5801.4	5608.7	5533.9	5500.1	5819.3	6520.3	7539.9	8420.5	8705.8	8799.3	8829.6	8680.5
DAY 10	8693.6	8608.4	8552.7	8520.4	8952.2	9296.8	8947.6	8587.3	8119.2	7493.5	6985.4	6286.8
DAY 11	5586.5	5557.4	5398.0	5326.1	5371.4	5715.0	5953.8	6534.4	6849.1	7174.4	7132.8	7068.1
DAY 12	6911.0	6785.7	6654.1	6700.4	7506.0	7873.3	7738.9	7520.2	7126.7	6800.6	6197.5	5668.8
DAY 13	5295.4	5051.5	4967.6	4909.6	4921.0	5037.8	5153.4	5594.8	5982.6	6341.5	626.7	6465.8
DAY 14	6324.1	6303.1	6177.4	6305.7	6954.5	7605.4	7454.2	7238.6	7004.9	6531.7	5937.2	5435.1
DAY 15	5268.0	5147.2	5210.6	5180.2	5478.0	6148.2	7200.1	7994.5	8467.1	8462.4	8403.2	8185.4
DAY 16	8195.9	8129.7	8136.2	8162.6	8754.2	9321.6	9142.2	8808.4	8339.5	7586.3	6875.6	6243.5
DAY 17	5830.1	5613.4	5430.3	5305.2	5623.4	6259.5	7253.5	8059.4	8352.4	8535.8	8487.1	8138.9
DAY 18	8169.0	8044.0	7979.2	7847.7	8393.7	9119.8	9009.6	8702.7	8255.6	7499.4	6774.6	6060.8
DAY 19	5759.9	5528.9	5423.4	5453.5	5769.7	6413.7	7317.9	8079.5	8452.0	8452.0	8357.7	8063.5
DAY 20	8145.2	8029.9	7975.1	7824.9	8330.6	9233.5	8970.6	8605.2	8190.9	7517.5	6737.2	6046.7
DAY 21	5683.3	5566.2	5464.8	5455.4	5699.3	6381.8	7285.9	8071.7	8374.5	8366.7	8398.5	8157.7
DAY 22	8236.7	8155.4	7959.0	7805.4	8344.3	9066.5	8954.8	8582.7	8127.7	7374.5	6625.6	5956.6
DAY 23	5754.9	5483.3	5406.6	5384.4	5677.9	6110.2	7272.6	7833.4	8359.8	8465.6	8426.1	8122.2
DAY 24	8192.3	8033.2	7898.6	7752.7	7962.8	8757.9	8644.9	8291.0	7852.9	7379.4	6760.2	6077.4
DAY 25	5696.6	5347.7	5301.2	5259.1	5376.6	5695.9	5894.8	6526.9	6894.2	7166.3	7046.3	6866.9
DAY 26	6689.6	6640.6	6575.3	6566.8	7263.3	7778.6	7600.2	7305.6	7028.6	6633.3	6123.2	5577.2
DAY 27	5244.1	4978.6	4852.9	4771.2	4627.6	4954.8	5079.0	5518.4	5998.5	6210.6	6375.6	6503.8
DAY 28	6606.7	6671.0	6666.1	6817.0	7337.7	7692.2	7624.8	7349.7	7075.6	6593.5	6016.5	5448.1
DAY 29	5274.2	5203.0	5070.9	5170.7	5280.7	6132.7	7323.1	8179.6	8629.2	8770.0	8907.7	8697.8
DAY 30	9777.8	8739.1	8719.9	8617.4	9042.0	9538.6	9073.3	8845.0	8410.9	7573.2	6825.3	6064.3
DAY 31	7570.0	5550.7	5428.0	5426.4	5657.5	6268.0	7467.4	8259.1	8557.1	8513.2	8298.7	8255.1
DAY 32	8250.0	8456.5	8294.3	8114.3	8665.6	9256.3	9000.7	8652.9	8278.3	7513.1	6792.2	6126.0
DAY 33	5774.9	5511.4	5367.9	5339.8	5545.9	6251.8	7407.1	8046.7	8385.8	8405.0	8361.7	8022.8
DAY 34	8045.4	8012.1	7951.0	7842.2	8229.6	9082.1	8921.4	8657.8	8241.2	7591.8	6707.6	5994.4
DAY 35	5635.8	5480.9	5389.3	5404.8	5580.4	6238.3	7356.1	8041.7	8442.5	8518.1	8500.1	8369.6
DAY 36	8459.4	8381.8	8208.2	8090.3	8436.5	9364.8	9183.3	8859.2	8427.8	7709.9	6915.9	6225.3
DAY 37	5962.1	5795.7	5654.2	5732.6	5918.5	6560.2	7685.6	8348.4	8476.5	8546.9	8324.8	8076.5
DAY 38	8053.3	8003.5	7865.6	7658.7	7936.9	8880.7	8732.6	8424.2	8018.7	7532.6	6890.9	6129.7
DAY 39	5825.1	5584.2	5491.0	5410.9	5504.5	5936.3	6053.0	6537.5	6970.1	7083.8	7037.4	6925.6
DAY 40	6755.5	5523.0	6493.9	6509.7	7089.9	7814.7	7702.1	7420.8	7054.2	6647.9	6146.4	5616.6
DAY 41	5248.1	4993.5	4888.5	4817.0	4732.2	4937.5	5132.5	5603.5	6067.3	6296.0	6351.7	6355.3
DAY 42	6245.7	6085.3	6092.3	6183.2	6744.5	7478.1	7310.4	7214.0	6857.0	6424.9	5946.9	5402.1
DAY 43	5101.8	5010.2	5023.5	5090.4	5288.0	6138.4	7203.7	7965.5	8326.2	8389.5	8342.7	8001.3
DAY 44	8159.5	8151.2	7954.2	7886.6	8363.7	9059.4	8850.8	8638.8	8142.2	7395.9	6713.4	6009.1
DAY 45	5660.2	5474.7	5363.3	5413.8	5721.4	6447.7	7409.4	8100.0	8416.2	8430.8	8303.7	7982.8
DAY 46	7998.3	7986.7	7868.8	7788.8	8261.7	9051.2	8875.4	8621.2	8176.1	7401.2	6613.2	5988.7
DAY 47	5560.5	5333.8	5277.1	5282.0	5591.8	6205.7	7383.7	8086.5	8447.7	8541.2	8470.3	8200.3
DAY 48	8246.4	8164.5	7947.5	7844.2	8210.3	9097.4	8932.7	8611.7	8177.6	7441.9	6717.4	6038.2
DAY 49	5682.9	5455.9	5421.4	5440.6	5704.0	6332.2	7486.2	8269.1	8523.9	8569.3	8494.8	8321.5
DAY 50	8284.5	8221.3	8051.3	8008.1	8338.0	9386.0	9174.2	8885.4	8503.5	7724.5	6884.7	6231.7
DAY 51	5911.5	5777.5	5736.6	5787.6	6026.1	6711.1	7764.7	8481.1	8602.4	8531.5	8574.4	8265.0
DAY 52	8224.5	8083.2	7925.7	7716.3	7904.3	8938.6	8815.6	8336.6	8243.1	7614.1	7022.6	6277.2
DAY 53	5969.5	5817.1	5687.4	5674.3	5767.5	6004.5	6366.0	6830.8	7139.2	7190.3	7155.1	6899.3
DAY 54	6730.9	6543.0	6436.4	6395.4	6810.2	7801.3	7668.3	7294.7	7143.6	6724.0	6215.1	5729.2
DAY 55	5314.8	5226.8	5044.3	5096.6	5122.5	5233.5	5322.5	5879.0	6173.9	6441.4	6386.8	6474.2
DAY 56	6448.0	6313.5	6488.9	6601.9	7016.9	7784.1	7771.3	7675.9	7430.8	6943.7	6358.8	5792.6
DAY 57	5632.1	5539.0	5554.2	5647.2	5906.3	6680.9	7795.5	8606.6	8778.5	8784.2	8670.6	8308.3
DAY 58	8314.9	8133.6	7968.9	7860.1	8311.8	9214.7	9090.3	8980.3	8578.3	7940.8	7114.2	6345.1
DAY 59	6031.5	5883.4	5739.5	5764.5	5942.7	6619.7	7759.5	8600.5	8836.0	8957.5	8900.4	8792.9
DAY 60	8913.9	8992.6	8928.9	8892.9	9344.4	9832.1	9615.2	9200.9	8743.4	7879.3	7092.5	6391.8
DAY 61	6117.3	5873.7	5811.6	5745.1	5926.0	6552.2	7637.9	8378.9	8647.9	8596.7	8713.8	8491.8
DAY 62	8563.5	8634.5	8677.9	8591.8	8749.7	9478.3	9246.6	8868.3	8440.2	7680.1	6906.4	6190.1

Figure 5-12. ULMOD Estimated Chronological Order

```
/JOB
ULMOD,T600.
ACCOUNT,DUM1234.
REQUEST,ULMODX,*PF.
REQUEST,DATA.
REQUEST,TAPE9.
REQUEST,TAPE10.
REQUEST,TAPE11,A2.
REQUEST,TAPE20,A2.
REQUEST,TAPE21,A2.
REQUEST,TAPE22,A1.
REQUEST,TAPE23,A2.
REQUEST,TAPE24,A2.
REQUEST,TAPE25,A0.
REQUEST,TAPE26,A0.
FILE,DATA,FL=80.
FILE,TAPE9,FL=80.
FILE,TAPE10,FL=80.
FILE,TAPE11,FL=132.
GETPF,DATA,ULDATA,ID=UID.
GETPF,TAPE9,SOLAR,ID=UID.
GETPF,TAPE10,LOADS,ID=UID.
ATTACH,ULMODX,ID=UID,PW=PSWORD.
COMMENT. PURGE,ULMODX,ID=UID.
COMMENT. FILE,ULMOD,FL=132.
COMMENT. GETPF,ULMOD,ULMOD,ID=UID.
COMMENT. FTN,I=ULMOD,R=ULMODX,R=0,L=0,ER,OPT=2.
COMMENT. CATALOG,ULMODX,ID=UID,XR=PSWORD.
COMMENT. AUDIT,ID=UID.
ULMODX.
REWIND,DATA.
COPYSRF,DATA,OUTPUT.
REWIND,TAPE11.
CATALOG,TAPE11,SAVEF,ID=UID.
EXIT.
/EDR
```

(Lines beginning in "COMMENT." are inactive, but removing the "COMMENT." will activate the command.)

Figure 5-13. Sample Runstream for ULMOD

SECTION 6.0

FINAM - FINANCIAL ANALYSIS MODEL

The purpose of FINAM is to determine the value of the alternative generation penetration assumed for each change case when compared with the base case. The inputs to this model are derived from the execution of electric utility expansion planning and production cost models. The results are the gross and marginal value of each alternative generation penetration. Refer to Sec. 7.0 of Vol. I for a description of the specific calculations performed in FINAM.

6.1 FACILITY SPECIFICS

FINAM uses a commercially available polynomial curve-fitting routine in the process of developing the marginal values. The routines are from the International Mathematical and Statistical Library (IMSL) and are called from the subroutine CFIT. If the IMSL package is not available, any other polynomial fitting routine can be used. The comments contained in CFIT should assist in this matter.

FINAM uses a LEVEL 2 statement within several routines. This command designates that specific data are to reside in the large central memory of a CDC 7600 computer. For use on other computers, delete all occurrences of the LEVEL 2 command and the preceding comment cards. Also, CDC equipment requires a PROGRAM card before the main routine. If CDC hardware is not used, this card may not be needed.

Like most other routines, FINAM utilizes a free format or list-directed input for data. This means that the data does not have to reside in specific fields on the cards but that each data value need only be separated by a space or comma. Most versions of FORTRAN have an equivalent input capability. The CDC version uses a * in place of a format number in the READ command. Each free-formatted data card type is usually preceded by a single, user-provided comment card that has no operational effect. Its purpose is to assist the user when making modifications to a data set.

6.2 FINAM INPUT DATA

Figure 6-1 is a listing of a sample set of manually created card type data required by FINAM. Card types A and B are required for all FINAM executions. Card type B determines if types C through S are required. If required, types E through I supply to FINAM the operational result of the utility planning models for the base case ($L = 1$) and each change case ($L = 2$, $NCASES + 1$). Card types E through I are grouped together first for the base case and then for each change case. These groups are followed by card types K through T, which provide to FINAM specific data concerning each conventional generating unit type. First come groups of types K through N to cover operating cost parameters for each generation type. These are followed by a group of types O through Q cards to cover capital cost parameters for each generation type. These groups are followed by a single group of type R

through T cards to cover expected unserved energy parameters. Card types U through BB are needed only if sensitivity studies are to be performed.

6.2.1 Title (Card Type A)

FORMAT (20A4)

Do not precede card type A with a comment card.

For future reference, the title for the initial execution of FINAM should be descriptive of the particular data being input. This card is required and has a maximum of 80 characters.

6.2.2 Sensitivity Run Flag (Card Type B)

FORMAT (FREE)

This card type must be preceded by a comment card.

ISENSI -- Flags whether this is a normal execution (ISENSI $\leq$ 0) or a sensitivity-only execution (ISENSI $>$ 1) where all initial data is provided from a computer data file (unit number 11 or "TAPE11") created by a previous normal execution. If ISENSI $>$ 1, card types C through T must not be provided. If ISENSI $\leq$ 0, card types C through T must be provided.

6.2.3 Execution Descriptive Information (Card Type C)

FORMAT (FREE)

This card type must be preceded by a comment card.

IYRPW -- Present worth year for all the reported results
 PWDISC -- Present worth discount rate, percent
 GNPDEF -- GNP deflator, percent
 NSIM -- Number of years of detailed simulation data to be provided, $\leq$ 20
 NCAPYR -- Number of capacity addition years to be used, $\leq$ 20
 NCASES -- Number of change cases to be analyzed in this execution, $\leq$ 10
 NGENT -- Number of conventional generation types, $\leq$ 12
 NYRAGN -- Expected life of alternative generation device, years
 FCRAGN -- Assumed fixed charge rate for alternative generation device, percent
 ICOST -- Flag to designate when costs are incurred;
 $\leq$ 0, assume costs at end of year = DOE-EPRI standard
 $>$ 1, assume costs at beginning of year

6.2.4 Base Case Identifier (Card Type D)

FORMAT (NONE)

This card type is simply a comment card corresponding to the comment preceding card type J. All the base-case system cost data must precede the change cases.

6.2.5 Generation Type Capacity Additions (Card Type E)

FORMAT (FREE)

This group of cards must be preceded by a single comment card. There must be one type E card for each simulation year ($J = 1, \text{NSIM}$), and a value must be given for each generation type ($K = 1, \text{NGENT}$). The years must be in increasing order.

IYR(J) -- Year this card is for; e.g., 1985
CAPADD(J,K,L) -- Added capacity of all generation types this year (MW):
 K = 1, NGENT
 L = 1 for base case
 L = 2, (NCASES+1) for change cases.

6.2.6 Total Operating Cost and All Fuel Costs (Card Type F)

FORMAT (FREE)

This group of cards must be preceded by a single comment card. There must be one type F card for each simulation year ($J = 1, \text{NSIM}$), and a value must be given for each generation type.

IYR(J) -- Year this card is for
SSDAT(J,1,L) -- Total operating cost (1000\$)
SYSDAT(J,K,L) -- Fuel cost for each generation type:
 K = 2, (1 + NGENT)
 L = 1 for base case
 L = 2, (NCASES+1) for change cases

6.2.7 Fixed O&M Operating Costs (Card Type G)

FORMAT (FREE)

This group of cards must be preceded by a single comment card. There must be one type G card for each simulation year ($J = 1, \text{NSIM}$), and a value must be given for each generation type.

IYR(J) -- Year this card is for
SYSDAT(J,K,L) -- Fixed O&M cost for each generation type (1000\$);
 K = 12, (11+NGENT)
 L = 1 for base case
 L = 2, (NCASES+1) for change cases

6.2.8 Variable O&M Operating Costs (Card Type H)

FORMAT (FREE)

This group of cards must be preceded by a single comment card. There must be one type H card for each simulation year ($J = 1, NSIM$), and a value must be given for each generation type.

IYR(J) -- Year this card is for
SYSDAT(J,K,L) -- Variable O&M costs for each generation type (1000\$):
 K = 22, (21+NGENT)
 L = 1 for base case
 L = 2, (NCASES+1) for change case

6.2.9 System Unserved Energy Cost (Card Type I)

FORMAT (FREE)

This group of cards must be preceded by a single comment card. There must be one type I card for each simulation year ($J = 1, NSIM$).

IYR(J) -- Year this card is for
SYSDAT(J,38,L) -- System cost of expected unserved energy (1000\$):
 L = 1 for base case
 L = 2, (NCASES+1) for change cases

6.2.10 Change Case Title and Capacity (Card Type J)

FORMAT (3A4,1X,F10.1)

This card type must be preceded by a comment card.

CASETL(I,L) -- Change case title;
 I = 1,3
CASCAP(L) -- Change case alternative generation capacity (MW);
 L = 1, NCASES

The type J card will be followed by type E,F,G,H, and I cards for the system cost information data for this change case. A group of J,E,F,G,H, and I cards is required for each change case. The value of L increases for each change case.

6.2.11 Generating Unit Type Title (Card Type K)

FORMAT (3A4)

This card type must be preceded by a comment card.

GENTL(I,L) -- Conventional generating unit type title:
I = 1,3
L = 1, NGENT

A set of K, L, and M cards must be provided for each generating unit type. There will, therefore, be NGENT groups of K, L, and M cards.

6.2.12 Generation Type Costs (Card Type L)

FORMAT (FREE)

This group of cards must be preceded by a single comment card. There must be one type L card for each simulation year (J = 1, NSIM).

IYR(J) -- Year this data is for
GENDAT(J,K) -- Generation specific data:
K = 1 - Fuel Cost (\$/MBtu)
K = 2 - Fixed O&M (\$/kW/yr)
K = 3 - Variable O&M (\$/MWh)

6.2.13 Number of Escalation Time Periods (Card Type M)

FORMAT (FREE)

This card must be preceded by a comment card. This card must not be included if there are no calculations beyond the last simulation year (IYREXT < last simulation year).

NESFCS -- Number of fuel cost escalation time periods for this generation type (1 < NESFCS < 10)
NESFOM -- Number of fixed O&M cost escalation time period (1 < NESFOM < 10)
NESVOM -- Number of variable O&M cost escalation time periods (1 < NESVOM < 10)

6.2.14 Escalation Time Period Data (Card Type N)

FORMAT (FREE)

This group of cards must not be preceded by a comment card. The number of type N cards required is equal to the larger of NESFCS, NESFOM, and NESVOM given on the above type M card. A value must be provided on each card for

each variable listed below. If the number of escalation periods desired are not equal (e.g., NESFCS = 3 and NESFOM = NESVOM = 1), then any number may be entered for the latter card entries for these cost components (e.g., second and third type N cards may have ESFOM (IZ,IQ) = FSVOM (IZ,IQ) = any number for IZ = 2 and 3 and IQ = 1 and 2). The year numbers given must increase from one card to the next.

ESFCST(IZ,1) -- Beginning year for fuel cost escalation period IZ
ESFCST(IZ,2) -- Escalation rate (percentage) for IZ
ESFOM(IZ,1) -- Beginning year for fixed O&M cost escalation period IZ
ESFOM(IZ,2) -- Escalation rate (percentage) for IZ
ESVOM(IZ,1) -- Beginning year for variable O&M cost escalation period IZ
ESVOM(IZ,2) -- Escalation rate (percentage) for IZ

6.2.15 Capital Costs (Card Type O)

FORMAT (FREE)

A single comment card must precede this group of cards. There must be one type O card for each capacity addition year (J = 1, NCAPYR) and a value must be given for each generation type (K = 1, NGENT).

ICAPYR(J) -- Year this card is for
CAPCST(K,J) -- Capital cost (\$/KW) for each generation type; K = 1, NGENT

6.2.16 Fixed Charge Rate for Capital Costs (Card Type P)

FORMAT (FREE)

A single comment card must precede this group of cards. There must be one type P card for each capacity addition year (J = 1, NCAPYR), and a value must be given for each generation type (K = 1, NGENT).

FCR(K) -- Fixed Charge Rate (percentage);
K = 1, NGENT

6.2.17 Fixed Charge Rate Years (Card Type Q)

FORMAT (FREE)

A single comment card must precede this group of cards. There must be one type Q card for each capacity addition year (J = 1, NCAPYR), and a value must be given for each generation type (K = 1, NGENT).

NFCRYR(K) -- Number of payout years fixed charge rate was based on;
K = 1, NGENT

6.2.18 Expected Unserved Energy Cost (Card Type R)

FORMAT (FREE)

A single comment card must precede this group of cards. A type R card must be provided for each simulation year ($J = 1, \text{NSIM}$).

IYR(J) -- Year these data are for

EUE(J) -- Cost of expected unserved energy in this year (\$/MWh)

6.2.19 Number of Escalation Periods for Expected Unserved Energy (Card Type S)

FORMAT (FREE)

A comment card must precede this card. This card must not be given if there are to be no calculations beyond the last simulation year.

NESEUE -- Number of escalation periods

6.2.20 Escalation Data for Expected Unserved Energy (Card Type T)

FORMAT (FREE)

This group of cards must not be preceded by a comment card. The number of type T cards needed is equal to NESEUE given on the type S card above. The year numbers provided must increase from card to card.

ESEUE(IZ,1) -- Beginning year for expected unserved energy costs
escalation period IZ

ESEUE(IZ,2) -- Escalation rate (percentage) for IZ

6.2.21 Sensitivity Title (Card Type U)

FORMAT (20A4)

Do not precede card type U with a comment card.

The title of the sensitivity case to be performed using the information that follows. Any number of sensitivity cases may be requested, but only one at a time. This request requires providing groups of card types U and V, plus additional types indicated in the discussion of each TSTSEN option on type V. To indicate the end of requested sensitivity cases, the flag "XXXX" is used on card type V.

6.2.22 Sensitivity Option and Variables (Card Type V)

FORMAT (FREE)

This card type does not require a preceding comment card since card type U serves this function.

TSTSEN -- Defines which single sensitivity changes are to be made. This flag consists of four alphanumeric characters in quotation marks. The quotation marks comply with FREE format requirements. Only one of the following sensitivities may be examined at a time.

"XXXX" -- No more sensitivity cases are desired

"MISC" -- Wish to change the present worth discount year, the life or fixed charge rate of the alternative generation device and/or assumption about when costs are incurred:
Requires a card type W to follow

"PWD " -- Wish to change present worth discount rate or GNP deflator;
Requires a card type X to follow

"FCST" -- Wish to change one or more generating types' fuel costs;
Requires card types Y, Z, and/or AA with BB to follow

"CAP " -- Wish to change one or more generating types' capital cost;
Requires card types Y and Z to follow

"FOM " -- Wish to change one or more generating types' fixed O&M costs;
Requires card types Y, Z, and/or AA with BB to follow

"VOM " -- Wish to change one or more generating types' variable O&M costs;
Requires card types Y, Z, and/or AA with BB to follow

"EUE " -- Wish to change the system expected unserved energy cost;
Requires card types Z and/or AA with BB to follow

IEXT -- This flags whether the sensitivity case is to:
(1) change the cost in each simulation year and the escalation rate for extension calculations (IEXT < 0 or
(2) change only the extension escalation rate (IEXT > 0). The user should not attempt to set IEXT > 0 if extension calculations are not desired (type C card, IYREXT).

NCHNG -- For TSTSEN = "FCST", "CAP ", "FOM ", and "VOM ", the desired number of generating unit types that wish to make a change in cost

6.2.23 Sensitivity--Miscellaneous (Card Type W)

FORMAT (FREE)

This card type must be preceded by a comment card. This card is needed only if TSTSEN = "MISC".

IYRPW -- Year for all present worth results
 NYRAGN -- Expected life of alternative generation device, years
 FCRAGN -- Assumed fixed charge rate of alternative generation device, percentage
 ICOST -- Flag to designate when costs are incurred;
 < 0, assume costs at end of year = DOE-EPRI standard
 > 1, assume costs at beginning of year

6.2.24 Sensitivity--Discount Rate (Card Type X)

FORMAT (FREE)

This card type must be preceded by a comment card. This card is needed only if TSTSEN = "PWD".

PWDISC -- Present worth discount rate; percentage
 GNPDEF -- GNP deflator; percent

6.2.25 Sensitivity--Generation Types (Card Type Y)

FORMAT (FREE)

Preceded by a comment card, this card type must be provided if TSTSEN = "FCST", "CAP ", "FOM " or "VOM ".

IGENCG(JJ) -- Numeric identifier of the generation type (types) to which a cost change is desired;
 JJ = 1, NCHNG

6.2.26 Sensitivity--Cost Changes (Card Type Z)

FORMAT (FREE)

This group of cards must be preceded by a single comment card. This card type must be provided only if

- (1) TSTSEN = "FCST", "CAP ", "FOM ", or "VOM " and IEXT < 0, or
- (2) TSTSEN = "EUE ".

One type W card is needed for each simulation year; $J = 1$, NSIM.

IYR(J) -- Year this data is for

RNEW(JJ) -- New cost for generation type JJ = IGENCG (J), $J = 1$, NCHNG;
New costs given as \$/MMBTU, \$/KW, \$/KW/YR, \$/MWh or \$/MWh if
TSTSEN = "FCST", "CAP ", "FOM ", "VOM ", or "EUE ",
respectively

6.2.27 Sensitivity--Number of Escalation Periods (Card Type AA)

FORMAT (FREE)

A single comment card must precede only the first type AA card. A group of types AA and BB cards will be required for each generation type (NCHNG) if TSTSEN = "FCST", "FOM ", or "VOM ". A single group is needed of TSTSEN = "EUE ".

NES -- Number of escalation periods ($1 < NES < 10$)

6.2.28 Sensitivity--Escalation Data (Card Type BB)

FORMAT (FREE)

A group of type BB cards must follow immediately after the type AA card. A comment card is not allowed. The number of BB cards required is equal to NES given on the AA card. The year numbers input must increase from card to card.

ES(IZ,1) -- Beginning year for escalation period IZ

ES(IZ,2) -- Escalation rate (percentage) for IZ

6.3 PRINTED OUTPUTS

FINAM printed outputs begin with all data input by card types (Fig. 6-2). If this execution is for sensitivity cases only, then the same output is produced using the original execution's input data. Each page has the title provided by input displayed across the top. If this is not a sensitivity-only execution, the results, using the original data, are presented on a separate page (Fig. 6-3). These results include, for each change case or alternative generation penetration, the change case title, capacity in MW, total value when compared with the base case (1000\$), the gross and marginal breakeven value per installed kW, and the coefficients of the gross and marginal value polynomial curve fits.

Each sensitivity case first reports the data being changed (Fig. 6-4) and then the results exactly as already described.

6.4 SAMPLE CONTROL CARD SEQUENCE

A sample control card sequence necessary to run FINAM is given as Fig. 6-5. This runstream uses the CDC-SCOPE operating system.

```

***** TFST DATA - 80,83,85 & 95 WITH CAP. CREDIT, WEIBULL ****
***** BASE CASE WITH 2 CHANGE CASES (10,254 WIND MACHINES)
0
IYRPW,PWDISC,GNPDEF,NSIM,NCAPYR,NCASES,NGENT,NYRAGN,FCRAGN,ICOST
1980 15.0 10.1 4 4 2 11 30 21.9 0
***** BASE CASE - NO TITLE NEEDED.
YEAR - CAP. TO ADD TO ALL GEN. TYPES (MW).
1980 0.0 0.0 0.0 0.0 0.0 0.0 0.0
0.0 0.0 0.0 0.0 0.0 0.0 0.0
1983 81. 64.0 0.0 0.0 0.0 0.0 0.0
1947.0 0.0 0.0 0.0 0.0 0.0 0.0
1985 187.0 0.0 390.0 0.0 0.0 0.0 61.0
187.0 0.0 9.0 0.0 0.0 0.0 0.0
1986 0.0 390.0 0.0 0.0 0.0 291.0
188.0 0.0 44.0 320.0 0.0 0.0
YEAR - TOTAL COST THEN FUEL COSTS BY TYPE (1000$).
1980 2705380.
2407550. 32465. 65842. 39566. 0.0
0. 9503. 0. 0. 0. 0.
1983 3649838.
3135130. 56489. 73539. 43484. 0.0
103851. 12391. 0. 0. 0. 0.
1985 4784187.
4173658. 62393. 93886. 39424. 1451.0
137160. 15362. 4102. 0. 0. 0.
1995 11914221.
8216416. 731015. 175425. 83392. 39151.
388826. 30025. 376104. 0. 261385. 440084.
YEAR - FIXED O&M COSTS (1000$).
1980 54606. 8765. 40463. 22286. 0.0
0. 3682. 0. 16665.7 0. 0.
1983 72486. 11702. 53136. 29265. 0.0
22104. 4835. 0. 21882.9 0. 0.
1985 87062. 14610. 63828. 25893. 1316.
29980. 5808. 107. 26286. 0. 0.
1995 212587. 53944. 159628. 62708. 25242.
101833. 14525. 12260. 74973. 189540. 240219.
YEAR - VARIABLE O&M (1000$).
1980 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
1983 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
1985 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
1995 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
YEAR - TOTAL COST OF EXPECTED UNSERVED ENERGY (1000$).
1980 3978.7
1983 9547.3
1985 1906.6
1995 25101.3

```

Figure 6-1. FINAM Manually Created Input Data

***** DATA SPECIFIC TO THE GEN. TYPES AND THE E.U.E.; BLR GEN. TYPE
BLR

YEAR	FUEL(\$/MMBTU)	FOM(\$/KW/YR)	VOM(\$/MWH)
1980	6.00	5.86	0.0
1983	8.54	7.71	0.0
1985	10.57	9.25	0.0
1995	21.38	23.12	0.0

NUMBER OF AND ESCALATIONS TO BE USED FOR EXTENSIONS (%).

5 3 1

1981	12.5	1981	12.6	1981	9.6
1985	10.0	1982	10.6	0000	000
1986	9.0	1983	9.6	0000	000
1987	8.0	0000	000	0000	000
1988	7.0	0000	000	0000	000

DIST GEN. TYPE TABLE

DIST

YEAR	FUEL(\$/MMBTU)	FOM(\$/KW/YR)	VOM(\$/MWH)
1980	6.50	8.34	0.0
1983	9.25	10.50	0.0
1985	11.45	9.7	0.0
1995	23.16	18.01	0.0

NUMBER OF AND ESCALATIONS TO BE USED FOR EXTENSIONS (%).

5 3 1

1981	12.5	1981	12.6	1981	9.6
1985	10.0	1982	10.6	0000	000
1986	9.0	1983	9.6	0000	000
1987	8.0	0000	000	0000	000
1988	7.0	0000	000	0000	000

COAL 1 GEN. TYPE TABLE

COAL 1

YEAR	FUEL(\$/MMBTU)	FOM(\$/KW/YR)	VOM(\$/MWH)
1980	1.06	45.78	0.0
1983	1.41	60.11	0.0
1985	1.68	72.20	0.0
1995	3.42	180.57	0.0

NUMBER OF AND ESCALATIONS TO BE USED FOR EXTENSIONS (%).

3 3 1

1981	10.0	1981	12.6	1981	9.6
1985	8.0	1982	10.6	0000	000
1990	7.0	1983	9.6	0000	000

Figure 6-1. FINAM Manually Created Input Data (Continued)

COAL4 GEN. TYPE TABLE
COAL4

YEAR	FUEL (\$/MMBTU)	FOM (\$/KW/YR)	VOM (\$/MWH)
1980	0.00	00.00	0.0
1983	0.00	00.00	0.0
1985	0.00	00.00	0.0
1995	4.58	206.92	0.0

NUMBER OF AND ESCALATIONS TO BE USED FOR EXTENSIONS (%).

3	3	1
1981	10.0	1981 12.6 1981 9.6
1985	8.0	1982 10.6 0000 000
1990	7.0	1983 9.6 0000 000

COAL5 GEN. TYPE TABLE
COAL5

YEAR	FUEL (\$/MMBTU)	FOM (\$/KW/YR)	VOM (\$/MWH)
1980	0.00	00.00	0.0
1983	0.00	00.00	0.0
1985	0.00	00.00	0.0
1995	5.49	179.27	0.0

NUMBER OF AND ESCALATIONS TO BE USED FOR EXTENSIONS (%).

3	3	1
1981	10.0	1981 12.6 1981 9.6
1985	8.0	1982 10.6 0000 000
1990	7.0	1983 9.6 0000 000

YEAR - CAPITAL COSTS OF EACH GEN. TYPE (\$/KW)

1980	600.0	330.0	1200.0	1200.0	1200.0	1500.0	1500.0
			1500.0	2200.0	1200.0	1200.0	
1983	828.0	455.4	1655.9	1655.9	1655.9	2069.9	2069.9
			2069.9	3035.9	1655.9	1655.9	
1985	1020.1	561.1	2040.3	2040.3	2040.3	2550.4	2550.4
			2550.4	3740.5	2040.3	2040.3	
1986	1132.4	622.8	2264.7	2264.7	2264.7	2830.9	2830.9
			2830.9	4152.0	2264.7	2264.7	

FIXED CHARGE RATE FOR EACH GEN. TYPE (%) EACH CAP. ADDITION YEAR.

1980	21.9	21.9	23.8	23.8	23.8	23.9	23.9	22.8	24.7	23.8	23.8
1983	21.9	21.9	23.8	23.8	23.8	23.9	23.9	22.8	24.7	23.8	23.8
1985	21.9	21.9	23.8	23.8	23.8	23.9	23.9	22.8	24.7	23.8	23.8
1986	21.9	21.9	23.8	23.8	23.8	23.9	23.9	22.8	24.7	23.8	23.8

NUMBER OF YEARS FOR CALCULATED ON IN EACH CAP. ADDITION YEAR.

1980	30	30	35	35	35	30	30	30	60	35	35
1983	30	30	35	35	35	30	30	30	60	35	35
1985	30	30	35	35	35	30	30	30	60	35	35
1986	30	30	35	35	35	30	30	30	60	35	35

YEAR - EXPECTED UNSERVED ENERGY COST (\$/MWH).

1980	100.0
1983	121.8
1985	138.9
1995	277.0

ESCALATIONS OF E.U.E. TO BE USED FOR EXTENSIONS (%).

1
1981 6.8

Figure 6-1. FINAM Manually Created Input Data (Continued)

***** CHANGE CASE 1 - 10 MOD-2 MACHINES - 25 MW

10 MOD-2 25.

YEAR - CAP. TO ADD TO ALL GEN. TYPES (MW).

1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	81.		64.0		0.0	0.0	0.0
	1947.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0		379.0		0.0	0.0	61.0
	187.0	0.0	9.0		0.0	0.0	0.0
1986	0.0		390.0		0.0	0.0	291.0
	188.0	0.0	44.0		320.0	0.0	0.0

YEAR - TOTAL COST THEN FUEL COSTS BY TYPE (1000\$).

1980	2701982.						
	2404207.	32470.	65841.	39566.	0.0		
	0.	9503.	0.	0.	0.	0.	
1983	3644890.						
	3130779.	56010.	73530.	43484.	0.0		
	103851.	12391.	0.	0.	0.	0.	
1985	4777609.						
	4167113.	62406.	93881.	39423.	1450.0		
	137160.	15362.	4102.	0.	0.	0.	
1995	11899604.						
	8211090.	722066.	175403.	83392.	39147.		
	388814.	30025.	376095.	0.	261326.	439953.	

YEAR - FIXED O&M COSTS (1000\$).

1980	54606.	8765.	40468.	22286.	0.0		
	0.	3682.	0.	16665.7	0.	0.	
1983	72486.	11702.	53136.	29265.	0.0		
	22104.	4835.	0.	21882.9	0.	0.	
1985	87062.	14583.	63828.	25893.	1316.		
	29980.	5808.	107.	26286.	0.	0.	
1995	212587.	53803.	159628.	62708.	25242.		
	101833.	14525.	12260.	74973.	189540.	240219.	

YEAR - VARIABLE O&M (1000\$).

1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

YEAR - TOTAL COST OF EXPECTED UNSERVED ENERGY (1000\$).

1980	3915.6
1983	9457.0
1985	1896.5
1995	25103.5

Figure 6-1. FINAM Manually Created Input Data (Continued)

***** CHANGE CASE 2 - 254 MOD-2 MACHINES - 635 MW

254 MOD-2 635.

YEAR - CAP. TO ADD TO ALL GEN. TYPES (MW).

1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	187.0	0.0	0.0	222.0	0.0	0.0	0.0	61.0
1986	188.0	0.0	0.0	390.0	0.0	0.0	0.0	291.0

YEAR - TOTAL COST THEN FUEL COSTS BY TYPE (1000\$).

1980	2622307.	2329096.	28858.	65778.	99563.	0.0
1983	3535639.	3028912.	50577.	73176.	43479.	0.0
1985	4639611.	4040157.	52402.	93556.	39424.	1446.0
1995	11614765.	8025631.	633674.	174636.	83392.	38974.

YEAR - FIXED OEM COSTS (1000\$).

1980	54606.	8765.	40468.	22286.	0.0
1983	72486.	11702.	53136.	29265.	0.0
1985	87062.	14180.	63828.	25893.	1316.
1995	212587.	52116.	159628.	62708.	25242.

YEAR - VARIABLE OEM (1000\$).

1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

YEAR - TOTAL COST OF EXPECTED UNSERVED ENERGY (1000\$).

1980	3046.1
1983	7981.6
1985	1677.7
1995	24013.9

Figure 6-1. FINAM Manually Created Input Data (Continued)

COAL 2 GEN. TYPE TABLE

COAL 2

YEAR	FUEL(\$/MMBTU)	FOM(\$/KW/YR)	VOM(\$/MWH)
1980	0.51	21.67	0.0
1983	0.68	29.41	0.0
1985	0.81	27.17	0.0
1995	1.65	84.06	0.0

NUMBER OF AND ESCALATIONS TO BE USED FOR EXTENSIONS (%).

3 3 1

1981 10.0 1981 12.6 1981 9.6

1985 8.0 1982 10.6 0000 000

1990 7.0 1983 9.6 0000 000

COAL 3 GEN. TYPE TABLE

COAL 3

YEAR	FUEL(\$/MMBTU)	FOM(\$/KW/YR)	VOM(\$/MWH)
1980	0.00	0.0	0.0
1983	0.00	0.0	0.0
1985	2.10	21.57	0.0
1995	4.29	206.90	0.0

NUMBER OF AND ESCALATIONS TO BE USED FOR EXTENSIONS (%).

3 3 1

1981 10.0 1981 12.6 1981 9.6

1985 8.0 1982 10.6 0000 000

1990 7.0 1983 9.6 0000 000

NUC 1 GEN. TYPE TABLE

NUC 1

YEAR	FUEL(\$/MMBTU)	FOM(\$/KW/YR)	VOM(\$/MWH)
1980	0.00	0.0	0.0
1983	0.76	11.35	0.0
1985	0.91	14.05	0.0
1995	1.85	33.70	0.0

NUMBER OF AND ESCALATIONS TO BE USED FOR EXTENSIONS (%).

4 3 1

1981 12.5 1981 12.6 1981 9.6

1982 10.0 1982 10.6 0000 000

1985 8.0 1983 9.6 0000 000

1990 7.0 0000 000 0000 000

Figure 6-1. FINAM Manually Created Input Data (Continued)

NUC 2 GEN. TYPE TABLE

NUC 2

YEAR	FUEL (\$/MMBTU)	FOM (\$/KW/YR)	VOM (\$/MWH)
1980	0.38	11.84	0.0
1983	0.52	15.54	0.0
1985	0.61	18.67	0.0
1995	1.25	46.70	0.0

NUMBER OF AND ESCALATIONS TO BE USED FOR EXTENSIONS (%).

4 3 1

1981	12.5	1981	12.6	1981	9.6
1982	10.0	1982	10.6	0000	000
1985	8.0	1983	9.6	0000	000
1990	7.0	0000	000	0000	000

GEO GEN. TYPE TABLE

GEO

YEAR	FUEL (\$/MMBTU)	FOM (\$/KW/YR)	VOM (\$/MWH)
1980	1.63	0.0	0.0
1983	2.17	0.0	0.0
1985	2.63	11.89	0.0
1995	5.30	27.99	0.0

NUMBER OF AND ESCALATIONS TO BE USED FOR EXTENSIONS (%).

4 3 1

1981	10.0	1981	12.6	1981	9.6
1986	9.0	1982	10.6	0000	000
1987	8.0	1983	9.6	0000	000
1988	7.0	0000	000	0000	000

HYDRO GEN. TYPE TABLE

HYDRO

YEAR	FUEL (\$/MMBTU)	FOM (\$/KW/YR)	VOM (\$/MWH)
1980	0.00	16.29	0.0
1983	0.00	21.39	0.0
1985	0.00	25.69	0.0
1995	0.00	43.01	0.0

NUMBER OF AND ESCALATIONS TO BE USED FOR EXTENSIONS (%).

3 3 1

1981	12.6	1981	12.6	1981	9.6
1982	10.6	1982	10.6	0000	000
1983	9.6	1983	9.6	0000	000

Figure 6-1. FINAM Manually Created Input Data (Continued)

*CHANGE LIFE OF WIND MACHINE
"MISC",00 00
P.W MISC - WIND MACHINE LIFETIME - AND FCR,ICOST
1980 40 21.9 0
*CHANGE THE PRESENT WORTH DISCOUNT RATE TO 12.
"PWD ",00 00
P.W. DISCOUNT RATE GNP DEF.
12.00 10.1
*CHANGE ONLY FUEL ESCALATION RATES
"FCST" 5 1
THE FUEL TYPES.
2 4 6 8 10
NUMBER AND ESCALATIONS FOR TYPE 2.
7
1981 12.5
1985 10.0
1986 9.1
1987 8.9
1988 8.5
1989 8.3
1990 8.4
NUMBER AND ESCALATIONS FOR TYPE 4.
7
1981 10.0
1985 8.7
1986 9.1
1987 8.9
1988 8.5
1989 8.3
1990 8.4
NUMBER AND ESCALATIONS FOR TYPE 6.
8
1981 12.5
1982 10.0
1985 8.7
1986 9.1
1987 8.9
1988 8.5
1989 8.3
1990 8.4

Figure 6-1. FINAM Manually Created Input Data (Continued)

NUMBER AND ESCALATIONS FOR TYPE 8.

7
1981 10.0
1985 8.7
1986 9.1
1987 8.9
1988 8.5
1989 8.3
1990 8.4

NUMBER AND ESCALATIONS FOR TYPE 10.

7
1981 10.0
1985 8.7
1986 9.1
1987 8.9
1988 8.5
1989 8.3
1990 8.4

*CHANGE ASSUMED DISTILATE FUEL TYPE CAPITAL COST.

"CAP" 1 0

THE GENERATOR TYPE

2

YEAR - NEW CAPITAL COST (\$/KW)

1980 600.0

1983 828.0

1985 1020.1

1986 1132.4

THAT IS ALL

"XXXX" 0 0

Figure 6-1. FINAM Manually Created Input Data (Concluded)

 ***** TEST DATA - 80,83,85 & 95 WITH CAP. CREDIT, WEIBULL ***

YEAR OF PRESENT WORTH RESULTS = 1980
 FIRST YEAR OF SIMULATION = 1980
 PRESENT WORTH DISCOUNT RATE (%) = 15.00
 NUMBER OF SIMULATION YEARS = 4
 NUMBER OF GENERATION TYPES = 11
 NUMBER OF CAPITAL COST YEARS = 4
 ALTERNATIVE GENERATION LIFE = 30
 AND FIXED CHARGE RATE = 21.90 %
 USING END OF YEAR COST ASSUMPTION
 LAST YEAR OF ALTERNATIVE CALCULATIONS = 2009
 GNP DEFLATOR RATE (%) = 10.10
 NUMBER OF CHANGE CASES = 2

*****GENERATION DATA FOR TYPE 1 = SLR
 YEAR FUEL COST * FIXED O&M * VARIABLE O&M *
 (\$/MMBTU) * (\$/KW) * (\$/MW/YR) *
 1980 6.5000 * 5.9600 * 0.0000 *
 1983 8.5400 * 7.7100 * 0.0000 *
 1985 10.5700 * 9.2500 * 0.0000 *
 1995 21.3800 * 23.1200 * 0.0000 *

EXTENSION ESCALATION DATA
 BEGIN RATE * BEGIN RATE * BEGIN RATE *
 YEAR (%) * YEAR (%) * YEAR (%) *
 1981 12.50 * 1981 12.60 * 1981 9.60 *
 1985 10.00 * 1982 10.60 * 0 0.00 *
 1986 9.00 * 1983 9.60 * 0 0.00 *
 1987 8.00 * 0 0.00 * 0 0.00 *
 1988 7.00 * 0 0.00 * 0 0.00 *

YEAR	CAPITAL COSTS (\$/KW)	FIXED CHARGE RATE(%)	BASED ON YEARS
1980	600.0	21.900	30
1983	828.0	21.900	30
1985	1020.1	21.900	30
1986	1132.4	21.900	30

*****GENERATION DATA FOR TYPE 2 = DIST
 YEAR FUEL COST * FIXED O&M * VARIABLE O&M *
 (\$/MMBTU) * (\$/KW) * (\$/MW/YR) *
 1980 6.5000 * 8.3400 * 0.0000 *
 1983 9.2500 * 10.5000 * 0.0000 *
 1985 11.4500 * 9.7000 * 0.0000 *
 1995 23.1600 * 18.0100 * 0.0000 *

EXTENSION ESCALATION DATA
 BEGIN RATE * BEGIN RATE * BEGIN RATE *
 YEAR (%) * YEAR (%) * YEAR (%) *
 1981 12.50 * 1981 12.60 * 1981 9.60 *
 1985 10.00 * 1982 10.60 * 0 0.00 *
 1986 9.00 * 1983 9.60 * 0 0.00 *
 1987 8.00 * 0 0.00 * 0 0.00 *
 1988 7.00 * 0 0.00 * 0 0.00 *

YEAR	CAPITAL COSTS (\$/KW)	FIXED CHARGE RATE(%)	BASED ON YEARS
1980	330.0	21.900	30
1983	455.4	21.900	30
1985	561.1	21.900	30
1986	622.8	21.900	30

Figure 6-2. FINAM Echo of Input Data

 ***** TEST DATA - 00.83.85 & 95 WITH CAP. CREDIT, WE-BULL *****

*****GENERATION DATA FOR TYPE 3 - COAL 1

YEAR	FUEL COST (\$/MMBTU)	FIXED O&M (\$/KW)	VARIABLE O&M (\$/MW/YR)
1980	1.0600	45.7000	0.0000
1983	1.4100	60.1100	0.0000
1985	1.6800	72.2000	0.0000
1995	3.4200	180.5700	0.0000

EXTENSION ESCALATION DATA			
BEGIN YEAR	RATE (%)	BEGIN YEAR	RATE (%)
1981	10.00	1981	12.60
1985	8.00	1982	10.60
1990	7.00	1983	9.60

YEAR	CAPITAL COSTS (\$/KW)	FIXED CHARGE RATE(%)	BASED ON YEARS
1980	1200.0	23.800	35
1983	1655.9	23.800	35
1985	2040.3	23.800	35
1986	2264.7	23.800	35

*****GENERATION DATA FOR TYPE 4 - COAL 2

YEAR	FUEL COST (\$/MMBTU)	FIXED O&M (\$/KW)	VARIABLE O&M (\$/MW/YR)
1980	.5100	21.6700	0.0300
1983	.6800	29.4100	0.0300
1985	.8100	27.1700	0.0300
1995	1.6500	84.0600	0.0300

EXTENSION ESCALATION DATA			
BEGIN YEAR	RATE (%)	BEGIN YEAR	RATE (%)
1981	10.00	1981	12.60
1985	8.00	1982	10.60
1990	7.00	1983	9.60

YEAR	CAPITAL COSTS (\$/KW)	FIXED CHARGE RATE(%)	BASED ON YEARS
1980	1200.0	23.800	35
1983	1655.9	23.800	35
1985	2040.3	23.800	35
1986	2264.7	23.800	35

Figure 6-2. FINAM Echo of Input Data (Continued)

 ***** TEST DATA - 80,83,85 & 95 WITH CAP. CREDIT, WEIBULL *****

*****GENERATION DATA FOR TYPE 5 - COAL 3

YEAR	FUEL COST (\$/MMBTU)	FIXED O&M (\$/KW)	VARIABLE O&M (\$/MW/YR)
1980	0.0000	0.0000	0.0000
1983	0.0000	0.0000	0.0000
1985	2.1000	21.5700	0.0000
1995	4.2900	206.9000	0.0000

EXTENSION ESCALATION DATA					
BEGIN YEAR	RATE (%)	BEGIN YEAR	RATE (%)	BEGIN YEAR	RATE (%)
1981	10.00	1981	12.60	1981	9.60
1985	8.00	1982	10.60	0	0.00
1990	7.00	1983	9.60	0	0.00

YEAR	CAPITAL COSTS (\$/KW)	FIXED CHARGE RATE(%)	BASED ON YEARS
1980	1200.0	23.800	35
1983	1655.9	23.800	35
1985	2040.3	23.800	35
1986	2264.7	23.800	35

*****GENERATION DATA FOR TYPE 6 - NUC 1

YEAR	FUEL COST (\$/MMBTU)	FIXED O&M (\$/KW)	VARIABLE O&M (\$/MW/YR)
1980	0.0000	0.0000	0.0000
1983	0.7600	11.9500	0.0000
1985	0.9100	14.0500	0.0000
1995	1.0500	33.7000	0.0000

EXTENSION ESCALATION DATA					
BEGIN YEAR	RATE (%)	BEGIN YEAR	RATE (%)	BEGIN YEAR	RATE (%)
1981	12.50	1981	12.60	1981	9.60
1982	10.00	1982	10.60	0	0.00
1985	8.00	1983	9.60	0	0.00
1990	7.00	0	0.00	0	0.00

YEAR	CAPITAL COSTS (\$/KW)	FIXED CHARGE RATE(%)	BASED ON YEARS
1980	1500.0	23.900	30
1983	2069.9	23.900	30
1985	2550.4	23.900	30
1986	2830.9	23.900	30

Figure 6-2. FINAM Echo of Input Data (Continued)

 ***** TEST DATA - 80,83,85 & 95 WITH CAP. CREDIT, WEIBULL *****

*****GENERATION DATA FOR TYPE 7 - NUC 2

YEAR	FUEL COST (\$/MMBTU)	FIXED O&M (\$/KW)	VARIABLE O&M (\$/MW/YR)
1980	.3800	11.8400	0.0000
1983	.5200	15.5400	0.0000
1985	.6100	18.6700	0.0000
1995	1.2500	46.7000	0.0000

EXTENSION ESCALATION DATA

BEGIN YEAR	RATE (%)	BEGIN YEAR	RATE (%)	BEGIN YEAR	RATE (%)
1981	12.50	1981	12.60	1981	9.60
1982	10.00	1982	10.60	0	0.00
1983	8.00	1983	9.60	0	0.00
1990	7.00	0	0.00	0	0.00

YEAR	CAPITAL COSTS (\$/KW)	FIXED CHARGE RATE(%)	BASED ON YEARS
1980	1500.0	23.500	30
1983	2069.9	23.500	30
1985	2550.4	23.900	30
1986	2830.9	23.900	30

*****GENERATION DATA FOR TYPE 8 - GEO

YEAR	FUEL COST (\$/MMBTU)	FIXED O&M (\$/KW)	VARIABLE O&M (\$/MW/YR)
1980	1.6300	0.0000	0.0000
1983	2.1700	0.0000	0.0000
1985	2.6300	11.8900	0.0000
1995	5.3000	27.9900	0.0400

EXTENSION ESCALATION DATA

BEGIN YEAR	RATE (%)	BEGIN YEAR	RATE (%)	BEGIN YEAR	RATE (%)
1981	10.00	1981	12.60	1981	9.60
1986	9.00	1982	10.60	0	0.00
1987	8.00	1983	9.60	0	0.00
1988	7.00	0	0.00	0	0.00

YEAR	CAPITAL COSTS (\$/KW)	FIXED CHARGE RATE(%)	BASED ON YEARS
1980	1500.0	22.800	30
1983	2069.9	22.800	30
1985	2550.4	22.800	30
1986	2830.9	22.800	30

Figure 6-2. FINAM Echo of Input Data (Continued)

 ***** TEST DATA - 80,83,85 & 95 WITH CAP. CREDIT, WEIBULL *****

*****GENERATION DATA FOR TYPE 9 - HYDRO

YEAR	FUEL COST (\$/MMBTU)	FIXED O&M (\$/KW)	VARIABLE O&M (\$/MW/YR)
1980	0.0000	16.2900	0.0000
1983	0.0000	21.3900	0.0000
1985	0.0000	25.6900	0.0000
1995	0.0000	43.0100	0.0000

EXTENSION ESCALATION DATA

BEGIN YEAR	RATE (%)	BEGIN YEAR	RATE (%)	BEGIN YEAR	RATE (%)
1981	12.60	1981	12.60	1981	9.60
1982	10.60	1982	10.60	0	0.00
1983	9.60	1983	9.60	0	0.00

YEAR	CAPITAL COSTS (\$/KW)	FIXED CHARGE RATE(%)	BASED ON YEARS
1980	2200.0	24.700	60
1983	3035.9	24.700	60
1985	3740.5	24.700	60
1986	4152.0	24.700	60

*****GENERATION DATA FOR TYPE 10 - COAL4

YEAR	FUEL COST (\$/MMBTU)	FIXED O&M (\$/KW)	VARIABLE O&M (\$/MW/YR)
1980	0.0000	0.0000	0.0000
1983	0.0000	0.0000	0.0000
1985	0.0000	0.0000	0.0000
1995	4.5800	206.9200	0.0000

EXTENSION ESCALATION DATA

BEGIN YEAR	RATE (%)	BEGIN YEAR	RATE (%)	BEGIN YEAR	RATE (%)
1981	10.00	1981	12.60	1981	9.60
1985	8.00	1982	10.60	0	0.00
1990	7.00	1983	9.60	0	0.00

YEAR	CAPITAL COSTS (\$/KW)	FIXED CHARGE RATE(%)	BASED ON YEARS
1980	1200.0	23.800	35
1983	1655.9	23.800	35
1985	2040.3	23.800	35
1986	2264.7	23.800	35

Figure 6-2. FINAM Echo of Input Data (Continued)

 ***** TEST DATA - 80,83,85 & 95 WITH CAP. CREDIT, WEIBULL *****

*****GENERATION DATA FOR TYPE 11 - COALS

YEAR	FUEL COST (\$/MMBTU)	FIXED O&M (\$/KW)	VARIABLE O&M (\$/MW/YR)
1980	0.0000	0.0000	0.0000
1983	0.0000	0.0000	0.0000
1985	0.0000	0.0000	0.0000
1995	5.4900	179.2700	0.0000

EXTENSION		ESCALATION DATA	
BEGIN YEAR	RATE (%)	BEGIN YEAR	RATE (%)
1981	10.00	1981	12.60
1985	8.00	1982	10.60
1990	7.00	1983	9.60

YEAR	CAPITAL COSTS (\$/KW)	FIXED CHARGE RATE(%)	BASED ON YEARS
1980	1200.0	23.800	35
1983	1655.9	23.800	35
1985	2040.3	23.800	35
1986	2264.7	23.800	35

 ***** TEST DATA - 80,83,85 & 95 WITH CAP. CREDIT, WEIBULL *****

YEAR-EXPECTED UNSERVED ENERGY COST (\$/MWH)	
1980	100.000
1983	121.900
1985	138.900
1995	277.000

BEGIN YEAR	ESCALATION RATE (%)
1981	6.800

Figure 6-2. FINAM Echo of Input Data (Continued)

 ***** TEST DATA - 80,83,85 & 95 WITH CAP. CREDIT, WEIBULL *****

BASE CASE SYSTEM COSTS (K\$)

YEAR 1980 *	GENERATION TYPE										
TOTAL *	1	2	3	4	5	6	7	8	9	10	11
2705380.0*											
FUELS *	2407550.0	32465.0	65842.0	39566.0	0.0	0.0	9503.0	0.0	0.0	0.0	0.0
FIXED O&M *	54606.0	8765.0	40468.0	22286.0	0.0	0.0	3682.0	0.0	16665.7	0.0	0.0
VAR. O&M *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
E.U.E. *	3978.700										

YEAR 1983 *	GENERATION TYPE										
TOTAL *	1	2	3	4	5	6	7	8	9	10	11
3649838.0*											
FUELS *	3135130.0	56489.0	73539.0	43484.0	0.0	103851.0	12391.0	0.0	0.0	0.0	0.0
FIXED O&M *	72486.0	11702.0	53136.0	29265.0	0.0	22104.0	4835.0	0.0	21882.9	0.0	0.0
VAR. O&M *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
E.U.E. *	9547.300										

YEAR 1985 *	GENERATION TYPE										
TOTAL *	1	2	3	4	5	6	7	8	9	10	11
4784187.0*											
FUELS *	4173658.0	62393.0	93886.0	39424.0	1451.0	137160.0	15362.0	4102.0	0.0	0.0	0.0
FIXED O&M *	87062.0	14610.0	63828.0	25893.0	1316.0	29980.0	5808.0	107.0	26286.0	0.0	0.0
VAR. O&M *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
E.U.E. *	1906.600										

YEAR 1995 *	GENERATION TYPE										
TOTAL *	1	2	3	4	5	6	7	8	9	10	11
11914221.0*											
FUELS *	8216416.0	731015.0	175425.0	83392.0	39151.0	388826.0	30025.0	376104.0	0.0	261385.0	440084.0
FIXED O&M *	212587.0	53944.0	159628.0	62708.0	25242.0	101833.0	14525.0	12260.0	74973.0	189540.0	240219.0
VAR. O&M *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
E.U.E. *	25101.300										

Figure 6-2. FINAM Echo of Input Data (Continued)

 ***** TEST DATA - 80,83,35 @ 95 WITH CAP. CREDIT, WEIBULL *****

BASE CASE CAPACITY ADDITIONS (MW)

**	GENERATION TYPE		3	4	5	6	7	8	9	10	11
YEAR **	1	2									
1980 **	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1983 **	81.00	64.00	0.00	0.00	0.00	1947.00	0.00	0.00	0.00	0.00	0.00
1985 **	0.00	390.00	0.00	0.00	61.00	187.00	0.00	9.00	0.00	0.00	0.00
1986 **	0.00	390.00	0.00	0.00	291.00	188.00	0.00	44.00	320.00	0.00	0.00

CHANGE CASE 1 = 10 MOD-2 -CAPACITY ADDITIONS (MW)

**	GENERATION TYPE		3	4	5	6	7	8	9	10	11
YEAR **	1	2									
1980 **	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1983 **	81.00	64.00	0.00	0.00	0.00	1947.00	0.00	0.00	0.00	0.00	0.00
1985 **	0.00	379.00	0.00	0.00	61.00	187.00	0.00	9.00	0.00	0.00	0.00
1986 **	0.00	390.00	0.00	0.00	291.00	188.00	0.00	44.00	320.00	0.00	0.00

CHANGE CASE 2 = 254 MOD-2 -CAPACITY ADDITIONS (MW)

**	GENERATION TYPE		3	4	5	6	7	8	9	10	11
YEAR **	1	2									
1980 **	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1983 **	81.00	64.00	0.00	0.00	0.00	1947.00	0.00	0.00	0.00	0.00	0.00
1985 **	0.00	222.00	0.00	0.00	61.00	187.00	0.00	9.00	0.00	0.00	0.00
1986 **	0.00	390.00	0.00	0.00	291.00	188.00	0.00	44.00	320.00	0.00	0.00

Figure 6-2. FINAM Echo of Input Data (Continued)

 ***** TEST DATA - 80.83,85 & 95 WITH CAP. CREDIT, WEIBULL *****

CHANGE CASE 1 = 10 MOD-2 -SYSTEM COSTS (K\$)

YEAR 1980 *	GENERATION TYPE										
TOTAL *	1	2	3	4	5	6	7	8	9	10	11
-2701982.0*											
FUELS *	2404207.0	32470.0	65841.0	39566.0	0.0	0.0	9503.0	0.0	0.0	0.0	0.0
FIXED O&M *	54606.0	8765.0	40468.0	22286.0	0.0	0.0	3682.0	0.0	16665.7	0.0	0.0
VAR. O&M *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
E.U.E. *	3915.600										

YEAR 1983 *	GENERATION TYPE										
TOTAL *	1	2	3	4	5	6	7	8	9	10	11
3644890.0*											
FUELS *	3130779.0	56010.0	73530.0	43484.0	0.0	103851.0	12391.0	0.0	0.0	0.0	0.0
FIXED O&M *	72486.0	11702.0	53136.0	29265.0	0.0	22104.0	4835.0	0.0	21882.9	0.0	0.0
VAR. O&M *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
E.U.E. *	9457.000										

YEAR 1985 *	GENERATION TYPE										
TOTAL *	1	2	3	4	5	6	7	8	9	10	11
4777609.0*											
FUELS *	4167113.0	62406.0	93881.0	39423.0	1450.0	137160.0	15362.0	4102.0	0.0	0.0	0.0
FIXED O&M *	87062.0	14583.0	63828.0	25893.0	1316.0	29980.0	5808.0	107.0	26286.0	0.0	0.0
VAR. O&M *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	C.C	0.0	0.0	0.0
E.U.E. *	1896.500										

YEAR 1995 *	GENERATION TYPE										
TOTAL *	1	2	3	4	5	6	7	8	9	10	11
11899604.0*											
FUELS *	8211090.0	722066.0	175403.0	83392.0	39147.0	388814.0	30025.0	376095.0	0.0	261326.0	439953.0
FIXED O&M *	212587.0	53803.0	159628.0	62708.0	25242.0	101833.0	14525.0	12260.0	74973.0	189540.0	240219.0
VAR. O&M *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
E.U.E. *	25103.500										

Figure 6-2. FINAM Echo of Input Data (Continued)

 ***** TEST DATA - 80,83,85 & 95 WITH CAP. CREDIT, WEIBULL ***

CHANGE CASE 2 = 254 MOD-2 -SYSTEM COSTS (K\$)

YEAR 1980 *	GENERATION TYPE										
TOTAL *	1	2	3	4	5	6	7	8	9	10	11
2622307.0*											
FUELS *	2329096.0	28858.0	65778.0	39563.0	0.0	0.0	9503.0	0.0	0.0	0.0	0.0
FIXED O&M *	54606.0	8765.0	40468.0	22286.0	0.0	0.0	3682.0	0.0	16665.7	0.0	0.0
VAR. O&M *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
E.U.E. *	3046.100										

YEAR 1983 *	GENERATION TYPE										
TOTAL *	1	2	3	4	5	6	7	8	9	10	11
3535639.0*											
FUELS *	3028912.0	50577.0	73176.0	43479.0	0.0	103726.0	12389.0	0.0	0.0	0.0	0.0
FIXED O&M *	72486.0	11702.0	53136.0	29265.0	0.0	22104.0	4835.0	0.0	21882.9	0.0	0.0
VAR. O&M *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
E.U.E. *	7981.600										

YEAR 1985 *	GENERATION TYPE										
TOTAL *	1	2	3	4	5	6	7	8	9	10	11
4639611.0*											
FUELS *	4040157.0	52402.0	93556.0	39424.0	1446.0	137075.0	15362.0	4102.0	0.0	0.0	0.0
FIXED O&M *	87062.0	14180.0	63828.0	25893.0	1316.0	29980.0	5808.0	107.0	26286.0	0.0	0.0
VAR. O&M *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
E.U.E. *	1677.700										

YEAR 1995 *	GENERATION TYPE										
TOTAL *	1	2	3	4	5	6	7	8	9	10	11
11614765.0*											
FUELS *	8025631.0	633674.0	174636.0	83392.0	38974.0	388283.0	30024.0	376103.0	0.0	259066.0	435490.0
FIXED O&M *	212587.0	52116.0	153628.0	62708.0	25242.0	101833.0	14525.0	12260.0	74973.0	189540.0	240219.0
VAR. O&M *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
E.U.E. *	24013.900										

Figure 6-2. FINAM Echo of Input Data (Concluded)

 ***** TEST DATA - 80,83,85 & 95 WITH CAP. CREDIT, WEIBULL *****

CHANGE CASE TITLE	** CAPACITY (MW) **	P.W. VALUE (1000\$)	** BREAKEVEN CAPITAL (\$/KW) **	MARGINAL VALUE (\$/KW) **
10 MOD-2	** 25.0 **	49442.5	1975.96	-.35
254 MOD-2	** 635.0 **	1063239.4	1164.43	-.35

EQUATION OF GROSS VALUE PER KW (\$/KW) CURVE
 $GROSS \$/KW = C1 + C2 \cdot AG$
 AG = ALTERNATIVE GENERATION CAPACITY (MW)
 C1 = 1384.006248
 C2 = -.345788

EQUATION OF MARGINAL VALUE PER KW (\$/KW) CURVE
 $MARGINAL \$/KW = CC1$
 CC1 = -.345788

Figure 6-3. FINAM Results

 *****CHANGE LIFE OF WIND MACHINE*****

***** CAUTION ***** ALL SENSITIVITY RUNS ASSUME THAT GENERATION TYPE UNIT CAPACITIES
 AS WELL AS DISPATCH AND COMMITMENT ORDER DO NOT CHANGE.

SENSITIVITY RUN NO. 1
 ANY OF THESE MAY BE CHANGED
 PRESENT WORTH RESULT YEAR = 1980
 ALTERNATIVE GENERATION LIFE = 40 YEARS AND FIXED CHARGE RATE = 21.90 %
 USING END OF YEAR COST ASSUMPTION
 LAST YEAR OF ALTERNATIVE CALCULATIONS = 2019

CHANGE CASE TITLE	** CAPACITY (MW) **	P.W. VALUE (1000\$)	** BREAKEVEN CAPITAL (\$/KW) **	MARGINAL VALUE (\$/KW)
10 MOD-2	25.0	53662.4	1475.71	-.38
254 MOD-2	635.0	1149296.7	1244.31	-.38

EQUATION OF GROSS VALUE PER KW (\$/KW) CURVE
 $GROSS \$/KW = C1 + C2 \cdot AG$
 $AG = \text{ALTERNATIVE GENERATION CAPACITY (MW)}$
 $C1 = 1485.195417$
 $C2 = -.379341$

EQUATION OF MARGINAL VALUE PER KW (\$/KW) CURVE
 $MARGINAL \$/KW = CC1$
 $CC1 = -.379341$

Figure 6-4. FINAM Sensitivity Results

 *****CHANGE THE PRESENT WORTH DISCOUNT RATE TO 12.*****

***** CAUTION ***** ALL SENSITIVITY RUNS ASSUME THAT GENERATION TYPE UNIT CAPACITIES
 AS WELL AS DISPATCH AND COMMITMENT ORDER DO NOT CHANGE.

SENSITIVITY RUN NO. 2
 THE PRESENT WORTH DISCOUNT RATE NOW = 12.000 PERCENT
 THE G.N.P. DEFATOR RATE NOW = 10.100 PERCENT

CHANGE CASE TITLE	** CAPACITY (MW) **	P.W. VALUE (1000\$)	** BREAKEVEN CAPITAL (\$/KW) **	MARGINAL VALUE (\$/KW) **
10 MOD-2	25.0	72414.4	1641.97	-.45
254 MOD-2	635.0	1531516.0	1367.19	-.45

EQUATION OF GROSS VALUE PER KW (\$/KW) CURVE
 GROSS \$/KW = C1 + C2*AG
 AG = ALTERNATIVE GENERATION CAPACITY (MW)
 C1 = 1653.231886
 C2 = -.450463

EQUATION OF MARGINAL VALUE PER KW (\$/KW) CURVE
 MARGINAL \$/KW = CC1
 CC1 = -.450463

 *****CHANGE ASSUMED DISTILLATE FUEL TYPE CAPITAL COST.*****

***** CAUTION ***** ALL SENSITIVITY RUNS ASSUME THAT GENERATION TYPE UNIT CAPACITIES
 AS WELL AS DISPATCH AND COMMITMENT ORDER DO NOT CHANGE.

SENSITIVITY RUN NO. 4 - CAPITAL COSTS CHANGED - CHANGES PRESENTED BELOW - (\$/KW)

YEAR	GENERATION TYPE
1980	2
1980	600.000
1983	828.000
1985	1020.100
1986	1132.400

CHANGE CASE TITLE	** CAPACITY (MW) **	P.W. VALUE (1000\$)	** BREAKEVEN CAPITAL (\$/KW) **	MARGINAL VALUE (\$/KW) **
10 MOD-2	25.0	53052.1	1475.77	-.41
254 MOD-2	635.0	1118367.9	1224.81	-.41

EQUATION OF GROSS VALUE PER KW (\$/KW) CURVE
 GROSS \$/KW = C1 + C2*AG
 AG = ALTERNATIVE GENERATION CAPACITY (MW)
 C1 = 1486.056822
 C2 = -.411419

EQUATION OF MARGINAL VALUE PER KW (\$/KW) CURVE
 MARGINAL \$/KW = CC1
 CC1 = -.411419

Figure 6-4. FINAM Sensitivity Results (Continued)

 *****CHANGE ONLY FUEL ESCALATION RATES*****

***** CAUTION ***** ALL SENSITIVITY RUNS ASSUME THAT GENERATION TYPE UNIT CAPACITIES
 AS WELL AS DISPATCH AND COMMITMENT ORDER DO NOT CHANGE.

SENSITIVITY RUN NO. 3 - FUEL COSTS CHANGED - CHANGES PRESENTED BELOW - (\$/MBTU)

EXTENSION ESCALATION DATA

GENERATION TYPE 2

BEGIN YEAR	RATE(%)
1981	12.500
1985	10.000
1986	9.100
1987	8.900
1988	8.500
1989	8.300
1990	8.400

EXTENSION ESCALATION DATA

GENERATION TYPE 4

BEGIN YEAR	RATE(%)
1981	13.000
1985	8.700
1986	9.100
1987	8.900
1988	8.500
1989	8.300
1990	8.400

EXTENSION ESCALATION DATA

GENERATION TYPE 6

BEGIN YEAR	RATE(%)
1981	12.500
1982	10.000
1985	8.700
1986	9.100
1987	8.900
1988	8.500
1989	8.300
1990	8.400

EXTENSION ESCALATION DATA

GENERATION TYPE 8

BEGIN YEAR	RATE(%)
1981	10.000
1985	8.700
1986	9.100
1987	8.900
1988	8.500
1989	8.300
1990	8.400

EXTENSION ESCALATION DATA

GENERATION TYPE-10

BEGIN YEAR	RATE(%)
1981	10.000
1985	8.700
1986	9.100
1987	8.900
1988	8.500
1989	8.300
1990	8.400

CHANGE CASE TITLE	** CAPACITY (MW) **	P.W. VALUE (1000\$)	** BREAKEVEN CAPITAL (\$/KW) **	MARGINAL VALUE (\$/KW) **
10 MOD-2	25.0	50348.3	1400.56	-.37
254 MOD-2	635.0	1073292.4	1175.44	-.37

EQUATION OF GROSS VALUE PER KW (\$/KW) CURVE

$$\text{GROSS } \$/\text{KW} = C1 + C2 \cdot AG$$

AG = ALTERNATIVE GENERATION CAPACITY (MW)

$$C1 = 1409.785755$$

$$C2 = -.369048$$

EQUATION OF MARGINAL VALUE PER KW (\$/KW) CURVE

$$\text{MARGINAL } \$/\text{KW} = CC1$$

$$CC1 = -.369048$$

Figure 6-4. FINAM Sensitivity Results (Concluded)

```
/JOB
FINAM.
ACCOUNT,DUM1234.
REQUEST,FINAMX,*PF.
ATTACH,IMSLIB,ID=PUBLIC.
LIBRARY,IMSLIB.
ATTACH,FINAMX,ID=UID,PW=PSWORD.
COMMENT. PURGE,FINAMX,ID=UID.
COMMENT. FILE,FINAM,FL=80.
COMMENT. GETPF,FINAM,FINAM,ID=UID.
COMMENT. FTN,I=FINAM,B=FINAMX,R=0,L=0,ER.
COMMENT. CATALOG,FINAMX,ID=UID,XP=PSWORD.
COMMENT. AUDIT,ID=UID.
FILE,DATA,FL=80.
GETPF,DATA,FINDAT,ID=UID.
FINAMX.
EXIT.
DMP.
REWIND,DATA.
COPYSBF,DATA,OUTPUT.
/EOB
```

(Lines beginning in "COMMENT." are inactive, but removing the "COMMENT." will activate the command.)

Figure 6-5. Sample Runstream for FINAM

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17. Document Analysis a. Descriptors Computerized Simulation; Costs; Electric Power; Electric Power Industry; Energy Models; Forecasting:Q1,Q2; Power Demand:T2; Power Generation:T1; Production; Reliability; Wind Power; Wind Power Plants; Energy Sources; Power; Power Plants; b. Identifiers/Open-Ended Terms Renewable Energy Sources; Simulation c. UC Categories 58b, 60			
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