N O T I C E

Lyndon B. Johnson Space Center
Houston, Texas 77058

JSC-16664

MAY 13 1980

COMPUTER PROGRAM DOCUMENTATION

ODRC DEMAND PLOTTING PROGRAM

USER'S GUIDE

Job Order 52-309

CPD-922

Prepared By

Lockheed Engineering & Management Services Co., Inc.

Houston Division

Houston, Texas

Contract NAS 9-15800

For

STRUCTURES AND MECHANICS DIVISION

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

LYNDON B. JOHNSON SPACE CENTER

HOUSTON, TEXAS

April 1980

LEMSCO-14847

COMPUTER PROGRAM DOCUMENTATION
ODRC DEMAND PLOTTING PROGRAM
USER'S GUIDE
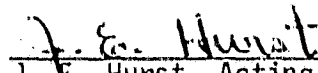
Job Order 52-309

CPD-922

Prepared By

S. J. Damico
S. J. Damico
Thermal Technology Section

Approved By

J. E. Hurst
J. E. Hurst, Acting Supervisor
Thermal Technology Section

W. J. Reicks
W. J. Reicks, Manager
Applied Mechanics Department

Prepared By

Lockheed Engineering & Management Services Co., Inc.
For
STRUCTURES AND MECHANICS DIVISION

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LYNDON B. JOHNSON SPACE CENTER
HOUSTON, TEXAS

April 1980

ACKNOWLEDGEMENTS

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
JSC-16664		

4. Title and Subtitle	5. Report Date
ODRC Demand Plotting Program	April 1980
	6. Performing Organization Code
	625-51

7. Author(s)	8. Performing Organization Report No.
S. J. Damico	LEMSCO-14847
Lockheed Engineering & Management Services Co., Inc.	
	10. Work Unit No.

9. Performing Organization Name and Address	11. Contract or Grant No.
Lockheed Engineering & Management Services Co., Inc.	
1830 NASA Rd. 1	NAS 9-15800
Houston, Texas 77058	
	13. Type of Report and Period Covered

12. Sponsoring Agency Name and Address	
National Aeronautics and Space Administration	Computer Program Document
Lyndon B. Johnson Space Center	14. Sponsoring Agency Code
Houston, Texas 77058 but	
Technical Monitor: R. G. Brown *E S.3*	

15. Supplementary Notes

16. Abstract

This document provides a user's guide for a computer program which will plot on a graphics terminal the temperature data recorded by thermocouples on the Orbital flight tests of the Shuttle. It discusses the various options available, the required input, the optional output, file assignments, and the restrictions of the program.

17. Key Words (Suggested by Author(s))	18. Distribution Statement
ODRC, Demand, Plotting, DISSPLA, Word Addressable, Numerical Summary, HSTFLO, HISTRY	

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price*
Unclassified	Unclassified	39	

CONTENTS

TABLES

FIGURES

1. INTRODUCTION

The Orbital Data Reduction Center, ODRC, Demand Plotting Program provides a means of viewing flight data (ODRC) and predicted flight data (generated by SINDA subroutines HSTFLO and HISTRY, referred to throughout the document as HSTFLO) in the demand mode on the Tektronix terminal. Reference 1 described a program which will: 1) Convert and transfer ODRC or HSTFLO from the raw forms, usually on tape, to a processed form on word addressable drum, 2) Plot this data in a batch run. This program is designed to provide quick access to the data so only the faster, processed, word addressable files are used. Figures 1, 2 and 3 show the word addressable file formats for the ODRC, HSTFLO, and HISTRY files, respectively. The program uses a measurement node correlation (MNC) list to determine which measurement ID (MID) and/or component nodes will be plotted. It then displays a numerical summary and/or plots of the data, according to user input instructions. These are generated according to the user input option. Option 1 displays ODRC data only. Options 2 and 3 display ODRC data and predicted ODRC data, obtained by calculating new ODRC values from the component node data. Option 3 also displays the component node data itself.

The plot consists of a maximum of eight curves displaying the values with respect to time for the ODRC MID's and HSTFLO component node numbers on the plot. The numerical summary provides the starting, stopping, maximum, and minimum values for the MID's and node numbers, the times at which they occur, and, for options 2 and 3, information depicting the maximum deviation between the data for a pair of MID's. The lines of a section of the numerical summary correspond with the curves on the plots so each section consists of eight or less lines. If a numerical summary is desired, a section is displayed even if no plots are desired. There is no maximum number of sections of the numerical summary, or plots, that can be generated but, a section of the summary, or a plot, each has a maximum of eight lines, or curves, whether or not both options, numerical summary and plotting, are used.

```
                 ┌─────────────────────┐
                 │ WORD POSITION DATA  │
                 │     1010 WORDS      │
                 │     (ARRAY IB)      │
IB(1) →          ├─────────────────────┤        ⎫
                 │      HEADER         │        ⎪
                 │     24 WORDS        │        ⎪
IB(2) →          ├─────────────────────┤        ⎪
                 │ DICTIONARY OF MID's │        ⎬
                 │    2*Jm WORDS       │        ⎪
IB(3) →          ├─────────────────────┤        ⎪
                 │    TIME ARRAY       │        ⎪
                 │  NOPT TIME POINTS   │        ⎭
IB(4) →          ├─────────────────────┤
                 │      MID 1          │
                 │    NOPT WORDS       │
IB(5) →          ├─────────────────────┤
                 │      MID 2          │
                 │    NOPT WORDS       │
                 ├─────────────────────┤
                 │         .           │
                 │         .           │
                 │         .           │
                 │         .           │
                 │         .           │
                 │         .           │
                 │         .           │
IB(3+Jm) →       ├─────────────────────┤
                 │      MID Jm         │
                 │    NOPT WORDS       │
IB(4+Jm) →       └─────────────────────┘
```

WORDS IN HEADER
1-19 DESCRIPTION
  20 TIME DELTA
  21 START TIME
  22 END TIME
  23 Jm = NUMBER OF MID's
  24 NOPT = NUMBER OF TIME POINTS
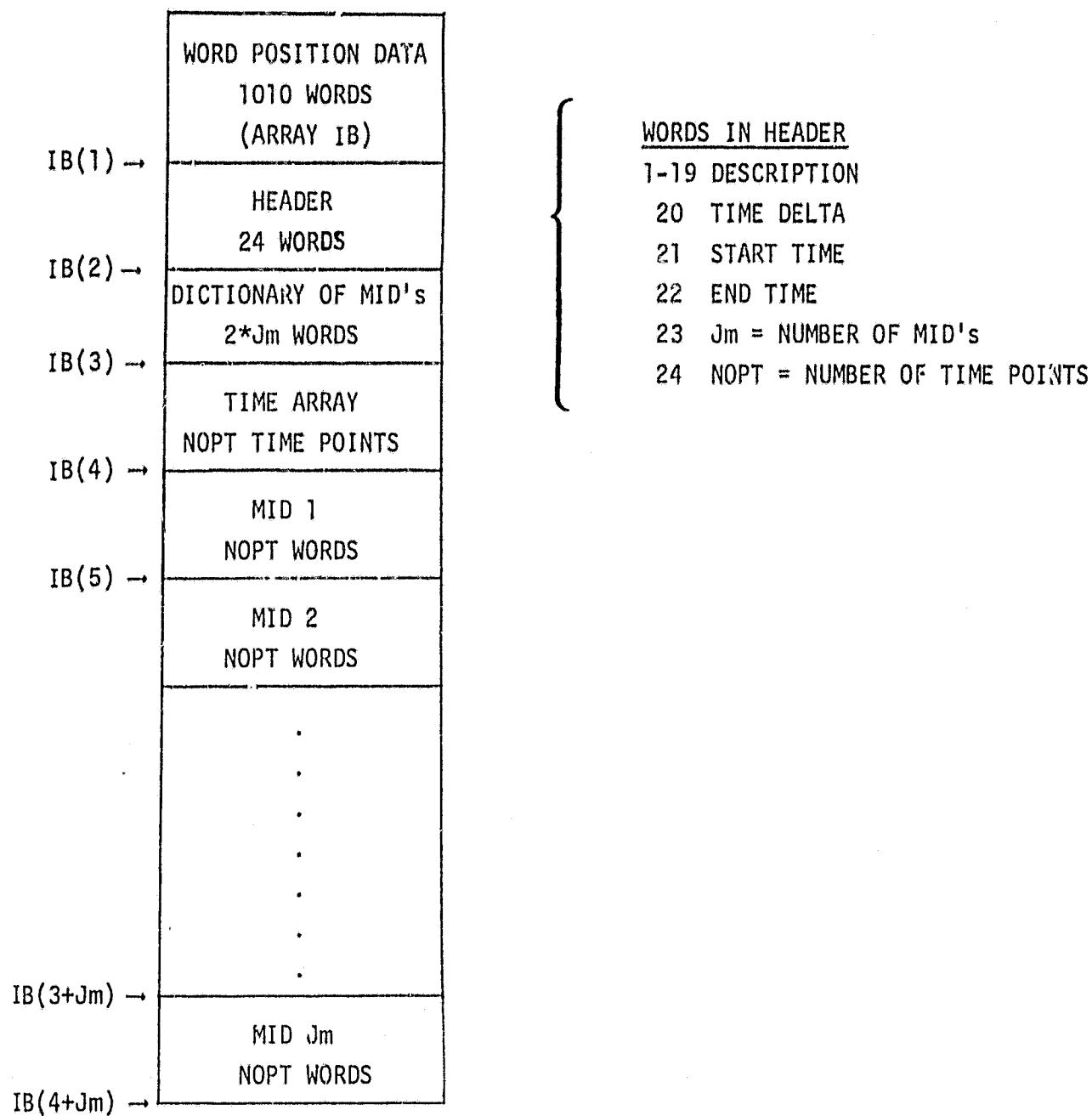
Figure 1. - Processed ODRC file format.

```
                WORD POSITION DATA
                     5 WORDS                          HEADER WORDS
                   (ARRAY IB)                         1-12  DESCRIPTION
IB(1) ─────────────────────────────                    13   START TIME
                                                        14   STOP TIME
                     HEADER                             15   TIME DELTA
                    27 WORDS                            16   NPTS - NUMBER OF TIME POINTS
IB(2) ─────────────────────────────                    17   UNUSED
                                                        18   NW
                   DICTIONARY                           19   NPR
                  NLTOTAL WORDS                         20   NV
           TUBE NUMBERS       1-NW                      21   0
           PRESSURE NUMBERS   1-NPR                     22   0
           VALVE NUMBERS      1-NV                      23   0
           NODE NUMBERS       1-NN                      24   0
IB(3) ─────────────────────────────                    25   0
                                                        26   0
                   TIME ARRAY                           27   NN
                  NPTS WORDS
IB(4) ─────────────────────────────
                    NODE 1
                  NPTS WORDS
             ──────────────────────
                    NODE 2
                  NPTS WORDS
             ──────────────────────
                                              LTOTAL = 2*NW+NPR+NV+NN
                      •                       NLTOTAL = NW+NPR+NV+NN
                      •
                      •                       LTOTAL NODES
                      •                       1-NW   PRESSURE DROPS
             ──────────────────────           1-NPR  PRESSURES
                  NODE LTOTAL                  1-NV   VALVE POSITIONS
                  NPTS WORDS                   1-NW   FLOW RATES
IB(5) ─────────────────────────────           1-NN   TEMPERATURES
```

Figure 2. - Processed HSTFLO file format.

```
              ┌─────────────────────────┐         HEADER WORDS
              │  WORD POSITION DATA      │         1-12  DESCRIPTION
              │     5 WORDS              │          13   START TIME
              │    (ARRAY  B)            │          14   STOP TIME
IB(1)         ├─────────────────────────┤          15   TIME DELTA
              │      HEADER              │          16   NPTS - NUMBER OF TIME POINTS
              │     27 WORDS             │          17   UNUSED
IB(2)         ├─────────────────────────┤          18   NWW
              │     DICTIONARY           │          19   NPRR
              │    NLTOTAL WORDS         │          20   NVP
              │  TUBE NUMBERS    1-NWW   │          21   NND
              │  PRESSURE NUMBERS 1-NPRR │          22   NGT
              │  VALVE NUMBERS   1-NVP   │          23   NCT
              │  NODE NUMBERS    1-NNT   │          24   NQI
              │  CONDUCTOR NUMBERS 1-NGT │          25   NNC
              │  CONSTANT NUMBERS 1-NCT  │          26   UNUSED
IB(3)         ├─────────────────────────┤          27   NSL
              │     TIME ARRAY           │
              │     NPTS WORDS           │
IB(4)         ├─────────────────────────┤
              │      NODE 1              │    LTOTAL = 2*NWW+NPRR+NVP+NSL+
              │     NPTS WORDS           │             NND+NNC+NQI+NGT+NCT
              ├─────────────────────────┤    NLTOTAL = NWW+NPRR+NVP+NNT+
              │      NODE 2              │             NGT+NCT
              │     NPTS WORDS           │
              ├─────────────────────────┤
              │          •              │    LTOTAL NODES
              │          •              │    1-NWW   PRESSURE DROPS
              │          •              │    1-NPRR  PRESSURES
              │          •              │    1-NVP   VALVE POSITIONS
              │          •              │    1-NWW   FLOW RATES
              ├─────────────────────────┤    1-NSL   TEMPERATURES
              │    NODE LTOTAL           │    1-NQI   INCIDENT HEATS
              │     NPTS WORDS           │    1-NND   HEAT CAPACITY
IB(5)         └─────────────────────────┘    1-NNC   NET HEAT
                                             1-NGT   CONDUCTIVITIES
                                             1-NCT   CONSTANTS
```

Figure 3. - Processed HISTRY file format.

2. DESCRIPTION

The ODRC Demand Plotting Program provides the user with three main options.
Option 1 reads data from a word addressable ODRC file for the MID's on the
MNC list. Options 2 and 3 read the MID data and the component node data,
for each MID, from word addressable HSTFLO files. Each option
then produces a numerical summary and/or plots from the ODRC and HSTFLO
data obtained for the MID's on the MNC list.

2.1 OPTIONS

One of three options provided by the program can be chosen by the user.
Option 1 reads the measurement node correlation (MNC) list and uses the MID
data from the ODRC files for each MID in the MNC list to generate a numeri-
cal summary and/or plots. Option 2 reads the MNC list and, for each MID on
the list, obtains the MID data from the ODRC file and node data, from the
word addressable HSTFLO file, which corresponds with that MID. The node
data is then used to generate a new predicted MID by using the weighting
factors from the MNC to calculate a new value for each time point from all
the component node data for that time point. These pairs of actual and pre-
dicted flight MID's are used to generate a numerical summary and/or plots.
Option 3 reads the MNC list and generates a new predicted MID as in option 2.
In addition, the component node data is also displayed on the numerical
summary and/or plots so only one MID from the MNC list is read and used for
one plot.

2.2 NUMERICAL SUMMARY

The numerical summary is an optional output for options 1, 2 and 3. It is
generated in the units of time specified by the user input instructions
with an H signifying hours, M-minutes, and S-seconds. The whole summary con-
sists of one or more summary sections with each section corresponding to the
data on one plot. If no plot is given, then the section is still written as
if it were with a plot and, since a plot has a maximum of eight curves, each
section of the summary has a maximum of eight lines. There is no maximum to

the number of sections that are used to generate the total summary. One MID
from the MNC list will result in one line of a section for option 1, two
lines for option 2, and up to eight lines for option 3. Therefore, each
section can contain a line from one to eight MID's for option 1, one to
four MID's for option 2, and only one MID for option 3. However, option 1
does not require eight MID's per section and option 2 does not require four
MID's per section. The actual number is determined from user input.

Each line for option 1 consists of the MID, the starting, stopping, maximum,
and minimum values for that MID, and the times at which each occurred.
Option 2 compares one ODRC MID to one predicted MID. Each line is similar
to option 1 except in option 2, the maximum deviation between the two MID's,
the values of the two MID's used to calculate the maximum deviation, and
their time values are included. The first two lines of option 3 are similar
to a pair of lines from option 2. Option 3 also includes a line for each of
the one to six component nodes used to calculate the predicte ID. Each
line for the component nodes consists of the node number, the starting,
stopping, maximum, and minimum values for that node, and the times at which
each occurred. There will only be one type of MID per section. Therefore,
if a new type is found in the MNC list before the desired number of MID's
have been read from the MNC list, that section is generated anyway and a new
section is started for the new MID type. Figures 4, 5, and 6 show sample
numerical summaries for options 1, 2, and 3 respectively.

2.3 PLOTTING

Plotting is an optional graphical output for options 1, 2 and 3. The plotting
routine uses the Display Integrated Software System and Plotting LAnguage (DISSPLA)
and interfaces with the Tektronix terminal to generate plots. Plots are
generated in the same units of time as the numerical summary. Each plot
contains a maximum of eight curves corresponding to the maximum of eight
lines per section of the numerical summary. Each curve consists of a maximum
of 1000 points. The title of the plot includes the MID's or node numbers of
the curves on the plot and the plotting symbol corresponding to each curve.
The X-axis label will indicate the units of time and the Y-axis label will

Figure 4. – Sample numerical summary for option 1.

MEASUREMENT	START TEMP	TIME(H)	STOP TEMP	TIME(H)	MAX. TEMP	TIME(H)	MIN. TEMP	TIME(H)
FL-U58T0101A	.7000+02	.03	.6031+02	1.80	.7000+02	.03	.6031+02	1.80
FL-U58T0201A	.7000+02	.03	.6956+02	1.80	.7000+02	.03	.6956+02	1.80
FL-U58T0301A	.6710+02	.03	-.1075+32	1.80	.6710+02	.03	-.1075+02	1.80
FL-U58T1524A	.7000+02	.03	.5798+02	1.80	.7000+02	.03	.5798+02	1.80
FL-U58T9335A	.7000+02	.03	.6368+02	1.80	.7000+02	.03	.6368+02	1.80
FL-U58T9235A	.7000+02	.03	.5798+02	1.80	.7000+02	.03	.5798+02	1.80
FL-U58T9135A	.7000+02	.03	.5798+02	1.80	.7000+02	.03	.5798+02	1.80
FL-U58T9458A	.6654+02	.03	-.2446+01	1.80	.6654+02	.03	-.2446+01	1.80
FL-U58T9462A	.4667+02	.03	.4535+02	1.80	.4667+02	.03	.4535+02	1.80
FL-U58T9003A	.6672+02	.03	-.2033+02	1.80	.6672+02	.03	-.2033+02	1.80
FL-U58T9328A	.6572+02	.03	-.1947+02	1.80	.6672+02	.03	-.1947+02	1.80
FL-U58T9228A	.6897+02	.03	.7974+01	1.80	.5897+02	.03	.7974+01	1.80
FL-U58T9107A	.6616+02	.03	-.4432+02	1.80	.6616+02	.03	-.4432+02	1.80
FL-U58T0161A	.6720+02	.03	-.2547+01	1.80	.6720+02	.03	-.2548+01	1.80

Figure 5. – Sample numerical summary for option 2.

MEASUREMENT	START TEMP	TIME(H)	STOP TEMP	TIME(H)	MAX. TEMP	TIME(H)	MIN. TEMP	TIME(H)	DEV. TEMP	TEMP	TIME(H)
FL-U58T0101A	.7000+02	.03	.6031+02	1.80	.7000+02	.03	.6031+02	1.80	.4627+00	.6091+02	1.73
PR-U58T0101A	.7000+02	.04	.6667+02	1.80	.7000+02	.04	.6667+02	1.80	.4627+00	.6137+02	1.73
FL-U58T0201A	.7000+02	.03	.6956+02	1.80	.7000+02	.03	.6956+02	1.80	.2023-01	.6956+02	1.80
PR-U58T0201A	.7000+02	.04	.6959+02	1.80	.7000+02	.04	.6959+02	1.80	.2623-01	.6959+02	1.80
FL-U58T0301A	.6710+02	.03	-.1075+02	1.80	.6710+02	.03	-.1075+02	1.80	.3779+01	.6570+02	.05
PR-U58T0301A	.7000+02	.04	-.9626+01	1.80	.7000+02	.04	-.9626+01	1.80	.3779+01	.6948+02	.05
FL-U58T1524A	.7000+02	.03	.5798+02	1.80	.7000+02	.03	.5798+02	1.80	.4565+00	.5832+02	1.77
PR-U58T1524A	.7000+02	.04	.5843+02	1.80	.7000+02	.04	.5843+02	1.80	.4565+00	.5877+02	1.77
FL-U58T9335A	.7000+02	.03	.6368+02	1.80	.7000+02	.03	.6368+02	1.80	.2435+00	.6386+02	1.77
PR-U58T9335A	.7000+02	.04	.6392+02	1.80	.7000+02	.04	.6392+02	1.80	.2435+00	.6411+02	1.77
FL-U58T9235A	.7000+02	.03	.5798+02	1.80	.7000+02	.03	.5798+02	1.80	.4565+00	.5832+02	1.77
PR-U58T9235A	.7000+02	.04	.5843+02	1.80	.7000+02	.04	.5843+02	1.80	.4565+00	.5877+02	1.77
FL-U58T9135A	.7000+02	.03	.5798+02	1.80	.7000+02	.03	.5798+02	1.80	.4565+00	.5832+02	1.77
PR-U58T9135A	.7000+02	.04	.5843+02	1.80	.7000+02	.04	.5843+02	1.80	.4565+00	.5877+02	1.77
FL-U58T9458A	.6654+02	.03	-.2446+01	1.80	.6654+02	.03	-.2446+01	1.80	.4522+01	.6486+02	.05
PR-U58T9458A	.7000+02	.04	-.1694+01	1.80	.7000+02	.04	-.1694+01	1.80	.4522+01	.6938+02	.05
FL-U58T9462A	.4667+02	.03	.4535+02	1.80	.4667+02	.03	.4535+02	1.80	.8150-01	.4542+02	1.75
PR-U58T9462A	.4667+02	.04	.4541+02	1.80	.4667+02	.04	.4541+02	1.80	.8150-01	.4551+02	1.75
FL-U58T9003A	.6672+02	.03	-.2033+02	1.80	.6672+02	.03	-.2033+02	1.80	.4253+01	.6516+02	.05
PR-U58T9003A	.7000+02	.04	-.1913+02	1.80	.7000+02	.04	-.1913+02	1.80	.4253+01	.6941+02	.05
FL-U58T9328A	.6672+02	.03	-.1947+02	1.80	.6672+02	.03	-.947+02	1.80	.4252+01	.6516+02	.05
PR-U58T9328A	.7000+02	.04	-.1829+02	1.80	.7000+02	.04	-.1829+02	1.80	.4252+01	.6941+02	.05

MEASUREMENT	START TEMP	TIME(H)	STOP TEMP	TIME(H)	MAX. TEMP	TIME(H)	MIN. TEMP	TIME(H)	DEV. TEMP	TEMP	TIME(H)
FL-U58T0101A	.7000+02	.03	.6031+02	1.80	.7000+02	.03	.6031+02	1.80	.4627+00	.6031+02	1.73
PR-U58T0101A	.7000+02	.04	.6057+02	1.80	.7000+02	.04	.6057+02	1.80	.4627+00	.6137+02	1.73
HS- 2511	.7000+02	.04	.6624+02	1.80	.7000+02	.04	.6624+02	1.80			
HS- 2512	.7000+02	.04	.5840+02	1.80	.7000+02	.04	.5840+02	1.80			
HS- 2513	.7000+02	.04	.5738+02	1.80	.7000+02	.04	.5738+02	1.80			
FL-U58T0201A	.7000+02	.03	.6956+02	1.80	.7000+02	.03	.6956+02	1.80	.2623-01	.6956+02	1.80
PR-U58T0201A	.7000+02	.04	.6959+02	1.80	.7000+02	.04	.6959+02	1.80	.2623-01	.6959+02	1.80
HS- 2536	.7000+02	.04	.7000+02	1.80	.7000+02	.04	.7000+02	1.80			.04
HS- 2537	.7000+02	.04	.7000+02	1.80	.7000+02	.04	.7000+02	1.80			.04
HS- 2602	.7000+02	.04	.6877+02	1.80	.7000+02	.04	.6877+02	1.80			1.80
FL-U58T0301A	.6710+02	.03	-.1075+02	1.80	.6710+02	.03	-.1075+02	1.80	.3779+01	.6570+02	.05
PR-U58T0301A	.7000+02	.04	-.9626+01	1.80	.7000+02	.04	-.9626+01	1.80	.3779+01	.6948+02	.05
HS- 212	.7000+02	.04	-.1347+02	1.80	.7000+02	.04	-.1347+02	1.80			
HS- 219	.7000+02	.04	-.6300+01	1.80	.7000+02	.04	-.6300+01	1.80			
HS- 215	.7000+02	.04	-.1344+02	1.80	.7000+02	.04	-.1344+02	1.80			
HS- 227	.7000+02	.04	-.5292+01	1.80	.7000+02	.04	-.5292+01	1.80			
FL-U58T1524A	.7000+02	.03	.5798+02	1.80	.7000+02	.03	.5798+02	1.80	.4565+00	.5832+02	1.77
PR-U58T1524A	.7000+02	.04	.5843+02	1.80	.7000+02	.04	.5843+02	1.80	.4565+00	.5877+02	1.77
HS- 223	.7000+02	.04	.5843+02	1.80	.7000+02	.04	.5843+02	1.80			
FL-U58T9335A	.7000+02	.03	.6368+02	1.80	.7000+02	.03	.6368+02	1.80	.2435+00	.6386+02	1.77
PR-U58T9335A	.7000+02	.04	.6392+02	1.80	.7000+02	.04	.6392+02	1.80	.2435+00	.6411+02	1.77
HS- 223	.7000+02	.04	.5843+02	1.80	.7000+02	.04	.5843+02	1.80			
HS- 1663	.7000+02	.04	.6942+02	1.80	.7000+02	.04	.6942+02	1.80			
FL-U58T9235A	.7000+02	.03	.5798+02	1.80	.7000+02	.03	.5798+02	1.80	.4565+00	.5832+02	1.77
PR-U58T9235A	.7000+02	.04	.5843+02	1.80	.7000+02	.04	.5843+02	1.80	.4565+00	.5877+02	1.77
HS- 223	.7000+02	.04	.5843+02	1.80	.7000+02	.04	.5843+02	1.80			
FL-U58T9135A	.7000+02	.03	.5798+02	1.80	.7000+02	.03	.5798+02	1.80	.4565+00	.5832+02	1.77
PR-U58T9135A	.7000+02	.04	.5843+02	1.80	.7000+02	.04	.5843+02	1.80	.4565+00	.5877+02	1.77
HS- 223	.7000+02	.04	.5843+02	1.80	.7000+02	.04	.5843+02	1.80			

FIGURE 6. SAMPLE NUMERICAL SUMMARY FOR OPTION 3.

indicate what type of MID is being plotted. Similar to the numerical summary, a plot will consist of only one MID type. If a new type is found in the MNC list, then that plot is generated with the curves that are already on it and a new plot will be started for the new MID type. Each plot will also contain grid lines for the major subdivisions of the X and Y axes and numerical labels for each grid line. Figures 7, 8 and 9 show sample plots for options 1, 2 and 3 respectively.
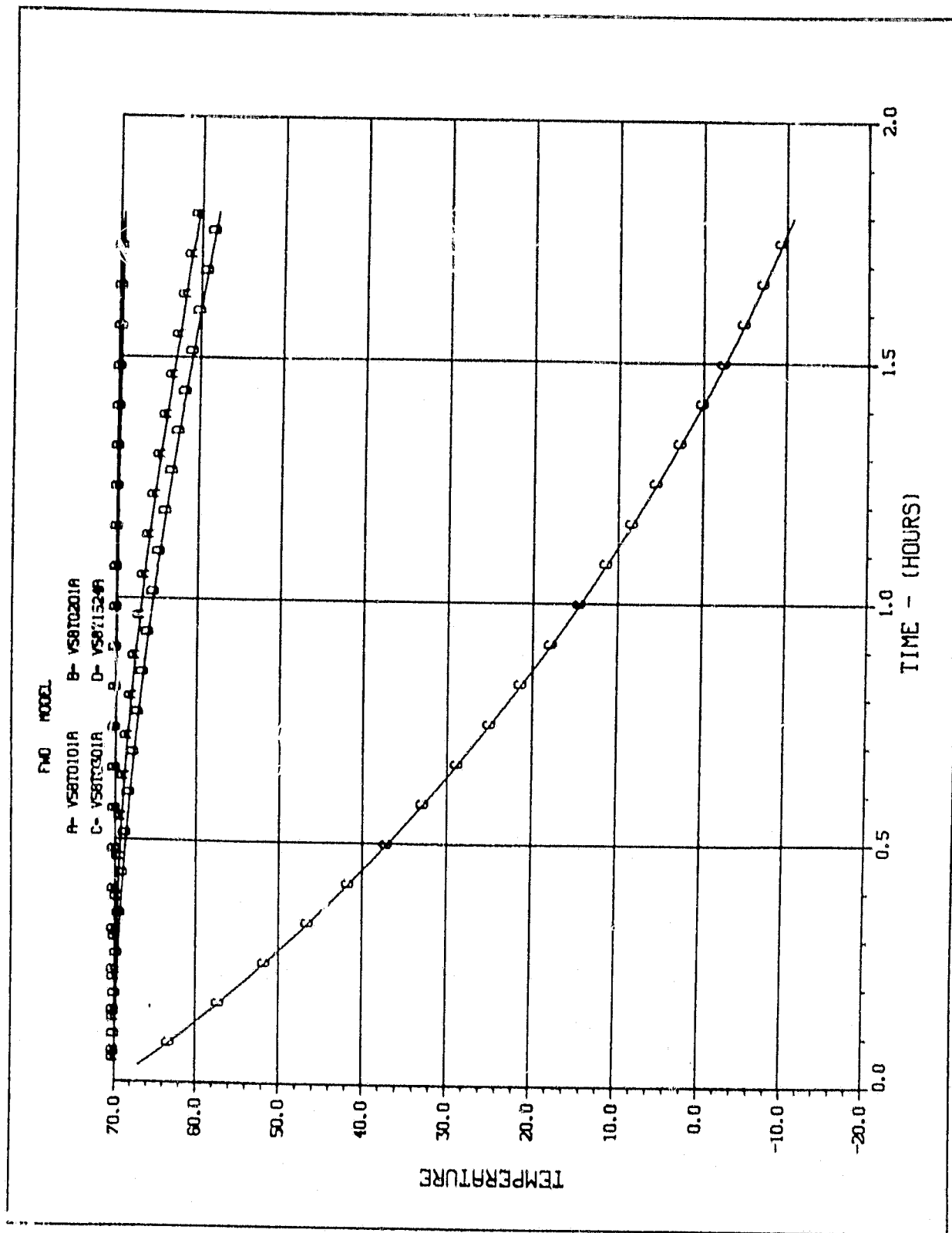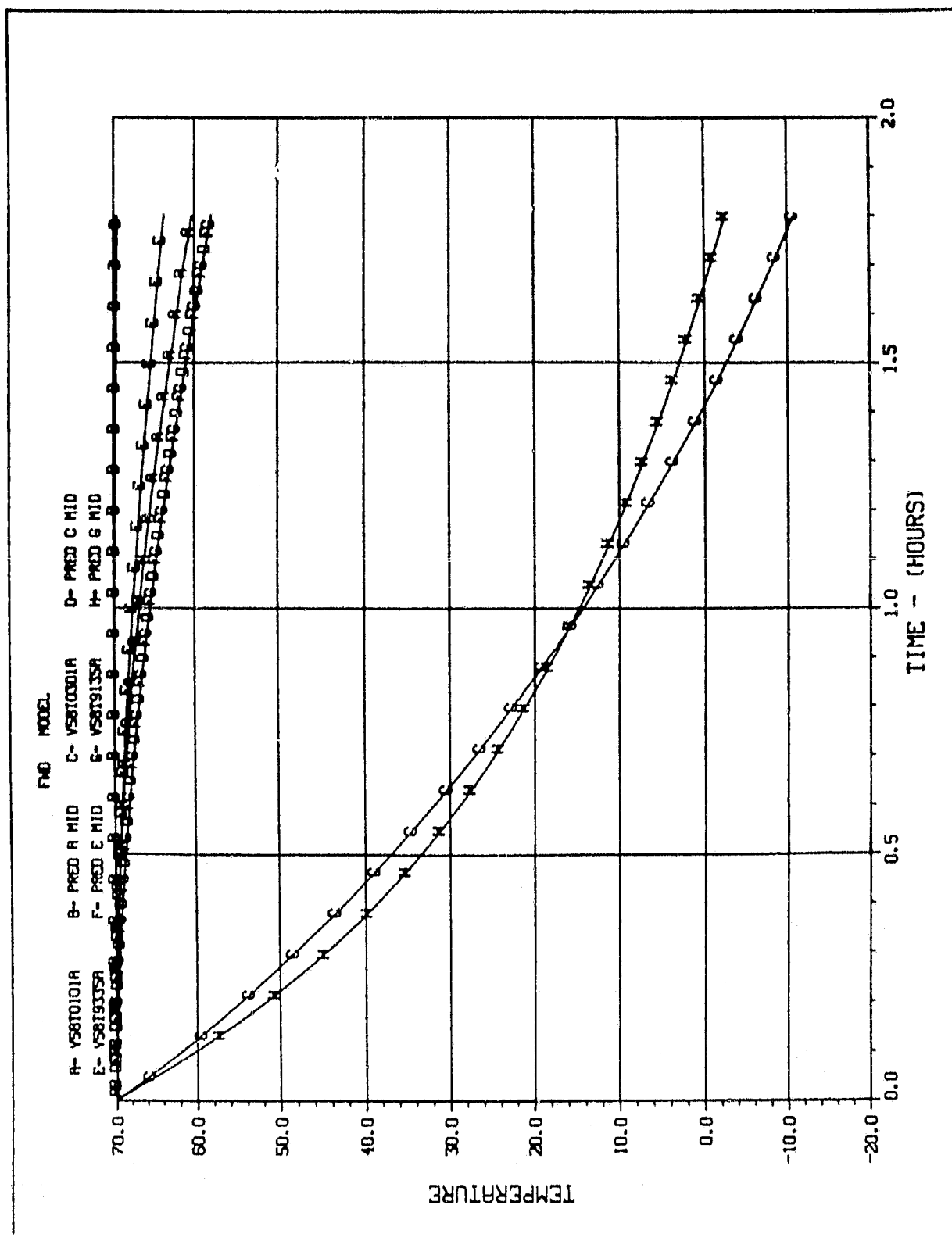
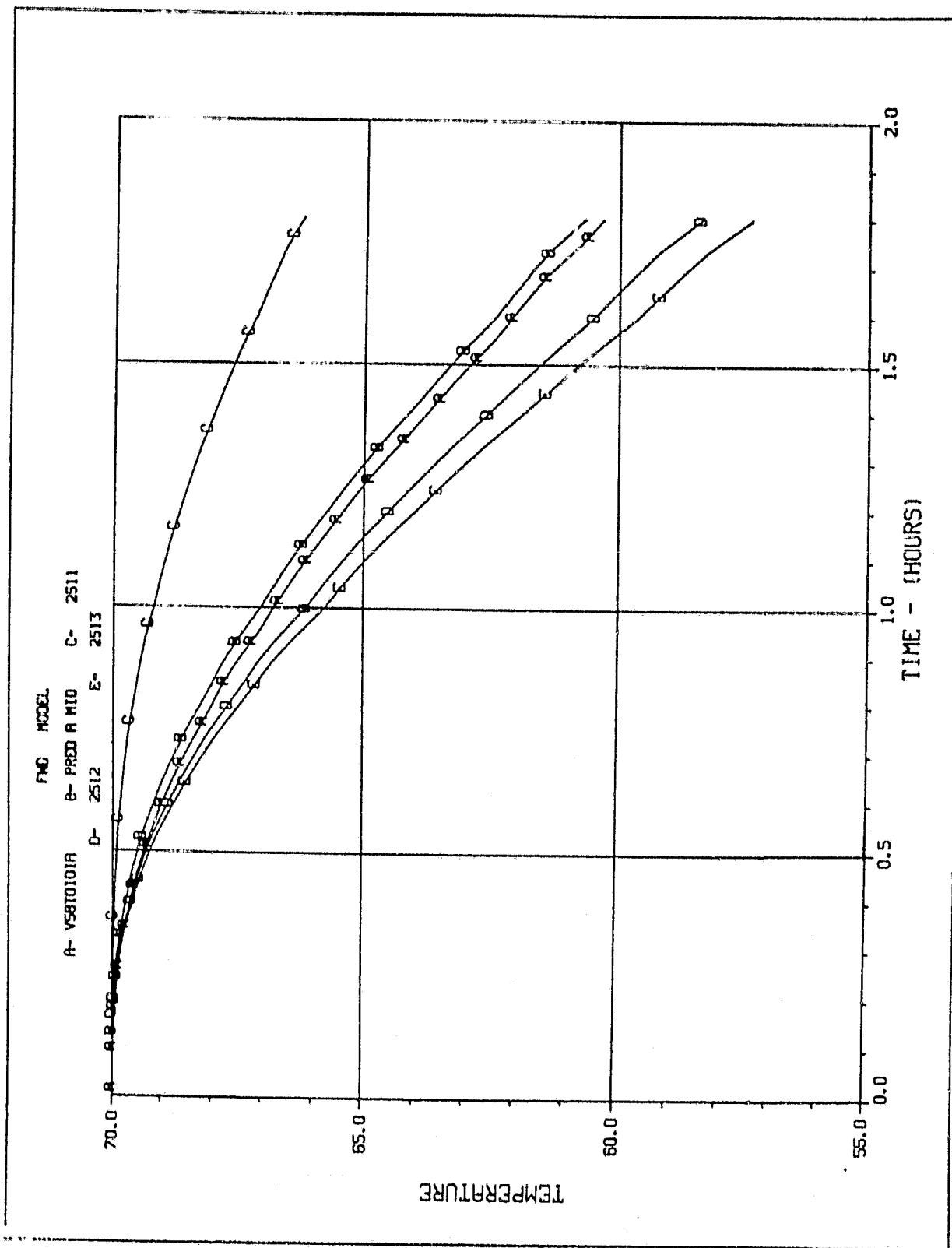Figure 7. -- Sample plot for option 1.

Figure 8. - Sample plot for option 2.

Figure 9. - Sample plot for option 3.

3. INPUT

The ODRC Demand Plotting Program requires three types of input data. First is the thermocouple data of the ODRC files and the thermal fluid data of the HSTFLO files. Secondly, the MNC list is needed to determine which MID's are desired from each of the input data files. Two sample MNC lists are shown in figure 10. Each MID line of the MNC list consists of a MID with a maximum of twelve characters, followed by the integer number of component nodes for the MID, followed by a six element array of the component node numbers themselves, and a six element array of the weighting factors corresponding to each node number. Each MID line is in a free format with a comma separating each element and a routine is called internally to determine the format of each line and then read it. A model name line consists of a model name of one to six characters.

Finally, a namelist, $ODRCPL, is used to provide the user with control of how the information obtained from the input data files will be used. It will determine the particular option desired, the time span, and several other variables. All the variables of $ODRCPL are described in table 1. A few restrictions should be noted. Options 1, 2 and 3 all require ODRC data so if LUNTOD contains no good ODRC files, then the program is terminated.

The units of time on HSTFLO files cannot be determined by just reading the file. Therefore, when using options 2 and 3, the HSTFLO files are to be in the same units of time as NHSTM, the final unit of time desired for the numerical summary and plots. For example, if NHSTM = 2, signifying that the unit of time for the summary and plots is minutes, then the input HSTFLO files must be in units of minutes. Figure 11 shown sample $ODRCPL namelists for each of the three options.

TABLE I. - $ODRCPL NAMELIST VARIABLE DESCRIPTION

NAME	DESCRIPTION	RANGE	DEFAULT
IHRCPY	PLOT HARD COPY INDICATOR (0 - NO, 1 - YES)	0,1	0
IOMNC	MNC INPUT LIST UNIT NUMBER	1-27 EXCEPT 5,6	0
IWAIT	INTEGER NUMBER OF SECONDS TO WAIT AFTER EACH PLOT FOR VIEWING	INTEGER	0
LSTEP	NUMBER OF POINTS SKIPPED BETWEEN PLOTTING SYMBOLS	INTEGER	10
(LUNTHS(I), I=1,8)	INPUT HSTFLO AND HISTRY UNIT NUMBERS	1-27 EXCEPT 5,6	0
(LUNTOD(I), I=1,8)	INPUT ODRC UNIT NUMBERS	1-27 EXCEPT 5,6	0
MFRAME	NUMBER OF CURVES PER PLOT NUMBER OF LINES PER SECTION OF NUMERICAL SUMMARY	1-8(OPT 1) 1-4(OPT 2) 1(OPT 3)	8 4 1
NHSTM	USER DESIRED UNITS OF TIME FOR THE NUMERICAL SUMMARY AND PLOTS	1,2,3	2
(NODUNY(I), I=1,8)	ARRAY OF UNITS OF TIME OF INPUT ODRC UNITS (1-secs, 2-mins, 3-hrs)	1,2,3	2
NOPT	OPTION SPECIFICATION	1,2,3	1
NPLOT	PLOTTING INDICATOR (0 - NO, 1 - YES)	0,1	0
NSUMKP	NUMERICAL SUMMARY INDICATOR (0 - NO, 1 - YES)	0,1	0
TFINAL	USER DESIRED STOP TIME FOR NUMERICAL SUMMARY AND PLOTS	REAL	10.0 hrs
TZERO	USER DESIRED START TIME FOR NUMERICAL SUMMARY AND PLOTS	REAL	0.0 hrs

FWD
V58T0101A.3,2511,2512,6705
V58T0201A.3,2536,2537,6716
V58T0301A.2,2511,2512
V58T0335A.2,223,1663
V58T0235A.2,2536,2537
V58T0135A.2,223,214
V58T0328A.2,239,238
V58T0228A.6,212,219,5091,5031,5030,519
V58T0128A.2,9157,9158
V58T0161A.1,226
V58T0261A.4,2106,2107,2108,2109
V58T0361A.4,2006,2007,2008,2009
V58T0984A.3,9365,9366,9367
V58T0933A.6,3,4,5,7,8,9
V58T0844A.6,5601,5605,5606,5607,5608,5609
V58T0833A.2,9307,9308
V58T0903A.2,5577,5578
V58T0983A.6,5001,5002,5003,5004,5005,5006
V58T0836A.1,2211
V58T0901A.2,2041,1802

10.B SINGLE FILE.

FWD
V58T0101A.3,2511,2512,6705
V58T0201A.3,2536,2537,6716
V58T0301A.2,2511,2512
V58T0335A.2,223,1663
V58T0235A.2,2536,2537
V58T0135A.2,223,214
V58T0328A.2,239,238
V58T0228A.6,212,219,5091,5031,5030,519
V58T0128A.2,9157,9158
V58T0161A.1,226

MID
V58T0101A.3,2511,2512,6705
V58T0201A.3,2536,2537,6716
V58T0301A.2,2511,2512
V58T0335A.2,223,1663
V58T0235A.2,2536,2537
V58T0135A.2,223,214
V58T0328A.2,239,238
V58T0228A.6,212,219,5091,5031,5030,519
V58T0128A.2,9157,9158
V58T0128A.2,9157,9158
V58T0161A.1,226

AFT
V58T0261A.4,2106,2107,2108,2109
V58T0361A.4,2006,2007,2008,2009
V58T0984A.3,9365,9366,9367
V58T0933A.6,3,4,5,7,8,9
V58T0844A.6,5601,5605,5606,5607,5608,5609
V58T0833A.2,5577,5578
V58T0903A.2,9307,9308
V58T0983A.6,5001,5002,5003,5004,5005,5006
V58T0836A.1,2211
V58T0901A.2,2041,1802

10.A MULTIPLE FILE.

FIGURE 10. SAMPLE MEASUREMENT MODE CORRELATION (MMC) LISTS.

```
$ ODRCPL                    $ ODRCPL                    $ ODRCPL
  NOPT=1,                     NOPT=2,                     NOPT=3,
  MFRAME=8,                   MFRAME=4,                   MFRAME=1,
  IOMNC=3,                    IOMNC=3,                    IOMNC=3,
  TZERO=0.0,                  TZERO=0.0,                  TZERO=0.0,
  TFINAL=10.0,                TFINAL=10.0,                TFINAL=7.1,
  NHSTM=2,                    NHSTM=2,                    NHSTM=2,
  NPLOT=1,                    NPLOT=0,                    NPLOT=1,
  NODUNY=2,                   NODUNY=2,                   NODUNY=2,
  NSUMKP=1,                   NSUMKP=1,                   NSUMKP=0,
  IHRCPY=1,                   IHRCPY=0,                   IHRCPY=0,
  LSTEP=5,                    LSTEP=10,                   LSTEP=15,
  LUNTOD=1,                   LUNTOD=1,                   LUNTOD=1,
  LUNTHS=0,                   LUNTHS=2,                   LUNTHS=2,
  IWAIT=10,                   IWAIT=5,                    IWAIT=20,
$ END                       $ END                       $ END


11.A. OPTION 1.            11.B OPTION 2.              11.C. OPTION 3.
```

Figure 11. - Sample $ODRCPL namelists for the three options.

4. PROGRAM FLOW

The input for the program is obtained by reading the $ODRCPL namelist. The program first checks to be sure there is a good ODRC unit and that MFRAME is in the allowable limits for the option desired. If NSUMKP=1, a BRKPT file, RELOOK, is opened and the numerical summary is written to it. The program then branches to the desired section of code for either option 1, 2 or 3. When the MNC list has been completed, an ERTRAN call for VBRKPT PRINT$ is executed to close the print file if NSUMKP=1. Then, if NPLOT=1, the plots are generated, one at a time, in order, according to the MNC list. If the user wants to see the numerical summary, he can do an VED,R RELOOK. after the execution is completed.

4.1 OPTION 1

The MNC list is read one MID at a time until all MFRAME MID's for this plot, a different type of MID, the end of the list, or a new model name has been read. A subroutine DMDDRC searches the ODRC file for the MID and, if found writes its data onto a temporary file for later use in constructing the summary or plot. If it is not found, it is skipped and the next MID is read from the MNC list. When the reading stops for any of the reasons mentioned above, a section of the summary and/or plot is generated (the summary to VBRKPT file RELOOK, the plot to a temporary file) according to user input instructions. The program continues reading the MNC list following the procedure above until the end of the MNC list has been read (NSTOP=1). Then, if NPLOT=1, the plots are generated on the terminal screen.

4.2 OPTION 2

The MNC list is read and stopped as in option 1 except that a MID will just be skipped if it is not a temperature MID. DMDDRC searches the ODRC file for the MID data as it does in option 1. If the MID is found, then the HSTFLO file is searched for the component nodes for that MID. The subroutine DMDFAC then takes the component node data that was found and uses the weighting factor for those nodes to generate a new predicted MID record. Both the ODRC and generated MID records are written to a temporary file for subsequent use. This procedure continues until the list has been completely read (NSTOP=1) and, when stopped as in option 1, writes a section of the numerical summary and/or a plot. Then, if

NPLOT=1, the plots are generated on the terminal screen.

4.3 OPTION 3

The MNC list is read as in option 2 using only temperature MID's, but there is a maximum of one MID per plot. DMDDRC searches the ODRC file for the MID data as in option 1. If it is found, then the HSTFLO file is searched and DMDFAC is called as in option 2. Also written to the temporary file, and used in generating the summary and plot, is the data for each component node used to generate the new MID record. Option 3 continues reading one MID at a time and generating a section of the summary and/or a plot for each MID.

5. RUNSTREAMS

The runstream must assign the needed ODRC, HSTFLO, HISTRY, and MNC list files and associate a unit number with each. If an input file is on tape, it must be transferred into a word addressable file as shown in lines 7 through 11 of figure 13. The runstream must also assign the VBRKPT file, RELOOK, for the numerical summary, map the program into TPF$, and execute the resulting absolute. The $ODRCPL namelist which is required following the VXQT statement, can be either a dynamic VADD element cf. figure 13 or data card images as shown in figure 12. Two examples of runstreams for options 1, 2 and 3, respectively, are shown in figures 12 and 13.

```
@USE G,E53-L723@6$GARATE        . ASSIGN FILE FOR DATA
@ASG,T 3.,F/1/TRK/10            . COPY MNC TO UNIT
@ED G,DMDDT,3.                  . ASSIGN WA ODRC
@ASG,A E53-L790BB$POGI.
@USE 1,ES3-L790BB$POGI
@FREE RELOOK.                   . FREE NUM SUM FILE
@DELETE RELOOK.                 . DELETE NUM SUM FILE
@ASG,CP RELOOK.,F40/0/TRK/100   . ASSIGN NUM. SUM. FILE
@MAP G,DMDMAP,ABS               . THIS IS THE MAP ELT.
@XQT ABS
$DDRCPL
 NOPT = 1,
 NFRAME = 3,6,
 IDRRC = 3,
 TZERO = 0.0,
 TFINAL = 10.0,
 MHSTR = 2,
 NPLOT = 1,
 NDRUMY = 2,
 NSUPEP = 1,
 INRCPY = 0,
 LSTEP = 5,
 LIMTOD = 1,
 INWT = 5,
$END
```

Figure 12. - Sample runstream for option 1

```
@USE G,E53-L723@6$GARATE        . ASSIGN FILE FOR DATA
@ASG,T 3.,F/1/TRK/10            . COPY MNC TO UNIT
@ED G,DMDDT,3.                  . ASSIGN WA ODRC FILE
@ASG,A E53-L790BB$POGI.
@USE 1,ES3-L790BB$POGI
@ASG,T 2.,D 0/TRK/400000        . ASSIGN WA FILE
@ASG,T X,8C,X0E775              . ASSIGN TAPE OF WA ODRC
@USE S,ES3R5URTEM
@S.TAP2DRM X.,.2.               . COPY TAPE TO FILE
@FREE S.
@FREE X.                        . FREE NUM SUM FILE
@FREE RELOOK.                   . DELETE NUM SUM FILE
@DELETE RELOOK.                 . ASSIGN NUM SUM FILE
@ASG,CP RELOOK.,F40/0/TRK/100   . THIS IS THE MAP ELT.
@MAP G,DMDMAP,ABS               . ADD NAMELIST DATA
@XQT ABS
@ADD G,DMDTSTC
```

Figure 13. - Sample runstream for options 2 and 3.

6. CONCLUSION

The ODRC Demand Plotting Program provides the user with three main options, each of which provides the additional option of generating a numerical summary and/or plots for the MID's on the MNC list. Option 1 reads MID data from word addressable ODRC files, stores the data on a temporary file, and uses it to build the numerical summary and/or plots, according to user input instructions. Options 2 and 3 re J MID data from a word addressable ODRC file and component node data from a word addressable HSTFLO or HISTRY file. The component node data is used to calculate a predicted MID. Then, for option 2, the MID and predicted MID data is used to generate a numerical summary and/or plots. For option 3, the component node data itself is used in generating the numerical summary and/or plots. The numerical summary is sent to the VBRKPT file, RELOOK, and can be viewed after the execution of the program by doing an VED,R RELOOK. and using the edit mode to find the desired section of the summary.

APPENDIX A

LIST OF ROUTINES

LIST OF ROUTINES

1. DMDDRC

DMDDRC is called by DMDMN and has the unit number of a word addressable file, the next position on the temporary file, and the desired MID as input. It searches the file for the MID data and stores it on the temporary file for subsequent use. It also stores the time array and the number of time points for the MID onto the file.

2. DMDFAC

DMDFAC is called by DMDMN and has the temporary file of component node data, the temporary file with plot data, and the present position on this file as input. It uses the weighting factors read by NODERD or, if all the weighting factors are zero, weights each node equally in calculating a new predicted MID from the component node data. It writes the predicted MID data and, if NOPT=3, the component node data to the temporary plot file.

3. DMDHST

DMDHST is called by DMDMN and has the unit number of an input HSTFLO or HISTRY file and a temporary file to store the component node data on as input. It searches for the component node data and reads the data for all the component nodes it can find. The times, data values, and the number of time points are written to the temporary file for subsequent use.

4. DMDMN

DMDMN is the main routine. It reads the $ODRCPL namelist input data, VBRKPT's the numerical summary to file RELOOK, if NSUMKP=1, executes option 1, 2 or 3, closes the VBRKPT file if NSUMKP=1 and, if NPLOT=1, generates plots. NODERD is called to read the MNC list. DMDMN calls DMDDRC to obtain the MID data and DMDHST to obtain the HSTFLO or HISTRY data. It calls DMDFAC to calculate a new predicted MID, DMDSUM to build the numerical summary, WRITNS to write the numerical summary, and PLOTR to generate the plots.

5. DMDSUM

DMDSUM is called by DMDMN and has the option indicator, NOPT, and the temporary file of X and Y coordinates of the curves for a section of the numerical summary as input. It takes this data and builds a section of the numerical summary in the form corresponding to the particular option.

6. NODERD

NODERD is called by DMDMN. It reads one line from the MNC list, calls RFORMT to determine the input format for that line, and returns to reread the information contained in that line with the established format. It also returns flags indicating whether or not the EOF has been read or an error has occurred.

7. PLOTR

PLOTR is called by DMDMN and has the temporary file with all the plot information as input. It reads the title information, number of curves per plot, and the minimum and maximum Y-axis values for the plot. It then reads NCVCTR, the number of curves per plot, records from the temporary file to get the coordinate data for the curves. It generates a plot and continues reading the file until it reads a record with 99999 in the first word. Then the plotting is complete.

8. RFORMT

RFORMT is called by NODERD and has a card image from the MNC list as input. It determines, and returns to NODERD, the format of that line of the MNC list.

9. WRITNS

WRITNS is called by DMDMN and has the array of numerical summary data formed in DMDSUM as input. It writes this array as a section of the numerical summary; not letting a section overlap the page and putting a title at the top of each page.

10. WRTFLG

WRTFLG is called by DMDMN and has the header information for a plot as input. It writes this information in the record immediately preceeding the record of the first curve to be written to the plot. Then PLOTR reads this record

before the data records and obtains the titles, and the minimum and maximum Y-axis values. These values are needed before the plots are built.

11. WRTTMP

WRTTMP is called by DMDMN and has the temporary file with the curve and numerical summary data, a file position word and the number of curves having data on the file as input. It searches the data for each plot, finds the highest start time and lowest stop time for the set of curves and rebuilds the data for that plot (or summary) omitting all times less than this maximum start time and greater than the minimum stop time.

APPENDIX B

BASIC FLOWCHART SHOWING MAIN PROGRAM FUNCTIONS

APPENDIX B
BASIC FLOWCHART SHOWING MAIN PROGRAM FUNCTIONS

```
            ┌──────────────────────────────┐
            │   READ ODRCPL NAMELIST        │
            └──────────────────────────────┘
                           │
                           ▼
          ┌──────────────────────────────────┐
          │  ASSIGN TEMPORARY DATA FILE        │
          │  ASSIGN TEMPORARY PLOT FILE        │
          └──────────────────────────────────┘
                           │
                           ▼
      ┌────────────────────────────────────────┐
      │   BRKPT TO NUMERICAL SUMMARY FILE        │
      └────────────────────────────────────────┘
                           │
       ┌───────────────────┼───────────────────┐
       ▼                   ▼                   ▼
  ┌──────────┐       ┌──────────┐       ┌──────────┐
  │ OPTION 1 │       │ OPTION 2 │       │ OPTION 3 │
  └──────────┘       └──────────┘       └──────────┘
       │                   │                   │
       └───────────────────┼───────────────────┘
                           ▼
             ┌──────────────────────────┐
             │  CLOSE BRKPT PRINT FILE    │
             └──────────────────────────┘
                           │
                           ▼
             ┌──────────────────────────┐
             │    PLOT GENERATION         │
             └──────────────────────────┘
                           │
                           ▼
                        ( STOP )
```

B.1 OPTION 1

B.2 OPTION 2

```
                                    ┌──────────────────┐
                                    │   CALL NODERD    │◄──────────────┐
                                    └──────────────────┘               │
        ╱╲                                   │                         │
       ╱  ╲                                  ▼                         │
      ╱MID IS╲                            ╱╲                           │
  YES╱        ╲                          ╱  ╲                          │
  ◄──A TEMPERATURE◄──────────┐    YES   ╱    ╲                         │
     ╲   MID   ╱             └─────────╱MEASN =╲                       │
      ╲      ╱                         ╲  MID  ╱                       │
       ╲    ╱                           ╲    ╱                         │
        ╲  ╱                             ╲  ╱                          │
     NO  ╲╱                               ╲╱ NO                        │
          │                                │                          │
          │                                │                          │
          │         ┌──────────────────┐   │                          │
          └────────►│  CALL DMDDRC     │◄──┘                          │
                    └──────────────────┘                              │
                             │                                        │
                             ▼                                        │
                    ┌──────────────────┐                              │
                    │  CALL DMDHST     │                              │
                    └──────────────────┘                              │
                             │                                        │
                             ▼                                        │
                    ┌──────────────────┐                              │
                    │  CALL DMDFAC     │                              │
                    └──────────────────┘                              │
                             │                                        │
                             ▼                                        │
                           ╱╲                                         │
                          ╱  ╲              YES                       │
                         ╱    ╲─────────────────────────────────────►│
                         ╲NCVCTR<2*MFRAME                             │
                          ╲    ╱                                      │
                           ╲  ╱                                       │
                            ╲╱ NO                                     │
                             │                                        │
                             ▼                                        │
                           ╱╲                        ┌──────────────┐ │
                          ╱  ╲        YES            │ CALL DMDSUM  │ │
                         ╱    ╲──────────────────────►│ CALL WRITNS  │ │
                         ╲NSUMKP=1                    └──────────────┘ │
                          ╲    ╱                            │         │
                           ╲  ╱                             │         │
                            ╲╱ NO                           │         │
                             │◄────────────────────────────┘         │
                             ▼                                        │
                           ╱╲                                         │
   ┌──────────┐   YES     ╱  ╲                                        │
   │ CONTINUE │◄─────────╱    ╲                                       │
   └──────────┘          ╲NSTOP=1                                     │
                          ╲    ╱                                      │
                           ╲  ╱                                       │
                            ╲╱ NO                                     │
                      B-3     └────────────────────────────────────► ┘
```
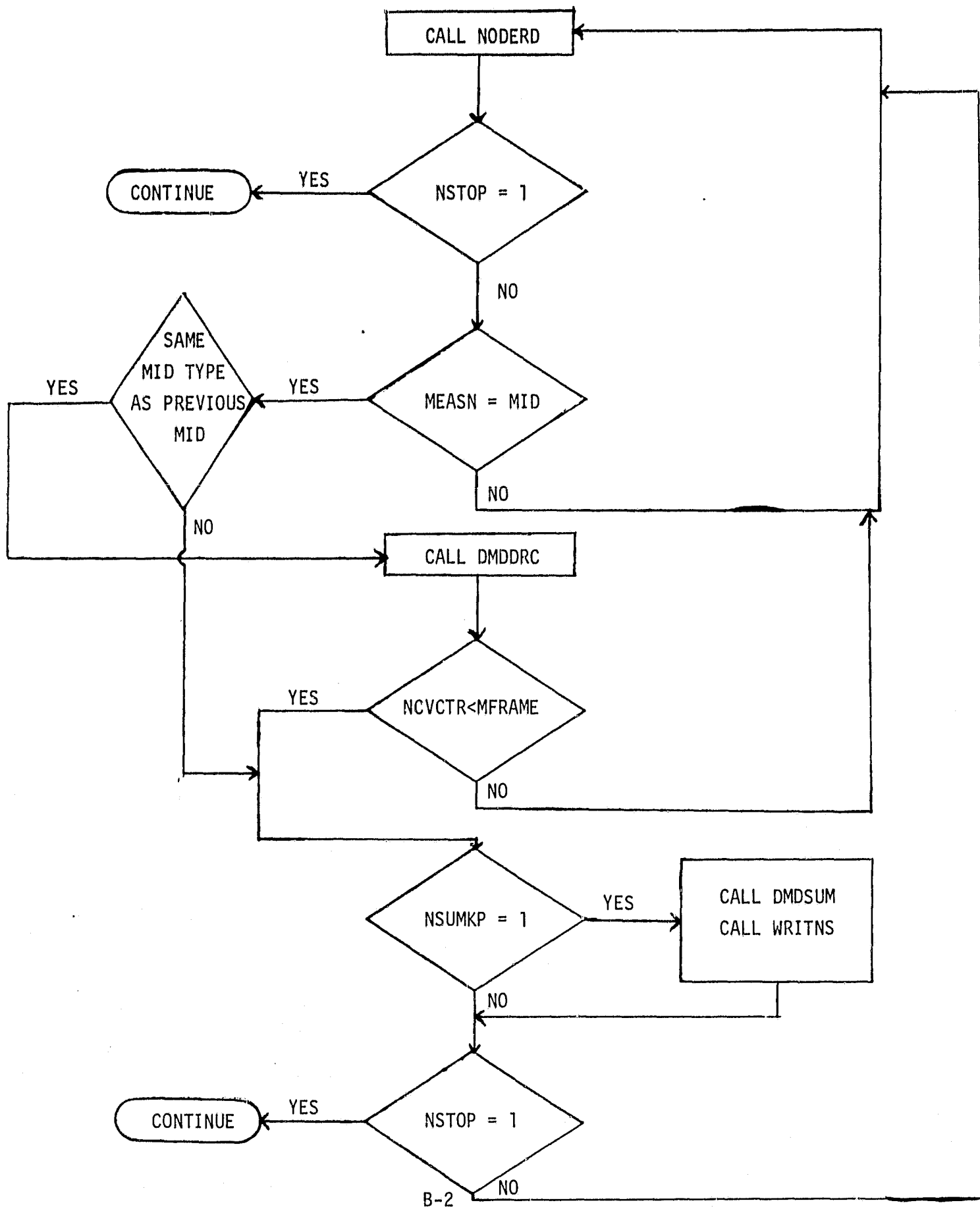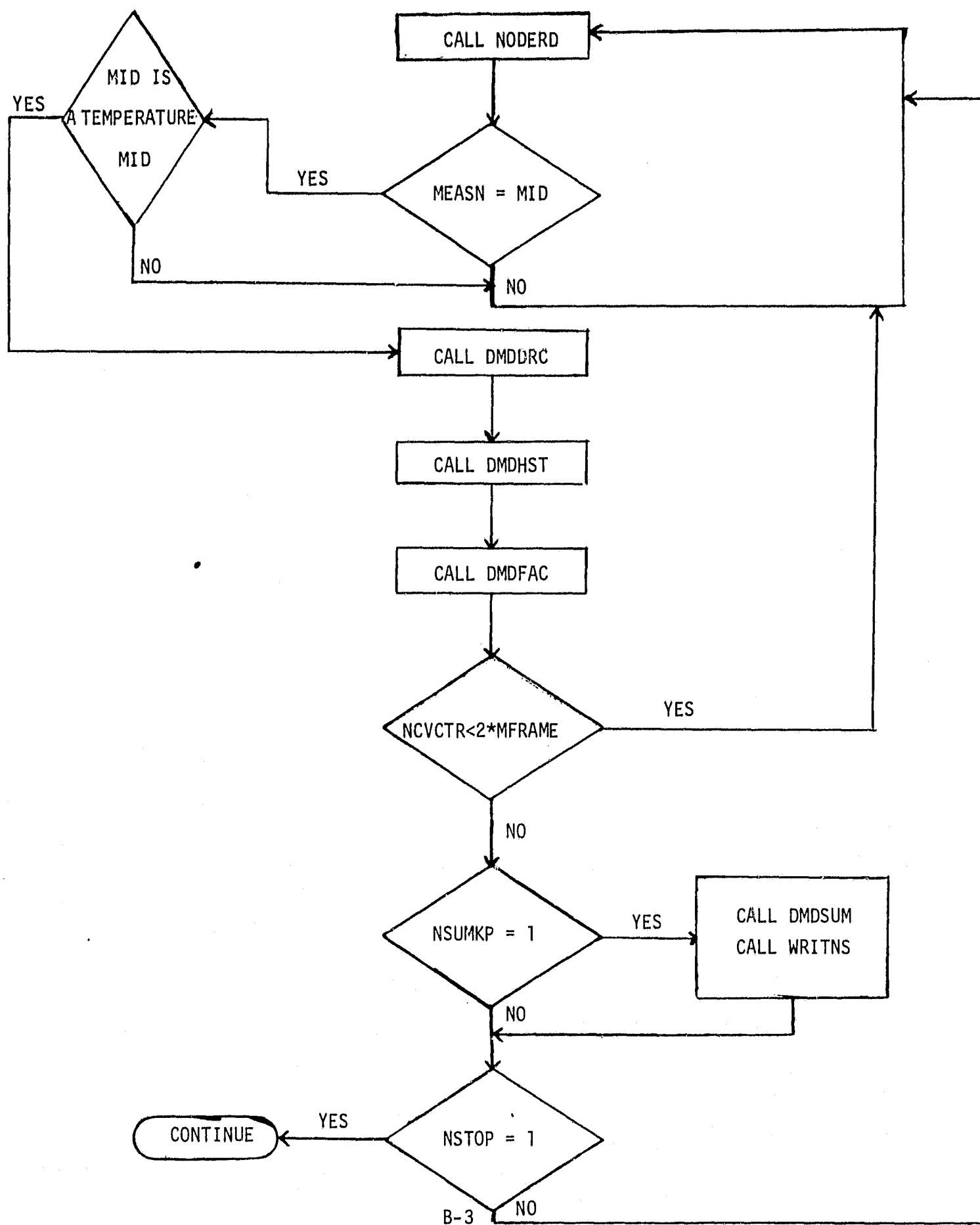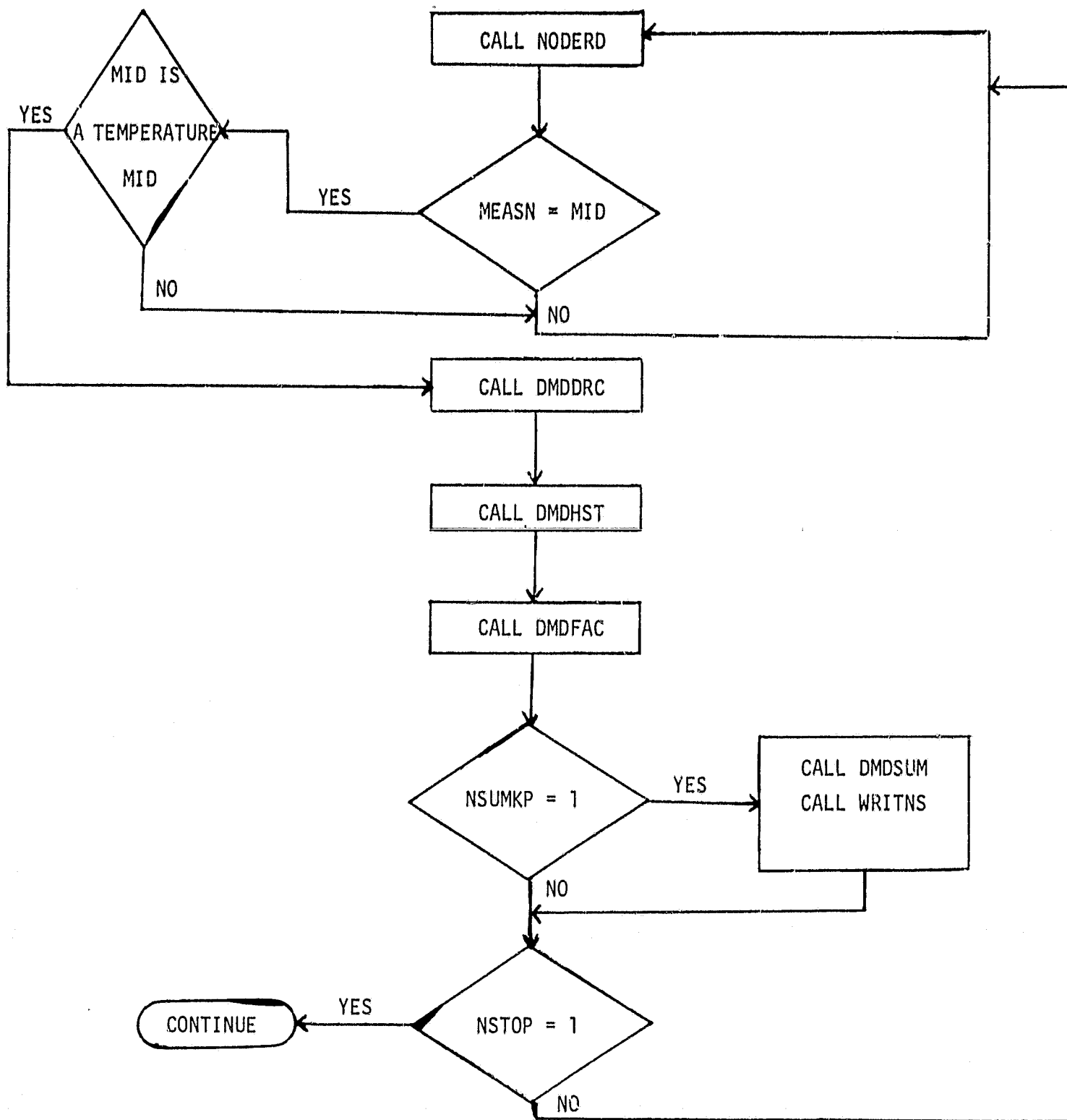
B.3 OPTION 3

APPENDIX C

REFERENCES

References

1. "ODRC Batch Plotting Program Users Guide", CPD-918, JSC-16283, LEMSCO-14000, Lockheed, Houston, Texas, January 1980.