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Project Report

PA-229-2
(RSP)

Data Reduction Program Documentation
ALTOAK

(Effective: March 1971)

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R. H. French
D. E. Nessman

19620

17 March 1971

Prepared for the Advanced Research Projects Agency,
the Department of the Army, and the Department of the Air Force
under Electronic Systems Division Contract F19628-70-C-0230 by

Lincoln Laboratory

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Lexington, Massachusetts



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ERRATUM SHEET

for

PROJECT REPORT PA-229-2

Page 2:

The channel on the transcription tape labeled Az error is in reality traverse error. Therefore, please replace Paragraph 2 with the following:

The VHF LC RCS is computed for all requested range gates. The gate with the peak RCS is identified, and the RCS in the Az and El error channels for this gate are computed. The RCS differences

$$\Delta\text{Tr (db)} = \text{Az error channel RCS} - \text{VHF LC RCS}$$

$$\Delta\text{El (db)} = \text{El error channel RCS} - \text{VHF LC RCS}$$

are computed and used to index prestored tables of $\Delta\text{Tr (deg)}$ vs $\Delta\text{Tr (db)}$ and $\Delta\text{El (deg)}$ vs $\Delta\text{El (db)}$. The magnitude of the angle offsets [$\Delta\text{Tr (deg)}$ and $\Delta\text{El (deg)}$] is then given. The azimuth offset is computed:

$$\Delta\text{Az (deg)} = \Delta\text{Tr (deg)} / \cos \text{El (deg)}.$$

The label on the transcription tape, Az error channel RCS, has not been changed.

see this Errata sheet

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17 May 1971

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MASSACHUSETTS INSTITUTE OF TECHNOLOGY
LINCOLN LABORATORY

6 DATA REDUCTION PROGRAM DOCUMENTATION ALTOAK
(EFFECTIVE: MARCH 1971).

10 C. R. BERNDTSON,
R. H. FRENCH
D. E. NESSMAN
Philco-Ford Corporation
Editors

12/64p.

9 PROJECT REPORT, PA-229-2 (RSP)

11 17 MAR 1971

15 F19628-70-C-0230,
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L. G. Hanson field

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FOREWORD

This is the second report in the Data Reduction Program Documentation series. It is dated according to the date of completion of the documentation. No implication is made that this program will not subsequently be modified, amended, or superseded: on the contrary, the history of radar data processing is one of continuous evolution of techniques, and it is unrealistic to assume that steady-state has been reached. The PA-229 series is being published for the convenience of interested parties, and Lincoln assumes no responsibility for the correctness of the information presented, nor for its currency.

The preparation of reports in this series is under the Editorship of Charles R. Berndtson of Lincoln, and of D. Nessman and R. French of Philco-Ford Corporation. Inquiries, suggestions, corrections, criticisms, and requests for additional copies should be directed to C. R. Berndtson.

The principal contributor to this report was A. J. Poirier (Philco-Ford). Due to the intricate, evolutionary manner in which the programs came into being, the editors regret that it is in general impossible to give due credit to all -- mathematicians or radar analysts or programmers -- who contributed to the definition and writing of the programs.


Alan A. Grometstein

CONTENTS

	<u>Page</u>
I. PURPOSE AND UTILIZATION	1
A. Source of Data	1
B. Data Input	1
C. Description	1
D. Output	1
II. DESCRIPTION	2
III. OPERATION	4
A. Input	4
B. Output	5
IV. PROGRAM LIMITATIONS	8
A. General Remarks	8
B. Limits of Parameters	8
V. PROGRAMMING	9
A. OAKOS	9
B. GLMP	9
C. TSPLIT	10
D. SUBOAK	10
E. REFC	12
F. OAKPLT	12
G. REW	13
H. ALREAD	13
J. Plotting System Subroutines	14
REFERENCES	15
COMMON SYMBOLS AND ABBREVIATIONS	16

CONTENTS (cont'd)

	<u>Page</u>
APPENDIX A - ALTOAK INPUT	19
APPENDIX B - ALTOAK OUTPUT	20
APPENDIX C - SUBROUTINE OAKOS PROGRAM LISTING	24
APPENDIX D - SUBROUTINE OAKOS FLOW DIAGRAM	28
APPENDIX E - SUBROUTINE GLMP PROGRAM LISTING	37
APPENDIX F - SUBROUTINE GLMP FLOW DIAGRAM	38
APPENDIX G - SUBROUTINE TSPLIT PROGRAM LISTING	40
APPENDIX H - SUBROUTINE SUBOAK PROGRAM LISTING	41
APPENDIX J - SUBROUTINE SUBOAK FLOW DIAGRAM	43
APPENDIX K - SUBROUTINE REFC PROGRAM LISTING	52
APPENDIX L - SUBROUTINE ALREAD PROGRAM LISTING	53

ALTOAK

I. PURPOSE AND UTILIZATION

A. Source of data

ALTAIR¹

B. Data Input

ALTAIR transcription tape

C. Description

ALTOAK is used to analyze data on ^{radar} targets which were not in angle track. For any object in range track by the ARS system, the program computes for selected averaging intervals the off-axis angle coordinates (ΔAz , ΔEl), the total off-axis angle ^{theta} (θ), and the ^{radar cross section} RCS-corrections at VHF and UHF. The angle coordinates are obtained by comparing the VHF LC-RCS with the RCS in the ^{azimuth} Az and ^{elevation} El error channels. The corresponding phases are used to determine the sense of ΔAz and ΔEl .

D. Output

1. A listing of all computed quantities.
2. Plots vs TAL of the uncorrected and corrected RCS at VHF LC (Optional: punched cards containing the RCS corrections).
3. Punched cards containing R, Az, and El, corrected for known errors, in a format suitable for input to NRTPOD.

ALTAIR recording system
delta azimuth, delta elevation
left circular polarization radar cross section

II. DESCRIPTION

The following computations are performed each averaging interval.

The VHF LC RCS is computed for all requested range gates. The gate with the peak RCS is identified, and the RCS in the Az and El error channels for this gate are computed. The RCS differences

$$\Delta Az \text{ (db)} = \text{Az error channel RCS} - \text{VHF LC RCS}$$

$$\Delta El \text{ (db)} = \text{El error channel RCS} - \text{VHF LC RCS}$$

are computed and used to index prestored tables of ΔAz (deg) vs ΔAz (db) and ΔEl (deg) vs ΔEl (db). The magnitude of the angle offsets (ΔAz (deg) and ΔEl (deg)) is then given.

The pulse by pulse phase of the Az and El error channels are compared with the VHF LC phase to produce:

$$PHAZ = \frac{1}{N} \sum_{i=1}^N (\text{Az phase} - \text{VHF LC phase})$$

$$PHEL = \frac{1}{N} \sum_{i=1}^N (\text{El phase} - \text{VHF LC phase})$$

where N is the number of pulses in the averaging interval.

The sign of ΔAz (deg) is positive when $\cos PHAZ$ is positive and the sign of ΔEl (deg) is positive when $\cos PHEL$ is positive.

The total off-axis angle (θ) is found by:

$$\theta = [\Delta El^2 + \Delta Az^2 \cos^2 El]^{\frac{1}{2}}$$

VHF and UHF RCS corrections are determined from tables of the VHF and UHF beam shapes. Plots of corrected and uncorrected VHF LC RCS vs TAL are produced.

The following options are also available:

1. Punched cards containing TAL and the VHF and UHF RCS corrections.
2. Punched cards in a format acceptable to NRTPOD may be obtained containing R, Az, and El corrected for certain errors. R is corrected for bias, tropospheric refraction, and target position in sampling pattern. El is corrected for bias, tropospheric refraction, and ΔEl . Az is corrected for bias and ΔAz . Ionospheric refraction corrections are not made.

A number of input parameters and transcription tape parameters are checked for validity before processing.

The main program checks the following input parameters:

IPAT	=	1 or 2
TAVG	≠	0
INTARG	≠	0
NRG	≠	0

Subroutine ALREAD² makes a number of other checks on transcription tape parameters. For some errors (missing format tables; end of file; target no., sampling pattern, or polarization not on tape) information is returned to the main program for decision to terminate.

III. OPERATION

A. Input

Start and stop times (GMT)

Averaging interval and skip time*

Target and sampling pattern numbers

Specified set of range gates

In addition, punched card output may be requested containing RCS corrections or observation data for input to NRTPOD. A sample ALTOAK input is shown in Appendix A.

CARD 1 (15A4)

(Col.)

1-60 TITLE 60 character title for printout and plots

CARD 2 (2 (2I3, F7.3), 4X, 4I5, 2F10.3, 2I5)

(Col.)

1-3 IH1 (I3)
4-6 IM1 (I3) } Start time (GMT) in h, min, and s
7-13 ZSEC1 (F7.3)

14-16 IH2 (I3)
17-19 IM2 (I3) } Stop time (GMT) in h, min, and s
20-26 ZSEC2 (F7.3)

31-35 NRG Number of range gates (I5)

36-40 INTARG Target no. (I5)

41-45	IPAT	Sampling pattern in which initial gate is located (15)
46-50	ING*	Location within IPAT of initial gate (15)
51-60	TAVG	Averaging interval in seconds (F10.3)
61-70	TSKIP	Skip time* in seconds (F10.3)
71-75	ICARD	1 = punch cards with VHF/UHF RCS corrections 0 = no punch
76-80	INRT	1 = punch cards for NRTPOD 0 = no punch
<u>CARD 3</u>	(315)	If INRT = 0 Card 3 must <u>not</u> be included
1-5	IYEAR	Last two digits of year
6-10	IMONTH	Month (1 to 12)
11-15	IDAY	Day of month

B. Output

LISTING

GMT

Az and El corrected for bias

VHF LC RCS for peak gate

Az and El error RCS for peak gate

ΔAz , ΔEl , and θ

VHF and UHF RCS corrections (db)

PHAZ and PHEL

CRLC (corrected VHF LC RCS)

RFRANG, AZCR, RFELV (corrected values of R, Az, and El for input to NRTPOD)

*Called ISG in program listing, and ISTGAT in ALREAD.

**Skip time is the time in seconds from the end of one averaging interval to the start of the next.

PICTS

Peak gate RCS vs TAL

Peak gate RCS corrected for off-axis position vs TAL
(Both standardized to 4 s/in for the abscissa and 20 db/in for the ordinate).

PUNCHED CARDS

RCS correction data:

TAL (F10.3)
 Δ VHF RCS (db) (F10.3)
 Δ UHF RCS (db) (F10.3)

Observation data (NRTPOD):

Radar identification (A3)
Year (3X, I2)
Month (I2)
Day (I2)
h (I2)
min (I2)
s (I2)
ms (I5)
Orbit no. (4X, I1)
Az (F8.3)
El (4X, F8.3)
R (4X, F12.4)

R, Az, and El are related to the middle pulse of an averaging interval.*

*They are determined in ALREAD as follows:

$$R = R_{t_0} + \dot{R}_{t_0} (t - t_0)$$

where R_{t_0} , \dot{R}_{t_0} are R and \dot{R} at the first pulse in the minor cycle

t_0 is the time of the first pulse in the minor cycle

t is the time of the middle pulse

Az and El values are available every 25 ms. The value closest to t in the major cycle containing the pulse is used.

The middle pulse is determined by the largest integer in $(N + 1)/2$, where N is the number of pulses in the averaging interval. Other output quantities are associated with the median time of the averaging interval, determined by $(T_{\text{last pulse}} - T_{\text{first pulse}})/2$. Sample ALTOAK outputs are shown in Appendix B.

IV. PROGRAM LIMITATIONS

A. General Remarks

When using ALTOAK, the following precautions should be observed.

The noise level should be determined theoretically or by examining a gate that does not contain a target. The signal in the VHF LC, Az, and El channels should be > 5 db above this noise level to obtain valid results. If the error channel signal is at or just above the noise level, the computed angle offset is an upper bound for the actual offset.

When correcting RCS for off-axis position, a rule of thumb frequently used is that the cross section correction must be ≤ 6 db. If the correction is > 6 db, the accuracy of the correction is questionable.

The user should be careful when using ALTOAK for trajectories that have high Az and El rates. Due to the method used in ALREAD for picking off the Az and El associated with a pulse, a lag of as much as 50 ms may result. This lag, which will vary in a saw tooth shape, probably will be small compared to the noise in the Az and El offset angles for trajectories with small angular rates. The RCS corrections and off-axis position data are not affected.

B. Limits of Parameters

Start Time	Must be on tape
Stop Time	Must be on tape
NRG	≤ 30 gates
TAVG	Must be larger than the PRI
TSKIP	Can not be negative
INTARG	Must be on tape within start and stop times
Length of Run	≤ 1200 averaging intervals

V. PROGRAMMING

A. OAKOS (see Appendices C and D.)

OAKOS is the control section of ALTOAK. OAKOS reads the input cards and calls all of the subroutines that process, plot, and print the data.

B. GLMP (see Appendices E and F.)

GLMP searches the array of gates selected to find the one with the largest RCS for each time interval. GLMP then computes and saves the corresponding PHEL, PHAZ, Az channel RCS, El channel RCS, and gate number. GLMP then inputs these values to SUBOAK along with GMT, R, Az, and lift-off time.

The call statement is GLMP (AVGAL, ISTGT, AVGAZ, AVGEL, IGAT, AVGTM, AVGRG, NRG, INDEX, ICARD, TLIFT).

INPUT

AVGAL	Alt*
AVGAZ	Az*
AVGEL	El*
AVGTM	Time* (GMT)
AVGRG	R*
ISTGT	Start gate for peak
NRG	Number of range gates
ICARD	Flag for punched cards
TLIFT	Lift-off time

OUTPUT

INDEX	Number of correction cards punched
IGAT	Peak gate number

*Midpoint in averaging interval.

C. TSPLIT (see Appendix G.)

GLMP calls TSPLIT. TSPLIT is used to convert time from total GMT to h, min, s, and decimal fractions of s.

The call statement is TSPLIT (AVGTM, IHM, TRUN).

	<u>INPUT</u>
AVGTM	GMT total seconds
	<u>OUTPUT</u>
IHM (1)	Hours
IHM (2)	Minutes
TRUN	Seconds and decimal fractions of seconds

D. SUBOAK (see Appendices H and J.)

GLMP calls SUBOAK. SUBOAK is the routine in which most of the computation is done. It consists mainly of pre-stored tables and equations to compute ΔAz , ΔEl , and $\Delta \theta$. SUBOAK computes correction factors for UHF and VHF RCS. SUBOAK also prints the data and punches the UHF/VHF correction cards.

The call statement is SUBOAK (IHR, IMIN, ZSEC, GMAX, AVGAL, IGAT, AVGTM, AZE, ELEX, PHAZ, PHEL, Az, El, INDEX, AVGRG, ICARD, TLIFT).

	<u>INPUT</u>
IHR	Hours (GMT)
IMIN	Minutes (GMT)
ZSEC	Seconds (GMT)
GMAX	RCS for peak gate
AVGAL	Alt for midpoint of averaging interval
AVGTM	GMT for midpoint of averaging interval

AVGRG	R for midpoint of averaging interval
IGAT	Peak gate number
AZE	Az
ELEX	EI
PHAZ	Az phase - VHF LC phase
PHEL	EI phase - VHF LC phase
Az	Az channel RCS
EI	EI channel RCS
ICARD	Flag for punching correction cards
TLIFT	Lift-off time

OUTPUT

INDEX	Number of correction cards punched
-------	------------------------------------

STORED IN COMMON

TIM	TAL
TEM	Seconds and fractions of seconds (portion of GMT)
CRLC	Corrected VHF LC RCS
GTMAX	Uncorrected VHF LC RCS
RRANG	R corrected for tropospheric refraction
RELEV	EI corrected for tropospheric refraction and off-axis position
AZCR	Az corrected for off-axis position

E. REFC (see Appendix K.)

SUBOAK calls REFC.

The tropospheric refraction correction subroutine, REFC, is based on tropospheric refraction tables in PPP-36.³ A modified version of this subroutine is now in use.

The call statement is REFC (E, R, DEE, DRR)

E	Uncorrected E1 (must be between 0° at 1 90°)
R	Uncorrected R (ft)
DEE	E1 tropospheric correction
DRR	R tropospheric correction (ft)

The corrected values to be computed after exiting from the REFC routine are:

E1	=	E - DEE
R (ft)	=	R - DRR

F. OAKPLT

OAKPLT is a plot routine which is called twice from OAKOS, once to plot the uncorrected VHF LC RCS vs TAL and once to plot the corrected VHF LC vs TAL. The user has no control over the size of the plot.

G. REW

REW is an entry to subroutine BREADS⁴ used to rewind the tape.

H. ALREAD²

ALREAD is the Fortran driver for the assembler language tape reading routines. Appendix L presents an ALREAD program listing which has minor differences from the listing in Ref. 1. These differences occur because:

1. ALTOAK requires VHF LC, Az and El error channel RCS data. Only one channel per run is used by the other versions of ALREAD.
2. Only ALTOAK requires Az and El data.

The call statement is ALREAD (TSTART, TSTOP, TLIFT, INTARG, INPAT, NOPHA, NPTS, NFP, NEWPAS, NRG, ISTGAT).

INPUT

TSTART	Start time of processing (GMT total seconds)
TSTOP	End time of processing (GMT total seconds)
INTARG	Target number to be processed
INPAT*	Sampling pattern in which initial gate is located
NOPHA	2 (phase and RCS data wanted)
NRG	Number of range gates to be processed
ISTGAT**	Location within INPAT of initial gate

INPUT AND OUTPUT PARAMETERS

NPTS †	Output: number of pulses of data returned
	Input: must be initialized by calling program before each call to ALREAD

*Also called IPAT.

**Also called ING or ISG.

† Set to zero for first call. Set to number of saved points for subsequent calls.

NEWPAS* Cycle and error pointer (see error returns and switch settings)

OUTPUT

TLIFT Lift-off time (GMT total seconds)
NFP Frequency code: 1 = VHF; 2 = UHF

STORED IN COMMON

TIMES Pulse times (GMT total seconds)
XSPHA RCS and phase for each pulse and gate
RANGKM R
ALSAV** Alt
IRGA Range gate array associated with XSPHA
AZI Az (rad)
ELE El (rad)
IPOL Data channels wanted
NPOL Number of data channels used

J. Plotting System Subroutines

The subroutines are REREAD, STOIDV, and PLTND.

*Also called IAGAIN.

**Valid only for first pulse of minor cycle. It is repeated for subsequent pulses.

REFERENCES

1. "ALTAIR Data User's Manual", LM-97, Lincoln Laboratory, M. I. T. (to be published), UNCLASSIFIED.
2. "Data Reduction Program Documentation, ALREAD, (Effective: March 1971)", PA-229-3, Lincoln Laboratory, M. I. T. (17 March 1971), UNCLASSIFIED.
3. J. P. Penhune, "Refraction Corrections for the TRADEX Radar", PPP-36, Lincoln Laboratory, M. I. T. (21 April 1965), UNCLASSIFIED.
4. "Data Reduction Program Documentation, ALTAIR Tape Read Package, (Effective: April 1970)", PA-229-1, Lincoln Laboratory, M. I. T. (17 March 1971), UNCLASSIFIED.

COMMON SYMBOLS AND ABBREVIATIONS

(The units given for certain quantities are the units commonly used for those quantities, unless otherwise noted.)

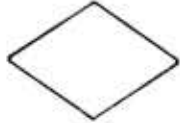
ADT	ALCOR Data Tape
Alt	Altitude (km)
APS	Average Pulse Shape
ARS	ALTAIR Recording System
Avg	Average, Averaging
Az	Azimuth (deg)
CADJ	Adjusted Calibration Constant (db)
C-band	ALCOR frequency, 5664 MHz (NB) and 5667 MHz (WB)
EI	Elevation (deg)
EOF	End of File
GMT	Greenwich Mean Time
h	Hours
Hz	Hertz
in	Inches
LC	Left Circular Polarization
min	Minutes
NB	Narrow Band
NRTPOD	Non-real Time Precision Orbit Determination Program
POD	Project PRESS Operation and Data Summary Report
Phase	Presented in deg
PRF	Pulse Repetition Frequency (pps)
PRI	Pulse Repetition Interval (s)
pps	Pulses per second
pts	Points

R	Range (km)
R	Range Rate (km/s)
rad	Radians
RC	Right Circular Polarization
RCS	Radar Cross Section (dbsm)
s	Seconds
SD _w	Standard Deviation of Wake Velocity
T	Time
TAL	Time After Launch (s)
UHF	ALTAIR Frequency; 415 MHz
V	Velocity
V _d	Doppler Velocity
V _w	Mean Wake Velocity
VHF	ALTAIR Frequency; 155.5 MHz
WB	Wide Band
θ	Total Off-axis Angle (deg)
λ	Wavelength
*	Denotes Multiplication

FLOW DIAGRAM SYMBOLS



PROCESS, ANNOTATION



DECISION



TERMINATOR



SUBROUTINE: where NAME is the entry call into the subroutine



CONNECTOR: where P specifies a page in the flow diagram, and L designates a statement number in the program listing or a reference point in the flow diagram



CONNECTOR: where X implies a continuation of the diagram to the next page



INPUT/OUTPUT OPERATION



MAGNETIC TAPE



PUNCHED CARD



DISK

APPENDIX B
ALTOAK OUTPUT

ALTAIR OAK VERSION 27 JAN 1971

ALTOAK G17 AI
TARGET NUMBER = 7

AT TIME = 6224.0500 THERE IS A TIME GAP OR BAD DATA EXTEN = 0.0000

AT TIME = 6224.1000 THERE IS A TIME GAP OR BAD DATA EXTEN = 0.0000

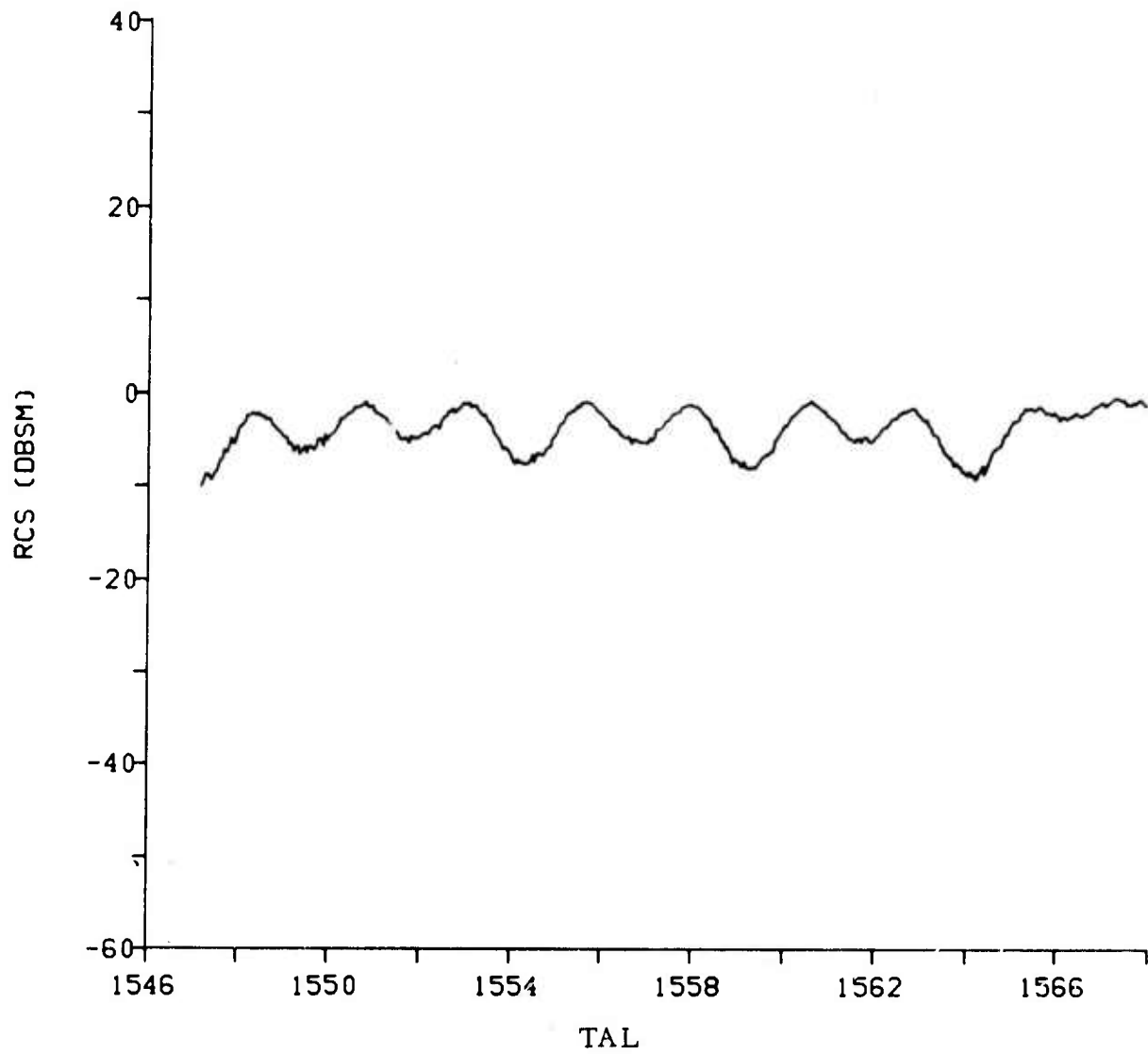
TIME	AZ	EL	V-LC(DG)	AZ(DG)	FL(DG)	AZ DEG	EL DEG	DEGAFES	VWF(DG)	UMF(DG)	PHAZ	PHEL	CRLC
1 44 3.225	50.10	6.08	-2.58	-11.44	-14.03	-0.70	0.59	0.89	2.36	19.97	140.057	80.785	-0.210
1 44 3.275	50.11	6.07	-2.21	-11.46	-9.83	-0.60	-0.80	1.04	3.12	27.87	140.533	113.970	0.917
1 44 3.325	50.10	6.07	-2.40	-10.71	-12.27	-0.76	0.65	0.99	2.87	22.79	151.160	85.237	0.472
1 44 3.374	50.09	6.06	-1.87	-11.85	-12.17	-0.62	0.62	0.88	2.34	15.77	154.564	70.043	0.463
1 44 3.425	50.09	6.06	-2.28	-11.81	-12.14	-0.66	0.65	0.92	2.54	17.20	150.022	76.300	0.263
1 44 3.475	50.07	6.05	-2.17	-11.31	-9.79	-0.69	-0.80	1.25	3.16	28.53	149.106	90.296	0.982
1 44 3.525	50.05	6.04	-2.48	-12.41	-13.76	-0.63	0.56	0.84	2.13	14.47	151.363	86.251	-0.349
1 44 3.575	50.03	6.04	-2.16	-12.42	-11.53	-0.59	-0.68	0.90	2.44	16.46	154.176	91.615	0.276
1 44 3.624	50.00	6.03	-2.17	-11.83	-9.72	-0.65	0.80	1.03	3.04	26.31	144.969	72.433	0.872
1 44 3.675	49.98	6.02	-1.86	-12.21	-9.79	-0.59	0.77	0.97	2.78	20.28	149.737	83.618	0.917
1 44 3.725	49.95	6.02	-1.66	-12.08	-13.42	-0.59	0.53	0.79	1.83	12.93	132.636	73.619	0.186
1 44 3.775	49.92	6.01	-1.25	-12.60	-9.13	-0.50	-0.78	0.93	2.55	17.27	139.412	96.235	1.298
1 44 3.825	49.88	6.01	-1.32	-13.18	-12.68	-0.46	0.56	0.72	1.35	10.40	131.638	86.875	0.027
1 44 3.874	49.84	6.00	-1.11	-14.45	-13.81	-0.35	0.48	0.63	0.62	6.78	153.539	77.303	-0.492
1 44 3.925	49.78	5.99	-0.90	-13.53	-9.66	-0.38	-0.72	0.81	1.97	13.67	132.402	95.574	1.078
1 44 3.975	49.73	5.99	-0.86	-13.85	-9.79	-0.36	-0.71	0.80	1.95	13.01	124.782	90.135	0.997
1 44 4.025	49.68	5.98	-1.29	-15.49	-9.57	-0.33	-0.75	0.82	2.00	13.78	120.968	97.514	0.767
1 44 4.074	49.64	5.98	-1.07	-15.61	-9.18	-0.32	-0.76	0.82	2.04	13.99	115.547	103.419	0.266
1 44 4.124	49.53	5.97	-0.87	-16.76	-13.63	-0.27	0.48	0.55	0.38	6.06	120.528	80.515	-0.492
1 44 4.175	49.47	5.96	-0.53	-13.95	-9.40	-0.29	-0.71	0.77	1.67	12.09	100.863	104.710	1.141
1 44 4.225	49.40	5.95	-0.39	-14.41	-9.45	-0.23	-0.77	0.83	2.10	14.31	109.812	102.722	1.707
1 44 4.275	49.33	5.95	-0.36	-12.37	-13.02	-0.44	-0.48	0.65	0.96	8.22	92.064	91.192	0.672
1 44 4.326	49.26	5.94	-0.59	-14.52	-10.80	-0.34	-0.63	0.71	1.31	10.18	101.028	105.175	0.714
1 44 4.375	49.22	5.93	-0.66	-14.06	-10.87	0.35	-0.63	0.72	1.36	10.44	79.147	92.521	0.701
1 44 4.425	49.14	5.92	-0.89	-14.07	-12.03	0.35	-0.55	0.65	0.92	7.99	73.961	95.238	0.428
1 44 4.475	49.07	5.91	-1.18	-12.16	-12.48	0.54	-0.56	0.77	1.71	12.30	69.939	118.268	0.427
1 44 4.525	49.01	5.90	-0.97	-10.90	-12.37	0.63	-0.55	0.83	2.10	14.31	81.464	108.266	1.131
1 44 4.576	48.97	5.89	-1.14	-12.66	-11.18	0.49	-0.64	0.80	1.89	13.23	60.722	91.110	0.750
1 44 4.626	48.92	5.88	-0.84	-11.24	-10.74	0.59	-0.65	0.87	2.31	15.61	66.997	105.811	1.471
1 44 4.675	48.88	5.87	-0.98	-11.71	-12.08	0.56	-0.57	0.80	1.97	13.10	62.121	94.341	0.888
1 44 4.725	48.85	5.86	-0.72	-11.67	-10.85	0.54	-0.63	0.83	2.07	14.18	48.513	118.854	1.398
1 44 4.776	48.80	5.85	-0.53	-9.73	-8.20	0.69	-0.79	1.05	3.13	28.01	61.519	116.303	2.597
1 44 4.825	48.76	5.84	-0.87	-11.51	-14.59	0.57	0.42	0.71	1.28	10.03	65.043	84.262	0.413
1 44 4.875	48.74	5.84	-1.11	-10.70	-10.08	0.65	-0.71	0.96	2.72	18.49	56.055	97.031	1.602
AT TIME = 6310.0360	TARGET 7	IS NOT ON THE TAPE.	TARGETS AVAILABLE ARE	12									
1 44 4.925	48.71	5.84	-1.12	-10.63	-10.51	0.66	-0.68	0.95	2.64	17.92	41.946	89.070	1.527

WFRANG	RFELV	AZCR
090.276	8.227	50.518
090.135	7.281	50.431
079.863	7.433	50.548
079.555	7.429	50.546
079.250	8.610	50.525
078.945	7.330	50.477
078.638	7.464	50.512
078.296	7.397	50.451
077.989	7.397	50.454
077.683	8.452	50.477
077.375	7.551	50.467
077.033	7.545	50.589
076.727	7.572	50.468
076.420	7.539	50.540
076.080	7.482	50.524
075.773	7.602	50.433
075.466	7.546	50.423
075.125	7.505	50.497
074.818	7.454	50.552
074.510	7.439	50.425
074.169	7.498	50.506
073.861	7.490	50.514
073.554	7.488	50.447
073.213	7.586	50.453
072.906	7.467	50.345
072.600	7.566	50.253
072.294	7.543	50.537
071.953	7.410	50.513

CORRECTED R, EL AND AZ FOR INPUT TO NRTPOD (ALSO OUTPUT ON PUNCHED CARDS)

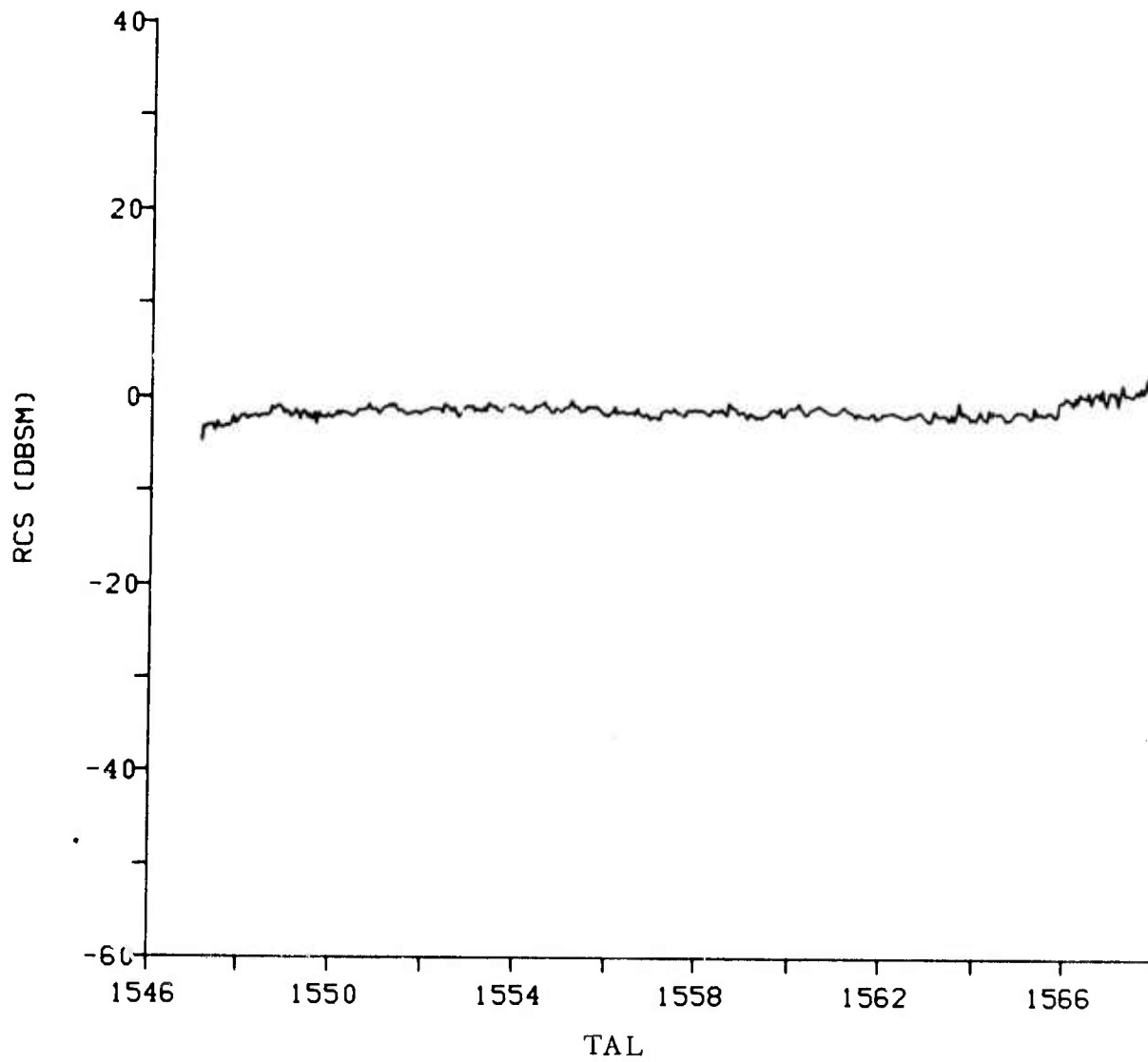
ALTOAK G37 AL
UNCORRECTED V-LC

TARGET 7



ALTOAK G37 AL
CORRECTED V-LC

TARGET 7



APPENDIX C
SUBROUTINE OAKOS PROGRAM LISTING

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DIMENSION DFPG(2),SUMSX(4,30),IDENT(15),IHM(2),UPLOG(4,30),      OAK00010
1SUMA(30),SUME(30),PLTAG(4),ELOTAG(4),MSEC(1200),ISEC(1200)      OAK00020
COMMON/OAK/TIM(1200),TEM(1200),CRLC(1200),GTMAX(1200),AVGSX(4,30), OAK00030
1DEL(30),RRANG(1200),RFLEV(1200),AZCR(1200),DAZ(30),IHRX(1200),  OAK00040
2IMINX(1200)                                                       OAK00050
COMMON/EDCONT/TIMES(300),XSPHA(4,30,300),RANGKM(300),ALSAV(300),  OAK00060
1A7I(300),ELE(300),IRGA(30),IPOL(4),NPOL                          OAK00070
DOUBLE PRECISION AVGTM,SEC,SUMTM,T1,T2,TIMES,TOTIM,TSTART,TSTOP,  OAK00080
1TSV,ZSEC,ZSEC1,ZSEC2,TIP,TLIFT,TEM,IM2,PRAC                      OAK00090
TOTIM(IH,IM,SEC)=DFLOAT(60*(60*IH+IM))+SEC                         OAK00100
DATA IMIL/1000000/                                                 OAK00110
DATA IORBII/0/                                                      OAK00120
DATA FADAR/'ALT'/                                                  OAK00130
DATA SUME/30*0.0/                                                  OAK00140
DATA SUMA/30*0.0/                                                  OAK00150
DATA SUMSX/120*0.0/                                                OAK00160
DATA UPLOG/120*0.0/                                                OAK00170
DATA ELOTAG,'UNCORRECTED V-IC'/                                     OAK00180
DATA PRTAG,'CORRECTED V-LC '/                                       OAK00190
CALL REREAD(99,530)                                                OAK00200
TSTOP=0.0                                                           OAK00210
IAGAIN=0                                                            OAK00220
41 SUMTM=0.0                                                         OAK00230
ICARD=0                                                             OAK00240
NPTS=0                                                              OAK00250
INDEX=0                                                             OAK00260
READ(5,20,END=901) IDENT                                           OAK00270
20 FORMAT(15A4)                                                      OAK00280
RFAD(5,60) IH1,IM1,ZSEC1,IH2,IM2,ZSEC2,NRG,INTARG,IPAT           OAK00290
1,ISG,TAVG,TSKIP,ICARD,INRT                                         OAK00300
60 FORMAT(2(2I3,F7.3),4X,4I5,2F10.3,2I5)                            OAK00310
IF(INRT.GT.0) READ(5,61) IYEAR,IMONTH,IDAY                          OAK00320
61 FORMAT(3I5)                                                       OAK00330
IPOL(1)=1                                                            OAK00340
IPOL(2)=3                                                            OAK00350
IFCL(3)=4                                                            OAK00360
IPOL(4)=0                                                            OAK00370
ISTGT=1                                                              OAK00380
WRITE(6,64)                                                          OAK00390
64 FORMAT(5X,'THESE ARE YOUR INPUT CARDS')                          OAK00400
WRITE(6,62) IH1,IM1,ZSEC1,IH2,IM2,ZSEC2,NRG,INTARG,IPAT,IPOL,    OAK00410
1ISG,TAVG,TSKIP                                                     OAK00420
62 FORMAT(2(2I3,F7.3),4X,8I3,2F10.3)                                OAK00430
WRITE(6,63) ISTGT                                                    OAK00440
63 FORMAT(I5)                                                        OAK00450
CALL STCIDV(IDENT,59,0)                                              OAK00460
IF(NRG.EQ.0) GO TO 550                                              OAK00470
IF(INTARG.EQ.0) GO TO 560                                           OAK00480
IF((IPAT.EQ.0).OR.(IPAT.GT.3)) GO TO 570                            OAK00490
IF(TAVG.EQ.0.0) GO TO 590                                           OAK00500
70 TSTART=TOTIM(IH1,IM1,ZSEC1)                                       OAK00510
IF((TSTART.GT.TSTOP).AND.(IAGAIN.NE.44)) GO TO 72                  OAK00520
CALL REW                                                             OAK00530
IAGAIN=1                                                             OAK00540
72 TSTOP=TOTIM(IH2,IM2,ZSEC2)                                       OAK00550

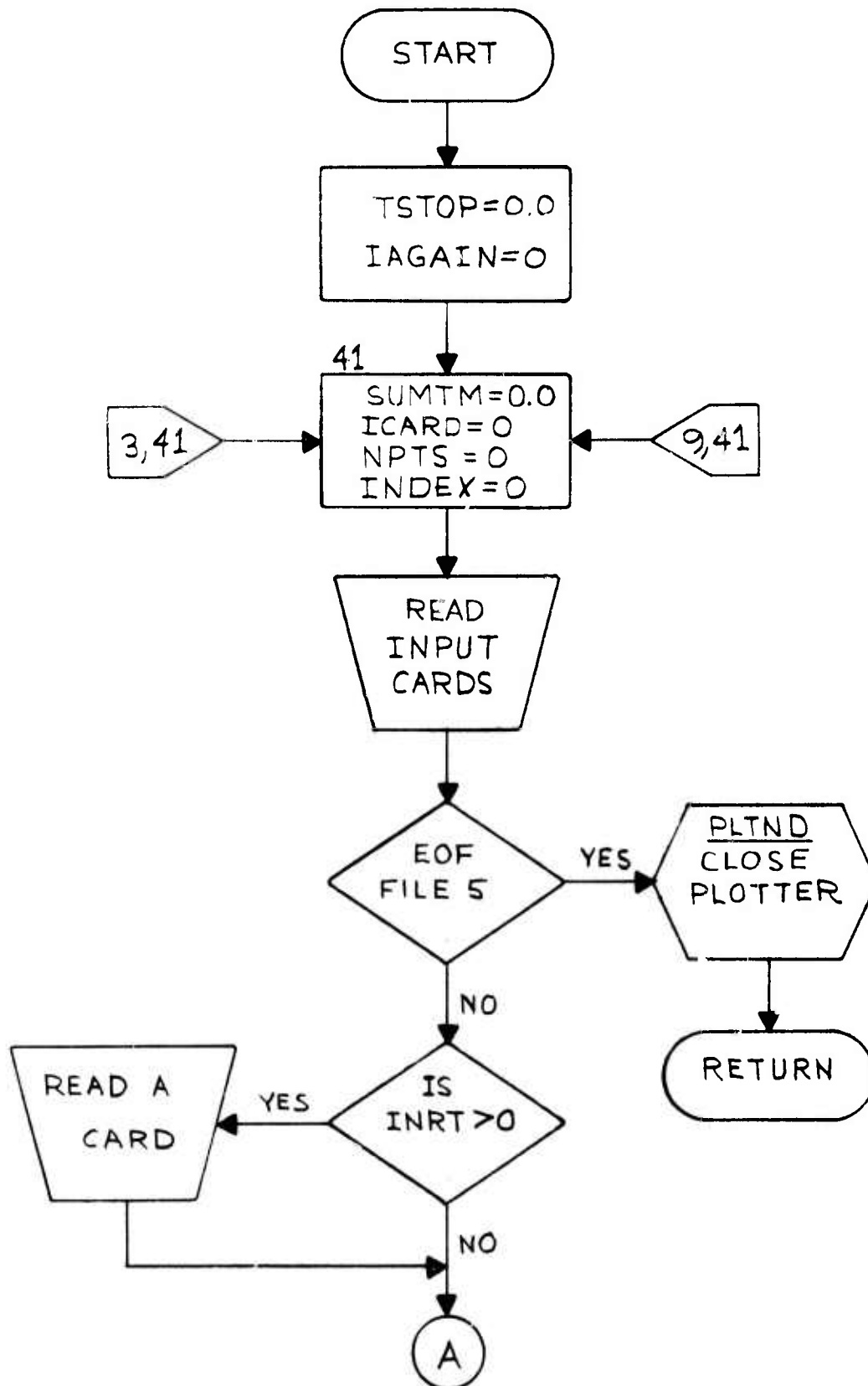
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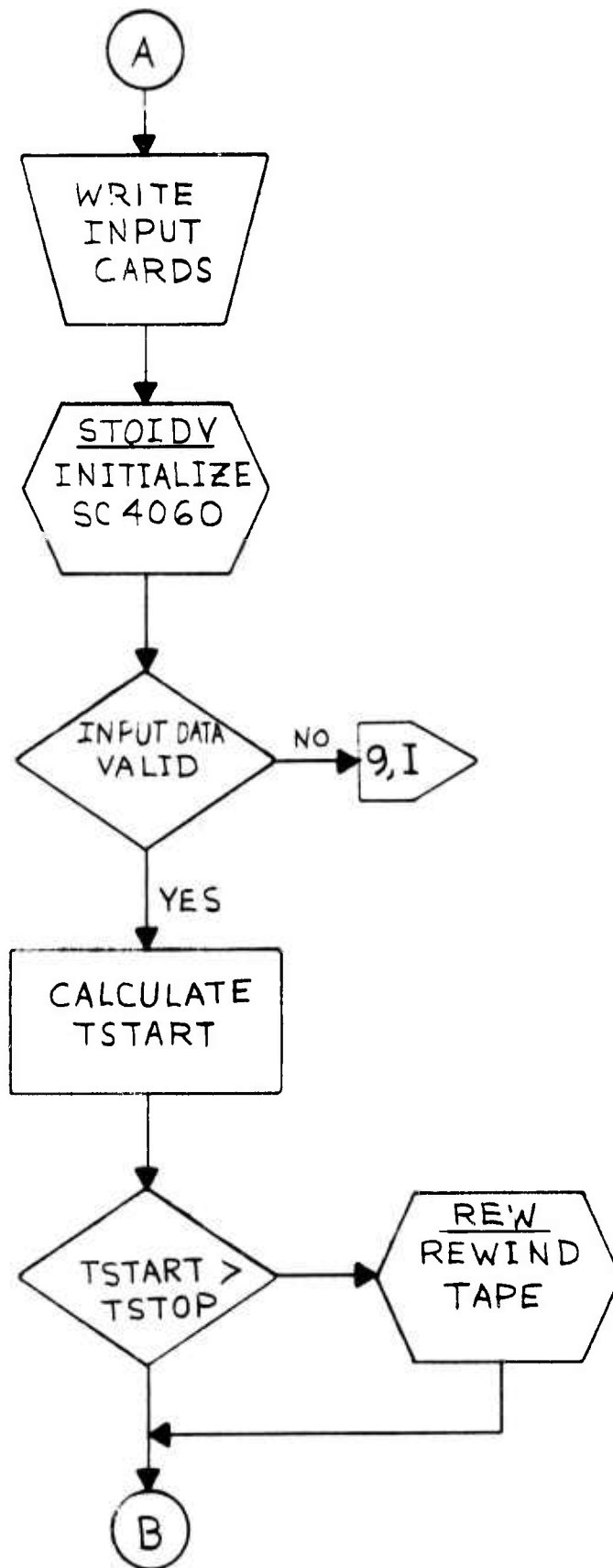
	COUNT=0	OAK00560
	INT=0	OAK00570
	T1=TSTART	OAK00580
	T2=T1+TAVG	OAK00590
100	CALL ALREAD(TSTART, TSTOP, TLIFT, INTARG, IPAT, 2, NPTS, NPPG, IAGAIN, INRG, ISG)	OAK00600
	IF (IAGAIN.EQ.55) GO TO 901	OAK00610
	IF (IAGAIN.EQ.44) GO TO 510	OAK00620
110	IF (NPTS.EQ.0) GO TO 41	OAK00630
	IF (INT.EQ.0) WRITE (6, 140) IDENT, INTARG	OAK00640
140	FORMAT ('1', 30X 'ALTAIR OAK VERSION 27 JAN 1971' //31X, 115A4/31X, 'TARGET NUMBER = ', I5//)	OAK00650
	IF ((INT.EQ.0) .AND. (ICARD.GT.0)) WRITE (7, 150) IDENT	OAK00660
150	FORMAT (15A4)	OAK00670
	INT=1	OAK00680
	DO 220 I=1, NPTS	OAK00690
160	IF (TIMES(I) .GT. T2) GO TO 240	OAK00700
	IF (T1.GT. TIMES(I)) GO TO 220	OAK00710
	INPT=I	OAK00720
	DO 210 N=1, NPCL	OAK00730
	DO 200 K=1, NRG	OAK00740
	EXTEN=(XSPHA(N, K, I)/10.)	OAK00750
	IF (EXTEN.GT.75.0) GO TO 245	OAK00760
	XSPHA(N, K, I)=10.**EXTEN	OAK00770
	SUMSX(N, K)=SUMSX(N, K)+XSPHA(N, K, I)	OAK00780
	IF (N.GT.1) GO TO 200	OAK00790
185	XSPHQ=XSPHA(2, K, I+150)-XSPHA(1, K, I+150)	OAK00800
	IF (ABS(XSPHQ) .LT. 180.) GO TO 190	OAK00810
	IF (XSPHQ.GT.0.0) XSPHA(1, K, I+150)=XSPHA(1, K, I+150)+360.	OAK00820
	IF (XSPHQ.LT.0.0) XSPHA(2, K, I+150)=XSPHA(2, K, I+150)+360.	OAK00830
	GO TO 185	OAK00840
190	XSPHQ=ABS(XSPHQ)	OAK00850
	SUMA(K)=SUMA(K)+XSPHQ	OAK00860
191	XSPHX=XSPHA(3, K, I+150)-XSPHA(1, K, I+150)	OAK00870
	IF (ABS(XSPHX) .LT. 180.) GO TO 192	OAK00880
	IF (XSPHX.GT.0.0) XSPHA(1, K, I+150)=XSPHA(1, K, I+150)+360.	OAK00890
	IF (XSPHX.LT.0.0) XSPHA(3, K, I+150)=XSPHA(3, K, I+150)+360.	OAK00900
	GO TO 191	OAK00910
192	XSPHX=ABS(XSPHX)	OAK00920
	SUME(K)=SUME(K)+XSPHX	OAK00930
200	CONTINUE	OAK00940
210	CONTINUE	OAK00950
	COUNT=COUNT+1	OAK00960
220	CONTINUE	OAK00970
	IF (IAGAIN.EQ.0) GO TO 240	OAK00980
	NPTS=0	OAK00990
	GO TO 100	OAK01000
240	IF (COUNT.NE.0.0) GO TO 280	OAK01010
245	WRITE (6, 260) T2, EXTEN	OAK01020
260	FORMAT (/25X 'AT TIME = 'P12.4, 2X 'THERE IS A TIME GAP OR BAD DATA 1 EXTEN = ', F10.4)	OAK01030
	GO TO 440	OAK01040
280	DO 350 M=1, NPCL	OAK01050
	DO 340 J=1, NRG	OAK01060
	IF (M.GT.1) GO TO 290	OAK01070
		OAK01080
		OAK01090
		OAK01100

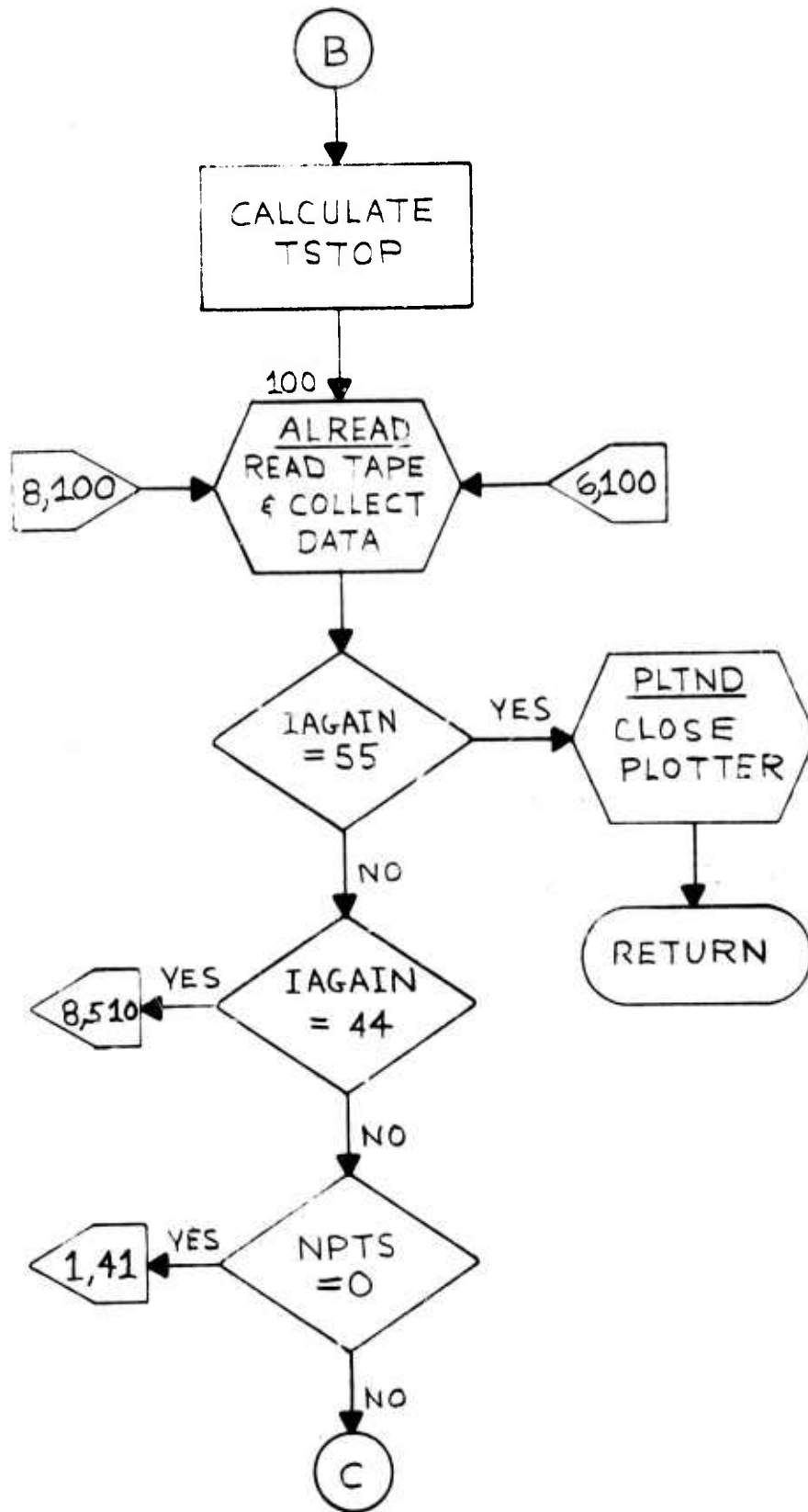
	DAZ (J) = SUMA (J) / COUNT	OAK01110
	DEL (J) = SUNE (J) / COUNT	OAK01120
290	UFLOG (M, J) = SUMSX (M, J) / CCUNT	OAK01130
	IF (UFLOG (M, J) .GT. 0.0) GO TO 300	OAKC1140
	AVGSX (M, J) = 99.9	OAK01150
	GO TO 320	OAK01150
300	AVGSX (M, J) = 10. *ALCG10 (UPLOG (M, J))	OAKC1170
320	SUMSX (M, J) = 0.0	OAK01180
	SUMA (J) = 0.0	OAKC1190
	SUNE (J) = 0.0	OAK01190
340	CONTINUE	OAKC1200
350	CONTINUE	OAK01210
	MIDPT = ((COUNT + 1) / 2) + INPT	OAK01220
	AVGEL = EIE (MIDPT)	OAK01230
	AVGAZ = AZI (MIDPT)	OAK01240
	AVGTM = TIMES (MIDPT)	OAK01250
	AVGRG = RANGKM (MIDPT)	OAK01260
	AVGAL = ALSAV (MIDPT)	OAK01270
	KCOUNT = CCUNT	OAK01280
358	IF (ISTGT .EQ. 0) GO TO 440	OAK01290
	CALL GLMP (AVGAL, ISTGT, AVGAZ, AVGEL, IGAT, AVGTM, AVGRG, NRG, INDEX,	OAK01300
	ICARD, TLIFT)	OAK01310
440	CCUNT = 0	OAK01320
	T1 = T2 + TSKIP	OAK01330
	T2 = T1 + TAVG	OAKC1340
	SUMTM = 0.0	OAK01350
	SUMRG = 0.0	OAK01360
	SUMAL = 0.0	OAK01370
	IF (T2 .LE. TIMES (NPTS)) GO TO 160	OAK01380
	IF (T2 .GT. TSTOP) GO TO 510	OAK01390
	DO 460 K = INET, NPTS	OAK01400
	KNPT = K	OAK01410
	IF (T1 .LE. TIMES (K)) GO TO 480	OAK01420
460	CONTINUE	OAK01430
480	ND = NPTS - KNPT + 1	OAK01440
	DO 501 N = 1, ND	OAK01450
	NL = KNPT + N - 1	OAK01460
	TIMES (N) = TIMES (NL)	OAKC1470
	RANGKM (N) = RANGKM (NL)	OAK01480
	ALSAV (N) = ALSAV (NL)	OAK01490
	AZI (N) = AZI (NL)	CAK01500
	EIE (N) = EIE (NL)	OAK01510
	DO 490 K = 1, NPCL	OAK01520
	DO 500 L = 1, NRG	OAKC1530
	XSPHA (K, I, N) = XSPHA (K, L, NL)	OAK01540
500	CONTINUE	OAKC1550
490	CONTINUE	OAK01560
501	CONTINUE	OAKC1570
	NFIS = ND	OAKC1580
	IF (IAGAIN .NE. 0) GO TO 100	OAK01590
510	CALL OAKPLT (TIM, GTMAX, INDEX, PLOTAG, INTARG, IDENT)	OAKC1600
	CALL OAKPLT (TIM, CRIC, INDEX, PLTAG, INTARG, IDENT)	OAK01610
	WRITE (6, 540)	OAKC1620
540	FORMAT (44X'RFRANG RPELV AZCR')	CAK01630
	WRITE (6, 541) (FRANG (N), RELEV (N), AZCR (N), N = 1, INDEX)	OAK01640
		OAKC1650

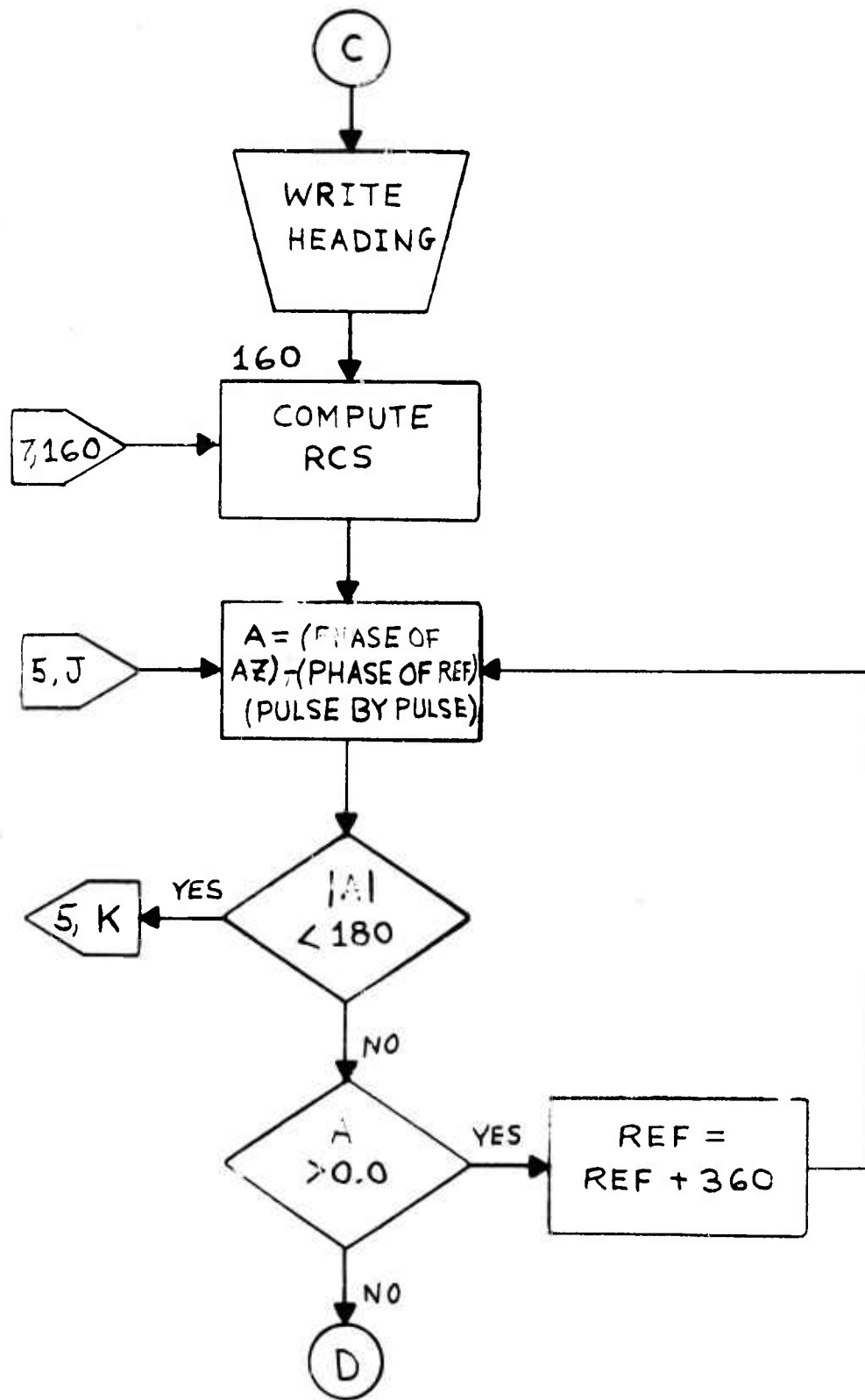
541	FORMAT(40X,3F10.3)	OAK01660
	IF(INRT.EQ.0)GO TO 5411	OAK01670
	DO 54100 M=1,INDEX	OAK01680
	TM2=IDINT(TFM(M))	OAK01690
	ISEC(M)=TM2	OAKC1700
	FPAC=TEM(M)-TM2	OAK01710
	IFRAC=IDINT(FRAC*IMIL)	OAK01720
	MSEC(M)=DFLOAT(IFRAC)/10.+5	OAK01730
54100	CONTINUE	OAK01740
	WRITE(7,5410)(RADAR,IYEAR,IMONTH,IDAY,IHRX(I),IMINX(I),ISEC(I),	OAKC1750
	1MSEC(I),IORBIT,AZCR(I),RELEV(I),RRANG(I),I=1,INDEX)	OAK01760
5410	FORMAT(A3,3X,6I2, '.',I5,1X,I1,P8.3,4X,P8.3,4X,P12.4)	OAK01770
5411	IF(ICARD.EQ.0)GO TO 900	OAKC1780
	WRITE(6,542)INDEX	OAK01790
542	FORMAT(///I5,'CORRECTION CARDS HAVE BEEN PUNCHED')	OAK01800
	GO TO 900	OAKC1810
550	WRITE(6,555)	OAKC1820
555	FORMAT(//2X'A ZERO VALUE WAS INPUT FOR NRG THIS IS A NO NO')	OAK01830
	GO TO 900	OAKC1840
560	WRITE(6,565)	OAK01850
565	FORMAT(//2X'A ZERO VALUE WAS INPUT FOR THE TARGET #, THE DATA EDITOR	OAK01860
	HAS GOOFED AGAIN')	OAKC1870
	GO TO 900	OAK01880
570	WRITE(6,575)IPAT	OAK01890
575	FORMAT(//2X'A VALUE OF',I5,' WAS INPUT FOR IPAT THE ONLY LEGAL VA	OAKC1900
	1LUES FOR IPAT ARE 1,2,3')	OAF01910
	GO TO 900	OAK01920
590	WRITE(6,595)	OAKC1930
595	FORMAT(//2X'A ZERO VALUE FOR TINC CAN NOT WORK IT WILL BE SET TO	OAK01940
	10.05 SECONDS AND THE PROGRAM WILL CONTINUE')	CAK01950
	TAVG=0.C5	OAKC1960
	GO TO 70	OAKC1970
900	IAGAIN=99	OAKC1980
	GO TO 41	OAK01990
901	CALL PLTND	OAK02000
	RETURN	OAK02010
	END	OAK02020

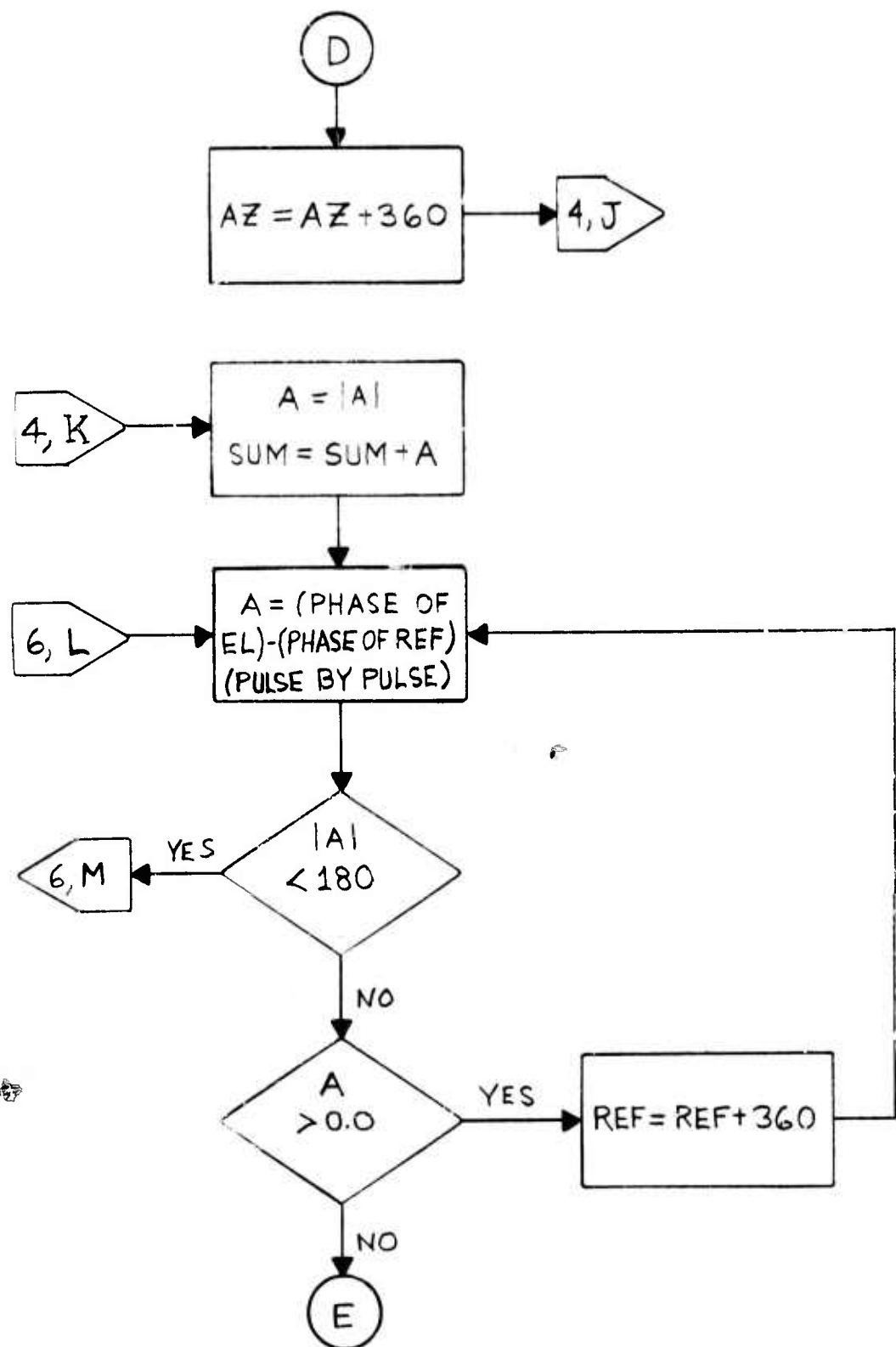
APPENDIX D
SUBROUTINE OAKOS FLOW DIAGRAM

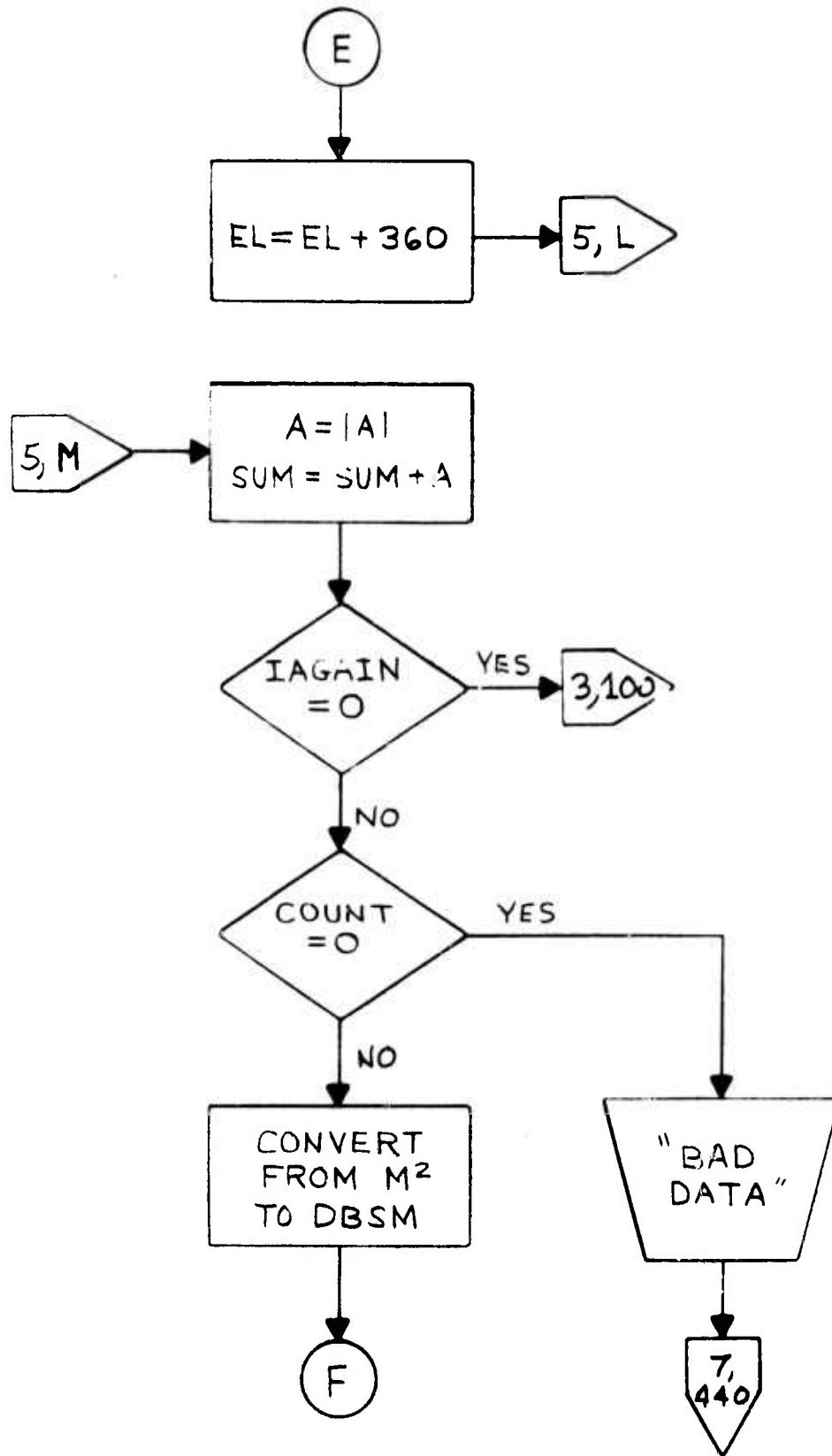


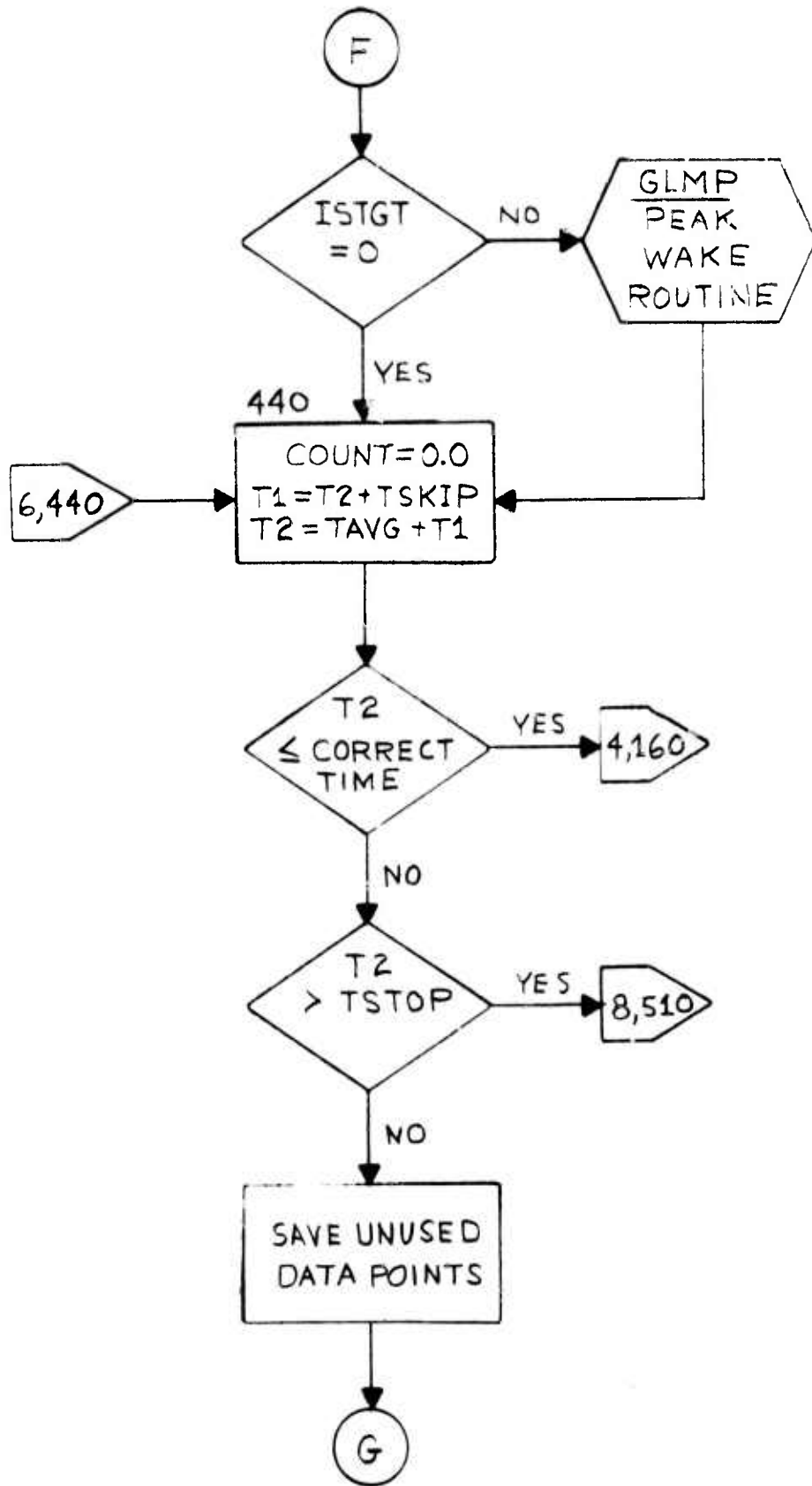


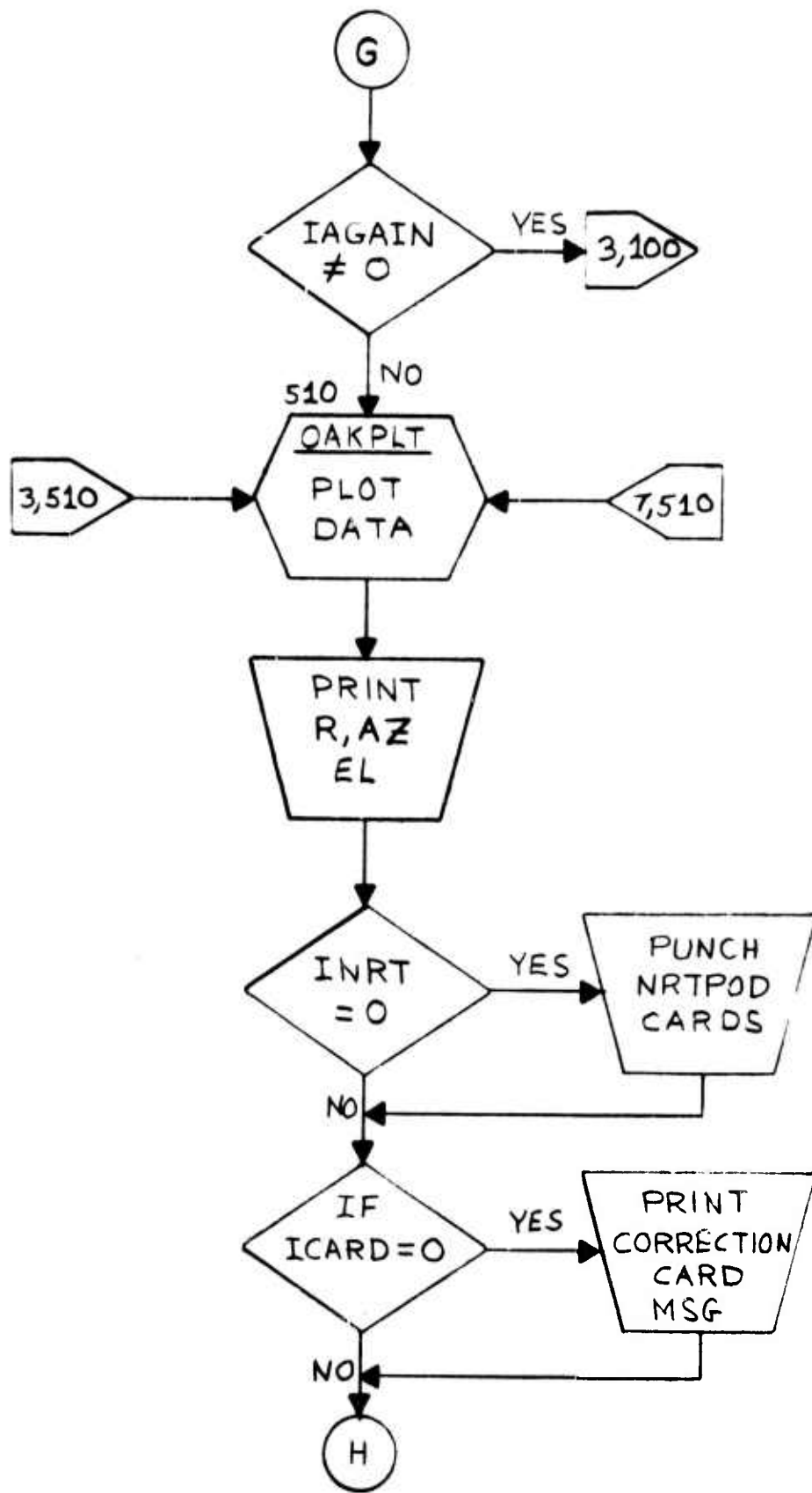


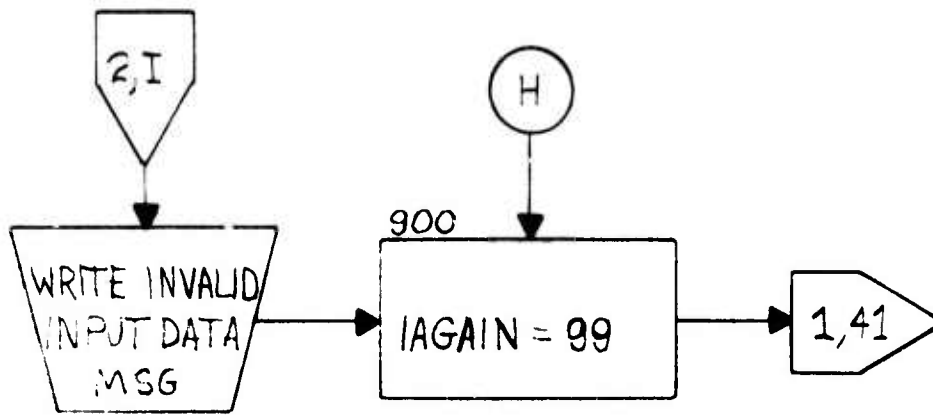








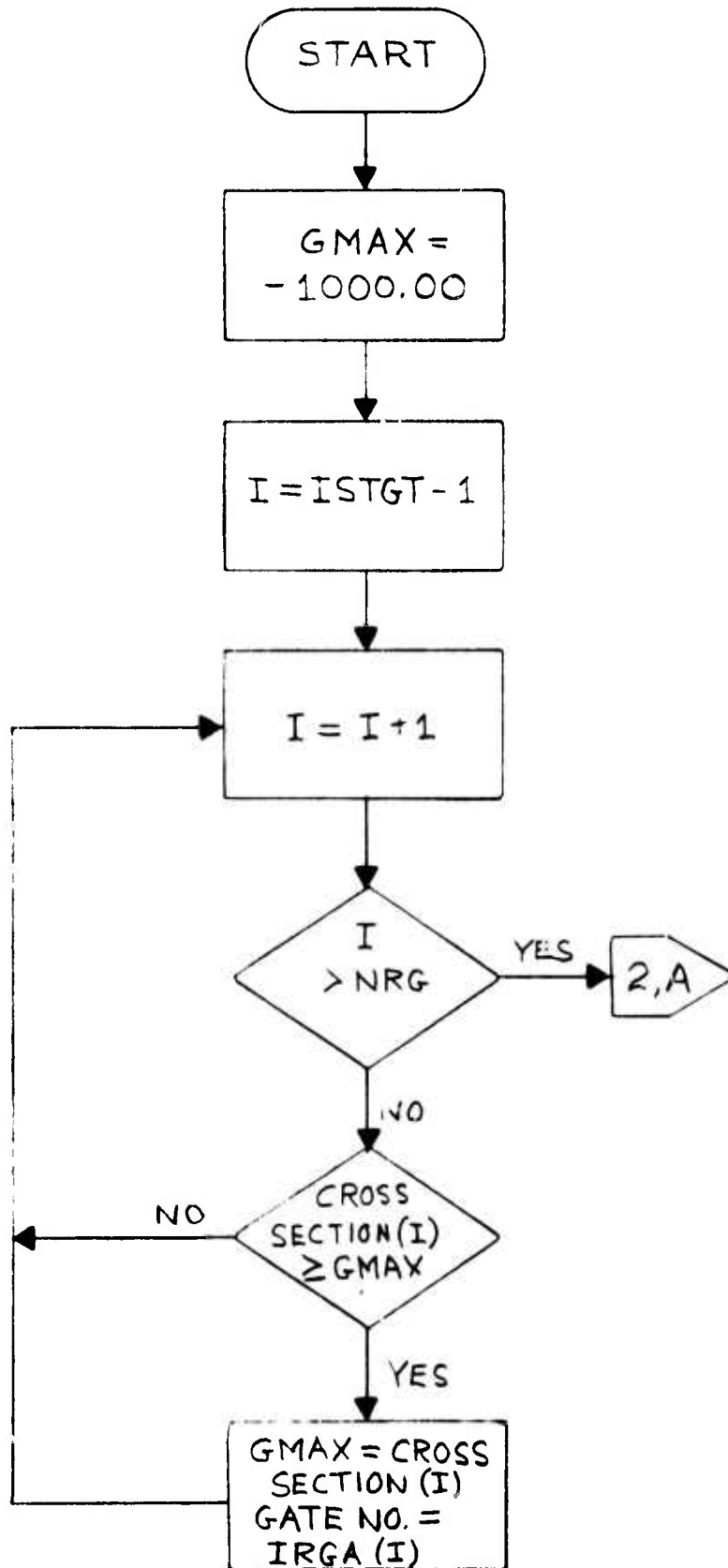


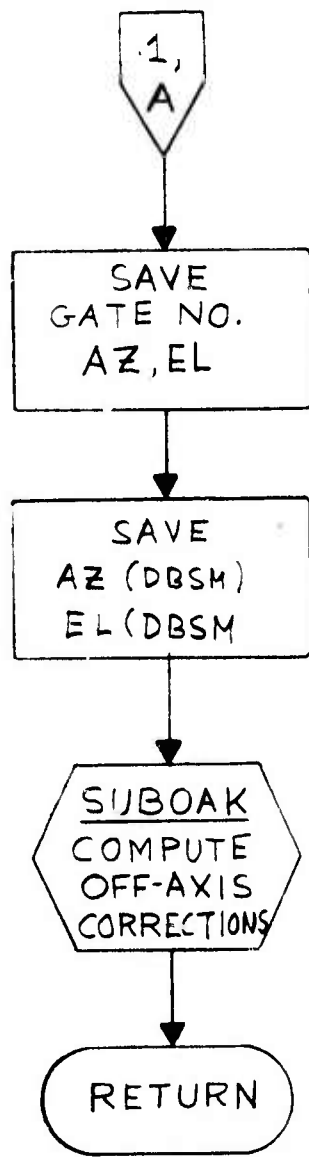


APPENDIX E
SUBROUTINE GLMP PROGRAM LISTING

SUBROUTINE GLMP(AVGAL, ISTGT, AVGAZ, AVGEL, IGAT, AVGTM, AVGRG, NRG	PEAC0010
1, INDEX, ICARD, TLIFT)	
DIMENSION IHM(2)	PEAC0050
DOUBLE PRECISION AVGTM, TIMES, ZSEC, TIM, TEN, TLIFT	
COMMON/OAK/TIM(1200), TEM(1200), CRCL(1200), GTHAX(1200), AVGSX(4, 30),	
1DEL(30), BRANG(1200), RELEV(1200), AZCR(1200), DAZ(30), YHRX(1200),	
2IMINX(1200)	
COMMON/RDCOMT/TIMES(300), XSPHA(4, 30, 300), RANGKM(300), ALSAV(300),	PEA00060
1AZI(300), ELE(300), IRGA(30), IPOL(4), NPOL	PEA00070
EQUIVALENCE(IHM(1), IHR), (IHM(2), IMIN)	PEAC0080
GMAX=-1000.0	PEA00090
DO 20 I=ISTGT, NRG	PEA00100
IF(AVGSX(1, I).LE.GMAX)GO TO 20	PEA00110
GMAX=AVGSX(1, I)	PEA00120
IGAT=IRGA(I)	PEA00130
NN=1	PEA00140
20 CONTINUE	PEA00150
CALL TSPLIT(AVGTM, IHM, ZSEC)	PEA00160
PHAZ=DAZ(NN)	PEA00170
PHEI=DEL(NN)	PEA00180
AZ=AVGSX(2, NN)	PEA00190
EL=AVGSX(3, NN)	PEA00200
CALL SUBOAK(IHR, IMIN, ZSEC, GMAX, AVGAZ, IGAT, AVGTM, AVGAZ, AVGEL, PHAZ, P	PEA00210
1HEL, AZ, EL, INDEX, AVGRG, ICARD, TLIFT)	
RETURN	PEA00230
END	

APPENDIX F
SUBROUTINE GLMP FLOW DIAGRAM





APPENDIX G
SUBROUTINE TSPLIT PROGRAM LISTING

SUBROUTINE TSPLIT(AVGTM,IHM,TRUN)	TSPC0010
DIMENSION IHM(2),DIVIDE(2)	TSP00020
DOUBLE PRECISION AVGTM,TRUN	TSP00030
DATA DIVIDE/3600.,60./	TSP00040
TRUN=AVGTM	TSPC0050
DO 20 I=1,2	TSP00060
IHM(I)=TRUN/DIVIDE(I)	TSP00070
TRUN=TRUN-FLOAT(IHM(I))*DIVIDE(I)	TSP00080
20 CONTINUE	TSP00090
RETURN	TSP00100
END	TSP00110

APPENDIX H
SUBROUTINE SUBOAK PROGRAM LISTING

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SUBROUTINE SUBOAK (IHR, IMIN, ZSEC, GMAX, AVGAL, IGAT, AVGTM, AZE, ELEX,      SUB00010
1PHAZ, PHEL, AZ, EL, INDEX, AVGRG, ICARD, TLIFT)
DIMENSION A(24), B(24), C(27), D(27), Q(27), R(16), S(16)
DOUBLE PRECISION ZSEC, TIM, AVGTM, TEM, TLIFT
COMMON/OAK/TIM(1200), TEM(1200), CRLC(1200), GTHAX(1200), AVGSX(4, 30),
1DEL(30), RRANG(1200), RELEV(1200), AZCR(1200), DAZ(30), IHRX(1200),
2IMINX(1200)
DATA DR, NIT, NNIT, NITT/.0174533, 24, 27, 27/
DATA XKMFT/.0003048/
DATA A/-29.6, -27.3, -23.2, -20.1, -17.0, -12.8, -10.4, -8.4, -6.2, -4.6,
1-3.2, -1.7, -0.7, 1.1, 1.7, 2.9, 4.1, 5.1, 7.0, 8.5, 9.5, 10.3, 10.8, 12.4/
DATA B/C.0, 0.03, 0.1, 0.17, 0.24, 0.37, 0.59, 0.75, 0.90, 1.05, 1.26, 1.34,
11.48, 1.61, 1.75, 1.88, 2.01, 2.14, 2.28, 2.39, 2.61, 2.74, 2.81, 2.93/
DATA C/-34.1, -29.3, -24.2, -19.9, -17.4, -13.8, -11.3, -8.9, -6.8, -5.0,
1-4.0, -2.3, -1.1, -0.1, 1.4, 2.6, 3.5, 4.8, 5.1, 7.9, 9.6, 11.3, 12.7, 14.2,
217.2, 18.4, 19.7/
DATA D/C.0, 0.07, 0.14, 0.21, 0.28, 0.42, 0.56, 0.71, 0.85, 1.0, 1.14, 1.29,
11.44, 1.57, 1.71, 1.85, 1.98, 2.12, 2.25, 2.39, 2.53, 2.66, 2.79, 2.92, 3.04,
23.17, 3.28/
DATA Q/0.0, 0.0, 0.0, 0.0, 0.1, 0.1, 0.4, 1.3, 2.2, 2.9, 3.6, 5.1, 6.3, 7.5,
19.1, 10.9, 12.5, 15.0, 17.5, 19.6, 24.0, 27.9, 31.7, 36.9, 43.0, 48.7, 52.3/
DATA R/0.0, 0.025, 0.10, 0.17, 0.24, 0.29, 0.35, 0.50, 0.61, 0.65, 0.75,
1C.84, C.56, 1.00, 1.07, 1.14/
DATA S/0.0, 0.25, 1.00, 1.25, 2.00, 3.00, 3.60, 5.25, 7.00, 8.10, 11.50, 14.5
1, 18.40, 23.70, 30.25, 40.25/
INDEX=INDEX+1
DELAZ=AZ-GMAX
DELEL=EL-GMAX
XD=99.9
DO 20 J=1, NIT
IF (DELAZ.GT.A(J)) GO TO 20
IF (DELAZ.EQ.A(J)) GO TO 15
IF (J.EQ.1) GO TO 14
XA=A(J)-A(J-1)
XB=B(J)-B(J-1)
XC=DELAZ-A(J-1)
XD=(XC/XA)*XB+B(J-1)
GO TO 25
14 XD=0.0
GO TO 25
15 XD=B(J)
GO TO 25
20 CONTINUE
25 AF=DR*PHAZ
AD=CCS(AB)
IF (AD.LT.0.C) XD=-XD
XH=99.9
DO 30 K=1, NNIT
IF (DELEL.GT.C(K)) GO TO 30
IF (DELEL.EQ.C(K)) GO TO 32
IF (K.EQ.1) GO TO 31
XF=C(K)-C(K-1)
XF=D(K)-D(K-1)
XG=DELEL-C(K-1)
XH=(XG/XE)*XF+D(K-1)

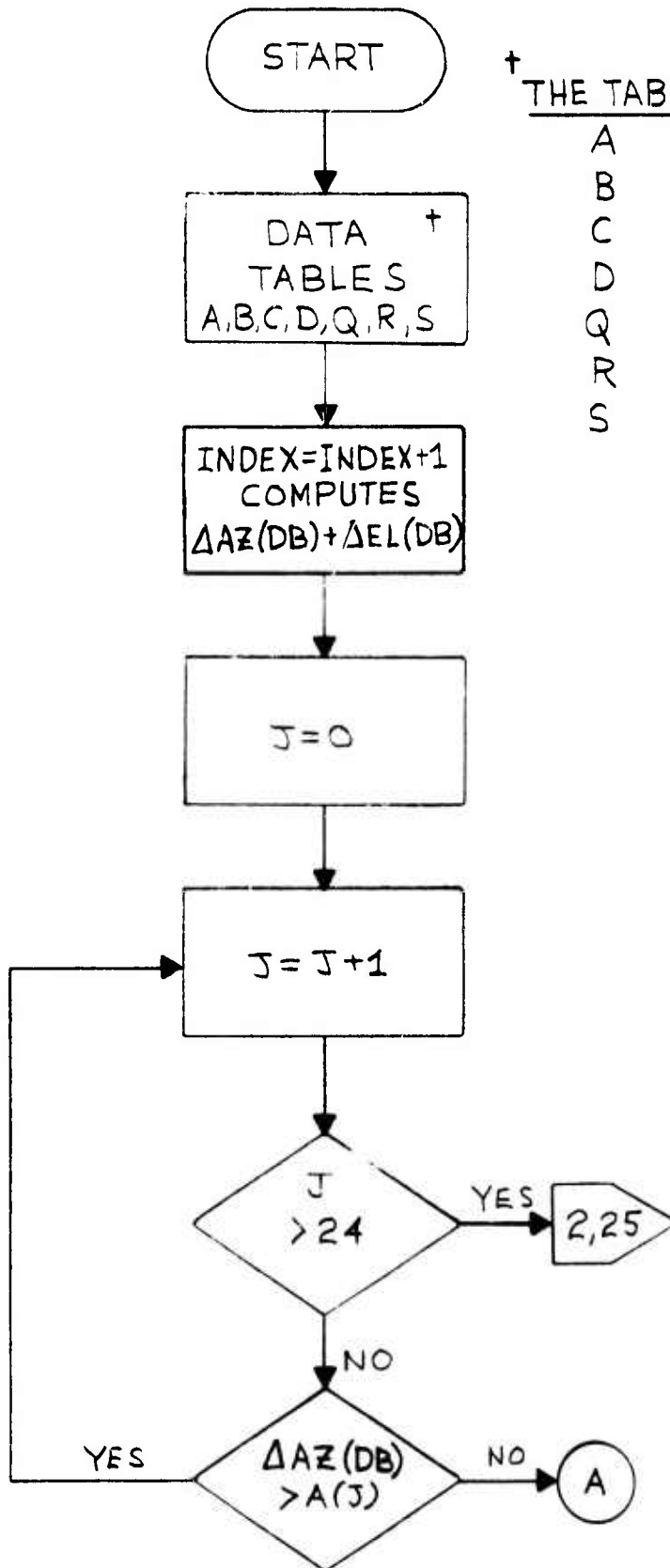
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GO TO 35
31 XH=0.0 SUBC0390
GO TO 35 SUBC0400
32 XH=D (J) SUBC00410
GO TO 35 SUBC00420
30 CONTINUE
35 AF=DR*PHL SUBC0430
AF=CCS (AE) SUBC0440
IF (AF.LT.0.0) XH=-XH
CFLEX=COS (FLEX)
DFLDG=SQRT ((XH**2) + ((CELEX) * (XD) ) **2)
XJ=99.9 SUBC0480
DO 40 L=1,NITT SUBC00490
IF (DELDG.GT.D (L)) GO TO 40 SUBC0510
IF (DELDG.EQ.D (L)) GO TO 45 SUBC0520
XJ= ((DELDG-D (L-1)) / (D (L)-D (L-1))) * (Q (L)-Q (L-1)) +Q (L-1) SUBC07530
GO TO 41 SUBC07550
45 XJ=Q (L) SUBC07550
GO TO 41
40 CONTINUE
41 XUHF=99.9 SUBC0570
NIX=16
DO 50 M=1,NIX
IF (DELDG.GT.R (M)) GO TO 50
IF (DELDG.EQ.R (M)) GO TO 51
XUHF= ((DELDG-R (M-1)) / (R (M)-R (M-1))) * (S (M)-S (M-1)) +S (M-1)
GO TO 52
51 XUHF=S (M)
GO TO 52
50 CONTINUE
52 ATE=AZE/DR
ELEX=ELEX/DR SUBC00590
IHR (INDEX) =IHR
IMIN (INDEX) =I*IN
TIM (INDEX) =AVGTM-TLIFT
TSM (INDEX) =ZSEC
GMAX (INDEX) =GMAX
CFLC (INDEX) =GMAX*XJ SUBC07620
AVGRG=AVGRG+ ((IGAT*30.0) /1000.0)
RF=AVGRG/XK*PT
E=ELEX SUBC07640
CALL REFC (E,RR,DFE,ERR) SUBC0650
RFANG (INDEX) =AVGRG- (DRR*XK*PT)
RELEV (INDEX) =ELEX-DFE+XH
AZCR (INDEX) =AZE+XD
XF=XUHF
IF (ICARD.EQ.0) GO TO 54
WRITE (7,53) AVGTM,XK,XJ
53 FORMAT (3F10.3)
54 IF (INDEX.GT.1) GO TO 70
WRITE (6,55)
55 FORMAT ('52X'DELTA DELTA DELTA DELTA DELTA')
WRITE (6,60)
60 FORMAT (8X'TIME AZ FL V-IC (DB) AZ (DB) EL (DB) AZ DEG EL DEGSUBC0730
1 DEGREES VHF (DB) DRP (DP) PHAZ PHEL CRIC')
70 WRITE (6,75) IHR,IMIN,ZSEC,AZE,ELEX,GMAX,AZ,FL,XD,XH,DELDG,XJ,XK,PHA
1Z,PFEL,CRIC (INDEX)
75 FORMAT (2I3,F7.3,2F7.2,F6.2,3X6.2,1X6.2,2X6.2,1X6.2,3 (2X6.2),
12F10.3,F10.3)
RETFEN
END

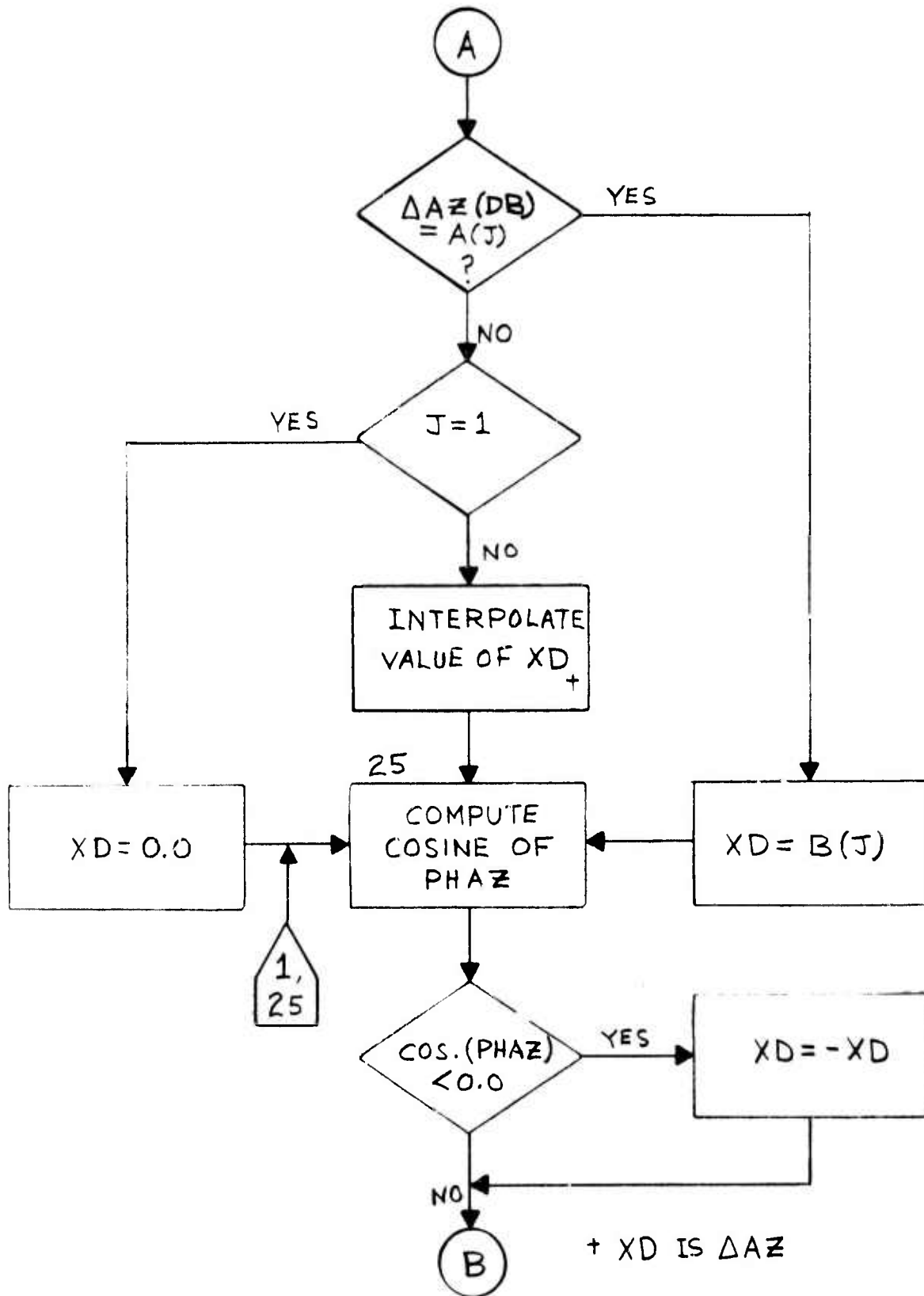
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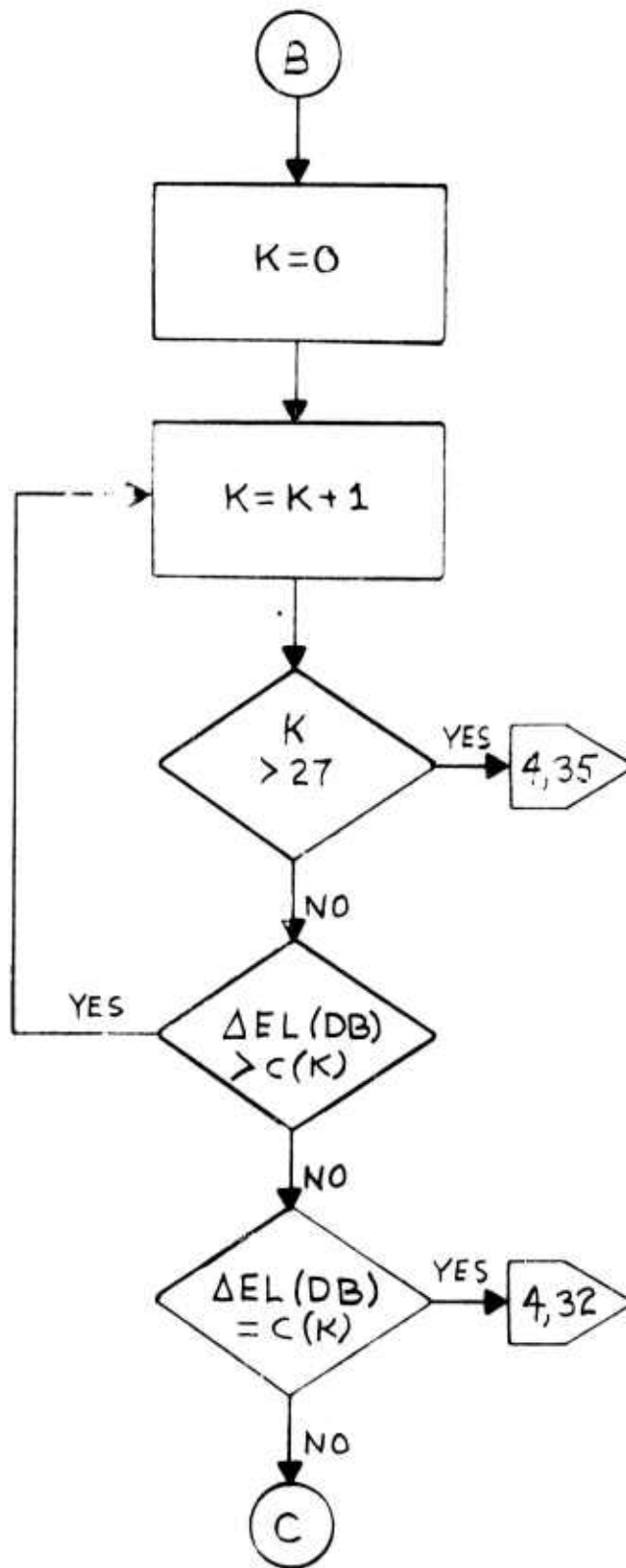
APPENDIX J
SUBROUTINE SUBOAK FLOW DIAGRAM

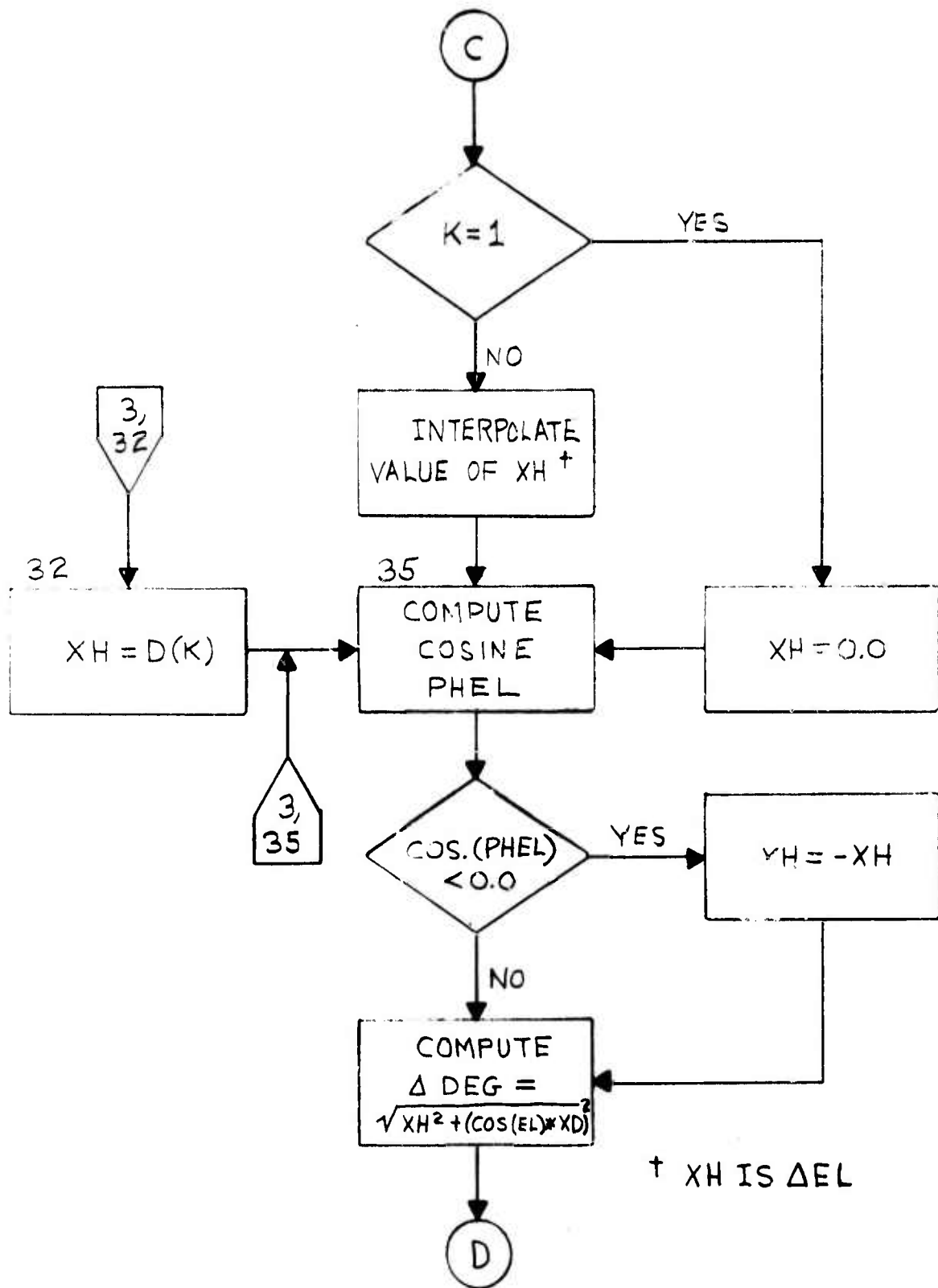


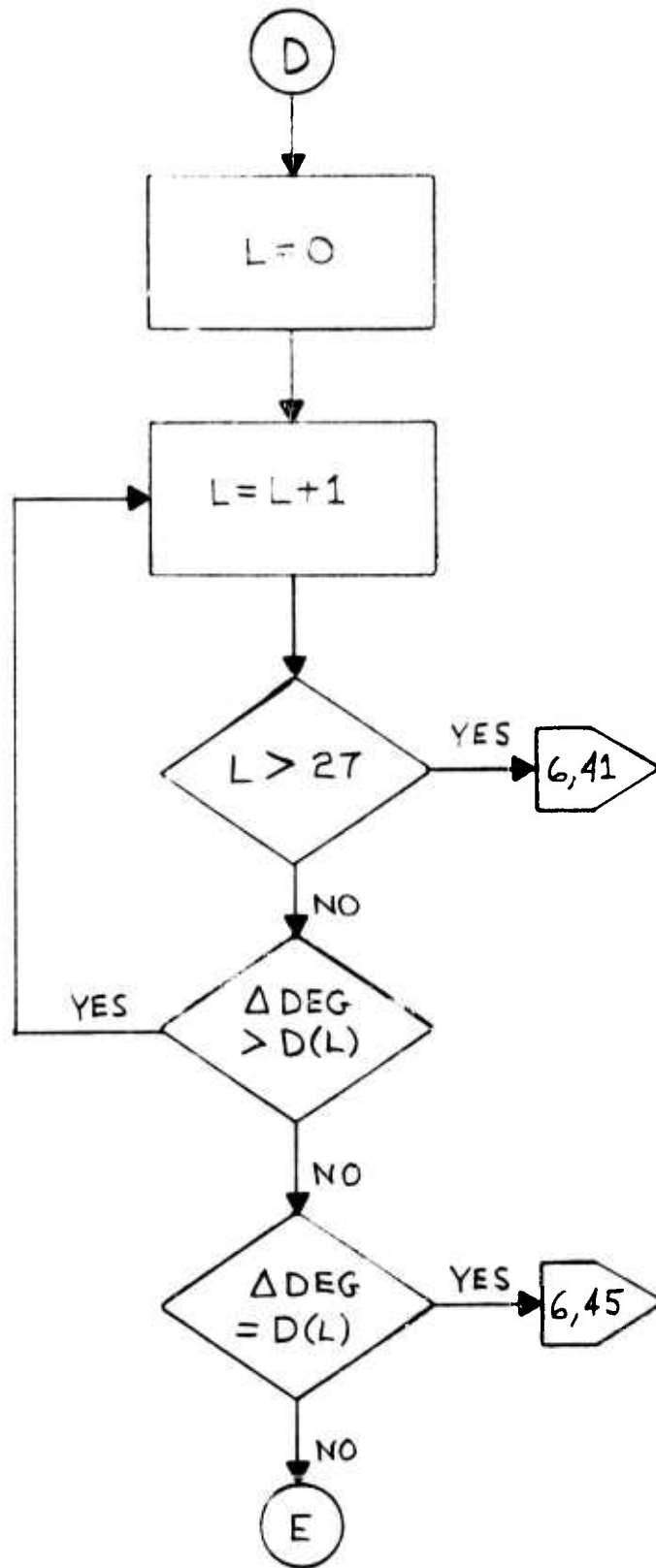
† THE TABLES CONTAIN:

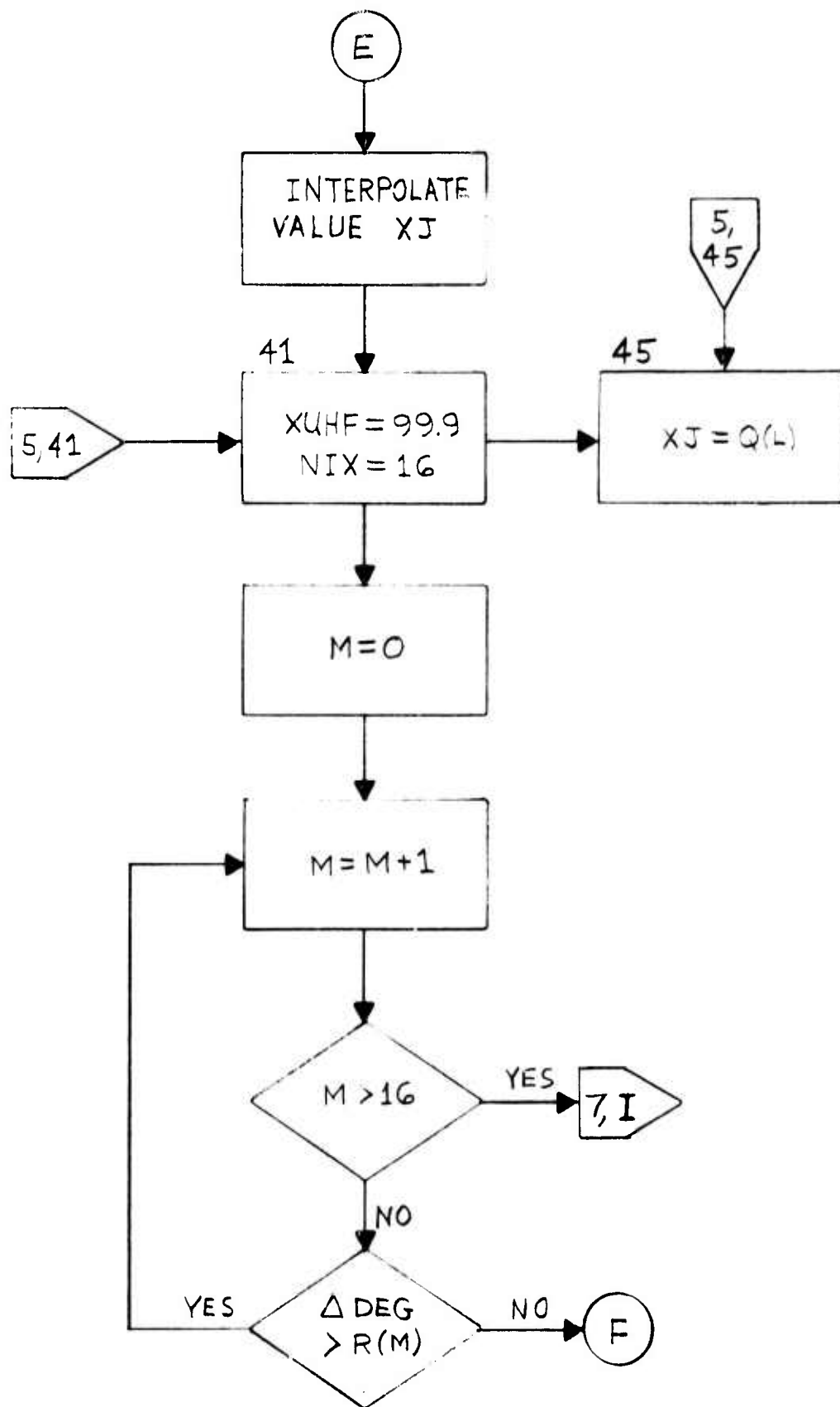
A	ΔAZ (DB)
B	ΔAZ
C	ΔEL (DB)
D	ΔEL & Δθ
Q	ΔVHF RCS (DB)
R	Δθ
S	ΔUHF RCS (DB)

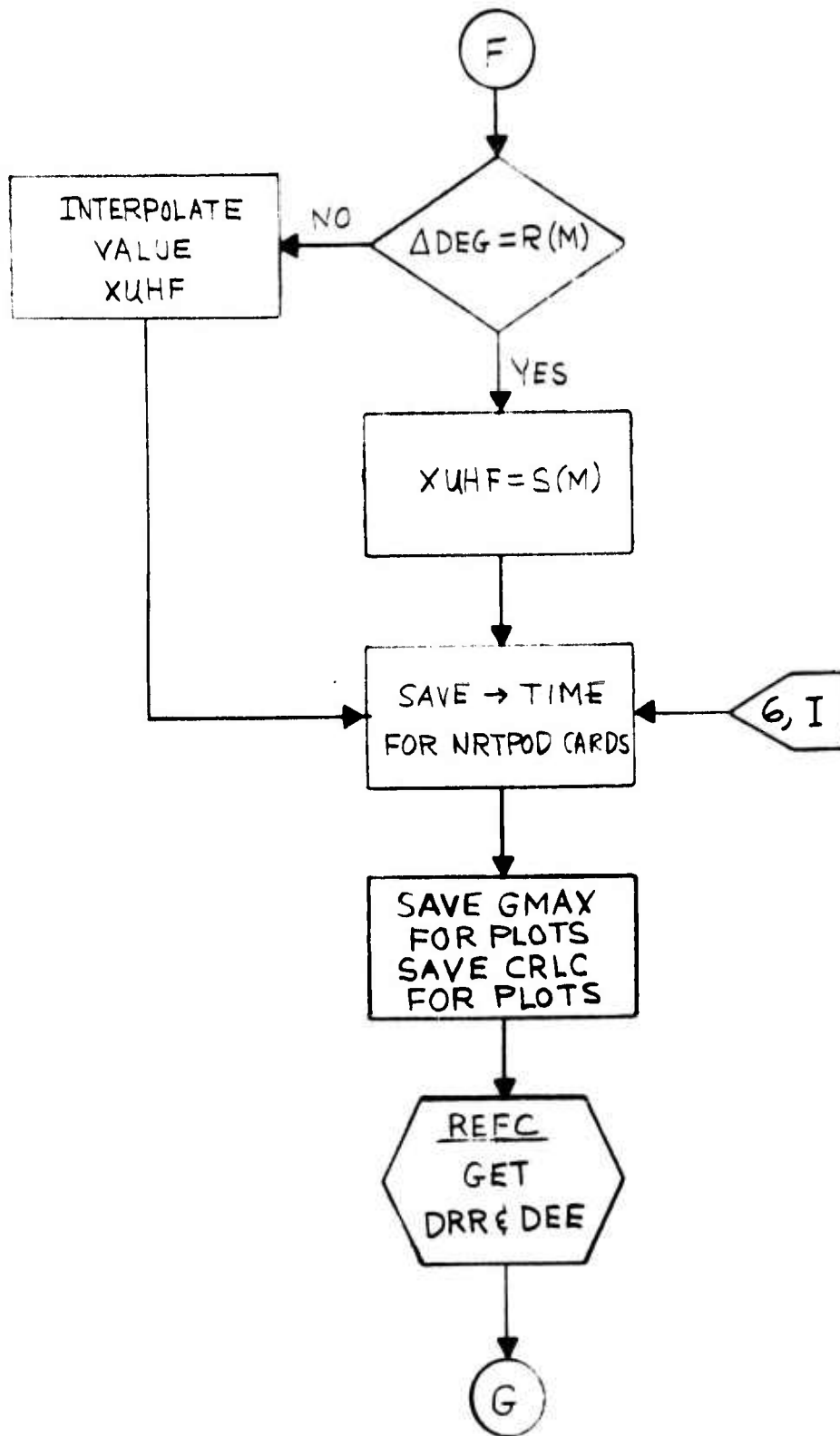


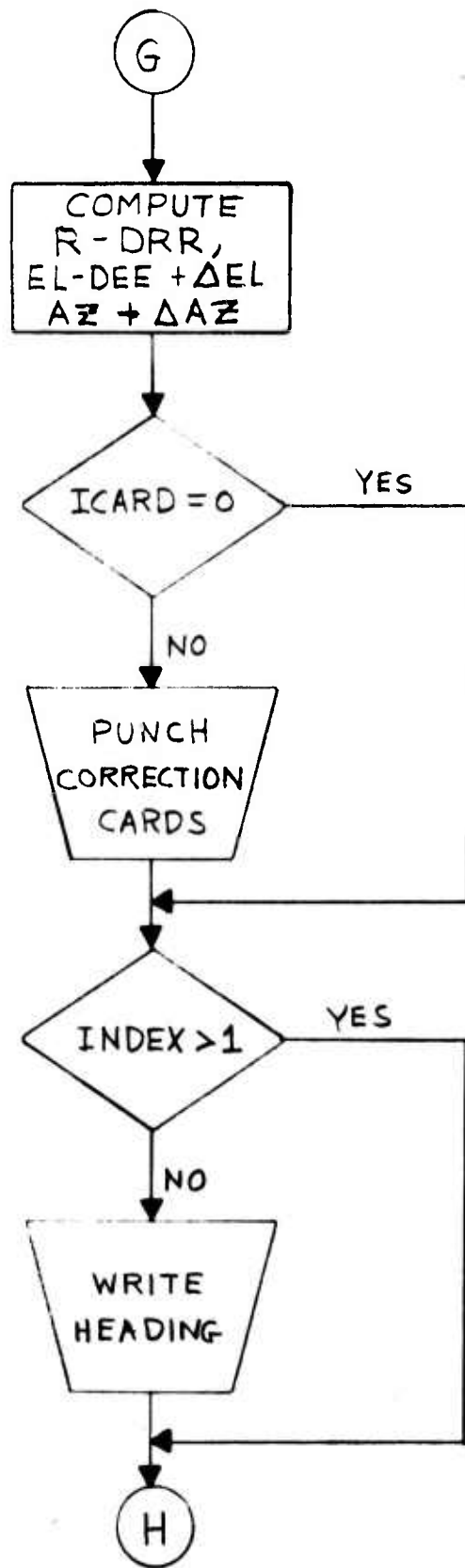


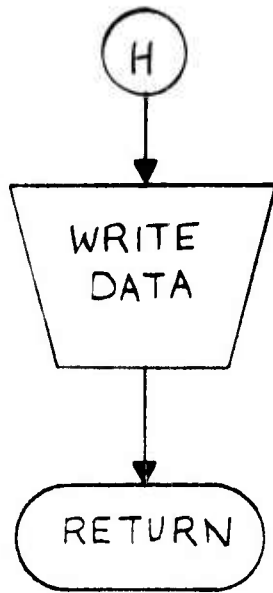












APPENDIX K
SUBROUTINE REFC PROGRAM LISTING

	SUBROUTINE REFC(F,R,DEE,DRR)	VERSION 6/16/70
	DIMENSION DE(16,8),DR(16,8),ED(16),RD(8)	REFC0010
	DATA DE/0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,	REFC0020
	10.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0313,	REFC0030
	20.0303,0.0292,0.0287,0.0282,0.0272,0.0262,0.0253,0.0243,0.0223,	REFC0040
	30.0214,0.0195,0.0171,0.0135,0.0075,0.0,0.0917,0.0848,0.0770,	REFC0050
	40.0732,0.0624,0.0627,0.0571,0.0522,0.0480,0.0412,0.0385,0.0337,	REFC0060
	50.0278,0.0205,0.0105,0.0,0.1850,0.1520,0.1250,0.1140,0.1050,	REFC0070
	60.0904,0.0795,0.0708,0.0636,0.0523,0.0478,0.0405,0.0323,0.0229,	REFC0080
	70.0114,0.0,0.5310,0.3070,0.2120,0.1830,0.1600,0.1280,0.1060,	REFC0090
	80.0899,0.0780,0.0612,0.0550,0.0455,0.0354,0.0246,0.0120,0.0,	REFC0100
	90.7550,0.3720,0.2400,0.2020,0.1750,0.1370,0.1120,0.0942,0.0811,	REFC0110
	10.0631,0.0566,0.0466,0.0361,0.0250,0.0122,0.0,0.9120,0.4110,	REFC0120
	80.2560,0.2140,0.1840,0.1420,0.1150,0.0967,0.0830,0.0643,0.0575,	REFC0130
	00.0472,0.0365,0.0252,0.0122,0.0,0.9700,0.4200,0.2600,0.2200,	REFC0140
	00.1900,0.1460,0.1170,0.0980,0.0840,0.0653,0.0584,0.0478,0.0369,	REFC0150
	00.0254,0.0123,0.0 /	REFC0160
	DATA CR/0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,	REFC0170
	1 0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,22.6,21.5,20.4,19.9,	REFC0180
	2 19.4,18.5,17.6,16.8,16.1,14.8,14.2,13.2,12.0,10.4,8.6,	REFC0190
	3 7.7,67.3,57.9,50.2,47.0,44.1,39.3,35.4,32.1,29.3,24.8,	REFC0200
	4 22.9,19.7,16.3,12.7,9.4,8.1,132.0,98.5,77.4,69.7,63.2,	REFC0210
	5 52.9,44.7,38.4,33.4,26.4,23.9,20.1,16.4,12.7,9.4,9.1,	REFC0220
	6 340.0,167.0,103.0,86.1,73.4,56.7,46.2,38.9,33.6,26.4,24.0,	REFC0230
	7 20.2,16.4,12.8,9.5,8.2,405.0,170.0,104.0,86.1,73.6,56.8,	REFC0240
	8 46.3,38.9,33.7,26.5,24.1,20.3,16.5,12.8,9.5,8.2,421.0,	REFC0250
	9 171.0,104.0,86.6,73.9,57.1,46.4,39.0,33.8,26.8,24.3,20.5,	REFC0260
	A 16.6,13.0,9.8,8.4,446.0,172.0,105.0,87.4,74.0,58.0,46.6,	REFC0270
	B 39.2,34.0,27.0,24.6,20.7,16.7,13.0,10.0,8.4,	REFC0280
	DATA ED,RTDEG/0.01,2.0,4.0,5.0,6.0,8.0,10.0,12.0,14.0,18.,20.,	REFC0290
	124.,30.,40.,60.,90.,57.29578/	REFC0300
	DATA RD/0.01,10.,30.,60.,200.,400.,1000.,2000./	REFC0310
	IF(R.LE.0.0)GO TO 300	REFC0320
	RG=R/6080.27	REFC0330
	DO 100 IED=2,15	REFC0340
	I=17-IED	REFC0350
	IF(E.GE.ED(I))GO TO 120	REFC0360
100	CONTINUE	REFC0370
	I=1	REFC0380
120	DO 200 JRD=2,8	REFC0390
	J=10-JRD	REFC0400
	IF(RG.GE.RD(J))GO TO 220	REFC0410
200	CONTINUE	REFC0420
	J=1	REFC0430
220	IF(J.EQ.8)GO TO 340	REFC0440
	ZR=ALOG(RG/RD(J))/ALOG(RD(J+1)/RD(J))	REFC0450
	IF(E.LE.0.0)GO TO 320	REFC0460
	ZF=ALOG(E/RD(I))/ALOG(ED(I+1)/ED(I))	REFC0470
	DF1=((DE(I+1,J)-DE(I,J))*(1.-ZR)+(DE(I,J+1)-DE(I,J))*ZR)*ZF	REFC0480
	DE2=((DE(I,J+1)-DE(I,J))*(1.-ZF)+(DE(I+1,J+1)-DE(I,J+1))*ZF)*ZF	REFC0490
	DEE=DE1+DE2+DE(I,J)	REFC0500
	DP1=((DR(I+1,J)-DR(I,J))*(1.-ZP)+(DR(I,J+1)-DR(I,J))*ZP)*ZF	REFC0510
	DP2=((DR(I,J+1)-DR(I,J))*(1.-ZF)+(DR(I+1,J+1)-DR(I,J+1))*ZF)*ZF	REFC0520
	OPR=(DR1+DE2+DR(I,J))	REFC0530
	GO TO 400	REFC0540
400	DEE=0.0	REFC0550
	DRR=0.0	REFC0560
	GO TO 400	REFC0570
320	DFE=DE(I,J)+(DE(I,J+1)-DE(I,J))*ZR	REFC0580
	DRR=DR(I,J)+(DR(I,J+1)-DR(I,J))*ZF	REFC0590
	GO TO 400	REFC0600
340	DFLT=(E-ED(I))/(ED(I+1)-ED(I))	REFC0610
	DEE=DELT*(DE(I+1,J)-DE(I,J))+DE(I,J)	REFC0620
	DRR=DELT*(DR(I+1,J)-DR(I,J))+DR(I,J)	REFC0630
400	RETURN	REFC0640
	END	REFC0650
		REFC0660

APPENDIX L

SUBROUTINE ALREAD PROGRAM LISTING

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SUBROUTINE ALREAD(TSTART, TSTOP, TLIFT, INTARG, INPAT, NOPHA, NPTS, NPP,
1NEWPAS, NRG, ISTGAT)
  DIMENSION ALT(5), AMT(3,5), AZ(6), CALADD(4), CALCON(19), EL(6), IHD(13)
1, IMT(5), INGATE(5,3), IPRICE(5), ISENS(6), ISLIDE(5,3), ISPAC(5,3),
2ITARDT(5,3,3), ITARG(5), IWAVE(6), LOC(5,3,4), MODE(5,3), NC(4), NEX(2),
3NMODES(5,3), NPTEST(2), NSAMP(5,3), NSAMPT(5), POWER(6), RAD(6,5),
4RANGE(5), VEL(5), IFPAR(22)
  COMMON/TREAD/LN, IFLG, IBTRHD, FMTRHD, FMTRHA, FMTRTG, FMTRPI, FMTRSP,
1FMXSEC, FMARSG, FMRR11, FMGLOT, FMCHAF, FMBSMC, FMASLP, FMAMP(6), FMPHA(6)
2, NAME(25), NI(24), IX(24), TAMP(128,6), TPH(128,6), ITEM(2000)
  COMMON/TIMCOM/IHMS, IFS
  COMMON/RDCOM/TIMES(300), XSPHA(4,30,300), RANGKA(300), ALSAV(300),
1AZI(300), ELE(300), IRGA(30), IPOL(4), NPOL
  EQUIVALENCE (IHD(1), IDREC), (IHD(2), LREC), (IHD(3), ITGT1),
1(IHD(4), ITGT2), (IHD(5), IFPG), (IHD(6), IPRI), (IHD(7), NELRD),
2(IHD(8), HACYBA), (IHD(9), NTARG), (IHD(10), NTDEA), (IHD(11), NMINOR),
3(IHD(12), HICYBA), (IHD(13), LMICY), (IFPAR(1), FMTRHD),
4(RAD(1,1), POWER(1)), (RAD(1,2), AZ(1)), (RAD(1,3), EL(1)),
5(ITARDT(1,1,1), MODE(1,1)), (ITARDT(1,1,2), ISPAC(1,1)),
6(ITARDT(1,1,3), NSAME(1,1)), (IMT(1), IGCHG), (IMT(2), IGAIN),
7(IMT(3), NELS), (IMT(4), ISLEA), (IMT(5), NBP), (AMT(1,1), RANGE(1)),
8(AMT(1,2), VEL(1)), (AMT(1,3), ALT(1))
  DATA PCON, RKM, VKM/1.0E6, 1.873703E-3, 4.4672E-4/
  DATA NEX, NPTEST/0, 1, 300, 150/
  DOUBLE PRECISION DRANG, FINTIM, PPG, GMTIME, PRF, TIME(6), TIMES, TIMOLD,
1TLIFT, TSTART, TSTOP, 2TDIF(6)
  INTEGER*2 ITEM
  IF(NEWPAS.GT.2) GO TO 2000
  IF(NRG.GT.30) NRG=30
  NPCI=0
  DO 10 I=1,4
  IF(IPOL(I).NE.0) NPOL=NECL+1
10 CONTINUE
  GMTIME=TSTART-1.0
  NPTS=0
  TINC=0.0
  NTERR=0
  CALL THEAD(NEWPAS, 89960)
  DO 60 I=1,6
  IF(IFPAR(I).GT.0) GO TO 60
  WRITE(6,40) NAME(I)
40 FORMAT(' FORMAT TABLE ',A4,' WAS NOT FOUND - RUN ABORTED.')
  NEWPAS=55
  RETURN
60 CONTINUE
80 DO 100 I=2,19
  CALCON(I)=GET(FMXSEC, IBTRHD, I)
100 CONTINUE
  TLIFT=0.0
  ITL=IGET(FMGLOT, IBTRHD, 1)
  IF(ITL.NE.2) GO TO 140
  IHMS=IGET(FMGLOT, IBTRHD, 2)
  IFS=IGET(FMGLOT, IBTRHD, 3)
  CALL GMTUPK(TLIFT)
  GO TO 140

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120 CALL BREAD(1)
140 IHD(1)=IGET(FMTRHD,IBTRHD,1)
    IF((IDREC.LT.127).AND.(IFIG.NE.3))GO TO 180
    WRITE(6,160)GMTIME
160 FORMAT(' END OF FILE ENCOUNTERED ON INPUT TAPE AFTER TIME ',F12.4)
    NEWPAS=44
    RETURN
180 IF(IDREC.NE.2)GO TO 120
    TIMOLD=GMTIME
    DO 200 I=2,13
    IHD(I)=IGET(FMTRHD,IBTRHD,I)
200 CONTINUE
    IHMS=ICFT(FMTRHD,IBTRHD,14)
    IFS=IGET(FMTRHD,IBTRHD,15)
    CALL GMTUPK(GMTIME)
    IF(GMTIME.LT.(TSTART-0.20))GO TO 120
    IF((GMTIME.GT.TIMOLD).AND.(MACYBA.EQ.0).AND.(NTDBA.EQ.0))GO TO 120
    NCONT=0
    IF(((DABS(TIMOLD-GMTIME)).GT.0.01).AND.(NTDBA.NE.0))GO TO 280
    IF(NTIEFR.NE.0)GO TO 120
    NCONT=1
    GO TO 1200
280 FINTIM=GMTIME
    TIMOLD=GMTIME
    NFP=IFPG+1
    DO 300 I=1,5
    NSAMPT(I)=0
300 CONTINUE
    PRF=PCON/FLOAT(IPFI)
    TINK=1./PRF
    IF(NBLRD.EQ.0)GO TO 600
    NBLRDC=NBLRD
    DO 500 I=1,NBLRD
    IBTRMA=IBTRHD+MACYBA+24*(I-1)
    DO 400 K=1,3
    RAD(I,K)=GET(FMTRMA,IETRMA,K)
400 CONTINUE
    IHMS=IGET(FMTRMA,IBTRMA,4)
    IFS=IGET(FMTRMA,IETRMA,5)
    CALL GMTUPK(TIME(I))
    ISENS(I)=IGET(FMTRMA,IBTRMA,6)
    IWAVE(I)=IGET(FMTRMA,IETRMA,7)
    IF(IWAVE(I).EQ.4)IWAVE(I)=3
    IF(IWAVE(I).GT.3)IWAVE(I)=0
500 CONTINUE
    NCHANZ=IFPG
    IF(IFPG.EQ.1)NCHANZ=NCHANZ+3
    DO 560 IP=1,NECL
    NC(IF)=NCHANZ+IPCI(IF)
    DO 520 I=1,NOPHA
    INDEX=(I-1)*6+NC(IF)+12
    IF(IFPAR(INDEX).GT.0)GO TO 520
    WRITE(6,40)NAME(INDEX)
    NEWPAS=66
    RETURN

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```

520  CONTINUE
      KCNGET=3*(NC(IP)-1)+IWAIVE(1)+1
      CALADD(IP)=CALCON(KCNGET)-POWER(1)-FLOAT(10*ISENS(1))
560  CONTINUE
600  IF(NTARG.EQ.0)GO TO 120
      ITPIK=0
      NBPTST=0
      DO 900 I=1,NTARG
        IBTRTC=IBTRHD+NTDBA+12*(I-1)
        ITARG(I)=IGET(FMTRTG,IBTRTG,1)
        IPRICE(I)=IGET(FMTRTG,IBTRTG,2)
        NK=1
        DO 800 K=1,3
          IK=NK+1
          NK=IK+2
          DO 700 L=1,3
            ITARDT(I,K,L)=IGET(FMTRTG,IBTRTG,I+IK)
700  CONTINUE
        IF(ISPAC(I,K).EQ.254)ISPAC(I,K)=-1
        ISPAC(I,K)=2**ISPAC(I,K)+NEX(IPPG+1)
        IF(ISPAC(I,K).EQ.0)ISPAC(I,K)=1
        NSAMPT(I)=NSAMPT(I)+NSAME(I,K)
        NMODES(I,K)=0
        DO 780 I=1,4
          LOC(I,K,L)=0
          MODUM=MOD(MODE(I,K),2)
          IF(MCEUM.EQ.0)GO TO 760
          NMODES(I,K)=NMODES(I,K)+1
          LOC(I,K,L)=NMODES(I,K)
760  MODE(I,K)=MODE(I,K)/2
780  CONTINUE
        ISLIDE(I,K)=2*NSAMP(I,K)*NMODES(I,K)
        NBPST=NBPTST+ISLIDE(I,K)
800  CONTINUE
        DO 820 J=1,3
          INGATE(I,J)=IGET(FMTRTG,IBTRTG,J+11)
820  CONTINUE
        IF(ITARG(I).EQ.INTARG)ITEIK=I
900  CONTINUE
        NBPST=NBPTST-MOD(NBPTST,6)
        NTERR=0
        IF(ITPIK.GT.0)GO TO 960
        WRITE(6,920)GMTIME,INTARG,(ITARG(I),I=1,NTARG)
920  FORMAT(' AT TIME =',F12.4,' TARGET ',I2,' IS NOT ON THE TAPE, TA
        RGETS AVAILABLE ARE ',5I3)
        IBTRMI=IBTRHD+MICYEA
        NBP=IGET(FMTRMI,IBTRMI,5)
        IF(NBP.EQ.NBPTST)GO TO 10000
        NTERF=1
        GO TO 120
960  IF(NMODES(ITPIK,INPAT).GE.NECL)GO TO 1020
        WRITE(6,1000)
1000  FORMAT(' EITHER POLARIZATION OR PATTERN CHOSEN IS NOT AVAILABLE')
        GO TO 10000
1020  IF(ISTGAT.GT.NSAME(ITEIK,INPAT))ISTGAT=i

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IF (ISTGAT.LT. 1) ISTGAT=1
NSTEST=NSAMP (ITPIK, INPAT) - ISTGAT+1
NSTGAT=ISTGAT
IPAT=INPAT
I=1
1040 IRGA (I) =INGATE (ITPIK, IPAT) + (NSTGAT-1) *ISPAC (ITPIK, IPAT)
NSTGAT=1
1060 IF (I.GE.NRG) GO TO 1100
IF ((I+1).GT.NSTEST) GO TO 1080
I=I+1
IRGA (I) =IRGA (I-1) +ISPAC (ITPIK, IPAT)
GO TO 1060
1080 IPAT=IPAT+1
IF (IPAT.GT.3) GO TO 1100
IF (NSAMP (ITPIK, IPAT).IE.0) GO TO 1080
NSTEST=NSTEST+NSAMP (ITPIK, IPAT)
IF (NMCDER (ITPIK, IPAT).LT.NPOL) GO TO 1100
I=I+1
IF (I.LE.NRG) GO TO 1040
I=I-1
1100 IPAT=INPAT
NRG=I
1200 IBTRMI=IBTRHD+MICYEA
DO 2200 MIN=1, NMINOF
IF (MIN.LE.1) GO TO 1220
IBTRMI=IBTRMI+LMICY+NPLS*NBP
1220 DO 1240 I=1,5
IMT (I) =IGET (FMTRMI, IBTRMI, I)
1240 CONTINUE
IF (NBP.FQ.NBPTST) GO TO 1280
WRITE (6, 1260) GMTIME, PIN, NBP, NBPTST
1260 FORMAT (' AT TIME = ', F10.4, ', MINOR CYCLE ', I1, ' SOMETHING IS SCRE
WED UP NBP = ', I5, ' IT SHOULD BE ', I4, ' - SHOOT HARTOGENSIS')
GO TO 1330
1280 IF (NPLS.GE.1) GO TO 1340
WRITE (6, 1320) NPLS, MIN, NMINOF
1320 FORMAT (' NPLS = ', I2, 3X, 'MINOR CYCLE ', I1, 3X, I1, ' MINOR CYCLES')
1330 GMTIME=GMTIME+TINC
GO TO 120
1340 TINC=FLCAT (NPLS) /PRF
DO 1500 L=1, NTARG
IBTRMT=IBTRMI+ (L-1) *12
DO 1400 I=1,3
AMT (L, I) =GET (FMTRMI, IBTRMT, I+5)
1400 CONTINUE
VEL (L) =VEL (L) *VKM
1500 CONTINUE
IBTRMT=IBTRMI+ (ITPIK-1) *12
NSDREI=IGET (FMTRMI, IBTRMT, 9)
NSDUM=NSAMPI (ITPIK)
IF (NRG.LT.NSDUM) NSDUM=NRG
DRANG=RANGE (ITPIK)
IF (DRANG.GT.0.0) GO TO 1560
WRITE (6, 1540) GMTIME, DRANG
1540 FORMAT (' AT TIME = ', F15.4, ' THE RANGE = ', 1PE20.6)

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DFANG=1.0
1560 DRANG=40.*DLOG10(ERANG)
CALIP=DRANG+FLOAT(IGAIN)
DC 2000 I=1,NPLS
IF((MIN.GT.1).OR.(I.GT.1)) FINTIM=FINTIM+TINK
IF(ISTART.GT.FINTIM)GO TC 2000
NPTS=NPTS+1
IF(NPTS.GT.1)GO TO 1600
1580 TIMES(NPTS)=FINTIM
GO TO 1620
1600 IF((I.EQ.1).AND.(MIN.EQ.1).AND.(NCONT.EQ.0))GO TO 1580
TIMES(NPTS)=TIMES(NPTS-1)+TINK
1620 RANGKM(NPTS)=RANGE(ITPIK)*RKM+VEL(ITPIK)*(TIMES(NPTS)-FINTIM)
ALSAV(NPTS)=ALT(ITPIK)
IF(NELRD.NE.0)GO TO 1630
INTEFF=NELRIC
GO TO 1650
1630 ZTDIF(1)=DABS(TIMES(NPTS)-TIME(1))
INTEFF=1
DO 1640 NAE=2,NBLRD
ZTDIF(NAE)=DABS(TIMES(NPTS)-TIME(NAE))
IF(ZTDIF(NAE).LE.ZTDIF(NAE-1))INTERP=NAE
1640 CONTINUE
1650 AZI(NPTS)=AZ(INTERP)
EIF(NPTS)=EL(INTERP)
ISAMPT=IBTRHD+ISEFA+ISEREI+(I-1)*NBF
NSTEST=NSAMP(ITPIK,INPAT)-ISTGAT+1
IAD=0
IF(INPAT.EQ.1)GO TO 1680
JST=INPAT-1
DO 1660 J=1,JST
IAD=IAD+ISLIDE(ITPIK,J)
1660 CONTINUE
1680 L=ISTGAT-1
DO 1800 K=1,NRG
L=L+1
IF(K.LE.NSTEST)GO TO 1700
IAD=IAD+ISLIDE(ITPIK,IPAT)
IPAT=IPAT+1
NSTEST=NSTEST+NSAMP(ITPIK,IPAT)
L=1
1700 DO 1780 IP=1,NPOL
IPIK=ISAMPT+IAD+2*(LOC(ITPIK,IPAT,IPOL(IP))-1+NMODES(ITPIK,IPAT)
1*(L-1))
IAMP=IGET(FMTRSP,IPIK,1)
IF((IAMP.LT.1).OR.(IAMP.GT.128))IAMP=1
XSPHA(IP,K,NPTS)=TAMP(IAMP,NC(IP))+CALIB+CALADD(IP)
1740 IF(NCFHA.EQ.1)GO TO 1780
IPHA=IGET(FMTRSP,IPIK,2)
IF((IPHA.GE.0).AND.(IPHA.LE.127))GO TO 1760
XSPHA(IP,K,NPTS+150)=0.0
GO TC 1780
1760 XSPHA(IP,K,NPTS+150)=TPH(IPHA+1,NC(IP))
1780 CONTINUE
1800 CONTINUE

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```
IPAT=INPAT
IF(ISTOP.LT.TIMES(NPTS))GO TO 10000
IF(NPTS.LI.NPTEST(NCPHA))GO TO 2000
NEWPAS=99
RETURN
2000 CONTINUE
2200 CONTINUE
GC TO 120
9960 WRITE(6,9980)
9980 FORMAT(' THEAD HAS DEFAULTED - RUN HAS BEEN ABORTED. ')
1000C NEWPAS=0
RETURN
END
```