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RAPLOT^{II}, A COMPUTER PROGRAM FOR DATA PROCESSING AND GRAPHICAL DISPLAY FOR RADIOISOTOPIC SAND TRACER STUDY

by Philip A. Turner

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MAY 1970

**U. S. ARMY, CORPS OF ENGINEERS
COASTAL ENGINEERING
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ABSTRACT

RAPLOT II is a computer program for processing radiation and navigation data from field surveys of the Radioisotopic Sand Tracer (RIST) study, but is applicable to any survey type operation on the nearshore Continental Shelf. Collected data are punched onto paper tape by the data collection computer on the research vessel. The data are later transferred to magnetic tape which provides the input for the RAPLOT II Program. Program control parameters are on punched cards. The navigation data, which consists of ranges to two shore-based radar beacons, are first edited for spurious data, and then converted to rectangular coordinates (in this case the California Lambert Coordinate System). Radiation data are converted to count rate as counts per second. Background count rate is computed and subtracted from the observed count rate, and any radiation counts that are significantly above the background count rate are corrected for time of decay since the isotope was injected. Output from the program is in three forms - printed output, graphical output, and magnetic tape record. The processed data are transferred to magnetic tape and made available for further processing such as the generation of contour maps.

FOREWORD

CERC Miscellaneous Paper 2-69, Radioisotopic Sand Tracer Study, Point Conception, California, reported the early results of the RIST study. This study is part of Contract AT(49-11)-2988 between the Atomic Energy Commission and CERC. Other participants in this continuing multi-agency study are the Oak Ridge National Laboratories of the Atomic Energy Commission; U. S. Navy Pacific Missile Range; U. S. Air Force (Western Test Range, First Strategic Aerospace Division); U. S. Army Corps of Engineers Los Angeles District office; NASA (Nuclear Systems and Space Power Division), the State of California (Department of Water Resources) and U. S. Army Mobility Equipment Command. The study involves the collection and analysis of an enormous amount of data. Computer processing is the only means by which these data could be handled.

Philip A. Turner, a geologist, developed the original RAPLOT program and prepared this report. The work was done under the general supervision of David B. Duane, Chief, Geology Branch, and George M. Watts, Chief, Engineering Development Division. CERC continues to refine data processing and improve the printed and graphic output which consists of maps drawn by an incremental plotter.

At the time of publication, Lieutenant Colonel Edward M. Willis was the Director of CERC; Joseph M. Caldwell was Technical Director.

NOTE: Comments on this publication are invited. Discussion will be published in the next issue of the CERC Bulletin.

This report is published under authority of Public Law 166, 79th Congress, approved July 31, 1945, as supplemented by Public Law 172, 88th Congress, approved November 7, 1963.

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Section A. INTRODUCTION

In 1966 the Coastal Engineering Research Center (CERC), in cooperation with the Atomic Energy Commission, initiated a 3-year radioisotopic sand tracer study of littoral transport around Point Conception, California. The purpose was to develop and use radioactive tracers for research in sand movement and littoral processes. The objectives included determination of suitable radioactive isotopes, development of handling and survey procedures, and development of computer programs for editing, processing and graphical display of the data. At the same time, studies of sediment transport around the Point Conception headland and of the mechanics of littoral transport were conducted. Methods developed by this program have direct application to engineering design of harbor development and beach erosion prevention, and quasi-military application such as the location of radioactive and other toxic materials.

Sand grains indigenous to the study area are labeled with a radioisotope that does not adversely affect their hydraulic properties. A mobile detector system, using cesium iodide crystals and housed in a "ball" towed behind an amphibious vehicle, detects the location and intensity of the radiation. Concurrently, additional field data are collected on sediment size and composition, isotope distribution, beach and nearshore bottom topography, weather, and sea and swell conditions.

During a sand-tracer field investigation, radiation measurements are made continuously as the mobile detector system is towed along a beach, through the surf, and over the offshore bottom. With a time selection mode for data acquisition available in increments from 0.1 to 10.0 seconds, a large mass of data is accumulated in a few hours. During a field test, surveying may go on several hours a day for several weeks. Computer processing is necessary to study and evaluate the great volume of collected data. Plotting and posting of the survey data is also useful for monitoring field operation.

The initial field investigations at Surf, California, relied on manual preparation of maps and subjective interpretation of data printed by the teletype of the onboard data acquisition system. It immediately became evident that computer processing and plotting must be employed in future operations, and CERC undertook development of computer programs to generate plots useful to continuing field operations. This specific program is called RAPLOT. The first version of the program was used to process the data collected in the December 1967 field test at Point Conception, California, and is documented in Appendix D of CERC report, M.P. 2-69, by Duane and Judge (1969). RAPLOT was originally compiled and made operational on the UNIVAC 1108 at the National Bureau of Standards, with graphic display on a Benson-Lehner incremental plotter at CERC. Later, the program was adapted to the IBM 7094 Computer and Milgo plotter at the Western Test Range of Vandenberg Air Force Base. This version of the program was used to support later field tests at Point Conception and Surf, California, in September and October 1968 and in February and June 1969.

Improvement and modification of program data acquisition systems created changes in the collection format which required a new version of the RAPLOT program. At the same time, experience gained from running the RAPLOT program was incorporated to provide an improved and more sophisticated data processing capability for the RIST project. The new program is called RAPLOT II and was used at CERC for processing field data for all tests after December 1968. Subsequently, the program was modified to run on an IBM 7094 computer to produce plots on a Stromberg-Carlson 4020 cathode ray tube. This version is called RAPLOT III (See Appendix B, page 47).

Section B. SUMMARY OF RAPLOT II PROGRAM

1. Hardware Requirements

RAPLOT II was written in FORTRAN V for the UNIVAC 1108 Computer and EXEC II operating system at the National Bureau of Standards (NBS) in Gaithersburg, Maryland. CERC is connected to NBS by a leased telephone line and has a UNIVAC 1004 for its remote terminal. The NBS UNIVAC 1108 has 65,000 words of core memory of which 38,400 are required for the RAPLOT II Program. FORTRAN V employs advanced features not found in standard FORTRAN IV. They are the NTRAN subroutine for executing binary input-output commands, and the FLD function, a bit manipulation routine.

For field program use, RAPLOT II has been modified and written in FORTRAN IV to run on an IBM 7094 computer at the Pacific Missile Range data processing center at Point Mugu, California. The size of the program had to be reduced considerably to fit into the 32,000 word memory. Consequently, the processing of the data is less thorough, and the writing out of the processed data on magnetic tape was eliminated. This version was used to support a RIST field test near Point Mugu where the primary requirement was for quick printout and graphic display of the processed survey data.

2. Program Description and Logic

A flow chart of the program is given in Figure 1; an outline description of the main steps in the program follows:

a. Read in two program control cards and a file legend card. Additional control parameters are computed from these input parameters.

b. Read in from magnetic tape a data file from a radio-isotopic tracer survey.

c. Check radar beacon ranges for errors. If distance-time ratio for successive ranges indicates a ship speed greater than 6 knots, or 3.09 meters per second, correct the ranges by linear interpolation. Experience has indicated that these beacon ranges may be erroneous (as much as an order of magnitude) as often as 5 percent of the time.

Figure 1. Flow Chart of RAPLOT II Program

d. Compute the position of the survey vessel at each fix. The program control cards provide the California Lambert Coordinates of the shore beacon, and the data input tapes provide the beacon ranges. By the cosine law this can be translated into distance in terms of a rectangular coordinate system:

$$DX_1 = (DB^2 + D_1^2 - D_2^2) / (2 \cdot DB)$$

$$DY_1 = (D_1^2 - DX_1^2)^{1/2}$$

Where D_1 = the distance of survey vessel from the upcoast radar beacon

D_2 = the distance from the downcoast beacon

DB = the distance between the two beacons

DX_1 = the distance of the fix position of survey vessel from the upcoast beacon in a direction parallel to a line intersecting the two beacons

DY_1 = the distance of the fix from an upcoast beacon in a direction normal to a line intersecting the two beacons.

These distances may be translated and rotated to give the Lambert Coordinates for each fix

$$NORTH_f = DX_1 \sin \theta + DY_1 \cos \theta + NORTH_b$$

$$EAST_f = DX_1 \cos \theta - DY_1 \sin \theta + EAST_b$$

Where θ = the angle of rotation of the coordinate system

$NORTH_b$ and $EAST_b$ = the Lambert coordinates of the upcoast radar beacon

$NORTH_f$ and $EAST_f$ = the coordinates of the fix.

Occasionally the two radar beacon ranges will produce an imaginary position. When this occurs, one of the coordinates of the radar fix is defined by the square root of a negative number. When such an imaginary fix occurs, the line of data producing the imaginary fix is eliminated from the file being processed.

e. The north and east coordinate arrays are searched for extreme values by Chauvenet's criterion and any data set containing extreme values is eliminated. Chauvenet's criterion is based on the normal distribution, and a value is rejected if the probability of occurrence of such a deviation from the mean of the n measurements is less than $1/2n$ (P. R. Rider, 1933).

f. Plot the track of the survey vessel by a call to subroutine BENLH2.

g. Compute the position of the mobile underwater detector for each fix by correcting for the distance the detector is towed astern of the survey vessel. Cable length, mean water depth, and length of survey vessel, are all input on the program control card. Assuming a position for the detector vehicle at the beginning of the survey, the position of the detector for each fix is computed by linear interpolation from the present position of the vessel to the last interpolated position of the detector.

$$YD_n = YV_n - \frac{CABLE (YV_n - YD_{n-1})}{\sqrt{(YV_n - YD_{n-1})^2 + (XV_n - XD_{n-1})^2}}$$

$$XD_n = XV_n - \frac{CABLE (YV_n - YD_{n-1})}{\sqrt{(YV_n - YD_{n-1})^2 + (XV_n - XD_{n-1})^2}}$$

where XD and YD are the coordinates of the detector and XV and YV are coordinates of the vessel. CABLE is the horizontal distance from the detector to the survey vessel.

h. Radiation data are converted to counts per second, and the mean and standard deviation of the background count rate is computed. An estimated background count rate is entered on the data control card for each channel. This estimated background count rate is used to compute the extreme values of the range of the background radiation level, again by means of Chauvenet's criterion. All counts between these extreme ranges are averaged to obtain the mean background count rate for each channel.

i. Plot uncorrected radiation values by a call to BENLH2 through RDPLT2 entry.

j. Correct the radiation data by subtracting the mean background count rate. Then correct the remainder, if it is significantly higher than background, for the time of the decay since the isotope was injected.

$$CCR = (NCR - 3\sigma)e^{\Lambda t} + 3\sigma$$

where $\Lambda = \frac{\log_e(2)}{T_{1/2}}$, and

where CCR = the corrected count rate

NCR = the net (observed radiation value less mean background) count rate

σ = the standard deviation of the background count rate

t = the elapsed time from the injection to the time of the fix

$T_{1/2}$ = the isotope halflife in hours.

Only radiation count rates that are significantly greater than background are corrected for time of decay. Otherwise, in a survey made one or more halflives after the injection, the correction would inflate background radiation readings to such a degree that they would appear to be significant.

k. Compute the weighted mean and weighted standard deviation of the coordinate location of the radioactivity. Compute the 95 percent confidence limits of the mean radiation location.

$$\overline{XD} = \frac{\sum_{i=1}^n XD_i \cdot CCR_i}{\sum_{i=1}^n CCR_i}$$

$$\overline{YD} = \frac{\sum_{i=1}^n YD_i \cdot CCR_i}{\sum_{i=1}^n CCR_i}$$

l. Print out the sequence number, time, radar beacon ranges, coordinates, and activity for each line of data.

m. Return to the beginning of the program to read in more data control cards, and process another file of data unless it is the end of job, in which case processing ends.

Section C. SUBROUTINES USED IN THE PROGRAM

1. BENLH2 - Plotting Subroutine

Subroutine BENLH2 performs the operations necessary to produce a plot of the trackline and of the radiation data on the Benson-Lehner incremental plotter. BENLH2 does this by calling the several subroutines of the Benson-Lehner plot package which translates the data given to the subroutines by BENLH2 into plot commands that are written out onto magnetic tape. The tape is used to drive a Benson-Lehner model 305 incremental plotter off-line. Figure 2 is a flow chart of this subroutine.

Subroutine TRACK is substituted for subroutine BENLH2 to produce the RAPLOT III program. TRACK interfaces the RAPLOT program with the plot subroutines for the Stromberg-Carlson 4060 cathode ray tube. Otherwise, it functions essentially like subroutine BENLH2. Both subroutines plot the trackline followed by the survey vessel, and both will also plot the uncorrected or corrected radiation values for each survey. These are symbol plots in which the count rate is represented by a symbol indicating a value between arbitrarily fixed limits. For uncorrected radiation, the limits are established in terms of standard deviation from the mean background count rate. For corrected radiation count rate, the internal limits for each symbol are established on a power of 2 scale. Also, a special symbol is used to indicate background if the count rate is less than 3 standard deviations from the background count rate. If the count rate is more than 3 standard deviations below background, the value is not plotted at all. The reason for this is that an abnormally low count rate may indicate that the detector was "flying" meaning that it was not in contact with the ocean bottom at the time of the fix. Both BENLH2 and TRACK will plot the location of the mean radiation position referred to as RADBAR. They may also plot the location of the injection site, if this is desired.

2. Statistical Subroutines

The subroutines described below are used to perform certain statistical computations required by the RAPLOT II program. To reduce the time necessary to prepare the program, these subroutines were taken from the STAT-PACK, a library of statistical subroutines available on the UNIVAC 1108 system. Further details may be obtained from the STAT-PACK Programmers' Reference Manual.

Subroutine STDEV computes the standard deviation of an array by the following formula:

$$\sigma = \left(\frac{\sum_{i=1}^n (X_i - \bar{X})^2}{n} \right)^{1/2}$$

Figure 2. Flow Chart of BENLH2 Program

where X = the array of values

$\bar{X}$ = the arithmetic mean of the X array

n = the number of elements in the X array

σ = the standard deviation

Subroutine AMEAN is called to compute the arithmetic mean of the X array.

Subroutine TINORM computes the value of the inverse of the normal distribution by a rational approximation. The inverse normal distribution is defined by the solution for X of the following integral equation

$$\frac{1}{\sqrt{2\pi}} \int_{-\infty}^X e^{-t^2/2} dt = \alpha$$

where α is the probability for which the ordinate is to be calculated. The rational approximation itself may be ascertained from the FORTRAN statements in the subroutine.

3. Input-Output Subroutines

The binary input-output statements in FORTRAN, although convenient to use, cannot make efficient use of magnetic tapes because the language does not permit total parallel processing. Furthermore, a considerable amount of time is used in processing a list because of its generality. More efficient use is attained by buffering the input or output in parallel with computing. On the UNIVAC 1108 system the NTRAN subroutine provides a means of buffering through a call statement in FORTRAN:

CALL NTRAN (UNIT, sequence of operations)

in which UNIT is an integer constant or variable designating the logical unit. If the unit is not busy, NTRAN initiates the first operation and stacks the remainder in a waiting list. If the unit is already busy, then the entire sequence is stacked in a waiting list and chained to the previously stacked sequence. Control is then returned to the program following the call NTRAN statement. When an interrupt occurs, NTRAN records the transmission status, initiates the next operation in the chain and returns control to the interrupted program.

The NTRAN subroutine is used to write out on magnetic tape the arrays containing the legend, sequence number, underwater detector coordinates and corrected count rate for both radiation channels for each file of survey data being processed. The information thus stored on

magnetic tape may be used for further processing such as drawing contour maps. No provision is made for outputting the processed data in RAPLOT III because no further processing was planned for any of the field test sites. Also deletion of the output statements reduces the running time of the program.

Call NTRAN statements are also used in RAPLOT II to position the input tape by end of file marks.

Section D. PROGRAM INPUT

1. Card Input

Input for the RAPLOT II program comes from punched cards and from magnetic tape. Three program control cards are read in for each file of survey data processed. Formats, and descriptions of the variables written onto the cards are given in Table I; names given to the variables in this table are the ones employed by the program. Figure 3 shows a data sheet that is used for filling out the control cards. It is useful not only for filling in the parameters on the cards, but also for keeping track of the data files when large numbers of files are being processed.

The last 12 characters of the legend (Card 3, spaces 66-78) are used for file identification. Before a file of survey data is read in, a 7-word identification array called SENTNL is read in from the beginning of the tape file. The first two words in SENTNL are compared with the last two words in LEGEND. If a match is not found, the tape is positioned at the beginning of the next file and a new SENTNL array is read in. This procedure is in lines 48 through 52 of the source language listing of RAPLOT II in Appendix A. It has been deleted from RAPLOT III.

2. Tape Input

When a RIST survey is underway in the field, data from various sensors are assembled by the onboard detector system, and punched on 8-channel paper tape in American Standard Code for Information Interchange (ASCII) code. At present, there are seven data fields for each line of record. A brief description of the variables and the tape record format is given in Table II; Figure 4 is a sample listing from a paper-tape data file.

In the actual processing of the RIST data files, it has been found necessary to edit the data files prior to putting them through the RAPLOT II program. The edited data are written out in unformatted magnetic tape files. This is why the READ statement in line 58 of the listing in Appendix A is an unformatted FORTRAN READ statement. Unformatted (or binary) input-output statements are much more efficient for the computer to execute than formatted statements. For that reason, they are employed wherever possible. RAPLOT III employs a formatted READ statement (line 51, Appendix B) for inputting a data file, since the need for short turn-around time is greater than the need to edit data files when supporting a field test.

TABLE I

Format of Program Control Cards

I Data Control Card (3F3.0,2F7.0,1X,2F2.0,F3.0,F5.2,3F2.0,4(1X,F7.0),13)

Column	Variable	Description
1-3	CABLE	Length of cable, in feet, on which the detector is towed.
4-6	DEPTH	Average water depth plus freeboard, in feet.
7-9	BOAT	Distance from radar mast to cable stanchion in feet.
10-16	BKG(1)	Estimated background count rate (counts per second) for radiation channel 1.
17-23	BKG(2)	Same for radiation channel 2.
25-28	ZHR,ZMIN	The time of injection in hours and minutes (24-hour clock).
29-31	DAYS	The number of days that have elapsed since the injection.
32-36	HLIFE	The halflife of the radioisotope in days.
37-40	SETIME, RMIN	The time when the survey was started, in hours and minutes (24-hour clock).
41-42	SEC	The time, in seconds, between successive fixes.
44-50 52-58 60-66 68-74	BEACIN } BEACIE } BEAC2N } BEAC2E }	California Lambert Coordinates of the radar beacons. BEACON 1 is always the upcoast beacon.
75-77	ISKIP	The number of lines to skip at the beginning of a data set in order to avoid reading in some bad data.

TABLE I (Continued)

Format of Program Control Cards

II Plot Control Card (4I1,F10.0,1X,3I2,1X,F10.0,2(1X,F10.0),1X,A6)

Column	Variable	Description
1-4	NOPT	Plot option controls. A numeral 1 in the column indicated causes the various options to be executed.
1		Plot trackline followed by survey vessel.
2		Plot uncorrected radiation values.
3		Plot radiation values corrected for background and for decay since injection.
4		Unused.
5-14	SCALE	Map scale in feet per inch.
16-17	NPLT(1) } NPLT(2) } NPLT(3) }	Options used for spotting data points for each plot option. User can specify that every Nth point be plotted. If left blank, every point will be plotted.
18-19		
20-21		
23-32	GRID	Intervals on the coordinate grid at which Lambert Coordinates will be posted. If GRID=0, tick marks are not plotted.
34-43	DUMP 1 } DUMP 2 }	Distance in meters from the injection site to the upcoast and downcoast beacon, respectively. If the fields are blank, then the injection site is not plotted.
45-54		
56-61	INDATE	Day, month and year that the radioactive sand was injected.

III Plot legend card (13A6,L2)

1-78	LEGEND	A descriptive legend that is included on the printed output, and is also written on the lower margin of the map.
79-80	JOBEND	The letter 'T' is entered here if the data file being processed is the last one in the job. Otherwise the field is left blank.

TABLE II

Format of Paper-tape Record on Which RIST Survey Data is Collected
Paper-Tape Format (16,3F7.1,3F7.0)

Column	Array	Description
1-6	NMBR	A line (record) number which is incremented with each line of data unless manually reset.
8-13	TIME	Cumulative time, in tenths of seconds, since the beginning of the survey. Time is reset to zero at the beginning of each survey.
15-20	D ₁	Distance, in tenths of meters, from the upcoast radar responder beacon.
22-27	D ₂	Distance, in tenths of meters, from the downcoast radar responder beacon.
29-34	RAD ₁	Radiation Channel 1: pulses from differential discriminator accumulated for time between successive records. It is automatically reset to zero at the writing of each record.
36-41	RAD ₂	Radiation Channel 2: same description.
43-48	FATH	Depth of water recorded by fathometer. This is not presently in operation.

000061	001240	001763	004900	000236	000201	000000
000062	001260	001793	004916	000175	000142	000000
000063	001280	001814	004919	000155	000132	000000
000064	001300	001846	004924	000150	000130	000000
000065	001320	001861	004929	000142	000119	000000
000066	001340	001878	004930	000152	000136	000000
000067	001360	001920	004920	000149	000124	000000
000068	001380	001925	004825	000152	000116	000000
000069	001400	001958	004947	000136	000114	000000
000070	001420	001980	004975	000130	000110	000000
000071	001440	001022	004932	000130	000101	000000
000072	001460	002027	004932	000127	000104	000000
000073	001480	002043	004945	000144	000117	000000
000074	001500	002092	004977	000145	000123	000000
000075	001520	002120	004966	000108	000089	000000
000076	001540	002143	004970	000140	000115	000000
000077	001560	002157	004970	000143	000117	000000
000078	001580	002189	004979	000174	000136	000000
000079	001600	002206	004981	000142	000114	000000
000080	001620	002234	004999	000138	000122	000000
000081	001640	002265	004996	000133	000108	000000
000082	001660	002286	004998	000188	000155	000000
000083	001680	002315	004016	000122	000101	000000
000084	001700	002327	005048	000164	000131	000000
000085	001720	002365	005011	000166	000133	000000
000086	001740	002386	005021	000178	000151	000000
000087	001760	002403	005039	000152	000120	000000
000088	001780	002448	005075	000133	000105	000000
000089	001800	002471	005073	000154	000131	000000
000090	001820	002497	005077	000169	000143	000000
000091	001840	002509	005089	000151	000128	000000
000092	001860	002549	005109	000174	000153	000000
000093	001880	002580	005135	000153	000130	000000
000094	001900	002611	005138	000158	000126	000000
000095	001920	002629	005156	000154	000124	000000
000096	001940	002658	005164	000145	000114	000000
000097	001960	002693	005191	000170	000141	000000
000098	001980	002719	005207	000189	000151	000000
000099	002000	002757	005211	000167	000137	000000
000100	002020	000774	005219	000147	000120	000000
000101	002040	000808	005238	000170	000133	000000
000102	002060	002836	005266	000173	000129	000000
000103	002080	002868	005272	000149	000126	000000
000104	002100	002902	005280	000146	000126	000000
000105	002120	002916	005302	000192	999149	000000
000106	002140	002958	005322	000140	000114	000000
000107	002160	002997	005342	000170	000136	000000
000108	002180	002028	005355	000163	000133	000000
000109	002200	003044	005363	000142	000121	000000

Figure 4. Sample Listing of Input Data File for RAPLOT 11

1. Printed Output

Three forms of output are generated by the RAPLOT II program - printed output, graphical output, and magnetic tape output.

The printed output for one data file consists of one page listing the program control parameters and summary statistics (Figure 5) followed by a complete listing of the unprocessed and processed data arrays (Figure 6).

The printout of program parameters and summary statistics for RAPLOT III (Figure 7) is virtually the same. However, the radar-range data and uncorrected radiation data are deleted from the printed listing (Figure 8). Also, only one channel of corrected radiation data is included.

Because of the large volume of data files that may be processed by the RAPLOT II program, it is usually necessary to keep track of the number of pages of output. Fifty lines are printed to a page of output; one page is required for program control parameters and another page for summary statistics. Therefore, the number of pages per data file = $2 + (\text{number of lines of data}/50.)$

2. Graphical Output

Graphical output from RAPLOT II is in the form of plot commands that are either written out on magnetic tape or punched onto cards to be used to drive a Benson-Lehner plotter off-line. Under the present setup, the plot commands are written out on logical tape unit 9; therefore, this same unit cannot be used for other tape input or output without first making changes. On the UNIVAC 1108 system, the plot commands are blocked and written out in card image length records at 556 bits per inch in even parity, BCD. Experience has shown that one full tape will hold approximately 20 separate plots. Assuming that 2 plots are generated per file of data, this means that 10 files of radiation survey data will generate a full tape of plot commands.

RAPLOT II graphical output consists of three types of plots - plots of the trackline followed by the survey vehicle, plots of uncorrected radiation data (for plotting background radiation), and plots of corrected radiation data. Selection of the various plots is controlled by the variable NOPT in Table I. The plot selection options are independent of each other. Any one of the three plot types may be selected, or all three if it is desired. Normally, the trackline plot is selected and then, depending on whether the data is from a background or a radiation survey, either the plot of uncorrected radiation or corrected radiation data is selected. Plots of the survey vehicle trackline and the corrected radiation data are shown in Figures 9 and 10.

REAL TIME CLOCK INTERROGATED AT 17:30.15
 SURF 600 FT S R-158 O/S RADIATION SURVEY AU-198 1451 10/04/1968 5 F

BEACON 1 451655.N 1217236.E BEACON 2 445357.N 1218250.E

SQUARE DIST BETWEEN = .40693000+08 DISTANCE BETWEEN = 6379.
 SINE = -.98729560-00 COSINE = .15895643-00
 INJECTION TIME = 11.13. CLOCK SET AT 14.51. DIGITIZING INTERVAL = 2.5 SECONDS
 DAYS ELAPSED SINCE INJECTION = 0.
 HALF-LIFE OF ISOTOPE = 3.00 DAYS DECAY FACTOR = .96270442-02 TIME-DELAY FACTOR = 3.63 HOURS
 CABLE LENGTH = 75. MEAN WATER DEPTH = 10. BOAT LENGTH = 12.
 DISTANCE FROM RADAR MAST TO DETECTOR = 86.3 FEET.

TRACKLINE 1 10/04/1968 5 PLOTS GENERATED 0 CORRECTED RADIATION 1

SUMMARY STATISTICS OF BACKGROUND RADIATION COUNT RATE

EST. BKG. COUNTS/SEC.	310.
MEAN BKG. COUNTS/SEC.	250.
STD. DEV. COUNTS/SEC.	254.
	18.

SUM OF CORRECTED RADIATION COUNTS

RADIATION CHANNEL 1	.40784094+07
RADIATION CHANNEL 2	.24124798+07

SUMMARY STATISTICS OF RADIATION LOCATION.

MEAN	
NORTH COORD	445611.
STD. DEV.	47.
CONFIDENCE	89.
LIMIT OF MEAN	2.

MAXIMUM COORD 446198.N 1218147.E

MINIMUM COORD 444978.N 1216421.E

Figure 5. Printed Output of RAPLOT II Program Control Parameters and Summary Statistics for One Data File

LINE	TIME SEC	SUNF	600 FT 5	R-158 0/5	RADIATION SURVEY	BOAT COORDINATES	BALL COORDINATES	CORRECTED RADIATION
					RAD1 RAD2	N E	N F	RAD1 RAD2
54	110.		1843.1	239.7	8065.	1217494.	4455604.	3849.
55	112.		1842.5	241.9	8066.	1217487.	4455588.	2879.
56	114.		1841.9	243.1	1502.	1217483.	4455589.	3870.
57	116.		1840.9	245.2	8107.	1217477.	4455561.	3003.
58	118.		1840.3	247.1	958.	1217471.	4455592.	167.
59	120.		1840.7	248.6	2215.	1217465.	4455593.	884.
60	122.		1839.8	251.0	17401.	1217455.	4455592.	6284.
61	124.		1838.4	254.7	10481.	1217446.	4455598.	5100.
62	126.		1837.2	255.7	60955.	1217436.	4455598.	31244.
63	128.		1837.9	257.9	45464.	1217427.	4455600.	23220.
64	130.		1837.1	260.6	34421.	1217415.	4455603.	17566.
65	132.		1836.5	262.7	77135.	1217403.	4455604.	26635.
66	134.		1837.2	264.2	99527.	1217397.	4455604.	18102.
67	136.		1835.1	266.0	48966.	1217387.	4455604.	27025.
68	138.		1835.4	267.7	97057.	1217376.	4455604.	47899.
69	140.		1835.1	270.0	97057.	1217367.	4455604.	23923.
70	142.		1834.6	271.7	102924.	1217358.	4455604.	28251.
71	144.		1834.1	273.2	103271.	1217348.	4455604.	26000.
72	146.		1833.2	275.2	101177.	1217338.	4455611.	25735.
73	148.		1833.1	277.2	105781.	1217328.	4455611.	29199.
74	150.		1832.3	279.5	98000.	1217316.	4455614.	29637.
75	152.		1831.9	281.2	90976.	1217305.	4455614.	24183.
76	154.		1830.6	282.6	99412.	1217294.	4455614.	50436.
77	156.		1829.9	285.2	100796.	1217283.	4455620.	21680.
78	158.		1830.5	287.4	94070.	1217273.	4455623.	33637.
79	160.		1830.4	289.3	99616.	1217264.	4455623.	44401.
80	162.		1828.1	291.1	104735.	1217254.	4455624.	34175.
81	164.		1828.5	293.1	93753.	1217243.	4455624.	51926.
82	166.		1828.7	295.2	97060.	1217232.	4455624.	32956.
83	168.		1827.2	297.5	93157.	1217221.	4455624.	49951.
84	170.		1828.2	299.7	83310.	1217210.	4455624.	27907.
85	172.		1825.4	301.6	54378.	1217200.	4455631.	22174.
86	174.		1825.2	303.5	62522.	1217189.	4455632.	30650.
87	176.		1825.7	305.3	57359.	1217178.	4455632.	29752.
88	178.		1825.0	307.5	90326.	1217168.	4455632.	23044.
89	180.		1825.5	309.4	48754.	1217157.	4455637.	47663.
90	182.		1825.5	307.5	93799.	1217146.	4455639.	26994.
91	184.		1825.2	311.4	90736.	1217135.	4455640.	23259.
92	186.		1825.9	313.4	86256.	1217124.	4455640.	19765.
93	188.		1825.1	315.9	93013.	1217113.	4455644.	22633.
94	190.		1822.0	320.0	101368.	1217102.	4455648.	27954.
95	192.		1820.8	323.3	104634.	1217091.	4455648.	34944.
96	194.		1820.0	326.2	85960.	1217080.	4455648.	38178.
97	196.		1820.2	328.9	55731.	1217069.	4455648.	28609.
98	198.		1818.5	331.8	41312.	1217058.	4455654.	21139.
99	200.		1817.1	334.8	56601.	1217047.	4455657.	22315.
100	202.		1816.3	337.5	32980.	1217036.	4455657.	16771.
101	204.		1814.3	340.5	33666.	1217025.	4455659.	17178.
102	206.		1812.2	343.7	19075.	1217014.	4455665.	10054.
103	208.		1812.5	346.8	16963.	1217003.	4455669.	8525.
					17336.	1217159.	445672.	10797.

Figure 6. Sample of Printed Output of RAPLOT II Processed Data for One RIST Data File

PT MUGU GROIN SITE BACKGROUND SURVEY 1 23/09/69 1445 F

BEACON 1 228153.N 1648021.E BEACON 2 227348.N 1649710.E

SQUARE DIST BETWEEN = 0.14383460E 07 DISTANCE BETWEEN = 1199.
 SINE = -0.67121892E 00 COSINE = 0.74125916E 00
 INJECTION TIME = 10. D. CLOCK SET AT 14.45. DIGITIZING INTERVAL = 2. SECONDS
 DAYS ELAPSED SINCE INJECTION = 0.
 HALF-LIFE OF ISOTOPE = 3. CDDAYS DECAY FACTOR = 0.96270442E-02 TIME-DELAY FACTOR = 4.75 HOURS
 CABLE LENGTH = 75. MEAN WATER DEPTH = 12. BOAT LENGTH = 12.
 DISTANCE FROM RADAR MAST TO DETECTOR = 86.0 FEET.

TRACKLINE 1 PLOTS GENERATED 1 CORRECTED RADIATION -0

SUMMARY STATISTICS OF BACKGROUND RADIATION COUNT RATE

EST. BKG. COUNTS/SEC. 75.
 MEAN BKG. COUNTS/SEC. 78.
 STD. DEV. COUNTS/SEC. 9.

MAXIMUM COORD 228192.N 1649201.E

MINIMUM COORD 226291.N 1647486.E

Figure 7. Printed Output of RAPIOT III Program Control Parameters and Summary Statistics for One Data File

PT HUGO GROIN SITE BACKGROUND SURVEY 1 23/09/69 1445

LINE	TIME SEC	DISTANCE TO BEACON 1 2	BOAT COORDINATES NORTH EAST	BALL COORDINATES NORTH EAST	UNCORRECTED RADIATION COUNTS/SEC	CORRECTED COUNTS/SEC	DEPTH FEET
0	2.		228177. 1648434.	228092. 1648429.		75.	0.
1	4.		228192. 1648435.	228106. 1648430.		92.	0.
2	6.		228182. 1648427.	228106. 1648430.		106.	0.
3	8.		228181. 1648424.	228106. 1648430.		88.	0.
4	10.		228171. 1648419.	228106. 1648430.		102.	0.
5	12.		228168. 1648416.	228106. 1648430.		97.	0.
6	14.		228160. 1648408.	228106. 1648430.		106.	0.
7	16.		228145. 1648406.	228106. 1648430.		104.	0.
8	18.		228145. 1648402.	228106. 1648430.		96.	0.
9	20.		228141. 1648398.	228106. 1648430.		92.	0.
10	22.		228130. 1648394.	228106. 1648430.		101.	0.
11	24.		228118. 1648392.	228106. 1648430.		160.	0.
12	26.		228119. 1648385.	228106. 1648430.		92.	0.
13	28.		228124. 1648379.	228106. 1648430.		113.	0.
14	30.		228108. 1648373.	228106. 1648430.		96.	0.
15	32.		228105. 1648361.	228106. 1648430.		109.	0.
16	34.		228101. 1648354.	228106. 1648430.		71.	0.
18	38.		228072. 1648334.	228101. 1648416.		70.	0.
19	40.		228063. 1648325.	228096. 1648404.		74.	0.
20	42.		228050. 1648314.	228090. 1648392.		59.	0.
21	44.		228040. 1648308.	228084. 1648382.		57.	0.
22	46.		228023. 1648311.	228075. 1648370.		72.	0.
23	48.		228015. 1648295.	228069. 1648362.		79.	0.
24	50.		228011. 1648288.	228063. 1648355.		63.	0.
25	52.		228005. 1648278.	228057. 1648347.		60.	0.
26	54.		227994. 1648273.	228050. 1648339.		76.	0.
27	56.		227989. 1648266.	228044. 1648332.		74.	0.
28	58.		227992. 1648254.	228040. 1648325.		66.	0.
29	60.		227970. 1648251.	228029. 1648314.		71.	0.
30	62.		227970. 1648241.	228024. 1648307.		76.	0.
31	64.		227960. 1648232.	228015. 1648298.		81.	0.
32	66.		227957. 1648220.	228009. 1648288.		75.	0.
33	68.		227942. 1648214.	227999. 1648278.		63.	0.
34	70.		227935. 1648204.	227992. 1648269.		66.	0.
35	72.		227919. 1648205.	227983. 1648262.		80.	0.
36	74.		227921. 1648199.	227982. 1648260.		80.	0.
37	76.		227913. 1648197.	227976. 1648255.		78.	0.
38	78.		227914. 1648192.	227974. 1648253.		64.	0.
39	80.		227906. 1648185.	227967. 1648246.		48.	0.
40	82.		227895. 1648179.	227958. 1648237.		52.	0.
41	84.		227894. 1648173.	227955. 1648234.		68.	0.
42	86.		227881. 1648173.	227947. 1648228.		64.	0.
43	88.		227886. 1648164.	227945. 1648226.		82.	0.
44	90.		227875. 1648157.	227936. 1648217.		59.	0.
45	92.		227862. 1648152.	227927. 1648208.		56.	0.
46	94.		227854. 1648147.	227920. 1648203.		64.	0.
47	96.		227856. 1648141.	227918. 1648201.		74.	0.
48	98.		227845. 1648138.	227910. 1648194.		75.	0.
49	100.		227833. 1648134.	227901. 1648187.		57.	0.
50	102.		227825. 1648128.	227893. 1648181.		55.	0.

Figure 8. Sample of Printed Output of RAPLOT III Processed Data for One RIST Data File

Figure 9. Trackline Plot Produced on Benson-Lehner Plotter by Subroutine BENLH2 of RAPLOT II

Figure 10. Plot of Corrected Radiation Data Produced on Benson-Lehner Plotter by Subroutine BENLH2 of RAPLOT II

The graphical output from RAPLOT III is produced on the Stromberg-Carlson 4020 computer recorder. The technique for getting the plots is somewhat the same as the Benson-Lehner plotter in that the plot commands are written out on magnetic tape and are then used off-line to generate the plots. There is a highly developed software package that goes with the S-C 4020 and if it is planned to use this method of generating plots, the Programmers' Reference Manual for the S-C 4020 should be used. Figure 11 is a trackline plot produced on the computer recorder at the Pacific Missile Range data processing center at Point Mugu. Figure 12 is a plot of uncorrected radiation data that was also produced there.

3. Magnetic Tape Output

The processed data is stored on magnetic tape for future reference by the calls to the NTRAN subroutine. The arrays written out are: LEGEND, sequence number (NMBR), coordinates of radiation location (NCORD and ECORD), and corrected radiation data (CCR). This procedure has been eliminated from RAPLOT III.

Section F. INSTRUCTIONS FOR RUNNING PROGRAM

An example of a job deck setup for running RAPLOT II is shown in Figure 13. Further instructions on running jobs are in the 1108 EXEC II Programmers' Reference Manual. Running time depends on the number of files being processed and the number of records in each file. Figure 14 shows a graph of UNIVAC 1108 central processing unit time to process one file versus the number of records in the file.

For running version III on the IBM 7094, consult the IBM reference manuals for FORTRAN IV and the system monitor (IBSYS). It may also be useful to have a copy of the Programmers' Reference Manual for the S-C 4020 Computer Recorder.

Section G. RADIATION CONTOURING PROGRAM

Present programming effort is directed toward completing RADCON, a FORTRAN V program for drawing contour maps of radiation data. The input for this program will be the files of processed data on magnetic tape that have been generated by RAPLOT II. If necessary, two or more data files may be combined to provide the input for one contour map. The radiation data are first smoothed by a moving average (LINAVE) procedure and then interpolated over a uniform grid by a weighted least-squares numerical approximation (NUPRX). The resulting grid is then contoured at equally spaced intervals of the gridded values. There are also options for transforming the radiation data, although the number of options and types of transformation is still undecided.

Figure 11. Trackline Plot Produced on S-C 4060 Computer Recorder by Subroutine TRACK of RAPLOT III

Figure 12. Plot of Uncorrected Radiation Data Produced on S-C 4060 Computer Records by Subroutine TRACK of RAPLOT III

Figure 13. Example of a RAPLOT II Job Deck Setup for UNIVAC 1108 Running under EXEC II

Figure 14. Graph of CPU Time Required to Plot One Data File Versus the Number of Records in the File.

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APPENDIX A

LISTING AND INDEX OF RAPLOT II PROGRAM

The source deck has been analyzed routine-by-routine and a directory of all statement numbers and variable names used in the source deck. The symbols are listed numerically and alphabetically. Beside each symbol appears line numbers followed by a code which designates where and how the symbol was referenced. The codes used are as follows:

<u>Code</u>	<u>Meaning</u>
Blank	A simple reference, such as the use of a statement number in an IF statement or a variable used in an arithmetic statement.
=	Arithmetic definition of a variable which appears on the left of an = sign.
*	Statement number defined at this line.
AG	Variable appears as an argument in a subroutine or function statement or as an argument in a CALL statement.
CO	Variable appears in a COMMON statement.
CX	Variable appears in a COMPLEX statement.
DA	Variable appears in a DATA statement.
DB	Variable appears in a DOUBLE PRECISION statement.
DI	Variable appears in a DIMENSION statement.
EQ	Variable appears in an EQUIVALENCE statement.
EX	Function name appears in an EXTERNAL statement.
IN	Variable appears in an INTEGER statement.
LG	Variable appears in a LOGICAL statement.
NM	Variable appears in a NAMELIST statement.
PR	Variable or FORMAT number appears in a PRINT statement.
PU	Variable or FORMAT number appears in a PUNCH statement.
RD	Variable or FORMAT number appears in a READ statement.
RL	Variable appears in a REAL statement.
WR	Variable or FORMAT number appears in a WRITE statement.

C	PROGRAM -- RAPLOT II	1
C	THE PURPOSE OF THIS PROGRAM IS TO REDUCE THE RADIOACTIVITY SURVEY	2
C	DATA FROM THE RIST PROJECT AND PLOT THE SURVEY ON A BENSON-LEHNER	3
C	INCREMENTAL PLOTTER. THE FOLLOWING PLOTS ARE THE OUTPUT	4
C	TRACKLINE FOLLOWED BY SURVEY VESSEL	5
C	PLOT OF UNCORRECTED RADIATION VALUES (BACKGROUND SURVEY)	6
C	SYMBOL PLOT OF RADIATION VALUES CORRECTED FOR BACKGROUND AND	7
C	DECAY SINCE INJECTION TIME.	8
C	PROGRAMMER: PHILIP A. TURNER	9
C	GEOLOGY BRANCH	10
C	U S ARMY COASTAL ENGINEERING RESEARCH CENTER	11
C	5201 LITTLE FALLS ROAD	12
C	WASHINGTON, D. C. 20016	13
C	COMPLETED IN JANUARY 1969	14
C	FORMAT AND ENTRIES ON DATA CONTROL CARD	15
C	COL 1-3 CABLE LENGTH IN FEET TO THE NEAREST FOOT.	16
C	COL 4-6 WATER DEPTH PLUS FREEBOARD TO THE NEAREST FOOT.	17
C	COL 7-9 DISTANCE FROM RADAR MAST TO CABLE STANCHION IN FEET	18
C	TO THE NEAREST FOOT.	19
C	COL 10-16 ESTIMATED BACKGROUND COUNT RATE IN COUNTS/SEC FOR	20
C	CHANNEL 1.	21
C	COL 17-23 ESTIMATED BACKGROUND COUNT RATE IN COUNTS/SEC FOR	22
C	CHANNEL 2.	23
C	COL 25-28 TIME OF INJECTION IN HOURS AND MINUTES.	24
C	COL 29-31 THE NUMBER OF DAYS SINCE THE INJECTION	25
C	COL 32-36 THE HALF LIFE OF THE RADIOISOTOPE IN DAYS.	26
C	THE DECIMAL POINT MUST BE PUNCHED IN.	27
C	COL 37-40 THE TIME WHEN THE SURVEY WAS STARTED, IN HOURS AND	28
C	MINUTES.	29
C	COL 41-42 TIME (IN SECONDS) BETWEEN SUCCESSIVE FIXES	30
C	COL 44-50 BEACON1 NORTH COORD/ LAMBERT COORDINATES OF RADAR	31
C	COL 52-58 BEACON1 EAST COORD/ BEACONS TO THE NEAREST FOOT.	32
C	COL 60-66 BEACON2 NORTH COORD/ BEACON1 IS ALWAYS UP-CAST.	33
C	COL 68-74 BEACON2 EAST COORD/	34
C	COL 75-77 THE NUMBER OF LINES OF DATA TO BE SKIPPED AT THE	35
C	BEGINNING OF A DATA SET IN ORDER TO AVOID	36
C	READING IN SOME BAD DATA.	37
C	FORMAT AND ENTRIES ON PLOT CONTROL CARD	38
C	COL 1-3 PLOT OPTION CONTROL. TO USE, PUNCH THE NUMERAL 1	39
C	IN THE COLUMN INDICATED.	40
C	1 = PLOT TRACKLINE FOLLOWED BY SURVEY VESSEL.	41
C	2 = PLOT UNCORRECTED RADIATION VALUES.	42
C	3 = PLOT RADIATION VALUES CORRECTED FOR BACKGROUND	43
C	AND DECAY SINCE TIME ZERO.	44
C	4 = UNUSED. LEAVE BLANK.	45
C	COL 5-14 MAP SCALE EXPRESSED IN FEET PER INCH	46
C	COL 16-17 OPTION 1 / USE WHEN SPOTTING DATA FOR EACH PLOT	47
C	COL 18-19) 2 / OPTION. USER CAN SPECIFY THAT EVERY NTH	48
C	COL 20-21) 4 / POINT BE PLOTTEO. IF LEFT BLANK, THE	49
C	PROGRAM ASSUMES EVERY POINT IS TO BE	50
C	PLOTTEO.	51
C	COL 23-32 INTERVALS ON THE COORDINATE GRID AT WHICH TICK	52
C	MARKS WITH THE LAMBERT COORDINATES WILL BE POSTED.	53
C	IF FIELD IS LEFT BLANK, PROGRAM WILL ASSUME THAT	54
C	NO TICK MARKS ARE TO BE PLOTTEO AND POSTED.	55
C	COL 34-43 BEACON 1 / INJECTION SITE. DISTANCE IN METERS TO	56
C	COL 45-54 BEACON 2 / THE NAMED BEACONS. IF FIELDS ARE LEFT	57
C	BLANK, SITE IS NOT PLOTTEO.	58
C	COL 56-61 DAY, MONTH AND YEAR THE SAND WAS INJECTED	59
C	FORMAT AND ENTRIES ON PLOT IDENTIFICATION CARD	60
C	COL 1-78 THIS FIELD WILL BE PLOTTEO ON THE LOWER MARGIN OF	61
C	THE MAP.	62
C	COL 80 PUNCH 'T' HERE ON THE LAST DATA SET.	63
1	COMMON NOPT(4), SCALE, NPLT(3), GRID, SITE, INDATE, LEGEND(13), BE	64
	IACIN, BEAC1E, BEAC2N, BEAC2E, LINE, BGCR(2), SIGMA(2), NBAR, EBAR, NENTRY, N	65
	2MAX, NMIN, EMAX, EMIN	66
2	REAL NORTH(2200), NCORD(2200), NBAR, NMAX, NMIN	67
3	DIMEIN, INMBR(2200), TIME(2200), D(2,2200), EAST(2200), ECORD(220	68
	10), RAD(2,2200), CCR(2,2200), L(4), IERR(2200), BK6(2), FATH(2200)	69
	2, ISIGN(3)	70
4	INTEGER SENTNL(7), WORD1, WORD2, BLANK, AS	71
5	LOGICAL JOBED	72
C		73
C	NTAPE IS THE NUMBER FOR THE INPUT TAPE CONTAINING THE SURVEY DATA	74
C	ITAPE IS THE UNIT ON WHICH THE PROCESSED DATA IS WRITTEN OUT	75
C		76
6	DATA WORD1, WORD2, NTAPE, ITAPE, COR1, COR2, BLANK, AS/6HEND OF 6H DATA ,	77
	17, 8, 2, 9, 2, 8, 6H , IH*/	78

PROGRAM -- RAPLOT II

	C		79
	C	READ IN DATA CONTROL CARD	80
	C		81
7	10	IF (L(1).NE.-1) GO TO 20	82
8		GO TO 10	83
9	20	IF (L(1).LT.-1) GO TO 770	84
10		READ (5,780) CABLE,DEPTH,BOAT,BKG,ZHR,ZMIN,DAYS,HLIFE,SETIME,RMIN, 1SEC,BEAC1N,BEAC1E,BEAC2N,BEAC2E,ISKIP	85
	C		86
	C	READ IN PLOT CONTROL PARAMETERS	87
	C		88
11		READ (5,790) NOPT,SCALE,(NPLT(I),I=1,3),GRID,DUMP1,DUMP2,INDATE	89
12		DO 40 I=1,3	90
13		IF (NPLT(I)) 30,30,40	91
14	30	NPLT(I)=1	92
15	40	CONTINUE	93
	C		94
	C	READ IN PLOT LEGEND	95
	C		96
	C		97
16		READ (5,800) LEGEND,JOBEND	98
17		WRITE (6,810) LEGEND,JOBEND	99
18		WRITE (6,820) BEAC1N,BEAC1E,BEAC2N,BEAC2E	100
	C		101
	C	COMPUTE PROGRAM PARAMETERS FROM DATA CONTROL CARD ENTRIES	102
	C		103
19		SQDSTB=(BEAC2N-BEAC1N)**2+(BEAC2E-BEAC1E)**2	104
20		DISTB=SQRT(SQDSTB)	105
21		WRITE (6,830) SQDSTB,DISTB	106
22		SINE=(BEAC2N-BEAC1N)/DISTB	107
23		COSINE=(BEAC2E-BEAC1E)/DISTB	108
24		WRITE (6,840) SINE,COSINE	109
25		WRITE (6,850) ZHR,ZMIN,SETIME,RMIN,SEC,DAYS	110
26		ZHR=ZHR+ZMIN/60.	111
27		SETIME=SETIME+RMIN/60.	112
28		DELAY=SETIME+DAYS*24.-ZHR	113
29		IF (HLIFE.GT.0.0) DECAY=ALOG(2.)/(HLIFE*24.)	114
30		WRITE (6,860) HLIFE,DECAY,DELAY	115
31		WRITE (6,870) CABLE,DEPTH,BOAT	116
32		CABLE=BOAT+SQRT(CABLE**2-DEPTH**2)	117
33		WRITE (6,880) CABLE	118
34		WRITE (6,890) (NOPT(I),I=1,3)	119
	C		120
	C	COMPUTE COORDINATES OF THE INJECTION SITE FROM THE DISTANCES FROM THE BEACONS	121
	C		122
	C		123
35		IF (DUMP1) 80,80,50	124
36	50	DUMP1=(DUMP1+COR1)*3.28083	125
37		DUMP2=(DUMP2+COR2)*3.28083	126
38		DX1=(SQDSTB+DUMP1-DUMP1-DUMP2)/DISTB*2.)	127
39		DY1=DUMP1-DUMP1-DX1*DX1	128
40		IF (DY1) 60,60,70	129
41	60	SITEN=-999999.	130
42		WRITE (6,900)	131
43		GO TO 80	132
44	70	DY1=-SQRT(DY1)	133
45		SITEE=DX1*COSINE-DY1*SINE+BEAC1E	134
46		SITEN=DX1*SINE+DY1*COSINE+BEAC1N	135
47		WRITE (6,910) SITEN,SITEE	136
	C		137
	C	TEST FILE SENTINEL TO BE SURE THAT THE CORRECT DATA FILE IS BEING	138
	C	READ IN	139
	C		140
48	80	READ (NTAPE) SENTNL	141
49		IF (SENTNL(1).EQ.WORD1.AND.SENTNL(2).EQ.WORD2) GO TO 730	142
50		IF (SENTNL(1).EQ.LEGEND(12).AND.SENTNL(2).EQ.LEGEND(13)) GO TO 90	143
51		CALL NTRAN (NTAPE,8,1)	144
52		GO TO 80	145
53	90	WRITE (6,920) SENTNL	146
	C		147
	C	READ IN THE DATA FILE FROM ONE RIST SURVEY	148
	C		149
54	100	IF (L(2).NE.-1) GO TO 110	150
55		GO TO 100	151
56	110	IF (L(2).LT.-1) GO TO 770	152
57		CALL NTRAN (ITAPE,1,13,LEGEND,L(1))	153
58		READ (NTAPE) LINE,(NMBR(N),TIME(N),D(1,N),D(2,N),RAD(1,N),RAD(2,N), 1,FATH(N),N=1,LINE)	154
59		CALL NTRAN (NTAPE,8,1)	155
60		IERR(1)=0	156
61		DO 130 N=2,LINE	157
			158

PROGRAM -- RAPLOT II

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62      IERR(N)=0                                159
      C                                          160
      C CHECK TO SEE THAT LINE NUMBERS AND TIMES OF FIXES ARE IN MONOTONIC 161
      C ASCENDING SEQUENCE.                    162
      C                                          163
63      IF (NMBR(N).LE.NMBR(N-1)) NMBR(N)=NMBR(N-1)+1 164
64      IF (TIME(N)-TIME(N-1)) 120,120,130          165
65      120 TIME(N)=TIME(N-1)+SEC                166
66      130 CONTINUE                             167
67      IF (ISKIP.LE.0) GO TO 160                 168
      C                                          169
      C SKIP LEADING CARD IMAGES THAT CONTAIN BAD DATA. 170
      C                                          171
68      NSTART=ISKIP+1                           172
69      DO 150 N=NSTART,LINE                     173
70      NMBR(N-ISKIP)=NMBR(N)                   174
71      TIME(N-ISKIP)=TIME(N)                   175
72      DO 140 I=1,2                             176
73      D(I,N-ISKIP)=D(I,N)                     177
74      140 RAD(I,N-ISKIP)=RAD(I,N)             178
75      150 FATH(N-ISKIP)=FATH(N)               179
76      LINE=LINE-ISKIP                         180
77      MSTOP=LINE-I                             181
      C                                          182
      C CHECK DISTANCES TO RADAR BEACONS FOR ERRORS. IF DISTANCE/TIME 183
      C FOR SUCCESSIVE BEACON RANGES INDICATE A SHIP SPEED .GT. 6 KNOTS 184
      C (3.09 METERS/SEC), RANGE IS IN ERROR.    185
      C                                          186
78      DO 270 I=1,2                             187
79      DO 200 M=1,MSTOP                         188
80      IF (D(I,M)) 200,200,170                 189
81      170 NSTART=M+1                           190
82      DO 190 N=NSTART,LINE                     191
83      IF (ABS(D(I,N)-D(I,M))-(TIME(N)-TIME(M))*3.0866S) 200,200,180 192
84      180 D(I,N)=-1.                           193
85      IERR(N)=IERR(N)+1                       194
86      190 CONTINUE                             195
87      200 CONTINUE                             196
88      DO 260 M=1,MSTOP                         197
89      IF (D(I,M)) 210,210,260                 198
90      210 NSTART=M                             199
      C                                          200
      C CORRECT ERRONEOUS BEACON RANGES BY LINEAR INTERPOLATION (ON TIME) 201
      C BETWEEN NON-ERRONEOUS RANGES.          202
      C                                          203
91      DO 230 N=NSTART,LINE                     204
92      IF (D(I,N)) 230,230,220                 205
93      220 NSTOP=N                             206
94      GO TO 240                                207
95      230 CONTINUE                             208
96      240 OTIME=TIME(NSTOP)-TIME(NSTART-1)    209
97      DD1=D(I,NSTOP)-D(I,NSTART-1)           210
98      N=NSTART                                 211
99      250 D(I,N)=D(I,NSTART-1)+DD1*(TIME(N)-TIME(NSTART-1))/OTIME 212
100     N=N+1                                    213
101     IF (N-NSTOP) 250,260,260                214
102     260 CONTINUE                             215
103     270 CONTINUE                             216
      C                                          217
      C COMPUTE POSITION OF SHIP FROM DISTANCES FROM THE TWO BEACONS 218
      C                                          219
104     LAG=0                                    220
105     DO 300 N=1,LINE                          221
      C                                          222
      C MAKE CONSTANT CORRECTION FOR CUBIC AUTOTAPE INTERROGATOR 223
      C AND CONVERT TO FEET                    224
      C                                          225
106     DFT1=(D(1,N)+COR1)*3.28083              226
107     DFT2=(D(2,N)+COR2)*3.28083              227
108     DX1=(SQD5T8+DFT1*DFT1-DFT2*DFT2)/(12.*DISTB) 228
109     DY1=DFT1*DFT1-DX1*DX1                   229
      C                                          230
      C CHECK FOR IMAGINARY ROOT.              231
      C                                          232
110     IF (DY1) 280,280,290                    233
111     280 IERR(N)=IERR(N)+4                    234
112     LAG=LAG+1                                235
113     GO TO 300                                236
114     290 DY1=-SQRT(DY1)                      237

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PROGRAM -- RAPLOT II

C		238
C	ROTATE COORDINATES AND TRANSLATE INTO CALIFORNIA LAMBERT COORDINAT	239
C	SYSTEM	240
C		241
115	EAST(N)=DX1*COSINE-DY1*SINE+BEAC1E	242
116	NORTH(N)=DX1*SINE+DY1*COSINE+BEAC1N	243
117	300 CONTINUE	244
118	IF (LAG.EQ.0) GO TO 360	245
119	ASSIGN 360 TO KEY	246
C		247
C	ELIMINATE DATA SETS FOR WHICH AN	248
C	IMAGINARY FIX WAS OBTAINED	249
C		250
120	310 LAG=0	251
121	DO 350 N=1,LINE	252
122	IF (IERR(N)-4) 330,320,320	253
123	320 LAG=LAG+1	254
124	GO TO 350	255
125	330 NMBR(N-LAG)=NMBR(N)	256
126	TIME(N-LAG)=TIME(N)	257
127	DO 340 I=1,2	258
128	D(I,N-LAG)=D(I,N)	259
129	340 RAD(I,N-LAG)=RAD(I,N)	260
130	EAST(N-LAG)=EAST(N)	261
131	NORTH(N-LAG)=NORTH(N)	262
132	IERR(N-LAG)=IERR(N)	263
133	350 CONTINUE	264
134	LINE=LINE-LAG	265
135	GO TO KEY,(360,430)	266
C		267
C	CHECK NORTH AND EAST COORDINATES FOR	268
C	EXTREME VALUES BY CHAUVENET'S CRITERION	269
C		270
136	360 NBAR=-1.	271
137	CALL STDEV (NORTH,LINE,NBAR,SDNRTH)	272
138	EBAR=-1.	273
139	CALL STDEV (EAST,LINE,EBAR,SDEAST)	274
140	ALPHA=1.-1./FLOAT(2*LINE)	275
141	CHVR=TINORM(ALPHA,\$365)	276
142	GO TO 370	277
143	365 CHVR=5.0	278
144	WRITE (6,930) ALPHA	279
145	370 GATE1=EBAR-CHVR*SDEAST	280
146	GATE2=EBAR+CHVR*SDEAST	281
147	GATEN1=NBAR-CHVR*SDNRTH	282
148	GATEN2=NBAR+CHVR*SDNRTH	283
149	LAG=0	284
150	DO 420 N=1,LINE	285
151	IF (EAST(N)-GATE1) 410,380,380	286
152	380 IF (EAST(N)-GATE2) 390,390,410	287
153	390 IF (NORTH(N)-GATEN1) 410,400,400	288
154	400 IF (NORTH(N)-GATEN2) 420,420,410	289
155	410 IERR(N)=IERR(N)+4	290
156	LAG=LAG+1	291
157	420 CONTINUE	292
158	ASSIGN 430 TO KEY	293
C		294
C	ELIMINATE ANY DATA SETS THAT HAVE AN EXTREME	295
C	VALUES OF THE NORTH OR EAST COORDINATES	296
C		297
159	IF (LAG.GT.0) GO TO 310	298
C		299
C	CALL SUBROUTINE FOR PLOTTING THE TRACK OF THE SURVEY VESSEL.	300
C		301
160	430 NENTRY=1	302
161	CALL NTRAN (ITAPE,1,LINE,NMBR,L(2))	303
162	IF (NOPT(1).EQ.1) CALL BENLH2 (NORTH,EAST,NMBR)	304
C		305
C	APPLY A CORRECTION TO ALLOW FOR THE DISTANCE THE DETECTOR IS TOWED	306
C	ASTERN OF THE SURVEY SHIP.	307
C		308
163	440 IF (L(3).NE.-1) GO TO 450	309
164	GO TO 440	310
165	450 IF (L(3).LT.-1) GO TO 770	311
166	DNO=NORTH(1)-(NORTH(2)-NORTH(1))	312
167	DEO=EAST(1)-(EAST(2)-EAST(1))	313
168	DENOM=SQRT((NORTH(1)-DNO)**2+(EAST(1)-DEO)**2)	314
169	NCORD(1)=NORTH(1)-CABLE*(NORTH(1)-DNO)/DENOM	315
170	ECORD(1)=EAST(1)-CABLE*(EAST(1)-DEO)/DENOM	316
171	DO 480 N=2,LINE	317

PROGRAM -- RAPLOT II

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172      DENOM=SQRT((NORTH(N)-NCORD(N-1))**2+(EAST(N)-ECORD(N-1))**2)      318
      C
      C THE CORRECTION FOR THE DISTANCE BETWEEN VESSEL AND THE DETECTOR      320
      C IS EQUAL TO 'CABLE' UNLESS THE VESSEL IS LESS THAN 'CABLE' FEET      321
      C AWAY FROM THE LAST COMPUTED POSITION OF THE DETECTOR VEHICLE. IN      322
      C THIS EVENT, THE NEW COMPUTED DETECTOR POSITION IS THE SAME AS      323
      C THE LAST DETECTOR POSITION      324
      C      325
173      IF (DENOM-CABLE) 470,470,460      326
174      460 NCORD(N)=NORTH(N)-CABLE*(NORTH(N)-NCORD(N-1))/DENOM      327
175      ECORD(N)=EAST(N)-CABLE*(EAST(N)-ECORD(N-1))/DENOM      328
176      GO TO 480      329
177      470 NCORD(N)=NCORD(N-1)      330
178      ECORD(N)=ECORD(N-1)      331
179      480 CONTINUE      332
180      CALL NTRAN (ITAPE,1,LINE,NCORD,LAG,1,LINE,ECORD,L(3))      333
181      490 IF (L(4).NE.-1) GO TO 500      334
182      GO TO 490      335
183      500 IF (L(4).LT.-1) GO TO 770      336
      C      337
      C CONVERT RADIATION READINGS TO COUNTS PER SECOND      338
      C      339
184      IF (BKG(1)) 650, 650, 505      339.5
185      505 CCR(2,1)=RAD(2,1)/SEC      340
186      CCR(1,1)=RAD(1,1)/SEC      341
187      DO 510 N=2,LINE      342
188      DO 510 I=1,2      343
189      510 CCR(I,N)=RAD(I,N)/SEC      344
      C      345
      C COMPUTE THE MEAN AND STANDARD DEVIATION OF THE BACKGROUND COUNT      346
      C RATE FROM THE RADIATION DATA THAT LIES WITHIN THE LIMITS OF THE      347
      C ESTIMATED BACKGROUND COUNT RATE SET BY CHAUVENET'S CRITERION.      348
      C      349
190      IF (CCR(1,1).GT.2.*BKG(1)) CCR(1,1)=BKG(1)      350
191      IF (CCR(2,1).GT.2.*BKG(2)) CCR(2,1)=BKG(2)      351
192      ALPHA=1.-1./FLOAT(2*LINE)      352
193      CHVR=TI/NORM(ALPHA,515)      353
194      GO TO 520      354
195      515 CHVR=5.      355
196      WRITE (6,930) ALPHA      356
197      520 DO 590 I=1,2      357
198      BGCR(I)=0.0      358
199      SIGMA(I)=0.0      359
200      NCOUNT=0      360
201      GATE1=BKG(1)+CHVR*SQRT(BKG(1)/SEC)      361
202      GATE2=BKG(1)+CHVR*SQRT(BKG(1)/SEC)      362
203      DO 550 N=1,LINE      363
204      IF (CCR(I,N)-GATE1) 550,550,530      364
205      530 IF (CCR(I,N)-GATE2) 540,550,550      365
206      540 NCOUNT=NCOUNT+1      366
207      BGCR(I)=BGCR(I)+CCR(I,N)      367
208      550 CONTINUE      368
209      BGCR(I)=BGCR(I)/FLOAT(NCOUNT)      369
210      DO 580 N=1,LINE      370
211      IF (CCR(I,N)-GATE1) 580,580,560      371
212      560 IF (CCR(I,N)-GATE2) 570,580,580      372
213      570 SIGMA(I)=SIGMA(I)+(CCR(I,N)-BGCR(I))**2      373
214      580 CONTINUE      374
215      590 SIGMA(I)=SQRT(SIGMA(I)/FLOAT(NCOUNT))      375
216      WRITE (6,940) BKG,BGCR,SIGMA      376
      C      377
      C CALL THE SUBROUTINE FOR PLOTTING UNCORRECTED RADIATION VALUES      378
      C      379
217      NENTRY=2      380
218      IF (NOPT(2).EQ.1) CALL RDPLT2 (NCORD,ECORD,CCR)      381
219      IF (NOPT(3).NE.1) GO TO 650      382
      C      383
      C CORRECT RADIATION VALUES FOR BACKGROUND COUNT RATE AND TIME-DECAY      384
      C      385
220      SUM=0.0      386
221      SUM2=0.0      387
222      NBAR=0.0      388
223      EBAR=0.0      389
224      DO 620 N=1,LINE      390
225      DO 610 I=1,2      391
226      CCR(I,N)=CCR(I,N)-BGCR(I)      392
227      IF (CCR(I,N) - 3.*SIGMA(I)) 610,610,600      393
228      600 CCR(I,N)=(CCR(I,N)-3.*SIGMA(I))*EXP(DECAY*(DELAY+TIME(N)/3600.))      394
      1 + 3.*SIGMA(I)      394.5

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PROGRAM -- RAPLOT II

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229 610 CONTINUE 395
230 IF (CCR(1,N).LE.0.0) GO TO 620 396
231 SUM=SUM+CCR(1,N) 397
232 SUM2=SUM2+CCR(2,N) 398
C 399
C COMPUTE WEIGHTED MEAN AND STD. DEV. OF ACTIVITY LOCATION 400
C 401
233 EBAR=EBAR+(ECORD(N)-ECORD(1))*CCR(1,N) 402
234 NBAR=NBAR+(NCORD(N)-NCORD(1))*CCR(1,N) 403
235 620 CONTINUE 404
236 NBAR=NCORD(1)+NBAR/SUM 405
237 EBAR=ECORD(1)+EBAR/SUM 406
238 SDNRTH=0.0 407
239 SDEAST=0.0 408
240 DO 640 N=1,LINE 409
241 IF (CCR(1,N)) 640,640,630 410
242 630 SDNRTH=SDNRTH+(NCORD(N)-NBAR)**2*CCR(1,N) 411
243 SDEAST=SDEAST+(ECORD(N)-EBAR)**2*CCR(1,N) 412
244 640 CONTINUE 413
245 SDNRTH=SQRT(SDNRTH/SUM) 414
246 SDEAST=SQRT(SDEAST/SUM) 415
247 WRITE (6,950) SUM,SUM2 416
248 WRITE (6,960) NBAR,EBAR,SDNRTH,SDEAST 417
C 418
C COMPUTE AND PRINT 95 PC. CONFIDENCE LIMITS OF MEAN RADIATION 419
C 420
C 421
249 RTSUM=SQRT(SUM/BGCR(1)) 422
250 CFION=1.96*SDNRTH/RTSUM 423
251 CFIDE=1.96*SDEAST/RTSUM 424
252 WRITE (6,970) CFION,CFIDE 425
253 650 DO 660 I=1,2 426
254 CCR(I,LINE+1)=BGCR(I) 427
255 660 CCR(I,LINE+2)=SIGMA(I) 428
256 NWRO=(LINE+2)*2 429
257 CALL NTRAN (ITAPE,1,NWRD,CCR,L(4)) 430
258 NENTRY=3 431
259 IF (NOPT(3).EQ.1) CALL RDPLT2 (NCORD,ECORD,CCR) 432
260 WRITE (6,980) NMAX,EMAX 433
261 WRITE (6,990) NMIN,EMIN 434
C 435
C WRITE OUT THE NUMBER, COORDINATES AND ACTIVITY OF EACH DATA POINT 436
C 437
262 KOUNT=50 438
263 DO 720 N=1,LINE 439
264 DO 690 J=1,3 440
265 IF (FLO(36-J,1,1ERR(N))) 670,670,680 441
266 670 ISIGN(J)=BLANK 442
267 GO TO 690 443
268 680 ISIGN(J)=AS 444
269 690 CONTINUE 445
270 IF (KOUNT=50) 710,700,700 446
271 700 WRITE (6,1000) LEGEND 447
272 KOUNT=0 448
273 710 WRITE (6,1010) NMBR(N),TIME(N),D(1,N),ISIGN(1),D(2,N),ISIGN(2),(RA 449
10(I,N),I=1,2),NORTH(N),EAST(N),ISIGN(3),NCORD(N),ECORD(N), (CCR(1,N 450
2),I=1,2) 451
274 720 KOUNT=KOUNT+1 452
275 WRITE (6,1020) 453
276 IF (.NOT.JOBEEND) GO TO 10 454
277 730 CONTINUE 455
C 456
C END-FILE PLOT TAPE 457
C 458
278 END FILE 9 4585
279 DO 760 I=1,4 459
280 740 IF (L(I).NE.-1) GO TO 750 460
281 GO TO 740 461
282 750 IF (L(I).LT.-1) GO TO 770 462
283 760 CONTINUE 463
284 CALL NTRAN (ITAPE,9) 464
285 770 STOP 465
C 466
286 780 FORMAT (3F3.0,2F7.0,1X,2F2.0,F3.0,F5.2,3F2.0,4(1X,F7.0),I3) 467
287 790 FORMAT (4I1,F10.0,1X,3I2,1X,F10.0,2(1X,F10.0),1X,A6) 468
288 800 FORMAT (13A6,L2) 469
289 810 FORMAT (10X,13A6,10X,L2) 470
290 820 FORMAT (/5X,8HBEACON 1,F10.0,1HN,F10.0,1HE,5X,8HBEACON 2,F10.0,1HN 471
1,F10.0,1HE//) 472

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PROGRAM -- RAPLOT II

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291      830  FORMAT (5X,21MSQUARE DIST BETWEEN =,E16.8,5X,18HDISTANCE BETWEEN = 473
1,F10.0) 474
292      840  FORMAT (5X,6HSINE =,E16.8,5X,8HCOSSINE =,E16.8) 475
293      850  FORMAT (5X,16HINJECTION TIME =,F3.0,10X,12HCLOCK SET AT,F3.0,5X, 476
121HDIITIZING INTERVAL =,F3.0,7HSECONDS/5X,30HDAYS ELAPSED SINCE I 477
2NJECTION =,F3.0) 478
294      860  FORMAT (5X,22HHALF-LIFE OF ISOTOPE =,F7.2,4HDAYS,5X,14HDECAY FACTO 479
1R =,E16.8,5X,19HTIME-DELAY FACTOR =,F7.2,5HHOURS) 480
295      870  FORMAT (10X,14HCABLE LENGTH =,F4.0,10X,18HMEAN WATER DEPTH =,F4.0, 481
110X,13HBOAT LENGTH =,F4.0) 482
296      880  FORMAT (10X,38HDISTANCE FROM RADAR MAST TO DETECTOR =,F6.1,5HFEEET. 483
1) 484
297      890  FORMAT (/40X,15HPLOTS GENERATED/10X,9HTRACKLINE,15,10X,20HBACKGRO 485
UND RADIATION,15,10X,19HCORRECTED RADIATION,15) 486
298      900  FORMAT (5X,51HBEACON RANGES FOR DUMP SITE COMPUTE IMAGINARY ROOT,) 487
299      910  FORMAT (10X,37HLAMBERT COORDINATES OF INJECTION SITE,F10.0,1HN,F10 488
1.0,1HE) 489
300      920  FORMAT (1H0,19X,7A6) 490
301      930  FORMAT (37H THERE WAS AN OVERFLOW WHEN ALPHA WAS,F6.3,5X,25HCHVR W 491
1AS SET EQUAL TO 5.0) 492
302      940  FORMAT (/20X,53HSUMMARY STATISTICS OF BACKGROUND RADIATION COUNT 493
1RATE/30X,13HRAD CHANNEL 1,5X,13HRAD CHANNEL 2/10X,21HEST. PKG. COU 494
NTS/SEC.,F10.0,8X,F10.0/10X,21HMEAN PKG. COUNTS/SEC.,F10.0,8X,F10. 495
30/10X,21HSTD. DEV. COUNTS/SEC.,F10.0,8X,F10.0) 496
303      950  FORMAT (/20X,53HSUM OF CORRECTED RADIATION COUNTS/25X,19HRADIATIO 497
1N CHANNEL 1,E16.8/25X,19HRADIATION CHANNEL 2,E16.8) 498
304      960  FORMAT (/20X,41HSUMMARY STATISTICS OF RADIATION LOCATION,/24X,11H 499
1NORTH COORD,10X,10HEAST COORD,16X,4HMEAN,5X,F10.0,10X,F10.0/11X,9H 500
2STD. DEV.,5X,F10.0,10X,F10.0) 501
305      970  FORMAT (10X,10HCONFIDENCE/7X,13HLIMIT OF MEAN,5X,F10.0,10X,F10.0) 502
306      980  FORMAT (/7X,13HMAXIMUM COORD,5X,F10.0,1HN,9X,F10.0,1HE) 503
307      990  FORMAT (/7X,13HMINIMUM COORD,5X,F10.0,1HN,9X,F10.0,1HE/) 504
308      1000  FORMAT (1H1,9X,13A6//2X,10HLINE TIME,5X,18HDISTANCE TO BEACON,5X, 505
115HRADIATION COUNT,4X,16HBOAT COORDINATES,4X,16HBALL COORDINATES,3 506
2X,19HCORRECTED RADIATION/9X,3HSEC,11X,1H1,10X,1H2,6X,4HRA1,6X,4HR 507
3A02,9X,1HN,9X,1HE,9X,1HN,9X,1HE,7X,4HRA1,3X,9H RAD2) 508
309      1010  FORMAT (1X,15,F6.0,F11.1,A1,F10.1,A1,4F10.0,A1,2F10.0,F11.0,F11.0) 509
310      1020  FORMAT (1H1) 510
311      END 511-

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10  - 7* 8 276
20  - 7 9*
30  - 13 14*
40  - 12 13 15*
50  - 35 36*
60  - 40 41*
70  - 40 44*
80  - 35 43 48* 52
90  - 50 53*
100 - 54* 55
110 - 54 56*
120 - 64 65*
130 - 61 64 66*
140 - 72 74*
150 - 69 75*
160 - 67 77*
170 - 80 81*
180 - 83 84*
190 - 82 86*
200 - 79 80 83 87*
210 - 89 90*
220 - 92 93*
230 - 91 92 95*
240 - 94 96*
250 - 99* 101
260 - 88 89 101 102*
270 - 76 103*
280 - 110 111*
290 - 110 114*
300 - 105 113 117*
310 - 120* 159
320 - 122 123*
330 - 122 125*
340 - 127 129*
350 - 121 124 133*
360 - 116 119 135 136*
365 - 143*

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PROGRAM -- RAPLOT II

370	-	142	145*						
380	-	151	152*						
390	-	152	153*						
400	-	153	154*						
410	-	151	152	153	154	155*			
420	-	150	154	157*					
430	-	135	158	160*					
440	-	163*	164						
450	-	163	165*						
460	-	173	174*						
470	-	173	177*						
480	-	171	176	179*					
490	-	181*	182						
500	-	181	183*						
505	-	184	185*						
510	-	187	188	189*					
515	-	195*							
520	-	194	197*						
530	-	204	205*						
540	-	205	206*						
550	-	203	204	205	208*				
560	-	211	212*						
570	-	212	213*						
580	-	215	211	212	214*				
590	-	197	215*						
600	-	227	228*						
610	-	225	227	229*					
620	-	224	230	235*					
630	-	241	242*						
640	-	240	241	244*					
650	-	184	219	253*					
660	-	253	255*						
670	-	265	266*						
680	-	265	268*						
690	-	264	267	269*					
700	-	270	271*						
710	-	270	273*						
720	-	263	274*						
730	-	49	277*						
740	-	280*	281						
750	-	280	282*						
760	-	278	283*						
770	-	9	56	165	183	282	285*		
780	-	10RD	286*						
790	-	11RD	287*						
800	-	16RD	288*						
810	-	17WR	289*						
820	-	18WR	290*						
830	-	21WR	291*						
840	-	24WR	292*						
850	-	25WR	293*						
860	-	30WR	294*						
870	-	31WR	295*						
880	-	33WR	296*						
890	-	34WR	297*						
900	-	42WR	298*						
910	-	47WR	299*						
920	-	53WR	300*						
930	-	144WR	196WR	301*					
940	-	216WR	302*						
950	-	247WR	303*						
960	-	248WR	304*						
970	-	252WR	305*						
980	-	260WR	306*						
990	-	261WR	307*						
1000	-	271WR	308*						
1010	-	273WR	309*						
1020	-	275WR	310*						
AB5	-	83							
ALOG	-	29							
ALPHA	-	140=	141	144WR	192=	193	196WR		
AS	-	41N	60A	268					
BEAC1E	-	1C0	10RD	18WR	19	23	45	115	
BEAC1N	-	1C0	10RD	18WR	19	22	46	116	
BEAC2E	-	1C0	10RD	18WR	19	23			
BEAC2N	-	1C0	10RD	18WR	19	22			
BEALH2	-	162							
BGCR	-	1C0	198=	207=	209=	213	216WR	226	249 254

PROGRAM -- RAPLOT II

BKG	-	301	10RD	184	190	191	201	202	216WR		
BLANK	-	4IN	60A	266							
BOAT	-	10RD	31WR	32							
CABLE	-	10RD	31WR	32=	33WR	169	170	173	174	175	
CCR	-	301	185=	186=	189=	190	191	204	205	207	211
		212	213	218AG	226=	227	228=	230	231	232	233
		234	241	242	243	254=	255=	257AG	259AG	273WR	
CFIDE	-	251=	252WR								
CFIDN	-	250=	252WR								
CHVR	-	141=	143=	145	146	147	148	193=	195=	201	202
COR1	-	60A	36	106							
COR2	-	60A	37	107							
COSINE	-	23=	24WR	45	46	115	116				
D	-	301	58RD	73=	80	93	84=	89	92	97	99=
		106	107	128=	273WR						
DAYS	-	10RD	25WR	28							
DO1	-	97=	99								
DE0	-	167=	168	170							
DECAY	-	29=	30WR	228							
DELAY	-	28=	30WR	228							
DENOM	-	168=	169	170	172=	173	174	175			
DEPTH	-	10RD	31WR	32							
OFT1	-	106=	108	109							
OFT2	-	107=	108								
DISTB	-	20=	21WR	22	23	38	108				
DNO	-	166=	168	169							
DTIME	-	96=	99								
DUMP1	-	11RD	35	36=	38	39					
DUMP2	-	11RD	37=	38							
DX1	-	38=	39	45	46	108=	109	115	116		
DY1	-	39=	40	44=	45	46	109=	110	114=	115	116
EAST	-	301	115=	130=	139AG	151	152	162AG	167	168	170
		172	175	273WR							
EABR	-	1CO	138=	139AG	145	146	223=	233=	237=	245	248WR
ECORD	-	301	170=	172	175=	178=	180AG	218AG	233	237	243
		259AG	273WR								
EMAX	-	1CO	260WR								
EMIN	-	1CO	261WR								
EXP	-	228									
FATH	-	301	58RD	75=							
FLD	-	265									
FLOAT	-	140	192	209	215						
GATE1	-	145=	151	201=	204	211					
GATE2	-	146=	152	202=	205	212					
GATEN1	-	147=	153								
GATEN2	-	148=	154								
GRID	-	1CO	11RD								
HLIFE	-	10RD	29	30WR							
I	-	11RD	12	13	14	34WR	72	73	74	78	80
		83	84	85	89	92	97	99	127	128	129
		186	189	197	198	199	201	202	204	205	207
		209	211	212	213	215	225	226	227	228	253
		254	255	273WR	279	280	282				
IERR	-	301	60=	62=	85=	111=	122	132=	155=	265	
INDATE	-	1CO	11RD								
ISIGN	-	301	266=	268=	273WR						
ISKIP	-	10RD	67	68	70	71	73	74	75	76	
ITAPE	-	60A	57AG	161AG	180AG	257AG	284AG				
J	-	264	266	268							
JOBEND	-	5LG	16RD	17WR	276						
KEY	-	119=	135	158=							
KOUNT	-	262=	270	272=	274=						
L	-	301	7	9	54	56	57AG	161AG	163	165	180AG
		181	183	257AG	280	282					
LAG	-	104=	112=	118	120=	123=	125	126	128	129	130
		131	132	134	149=	159	180AG				
LEGEND	-	1CO	16RD	17WR	50	57AG	271WR				
LINE	-	1CO	58RD	61	69	76=	77	82	91	105	121
		134=	137AG	139AG	150	161AG	171	180AG	187	203	210
		224	240	254	255	256	263				
M	-	79	80	81	83	88	89	90			
MSTOP	-	77=	79	88							
N	-	58RD	61	62	63	64	65	69	70	71	73
		74	75	82	83	84	85	91	92	93	98=
		99	100=	101	105	106	107	111	115	116	121
		122	125	126	128	129	130	131	132	150	151
		152	153	154	155	171	172	174	175	177	178
		187	189	203	204	205	207	210	211	212	213
		224	226	227	228	230	231	232	233	234	240

PROGRAM -- RAPLOT II

NBAR	-	241	242	243	263	265	273WR	222=	234=	236=	242
		1CO	2RL	136=	137AG	147	148				
NCORD	-	248WR									
		2RL	169=	172	174=	177=	180AG	218AG	234	236	242
NCOUNT	-	259AG	273WR								
NENTRY	-	200=	206=	209	215						
		1CO	160=	217=	258=						
NMAX	-	1CO	2RL	260WR							
NMBR	-	301	58RD	63	70=	125=	161AG	162AG	273WR		
NMIN	-	1CO	2RL	261WR							
NOPT	-	1CO	11RD	34WR	162	218	219	259			
NORTH	-	2RL	116=	131=	137AG	153	154	162AG	166	168	169
		172	174	273WR							
NPLT	-	1CO	11RD	13	14=						
NSTART	-	68=	69	81=	82	90=	91	96	97	98	99
NSTOP	-	93=	96	97	101						
NTAPE	-	60A	48RD	51AG	58RD	59AG					
NTRAN	-	51	57	59	161	180	257	284			
NWRD	-	256=	257AG								
RAD	-	301	58RD	74=	129=	185	186	189	273WR		
RDPLT2	-	218	259								
RMIN	-	10RD	25WR	27							
RTSUM	-	249=	250	251							
SCALE	-	1CO	11RD								
SDEAST	-	139AG	145	146	239=	243=	246=	248WR	251		
SDNRTH	-	137AG	147	148	238=	242=	245=	248WR	250		
SEC	-	10RD	25WR	65	185	186	189	201	202		
SENTNL	-	4IN	48RD	49	50	53WR					
SETIME	-	10RD	25WR	27=	28						
SIGMA	-	1CO	199=	213=	215=	216WR	227	228	255		
SINE	-	22=	24WR	45	46	115	116				
SITEE	-	1CO	45=	47WR							
SITEN	-	1CO	41=	46=	47WR						
SODSTB	-	19=	20	21WR	38	108					
SORT	-	20	32	44	114	168	172	201	202	215	245
		246	249								
STDEV	-	137	139								
STOP	-	285									
SUM	-	220=	231=	236	237	245	246	247WR	249		
SUM2	-	221=	232=	247WR							
TIME	-	301	58RD	64	65=	71=	83	96	99	126=	228
		273WR									
TINORM	-	141	193								
WORD1	-	4IN	60A	49							
WORD2	-	4IN	60A	49							
ZHR	-	10RD	25WR	26=	28						
ZMIN	-	10RD	25WR	26							

I N D E X

SUBROUTINE BENLH2 (NORTH,EAST,NMBR)

1		SUBROUTINE BENLH2 (NORTH,EAST,NMBR)	R-L	1
C			R-L	2
C		THIS SUBROUTINE GENERATES THE PLOT INSTRUCTIONS TO DRIVE A BENSON-LEHNER MODEL 305 DIGITAL PLOTTER. IF THE INSTRUCTIONS ARE BEING WRITTEN ON TAPE, USE OPTIONS N, K, AND E ON THE ASSIGN CARD.	R-L	3
C		PROGRAMMER: PHILIP A. TURNER, GEOLOGY BR, U S A CERC	R-L	4
C			R-L	5
C			R-L	6
2		COMMON NOPT(4),SCALE,NPLT(3),GRID,DUMPN,DUMPE,INDATE,LEGEND(13),BEB,1AC1N,BEAC1E,BEAC2N,BEAC2E,NPTS,BGCR(2),SIGMA(2),NBAR,EBAR,NENTRY,NR,2MAX,NMIN,EMAX,EMIN	R-L	7
3		DIMENSION EAST(2200), RAD(2,2200), NMBR(2200), X(2200), Y(2200), 1ADUL(7)	R-L	8
4		REAL NORTH(2200),NBAR,NMAX,NMIN,NORGIN	R-L	9
5		ITRNP=0	R-L	10
6		GO TO 10	R-L	11
7		ENTRY RDPLT2 (NORTH,EAST,RAD)	R-L	12
8		IF (NOPT(1).EQ.1) GO TO 120	R-L	13
9		IF (NOPT(2).EQ.1.AND.NENTRY.EQ.3) GO TO 120	R-L	14
C		DEFINE THE LOGICAL UNIT ON WHICH PLOTTER COMMANDS ARE TO BE OUTPUT	R-L	15
C		CARD PUNCH = 3	R-L	16
C		MAGNETIC TAPES = 7-34	R-L	17
C			R-L	18
10	10	CALL INPLOT (9)	R-L	19
C			R-L	20
C		DETERMINE THE MAXIMUM AND MINIMUM VALUES FOR BOTH COORDINATES.	R-L	21
C			R-L	22
C			R-L	23
C			R-L	24
C			R-L	25

SUBROUTINE BENLH2 (NORTH,EAST,NMBR)

11		NMAX=NORTH(1)	R-L	26
12		NMIN=NORTH(1)	R-L	27
13		EMAX=EAST(1)	R-L	28
14		EMIN=EAST(1)	R-L	29
15		DO 20 N=2,NPTS	R-L	30
16		NMAX=AMAX1(NMAX,NORTH(N))	R-L	31
17		NMIN=AMIN1(NMIN,NORTH(N))	R-L	32
18		EMAX=AMAX1(EMAX,EAST(N))	R-L	33
19		EMIN=AMIN1(EMIN,EAST(N))	R-L	34
20	20	CONTINUE	R-L	35
	C		R-L	36
	C	CHECK SCALE TO BE SURE THAT NO FIXES WILL PLOT OFF THE MAP.	R-L	37
	C	CHANGE SCALE UNTIL ALL THE FIXES FIT ON THE PLOT.	R-L	38
	C		R-L	39
21		YSCALE=SCALE	R-L	40
22		IF ((NMAX-(NMIN+25.*SCALE)) 60,60,30	R-L	41
23	30	ITRNP=1	R-L	42
24		IF (EMAX-(EMIN+25.*SCALE)) 60,60,40	R-L	43
25	40	IF ((EMAX-EMIN)-(NMAX-NMIN)) 60,50,50	R-L	44
26	50	ITRNP=0	R-L	45
27	60	IF (ITRNP.EQ.0) GO TO 90	R-L	46
28		ASSIGN 90 TO KEY	R-L	47
29	70	CELL=EMAX	R-L	48
30		EMAX=NMAX	R-L	49
31		NMAX=-EMIN	R-L	50
32		EMIN=NMIN	R-L	51
33		NMIN=-CELL	R-L	52
34		DO 80 N=1,NPTS	R-L	53
35		CELL=NORTH(N)	R-L	54
36		NORTH(N)=-EAST(N)	R-L	55
37	80	EAST(N)=CELL	R-L	56
38		GO TO KEY,(90,130)	R-L	57
39	90	IF (NMAX-(NMIN+25.*SCALE)) 110,110,100	R-L	58
40	100	SCALE=SCALE+YSCALE	R-L	59
41		GO TO 90	R-L	60
	C		R-L	61
	C	TAKE THE ORIGIN OF THE PLOT AS THE MINIMUM COORDINATES REMAINDERED	R-L	62
	C	BY THE PLOT SCALE.	R-L	63
	C		R-L	64
42	110	NORGIN=SCALE*AMIN1(NMIN/SCALE)	R-L	65
43		YORGIN=NORGIN/SCALE	R-L	66
44		EORGIN=SCALE*AMIN1(EMIN/SCALE)	R-L	67
45		XORGIN=EORGIN/SCALE	R-L	68
46	120	IF (NENTRY.EQ.3.AND.NOPT(2).EQ.1) GO TO 150	R-L	69
	C		R-L	70
	C	DIVIDE THE COORDINATES (IN FEET) BY THE SCALE (IN FEET).	R-L	71
	C		R-L	72
47		IF (NENTRY.EQ.1.OR.ITRNP.EQ.0) GO TO 130	R-L	73
48		ASSIGN 130 TO KEY	R-L	74
49		GO TO 70	R-L	75
50	130	DO 140 N=1,NPTS	R-L	76
51		X(N)=EAST(N)/SCALE	R-L	77
52	140	Y(N)=NORTH(N)/SCALE	R-L	78
	C		R-L	79
	C	WRITE IN THE LEGEND, SCALE, TYPE OF PLOT AN INJECTION DATE AT THE	R-L	80
	C	BOTTOM EDGE OF THE PLOT.	R-L	81
	C		R-L	82
53	150	CALL LETTER (78,8,0,1.0,-1.0,LEGEND)	R-L	83
54		CALL LETTER (8,8,0,5,0,-2.2,8H1 INCH =)	R-L	84
55		CALL NUMBER (SCALE,4,1,8,0,7.2,-2.2)	R-L	85
56		CALL LETTER (4,8,0,9,8,-2.2,4HFEET)	R-L	86
57		GO TO (160,170,180), NENTRY	R-L	87
58	160	CALL LETTER (25,8,0,12,-2.2,25HPLOT OF SURVEY TRACK LINE)	R-L	88
59		GO TO 190	R-L	89
60	170	CALL LETTER (29,6,0,12,-2.0,29HPLOT OF UNCORRECTED RADIATION)	R-L	90
61		CALL LETTER (29,6,0,12,-2.6,29HROUNDED TO NEAREST 100 COUNTS)	R-L	91
62		GO TO 190	R-L	92
63	180	CALL LETTER (28,6,0,12,-2.0,28HPLOT OF CORRECTED RADIATION)	R-L	93
64		CALL LETTER (27,6,0,12,-2.6,27HBACKGROUND RADIATION RATIOS)	R-L	94
65	190	CALL LETTER (14,6,0,20,-2.0,14HINJECTION DATE)	R-L	95
66		CALL LETTER (6,6,0,21,8,-2.5,INDATE)	R-L	96
67		CALL PLOT (0,0,0,0,3)	R-L	97
68		CALL PLOT (XORGIN,YORGIN,1)	R-L	98
	C		R-L	99

SUBROUTINE BENLH2 (NORTH,EAST,NMBR)

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C      PLOT IN TIC MARKS, WITH COORDINATES, AT THE LEFT AND LOWER BORDERS-R 100
C      OF THE PLOT. R-L 101
C      R-L 102
69      CALL SYMBOL (XORGIN,YORGIN,20,66) R-L 103
70      IF (GRID.LE.0.0) GO TO 230 R-L 104
71      T1CN=GRID*(1.+AINT(NORGIN/GRID)) R-L 105
72      T1CE=GRID*(1.+AINT(EORGIN/GRID)) R-L 106
73      YTIC=T1CN/SCALE R-L 107
74      XSHIFT=XORGIN-1.28 R-L 108
75      200 CALL REPSYM (XORGIN,YTIC) R-L 109
76      CALL NUMBER (T1CN,8,0,4,0,XSHIFT,YTIC) R-L 110
77      YTIC=YTIC*GRID/SCALE R-L 111
78      T1CN=T1CN*GRID R-L 112
79      IF (YTIC-(YORGIN+25.)) 200,200,210 R-L 113
80      210 XTIC=T1CE/SCALE R-L 114
81      YSHIFT=YORGIN-.5 R-L 115
82      220 CALL REPSYM (XTIC,YORGIN) R-L 116
83      CALL NUMBER (T1CE,8,0,4,0,XTIC,YSHIFT) R-L 117
84      XTIC=XTIC*GRID/SCALE R-L 118
85      T1CE=T1CE*GRID R-L 119
86      IF (XTIC-(XORGIN+25.)) 220,220,230 R-L 120
87      230 CONTINUE R-L 121
C      R-L 122
C      PLOT THE INJECTION SITE. R-L 123
C      R-L 124
88      IF (DUMPN.GT.NMAX.OR.DUMPN.LT.NMIN) GO TO 240 R-L 125
89      YO=DUMPN/SCALE R-L 126
90      XO=DUMPE/SCALE R-L 127
91      CALL SYMBOL (XO,YO,10,70) R-L 128
92      XO=XO+.2 R-L 129
93      CALL LETTER (4,4,0,XO,YO,4HDUMP) R-L 130
C      R-L 131
C      PLOT THE MEAN LOCATION OF THE RADIATION DISTRIBUTION. R-L 132
C      R-L 133
94      240 IF (NENTRY=3) 260,250,260 R-L 134
95      250 IF (ITRNP.EQ.1) GO TO 260 R-L 135
96      YB=NBAR/SCALE R-L 136
97      XB=EBAR/SCALE R-L 137
98      CALL SYMBOL (XB,YB,10,71) R-L 138
99      XB=XB+.2 R-L 139
100     CALL LETTER (6,4,0,XB,YB,6HRADBAR) R-L 140
101     260 NN=NPLT(NENTRY) R-L 141
102     NSTART=1+NN R-L 142
103     IF (NENTRY=2) 270,290,310 R-L 143
C      R-L 144
C      PLOT THE TRACK LINE FOLLOWED BY THE SURVEY VESSEL. R-L 145
C      R-L 146
104     270 CALL LINE (X,Y,NPTS,3,65,5) R-L 147
105     DO 280 N=1,NPTS,NN R-L 148
106     Z=FLOAT(NMBR(N)) R-L 149
107     CALL NUMBER (Z,3,0,2,0,X(N),Y(N)) R-L 150
108     CONTINUE R-L 151
109     GO TO 440 R-L 152
C      R-L 153
C      PLOT THE BACKGROUND RADIATION AT EVERY NNTH POINT. R-L 154
C      R-L 155
110     290 CALL SYMBOL (X(1),Y(1),3,67) R-L 156
111     Z=RAD(1,1)/100. R-L 157
112     CALL NUMBER (Z,3,0,2,0,X(1),Y(1)) R-L 158
113     DO 300 I=NSTART,NPTS R-L 159
114     CALL REPSYM (X(I),Y(I)) R-L 160
115     IF (MOD(I,NN).NE.0) GO TO 300 R-L 161
116     Z=RAD(I,1)/100. R-L 162
117     CALL NUMBER (Z,3,0,2,0,X(I),Y(I)) R-L 163
118     300 CONTINUE R-L 164
119     GO TO 440 R-L 165
C      R-L 166
C      PLOT CORRECTED RADIATION VALUES AT EVERY NNTH POINT. R-L 167
C      R-L 168
120     310 RADUL(1)=3.*SIGMA(1) R-L 169
121     RADUL(2)=100. R-L 170
122     DO 320 L=3,7 R-L 171
123     320 RADUL(L)=2.*RADUL(L-1) R-L 172
124     LAST=0 R-L 173
125     DO 420 I=1,NPTS R-L 174
C      R-L 175

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SUBROUTINE BENLH2 (NORTH,EAST,NMBR)

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C DATA POINTS HAVING CORRECTED RADIATION COUNTS MORE THAN 3 STANDARD DEVIATIONS BELOW MEAN BACKGROUND COUNT RATE ARE NOT PLOTTED. SUCH LOW READINGS MAY INDICATE THAT THE DETECTOR WAS OVERTURNED OR WAS FLYING
C
120 IF (RAD(1,1)+RADUL(1)) 420,420,330
127 330 DO 350 L=1,7
128 IF (RAD(1,1)-RADUL(L)) 340,340,350
129 340 NSYM=64+L
130 IF=1
131 IF (NSYM.GT.65) IH=2
132 IF (NSYM.GT.69) IH=4
133 GO TO 360
134 350 CONTINUE
135 NSYM=72
136 IH=4
137 360 IF (NSYM-LAST) 380,370,360
138 370 CALL REPSYM (X(1),Y(1))
139 GO TO 390
140 380 CALL SYMBOL (X(1),Y(1),IH,NSYM)
141 LAST=NSYM
142 390 IF (MOD(1,NK)) 400,400,420
143 400 IF (RAD(1,1)-BGCR(1)) 420,420,410
144 410 Z=RAD(1,1)/BGCR(1)
145 CALL NUMBER (Z*3*0+2*0,X(1),Y(1))
146 CONTINUE
147 420 XEDGE=AMAX1((EMAX/SCALE)+2.,XORGIN+27)
148 YPT=YORGIN+12.5
149 CALL LETTER (26*4*0+XEDGE,YPT,26H CORRECTED COUNT RATE (C/S))
150 YPT=YPT-.5
151 XSHIFT=XEDGE+.5
152 XSHFT2=XSHIFT+2.0
153 NSYM=64
154 IH=1
155 DO 430 L=1,7
156 NSYM=NSYM+1
157 IF (NSYM.GT.65) IH=2
158 IF (NSYM.GT.69) IH=4
159 CALL SYMBOL (XEDGE,YPT,IH,NSYM)
160 CALL LETTER (16*3*0+XSHIFT,YPT,16HCCR .LT. OR .EQ.)
161 CALL NUMBER (RADUL(L),5*1*3*0+XSHFT2,YPT)
162 430 YPT=YPT+.4
163 CALL SYMBOL (XEDGE,YPT,IH,72)
164 CALL LETTER (16*3*0+XSHIFT,YPT,16H CCR .GT.)
165 CALL NUMBER (RADUL(7),5*1*3*0+XSHFT2,YPT)
C
C MOVE PEN TO RIGHT BORDER OF PLOT IN PREPARATION FOR NEXT PLOT.
C
166 440 XEDGE=AMAX1(EMAX/SCALE+9.,XORGIN+34.)
167 CALL PLOT (XEDGE,YORGIN+3)
168 CALL PLOT (0.0,0.0+1)
169 CALL PLOT (0.0,0.0-3)
170 IF (ITRNP.EQ.0) GO TO 460
171 CELL=EMAX
172 EMAX=NMIN
173 NMIN=EMIN
174 EMIN=NMAX
175 NMAX=CELL
176 DO 450 N=1,NPTS
177 CELL=EAST(N)
178 EAST(N)=NORTH(N)
179 450 NORTH(N)=CELL
180 460 RETURN
181 END
SYMBOL
10 - 5 10*
20 - 15 20*
30 - 22 23*
40 - 24 25*
50 - 25 26*
60 - 22 24 25 27*
70 - 29* 49
80 - 34 37*
90 - 27 28 38 39* 41
100 - 39 40*
110 - 39 42*

```

SUBROUTINE BENLH2 (NORTH,EAST,NMBR)

120	-	8	9	46*															
130	-	38	47	48	50*														
140	-	50	52*																
150	-	46	53*																
160	-	57	58*																
170	-	57	60*																
180	-	57	63*																
190	-	59	62	65*															
200	-	75*	79																
210	-	79	80*																
220	-	82*	86																
230	-	70	86	87*															
240	-	88	94*																
250	-	94	95*																
260	-	94	95	101*															
270	-	103	104*																
280	-	105	108*																
290	-	103	110*																
300	-	113	115	118*															
310	-	103	120*																
320	-	122	123*																
330	-	126	127*																
340	-	128	129*																
350	-	127	128	134*															
360	-	133	137*																
370	-	137	138*																
380	-	137	140*																
390	-	139	142*																
400	-	142	143*																
410	-	143	144*																
420	-	125	126	142	143	146*													
430	-	155	162*																
440	-	109	119	166*															
450	-	176	179*																
460	-	170	180*																
AINI	-	42	44	71	72														
AMAX1	-	16	18	147	166														
AMIN1	-	17	19																
BEAC1E	-	2C0																	
BEAC1N	-	2C0																	
BEAC2E	-	2C0																	
BEAC2N	-	2C0																	
BENLH2	-	1																	
BCCR	-	2C0	143	144															
CELL	-	29=	33	35=	37	171=	175	177=	179										
DUMPE	-	2C0	90																
DUMPN	-	2C0	88	89															
EAST	-	1AG	30I	7	13	14	18	19	36	37=	51								
	-	177	178=																
EBAR	-	2C0	97																
EMAX	-	2C0	13=	18=	24	25	29	30=	147	166	171								
	-	172=																	
EMIN	-	2C0	14=	19=	24	25	31	32=	44	173	174=								
EOGIN	-	44=	45	72															
FLOAT	-	106																	
GRID	-	2C0	70	71	72	77	78	84	85										
I	-	113	114AG	115	116	125	126	128	138AG	140AG	142								
	-	143	144																
IH	-	130=	131=	132=	136=	140AG	154=	157=	158=	159AG	163AG								
INDATE	-	2C0																	
INPLOT	-	10																	
ITRNP	-	5=	23=	26=	27	47	95	170											
KEY	-	28=	38	48=															
L	-	122	123	127	128	129	155	161AG											
LAST	-	124=	137	141=															
LEGEND	-	2C0																	
LETTER	-	53	54	56	58	60	61	63	64	65	66								
	-	93	100	149	160	164													
LINE	-	104																	
MOD	-	115	142																
N	-	15	16	17	18	19	34	35	36	37	50								
	-	51=	52	105	106	176	177	178	179										
NBAR	-	2C0	4RL	96															
NENTRY	-	2C0	9	46	47	57	94	101	103										
NMAX	-	2C0	4RL	11=	16=	22	25	30	31=	39	88								
	-	174	175=																
NMBR	-	1AG	30I	106															
NMIN	-	2C0	4RL	12=	17=	22	25	32	33=	39	42								

SUBROUTINE AMEAN(X,N,XBAR)

```

1      SUBROUTINE AMEAN(X,N,XBAR)
C-----
C      CALCULATES THE ARITHMETIC MEAN OF A SEQUENCE OF DATA POINTS
C-----
2      DIMENSION X(1)
3      XBAR=0.
4      DO 1 I=1,N
5      1 XBAR=XBAR+X(I)
6      XBAR = XBAR/FLOAT(N)
7      RETURN
8      END

```

SYMBOL = = = = = REFERENCES = = = = =

```

1      -      4      5*
AMEAN -      1
FLOAT -      6
1      -      4
N      -      1AG      4      6
RETURN -      7
X      -      1AG      2D1      5
XBAR  -      1AG      3=      5=      6=

```

```

1      FUNCTION TINORM(ALPHA,S)
2      DIMENSION A(3),B(3)
3      DATA(A(1),I=1,3)/.010328,.802853,2.515517/, (B(1),I=1,3)/.0010308,
1.189269,1.432788/
C-----
C      APPROXIMATION TO INVERSE NORMAL DISTRIBUTION
C-----
4      IF(.NOT.(ALPHA.GT.0..AND.ALPHA.LT.1.)) GO TO 1
5      X=ALPHA
6      IF(X.GT..5) X=1.-X
7      X=SQRT(-2.*ALOG(X))
8      TINORM=X-(A(3)+X*(A(2)+X*A(1)))/(1.+X*(B(3)+X*(B(2)+X*B(1))))
9      CALL OVERFL(I)
10     IF(I.EQ.1) RETURN 2
11     IF(ALPHA.LT..5) TINORM=-TINORM
12     RETURN
13     1 RETURN 2
14     END

```

SYMBOL = = = = = REFERENCES = = = = =

```

1      -      4      13*
A      -      2D1      3DA      8
ALOG   -      7
ALPHA  -      1AG      4      5      11
B      -      2D1      3DA      8
I      -      3DA      9AG      10
OVERFL -      9
RETURN -      10      12      13
SQRT   -      7
TINORM -      1      8=      11=
X      -      5=      6      7=      8

```

+-----+

APPENDIX B

LISTING AND INDEX OF RAPLOT III PROGRAM

FORTRAN IV Listing of RAPLOT III and Subroutines
TRACK and TINORM with an Index to all Statement
Numbers, Variable Names, and Subroutine Calls

PROGRAM -- RAPLOT III MODIFIED FOR IBM-7094 WITH SC-4060 CRT

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C PROGRAM -- RAPLOT III MODIFIED FOR IBM-7094 WITH SC-4060 CRT 1
C THE PURPOSE OF THIS PROGRAM IS TO REDUCE THE RADIOACTIVITY SURVEY 2
C DATA FROM THE RIST PROJECT AND PLOT THE SURVEY ON A BENSON-LEHNER 3
C INCREMENTAL PLOTTER. THE FOLLOWING PLOTS ARE THE OUTPUT 4
C TRACKLINE FOLLOWED BY SURVEY VESSEL 5
C PLOT OF UNCORRECTED RADIATION VALUES (BACKGROUND SURVEY) 6
C SYMBOL PLOT OF RADIATION VALUES CORRECTED FOR BACKGROUND AND 7
C DECAY SINCE INJECTION TIME. 8
C PROGRAMMER: PHILIP A. TURNER 9
C GEOLOGY BRANCH 10
C U S ARMY COASTAL ENGINEERING RESEARCH CENTER 11
C 5201 LITTLE FALLS ROAD 12
C WASHINGTON, D. C. 20016 13
C COMPLETED IN JANUARY 1969 14
C 15
C FORMAT AND ENTRIES ON DATA CONTROL CARD 16
C COL 1-3 CABLE LENGTH IN FEET TO THE NEAREST FOOT. 17
C COL 4-6 WATER DEPTH PLUS FREEBOARD TO THE NEAREST FOOT. 18
C COL 7-9 DISTANCE FROM RADAR MAST TO CABLE STANCHION IN FEET 19
C TO THE NEAREST FOOT. 20
C COL 10-16 ESTIMATED BACKGROUND COUNT RATE IN COUNTS/SEC FOR 21
C CHANNEL 1. 22
C COL 17-23 ESTIMATED BACKGROUND COUNT RATE IN COUNTS/SEC FOR 23
C CHANNEL 2. 24
C COL 25-28 TIME OF INJECTION IN HOURS AND MINUTES. 25
C COL 29-31 THE NUMBER OF DAYS SINCE THE INJECTION 26
C COL 32-36 THE HALF LIFE OF THE RADIOISOTOPE IN DAYS. 27
C THE DECIMAL POINT MUST BE PUNCHED IN. 28
C COL 37-40 THE TIME WHEN THE SURVEY WAS STARTED, IN HOURS AND 29
C MINUTES. 30
C COL 44-50 BEACON1 NORTH COORD/ LAMBERT COORDINATES OF RADAR 31
C COL 52-58 BEACON1 EAST COORD/ BEACONS TO THE NEAREST FOOT. 32
C COL 60-66 BEACON2 NORTH COORD/ BEACON1 IS ALWAYS UP-CAST. 33
C COL 68-74 BEACON12 EAST COORD/ 34
C COL 75-77 THE NUMBER OF LINES OF DATA TO BE SKIPPED AT THE 35
C BEGINNING OF A DATA SET IN ORDER TO AVOID 36
C READING IN SOME BAD DATA. 37
C FORMAT AND ENTRIES ON PLOT CONTROL CARD 38
C COL 1-3 PLOT OPTION CONTROL. TO USE, PUNCH THE NUMERAL 1 39
C IN THE COLUMN INDICATED. 40
C 1 = PLOT TRACKLINE FOLLOWED BY SURVEY VESSEL. 41
C 2 = PLOT UNCORRECTED RADIATION VALUES. 42
C 3 = PLOT RADIATION VALUES CORRECTED FOR BACKGROUND 43
C AND DECAY SINCE TIME ZERO. 44
C 4 = UNUSED. LEAVE BLANK. 45
C COL 5-14 MAP SCALE EXPRESSED IN UNITS PER INCH 46
C COL 16-17 OPTION 1 / USE WHEN SPOTTING DATA FOR EACH PLOT 47
C COL 18-19 J 2 / OPTION. USER CAN SPECIFY THAT EVERY NTH 48
C COL 20-21 J 4 / POINT BE PLOTTED. IF LEFT BLANK, THE 49
C PROGRAM ASSUMES EVERY POINT IS TO BE 50
C PLOTTED. 51
C COL 23-32 INTERVALS ON THE COORDINATE GRID AT WHICH TICK 52
C MARKS WITH THE LAMBERT COORDINATES WILL BE POSTED. 53
C IF FIELD IS LEFT BLANK, PROGRAM WILL ASSUME THAT 54
C NO TICK MARKS ARE TO BE PLOTTED AND POSTED. 55
C COL 34-43 BEACON 1 / INJECTION SITE, DISTANCE IN METERS TO 56
C COL 45-54 BEACON 2 / THE NAMED BEACONS. IF FIELDS ARE LEFT 57
C BLANK, SITE IS NOT PLOTTED. 58
C COL 56-61 DAY, MONTH AND YEAR THE SAND WAS INJECTED 59
C FORMAT AND ENTRIES ON PLOT IDENTIFICATION CARD 60
C COL 1-78 THIS FIELD WILL BE PLOTTED ON THE LOWER MARGIN OF 61
C THE MAP. 62
C COL 80 PUNCH 'T' HERE ON THE LAST DATA SET. 63
1 COMMON /AA/ NOPT(4),NPLT(3),SCALE,GRID,DUMP,NBAR,EBAR,LEGEN 64
10 ID(13),INDATE,LINE,BGCR,SIGMA,NMAX,NMIN,EMAX,EMIN,JOBEAD,NENTRY,NCA 65
2 2LLS,NCAM 66
3 REAL NORTH(2000),NCORD(2000),NBAR,NMAX,NMIN 67
3 DIMENSION NMNR(2000), TIME(2000), D(2*2000), EAST(2000), ECORD(200 68
10), RAD(2000), CCR(2000), FATH(2000) 69
4 EQUIVALENCE (RAD(1),CCR(1)), (D(1:1),NCORD(1)), (D(1:1001),ECORD(1 70
1)), 71
5 LOGICAL JOBEAD 72
6 DATA CORR1,CORR2/2.9*2.8/IFLAG/1H*/ 73
7 WRITE (6,610) 74
8 NCAM=9 75
9 NCALLS=0 76
10 10 NCALLS=NCALLS+1 77

```

	C		78
	C	READ IN DATA CONTROL CARD	79
	C		80
11		READ (5,620) CABLE,DEPTH,BOAT,BKG,ZHR,ZMIN,DAYS,HLIFE,SETIME,RMIN,	81
		LSEC,BEACIN,BEAC1E,BEAC2N,BEAC2E,ISKIP	82
	C		83
	C	READ IN PLOT CONTROL PARAMETERS	84
	C		85
12		READ (5,630) NOPT,SCALE,(NPLT(I),I=1,3),GRID,DUMP1,DUMP2,INDATE	86
13		DO 30 I=1,3	87
14		IF (NPLT(I)) 20,20,30	88
15	20	NPLT(I)=1	89
16	30	CONTINUE	90
	C		91
	C	READ IN PLOT LEGEND	92
	C		93
17		READ (5,640) LEGEND,JOBEEND	94
18		WRITE (6,650) LEGEND,JOBEEND	95
19		WRITE (6,660) BEACIN,BEAC1E,BEAC2N,BEAC2E	96
	C		97
	C	COMPUTE PROGRAM PARAMETERS FROM DATA CONTROL CARD ENTRIES	98
	C		99
20		SODSTB=(BEAC2N-BEACIN)**2+(BEAC2E-BEAC1E)**2	100
21		DISTB=SQRT(SODSTB)	101
22		WRITE (6,670) SODSTB,DISTB	102
23		SINE=(BEAC2N-BEACIN)/DISTB	103
24		COSINE=(BEAC2E-BEAC1E)/DISTB	104
25		WRITE (6,680) SINE,COSINE	105
26		WRITE (6,690) ZHR,ZMIN,SETIME,RMIN,SEC,DAYS	106
27		ZHR=ZHR+ZMIN/60.	107
28		SETIME=SETIME+RMIN/60.	108
29		DELAY=SETIME+DAYS*24.-ZHR	109
30		IF (HLIFE.GT.0.0) DECAY=ALOG(2.)/(HLIFE*24.)	110
31		WRITE (6,700) HLIFE,DECAY,DELAY	111
32		WRITE (6,710) CABLE,DEPTH,BOAT	112
33		CABLE=BOAT+SQRT(CABLE**2-DEPTH**2)	113
34		WRITE (6,720) CABLE	114
35		WRITE (6,730) (NOPT(I),I=1,3)	115
	C		116
	C	COMPUTE COORDINATES OF THE INJECTION SITE FROM THE DISTANCES FROM	117
	C	THE BEACONS	118
	C		119
36		IF (DUMP1) 70,70,40	120
37	40	DUMP1=(DUMP1+CORR1)*3.28083	121
38		DUMP2=(DUMP2+CORR2)*3.28083	122
39		DX1=(SODSTB+DUMP1*DUMP1-DUMP2*DUMP2)/(DISTB*2.)	123
40		DY1=DUMP1-DUMP1-DX1	124
41		IF (DY1) 50,50,60	125
42	50	SITEN=-999999.	126
43		WRITE (6,740)	127
44		GO TO 70	128
45	60	DY1=-SQRT(DY1)	129
46		SITEE=DX1*COSINE-DY1*SINE+BEAC1E	130
47		SITEN=DX1*SINE+DY1*COSINE+BEACIN	131
48		WRITE (6,750) SITEN,SITEE	132
	C		133
	C	READ IN THE DATA FILE FROM ONE RIST SURVEY, ELIMINATING ANY LINES	134
	C	THAT CONTAIN A -3, WHICH IS AN ERROR FLAG	135
	C		136
49	70	N=1	137
50	80	CALL RESET	138
51		READ (5,760) NMBR(N),TIME(N),D(1,N),D(2,N),RAD(N),FATH(N),JFLAG	139
	C		140
	C	CHECK FOR END OF FILE	141
	C		142
52		CALL CHECK (E)	143
53		IF (E) 100,90,100	144
	C		145
	C	CHECK ERROR FLAG ON INPUT RECORD	146
	C		147
54	90	IF (JFLAG.NE.JFLAG) GO TO 80	148
55		IF (NMBR(N).LT.0) GO TO 80	149
56		IF (TIME(N).LT.0.0) GO TO 80	150
57		IF (D(1,N).LT.0.0) GO TO 80	151
58		IF (D(2,N).LT.0.0) GO TO 80	152
59		IF (RAD(N).LT.0.0) GO TO 80	153
60		IF (FATH(N).LT.0.0) GO TO 80	154
61		IF (N.GE.1000) GO TO 100	155
62		N=N+1	156
63		GO TO 80	157

PROGRAM -- RAPLOT III MODIFIED FOR IBM-7094 WITH SC-4060 CRT

```

64 100 CONTINUE 154
65 N=N-1 159
66 LINE=N-1 160
67 IF (ISKIP.LE.0) GO TO 130 161
C 162
C SKIP LEADING CARD IMAGES THAT CONTAIN BAD DATA. 163
C 164
68 NSTART=ISKIP+1 165
69 DO 120 N=NSTART,LINE 166
70 NN=N-ISKIP 167
71 NMBR(NN)=NMBR(N) 168
72 TIME(NN)=TIME(N) 169
73 DO 110 I=1,2 170
74 D(I,NN)=D(I,N) 171
75 RAD(NN)=RAD(N) 172
76 FATH(NN)=FATH(N) 173
77 LINE=LINE-ISKIP 174
78 130 MSTOP=LINE-1 175
C 176
C CHECK DISTANCES TO RADAR BEACONS FOR ERRORS. IF DISTANCE/TIME 177
C FOR SUCCESSIVE BEACON RANGES INDICATE A SHIP SPEED .GT. 6 KNOTS 178
C (3.09 METERS/SEC), RANGE IS IN ERROR. 179
C 180
79 DO 240 I=1,2 181
80 DO 170 M=1,MSTOP 182
81 IF (D(I,M)) 170,170,140 183
82 140 NSTART=M+1 184
83 DO 150 N=NSTART,LINE 185
84 IF (ABS(D(I,N)-D(I,M))-(TIME(N)-TIME(M))*3.08865) 170,170,150 186
85 150 D(I,N)=-1. 187
86 160 CONTINUE 188
87 170 CONTINUE 189
88 DO 230 M=1,MSTOP 190
89 IF (D(I,M)) 180,180,230 191
90 180 NSTART=M 192
C 193
C CORRECT ERRONEOUS BEACON RANGES BY LINEAR INTERPOLATION (ON TIME) 194
C BETWEEN NON-ERRONEOUS RANGES. 195
C 196
91 DO 200 N=NSTART,LINE 197
92 IF (D(I,N)) 200,200,190 198
93 190 NSTOP=N 199
94 GO TO 210 200
95 200 CONTINUE 201
96 210 DTIME=TIME(NSTOP)-TIME(NSTART-1) 202
97 DD1=D(I,NSTOP)-D(I,NSTART-1) 203
98 N=NSTART 204
99 220 D(I,N)=D(I,NSTART-1)+DD1*(TIME(N)-TIME(NSTART-1))/DTIME 205
100 N=N+1 206
101 IF (N=NSTOP) 220,230,230 207
102 230 CONTINUE 208
103 240 CONTINUE 209
C 210
C COMPUTE POSITION OF SHIP FROM DISTANCES FROM THE TWO BEACONS 211
C 212
104 LAG=0 213
105 DO 270 N=1,LINE 214
C 215
C MAKE CONSTANT CORRECTION FOR CUBIC AUTOTAPE INTERROGATOR 216
C AND CONVERT TO FEET 217
C 218
106 DFT1=(D(1,N)+CORR1)*3.28083 219
107 DFT2=(D(2,N)+CORR2)*3.28083 220
108 DX1=(SQRT8*DFT1*DFT1-DFT2*DFT2)/(2*.01578) 221
109 DY1=DFT1*DFT1-DX1*DX1 222
C 223
C CHECK FOR IMAGINARY ROOT. 224
C 225
110 IF (DY1) 250,250,260 226
111 250 NORTH(N)=-1. 227
112 LAG=LAG+1 228
113 GO TO 270 229
114 260 DY1=-SQRT(DY1) 230
C 231
C ROTATE COORDINATES AND TRANSLATE INTO CALIFORNIA LAMBERT COORDINATE 232
C SYSTEM 233
C 234
115 EAST(N)=DX1*COSINE-DY1*SINE+BEAC1E 235
116 NORTH(N)=DX1*SINE+DY1*COSINE+BEAC1N 236

```


117	270	CONTINUE	237
118		IF (LAG.EQ.0) GO TO 330	238
119		ASSIGN 330 TO KEY	239
	C		240
	C	ELIMINATE DATA SETS FOR WHICH AN	241
	C	IMAGINARY FIX WAS OBTAINED	242
	C		243
120	280	LAG=0	244
121		DO 320 N=1,LINE	245
122		IF (NORTH(N)) 290,290,300	246
123	290	LAG=LAG+1	247
124		GO TO 320	248
125	300	NN=N-LAG	249
126		NMBR(NN)=NMBR(N)	250
127		TIME(NN)=TIME(N)	251
128		DO 310 I=1,2	252
129	310	D(I,NN)=D(I,N)	253
130		RAD(NN)=RAD(N)	254
131		EAST(NN)=EAST(N)	255
132		NORTH(NN)=NORTH(N)	256
133	320	CONTINUE	257
134		LINE=LINE-LAG	258
135		GO TO KEY, (330,400)	259
	C		260
	C	CHECK NORTH AND EAST COORDINATES FOR	261
	C	EXTREME VALUES BY CHAUVENET'S CRITERION	262
	C		263
136	330	NBAR=-1.	264
137		CALL STDEV (NORTH,LINE,NBAR,SDNORTH)	265
138		EBAR=-1.	266
139		CALL STDEV (EAST,LINE,EBAR,SDEAST)	267
140		ALPHA=1.-1./FLOAT(2*LINE)	268
141		CALL TFORM (CHVR,ALPHA,\$335)	269
142		GO TO 340	270
143	335	CHVR=5.	271
144		WRITE (6,770) ALPHA	272
145	340	GATE1=EBAR-CHVR*SDEAST	273
146		GATE2=EBAR+CHVR*SDEAST	274
147		GATEN1=NBAR-CHVR*SDNORTH	275
148		GATEN2=NBAR+CHVR*SDNORTH	276
149		LAG=0	277
150		DO 390 N=1,LINE	278
151		IF (EAST(N)-GATE1) 380,350,350	279
152	350	IF (EAST(N)-GATE2) 360,360,380	280
153	360	IF (NORTH(N)-GATEN1) 380,370,370	281
154	370	IF (NORTH(N)-GATEN2) 390,390,380	282
155	380	NORTH(N)=-1.	283
156		LAG=LAG+1	284
157	390	CONTINUE	285
158		ASSIGN 400 TO KEY	286
	C		287
	C	ELIMINATE ANY DATA SETS THAT HAVE AN EXTREME	288
	C	VALUES OF THE NORTH OR EAST COORDINATES	289
	C		290
159		IF (LAG.GT.0) GO TO 280	291
	C		292
	C	CALL SUBROUTINE FOR PLOTTING THE TRACK OF THE SURVEY VESSEL.	293
	C		294
160	400	NENTRY=1	295
161		IF (NOPT(1).EQ.1) CALL TRACK (NORTH,EAST,NMBR)	296
	C		297
	C	APPLY A CORRECTION TO ALLOW FOR THE DISTANCE THE DETECTOR IS TOWED	298
	C	ASTERN OF THE SURVEY SHIP.	299
	C		300
162		DNQ=NORTH(1)-(NORTH(2)-NORTH(1))	301
163		DEQ=EAST(1)-(EAST(2)-EAST(1))	302
164		DENOM=SQRT((NORTH(1)-DNQ)**2+(EAST(1)-DEQ)**2)	303
165		NCORD(1)=NORTH(1)-CABLE*(NORTH(1)-DNQ)/DENOM	304
166		ECORD(1)=EAST(1)-CABLE*(EAST(1)-DEQ)/DENOM	305
167		DO 430 N=2,LINE	306
168		DENOM=SQRT((NORTH(N)-NCORD(N-1))**2+(EAST(N)-ECORD(N-1))**2)	307
	C		308
	C	THE CORRECTION FOR THE DISTANCE BETWEEN VESSEL AND THE DETECTOR	309
	C	IS EQUAL TO 'CABLE' UNLESS THE VESSEL IS LESS THAN 'CABLE' FEET	310
	C	AWAY FROM THE LAST COMPUTED POSITION OF THE DETECTOR VEHICLE. IN	311
	C	THIS EVENT, THE NEW COMPUTED DETECTOR POSITION IS THE SAME AS	312
	C	THE LAST DETECTOR POSITION	313
	C		314

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169      IF (DENOM-CABLE) 420,420,410      315
170      NCORD(N)=NORTH(N)-CABLE*(NORTH(N)-NCORD(N-1))/DENOM      316
171      ECORD(N)=EAST(N)-CABLE*(EAST(N)-ECORD(N-1))/DENOM      317
172      GO TO 430      318
173      420 NCORD(N)=NCORD(N-1)      319
174      ECORD(N)=ECORD(N-1)      320
175      430 CONTINUE      321
      C      322
      C      CONVERT RADIATION READINGS TO COUNTS PER SECOND      323
      C      324
176      CCR(1)=RAD(1)/SEC      325
177      DO 450 N=2,LINE      326
178      IF (NMBR(N).NE.NMBR(N-1)+1) GO TO 440      327
179      CCR(N)=RAD(N)/(TIME(N)-TIME(N-1))      328
180      GO TO 450      329
181      440 CCR(N)=RAD(N)/SEC      330
182      450 CONTINUE      331
      C      332
      C      COMPUTE THE MEAN AND STANDARD DEVIATION OF THE BACKGROUND COUNT      333
      C      RATE FROM THE RADIATION DATA THAT LIES WITHIN THE LIMITS OF THE      334
      C      ESTIMATED BACKGROUND COUNT RATE SET BY CHAUVENET'S CRITERION.      335
      C      336
183      IF (CCR(1).GT.2.*BKG) CCR(1)=BKG      337
184      ALPHA=1.-1./FLOAT(2*LINE)      338
185      CALL TINORM (CHVR,ALPHA,.5455)      339
186      GO TO 460      340
187      455 CHVR=.5      341
188      WRITE (6,770) ALPHA      342
189      460 BGCR=0.0      343
190      SIGMA=0.0      344
191      NCOUNT=0      345
192      GATE1=BKG-CHVR*SQRT(BKG/SEC)      346
193      GATE2=BKG+CHVR*SQRT(BKG/SEC)      347
194      DO 490 N=1,LINE      348
195      IF (CCR(N)-GATE1) 490,490,470      349
196      IF (CCR(N)-GATE2) 480,490,490      350
197      480 NCOUNT=NCOUNT+1      351
198      BGCR=BGCR+CCR(N)      352
199      490 CONTINUE      353
200      BGCR=BGCR/FLOAT(NCOUNT)      354
201      DO 520 N=1,LINE      355
202      IF (CCR(N)-GATE1) 520,520,500      356
203      IF (CCR(N)-GATE2) 510,520,520      357
204      510 SIGMA=SIGMA+(CCR(N)-BGCR)**2      358
205      520 CONTINUE      359
206      SIGMA=SQRT(SIGMA/FLOAT(NCOUNT))      360
207      WRITE (6,780) BKG,BGCR,SIGMA      361
      C      362
      C      CALL THE SUBROUTINE FOR PLOTTING UNCORRECTED RADIATION VALUES      363
      C      364
208      NENTRY=2      365
209      IF (NOPT(2).EQ.1) CALL RADPLT (NCORD,ECORD,CCR)      366
210      IF (NOPT(3).NE.1) GO TO 570      367
      C      368
      C      CORRECT RADIATION VALUES FOR BACKGROUND COUNT RATE AND TIME-DECAY      369
      C      370
211      SUM=0.0      371
212      NBAR=0.0      372
213      EBAR=0.0      373
214      SDNRTH=0.0      374
215      SDEAST=0.0      375
216      DO 540 N=1,LINE      376
217      CCR(N)=CCR(N)-BGCR      377
218      IF (CCR(N)-3.*SIGMA) 540,540,530      378
219      530 CCR(N)=(CCR(N)-3.*SIGMA)*EXP(DECAY*(DELAY+TIME(N)/3600.))      379
      1 + 3.*SIGMA      379.5
220      SUM=SUM+CCR(N)      380
221      NBAR=NBAR+(NCORD(N)-NCORD(1))*CCR(N)      381
222      EBAR=EBAR+(ECORD(N)-ECORD(1))*CCR(N)      382
223      540 CONTINUE      383
224      WRITE (6,790) SUM      384
      C      385
      C      COMPUTE WEIGHTED MEAN AND STD. DEV. OF ACTIVITY LOCALIZATION      386
      C      387
225      NBAR=NCORD(1)+NBAR/SUM      388
226      EBAR=ECORD(1)+EBAR/SUM      389
227      DO 560 N=1,LINE      390
228      IF (CCR(N)) 560,560,550      391

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PROGRAM -- RAPLOT III MODIFIED FOR IBM-7094 WITH SC-4060 CRT

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229 550 SONRTH=SONRTH+(NCORD(N)-NBAR)*(NCORD(N)-NBAR)*CCR(N) 392
230 SDEAST=SDEAST+(ECORD(N)-EBAR)*(ECORD(N)-EBAR)*CCR(N) 393
231 560 CONTINUE 394
232 SONRTH=SQRT(SONRTH/SUM) 395
233 SDEAST=SQRT(SDEAST/SUM) 396
234 WRITE (6,800) NBAR,EBAR,SONRTH,SDEAST 397
C 398
C COMPUTE AND PRINT 95 PC. CONFIDENCE LIMITS OF MEAN RADIATION 399
C LOCATION. 400
C 401
235 RTSUM=SQRT(SUM/86CCR) 402
236 CFIDN=1.96*SONRTH/RTSUM 403
237 CFIDE=1.96*SDEAST/RTSUM 404
238 WRITE (6,810) CFIDN,CFIDE 405
239 570 NENTRY=3 406
240 IF (NOPT(3).EQ.1) CALL RADPLT (NCORD,ECORD,CCR) 407
241 WRITE (6,820) NMAX,EMAX 408
242 WRITE (6,830) NMIN,EMIN 409
C 410
C WRITE OUT THE NUMBER, COORDINATES AND ACTIVITY OF EACH DATA POINT 411
C 412
243 KOUNT=50 413
244 DO 600 N=1,LINE 414
245 IF (KOUNT=50) 590,580,580 415
246 580 WRITE (6,840) LEGEND 416
247 KOUNT=0 417
248 590 WRITE (6,850) NMBR(N),TIME(N),NORTH(N),EAST(N),NCORD(N),ECORD(N),C 418
1CR(N),FATH(N) 419
249 600 KOUNT=KOUNT+1 420
250 WRITE (6,860) 421
251 IF (.NOT.JOBEND) GO TO 10 422
252 STOP 423
C 424
253 610 FORMAT (1H1) 425
254 620 FORMAT (3F3.0,F7.0,8X,2F2.0,F3.0,F5.2,3F2.0,4(1X,F7.0),I3) 426
255 630 FORMAT (41F10.0,1X,3I2,1X,F10.0,2(1X,F10.0),1X,A6) 427
256 640 FORMAT (13A6,L2) 428
257 650 FORMAT (10X,13A6,10X,L2) 429
258 660 FORMAT (/5X,8HBEACON 1,F10.0,1HN,F10.0,1HE,5X,8HBEACON 2,F10.0,1HN 430
1,F10.0,1HE//) 431
259 670 FORMAT (5X,21HSQUARE DIST BETWEEN =,E16.8,5X,18HDISTANCE BETWEEN = 432
1,F10.0) 433
260 680 FORMAT (5X,6HSINE =,E16.8,5X,8HCOSINE =,E16.8) 434
261 690 FORMAT (5X,16HIJECTION TIME =,2F3.0,10X,12HCLOCK SET AT,2F3.0,5X, 435
12HDIITIZING INTERVAL =,F3.0,7HSECONDS/5X,30HDAYS ELAPSED SINCE I 436
2NJECTION =,F3.0) 437
262 700 FORMAT (5X,22HHALF-LIFE OF ISOTOPE =,F7.2,4HDAYS,5X,14HDECAY FACTO 438
1R =,E16.8,5X,19HTIME-DELAY FACTOR =,F7.2,5HHOURS) 439
263 710 FORMAT (10X,14HCABLE LENGTH =,F4.0,10X,18HMEAN WATER DEPTH =,F4.0, 440
110X,13HBOAT LENGTH =,F4.0) 441
264 720 FORMAT (10X,38HDISTANCE FROM RADAR MAST TO DETECTOR =,F6.1,5HFEET. 442
1) 443
265 730 FORMAT (/40X,15HPLOTS GENERATED/10X,9HTRACKLINE,IS,10X,20HBACKGRO 444
1UND RADIATION,IS,10X,19HCORRECTED RADIATION,IS) 445
266 740 FORMAT (5X,51HBEACON RANGES FOR DUMP SITE COMPUTE IMAGINARY ROOT.) 446
267 750 FORMAT (10X,37HLAMBERT COORDINATES OF INJECTION SITE,F10.0,1HN,F10 447
1.0,1HE) 448
268 760 FORMAT (16,3F7.1,F7.0,7X,F7.0,A1) 449
269 770 FORMAT (13H THERE WAS AN OVERFLOW WHEN ALPHA WAS,F6.3,5X,25HCHVR W 450
1AS SET EQUAL TO 5.0) 451
270 780 FORMAT (/20X,53HSUMMARY STATISTICS OF BACKGROUND RADIATION COUNT 452
1RATE/10X,21HEST. PKG. COUNTS/SEC.,F10.0/10X,21HMEAN RKG. COUNTS/SE 453
2C,F10.0/10X,21HSTD. DEV. COUNTS/SEC.,F10.0) 454
271 790 FORMAT (/10X,33HSUM OF CORRECTED RADIATION COUNTS,E16.8) 455
272 800 FORMAT (/20X,41HSUMMARY STATISTICS OF RADIATION LOCATION,/24X,11H 456
1NORTH COORD,10X,10HEAST COORD/16X,4HMEAN,5X,F10.0,10X,F10.0/11X,9H 457
2STD. DEV.,5X,F10.0,10X,F10.0) 458
273 810 FORMAT (10X,10HCONFIDENCE/7X,13HLIMIT OF MEAN,5X,F10.0,10X,F10.0) 459
274 820 FORMAT (/7X,13HMAXIMUM COORD,5X,F10.0,1HN,9X,F10.0,1HE) 460
275 830 FORMAT (/7X,13HMINIMUM COORD,5X,F10.0,1HN,9X,F10.0,1HE//) 461
276 840 FORMAT (1H1,9X,13A6//2X,50HLINE TIME DISTANCE TO BEACON BOAT 462
1COORDINATES,4X,50HBALL COORDINATES UNCORRECTED CORRECTED DEP 463
2TH/9X,3HSEC,8X,1H1,9X,1H2,6X,5HNORTH,6X,4HEAST,5X,5HNORTH,6X,4HEAS 464
3T,4X,20HRADIATION COUNTS/SEC,6X,4HFEET) 465
277 850 FORMAT (1X,15,F6.0,20X,4F10.0,13X,F11.0,F10.0) 466
278 860 FORMAT (1H1) 467
279 ENO 468-

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PROGRAM -- RAPLOT III MODIFIED FOR IBM-7094 WITH SC-4060. CRT

10	-	10*	251							
20	-	14	15*							
30	-	13	14	16*						
40	-	36	37*							
50	-	41	42*							
60	-	41	45*							
70	-	36	44	49*						
80	-	50*	54	55	56	57	58	59	60	63
90	-	53	54*							
100	-	53	61	64*						
110	-	73	74*							
120	-	69	76*							
130	-	67	78*							
140	-	81	82*							
150	-	84	85*							
160	-	83	86*							
170	-	80	81	84	87*					
180	-	89	90*							
190	-	92	93*							
200	-	91	92	95*						
210	-	94	96*							
220	-	99*	101							
230	-	88	89	101	102*					
240	-	79	103*							
250	-	110	111*							
260	-	110	114*							
270	-	105	113	117*						
280	-	120*	159							
290	-	122	123*							
300	-	122	125*							
310	-	128	129*							
320	-	121	124	133*						
330	-	118	119	135	136*					
335	-	143*								
340	-	142	145*							
350	-	151	152*							
360	-	152	153*							
370	-	153	154*							
380	-	151	152	153	154	155*				
390	-	150	154	157*						
400	-	135	158	160*						
410	-	169	170*							
420	-	169	173*							
430	-	167	172	175*						
440	-	178	181*							
450	-	177	180	182*						
455	-	187*								
460	-	186	189*							
470	-	195	196*							
480	-	196	197*							
490	-	194	195	196	199*					
500	-	202	203*							
510	-	203	204*							
520	-	201	202	203	205*					
530	-	218	219*							
540	-	216	218	223*						
550	-	228	229*							
560	-	227	228	231*						
570	-	210	239*							
580	-	245	246*							
590	-	245	248*							
600	-	244	249*							
610	-	7WR	253*							
620	-	11RD	254*							
630	-	12RD	255*							
640	-	17RD	256*							
650	-	18WR	257*							
660	-	19WR	258*							
670	-	22WR	259*							
680	-	25WR	260*							
690	-	26WR	261*							
700	-	31WR	262*							
710	-	32WR	263*							
720	-	34WR	264*							
730	-	35WR	265*							
740	-	43WR	266*							
750	-	48WR	267*							
760	-	51RD	268*							
770	-	144WR	1A8WR	269*						

PROGRAM -- RAPLOT III MODIFIED FOR IBM-7094 WITH SC-4060 CRT

870	-	207WR	270*
790	-	224WR	271*
800	-	234WR	272*
810	-	238WR	273*
820	-	241WR	274*
830	-	242WR	275*
840	-	246WR	276*
850	-	248WR	277*
860	-	250WR	278*
AA	-	1C0	
ABS	-	84	
ALOG	-	30	
ALPHA	-	140=	141AG 144WR 184= 185AG 188WR
BEAC1E	-	11RD	19WR 20 24 46 115
BEAC1N	-	11RD	19WR 20 23 47 116
BEAC2E	-	11RD	19WR 20 24
BEAC2N	-	11RD	19WR 20 23
BGCR	-	1C0	189= 198= 200= 204 207WR 217 235
BKG	-	11RD	183 192 193
BOAT	-	11RD	32WR 33 34WR 165 166 169 170 171
CABLE	-	11RD	32WR 33= 179= 181= 183 195 196 198 202
CCR	-	30I	4EQ 176= 217= 218 219= 220 221 222 228
		203	204 209AG 217=
		229	230 240AG 248WR
CF1OE	-	237=	238WR
CF1DN	-	236=	238WR
CHECK	-	52	
CHWR	-	141AG	143= 145 146 147 148 185AG 187= 192 193
CORR1	-	6DA	37 106
CORR2	-	6DA	38 107
COSINE	-	24=	25WR 46 47 115 116
D	-	30I	4EQ 51RD 57 58 74= 81 84 85= 89
		92	97 99= 106 107 129=
DAYS	-	11RD	26WR 29
DD1	-	97=	99
DEU	-	163=	164 166
DECAY	-	30=	31WR 219
DELAY	-	29=	31WR 219
DEPTHOM	-	164=	165 166 168= 169 170 171
DEPTH	-	11RD	32WR 33
DFT1	-	106=	108 109
DFT2	-	107=	108
DISTB	-	21=	22WR 23 24 39 108
DMO	-	162=	164 165
DTIME	-	96=	99
DUMP1	-	12RD	36 37= 39 40
DUMP2	-	12RD	38= 39
DUMPE	-	1C0	
DUNPN	-	1C0	
DX1	-	39=	40 46 47 108= 109 115 116
DY1	-	40=	41 45= 46 47 109 110 114= 115 116
E	-	52AG	53
EAST	-	30I	115= 131= 139AG 151 152 161AG 163 164 166
		168	171 248WR
EDAR	-	1C0	138= 139AG 145 146 213= 222= 226= 230 234WR
ECORD	-	30I	4EQ 166= 168 171= 174= 209AG 222 226
		240AG	248WR
EMAX	-	1C0	241WR
EMIN	-	1C0	242WR
EXP	-	219	
FATH	-	30I	51RD 60 76= 248WR
FLOAT	-	140	184 200 206
GATE1	-	145=	151 192= 195 202
GATE2	-	146=	152 193= 196 203
GATEN1	-	147=	153
GATEV2	-	148=	154
GRID	-	1C0	12RD
LHIFE	-	11RD	30 31WR
I	-	12RD	13 14 15 35WR 73 74 79 81 84
		85	89 92 97 99 128 129
JFLAG	-	6DA	54
INDATE	-	1C0	12RD
ISKIP	-	11RD	67 68 70 77
JFLAG	-	51RD	54
JOBEND	-	1C0	5LG 17RD 18WR 251
KEY	-	119=	135 158=
KOUNT	-	243=	245 247= 249=
LAG	-	104=	112= 118 120= 123= 125 134 149= 156= 159

PROGRAM -- RAPLOT III MODIFIED FOR IBM-7094 WITH SC-4060 CRT

LEGEND	-	1C0	17R0	18WR	246WR								
LINE	-	1C0	66=	69	77=	78	83	91	105	121	134=		
	-	137AG	139AG	150	167	177	194	201	216	227	244		
M	-	80	81	82	84	88	89	90					
MSTOP	-	78=	80	88									
N	-	49=	51RD	55	56	57	58	59	60	61	62=		
	-	65=	66	69	70	71	72	74	75	76	83		
	-	84	85	91	92	93	98=	99	100=	101	105		
	-	106	107	111	115	116	121	122	125	126	127		
	-	129	130	131	132	150	151	152	153	154	155		
	-	167	168	170	171	173	174	177	178	179	181		
	-	194	195	196	198	201	202	203	204	216	217		
	-	218	219	220	221	222	227	228	229	230	244		
	-	248WR											
NBAR	-	1C0	2RL	136=	137AG	147	148	212=	221=	225=	229		
	-	234WR											
NCALLS	-	1C0	9=	10=									
NCAM	-	1C0	8=										
NCORD	-	2RL	4EQ	165=	168	170=	173=	209AG	221	225	229		
	-	240AG	248WR										
NCOUNT	-	191=	197=	200	206								
NENTRY	-	1C0	160=	208=	239=								
NMAX	-	1C0	2RL	241WR									
NMBR	-	30I	51RD	55	71=	126=	161AG	178	248WR				
NMIN	-	1C0	2RL	242WR									
NN	-	70=	71	72	74	75	76	125=	126	127	129		
	-	130	131	132									
NOPT	-	1C0	12RD	35WR	161	209	210	240					
NORTH	-	2RL	111=	116=	122	132=	137AG	153	154	155=	161AG		
	-	162	164	165	168	170	248WR						
NPLT	-	1C0	12RD	14	15=								
NSTART	-	68=	69	82=	83	90=	91	96	97	98	99		
NSTOP	-	93=	96	97	101								
RAD	-	30I	4EQ	51RD	59	75=	130=	176	179	181			
RAOPLT	-	209	240										
RESET	-	50											
RMIN	-	11RD	26WR	28									
RTSUM	-	235=	236	237									
SCALE	-	1C0	12RD										
SCEAST	-	139AG	145	146	215=	230=	233=	234WR	237				
SDNRTH	-	137AG	147	148	214=	229=	232=	234WR	236				
SEC	-	11RD	26WR	176	181	192	193						
SETIME	-	11RD	26WR	28=	29								
SIGMA	-	1C0	190=	204=	206=	207WK	218	219					
S1NE	-	23=	25WR	46	47	115	116						
SITEE	-	46=	48WR										
SITEN	-	42=	47=	48WR									
SQDSTB	-	20=	21	22WR	39	108							
SQRT	-	21	33	45	114	164	168	192	193				

SUBROUTINE TRACK (NORTH,EAST,NMBR)

1		SUBROUTINE TRACK (NORTH,EAST,NMBR)	TRK	1
	C		TRK	2
	C	THIS SUBROUTINE GENERATES PLOT INSTRUCTIONS FOR THE STROMBERG-	TRK	3
	C	CARLSON 4020 CATHODE RAY TUBE.	TRK	4
	C		TRK	5
2		COMMON /AA/ NOPT(4),NPLT(3),SCALE,GRID,DUMPN,DUMPE,NBAR,EBAR,LEGENTRK	TRK	6
		10(13),INDATE,NPTS,BGCR,SIGMA,NMAX,NMIN,EMAX,EMIN,JOBEND,NENTRY,NCATRK	TRK	7
		2LLS,NCAM	TRK	8
3		01MENSION EAST(2000), NMBR(2000)	TRK	9
4		REAL NORTH(2000),NBAR,NMAX,NMIN,EMAXV	TRK	10
5		LOGICAL JOBEND	TRK	11
6	10	IF (NCALLS.GT.1) GO TO 20	TRK	12
	C		TRK	13
	C	INITIALIZE CAMERA, AND PRINT ID FRAME	TRK	14
	C		TRK	15
7		PHI=ALOG(2.)	TRK	16
8		CALL FRAMEV	TRK	17
9		CALL SETMIV (0,140,32,0)	TRK	18
10	20	LAST=3	TRK	19
11	30	IF (NOPT(LAST),NE.0) GO TO 40	TRK	20
12		LAST=LAST-1	TRK	21
13		GO TO 30	TRK	22
	C		TRK	23
	C	COMPUTE MAXIMUM AND MINIMUM VALUES OF NORTH AND EAST ARRAYS	TRK	24
	C		TRK	25
14	40	NMAX=NORTH(1)	TRK	26
15		NMIN=NORTH(1)	TRK	27
16		EMAX=EAST(1)	TRK	28
17		EMIN=EAST(1)	TRK	29
18		DO 50 N=2,NPTS	TRK	30
19		NMAX=AMAX1(NMAX,NORTH(N))	TRK	31
20		NMIN=AMIN1(NMIN,NORTH(N))	TRK	32
21		EMAX=AMAX1(EMAX,EAST(N))	TRK	33
22	50	EMIN=AMIN1(EMIN,EAST(N))	TRK	34
23		XRATIO=(EMAX-EMIN)/883.	TRK	35
24		YRATIO=(EMAX-NMIN)/991.	TRK	36
25		IF (XRATIO-YRATIO) 60,80,70	TRK	37
26	60	EMAXV=EMIN+YRATIO*883.	TRK	38
27		NMAXV=NMAX	TRK	39
28		GO TO 80	TRK	40
29	70	NMAXV=NMIN+XRATIO*991.	TRK	41
30		EMAXV=EMAX	TRK	42
31		GO TO 80	TRK	43
32		ENTRY RADPLT(NORTH,EAST,RAD)	TRK	43.5
33		DIMENSION RAD(2000)	TRK	44
34		IF (NOPT(1),EQ.0.AND.NENTRY,EQ.2) GO TO 10	TRK	45
35		IF (NOPT(1),EQ.0.AND.NOPT(2),EQ.0.AND.NENTRY,EQ.3) GO TO 10	TRK	46
	C		TRK	47
	C	PRINT LEGEND AND INJECTION DATE AT BASE OF MAP.	TRK	48
	C		TRK	49
36	80	CALL PRINTV (78,LEGEND,24,24)	TRK	50
37		CALL PRINTV (-14,14,INJECTION DATE,720,8)	TRK	51
38		CALL PRINTV (6,INDATE,848,8)	TRK	52
39		NN=NPLT(NENTRY)	TRK	53
40		GO TO (90,110,140), NENTRY	TRK	54
41	90	CALL PRINTV (-25,25,PLOT OF SURVEY TRACK LINE,24,8)	TRK	55
42		CALL GRID1V (2,EMIN,EMAXV,NMIN,NMAXV,SCALE,SCALE,5,5,5,-5,-4)	TRK	56
	C		TRK	57
	C	PLOT TRACK LINE FOLLOWED BY SURVEY VESSEL	TRK	58
	C		TRK	59
43		DO 100 N=2,NPTS	TRK	60
44		CALL LINEV (NXV(EAST(N-1)),NYV(NORTH(N-1)),NXV(EAST(N)),NYV(NORTH(N-1)))	TRK	61
			TRK	62
45		IF (MOD(N,NN),NE.0) GO TO 100	TRK	63
46		CALL POINTV (EAST(N),NORTH(N),-3)	TRK	64
47		D=FLOAT(NMBR(N))	TRK	65
48		IX=NXV(EAST(N))+5	TRK	66
	C		TRK	67
	C	PLOT FIX NUMBER OF EVERY NNTH FIX	TRK	68
	C		TRK	69
49		CALL LABLV (D,IX,NYV(NORTH(N)),4,1,4)	TRK	70
50	100	CONTINUE	TRK	71
51		GO TO 220	TRK	72
52	110	CALL PRINTV (-62,62,PLOT OF UNCORRECTED RADIATION IN STD. DEVS. FROM	TRK	73
		10M MEAN BKG. CR.,24,8)	TRK	74
53		CALL GRID1V (2,EMIN,EMAXV,NMIN,NMAXV,SCALE,SCALE,5,5,5,-5,-4)	TRK	75
	C		TRK	76
	C	PLOT UNCORRECTED RADIATION VALUES IN STANDARD DEVIATIONS FROM MEAN	TRK	77
	C	BACKGROUND COUNT RATE	TRK	78
	C		TRK	79

SUBROUTINE TRACK (NORTH,EAST,NMBR)

```

54      DO 120 N=1,NPTS                                TRK 80
55      IF (MOD(N,NN).NE.0) GO TO 120                  TRK 81
56      IVAL=IFIX((RAD(N)-BGCR)/SIGMA+6.)              TRK 82
57      IF (IVAL.LT.0) IVAL=0                          TRK 83
58      IF (IVAL.GT.11) IVAL=11                        TRK 84
59      IVAL=-IVAL                                       TRK 85
60      CALL POINTV (EAST(N),NORTH(N),IVAL)            TRK 86
61      120 CONTINUE                                    TRK 87
      C                                                TRK 88
      C PRINT LEGEND FOR SYMBOLS REPRESENTING UNCORRECTED VALUES TRK 89
      C                                                TRK 90
62      CALL PRINTV (-6,6HLEGEND,912,800)              TRK 91
63      CALL POINTV (887,768,0,ANY)                    TRK 92
64      CALL PRINTV (-8,8HCCR .LE.,903,768)            TRK 93
65      D=BGCR-5.*SIGMA                                TRK 94
66      CALL LABLV (D,975,768,6,1,6)                  TRK 95
67      IY=752                                          TRK 96
68      DO 130 I=1,11                                  TRK 97
69      N=-I                                            TRK 98
70      CALL POINTV (887,IY,N,ANY)                     TRK 99
71      CALL PRINTV (-8,8HCCR .GT.,903,IY)             TRK 100
72      CALL LABLV (D,975,IY,6,1,6)                   TRK 101
73      D=D+SIGMA                                       TRK 102
74      IY=IY-16                                       TRK 103
75      GO TO 220                                       TRK 104
76      140 CALL PRINTV (-38,38H PLOT OF CORRECTED RADIATION COUNT RATE,24,8) TRK 105
77      CALL GRIDV (2,EMIN,EMAXV,NMIN,NMAXV,SCALE,SCALE,5,5,5,-5,-4) TRK 106
      C                                                TRK 107
      C PLOT CORRECTED RADIATION COUNT RATE AS BACKGROUND IF .LT. 3 STD. TRK 108
      C DEVS. FROM BACKGROUND. IF COUNT RATE IS MORE THAN 3 STD. DEVS. TRK 109
      C BELOW BACKGROUND, THE VALUE IS NOT PLOTTED AT ALL. TRK 110
      C                                                TRK 111
78      DO 190 N=1,NPTS                                TRK 112
79      IF (MOD(N,NN).NE.0) GO TO 190                  TRK 113
80      IF (RAD(N)+3.*SIGMA) 190,160,150              TRK 114
81      IF (RAD(N)-3.*SIGMA) 160,160,170              TRK 115
82      IVAL=0                                          TRK 116
83      160 GO TO 180                                   TRK 117
      C                                                TRK 118
      C IF THE COUNT RATE IS .G.. BACKGROUND, THE VALUE IS PLOTTED ON A TRK 119
      C POWER OF 2 * 25 SCALE                          TRK 120
      C                                                TRK 121
84      170 IVAL=IFIX(ALOG(RAD(N)/100.)/PHI+3.)         TRK 122
85      IF (IVAL.LT.1) IVAL=1                          TRK 123
86      IF (IVAL.GT.12) IVAL=12                        TRK 124
87      IVAL=-IVAL                                       TRK 125
88      180 CALL POINTV (EAST(N),NORTH(N),IVAL)         TRK 126
89      190 CONTINUE                                    TRK 127
      C                                                TRK 128
      C PRINT LEGEND FOR SYMBOLS REPRESENTING CORRECTED VALUES TRK 129
      C                                                TRK 130
90      CALL PRINTV (-6,6HLEGEND,912,800)              TRK 131
91      CALL POINTV (887,768,0,ANY)                    TRK 132
92      CALL PRINTV (-8,8HCCR .LE.,903,768)            TRK 133
93      D=3.*SIGMA                                      TRK 134
94      CALL LABLV (D,975,768,6,1,6)                  TRK 135
95      D=25.                                           TRK 136
96      IY=752                                          TRK 137
97      DO 200 I=1,12                                  TRK 138
98      N=-I                                            TRK 139
99      CALL POINTV (887,IY,N,ANY)                     TRK 140
100     CALL PRINTV (-8,8HCCR .GE.,903,IY)             TRK 141
101     CALL LABLV (D,975,IY,6,1,6)                   TRK 142
102     D=D*2.                                          TRK 143
103     200 IY=IY-16                                    TRK 144
      C                                                TRK 145
      C PLOT MEAN RADIATION LOCATION                  TRK 146
      C                                                TRK 147
104     IX=NXV(EBAR)                                    TRK 148
105     IY=NYV(NBAR)                                    TRK 149
106     CALL POINTV (IX,IY,0,ANY)                      TRK 150
107     CALL PRINTV (-8,8HO RADBAR,IX,IY)              TRK 151
      C                                                TRK 152
      C PLOT POSITION OF INJECTION SITE                TRK 153
      C                                                TRK 154
108     IF (DUMPN.GT.NMAX.OR.DUMPN.LT.NMIN) GO TO 210 TRK 155
109     IX=NXV(DUMPE)                                    TRK 156
110     IY=NYV(DUMPN)                                    TRK 157

```


SUBROUTINE TRACK (NORTH,EAST,NMBR)

```

NMIN - 2C0 4RL 15= 20= 24 29 42AG 53AG 77AG 108
NN - 39= 45 55 79
NOPT - 2C0 11 34 35
NORTH - 1AG 8RL 14 15 19 20 32 44AG 46AG 49AG
        60AG 8AG
NPLT - 2C0 39
NPTS - 2C0 18 43 54 78
NIXV - 44AG 48 104 109
NIYV - 44AG 49AG 105 110
PHI - 7= 84
POINTV - 46 60 63 70 88 91 99 106 111
PRINTV - 36 37 38 41 52 62 64 71 76 90
        92 100 107 112
RAD - 32 33DI 56 80 81 84
RADPLT - 32
RETURN - 115 116
SCALE - 2C0 42AG 53AG 77AG
SETMIV - 9
SIGMA - 2C0 56 65 73 80 81 93
TRACK - 1
XRATIO - 23= 25 29
YRATIO - 24= 25 26

```

I N D E X

SUBROUTINE TINORM(ZVAL,ALPHA,*)

```

1 SUBROUTINE TINORM(ZVAL,ALPHA,*) TINORM
2 DIMENSION A(3), B(3) TINORM
3 DATA(A(I),I=1,3)/.010328,.802853,2.515517/, (B(I),I=1,3)/.0010308, TINORM
  1.189269,1.432788/ TINORM
C-----TINORM
C APPROXIMATION TO INVERSE NORMAL DISTRIBUTION TINORM
C-----TINORM
4 IF(.NOT.(ALPHA.GT.0..AND.ALPHA.LT.1.)) GO TO 1 TINORM
5 X=ALPHA TINORM
6 IF(X.GT..5) X=1.-X TINORM
7 X=SORT(-2.*ALOG(X)) TINORM
8 ZVAL =X*(A(3)+X*(A(2)+X*A(1)))/(1.+X*(B(3)+X*(B(2)+X*B(1)))) TINORM
9 CALL OVERFL(I) TINORM
10 IF(I.EQ.1) RETURN 3 TINORM
11 IF(ALPHA.LT..5) ZVAL = - ZVAL TINORM
12 RETURN TINORM
13 1 RETURN 3 TINORM
14 END TINORM

```

I N D E X

SUBROUTINE TINORM(ZVAL,ALPHA,*)

```

SYMBOL == == == == == REFERENCES == == == == ==
1 - 4 13*
A - 2DI 3DA 8
ALOG - 7
ALPHA - 1AG 4 5 11
B - 2DI 3DA 8
I - 3DA 9AG 10
OVERFL - 9
RETURN - 10 12 13
SORT - 7
TINORM - 1
X - 5= 6 7= 8
ZVAL - 1AG 8= 11=

```

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13. ABSTRACT RAPLOT II is a computer program for processing radiation and navigation data from field surveys of radioisotopic sand tracer (RIST) study, but is applicable to any survey type operation on the nearshore Continental Shelf. Collected data are punched onto paper tape by the data collection computer on the research vessel. The data are later transferred to magnetic tape which provides the input for the RAPLOT II Program. Program control parameters are on punched cards. The navigation data, which consists of ranges to two shore-based radar beacons, are first edited for spurious data, and then converted to rectangular coordinates (in this case the California Lambert Coordinate System). Radiation data are converted to count rate as counts per second. Background count rate is computed and subtracted from the observed count rate, and any radiation counts that are significantly above the background count rate are corrected for time of decay since the isotope was injected. Output from the program is in three forms - printed output, graphical output, and magnetic tape record. The processed data are transferred to magnetic tape and made available for further processing, such as the generation of contour maps.			

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