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# Preparation of Magnetic Anomaly Profile and Contour Maps from DOE-NURE Aerial Survey Data

## Volume I: Processing Procedures

Eddie P. Tinnel
William J. Hinze

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# PREPARATION OF MAGNETIC ANOMALY PROFILE AND CONTOUR MAPS FROM DOE-NURE AERIAL SURVEY DATA

## Volume I: Processing Procedures

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West Lafayette, Indiana 47907

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## ABSTRACT

Total intensity magnetic anomaly data acquired as a supplement to radiometric data in the DOE National Uranium Resource Evaluation (NURE) Program are useful in preparing regional profile and contour maps. Survey-contractor-supplied magnetic anomaly data are subjected to a multiprocess, computer-based procedure which prepares these data for presentation. This procedure is used to produce the following machine plotted maps of National Topographic Map Series quadrangle units at a 1:250,000 scale: (1) profile map of contractor-supplied magnetic anomaly data, (2) profile map of high-cut filtered data with contour levels of each profile marked and annotated on the associated flight track, (3) profile map of critical-point data with contour levels indicated, and (4) contour map of filtered and selected data. These quadrangle maps are supplemented with a range of statistical measures of the data which are useful in quality evaluation.


## I. INTRODUCTION

The National Uranium Resource Evaluation (NURE) Program of the U.S. Department of Energy (DOE) was initiated to assess uranium resources of the nation and to provide data and technology for discovery and exploration of uranium ores. The National Aerial Radiometric Reconnaissance Survey (ARRS), an important element of this program, is a form of remote geochemical reconnaissance designed to search for potential uraniferous provinces and formations utilizing airborne gamma-ray spectrometer measurements. Principal products of this aerial survey program will be 1) national radio-element maps to supplement the national geologic map and 2) related statistics on uranium, thorium, and potassium concentrations. Since the beginning of the ARRS program in 1974, total intensity magnetic observations have been recorded concurrently with the spectrometer measurements. The objective of these magnetic measurements is to provide a degree of three-dimensional investigative capacity over and above the essentially one-dimensional radiometric measurements while incurring only a minimal survey cost increase.

Although the aerial survey program is designed to optimize radiometric observations without concern for magnetic observation problems, comparisons of selected magnetic anomaly maps prepared from the NURE-ARRS program data with maps derived from surveys performed specifically for magnetic mapping indicate the NURE survey data generally are useful in mapping the regional magnetic anomaly field of the United States.

The utility of magnetic anomaly maps is a function of flight-track spacing, flight elevation relative to the depth of magnetic sources, flight direction relative to prevailing strike of magnetic anomalies, and temporal magnetic activity during data acquisition. Reasonably precise magnetic anomaly maps can be prepared from surveys observed along flight tracks perpendicular to the strike of magnetic anomalies and spaced at two or less times the vertical distance to magnetic sources. Considering the predominate flight-track spacing of the NURE survey, this condition will be approached only in regions underlain by the deepest portions of sedimentary basins. Furthermore, the aerial survey program is performed regardless of the intensity of temporal magnetic activity. Despite these recognized limitations, maps prepared from NURE-ARRS data are the best publicly available over many areas of the conterminous U.S. and Alaska and, furthermore, represent the only digitally available magnetic anomaly data over much of the U.S.

NURE magnetic data maps are significant to the completion of photo-composite U.S. magnetic anomaly maps currently in preparation by the U.S. Geological Survey and the Society of Exploration Geophysicists as well as to other potential regional mapping uses. The data in digital form find importance in the preparation of a variety of machine-processed maps and other analyses that enhance specific characteristics of the anomaly field and thus aid geologic interpretation. In recognition of the potential usefulness of NURE-ARRS magnetic anomaly data, profile and contour maps and digital data sets of National Topographic Map Series (NTMS) quadrangle units are being prepared from aerial survey contractor-supplied data by the Geographic Data Systems (GDS) Group, Computer Sciences Division, Union Carbide Corporation, Nuclear Division, at Oak Ridge, Tennessee, for the Department of Energy, NURE Program, Grand Junction, Colorado.

Several specific characteristics of the aerial survey data collection and reduction procedures, as well as time and financial limitations, have had an important role in defining and constraining processes developed for the preparation of maps and data sets. The large number of NTMS quadrangle units to be examined requires that manual effort be minimized and that generality be maximized in the procedures for manipulation and presentation of data. Thus the use of computers, particularly in machine plotting of survey data, has been given priority in the attempt to meet these goals.

Acceptable machine contouring of aeromagnetic data normally presents a difficult problem because of high data density along relatively widely spaced survey tracks. The low flight elevation and wide track spacing predicated by the radiometric survey requirements of the NURE-ARRS program make this a particularly significant situation. This problem has been considerably reduced, however, by the application of techniques developed for selective data filtering and critical observation retention.

The development of a process to analyze and present the magnetic data has also been influenced by prior reduction of data by the aerial-survey contractors. Corrections are commonly already applied for temporal variations, instrumental noise and bias, and variations caused by long-wavelength, core-derived magnetic fields. Although these procedures vary widely among contractors for pre-1979 data, no attempt has been made to re-reduce the data in a consistent manner. Nevertheless, previous reduction of data by the contractors has often lessened problems associated with the presentation of these data in map form.

Data quality limitations imposed upon the magnetic data by differing reduction procedures and required survey parameters mandate that information be presented which will aid in evaluating not only the maps produced, but also the precision of the data itself. Thus, computerized "quality evaluation" (QE) procedures are included in the processing sequence. Both the anomaly maps and the QE results are available as open-file reports from the DOE Grand Junction office.

The purpose of this report is the documentation of the methodology that has been developed to present magnetic anomaly data, maps, and collateral quality evaluation statistics of NTMS quadrangle units that, because of their peculiar magnetic or geologic importance, have been selected for processing. This report is intended to encourage the use and increase the effectiveness of the maps and data sets released to the public. Furthermore, it should serve to bring attention to the entire collection of NURE-ARRS program magnetic anomaly data as a national resource and foster increased utilization of these data for a variety of scientific and applied purposes.

This report is supplemented by a companion volume[1] which provides the computer codes developed for presentation of NURE-ARRS data. Although discussion of procedures and computer programs in this report centers on magnetic anomaly data, much of the methodology is also applicable to radiometric data processing and presentation.

## 2. AERIAL-SURVEY CONTRACTORS ACQUISITION AND REDUCTION PROCEDURES

General airborne survey data acquisition procedures for the NURE Aerial Radiometric Reconnaissance Survey have remained essentially constant since inception of the program in 1974. Magnetic data collection and reduction procedures, however, have evolved to extend the utility of the data by taking advantage of readily applied technological and scientific developments and to improve the consistency of procedures used by the several geophysical contractors involved in the surveys. Modification of magnetic data acquisition procedures has always been achieved within an overall data collection framework which maximizes the quality and utility of radiometric data. Specific details concerning the methods used in each aerial survey are presented in individual reports, prepared by survey contractors, which are on open-file with the Department of Energy.

The basic project and reporting units, with few exceptions, are NTMS 1:250,000 scale quadrangles or groups thereof. Survey tracks (flight lines) are normally oriented east-west and are separated in the conterminous U.S. by an average of 7 km. Depending upon geologic conditions relative to potential uranium occurrences, track spacings of up to 10 km have been used in some quadrangles and detailed surveys with spacings of less than 2 km have been employed in others. Track separation is generally constant within any one NTMS quadrangle, although in some cases specific sub-areas of a unit have received more detailed treatment. Figure 1 shows the track spacing used in the conterminous U.S. The extent of NURE-ARRS program efforts in Alaska is shown in Fig. 2., where, unlike those in the contiguous states, the surveys have utilized a consistent 10 km flight-track spacing. In most cases, tie lines are flown normal to survey traverses at approximately a 1:4 ratio. Both fixed- and rotary-winged aircraft are employed with selection so as to best meet survey specifications. Observations are recorded at one-second intervals which correspond to a median horizontal distance between samples in the range of 45 to 60 meters. Although varying as a function of air speed and terrain conditions, flight elevation is nominally 122 meters with an accepted envelope of 60 to 215 meters.

Total intensity (scalar) magnetic field data are measured using either relative (flux-gate) or absolute (proton-precession) magnetometers with a sensitivity of one gamma (nanotesla) or less. Observations made with flux-gate magnetometers necessarily result in data referenced to an arbitrary datum. Whenever possible, such surveys are tied to the absolute datum with auxiliary absolute measurements. Since 1979, all magnetic systems have been required to have, at the two-standard deviation level, resolution of 0.25 gamma and noise limited to plus or minus one gamma for fixed-winged aircraft and plus or minus two gammas for rotary-winged aircraft installations. The observation system is compensated for aircraft heading error to within one gamma. Survey contractors have been required, ORNL-DWG 80-19308

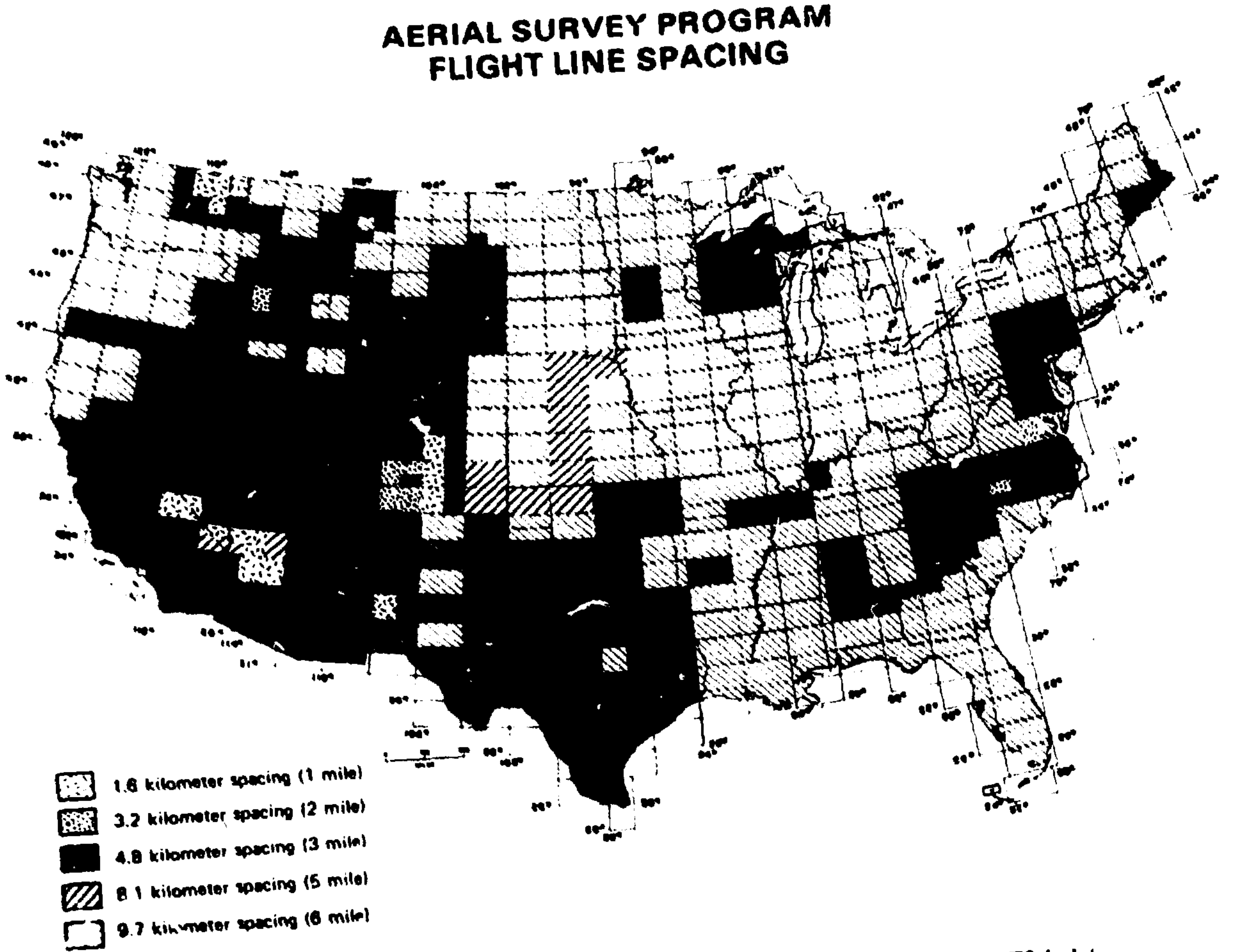


Fig. 1. DOE-NURE Aerial Radiometric Reconnaissance Survey Flight-Track Spacing in the Conterminous U.S.

ORNL-DWG 80-19307

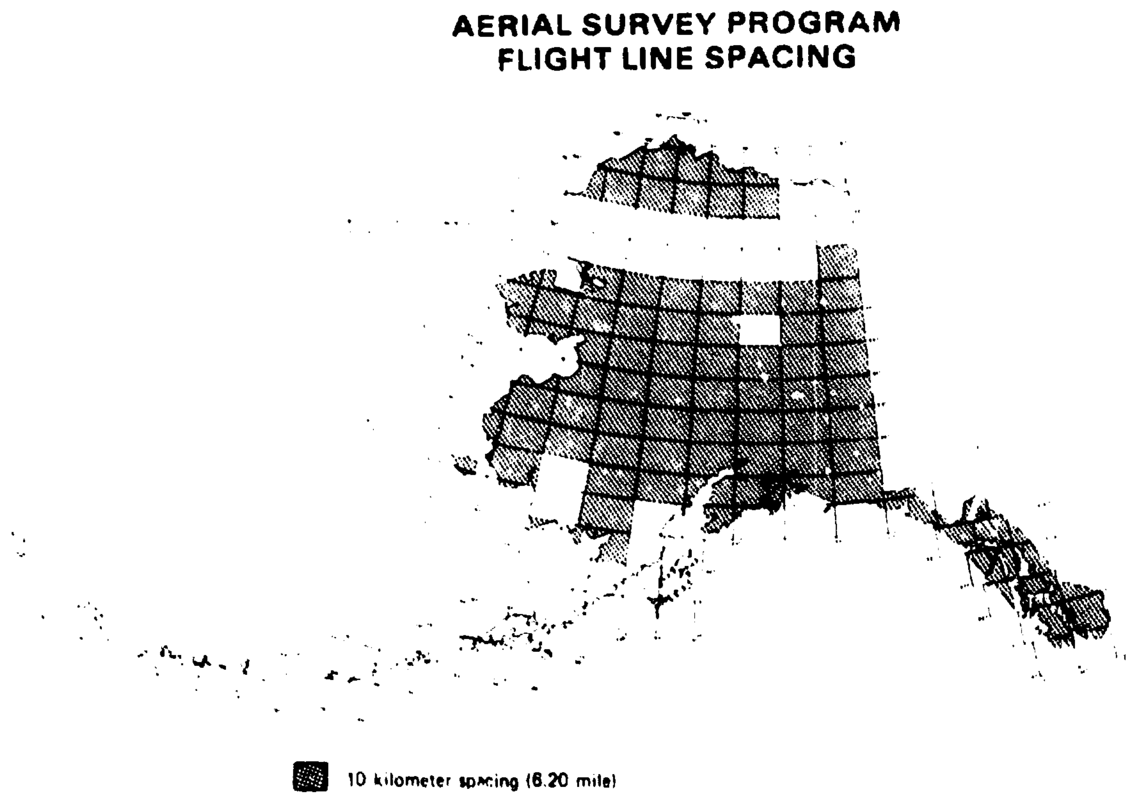


Fig. 2. DOE-NURE Aerial Radiometric Reconnaissance Survey Coverage of Alaska (1/81). Flight Track Spacing is 10 km (6.2 miles).

since 1979, to record total intensity magnetic observations, at a sampling rate of four seconds or less, from a magnetic monitor operated at the local base of operations. This information provides a record of diurnal magnetic variations occurring during flight periods.

Flight path recovery data at each observation point are converted to latitude-longitude and recorded to a ten-thousandth of a degree. Radar altimeter measurements, flight-level barometric pressure, and outside air-temperature are sampled and digitally recorded along with a range of radiometric measurements which will not be discussed here. Survey contractors have been required, post-1979, to correct total intensity magnetic data for heading error, diurnal variation using tie-line data, and the earth's core-derived (normal) field using the 1975 International Geomagnetic Reference Field (IGRF) updated to the month of the survey. Previously, a variety of core-derived fields and other reduction procedures were used by contractors necessitating review of the specifications for a particular survey to determine the exact reduction procedures. The reduced magnetic (anomaly) data, in profile form, are presented together with ancillary data in the survey reports. Reports prepared from surveys performed since 1979 have included a printer-plot contour map of the total intensity magnetic anomaly data at a scale of 1:500,000. The preceding specifications for surveys and reports were established in a report bv Bendix Field Engineering Corporation.[2]

Contractors are required to provide on magnetic tape several data sets pertaining to a given quadrangle survey. Most information used in the processing described in this report is obtained from the Single Record Reduced Data Set with the Magnetic Data Set providing magnetic monitor and auxiliary data. This latter data set is not always available or usable.

# 3. PROCESSING PROCEDURE

## 3.1 Introduction

Recognition of the Department of Energy NURE-ARRS magnetic anomaly data as a valuable national resource has led to the development of a procedure for total intensity magnetic anomaly map preparation and the execution of this procedure for selected NTMS quadrangle units. The preparation-priority ranking of quadrangle units is based upon their potential usefulness in other NURE programs and upon coverage needed for national and regional maps, in both the conterminous U.S. and Alaska, where other magnetic anomaly maps are not publicly available.

The objective of this map preparation procedure is the machine-based production of profile and contour total intensity magnetic anomaly maps and related quality evaluation statistics of quadrangles for the DOE-NURE program and its contractors, federal and state agencies preparing national and regional maps, and the resource exploration industry. Maps being produced for each quadrangle are: (1) A profile map of the contractor-supplied, reduced magnetic anomaly data using the survey- and tie-line tracks as an arbitrary, but constant, level within a quadrangle. This map is occasionally supplemented by a similar profile map of data adjusted for errors and inconsistencies. (2) A profile map of high-cut filtered magnetic anomaly data with contour levels of each profile marked and annotated on the flight tracks. (3) A profile map of critical-point data also with annotated contour levels. (4) A contour map of critical-point total intensity magnetic anomaly data at an appropriate contour interval. The processing procedure is schematically diagrammed in Fig. 3 and detailed

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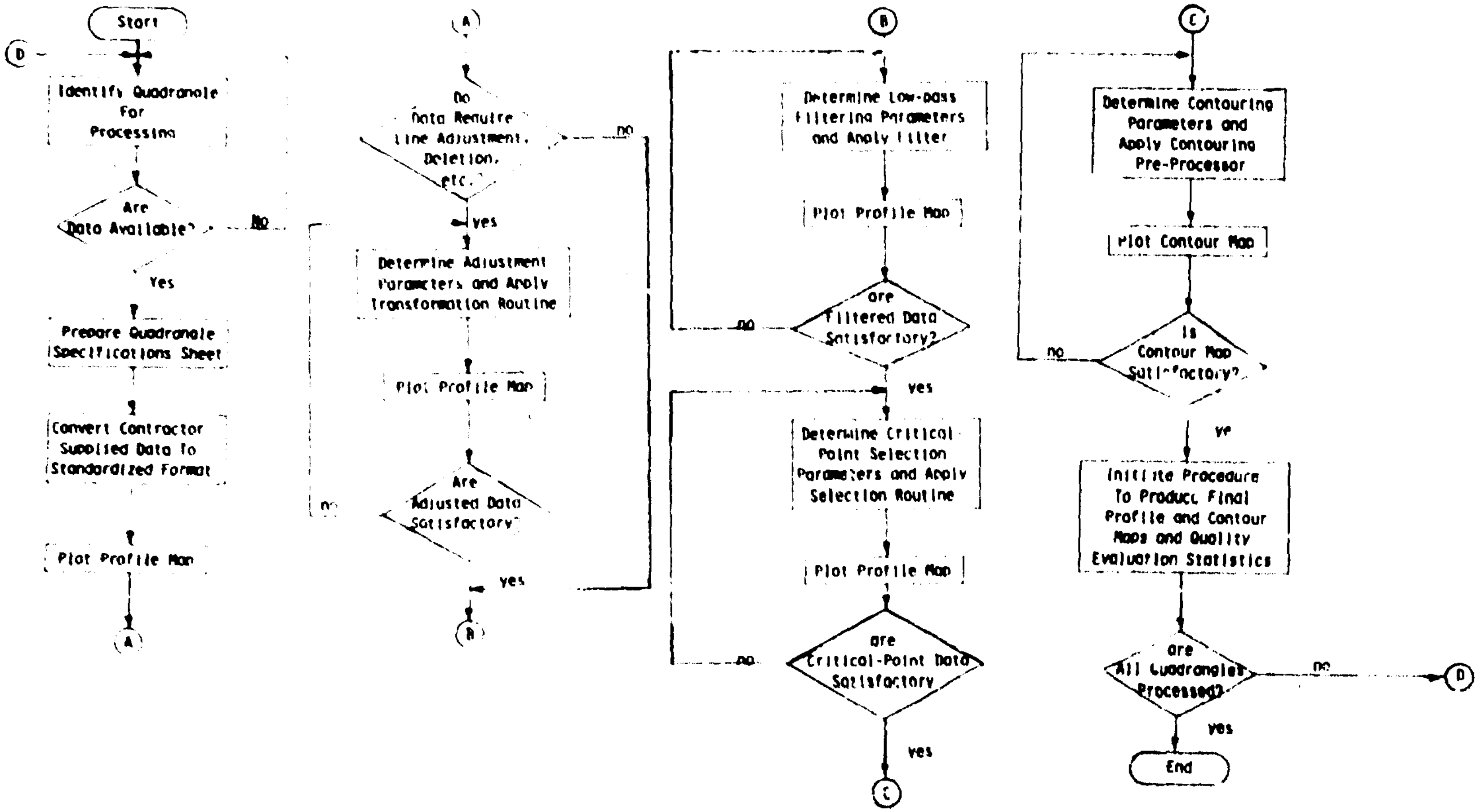


Fig. 3. Simplified Processing Flow Chart of DOE-NURE Program Magnetic Anomaly Map Preparation.

in Appendix A. This appendix specifies the interrelationship of the elements (manual processing steps, computer programs, data files, hardcopy products) of the processing system.

The initial step in processing NURE-ARRS program data is the review of contractor reports for specifications concerning acquisition and reduction of survey and base magnetic-monitor observations. Each survey report is carefully perused and a specification form prepared for use in the presentation and evaluation of magnetic data. This form provides such information as magnetometer sensitivity, core-derived field and diurnal removal schemes, survey dates, and survey- and tie-line spacing as well as other pertinent data. Figure 4 illustrates a specification form appropriately completed for the O'Neill, Nebraska, quadrangle survey.

### 3.2 Format Conversion

Data used in preparation of maps and statistics are obtained from aerial survey contractor-supplied Single Record Reduced and Magnetic Data tapes. The former provides navigational, radiometric, and magnetic anomaly values, while the latter, which is not available for all quadrangles, supplies base magnetic-monitor, barometric pressure, and time-of-sample information. Bendix Field Engineering Corporation established specifications relating to the data content and format of these (and other) contractor-furnished tapes in 1979.[2] Previously, data were released in formats inconsistent even among tapes supplied by a single organization. As a result of this variation, and for later processing efficiency, a routine was prepared to rewrite these data in a standardized rrangement.

Quadrangle *O'Neill*
Report No. *GJBX-100 (78)*

**NURE-DOE**

**Magnetic Aerial Survey Specification Form**

I. QUADRANGLE *O'Neill (Nebraska)*
Latitude *42°-43°N*
Longitude *98°-100°W*
Other Quadrangles in Report - *Yes*
Date of Report *June, 1978*
Prepared by *Texas Instruments, Inc.*

II. SURVEY
Date of Survey *July-October, 1977*
Flight Line
Spacing *8 km*
Direction *East/West*
Tie-Line
Spacing *48 km*
Direction *North/South*

III. INSTRUMENTATION
Type of Magnetometer *Proton Magnetometer*
Sensitivity
Sampling Interval *1 second (≈ 54 meters)*
(Doppler Used?) *No, VLF Navigation Systems with 35mm Tracking Camera*
Information on Location of the Numbered Flight Lines - *Yes (maps)*
Magnetic Monitor Data - *Yes*

IV. REDUCTION
What magnetic reference field used? *IGRF 1975*
Updated? *Yes (to nearest month)*
DC Bias Applied? - *no*
Diurnal Correction Applied? (Method?) *Yes, line biasing with linear adjustments*
Tie-Line Adjustment? - *yes*
Cultural Effects Removed? - *Corrected for Spikes*
Noise Filter? - *Spike Filter*

V. DATA PRESENTATION AND INTERPRETATION
Magnetic Contour Map with Report? - *No*
(Scale, Contour Interval)
Stacked Magnetic Profiles Provided? - *Yes*
Magnetic Depths Determined? - *No*
Method
Magnetic Interpretation? - *No*

LIST OF OTHER QUADRANGLES IN REPORT

| | | | |
|---|---|---|---|
| *Beloit* | *Grand Island* | *Lamar* | *Tulsa* |
| *Broken Bow* | *Great Bend* | *O'Neill* | *Wichita* |
| *Dodge City* | *Joplin* | *Pratt* | |
| *Enid* | *La Junta* | *Sioux City* | |

Fig. 4. DOE-NURE Magnetic Aerial Survey Specification Form.

The reformatting program, CONVRT,* reads data in sundry contractor-defined formats, determines data elements (variables) to be retained, identifies traverse types (survey- or tie-lines), and computes common unit conversions and statistics. A report, partially illustrated in Appendix B, containing data tabulations and rough frequency distributions is then generated and the standardized binary form, GDS format (Appendix C), of the contractor-supplied data is written. Essentially all other routines in the processing scheme read and write data sets in this format.

### 3.3 Data Adjustment

In some cases, it is necessary to adjust anomaly data from a given quadrangle survey to the same base level as that of a neighbor or to remove data obviously in error. These adjustment and editing facilities are provided by a transformation generator, TRANS, which, if used, is generally applied only to the contractor-supplied data set produced by CONVRT. TRANS supports a range of numerical operations which can be selectively performed either on a complete data set or specified sections therefrom. In addition, comparative operators are supplied which can often be used to reduce the effects of sensor-related problems by effecting the removal from the data set of those points having values over or under specified constants. For those few cases in which the data on a line contain uncorrectable errors, the entire traverse can be removed. The necessity for data adjustment does not arise in every case and therefore the intermediate, or adjusted, data set is not always created. In the

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* Computer program names are represented in all capital letters.

remainder of this report, any mention of adjusted data processing is subject to this consideration.

## 2.4 Filtering

The contractor-supplied magnetic anomaly data commonly include high-frequency components which can cause complication of or erroneous results in machine contouring. These constituents may be dichotomized into general classes depending on origin. The simplest to recognize and eliminate can be considered noise resulting from instrumentation problems or cultural effects. These signals involve relatively few data points (both sequentially and totally) and occur at apparently random locations within a survey area. Although some may be recognized as originating from cultural features through correlation of related magnetic signatures with man-made features identified and located on maps, others show no such relationship and can be generally attributed to some system problem. This noise type is readily removed from the anomaly data through the application of a moving median filter[3] with a window width of around 13 to 17 data points (0.6 to 1.0 km). This procedure, which is incorporated in program NFILTR, has proven effective in rejecting isolated spurious values or small sets thereof.

The other type of undesirable high-frequency signal is caused by local geologic features which produce anomalies with no correlation between adjacent flight tracks. The relatively large separation between survey lines allows these localized anomalies to cause aliasing problems which in turn make effective machine-contouring difficult and often lead to invalid contour lines. Reduction or elimination of this signal type, which tends to pervade a large portion, or all, of an entire quadrangle, requires a more severe filter than the moving median. Thus, this filter is applied with caution and only as a last resort in the development of a data set which can be machine-contoured. The procedure (within MFILTR) used to remove this signal type is a one-dimensional recursive filter.[4] By operating on the data of a survey track without requiring prior transformation to the frequency domain, the procedure is quite efficient in processing large quantities of data. This filter has the inherent assumption of a constant sample separation although this is actually the case only along acquisition tracks where the sampling rate has been Doppler-controlled. An average separation value of approximately 60 meters has been determined from survey reports and data analysis and is the value employed in the design of the filter. The attenuation of this high-frequency (wavenumber) filter is set at 12 dB per octave and the wavelength specified corresponds to the -3 dB level. Figures 5, 6, 7, 8, and 9 show, respectively, profile maps of contractor-supplied and 1, 2, 4, and 6 km wavelength, high-cut filtered data for the Lime Hills, Alaska, quadrangle unit.

### 3.5 Critical-Point Selection

One of the problems encountered in machine contouring aerial survey data is the high density of data along widely spaced acquisition tracks. In addition to the expense of machine contouring such biased data sets (containing from 30,000 to more than 200,000 samples), this situation generally results in unacceptable maps by suppressing track-to-track interactions in gridding processes. To reduce this problem, a method of critical-point selection[5] has been adapted.

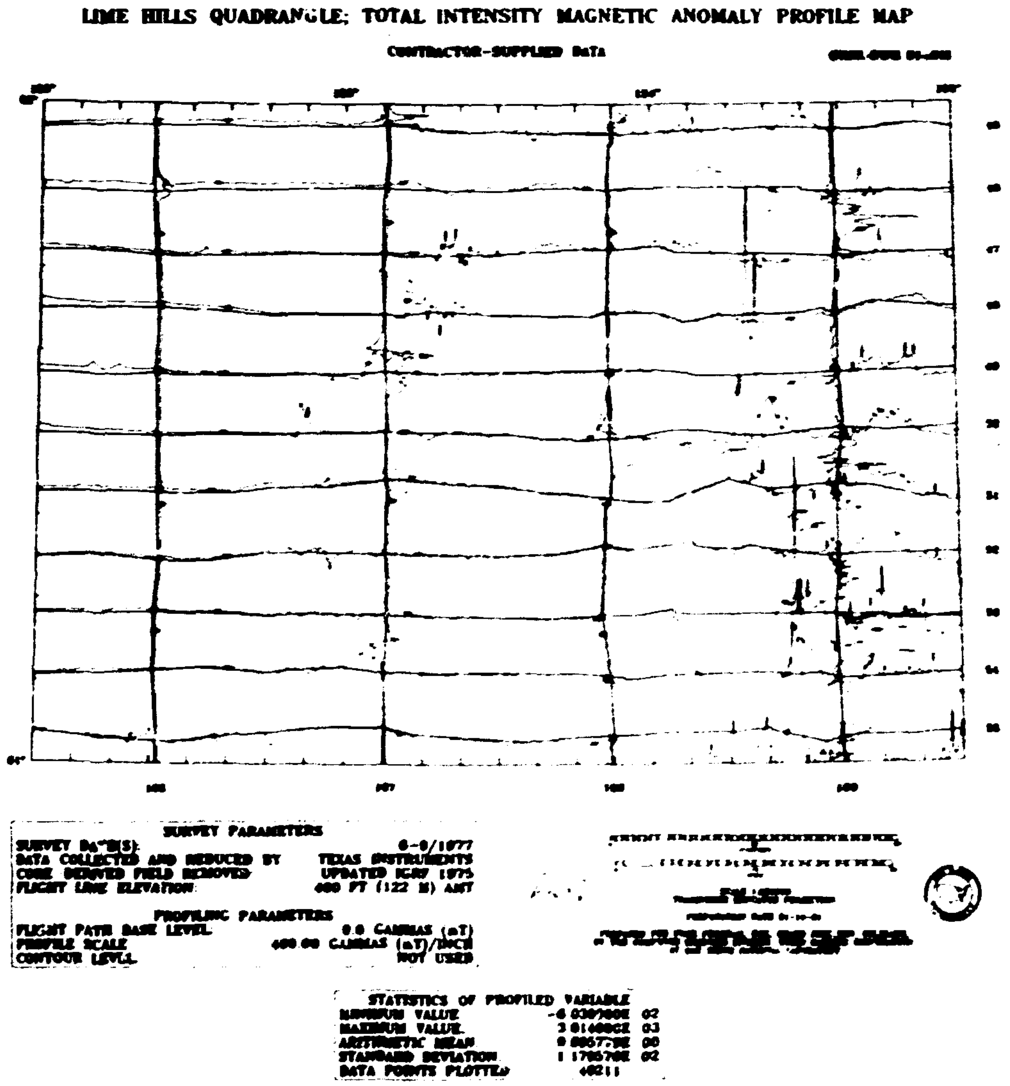



Fig. 5. Lime Hills, Alaska, Quadrangle Total Intensity Magnetic Anomaly Profile Map Prepared from Contractor-Supplied Anomaly Data. In this and Other Profile or Contour Maps Reproduced in this Report the Map Scale is About 12.7 km/cm and the Magnetic Anomaly Scale is Approximately 800 gammas (nT)/cm.

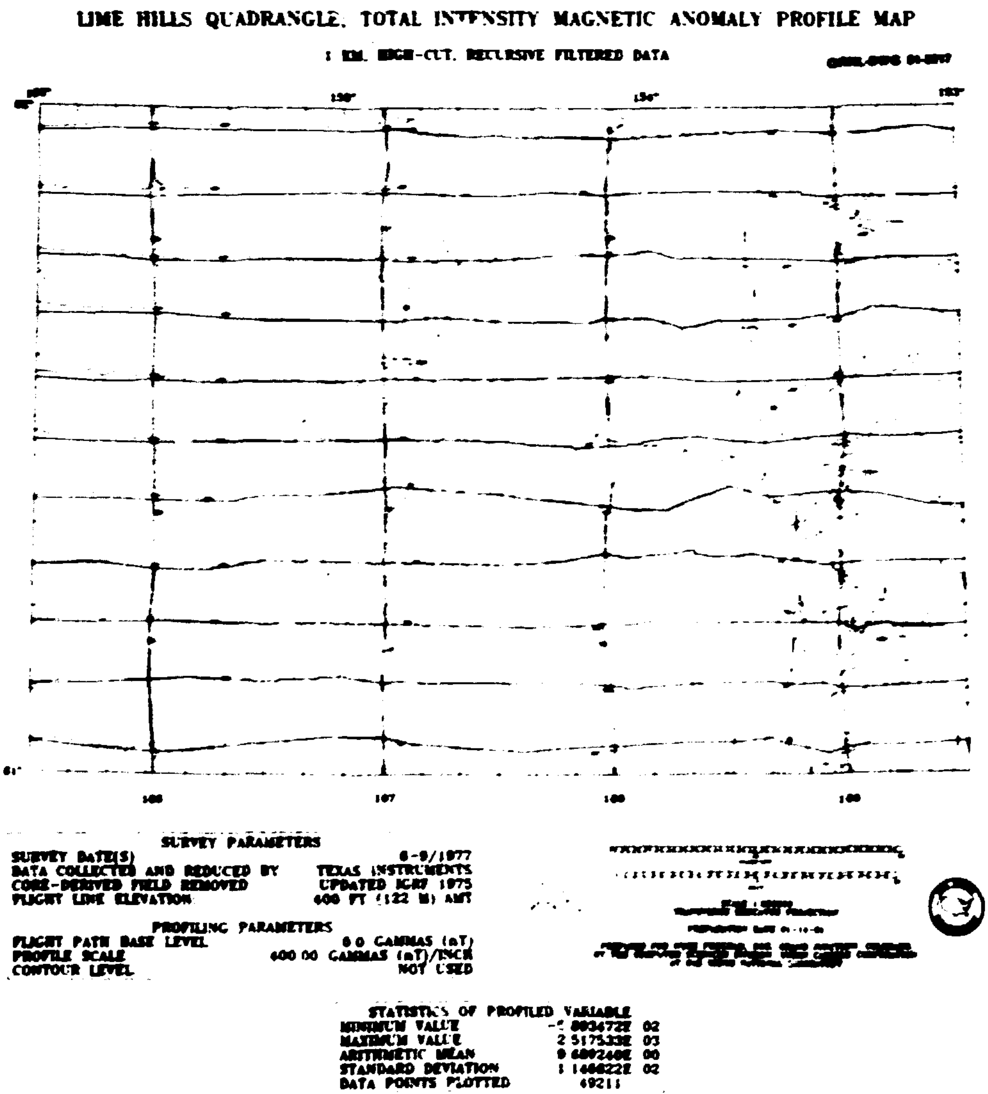



Fig. 6. Lime Hills, Alaska, Quadrangle Total Intensity Magnetic Anomaly Profile Map Prepared from High-Cut Filtered Data. Filtering Performed Utilizing a 1-km Cutoff Wavelength.

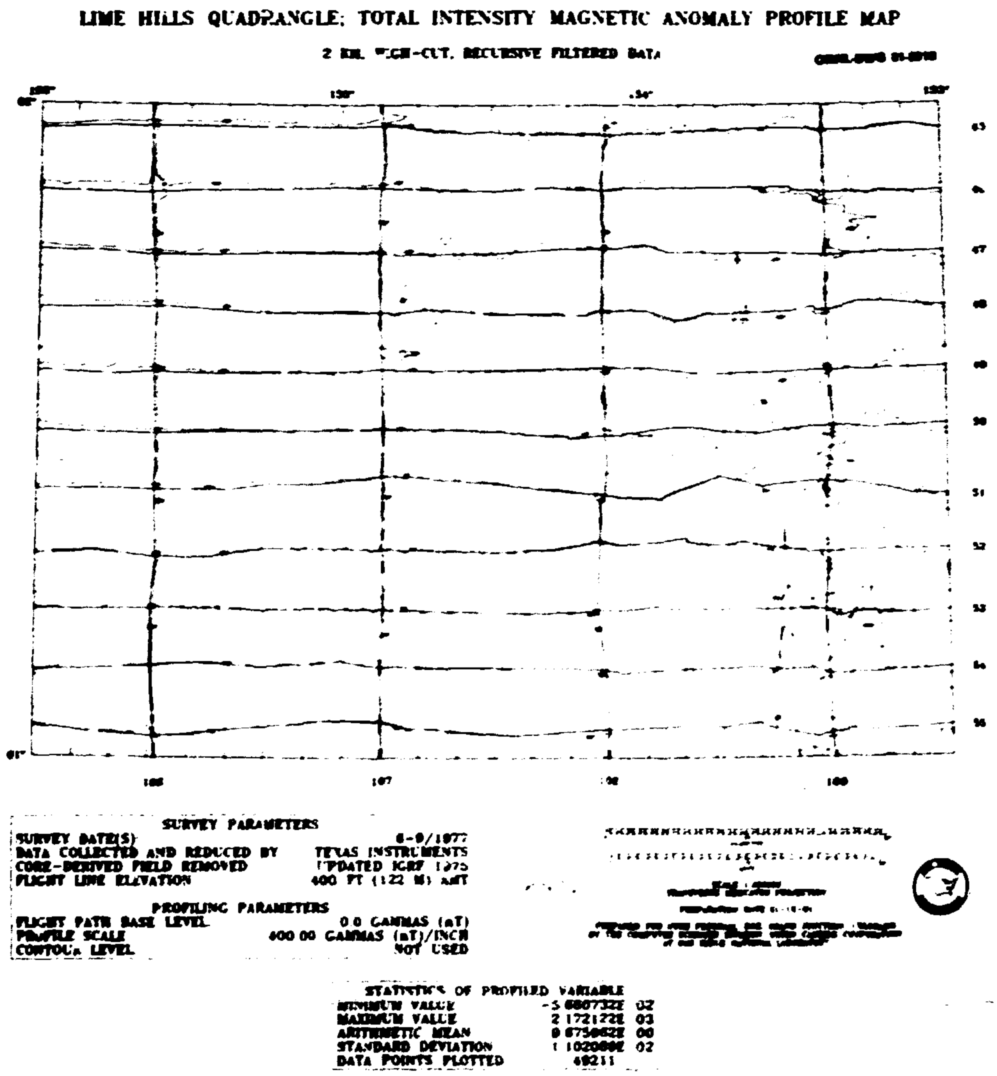



Fig. 7. Lime Hills, Alaska, Quadrangle Total Intensity Magnetic Anomaly Profile Map Prepared from High-Cut Filtered Data. Filtering Performed Utilizing a 2-km Cutoff Wavelength.

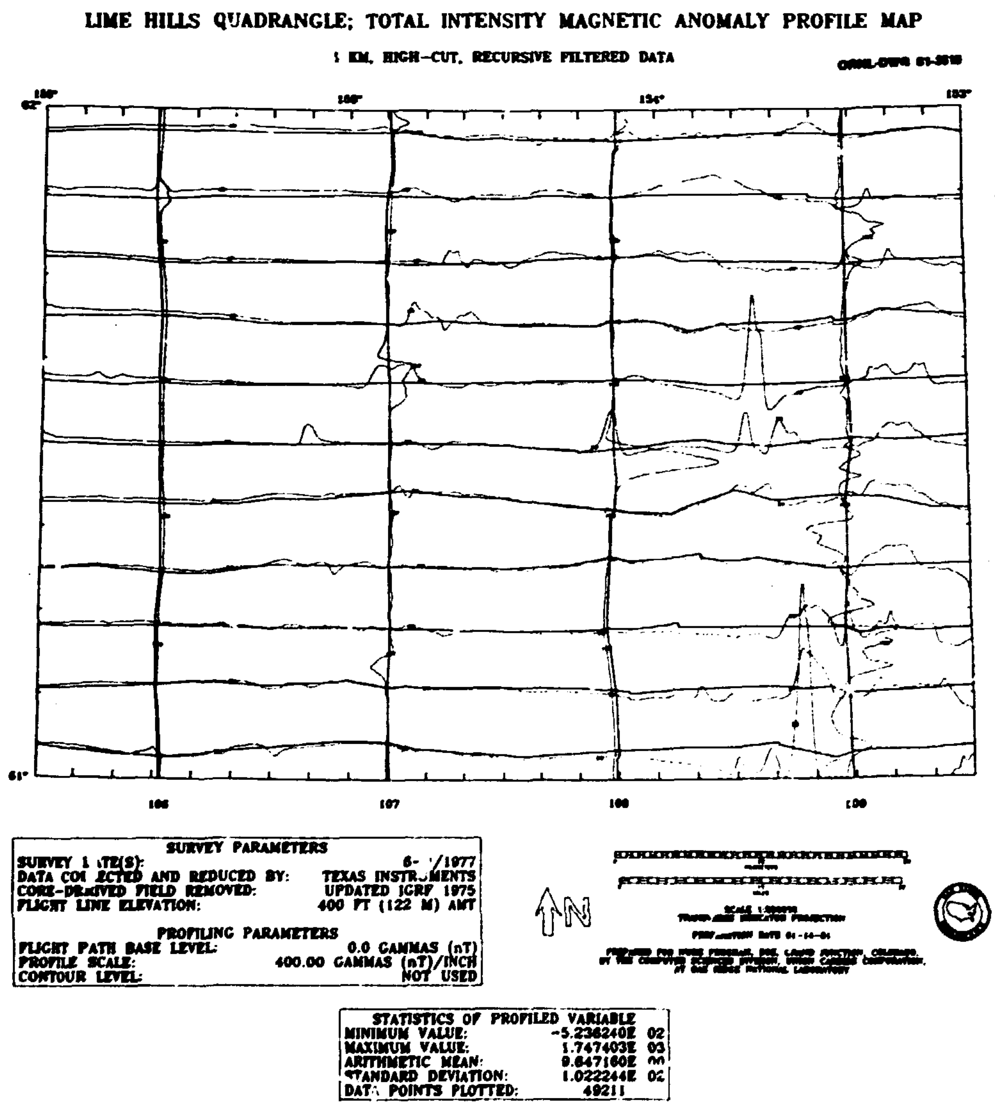



Fig. 8. Lime Hills, Alaska, Quadrangle Total Intensity Magnetic Anomaly Profile Map Prepared from High-Cut Filtered Data. Filtering Performed Utilizing a 4-km Cutoff Wavelength.

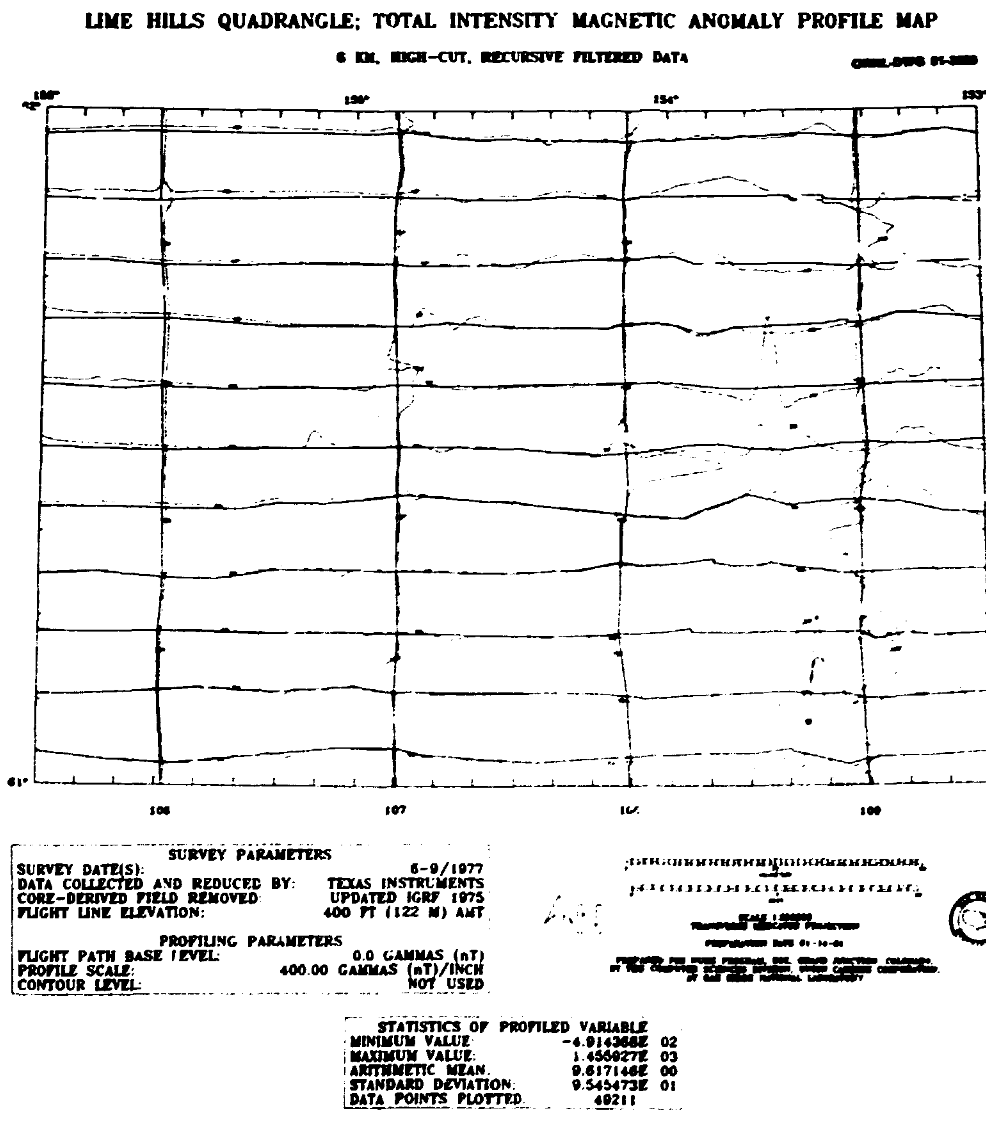



Fig. 9. Lime Hills, Alaska, Quadrangle Total Intensity Magnetic Anomaly Profile Map Prepared from High-Cut Filtered Data. Filtering Performed Utilizing a 6-km Cutoff Wavelength.

Points not necessary to the reproduction, within a specified error tolerance, of a data profile are eliminated from data sets by a procedure incorporated in program SELPT2. The selection mechanism can be illustrated by tracing typical operations on the simple data set whose profile is shown in Fig. 10(a). The first approximation (Fig.10 (b)) is obtained by choosing the endpoints of the profile and constructing the line between them. All other points are now examined to find their respective distances from this initial line segment, and the maximum of these distances and the specified error tolerance are compared. Should the maximum distance be greater than the acceptable error, the initial approximation is insufficiently precise and the algorithm continues by adding the point so indicated to the data set (Fig. 10(c)). The distance test is now repeated for each point falling between currently selected points and the data set is updated accordingly. Figure 10(d) shows the resulting profile for the sample data set when sufficient points have been included to ensure that no remaining point exceeds the error tolerance in distance from its associated line segment.

An extension to the algorithm, not illustrated in Fig. 10, allows a constraint to be placed on the maximum linear separation of adjacent selected data points. After the critical points are initially chosen, the distance between each pair is examined to determine whether it exceeds this specificied maximum separation. If so, the number of equally spaced interim points needed to relieve this condition is computed and, if available from the initial data set, these samples are added to the set of critical points. These secondary critical points, although not necessary to the satisfaction of the error tolerance criterion, ensure that

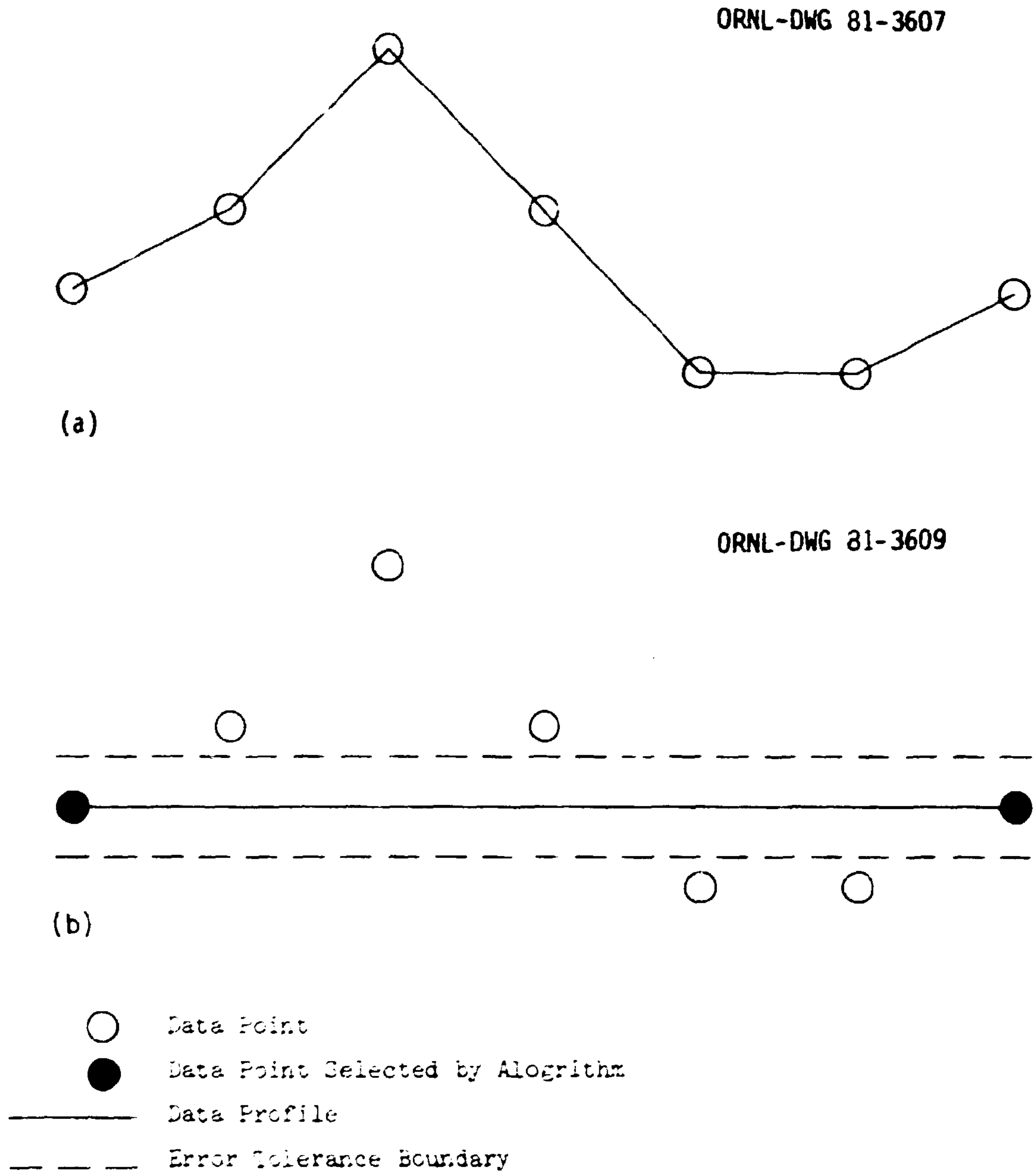



Fig. 10. Critical-Point Selection Procedure.

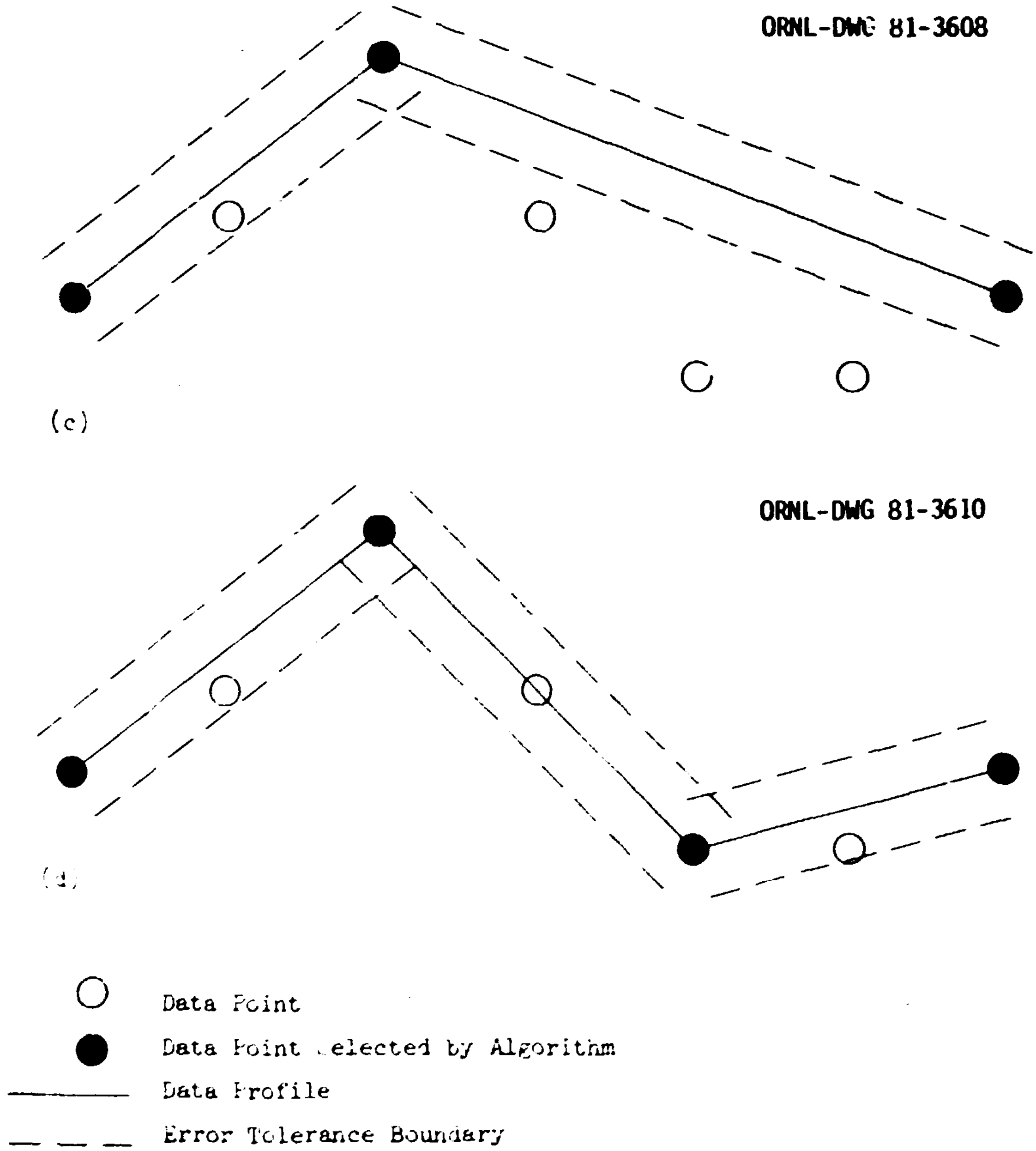

ORNL-DWG 81-3608
(c)
ORNL-DWG 81-3610
(d)
Data Point
Data Point Selected by Algorithm
Data Profile
Error Tolerance Boundary

Fig. 10 (Cont'd).

sufficient data will be available for later gridding processes in sections where profiles exhibit gradually changing slope.

Establishment of critical-point magnetic anomaly selection parameters is based on the smoothness of existing data, the amount of further smoothing allowable, and the spacing of survey tracks. Although data dependency and parameter interplay make definition of set rules for the specification of selection parameters quite difficult, generally, an error criterion in the range of 5 to 20 gammas and a maximum distance of 2 to 4 km have proven acceptable. These characteristically result in the retention of 1,500 to 3,000 samples from filtered data sets originally containing 40,000 to 75,000 data points. It should be noted that only survey-line data are utilized for the selection process; no samples from tie-lines are included in critical-point data sets. Table 1 summarizes the numerical results from several critical-point selection trials involving various error tolerance and maximum distance specifications for the O'Neill, Nebraska, quadrangle.

Table 1. Relationship of Error Tolerance and Maximum Distance Specifications to Number of Critical Points Chosen. Selection Performed on O'Neill, Nebraska, 13-Point Median Filtered Data.

| ERROR TOLERANCE (GAMMAS) | MAXIMUM DISTANCE (METERS) | NUMBER OF POINTS CHOSEN | PERCENT OF SURVEY LINE POINTS |
|---|---|---|---|
| 2 | 2000 | 2897 | 8.46 |
| 5 | 2000 | 1770 | 5.17 |
| 15 | 2000 | 1432 | 4.18 |
| 20 | 2000 | 1379 | 4.02 |
| 50 | 2000 | 1266 | 3.70 |
| 2 | 3000 | 2723 | 7.95 |
| 5 | 3000 | 1456 | 4.25 |
| 15 | 3000 | 1062 | 3.10 |
| 20 | 3000 | 1008 | 2.94 |
| 50 | 3000 | 889 | 2.59 |
| 2 | 4000 | 2684 | 7.83 |
| 5 | 4000 | 1327 | 3.87 |
| 15 | 4000 | 870 | 2.54 |
| 20 | 4000 | 811 | 2.37 |
| 50 | 4000 | 693 | 2.02 |

Total Number of Points in Quadrangle: 40,954
Number of Points on Survey Lines: 34,261

### 3.6 Data Display

A program is used in conjunction with several of the data sets derived during general production processing to graphically present magnetic anomaly data by the production of profile maps. PROFIL accepts data in GDS format and plots a map of any quadrangle unit in the transverse Mercator projection. Flight paths are indicated within the map boundary by incremental lines connecting the coordinates of successive data points for a given traverse and each path is labeled on the right or bottom of the map border with its corresponding contractor-assigned identifier. All flight tracks are assigned a constant value, and each thus serves as a base relative to which its associated profile curve is drawn. Data values exceeding that assigned the flight tracks result in profile curves plotted above or to the right of the associated track, depending on flight orientation, while values less than the base level are plotted below or to the left. The anomaly data profiles consistently utilize a displacement scale of one inch equals 400 gammas relative to the mean anomaly value for that quadrangle rounded to the nearest hundred gammas. Production maps prepared from contractor-supplied and adjusted data have profiles embellished only with the path identifier to aid flight track to profile correlation. Filtered and critical-point data maps have, in addition, interpolated contour levels indicated by tick marks on the same side of the path as the profile itself. These ticks occur at 20, and are labeled at 100, gamma increments. All production maps are plotted at a scale of 1:250,000 with the northing-easting origin located at the intersection of the southern parallel and central meridian of the specified window. Although not generally applied, options such as marking of data point locations, windowing to any latitude-longitude boundary, scaling to any desired ratio, and automatic computation of profile scale and base level are available for analysis of exceptional cases. Legends, titles, barscales, and numerical statistics are provided on the map in all cases. Figures 5 through 9 and 11 through 13 illustrate maps produced by PROFIL for the Lime Hills, Alaska, and O'Neill, Nebraska, quadrangles.

The other cartographic data display produced by this processing scheme is a total intensity magnetic anomaly contour map, shown for the O'Neill quadrangle in Fig. 14. Utilizing critical-point data, this map is prepared for a quadrangle unit only after careful evaluation of related profile maps to determine the effects of previous processing steps.

SELPT2, the critical-point selection routine, generates two data files. One, in GDS format, is used to produce profile maps, while the other, which contains only anomaly-related information in "XYZ" format (Appendix D), serves as the basis for contour maps. This latter file is read, with control parameters, by an annotation generating and data reformatting program, GPCFMT, which prepares the command and data files necessary for contouring. Actual machine contouring is performed by the General Purpose Contouring Program, GPCP-II, from California Computer Products, Inc. (CalComp).[6] Most basic control information produced by GPCFMT is standardized for consistency in map plotting. The map scale and projection (and its origin) are the same as used for profile maps, flight paths are indicated, and legends, titles, barscales, statistics, and related data are again provided. Contours are usually drawn at an interval of 20 gammas, with hundred gamma multiples bold and closed minima hatchured.

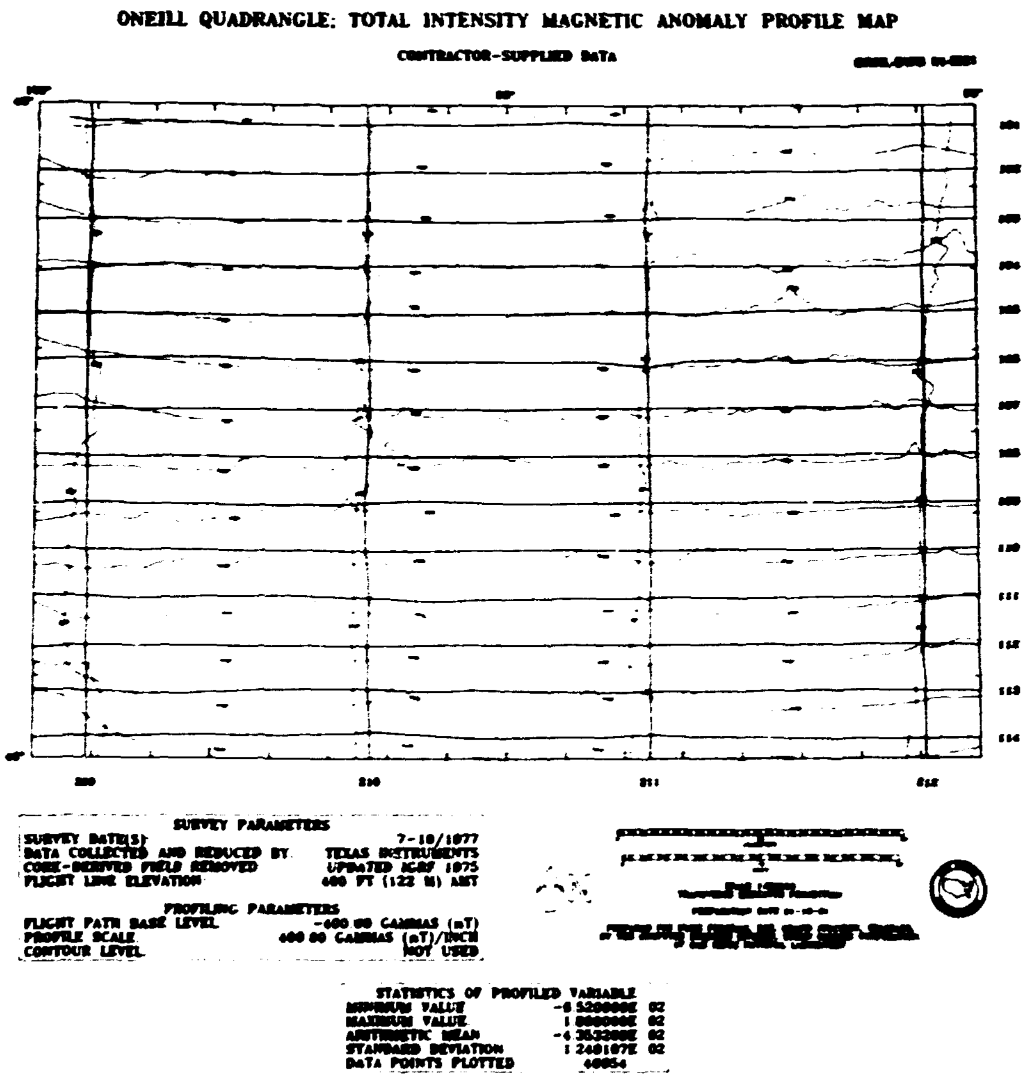



Fig. 11. O'Neill, Nebraska, Quadrangle Total Intensity Magnetic Anomaly Profile Map Prepared from Contractor-Supplied Anomaly Data. Numbers on Lower and Right-Hand Map Margins are Track-Line Identifiers.

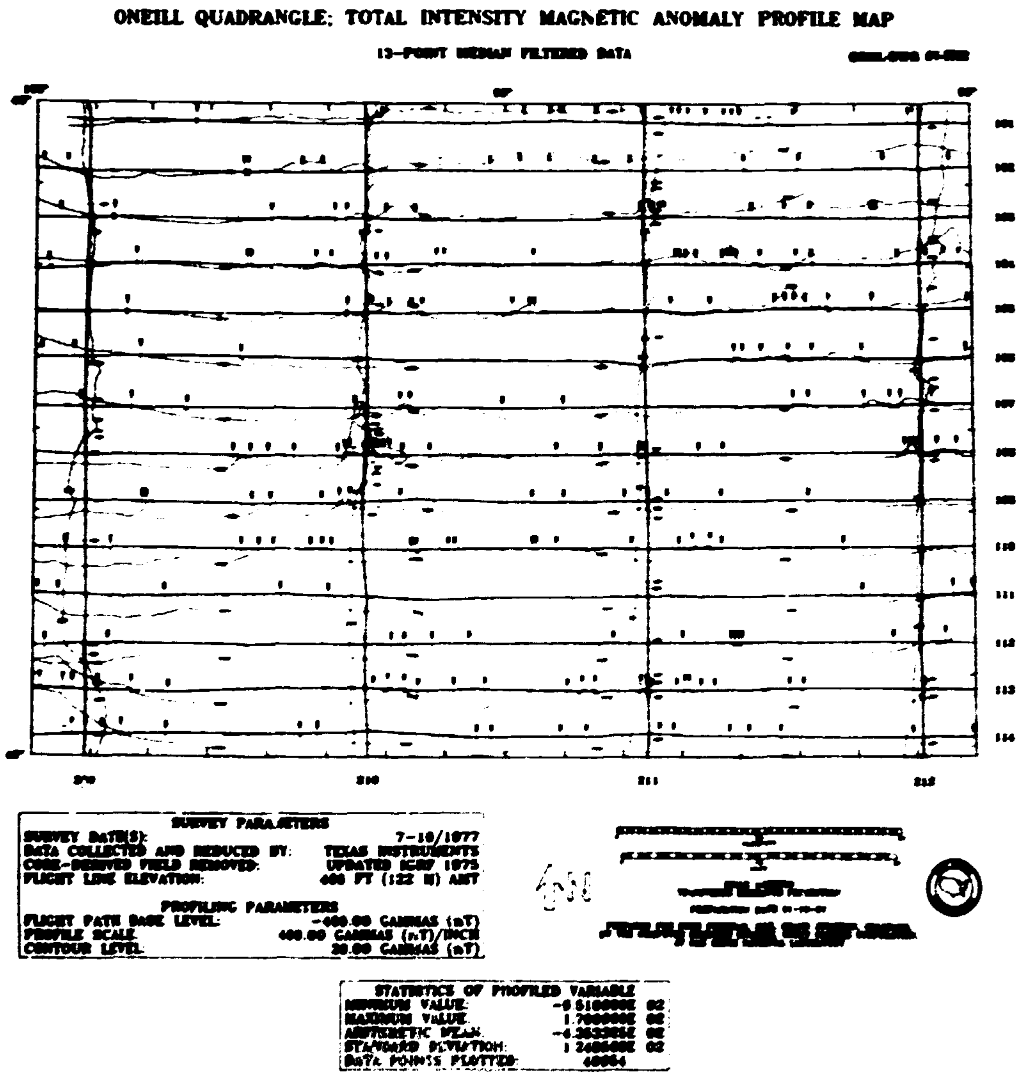



Fig. 12. O'Neill, Nebraska, Quadrangle Total Intensity Magnetic Anomaly Profile Map Prepared from 13-Point Median Filtered Data. Contour Levels (20 gamma Intervals) Marked And Annotated on Flight Tracks.

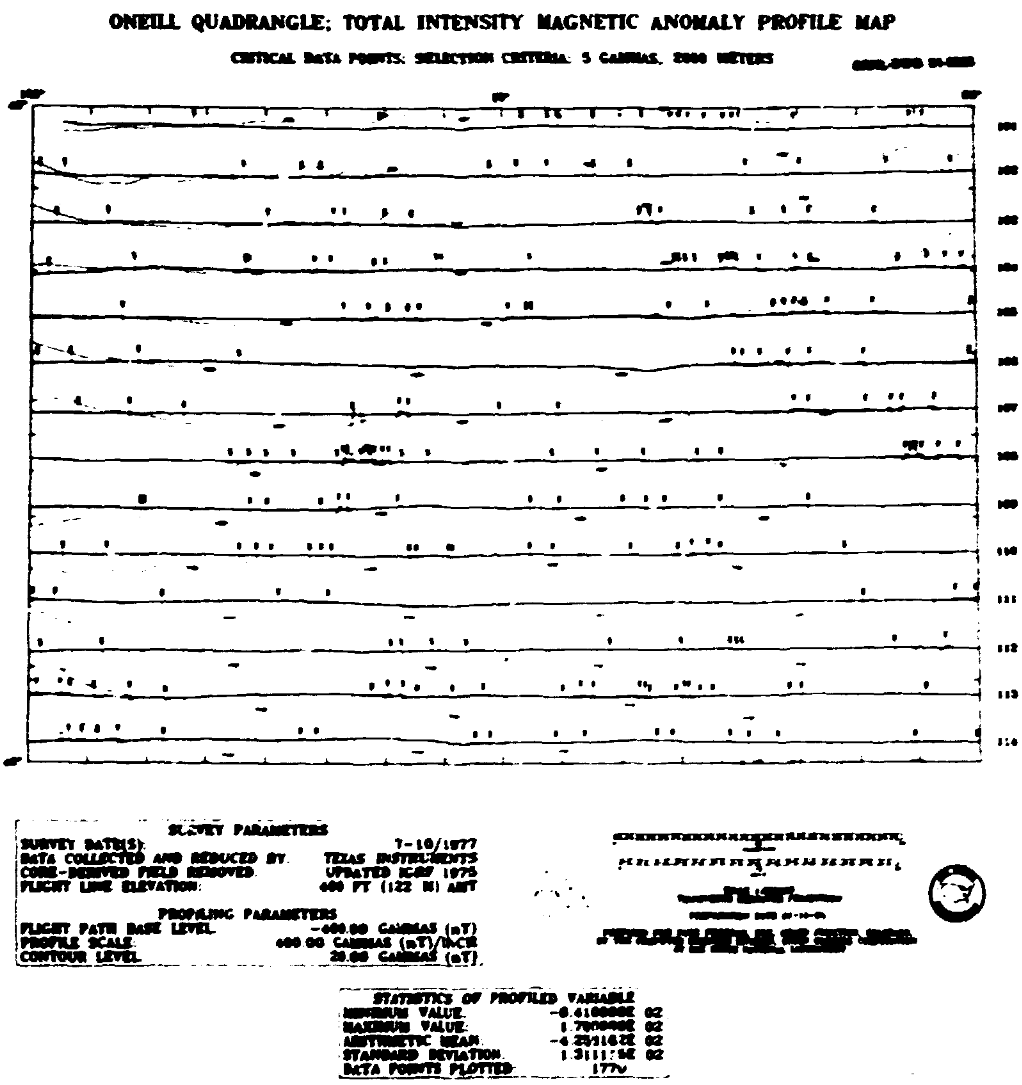



Fig. 13. O'Neill, Nebraska Quadrangle Total Intensity Magnetic Anomaly Profile Map Prepared from Critical-Point Data Selected From 13-Point Filtered Data Using a 5 gamma Error Tolerance And a Maximum Distance Between Data Points of 2000 Meters.

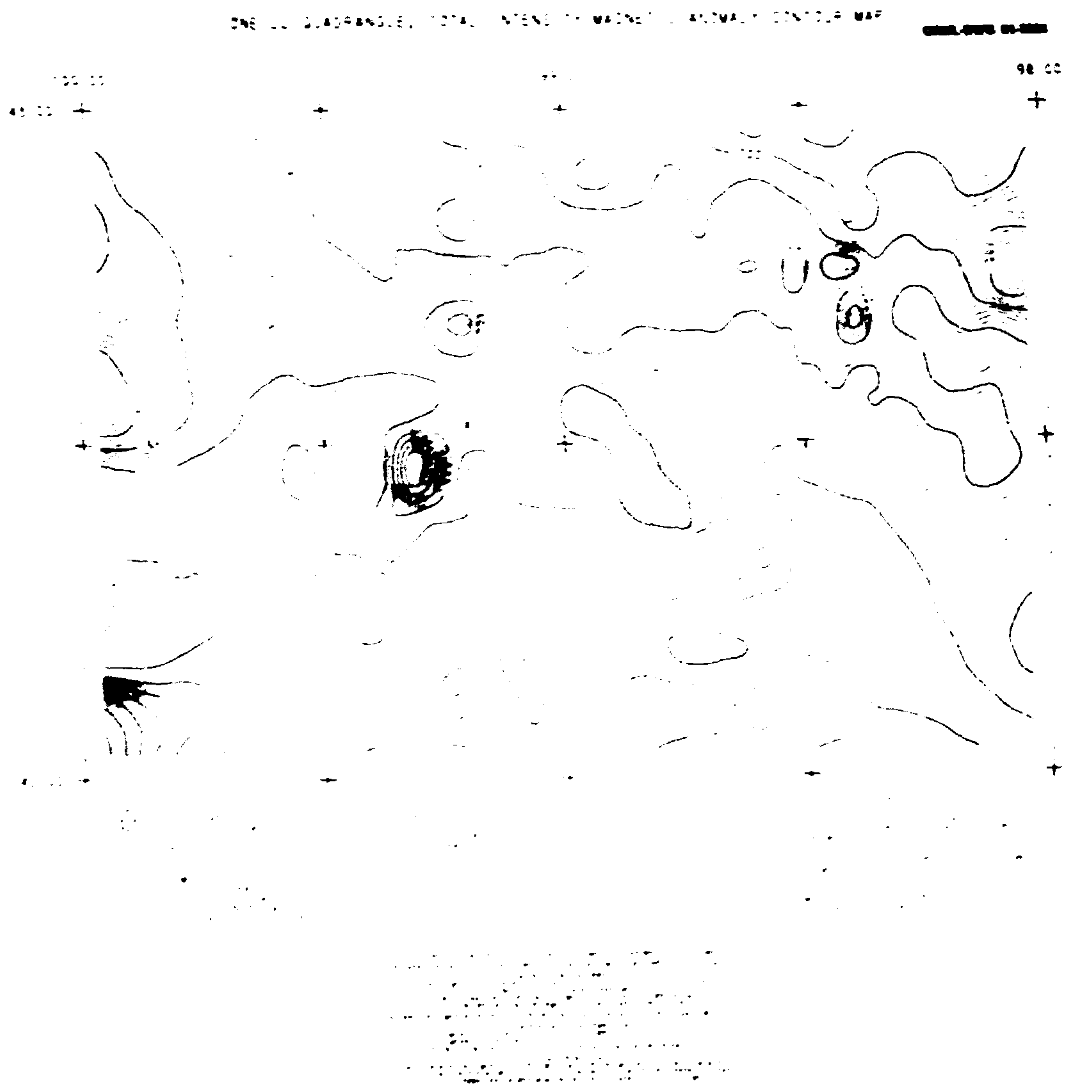


Fig. 14. O'Neill, Nebraska, Quadrangle Total Intensity Magnetic Anomaly Contour Map Prepared from Data Shown in Figure 13. Machine Contoured from a 50 (E-W) by 25 (N-S) Cell Orthogonal Grid Interpolated from 40 Nearest Neighboring Data Points.

GPCP-II interpolates a neighborhood of data point values to an orthogonal contouring grid whose origin is located at the lower left boundary of the map. The size of the individual cells in this grid is derived from survey-line spacing and is generally specified so that on the order of 50 cells span the east-west extent of the quadrangle while 25 cells cover north to south. Use of grid cells that are small with respect to the flight-line separation of the aerial survey will produce overly complex maps. Figure 15 illustrates the effect of a 150 by 75 cell grid on the same data as contoured in Fig. 14 where a grid of 50 by 25 cells was utilized. The number of neighboring data points specified for grid value interpolation ranges from 20 to 40 as more smoothing is mandated by data fluctuations. An example contour map, again of the O'Neill data, prepared from a grid (50 by 25 cells) established by interpolation from 20 nearest neighbors is shown in Fig. 16. The unacceptable contouring obtained is illustrated by the comparison of this map with Fig. 14 where 40 neighboring points were used to define the grid.

The orthogonal contouring grid described above gives rise to some undesirable artifacts in the contour maps produced by GPCP-II. Figures 14 through 16 show that the map border drawn is rectangular, unlike the projection boundary drawn by PROFIL (Fig. 11, for example). Inasmuch as map projections are not supported by GPCP-II, all coordinate conversions are performed by GPCFMT. The commands necessary to draw a projection boundary could be generated at the same time, but because the contouring program will either contour completely or leave blank a given cell in the orthogonal grid, unacceptable stairstepping of the contoured area would result.

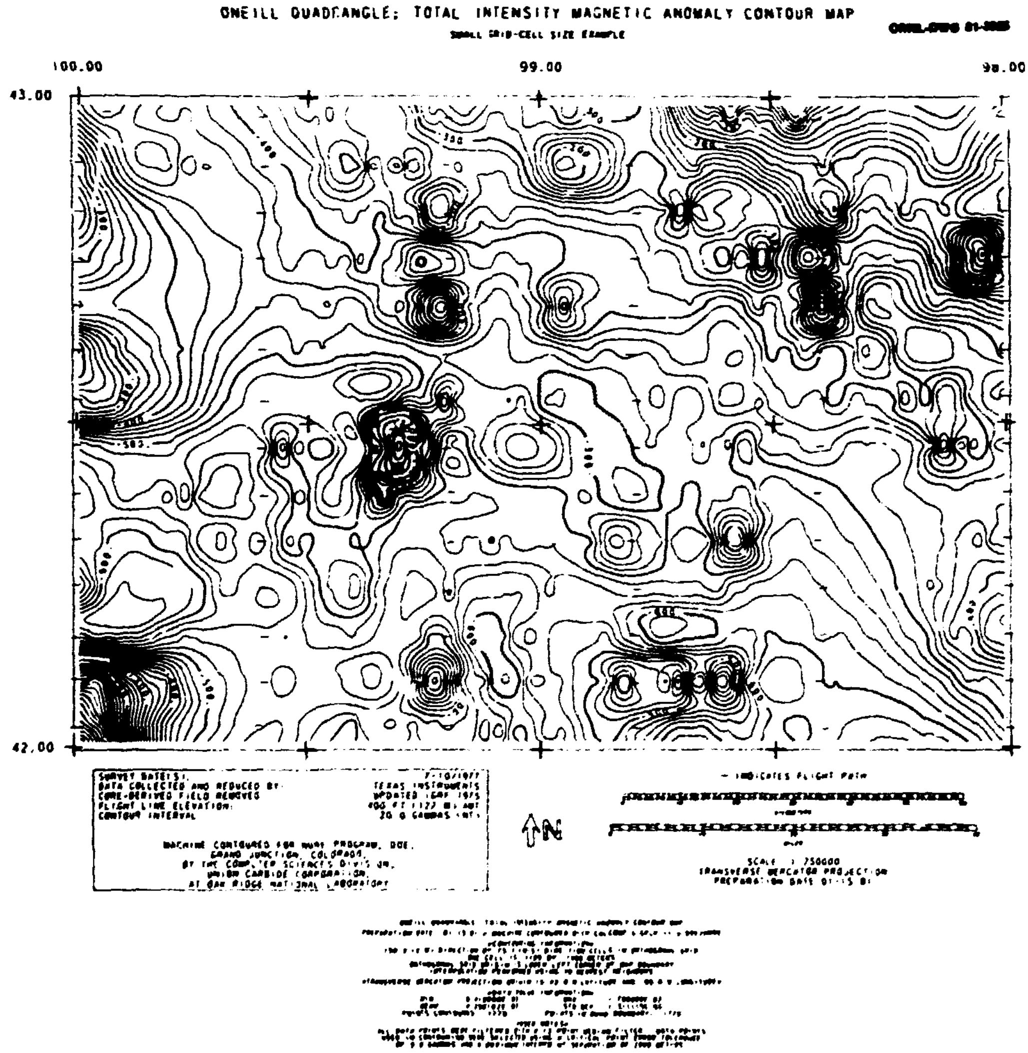



Fig. 15. O'Neill, Nebraska, Quadrangle Total Intensity Magnetic Anomaly Contour Map Prepared from Data Shown in Figure 13. Machine Contoured From a 150 (E-W) by 75 (N-S) Cell Orthogonal Grid Interpolated From 40 Nearest Neighboring Data Points.

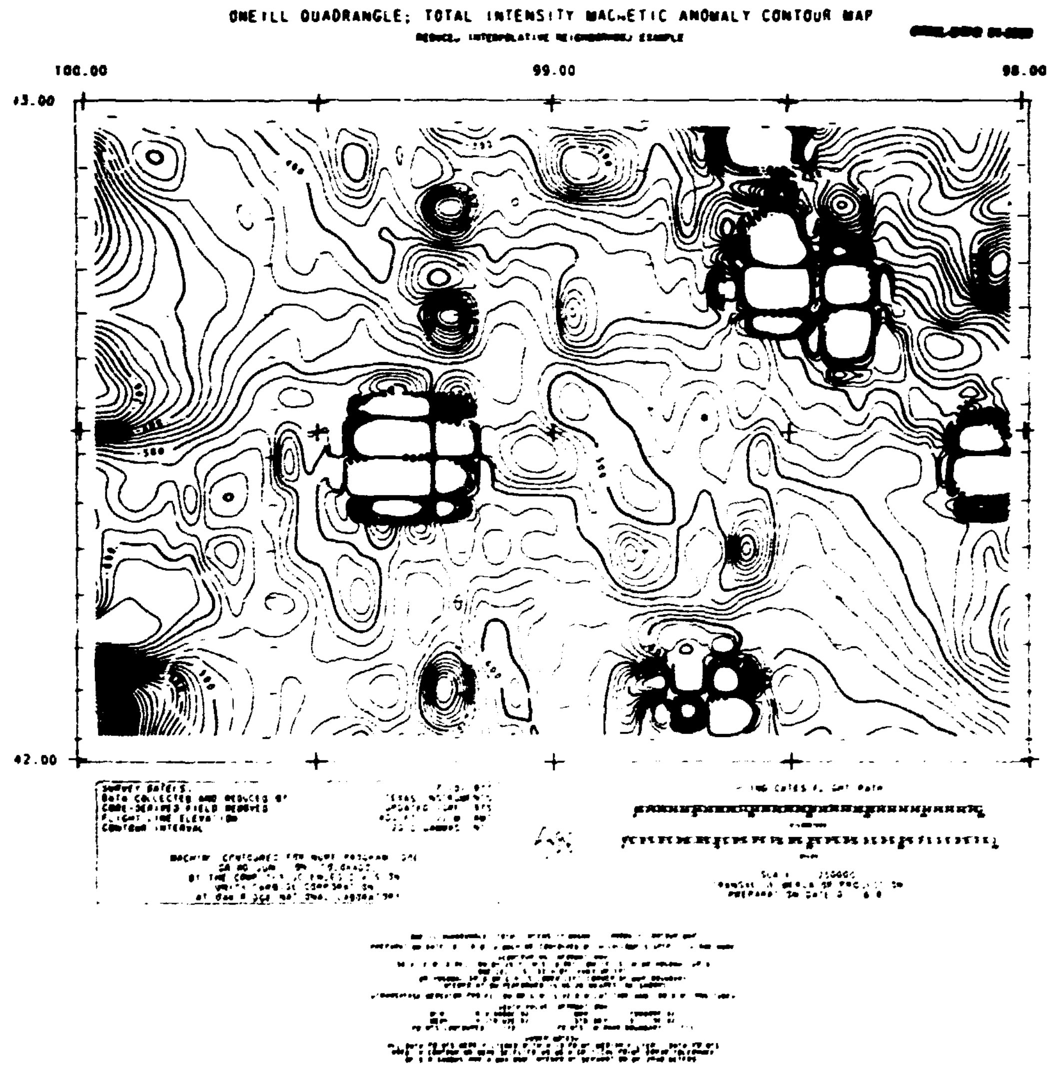



Fig. 16. O'Neill, Nebraska, Quadrangle Total Intensity Magnetic Anomaly Contour Map Prepared from Data Shown in Figure 13. Machine Contoured From a 50 (E-W) by 25 (N-S) Cell Orthogonal Grid Interpolated From 20 Nearest Neighboring Data Points.

## 3.7 Quality Evaluation

Information to aid in assessment of data validity is extracted from various GDS format data sets by a series of three quality evaluation (QE) programs. Contractor-supplied, adjusted, and filtered data sets are processed and results are presented in the form of tabular listings, bargraphs, and related numeric statistics. Appendix E provides representative samples of reports produced by the QE routines for the O'Neill, Nebraska, quadrangle unit.

Frequency distributions of sample point data values are developed by QEVAL. Normally, the classification limits for a variable are determined automatically from the arithmetic mean of the data plus or minus three standard deviations and the class interval is specified by the user. Magnetic anomaly, terrain clearance, and interpoint distance* information from contractor-supplied and adjusted data are analyzed using nominal class intervals of 20 gammas, 5 meters, and 50 meters, respectively (Appendix E.1). After filtering, magnetic anomaly data are again processed utilizing the same class interval as before (Appendix E.2).

Another parameter reflecting the quality of a survey is derived from values at or near survey- and tie-line intersections. Reduced magnetic anomaly data, for example, should be very similar for points from each line type near such a crossing. Actual mathematical intersections, in which points share precisely the same coordinates, are unlikely because traverses consist of strings of discrete points. FLTLQE searches for the best

*Interpoint distance is defined in this case to be the separation of adjacent samples along a given traverse.

approximations to true intersections through a combination of coordinate bracketing and distance minimization. Output, in addition to tabular listings and bargraphs, includes an intersection-by-intersection trace noting line identifiers, values of pertinent variables, and survey- to tie-line differences and distances. Exceptional conditions identified include separation of intersection components greater than three standard deviations from the mean interpoint distance for the quadrangle unit and failure of lines to intersect as can occur at national boundaries or the Great Lakes. FLTLQE is usually applied to contractor-supplied and adjusted data in order to provide assessment information for survey- minus tie-line magnetic anomaly differences, distances between component intersection points, and survey- minus tie-line terrain clearance differences. Respective class intervals are 5 gammas, 10 meters, and 5 meters (Appendix E.3).

The remaining QE program, TBQE, is used in analysis of magnetic monitor data, when available, from contractor-supplied and adjusted data sets. A linear, least-squares fit is computed for data covering each 1-, 3-, and 10-minute time interval along flight paths and interval slope and dispersion characteristics are determined. For each interval, least mean-squared error, correlation coefficient, standard deviation of computed versus observed values, and slope comprise information tabulated and bargraphed (Appendix E.4). Correlation coefficient values are generally processed utilizing overall limits of plus and minus 1.0 and a class interval of 0.025. Classification limits for the remaining values are developed from their respective means plus or minus two standard deviations with class intervals then selected as one-fiftieth this computed range.

## 4. FINAL PRODUCTS PROCESSING

After the validity of parameters chosen for data adjustment, filtering, critical point selection, and contouring have been confirmed by manual review of preliminary profile and contour maps and quality evaluation statistics, final Mylar map copies can be prepared. Contractor-supplied, adjusted, filtered, and critical-point total intensity magnetic anomaly profile maps are produced as shown in the Final Products Processing Flow Chart (Appendix F). These maps are prepared in the same manner as described in Section 3.6, and Figs. 5 through 9 and 11 through 13 are again illustrative.

Final contour maps on Mylar are produced in a fashion analogous to that described in Section 3.6, but with a modification to minimize, where possible, contour mismatch between adjacent quadrangle units. As shown in Appendix F, program XYZCOP produces a data base, in "XYZ" format, containing the critical-point data from all quadrangle units processed to date. GPCFMT then accesses this data base and retrieves points falling within a latitude-longitude boundary specified to include not only the quadrangle desired, but also a 7.5-minute ingress into those surrounding regions known to have been previously processed. Though this additional area is not visible on the map, data contained therein are considered by the gridding procedure and hence affect contour generation. This method does improve contouring performance but slight discrepancies in orthogonal grid positions from quadrangle to quadrangle make exact matches unlikely. Where adjacent data are not available, a blank region equivalent to the width or height of one grid cell is generated to avoid erroneous contours.

## 5. SUMMARY

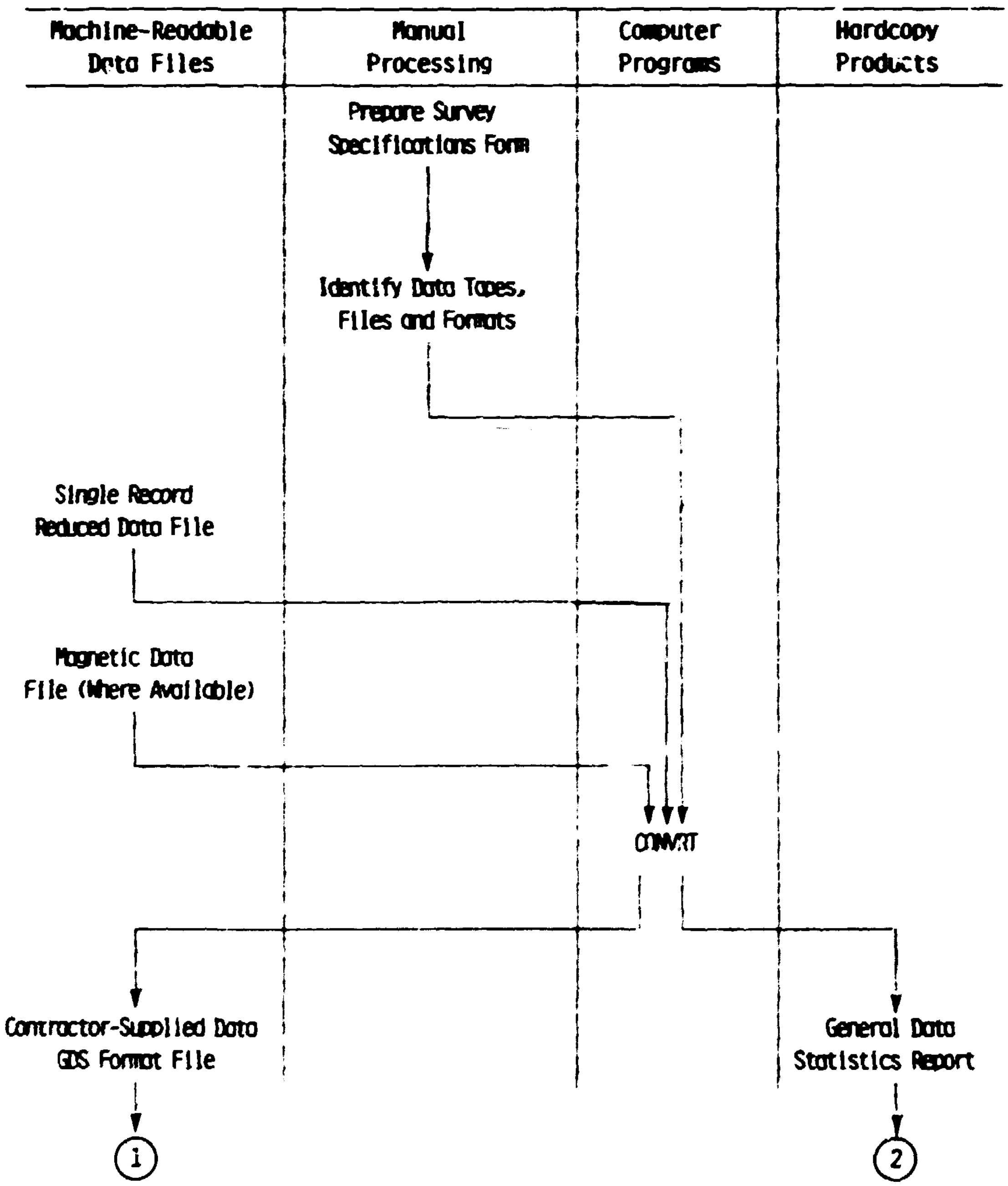
A general, computer-based processing procedure has been developed and is being applied to DOE National Uranium Resource Evaluation Program data to produce regional total intensity magnetic anomaly profile and contour maps of NTMS quadrangle units. These maps and their related quality evaluation information, both available as open-file reports from the DOE Grand Junction Office, should not only prove useful in themselves, but also serve to illustrate the value of the NURE data as a whole and encourage its use in applied and scientific uses.

## REFERENCES

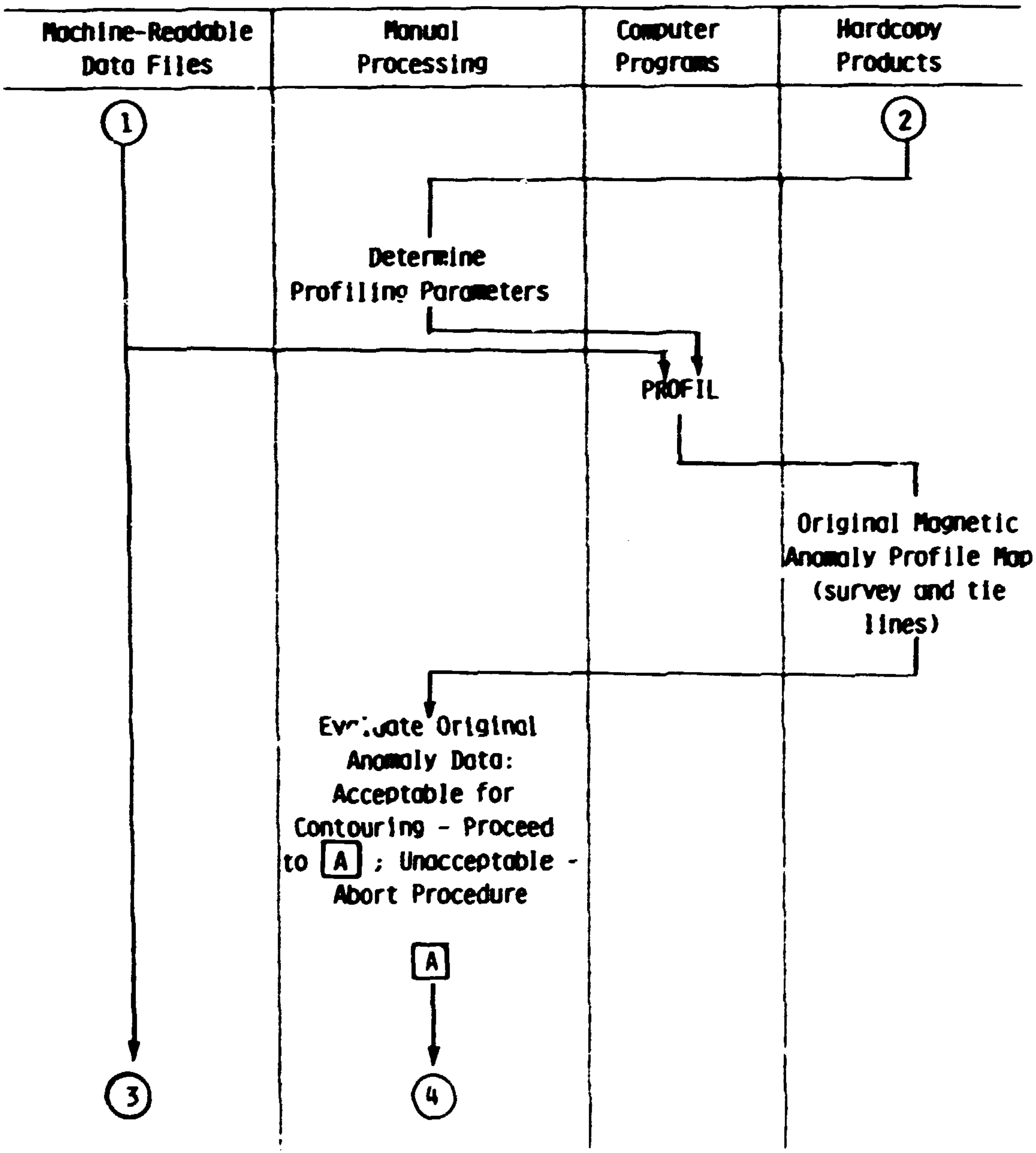

1. Tinnel, E. P., <u>Preparation of Magnetic Anomaly Profile and Contour Maps from DOE-NURE Aerial Survey Data, Volume II: Computer Codes</u>, ORNL Report (in preparation), 1981.
2. Bendix Field Engineering, "General Specifications for Airborne Geophysical Surveys", Bendix Field Engineering Corp., Grand Junction Operations, Colorado, Spec. No. BFEC 1200-C, 1979.
3. Claerbout, J. F. and Muir, F., "Robust Modeling With Erratic Data", <u>Geophysics</u>, 38: No. 5, p. 826-44, 1973.
4. Baker, M. R., "Application of Time Series Analysis to the Enhancement of Seismic Refraction Data Interpretation", Unpub. M.S. Thesis, Purdue University, West Lafayette, IN, 1979.
5. Douglas, D. and Peucker, T., "Algorithms for Reduction of the Number of Points Required to Represent a Digitized Line or its Caricature", <u>Canadian Cartographer</u>, 10: No. 2, p. 112-22, 1973.
6. "GPCP-II, A General Purpose Contouring Program - User's Guide", California Computer Products, Inc. (CalComp), 2411 West LaPalma, Anahein, CA 92801, 1972.

# Appendix A

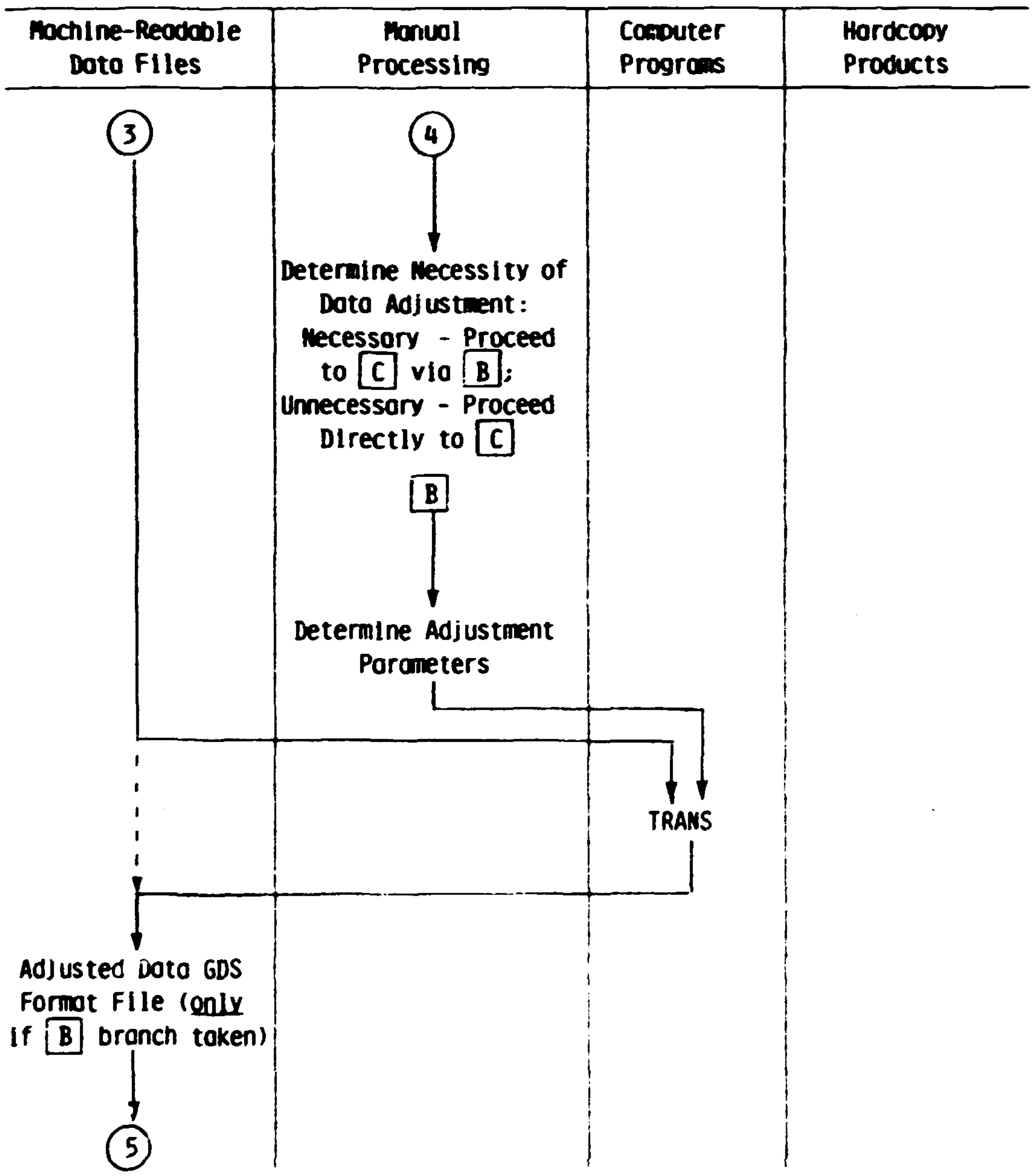
General Production Processing Flow Chart of
Magnetic Anomaly Map Preparation from
DOE-NURE Aerial Survey Data



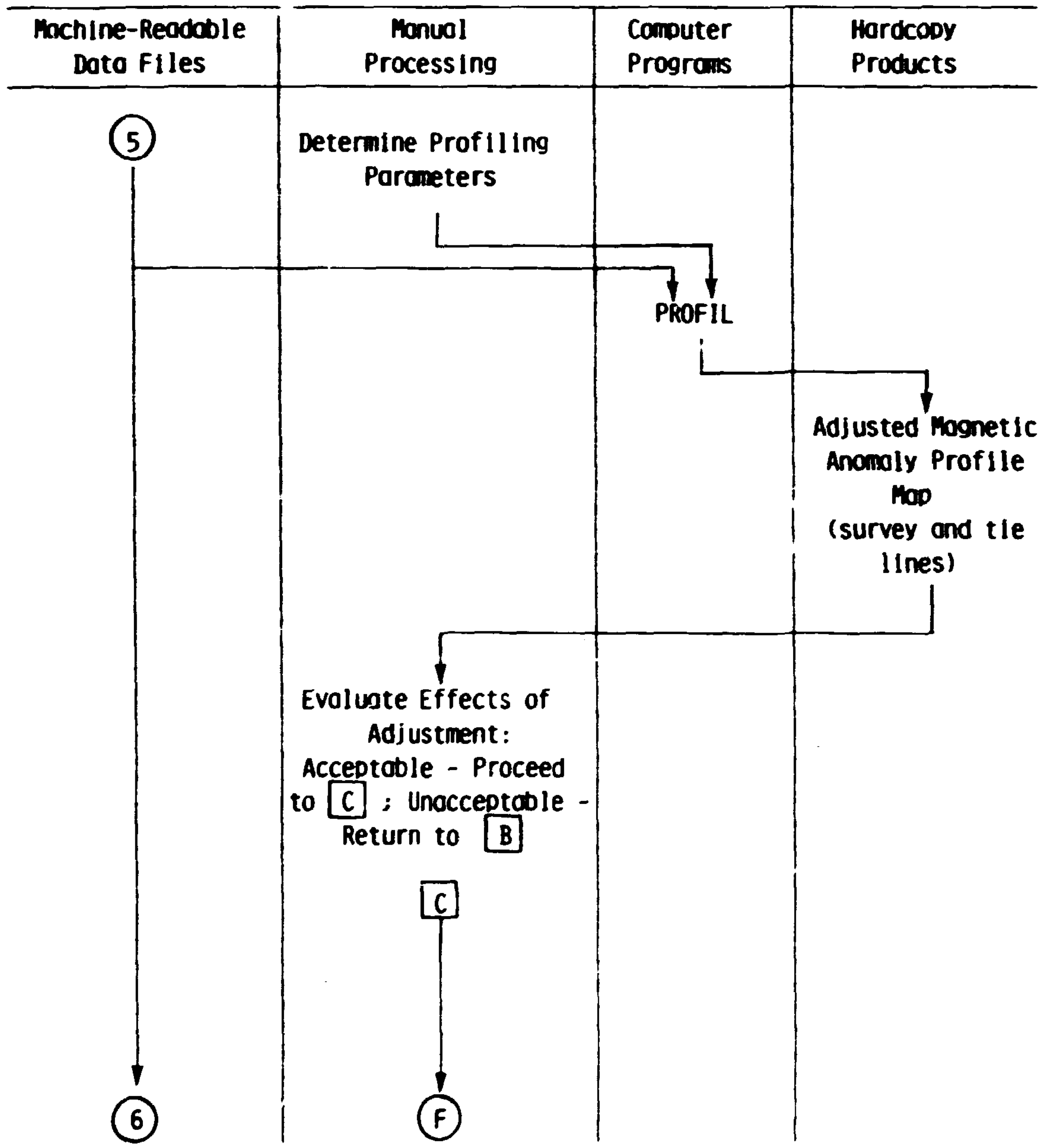
Appendix A (Cont'd.)



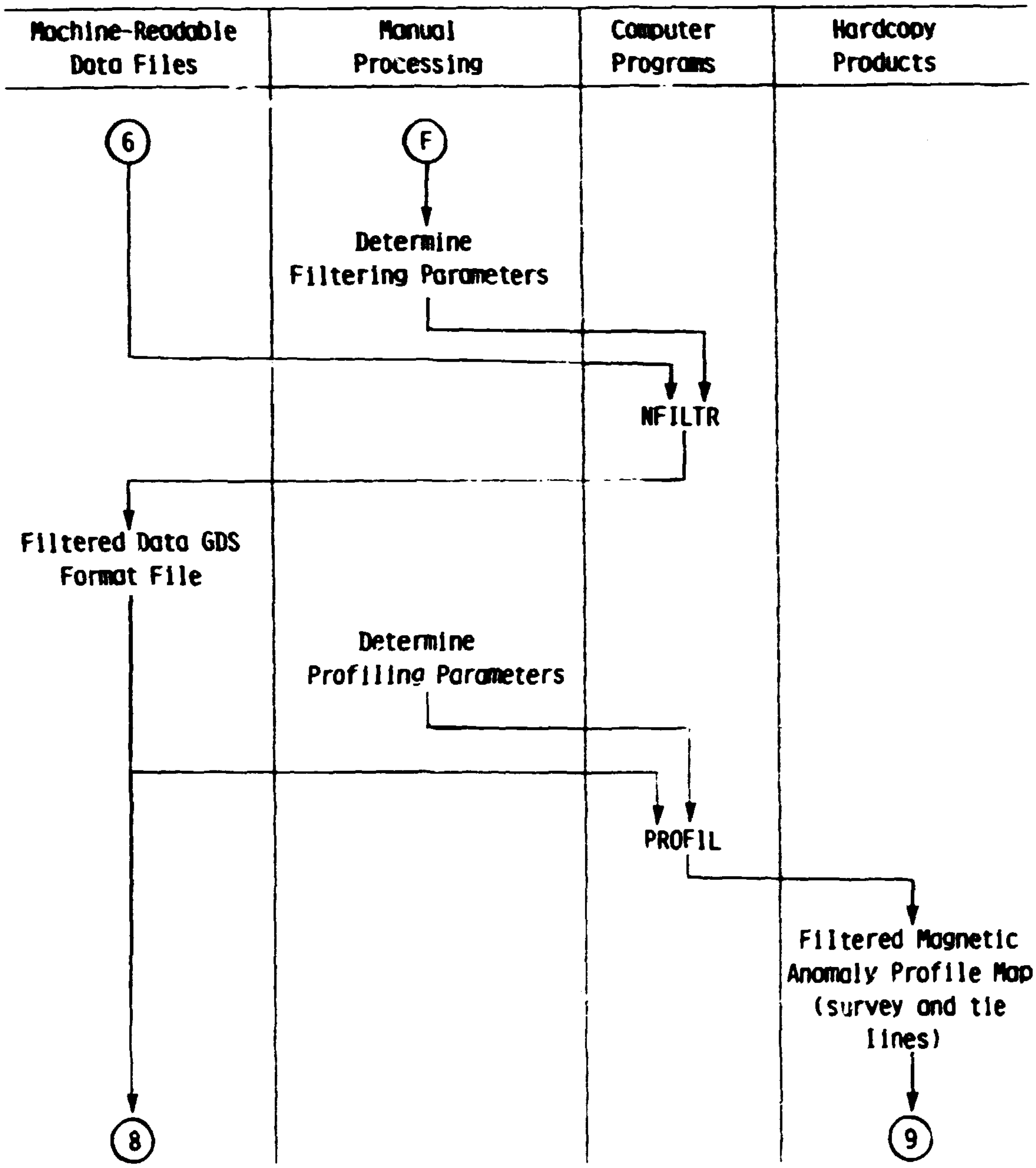
Appendix A (Cont'd.)



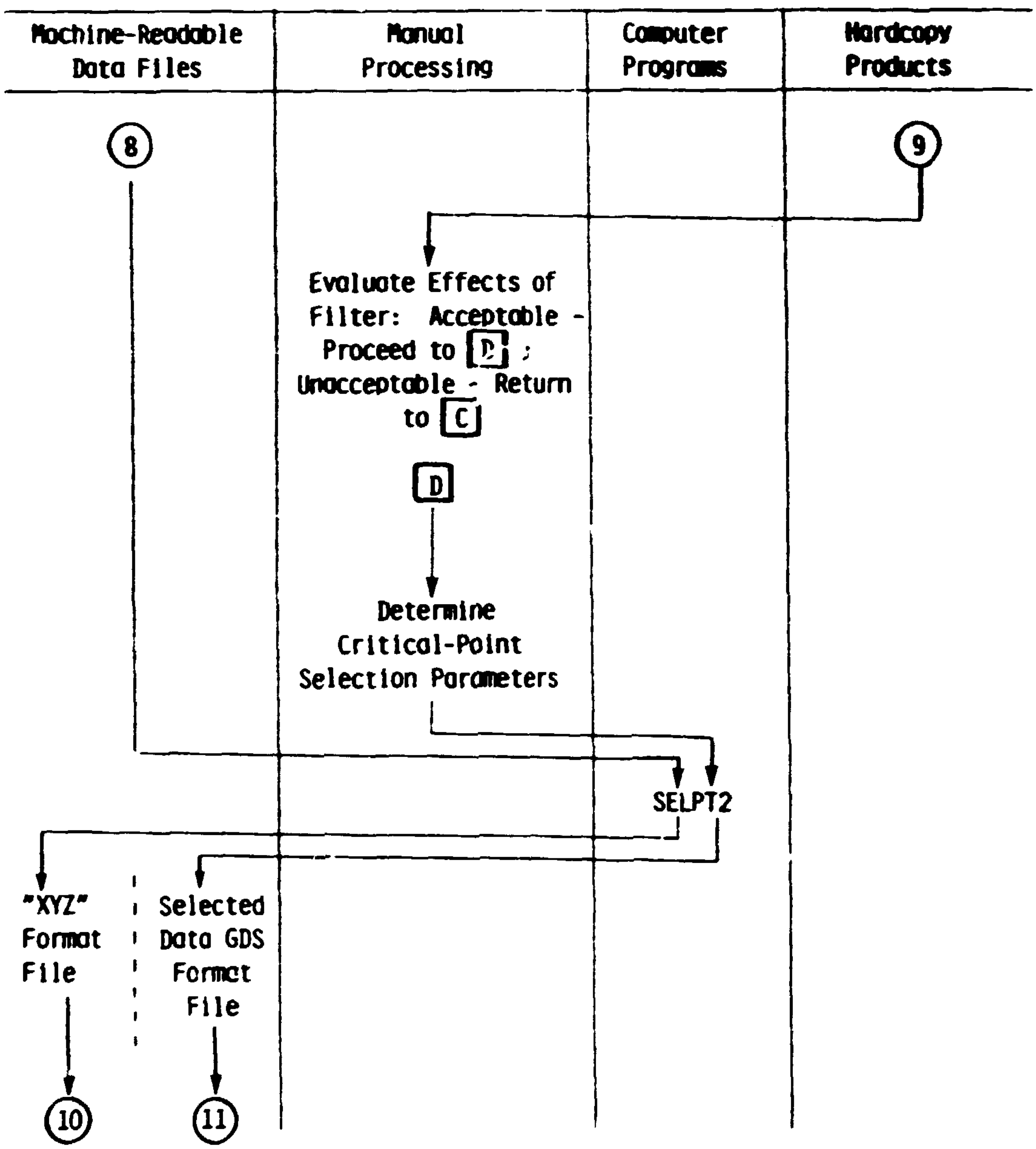
Appendix A (Cont'd.)



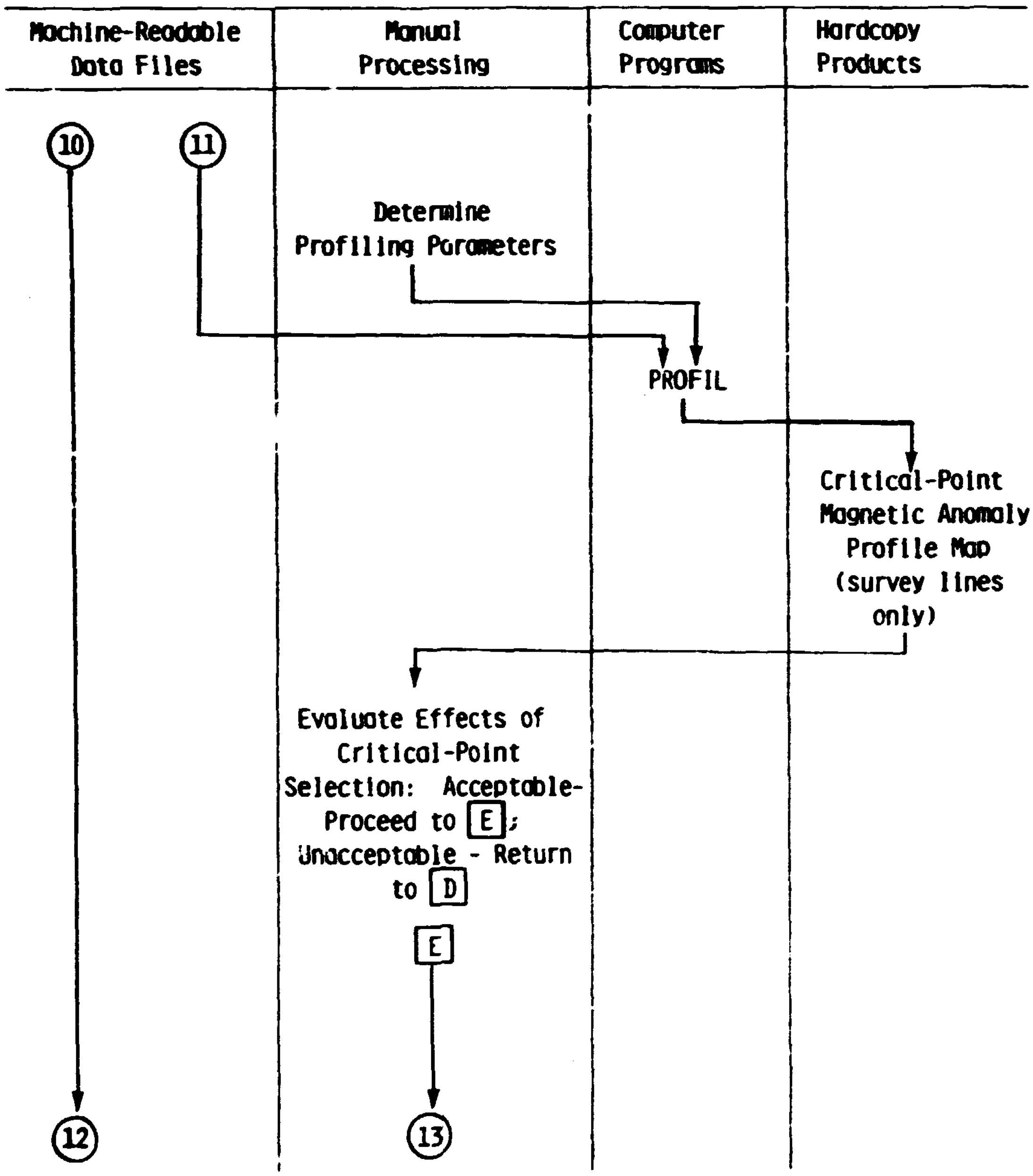
Appendix A (Cont'd.)



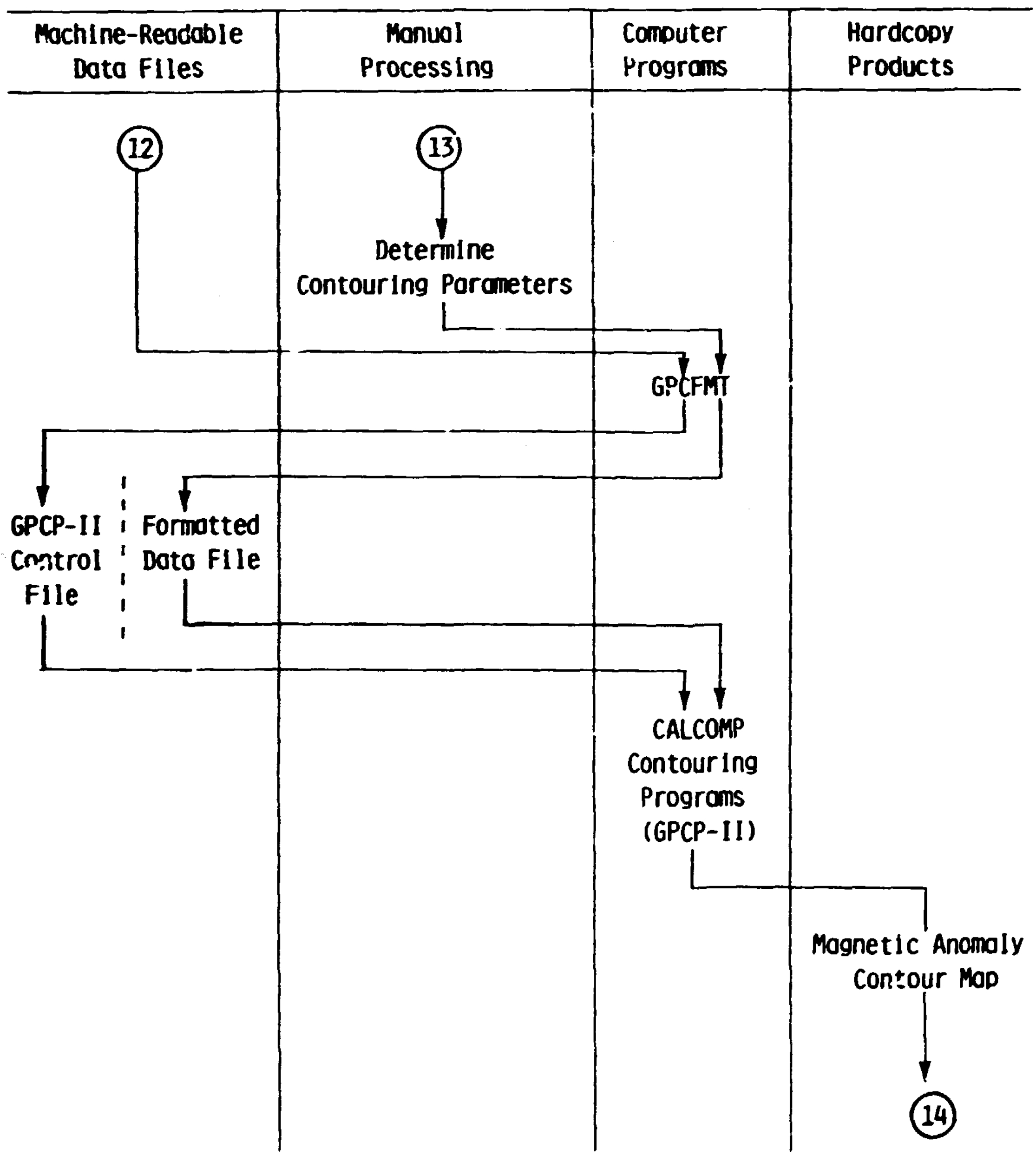
Appendix A (Cont'd.)



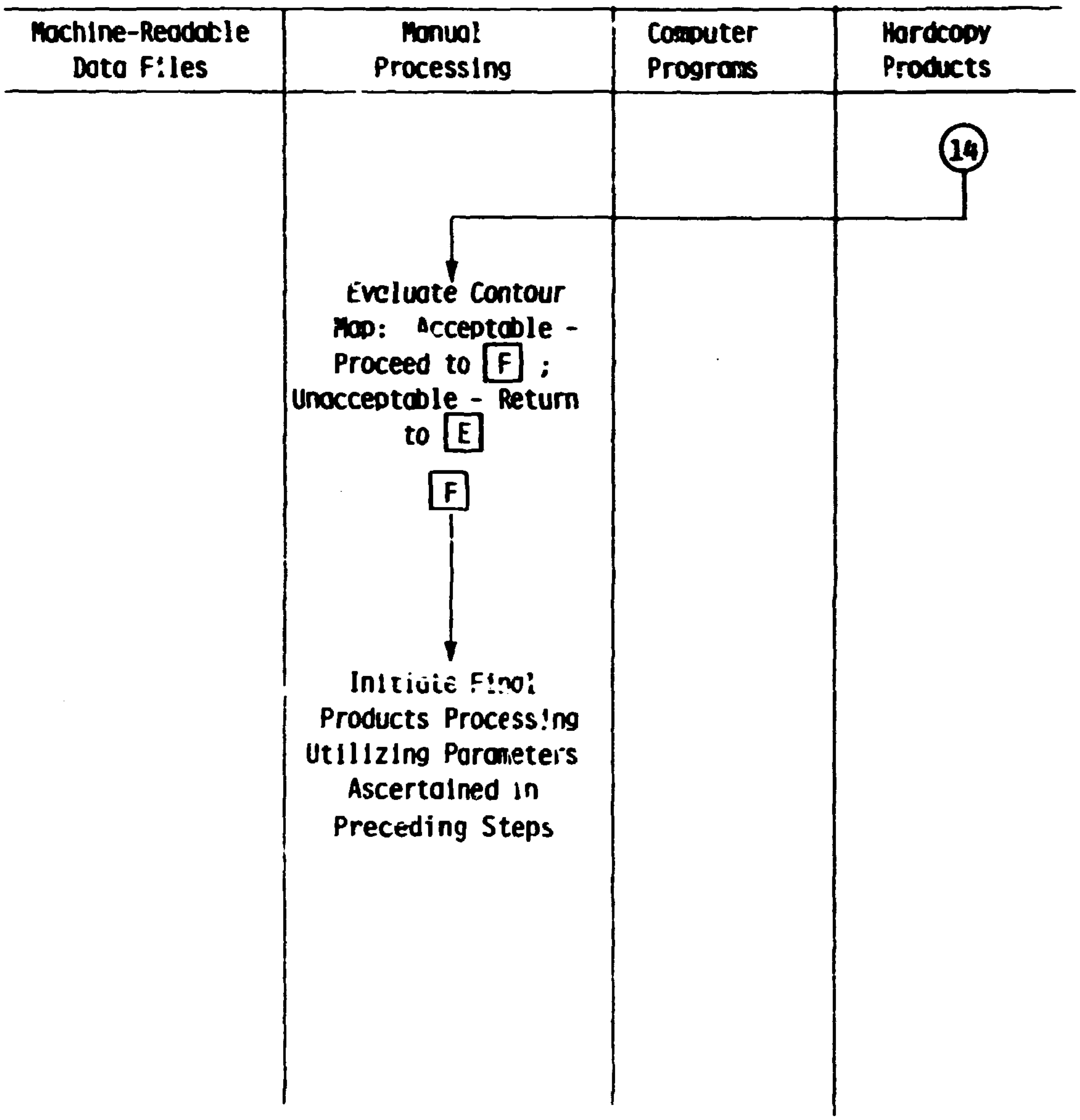
Appendix A (Cont'd.)



Appendix A (Cont'd.)



Appendix A (Cont'd.)



## APPENDIX B

## GENERAL DATA STATISTICS TABULATION
## EXAMPLE - O'NEILL, NEBRASKA, QUADRANGLE,
## CONTRACTOR-SUPPLIED DATA

# Appendix B

General Data Statistics Tabulation
Example - O'Neill, Nebraska, Quadrangle
Contractor-Supplied Data

```
        GDS FORMAT DATA CONVERSION ROUTINE
                    FOR THE
  NATIONAL URANIUM RESOURCE EVALUATION PROGRAM
-----------------------------------------------


   ***********************************
   *****  ONEILL     QUADRANGLE  *****
   ***********************************


   DATE OF CONVERSION           :  01-12-81
   SOUTHERN LATITUDE            :   42.00
   NORTHERN LATITUDE            :   43.00
   EASTERN LONGITUDE            :   98.00
   WESTERN LONGITUDE            :  100.00
   NUMBER OF VARIABLES          :      14
   NUMBER OF FLIGHT LINES       :      14
   NUMBER OF TIE LINES          :       4
   NUMBER OF POINTS (QUAD)      :   40954

   FLIGHT LINES ARE PARALLEL TO LATITUDE

   QUAD HEADER COMMENTS:
      ONEILL QUADRANGLE - TI002
```

Appendix B (Cont'd.)

VARIABLE NAME : LAT

CLASS INTERVAL = 0.10

| LOWER LIMIT | UPPER LIMIT | MEMBERS |
|---|---|---|
| 42.00 | 42.10 | 3261 |
| 42.10 | 42.20 | 5448 |
| 42.20 | 42.30 | 3117 |
| 42.30 | 42.40 | 5526 |
| 42.40 | 42.50 | 3190 |
| 42.50 | 42.60 | 3113 |
| 42.60 | 42.70 | 5568 |
| 42.70 | 42.80 | 3058 |
| 42.80 | 42.90 | 5205 |
| 42.90 | 43.00 | 3450 |

VARIABLE NAME : LONG

CLASS INTERVAL = 0.20

| LOWER LIMIT | UPPER LIMIT | MEMBERS |
|---|---|---|
| 98.00 | 98.20 | 5120 |
| 98.20 | 98.40 | 3469 |
| 98.40 | 98.60 | 3504 |
| 98.60 | 98.80 | 5163 |
| 98.80 | 99.00 | 3422 |
| 99.00 | 99.20 | 3451 |
| 99.20 | 99.40 | 5090 |
| 99.40 | 99.60 | 3371 |
| 99.60 | 99.80 | 3401 |
| 99.80 | 100.00 | 4945 |

VARIABLE NAME : MAGNETOM

CLASS INTERVAL = 83.80

| LOWER LIMIT | UPPER LIMIT | MEMBERS |
|---|---|---|
| -652.00 | -568.20 | 4547 |
| -568.20 | -484.40 | 12104 |
| -484.40 | -400.60 | 10815 |
| -400.60 | -316.80 | 7120 |
| -316.80 | -233.00 | 3230 |
| -233.00 | -149.20 | 1587 |
| -149.20 | -65.40 | 1217 |
| -65.40 | 18.40 | 165 |
| 18.40 | 102.20 | 132 |
| 102.20 | 186.00 | 19 |

Appendix B (Cont'd.)

VARIABLE NAME : ALTITUDE

CLASS INTERVAL = 16.70

| LOWER LIMIT | UPPER LIMIT | MEMBERS |
|---|---|---|
| 74.98 | 91.68 | 188 |
| 91.68 | 108.39 | 5305 |
| 108.39 | 125.09 | 24891 |
| 125.09 | 141.79 | 8717 |
| 141.79 | 158.50 | 1152 |
| 158.50 | 175.20 | 341 |
| 175.20 | 191.90 | 247 |
| 191.90 | 208.61 | 53 |
| 208.61 | 225.31 | 17 |
| 225.31 | 242.01 | 25 |

VARIABLE NAME : MAGMON

CLASS INTERVAL = 5.40

| LOWER LIMIT | UPPER LIMIT | MEMBERS |
|---|---|---|
| 57505.00 | 57510.40 | 1332 |
| 57510.40 | 57515.80 | 4613 |
| 57515.80 | 57521.20 | 3980 |
| 57521.20 | 57526.60 | 1264 |
| 57526.60 | 57532.00 | 10313 |
| 57532.00 | 57537.40 | 3677 |
| 57537.40 | 57542.80 | 6655 |
| 57542.80 | 57548.20 | 4773 |
| 57548.20 | 57553.60 | 1059 |
| 57553.60 | 57559.00 | 3070 |

Appendix B (Cont'd.)

GEOLOGIES IN ONEILL QUADRANGLE

| GEOLOGY CODE | NUMBER OF OCCURRENCES |
|---|---|
| CDS | 31396 |
| KP | 1876 |
| CAL | 1543 |
| (WATER) | 129 |
| KN-1 | 79 |
| KN-2 | 28 |
| TC | 412 |
| TCS | 2973 |
| CTS | 2516 |

NUMBER OF DIFFERENT GEOLOGIES: 9

VARIABLE: MAGNETOM
QUAD: ONEILL

| INTERNAL SEQUENCE NUMBER | CONTRACTOR LINE NUMBER | NUMBER OF POINTS | AVERAGE LATITUDE | AVERAGE LONGITUDE | MINIMUM | MAXIMUM | MEAN | STANDARD DEVIATION |
|---|---|---|---|---|---|---|---|---|
| FL1 | 101 | 2464 | 42.971 | 98.968 | -495.000 | 25.000 | -255.636 | 127.704 |
| FL2 | 102 | 2354 | 42.898 | 98.992 | -486.000 | -132.000 | -299.284 | 94.604 |
| FL3 | 103 | 2493 | 42.824 | 98.984 | -461.000 | -128.000 | -337.317 | 70.238 |
| FL4 | 104 | 2382 | 42.754 | 98.997 | -509.000 | -13.000 | -371.563 | 79.806 |
| FL5 | 105 | 2452 | 42.682 | 98.996 | -479.000 | -126.000 | -391.784 | 67.500 |
| FL6 | 106 | 2437 | 42.610 | 98.999 | -501.000 | -174.000 | -436.045 | 60.255 |
| FL7 | 107 | 2437 | 42.536 | 98.998 | -537.000 | -247.000 | -448.735 | 68.703 |
| FL8 | 108 | 2516 | 42.464 | 99.001 | -559.000 | 186.000 | -469.591 | 68.513 |
| FL9 | 109 | 2490 | 42.392 | 98.982 | -599.000 | -327.000 | -500.644 | 41.087 |
| FL10 | 110 | 2376 | 42.320 | 98.995 | -611.000 | -355.000 | -511.670 | 48.144 |
| FL11 | 111 | 2442 | 42.247 | 98.990 | -643.000 | -380.000 | -542.024 | 54.630 |
| FL12 | 112 | 2470 | 42.174 | 98.997 | -626.000 | -345.000 | -550.601 | 55.046 |
| FL13 | 113 | 2455 | 42.103 | 98.994 | -638.000 | -64.000 | -600.700 | 116.971 |
| FL14 | 114 | 2430 | 42.034 | 99.004 | -634.000 | 99.000 | -614.140 | 144.665 |
| TL15 | 209 | 1641 | 42.503 | 99.889 | -652.000 | -165.000 | -429.768 | 134.136 |
| TL16 | 210 | 1682 | 42.504 | 99.295 | -562.000 | 68.000 | -437.655 | 117.303 |
| TL17 | 211 | 1681 | 42.509 | 98.699 | -631.000 | -183.000 | -441.823 | 116.720 |
| TL18 | 212 | 1639 | 42.498 | 98.113 | -621.000 | -82.000 | -364.927 | 134.061 |
| QUAD | ---> | 40954 | 42.500 | 98.993 | -652.000 | 186.000 | -435.321 | 124.911 |

Appendix B (Cont'd.)

VARIABLE: ALTITUDE
QUAD: ONEILL

| INTERNAL SEQUENCE NUMBER | CONTRACTOR LINE NUMBER | NUMBER OF POINTS | AVERAGE LATITUDE | AVERAGE LONGITUDE | MINIMUM | MAXIMUM | MEAN | STANDARD DEVIATION |
|---|---|---|---|---|---|---|---|---|
| FL1 | 101 | 2464 | 42.971 | 98.968 | 92.354 | 181.051 | 117.628 | 11.151 |
| FL2 | 102 | 2354 | 42.898 | 98.992 | 83.820 | 184.055 | 120.223 | 13.657 |
| FL3 | 103 | 2493 | 42.824 | 98.984 | 74.981 | 182.578 | 121.399 | 13.938 |
| FL4 | 104 | 2342 | 42.754 | 98.997 | 76.200 | 200.863 | 124.077 | 20.210 |
| FL5 | 105 | 2452 | 42.682 | 98.996 | 87.782 | 175.870 | 118.513 | 11.333 |
| FL6 | 106 | 2437 | 42.610 | 98.999 | 89.611 | 174.041 | 117.675 | 9.786 |
| FL7 | 107 | 2437 | 42.536 | 98.998 | 98.146 | 242.011 | 126.260 | 20.471 |
| FL8 | 108 | 2516 | 42.464 | 99.001 | 87.782 | 199.335 | 118.671 | 12.647 |
| FL9 | 109 | 2490 | 42.392 | 98.982 | 75.280 | 149.047 | 116.685 | 9.369 |
| FL10 | 110 | 2379 | 42.320 | 98.995 | 82.906 | 145.072 | 121.995 | 15.364 |
| FL11 | 111 | 2442 | 42.247 | 98.990 | 88.392 | 145.085 | 116.768 | 8.847 |
| FL12 | 112 | 2470 | 42.174 | 98.997 | 90.221 | 158.496 | 118.462 | 9.171 |
| FL13 | 113 | 2455 | 42.103 | 98.994 | 90.830 | 194.767 | 121.201 | 11.920 |
| FL14 | 114 | 2440 | 42.034 | 99.004 | 86.258 | 145.085 | 120.984 | 9.197 |
| TL15 | 209 | 1641 | 42.503 | 98.889 | 91.745 | 182.578 | 121.259 | 10.485 |
| TL16 | 210 | 1082 | 42.504 | 99.295 | 84.734 | 146.914 | 115.240 | 9.871 |
| TL17 | 211 | 1681 | 42.509 | 98.699 | 88.697 | 167.640 | 118.421 | 12.663 |
| TL18 | 212 | 1689 | 42.498 | 98.113 | 93.269 | 179.222 | 123.264 | 12.435 |
| QUAD | ---> | 40454 | 42.500 | 98.993 | 74.981 | 242.011 | 119.635 | 13.164 |

Appendix 5 (Cont'd.)

VARIABLE: MAGMON
QUAD: ONEILL

| INTERNAL SEQUENCE NUMBER | CONTRACTOR LINE NUMBER | NUMBER OF POINTS | AVERAGE LATITUDE | AVERAGE LONGITUDE | MINIMUM | MAXIMUM | MEAN | STANDARD DEVIATION |
|---|---|---|---|---|---|---|---|---|
| FL1 | 101 | 2464 | 42.971 | 98.969 | 57526.000 | 57531.000 | 57528.980 | 1.395 |
| FL2 | 102 | 2354 | 42.898 | 98.992 | 57526.000 | 57533.000 | 57529.727 | 1.882 |
| FL3 | 103 | 2493 | 42.824 | 98.984 | 57538.000 | 57545.000 | 57541.332 | 1.949 |
| FL4 | 104 | 2382 | 42.754 | 98.997 | 57540.000 | 57546.000 | 57541.512 | 1.308 |
| FL5 | 105 | 2452 | 42.682 | 98.996 | 57540.000 | 57545.000 | 57543.012 | 1.241 |
| FL6 | 106 | 2417 | 42.610 | 98.999 | 57531.000 | 57538.000 | 57534.281 | 2.309 |
| FL7 | 107 | 2437 | 42.536 | 98.998 | 57526.000 | 57531.000 | 57529.625 | 1.328 |
| FL8 | 108 | 2516 | 42.464 | 99.001 | 57530.000 | 57535.000 | 57531.645 | 0.916 |
| FL9 | 109 | 2490 | 42.392 | 98.992 | 57524.000 | 57533.000 | 57527.688 | 2.395 |
| FL10 | 110 | 2377 | 42.320 | 98.995 | 57517.000 | 57523.000 | 57519.277 | 1.175 |
| FL11 | 111 | 2442 | 42.247 | 98.990 | 57538.000 | 57543.000 | 57539.770 | 1.472 |
| FL12 | 112 | 2470 | 42.174 | 98.997 | 57550.000 | 57557.000 | 57554.551 | 1.619 |
| FL13 | 113 | 2455 | 42.103 | 98.994 | 57511.000 | 57529.000 | 57518.824 | 5.649 |
| FL14 | 114 | 2490 | 42.034 | 99.004 | 57505.000 | 57521.000 | 57511.414 | 3.056 |
| TL15 | 209 | 1641 | 42.503 | 99.489 | 57544.000 | 57548.000 | 57546.039 | 1.122 |
| TL16 | 210 | 1642 | 42.504 | 99.295 | 57548.000 | 57559.000 | 57554.578 | 3.642 |
| TL17 | 211 | 1681 | 42.509 | 98.699 | 57510.000 | 57517.000 | 57513.172 | 2.785 |
| TL18 | 212 | 1689 | 42.498 | 98.113 | 57510.000 | 57515.000 | 57512.520 | 1.206 |
| QUAD | ---> | 40954 | 42.500 | 98.393 | 57505.000 | 57559.000 | 57532.137 | 12.834 |

Appendix B (Cont'd.)

# APPENDIX C

## GDS (GEOGRAPHIC DATA SYSTEMS) DATA FORMAT

# Appendix C

## GDS (Geographic Data Systems) Data Format

This format, designed to accommodate aerial radiometric and magnetic data from the NURE-ARRS program, is the form written and read by most routines described in the text of this report. Utilizing IBM computers, all information in the three record types is recorded in binary (FORTRAN unformatted I/O) and consists of blocked, variable-length, spanned records in sequential data sets with a standard block size of 13,030 8-bit bytes. Data types described on the following pages are as defined by IBM FORTRAN IV, and all are four bytes (32 bits) in length. Unless specifically indicated, data items are numeric and coordinate information is in decimal degrees.

### Quadrangle Header Record

General information concerning an entire quadrangle unit is contained in this record type. It occurs one time only, at the beginning of a GDS format data set, and has a maximum length of 4372 bytes.

| data type | description |
|---|---|
| real | first four characters of quadrangle name |
| real | last four characters of quadrangle name |
| real | southern latitude boundary |
| real | northern latitude boundry |
| real | eastern longitude boundry |
| real | western longitude boundary |

Appendix C (Cont'd.)

| | |
|---|---|
| integer | total number of sample points |
| integer | number of survey lines |
| integer | number of tie lines |
| real | survey line orientation code; ≤1: E-W; >1 N-S |
| integer | data of conversion to GDS format |
| integer | number of unique geology codes (300 maximum) |

- the following 12 bytes occur once for each geology code -

| | |
|---|---|
| integer | first four characters of geology code |
| integer | last four characters of geology code |
| integer | number of samples with this geology code |
| integer | number of variables (20 maximum) |

- the following 8 bytes occur once for each variable -

| | |
|---|---|
| real | first four characters of variable name |
| real | last four characters of variable name |

- the following 16 bytes occur once for each variable -

| | |
|---|---|
| real | variable minimum |
| real | variable maximum |
| real | variable arithmetic mean |
| real | variable standard deviation |

- the following 4 bytec occur 60 times -

| | |
|---|---|
| integer | comments field (240 characters) |

Appendix C (Cont'd.)

## Line Header Record

Information specific to a particular survey- or tie-line is contained in this record type. It occurs once at the beginning of the data for each traverse and has a maximum length of 340 bytes.

| data type | description |
|---|---|
| integer | four-character line sequence and type flag |
| integer | contractor-assigned line number |
| integer | number of samples on this line |
| real | average latitude of line |
| real | average longitude of line |

- the following 16 bytes are repeated once for each variable -

| | |
|---|---|
| real | variable minimum |
| real | variable maximum |
| real | variable arithmetic mean |
| real | variable standard deviation |

Appendix C (Cont'd.)

Sample-Point Data Record

Information concerning each individual data point is included in this record type. It occurs once for each sample point and the collection of those defining the data for a given traverse follows the associated Line Header Record. It is of fixed, 120-byte length.

| data type | description |
|---|---|
| integer | contractor-assigned tape sequence number |
| integer | contractor-assigned record number |
| integer | contractor-assigned data quality number |
| integer | date of sample (mmddyy) |
| integer | contractor-assigned line number |
| integer | first four characters of geology code |
| integer | last four characters of geology code |
| integer | time of sample (hhmmss) |
| integer | reserved for future use |
| integer | reserved for future use |

- the following 4 bytes are repeated once for each variable -

| | |
|---|---|
| real | positional variable value* |

- any length remaining is reserved for future use -

*Variable values occur in the same order as variable names in the Quadrangle Header Record.

# Appendix D

## "XYZ" Data Format

In order to minimize contour mismatch between adjacent quadrangle units, information from those neighboring areas is needed for use in contour grid construction. "XYZ" format contains a subset of the data contained in a GDS format file, and, while variable-specific, allows much faster selection of data from a specified latitude-longitude boundary. As in the GDS format, all information is binary and all data elements are of four-byte length. Data in "XYZ" format are associated with specific quadrangle units solely by latitude-longitude, necessitating definition of only two record types.

### Line Header Record

This record type functions to identify the line and indicate its orientation. It occurs once at the beginning of each traverse and is of fixed, 16-byte length.

| data type | description |
|---|---|
| integer | four-character line sequence and type flag |
| integer | contractor-assigned line number |
| integer | number of points on this line |
| real | survey line orientation code; $\leq 1$: E-W;$>1$: N-S |

Appendix D (Cont'd.)

## Sample-Point Data Record

Any variable from a standard GDS format data set may be stored in "XYZ" format sample-point data records. One occurrence of this record type appears for each data point in the file, and collections defining traverse lines follow Line Header Records. The records are of fixed, 16-byte length.

| data type | description |
|---|---|
| real | latitude of sample |
| real | longitude of sample |
| real | z-value of sample, e.g., magnetic anomaly, etc. |
| real | terrain clearance of sample |

Appendix E-1

Data Value Frequency Distribution Analysis: Magnetic Anomaly, Terrain Clearance, and Interpoint Distance Data from Contractor-Supplied Data Set

```
+--------------------------------+
!                                !
! NURE DATA QUALITY EVALUATION   !
!                                !
+--------------------------------+

   GEOGRAPHIC DATA SYSTEMS GROUP
     UNION CARBIDE CORPORATION
         NUCLEAR  DIVISION

 DATE: 01-21-81    TIME: 18.43.18

RUN IDENTIFICATION: ONEILL  CONTRACTOR-SUPPLIED MAGNETOMETER DATA (GADMAN)

QUAD BOUNDARY:
     MINIMUM LATITUDE:    4.200000E 01      MAXIMUM LATITUDE:    4.300000E 01
     MINIMUM LONGITUDE:   9.800000E 01      MAXIMUM LONGITUDE:   1.000000E 02

COMMENTS FROM INPUT FILE: ONEILL QUADRANGLE - T1002


THE VARIABLE CHOSEN IS 'MAGNETOM' AND THE FLIGHT LINE/TIE LINE SWITCH IS SET TO 'BOTH'

BARGRAPH HEADING CONTROL IS 'SPLIT    ' AND THE UNIT TO BE USED FOR INPUT IS 50

CLASS INTERVAL IN USE IS  2.000000D 01


---> BEGINNING POINT DATA INPUT

---> POINT DATA INPUT COMPLETED USING    3.96 CPU SECONDS


FOR THE ENTIRE DATASET,  18 MAP ( 14 FLIGHT AND   4 TIE) LINES WERE PROCESSED,  40954 VALUES WERE WRITTEN,
AND      0 VALUES WERE DISCARDED

FOR THE VARIABLE SELECTED, THE FOLLOWING STATISTICS WERE COMPUTED:
     MINIMUM: -6.520000D 02; MAXIMUM:  1.860000D 02; MEAN: -4.333208D 02; STD DEV:  1.249107D 02


OVERALL DATA LIMITS, -8.100529D 02 TO -6.058884D 0   WERE CHOSEN FROM DATA MEAN - AND + THREE STD DEVIATIONS
```

* * * * * * * * * * B A R G R * * * * * * * * * *

TITLE: ONEILL; CONTRACTOR-SUPPLIED MAGNETOMETER DATA (GAMMAS)

40650 VALUES CLASSIFIED; 304 VALUES NOT CLASSIFIED; 40954 TOTAL VALUES PROCESSED

CLASS INTERVAL IN USE IS 2.000000D 01

| | | | | |
|---|---|---|---|---|
| FOR THE CLASSIFIED DATA VALUES: | MINIMUM: | -6.520000D 02 | MAXIMUM: | -6.100000D 01 |
| | MEAN: | -4.387442D 02 | STD. DEV.: | 1.188075D 02 |

EACH BARGRAPH SYMBOL REPRESENTS 2.816667D 01 CLASS MEMBERS

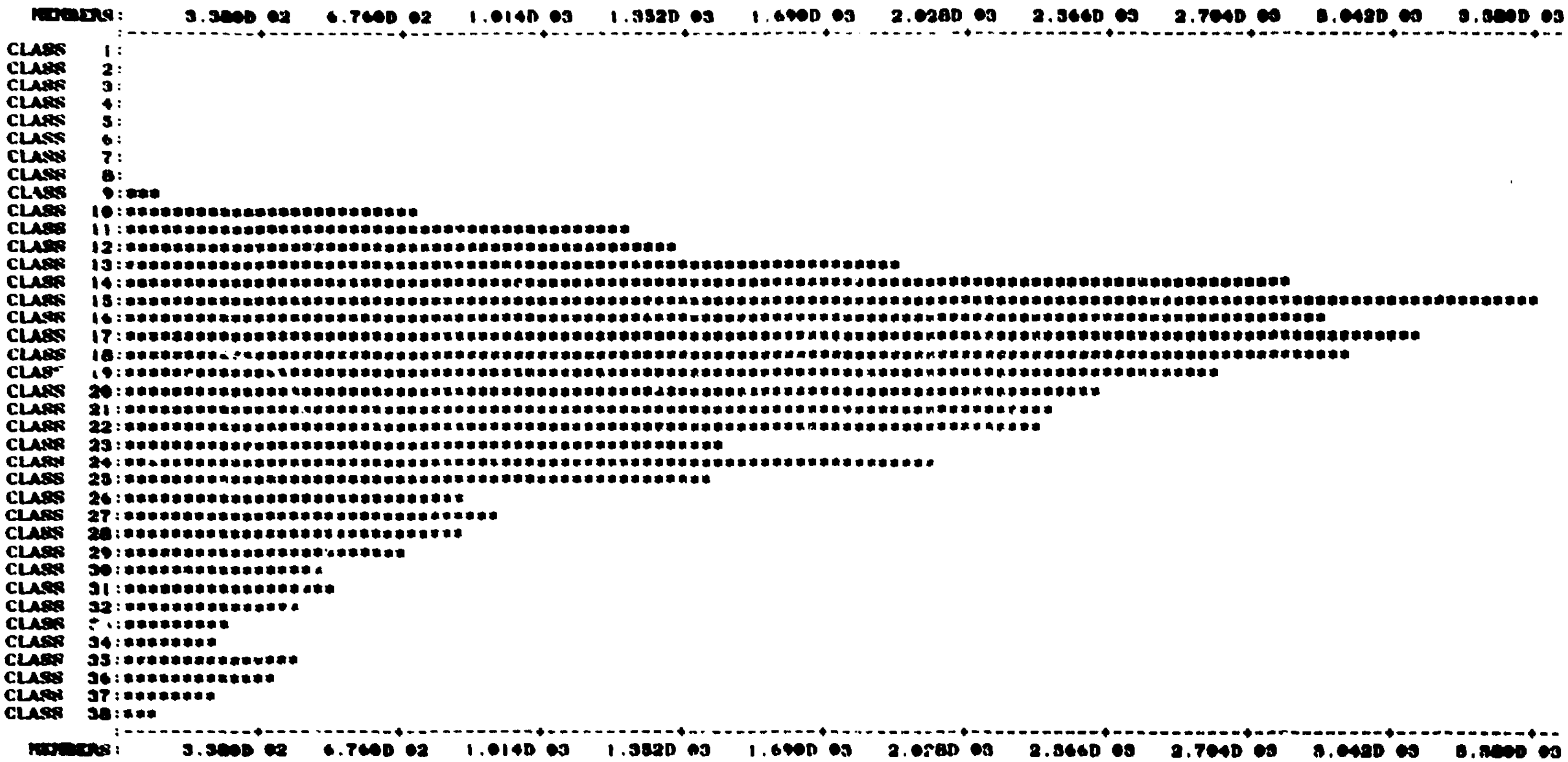
| | | | | |
|---|---|---|---|---|
| FOR THE ENTIRE DATA SET: | MINIMUM: | -6.520000D 02 | MAXIMUM: | 1.860000D 02 |
| | MEAN: | -4.353208D 02 | STD. DEV.: | 1.249107D 02 |

Appendix E-1 (Cont'd.)

ONEILL: CONTRACTOR-SUPPLIED MAGNETOMETER DATA (GAMMAS) CLASS LISTING - PAGE 1 01-21-81/18.48.43

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| CLASS 1 | (-8.200000D 02::-8.000000D 02) | 0 | MEMBERS | CLASS 2 | (-8.000000D 02::-7.800000D 02) | 0 | MEMBERS |
| CLASS 3 | (-7.800000D 02::-7.600000D 02) | 0 | MEMBERS | CLASS 4 | (-7.600000D 02::-7.400000D 02) | 0 | MEMBERS |
| CLASS 5 | (-7.400000D 02::-7.200000D 02) | 0 | MEMBERS | CLASS 6 | (-7.200000D 02::-7.000000D 02) | 0 | MEMBERS |
| CLASS 7 | (-7.000000D 02::-6.800000D 02) | 0 | MEMBERS | CLASS 8 | (-6.800000D 02::-6.600000D 02) | 0 | MEMBERS |
| CLASS 9 | (-6.600000D 02::-6.400000D 02) | 88 | MEMBERS | CLASS 10 | (-6.400000D 02::-6.200000D 02) | 712 | MEMBERS |
| CLASS 11 | (-6.200000D 02::-6.000000D 02) | 1222 | MEMBERS | CLASS 12 | (-6.000000D 02::-5.800000D 02) | 1330 | MEMBERS |
| CLASS 13 | (-5.800000D 02::-5.600000D 02) | 1838 | MEMBERS | CLASS 14 | (-5.600000D 02::-5.400000D 02) | 2799 | MEMBERS |
| CLASS 15 | (-5.400000D 02::-5.200000D 02) | 3380 | MEMBERS | CLASS 16 | (-5.200000D 02::-5.000000D 02) | 2862 | MEMBERS |
| CLASS 17 | (-5.000000D 02::-4.800000D 02) | 3085 | MEMBERS | CLASS 18 | (-4.800000D 02::-4.600000D 02) | 2938 | MEMBERS |
| CLASS 19 | (-4.600000D 02::-4.400000D 02) | 2424 | MEMBERS | CLASS 20 | (-4.400000D 02::-4.200000D 02) | 2351 | MEMBERS |
| CLASS 21 | (-4.200000D 02::-4.000000D 02) | 2226 | MEMBERS | CLASS 22 | (-4.000000D 02::-3.800000D 02) | 2194 | MEMBERS |
| CLASS 23 | (-3.800000D 02::-3.600000D 02) | 1448 | MEMBERS | CLASS 24 | (-3.600000D 02::-3.400000D 02) | 1946 | MEMBERS |
| CLASS 25 | (-3.400000D 02::-3.200000D 02) | 1486 | MEMBERS | CLASS 26 | (-3.200000D 02::-3.000000D 02) | 811 | MEMBERS |
| CLASS 27 | (-3.000000D 02::-2.800000D 02) | 893 | MEMBERS | CLASS 28 | (-2.800000D 02::-2.600000D 02) | 807 | MEMBERS |
| CLASS 29 | (-2.600000D 02::-2.400000D 02) | 680 | MEMBERS | CLASS 30 | (-2.400000D 02::-2.200000D 02) | 480 | MEMBERS |
| CLASS 31 | (-2.200000D 02::-2.000000D 02) | 518 | MEMBERS | CLASS 32 | (-2.000000D 02::-1.800000D 02) | 415 | MEMBERS |
| CLASS 33 | (-1.800000D 02::-1.600000D 02) | 250 | MEMBERS | CLASS 34 | (-1.600000D 02::-1.400000D 02) | 213 | MEMBERS |
| CLASS 35 | (-1.400000D 02::-1.200000D 02) | 426 | MEMBERS | CLASS 36 | (-1.200000D 02::-1.000000D 02) | 373 | MEMBERS |
| CLASS 37 | (-1.000000D 02::-8.000000D 01) | 222 | MEMBERS | CLASS 38 | (-8.000000D 01::-6.000000D 01) | 93 | MEMBERS |

ONEILL, CONTRACTOR-SUPPLIED MAGNETOMETER DATA (CAMMAR)   CLASS BARGRAPHS - PAGE 1   01-21-81/18.40.40




* * * * * * * * * * BARGR * * * * * * * * * *

Appendix E-1 (Cont'd.)

* * * * * * * * * * B A R G R * * * * * * * * * *

TITLE: ONEILL; CONTRACTOR-SUPPLIED TERRAIN CLEARANCE DATA (METERS)

40285 VALUES CLASSIFIED; 669 VALUES NOT CLASSIFIED; 40954 TOTAL VALUES PROCESSED

CLASS INTERVAL IN USE IS 5.000000D 00

| | | | | |
|---|---|---|---|---|
| FOR THE CLASSIFIED DATA VALUES: | MINIMUM: | 8.016238D 01 | MAXIMUM: | 1.597182D 02 |
| | MEAN: | 1.189938D 02 | STD. DEV.: | 1.063016D 01 |

EACH BARGRAPH SYMBOL REPRESENTS 6.697500D 01 CLASS MEMBERS

| | | | | |
|---|---|---|---|---|
| FOR THE ENTIRE DATA SET: | MINIMUM: | 7.498079D 01 | MAXIMUM: | 2.420112D 02 |
| | MEAN: | 1.199347D 02 | STD. DEV.: | 1.316401D 01 |

Appendix E-1 (Cont'd.)

ONEILL: CONTRACTOR-SUPPLIED TERRAIN CLEARANCE DATA (METERS) CLASS LISTING - PAGE 1 01-21-81/18.44.05

| | | | | | |
|---|---|---|---|---|---|
| CLASS 1 | ( 8.000000D 01:: 8.500000D 01) | 24 MEMBERS | CLASS 2 | ( 8.500000D 01:: 9.000000D 01) | 98 MEMBERS |
| CLASS 3 | ( 9.000000D 01:: 9.500000D 01) | 237 MEMBERS | CLASS 4 | ( 9.500000D 01:: 1.000000D 02) | 646 MEMBERS |
| CLASS 5 | ( 1.000000D 02:: 1.050000D 02) | 1886 MEMBERS | CLASS 6 | ( 1.050000D 02:: 1.100000D 02) | 4309 MEMBERS |
| CLASS 7 | ( 1.100000D 02:: 1.150000D 02) | 7789 MEMBERS | CLASS 8 | ( 1.150000D 02:: 1.200000D 02) | 8037 MEMBERS |
| CLASS 9 | ( 1.200000D 02:: 1.250000D 02) | 7359 MEMBERS | CLASS 10 | ( 1.250000D 02:: 1.300000D 02) | 4352 MEMBERS |
| CLASS 11 | ( 1.300000D 02:: 1.350000D 02) | 2551 MEMBERS | CLASS 12 | ( 1.350000D 02:: 1.400000D 02) | 1474 MEMBERS |
| CLASS 13 | ( 1.400000D 02:: 1.450000D 02) | 724 MEMBERS | CLASS 14 | ( 1.450000D 02:: 1.500000D 02) | 403 MEMBERS |
| CLASS 15 | ( 1.500000D 02:: 1.550000D 02) | 244 MEMBERS | CLASS 16 | ( 1.550000D 02:: 1.600000D 02) | 157 MEMBERS |

```
ONEILL: CONTRACTOR-SUPPLIED TERRAIN CLEARANCE DATA (METERS)   CLASS BARGRAPHS - PAGE  1                    01-21-81/18.44.05

  MEMBERS:      8.037D 02   1.607D 03   2.411D 03   3.215D 03   4.019D 03   4.822D 03   5.626D 03   6.430D 03   7.233D 03   8.037D 03
          :------------+------------+------------+------------+------------+------------+------------+------------+------------+------------+--
CLASS    1:
CLASS    2:*
CLASS    3:****
CLASS    4:***********
CLASS    5:******************************
CLASS    6:*********************************************************************
CLASS    7:*****************************************************************************************************************************
CLASS    8:*********************************************************************************************************************************
CLASS    9:**********************************************************************************************************************
CLASS   10:** *******************************************************************
CLASS   11:****** **********************************
CLASS   12:***** *****************
CLASS   13:***********
CLASS   14:******
CLASS   15:****
CLASS   16:**
          :------------+------------+------------+------------+------------+------------+------------+------------+------------+------------+--
  MEMBERS:      8.037D 02   1.607D 03   2.411D 03   3.215D 03   4.019D 03   4.822D 03   5.626D 03   6.430D 03   7.233D 03   8.037D 03

                 + + + + + + + + + + B A R G R + + + + + + + + + +
```

Appendix E-1 (Cont'd.)

* * * * * * * * * * B A R G R * * * * * * * * * *

TITLE: OREILL; INTERPOINT DISTANCES FROM CONTRACTOR DATA (METERS)

40327 VALUES CLASSIFIED;    609 VALUES NOT CLASSIFIED;  40936 TOTAL VALUES PROCESSED

CLASS INTERVAL IN USE IS  5.0000000D 01

| | | | | |
|---|---|---|---|---|
| FOR THE CLASSIFIED DATA VALUES: | MINIMUM: | 4.8545680D 01 | MAXIMUM: | 1.4840837D 02 |
| | MEAN: | 6.4984040D 01 | STD. DEV.: | 6.1278830D 00 |

EACH BARGRAPH SYMBOL REPRESENTS  3.3360830D 02 CLASS MEMBERS

| | | | | |
|---|---|---|---|---|
| FOR THE ENTIRE DATA SET: | MINIMUM: | 4.8545680D 01 | MAXIMUM: | 3.5598940D 02 |
| | MEAN: | 6.6964400D 01 | STD. DEV.: | 1.7445360D 01 |

Appendix E-1 (Cont'd.)

```
ONEILL; INTERPOINT DISTANCES FROM CONTRACTOR DATA (METERS)    CLASS LISTING - PAGE  1                    01-21-81/18.44.28
        CLASS   1 ( 0.0          :: 5.000000D 01)    248 MEMBERS        CLASS   2 ( 5.000000D 01:: 1.000000D 02) 40033 MEMBERS
        CLASS   3 ( 1.000000D 02:: 1.500000D 02)     46 MEMBERS
```

Appendix E-1 (Cont'd.)

Appendix E-1 (Cont'd.)

```
ONEILL; INTERPOINT DISTANCES FROM CONTRACTOR DATA (METERS)    CLASS BARGRAPHS - PAGE  1                              01-21-81/18.44.28

  MEMBERS:      4.003D 03    8.007D 03    1.201D 04    1.601D 04    2.002D 04    2.402D 04    2.802D 04    3.203D 04    3.603D 04    4.003D 04
           :-----------+------------+------------+------------+------------+------------+------------+------------+------------+------------+--
CLASS    1:*
CLASS    2:*************************************************************************************************************************************
CLASS    3:
           :-----------+------------+------------+------------+------------+------------+------------+------------+------------+------------+--
  MEMBERS:      4.003D 03    8.007D 03    1.201D 04    1.601D 04    2.002D 04    2.402D 04    2.802D 04    3.203D 04    3.603D 04    4.003D 04

                                        + + + + + + + + + + B A R G R + + + + + + + + + +
```

Appendix E-2

Data Value Frequency Distribution Analysis: Magnetic Anomaly Data From 13-Point Median Filtered Data Set.

```
+-------------------------------+
!                               !
! NURE DATA QUALITY EVALUATION  !
!                               !
+-------------------------------+

   GEOGRAPHIC DATA SYSTEMS GROUP
    UNION CARBIDE CORPORATION
         NUCLEAR  DIVISION

  DATE: 01-21-81   TIME: 18.46.54

RUN IDENTIFICATION: ONEILL; 13-POINT MEDIAN FILTERED MAGNETOMETER DATA (GAMMAS)

QUAD BOUNDARY:
     MINIMUM LATITUDE:    4.200000E 01     MAXIMUM LATITUDE:    4.300000E 01
     MINIMUM LONGITUDE:   9.800000E 01     MAXIMUM LONGITUDE:   1.000000E 02

COMMENTS FROM INPUT FILE: ONEILL QUADRANGLE - T1002; NFILTR 01-12-81, TYPE=MED, NWIDTH=13.0, VAR=MAGNETOM


THE VARIABLE CHOSEN IS 'MAGNETOM' AND THE FLIGHT LINE/TIE LINE SWITCH IS SET TO 'BOTH'

BARGRAPH HEADING CONTROL IS 'SPLIT   ' AND THE UNIT TO BE USED FOR INPUT IS 50

CLASS INTERVAL IN USE IS  2.000000D 01


---> BEGINNING POINT DATA INPUT

---> POINT DATA INPUT COMPLETED USING    5.95 CPU SECONDS


FOR THE ENTIRE DATASET,  18 MAP ( 14 FLIGHT AND   4 TIE) LINES WERE PROCESSED,  40954 VALUES WERE WRITTEN,
AND      0 VALUES WERE DISCARDED

FOR THE VARIABLE SELECTED, THE FOLLOWING STATISTICS WERE COMPUTED:
     MINIMUM: -6.510000D 02; MAXIMUM:  1.700000D 02; MEAN: -4.353328D 02; STD DEV:  1.248568D 02


OVERALL DATA LIMITS, -8.099032D 02 TO -5.076230D 01, WERE CHOSEN FROM DATA MEAN - AND + THREE STD DEVIATIONS
```

\+ + + + + + + + + B A R G R + + + + + + + + + +

TITLE: ONEILL; 13-POINT MEDIAN FILTERED MAGNETOMETER DATA (GAMMAS)

40650 VALUES CLASSIFIED; 304 VALUES NOT CLASSIFIED; 40954 TOTAL VALUES PROCESSED

CLASS INTERVAL IN USE IS 2.000000D 01

| | | | | |
|---|---|---|---|---|
| FOR THE CLASSIFIED DATA VALUES: | MINIMUM: | -6.510000D 02 | MAXIMUM: | -6.100000D 01 |
| | MEAN: | -4.387536D 02 | STD. DEV.: | 1.187622D 02 |

EACH BARGRAPH SYMBOL REPRESENTS 2.829167D 01 CLASS MEMBERS

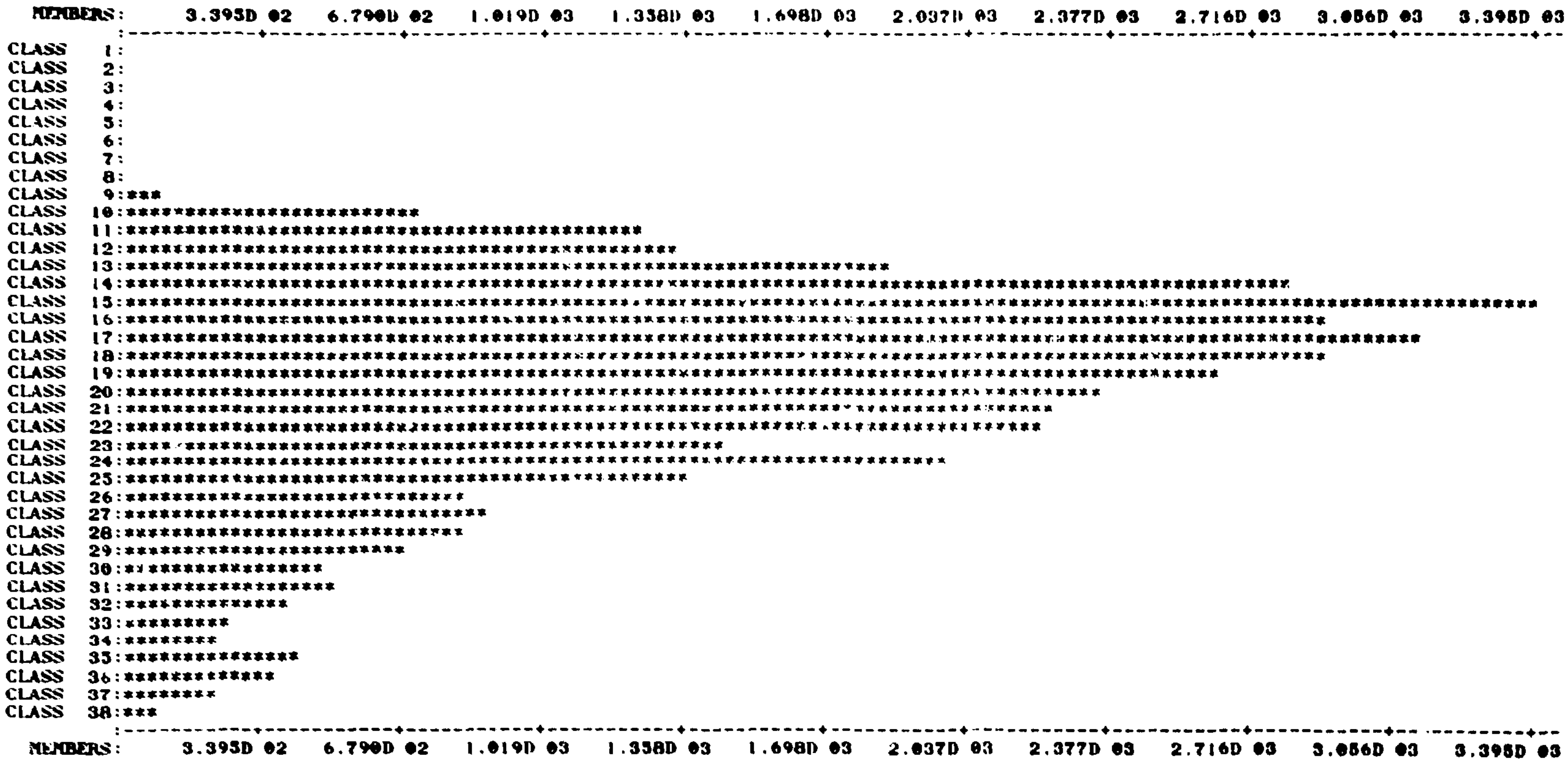
| | | | | |
|---|---|---|---|---|
| FOR THE ENTIRE DATA SET: | MINIMUM: | -6.510000D 02 | MAXIMUM: | 1.700000D 02 |
| | MEAN: | -4.353328D 02 | STD. DEV.: | 1.248568D 02 |

Appendix E-2 (Cont'd.)

ONEILL; 13-POINT MEDIAN FILTERED MAGNETOMETER DATA (GAMMAS)   CLASS LISTING - PAGE 1   01-21-81/18.47.37

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| CLASS | 1 | (-8.200000D 02::-8.000000D 02) | 0 MEMBERS | CLASS | 2 | 8.000000D 02::-7.800000D 02) | 0 MEMBERS |
| CLASS | 3 | (-7.800000D 02::-7.600000D 02) | 0 MEMBERS | CLASS | 4 | (-7.600000D 02::-7.400000D 02) | 0 MEMBERS |
| CLASS | 5 | (-7.400000D 02::-7.200000D 02) | 0 MEMBERS | CLASS | 6 | (-7.200000D 02::-7.000000D 02) | 0 MEMBERS |
| CLASS | 7 | (-7.000000D 02::-6.800000D 02) | 0 MEMBERS | CLASS | 8 | (-6.800000D 02::-6.600000D 02) | 0 MEMBERS |
| CLASS | 9 | (-6.600000D 02::-6.400000D 02) | 82 MEMBERS | CLASS | 10 | (-6.400000D 02::-6.200000D 02) | 700 MEMBERS |
| CLASS | 11 | (-6.200000D 02::-6.000000D 02) | 1231 MEMBERS | CLASS | 12 | (-6.000000D 02::-5.800000D 02) | 1329 MEMBERS |
| CLASS | 13 | (-5.800000D 02::-5.600000D 02) | 1844 MEMBERS | CLASS | 14 | (-5.600000D 02::-5.400000D 02) | 2802 MEMBERS |
| CLASS | 15 | (-5.400000D 02::-5.200000D 02) | 3395 MEMBERS | CLASS | 16 | (-5.200000D 02::-5.000000D 02) | 2875 MEMBERS |
| CLASS | 17 | (-5.000000D 02::-4.800000D 02) | 3103 MEMBERS | CLASS | 18 | (-4.800000D 02::-4.600000D 02) | 2899 MEMBERS |
| CLASS | 19 | (-4.600000D 02::-4.400000D 02) | 2637 MEMBERS | CLASS | 20 | (-4.400000D 02::-4.200000D 02) | 2343 MEMBERS |
| CLASS | 21 | (-4.200000D 02::-4.000000D 02) | 2231 MEMBERS | CLASS | 22 | (-4.000000D 02::-3.800000D 02) | 2215 MEMBERS |
| CLASS | 23 | (-3.800000D 02::-3.600000D 02) | 1430 MEMBERS | CLASS | 24 | (-3.600000D 02::-3.400000D 02) | 1973 MEMBERS |
| CLASS | 25 | (-3.400000D 02::-3.200000D 02) | 1371 MEMBERS | CLASS | 26 | (-3.200000D 02::-3.000000D 02) | 827 MEMBERS |
| CLASS | 27 | (-3.000000D 02::-2.800000D 02) | 888 MEMBERS | CLASS | 28 | (-2.800000D 02::-2.600000D 02) | 807 MEMBERS |
| CLASS | 29 | (-2.600000D 02::-2.400000D 02) | 680 MEMBERS | CLASS | 30 | (-2.400000D 02::-2.200000D 02) | 492 MEMBERS |
| CLASS | 31 | (-2.200000D 02::-2.000000D 02) | 517 MEMBERS | CLASS | 32 | (-2.000000D 02::-1.800000D 02) | 407 MEMBERS |
| CLASS | 33 | (-1.800000D 02::-1.600000D 02) | 245 MEMBERS | CLASS | 34 | (-1.600000D 02::-1.400000D 02) | 222 MEMBERS |
| CLASS | 35 | (-1.400000D 02::-1.200000D 02) | 417 MEMBERS | CLASS | 36 | (-1.200000D 02::-1.000000D 02) | 377 MEMBERS |
| CLASS | 37 | (-1.000000D 02::-8.000000D 01) | 218 MEMBERS | CLASS | 38 | (-8.000000D 01::-6.000000D 01) | 93 MEMBERS |

ONEILL: 13-POINT MEDIAN FILTERED MAGNETOMETER DATA (GAMMAS)   CLASS BARGRAPHS - PAGE 1   01-21-81/18.47.37




* * * * * * * * * * B A R G R * * * * * * * * * *

Appendix E-2 (Cont'd.)

Appendix E-3

**Survey- and Tie-line** Intersection Analysis: Magnetic **Anomaly**
**And Terrain Clearance** Differences and Intersection Component
**Separation** from Contractor-Supplied Data Set.

```
+-----------------------+
!                       !
!      NURE  DATA       !
! FLIGHT LINE/TIE LINE  !
! INTERSECTION ROUTINE  !
!                       !
+-----------------------+

GEOGRAPHIC DATA SYSTEMS GROUP
 UNION CARBIDE CORPORATION
     NUCLEAR  DIVISION

DATE: 01-21-87    TIME: 18.44.46

RUN IDENTIFICATION: ONEILL; FL/TL INTERSECT; CONTRACTOR MAGNETOM DATA (GAMMAS)

QUAD BOUNDARY:
     MINIMUM LATITUDE:    4.200000E 01     MAXIMUM LATITUDE:    4.300000E 01
     MINIMUM LONGITUDE:   9.800000E 01     MAXIMUM LONGITUDE:   1.000000E 02

INFORMATION READ FROM INPUT FILE HEADER:
     QUADRANGLE IDENTIFICATION:             ONEILL
     DATE OF CONVERSION TO GDS FORMAT:       11281
     SLOPE OF FLIGHT LINES:                 0.0
     COMMENTS:
          ONEILL QUADRANGLE - T1002

VARIABLE CHOSEN IS 'MAGNETOM' AND THE CLASS INTERVAL IS     1.0000

MEAN QUADRANGLE INTERPOINT DISTANCE (METERS):        6.662900E 01
INTERPOINT DISTANCE STANDARD DEVIATION (METERS):     1.849359E 01
THREE STANDARD DEVIATIONS (METERS):                  5.548077E 01

COMPUTED SEARCH INCREMENTS (DEGREES): LATITUDE:   4.501289E-04; LONGITUDE:   6.082754E-04
```

```
FLIGHT LINE NUMBER 101 - LAT:  4.297260E 01; LON:  9.988499E 01; N:  1.084149E 05; E: -7.219606E 04
     VARIABLE VALUE: -4.690009E 02; CLEARANCE:  1.188720E 02 METERS
   TIE LINE NUMBER 209 - LAT:  4.297249E 01; LON:  9.988519E 01; N:  1.084033E 05; E: -7.221238E 04
     VARIABLE VALUE: -4.690000E 02; CLEARANCE:  1.191768E 02 METERS
>>>>>FL POINT -> TL POINT DISTANCE:  2.006728E 01 METERS; CLEARANCE DIFFERENCE: -3.048096E-01 METERS
>>>>>-----> VALUE DIFFERENCE:  0.0         UNITS

***** THE DISTANCE BETWEEN THE POINT SELECTED FROM FLIGHT LINE 101 AND THE POINT SELECTED FROM TIE LINE 210 IS GREATER *****
***** THAN THREE STANDARD DEVIATIONS AWAY FROM THE MEAN INTERPOINT DISTANCE FOR THE QUAD.    ASSUMING NO INTERSECTION. *****

***** THE DISTANCE BETWEEN THE POINT SELECTED FROM FLIGHT LINE 101 AND THE POINT SELECTED FROM TIE LINE 211 IS GREATER *****
***** THAN THREE STANDARD DEVIATIONS AWAY FROM THE MEAN INTERPOINT DISTANCE FOR THE QUAD.    ASSUMING NO INTERSECTION. *****

***** THE DISTANCE BETWEEN THE POINT SELECTED FROM FLIGHT LINE 101 AND THE POINT SELECTED FROM TIE LINE 212 IS GREATER *****
***** THAN THREE STANDARD DEVIATIONS AWAY FROM THE MEAN INTERPOINT DISTANCE FOR THE QUAD.    ASSUMING NO INTERSECTION. *****

***** THE DISTANCE BETWEEN THE POINT SELECTED FROM FLIGHT LINE 102 AND THE POINT SELECTED FROM TIE LINE 209 IS GREATER *****
***** THAN THREE STANDARD DEVIATIONS AWAY FROM THE MEAN INTERPOINT DISTANCE FOR THE QUAD.    ASSUMING NO INTERSECTION. *****

FLIGHT LINE NUMBER 102 - LAT:  4.289609E 01; LON:  9.929549E 01; N:  9.957819E 04; E: -2.413508E 04
     VARIABLE VALUE: -3.430000E 02; CLEARANCE:  1.103376E 02 METERS
   TIE LINE NUMBER 210 - LAT:  4.289360E 01; LON:  9.929539E 01; N:  9.952394E 04; E: -2.412771E 04
     VARIABLE VALUE: -3.420000E 02; CLEARANCE:  1.133856E 02 METERS
>>>>>FL POINT -> TL POINT DISTANCE:  5.473749E 01 METERS; CLEARANCE DIFFERENCE: -3.048004E 00 METERS
>>>>>-----> VALUE DIFFERENCE: -1.000000E 00 UNITS

***** THE DISTANCE BETWEEN THE POINT SELECTED FROM FLIGHT LINE 102 AND THE POINT SELECTED FROM TIE LINE 211 IS GREATER *****
***** THAN THREE STANDARD DEVIATIONS AWAY FROM THE MEAN INTERPOINT DISTANCE FOR THE QUAD.    ASSUMING NO INTERSECTION. *****

***** THE DISTANCE BETWEEN THE POINT SELECTED FROM FLIGHT LINE 102 AND THE POINT SELECTED FROM TIE LINE 212 IS GREATER *****
***** THAN THREE STANDARD DEVIATIONS AWAY FROM THE MEAN INTERPOINT DISTANCE FOR THE QUAD.    ASSUMING NO INTERSECTION. *****

***** THE DISTANCE BETWEEN THE POINT SELECTED FROM FLIGHT LINE 103 AND THE POINT SELECTED FROM TIE LINE 209 IS GREATER *****
***** THAN THREE STANDARD DEVIATIONS AWAY FROM THE MEAN INTERPOINT DISTANCE FOR THE QUAD.    ASSUMING NO INTERSECTION. *****

FLIGHT LINE NUMBER 103 - LAT:  4.282430E 01; LON:  9.929610E 01; N:  9.160319E 04; E: -2.421259E 04
     VARIABLE VALUE: -3.650000E 02; CLEARANCE:  1.133836E 02 METERS
   TIE LINE NUMBER 210 - LAT:  4.282320E 01; LON:  9.929610E 01; N:  9.148113E 04; E: -2.421332E 04
     VARIABLE VALUE: -3.620000E 02; CLEARANCE:  1.085088E 02 METERS
>>>>>FL POINT -> TL POINT DISTANCE:  1.220632E 02 METERS; CLEARANCE DIFFERENCE:  4.876801E 00 METERS
>>>>>-----> VALUE DIFFERENCE: -3.000000E 00 UNITS

***** THE DISTANCE BETWEEN THE POINT SELECTED FROM FLIGHT LINE 103 AND THE POINT SELECTED FROM TIE LINE 211 IS GREATER *****
***** THAN THREE STANDARD DEVIATIONS AWAY FROM THE MEAN INTERPOINT DISTANCE FOR THE QUAD.    ASSUMING NO INTERSECTION. *****

FLIGHT LINE NUMBER 103 - LAT:  4.282489E 01; LON:  9.811069E 01; N:  9.201038E 04; E:  7.272175E 04
     VARIABLE VALUE: -2.310000E 02; CLEARANCE:  1.487424E 02 METERS
   TIE LINE NUMBER 212 - LAT:  4.282599E 01; LON:  9.811069E 01; N:  9.213244E 04, E:  7.272044E 04
     VARIABLE VALUE: -2.300000E 02; CLEARANCE:  1.267968E 02 METERS
>>>>>FL POINT -> TL POINT DISTANCE:  1.220695E 02 METERS; CLEARANCE DIFFERENCE:  2.194560E 01 METERS
>>>>>-----> VALUE DIFFERENCE: -1.000000E 00 UNITS

***** THE DISTANCE BETWEEN THE POINT SELECTED FROM FLIGHT LINE 104 AND THE POINT SELECTED FROM TIE LINE 209 IS GREATER *****
***** THAN THREE STANDARD DEVIATIONS AWAY FROM THE MEAN INTERPOINT DISTANCE FOR THE QUAD.    ASSUMING NO INTERSECTION. *****

***** THE DISTANCE BETWEEN THE POINT SELECTED FROM FLIGHT LINE 104 AND THE POINT SELECTED FROM TIE LINE 210 IS GREATER *****
***** THAN THREE STANDARD DEVIATIONS AWAY FROM THE MEAN INTERPOINT DISTANCE FOR THE QUAD.    ASSUMING NO INTERSECTION. *****

***** THE DISTANCE BETWEEN THE POINT SELECTED FROM FLIGHT LINE 104 AND THE POINT SELECTED FROM TIE LINE 211 IS GREATER *****
***** THAN THREE STANDARD DEVIATIONS AWAY FROM THE MEAN INTERPOINT DISTANCE FOR THE QUAD.    ASSUMING NO INTERSECTION. *****
```

```
***** THE DISTANCE BETWEEN THE POINT SELECTED FROM FLIGHT LINE 104 AND THE POINT SELECTED FROM TIE LINE 212 IS GREATER *****
***** THAN THREE STANDARD DEVIATIONS AWAY FROM THE MEAN INTERPOINT DISTANCE FOR THE QUAD.    ASSUMING NO INTERSECTION. *****

FLIGHT LINE NUMBER 105 - LAT:  4.267940E 01; LON:  9.989040E 01; N:  7.584925E 04; E: -7.290088E 04
      VARIABLE VALUE: -3.850000E 02; CLEARANCE:  1.097280E 02 METERS
   TIE LINE NUMBER 209 - LAT:  4.267949E 01; LON:  9.989049E 01; N:  7.585950E 04; E: -7.298825E 04
      VARIABLE VALUE: -3.850000E 02; CLEARANCE:  1.277112E 02 METERS
>>>>>FL POINT -> TL POINT DISTANCE:  1.262747E 01 METERS; CLEARANCE DIFFERENCE: -1.798320E 01 METERS
>>>>>------> VALUE DIFFERENCE:  0.0          UNITS

***** THE DISTANCE BETWEEN THE POINT SELECTED FROM FLIGHT LINE 105 AND THE POINT SELECTED FROM TIE LINE 210 IS GREATER *****
***** THAN THREE STANDARD DEVIATIONS AWAY FROM THE MEAN INTERPOINT DISTANCE FOR THE QUAD.    ASSUMING NO INTERSECTION. *****

***** THE DISTANCE BETWEEN THE POINT SELECTED FROM FLIGHT LINE 105 AND THE POINT SELECTED FROM TIE LINE 211 IS GREATER *****
***** THAN THREE STANDARD DEVIATIONS AWAY FROM THE MEAN INTERPOINT DISTANCE FOR THE QUAD.    ASSUMING NO INTERSECTION. *****

***** THE DISTANCE BETWEEN THE POINT SELECTED FROM FLIGHT LINE 105 AND THE POINT SELECTED FROM TIE LINE 212 IS GREATER *****
***** THAN THREE STANDARD DEVIATIONS AWAY FROM THE MEAN INTERPOINT DISTANCE FOR THE QUAD.    ASSUMING NO INTERSECTION. *****

***** THE DISTANCE BETWEEN THE POINT SELECTED FROM FLIGHT LINE 106 AND THE POINT SELECTED FROM TIE LINE 209 IS GREATER *****
***** THAN THREE STANDARD DEVIATIONS AWAY FROM THE MEAN INTERPOINT DISTANCE FOR THE QUAD.    ASSUMING NO INTERSECTION. *****

***** THE DISTANCE BETWEEN THE POINT SELECTED FROM FLIGHT LINE 106 AND THE POINT SELECTED FROM TIE LINE 210 IS GREATER *****
***** THAN THREE STANDARD DEVIATIONS AWAY FROM THE MEAN INTERPOINT DISTANCE FOR THE QUAD.    ASSUMING NO INTERSECTION. *****

***** THE DISTANCE BETWEEN THE POINT SELECTED FROM FLIGHT LINE 106 AND THE POINT SELECTED FROM TIE LINE 211 IS GREATER *****
***** THAN THREE STANDARD DEVIATIONS AWAY FROM THE MEAN INTERPOINT DISTANCE FOR THE QUAD.    ASSUMING NO INTERSECTION. *****

***** THE DISTANCE BETWEEN THE POINT SELECTED FROM FLIGHT LINE 106 AND THE POINT SELECTED FROM TIE LINE 212 IS GREATER *****
***** THAN THREE STANDARD DEVIATIONS AWAY FROM THE MEAN INTERPOINT DISTANCE FOR THE QUAD.    ASSUMING NO INTERSECTION. *****

***** THE DISTANCE BETWEEN THE POINT SELECTED FROM FLIGHT LINE 107 AND THE POINT SELECTED FROM TIE LINE 209 IS GREATER *****
***** THAN THREE STANDARD DEVIATIONS AWAY FROM THE MEAN INTERPOINT DISTANCE FOR THE QUAD.    ASSUMING NO INTERSECTION. *****

FLIGHT LINE NUMBER 107 - LAT:  4.253539E 01; LON:  9.929059E 01; N:  5.950867E 04; E: -2.387279E 04
      VARIABLE VALUE: -4.610000E 02; CLEARANCE:  1.240536E 02 METERS
   TIE LINE NUMBER 210 - LAT:  4.253529E 01; LON:  9.929070E 01; N:  5.949853E 04; E: -2.388159E 04
      VARIABLE VALUE: -4.610000E 02; CLEARANCE:  1.143000E 02 METERS
>>>>>FL POINT -> TL POINT DISTANCE:  1.343219E 01 METERS; CLEARANCE DIFFERENCE:  9.753601E 00 METERS
>>>>>------> VALUE DIFFERENCE:  0.0          UNITS
```

* * * * * * * * * * B A R G R * * * * * * * * * *

TITLE: ONEILL; FL/TL INTERSECT; CONTRACTOR MAGNETON DATA (CAMMAS)

12 VALUES CLASSIFIED; 0 VALUES NOT CLASSIFIED; 12 TOTAL VALUES PROCESSED

CLASS INTERVAL IN USE IS 1.0000000D 00

| | | | | |
|---|---|---|---|---|
| FOR THE CLASSIFIED DATA VALUES: | MINIMUM: | -3.0000000D 00 | MAXIMUM: | 1.0000000D 00 |
| | MEAN: | -4.1666667D-01 | STD. DEV.: | 9.5379360D-01 |

EACH BARGRAPH SYMBOL REPRESENTS 5.8333333D-02 CLASS MEMBERS

Appendix E-3 (Cont'd.)

```
ONEILL; FL/TL INTERSECT; CONTRACTOR MAGNETON DATA (GAMMAS)    CLASS LISTING - PAGE  1                        01-21-81/18.45.29
        CLASS   1 (-3.0000000D 00::-2.0000000D 00)     1 MEMBERS        CLASS   2 (-2.0000000D 00::-1.0000000D 00)    0 MEMBERS
        CLASS   3 (-1.0000000D 00:: 0.0           )    3 MEMBERS        CLASS   4 ( 0.0           :: 1.0000000D 00)    7 MEMBERS
        CLASS   5 ( 1.0000000D 00:: 2.0000000D 00)     1 MEMBERS
```

```
ONEILL: FL/TL INTERSECT: CONTRACTOR MAGNETOM DATA (GAMMAS)    CLASS BARGRAPHS - PAGE  1                  01-21-81/18.45.29

  MEMBERS:     7.000D-01   1.400D 00   2.100D 00   2.800D 00   3.500D 00   4.200D 00   4.900D 00   5.600D 00   6.300D 00   7.000D 00
          :------------+------------+------------+------------+------------+------------+------------+------------+------------+------------+--
CLASS    1:******************
CLASS    2:
CLASS    3:******************************************************
CLASS    4:********************************************************************************************************************************
CLASS    5:******************
          :------------+------------+------------+------------+------------+------------+------------+------------+------------+------------+--
  MEMBERS:     7.000D-01   1.400D 00   2.100D 00   2.800D 00   3.500D 00   4.200D 00   4.900D 00   5.600D 00   6.300D 00   7.000D 00

                          + + + + + + + + + +  B A R G R  + + + + + + + + + +
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Appendix E-3 (Cont'd.)

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TITLE: CLEARANCE DIFFERENCES: FL AND TL INTERSECTION POINTS--METERS

12 VALUES CLASSIFIED; 0 VALUES NOT CLASSIFIED; 12 TOTAL VALUES PROCESSED

CLASS INTERVAL IN USE IS [illegible].0000000D 00

| | | | | |
|---|---|---|---|---|
| FOR THE CLASSIFIED DATA VALUES: | MINIMUM: -1.798320D 01 | | MAXIMUM: 2.194560D 01 | |
| | MEAN: 9.651985D-01 | | STD. DEV.: 1.002126D 01 | |

EACH BARGRAPH SYMBOL REPRESENTS 2.500000D-02 CLASS MEMBERS

```
CLEARANCE DIFFERENCES: FL AND TL INTERSECTION POINTS--METERS  CLASS LISTING - PAGE  1                    01-21-81/18.45.30

        CLASS   1 (-2.000000D 01::-1.500000D 01)    1 MEMBERS       CLASS   2 (-1.500000D 01::-1.000000D 01)    0 MEMBERS
        CLASS   3 (-1.000000D 01::-5.000000D 00)    2 MEMBERS       CLASS   4 (-5.000000D 00:: 0.0          )    3 MEMBERS
        CLASS   5 ( 0.0          :: 5.000000D 00)    3 MEMBERS       CLASS   6 ( 5.000000D 00:: 1.000000D 01)    1 MEMBERS
        CLASS   7 ( 1.000000D 01:: 1.500000D 01)    1 MEMBERS       CLASS   8 ( 1.500000D 01:: 2.000000D 01)    0 MEMBERS
        CLASS   9 ( 2.000000D 01:: 2.500000D 01)    1 MEMBERS
```

```
CLEARANCE DIFFERENCES: FL AND TL INTERSECTION POINTS--METERS  CLASS BARGRAPHS - PAGE  1                   01-21-81/18.45.30

  MEMBERS:      3.000D-01    6.000D-01    9.000D-01    1.200D 00    1.500D 00    1.800D 00    2.100D 00    2.400D 00    2.700D 00    3.000D 00
           :-----------+-----------+-----------+-----------+-----------+-----------+-----------+-----------+-----------+-----------+--
CLASS     1:****************************************
CLASS     2:
CLASS     3:********************************************************************************
CLASS     4:************************************************************************************************************************
CLASS     5:************************************************************************************************************************
CLASS     6:****************************************
CLASS     7:****************************************
CLASS     8:
CLASS     9:****************************************
           :-----------+-----------+-----------+-----------+-----------+-----------+-----------+-----------+-----------+-----------+--
  MEMBERS:      3.000D-01    6.000D-01    9.000D-01    1.200D 00    1.500D 00    1.800D 00    2.100D 00    2.400D 00    2.700D 00    3.000D 00


                    + + + + + + + + + + B A R G R + + + + + + + + + +
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Appendix E-3 (Cont'd.)

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+ + + + + + + + + + B A R G R + + + + + + + + + +

TITLE: DISTANCES BETWEEN FL AND TL INTERSECTION POINTS - METERS

   12 VALUES CLASSIFIED;      0 VALUES NOT CLASSIFIED;     12 TOTAL VALUES PROCESSED
CLASS INTERVAL IN USE IS  1.000000D 01

FOR THE CLASSIFIED DATA VALUES:    MINIMUM:    1.262747D 01     MAXIMUM:    1.220695D 02
                                   MEAN:       5.802328D 01     STD. DEV.:  4.165111D 01

EACH BARGRAPH SYMBOL REPRESENTS  3.333333D-02 CLASS MEMBERS
```

Appendix E-3 (Cont'd.)

DISTANCES BETWEEN FL AND TL INTERSECTION POINTS - METERS CLASS LISTING - PAGE 1 01-21-81/18.45.30

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| CLASS | 1 | ( 1.000000D 01:: 2.000000D 01) | 4 MEMBERS | CLASS | 2 | ( 2.000000D 01:: 3.000000D 01) | 1 MEMBERS |
| CLASS | 3 | ( 3.000000D 01:: 4.000000D 01) | 0 MEMBERS | CLASS | 4 | ( 4.000000D 01:: 5.000000D 01) | 0 MEMBERS |
| CLASS | 5 | ( 5.000000D 01:: 6.000000D 01) | 1 MEMBERS | CLASS | 6 | ( 6.000000D 01:: 7.000000D 01) | 2 MEMBERS |
| CLASS | 7 | ( 7.000000D 01:: 8.000000D 01) | 1 MEMBERS | CLASS | 8 | ( 8.000000D 01:: 9.000000D 01) | 0 MEMBERS |
| CLASS | 9 | ( 9.000000D 01:: 1.000000D 02) | 0 MEMBERS | CLASS | 10 | ( 1.000000D 02:: 1.100000D 02) | 0 MEMBERS |
| CLASS | 11 | ( 1.100000D 02:: 1.200000D 02) | 1 MEMBERS | CLASS | 12 | ( 1.200000D 02:: 1.300000D 02) | 2 MEMBERS |

```
DISTANCES BETWEEN FL AND TL INTERSECTION POINTS - METERS      CLASS BARGRAPHS - PAGE  1                      01-21-81/18.45.30
  MEMBERS:      4.000D-01    8.000D-01    1.200D 00    1.600D 00    2.000D 00    2.400D 00    2.800D 00    3.200D 00    3.600D 00    4.000D 00
            :-----------+-----------+-----------+-----------+-----------+-----------+-----------+-----------+-----------+-----------+--
CLASS    1:************************************************************************************************************************
CLASS    2:******************************
CLASS    3:
CLASS    4:
CLASS    5:******************************
CLASS    6:************************************************************
CLASS    7:******************************
CLASS    8:
CLASS    9:
CLASS   10:
CLASS   11:******************************
CLASS   12:************************************************************
            :-----------+-----------+-----------+-----------+-----------+-----------+-----------+-----------+-----------+-----------+--
  MEMBERS:      4.000D-01    8.000D-01    1.200D 00    1.600D 00    2.000D 00    2.400D 00    2.800D 00    3.200D 00    3.600D 00    4.000D 00

                         + + + + + + + + + + B A R G R + + + + + + + + + +
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Appendix E-3 (Cont'd.)

## Appendix E-4

### Time-Based Slope and Dispersion Analysis: Magnetic Monitor Data For 10-Minute Intervals from Contractor-Supplied Data Set.

```
*****************************************
**** TIME BASED QUALITY EVALUATION ****
*****************************************

DATE JOB RUN:  01-21-81

NAME OF QUADRANGLE:  ONEILL; MAGNETIC MONITOR DATA

SOUTHERN LATITUDE:  42.00      NORTHERN LATITUDE:  43.00

EASTERN LONGITUDE:  98.00      WESTERN LONGITUDE: 100.00

FLIGHT LINE OPTION (FL/TL/BOTH) : BOTH

VARIABLE TYPE : MAGMON
```

CLASS INTERVALS

| TIME MINUTES | SLOPE GAM/MIN | SIGMA GAMMAS | RHO GAMMAS | LMSE |
|---|---|---|---|---|
| 1 | 0.0 | 0.0 | 0.25000E-01 | 0.0 |
| 3 | 0.0 | 0.0 | 0.25000E-01 | 0.0 |
| 10 | 0.0 | 0.0 | 0.25000E-01 | 0.0 |

*NOTE : CLASS INTERVAL OF 0.0 WILL CAUSE PROGRAM TO USE DEFAULTS COMPUTED AS 1/50 THE TOTAL INTERVAL IF AND ONLY IF MIN > MAX IN BOUNDARY SELECTION CRITERIA (SEE BELOW).

MIN/MAX BOUNDARIES

| MIN/MAX | MIN/MAX | MIN/MAX | MIN/MAX |
|---|---|---|---|
| 0.10000E 01 | 0.10000E 01 | -0.10000E 01 | 0.10000E 01 |
| -0.10000E 01 | -0.10000E 01 | 0.10000E 01 | -0.10000E 01 |
| 0.10000E 01 | 0.10000E 01 | -0.10000E 01 | 0.10000E 01 |
| -0.10000E 01 | -0.10000E 01 | 0.10000E 01 | -0.10000E 01 |
| 0.10000E 01 | 0.10000E 01 | -0.10000E 01 | 0.10000E 01 |
| -0.10000E 01 | -0.10000E 01 | 0.10000E 01 | -0.10000E 01 |

*NOTE : MIN > MAX WILL CAUSE PROGRAM TO COMPUTE BOUNDARIES WITHIN 2 STANDARD DEVIATIONS OF THE MEAN. MIN = MAX = 0. WILL CAUSE PROGRAM TO USE ACTUAL DATA MIN/MAX.

NUMBER OF RECS .        420

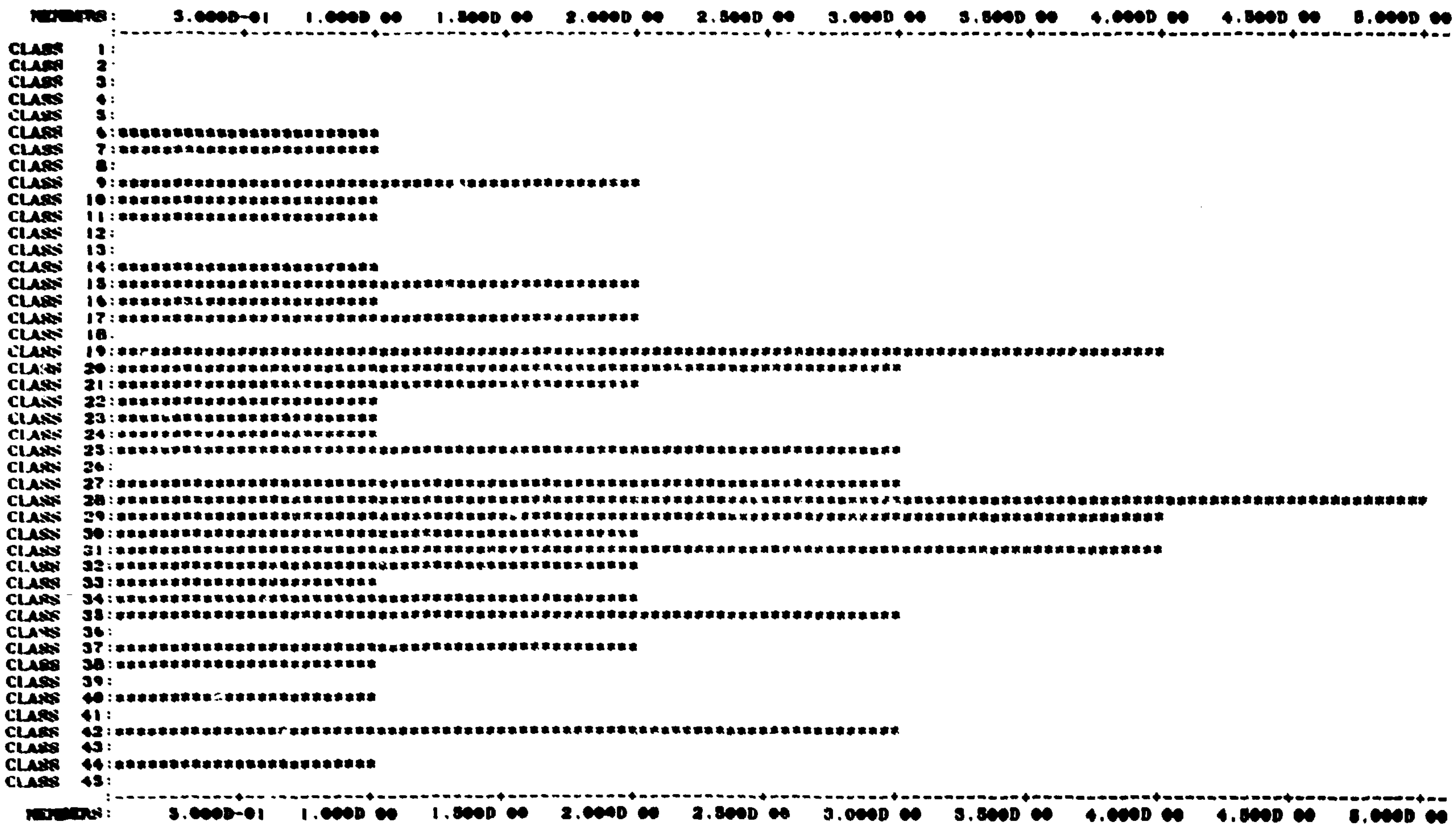
```
* * * * * * * * * * B A R G R * * * * * * * * * *

TITLE: ONEILL; MAGNETIC MONITOR DATA                SLOPE   10 MIN


   64 VALUES CLASSIFIED;      5 VALUES NOT CLASSIFIED;     69 TOTAL VALUES PROCESSED

CLASS INTERVAL IN USE IS  1.7883330D-02


FOR THE CLASSIFIED DATA VALUES:    MINIMUM:   -3.591836D-01     MAXIMUM:    4.062960D-01
                                   MEAN:       8.170177D-03     STD. DEV.:  1.810548D-01


EACH BARGRAPH SYMBOL REPRESENTS  4.166667D-02 CLASS MEMBERS


FOR THE ENTIRE DATA SET:           MINIMUM:   -5.190121D-01     MAXIMUM:    6.266851D-01
                                   MEAN:      -1.174775D-02     STD. DEV.:  2.235416D-01
```

Appendix E-4 (Cont'd.)

ONEILL; MAGNETIC MONITOR DATA SLOPE 10 MIN CLASS LISTING - PAGE 1 01-21-81/18.46.34

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| CLASS | 1 (-4.649665D-01::-4.470832D-01) | 0 | MEMBERS | CLASS | 2 (-4.470832D-01::-4.291999D-01) | 0 | MEMBERS |
| CLASS | 3 (-4.291999D-01::-4.113166D-01) | 0 | MEMBERS | CLASS | 4 (-4.113166D-01::-3.934332D-01) | 0 | MEMBERS |
| CLASS | 5 (-3.934332D-01::-3.755499D-01) | 0 | MEMBERS | CLASS | 6 (-3.755499D-01::-3.576666D-01) | 1 | MEMBERS |
| CLASS | 7 (-3.576666D-01::-3.397832D-01) | 1 | MEMBERS | CLASS | 8 (-3.397832D-01::-3.218999D-01) | 0 | MEMBERS |
| CLASS | 9 (-3.218999D-01::-3.040166D-01) | 2 | MEMBERS | CLASS | 10 (-3.040166D-01::-2.861333D-01) | 1 | MEMBERS |
| CLASS | 11 (-2.861333D-01::-2.682499D-01) | 1 | MEMBERS | CLASS | 12 (-2.682499D-01::-2.503666D-01) | 0 | MEMBERS |
| CLASS | 13 (-2.503666D-01::-2.324833D-01) | 0 | MEMBERS | CLASS | 14 (-2.324833D-01::-2.145999D-01) | 1 | MEMBERS |
| CLASS | 15 (-2.145999D-01::-1.967166D-01) | 2 | MEMBERS | CLASS | 16 (-1.967166D-01::-1.788333D-01) | 1 | MEMBERS |
| CLASS | 17 (-1.788333D-01::-1.609500D-01) | 2 | MEMBERS | CLASS | 18 (-1.609500D-01::-1.430666D-01) | 0 | MEMBERS |
| CLASS | 19 (-1.430666D-01::-1.251833D-01) | 4 | MEMBERS | CLASS | 20 (-1.251833D-01::-1.073000D-01) | 3 | MEMBERS |
| CLASS | 21 (-1.073000D-01::-8.941664D-02) | 2 | MEMBERS | CLASS | 22 (-8.941664D-02::-7.153331D-02) | 1 | MEMBERS |
| CLASS | 23 (-7.153331D-02::-5.364999D-02) | 1 | MEMBERS | CLASS | 24 (-5.364999D-02::-3.576666D-02) | 1 | MEMBERS |
| CLASS | 25 (-3.576666D-02::-1.788333D-02) | 3 | MEMBERS | CLASS | 26 (-1.788333D-02:: 0.0 ) | 0 | MEMBERS |
| CLASS | 27 ( 0.0 :: 1.788333D-02) | 3 | MEMBERS | CLASS | 28 ( 1.788333D-02:: 3.576666D-02) | 5 | MEMBERS |
| CLASS | 29 ( 3.576666D-02:: 5.364999D-02) | 4 | MEMBERS | CLASS | 30 ( 5.364999D-02:: 7.153331D-02) | 2 | MEMBERS |
| CLASS | 31 ( 7.153331D-02:: 8.941664D-02) | 4 | MEMBERS | CLASS | 32 ( 8.941664D-02:: 1.073000D-01) | 2 | MEMBERS |
| CLASS | 33 ( 1.073000D-01:: 1.251833D-01) | 1 | MEMBERS | CLASS | 34 ( 1.251833D-01:: 1.430666D-01) | 2 | MEMBERS |
| CLASS | 35 ( 1.430666D-01:: 1.609500D-01) | 3 | MEMBERS | CLASS | 36 ( 1.609500D-01:: 1.788333D-01) | 0 | MEMBERS |
| CLASS | 37 ( 1.788333D-01:: 1.967166D-01) | 2 | MEMBERS | CLASS | 38 ( 1.967166D-01:: 2.145999D-01) | 1 | MEMBERS |
| CLASS | 39 ( 2.145999D-01:: 2.324833D-01) | 0 | MEMBERS | CLASS | 40 ( 2.324833D-01:: 2.503666D-01) | 1 | MEMBERS |
| CLASS | 41 ( 2.503666D-01:: 2.682499D-01) | 0 | MEMBERS | CLASS | 42 ( 2.682499D-01:: 2.861333D-01) | 3 | MEMBERS |
| CLASS | 43 ( 2.861333D-01:: 3.040166D-01) | 0 | MEMBERS | CLASS | 44 ( 3.040166D-01:: 3.218999D-01) | 1 | MEMBERS |
| CLASS | 45 ( 3.218999D-01:: 3.397832D-01) | 0 | MEMBERS | CLASS | 46 ( 3.397832D-01:: 3.576666D-01) | 1 | MEMBERS |
| CLASS | 47 ( 3.576666D-01:: 3.755499D-01) | 1 | MEMBERS | CLASS | 48 ( 3.755499D-01:: 3.934332D-01) | 0 | MEMBERS |
| CLASS | 49 ( 3.934333D-01:: 4.113166D-01) | 1 | MEMBERS | CLASS | 50 ( 4.113166D-01:: 4.291999D-01) | 0 | MEMBERS |

OREILL; MAGNETIC MONITOR DATA  SLOPE  10 MIN  CLASS BARGRAPHS - PAGE 1  01-21-81/18.46.34




Appendix E-4 (Cont'd.)

```
ONEILL: MAGNETIC MONITOR DATA               SLOPE    10 MIN   CLASS BARGRAPHS - PAGE  2                  01-21-81/18.46.34

  MEMBERS:        5.000D-01   1.000D 00   1.500D 00   2.000D 00   2.500D 00   3.000D 00   3.500D 00   4.000D 00   4.500D 00   5.000D 00
          :-----------+-----------+-----------+-----------+-----------+-----------+-----------+-----------+-----------+-----------+--
CLASS   46:************************
CLASS   47:************************
CLASS   48:
CLASS   49:************************
CLASS   50:
          :-----------+-----------+-----------+-----------+-----------+-----------+-----------+-----------+-----------+-----------+--
  MEMBERS:        5.000D-01   1.000D 00   1.500D 00   2.000D 00   2.500D 00   3.000D 00   3.500D 00   4.000D 00   4.500D 00   5.000D 00

                     + + + + + + + + + +  B A R G R  + + + + + + + + + +
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Appendix E-4 (Cont'd.)

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* * * * * * * * * * B A R G R * * * * * * * * * *

TITLE: ONEILL; MAGNETIC MONITOR DATA               SIGMA   10 MIN


    66 VALUES CLASSIFIED;      3 VALUES NOT CLASSIFIED;      69 TOTAL VALUES PROCESSED

CLASS INTERVAL IN USE IS  9.742036D-03


FOR THE CLASSIFIED DATA VALUES:     MINIMUM:     1.097650D-01     MAXIMUM:     4.821131D-01
                                    MEAN:        2.506315D-01     STD. DEV.:   8.695461D-02


EACH BARGRAPH SYMBOL REPRESENTS  5.833333D-02 CLASS MEMBERS


FOR THE ENTIRE DATA SET:            MINIMUM:     1.097650D-01     MAXIMUM:     8.844128D-01
                                    MEAN:        2.675466D-01     STD. DEV.:   1.217753D-01
```

Appendix E-4 (Cont'd.)

ONEILL: MAGNETIC MONITOR DATA SIGMA 10 MIN CLASS LISTING - PAGE 1 01-21-81/18.46.37

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| CLASS 1 | ( 1.948408D-02:: | 2.922611D-02) | 0 | MEMBERS | CLASS 2 | ( 2.922611D-02:: | 3.896815D-02) | 0 | MEMBERS |
| CLASS 3 | ( 3.896815D-02:: | 4.871019D-02) | 0 | MEMBERS | CLASS 4 | ( 4.871019D-02:: | 5.845223D-02) | 0 | MEMBERS |
| CLASS 5 | ( 5.845223D-02:: | 6.819427D-02) | 0 | MEMBERS | CLASS 6 | ( 6.819427D-02:: | 7.793631D-02) | 0 | MEMBERS |
| CLASS 7 | ( 7.793631D-02:: | 8.767834D-02) | 0 | MEMBERS | CLASS 8 | ( 8.767834D-02:: | 9.742038D-02) | 0 | MEMBERS |
| CLASS 9 | ( 9.742038D-02:: | 1.071624D-01) | 0 | MEMBERS | CLASS 10 | ( 1.071624D-01:: | 1.169045D-01) | 1 | MEMBERS |
| CLASS 11 | ( 1.169045D-01:: | 1.266465D-01) | 1 | MEMBERS | CLASS 12 | ( 1.266465D-01:: | 1.363885D-01) | 0 | MEMBERS |
| CLASS 13 | ( 1.363885D-01:: | 1.461306D-01) | 1 | MEMBERS | CLASS 14 | ( 1.461306D-01:: | 1.558726D-01) | 2 | MEMBERS |
| CLASS 15 | ( 1.558726D-01:: | 1.656147D-01) | 3 | MEMBERS | CLASS 16 | ( 1.656147D-01:: | 1.753567D-01) | 4 | MEMBERS |
| CLASS 17 | ( 1.753567D-01:: | 1.850987D-01) | 4 | MEMBERS | CLASS 18 | ( 1.850987D-01:: | 1.948408D-01) | 2 | MEMBERS |
| CLASS 19 | ( 1.948408D-01:: | 2.045828D-01) | 3 | MEMBERS | CLASS 20 | ( 2.045828D-01:: | 2.143248D-01) | 6 | MEMBERS |
| CLASS 21 | ( 2.143248D-01:: | 2.240669D-01) | 7 | MEMBERS | CLASS 22 | ( 2.240669D-01:: | 2.338089D-01) | 5 | MEMBERS |
| CLASS 23 | ( 2.338089D-01:: | 2.435510D-01) | 0 | MEMBERS | CLASS 24 | ( 2.435510D-01:: | 2.532930D-01) | 2 | MEMBERS |
| CLASS 25 | ( 2.532930D-01:: | 2.630350D-01) | 4 | MEMBERS | CLASS 26 | ( 2.630350D-01:: | 2.727771D-01) | 0 | MEMBERS |
| CLASS 27 | ( 2.727771D-01:: | 2.825191D-01) | 1 | MEMBERS | CLASS 28 | ( 2.825191D-01:: | 2.922611D-01) | 2 | MEMBERS |
| CLASS 29 | ( 2.922611D-01:: | 3.020032D-01) | 3 | MEMBERS | CLASS 30 | ( 3.020032D-01:: | 3.117452D-01) | 1 | MEMBERS |
| CLASS 31 | ( 3.117452D-01:: | 3.214873D-01) | 0 | MEMBERS | CLASS 32 | ( 3.214873D-01:: | 3.312293D-01) | 0 | MEMBERS |
| CLASS 33 | ( 3.312293D-01:: | 3.409713D-01) | 2 | MEMBERS | CLASS 34 | ( 3.409713D-01:: | 3.507134D-01) | 2 | MEMBERS |
| CLASS 35 | ( 3.507134D-01:: | 3.604554D-01) | 0 | MEMBERS | CLASS 36 | ( 3.604554D-01:: | 3.701975D-01) | 1 | MEMBERS |
| CLASS 37 | ( 3.701975D-01:: | 3.799395D-01) | 1 | MEMBERS | CLASS 38 | ( 3.799395D-01:: | 3.896815D-01) | 1 | MEMBERS |
| CLASS 39 | ( 3.896815D-01:: | 3.994236D-01) | 2 | MEMBERS | CLASS 40 | ( 3.994236D-01:: | 4.091656D-01) | 1 | MEMBERS |
| CLASS 41 | ( 4.091656D-01:: | 4.189076D-01) | 0 | MEMBERS | CLASS 42 | ( 4.189076D-01:: | 4.286497D-01) | 0 | MEMBERS |
| CLASS 43 | ( 4.286497D-01:: | 4.383917D-01) | 1 | MEMBERS | CLASS 44 | ( 4.383917D-01:: | 4.481338D-01) | 1 | MEMBERS |
| CLASS 45 | ( 4.481338D-01:: | 4.578758D-01) | 1 | MEMBERS | CLASS 46 | ( 4.578758D-01:: | 4.676178D-01) | 0 | MEMBERS |
| CLASS 47 | ( 4.676178D-01:: | 4.773599D-01) | 0 | MEMBERS | CLASS 48 | ( 4.773599D-01:: | 4.871019D-01) | 1 | MEMBERS |
| CLASS 49 | ( 4.871019D-01:: | 4.968440D-01) | 0 | MEMBERS | CLASS 50 | ( 4.968440D-01:: | 5.065860D-01) | 0 | MEMBERS |

```
ONEILL: MAGNETIC MONITOR DATA              SIGMA    10 MIN   CLASS BARGRAPHS - PAGE  1                                    01-21-81/18.46.57

   MEMBERS:       7.000D-01   1.400D 00   2.100D 00   2.800D 00   3.500D 00   4.200D 00   4.900D 00   5.600D 00   6.300D 00   7.000D 00
             :-----------+-----------+-----------+-----------+-----------+-----------+-----------+-----------+-----------+-----------+--
CLASS    1:
CLASS    2:
CLASS    3:
CLASS    4:
CLASS    5:
CLASS    6:
CLASS    7:
CLASS    8:
CLASS    9:
CLASS   10:*****************
CLASS   11:*****************
CLASS   12:
CLASS   13:*****************
CLASS   14:**********************************
CLASS   15:***************************************************
CLASS   16:*********************************************************************
CLASS   17:*********************************************************************
CLASS   18:**********************************
CLASS   19:***************************************************
CLASS   20:*******************************************************************************************************
CLASS   21:************************************************************************************************************************
CLASS   22:**************************************************************************************
CLASS   23:
CLASS   24:**********************************
CLASS   25:*********************************************************************
CLASS   26:
CLASS   27:*****************
CLASS   28:**********************************
CLASS   29:***************************************************
CLASS   30:*****************
CLASS   31:
CLASS   32:
CLASS   33:**********************************
CLASS   34:**********************************
CLASS   35:
CLASS   36:*****************
CLASS   37:*****************
CLASS   38:*****************
CLASS   39:**********************************
CLASS   40:*****************
CLASS   41:
CLASS   42:
CLASS   43:*****************
CLASS   44:*****************
CLASS   45:*****************
             :-----------+-----------+-----------+-----------+-----------+-----------+-----------+-----------+-----------+-----------+--
   MEMBERS:       7.000D-01   1.400D 00   2.100D 00   2.800D 00   3.500D 00   4.200D 00   4.900D 00   5.600D 00   6.300D 00   7.000D 00
```

Appendix E-4 (Cont'd.)

Appendix E-4 (Cont'd.)

```
ONEILL, MAGNETIC MONITOR DATA            SIGMA   10 MIN   CLASS BARGRAPHS - PAGE  2                 01-21-81/18.46.37

  MEMBERS:     7.000D-01   1.400D 00   2.100D 00   2.800D 00   3.500D 00   4.200D 00   4.900D 00   5.600D 00   6.300D 00   7.000D 00
          :-----------+-----------+-----------+-----------+-----------+-----------+-----------+-----------+-----------+-----------+
CLASS  46:
CLASS  47:
CLASS  48:****************
CLASS  49:
CLASS  50:
          :-----------+-----------+-----------+-----------+-----------+-----------+-----------+-----------+-----------+-----------+
  MEMBERS:     7.000D-01   1.400D 00   2.100D 00   2.800D 00   3.500D 00   4.200D 00   4.900D 00   5.600D 00   6.300D 00   7.000D 00

                        + + + + + + + + + +  B A R G R  + + + + + + + + + +
```

* * * * * * * * * * B A R G R * * * * * * * * * *

TITLE: ONEILL; MAGNETIC MONITOR DATA    RHO    10 MIN

69 VALUES CLASSIFIED;    0 VALUES NOT CLASSIFIED;    69 TOTAL VALUES PROCESSED

CLASS INTERVAL IN USE IS  2.5000000D-02

FOR THE CLASSIFIED DATA VALUES:    MINIMUM:   -9.529399D-01    MAXIMUM:    9.685546D-01
MEAN:    1.190321D-02    STD. DEV.:  6.613176D-01

EACH BARGRAPH SYMBOL REPRESENTS  4.166667D-02 CLASS MEMBERS

Appendix E-4 (Cont'd.)

```
ONEILL, MAGNETIC MONITOR DATA                RHO     10 MIN   CLASS LISTING - PAGE  1                        01-21-81/18.46.40
        CLASS   1 (-1.025000D 00:::-9.999999D-01)   0 MEMBERS      CLASS   2 (-9.999999D-01:::-9.749999D-01)   0 MEMBERS
        CLASS   3 (-9.749999D-01:::-9.499999D-01)   1 MEMBERS      CLASS   4 (-9.499999D-01:::-9.249999D-01)   0 MEMBERS
        CLASS   5 (-9.249999D-01:::-8.999999D-01)   5 MEMBERS      CLASS   6 (-8.999999D-01:::-8.749999D-01)   1 MEMBERS
        CLASS   7 (-8.749999D-01:::-8.499999D-01)   2 MEMBERS      CLASS   8 (-8.499999D-01:::-8.250000D-01)   3 MEMBERS
        CLASS   9 (-8.250000D-01:::-8.000000D-01)   1 MEMBERS      CLASS  10 (-8.000000D-01:::-7.750000D-01)   0 MEMBERS
        CLASS  11 (-7.750000D-01:::-7.500000D-01)   3 MEMBERS      CLASS  12 (-7.500000D-01:::-7.250000D-01)   1 MEMBERS
        CLASS  13 (-7.250000D-01:::-7.000000D-01)   2 MEMBERS      CLASS  14 (-7.000000D-01:::-6.750000D-01)   0 MEMBERS
        CLASS  15 (-6.750000D-01:::-6.500000D-01)   1 MEMBERS      CLASS  16 (-6.500000D-01:::-6.250000D-01)   0 MEMBERS
        CLASS  17 (-6.250000D-01:::-6.000000D-01)   1 MEMBERS      CLASS  18 (-6.000000D-01:::-5.750000D-01)   0 MEMBERS
        CLASS  19 (-5.750000D-01:::-5.500000D-01)   1 MEMBERS      CLASS  20 (-5.500000D-01:::-5.250000D-01)   0 MEMBERS
        CLASS  21 (-5.250000D-01:::-5.000000D-01)   1 MEMBERS      CLASS  22 (-5.000000D-01:::-4.750000D-01)   1 MEMBERS
        CLASS  23 (-4.750000D-01:::-4.500000D-01)   0 MEMBERS      CLASS  24 (-4.500000D-01:::-4.250000D-01)   0 MEMBERS
        CLASS  25 (-4.250000D-01:::-4.000000D-01)   0 MEMBERS      CLASS  26 (-4.000000D-01:::-3.750000D-01)   1 MEMBERS
        CLASS  27 (-3.750000D-01:::-3.500000D-01)   1 MEMBERS      CLASS  28 (-3.500000D-01:::-3.250000D-01)   1 MEMBERS
        CLASS  29 (-3.250000D-01:::-3.000000D-01)   0 MEMBERS      CLASS  30 (-3.000000D-01:::-2.750000D-01)   0 MEMBERS
        CLASS  31 (-2.750000D-01:::-2.500000D-01)   1 MEMBERS      CLASS  32 (-2.500000D-01:::-2.250000D-01)   0 MEMBERS
        CLASS  33 (-2.250000D-01:::-2.000000D-01)   0 MEMBERS      CLASS  34 (-2.000000D-01:::-1.750000D-01)   0 MEMBERS
        CLASS  35 (-1.750000D-01:::-1.500000D-01)   1 MEMBERS      CLASS  36 (-1.500000D-01:::-1.250000D-01)   1 MEMBERS
        CLASS  37 (-1.250000D-01:::-9.999999D-02)   0 MEMBERS      CLASS  38 (-9.999999D-02:::-7.500000D-02)   1 MEMBERS
        CLASS  39 (-7.500000D-02:::-5.000000D-02)   0 MEMBERS      CLASS  40 (-5.000000D-02:::-2.500000D-02)   0 MEMBERS
        CLASS  41 (-2.500000D-02::: 0.0          )   0 MEMBERS      CLASS  42 ( 0.0          ::: 2.500000D-02)   0 MEMBERS
        CLASS  43 ( 2.500000D-02::: 5.000000D-02)   1 MEMBERS      CLASS  44 ( 5.000000D-02::: 7.500000D-02)   1 MEMBERS
        CLASS  45 ( 7.500000D-02::: 9.999999D-02)   0 MEMBERS      CLASS  46 ( 9.999999D-02::: 1.250000D-01)   0 MEMBERS
        CLASS  47 ( 1.250000D-01::: 1.500000D-01)   1 MEMBERS      CLASS  48 ( 1.500000D-01::: 1.750000D-01)   1 MEMBERS
        CLASS  49 ( 1.750000D-01::: 2.000000D-01)   0 MEMBERS      CLASS  50 ( 2.000000D-01::: 2.250000D-01)   1 MEMBERS
```

Appendix E-4 (Cont'd.)

Appendix E-4 (Cont'd.)

ONEILL; MAGNETIC MONITOR DATA RHO 10 MIN CLASS LISTING - PAGE 2 01-21-81/18.46.40

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| CLASS | 51 | ( 2.250000D-01:: 2.500000D-01) | 1 | MEMBERS | CLASS | 52 | ( 2.[illegible]D-01:: 2.750000D-01) | 0 | MEMBERS |
| CLASS | 53 | ( 2.750000D-01:: 3.000000D-01) | 2 | MEMBERS | CLASS | 54 | ( [illegible].000000D-01:: 3.250000D-01) | 1 | MEMBERS |
| CLASS | 55 | ( 3.250000D-01:: 3.500000D-01) | 1 | MEMBERS | CLASS | 56 | 3.500000D-01:: 3 750000D-01) | 0 | MEMBERS |
| CLASS | 57 | ( 3.750000D-01:: 4.000000D-01) | 1 | MEMBERS | CLASS | 58 | ( 4.000000D-01:: 4.250000D-01) | 1 | MEMBERS |
| CLASS | 59 | ( 4.250000D-01:: 4.500000D-01) | 2 | MEMBERS | CLASS | 60 | ( 4.500000D-01:: 4.750000D-01) | 0 | MEMBERS |
| CLASS | 61 | ( 4.750000D-01:: 5.000000D-01) | 2 | MEMBERS | CLASS | 62 | ( 5.000000D-01:: 5.250000D-01) | 3 | MEMBERS |
| CLASS | 63 | ( 5.250000D-01:: 5.500000D-01) | 1 | MEMBERS | CLASS | 64 | ( 5.500000D-01:: 5.750000D-01) | 1 | MEMBERS |
| CLASS | 65 | ( 5.750000D-01:: 6.000000D-01) | 0 | MEMBERS | CLASS | 66 | ( 6.000000D-01:: 6.250000D-01) | 2 | MEMBERS |
| CLASS | 67 | ( 6.250000D-01:: 6.500000D-01) | 1 | MEMBERS | CLASS | 68 | ( 6.500000D-01:: 6.750000D-01) | 0 | MEMBERS |
| CLASS | 69 | ( 6.750000D-01:: 7.000000D-01) | 1 | MEMBERS | CLASS | 70 | ( 7.000000D-01:: 7.250000D-01) | 1 | MEMBERS |
| CLASS | 71 | ( 7.250000D-01:: 7.500000D-01) | 0 | MEMBERS | CLASS | 72 | ( 7.500000D-01:: 7.750000D-01) | 1 | MEMBERS |
| CLASS | 73 | ( 7.750000D-01:: 8.000000D-01) | 1 | MEMBERS | CLASS | 74 | ( 8.000000D-01:: 8.250000D-01) | 0 | MEMBERS |
| CLASS | 75 | ( 8.250000D-01:: 8.499999D-01) | 1 | MEMBERS | CLASS | 76 | ( 8.499999D-01:: 8.749999D-01) | 2 | MEMBERS |
| CLASS | 77 | ( 8.749999D-01:: 8.999999D-01) | 0 | MEMBERS | CLASS | 78 | ( 8.999999D-01:: 9.249999D-01) | 3 | MEMBERS |
| CLASS | 79 | ( 9.249999D-01:: 9.499999D-01) | 3 | MEMBERS | CLASS | 80 | ( 9.499999D-01:: 9.749999D-01) | 1 | MEMBERS |
| CLASS | 81 | ( 9.749999D-01:: 9.999999D-01) | 0 | MEMBERS | CLASS | 82 | ( 9.999999D-01:: 1.025000D 00) | 0 | MEMBERS |

```
ORBILL; MAGNETIC MONITOR DATA              RHO     10 MIN   CLASS BARGRAPHS - PAGE  1                       01-21-81/18.46.40
   MEMBERS:     5.000D-01   1.000D 00   1.500D 00   2.000D 00   2.500D 00   3.000D 00   3.500D 00   4.000D 00   4.500D 00   5.000D 00
           :-----------+-----------+-----------+-----------+-----------+-----------+-----------+-----------+-----------+-----------+--
CLASS    1:
CLASS    2:
CLASS    3:************************
CLASS    4:
CLASS    5:************************************************************************************************************************
CLASS    6:************************
CLASS    7:************************************************
CLASS    8:************************************************************************
CLASS    9:************************
CLASS   10:
CLASS   11:************************************************************************
CLASS   12:************************
CLASS   13:************************************************
CLASS   14:
CLASS   15:************************
CLASS   16:
CLASS   17:************************
CLASS   18:
CLASS   19:************************
CLASS   20:
CLASS   21:************************
CLASS   22:************************
CLASS   23:
CLASS   24:
CLASS   25:
CLASS   26:************************
CLASS   27:************************
CLASS   28:************************
CLASS   29:
CLASS   30:
CLASS   31:************************
CLASS   32:
CLASS   33:
CLASS   34:
CLASS   35:************************
CLASS   36:************************
CLASS   37:
CLASS   38:************************
CLASS   39:
CLASS   40:
CLASS   41:
CLASS   42:
CLASS   43:************************
CLASS   44:************************
CLASS   45:
           :-----------+-----------+-----------+-----------+-----------+-----------+-----------+-----------+-----------+-----------+--
   MEMBERS:     5.000D-01   1.000D 00   1.500D 00   2.000D 00   2.500D 00   3.000D 00   3.500D 00   4.000D 00   4.500D 00   5.000D 00
```

Appendix E-4 (Cont'd.)

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ONEILL: MAGNETIC MONITOR DATA                RHO     10 MIN   CLASS BARGRAPHS - PAGE  2                                    01-21-81/18.46.40
  MEMBERS:       5.000D-01   1.000D 00   1.500D 00   2.000D 00   2.500D 00   3.000D 00   3.500D 00   4.000D 00   4.500D 00   5.000D 00
           :-----------+-----------+-----------+-----------+-----------+-----------+-----------+-----------+-----------+-----------+--
CLASS   46:
CLASS   47:*************************
CLASS   48:*************************
CLASS   49:
CLASS   50:*************************
CLASS   51:*************************
CLASS   52:
CLASS   53:**************************************************
CLASS   54:*************************
CLASS   55:*************************
CLASS   56:
CLASS   57:*************************
CLASS   58:*************************
CLASS   59:**************************************************
CLASS   60:
CLASS   61:**************************************************
CLASS   62:***************************************************************************
CLASS   63:*************************
CLASS   64:*************************
CLASS   65:
CLASS   66:**************************************************
CLASS   67:*************************
CLASS   68:
CLASS   69:*************************
CLASS   70:*************************
CLASS   71:
CLASS   72:*************************
CLASS   73:*************************
CLASS   74:
CLASS   75:*************************
CLASS   76:**************************************************
CLASS   77:
CLASS   78:***************************************************************************
CLASS   79:***************************************************************************
CLASS   80:*************************
CLASS     :
CLASS
           :-----------+-----------+-----------+-----------+-----------+-----------+-----------+-----------+-----------+-----------+--
  MEMBERS:       5.000D-01   1.000D 00   1.500D 00   2.000D 00   2.500D 00   3.000D 00   3.500D 00   4.000D 00   4.500D 00   5.000D 00

                  + + + + + + + + + + B A R G R + + + + + + + + + +
```

Appendix E-4 (Cont'd.)

Appendix E-4 (Cont'd.)



* * * * * * * * * * B A R G R * * * * * * * * * *

TITLE: ONEILL; MAGNETIC MONITOR DATA LMNE 10 MIN

67 VALUES CLASSIFIED; 2 VALUES NOT CLASSIFIED; 69 TOTAL VALUES PROCESSED

CLASS INTERVAL IN USE IS 2.148851D-02

| | | | | |
|---|---|---|---|---|
| FOR THE CLASSIFIED DATA VALUES: | MINIMUM: | 1.154021D-01 | MAXIMUM: | 9.417404D-01 |
| | MEAN: | 4.403098D-01 | STD. DEV.: | 1.817512D-01 |

EACH BARGRAPH SYMBOL REPRESENTS 5.833333D-02 CLASS MEMBERS

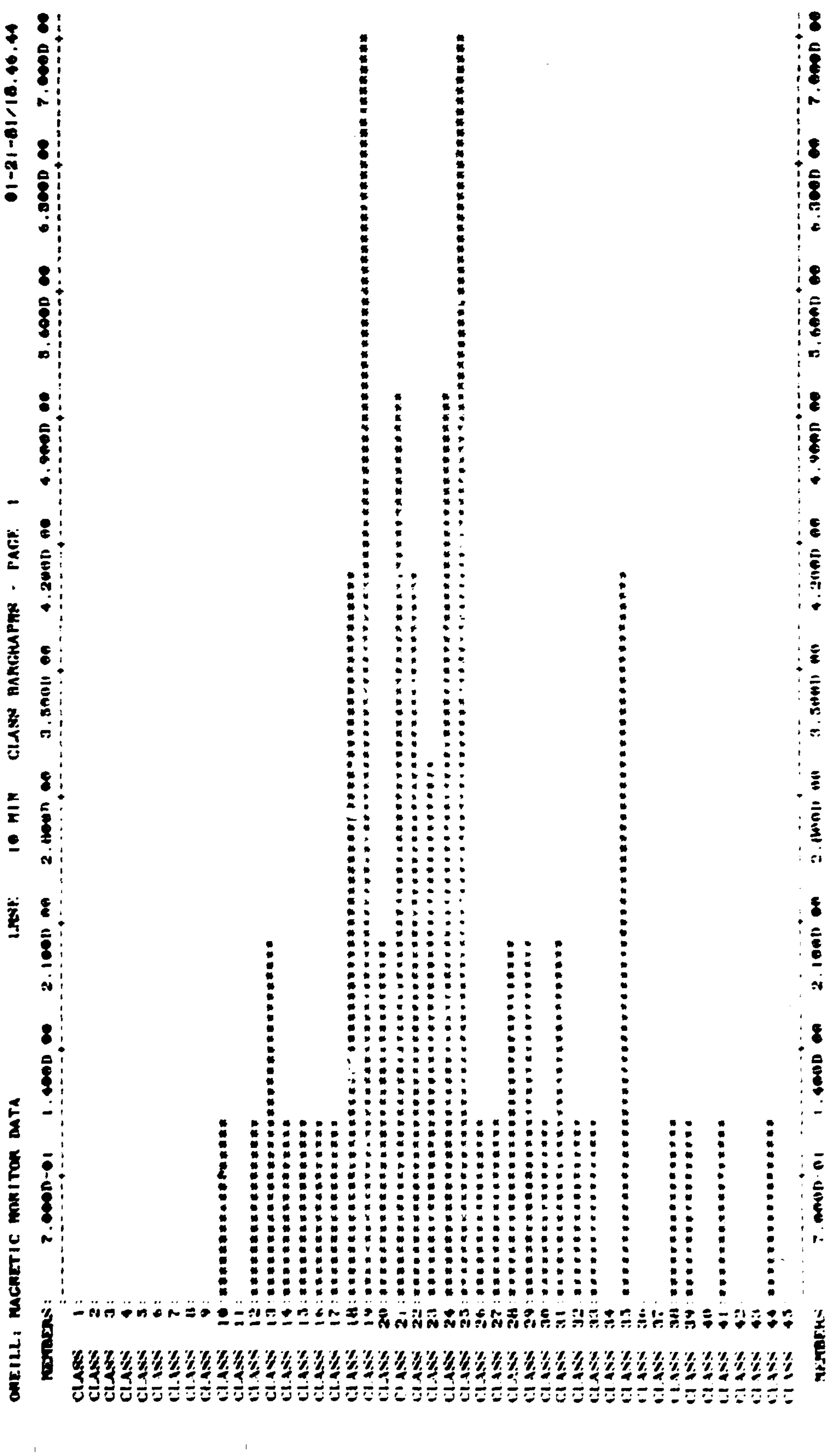
| | | | | |
|---|---|---|---|---|
| FOR THE ENTIRE DATA SET: | MINIMUM: | 1.154021D-01 | MAXIMUM: | 2.030477D 00 |
| | MEAN: | 4.713310D-01 | STD. DEV.: | 2.686063D-01 |

Appendix E-4 (Cont'd.)

ONEILL: MAGNETIC MONITOR DATA LMSF 10 MIN CLASS LISTING - PAGE 1 01-21-81/18.46.44

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| CLASS | 1 | (-8.595402D-02::-6.446552D-02) | 0 MEMBERS | CLASS | 2 | (-6.446552D-02::-4.297701D-02) | 0 MEMBERS |
| CLASS | 3 | (-4.297701D-02::-2.148851D-02) | 0 MEMBERS | CLASS | 4 | (-2.148851D-02:: 0.0 ) | 0 MEMBERS |
| CLASS | 5 | ( 0.0 :: 2.148851D-02) | 0 MEMBERS | CLASS | 6 | ( 2.148851D-02:: 4.297701D-02) | 0 MEMBERS |
| CLASS | 7 | ( 4.297701D-02:: 6.446552D-02) | 0 MEMBERS | CLASS | 8 | ( 6.446552D-02:: 8.595402D-02) | 0 MEMBERS |
| CLASS | 9 | ( 8.595402D-02:: 1.074425D-01) | 0 MEMBERS | CLASS | 10 | ( 1.074425D-01:: 1.289310D-01) | 1 MEMBERS |
| CLASS | 11 | ( 1.289310D-01:: 1.504195D-01) | 0 MEMBERS | CLASS | 12 | ( 1.504195D-01:: 1.719080D-01) | 1 MEMBERS |
| CLASS | 13 | ( 1.719080D-01:: 1.933966D-01) | 2 MEMBERS | CLASS | 14 | ( 1.933966D-01:: 2.148851D-01) | 1 MEMBERS |
| CLASS | 15 | ( 2.148851D-01:: 2.363736D-01) | 1 MEMBERS | CLASS | 16 | ( 2.363736D-01:: 2.578621D-01) | 1 MEMBERS |
| CLASS | 17 | ( 2.578621D-01:: 2.793506D-01) | 1 MEMBERS | CLASS | 18 | ( 2.793506D-01:: 3.008391D-01) | 4 MEMBERS |
| CLASS | 19 | ( 3.008391D-01:: 3.223276D-01) | 7 MEMBERS | CLASS | 20 | ( 3.223276D-01:: 3.438161D-01) | 2 MEMBERS |
| CLASS | 21 | ( 3.438161D-01:: 3.653046D-01) | 5 MEMBERS | CLASS | 22 | ( 3.653046D-01:: 3.867931D-01) | 4 MEMBERS |
| CLASS | 23 | ( 3.867931D-01:: 4.082816D-01) | 3 MEMBERS | CLASS | 24 | ( 4.082816D-01:: 4.297701D-01) | 5 MEMBERS |
| CLASS | 25 | ( 4.297701D-01:: 4.512586D-01) | 7 MEMBERS | CLASS | 26 | ( 4.512586D-01:: 4.727471D-01) | 1 MEMBERS |
| CLASS | 27 | ( 4.727471D-01:: 4.942356D-01) | 1 MEMBERS | CLASS | 28 | ( 4.942356D-01:: 5.157241D-01) | 2 MEMBERS |
| CLASS | 29 | ( 5.157241D-01:: 5.372126D-01) | 2 MEMBERS | CLASS | 30 | ( 5.372126D-01:: 5.587012D-01) | 1 MEMBERS |
| CLASS | 31 | ( 5.587012D-01:: 5.801897D-01) | 2 MEMBERS | CLASS | 32 | ( 5.801897D-01:: 6.016782D-01) | 1 MEMBERS |
| CLASS | 33 | ( 6.016782D-01:: 6.231667D-01) | 1 MEMBERS | CLASS | 34 | ( 6.231667D-01:: 6.446552D-01) | 0 MEMBERS |
| CLASS | 35 | ( 6.446552D-01:: 6.661437D-01) | 4 MEMBERS | CLASS | 36 | ( 6.661437D-01:: 6.876322D-01) | 0 MEMBERS |
| CLASS | 37 | ( 6.876322D-01:: 7.091207D-01) | 0 MEMBERS | CLASS | 38 | ( 7.091207D-01:: 7.306092D-01) | 1 MEMBERS |
| CLASS | 39 | ( 7.306092D-01:: 7.520977D-01) | 1 MEMBERS | CLASS | 40 | ( 7.520977D-01:: 7.735862D-01) | 0 MEMBERS |
| CLASS | 41 | ( 7.735862D-01:: 7.950747D-01) | 1 MEMBERS | CLASS | 42 | ( 7.950747D-01:: 8.165632D-01) | 0 MEMBERS |
| CLASS | 43 | ( 8.165632D-01:: 8.380517D-01) | 0 MEMBERS | CLASS | 44 | ( 8.380517D-01:: 8.595402D-01) | 1 MEMBERS |
| CLASS | 45 | ( 8.595402D-01:: 8.810287D-01) | 0 MEMBERS | CLASS | 46 | ( 8.810287D-01:: 9.025172D-01) | 1 MEMBERS |
| CLASS | 47 | ( 9.025172D-01:: 9.240058D-01) | 1 MEMBERS | CLASS | 48 | ( 9.240058D-01:: 9.454943D-01) | 1 MEMBERS |
| CLASS | 49 | ( 9.454943D-01:: 9.669828D-01) | 0 MEMBERS | CLASS | 50 | ( 9.669828D-01:: 9.884713D-01) | 0 MEMBERS |

Appendix E-4 (Cont'd.)



```
ONEILL: MAGNETIC MONITOR DATA               LMSE     10 MIN    CLASS BARGRAPHS - PAGE  2                         01-21-81/18.46.44

  MEMBERS:        7.000D-01    1.400D 00    2.100D 00    2.800D 00    3.500D 00    4.200D 00    4.900D 00    5.600D 00    6.300D 00    7.000D 00
              :------------+------------+------------+------------+------------+------------+------------+------------+------------+------------+--
CLASS   46:******************
CLASS   47:******************
CLASS   48:******************
CLASS   49:
CLASS   50:
              :------------+------------+------------+------------+------------+------------+------------+------------+------------+------------+ .
  MEMBERS:        7.000D-01    1.400D 00    2.100D 00    2.800D 00    3.500D 00    4.200D 00    4.900D 00    5.600D 00    6.300D 00    7.000D 00

                                   * * * * * * * * * * B A R G R * * * * * * * * * *
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Appendix E-4 (Cont'd.)

*********** SUMMARY PAGE ***********

TITLE : ONEILL: MAGNETIC MONITOR DATA ATTRIBUTE : MAGMON

SLOPE : MIN

| | | |
|---|---|---|
| MINIMUM VALUE | : | -3.5356358E 00 |
| MAXIMUM VALUE | : | 4.2425667E 00 |
| ARITHMETIC MEAN | : | -2.0683044E-02 |
| MEDIAN ESTIMATE | : | 3.1414587E-03 |
| MODE ESTIMATE | : | 5.0791235E-02 |

SIGMA : MIN

| | | |
|---|---|---|
| MINIMUM VALUE | : | 2.0169555E-02 |
| MAXIMUM VALUE | : | 7.0415337E-01 |
| ARITHMETIC MEAN | : | 1.9600128E-01 |
| MEDIAN ESTIMATE | : | 1.8255216E-01 |
| MODE ESTIMATE | : | 1.6765306E-01 |

RHO : MIN

| | | |
|---|---|---|
| MINIMUM VALUE | : | -9.5106175E-01 |
| MAXIMUM VALUE | : | 9.4273345E-01 |
| ARITHMETIC MEAN | : | -1.1289455E-02 |
| MEDIAN ESTIMATE | : | 5.3586745E-03 |
| MODE ESTIMATE | : | 3.8634925E-02 |

LMSE : MIN

| | | |
|---|---|---|
| MINIMUM VALUE | : | 1.2650499E-01 |
| MAXIMUM VALUE | : | 9.6092155E-01 |
| ARITHMETIC MEAN | : | 3.1480955E-01 |
| MEDIAN ESTIMATE | : | 3.0186845E-01 |
| MODE ESTIMATE | : | 2.7598615E-01 |

Appendix E-4 (Cont'd.)

Appendix E-4 (Cont'd.)

********** SUMMARY PAGE **********

TITLE : ONEILL; MAGNETIC MONITOR DATA                    ATTRIBUTE : MAGNON

**SLOPE 3 MIN**

| | | |
|---|---|---|
| MINIMUM VALUE | : | -2.095504E 00 |
| MAXIMUM VALUE | : | 1.575620E 00 |
| ARITHMETIC MEAN | : | -2.600926E-02 |
| MEDIAN ESTIMATE | : | -1.240007E-03 |
| MODE ESTIMATE | : | 3.229822E-02 |

**SIGMA 3 MIN**

| | | |
|---|---|---|
| MINIMUM VALUE | : | 7.434583E-02 |
| MAXIMUM VALUE | : | 6.621737E-01 |
| ARITHMETIC MEAN | : | 2.003709E-01 |
| MEDIAN ESTIMATE | : | 1.926652E-01 |
| MODE ESTIMATE | : | 1.709537E-01 |

**RHO 3 MIN**

| | | |
|---|---|---|
| MINIMUM VALUE | : | -9.779524E-01 |
| MAXIMUM VALUE | : | 9.471939E-01 |
| ARITHMETIC MEAN | : | -1.096020E-02 |
| MEDIAN ESTIMATE | : | -2.895361E-03 |
| MODE ESTIMATE | : | 1.320031E-02 |

**LINE 3 MIN**

| | | |
|---|---|---|
| MINIMUM VALUE | : | 7.546440E-02 |
| MAXIMUM VALUE | : | 1.251118E 00 |
| ARITHMETIC MEAN | : | 3.365740E-01 |
| MEDIAN ESTIMATE | : | 3.209091E-01 |
| MODE ESTIMATE | : | 2.895792E-01 |

************* SUMMARY PAGE *************

TITLE : ONEILL; MAGNETIC MONITOR DATA ATTRIBUTE : MAGMON

### SLOPE 10 MIN

| | | |
|---|---|---|
| MINIMUM VALUE | : | -5.190120E-01 |
| MAXIMUM VALUE | : | 6.266851E-01 |
| ARITHMETIC MEAN | : | -1.174775E-02 |
| MEDIAN ESTIMATE | : | 1.975736E-02 |
| MODE ESTIMATE | : | 8.276755E-02 |

### SIGMA 10 MIN

| | | |
|---|---|---|
| MINIMUM VALUE | : | 1.097649E-01 |
| MAXIMUM VALUE | : | 8.844128E-01 |
| ARITHMETIC MEAN | : | 2.675466E-01 |
| MEDIAN ESTIMATE | : | 2.241603E-01 |
| MODE ESTIMATE | : | 1.373878E-01 |

### RHO 10 MIN

| | | |
|---|---|---|
| MINIMUM VALUE | : | -9.529399E-01 |
| MAXIMUM VALUE | : | 9.685546E-01 |
| ARITHMETIC MEAN | : | 1.190321E-02 |
| MEDIAN ESTIMATE | : | 1.635584E-01 |
| MODE ESTIMATE | : | 4.662687E-01 |

### LMSE 10 MIN

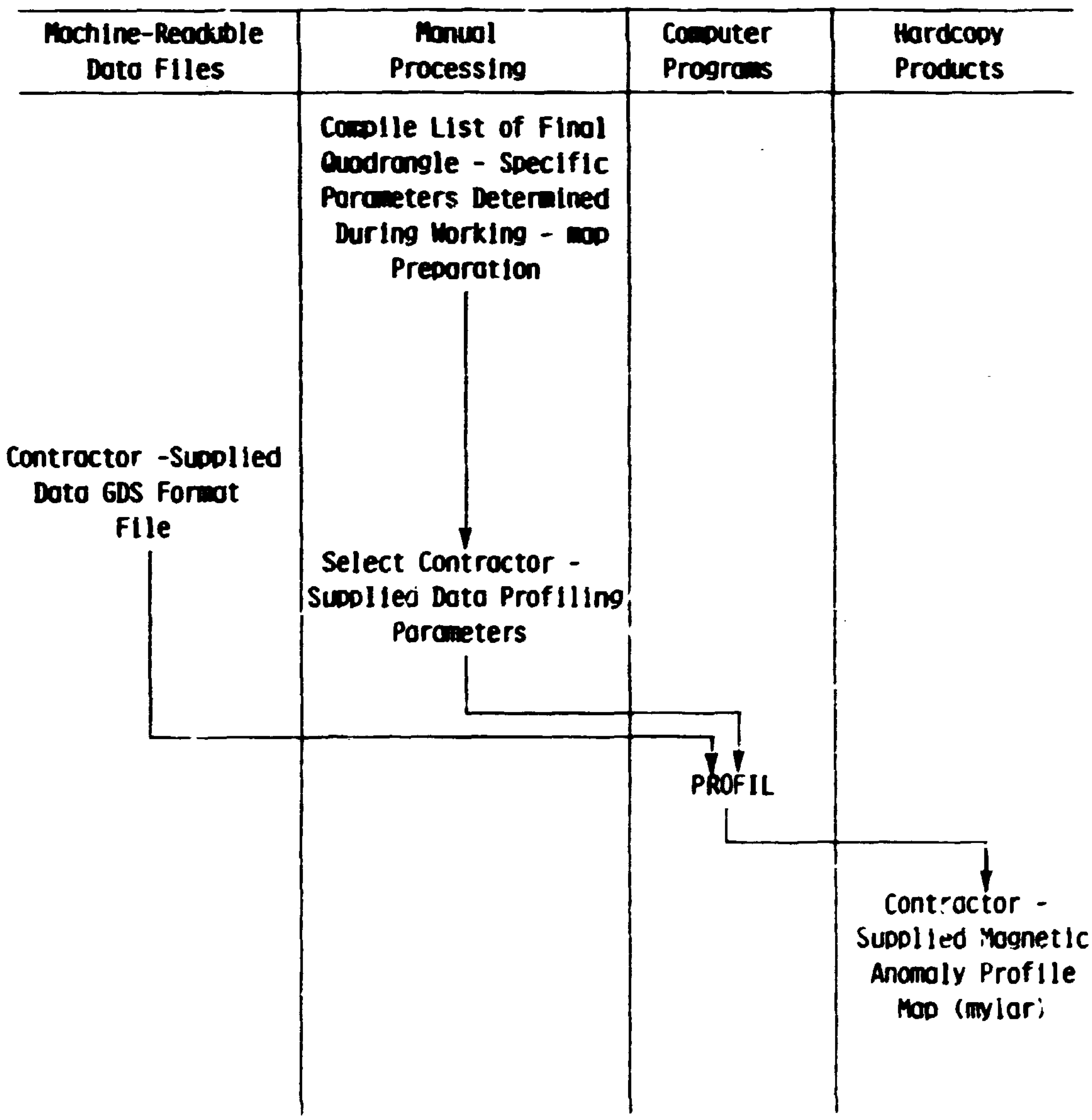
| | | |
|---|---|---|
| MINIMUM VALUE | : | 1.154021E-01 |
| MAXIMUM VALUE | : | 2.030477E 00 |
| ARITHMETIC MEAN | : | 4.713310E-01 |
| MEDIAN ESTIMATE | : | 4.148297E-01 |
| MODE ESTIMATE | : | 3.018270E-01 |

# APPENDIX F

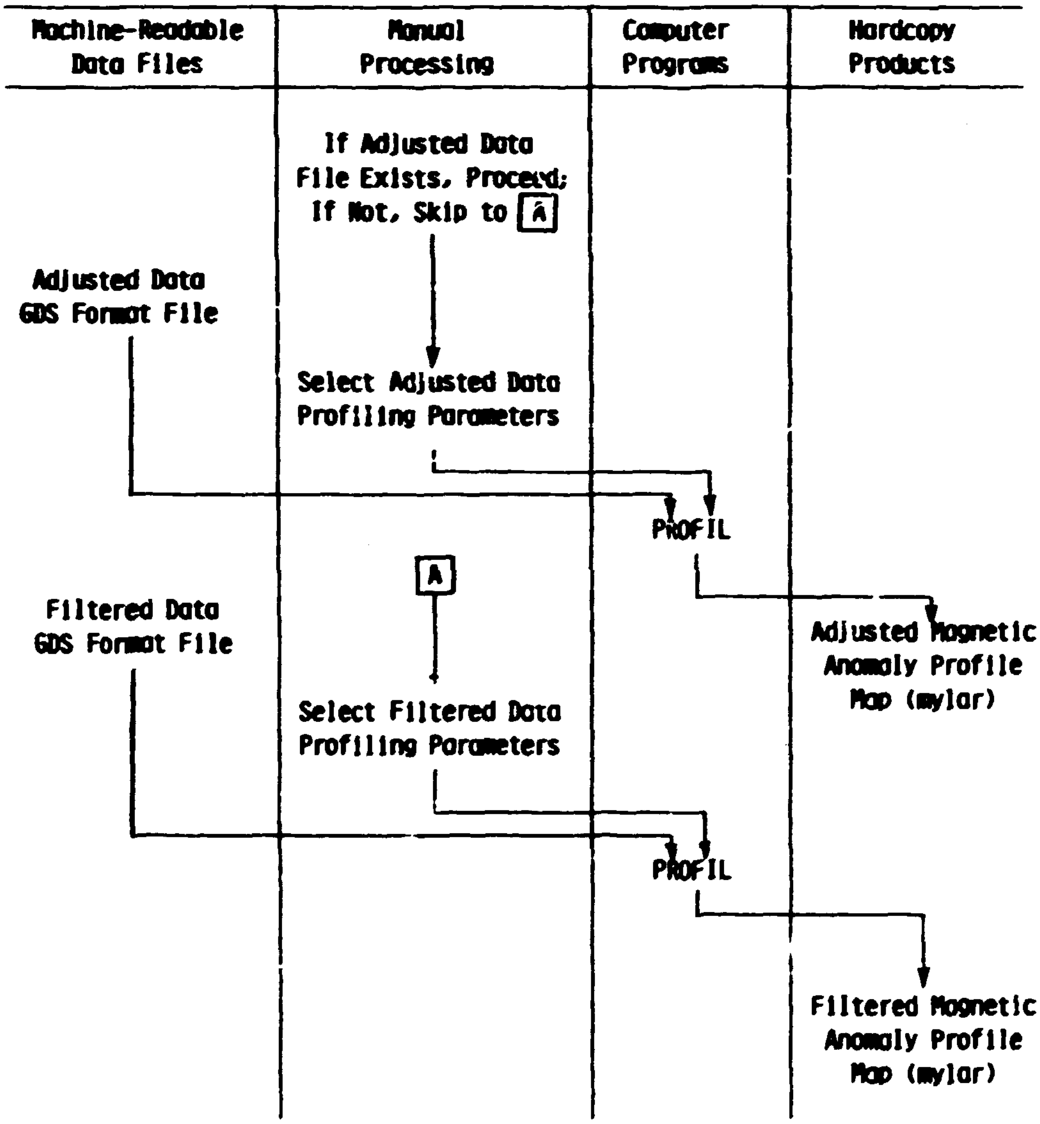
# FINAL PRODUCTS PROCESSING FLOW CHART

# Appendix F

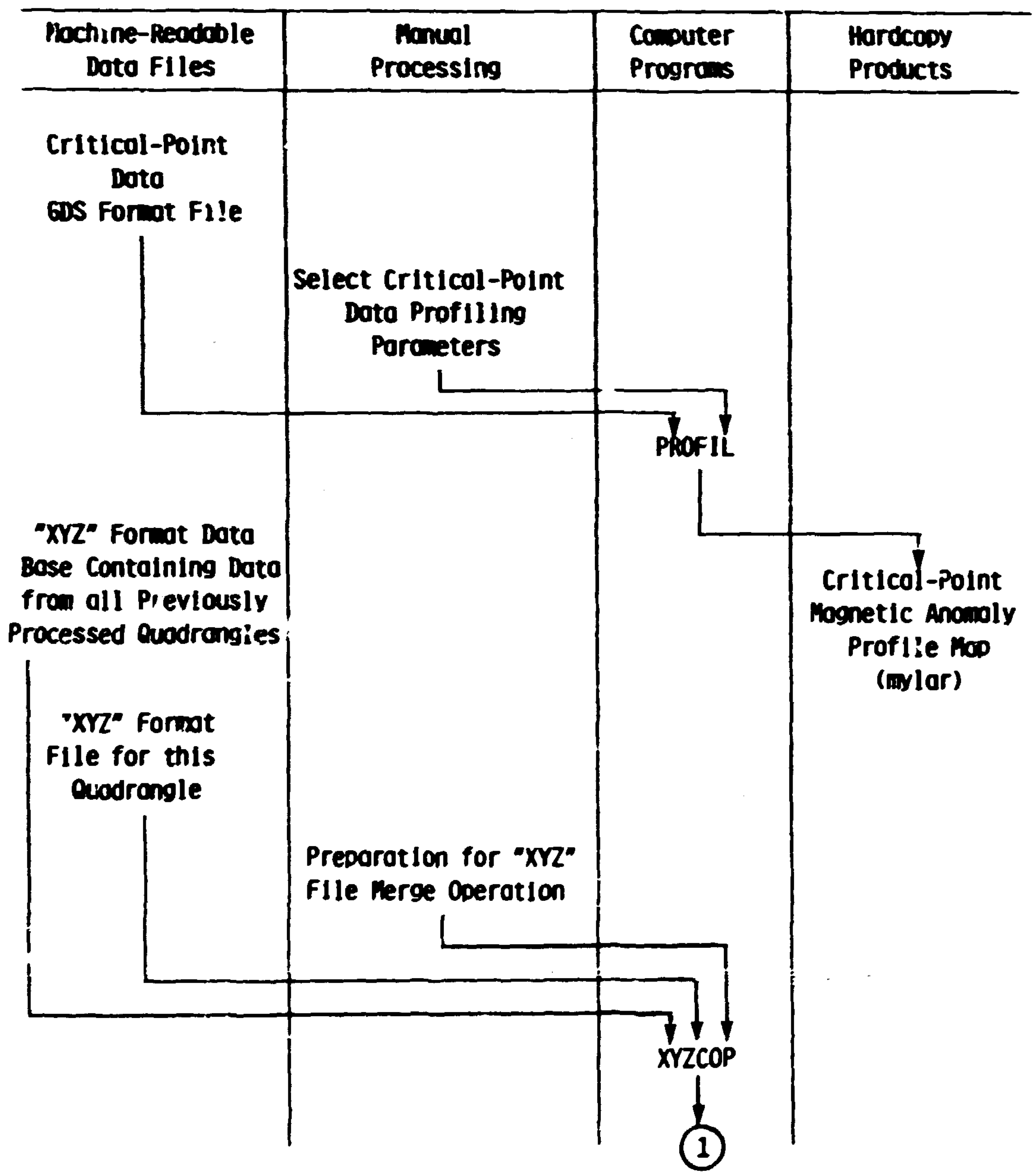
Final Products Processing Flow Chart



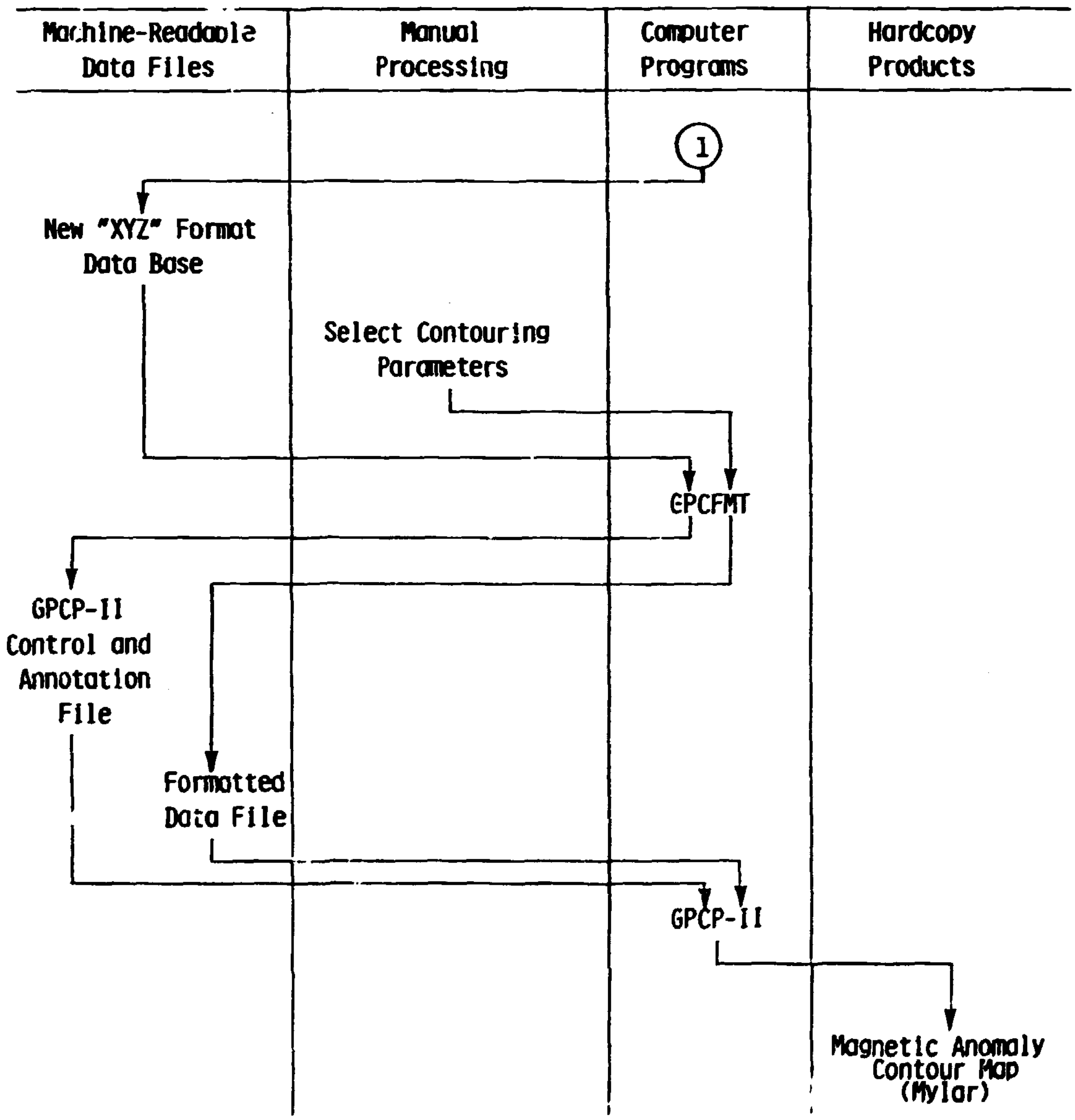
Appendix F (Cont'd.)



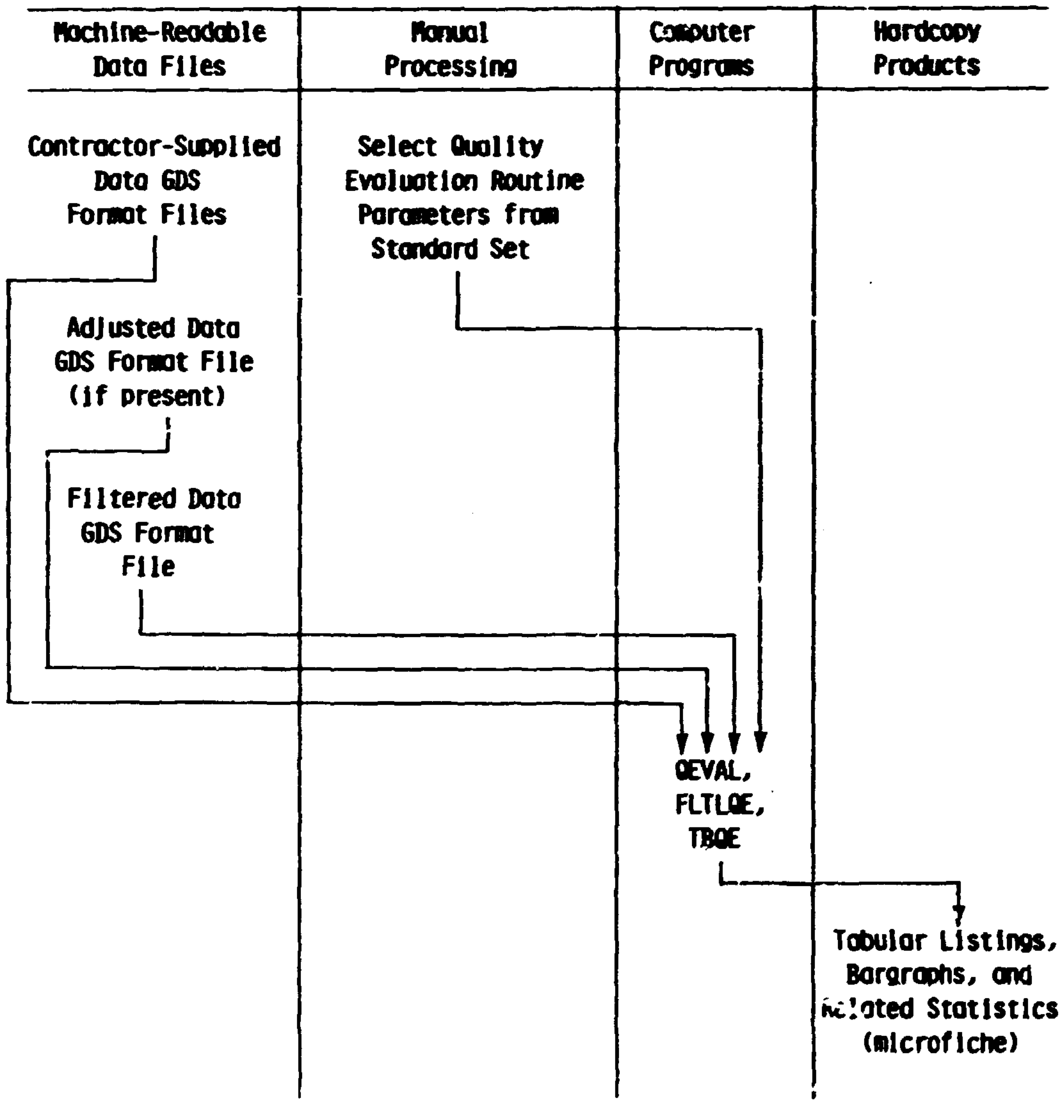
Appendix F (Cont'd.)



Appendix F (Cont'd.)



Appendix F (Cont'd.)



Appendix F (Cont'd.)