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AD 913124

Project Report

PA-229-8
(RSP)

Data Reduction Program Documentation ALCTAP

(Effective: April 1971)

C. R. Berndtson
R. H. French
D. E. Nessman

19684

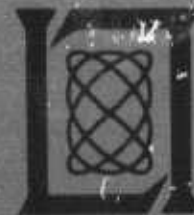
5 May 1971

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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MASSACHUSETTS INSTITUTE OF TECHNOLOGY
LINCOLN LABORATORY

6 DATA REDUCTION PROGRAM DOCUMENTATION
ALCTAP

(EFFECTIVE: APRIL 1971).

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Editors

14 PA-229-8

9 PROJECT REPORT, PA-229-8 (RSP)

11 5 MAY 1971

12 43p.

15 F-19628-70-C-0230, ARPA Order-600

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The work reported in this document was performed at Lincoln Laboratory, a center for research operated by Massachusetts Institute of Technology. This work was sponsored by the Advanced Research Projects Agency of the Department of Defense (ARPA Order 600), the Department of the Army, and the Department of the Air Force under Air Force Contract F19628-70-C-0230.

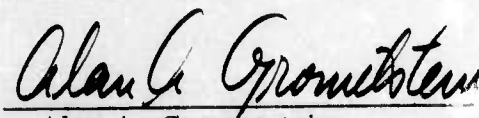
Unclassified

FOREWORD

This is the eighth 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 No implication is made that this program will not subsequently be modified, amended, or superseded; on the contrary, the history of radar data processing is one of continuous evolution of techniques, and it is unrealistic to assume that steady-state has been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 G. L. Shapiro (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

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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
ALCOR	ARPA-Lincoln C-band Observables Radar
ALTAIR	ARPA Long-Range Tracking and Instrumentation Radar
Alt	Altitude (km)
APS	Average Pulse Shape
ARS	ALTAIR Recording System
Avg	Average, Averaging
Az	Azimuth (deg)
c	Speed of Light
CADJ	Adjusted Calibration Constant (db)
C-band	ALCOR frequency, 5664 MHz (NB) and 5667 MHz (WB)
DBLT	Wide Band Pulse Doublet
El	Elevation (deg)
EOF	End of File
GMT	Greenwich Mean Time
h	Hours
Hz	Hertz
IF	Intermediate Frequency
in	Inches
LC	Left Circular Polarization
lsb	Least Significant Bit
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)
$\dot{R}$	Range Rate (km/s)
rad	Radians
RC	Right Circular Polarization
RCS	Radar Cross Section (dbsm)
RF	Radio Frequency
s	Seconds
SD_w	Standard Deviation of Wake Velocity
SDBLT	Wide Band Slaved Pulse Doublet
S/N	Signal-to-noise Ratio
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
WBS	Wide Band Slaved
WTR	Western Test Range
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

ALCTAP

1. PURPOSE and UTILIZATION

A. Source of Data

ALCOR¹

B. Data Input

ALCOR Data Tape (ADT)

C. Description

ALCTAP is designed to obtain RCS data on waking targets (NB and WB) and on multiple radar scattering centers (WB). It computes LC and RC RCS for up to 170 range cells. It is usually run every 0.1 s with the data averaged over 0.1 s.

radar cross section
narrowband and wideband
wideband

D. Output

1. A listing of RCS data (LC and RC) for up to 60 gates. #
2. Plots of RCS vs relative range ## for each averaging interval (optional). This is a non-coherent Average Pulse Shape (APS) which gives the relative position and intensity of radar scattering centers (WB) and non-coherent body and wake RCS (NB and WB). #
3. Punched cards containing Alt and peak RCS over a pre-selected set of range gates (optional). These cards are edited and then used in a plotting program to produce the peak wake plot.
4. Plots of LC and RC peak wake RCS vs Alt to aid in editing cards for final plots.

*left and right circular polarization
radar cross sections*

[#] Separate listings and plots are produced for each range offset for WB tapes if requested.

^{##} The range span is determined by selecting initial and final gates.

II. DESCRIPTION

ALCTAP computes average RCS as a function of range gate and time. ALCTAP will process both RC and LC channels in one run for the printout, punched cards, and peak wake plots, but will only produce APS plots for one selected polarization/run. The program averages in m^2 and then converts to dbsm for printouts and plots.

The averaging interval and skip time are selected by the number of pulses to be averaged (INTAV) and the number of pulses to be skipped (ISKIP). Since averaging interval (s) = INTAV/PRF, and skip interval (s) = ISKIP/PRF, the averaging interval and skip interval will change whenever the PRF changes.

Only primary pulses (pulses with zero range offset) are included in INTAV, ISKIP, and PRF.

For wide band slaved (WBS), doublet (DBLT), and slaved doublet (SDBLT) waveforms, the program will average or skip all inclusive slaved or slaved doublet pulses with the same range offsets. This means that all non-primary pulses[#] should be ignored when averaging and skip intervals are being determined, since the program will handle these pulses automatically.

RCS is computed as follows:

$$LC \text{ RCS} = XATBL(N) + 40 \log R + XPPAGC + CONLC - POWER T$$

$$RC \text{ RCS} = XATBL(M) + 40 \log R + XOPAGC + CONRC - POWER T$$

where

XATBL(N) is obtained by indexing the LC calibration table with the LC amplitude values obtained in the ADT data record.¹

XATBL(M) is obtained by indexing the RC calibration table with the RC amplitude values obtained in the ADT data record.¹

[#] Pulses offset in range.

XPPAGC is total LC attenuation (db)²

XOPAGC is total RC attenuation (db)²

CONLC[#] and CONRC[#] are calibration constants (db) obtained from
Calibration Record Words 624 (NB LC), 625 (NB RC),
627 (WB LC), and 628 (WB RC)

POWER_T (peak transmit power in dbw) for NB
= PWRCN + PWRSN log XPKPWR

POWER_T for WB
= PWRSN + PWRSW log XPKPWR

where

PWRCN is Calibration Record Word 620

PWRSN is Calibration Record Word 621

PWRCW is Calibration Record Word 622

PWRSW is Calibration Record Word 623

XPKPWR is ADT Record Byte 344

R, Az, and El are corrected as follows:

$R = IRANGE + TRBIAS + TTCOR + RRCOR - RCORF$

$Az = IAZ + AZBIAS$

$El = IEL + ELBIAS - ECORF$

where

IRANGE is uncorrected R

TRBIAS is range bias

$TTCOR$ (transit time correction) = $\frac{RR}{c}$

RRCOR is range doppler coupling correction

RCORF is tropospheric refraction correction

IAZ is Az encoder angle

AZBIAS is Az bias (Calibration Record Word 602)

[#] Called KRCS (LC) and KRCS (RC) on output listing.

IEL is El encoder angle

ELBIAS is El bias (Calibration Record Word 603)

ECORF is tropospheric refraction correction

Alt is computed as follows:

$$\text{Alt} = (R^2 + R_e^2 + 2 R R_e \sin \text{El})^{\frac{1}{2}} - R_e$$

where R_e = radius of earth (6378.145 km)

Before processing, the main program checks that ITBAND (tape) = IBAND (input). This determines that if WB data is requested, WB data exists on the tape requested.

III. OPERATION

A. Input

Launch time (total GMT ms)

Waveform and polarization (APS only) _____

Averaging interval (pulses)

Skip interval (pulses)

Start and stop range gates for listing, APS plots, and peak wake
RCS search

First and last pulse nos. of processing intervals

No. of processing intervals

Scale factors for APS plots

Glitch remover (only used when site has serious problem with
A/D counter)

Options for plotting, punching, and deleting non-primary pulses
from output

A sample input is shown in Appendix A.

CARD 1 (I10, 12I5, 1X, A4)

(Col.)

1-10	ILNCH	Launch time in total GMT ms
11-15	NCELL1 [#]	Initial gate for APS plot (1)
16-20	NCELL2 [#]	Final gate for APS plot (170)
21-25	NBAND	0 = NB; 1 = WB
26-30	IPOLAR	0 = LC APS only; 1 = RC APS only
31-35	IPLOT	0 = APS plots; 1 = no APS plots
36-40	ICELP1 [#]	Initial gate for listing (46) ^{##}
41-45	ICELP2 [#]	Final gate for listing (105)

[#] If left blank, program sets to indicated value.

^{##} Program will not list more than 60 gates.

(Col.)

46-50	INTAV	No. of pulses in averaging interval
51-55	ISKIP	No. of pulses between averaging intervals
56-60	IPEAK1 [#]	Initial gate for search for peak wake RCS (54) ^{##}
61-65	IPEAK2 [#]	Final gate for search for peak wake RCS (90)
66-70	NVALS	No. of processing intervals
72-75	TITL	Title for listing and plots

CARD 2 (2F10.3, 3110)

1-10	DBB [#]	Minimum value for ordinate of plots (-60 dbsm)
11-20	DBT [#]	Maximum value for ordinate of plots (+40 dbsm)
21-30	IPKAD [#]	A/D count limit (130)
31-40	IPUNC	0 = punched peak wake cards 1 = no punched cards
41-50	IPRIME	0 = All pulses are output 1 = Primary pulses only are output

CARD 3 (6110)

1-10	NSTART	First pulse no. of initial processing interval
11-20	NSTOP	Last pulse no. of initial processing interval
21-30	NSTART	First pulse no. of second processing interval
31-40	NSTOP	Last pulse no. of second processing interval
41-50	NSTART	First pulse no. of third processing interval
51-60	NSTOP	Last pulse no. of third processing interval

Repeat Card 3 as necessary.

[#] If left blank, program sets to indicated value.

^{##} Only primary pulses used to determine peak wake RCS.

B. Output

LISTING

Selected input parameters

First and last pulse nos. # in averaging interval (includes primary and offset pulses)

KRCS (LC) and KRCS (RC) ##

No. of pulses averaged

TAL, GMT total s, and GMT h, min, s, and ms

R, $\hat{R}$, range offset, Alt, AGC (dbsm)[†]

Average RCS^{††} (LC and RC) for each range gate selected in ICELP1 and ICELP2

APS PLOTS

RCS vs relative range (m)

PEAK WAKE PLOTS

Peak Wake RCS vs Alt

PUNCHED PEAK WAKE DATA

CARD 1: Polarization (A2), bandwidth (2X, A2), Title (2X, A4)

CARD 2: Alt (F10.3), RCS (F10.3)

A set of Alt and RCS cards are produced for each polarization.

Sample outputs are given in Appendix B.

Called PRI (start) and PRI (stop) in listing.

Also called CONLC and CONRC.

[†] AGC is the total LC or RC attenuation, depending on the polarization selected for APS plots.

^{††} For each range offset.

IV. PROGRAM LIMITATIONS

NVALS ≤ 50 processing intervals

[ICELP2 - ICELP1] ≤ 60 gates

Length of run ≤ 2000 averaging intervals

No. of range offsets on tapes during averaging interval must not exceed 20 (including 0 offset). If greater than 20, only first 20 will be processed.

V. PROGRAMMING

A. TAPALC (see Appendices C and D.)

TAPALC is the control section of ALCTAP. TAPALC reads the input cards, makes the call to READJS, and averages the data returned. TAPALC separates the pulses according to range offset, searches for the peak response, and saves this value along with its corresponding altitude. TAPALC also calls the subroutines that plot and print the data.

B. HEDADT (see Appendix E.)

Subroutine HEDADT unpacks the ADT header record which contains bandwidth, reel no., WTR no., date of mission, and mission designator. The call statement is HEDADT [ISIG,[#] INBUF(1), IEQM(1)] .

INPUT

INBUF(1) First word in the ADT header record^{##}

OUTPUT

IEQM(1)	IZBAND	(bandwidth: 1 = WB, 0 = NB)
IEQM(2)	ITREEL	(reel no.)
IEQM(3)	ITWTR	(WTR no.)
IEQM(4)	IMTH	} (Date of test)
IEQM(5)	IDAY	
IEQM(6)	IYR	
IEQM(7-9)	ITDFSG	(mission designator)

C. READJS²

The first call to subroutine READJS opens the file and reads the ADT header record. The second call to READJS reads the ADT calibration record and

[#] Not used.

^{##} INBUF (2) to INBUF (1803) contain the remaining words in the record.

stores the values in a buffer area. TAPALC extracts the individual calibration values it requires. Each subsequent call to READJS reads an ADT data record consisting of eight ALCOR pulses.

D. UNPACK²

Subroutine UNPACK unpacks the raw data from the ADT, and translates it into a format usable by the IBM 360/67 computer.

E. REFC (see Appendix F.)

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 El (must be between 0° and 90°)
R	Uncorrected R (<u>ft</u>)
DEE	El tropospheric correction
DRR	R tropospheric correction (<u>ft</u>)

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

El	= E - DEE
R (<u>ft</u>)	= R - DRR

F. PLOTT

Subroutine PLOTT plots the APS and peak wake RCS plots.

REFERENCES

1. "ALCOR Data Users Manual", LM-86, Lincoln Laboratory, M.I.T. (17 June 1970), UNCLASSIFIED.
2. "Data Reduction Program Documentation, ALCOR Tape Read Package, (Effective: April 1971)", PA-229-7, Lincoln Laboratory, M.I.T. (26 April 1971), UNCLASSIFIED.
3. J.P. Penhune, "Refraction Corrections for the TRADEX Radar", PPP-36, Lincoln Laboratory, M.I.T. (21 April 1965), UNCLASSIFIED.

APPENDIX B

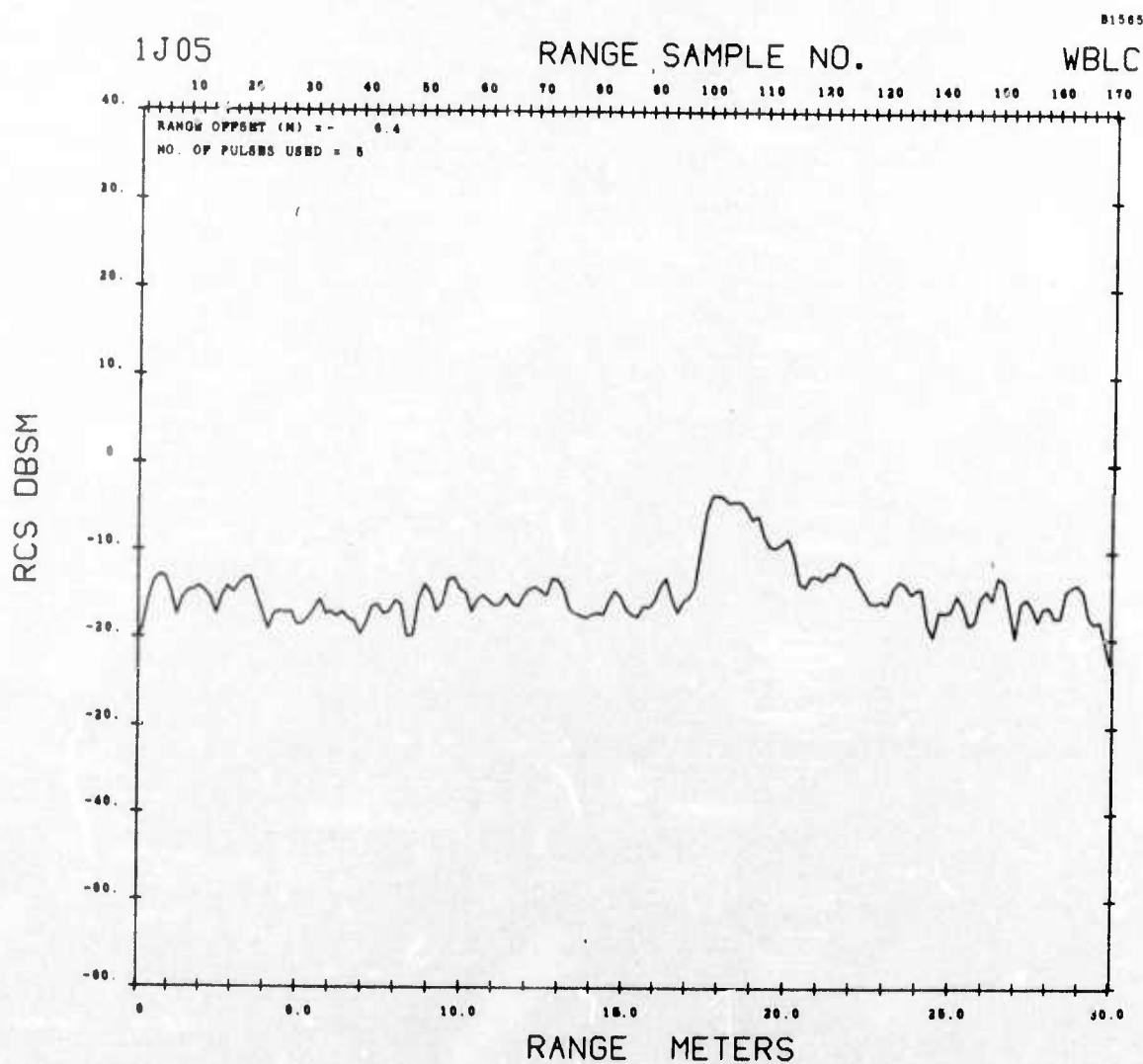
```
TAP-ALCOR  POLAR = LC  BAND = W3  REEL NO. = 1  TITLE = LJ05  DATE = 2/28/71
CELL BEGIN (PLOT) = 1  CELL BEGIN (PRINT) = 46  CELL BEGIN (PEAK) = 54  KRCS(LC) = -85.500  IRANO = 1  IPLOT = 0
CELL END (PLOT) = 170  CELL END (PRINT) = 105  CELL END (PEAK) = 90  KRCS(RC) = -85.600  IPOLAR = 0
INTAV = 10  ISKIP = 3
```

START	STOP	START	STOP	START	STOP
8209	8729				

LIFT OFF TIME = 21600.838

*TIME (GMT)	6 24 0. 63	TSEC 23040.063	TA	1439.225	RANGE(KM)	1158.130	3.OFFSET(M) =	η.0	ROOT	HEIGHT {KM}	464.5
	AGC(083M) =		0.0	PRI(STOP)	8209	PRI(STOP)	8222	NO.PULSES =	10.0	ROOT	HEIGHT {KM}
RANGE GATES			46	47	48	49	50	51	52	53	54
LC			-14.1	-14.2	-14.5	-11.8	-7.5	-3.7	-2.2	-1.7	-1.0
RC			-10.9	-9.4	-8.6	-8.4	-9.7	-10.5	-9.7	-7.5	-5.4
RANGE GATES			61	62	63	64	65	66	67	68	69
LC			-10.6	-12.1	-15.5	-17.3	-15.4	-17.0	-16.3	-15.9	-14.3
RC			-3.6	-7.2	-10.9	-11.5	-10.3	-9.8	-9.3	-10.9	-10.9
RANGE GATES			76	77	78	79	80	81	82	83	84
LC			-11.0	-15.8	-15.8	-14.3	-13.0	-12.3	-14.1	-14.9	-15.1
RC			-16.4	-12.0	-9.5	-8.7	-10.2	-12.1	-11.6	-11.0	-9.0
RANGE GATES			91	92	93	94	95	96	97	98	99
LC			-15.9	-16.7	-17.3	-17.0	-16.6	-16.4	-15.3	-15.0	-14.1
RC			-13.4	-11.2	-9.7	-9.1	-8.7	-9.7	-11.1	-10.7	-10.3
RANGE GATES			100	101	102	103	104	105	106	107	108
LC			-14.5	-14.7	-14.4	-15.9	-15.7	-15.8	-15.7	-15.8	-15.8
RC			-10.6	-11.0	-10.6	-11.0	-10.6	-11.0	-10.6	-11.0	-10.6

TAL	C.O.	PRI(START)	RANGE(KM)	1158.830 PRI(STOP)	8222	NJ.PULSES =	R.OFFSET(M) =	30.0	XDOT	M/SEC.)	HEIGHT {KM}	464.5	
46	47	48	49	50	51	52	53	54	55	56	57	58	60
-15.5	-14.0	-12.8	-15.7	-20.1	-16.7	-18.2	-18.3	-17.4	-18.2	-19.2	-16.7	-15.8	-15.7
-6.1	-6.5	-7.9	-9.0	-9.8	-8.5	-9.4	-10.2	-11.6	-9.7	-7.0	-5.7	-7.8	-13.1
-16.4	-17.9	-18.4	-15.4	-13.0	-12.6	-13.6	-18.6	-17.7	-15.0	-14.3	-11.8	-12.1	-12.0
-11.3	-10.5	-11.8	-10.1	-10.0	-10.8	-12.6	-13.1	-11.4	-10.3	-10.5	-10.9	-10.6	-13.1
76	77	78	79	80	81	82	83	84	85	86	87	88	90
-14.8	-17.7	-17.0	-15.4	-14.4	-15.6	-17.6	-15.1	-15.8	-15.4	-15.4	-14.3	-15.7	-16.3
-11.6	-10.5	-9.5	-10.1	-11.4	-10.9	-10.6	-12.9	-12.8	-12.0	-11.3	-8.8	-7.8	-9.2
91	92	93	94	95	96	97	98	99	100	101	102	103	104
-12.1	-12.5	-14.8	-15.6	-17.5	-17.2	-15.4	-14.8	-14.9	-15.2	-13.8	-14.3	-13.0	-13.3
-11.5	-9.0	-7.2	-8.1	-7.5	-8.8	-10.8	-11.6	-11.2	-9.6	-9.8	-10.8	-9.0	-8.4



PRI START-STOP

0026

0042

GWT

0 24 5 653

TAL (SBC)

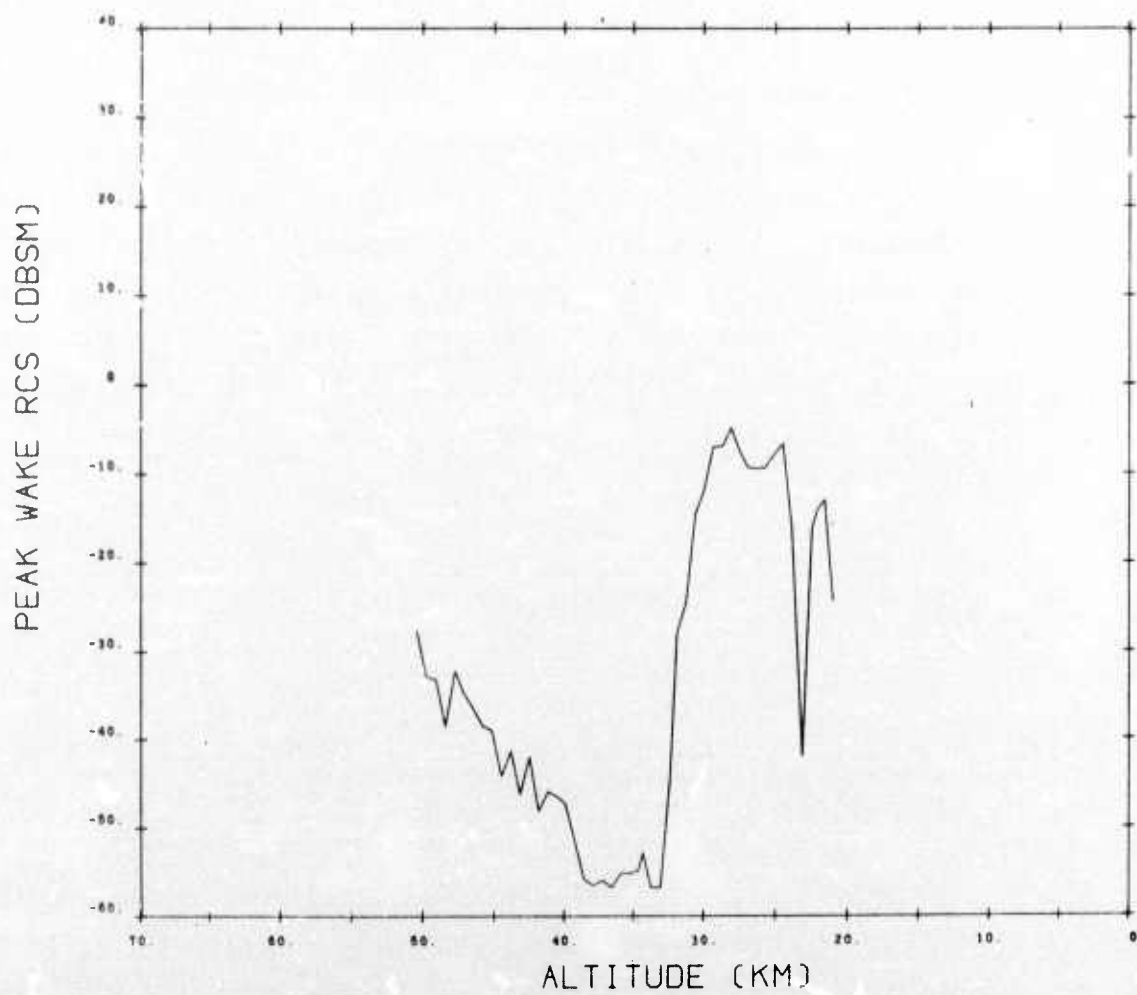
1444.82

ALTITUDE(KM)

452.6

1J05

NBRC



Polarization

Bandwidth

Title

LC WB 1J19

CARD 1

[illegible]

Alt	RCS
624.309	-2.971

CARD 2

[illegible]

APPENDIX C TAPALC PROGRAM LISTING

```

C      DOUBLE PRECISION XLNCH,D1000,TAL,TCTL,TALBEG,TOTBEG

      DIMENSION NSTART(50),NSTOP(50)
      DIMENSION XLCSUM(20,170),XRCSUM(20,170),IAVLC(20,170),IAVRC(20,170
1),XATBL(128),XLCDB(170),XRCDB(170),ILCAMP(170),IRCAMP(170)
2,ILCPHA(170),IRCPHA(170),YPRNT(170)
      DIMENSION IOUT(170),QBIAS(8)
      DIMENSION XNBUF(1803),PIFA(16),OIFA(16),XKRCS(5)
      DIMENSION IEQM(9),ITDESG(3),XSRANG(20)
      DIMENSION IJCONT(20)

C      COMMON/ICOM/INPUF(1803),IAZ,IEL,INDEX,IPPRCS,ICRS,IRANGE,IPKPWR,IR
      IDOT,IALT,INDAZ,JNDAZ,INDEL,IRB54,IRB85,ICPRCS,I240B1,I240B2,I240B3
1,I241B1,I241B2,I241B3,XPPAGC,IBETA,NEWA,IBAND,NSW,RBIAS(8),ISVPRI,
1IHRS,IMIN,ISEC,IMSEC,ISTAT(21),TRBIAS,ISTAT1,ISTAT2,ISTAT3,ISTAT4,
1IALSW,ISTSW,NBWB,ISIGNC,I27B12,JCON,NBEG,NEND,ITST,NUMPRI,XOPAGC,
1ITBAND,ITAPNC,IPRF,IPOLAR,ISSERR,PIFA,CIFA,PESA,OFSA,PSSA,CSSA,
1PSSL,OSSL,ICCDF,I27B5,I27B6,I27B7,I27B8,IMCVP,IMCVC,IUFFST,
1IDAT(682)
      COMMON /ICLZ/ JJ,TITL,ALTI(2000),YLC(2000),YRC(2000)

C      EQUIVALENCE (ILCAMP(1),IDAT(1)),(ILCPHA(1),IDAT(171)),(IRCAMP(1),
1IDAT(341)),(IRCPHA(1),IDAT(511))
      EQUIVALENCE(XNPUF(1),INBUF(1))
      EQUIVALENCE (IEQM(1),IZBAND),(IEQM(2),ITREEL),(IEQM(3),ITWTR),
2(IEQM(4),IMTH),(IEQM(5),IDAY),(IEQM(6),IYR),
3(IEQM(7),ITDESG(1))

C      DATA ZLC/'LC','ZRC/'RC','ZWB/'WB','ZNB/'NB'
      DATA IFRST1/0/,IFRST2/0/,IFRST3/0/,IFRST4/0/
      DATA ER /6378.145/,D1000/1000.00/
      DATA IBLANK/' ','IASTR/'*

C      IPOLAR = 0 LEFT CIRCULAR DATA REQUESTED
C      IPOLAR = 1 RIGHT CIRCULAR DATA REQUESTED
C      NBAND = 0 NARROW BAND DATA REQUESTED
C      NBAND = 1 WIDE BAND DATA REQUESTED
C      IPLCT = 0 SC4060 PLOTS
C      IPLCT = 1 NO SC4060 PLOTS
C      IPUNC = 0 PUNCH ALT. VS RCS CARDS
C      IPUNC = 1 NO PUNCHED CARDS
C      NEWA = 0 MISSION FLOWN BEFORE 15 OCT 70 (OLD ATTN.)
C      NEWA = 1 MISSION FLOWN AFTER 15 OCT 70 (NEW ATTN.)

C      READ(5,1)ILNCH,NCELL1,NCELL2,NBAND,IPOLAR,IPLCT,ICELP1,ICELP2,
1INTAV,ISKIP,IPFAK1,IPEAK2,NVALS,TITL,DBB,DBT,IPKAD,IPUNC,Iprime,
2(NSTART(1),NSTOP(1),I=1,NVALS)
1 FORMAT(I10,I2I5,1X,A4/2F10.3,3I10/(6I10))
      NNSET=ISKIP

```

```

C      IEOF=0
      IERR=0
      CALL READJS(INRUF,IEOF,IERR)
      ISIG=1
      CALL HEDADT (ISIG,INBUF(1),IEQM(1))
      ITBAND=IZBAND
      NEWA=0
      IF(IYR.GT.70)GO TO 282
      IF(IYR.LT.70)GO TO 283
      IF(IMTH.GT.10)GO TO 282
      IF(IMTH.LT.10)GO TO 283
      IF(IDAY.LT.15)GO TO 283
282 NEWA=1
283 CCNTINUE
      IERR=0
      CALL READJS(INRUF,IEOF,IERR)

C
C      STORE THE DESIRED CALIBRATION VALUES
C
      N=0
      DO 20 K=256,383
      N=N+1
20  XATBL(N)=XNBUF(K)

C
      N=0
      DO 22 K=512,527
      N=N+1
22  PIFA(N)=XNBUF(K)
      N=0
      DO 23 K=528,543
      N=N+1
23  OIFA(N)=XNBUF(K)

C
      PFSA=XNBUF(592)
      PSSA=XNBUF(593)
      OFSA=XNBUF(594)
      OSSA=XNBUF(595)

C
      ABIAS=XNBUF(602)
      EBIAS=XNBUF(603)
      DEGCON=(180.*.0479369)/3141.59
      AZBIAS=DEGCON*ABIAS
      ELBIAS=DEGCON*EBIAS

C
      N=0
      DO 25 K=604,611
      N=N+1
      QBIAS(N)=XNBUF(K)
25  RBIAS(N)=QBIAS(N)

C
      PWRGN=XNBUF(620)
      PWRSN=XNBUF(621)
      PWRGW=XNBUF(622)
      PWRSW=XNBUF(623)

C
      N=0

```

```

      DO 27 K=624,628
      N=N+1
27  XKRCS(N)=XNBUF(K)
C
      PSSL=XNBUF(629)
      OSSL=XNBUF(630)
C
      JCCN=-1
      INDEX=0
      ITST=1
      JJ=0
      IPULS=0
      JX=20
      NPRMRY=0
C
      DO 120 IJ=1,NVALS
      NBEG=NSTART(IJ)
C
      NM=1
      DO 72 M=1,JX
      IJCONT(M)=0
      XSRANG(M)=0.
      DO 72 K=1,170
      IAVLC(M,K)=0
      IAVRC(M,K)=0
      XLCSUM(M,K)=0.
      XRCSUM(M,K)=0.
72  CCNTINUE
C
      3  JCCN=JCON+1
      IF(JCON.EQ.9.OR.JCON.EQ.0)GO TO 97
      INDEX=(JCON-1)*900
      GO TO 99
97  JCCN=1
      INDEX=0
98  IEOF=0
      IERR=0
      CALL READJS(INPUF,IEOF,IERR)
      IF(IERR.EQ.1)GO TO 103
99  CALL UNPACK
      XOFFST=(FLOAT(IOFFST)/2048.)*14.989625
      IF(ICODE.EQ.5)XOPAGC=XPPAGC
      IF(ICODE.EQ.7)YOPAGC=XPPAGC
      IF(IFRST2.EQ.1)GO TO 92
      IF(NCELL1.LE.0)NCELL1=1
      IF(NCELL2.LE.0)NCELL2=170
      IF(IPKAD.LE.0)IPKAD=130
      IF(ICELP2.GT.0.AND.ICELP1.GT.0)GO TO 93
      ICELP1=46
      ICELP2=105
      GO TO 95
93  IF((ICELP2-ICELP1+1).LE.60)GO TO 95
      ICELP2=ICELP1+59
95  CCNTINUE
      IF(IPEAK1.GT.0.AND.IPEAK2.GT.0)GO TO 96
      IPEAK1=54
      IPEAK2=90

```

```

96 CONTINUE
  ZBAN=ZNB
  IF(ITBAND.EQ.1)ZBAN=ZWB
  ZPOL=ZLC
  IF(IPOLAR.EQ.1)ZPOL=ZRC
  RRUSE=-.00943
  IF(ITBAND.EQ.1)RRUSE=-.000115
  PWRUS1=PWRCN
  IF(NBAND.EQ.1)PWRUS1=PWRCH
  PWRUS2=PWRSN
  IF(NBAND.EQ.1)PWRUS2=PWRSH
  CCNLC=XKRCS(1)
  CCNRC=XKRCS(2)
  IF(NBAND.EQ.1)GO TO 17
  CONLC=XKRCS(4)
  CONRC=XKRCS(5)
17 CONTINUE
  IF(ICODE.EQ.5)CONRC=CONLC
  IF(ICODE.EQ.7)CONRC=CONLC
C
  WRITE(6,200)ZPOL,ZBAN,ITREEL,TITL,(IEQP(I),I=4,6)
200 FORMAT('1TAP-ALCOR POLAR = ',A2,4X,'BAND = ',A2,4X,'REEL NO. = ',
1,I5,' TITLE = ',A4,' DATE = ',I2,'/',I2,'/',I2)
  WRITE(6,208)NCFLL1,ICELP1,IPEAK1,CCNLC,NBAND,IPLOT
208 FORMAT('OCELL BEGIN (PLOT) = ',I3,5X,'CELL BEGIN (PRINT) = ',I3,5X
1,'CELL BEGIN (PEAK) = ',I3,5X,'KRCS(LC) = ',F8.3
1,4X,'IBAND = ',I1,3X,'IPLOT = ',I1)
  WRITE(6,210)NCELL2,ICELP2,IPEAK2,CONRC,IPOLAR
210 FORMAT('OCELL END (PLOT) = ',I3,5X,'CELL END (PRINT) = ',I3,5X
1,'CELL END (PEAK) = ',I3,5X,'KRCS(RC) = ',F8.3
1,4X,'IPOLAR = ',I1)
  WRITE(6,211)INTAV,NNSET
211 FORMAT('O',I2X,'INTAV = ',I3,18X,'ISKIP = ',I3)
  WRITE(6,212)(NSTART(I),NSTOP(I),I=1,NVALS)
212 FORMAT('O START STOP ',I2X,'START STOP ',I2X,'START
1STOP ',I2X,'START STOP ' / (4(I2X,I5,2X,I5,15X)))
  XLNCH=OFLOAT(IINCH)/O1000
  WRITE(6,214)XLNCH
214 FORMAT('O LIFT OFF TIME = ',F10.3)
C
  IF(NBAND.NE.ITPAND)GO TO 695
  IFRST2=1
92 CONTINUE
C
620 IF(NUMPRI.LT.NSTART(IJ))GO TO 3
  IF(NUMPRI.GT.NSTART(IJ))GO TO 628
C
  ITST=1
  NSWIT=1
  IF(ICODE.EQ.3.OR.ICODE.EQ.7.OR.ICODE.EQ.2)GO TO 600
  GO TO 629
600 NSTART(IJ)=NSTART(IJ)+1
  WRITE(6,6314)IJ,NSTART(IJ)
6314 FORMAT('ONSTART(',I3,') HAS BEEN CHANGED TO ',I10)
  GO TO 3
628 IF(ICODE.EQ.3.OR.ICODE.EQ.7.OR.ICODE.EQ.2)GO TO 626
629 IPULS=IPULS+1

```



```

626 IF (INTAV.EQ.1.AND.ISKIP.EQ.0) IPULS=1
631 GO TO (660,661),NSWIT
C
660 ITST=1
    IF (IPULS.NE.INTAV) GO TO 10
    NSWIT=2
    ITST=2
    IPULS=0
    IF (NNSET.EQ.0) NSWIT=1
    GO TO 10
C
661 IF (IPULS.NE.NNSET) GO TO 118
    IPULS=0
    NSWIT=1
    ITST=1
    GO TO 118
C
10 CONTINUE
    IF (IFRST4.EQ.1) GO TO 341
    IPRCLD=IPRF
    XOPOLD=XOPAGC
    XPPOLD=XPPAGC
    IFRST4=1
C
C      DETERMINE OFFSET POSITION OF DATA
C
341 CONTINUE
    IF (ABS(XOFFST-XSRANG(1)).GT.1.) GO TO 343
    MM=1
    NPRMRY=1
    GO TO 342
343 DO 345 K=2,JX
    IF (ABS(XOFFST-XSRANG(K)).GT.1.) GO TO 345
    MM=K
    GO TO 342
345 CONTINUE
    NM=NM+1
    IF (NM.GT.JX) GO TO 19
    MM=NM
    XSRANG(MM)=XOFFST
342 CONTINUE
    IJCONT(MM)=IJCONT(MM)+1
C
    IF (IPOLAR.EQ.1) GO TO 609
    IF (ABS(XPPOLD-XPPAGC).LE.1.) GO TO 610
    WRITE(6,622) NUMPRI,XPPOLD,XPPAGC
622 FORMAT(/2X'CURRENT PRI = ',18,' OLD AGC = ',F5.1,' CURRENT AGC
    = ',F5.1)
    XPPOLD=XPPAGC
    GO TO 610
609 IF (ABS(XOPOLD-XOPAGC).LE.1.) GO TO 610
    WRITE(6,624) NUMPRI,XOPOLD,XOPAGC
    XOPOLD=XOPAGC
C
610 IF (IPRF.EQ.IPRCLD) GO TO 611
    WRITE(6,624) NUMPRI,IPRCLD,IPRF
624 FORMAT(/25X'CURRENT PRI = ',18,' OLD PRF = ',15,' CURRENT PRF =

```



```

1  ',15)
  IPRGLD=IPRF
  IFRST4=0
611 CCNTINUE
  ITOT=(3600*IHR5+60*IMIN+ISEC)*1000+1MSEC
  ITAL=ITOT-ILNCH
  TOTL=DFLOAT(ITOT)/D1000
  TAL=DFLOAT(ITAL)/D1000
  RDOT=(IRCOT/(8192.C))*14.989625
  RANGE=(FLOAT(IRANGE)/2048000.)*14.989625+TRBIAS*.14989625
  TTCOR=(RANGE/299776.)*(RDOT/1000.)
  RANGE=RANGE+TTCOR
  RRCOR=RRUSE*RDOT
  RANGE=RANGE+RRCOR/1000.
  AZ=(IAZ*2*3141.59265358)/(2.0**17)
  XAZ=AZ*.0572958
  XAZ=XAZ+AZBIAS
  EL=(IEL*2*3141.59265358)/(2.0**17)
  XEL=EL*.0572958
  XEL=XEL+ELBIAS
  CALL REFC(XEL,RANGE,ECORF,RCORF)
  RNGF=RANGE-RCORF
  ELVF=XEL-ECORF
  RADEL=ELVF*.017453
  CALT=SQRT(RNGF**2+ER*ER+2.*RNGF*ER*SIN(RADEL))-ER
  RANGE=RNGF
  XTRR=40.*ALOG10(RANGE)
  XPKPWR=IPKPWR
  POWER=PWRUS1+PWRUS2*ALOG10(XPKPWR)

```

```

C
  IF(IFRST1.EQ.1)GC TO 11
  NPRBEG=NUMPRI
  ALTBEG=CALT
  TALBEG=TAL
  TOTBEG=TOTL
  RDOBEG=RDOT
  RANBEG=RANGE
  POWBEG=POWER
  XHRB=IHR5
  XMNB=IMIN
  XSCB=ISEC
  XXSB=IMSEC
  IHRB=IHR5
  IMNB=IMIN
  ISCB=ISEC
  IXSB=IMSEC
  XPPBEG=XPPAGC
  XOPBEG=XOPAGC
  IFRST1=1
11 CONTINUE
  NPREND=NUMPRI

```

```

C
  DO 39 K=1,170
  IF(K.LT.NCELL1.OR.K.GT.NCELL2)GO TO 39
  N=ILCAMP(K)+1
  IF(N.GT.IPKAD)GO TO 34
  XLCDB(K)=XATBL(N)+XTRR+XPPAGC+CONLC-POWER

```

```

      XLCSUM(MM,K)=XLCSUM(MM,K)+10.**(XLCDB(K)/10.)
      IAVLC(MM,K)=IAVLC(MM,K)+1
34  M=IRCAMP(K)+1
      IF(M.GE.IPKAD)GO TO 39
      XRCDB(K)=XATBL(M)+XTRR+XOPAGC+CONRC-POWER
      XRCSUM(MM,K)=XRCSUM(MM,K)+10.**(XRCDB(K)/10.)
      IAVRC(MM,K)=IAVRC(MM,K)+1
39  CCNTINUE

C
40  GO TO (199,19),ITST
199 IF(NUMPRI.NE.NSTOP(IJ))GO TO 118

C
19  IF(NM.GT.JX)NM=JX
      IF(IPRIME.LE.0)GO TO 41
      NQ=1
      NM=1
41  CONTINUE
      NQ=1
      IF(NPRMY.EQ.0)NQ=2
      IF(NQ.EQ.2.AND.IPRIME.GE.1)GO TO 79
      DO 60 LL=NQ,NM
      DO 42 K=1,17C
      IF(K.LT.NCELL1.OR.K.GT.NCELL2)GO TO 42
      IF(IAVLC(LL,K).LE.0)IAVLC(LL,K)=1
      IF(XLCSUM(LL,K).LE..00000001)XLCSUM(LL,K)=.00000001
      XLCDB(K)=10.*ALOG10(XLCSUM(LL,K)/FLOAT(IAVLC(LL,K)))
      IF(IAVRC(LL,K).LE.0)IAVRC(LL,K)=1
      IF(XRCSUM(LL,K).LE..00000001)XRCSUM(LL,K)=.00000001
      XRCDB(K)=10.*ALOG10(XRCSUM(LL,K)/FLOAT(IAVRC(LL,K)))
42  CCNTINUE

C
      IF(LL.NE.1)GO TO 55
      XLCPK=-1000.
      XRCPK=-1000.
      DO 44 K=IPEAK1,IPEAK2
      IF(XLCDB(K).GT.XLCPK)XLCPK=XLCDB(K)
      IF(XRCDB(K).GT.XRCPK)XRCPK=XRCDB(K)
44  CONTINUE
      JJ=JJ+1
      ALTI(JJ)=ALTBEG
      YLC(JJ)=XLCPK
      YRC(JJ)=XRCPK
      IF(JJ.EQ.2000)GO TO 121

C
55  XOUTBG=XPPBEG
      XNUMO=IJCONT(LL)
      YSLVED=XSRANG(LL)
      IF(IPOLAR.EQ.1)XOUTBG=XOPBEG
      IBGG=IBLANK
      IF(LL.EQ.1)IBGC=IASTR
      WRITE(6,56)IBGC,IHRB,IMNB,ISCB,IXSB,TALBEG,RANBEG,YSLVED,ALTBEG,
      1TOTBEG,XOUTBG,APRBEG,NUMPRI,XNUMO,RDOBEG
56  FORMAT(/6X,A1,'TIME(GMT) ',12,1X,12,1X,12,1X,' ',13,8X,'TAL ',F9.3,'
      1 RANGE(KM) ',F9.3,6X,'R.OFFST(M) = ',F9.1,7X,'HEIGHT (KM)',F7.1,/,
      23X,'TSEC',F10.3,3X,'AGC(DBSM) = ',F5.1,3X,'PRI(START)',2X,15,2X,
      3' PRI(STOP)',2X,15,3X,'NO.PULSES = ',F4.0,2X,'RDOT (M/SEC) = ',
      4F9.3)

```

```

NSWTCH=0
INDX1=C
C
DO 52 K=1,170
IF(K.LT.ICELP1.OR.K.GT.ICELP2)GO TO 52
IF(NSWTCH.EQ.1)GO TO 51
IXA=K
NSWTCH=1
51 CCNTINUE
IXZ=K
IOUT(K)=K
INDX1=INDX1+1
IF(K.EQ.ICELP2)GO TO 53
IF(INDX1.NE.15)GO TO 52
53 NSWTCH=0
INDX1=C
WRITE(6,59)(IOUT(N),N=IXA,IXZ)
59 FORMAT(20X,'RANGE GATES',4X,15I6)
WRITE(6,62)(XLCDB(N),N=IXA,IXZ)
62 FORMAT(29X,'LC',4X,15F6.1)
WRITE(6,63)(XRCDB(N),N=IXA,IXZ)
63 FORMAT(29X,'RC',4X,15F6.1)
52 CCNTINUE
C
DO 47 K=1,170
IF(IPOLAR.EQ.1)GO TO 49
YPRNT(K)=XLCDB(K)
GO TO 47
49 YPRNT(K)=XRCDB(K)
47 CCNTINUE
IF(IPLOT.NE.0)GO TO 60
INDIC=1
XPOFFS=XSRANG(LL)
48 CALL PLOTT(INDIC , YPRNT(1),NCELL1,NCELL2,ITBAND,IPOLAR,NPRBEG,
INPREND,DBB,DBT,ALTBEG,YALBEG,XHRB,XMNB,XSCB,XXSB,XPCFFS,XNUMO)
60 CCNTINUE
C
79 CCNTINUE
NM=1
NPRMRY=0
DO 82 M=1,JX
IJCCNT(M)=C
XSRANG(M)=0.
DO 82 K=1,170
IAVLC(M,K)=0
IAVRC(M,K)=0
XLCSUM(M,K)=0.
XRCSUM(M,K)=0.
82 CCNTINUE
C
IFRST4=0
IFRST1=0
118 IF(NUMPRI.LT.NSTCP(IJ))GO TO 3
IPULS=0
119 IFRST3=0
120 CCNTINUE
C

```

```

121 CCNTINUE
    IF(IPUNC.EQ.1)GO TO 128
    WRITE(7,131)ZLC,ZBAN,TITL
131 FORMAT(A2,2X,A2,2X,A4)
    GO 122 K=1,JJ
122 WRITE(7,133)ALTI(K),YLC(K)
133 FORMAT(2F10.3)
    WRITE(7,131)ZRC,ZBAN,TITL
    GO 126 K=1,JJ
126 WRITE(7,133)ALTI(K),YRC(K)
128 INDIC=2
129 CALL PLOTT(INDIC , YPRNT(1),NCELL1,NCELL2,ITBANO,IPCLAR,NPRBEG,
    INPREND,OBBD,ALTBEG,TALBEG,XHRB,XMNB,XSCB,XXSB,XPCFFS,XNUMO)
C
    GO TO 125
103 WRITE(6,107)NMPRI
107 FORMAT('OPARITY ERROR ON READ AFTER PRI = ',I10)
    GO TO 99
680 WRITE(6,109)NMPRI
109 FORMAT(' END OF FILE REACHED LAST NMPRI VALUE = ',I10)
    GO TO 125
695 WRITE(6,114)NBAND,ITBAND
114 FORMAT(' INPUT BAND= 'I10,' BAND ON TAPE = 'I10)
125 RETURN
    ENO
    SUBROUTINE PLOTT (INOIC,YPRNT,NCELL1,NCELL2,ITBANO,IPOLAR,NPRBEG,
    INPREND,DBB,DBT,ALTBEG,TALBEG,XHRB,XMNB,XSCB,XXSB,XPOFFS,XNUMC)
C
    DOUBLE PRECISION TALBEG
    DIMENSION XPRNT(170),YPRNT(1),XWORO(4)
C
    COMMON /ICLZ/ JJ,TITL,ALTI(2000),YLC(2000),YRC(2000)
    DATA XWORO/'NBLCNBRCWBLCWBR'/,NTIME/0/,ICNCE/0/
C
    IPOLAR = 0 LEFT CIRCULAR DATA REQUESTED
    IPOLAR = 1 RIGHT CIRCULAR DATA REQUESTED
    IBAND = 0 NARROW BANO DATA REQUESTED
    IBAND = 1 WIDE BAND DATA REQUESTED
C
    ZALBEG=TALBEG
    IF(ICNCE.EQ.1)GO TO 10
    CALL STOIOV('ALCTAP',5,0)
    ML=100
    MR=940
    MB=200
    MT=940
    IF(NCELL1.EQ.0)NCELL1=1
    IF(NCELL2.EQ.0)NCELL2=170
    XCELL1=NCELL1
    XCELL2=NCELL2
    IF(ABS(OBB).LE..C05)OBB=-60.
    IF(ABS(OBT).LE..C05)OBT= 40.
    DO 7 K=1,170
    XPRNT(K)=K
    7 CCNTINUE
    ICNCE=1
    10 CONTINUE

```

```

C
11 IF(INDIC.EQ.1)GO TO 13
   XCELL1=70.
   XCELL2=0.
13 CONTINUE

C
   CALL LINEV (ML,MB,ML,MT)
   CALL LINEV (ML,MT,MR,MT)
   CALL LINEV (MR,MT,MR,MB)
   CALL LINEV (MR,MB,ML,MB)

C
   CALL YSCALV (DBB,DBT,MB,1023-MT)
   CALL LINRV (2,ML-35,ML-5,ML+5,DBB,DBT,10.,1,1,3,10)
   CALL LINRV (2,MR+35,MR-5,MR+5,DBB,DBT,10.,1,0,0,10)

C
   IF(INDIC.EQ.1)GO TO 16
   M1=2
   M2=2
   Z1=5.
   GO TO 33

C
16 M1=5
   M2=5
   Z1=2.
   IF((NCELL2-NCELL1).GT.85)GO TO 14
   Z1=1.
14 CONTINUE

C
   IF(ITBAND.EQ.0)GO TO 30
   XLRNG=(XCELL1-1.)*.177515
   XRRNG=(XCELL2-1.)*.177515
   Z2=1.
   N1=5
   N2=5
   GO TO 31
30 XLRNG=(XCELL1-1.)*14.7929
   XRRNG=(XCELL2-1.)*14.7929
   Z2=100
   N1=2
   N2=2
31 CONTINUE

C
   CALL XSCALV (XLRNG,XRRNG,ML,1023-MR)
   CALL LINRV(1,MP-20,MB-5,MB+5,XLRNG,XRRNG,Z2,N1,N2,4,8)
33 CALL XSCALV (XCELL1,XCELL2,ML,1023-MR)
   IF(INDIC.EQ.1)GO TO 34
   CALL LINRV(1,MB-20,MB-5,MB+5 ,XCELL1,XCELL2,Z1,M1,M2,3,8)
   CALL LINRV(1,MT+20,MT+5,MT-5,XCELL1,XCELL2,Z1,M1,0,0,8)
   GO TO 36
34 CALL LINRV(1,MT+20,MT+5,MT-5 ,XCELL1,XCELL2,Z1,M1,M2,3,8)
36 CONTINUE

C
   BPRBEG=NPRBEG
   BPREND=NPREND
   IF(ITBAND.EQ.0.AND.IPOLAR.EQ.0)XUSE=XWCRD(1)
   IF(ITBAND.EQ.0.AND.IPOLAR.EQ.1)XUSE=XWCRD(2)
   IF(ITBAND.EQ.1.AND.IPOLAR.EQ.0)XUSE=XWCRD(3)

```

```

IF(ITBAND.EQ.1.AND.IPOLAR.EQ.1)XUSE=XWORD(4)
IF(INOIC.EQ.1)GO TO 35
CALL RITE2V(C,MB+250,1023,90,2,20,1,'PEAK WAKE RCS (DBSM)',NLAST)
CALL RITE2V(ML+350,MB-50,1023,0,2,13,1,'ALTITUOE (KM)',NLAST)
CALL RITE2V(ML+800,MT+50,1023,0,2,4,1,XUSE,NLAST)
CALL RITE2V(ML,MT+50,1023,0,2,4,1,TITL,NLAST)
JJJ=JJ-1
53 DO 57 I=1,JJJ
J=I+1
IX1=NXV(ALT1(I))
IY1=NYV(YLC(I))
IF(INDIC.EQ.3)IY1=NYV(YRC(I))
IX2=NXV(ALT1(J))
IY2=NYV(YLC(J))
IF(INOIC.EQ.3)IY2=NYV(YRC(J))
CALL LINEV(IX1,IY1,IX2,IY2)
57 CCNTINUE
GO TO (59,63,58),INDIC
63 INOIC=3
IPOLAR=1
GO TO 59

```

C

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58 CALL PLTND
GO TO 60
35 CALL RITE2V (0,MB+350,1023,90,2,8,1,'RCS DBSM',NLAST)
CALL RITE2V (ML+350,MB-50,1023,0,2,13,1,'RANGE METERS',NLAST)
CALL RITE2V (ML+350,MT+50,1023,0,2,16,1,'RANGE SAMPLE NC.',NLAST)
CALL RITE2V (ML+800,MT+50,1023,0,2,4,1,XUSE,NLAST)
CALL RITE2V(ML,MT+50,1023,0,2,4,1,TITL,NLAST)
CALL PRINTV (14,'PRI START-STOP',ML,MB-150)
CALL PRINTV (4,'GMT ',ML+200,MB-150)
CALL PRINTV (9,'TAL (SEC)',ML+400,MB-150)
CALL PRINTV (12,'ALTITUDE(KM)',ML+600,MB-150)
CALL PRINTV (20,'RANGE OFFSET (M) = ',ML+15,MT-15)
CALL PRINTV(21,'NO. OF PULSES USED = ',ML+15,MT-35)
CALL LABLV(XPOFFS,ML+170,MT-15,7,1,5)
CALL LABLV(XNUM0,ML+155,MT-35,5,1,5)
CALL LABLV (BPRBEG,ML,MB-170,5,1,5)
CALL LABLV (BPREND,ML,MB-190,5,1,5)
CALL LABLV (XHRB,ML+200,MB-170,2,1,2)
CALL LABLV (XMNB,ML+230,MB-170,2,1,2)
CALL LABLV (XSCB,ML+260,MB-170,2,1,2)
CALL LABLV (XXSB,ML+290,MB-170,3,1,3)
CALL LABLV (ZALBEG,ML+400,MB-170,7,1,4)
CALL LABLV (ALTBEG,ML+600,MB-170,6,1,4)

```

C

```

DO 50 I=1,169
J=I+1
IF(I.LT.NCELL1.OR.J.GT.NCELL2)GO TO 50
IX1=NXV(XPRNT(I))
IY1=NYV(YPRNT(I))
IX2=NXV(XPRNT(J))
IY2=NYV(YPRNT(J))
CALL LINEV(IX1,IY1,IX2,IY2)
50 CCNTINUE

```

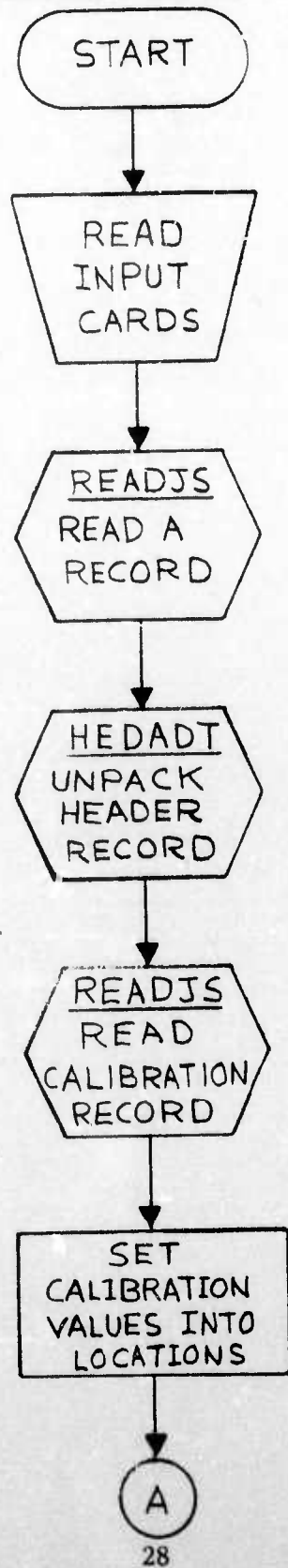
C

```

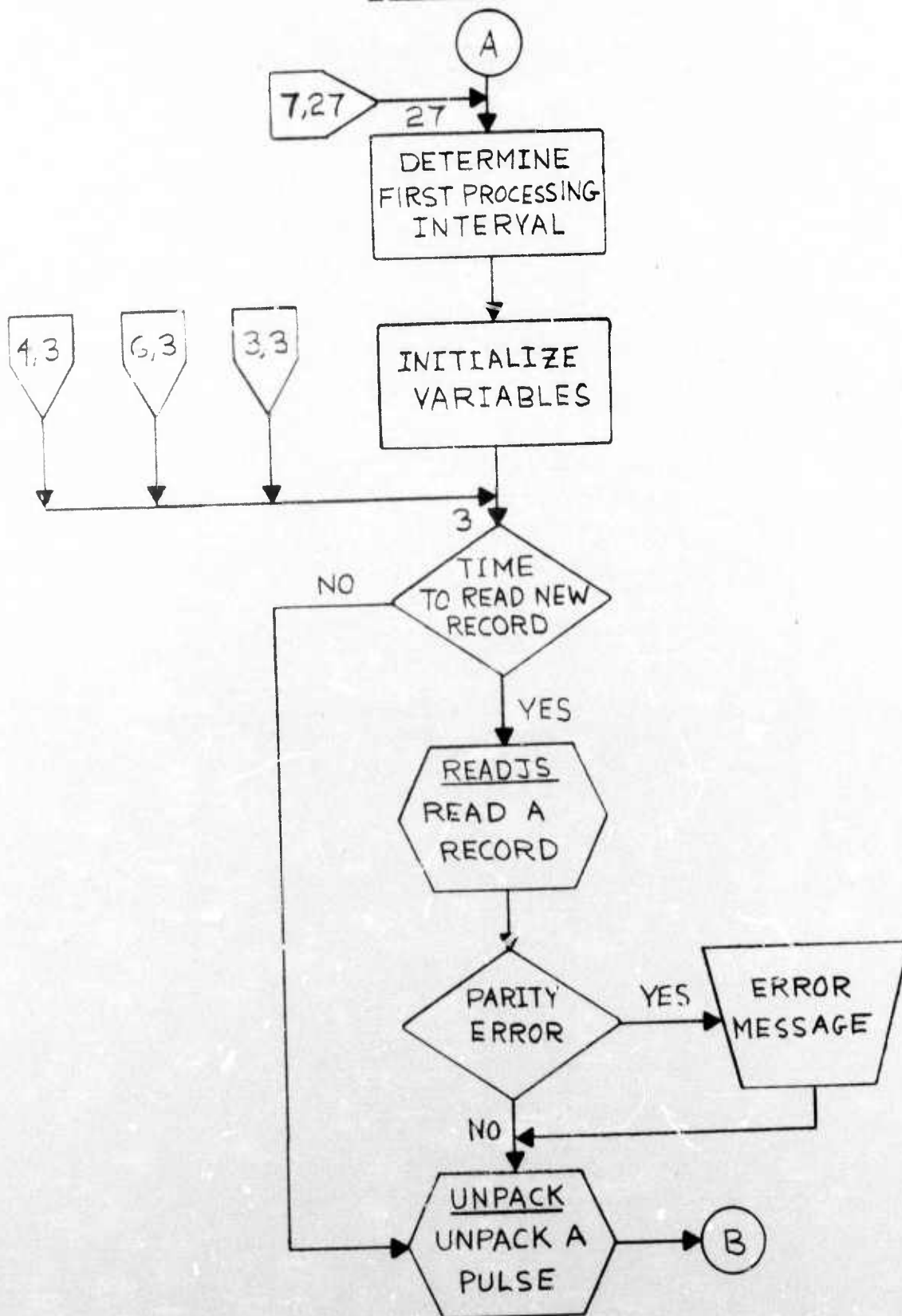
59 CALL FRAMEV(C)
IF(INDIC.EQ.3)GO TO 11
60 RETURN
END

```

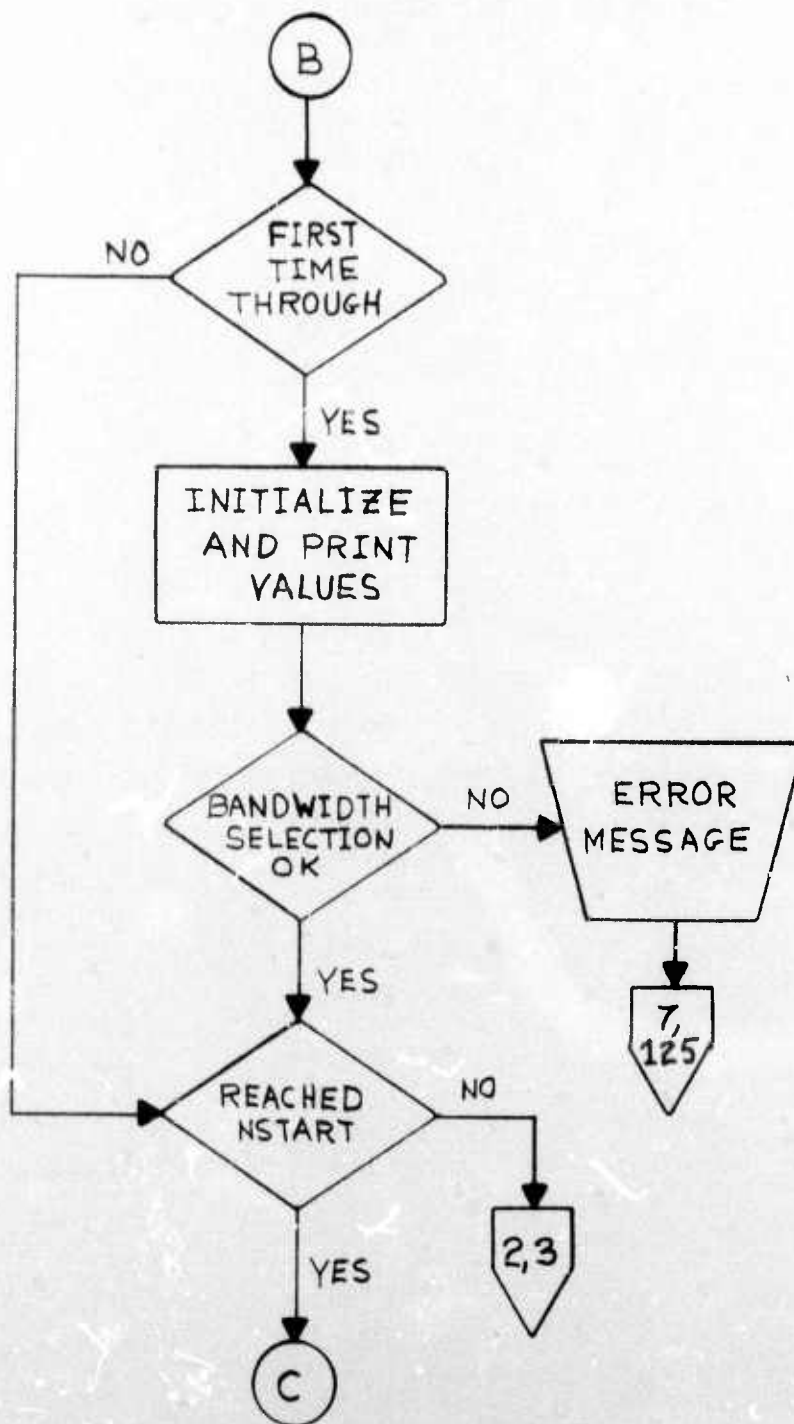

APPENDIX D
TAPALC FLOW DIAGRAM



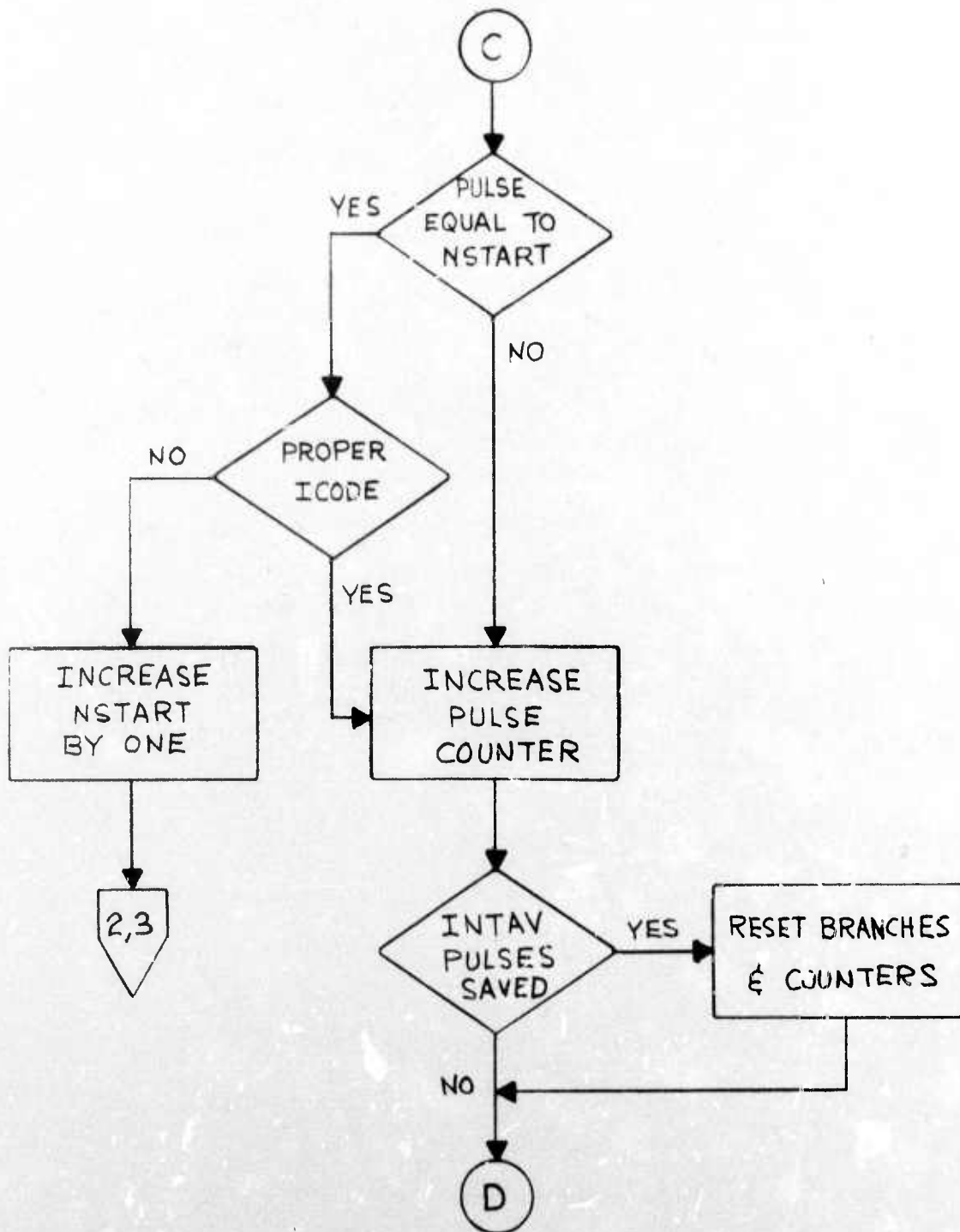
APPENDIX D-2



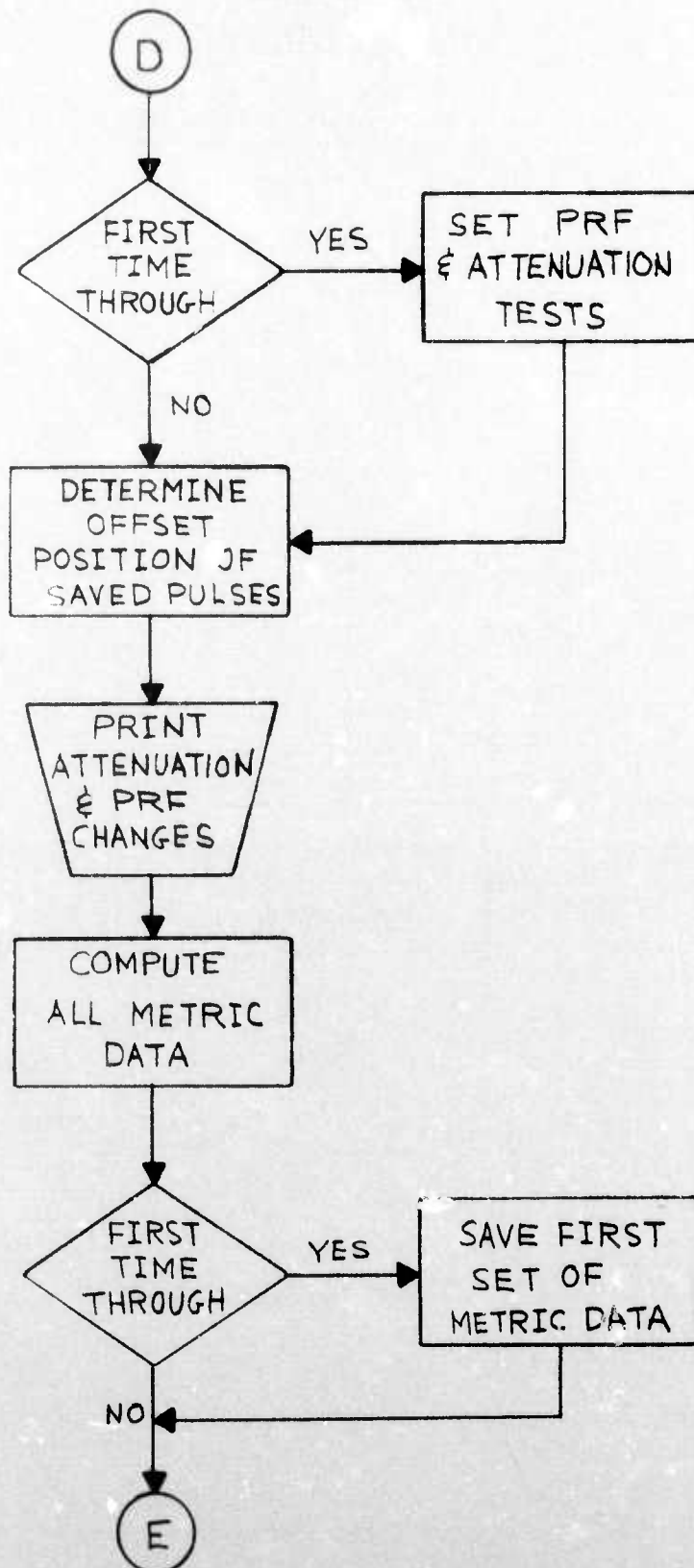
APPENDIX D-3



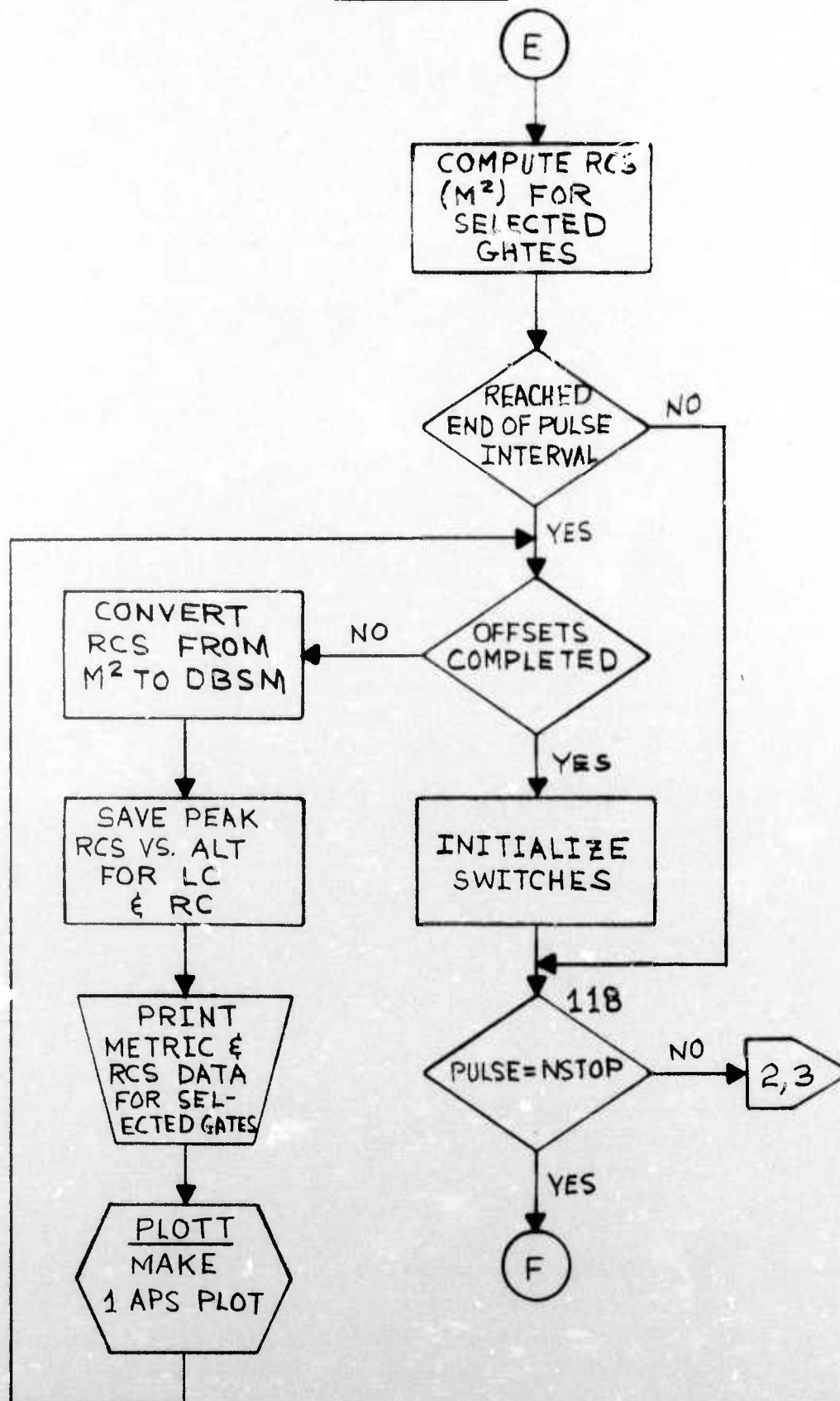
APPENDIX D-4



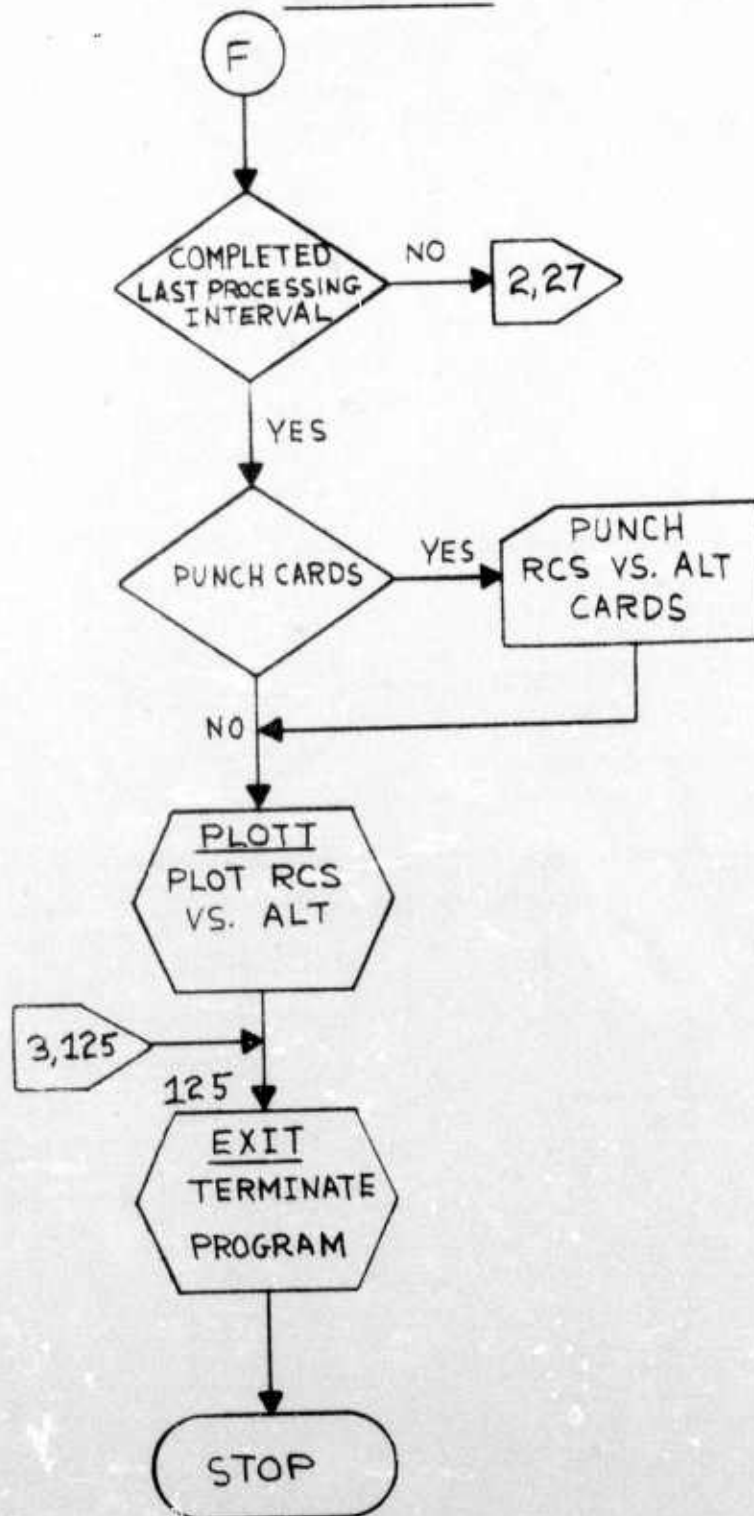
APPENDIX D-5



APPENDIX D-6



APPENDIX D-7



APPENDIX E SUBROUTINE HEDADT PROGRAM LISTING

```

*          CALL HEDADT (ISIG,INBUF,IEQU)
*          ISIG.= 1      UNPACK THE 20 WORD ADT HEADER

START
ENTRY HEDADT
SPACE
XISIG     EQU    4
XICAL     EQU    5
XIEQU     EQU    6
BASE      EQU    12
HEDADT    SPACE
          SAVE    (14,12),T,*
          BALR    12,C
          USING   *,BASE
          ST      13,SAVEA+4
          LA      7,SAVEA
          ST      7,8(0,13)
          LR      13,7
          SPACE
          LM      XISIG,XIEQU,0(1)
          SPACE
          L        8,0(XICAL)
          ST        8,TEMP1
          ST        8,TEMP2
          SRL       8,31
          ST        8,0(XIEQU)      MBAND
          L        8,TEMP1
          SLL       8,1
          SRL       8,25
          ST        8,4(XIEQU)      MREEL
          SPACE
          L        8,4(XICAL)
          ST        8,TEMP1
          ST        8,TEMP2
          SRL       8,16
          ST        8,8(XIEQU)      MWTR
          L        8,TEMP1
          SLL       8,16
          SRL       8,24
          ST        8,12(XIEQU)     MMNTH
          L        8,TEMP2
          SLL       8,24
          SRL       8,24
          ST        8,16(XIEQU)     MDAY
          SPACE
          SR        8,8
          IC        8,8(XICAL)
          ST        8,20(XIEQU)     MYEAR
          MVC       24(9,XIEQU),9(XICAL)  MISSION DES.
          SPACE
RETURN    L        13,SAVEA+4
          RETURN   (14,12),T
          CNOP     0,4
TEMP1     DC      F'0'
TEMP2     DC      F'0'
SAVEA     DC      18A(*)
END

```

APPENDIX F SUBROUTINE REFC PROGRAM LISTING

```

SUBROUTINE REFC(E,R,DEE,DRR)
  DIMENSION DE(16,8),DR(16,8),EO(16),RD(8)
  DATA DE/0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,
10.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0313,
20.0303,0.0292,0.0287,0.0282,0.0272,0.0262,0.0253,0.0243,0.0223,
30.0214,0.0195,0.0171,0.0135,0.0075,0.0,0.0937,0.0848,0.0770,
40.0732,0.0694,0.0627,0.0571,0.0522,0.0480,0.0412,0.0385,0.0337,
50.0278,0.0205,0.0105,0.0,0.1850,0.1520,0.1250,0.1140,0.1050,
60.0904,0.0795,0.0708,0.0636,0.0523,0.0478,0.0405,0.0323,0.0229,
70.0114,0.0,0.5310,0.3070,0.2120,0.1830,0.1600,0.1280,0.1060,
80.0899,0.0780,0.0612,0.0550,0.0455,0.0354,0.0246,0.0120,0.0,
90.7550,0.3720,0.2400,0.2020,0.1750,0.1370,0.1120,0.0942,0.0811,
A0.0631,0.0566,0.0466,0.0361,0.0250,0.0122,0.0,0.9120,0.4110,
80.2560,0.2140,0.1840,0.1420,0.1150,0.0967,0.0830,0.0642,0.0575,
C0.0472,0.0365,0.0252,0.0122,0.0,0.9700,0.4200,0.2600,0.2200,
D0.1900,0.1460,0.1170,0.0980,0.0840,0.0653,0.0584,0.0478,0.0369,
EO.0254,0.0122,0.0 /
  DATA DR/ C.C, C.C, C.C, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0,
1 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, C.0, 22.6, 21.5, 20.4, 19.9,
2 19.4, 18.5, 17.6, 16.8, 16.1, 14.8, 14.2, 13.2, 12.0, 10.4, 8.6,
3 7.7, 67.3, 57.9, 50.2, 47.0, 44.1, 39.3, 35.4, 32.1, 29.3, 24.8,
4 22.9, 19.7, 16.3, 12.7, 9.4, 8.1,132.0, 98.5, 77.4, 69.7, 63.2,
5 52.9, 44.7, 39.4, 33.4, 26.4, 23.9, 20.1, 16.4, 12.7, 9.4, 8.1,
6340.0,167.0,103.0, 86.1, 73.4, 56.7, 46.2, 38.9, 33.6, 26.4, 24.0,
7 20.2, 16.4, 12.8, 9.5, 8.2,405.0,170.0,104.0, 86.3, 73.6, 56.8,
8 46.3, 38.9, 31.7, 26.5, 24.1, 20.3, 16.5, 12.8, 9.5, 8.2,421.0,
9171.0,104.0, 86.6, 73.9, 57.1, 46.4, 39.0, 33.8, 26.8, 24.3, 20.5,
A 16.6, 13.0, 9.8, 8.4,446.0,172.0,105.0, 87.4, 74.0, 58.0, 46.6,
8 39.2, 34.0, 27.0, 24.6, 20.7, 16.7, 13.0, 10.0, 8.4/
  DATA EC,RTCEG/0.01,2.0,4.0,5.0,6.0,8.0,10.0,12.0,14.0,18.,20.,
124.,30.,40.,60.,90.,57.29578/
  DATA RD/0.01,10.,30.,60.,200.,400.,1000.,2000./
  IF(R.LE.0.0)GO TO 300
  RG=R/1.8520+CO
  DO 100 IEC=2,15
  I=17-IEC
  IF(E.GE.ED(I))GO TO 120
  CCNTINUE
100 I=1
  DO 200 JRD=2,8
  J=10-JRD
  IF(R.GE.RD(J))GO TO 220
  CCNTINUE
200 J=1
220 IF(J.EQ.8)GO TO 340
  ZR=ALOG(RG/RD(J))/ALOG(RD(J+1)/RD(J))
  IF(E.LE.0.0)GO TO 320
  ZE=ALOG(E/ED(I))/ALOG(EO(I+1)/ED(I))
  DE1=((DE(I+1,J)-DE(I,J))*(1.-ZR)+(DE(I,J+1)-DE(I,J))*ZR)*ZE
  DE2=((DE(I,J+1)-DE(I,J))*(1.-ZE)+(DE(I+1,J+1)-DE(I,J+1))*ZE)*ZR
  DEE=DE1+DE2+DE(I,J)
  DR1=((DR(I+1,J)-DR(I,J))*(1.-ZR)+(DR(I,J+1)-DR(I,J))*ZR)*ZE
  DR2=((DR(I,J+1)-DR(I,J))*(1.-ZE)+(DR(I+1,J+1)-DR(I,J+1))*ZE)*ZR
  DRR=(DR1+DR2+DR(I,J))
  GO TO 400
300 DEE=D.C
  DRR=0.0
  GO TO 400
320 DEE=OE(I,J)+(DE(I,J+1)-DE(I,J))*ZR
  DRR=DR(I,J)+(DR(I,J+1)-DR(I,J))*ZR
  GO TO 400
340 DELT=(E-ED(I))/(ED(I+1)-ED(I))
  DEE=DELT*(DE(I+1,J)-DE(I,J))+DE(I,J)
  ORR=DELT*(DR(I+1,J)-DR(I,J))+DR(I,J)
100 DRR=DRR+.30480-C3
  RETURN
  END

```