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CONTROLLER-REPORTED PERFORMANCE DEFECTS IN THE AIR TRAFFIC CONTROL RADAR BEACON SYSTEM (1971 SURVEY)

Bruce Rubinger

Transportation Systems Center

Prepared for:

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March 1973

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FINAL REPORT

Prepared for

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
Systems Research and Development Service
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16. Abstract

This report analyzes the returns from a recent ATC performance survey initiated by the Beacon System Interference Problem Subgroup. The survey began on 27 November 1971 and lasted for two weeks. Participation was limited to 37 facilities with problems considered representative of the entire system; included were enroute centers, civilian towers and military air traffic installations.

Examination of the deficiency data revealed that the most common nationwide problem was the loss of beacon coverage for a short period of time. This is followed by broken target slash, ring around, loss of coverage for long time, and false targets. The returns are sorted to identify the type of aircraft involved in the reported discrepancies. For each aircraft the data is further refined on the basis of error category, and the performance summarized by an error matrix. Attention is focused on the air carriers and the beacon discrepancies associated with this group are catalogued. Air traffic statistics are derived and employed to normalize the discrepancy information. The resulting data reveals significant performance variation among the different air carriers, as well as between different aircraft. Finally, the manner in which the survey was conducted is discussed, and recommendations made for automating future performance tests.

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PREFACE

The work described in this report was carried out in the Radar and Navigation Branch at the Transportation Systems Center for the Systems Research and Development Service (FAA-SRDS), Department of Transportation. The objective of this effort was to analyze the data acquired in a recent beacon system performance survey which was initiated to assess the impact of several improvement programs.

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In the course of researching background material for this report the author received assistance from many individuals. These include Ms. Augusta Gilbreath, Operations Analysis Branch, Air Traffic Service; Mr. Doug Wooten, Bureau of Accounts and Statistics, Civil Aeronautics Board; Mr. Wayne Decker (Chief) and Mr. Hal Greenlief (Deputy Chief) of the Salt Lake City Air Route Traffic Control Center (ARTCC); and Messrs. Orv Graham (Area Officer) and E. T. Harris (Chief) of the Los Angeles ARTCC.

It is a pleasure to acknowledge the contributions of my colleague, Dr. Bernard Kulke, with whom numerous discussions were held concerning the manner in which the survey returns should be processed. Finally, the assistance and support of Mr. George Haroules are deeply appreciated.

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1. INTRODUCTION

In 1968, the Beacon System Interference Subgroup initiated an ATCRBS performance survey to determine the type of problems encountered by the controllers.[1] This nation-wide survey was conducted for a period of one month beginning on 17, June 1968. The acquired data revealed that the most common deficiencies were false targets, ring around and broken slashes (Table 5-2). As a result of these findings, a program of improvements was initiated which included installation of sidelobe suppression, improved sidelobe suppression and interrogation power reduction.

In 1971 a second survey was undertaken to determine the impact on system performance of the above modifications. This test began on 27, November 1971 and lasted for two weeks. Participation in the survey was limited to 36 facilities which were considered representative of the entire system. Criteria for site selection included "identification of the area by flight check reports as having had problems, high saturation of radar systems, and whether or not improved sidelobe suppression has been installed".[2] Controllers at the selected facilities were requested to document instances of system degradation by noting on a questionnaire (Fig. 1-1) the nature of the malfunction.

In addition, each facility supplied information on the nature of its beacon equipment (Fig. 1-2). This included specification of the antenna and interrogator type, the operational power output, STC characteristics and sidelobe suppression status. Copies of these materials were delivered to TSC at the end of January 1972.

1.1 PARTICIPATION IN THE SURVEY

In response to the survey, a total of 2426 descrepancy reports were filed; of these, 1772 replies were from centers and civilian towers while the remainder (654) represent military installations. A breakdown of the returns by facility is given in Table 1-1.

ATCRBS SURVEY
RADAR BEACON DISCREPANCY

1) FACILITY NAME ____________ 2) TRAFFIC COUNT ____________

3) RADAR SYSTEM ____________

4) RANGE/AZIMUTH ____________ 5) DATE/GMT ____________

6) A/C ID ____________ 7) A/C TYPE ____________

8) DISCREPANCY CODE: (CIRCLE)

1 Ring around/ghosts/side lobes/reflections/false tgts.

2 Fruit

3 Tgt. too wide

4 Tgt. too narrow

5 Tgt. never acquired

Tgt. lost short time:

6.1 straight and level

6.2 turning

6.3 climb or descent

Tgt. lost long time:

7.1 straight and level

7.2 turning

7.3 climb or descent

8 Tgt. broken/intermittent/chopped

9 Mode A/3 Code incorrect

10 Alt readout incorrect

11 IDENT malfunction

12 Other - describe

9) COMMENTS: ____________

____

____

____

FAA Form 6360-1 OT (11-71)(Use Expires 12/31/71) Local Reproduction Auth.

Figure 1-1. ATCRBS Survey Beacon Discrepancy Report Form

ATCRBS SURVEY
RADAR SYSTEM DATA

1) RADAR SITE LOCATION NAME________________________________

2) TYPE BEACON EQUIPMENT

a) INTERROGATOR- ATCBI-________UPX________OTHER________________

b) DEFRUITER TYPE________________________

c) DECODER- ATCBI-________GPX________UPA________OTHER__________

3) ANTENNA (DIRECTIONAL)

a) TYPE NO. __________________

b) DATE INSTALLED OR REPLACED__________________

4) SIDE LOBE SUPPRESSION OPERATION

a) SLS- YES__________ NO__________

b) FAA IMPROVED SLS- YES___________ NO__________

5) OPERATIONAL POWER OUTPUT*

a) CHANNEL 1 __________________

b) CHANNEL 2 __________________

6) STC CURVE (INITIAL DEPTH) _____________________

*If power output is different, then dates and time of operation for each channel during the test period must be included

FAA Form 6360-2 OT (11-71)(Use Expires 12/31/71) Local Reproduction Auth.

Figure 1-2. ATCRBS Survey Radar System Data Report Form

TABLE 1-1. PARTICIPATION IN THE 1971 ATCRBS FAULT SURVEY

Facility	Number of Returns
EASTERN REGION	
Albany Tower	7
Atlantic City Tower	7
Binghamton CS/T	3
New York ARTCC	158
New York CIFRR	31
Philadelphia Tower	71
Wilkes Barre Tower	0
White Plains Tower	93
(Military)	
Griffis AFB	24
McGuire AFB	3
NEW ENGLAND REGION	
Bradley Tower	84
(Military)	
Quonset Point NAS	0
ROCKY MOUNTAIN REGION	
Salt Lake City ARTCC	468
(Military)	
Mt. Home Rapcon	3
SOUTHERN REGION	
Miami ARTCC	158
Tampa Tower	44
Orlando Tower	36
(Military)	
Eglin AFB	15
SOUTHERN REGION (Cont.)	
Myrtle Beach AFB	3
Patrick AFB	9
Tyndall AFB	31
SOUTHWEST REGION	
Albuquerque ARTCC	79
Albuquerque Tower	26
El Paso Tower	13
(Military)	
Hollman AFB	14
Laredo AFB	277
Randolf AFB	79
WESTERN REGION	
Burbank Tower	27
Long Beach Tower	3
Los Angeles ARTCC	456
Los Angeles TRACON	8
(Military)	
Castle AFB	11
Hamilton AFB	45
Lemoore RATCC	76
March RAPCON	41
Travis AFB	2
Vandenberg AFB	21

The largest number of replies were from the Salt Lake Center (468), followed by the Los Angeles ARTCC (456), Laredo AFB (277), New York ARTCC (158) and Miami Center (158). Participation in the survey showed little correlation between traffic count and the number of deficiencies reported. For example, the Los Angeles Tower, which experiences many of the same problems as the Los Angeles Center, noted only 8 cases of system degradation. Since the respective traffic counts at these facilities are on the order of three-to-one, about 150 returns would normally be expected from the Los Angeles Tower.

1.2 PROCEDURE EMPLOYED IN PROCESSING DATA

The following steps were employed in processing the returns from the performance survey: first, each reply was assigned a case number to simplify cross-referencing the data. Then, for each instance of system degradation the following information was transferred to a computer card.

a) Case number
b) Facility name
c) Traffic count
d) Radar unit involved
e) Radar sidelobe suppression capability
f) Target range and azimuth
g) Date and time when deficiency occurred
h) Aircraft identification
i) Aircraft type
j) Nature of deficiency
k) Number of aircraft involved
l) Presence of comment on questionnaire
m) Aircraft classification; air carrier, military or general aviation.

Next, all the information was entered into magnetic storage (via an IBM 7094) so that the "sorts" could be performed using electronic logic. Employing this approach, the data only need be read into the computer input file once, and an entire sequence of correlations can be performed. This procedure is preferable to the use of a mechanical sorting device (such as the IBM 702 Electronic Accounting Machine) since the latter technique requires that the data cards be run through the machine many times; at least once for each character sorted upon. Employing magnetic core memory simplifies the task of data processing, reduces the time required to analyze the returns, and permits the generation of graphical output.

1.3 ERROR CATEGORIES EMPLOYED FOR ANALYSIS OF RETURNS

The error categories employed for the performance survey were defined by the discrepancy report form. In the course of processing the returns it was observed that the controller often circled a subcategory rather than the main error class; for example, "ring around" or "false targets" might be underlined as opposed to error category 1. In order to extract this additional bit of information, each error subclass was denoted by a separate error code.

Thus, for this study, the first error category was represented by the following error codes:

Discrepancy	Error Code
Ring Around/Ghosts/ Sidelobes/Reflections/ False Targets	010
Ring Around	011
Ghosts	012
Sidelobes	013
Reflections	014
False targets	015

In tabulating the returns from Salt Lake City, it was noticed that most of the comments dealt with problems of false emergency alarms. Therefore, an additional error category was created for this phenomenon (140), and false alarms no longer listed as comments.

The error codes employed for this study, and the beacon problems they represent are defined in Table 1-2.

TABLE 1-2. ERROR CODES EMPLOYED FOR ANALYSIS OF THE BEACON FAULT REPORTS

ERROR CATEGORY	CODE
Ring Around/Ghosts/Sidelobes/Reflections/ False Targets	010
Ring Around	011
Ghosts	012
Sidelobes	013
Reflections	014
False Targets	015
Fruit	020
Target too Wide	030
Target too Narrow	040
Target never Acquired	050
TARGET LOST SHORT TIME	
Straight and Level	061
Turning	062
Climb or Descent	063
TARGET LOST LONG TIME	
Straight and Level	071
Turning	072
Climb or Descent	073
Target Broken/Intermittent/Chopped	080
Target Broken	081
Target Intermittent	082
Target Chopped	083
Mode 3/A Code Incorrect	090
Altitude Readout Incorrect	100
IDENT Malfunction	110
Other	120
False Emergency Replies	140

2. ANALYSIS OF RETURNS FROM SALT LAKE CITY ARTCC

The returns from the Salt Lake ARTCC were chosen to be processed first since this facility had sent in the largest number of fault reports. As the initial group, it was considered a vehicle for experimentation, and a variety of correlations were performed to determine what information could be extracted from this data. In establishing this benchmark, several related efforts were undertaken; these included, first the processing of flight progress strips to derive air population statistics, and secondly, a visit to the Salt Lake Center for a firsthand view of the operational problems related to the data in question.

One unique feature of Salt Lake's participation in the survey is that this group had been included by their own request. The Salt Lake Center was experiencing severe problems with false emergency alarms and considered the survey a forum for focusing attention on this matter. Since the false emergency phenomena was most common at the Rock Springs and Ashton radar sites, only the performance of these units was monitored.

2.1 ANALYSIS OF FAULT REPORTS (UNNORMALIZED DATA)

The first breakdown of the discrepancy reports was by aircraft mission. These results reveal (Fig. 2-1) that 71.7% of the complaints involved air carriers, 19.5% military aircraft, and 7.6% general aviation. The aircraft identification was unknown in the remaining 1.1% of the replies.

2.2 BREAKDOWN OF FAULT REPORTS BY ERROR CATEGORY

Next, the survey data was analyzed to determine the nature of the deficiencies encountered at the Salt Lake facility. This output is presented in Table 2-1, where the elemental error codes have been employed. However, in proceeding with the analysis of the returns, it seemed natural to group ring around and sidelobes since these are similar phenomena, and to lump together ghosts, false targets and reflections. Therefore, the first error category

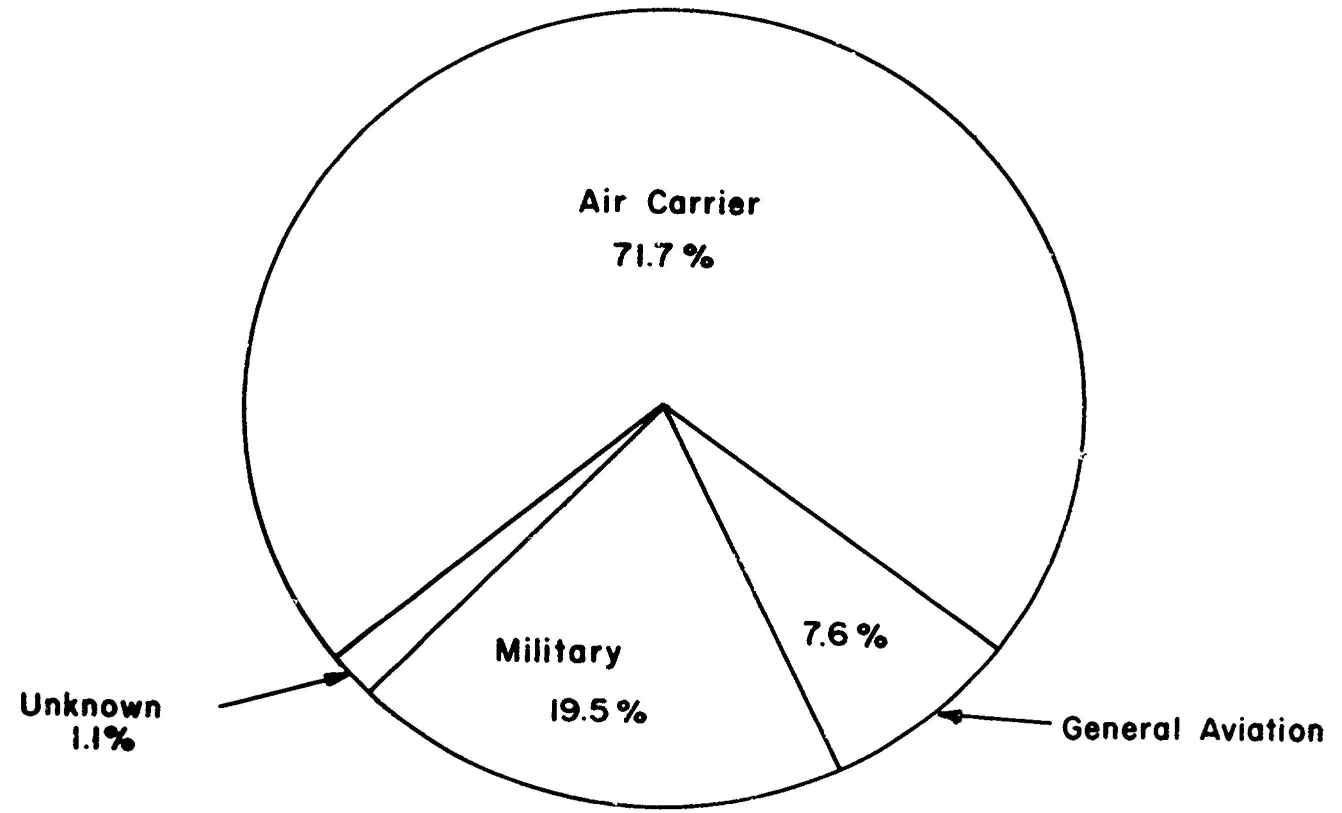


Figure 2-1. Breakdown of Discrepancy Reports by Aircraft Mission, Facility; Salt Lake City ARTCC

TABLE 2-1. DISTRIBUTION OF DISCREPANCY REPORTS BY ELEMENTAL ERROR CODES

Facility: Salt Lake ARTCC, November 1971

ERROR CODE*	NUMBER OF DEFICIENCIES	%
010	23	2.96
011	37	4.76
013	21	2.70
014	2	0.25
015	8	1.02
030	14	1.80
040	16	2.05
050	6	0.77
061	87	11.19
062	0	0.00
063	11	1.41
071	97	12.48
072	1	0.12
073	15	1.93
080	264	33.97
081	44	5.66
082	15	1.93
083	11	1.41
090	1	0.12
110	31	3.98
120	13	1.67
140	60	7.72

*For key to error codes see Table 1-2

on the report form was represented by these two subcategories, each characterizing a different form of degradation. This was accomplished by assigning all the members of the general category, 010, to one of these two groups in proportion to their original count. In an analagous fashion, the remaining basic error codes were grouped under a general problem heading. These results are plotted in Figure 2-2.

The most common complaint is target broken/intermittent/chopped, which accounted for 42.9% of the discrepancies. Other problems are listed in the order of frequency of occurence, in Table 2-2. It is interesting to note that false emergency alarms are documented in 7.7% of the reports.

The elements of each error category were further refined on the basis of aircraft mission. These results are presented in Table 2-3. Broken target-slash remains the most common problem for each class of user, while the combined category of lost targets occupies the second slot. The deficiency of ring around/sidelobes is listed third for military and general aviation users, whereas false emergency alarms assume this position for air carriers.

2.3 BREAKDOWN OF DISCREPANCY REPORTS BY AIRCRAFT INVOLVED

After determining the nature of the system malfunctions, the next logical step was to sort by the type of aircraft involved in these incidences. These results are contained in Table 2-4, and illustrated in Figure 2-3 for aircraft involved in 15 or more discrepancies.

In generating this data, similar aircraft were grouped under a general name. For example, variations of the B-707, such as the B-707-100B, B-707-200, B-707-300C, were merged under the generic heading B-707.

From Table 2-4, it appears that the aircraft most frequently cited is the B-727 (38.2% of the total complaints). This is followed by the B-707 (8.4%), DC-8 (8.1%), B-720 (4.4%), and C-141 (4.2%).

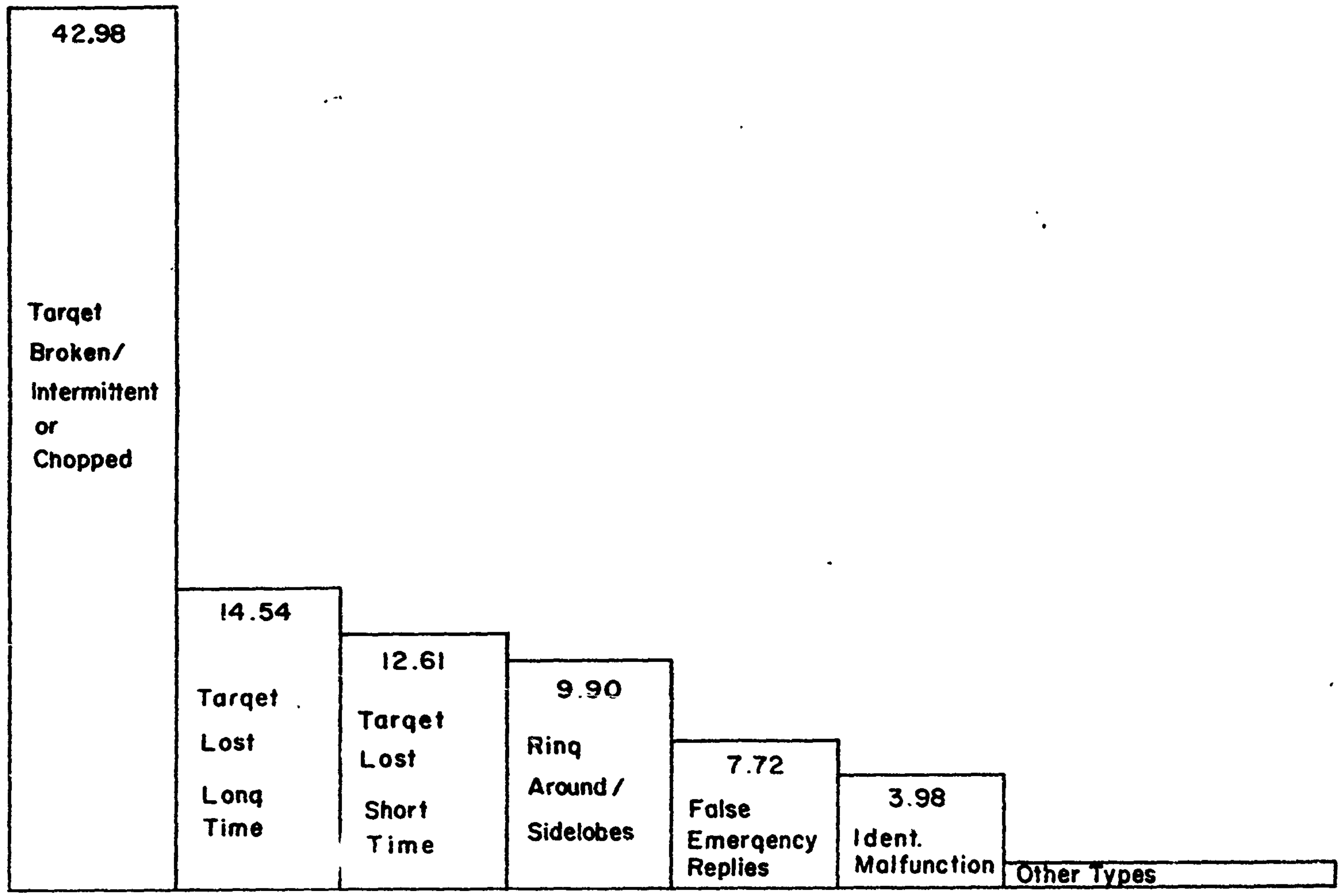


Figure 2-2. Distribution of Discrepancy Reports by Error Category, Facility: Salt Lake City ARTCC

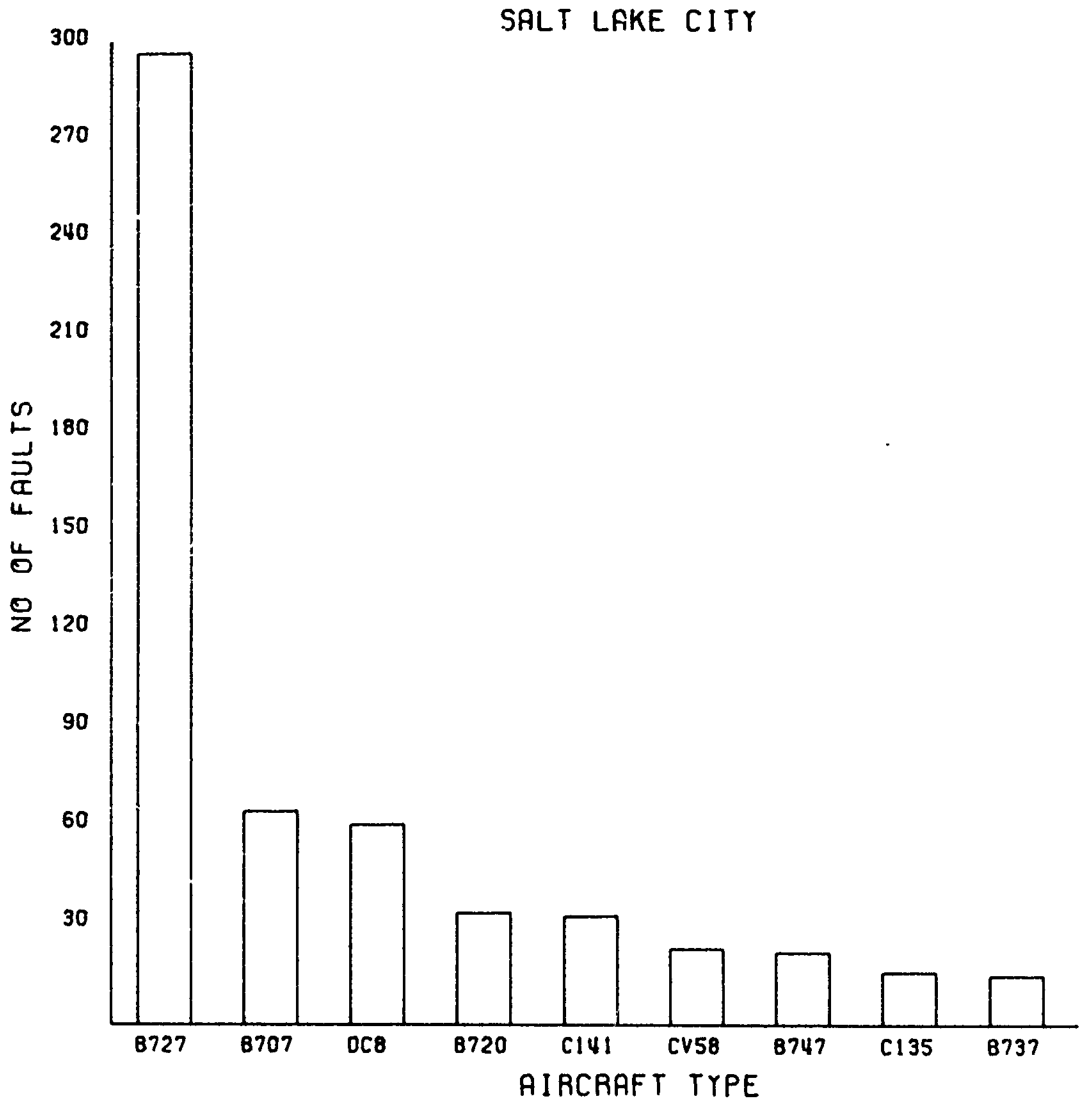


Figure 2-3. Distribution of Discrepancy Reports by Aircraft Type, Facility: Salt Lake City ARTCC

TABLE 2-2. DISTRIBUTION OF DISCREPANCY REPORTS BY ERROR CATEGORY
Facility: Salt Lake City ARTCC

ERROR CATEGORY	NO. OF OCCURENCES	%
Target Broken/Intermittent/Chopped	334	42.98
Target Lost Long Time	113	14.54
Target Lost Short Time	98	12.61
Ring Around/Sidelobes	77	9.90
False Emergency Replies	60	7.72
IDENT Malfunction	31	3.98
Target too Narrow	16	2.05
Ghosts/ Reflections/False Targets	14	1.80
Target too Wide	14	1.80
Other	13	1.67
Target Never Acquired	6	0.77
Mode 3/A Code Incorrect	1	0.12
Fruit	0	0.00
Altitude Readout Incorrect	0	0.00

TABLE 2-3. SUBDIVISION OF ERROR CATEGORIES BY AIRCRAFT MISSION
Facility: Salt Lake City ARTCC

ERROR CATEGORY	NUMBER OF OCCURENCES		
	MILITARY	COMMERCIAL	GENERAL AVIATION
Target Broken/Intermittent/Chopped	60	248	25
Target Lost Long Time	23	77	11
Target Lost Short Time	10	78	10
Ring Around/Sidelobes	32	38	5
False Emergency Replies	5	54	1
IDENT Malfunction	6	23	2
Target too Narrow	5	9	2
Ghosts/Reflections/False Targets	5	6	0
Target too Wide	3	9	2
Other Malfunction	1	11	0
Traget Never Acquired	2	3	1
Mode 3/A Code Incorrect	0	1	0
Fruit	0	0	0
Altitude Readout Incorrect	0	0	0

TABLE 2-4. AIRCRAFT DISCREPANCY REPORT MATRIX

Facility: Salt Lake ARTCC

A/C TYPE	TOTAL	%	RING*	GHOST	FRUIT	WIDE	NARRW	NEVER	(ST) LSTSH	(MN) LSTSH	(ST) LSTLN	(MN) LSTLN	BROKN	MODE	ALTIT	IDENT	OTHER	FALSE
B727	297	38.2	20	3	0	5	4	0	38	6	31	6	132	1	0	14	7	30
B707	65	8.4	5	0	0	0	3	0	8	0	7	0	29	0	0	3	1	9
DC8	63	8.1	3	0	0	1	0	1	4	2	10	2	28	0	0	3	1	8
B720	34	4.4	0	1	0	1	0	0	4	1	5	1	15	0	0	2	1	3
C141	33	4.2	5	0	0	2	2	0	1	0	5	0	14	0	0	1	1	2
CV58	23	3.0	5	0	0	0	0	0	4	0	2	3	9	0	0	0	0	0
B747	22	2.8	2	0	0	0	0	0	3	0	1	0	12	0	0	1	0	3
Unknown	20	2.6	0	6	0	0	0	0	1	1	2	1	7	0	0	0	1	1
C135	16	2.0	1	2	0	0	0	1	2	0	4	0	5	0	0	0	0	1
B737	15	1.9	1	0	0	0	2	0	1	0	3	1	6	0	0	0	1	0
T29	15	1.9	5	0	0	1	0	0	3	0	1	0	5	0	0	0	0	0
T33	14	1.8	4	0	0	0	0	0	0	0	0	0	7	0	0	2	0	1
B52	13	1.7	1	1	0	0	1	0	0	0	3	1	5	0	0	1	0	0
C118	11	1.4	4	0	0	0	0	0	1	0	1	0	4	0	0	0	0	1
FFJ	10	1.3	1	2	0	2	0	0	1	0	1	0	3	0	0	0	0	0
LR24	9	1.1	1	0	0	0	0	0	2	0	1	0	3	0	0	1	0	0
CV88	8	1.0	0	0	0	0	0	0	2	0	0	0	6	0	0	0	0	0
C54	7	0.9	4	0	0	0	0	0	0	0	2	0	1	0	0	0	0	0
C320	7	0.9	1	0	0	0	0	0	1	0	2	0	2	0	0	1	0	0
T331	7	0.9	0	1	0	0	1	0	0	0	2	0	2	0	0	1	0	0
F100	6	0.8	2	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0
MU2	6	0.8	2	0	0	1	0	0	1	0	0	0	2	0	0	0	0	0
L329	5	0.6	0	0	0	0	1	0	1	0	1	0	2	0	0	0	0	0
C119	4	0.5	0	0	0	0	0	0	0	0	2	0	2	0	0	0	0	0
DC9	4	0.5	1	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0
A6	4	0.5	0	1	0	0	0	0	0	0	1	0	1	0	0	1	0	0
BE55	4	0.5	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0
PA31	3	0.4	0	0	0	0	0	1	0	0	1	0	1	0	0	0	0	0
B57	3	0.4	0	1	0	0	0	0	0	0	0	0	2	0	0	0	0	0
F106	3	0.4	2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
C421	3	0.4	0	0	0	0	0	0	0	0	1	0	2	0	0	0	0	0
C124	3	0.4	0	0	0	0	0	0	1	0	0	0	2	0	0	0	0	0
DC81	3	0.4	0	0	0	0	0	0	0	1	0	0	2	0	0	0	0	0
F111	2	0.3	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0
BE90	2	0.3	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
MO20	2	0.3	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0
SR71	2	0.3	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0
BE35	2	0.3	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0
DC10	2	0.3	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0
F101	2	0.3	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0
L382	2	0.3	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0
N265	2	0.3	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0
FA27	2	0.3	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0
BE18	2	0.3	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0
T39	2	0.3	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0
BE33	2	0.3	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0
PA2T	2	0.3	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0
C130	2	0.3	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0
BE55	2	0.3	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0
L18	1	0.1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
L188	1	0.1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
AC21	1	0.1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
F102	1	0.1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T53	1	0.1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTALS	777		72	19	0	14	16	6	87	11	97	16	334	1	0	31	13	

*For Key to error code abbreviations see Table 2-5.

The above results can be misleading since they do not take into account an aircraft's popularity; as its usage increases the likelihood of involvement in system malfunctions goes up in a corresponding manner. On the other hand, an aircraft with serious ATCRBS deficiencies might turn up near the bottom of Table 2-4 if it were employed for only a limited number of flights. In order to obtain a more realistic performance picture, the traffic population must be utilized to derive normalized discrepancy data. This step will be carried out toward the end of the chapter.

In addition to listing the number of discrepancies associated with each aircraft, Table 2-4 includes a breakdown of this information by error category. The format employed is that of an error matrix, with the aircraft-type specified along the vertical axis and the error categories along the horizontal axis.

As an illustration, consider the B-727; from the discrepancy matrix this aircraft was involved in the types of system degradation summarized by Table 2-5. The above breakdown of the sources of degradation assists in interpreting the data. For example, problems of ghosts and false targets indicate a deficiency in the site location, while lost targets suggest nulls in the elevation pattern of the interrogator antenna when the loss occurs while the aircraft is traveling straight and level. On the other hand, airframe shadowing of the transponder antenna is the probable cause when coverage is lost while the aircraft is maneuvering. Focusing on the phenomena of broken or intermittent target slash, the source of this problem is overinterrogation, and as such this error category provides a measure of the interrogation environment.

With regards to the deficiencies of ring around and sidelobes, it should be pointed out that by the end of 1969 all FAA type ground interrogators (i.e. ATCBI-3) were equipped with sidelobe suppression. However, at the present time, there remain some joint use facilities, such as those with the older UPX-6 equipment, which lack this capability. In addition to supplying the discrepancy reports, each facility sent in detailed information on its radar equipment which included the status of the sidelobe-suppression

TABLE 2-5. DISTRIBUTION OF FAULT REPORTS INVOLVING THE B-727
Facility: Salt Lake ARTCC

ABBREVIATED ERROR TITLE	PROBLEM	NO. REPORTS
RING	Ring Around/Sidelobes	20
GHOSTS	Ghosts/False Targets/Reflections	3
FRUIT	Fruit	0
WIDE	Target too Wide	5
NARRW	Target too Narrow	4
NEVER	Target never Acquired	0
LSTSH ST	Target Lost Short Time, Traveling Straight & Level	38
LSTSH MN	Target Lost Short Time while Maneuvering	6
LSTLN ST	Lost Long Time, Traveling Straight and Level	31
LSTLN MN	Target Lost Long Time while Maneuvering	6
BROKN	Target Broken/Intermittent/Chopped	132
MODE	Mode 3/A code Incorrect	1
ALTIT	Altitude Readout Incorrect	0
IDENT	IDENT Malfunction	14
OTHER	Other Malfunction	7
FALSE	False Emergency Alarms	30

feature. When processing returns from sites without SLS, the deficiencies of ring around and sidelobes were attributed to the ground station, and consequently were omitted from any breakdown of the data by the air carrier or aircraft. As a result of this procedure, any reference to these phenomena in the aircraft discrepancy matrix involves ARSR radar sites with operational SLS, and under these circumstances suggests improper functioning of the transponder circuitry.

2.4 ANALYSIS OF DISCREPANCY REPORTS INVOLVING AIR CARRIERS

Attention was next focused upon the air carriers and the discrepancy reports associated with this group. It was not the intent of the survey to conduct a competitive evaluation of either ground or airborne equipment. In line with this idea, it has been deemed appropriate to report air carrier data by code to prevent competitive use of the report results. Henceforth, all reference to individual carriers will be made in this manner.

A breakdown of the fault reports by carrier and error category is presented in Table 2-6. From these results, the airline involved in the largest number of discrepancies is identified by the code AL102. Examination of the reports referencing this carrier reveals the following error distribution:

PROBLEM	%
Target Broken/Intermittent/Chopped	45
Target Lost Short Time	14
Target Lost Long Time	13
False Emergency Alarms	13
Ident Malfunctions	5
Ring Around/Sidelobes	4
Ghosts/Reflections/False Targets	1

From the above statistics it appears that a majority of the complaints originated with factors external to the aircraft, with antenna nulls, site deficiencies, and interrogator environment playing significant roles.

TABLE 2-6. BREAKDOWN OF FAULT REPORTS INVOLVING AIR CARRIERS BY ERROR CATEGORY
Facility: Salt Lake City ARTCC

Fault	AL101	AL102	AL103	AL104	AL107	AL108	AL109	AL110	AL111	AL112	AL114	AL116	AL118	AL121	AL124
Ring Around/Sidelobes*	3	4	4	6		11			24				20		33
Ghosts/Reflections/False Targets	3	1						13				15			33
Fruit															
Target too Wide		1		1		5									
Target too Narrow	3		7	4		2						8			
Target Never Acquired															
Target Lost Short Time	11	14	11	18		14			19			8			33
Target Lost Long Time	9	13	26	9		14		25	19	33		15		50	
Target Broken/Intermittent/Chopped	51	45	44	44		45		38	38	67		54	60	50	
Mode A/3 Code Incorrect						1									
Altitude Readout Incorrect															
IDENT Malfunction	6	5		7		1		25							
Other		2	4	2		2									
False Emergency Replies	14	13	4	9	100	5							20		
Total Discrepancies	35	223	27	85	1	106	0	8	21	3	0	13	5	2	3

*The elements of the array are expressed on a percent basis

The results in Table 2-6 were further refined on the basis of the aircraft involved. This information is contained in Table 2-7.

TABLE 2-7. BREAKDOWN OF FAULT REPORTS INVOLVING AIR CARRIERS BY AIRCRAFT TYPE
Facility: Salt Lake City ARTCC

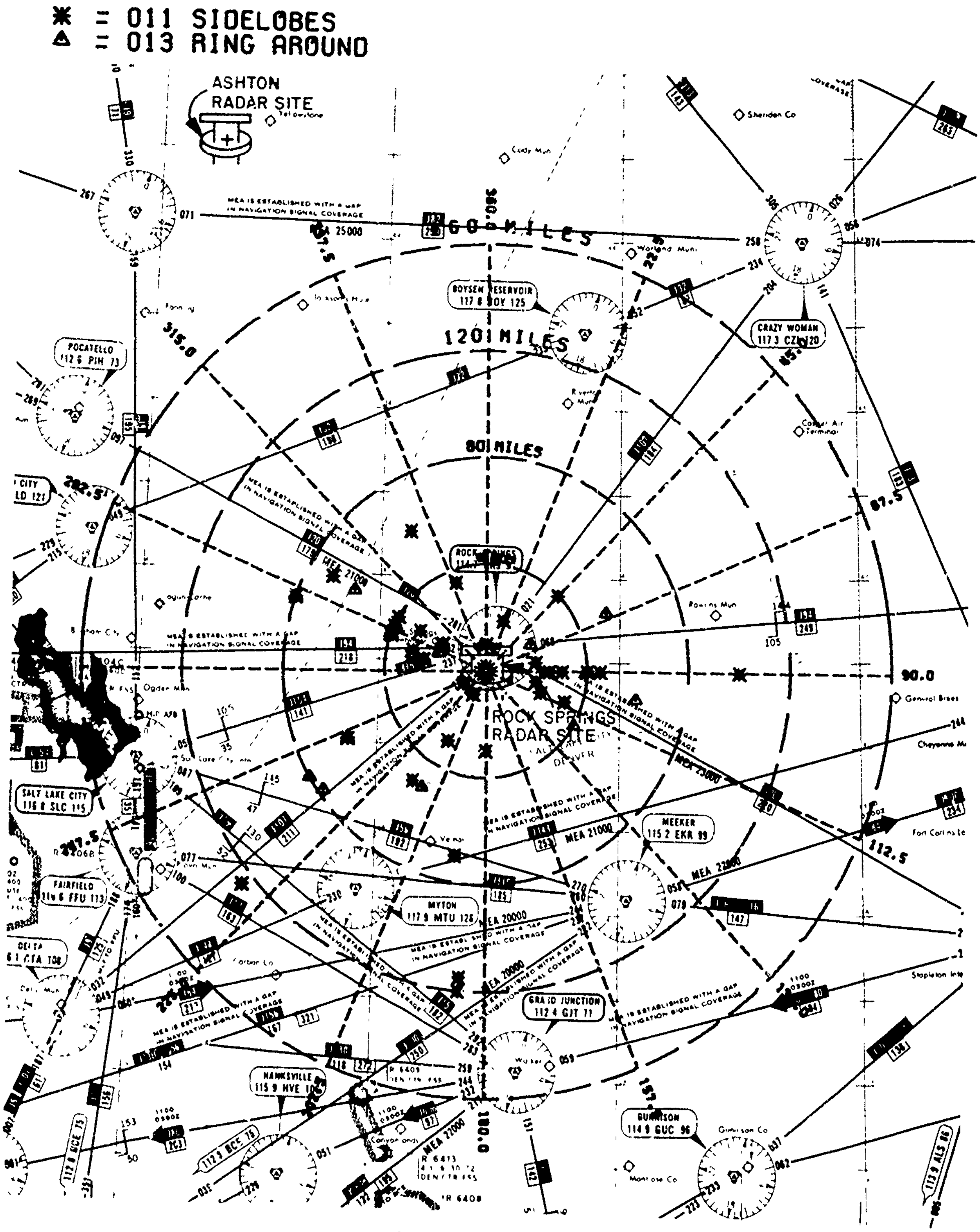
CARRIER	TOTAL	% *	B707	B720	B727	B737	B747	CV58	CV88	DC8	DC9	DC10	BA27	FFJ
AL101	31	3.98	13	1			9		8					
AL102	215	27.67		20	139					56				
AL103	27	3.47		12		15								
AL104	85	10.93	44		36		5							
AL107	1	0.12			1									
AL108	106	13.64	1		101						4			
AL109	0	0.00												
AL110	8	1.02			8									
AL111	21	2.70						21						
AL112	2	0.25								2				
AL114	0	0.00												
AL116	13	1.67	2		7		4							
AL118	5	0.64	1				4							
AL121	0	0.00												
AL124	3	0.38												3
Totals	518	66.7	61	33	292	15	22	21	8	58	4	0	0	3

*Expressed as a percentage of total faults reported.

2.5 LOCATIONS ASSOCIATED WITH BEACON DISCREPANCIES

The deficiency reports from Salt Lake were examined to determine if they followed any geographical pattern. For this purpose, computer plots were generated showing aircraft locations where beacon discrepancies arose. Through this procedure the data were analyzed to identify areas where target loss was common, and locate "hot spots" where incidence of broken targets was concentrated.

The first of these graphs is presented in Figure 2-4, and addresses the problem of ring around and sidelobes at the Rock Springs ARSR radar. In examining this plot, it became apparent that knowledge of the traffic patterns in the vicinity of the radar site was desirable for interpreting the data. Therefore the graph was modified by superimposing the air traffic flow upon the discrepancy



SALT LAKE CITY CENTER

ROCK SPRINGS, WYO RADAR SITE

Figure 2-4. Locations Associated with Problems of Ring Around or Sidelobes-RKS Radar Site.

locations (Fig. 2-5). In carrying out this alteration, only the main high altitude routes were considered since these characterize a majority of the flights; the number of low altitude missions being limited by the mountainous terrain. Similar air route information is contained on the graphs which follow in this section.

Locations where ghosts, reflections, and false targets arose are shown in Figure 2-6; this form of degradation does not appear to be too common at the RKS site, judging from the number of documented cases. Problems of lost targets are treated next, with reports of short duration losses handled in Figure 2-7, and long duration loss times addressed in Figure 2-8. These plots are limited to discrepancies where target loss occured while an aircraft was traveling straight and level; cases of beacon loss associated with maneuvering aircraft were not included, since they could be attributed to airframe shielding of the transponder antenna.

An examination of these two graphs reveals that many of the instances of target loss occurred within 30 miles of the radar site. This can be traced to the "cone of silence" surrounding the interrogator antenna, a deficiency which has been aggravated by locating the radar facility within ten miles of the RKS VORTAC. As a result, coverage is lost as aircraft approach the fix, and controllers are often unable to provide radar separation at this point.

On a visit to the Salt Lake Center, the phenomena of target loss was frequently observed. As aircraft moved closer to the VORTAC the target slash would shrink, often disappearing entirely within ten or twenty miles of the "main bang". Then, after passing beyond this point, the target would slowly re-emerge.

The next series of plots deals with broken, intermittent or chopped targets. These graphs show separately the occurence of this fault for commercial aircraft, (Fig. 2-9), general aviation, (Fig. 2-10), and military aircraft (Fig. 2-11). The data were separated in this manner since chopped targets can originate from the Top/Bottom antenna switching, unique to military aircraft, and

✱ = 011 SIDELOBES   △ = 013 RING AROUND

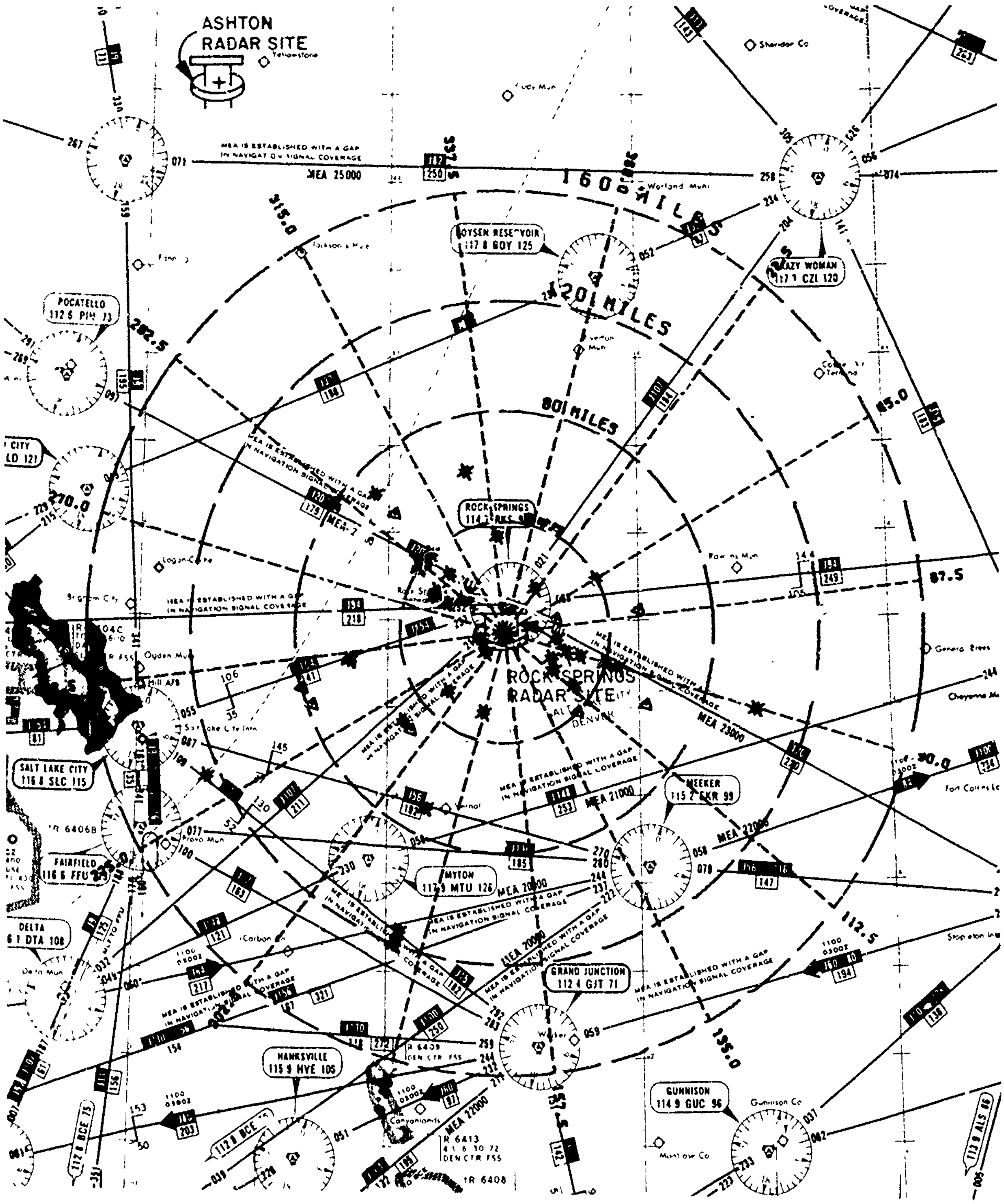


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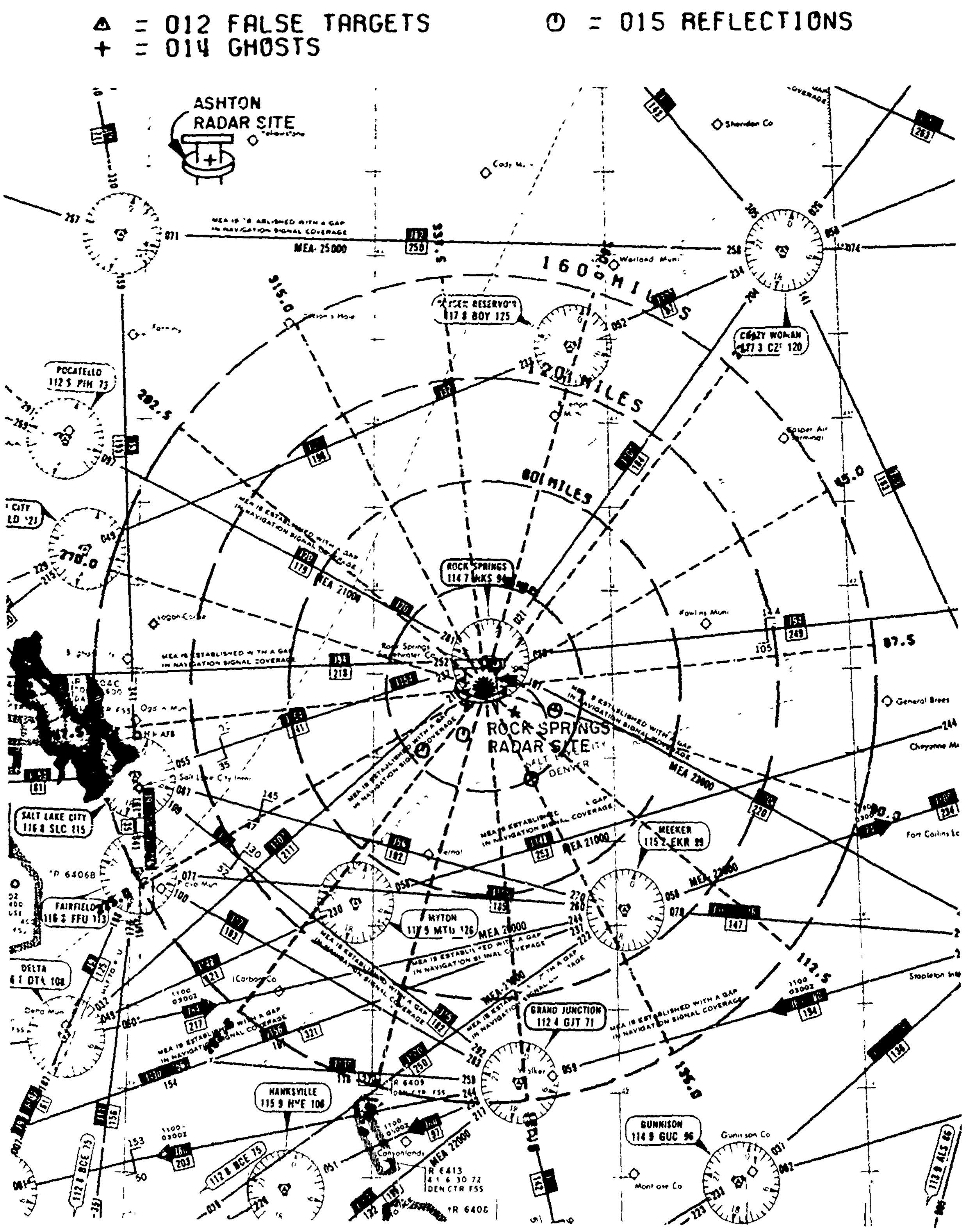
Figure 2-5. Superposition of Traffic Flow Upon Locations Associated with Ring Around/Sidelobes-RKS Radar Site.



SALT LAKE CITY CENTER — ROCK SPRINGS, WYO RADAR SITE

Figure 2-6. Locations Associated with Ghosts, False Targets and Reflections-RKS Radar Site.

▲ = 061-TARGET LOST SHORT TIME

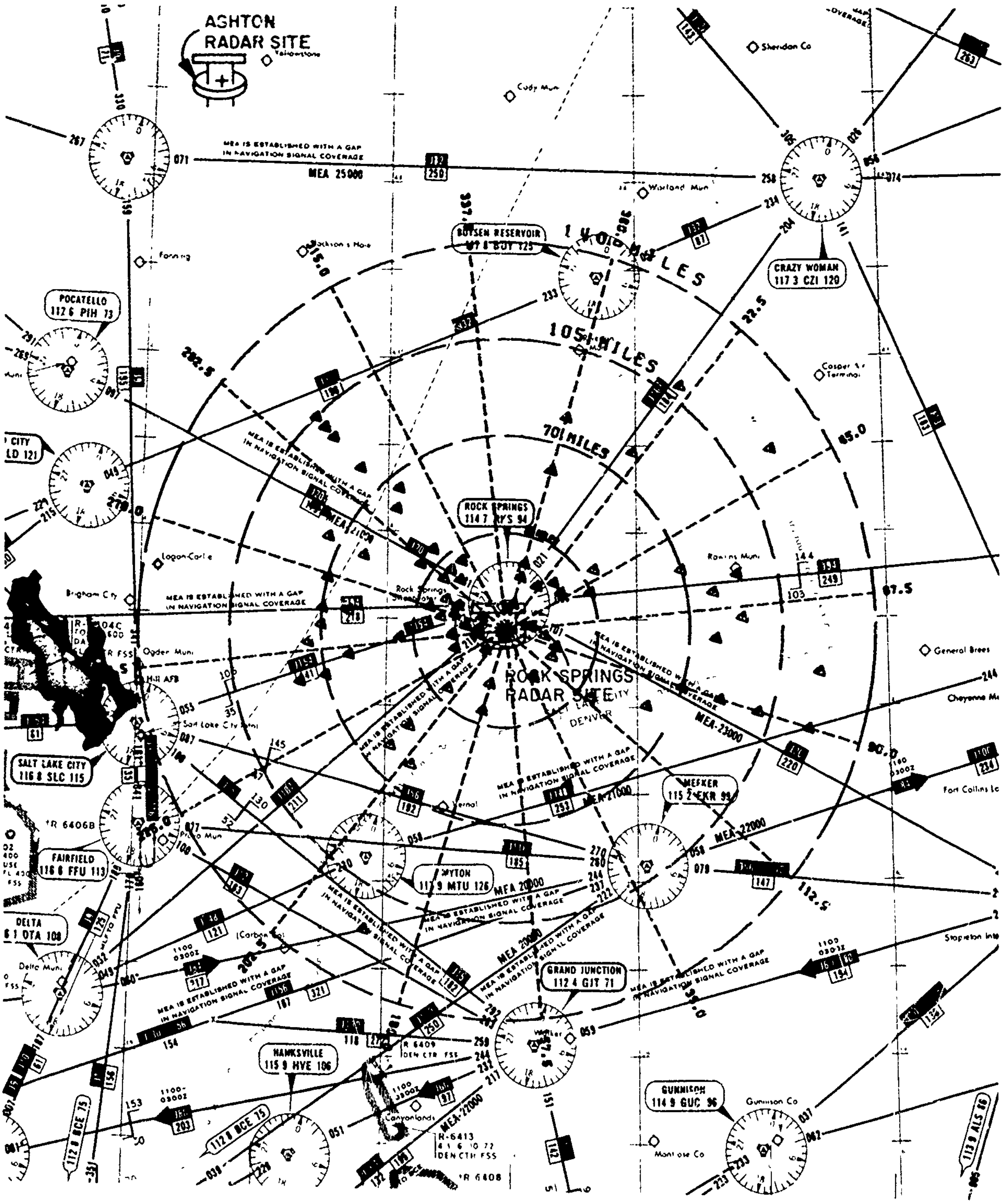


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Figure 2-7. Locations Associated with Loss of Targets for a Short Interval-RKS Radar Site.

◆ = 071-TARGET LOST LONG TIME

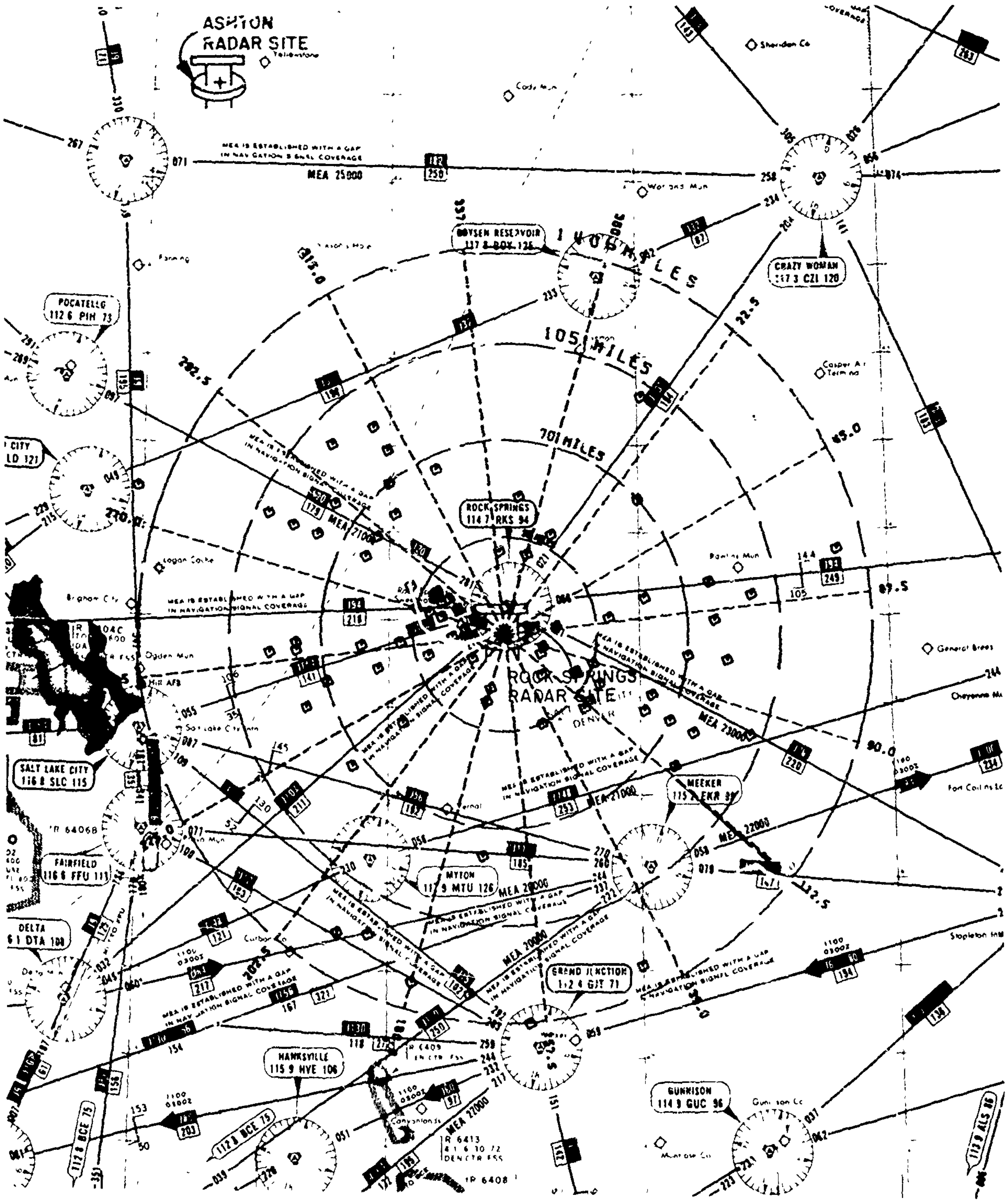

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Figure 2-8. Locations Associated with Loss of Targets for a Long Interval-RKS Site.

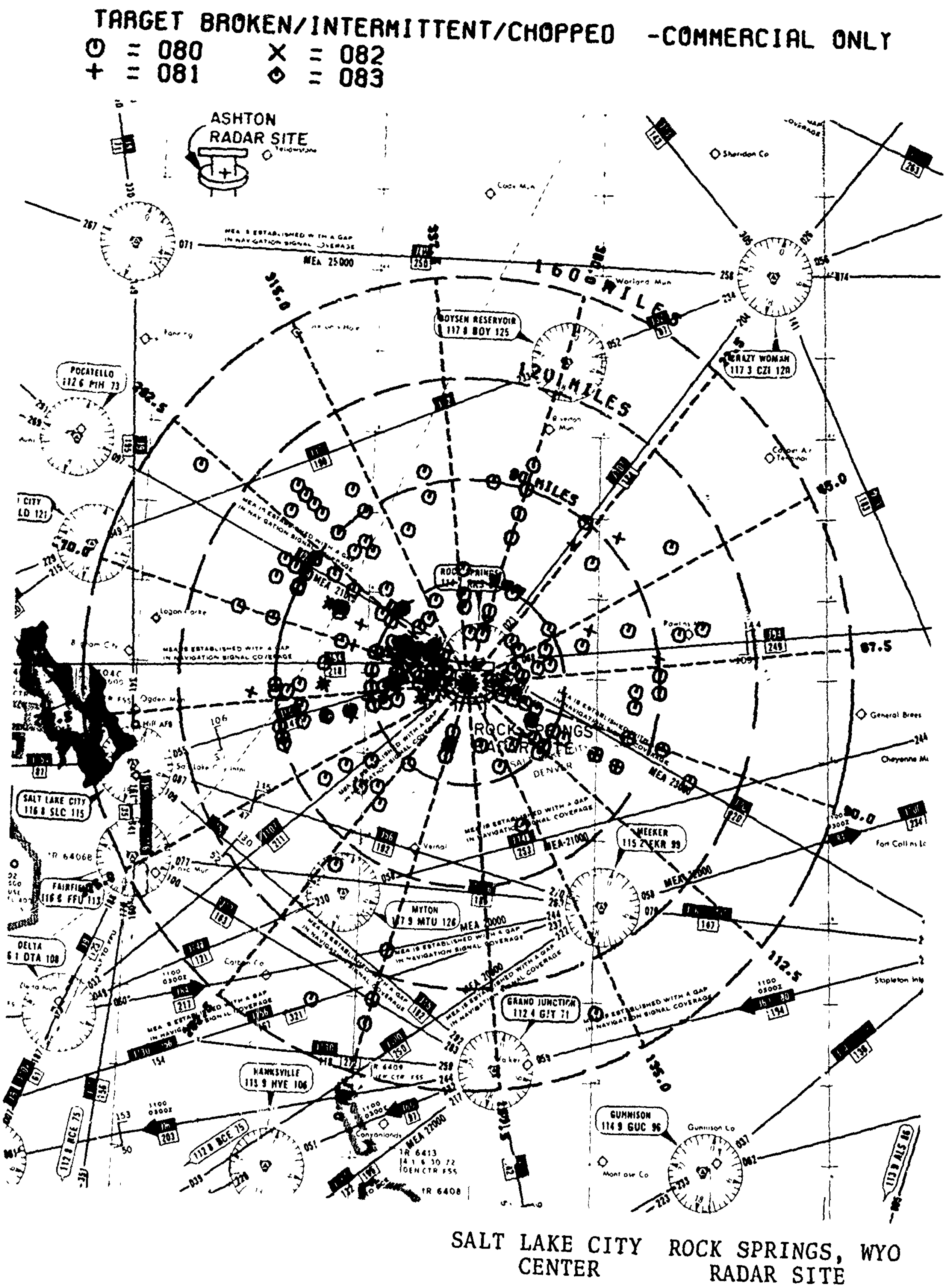

Figure 2-9. Locations Associated with Broken Targets for Commercial Aircraft-RKS Site.

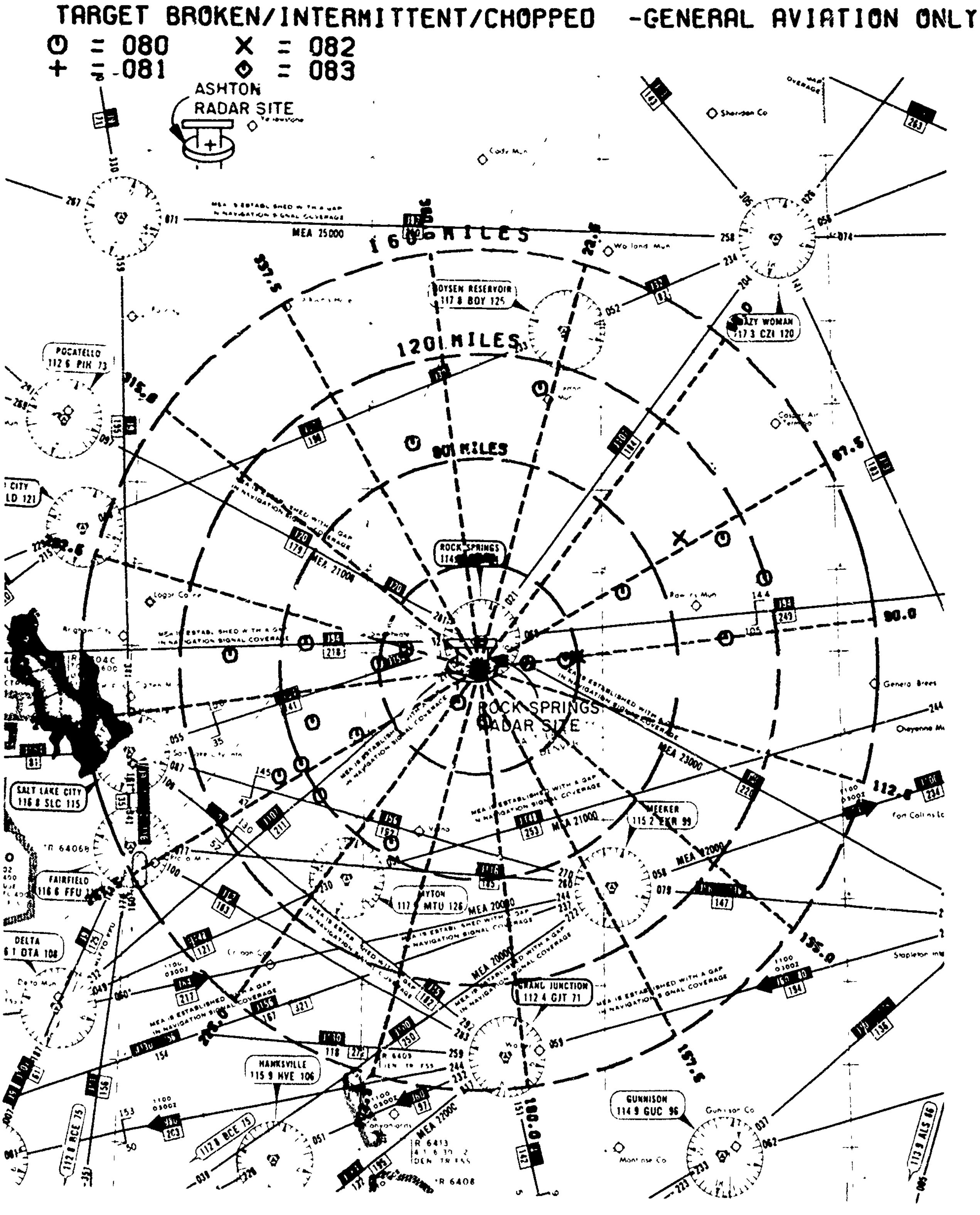

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Figure 2-10. Locations Associated with Broken Targets for General Aviation-RKS Site.

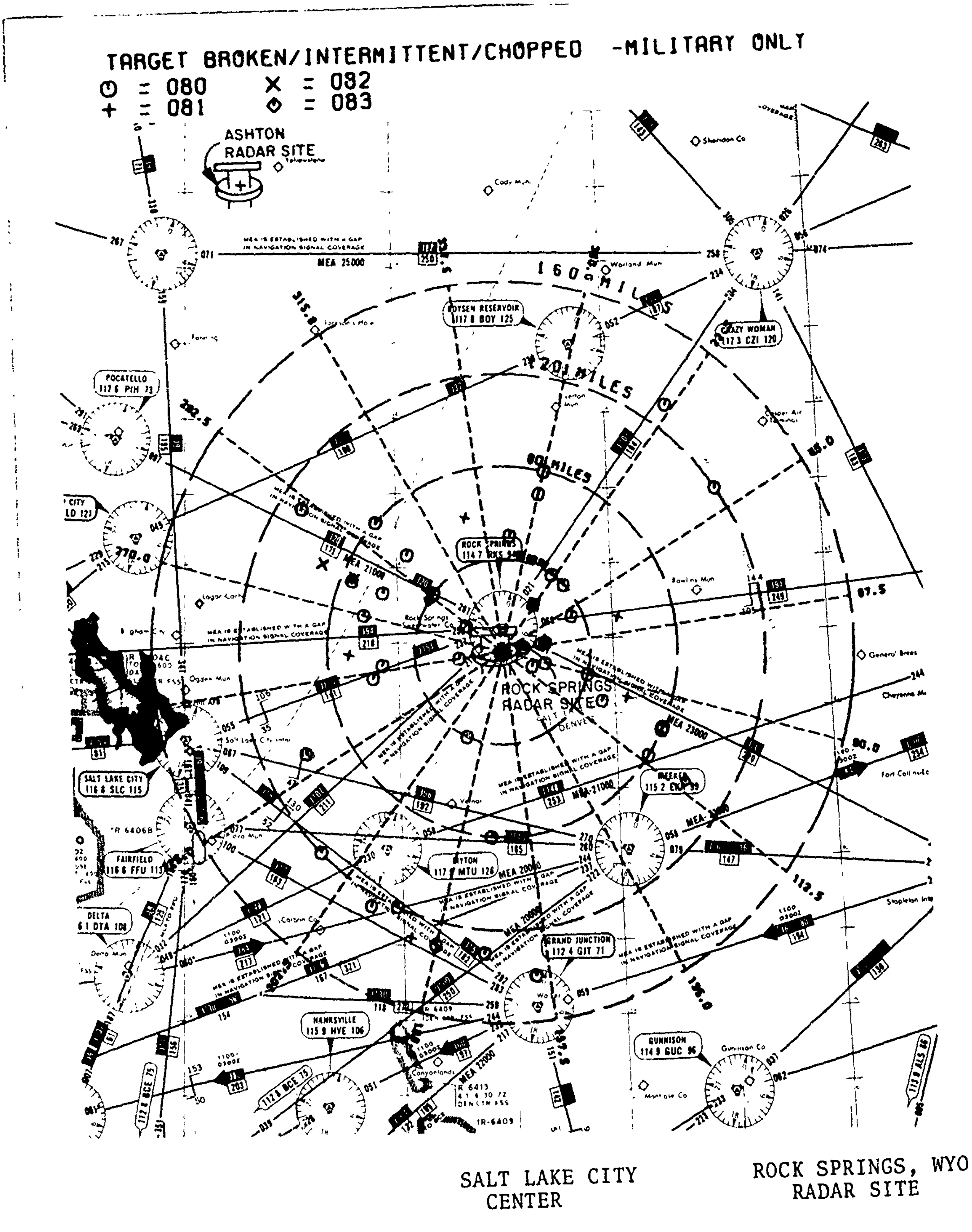


Figure 2-11. Locations Associated with Broken Targets for Military Aircraft-RKS Site.

it was considered desirable to isolate this type of degradation.

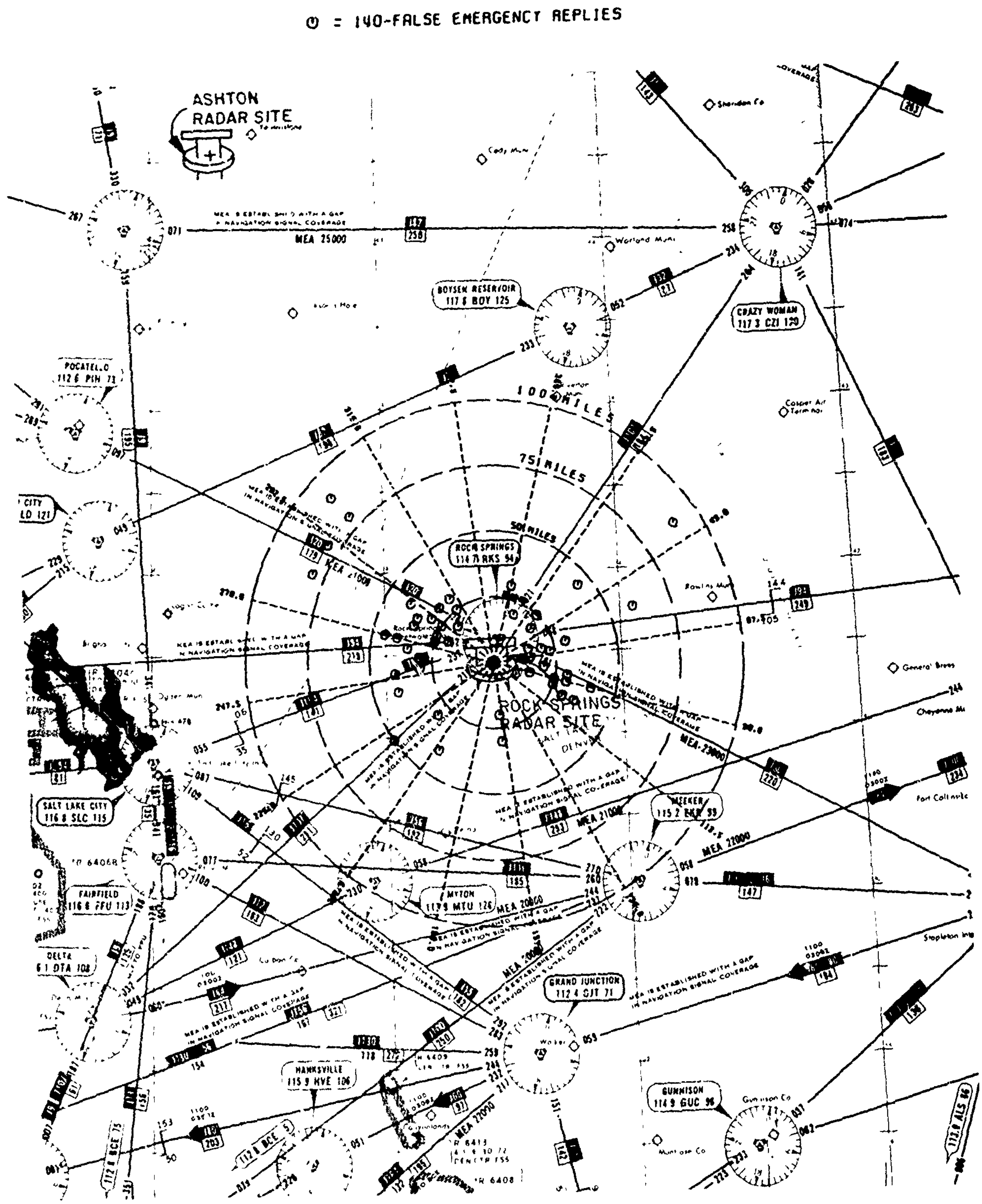
From Figure 2-9, it appears that the locations of broken targets are closely correlated with the general pattern of commercial traffic, occuring more frequently where traffic is dense. This suggests that broken targets are equally likely to occur at any point on the scope and that the documented discrepancies reflect the flow of traffic.

While at the Salt Lake facility, this picture was reinforced. There target breakup was observed, occuring with extreme regularity, at all sectors of the scope. In response to a question concerning other interrogators operating in the region of the Rock Springs site, it was stated that there were no (known) such installations. This fact, coupled with the erratic pattern of the target breakup, suggests that the signal processing and display units may play a role in this deficiency. At the present time, the center is equipped with the older type RBDE-4 scan converter and display system. This model was introduced in the early fifties and the FAA is considering plans for its replacement. Looking further ahead, within three to five years the facility will receive new equipment as part of the conversion to automated NAS operation.

The final graph in this series depicts the locations associated with false emergency alarms (Fig. 2-12). As was the case with broken targets, this curve seems to follow the general traffic pattern.

The phenomena of false alarms is caused by the interleaving of reply pulse trains. For example, codes 2300 and 2100 can combine to form the emergency code 7700. At the time of the survey, code 2100 was in general usage at the Salt Lake Center and code 2300 was employed at the neighboring Denver, Seattle and Great Falls centers. Plans are underway to alleviate this situation by changing the controllers handbook to replace 2300 with another code for flights above 35,000 feet.* It is felt that this type of discrepancy is a temporary problem, and should be alleviated by the

*Effective 1 August 1972, the ATC procedures handbooks specify code 2400 as the replacement.



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CENTER

ROCK SPRINGS, WYO
RADAR SITE

Figure 2-1̃ Locations where False Emergency Alarms Occurred-RKS Radar Site.

introduction of discrete codes under NAS.

The data from the Ashton radar has been processed in the same manner as that from Rock Springs and is presented in Figures 2-13 through 2-20. The problem of sidelobes/ring around is addressed in Figure 2-13, reflections/false targets in Figure 2-14, lost targets in Figures 2-15 and 2-16, broken targets in Figures 2-17 to 2-19 and false emergency alarms in Figure 2-20.

2.6 AIR-TRAFFIC-POPULATION STATISTICS DERIVED FROM FLIGHT STRIPS

As was pointed out previously while discussing the breakdown of error reports by aircraft type, knowledge of the air traffic population is essential for interpreting the discrepancy data. Since such information is not available directly, these statistics were derived from flight progress strips.

The flight strips posted for the interval the beacon survey was conducted were not available at the time of this study, since they had been destroyed after 15 days, as is standard practice. Therefore, other progress strips were requested from the Salt Lake Center covering one week of operation; this was considered the minimum period required to monitor flights by air carriers in view of their periodic nature.

A delay was encountered in obtaining this information since these forms were already being set aside on certain days to satisfy the requirements of the center for data covering peak traffic, and the thirty-seventh busiest day. Rather than wait until 7 consecutive days of activity became available, it was decided to synthesize a full week's activity by substituting data from a different week for the missing strips.

A picture of the air traffic population was derived using the following days' activity: Monday, March 6; Tuesday, March 7; Wednesday, March 8; Thursday, March 16; Friday, April 7; Saturday, March 4; Sunday, March 5 (all in 1972).

In glancing through the flight strips it was observed that there might be as many as seven entries covering a given flight.

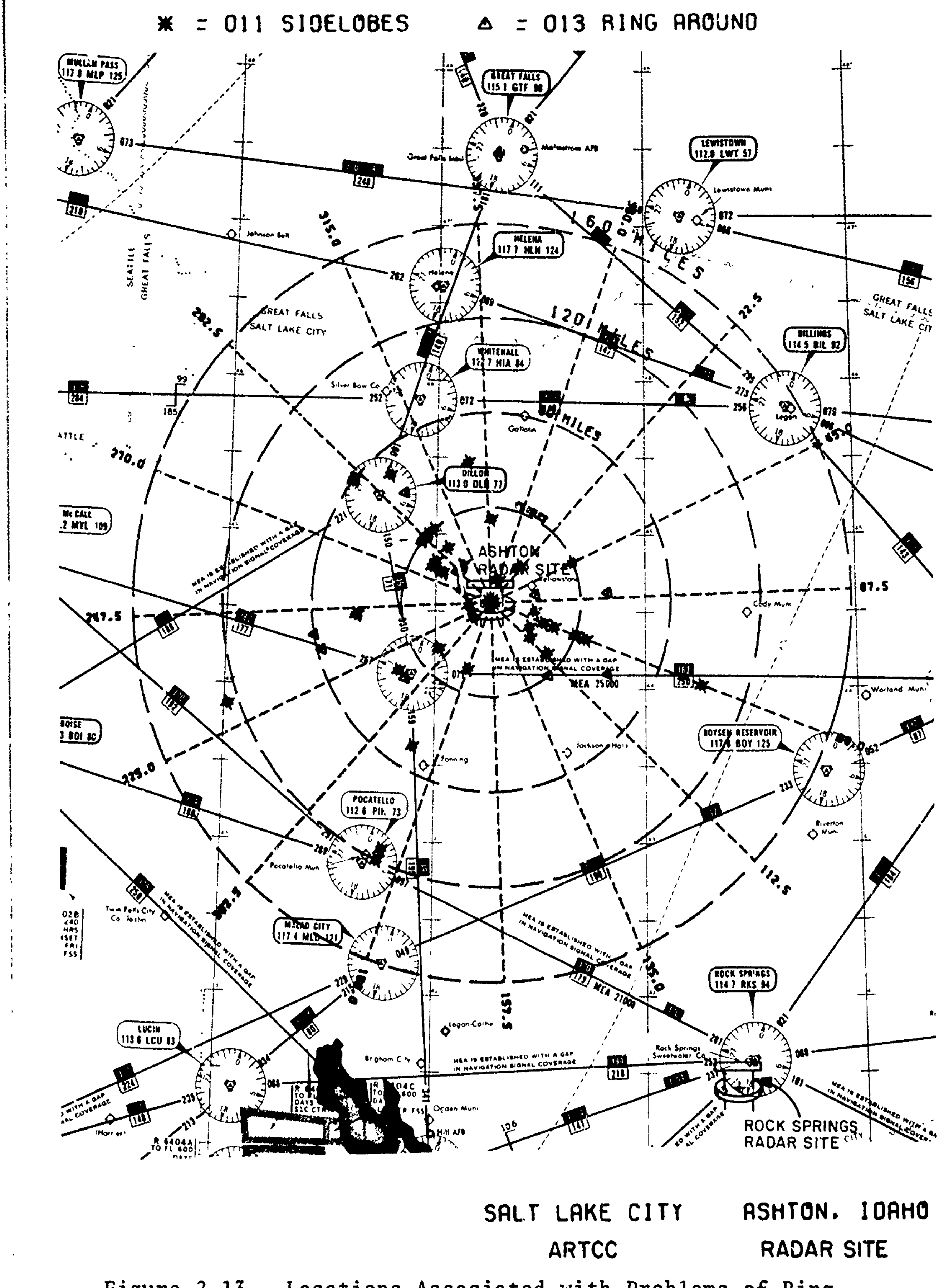


Figure 2-13. Locations Associated with Problems of Ring Around or Sidelobes-Ashton Site.

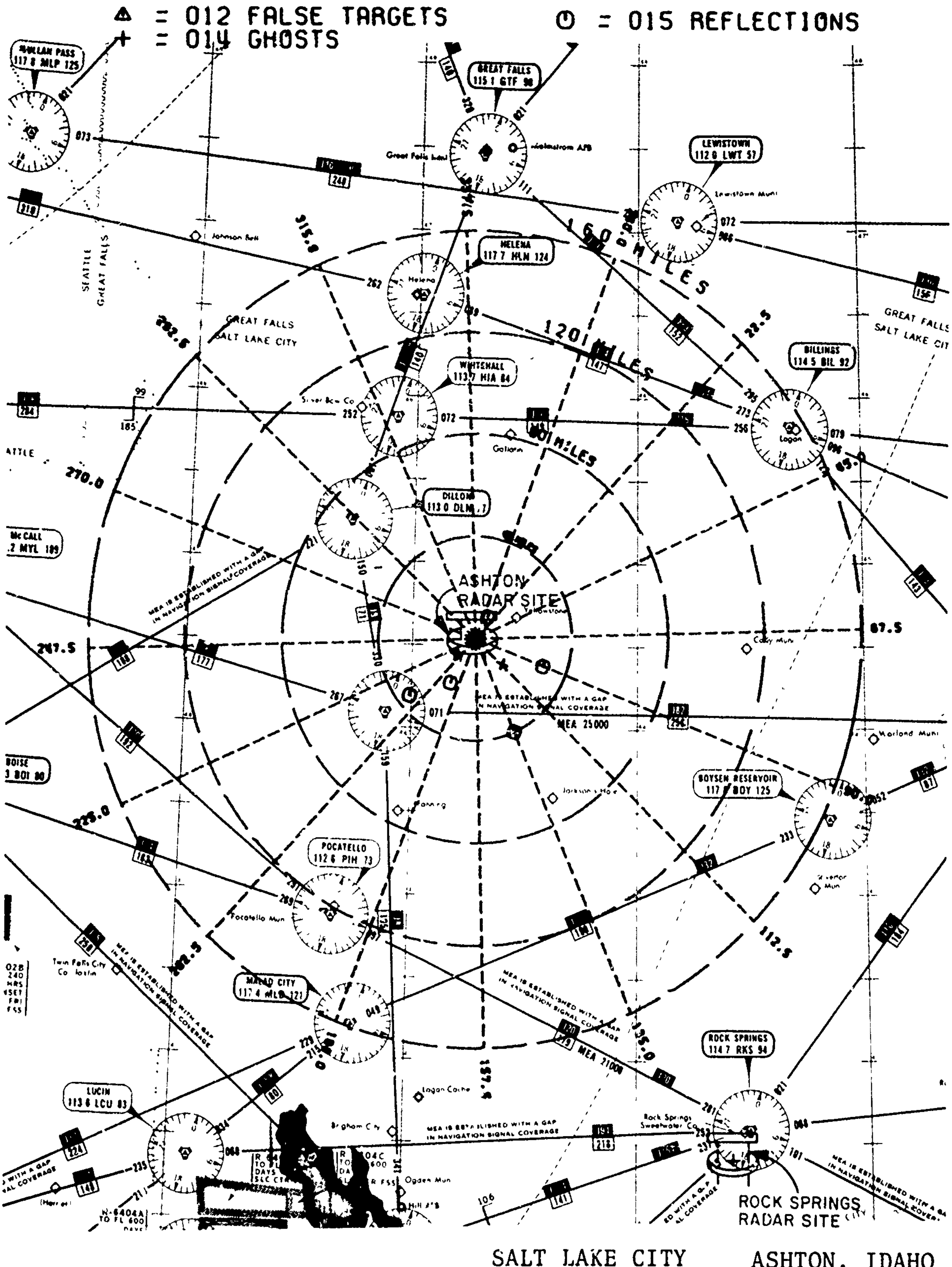


Figure 2-14. Locations Associated with Ghosts, False Targets, Reflections-Ashton Site.

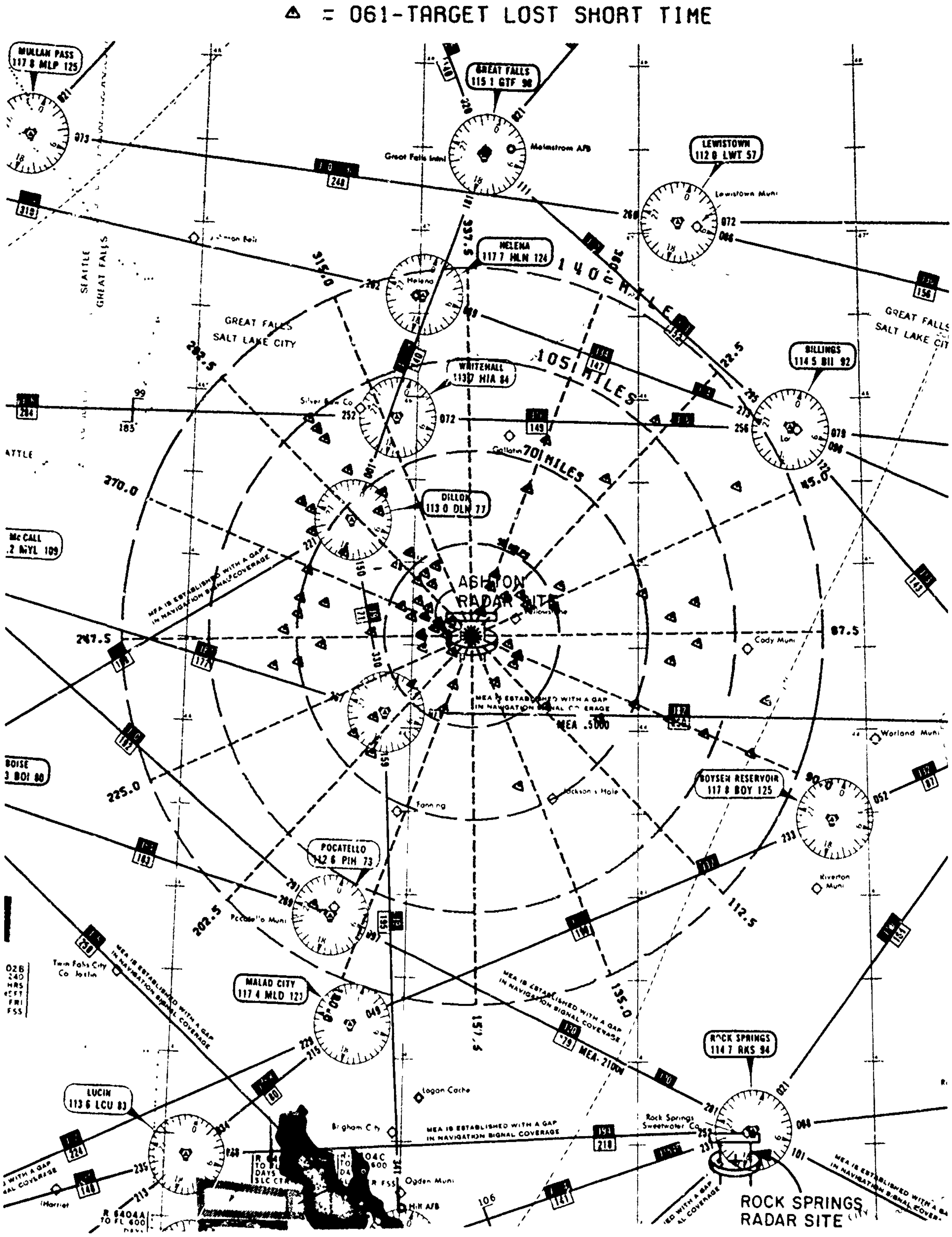
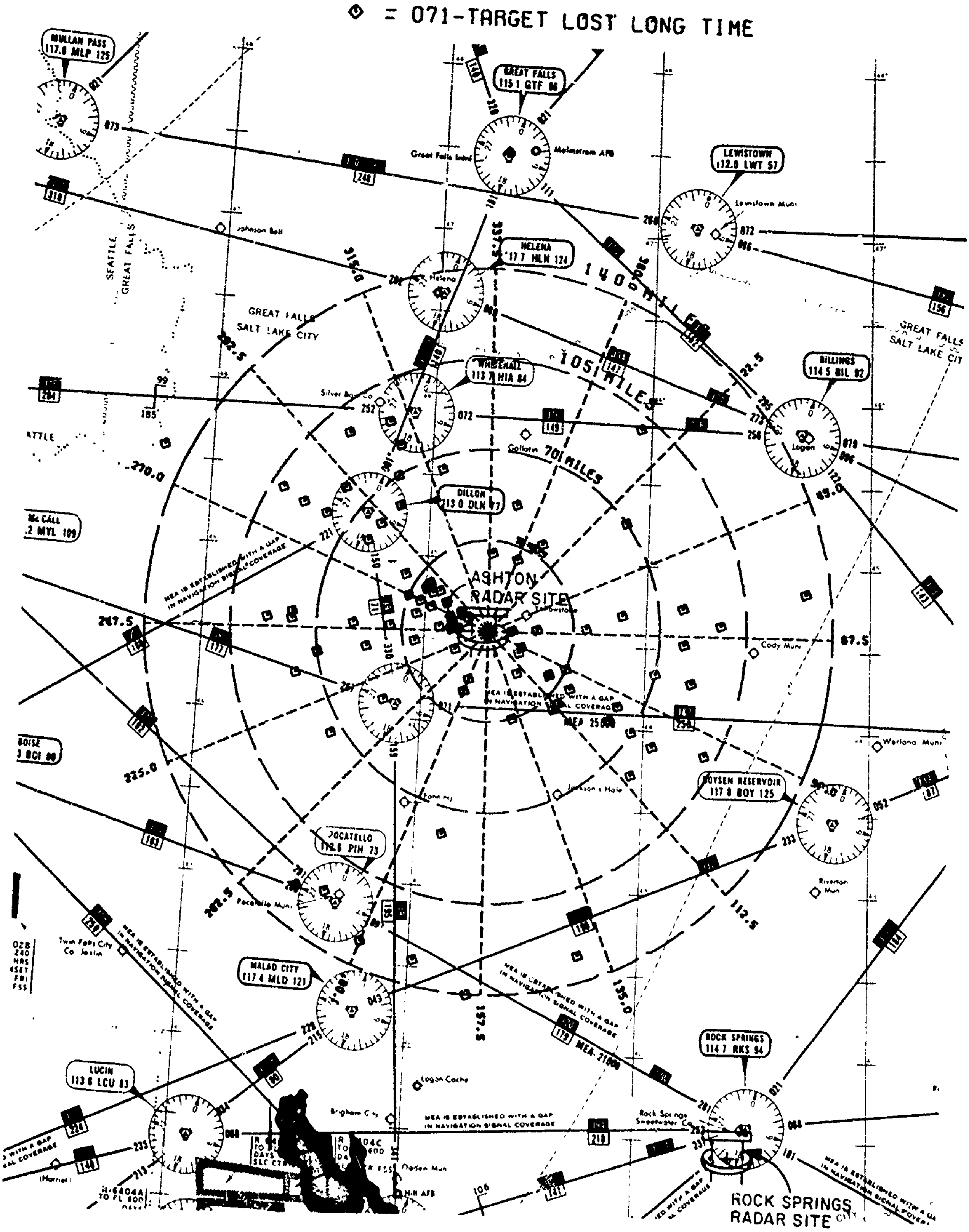


Figure 2-15. Locations where Targets were Lost for a Short Time-Ashton Site.



SALT LAKE CITY
ARTCC

ASHTON, IDAHO
RADAR SITE

Figure 2-16. Locations where Targets were Lost for a Long Time-Ashton Site.

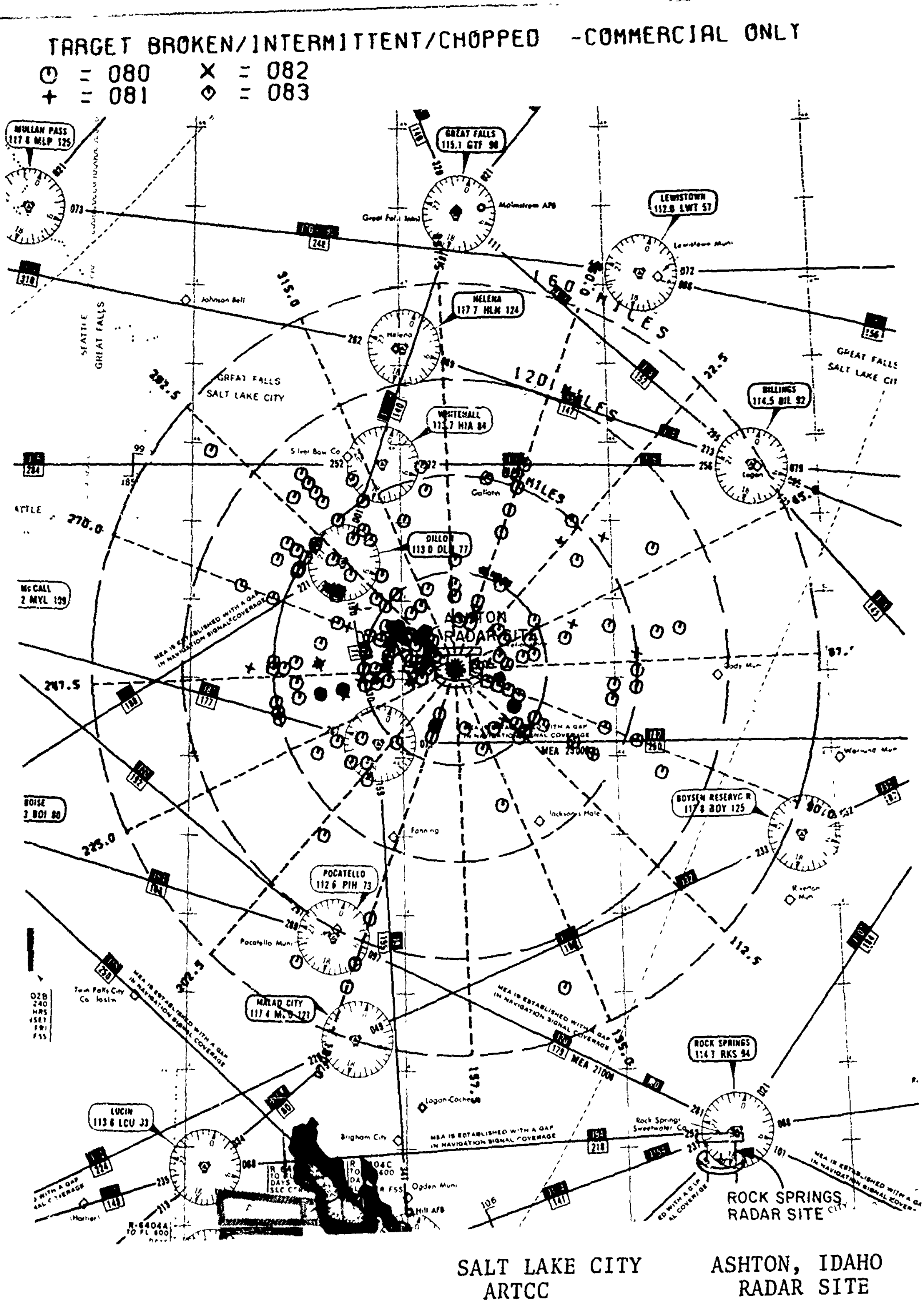


Figure 2-17. Locations Associated with Broken Targets; Commercial Aircraft-Ashton Site.

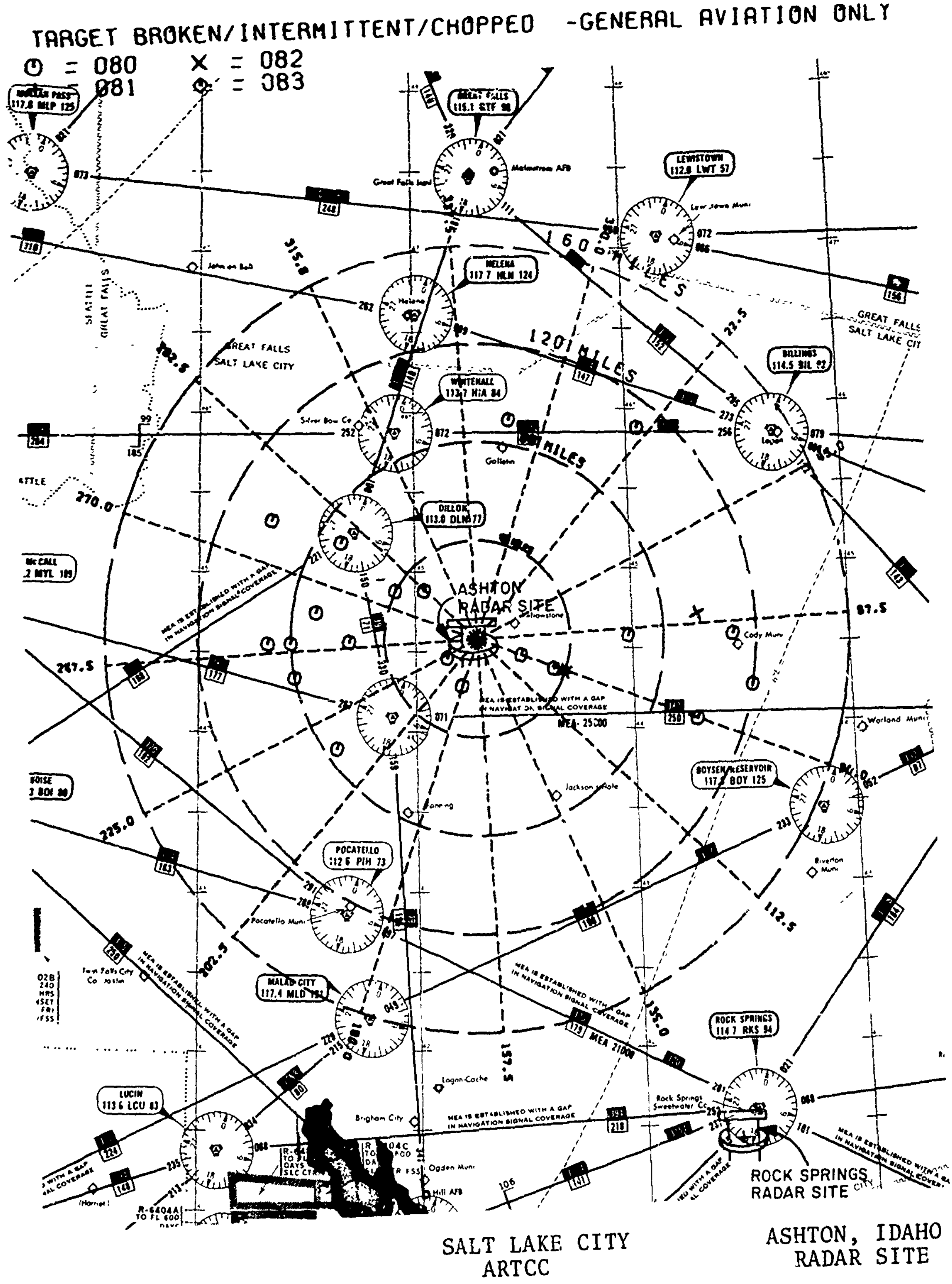
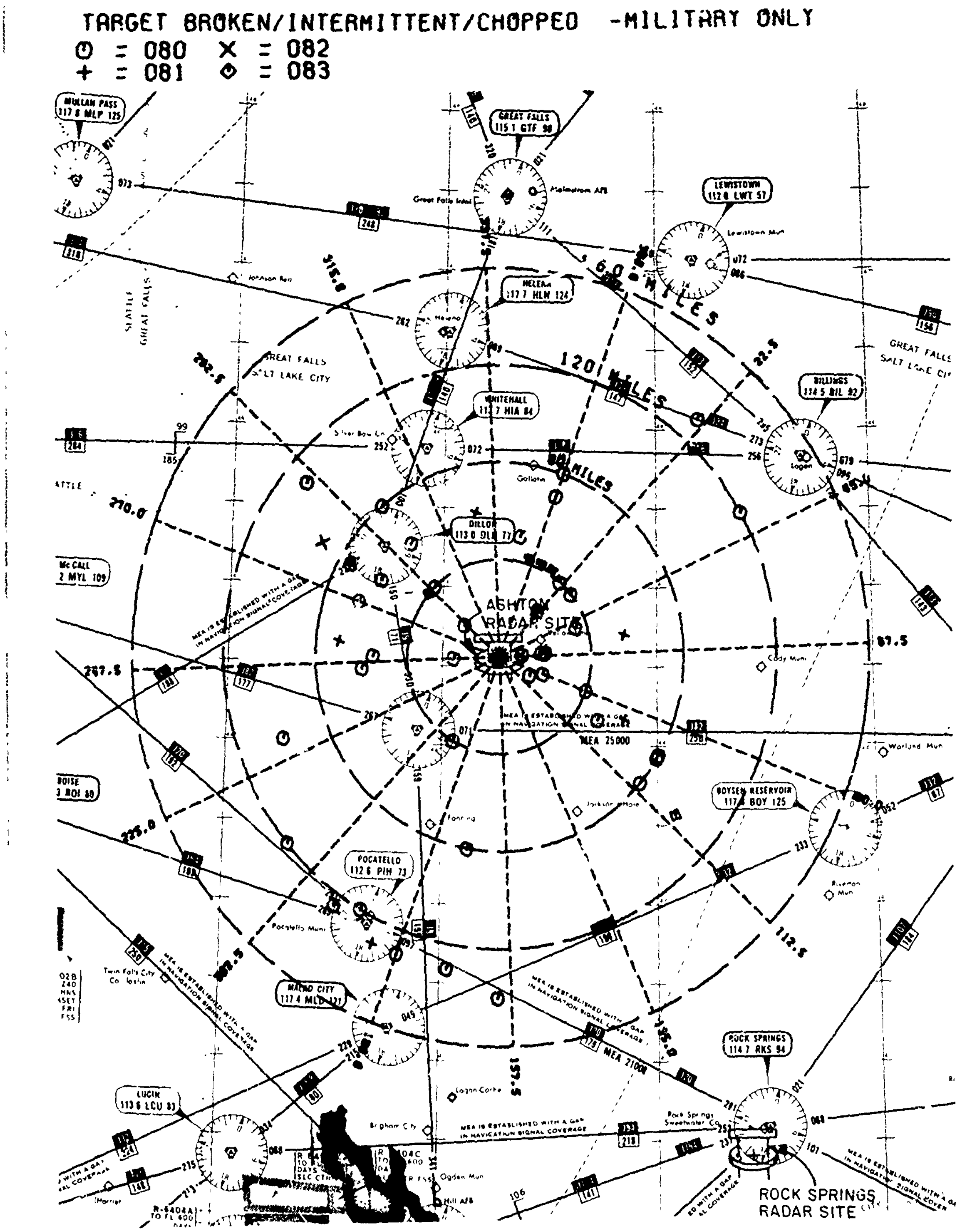


Figure 2-18. Locations Associated with Broken Targets; General Aviation-Ashton Site.



SALT LAKE CITY ARTCC

ASHTON, IDAHO RADAR SITE

Figure 2-19. Locations Associated with Broken Targets; Military Aircraft-Ashton Site.

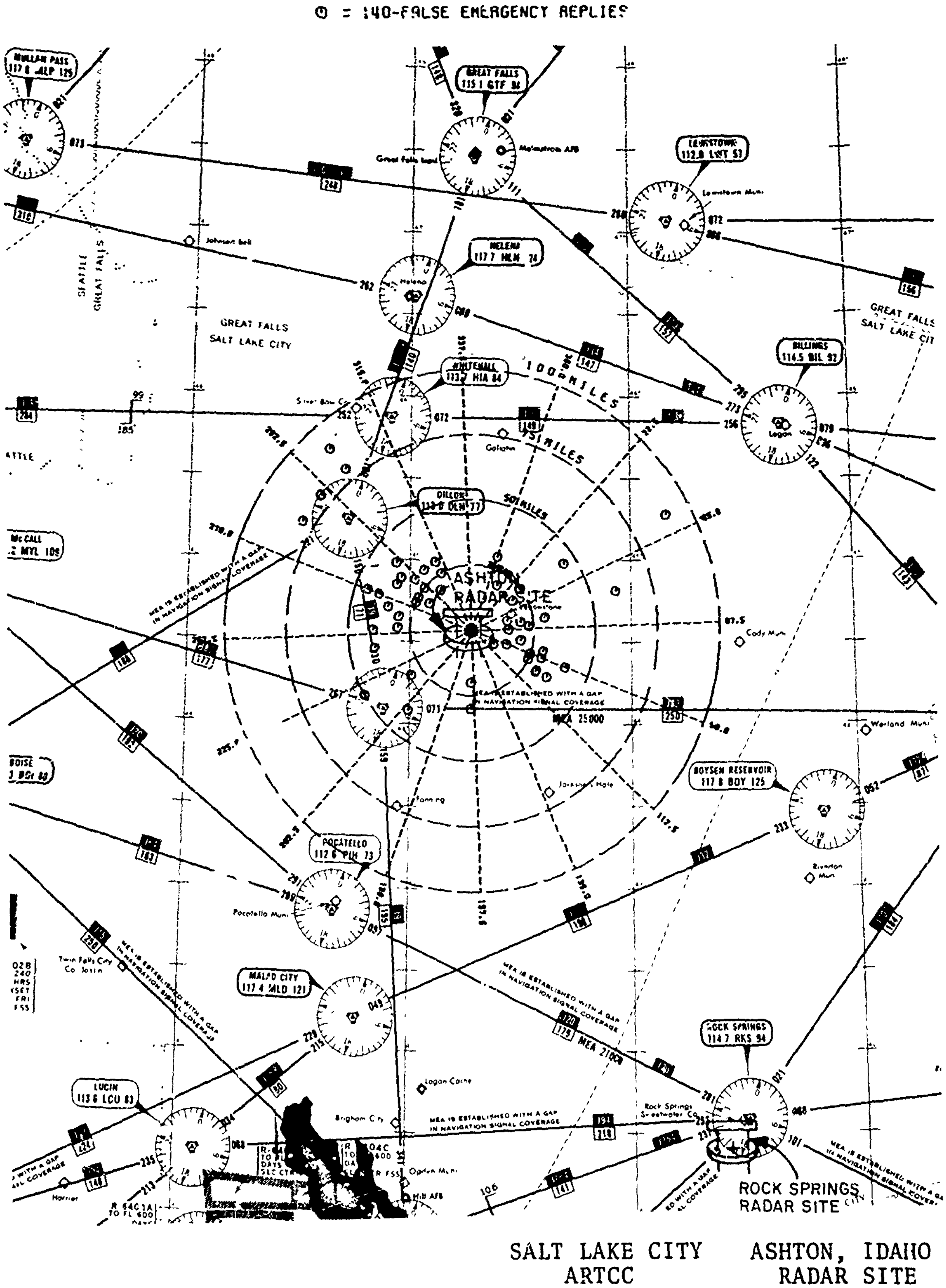


Figure 2-20. Locations where False Emergency Alarms Occurred-Ashton Site.

The number of strips posted per flight varied with the number of sectors intercepted, and within a given sector a progress strip would be entered at each fix along the route. Fortunately, in carrying out the task of extracting the population information, the amount of duplication could be minimized through knowledge of the sectorization.

The low and high altitude sectors are described in Figures 2-21 and 2-22 respectively. Since the Salt Lake ARTCC discrepancy reports referenced the Rock Springs and Ashton radar sites, only the progress strips associated with these locations were processed. This involved handling sectors 39 and 40 in the case of Rock Springs, and sectors 4 and 5 for Ashton.

From an analysis of the flight strips, the following picture emerged of the air traffic population (Table 2-8). The most commonly encountered aircraft is the B-727, of which there were 465 flights. Next in popularity is the B-707 (210 flights), followed by the DC-8 (159 flights), B-737 (102 flights), C135 (94 flights), and CV58 (94 flights). It must be emphasized that these statistics are based upon seven days of activity at just the Rock Springs and Ashton radar sites.

Data on the activity of the various air carriers was also extracted from the flight strips. These results are found in Table 2-9.

The above information was refined by subdividing the activity of each carrier on the basis of the aircraft involved. This data is presented in Table 2-10.

Finally, the flight strips were used to obtain information on the traffic flow as a function of time. This data is presented in Figure 2-23. For the purpose of comparison, the fault occurence rate is illustrated in the following graph, Figure 2-24.

The traffic flow exhibits a broad peak in the morning, extending from 10 AM to 12 AM. A smaller peak occurs in the early afternoon and runs from 2 PM to 4 PM. This is followed by a gradual slackening in traffic, so that between 9 PM and 8 AM very light traffic is experienced.

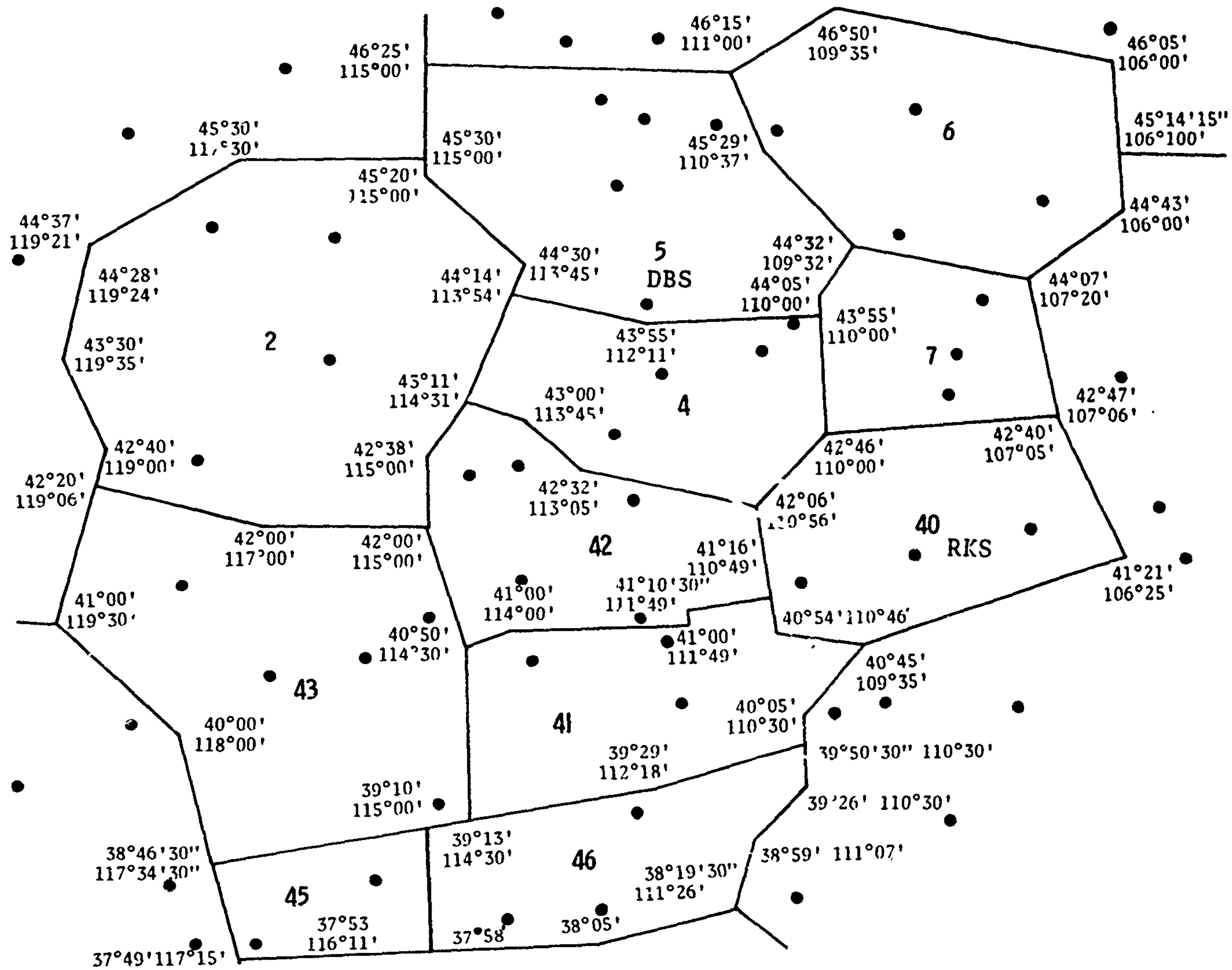


Figure 2-21. Salt Lake City ARTCC Sectorization-Low Altitude

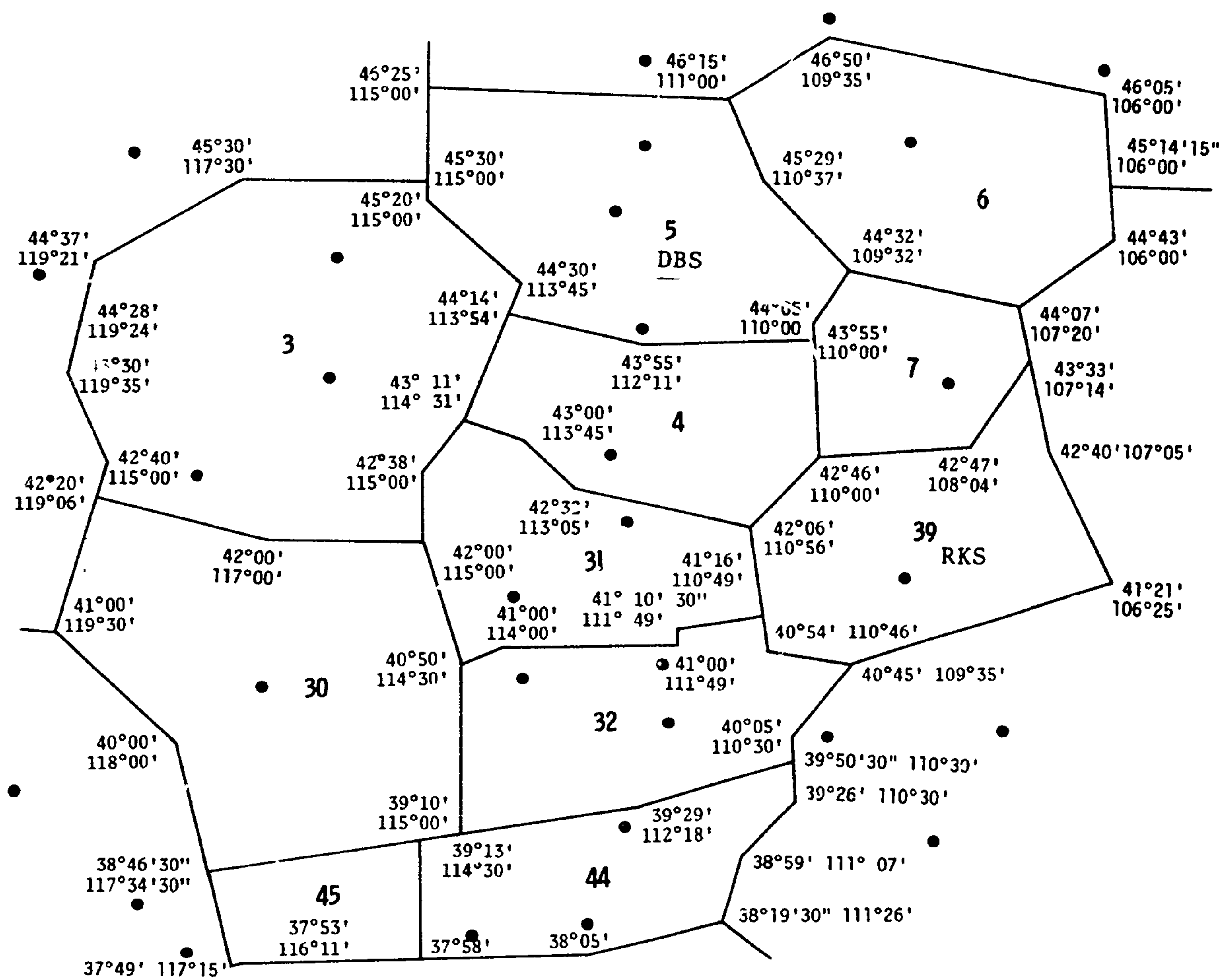


Figure 2-22. Salt Lake City ARTCC Sectorization-High Altitude

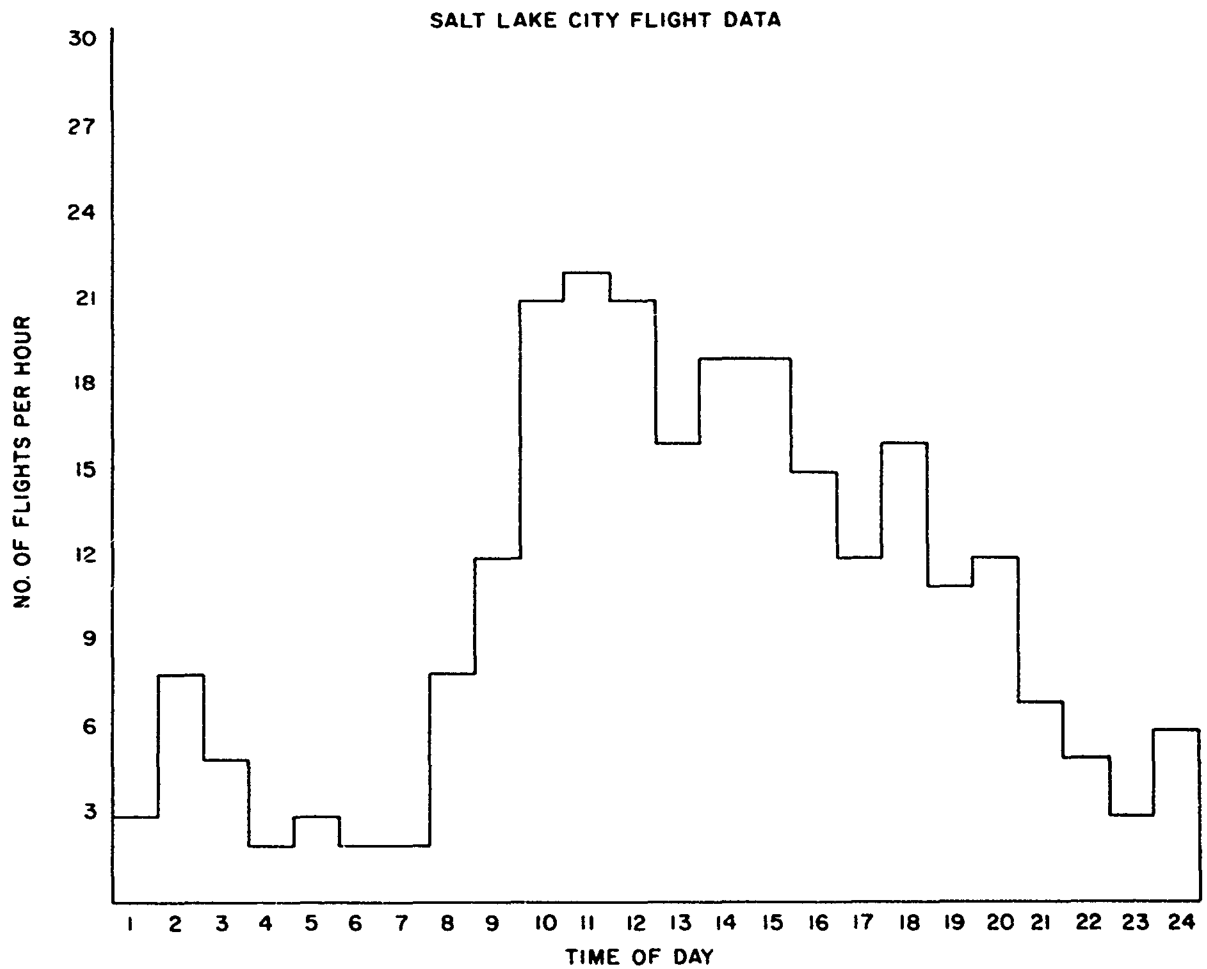


Figure 2-23. Air Traffic Activity vs. Time within the Rock Springs and Ashton Sectors, from Flight Strips.

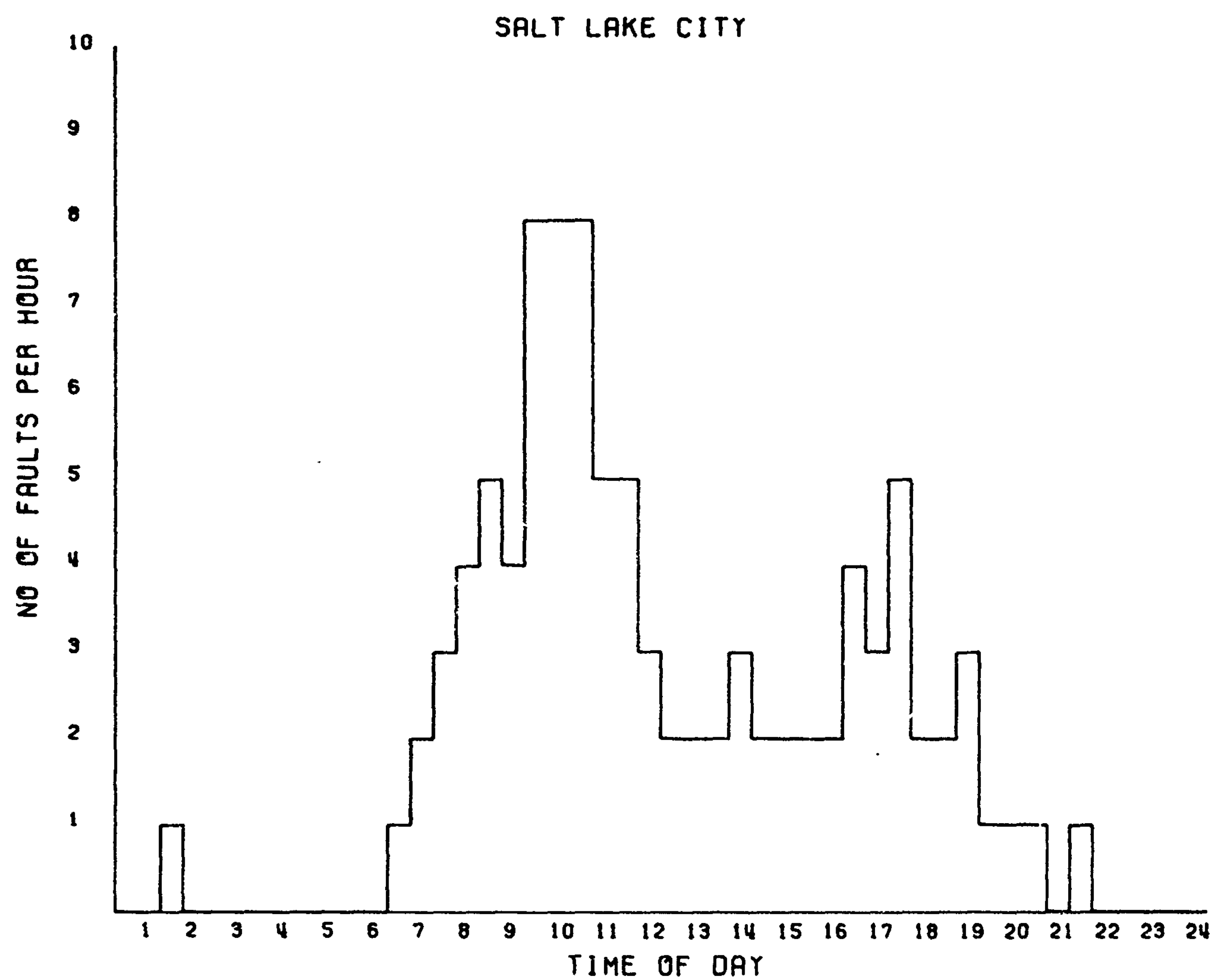


Figure 2-24. Discrepancy Rate vs. Time within the Rock Springs and Ashton Sectors, from Flight Strips.

TABLE 2-8. AIR TRAFFIC POPULATION STATISTICS DERIVED FROM FLIGHT STRIPS
Facility: Salt Lake ARTCC

A/C TYPE	NO. FLIGHTS	A/C TYPE	NO. FLIGHTS
A3	3	DC86	26
A4	1	DH5	1
A6	3	F4	4
AC21	5	F8	1
AC50	14	F9	1
AC68	4	F101	5
B52	56	F102	2
B57	16	F104	1
B707	210	F105	1
B720	73	F106	12
B727	465	F111	20
B737	102	FA27	8
B747	58	FFJ	8
BE33	1	G2	10
BE35	7	G159	2
BE55	5	H60	1
BE60	3	HS25	5
BE80	1	L18	2
BE90	11	L188	10
C1	1	L326	0
C9	3	L329	7
C54	6	LR23	1
C117	1	LR24	6
C118	10	LR25	13
C119	2	M152	1
C121	5	MO21	2
C124	14	MU2	1
C130	8	N265	9
C131	3	P3	3
C135	94	PA23	2
C141	33	PA24	3
C172	1	PA28	4
C182	1	PA30	5
C206	2	PA31	10
C210	2	PA34	1
C310	3	PAZT	7
C320	7	Q21	1
C337	2	SR71	5
C411	3	T2	1
C414	1	T28	1
C421	4	T29	10
CF4	1	T33	24
CV58	90	T38	4
CV88	7	T39	9
DC3	1	TA4	1
DC8	159	TS60	2
DC9	11		
DC10	2		
DC85	5		

TABLE 2-9. AIR CARRIER ACTIVITY WITHIN THE ROCK SPRINGS AND ASHTON SECTORS OVER A 7-DAY PERIOD. (DERIVED FROM FLIGHT STRIPS)

CARRIER	NO. FLIGHTS
AL101	77
AL102	456
AL103	143
AL104	160
AL107	4
AL108	98
AL109	0
AL110	23
AL111	91
AL112	2
AL114	0
AL116	104
AL118	12
AL121	13
AL123	0
AL124	0

TABLE 2-10. DISTRIBUTION OF AIR CARRIER ACTIVITY BY AIRCRAFT TYPE (DERIVED FROM FLIGHT STRIPS) Facility: Salt Lake ARTCC

CARRIER	TOTAL	%*	B707	B720	B727	B737	B747	CV58	CV88	DC8**	DC9	DC10	FA27	FFJ
AL101	77	4.32	52		1	1	16		7					
AL102	456	25.63	1	31	239		10			173		2		
AL103	143	8.03	1	38	4	96				4				
AL104	160	8.99	115		33		11			1				
AL107	4	0.22			4									
AL108	98	5.50	1		97									
AL109	0	0.0												
AL110	23	1.29		22						1				
AL111	91	5.11				2		89						
AL112	2	0.11								2				
AL114	0	0.0												
AL116	104	5.48	24	3	64		13							
AL118	12	0.67	3			1	8							
AL121	13	0.73									5		8	
AL123	0	0.00												
AL124	0	0.00												
TOTALS	1183	66.5	197	72	464	100	58	89	7	181	5	2	8	0

* Percent of total traffic
**Includes the DC85 and DC86

The discrepancy rate in the morning follows the same general pattern as the traffic load. However, its peak is fairly sharp and lasts only from 10 AM to 11 AM. After this time, the number of discrepancies drops off quite rapidly, and remains low except for some secondary spikes in the vicinity of 5 PM.

2.7 NORMALIZED DISCREPANCY DATA BY AIRCRAFT TYPE AND CARRIER INVOLVED

In this section the population statistics are employed to normalize the discrepancy reports. The objective is to compute the discrepancy rate per flight, a system performance parameter which allows comparison between various air carriers and among aircraft.

The normalized discrepancy rate characterizing selected aircraft is listed in Table 2-11. These results are limited to the five commercial aircraft most common in the region, as indicated by the flight strip information. Since the traffic data were collected over a seven day period while the discrepancy reports reference a two week interval, a factor of two enters these calculations. It is interesting to note the large performance variation revealed by this chart.

Next, the discrepancy rate associated with the various air carriers was determined. This data is presented in Table 2-12, for airlines with 75 or more flights through this region in a 7-day period.

For a given type of aircraft, a variation in performance can arise among different carriers. This deviation could be introduced by such variables as the use of different transponder equipment and varying maintenance procedures. In order to examine this phenomena, the performance of aircraft listed in Table 2-11 was derived as a function of air carrier. The results are contained in Table 2-13; computations were performed for those aircraft-carrier combinations exceeding 20 flights per week as indicated by Table 2-10.

It is interesting to note the large variation in performance suggested by Table 2-13. Among all aircraft, the highest discrepancy

TABLE 2-11. BEACON DISCREPANCY RATE ASSOCIATED WITH SELECTED AIRCRAFT
Facility: Salt Lake ARTCC

AIRCRAFT	NUMBER OF DISCREPANCIES	FLIGHTS*/2	DISCREPANCY/FLIGHT
B-707	65	210	.154
B-720	34	73	.232
B-727	297	465	.318
B-737	15	102	.073
CV-580	23	90	.127
DC-8**	63	190	.165

* Flight information references a 7-day period while discrepancy data covers two weeks

**Includes the DC-85 and DC-86

TABLE 2-12. NORMALIZED DISCREPANCY RATE OF SELECTED AIR CARRIERS
Facility: Salt Lake ARTCC

CARRIER	NO. FLIGHTS*/2	NUMBER OF DISCREPANCIES	DISCREPANCY/FLIGHT
AL101	77	35	.227
AL102	456	223	.244
AL103	143	27	.094
AL104	160	85	.265
AL108	98	106	.540
AL111	91	21	.115
AL116	104	13	.062

*Flight information references a 7-day period while discrepancy data covers two weeks

TABLE 2-13. NORMALIZED DISCREPANCY RATE BY CARRIER AND AIRCRAFT
Facility: Salt Lake ARTCC

CARRIER	B-707	B-720	B-727	B-737	CV580	DC-8
AL101	.125					
AL102		.322	.290			.161
AL103		.157		.078		
AL104	.191		.545			
AL108			.520			
AL110			.181			
AL111					.117	
AL116	.083		.054			

rate is associated with B727's operated by the carriers designated AL104 and AL108. Strangely enough, the lowest discrepancy rate involves another fleet of the B727; in this case, under the command of AL116. It would be useful to explore the differences between these aircraft in order to account for this performance variation.

3. ANALYSIS OF SURVEY RETURNS FROM LOS ANGELES ARTCC

The Los Angeles center handles an area which stretches from the Pacific Ocean to as far east as Escalante, Utah; and is bounded on the north by Tonopah, Nevada, and on the south by the Mexican border (Fig. 3-1). Within this region, beacon coverage is provided by six radar units. These are located at[3]; 1) San Pedro, California, 2) Boron, California, 3) Las Vegas, Nevada, 4) Mt. Laguna, California, 5) Paso Robles, California, 6) Cedar City, Utah.

In response to the survey, the Los Angeles Center sent in 456 reports. This group of replies was of particular interest due to the high density of military aircraft in the region and the unique problems caused by this situation.

3.1 ANALYSIS OF FAULT REPORTS (UNNORMALIZED DATA)

The discrepancy reports were first sorted on the basis of aircraft mission. This analysis revealed (Fig. 3-2) that 36.5% of the deficiencies involved military aircraft, 57.7% commercial carriers and 3.3% general aviation.

Next, the fault reports were grouped as a function of the time of occurrence. According to these results, (Fig. 3-3) the most severe problems arose in the morning, between 9:30 and 10:30 AM. During this period, which coincides with the morning rush hour, the discrepancy rate reached a peak of 18 deficiencies per hour. After this time the fault rate steadily declined, although a small peak (6.2 per hour) was experienced in the afternoon. Between the hours of 7 PM and 7 AM, the number of faults reported was negligible, undoubtedly reflecting the light air traffic during this interval.

One surprising feature, assuming the traffic load were the same, is that the fault rate recorded during evening rush hours is a fraction of the peak during the morning. This could be due to the fact that a different group of controllers were on

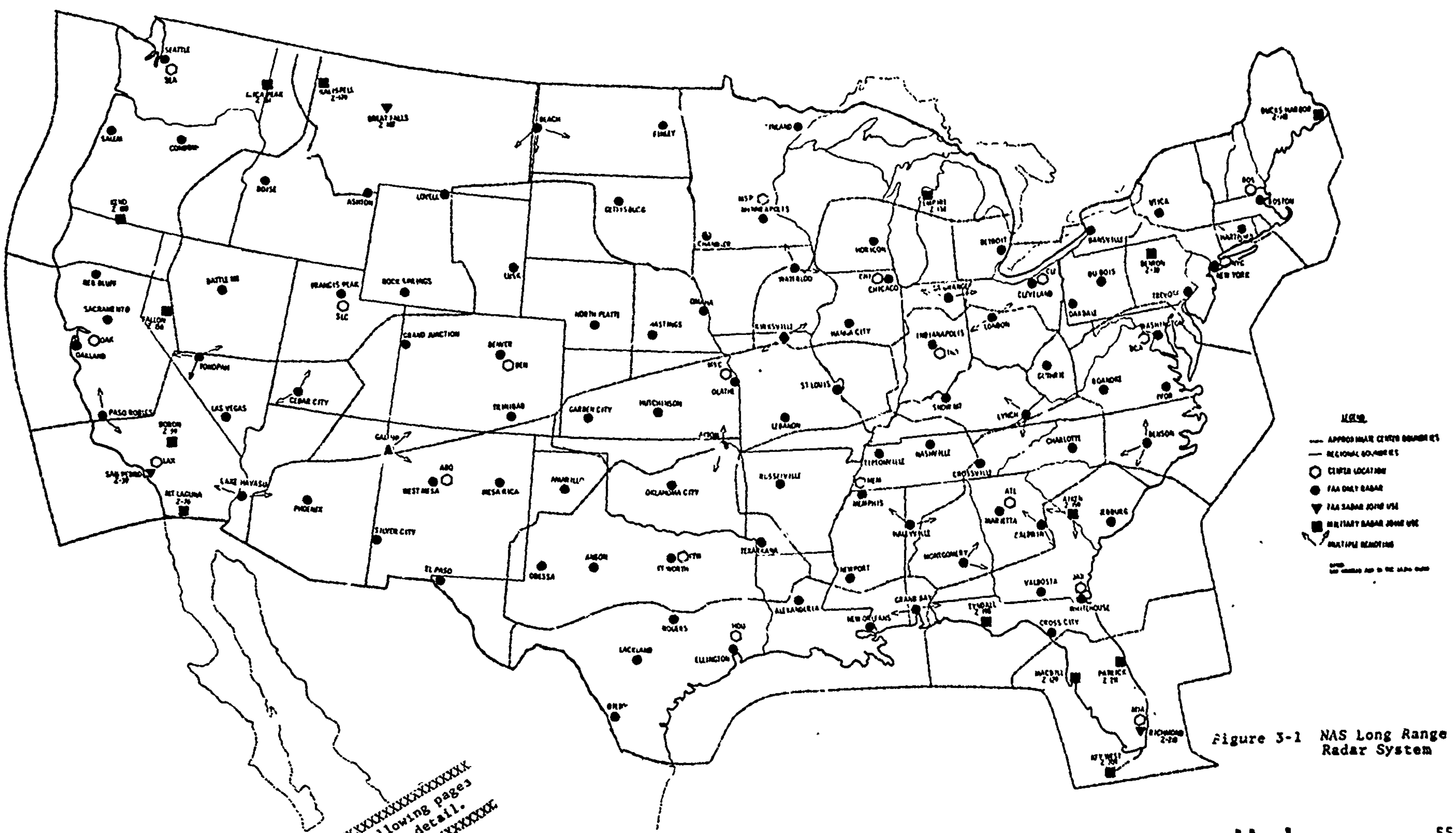


Figure 3-1 NAS Long Range Radar System

See the following pages for greater detail.

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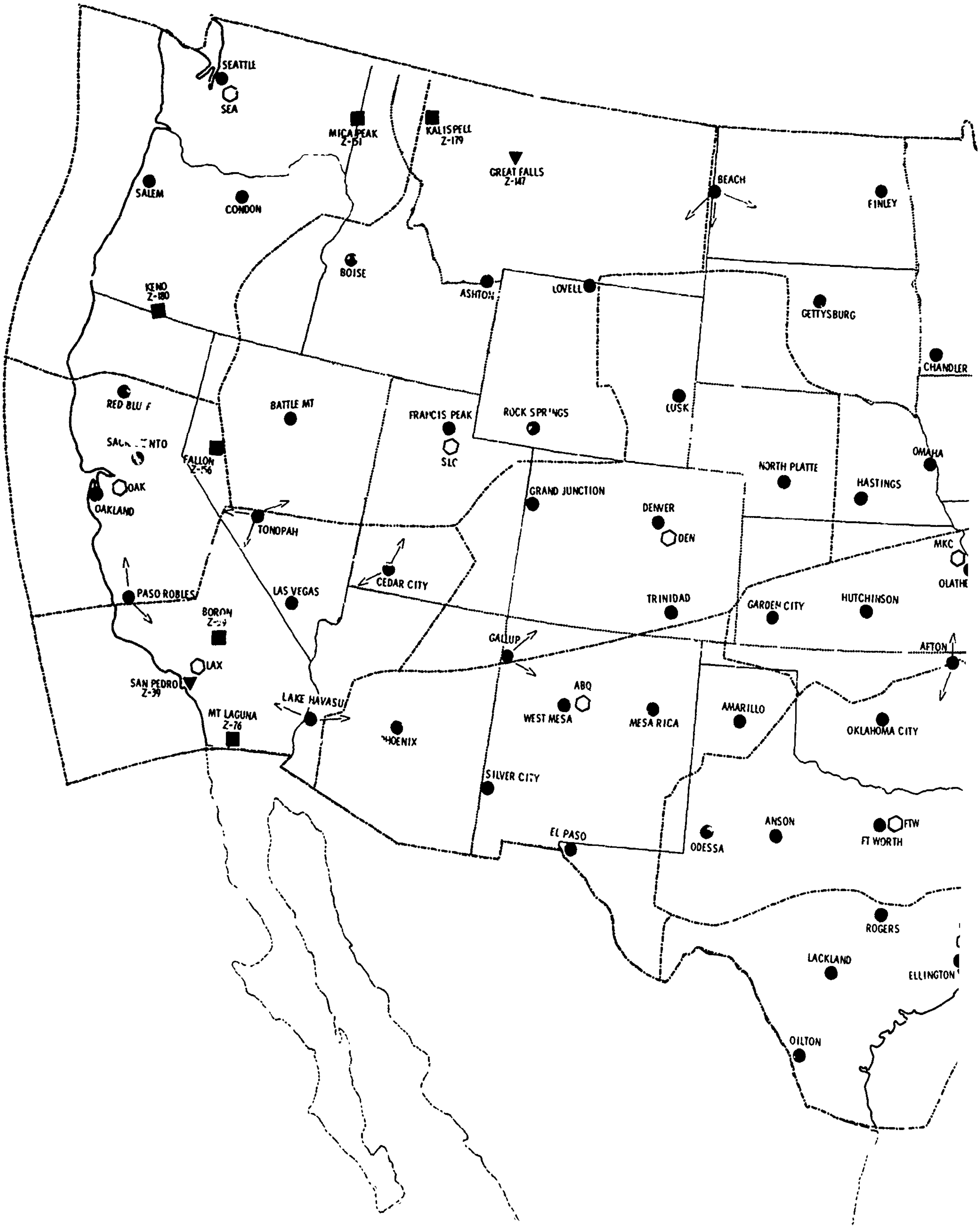
SEATTLE
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ASHTON
LOVELL
GETTYSBURG
CHANDLER
KENO
Z-180
BATTLE MT
FRANCIS PEAK
SLC
ROCK SPRINGS
LUSK
FALLON
OAK
OAKLAND
NORTH PLATTE
HASTINGS
OMAHA
GRAND JUNCTION
DENVER
DEN
TONOPAH
MKC
OLATHE
CEDAR CITY
PASO ROBLES
LAS VEGAS
BORON
TRINIDAD
GARDEN CITY
HUTCHINSON
GALLUP
AFTON
LAX
SAN PEDRO
Z-39
ABQ
LAKE HAVASU
MT LAGUNA
Z-76
WEST MESA
MESA RICA
AMARILLO
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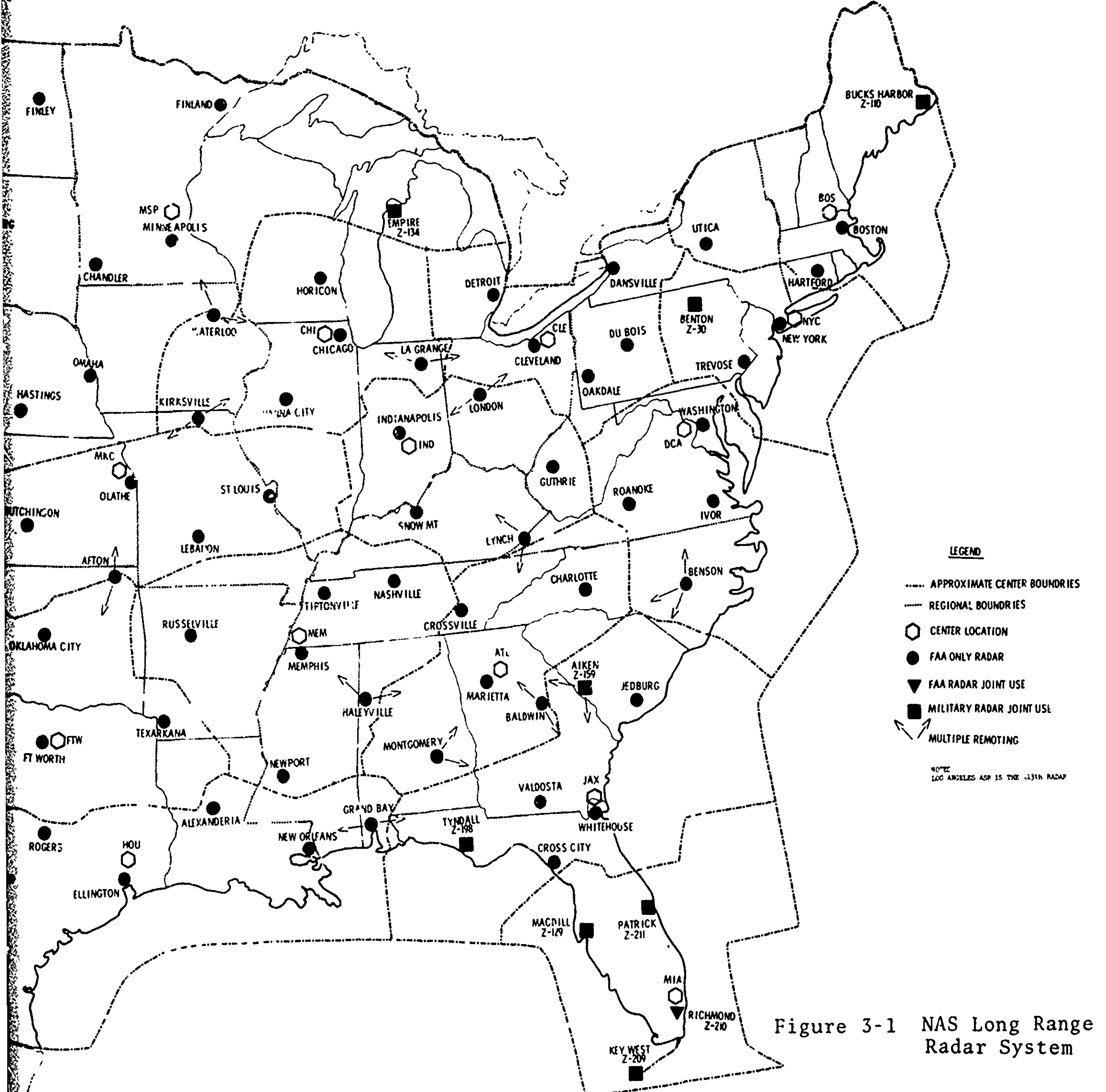

Figure 3-1 NAS Long Range Radar System

B

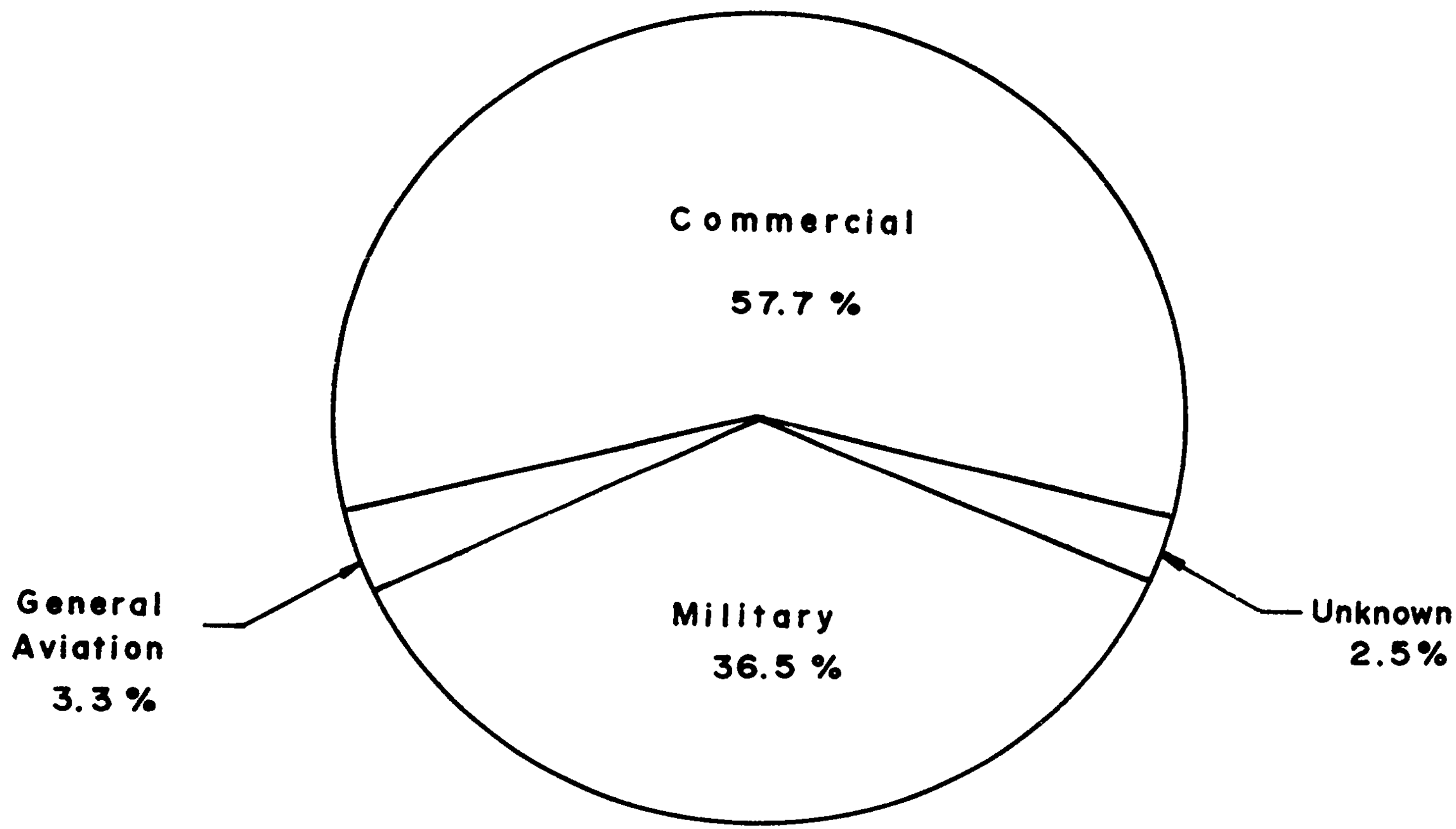

Figure 3-2 Breakdown of Discrepancy Reports by Aircraft Mission, Los Angeles ARTCC

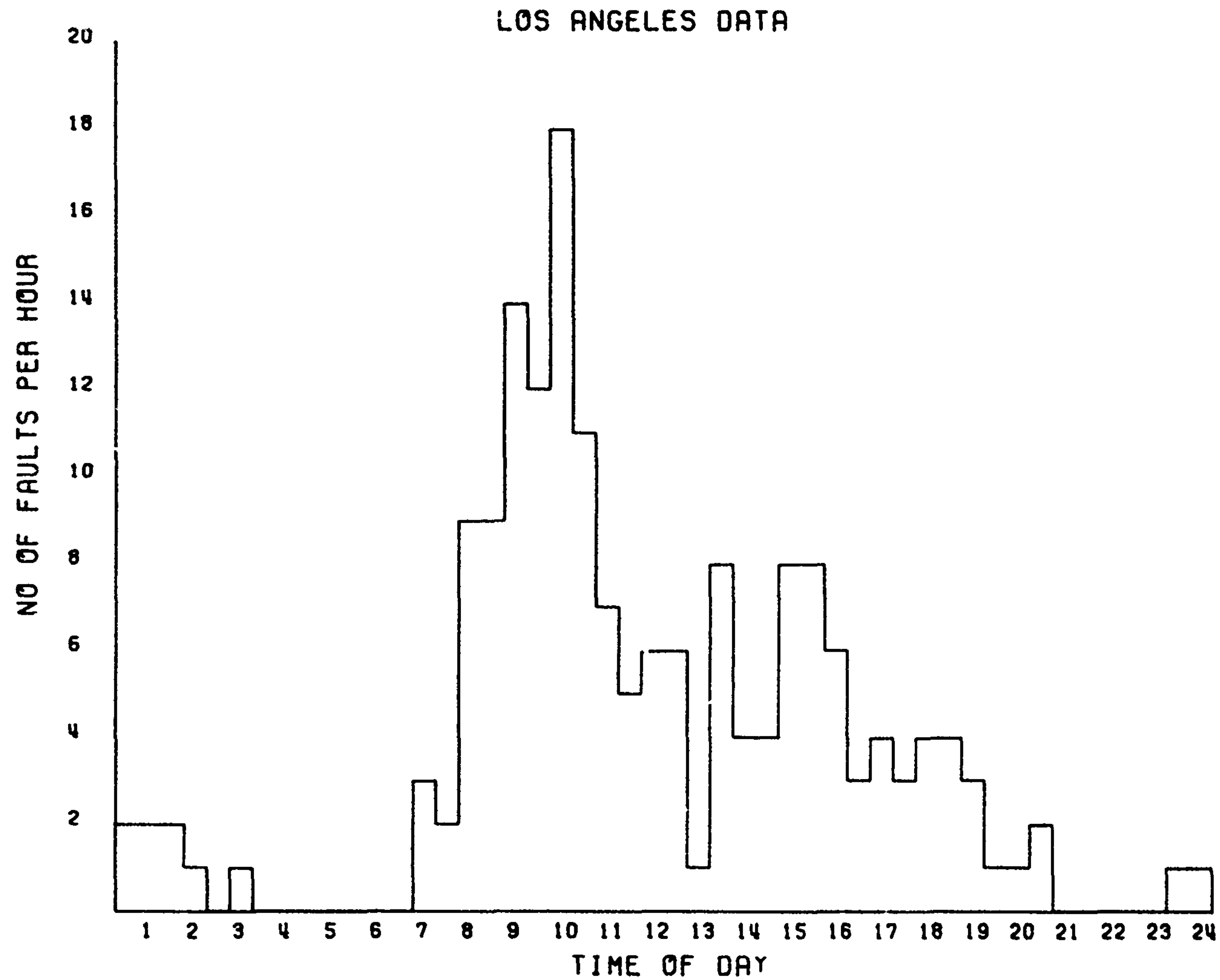

Figure 3-3 Beacon System Reported Discrepancy Rate vs. Time, Los Angeles ARTCC

duty, and underscores the subjective nature of the manner in which the data was obtained.

3.2 ANALYSIS OF FAULT REPORTS BY ERROR CATEGORY

An examination of the type of system degradation experienced by the Los Angeles ARTCC was carried out and revealed that the most frequent complaint was ring around/sidelobes (Fig 3-4). This phenomenon was cited in 27.64% of the reports. Other problems, in order of severity, are listed below:

TABLE 3-1 LOS ANGELES DISCREPANCY REPORTS BROKEN DOWN BY ERROR CATEGORY

COMPLAINT	%
Ring Around/Sidelobes	27.64
Target Broken/Intermittent/Chopped	23.25
Target Lost Short Time	23.00
Ghosts/Reflections/False Targets	10.97
Target Lost Long Time	8.37
Target Too Wide	2.11
Other	1.46
Target Too Narrow	1.05
Target Never Acquired	0.89
Fruit	0.73
False Emergency Replies	0.32
Mode 3/A Code Incorrect	0.08
IDENT Malfunction	0.08
Altitude Readout Incorrect	0.00

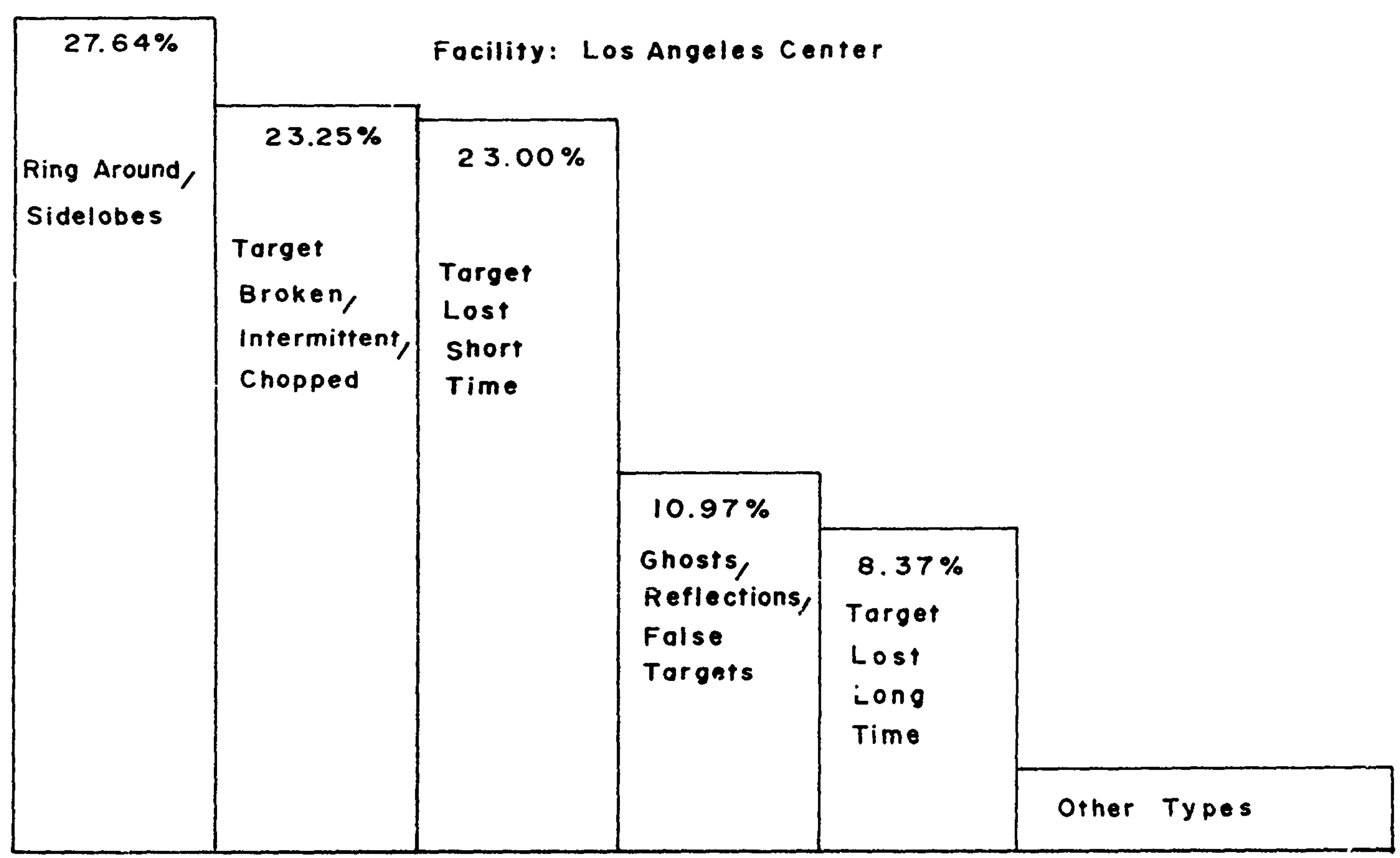

Figure 3-4 Distribution of Discrepancy Reports by Error Category, Los Angeles ARTCC

Comparing the above breakdown with the results from the Salt Lake ARTCC, points up the large variation in operational problems among facilities. For example, target broken/intermittent/chopped was the most frequent problem at Salt Lake, accounting for 43% of the complaints, whereas here it is down to 23.2%. In addition, ring around/sidelobes has risen from 9.9%, the number four problem, to become the most common form of system degradation (27.6%). Finally, consider the situation with false emergency replies; this phenomena constituted a serious problem in Salt Lake (7.7%) yet the number of cases documented in Los Angeles is negligible (0.32%).

The error categories in Table 3-1 were subdivided on the basis of aircraft mission (Table 3-2). It appears that for military aircraft the most common deficiency is target broken/intermittent/chopped. This is followed by target lost short time and ring around/sidelobes. The distribution of complaints involving commercial aircraft is quite different; listed first is ring around/sidelobes, followed by target lost short time, and target broken/intermittent/chopped.

3.3 ANALYSIS OF FAULT REPORTS BY AIRCRAFT INVOLVED

After ascertaining the nature of the ATCRBS problems experienced in Los Angeles, the next step was to determine the type of aircraft involved in these reports. The results are plotted in Figure 3-5 for the 10 aircraft most frequently cited. A B727 was involved in 19.2% of the complaints. This was followed by the A-4 (14.5%), B707 (12.0%), DC-9 (8.1%) and DC-8 (4.5%).

Additional data is listed in Table 3-3. These results are presented in the form of an aircraft fault report matrix, the use of which was introduced in the previous chapter (Table 2-4). As an illustration, the discrepancies associated with the DC-9 are detailed in Table 3.4.

This list reveals that a high proportion of the reports involve the phenomena of sidelobes or ring around. Since the ground interrogators involved are equipped with sidelobe suppression, assuming this feature is working properly, it appears likely the deficiency originates with the aircraft transponder.

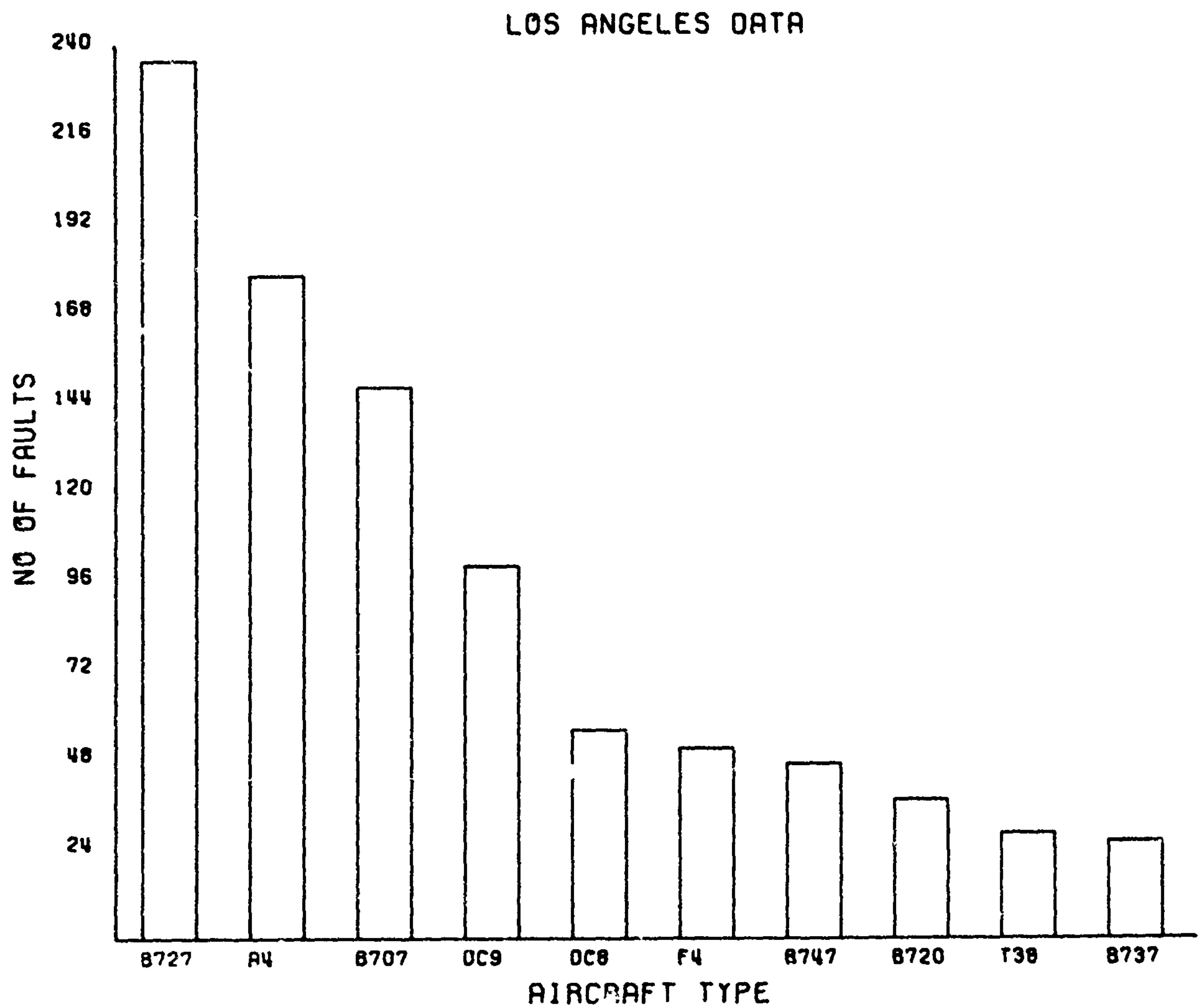

Figure 3-5 Breakdown of Discrepancy Reports by Aircraft Type, Los Angeles ARTCC

TABLE 3-2 SUBDIVISION OF ERROR CATEGORIES BY AIRCRAFT MISSION

Facility: Los Angeles ARTCC

ERROR CATEGORY	MILITARY	COMMERCIAL	GENERAL AVIATION
Ring Around/Sidelobes	80	241	11
Target Broken/Intermittent/Chopped	141	129	9
Target Lost Short Time	98	168	9
Ghosts/Reflections/False Targets	30	102	2
Target Lost Long Time	57	40	2
Target Too Wide	4	17	3
Other	10	5	2
Target Too Narrow	11	1	1
Target Never Acquired	9	1	1
Fruit	4	5	0
False Emergency Replies	3	1	0
Mode 3/A Code Incorrect	1	0	0
IDENT Malfunction	1	0	0
Altitude Readout Incorrect	0	0	0

TABLE 3-3 AIRCRAFT DISCREPANCY REPORT MATRIX; FACILITY: LOS ANGELES ARTCC

A/C TYPE	TOTAL	%	RING*	GHOST	FRUIT	WIDE	NARRW	NEVER	(ST) LSTSH	(MN) LSTSH	(ST) LSTLN	(MN) LSTLN	BROKN	MODE	ALTIT	IDENT	OTHER	FALSE
B727	236	19.2	77	38	2	8	0	1	26	25	9	6	41	0	0	0	2	1
A4	178	14.5	24	7	0	2	4	2	21	14	21	5	73	0	0	0	5	0
B707	148	12.0	50	18	1	4	1	0	21	18	6	1	28	0	0	0	0	0
DC9	100	8.1	40	7	0	0	0	0	15	11	7	1	18	0	0	0	1	0
DC8	68	5.5	26	11	0	0	0	0	6	10	1	2	12	0	0	0	0	0
F4	51	4.1	13	6	1	0	2	2	10	2	2	3	10	0	0	0	0	0
B747	47	3.8	16	6	0	0	0	0	2	9	0	3	10	0	0	0	1	0
B720	37	3.0	12	11	0	0	0	0	3	6	0	0	5	0	0	0	0	0
T38	28	2.3	8	5	0	0	0	0	2	5	1	1	6	0	0	0	0	0
B737	26	2.1	4	5	0	1	0	0	3	3	0	1	8	0	0	0	1	0
FA27	26	2.1	9	0	2	6	0	0	3	5	0	0	1	0	0	0	0	0
T39	23	1.9	5	2	0	0	0	0	4	2	3	1	6	0	0	0	0	0
Unknown	22	1.8	5	2	0	2	0	0	2	3	1	2	4	0	0	0	1	0
DC10	17	1.4	4	2	0	0	0	0	2	1	1	2	5	0	0	0	0	0
F8	16	1.3	2	2	0	0	1	0	1	3	0	1	6	0	0	0	0	0
A6	16	1.3	2	0	1	0	1	0	1	0	5	0	6	0	0	0	0	0
B52	15	1.2	4	0	0	0	0	0	1	1	4	0	5	0	0	0	0	0
A7	15	1.2	5	0	0	0	0	0	0	2	2	0	4	1	0	0	0	1
FFJ	12	1.0	3	1	0	0	1	0	3	0	1	0	3	0	0	0	0	0
T29	12	1.0	1	1	0	0	0	2	3	0	2	0	0	0	0	0	2	1
F104	11	0.9	2	0	0	0	0	1	4	0	1	0	3	0	0	0	0	0
C117	11	0.9	1	4	1	2	0	0	2	0	1	0	0	0	0	0	0	0
OV10	9	0.7	0	1	1	0	1	1	3	0	0	0	2	0	0	0	0	0
C130	8	0.6	0	0	0	0	0	0	0	1	0	1	5	0	0	0	1	0
F105	7	0.6	2	0	0	0	0	0	2	0	1	0	2	0	0	0	0	0
P3	7	0.6	0	0	0	0	0	0	1	0	2	0	4	0	0	0	0	0
F111	7	0.6	0	0	0	0	0	0	1	0	0	0	4	0	0	1	1	0
DC°7	7	0.6	3	1	0	0	0	0	1	1	0	0	1	0	0	0	0	0
C135	6	0.5	2	0	0	0	1	0	2	1	0	0	0	0	0	0	0	0
C141	6	0.5	2	1	0	0	0	0	2	0	0	0	1	0	0	0	0	0
A8	5	0.4	0	0	0	0	1	0	1	1	0	0	2	0	0	0	0	0
CV88	4	0.3	1	1	0	0	0	0	1	0	0	0	1	0	0	0	0	0
HS3	4	0.3	2	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0
LR24	3	0.2	1	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0
BE55	3	0.2	0	[illegible]	0	0	0	0	1	0	0	0	1	0	0	0	0	0
N265	3	0.2	1	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0
C124	3	0.2	0	0	0	0	0	0	0	1	0	0	2	0	0	0	0	0
BE18	3	0.2	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0
BE35	3	0.2	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0
C421	3	0.2	1	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0
F102	3	0.2	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0
L'	2	0.2	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
PA24	2	0.2	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
HS25	2	0.2	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0
T37	2	0.2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F9	2	0.2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T33	2	0.2	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0
C54	2	0.2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
S2	2	0.2	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	1
C140	1	0.1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
P2	1	0.1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
A3	1	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
C118	1	0.1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTALS	1229		335	139	9	26	13	11	156	127	73	30	286	1	0	1	18	0

*For Key to error code abbreviations, see Table 3-4

TABLE 3-4 LOS ANGELES DISCREPANCY REPORTS ASSOCIATED WITH THE DC-9

ABBREVIATED ERROR CODE	DEFICIENCY	NUMBER OF REPORTS
RING	Ring Around/Sidelobes	40
GHOST	Ghosts/Reflections/False Targets	7
FRUIT	Fruit	0
WIDE	Target Too Wide	0
NARROW	Target Too Narrow	0
NEVER	Target Never Acquired	0
LSTSH ST	Target Lost Short Time-Traveling Straight and Level	15
LSTSH MN	Target Lost Short Time-While Maneuvering	11
LSTLN ST	Target Lost Long Time-Traveling Straight and Level	7
LSTLN MN	Target Lost Long Time-While Maneuvering	1
BROKN	Target Broken/Intermittent/Chopped	18
MODE	Mode 3/A Code Incorrect	0
ALTIT	Altitude Readout Incorrect	0
IDENT	IDENT Malfunction	0
OTHER	Other Malfunction	1
FALSE	False Emergency Replies	0

3.4 SYSTEM DISCREPANCIES INVOLVING AIR CARRIERS

Attention was next restricted to the air carriers; these results are presented in Table 3-5. It should be noted, that for any particular airline, the elements of the discrepancy array are expressed on a percent basis. For example, AL108 was involved in 118 instances of system degradation. The deficiencies experienced were distributed in the following manner:

Ring Around/Sidelobes	37%
Ghosts/Reflections/False Targets	14%
Target Lost Short Time	24%
Target Lost Long Time	7%
Target Broken/Intermittent/Chopped	18%

For each airline, the fault reports were further refined in terms of the type of aircraft involved (Table 3-6). As an illustration, the 193 malfunctions associated with AL104 refer to a B-707 in 110 cases, a B-720 in 2 cases, B-727 in 64 instances, and B-747 in 17 cases.

3.5 USE OF DEPARTURE INFORMATION TO NORMALIZE FAULT DATA

The above results can lead to misinterpretation since they neglect the air traffic population. In order to take this variable into account and derive performance measures independent of the traffic, it is necessary to employ population statistics to normalize the data.

Unfortunately, air traffic population data is not available directly. However, comprehensive records are maintained on departures by air carriers,[4] and it is possible to construct a picture of the traffic in the Los Angeles region from this information. It should be realized that this synthesis procedure is not exact, since it does not take into account overflights. However, in 1971 overflights amounted to only 5% of the air carrier activity handled by the Los Angeles ARTCC[5], and the traffic picture derived in this manner yields a good first order approximation to the actual condition.

TABLE 3-5 DISTRIBUTION OF FAULT REPORTS INVOLVING AIR CARRIERS
FACILITY: Los Angeles ARTCC

DISCREPANCY*	AL101	AL102	AL103	AL104	AL107	AL108	AL109	AL110	AL111	AL112	AL114	AL115	AL116	AL118	AL121	AL123	AL125	AL126
Ring Around/Sidelobes	25	27	23	36		37	34	38		43	48	50		40	34	14	13	10
Ghosts/Reflections/False Targets	14	23	23	13		14	22	14	25	14	12				9	14	27	30
Fruit				1					25						2			
Target Too Wide		1		3					25						8		20	
Target Too Narrow				1														
Target Never Acquired			3															
Target Lost Short Time	22	21	27	23		24	31	14	25	29	16			40	30	29	27	10
Target Lost Long Time	3	8	3	7		7		10			4				4			
Target Broken/Intermittent/Chopped	32	19	20	16		18	13	24		14	20	50		20	11	43	7	40
Mode 3/A Code Incorrect																		
Altitude Readout Incorrect																		
IDENT Malfunction																		
Other	2			1											2	7	7	10
False Emergency Replies	2																	
Total Number of Faults	6[illegible]	[illegible]3	30	195	0	118	32	21	4	7	25	2	0	5	53	7	15	10

*For each airline the array elements are expressed on a percent basis

TABLE 3-6 DISTRIBUTION OF FAULT REPORTS ASSOCIATED WITH AIR CARRIERS BY AIRCRAFT TYPE

Facility: Los Angeles ARTCC

CARRIER	TOTAL	%*	B-707	B-720	B-727	B-737	B-747	CV58	CV88	DC-8	DC-9	DC-10	FA27
AL101	63	5.12	17		37		5		4				
AL102	73	5.93		9	15		4			30		15	
AL103	30	2.43	3	13	2	12							
AL104	193	15.69	110	2	64		17						
AL107	0	0.00											
AL108	116	9.43	2	11	45		4				54		
AL109	32	2.60	2				15			15			
AL110	21	1.70			21								
AL111	4	0.32			4								
AL112	0	0.00											
AL114	25	2.03			3		2			20			
AL115	2	0.16			2								
AL116	0	0.00											
AL118	5	0.40	5										
AL121	51	4.14	4		2						31		14
AL123	7	0.56									7		
AL125	15	1.21			11	4							
AL126	10	0.81				10							
Totals	637	51.8	143	35	206	26	47	0	4	65	92	15	14

*Percent of total facility discrepancies

Table 3-7 summarizes the departure information; the number of flights is presented by airport and by air carrier. From this data, it appears United Airlines (UA) has the largest number of flights in this region, followed by Western Airlines (WA) and Hughes Air West (RW).

By dividing the number of discrepancies involving the various air carriers, by the number of flights during the period the study was conducted, the number of faults per flight can be computed. In carrying out this calculation, the departure information listed in Table 3-7 was multiplied by two to obtain the total flights per year, and then divided by twenty-six to derive the number of flights conducted within a two week interval (corresponding to the duration of the survey). These results are shown in Table 3-8, for airlines with 5,000 or more departures within the LA region. It is interesting to note the large performance variation among the carriers.

The airport activity information is broken down in terms of aircraft type in Table 3-9; this data is derived from Reference 6, Part II, Table 4. Using these statistics, the system fault occurrence rate associated with various aircraft can be determined. The results are contained in Table 3-10 for the most popular aircraft.

Since a variation in performance can arise among similar aircraft operated by different airlines, this phenomena was investigated next.

Table 3-11 gives the discrepancy rate per flight as a function of aircraft type and carrier. These results reveal a large variation in system performance for a given variety of aircraft, where the variable involved is the carrier. Focusing, for example, upon the DC-9, those aircraft operated by carrier AL108 are involved in a high rate of discrepancies, while similar aircraft operated by AL121 are cited for relatively few beacon problems. The data pertaining to the B727 reveals a similar situation, with the discrepancy rate per flight extending over a range from .084 to .004. This variation seems to suggest that the transponder equipment and its maintenance are important parameters in ATCRBS performance.

TABLE 3-7 AIRCRAFT ACTIVITY WITHIN THE LOS ANGELES REGION IN 1971

Derived from Departure Statistics

AIRPORT	AA*	CO	DL	EA	FT	FL	NA	NE	NW	RD	RW	TT	TW	UA	WA	TOT. DEPART. PER AIRPORT
Las Vegas			1218			1541	1406				15093	—	6234	4956	12140	42,648
Los Angeles/Burbank/ Long Beach	23741	16090	5773	1700	905		4234	871	541	460	14435	1032	22544	38945	25948	157,219
Oxnard/Ventura											962	—				962
San Bernadino	2159	2318		5							4324	—	10	610	[illegible]	14,266
San Diego	6152		1700				971				895	—		4459	6869	21,046
Santa Barbara											1317	—		1911		3,228
Total Departures per carrier	32051	18408	8691	1705	905	1541	7068	871	541	460	37026	1032	28848	50881	49797	

*For Key to Air Carrier Codes see Glossary.

TABLE 3-8 NORMALIZED DISCREPANCY RATE FOR SELECTED CARRIERS

Facility: Los Angeles ARTCC

CARRIER	DISCREPANCY/FLIGHT
AL101	.028
AL102	.018
AL103	.007
AL104	.079
AL108	.083
AL109	.047
AL114	.045
AL121	.018

TABLE 3-9 AIR CARRIER ACTIVITY WITHIN THE LOS ANGELES REGION IN 1971; BY AIRCRAFT TYPE

CARRIER	B-707	B-720	B-727	B-737	B-747	DC-8	DC-9	OTHER	TOTAL
AA	18,191	1,752	9,972		2,136				32,051
CO	2,753	4,329	6,904		1,158		3,264		18,408
DL					469	7,572		L-100/ 588; CV880/2	8,611
NA			2,318		232	4,518			7,068
RW							26,180	F-27: 10,846	37,026
TW	17,641		7,209		1,330			CV-880: 2,668	28,848
UA		4,921	21,507	3,604	982	19,856			50,879
WA	1,601	12,017	5,287	30,892					49,797
Total Departures	40,186	23,019	53,197	34,496	6,307	31,952	29,444		

TABLE 3-10 OCCURRENCE RATE OF BEACON DISCREPANCIES FOR SELECTED COMMERCIAL AIRCRAFT

Facility: Los Angeles ARTCC

AIRCRAFT	NUMBER OF DISCREPANCIES	TOTAL DEPARTURES	DISCREPANCY/FLIGHT
B-707	148	40,186	.047
B-720	37	23,019	.020
B-727	236	53,197	.057
B-737	26	34,496	.009
DC-8	68	31,952	.027
DC-9	100	29,444	.044

TABLE 3-11 AIRCRAFT DISCREPANCY RATE PER FLIGHT; BY CARRIER AND TYPE

Facility: Los Angeles ARTCC

CARRIER	B-707	B-720	B-727	B-737	DC-8	DC-9
AL101	.012		.067			
AL102		.023	.009		.019	
AL103	.024	.014	.005	.005		
AL104	.078	.014	.083			
AL108	.009	.033	.084			.215
AL109					.025	
AL114			.016		.057	
AL121						.015

3.6 AIRCRAFT LOCATIONS ASSOCIATED WITH BEACON DISCREPANCIES

The discrepancy reports received from the Los Angeles ARTCC were next examined for geographical patterns. For this purpose, computer generated plots were derived showing locations where beacon problems were encountered. Rather than include six sets of graphs, one for each radar site feeding the center, only the results pertaining to the Mt. Laguna interrogator will be presented. Mt. Laguna was selected for inclusion since it was listed in a majority of the fault reports. In the plots which follow, range and azimuth will be referenced to this site; i.e. latitude 32°51'33", and longitude 116° 24' 51".

The problems of ring around and sidelobes are addressed in Figure 3-6, while the deficiencies of ghosts, reflections and false targets are covered in Figure 3-7. From this latter graph it appears that the phenomenon of reflections is most severe at the following azimuth positions: 20°, 45°, 290°, 350°.

Locations where targets are lost for short periods of time, while traveling straight and level, are shown in Figure 3-8; similar information is presented in Figure 3-9 covering the case of targets lost for a long period.

The phenomena of broken, intermittent or chopped targets is described next; Figure 3-10 is restricted to military aircraft, Figure 3-11 to commercial carriers and Figure 3-12 to general aviation It should be noted that this represents the major error category for military aircraft (Table 3-2). Finally, the discrepancy of false emergency alarms is dealt with in Figure 3-13.

In order to interpret these plots, knowledge of the air traffic patterns in the vicinity of the Mt. Laguna site is invaluable. The low altitude airways are illustrated in Figure 3-14 and the high altitude routes described in Figure 3-15.

The following traffic picture emerged from a recent private communication:*

The Mt. Laguna sector handles a large volume of commercial

*Mr. Ruben Salazar, Area Specialist, Los Angeles ARTCC

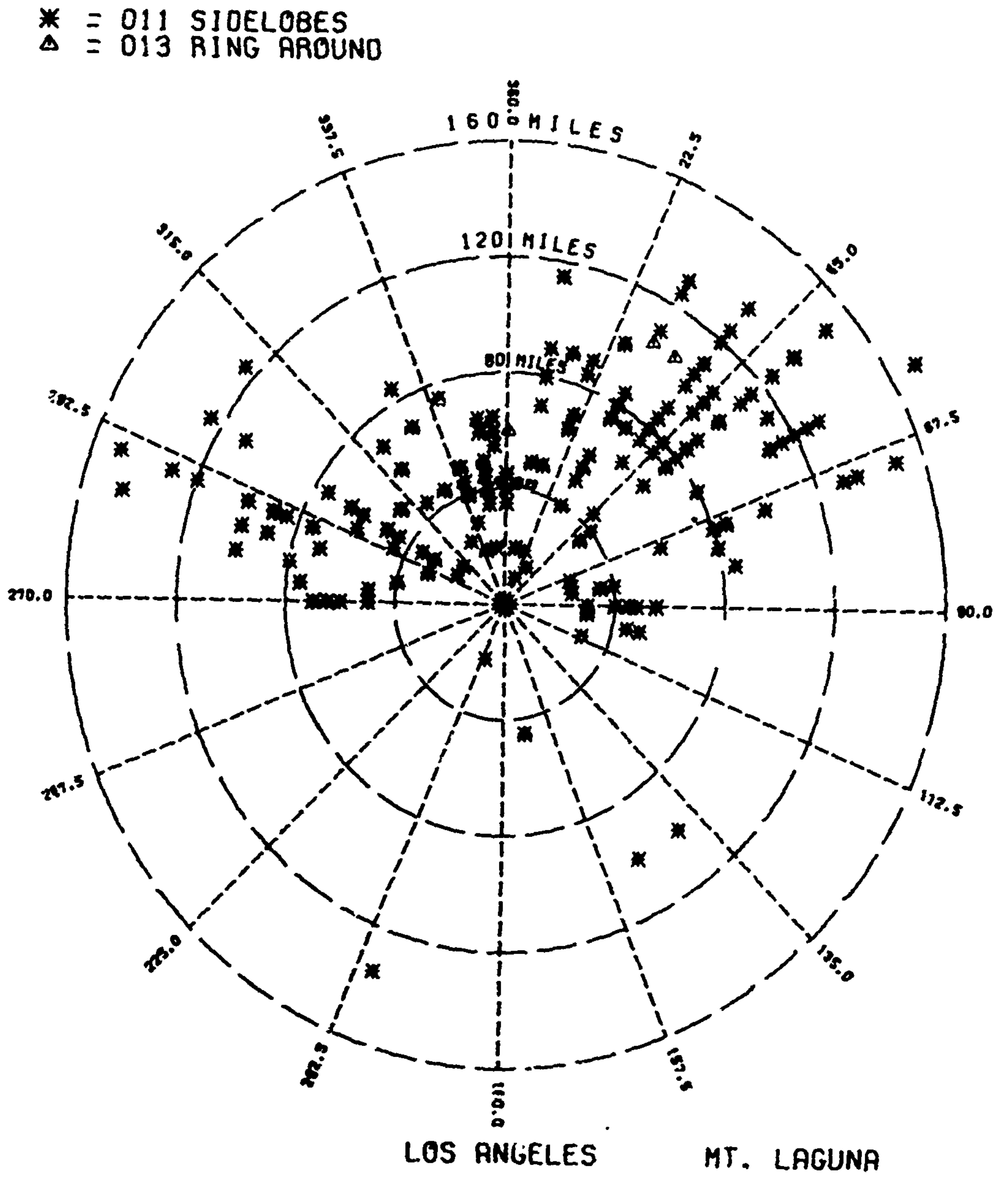

Figure 3-6 Locations Associated with Problems of Sidelobes and Ring Around; Mt. Laguna Radar Site, Los Angeles ARTCC

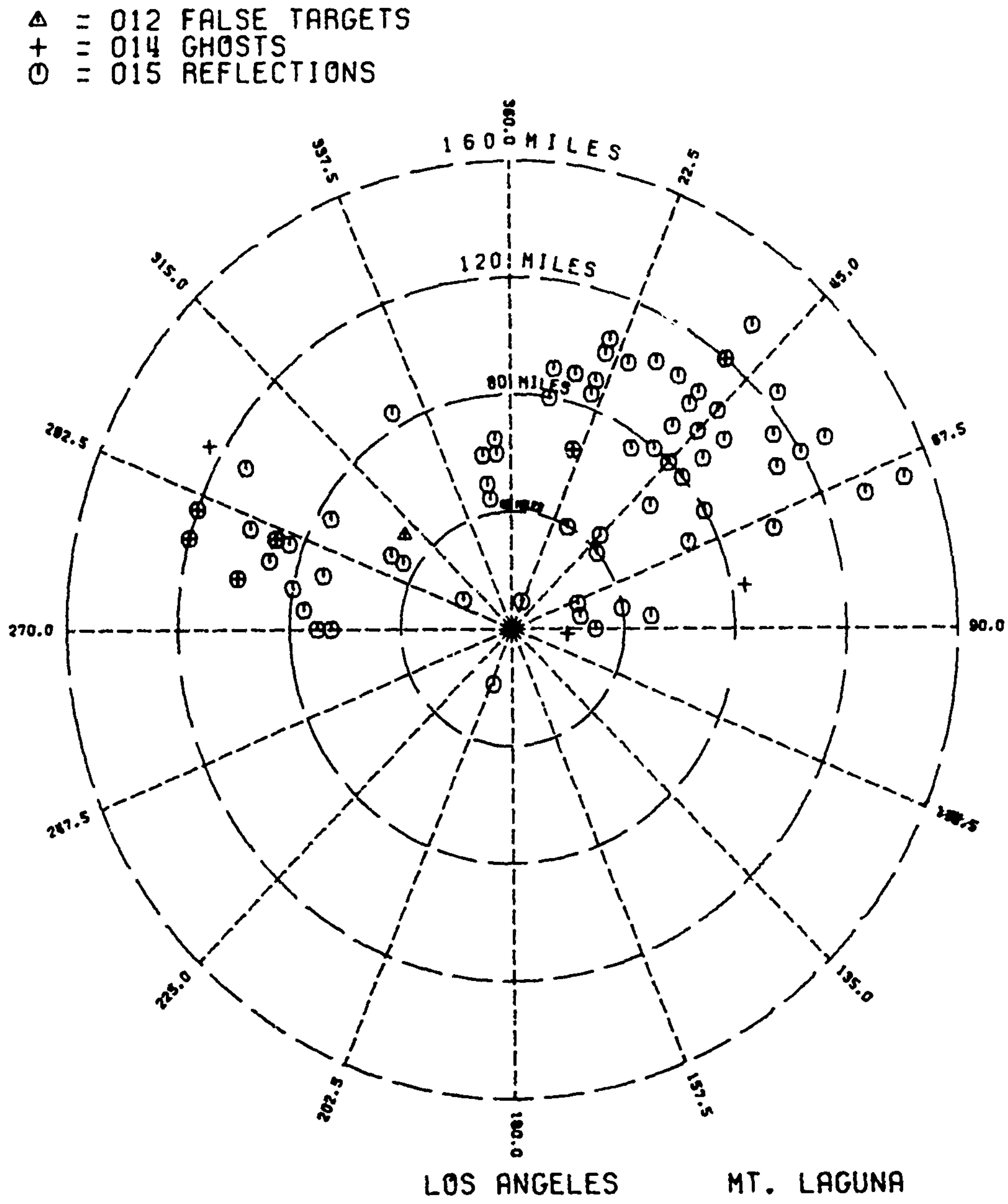

Figure 3-7 Locations Associated with Problems of Ghosts, Reflections and False Targets; Facility: Mt. Laguna Radar Site, Los Angeles ARTCC

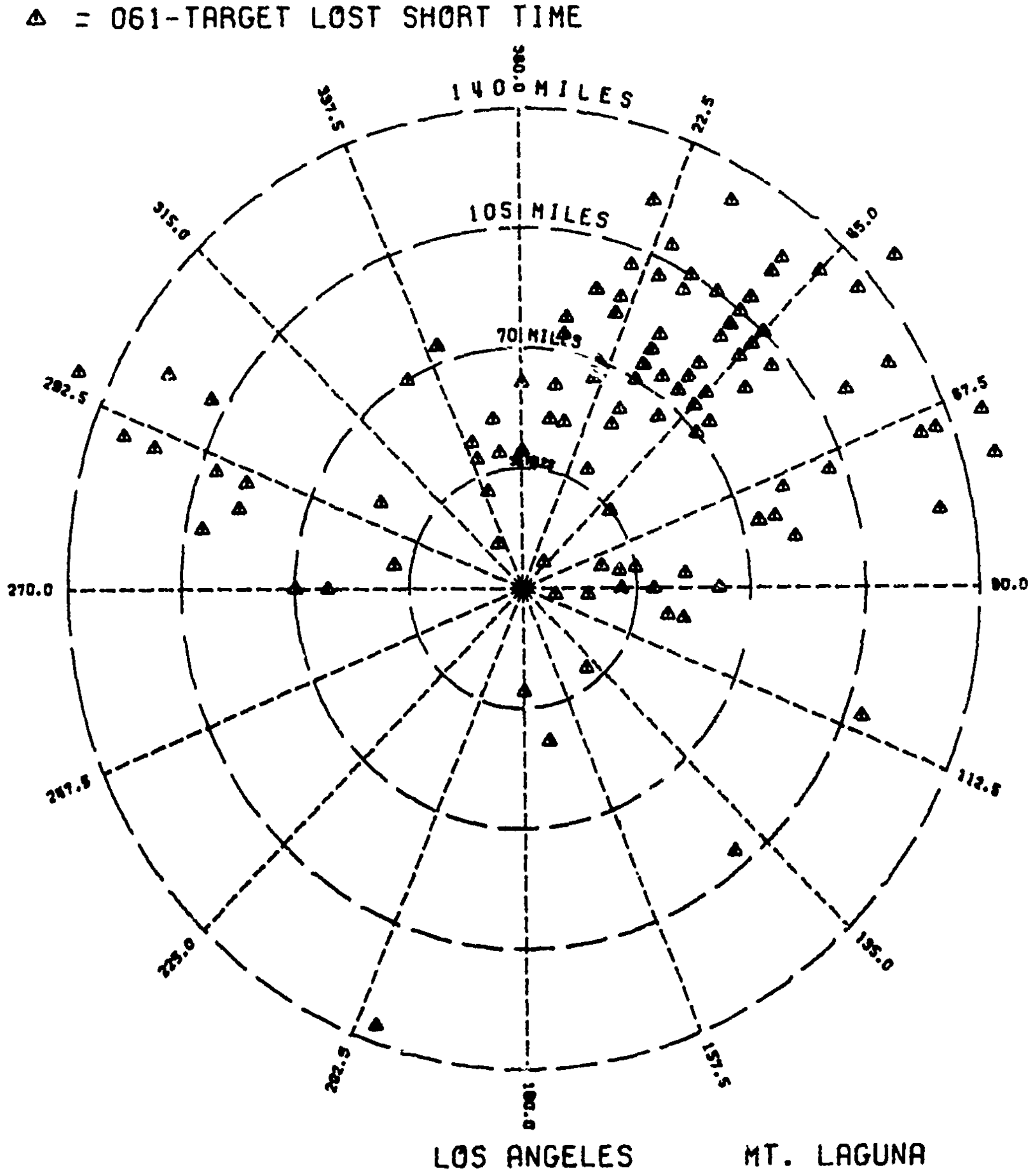

Figure 3-8 Locations Associated with Loss of Targets for a Short Time: Facility: Mt. Laguna Radar Site, Los Angeles ARTCC

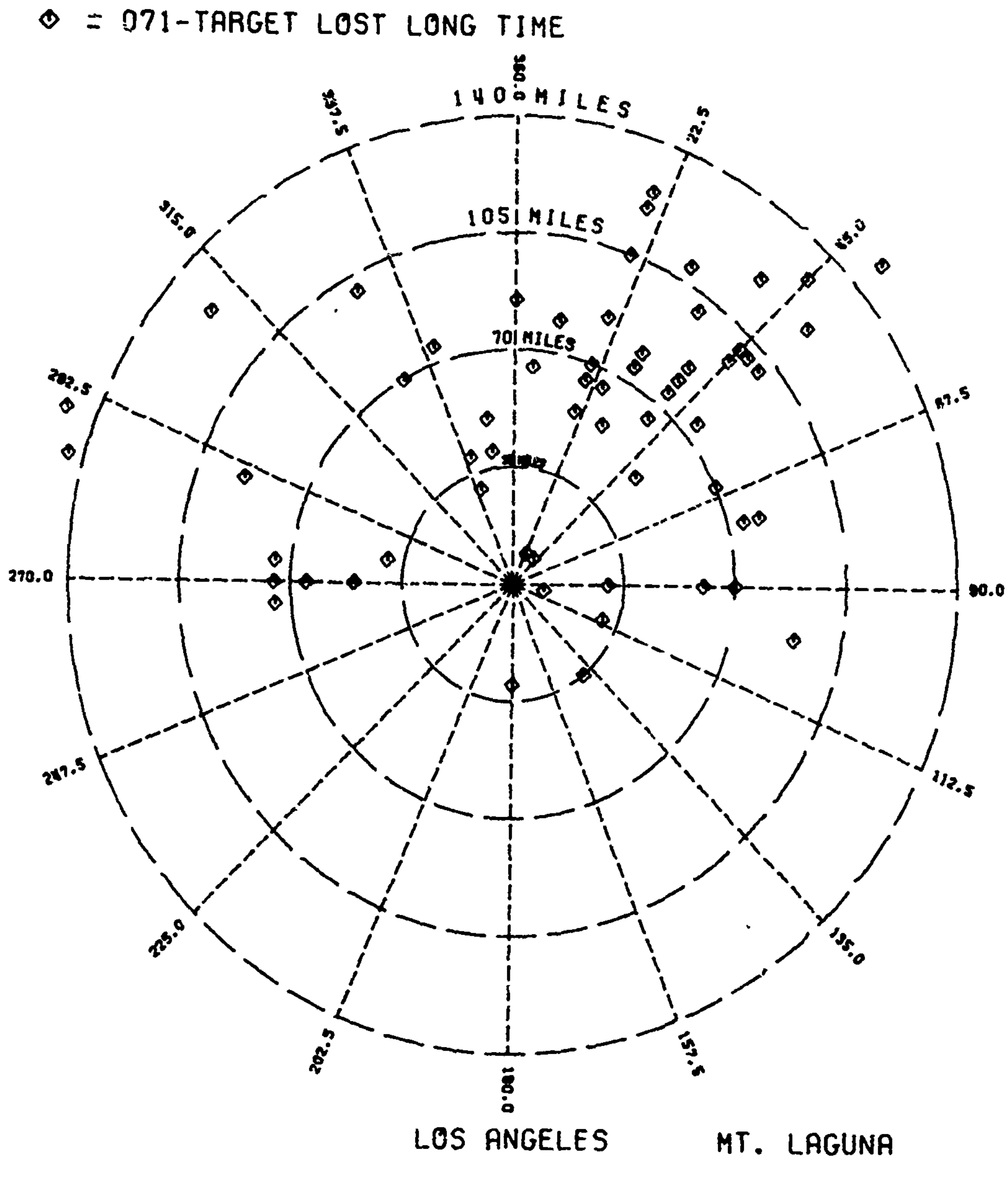

Figure 3-9 Locations Associated with Loss of Targets for a Long Time; Facil ty: Mt. Laguna Radar Site, Los Angeles ARTCC

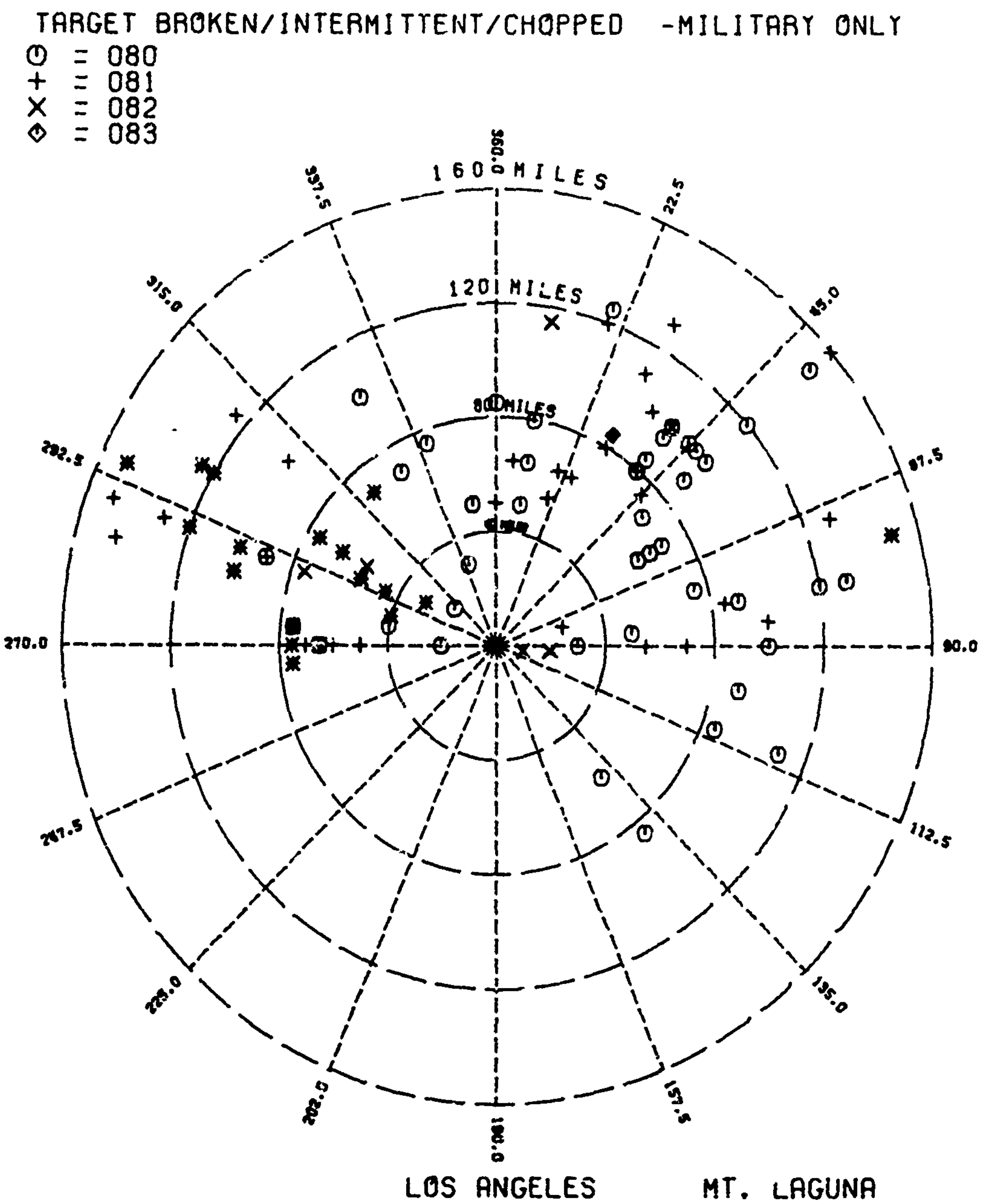

Figure 3-10 Locations Associated with Broken, Intermittent, or Chopped Targets; Military Aircraft Only, Facility: Mt. Laguna Radar Site, Los Angeles ARTCC

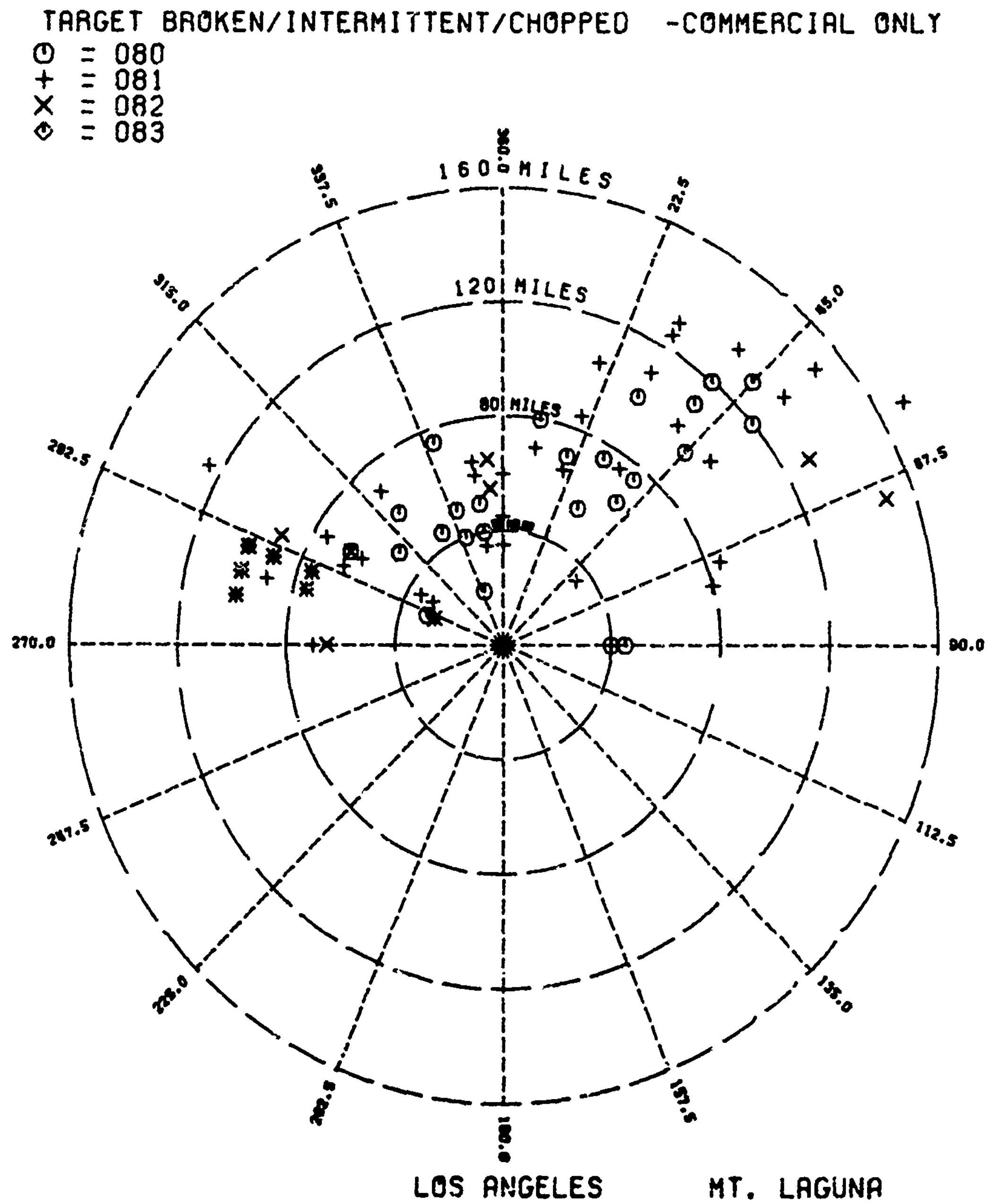

Figure 3-11 Locations Associated with Broken, Intermittent or Chopped Targets; Commercial Carriers Only, Facility: Mt. Laguna Radar Site, Los Angeles ARTCC

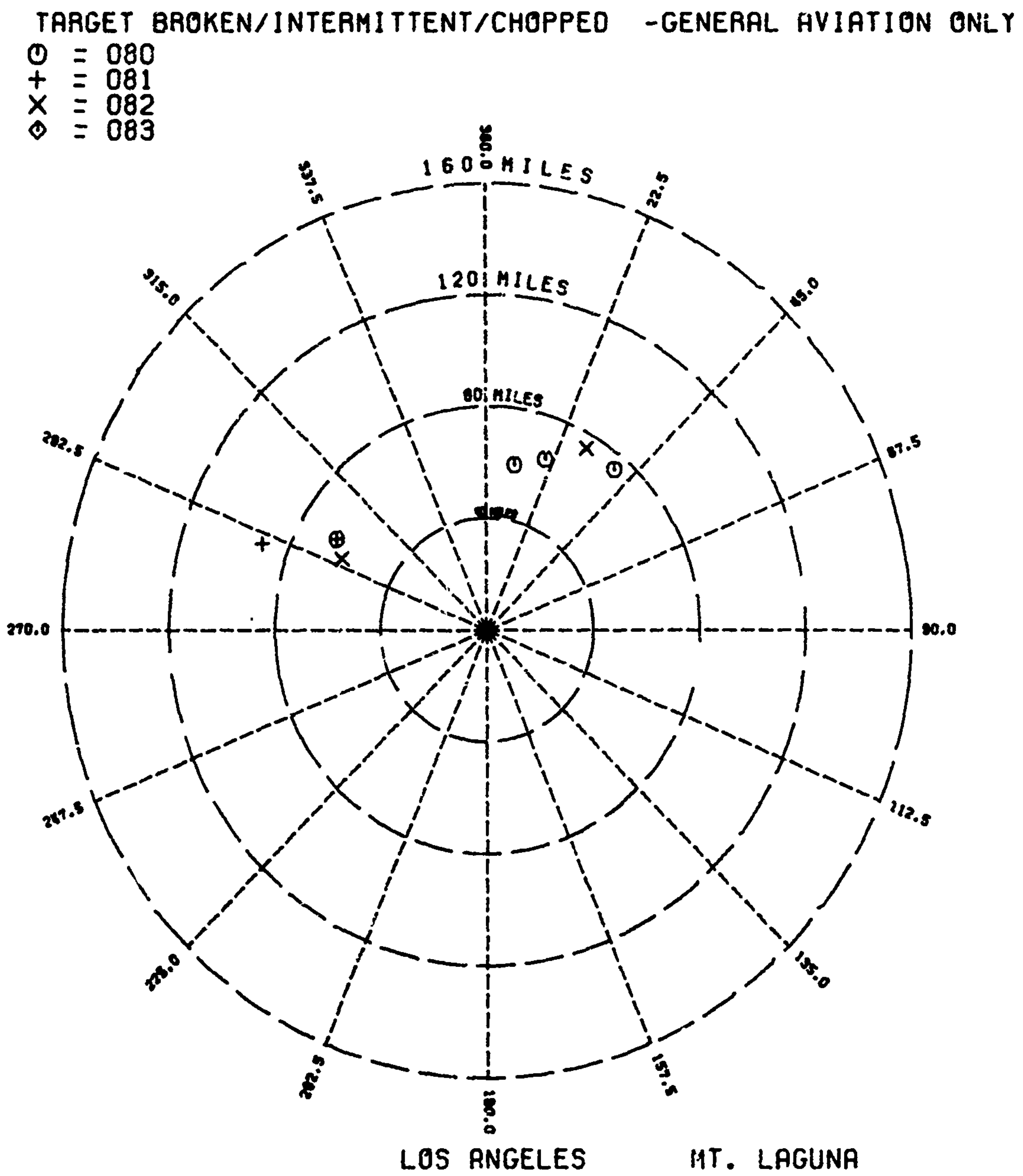

Figure 3-12 Locations Associated with Broken, Intermittent or Chopped Targets; General Avation, Facility: Mt. Laguna Radar Site, Los Angeles ARTCC

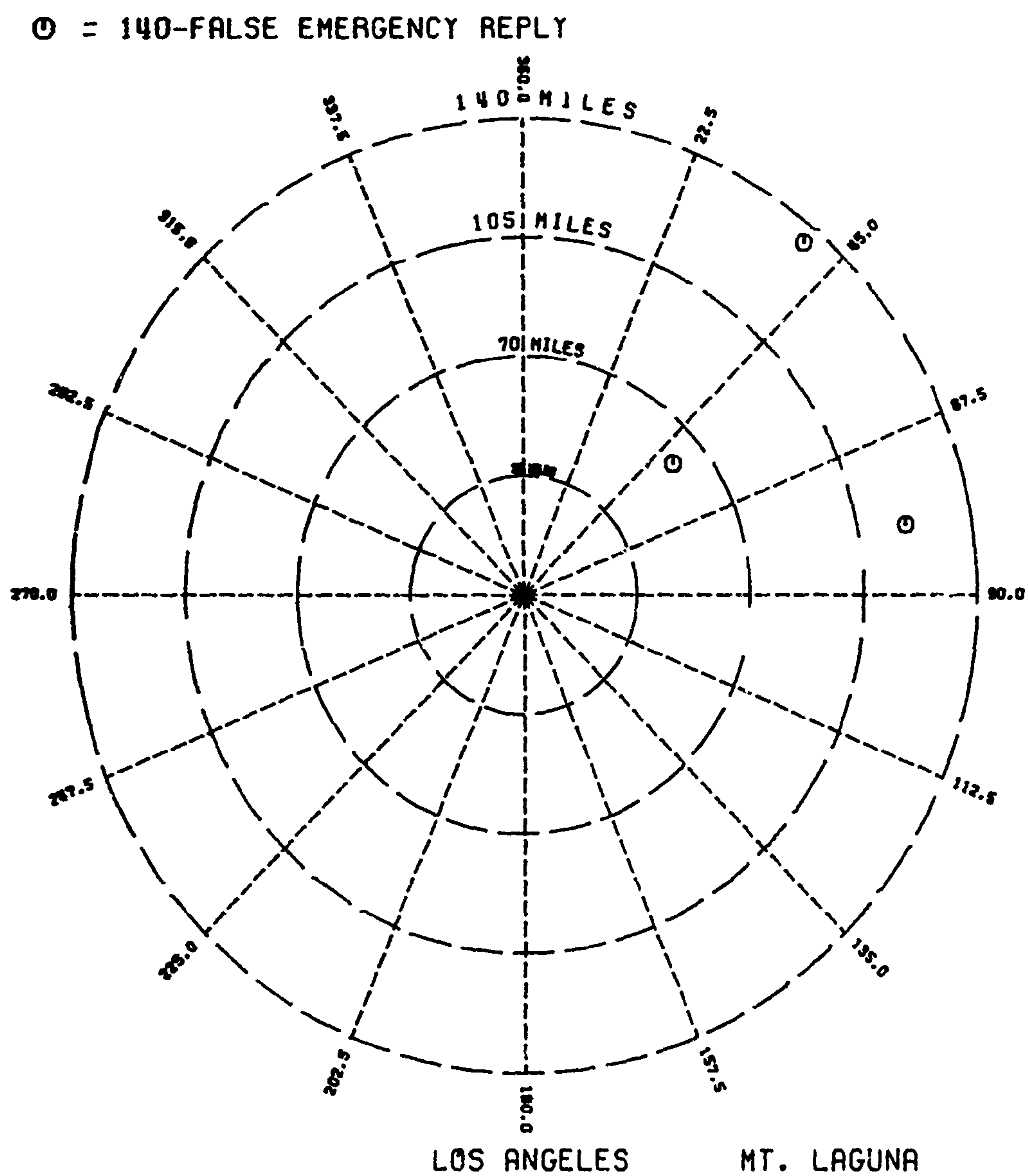

Figure 3-13 Aircraft Locations Where False Emergency Alarms Occurred, Facility: Mt. Laguna Radar Site, Los Angeles ARTCC

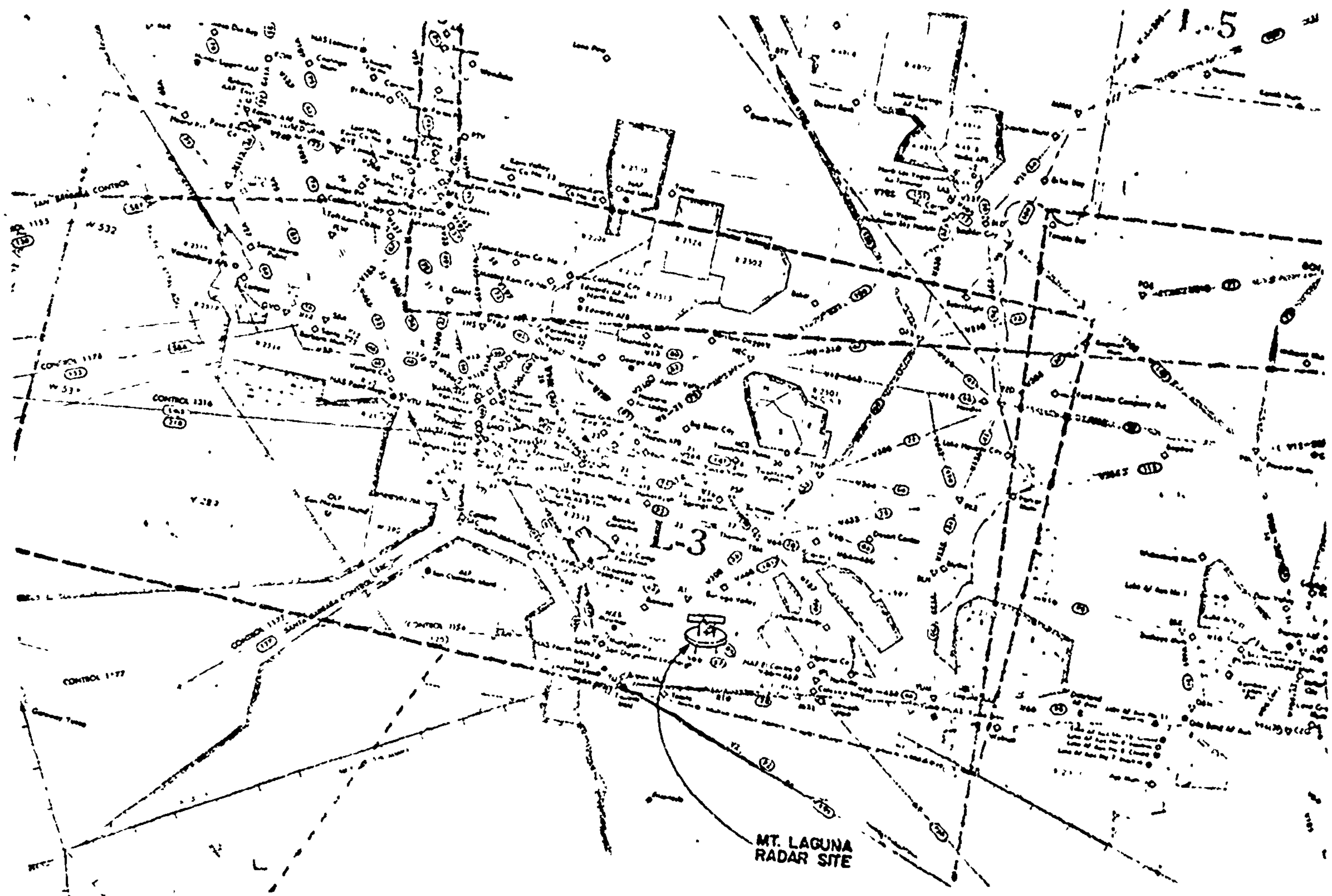

Figure 3-14 Low Altitude Airways in the Region of the Mt. Laguna Radar Site

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See the following pages for greater detail.
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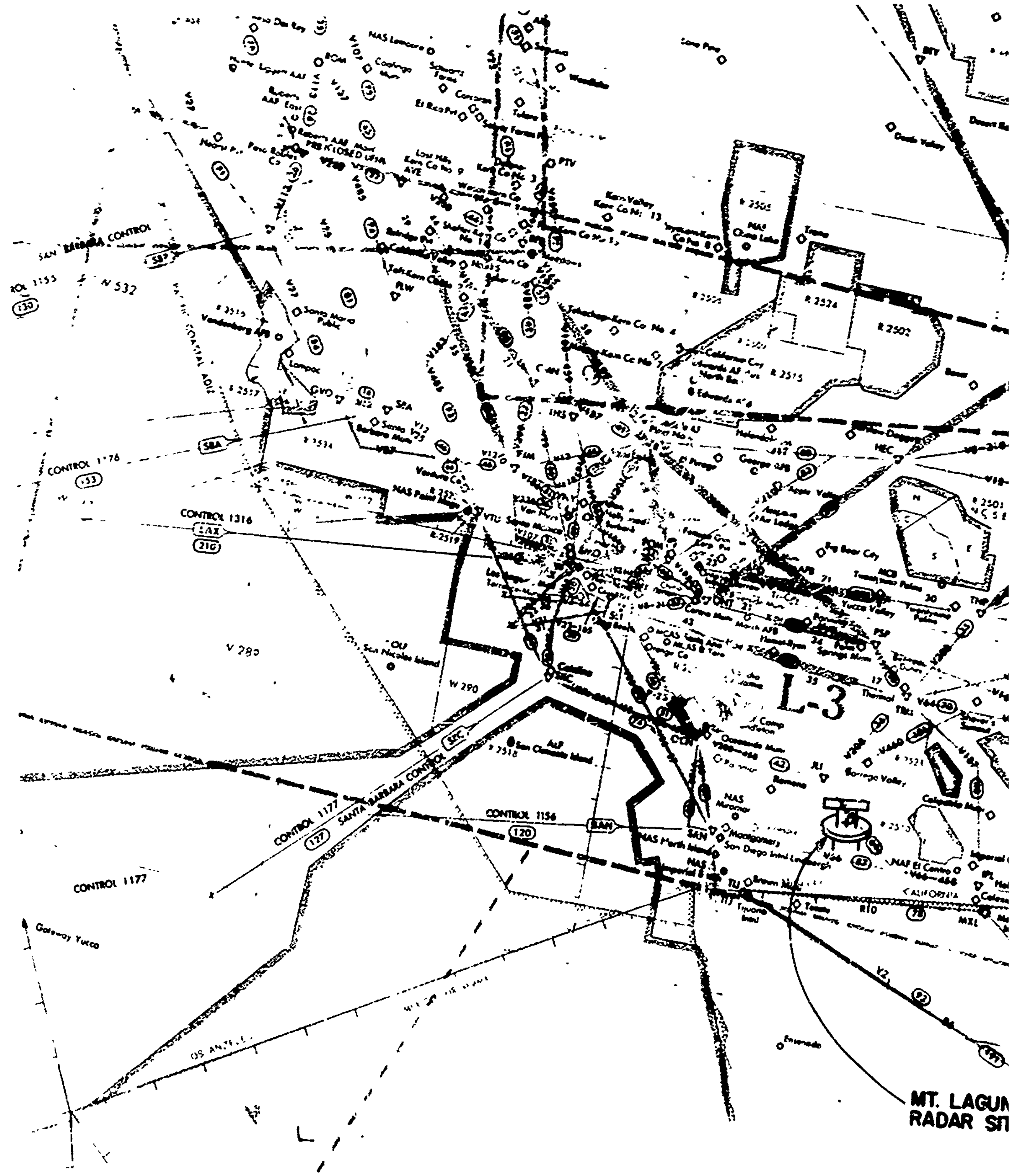

L-3
MT. LAGUN
RADAR SIT
SANTA BARBARA CONTROL
CONTROL 1177
CONTROL 1177
CONTROL 1156
CONTROL 1316
CONTROL 1176
W 290
NAS Lemoore
Vandenberg AFB
San Nicolas Island
San Clemente Island
NAS Miramar
NAS North Island
Gateway Yucca
Ensenada
CALIFORNIA

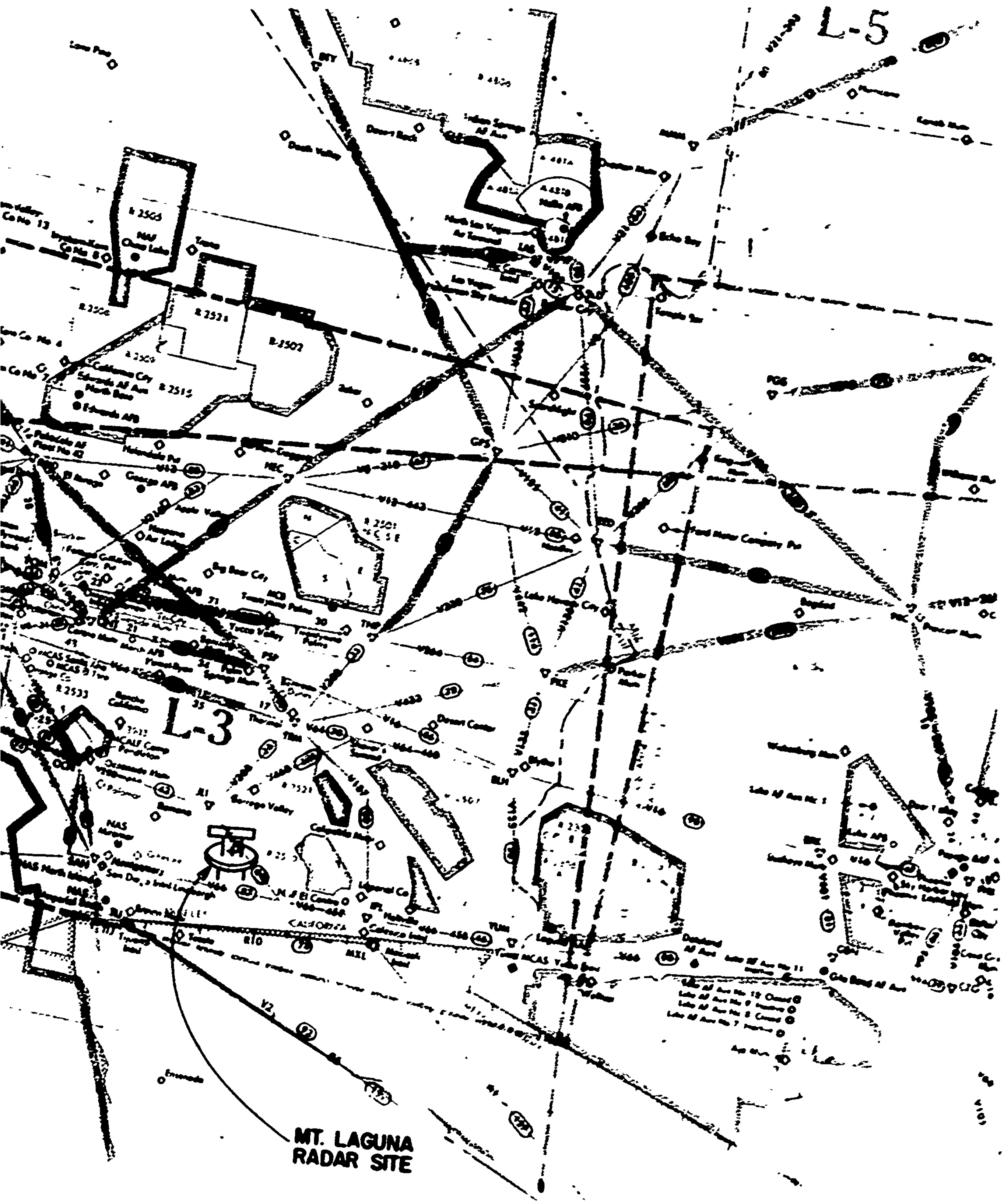

Figure 3-14 Low Altitude Airways in the Region of the Mt. Laguna Radar Site

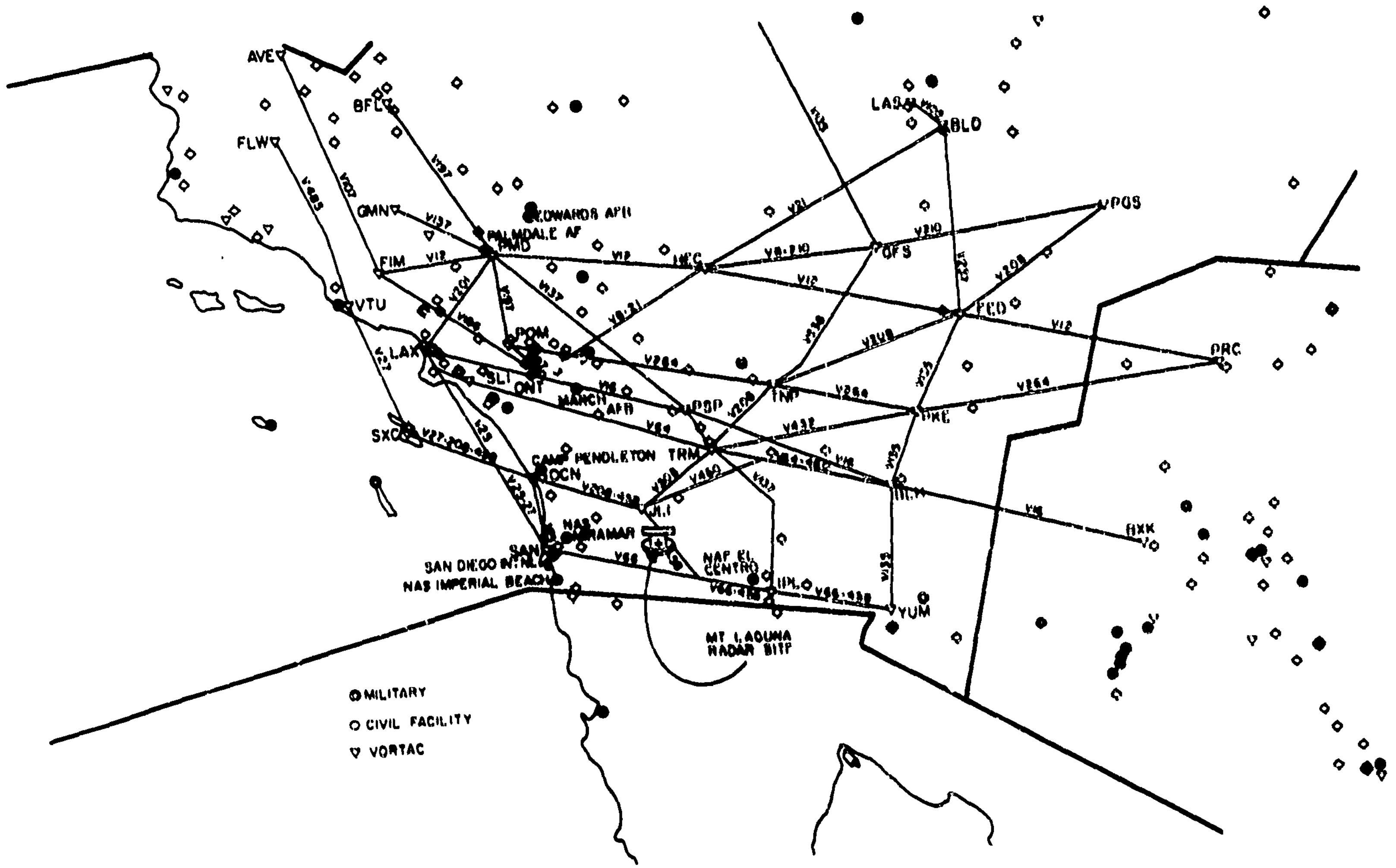

Figure 3-15. High Altitude IFR routes in the Region of the Mt. Laguna Radar Site

traffic heading to and from the Los Angeles Airport from the east. A common route is the following: from LA to the Seal Beach VORTAC (SLI), then along V64 to Thermal (TRM) and direct to Parker (PKE) or Blythe (BLH).

A further source of commercial traffic arises from the flights involving the San Diego International Airport. Traffic between San Diego and Los Angeles moves southbound along V25, and heads north along V23. Flights arriving from the northeast often approach San Diego via the Parker fix, going straight to Julian (JLI) and then direct to the airport. Arrivals from points further south, such as Phoenix and Tucson, usually approach by way of Yuma, flying J-2 into San Diego. Outbound flights transit the above routes in reverse order.

In addition to the commercial flights, the Mt. Laguna site handles a heavy concentration of military traffic. Much of this activity is associated with the Miramar Naval Air Station, and the Marine Corps facility at El Toro. However, there is also significant activity generated by some of the other military installations; these include the March AFB, Edwards AFB, Camp Pendleton MCALF and the naval facility at El Centro.

A common departure route from El Toro is southeast towards Julian, then direct to Imperial where J-2 is intercepted. Another popular path heads direct to Thermal, and then on towards Parker or Blythe.

Many of these air routes are shown in Figure 3-16, superimposed upon the locations where problems of sidelobes or ring around were experienced. As expected, there is a close correlation between the two plots. It should also be noted that a minimum of air activity occurs south of the radar site, due to its close proximity to the Mexican border (25 miles).

Figure 3-14 points up an important characteristic of the air traffic environment in this area, namely the concentration of ground interrogation stations. Some of the beacon interrogators located within 150 miles of the Laguna site, are operated by the following facilities: Los Angeles International Airport,

* = 011 SIDELOBES   ▲ = 013 RING AROUND

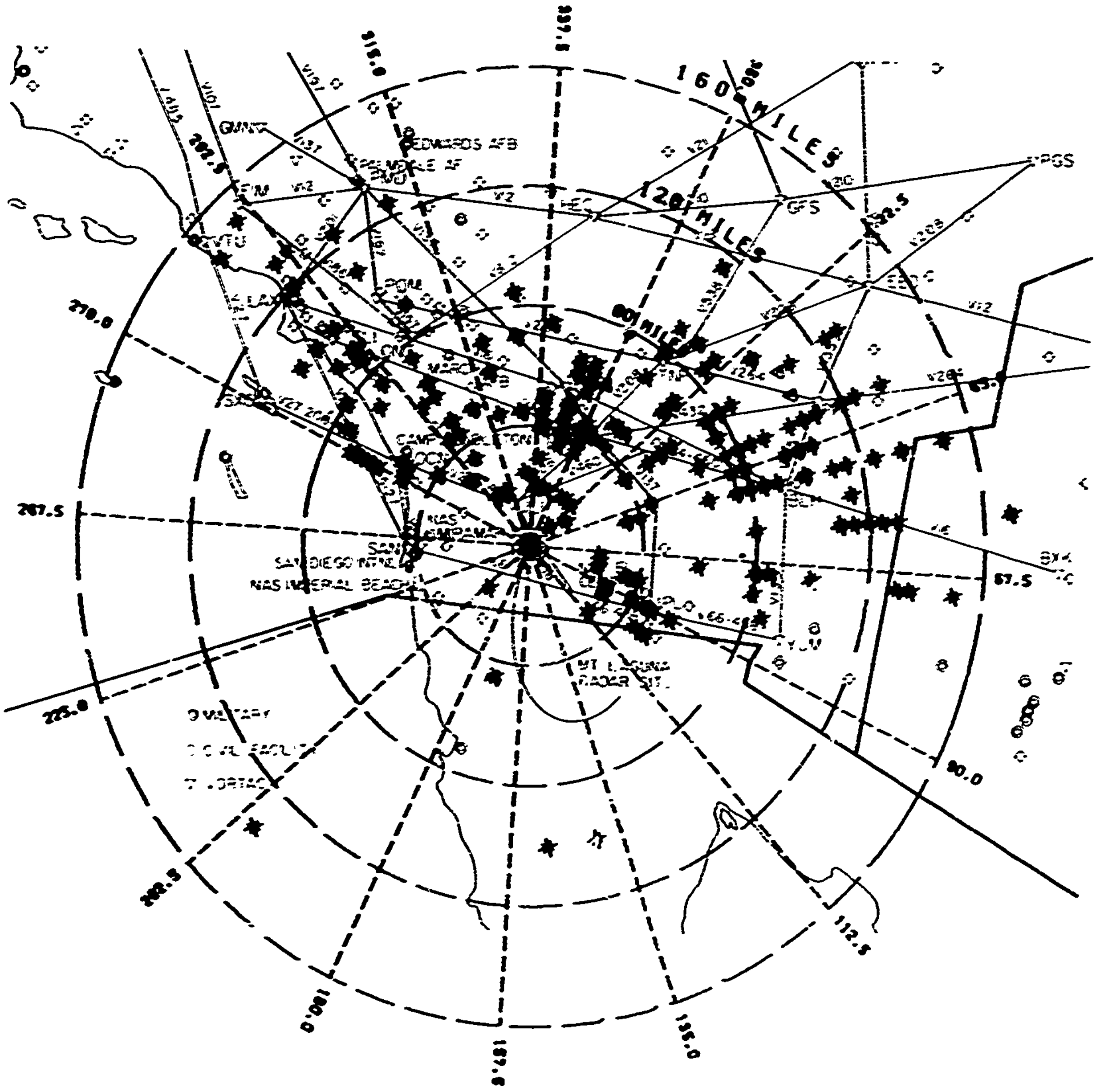

Figure 3-16 IFR Airways Superposed on Locations where Problems of Sidelobes or Ring Around Occurred, Mt. Laguna Radar Site

San Diego Airport, Long Beach Airport, Miramar NAS, El Toro, Camp Pendleton, March AFB, Marine Corps Air Station Yuma, Norton Air Force Base and George Air Force Base. In view of the large number of interrogators, it is not surprising to find a problem of over-interrogation as reflected in the high incidence of broken targets documented by the survey.

4. ANALYSIS OF SURVEY RETURNS FROM LAREDO AFB, NEW YORK ARTCC, AND MIAMI ARTCC

Aside from the Salt Lake and Los Angeles facilities, the largest number of returns was received from the Laredo AFB, which sent back 277 fault report forms. The next largest group was received from the New York Center (158 replies) and the Miami ARTCC (158 replies). Since the operating conditions vary greatly among these facilities, it was felt that it would be informative to present and compare the problems at these sites.

4.1 LAREDO AIR FORCE BASE

The returns from the Laredo AFB are analyzed first. A distribution of the discrepancy reports on the basis of error category is given in Table 4-1, while this data is sorted by aircraft type in Table 4-2. It appears that all the reports reference two kinds of military aircraft which are used for flight training, namely the T37 and T38.

Lost targets represent the major complaint, accounting for 71.1% of the deficiencies. Broken, intermittent or chopped targets is cited next (17.4%), while the remaining error categories are involved in only 11.4% of the discrepancies.

4.2 THE NEW YORK ARTCC

The New York Center receives data from three radar units. These are located at New York (Kennedy Airport); Benton, Pennsylvania; and Trevose, Pennsylvania. The JFK and Trevose installations are equipped with model ATCBI-3 interrogators and have sidelobe suppression. However, the Benton site employs the older UPX-14 interrogator, and remains to be upgraded with the SLS feature.

A breakdown of the discrepancy reports by error category is given in Table 4-3. The most serious problem is that of lost targets, which represents 50.7% of the complaints. Broken target-slash is listed second (19.2%), followed by ring around/sidelobes

TABLE 4-1. BREAKDOWN OF FAULT REPORTS BY ERROR CATEGORY
Facility: Laredo AFB

ERROR CATEGORY	NO. OF OCCURRENCES	%
Target Lost Short Time	104	44.06
Target Lost Long Time	64	27.11
Target Broken/Intermittent/Chopped	41	17.37
Target Never Acquired	8	3.38
Other	6	2.54
Target Too Narrow	5	2.11
IDENT Malfunction	3	1.27
Fruit	2	0.84
Ghosts/Reflections/False Targets	1	0.42
Target Too Wide	1	0.42
Mode 3/A Code Incorrect	1	0.42
Ring Around/Sidelobes	0	0.00
Altitude Readout Incorrect	0	0.00
False Emergency Replies	0	0.00

TABLE 4-2. AIRCRAFT FAULT REPORT MATRIX

Facility: Laredo AFB

A/C TYPE	TOTAL	%	RING*	GHOST	FRUIT	WIDE	NARRW	NEVER	LSTSH (ST)	LSTSH (MN)	LSTLN (ST)	LSTLN (MN)	BROKN	MODE	ALTIT	IDENT	OTHER	FALSE
T38	169	71.6	0	1	1	1	5	7	7	73	4	41	21	1	0	2	5	0
T37	35	14.8	0	0	1	0	0	1	0	11	1	8	11	0	0	1	1	0
Unknown	32	13.5	0	0	0	0	0	0	0	13	0	10	9	0	0	0	0	0
Totals	236		0	1	2	1	5	8	7	97	5	59	41	1	0	3	6	0

*For key to error Code abbreviations see Table 3-4.

TABLE 4-3. DISTRIBUTION OF DISCREPANCY REPORTS BY ERROR CATEGORY
Facility: New York ARTCC

ERROR CATEGORY	NO. OF OCCURENCES	%
Target Lost Long Time	78	30.00
Target Lost Short Time	54	20.76
Target Broken/Intermittent/Chopped	50	19.23
Ring Around/Sidelobes	24	9.23
IDENT Malfunction	19	7.30
Ghosts/Reflections/False Targets	13	5.00
Other	9	3.46
Target Never Acquired	8	3.07
Target Too Wide	3	1.15
Fruit	2	0.76
Target Too Narrow	0	0.00
Mode 3/A Incorrect	0	0.00
Altitude Readout Incorrect	0	0.00
False Emergency Replies	0	0.00

(9.2%) and IDENT malfunction (7.3%). As expected, ghosts and reflections are a common phenomena, occupying 5.0% of the reports, in contrast to 1.8% at the Salt Lake Center.

The error categories are refined by aircraft mission in Table 4-4; 40.0% of the reports involved general aviation, 33.4% commercial carriers, and 7.3% military aircraft. In the remaining 19.2% of the returns the aircraft I/D was unknown.

The beacon discrepancies are listed by aircraft type in Table 4-5 and this data is illustrated in Figure 4-1. An unusual feature of this chart is the preponderance of smaller airplanes; included among the top ten aircraft are the Beech King (BE90), Beech Airliner (BE99), Piper Navajo (PA31), Cessna 421, and Beech Baron (BE55).

Problems involving air carriers are addressed next. Table 4-6 contains a distribution of carrier discrepancy data by error category while this information is expressed in terms of aircraft type in Table 4-7.

4.3 MIAMI ARTCC

The returns from the Miami Center were processed in the same manner as those from New York. These results are given in Tables 4-8 through 4-12. In addition, the distribution of discrepancy reports by aircraft type is presented in Figure 4-2.

It is useful to compare the problems experienced at Miami with those of New York and Laredo. At each of these facilities lost targets represent the most common deficiency, followed by broken or intermittent target-slash. The discrepancy of sidelobes or ring around is listed third for both New York and Miami while target never acquired occupies this position at the Laredo AFB. In view of the vast difference in the air traffic population encountered at these sites, it is interesting to find that the complaints follow the same general pattern.

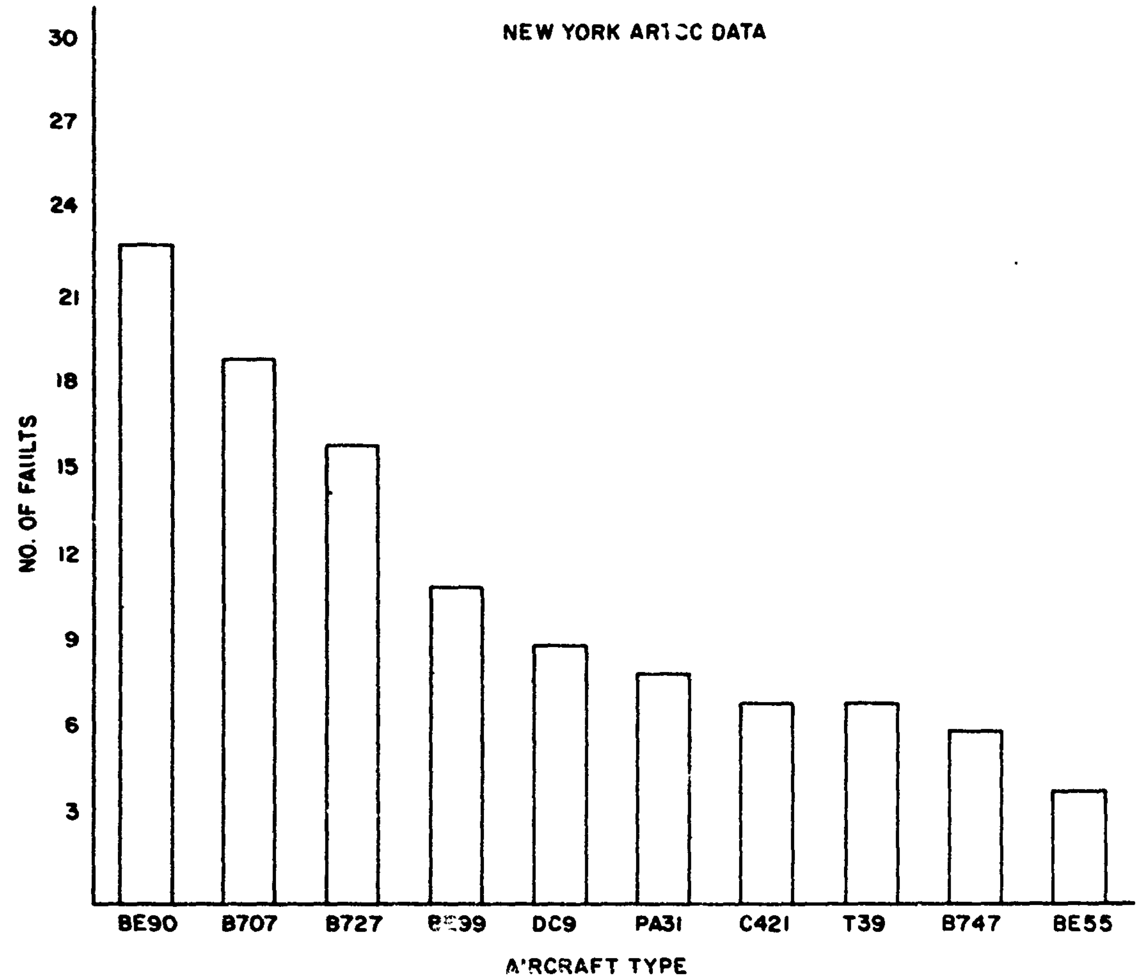

Figure 4-1. Distribution of Discrepancy Reports by Aircraft Type; Facility: New York ARTCC

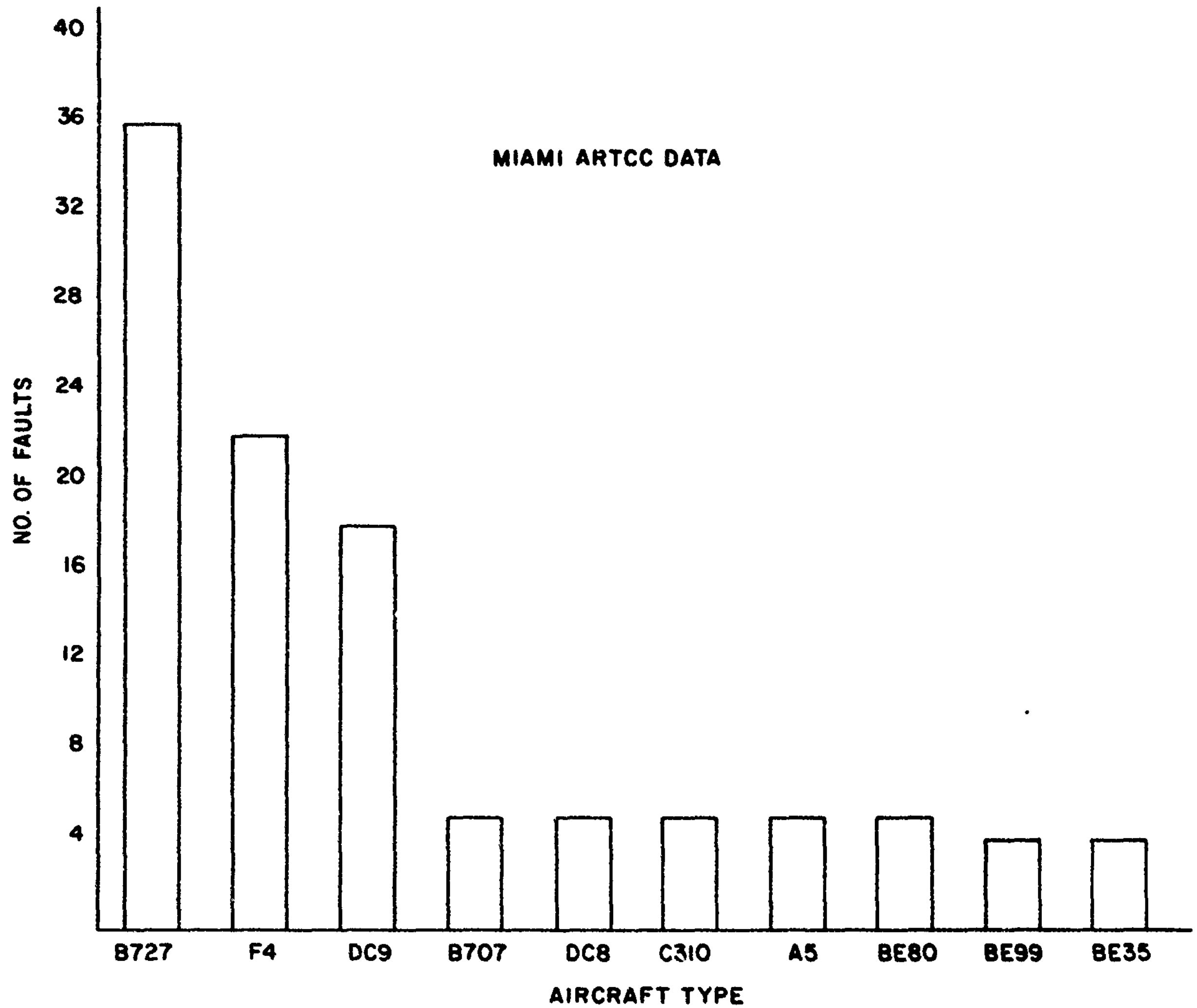

Figure 4-2 Distribution of Discrepancy Reports by Aircraft Type; Facility: Miami ARTCC

TABLE 4-4. SUBDIVISION OF ERROR CATEGORIES BY AIRCRAFT MISSION
Facility: New York ARTCC

ERROR CATEGORY	MILITARY	COMMERCIAL	GENERAL AVIATION
Target Lost Long Time	7	29	39
Target Lost Short Time	1	16	25
Target Broken/Intermittent/Chopped	8	12	24
Ring Around/Sidelobes	0	16	3
IDENT Malfunction	3	8	5
Ghosts/Reflections/False Targets	0	0	0
Other	0	0	4
Target Never Acquired	0	4	4
Target Too Wide	0	2	0
Fruit	0	0	0
Target Too Narrow	0	0	0
Mode 3/A Incorrect	0	0	0
Altitude Readout Incorrect	0	0	0
False Emergency Replies	0	0	0

TABLE 4-5. AIRCRAFT FAULT REPORT MATRIX

Facility: New York ARTCC

A/C TYPE	TOTAL	%	RING	GHOST	FRUIT	WIDE	NARRW	NEVER	LSTSH	LSTLN	BROKN	MODE	ALTIT	IDENT	OTHER	FALSE
BE90	23	9.4	1					1	5	7	7			1	1	
B707	19	7.8	1			1			3	9	1			4		
B727	16	6.5	3					1	5	4	2			1		
BE99	11	4.5						1	2	6	2					
DC9	9	3.7	1					1		2	2			3		
PA31	8	3.3						1	4	3						
C421	7	2.8							1	2	3				1	
T39	7	2.8								3	4					
B747	6	2.4							1	4	1					
BE55	4	1.6							1	2				1		
DC38	4	1.6						1		3						
CV58	3	1.2							1		2					
BE18	3	1.2								1	1				1	
BE80	3	1.2							1	2						
HS25	3	1.2							2					1		
AC21	3	1.2	1						2							
G1	3	1.2							1	1	1					
U8	3	1.2												3		
DH6	3	1.2							1	1	1					
BE35	3	1.2							1	1	1					
C130	3	1.2							1	1	1					
C140	2	0.8								1	1					
DC3	2	0.8							1	1						
MU2	2	0.8							1	1						
BE10	2	0.8								1	1					
N265	2	0.8							2							
LR23	2	0.8								1	1					
BA11	2	0.8								1	1					
PA30	2	0.8								1					1	
PAZT	2	0.8						1	1							
U8FT	2	0.8								1				1		
G2	2	0.8									2					
AC68	2	0.8									1			1		
T29	2	0.8								1	1					
PA28	2	0.8							1		1					
DC87	2	0.8							1	1						
127A	1	0.4				1										

TABLE 4-5. AIRCRAFT FAULT REPORT MATRIX (CONTINUED)
Facility: New York ARTCC

A/C TYPE	TOTAL	%	RING*	GHOST	FRUIT	WIDE	NARRW	NEVER	LSTSH	LSTLN	BROKN	MODE	ALTIT	IDENT	OTHER	FALSE
BE60	1	0.4							1							
BE95	1	0.4								1						
C54B	1	0.4									1					
L329	1	0.4							1							
DC93	1	0.4							1							
PA32	1	0.4								1						
B737	1	0.4							1							
DC8	1	0.4							1							
C411	1	0.4								1						
SW2A	1	0.4									1					
G159	1	0.4									1					
FA22	1	0.4						1								
C310	1	0.4								1						

*For key to error code abbreviations see Table 3-4.

TABLE 4-6. DISTRIBUTION OF DISCREPANCY REPORTS ASSOCIATED WITH AIR CARRIERS BY ERROR CATEGORY

Facility: New York ARTCC

FAULT / CARRIER	AL101	AL102	AL103	AL104	AL106	AL107	AL108	AL109	AL110	AL111	AL112	AL113	AL114	AL115	AL116	AL117	AL118	AL119	AL120	AL122
Ring Around/Sidelobes	11			14																
Ghosts/Reflections/False Targets					17															
Fruit																				
Target Too Wide				7								25								
Target Too Narrow																				
Target Never Acquired	11											25								
Target Lost Short Time	44	100		21	17										100			100		
Target Lost Long Time				50	17				25			25					100			
Target Intermittent/Broken/Chopped	11			7	50				50			25								
Mode 3/A Code Incorrect																				
Altitude Readout Incorrect																				
IDENT Malfunction	11								25											
Other																				
False Emergency Replies																				
Total Discrepancies	9	1	0	14	6	0	0	0	4	0	0	4	0	0	2	0	6	1	0	0

Note: Array Elements are Expressed on a Percent Basis

TABLE 4-7. DISTRIBUTION OF DISCREPANCY REPORTS INVOLVING AIR CARRIERS BY AIRCRAFT TYPE

Facility: New York ARTCC

CARRIER	TOTAL	%	B-707	B-720	B-727	B-737	B-747	CV58	CV88	DC8	DC9	DC10	BA11	FA27
AL101	9	3.67	5	0	4	0	0	0	0	0	0	0	0	0
AL102	1	0.40	0	0	0	0	0	0	0	1	0	0	0	0
AL103	0	0.00	0	0	0	0	0	0	0	0	0	0	0	0
AL104	14	5.71	2	0	9	0	3	0	0	0	0	0	0	0
AL106	6	2.44	0	0	0	0	0	3	0	0	3	0	0	0
AL107	0	0.00	0	0	0	0	0	0	0	0	0	0	0	0
AL108	0	0.00	0	0	0	0	0	0	0	0	0	0	0	0
AL109	0	0.00	0	0	0	0	0	0	0	0	0	0	0	0
AL110	4	1.63	0	0	1	0	2	0	0	0	1	0	0	0
AL111	0	0.00	0	0	0	0	0	0	0	0	0	0	0	0
AL112	0	0.00	0	0	0	0	0	0	0	0	0	0	0	0
AL113	3	1.23	0	0	0	0	0	0	0	0	0	0	2	1
AL114	0	0.00	0	0	0	0	0	0	0	0	0	0	0	0
AL115	0	0.00	0	0	0	0	0	0	0	0	0	0	0	0
AL116	2	0.81	0	0	1	0	1	0	0	0	0	0	0	0
AL117	0	0.00	0	0	0	0	0	0	0	0	0	0	0	0
AL118	6	2.44	6	0	0	0	0	0	0	0	0	0	0	0
AL119	1	0.40	0	0	0	1	0	0	0	0	0	0	0	0
AL120	0	0.00	0	0	0	0	0	0	0	0	0	0	0	0
AL122	0	0.00	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL FAULTS	46	18.7	13	0	15	1	6	3	0	1	4	0	2	1

TABLE 4-8. BREAKDOWN OF FAULT REPORTS BY ERROR CATEGORY
Facility: Miami ARTCC

ERROR CATEGORY	NO. OF OCCURRENCES	%
Target Lost Short Time	52	28.26
Target Lost Long Time	33	17.93
Target Broken/Intermittent/Chopped	33	17.93
Ring Around/Sidelobes	28	15.21
Target Too Wide	12	6.52
Ghosts/Reflections/False Targets	8	4.34
Fruit	6	3.26
Target Never Acquired	6	3.26
Other	5	2.71
Target Too Narrow	1	0.54
Mode 3/A Code Incorrect	0	0.00
Altitude Readout Incorrect	0	0.00
IDENT Malfunction	0	0.00
False Emergency Replies	0	0.00

TABLE 4-9. SUBDIVISION OF ERROR CATEGORIES BY AIRCRAFT MISSION
Facility: Miami ARTCC

	NUMBER OF OCCURRENCES		
ERROR CATEGORY	MILITARY	COMMERCIAL	GENERAL AVIATION
Target Lost Short Time	14	21	17
Target Lost Long Time	12	4	16
Target Broken/Intermittent/Chopped	7	21	4
Ring Around/Sidelobes	4	18	6
Target Too Wide	3	9	0
Ghosts/Reflections/False Targets	0	5	0
Fruit	2	1	1
Target Never Acquired	4	1	0
Other	3	1	0
Target Too Narrow	0	1	0
Mode 3/A Code Incorrect	0	0	0
Altitude Readout Incorrect	0	0	0
IDENT Malfunction	0	0	0
False Emergency Replies	0	0	0

TABLE 4-10. AIRCRAFT DISCREPANCY REPORT MATRIX

Facility: Miami ARTCC

A/C TYPE	TOTAL	%	RING*	GHOST	FRUIT	WIDE	NARRW	NEVER	(ST) LSTSH	(MN) LSTSH	(ST) LSTLN	(MN) LSTLN	BROKN	MODE	ALTIT	IDENT	OTHER	FALSE
B727	36	19.6	10	0	0	3	0	1	5	2	0	1	13	0	0	0	1	0
F4	22	11.9	0	0	0	2	0	2	4	6	1	1	3	0	0	0	3	0
DC9	18	9.8	6	2	1	2	1	0	2	3	1	0	0	0	0	0	0	0
Unkn	10	5.4	1	2	2	0	0	1	0	0	0	0	3	0	0	0	1	0
B707	5	2.7	0	1	0	2	0	0	1	0	0	0	1	0	0	0	0	0
DC8	5	2.7	0	2	0	0	0	0	2	0	0	0	1	0	0	0	0	0
C310	5	2.7	0	0	0	0	0	0	1	0	3	0	1	0	0	0	0	0
A5	5	2.7	0	0	0	0	0	0	1	0	3	0	1	0	0	0	0	0
BE80	5	2.7	2	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0
BE99	4	2.2	0	1	0	0	0	0	1	1	0	[illegible]	1	0	0	0	0	0
BE35	4	2.2	1	0	0	0	0	0	1	0	2	0	0	0	0	0	0	0
PAZT	4	2.2	0	0	0	0	0	0	2	0	2	0	0	0	0	0	0	0
C121	4	2.2	0	0	0	0	0	0	1	0	2	0	1	0	0	0	0	0
DC6	3	1.6	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0
BE55	3	1.6	0	0	0	0	0	0	1	0	2	0	0	0	0	0	0	0
B57	2	1.1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
FA27	2	1.1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
C130	2	1.1	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0
T39	2	1.1	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0
AC21	2	1.1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
BE90	2	1.1	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0
T29	2	1.1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0
C421	2	1.1	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0
T33	2	1.1	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0
C119	2	1.1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A3	1	0.5	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
C46	1	0.5	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
BA11	1	0.5	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
C123	1	0.5	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
C135	1	0.5	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
F9	1	0.5	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
F84	1	0.5	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
H2	1	0.5	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
S2	1	0.5	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
C411	1	0.5	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
PA33	1	0.5	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
PA23	1	0.5	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0

*For key to error code abbreviations see Table 3-4.

TABLE 4-10. AIRCRAFT DISCREPANCY REPORT MATRIX (CONTINUED)
Facility: Miami ARTCC

A/C TYPE	TOTAL	PERCENT	RING	GHOST	FRUIT	WIDE	NARRW	NEVER	LSTSH (ST)	LSTSH (MN)	LSTLN (ST)	LSTLN (MN)	BROKN	MODE	ALTIT	IDENT	OTHER	FALSE
BE18	1	0.5	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
DHC6	1	0.5	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
PA24	1	0.5	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
PA36	1	0.5	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
MO21	1	0.5	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
BE78	1	0.5	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
C402	1	0.5	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
MU2	1	0.5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B720	1	0.5	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F227	1	0.5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C172	1	0.5	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
T38	1	0.5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PA28	1	0.5	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
PA32	1	0.5	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
BE65	1	0.5	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
UH1	1	0.5	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
B100	1	0.5	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
C207	1	0.5	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
C116	1	0.5	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
TOTALS	184		25	11	6	12	1	6	38	14	29	4	33	0	0	0	5	0

TABLE 4-11. DISTRIBUTION OF FAULT REPORTS INVOLVING AIR CARRIERS BY ERROR CATEGORY
Facility: Miami ARTCC

ERROR CATEGORY \ Carrier	AL101	AL102	AL104	AL107	AL109	AL110	AL114	AL115	AL116	AL118	AL120	AL122
Ring Around/Sidelobes	33					29	17					100
Ghosts/Reflections/False Targets				100	100		25			43		
Fruit						4						
Target Too Wide							8			43		
Target Too Narrow												
Target Never Acquired							8					
Target Lost Short Time	33					38	8		50			
Target Lost Long Time						4	8					
Target Broken/Intermittent/Chopped	33					25	25	50	50	14		
Mode 3/A Code Incorrect												
IDENT Malfunction												
Other								50				
False Emergency Replies												
Total Discrepancies	3	0	0	1	1	24	12	2	2	7	0	3

Note: Array elements are expressed on a percent basis.

TABLE 4-12. DISTRIBUTION OF FAULT REPORTS INVOLVING AIR CARRIERS BY AIRCRAFT TYPE
Facility: Miami ARTCC

CARRIER	TOTAL	%*	B-707	B-720	B-727	B-737	B-747	CV58	CV88	DC-8	DC-9	DC-10	FA27
AL101	3	1.63			3								
AL102	0	0.0											
AL104	0	0.0											
AL107	1	0.54			1								
AL109	1	0.54									1		
AL110	24	13.04			13					1	10		
AL114	12	6.52			10					2			
AL115	2	1.08			2								
AL116	2	1.08			2								
AL118	7	3.80	3	1	3								
AL120	0	0.0											
AL122	3	1.63									3		
TOTAL FAULTS	55	29.9	3	1	34	0	0	0	0	3	14	0	0

*Percent of Total Facility Discrepancies.

5. OVERALL SYSTEM PROBLEMS

In order to obtain a picture of the overall system problems, the returns from all the facilities were grouped together for analysis. The collective replies were first examined on the basis of aircraft mission (Fig. 5-1); this revealed that 43.7% of the discrepancies involved air carriers, 35.9% military aviation and 15.1% general aviation. In the remaining cases, the target was either a helicopter, 0.3%, or the aircraft identification was not reported.

5.1 ANALYSIS OF FAULT REPORTS BY ERROR CATEGORY

The survey returns were next sorted in terms of the error categories; this data is contained in Table 5-1 and illustrated in Figure 5-2.

The most common form of system degradation, accounting for 24.0% of the complaints, was the loss of a target for a short period of time. This is followed by the deficiencies of target broken/intermittent/chopped, 21.3%; ring around/sidelobes, 18.3%; target lost long time, 15.5%; and ghosts/reflections/false targets, 9.0%.

Since target loss represents the number one problem, it is worthwhile to focus attention on this deficiency. Examining the circumstances under which this discrepancy occurred, reveals that when the loss was of short duration, the target was traveling straight and level in about half the cases (49%), while in the remaining instances it was manuevering (51%). With regards to target loss for a long period, in 58.7% of these reports the target was heading straight and level, and was maneuvering for the remainder(41.3%). Combining the above groups enables the phenomena of lost targets to be divided in the following manner:

Target lost while traveling straight and level:	20.6%
Target lost while maneuvering:	18.5%.

The occurrence of target loss while an aircraft is traveling straight and level, which represents 20% of the total deficiencies, can be attributed to nulls in the elevation pattern of the

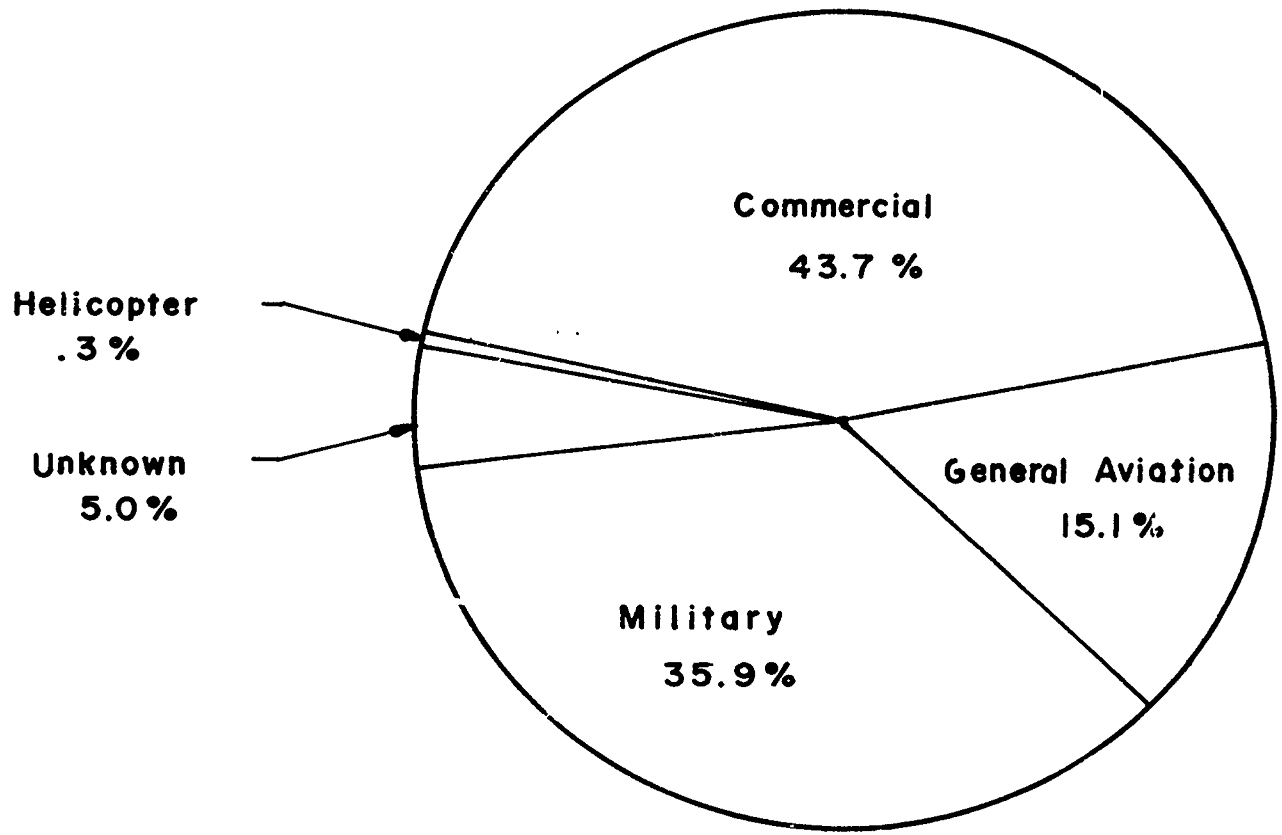

Figure 5-1. Distribution of Discrepancy Reports by Aircraft Mission; Derived from Total Survey Response

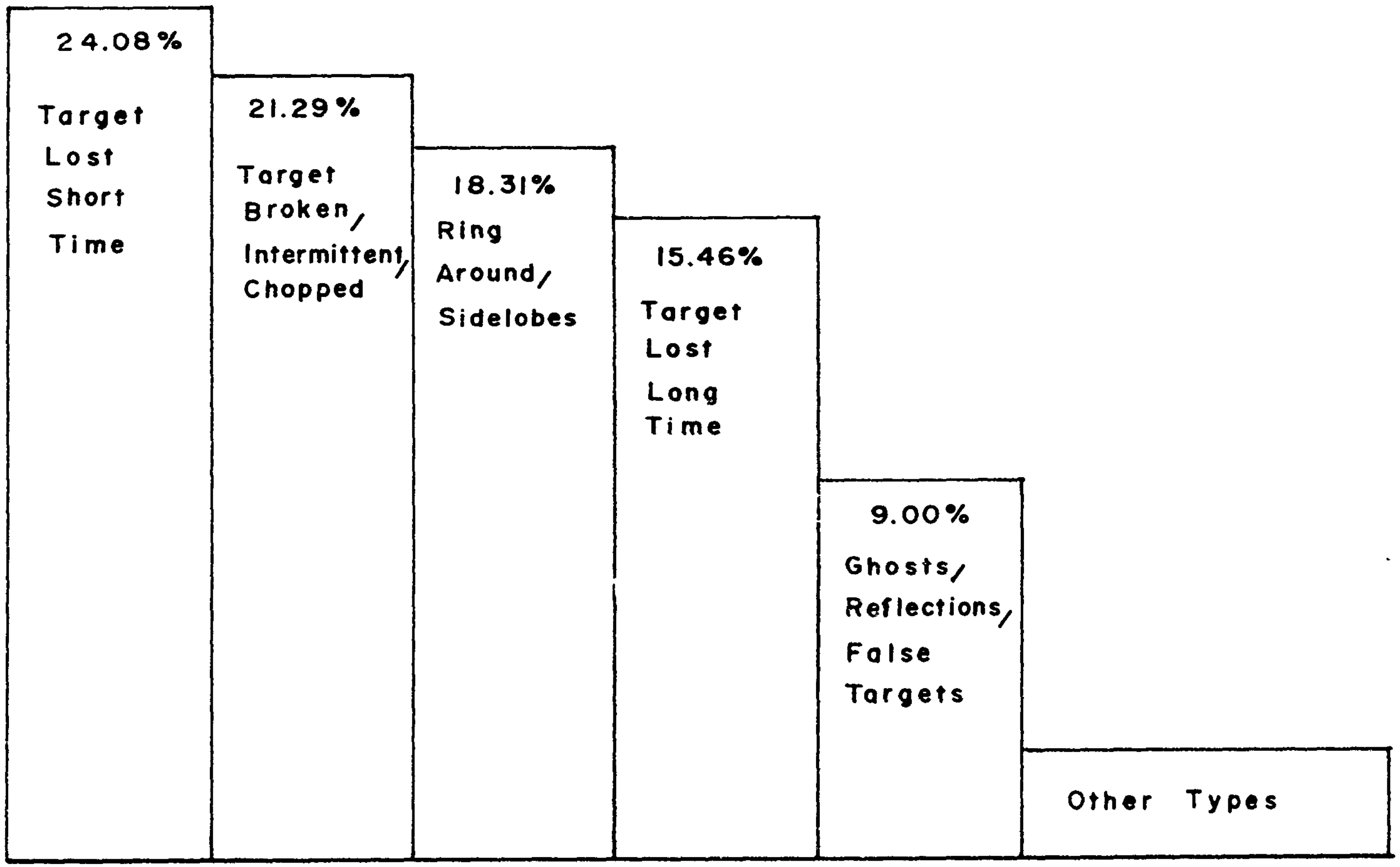

Figure 5-2 Rate of Occurrence of Various Forms of Beacon System Degradation; Derived from Total Survey Response

TABLE 5-1. DISTRIBUTION OF DISCREPANCY REPORTS BY ERROR CATEGORY: ALL DATA

ERROR CATEGORY	NO. OF OCCURRENCES	%
Target Lost Short Time	1003	24.08
Target Broken/Intermittent/Chopped	887	21.29
Ring Around/Sidelobes	763	18.31
Target Lost Long Time	644	15.46
Ghosts/Reflections/False Targets	375	9.00
Target Too Wide	98	2.35
Other	85	2.04
Target Never Acquired	74	1.77
False Emergency Replies	70	1.68
IDENT Malfunction	69	1.65
Target Too Narrow	53	1.27
Fruit	36	0.86
Mode 3/A Code Incorrect	8	0.19
Altitude Readout Incorrect	0	0.00

interrogator antenna. The second form of degradation, the loss of coverage associated with a maneuvering target, arises from shielding of the transponder antenna by the aircraft frame.

It is useful to compare the results in Table 5-1, with findings of the 1968 ATCRBS survey; these are reproduced from Reference 1 and are presented in Table 5-2. Before any comparision can be made, it is necessary to convert the deficiencies listed in Table 5-2 into the error categories employed for this study. This involves grouping ring around/ringing and sidelobe response; false targets and ghosts; broken slash, split target and intermittent target; etc. The problems referred to as target fade, and target lost for___ miles, belong under the heading of lost targets. However, it is impossible to know if the loss described occurred for a long or short period of time, and therefore, it is necessary to merge these two categories under lost targets. Carrying out these operations, the data from the 1968 survey can be expressed in the following manner;

Ghosts/False Targets:	25.6%
Ring Around/Sidelobes:	19.0%
Target Broken/Intermittent/Split:	17.7%
Lost Target:	13.8%

Comparing the above results with the findings of the present survey (Table 5-1), points up most succinctly the impact of sidelobe suppression and improved sidelobe suppression on the operation of the beacon system. There has been a sharp decline in reports of false targets, with the result that this deficiency has shifted from the number one complaint to a minor position. Simultaneously, the number of occurrences of ring around/sidelobes has been reduced, so that this discrepancy is now listed third. With a decline in false targets and ring around, other error categories have assumed new importance; currently the most serious problems are those of lost targets and broken or intermittent targets.

The data in Table 5-1 were refined by subdividing the discrepancy reports on the basis of aircraft mission; this information is presented in Table 5-3 and illustrated in Figures 5-3 through 5-5.

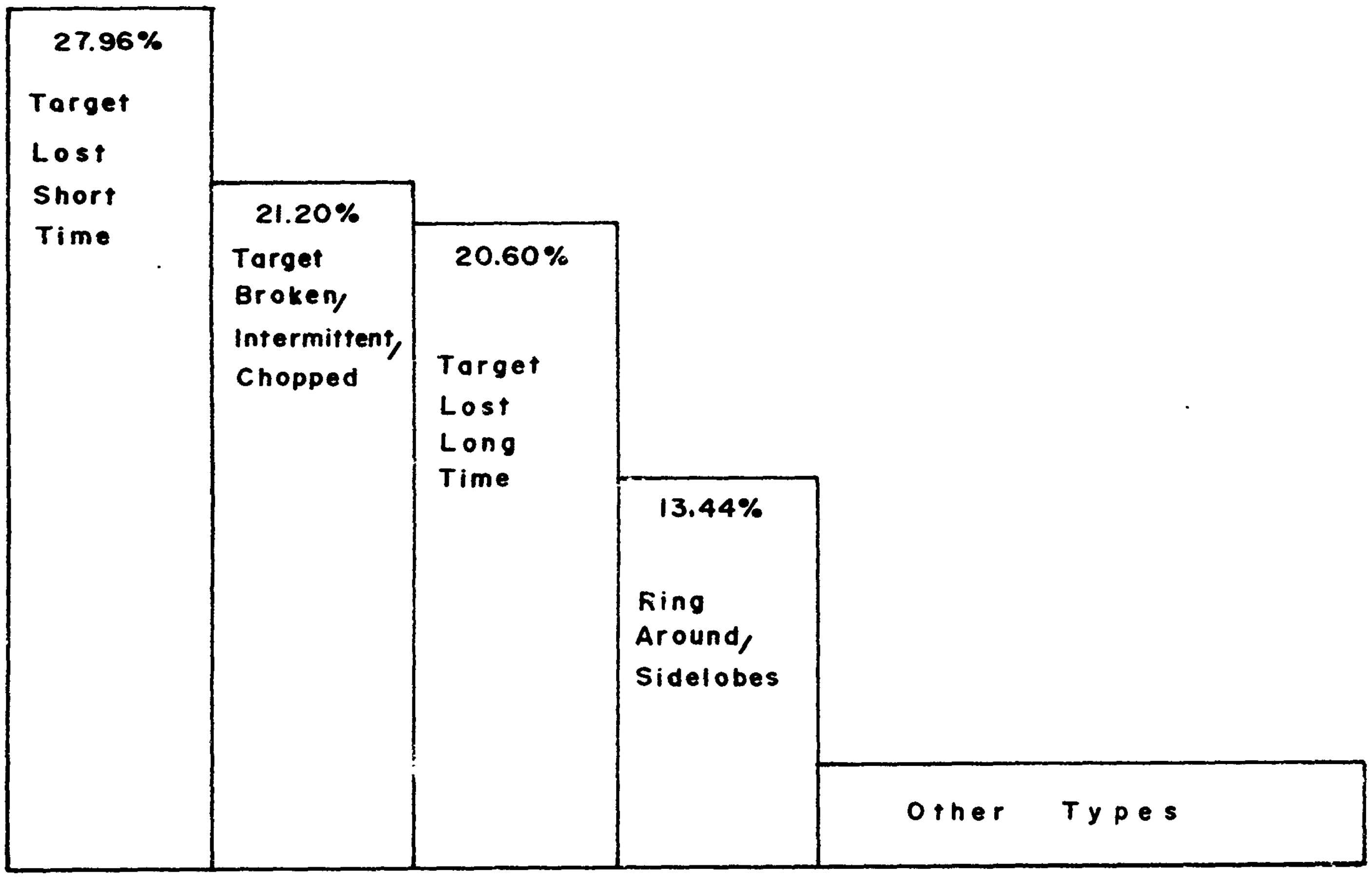

Figure 5-3. Distribution of Discrepancy Reports Involving Military Aircraft by Error Category; Derived from Total Survey Response

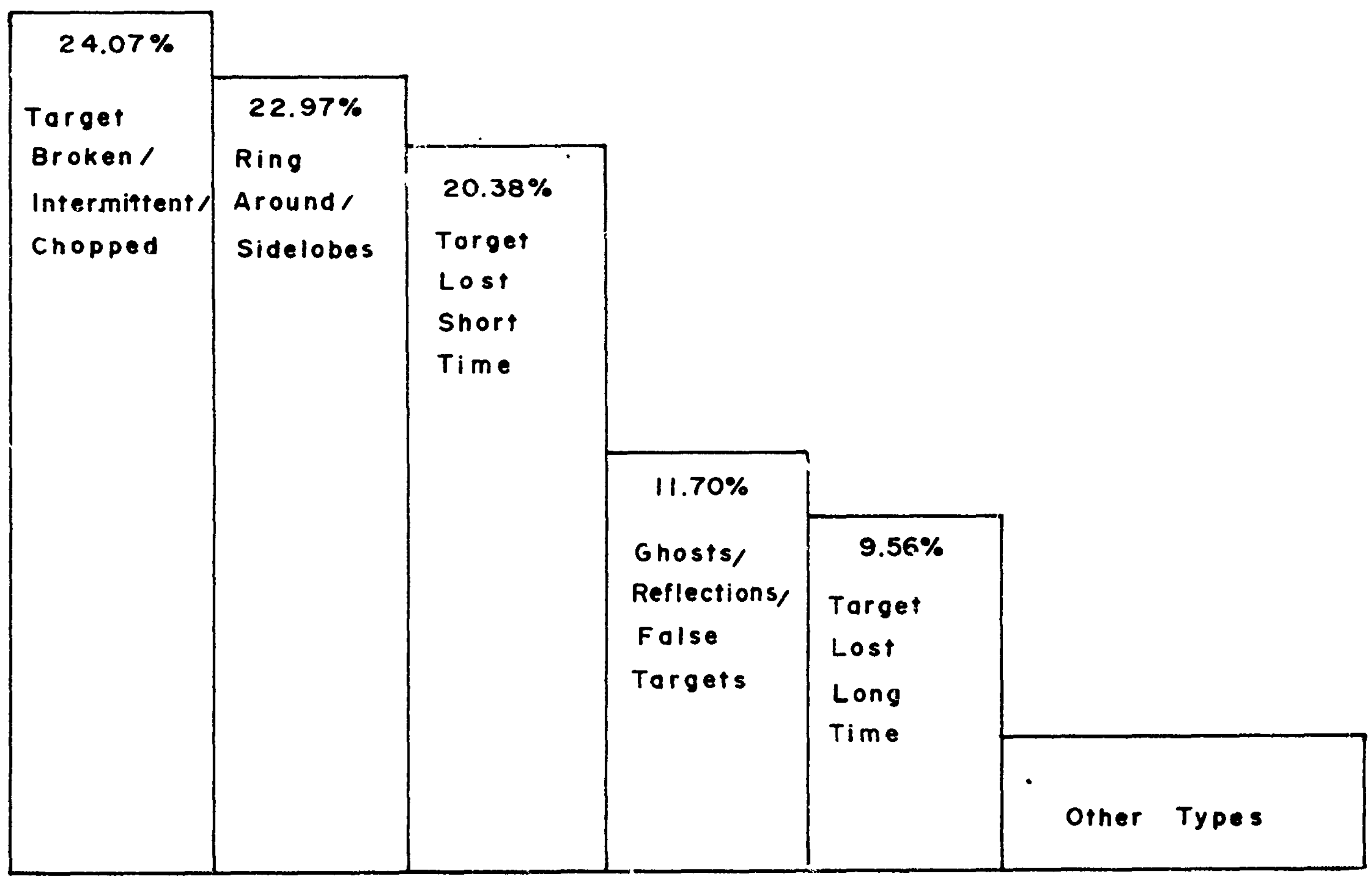

Figure 5-4. Distribution of Discrepancy Reports Involving Commercial Carriers by Error Category; Derived from all Data

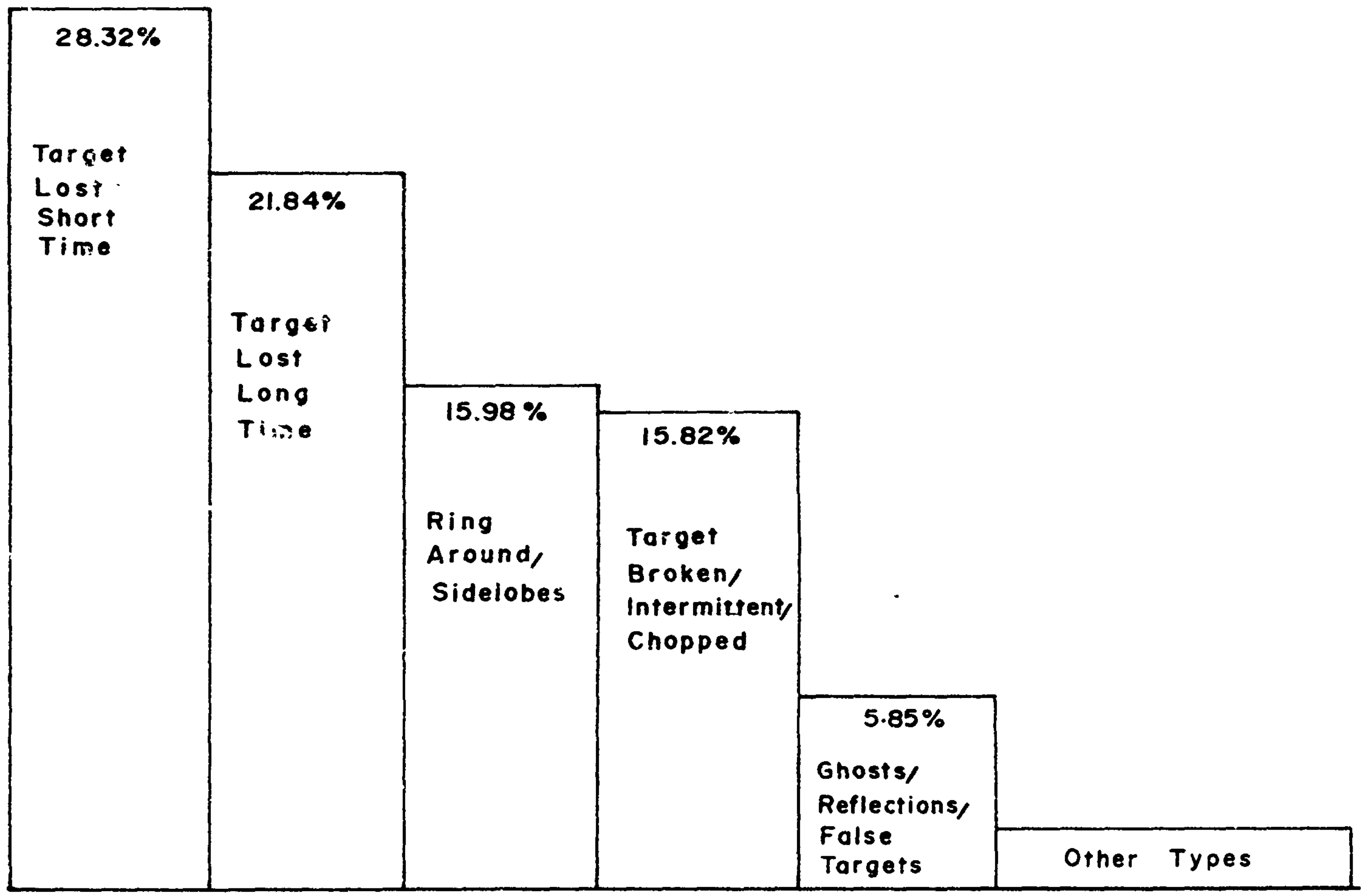

Figure 5-5. Distribution of Discrepancy Reports Involving General Aviation by Error Category; Derived from all Data

TABLE 5-2. SYSTEM DEFICIENCIES REPORTED IN 1968 ATCRBS SURVEY

NUMBER OF DEFICIENCIES*	TYPE OF DEFICIENCY
2927	False targets
2268	Ring around/ringing
1255	Broken slash
803	Lost beacon target
611	Split target
398	No beacon return
381	Target fade
374	Intermittent target
341	Lost target for ___ miles
314	Weak or fuzzy target/signal
308	Ghosts
282	Target lost or bad at one facility but good at another
220	Lost target for ___ sweeps
158	Blooming targets
145	Wrong code
143	Beacon ground failed
133	Sidelobe response
130	Beacon out of focus
121	Certain codes not coming through

*Cutoff at 100

TABLE 5-3. SUBDIVISION OF DISCREPANCY REPORTS BY AIRCRAFT MISSION: ALL DATA

ERROR CATEGORY	MILITARY	COMMERCIAL	GENERAL AVIATION
Target Lost Short Time	418	371	179
Target Broken/Intermittent/Chopped	317	438	100
Ring Around/Sidelobes	201	418	101
Target Lost Long Time	308	174	138
Ghosts/Reflections/False Targets	84	213	37
Target Too Wide	22	62	9
Other	29	23	13
Target Never Acquired	34	14	24
False Emergency Replies	12	57	1
IDENT Malfunction	22	31	13
Target Too Narrow	31	11	11
Fruit	12	7	5
Mode 3/A Code Incorrect	5	1	1
Altitude Readout Incorrect	0	0	0

Among air carriers, the major deficiency experienced nationwide is broken target-slash. This is followed by ring around/sidelobes and target lost a short time. With military aircraft the most common complaint is target lost a short time. Listed next is broken target-slash, followed by target lost a long time, and ring around/sidelobes. Focusing on general aviation the deficiency distribution is dominated by lost targets; the order of complaints being target lost short time, target lost long time, ring around/sidelobes, and broken target-slash.

5.2 ANALYSIS OF FAULT REPORTS BY AIRCRAFT TYPE

The survey returns were next examined for the type of aircraft involved in the instances of degradation. These results are plotted in Figure 5-6, which is limited to the ten aircraft most frequently cited. A B-727 was listed in 16.4% of the reports; this is followed by the T38 (7.0%), B-707 (6.6%), DC-9 (5.1%), A4 (5.0%), DC-8 (3.9%), F4 (2.5%), B-747 (2.1%), and B-720 (2.0%).

An analysis of the discrepancies associated with each of these aircraft is contained in the Fault Report Matrix, Table 5-4. Focusing attention on the B-727, for example, the most common complaint was broken target-slash (cited in 194 reports). In addition, the data reveals a significant number of cases of ring around (130). The information in Table 5-4 is reproduced in Table 5-5 with the distinction that the discrepancies associated with each aircraft are now expressed on a percent basis. It is felt that this format should make it easier to examine the performance of any aircraft, and should make any deviation from the norm more apparent.

5.3 SYSTEM DISCREPANCIES ASSOCIATED WITH AIR CARRIERS

Attention was next shifted to the air carriers and the deficiencies associated with this group were examined. An analysis of the discrepancy reports by carrier is contained in Table 5-6 for airlines involved in five or more deficiencies. This information is refined on the basis of the aircraft involved in the reports (Table 5-7). It must be emphasized that this data

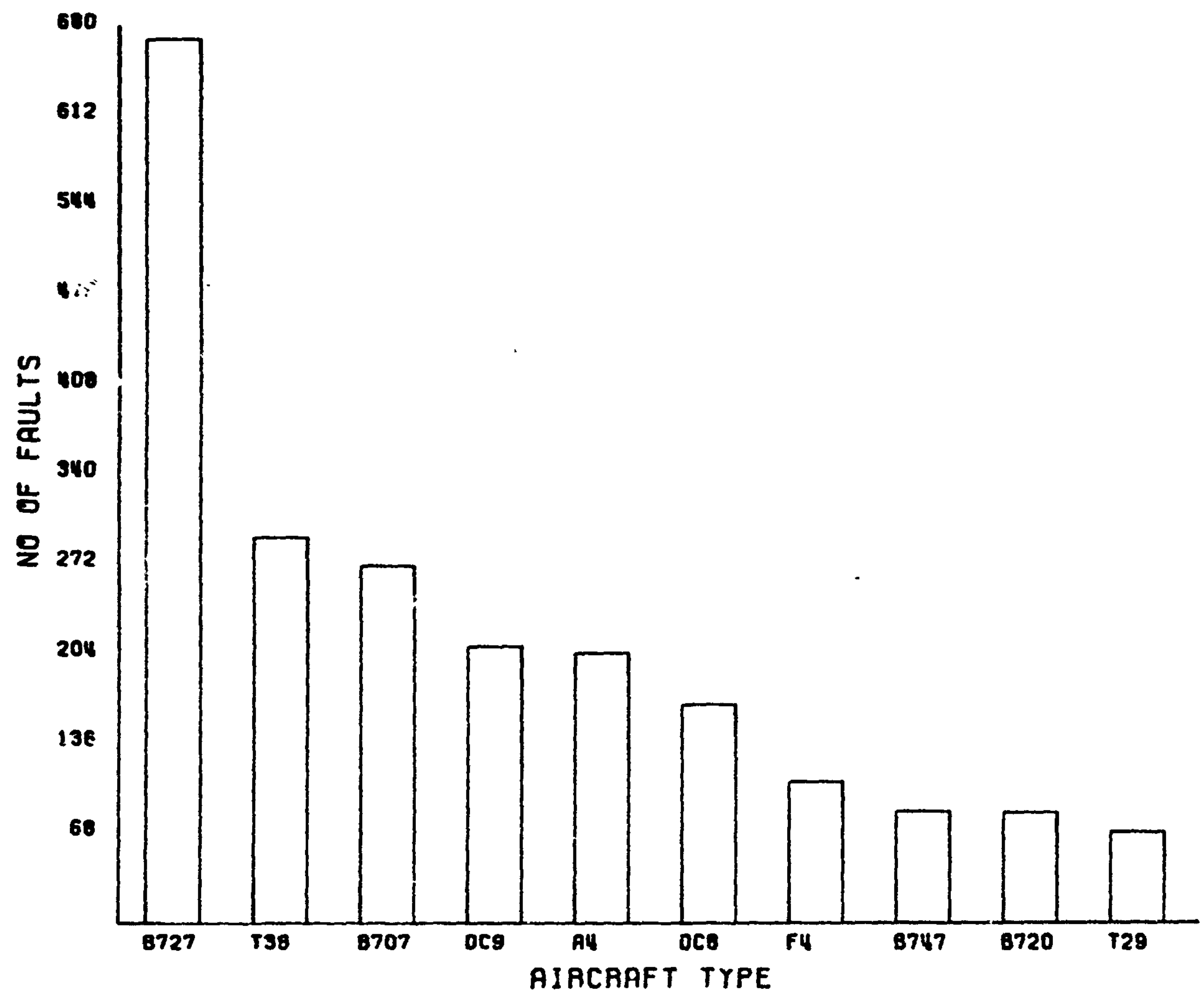

Figure 5-6 Distribution of Discrepancy Reports by Aircraft Type; All Data

TABLE 5-4. AIRCRAFT FAULT REPORT MATRIX: ALL DATA

A/C TYPE*	TOTAL	PERCENT	RING**	GHOST	FRUIT	WIDE	NARRW	NEVER	LSTSH (ST)	LSTSH (MN)	LSTLN (ST)	LSTLN (MN)	BROKN	MODE	ALTIT	IDENT	OTHER	FALSE
B727	571	16.4	130	72	2	23	4	3	75	47	44	18	194	1	0	15	12	31
T38	293	7.1	11	9	1	1	5	7	16	110	24	69	28	2	0	4	5	1
B707	271	6.6	68	26	1	9	4	0	33	23	17	10	61	0	0	7	3	9
Unknown	226	5.5	31	41	11	4	0	2	10	29	12	22	40	1	0	2	20	1
DC9	210	5.1	64	40	2	6	1	1	20	22	13	6	27	0	0	3	3	2
A4	205	5.0	26	7	0	2	4	3	23	16	25	10	83	0	0	0	6	0
DC8	166	4.0	54	24	0	4	0	1	14	18	11	4	44	0	0	3	1	8
F4	107	2.6	14	7	1	[illegible]	2	5	21	16	8	9	15	0	0	3	4	0
B747	85	2.1	21	7	0	0	0	2	6	11	2	6	25	0	0	1	1	3
B720	84	2.0	15	14	0	3	0	0	7	12	6	1	20	0	0	2	1	3
T29	69	1.7	8	6	2	[illegible]	0	2	12	6	9	3	15	0	0	0	2	2
C141	62	1.5	10	9	0	[illegible]	2	0	5	1	7	2	17	0	0	1	2	2
T37	61	1.5	1	1	1	0	4	1	8	22	1	8	12	0	0	1	1	0
T39	55	1.3	7	2	1	0	0	0	8	3	8	9	17	0	0	0	0	0
B737	54	1.3	5	[illegible]	0	2	2	0	6	6	3	6	16	0	0	0	2	0
T33	50	1.2	8	[illegible]	2	0	2	1	7	6	3	4	10	0	0	3	1	1
PA28	48	1.2	1	3	1	0	2	2	12	4	13	2	6	0	0	0	2	0
B52	44	1.1	6	4	0	1	1	0	3	9	7	2	10	0	0	1	0	0
BE90	41	1.0	7	0	0	0	1	3	7	4	8	2	7	0	0	1	1	0
C135	37	0.9	8	2	0	2	1	2	6	4	4	1	6	0	0	0	0	1
F106	37	0.9	7	0	0	0	4	2	6	6	0	5	6	0	0	1	0	0
FA27	35	0.8	9	3	2	10	0	0	3	5	0	1	2	0	0	0	0	0
CV58	33	0.8	6	0	0	0	0	0	6	4	2	3	12	0	0	0	0	0
BE99	32	0.8	3	6	0	1	0	1	4	5	3	4	5	0	0	0	0	0
C130	31	0.8	3	2	1	0	0	1	2	5	4	2	9	1	0	0	1	0
FFJ	31	0.8	8	4	0	3	1	0	4	2	2	0	7	0	0	0	0	0
BA11	29	0.7	11	6	0	0	0	1	4	4	0	1	2	0	0	0	0	0
F8	28	0.7	2	2	0	0	1	0	4	5	3	3	8	0	0	0	0	0
BE55	27	0.6	2	0	0	0	1	0	8	2	5	2	5	0	0	1	1	0
BE35	27	0.6	2	1	0	1	1	3	3	3	7	3	2	0	0	0	1	0
A7	27	0.6	5	2	0	0	0	1	1	4	5	3	4	1	0	0	0	1
C172	25	0.6	1	5	1	0	0	1	6	4	5	0	2	0	0	0	0	0
C118	25	0.6	7	0	0	0	0	1	3	1	3	1	8	0	0	0	0	1
BE18	24	0.6	0	2	0	0	0	1	6	1	4	2	6	0	0	0	2	0
A6	22	0.5	3	0	1	0	1	0	1	0	6	1	8	0	0	1	0	0
B57	21	0.5	3	10	0	2	0	0	0	3	0	0	2	0	0	0	0	1
C131	20	0.5	1	5	0	0	0	0	3	2	3	0	3	0	0	0	3	0
LR24	20	0.5	8	1	0	0	0	0	3	1	1	0	4	0	0	1	0	1
N265	19	0.5	5	0	0	0	0	0	2	6	1	1	4	0	0	0	0	0

*Cutoff at 7 discrepancies
**Error code abbreviations are defined in Table 3.4

TABLE 5-4. AIRCRAFT FAULT REPORT MARTIX: ALL DATA (CONTINUED)

A/C TYPE	TOTAL	PERCENT	RING	GHOST	FRUIT	WIDE	NARRW	NEVER	LSTSH (ST)	LSTSH (MN)	LSTLN (ST)	LSTLN (MN)	BROKN	MODE	ALTIT	IDENT	OTHER	FALSE
PAZT	19	0.5	2	2	1	1	1	1	5	1	2	1	2	0	0	0	0	0
FA22	19	0.5	7	2	0	0	0	1	2	7	0	0	0	0	0	0	0	0
C310	19	0.5	0	1	0	0	0	1	5	1	6	3	1	0	0	1	0	0
C124	19	0.5	0	2	0	0	0	0	2	4	3	1	6	0	0	1	0	0
DC10	19	0.5	4	2	0	0	0	0	3	1	1	2	6	0	0	0	0	0
CV88	19	0.4	5	2	0	0	0	0	3	0	1	0	7	0	0	0	0	0
C421	17	0.4	1	0	0	0	0	0	2	2	3	0	7	0	0	0	2	0
F111	17	0.4	0	0	0	0	1	0	2	1	0	4	7	0	0	1	1	0
PA31	16	0.4	3	1	0	0	0	2	3	1	4	1	1	0	0	0	0	0
DC3	16	0.4	6	0	0	0	0	1	3	2	2	2	0	0	0	0	0	0
PA30	16	0.4	5	0	0	1	0	0	2	3	1	1	1	0	0	0	2	0
L188	16	0.4	0	5	0	1	0	0	2	5	1	0	2	0	0	0	0	0
C54	15	0.4	6	2	0	0	0	1	0	1	2	0	2	0	0	0	0	1
G159	15	0.4	7	1	0	0	0	0	0	2	1	1	2	1	0	0	0	0
S2	15	0.4	0	1	0	0	0	3	2	0	5	2	1	0	0	0	1	0
P3	15	0.4	0	0	0	0	0	0	2	1	3	1	8	0	0	0	0	0
DV10	15	0.4	0	3	1	0	1	1	3	0	2	2	2	0	0	0	0	0
BE33	14	0.3	1	0	0	0	1	1	1	1	4	0	3	0	0	2	0	0
F100	14	0.3	7	2	0	1	0	0	0	0	0	0	4	0	0	0	0	0
AC21	13	0.3	4	0	0	0	0	0	3	4	0	0	1	0	0	1	0	0
DH6	13	0.3	3	1	0	1	0	2	3	1	1	0	1	0	0	0	0	0
DC87	13	0.3	3	3	0	1	0	0	2	2	1	0	1	0	0	0	0	0
F101	13	0.3	0	1	0	0	0	0	2	6	2	0	2	0	0	0	0	0
MU2	12	0.3	5	0	0	1	0	0	3	1	1	0	2	0	0	0	0	0
C206	12	0.3	0	2	1	0	1	2	1	0	2	2	1	0	0	0	0	0
F102	12	0.3	2	1	0	0	0	0	2	2	1	2	0	1	0	1	0	0
C117	12	0.3	1	4	1	2	0	0	3	0	1	0	0	0	0	0	0	0
F104	12	0.3	2	0	0	0	0	1	4	0	1	0	4	0	0	0	0	0
BE80	11	0.3	2	0	1	0	0	0	3	2	2	0	1	0	0	0	0	0
C320	11	0.3	2	0	0	0	0	0	2	1	2	0	3	0	0	1	0	0
KC13	11	0.3	0	1	0	0	0	0	3	3	0	1	3	0	0	0	0	0
TA4	10	0.2	0	2	0	0	0	0	2	2	1	2	1	0	0	0	0	0
T331	9	0.2	0	3	0	0	1	0	0	0	2	0	2	0	0	1	0	0
F105	9	0.2	2	0	0	0	0	0	3	0	1	0	3	0	0	0	0	0
L329	8	0.2	2	0	0	0	1	0	1	1	1	0	2	0	0	0	0	0
C119	8	0.2	0	2	0	0	0	0	0	0	2	1	3	0	0	0	0	0
F22	8	0.2	3	0	0	0	0	0	1	4	0	0	0	0	0	0	0	0
PS25	7	0.2	2	0	0	0	0	0	1	1	1	0	1	0	0	1	0	0
U8	7	0.2	0	0	0	0	0	0	0	0	3	0	1	0	0	3	0	0

TABLE 5-5. AIRCRAFT FAULT REPORT MATRIX WITH ENTRIES EXPRESSED ON A PERCENT BASIS (ALL DATA)

A/C TYPE**	TOT*	PERC	RING %	GHOST %	FRUIT %	WIDE %	NARRW %	NEVER %	(ST) LSTSH %	(MN) LSTSH %	(ST) LSTLN %	(MN) LSTLN %	BROKN %	MODE %	ALTIT %	IDENT %	OTHER %	FALSE %
B727	671	16.4	19.4	10.7	0.3	3.4	0.6	0.4	11.2	7.0	6.6	2.7	28.9	0.1	0.0	2.2	1.8	4.6
T38	293	7.1	3.8	3.1	0.3	0.3	1.7	2.4	5.5	37.5	8.2	23.5	9.6	0.7	0.0	1.4	1.7	0.3
B707	271	6.6	25.1	9.6	0.4	3.3	1.5	0.0	12.2	8.5	6.3	3.7	22.5	0.0	0.0	2.6	1.1	3.3
UNKNOWN	226	5.5	13.7	18.1	4.9	1.8	0.0	0.9	4.4	12.8	5.3	9.7	17.7	0.4	0.0	0.9	8.8	0.4
DC9	210	5.1	30.5	19.0	1.0	2.9	0.5	0.5	9.5	10.5	6.2	2.9	12.9	0.0	0.0	1.4	1.4	1.0
A4	205	5.0	12.7	3.4	0.0	1.0	2.0	1.5	11.2	7.8	12.2	4.9	40.5	0.0	0.0	0.0	2.9	0.0
DC9	166	4.0	20.5	14.5	0.0	2.4	0.0	0.6	8.4	10.8	6.6	2.4	26.5	0.0	0.0	1.8	0.6	4.8
F[illegible]	107	2.6	13.1	6.5	0.9	1.9	1.9	4.7	19.6	1[illegible].0	7.5	8.4	14.0	0.0	0.0	2.8	3.7	0.0
B747	85	2.1	24.7	8.2	0.0	0.0	0.0	2.4	7.1	12.9	2.4	7.1	29.4	0.0	0.0	1.2	1.2	3.5
B720	84	2.0	17.9	16.7	0.0	3.6	0.0	0.0	8.3	14.3	7.1	1.2	23.9	0.0	0.0	2.4	1.2	3.6
T29	69	1.7	11.6	8.7	2.9	2.9	0.0	2.9	17.4	8.7	13.0	4.3	21.7	0.0	0.0	0.0	2.9	2.9
C141	62	1.5	16.1	14.5	0.0	6.5	3.2	0.0	8.1	1.6	11.3	3.2	27.[illegible]	0.0	0.0	1.6	3.2	[illegible].2
T37	61	1.5	1.6	1.6	1.6	0.0	6.6	1.6	13.1	36.1	1.6	13.1	1[illegible].7	0.0	0.0	1.6	1.6	0.0
T39	55	1.3	12.7	3.6	1.8	0.0	0.0	0.0	14.5	5.5	14.5	16.4	[illegible]	0.0	0.0	0.0	0.0	0.0
B737	54	1.3	9.3	11.1	0.0	3.7	3.7	0.0	11.1	11.1	5.6	11.1	29.[illegible]	0.0	0.0	0.0	3.7	0.0
T33	50	1.2	16.0	4.0	4.0	0.0	4.0	2.0	14.0	12.0	6.0	8.0	20.0	0.[illegible]	0.0	6.0	2.0	2.0
PA23	48	1.2	2.1	6.3	2.1	0.0	4.2	4.2	25.0	8.3	27.1	4.2	[illegible]	[illegible]	0.0	0.0	4.2	0.0
B52	44	1.1	13.6	9.1	0.0	2.3	2.3	0.0	6.8	20.5	15.9	4.5	22.[illegible]	[illegible].0	0.0	2.3	0.0	0.0
[illegible]	41	1.0	17.1	0.0	0.0	0.0	2.4	7.3	17.1	9.8	19.[illegible]	4.9	17.[illegible]	[illegible]	0.0	2.4	2.4	0.0
F106	37	0.9	18.9	0.0	0.0	0.0	10.8	5.4	16.2	16.2	0.0	13.5	16.[illegible]	0.0	0.[illegible]	2.7	0.0	0.0
C135	36	0.9	22.2	5.6	0.0	5.6	0.0	5.6	16.7	11.1	11.1	2.8	16.[illegible]	0.0	0.0	0.0	0.0	2.8
FA27	35	0.9	25.7	8.6	5.7	28.6	0.0	0.0	8.6	14.3	0.0	2.9	5.[illegible]	0.0	[illegible]	[illegible]	0.0	0.0
CV58	33	0.8	18.2	0.0	0.0	0.0	0.0	0.0	18.2	12.1	6.1	9.1	36.[illegible]	0.0	0.0	0.0	0.0	0.0
BE99	32	0.8	9.4	18.8	0.0	3.1	0.0	3.1	12.5	15.6	9.4	12.5	15.6	0.[illegible]	0.0	0.0	0.0	0.0
C130	31	0.8	9.7	6.5	3.2	0.0	0.0	3.2	6.5	16.1	12.9	6.5	29.0	3.2	0.0	0.0	3.2	0.0
FFJ	31	0.8	25.8	12.9	0.0	9.7	3.2	0.0	12.9	6.5	6.5	0.0	22.6	0.0	0.0	0.0	0.0	0.0
BA11	29	0.7	37.9	20.7	0.0	0.0	0.0	3.4	13.8	13.8	0.0	3.4	6.9	0.0	0.0	0.0	0.0	0.0
F8	28	0.7	7.1	7.1	0.0	0.0	3.6	0.0	14.3	17.9	10.7	10.7	29.6	0.0	0.0	0.0	0.0	0.0
BE35	27	0.6	7.4	3.7	0.0	3.7	3.7	11.1	11.1	11.1	25.9	11.1	7.4	0.0	0.0	0.0	3.7	0.0
A7	27	0.6	18.5	7.4	0.0	0.0	0.0	3.7	3.7	14.8	18.5	11.1	14.8	3.7	0.0	0.0	0.0	3.7
BE55	27	0.6	7.4	0.0	0.0	0.0	3.7	0.0	29.6	7.4	13.5	7.4	18.5	0.0	0.0	3.7	3.7	0.0
C118	25	0.6	28.0	0.0	0.0	0.0	0.0	4.0	12.0	4.0	12.0	4.0	32.0	0.0	0.0	0.0	0.0	4.0
C172	25	0.6	4.0	20.0	4.0	0.0	0.0	4.0	24.0	16.0	20.0	0.0	8.0	0.0	0.0	0.0	0.0	0.0
BE18	24	0.6	0.0	8.3	0.0	0.0	0.0	4.2	25.0	4.2	16.7	8.3	25.0	0.0	0.0	0.0	8.3	0.0
A6	22	0.5	13.6	0.0	4.5	0.0	4.5	0.0	4.5	0.0	27.3	4.5	36.4	0.0	0.0	4.5	0.0	0.0
B57	21	0.5	14.3	47.6	0.0	9.5	0.0	0.0	0.0	14.3	0.0	0.0	9.5	0.0	0.0	0.0	0.0	4.8
LR24	20	0.5	40.0	5.0	0.0	0.0	0.0	0.0	15.0	5.0	5.0	0.0	20.0	0.0	0.0	5.0	0.0	5.0

*NOTE - ARRAY ELEMENTS ARE PERCENT OF A/C TYPE TOTAL

** CUTOFF AT FIVE DISCREPANCIES

TABLE 5-5. AIRCRAFT FAULT REPORT MATRIX WITH ENTRIES EXPRESSED ON A PERCENT BASIS (CONT'D) (ALL DATA) (CONT'D)

A/C TYPE	TOT*	PERC	RING %	GHOST %	FRUIT %	WIDE %	NARR %	NEVER %	(ST) LSTSH %	(MN) LSTSH %	(ST) LSTLN %	(MN) LSTLN %	BROKN %	MODE %	ALTIT %	IDENT %	OTHER %	FALSE %
C131	20	0.5	5.0	25.0	0.0	0.0	0.0	0.0	15.0	10.0	15.0	0.0	15.0	0.0	0.0	0.0	15.0	0.0
N265	19	0.5	26.3	0.0	0.0	0.0	0.0	0.0	10.5	31.6	5.3	5.3	21.1	0.0	0.0	0.0	0.0	0.0
DC10	19	0.5	21.1	10.5	0.0	0.0	0.0	0.0	15.8	5.3	5.3	10.5	31.6	0.0	0.0	0.0	0.0	0.0
C124	19	0.5	0.0	10.5	0.0	0.0	0.0	0.0	10.5	21.1	15.8	5.3	31.6	0.0	0.0	5.3	0.0	0.0
C310	19	0.5	0.0	5.3	0.0	0.0	0.0	5.3	26.3	5.3	31.6	15.8	5.3	0.0	0.0	5.3	0.0	0.0
PAZT	19	0.5	10.5	10.5	5.3	5.3	5.3	5.3	26.3	5.3	10.5	5.3	10.5	0.0	0.0	0.0	0.0	0.0
FA22	19	0.5	36.8	10.5	0.0	0.0	0.0	5.3	10.5	36.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CV88	18	0.4	27.8	11.1	0.0	0.0	0.0	0.0	16.7	0.0	5.6	0.0	38.9	0.0	0.0	0.0	0.0	0.0
F111	17	0.4	0.0	0.0	0.0	0.0	5.9	0.0	11.8	5.[illegible]	0.0	23.5	41.2	0.0	0.0	5.9	5.9	0.0
C421	17	0.4	5.9	0.0	0.0	0.0	0.0	0.0	11.8	11[illegible]	[illegible].6	0.0	41.2	0.0	0.0	0.0	11.8	0.0
PA31	16	0.4	18.8	6.3	0.0	0.0	0.0	12.5	18.8	[illegible]	[illegible].0	6.3	6.3	0.0	0.0	0.0	0.0	0.0
L188	16	0.4	0.0	31.3	0.0	6.3	0.0	0.0	12.5	31[illegible]	6.3	0.0	12.5	0.0	0.0	0.0	0.0	0.0
DC3	16	0.4	37.5	0.0	0.0	0.0	0.0	6.3	18.8	12.[illegible]	12.5	12.5	0.0	0.0	0.0	0.0	0.0	0.0
PA30	16	0.4	31.3	0.0	0.0	6.3	0.0	0.0	12.5	18.8	6.3	6.3	6.3	0.0	0.0	0.0	12.5	0.0
P3	15	0.4	0.0	0.0	0.0	0.0	0.0	0.0	13.3	6.7	20.0	6.7	53.3	0.0	0.0	0.0	0.0	0.0
C54	15	0.4	40.0	13.3	0.0	0.0	0.0	6.7	0.0	6.7	13.3	0.0	13.3	0.0	0.0	0.0	0.0	6.7
S2	15	0.4	0.0	6.7	0.0	0.0	0.0	20.0	13.3	0.0	33.3	13.3	6.7	0.0	0.0	0.0	6.7	0.0
OV10	15	0.4	0.0	20.0	6.7	0.0	6.7	6.7	20.0	0.0	13.3	13.3	13.3	0.0	0.0	0.0	0.0	0.0
G159	15	0.4	46.7	6.7	0.0	0.0	0.0	0.0	0.0	13.3	6.7	6.7	13.3	6.7	0.0	0.0	0.0	0.0
BE33	14	0.3	7.1	0.0	0.0	0.0	7.1	7.1	7.1	7.1	28.6	0.0	21.4	0.0	0.0	14.3	0.0	0.0
F100	14	0.3	50.0	14.3	0.0	7.1	0.0	0.0	0.0	0.0	0.0	0.0	28.6	0.0	0.0	0.0	0.0	0.0
DC87	13	0.3	23.1	23.1	0.0	7.7	0.0	0.0	15.4	15.4	7.7	0.0	7.7	0.0	0.0	0.0	0.0	0.0
AC21	13	0.3	30.8	0.0	0.0	0.0	0.0	0.0	23.1	30.8	0.0	0.0	7.7	0.0	0.0	7.7	0.0	0.0
F101	13	0.3	0.0	7.7	0.0	0.0	0.0	0.0	15.4	46.2	15.4	0.0	15.4	0.0	0.0	0.0	0.0	0.0
DH6	13	0.3	23.1	7.7	0.0	7.7	0.0	15.4	23.1	7.7	7.7	0.0	7.7	0.0	0.0	0.0	0.0	0.0
C117	12	0.3	8.3	33.3	8.3	16.7	0.0	0.0	25.0	0.0	8.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
F102	12	0.3	16.7	8.3	0.0	0.0	0.0	0.0	16.7	16.7	8.3	16.7	0.0	8.3	0.0	8.3	0.0	0.0
F104	12	0.3	16.7	0.0	0.0	0.0	0.0	8.3	33.3	0.0	8.3	0.0	33.3	0.0	0.0	0.0	0.0	0.0
MU2	12	0.3	41.7	0.0	0.0	8.3	0.0	0.0	16.7	8.3	8.3	0.0	16.7	0.0	0.0	0.0	0.0	0.0
C206	12	0.3	0.0	16.7	8.3	0.0	8.3	16.7	8.3	0.0	16.7	16.7	8.3	0.0	0.0	0.0	0.0	0.0
BE80	11	0.3	18.2	0.0	9.1	0.0	0.0	0.0	27.3	18.2	18.2	0.0	9.1	0.0	0.0	0.0	0.0	0.0
C320	11	0.3	18.2	0.0	0.0	0.0	0.0	0.0	18.2	9.1	18.2	0.0	27.3	0.0	0.0	9.1	0.0	0.0
KC13	11	0.3	0.0	9.1	0.0	0.0	0.0	0.0	27.3	27.3	0.0	9.1	27.3	0.0	0.0	0.0	0.0	0.0
TA4	10	0.2	0.0	20.0	0.0	0.0	0.0	0.0	20.0	20.0	10.0	20.0	10.0	0.0	0.0	0.0	0.0	0.0
F105	9	0.2	22.2	0.0	0.0	0.0	0.0	0.0	33.3	0.0	11.1	0.0	33.3	0.0	0.0	0.0	0.0	0.0
T331	9	0.2	0.0	33.3	0.0	0.0	11.1	0.0	0.0	0.0	22.2	0.0	22.2	0.0	0.0	11.1	0.0	0.0
C119	8	0.2	0.0	25.0	0.0	0.0	0.0	0.0	0.0	0.0	25.0	12.5	37.5	0.0	0.0	0.0	0.0	0.0

*NOTE - ARRAY ELEMENTS ARE PERCENT OF A/C TYPE TOTAL

TABLE 5-5. AIRCRAFT FAULT REPORT MATRIX WITH ENTRIES EXPRESSED ON A PERCENT BASIS (CONT'D) (ALL DATA) (CONT'D)

A/C TYPE	TOT *	PERC	RING %	GHOST %	FRUIT %	WIDE %	NARRW %	NEVER %	(ST) LSTSH %	(MN) LSTSH %	(ST) LSTLN %	(MN) LSTLN %	PROKN %	MODE %	ALTIT %	IDENT %	OTHER %	FALSE %
L329	8	0.2	25.0	0.0	0.0	0.0	12.5	0.0	12.5	12.5	12.5	0.0	25.0	0.0	0.0	0.0	0.0	0.0
F22	8	0.2	37.5	0.0	0.0	0.0	0.0	0.0	12.5	50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HS25	7	0.2	28.6	0.0	0.0	0.0	0.0	0.0	14.3	14.3	14.3	0.0	14.3	0.0	0.0	14.3	0.0	0.0
U8	7	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	42.9	0.0	14.3	0.0	0.0	42.9	0.0	0.0
PA24	6	0.1	16.7	0.0	0.0	0.0	0.0	0.0	33.3	0.0	0.0	0.0	50.0	0.0	0.0	0.0	0.0	0.0
DHC6	6	0.1	0.0	16.7	0.0	16.7	0.0	0.0	33.3	0.0	16.7	0.0	16.7	0.0	0.0	0.0	0.0	0.0
PA32	6	0.1	0.0	0.0	0.0	0.0	16.7	0.0	16.7	0.0	50.0	0.0	0.0	0.0	0.0	16.7	0.0	0.0
G2	6	0.1	16.7	0.0	0.0	0.0	0.0	0.0	0.0	33.3	0.0	16.7	33.3	0.0	0.0	0.0	0.0	0.0
C210	6	0.1	0.0	0.0	0.0	0.0	0.0	16.7	0.0	0.0	33.3	33.3	16.7	0.0	0.0	0.0	0.0	0.0
C150	6	0.1	0.0	0.0	0.0	16.7	0.0	0.0	16.7	50.0	0.0	0.0	16.7	0.0	0.0	0.0	0.0	0.0
LR25	6	0.1	33.3	0.0	0.0	0.0	0.0	0.0	0.0	16.7	0.0	33.3	16.7	0.0	0.0	0.0	0.0	0.0
DC7	6	0.1	33.3	33.3	0.0	16.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.7
H53	5	0.1	40.0	0.0	20.0	0.0	0.0	0.0	20.0	0.0	0.0	0.0	20.0	0.0	0.0	0.0	0.0	0.0
A8	5	0.1	0.0	0.0	0.0	0.0	20.0	0.0	20.0	20.0	0.0	0.0	40.0	0.0	0.0	0.0	0.0	0.0
A5	5	0.1	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.0	60.0	0.0	20.0	0.0	0.0	0.0	0.0	0.0
C121	5	0.1	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.0	60.0	0.0	20.0	0.0	0.0	0.0	0.0	0.0
L382	5	0.1	0.0	0.0	0.0	0.0	0.0	20.0	20.0	20.0	20.0	0.0	20.0	0.0	0.0	0.0	0.0	0.0
C182	5	0.1	0.0	0.0	0.0	0.0	0.0	0.0	40.0	40.0	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.0

*NOTE - ARRAY ELEMENTS ARE PERCENT OF A/C TYPE TOTAL

TABLE 5-6. DISTRIBUTION OF FAULT REPORTS INVOLVING AIR CARRIERS: ALL DATA

FAULT* / CARRIER**	AL101	AL102	AL103	AL104	AL105	AL106	AL108	AL109	AL110	AL111	AL112	AL113	AL114	AL115	AL116	AL118	AL121	AL122	AL123	AL125	AL126
Ring Around/Sidelobes	20	10	14	28	0	26	24	35	23	23	27	36	38	31	15	32	30	43	8	13	10
Ghosts/Reflections/False Targets	16	8	12	10	0	17	14	30	16	0	9	14	27	15	10	0	10	0	46	27	30
Fruit	0	0	0	0	0	0	0	0	1	4	0	0	0	0	0	0	2	0	9		
Target Too Wide	0	1	0	3	0	0	3	2	2	4	0	3	5	8	0	12	10	0	0	20	
Target Too Narrow	1	0	4	1	0	0	1	0	0	0	0	0	0	0	5	0	0	0	0		
Target Never Acquired	1	0	2	0	20	0	0	0	0	0	0	3	2	0	0	0	0	0	0		
Target Lost Short Time	21	18	19	20	20	20	18	23	17	23	27	38	11	8	20	8	30	29	15	27	10
Traget Lost Long Time	4	12	14	10	20	9	9	0	10	15	9	3	4	8	10	24	5	14	0		
Target Broken/Intermittent/Chopped	30	36	32	22	0	23	27	9	24	31	27	2	14	23	40	20	12	14	23	7	40
Mode 3/A Code Incorrect	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Altitude Readout Incorrect	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
IDENT Malfunction	2	4	0	2	40	0	0	0	3	0	0	0	0	0	0	0	0	0	0		
Other	2	2	2	1	0	6	1	0	1	0	0	0	0	8	0	0	2	0	0	7	10
False Emergency Replies	4	9	2	3	0	0	3	0	0	0	0	0	0	0	0	4	0	0	0		
Total Discrepancies	147	317	57	316	5	35	260	43	86	26	11	58	56	13	20	25	60	7	13	15	10

*Array elements are expressed on a percent basis.

**Cutoff at 5 deficiencies.

TABLE 5-7. DISTRIBUTION OF FAULT REPORTS CITING AIR CARRIERS BY AIRCRAFT TYPE: DERIVED FROM ALL DATA

CARRIER*	TOTAL	%	B-707	B-720	B-727	B-737	B-747	CV-58	CV-88	DC-8	DC-9	DC-10	FA-27	BA-11
AL101	143	3.48	44	1	63	0	17	0	18	0	0	0	0	0
AL102	311	7.58	0	31	159	3	4	0	0	99	0	15	0	0
AL103	57	1.39	3	25	2	27	0	0	0	0	0	0	0	0
AL104	312	7.60	171	2	112	0	27	0	0	0	0	0	0	0
AL105	4	0.09	0	0	0	0	0	0	0	0	4	0	0	0
AL106	34	0.83	0	0	0	0	0	9	0	0	25	0	0	0
AL108	258	6.29	3	13	151	0	4	0	0	0	87	0	0	0
AL109	43	1.04	2	0	0	0	15	0	0	21	5	0	0	0
AL110	86	2.09	0	0	59	0	2	0	0	7	18	0	0	0
AL111	26	0.63	0	0	4	0	0	22	0	0	0	0	0	0
AL112	2	0.04	0	0	0	0	0	0	0	2	0	0	0	0
AL113	29	0.70	0	0	0	0	0	0	0	0	0	0	2	27
AL114	53	1.29	0	0	26	0	2	0	0	25	0	0	0	0
AL115	11	0.26	0	0	9	0	0	0	0	2	0	0	0	0
AL116	20	0.48	2	0	13	0	5	0	0	0	0	0	0	0
AL118	25	0.60	17	1	3	0	4	0	0	0	0	0	0	0
AL121	58	1.41	4	0	2	0	0	0	0	0	33	0	19	0
AL122	7	0.17	0	0	0	0	0	0	0	0	7	0	0	0
AL123	13	0.31	0	0	0	0	0	0	0	0	13	0	0	0
AL125	15	0	0	0	11	4	0	0	0	0	0	0	0	0
AL126	10	0	0	0	0	10	0	0	0	0	0	0	0	0
TOTALS	1517	37.0	246	73	614	44	80	31	18	154	194	15	21	27

*Cutoff at five deficiencies.

is unnormalized, and does not take into account the number of flights by the various carriers or the type of aircraft employed. As a result it is not as significant as the normalized discrepancy rate computed previously, for the returns from the Salt Lake and Los Angeles Centers.

5.4 REVISED SURVEY-QUESTIONNAIRE FORMAT

At this point it is worthwhile to reflect upon the format employed for the survey questionnaire and consider ways in which it could be improved for future usage.

First, it appears that a majority of the complaints involved only five error categories; it would be desirable to locate these deficiencies in a prominent position on the form. On the other hand, several discrepancy codes were rarely checked off, and should be eliminated or merged with other problems.

It is useful to consider the reasons for conducting any future performance study and tailor the questionnaire to this need. In view of the present findings, it is reasonable to assume that any subsequent survey will wish to focus attention on the deficiency of lost targets, and investigate the circumstances under which this phenomena occurs. To facilitate this task the report format should be expanded to include such factors as aircraft altitude and weather conditions, since these parameters bear directly on the problem.

An example of a questionnaire which meets the above requirements is illustrated in Figure 5-7.

SUGGESTED REVISED SURVEY FORMAT

1) Facility Name ______________ 2) Traffic Count ______________

2) Radar System ______________ 4) Date/GMT ______________

3) Target Aximuth = /Range = nm/Elevation = ft.

6) A/C ID ______________ 7) A/C Type ______________

8) Weather Condition at radar site: ☐ clear; ☐ light rain; ☐ heavy rain;

Discrepancy Code: (check off)

☐ Ring around or sidelobes ☐ Target broken or intermittent

☐ Ghost or false targets ☐ False emergency alarms

Lost Targets

Target Lost Short Time	Target Lost Long Time
☐ straight and level	☐ straight and level
☐ maneuvering	☐ maneuvering
☐ Target too wide	☐ Target never acquired
☐ Target too narrow	☐ Squawking wrong code
☐ Fruit	☐ IDENT malfunction

Figure 5-7. Revised Survey-Questionnaire Format

6. SUMMARY

The ATCRBS performance survey described in this report is based on controller reported data secured in 1971 pertaining to operational problems experienced with the radar beacon system. This study represents an important diagnostic tool for assessing system deficiencies and focusing attention upon their elimination.

In 1968, the first nationwide survey was conducted and revealed that the most common forms of system degradation were false targets and ring around. As a result of these earlier findings a program of improvements was initiated which included sidelobe suppression, improved sidelobe suppression, and a reduction of interrogator power levels. A follow-up study was undertaken in 1971 to determine the impact on system performance of the above modifications. This test began on 27 November 1971 and lasted for two weeks. Participation was limited to 36 facilities which were considered representative of the entire system; controllers at these sites were asked to document instances of system degradation by noting on a questionnaire the nature of the malfunction.

In response to the survey a total of 2426 discrepancy reports were filed. Of these, 1772 were from FAA enroute and terminal facilities while the remainder (654) represent military installations.

The deficiency data were first analyzed on the basis of error category. The most common problem cited was the loss of a target for a short period of time, a complaint referred to in 24.0% of the returns. The discrepancy of broken target slash was listed next (21.3%); followed by ring around (18.3%); target lost long time (15.4%); false targets (9.0%); target too wide (2.3%); target never acquired (1.8%); false emergency reply (1.6%); IDENT malfunction (1.6%); target too narrow (1.3%); fruit (0.9%); and mode 3/A code incorrect (0.2%).

Combining the error categories involving lost targets reveals that 20.6% of all fault reports describe the loss of coverage for aircraft traveling straight and level, while 18.5% refer to a similar problem with maneuvering aircraft. The first effect is caused by nulls in the elevation pattern of the ground antenna and the second phenomena is induced by fuselage shielding of the transponder antenna during maneuvers. In this respect, the survey results provide a quantitative measure of the relative degradation arising from these sources. The main conclusion which emerges from the above findings is the need to improve the interrogator pattern, and consider the use of some form of diversity antenna for transponder power radiation.

After determining the nature of the beacon system discrepancies, the returns were sorted for the type of aircraft involved in these incidences. A B-727 was listed in 14.4% of the reports. This was followed by the T38 (7.0%); B-707 (6.6%); DC-9 (5.1%); A4 (5.0%); DC-8 (3.9%); F4 (2.5%); B-747 (2.1%); and B-720 (2.0%).

The data were further reduced by dividing the reports associated with each aircraft on the basis of error type. This information is presented in the form of a discrepancy report matrix which summarizes the performance of each aircraft. Use of this matrix allows the fault reports to be readily interpreted in terms of problems arising from the site, the interrogation environment or improper transponder operation. For instance, a high percentage of complaints involving reflections suggest a deficiency in the site location, while problems of ring around indicate incorrect functioning of the sidelobe suppression circuitry.

Attention was focused on the air carriers and the discrepancies associated with this group. In order to normalize the deficiency reports, a knowledge of the air traffic population is required. As part of this effort, air population statistics were derived for two enroute centers; in the case of the Salt Lake ARTCC, this information was extracted from flight progress strips, and for Los Angeles from departure information. The normalized performance data obtained in this manner showed a significant variation among the air carriers, and among the various aircraft. Surprisingly, similar aircraft operated by different carriers showed a large performance span. It was not the intent of this survey to conduct a competitive evaluation of either ground or airborne equipment. To prevent competitive use of the results it has been deemed appropriate to report air carrier data by code.

In addition to assessing the overall system problems, the controller reports were examined on a site-by-site basis. The returns from each facility, which supplied more than a certain minimum number of replies, were sorted on the basis of error category and aircraft type. To complement this effort, an in depth study was carried out that focused on the five installations with the largest data base. This analysis revealed a wide variation in operational problems among ATC facilities. For instance, the Salt Lake Center cited broken targets as the most prevalent deficiency, and also documented numerous instances of false emergency alarms. In contrast, the Los Angeles Center described ring around as the number one problem, with practically no cases of false alarms. On the east coast the situation was quite different, with lost targets the dominant discrepancy reported by the New York Center, and false targets a prominent factor. The implication of these results is discussed further in the text.

In the course of processing the survey returns it became apparent that this form of data acquisition suffers several shortcomings, and suggestions for improvement of future studies are offered herewith. First, controllers experiencing the most severe problems are least likely to fill out the fault reports, thus introducing an optimistic bias into the results. In addition, the response is subjective so that two controllers observing the same phenomena might report it differently. A suggested method of eliminating these factors would be to employ an independent group of observers to monitor scopes and tabulate deficiencies.

Looking further into the future, it would be desirable if the performance test were completely automated; this would eliminate the bottleneck imposed by the current data acquisition and reduction process, and make the results more immediately available for corrective action. One way of realizing such a real-time monitoring function would be by adapting the software available in the ATC processor. For example, the ARTS system incorporates data extractor programs which could perform this function. A second recommendation thus is that the ATC system modifications required to perform automatic performance monitoring be defined, and that all future systems incorporate such a feature.

Finally, as their participation in the survey imposed an extra burden on the controllers, they should be made aware of the end results of their efforts. The findings of this study and any actions arising out of it should be brought to their attention.

7. CONCLUSIONS AND RECOMMENDATIONS

The ATCRBS performance survey provides an important diagnostic tool for assessing the operational problems of the beacon system. As such it pinpoints weak areas, thereby indicating the direction in which efforts should be undertaken to improve performance.

A similar survey was conducted in 1968 and revealed that the most common forms of degradation were false targets and ring around. Since that time the system has been upgraded through the extensive introduction of sidelobe suppression, and improved sidelobe suppression. The impact of this program is apparent and demonstrated in the present report. There has been a sharp decline in reports of false targets and this deficiency is now listed fifth. Simultaneously, the problem of ring around has decreased in severity and is now cited third.

As improvements in the system reduced the occurence of the above forms of degradation, other error categories assumed new importance. The present survey indicates the most frequent beacon problem is target lost for short time (24.0%); broken targets are cited next (21.3%), followed by ring around (18.5%), target lost a long time (15.4%), and false targets (9.0%).

Since lost targets represent the most serious problem, the circumstances under which this deficiency occurred were examined. This analysis revealed that 20.6% of the fault reports describe the loss of coverage for targets which are traveling straight and level, while 18.5% involve an aircraft that is maneuvering. The first problem can be traced to the poor elevation pattern of the interrogator antenna, with its attendant nulls and cone of silence; the second form of degradation is attributed to the shielding of the transponder antenna which often accompanies aircraft maneuvers.

The returns indicate that the discrepancy of broken, intermittent, or chopped target-slash has assumed significant importance. This phenomena arises from two main sources; overinterrogation and the switching between top/bottom antennas on military aircraft.

In view of the ATCRBS deficiencies documented by the survey, the following course of action is recommended:

1. The interrogator antenna should be upgraded to improve the elevation pattern.

2. The adoption of a diversity transponder antenna should be considered to eliminate coverage loss during maneuvers. In line with this idea, a cost/benefit study should be carried out to determine the impact of such a program.

3. The FAA should continue its policy of monitoring the beacon environment, with a view to limiting the number of ground interrogators and reducing transmitter power to the minimum level required for adequate coverage.

As part of the study, aircraft population statistics were employed to normalize the discrepancy data. In this manner, the discrepancy-rate-per-flight was computed, so that the beacon performance of various air carriers and aircraft could be compared. This computation revealed a significant variation in discrepancy rate among the air carriers, and between different aircraft. Even among similar aircraft operated by different carriers, the performance spanned a large range. In order to reduce this deviation, it is suggested that transponder maintenance procedures by tightened.

At this point, some comments are in order concerning the manner in which the survey was conducted. This form of data acquisition appears to suffer from the following major deficiencies:

1. Controllers experiencing the most severe beacon problems are those least able to fill out fault reports---this introduces an optimistic bias into the data.

2. The response is subjective, so that two controllers observing the same phenomena might report it differently.

To eliminate these factors it is suggested that as part of any future survey an independent group of observers be employed to monitor the radar scopes and tabulate discrepancies. One way this might be accomplished would be to concentrate on major ATC sites experiencing problems considered representative of the entire system. At these facilities, system performance should be observed for a minimum period of one week, since this covers the basic traffic cycle. If greater confidence in the data were desired the test duration time could be extended accordingly.

A revised fault report questionnaire has been prepared for use in any future survey. The updated format is geared to the discrepancies revealed by the current survey; therefore, some error categories have been deleted and others merged. In addition, such parameters as aircraft altitude and weather conditions have been added since they bear directly on the problem of antenna nulls.

In processing the survey replies it became apparent that the bulk of the time was consumed transferring the data from questionnaires to IBM cards. To eliminate this bottleneck it is recommended that any future performance study be automated. This could be accomplished through the use of special forms and magnetic pencils, or by direct entry of the data via small desk consoles for the observers. This latter technique would readily allow for the simultaneous acquisition of traffic data necessary to normalize the deficiency reports. Looking further ahead, the ideal solution would be to adapt the software logic already available in the ATC processor for automatic performance monitoring. As an example, the ARTS system incorporates data extractor programs which could be employed for this purpose. It is recommended that the software modifications required to perform performance monitoring be defined, and that all future ATC systems incorporate some form of this feature.

Finally, the controllers who participated in the survey should be made aware of the end result of their efforts. The findings of this study, and any actions arising out of it should be brought to the attention of this group.

GLOSSARY OF TERMS

Air Carrier - An aircraft certified by the FAA for the purpose of carrying persons or goods for hire on an established airway. The term also applies to an organization operating an air carrier.

Airframe - The main body of an air vehicle which is in contact with the air. Thus it does not include the propulsion system, or control and guidance equipment.

ATC Processor - General purpose processor performing the target detection, code validation, and center marking functions for the terminal area beacon systems.

Beacon System - A system of electronic equipment that automatically transmits a reply message whenever an interrogation signal is received.

Controller - Individual providing instructions maintaining separation of aircraft and other instructions to aircraft participating and receiving traffic separation service from the ATC system.

Decoder - The device in the beacon system video circuit between the receiver and the radar display used to decipher signals received from replying transponders. Codes are selected for deciphering by means of a control panel at the controller's position.

Defruiter - Device that deletes random asynchronous replies from the video input by comparing video signals on successive sweeps.

False Emergency Replies - A non-emergency reply code from the transponder that has been modified prior to entering the ground decoder by the presence of an extraneous pulse or pulses caused by fruit, reflection or overlapping reply codes.

False Targets - Erroneous target returns appearing on the Controller's display at incorrect azimuth and/or range due to reflections, fruit or overlapping reply codes.

Fruit - Random asynchronous replies elicited by interrogations from other ground stations.

Interrogator - A radar set or other electronic device that transmits an interrogation.

Mode 3/A code - Specific beacon code used to identify civil and military flights.

Reflections - False signals caused by interrogations or replies that are reflected from ground objects such as hangars, buildings, towers, or hills.

Ring Around - The triggering of a transponder at all bearings by antenna side-lobes causing a ring presentation on a PPI display.

Sector - An FAA sector is a geographic area limited to altitude, assigned to a controller to exercise control and advisory responsibilities. An Air Defense Center Sector is a geographical area under surveillance of a unit of the Air Defense Command. An Air Defense Sector is much larger than an FAA sector. An ARTCC geographic area is of approximately the same size as an ADC Sector.

Transponder - An airborne radar beacon receiver-transmitter which automatically receives radio signals from all interrogators on the ground and which selectively replies with a specific reply pulse or pulse group only to those interrogations being received on the mode to which it is set to respond.

For a more extensive glossary of air traffic terminology see "NAS glossary Acronyms", by A. T. Pezza, MITRE Report WP-8124, Sept. 71.

AIR CARRIER CODES

AA	American Airlines, Inc.
AL	Allegheny Airlines, Inc.
AS	Alaska Airlines, Inc.
BN	Braniff Airways, Inc.
CB	Caribbean-Atlantic Airlines, Inc.
CH	Chicago Helicopter Airways Inc.
CO	Continental Air Lines, Inc.
DL	Delta Air Lines, Inc.
EA	Eastern Air Lines, Inc.
FL	Frontier Airlines, Inc.
FT	Flying Tiger Line Inc., The
HA	Hawaiian Airlines, Inc.
KO	Kodiak Airways, Inc.
LX	Los Angeles Airways, Inc.
MO	Mohawk Airlines, Inc.
NA	National Airlines, Inc.
NE	Northeast Airlines, Inc.
NO	North Central Airlines, Inc.
NW	Northwest Airlines, Inc.
NY	New York Airways, Inc.
OH	San Francisco & Oakland Helicopter Airlines, Inc.
OZ	Ozark Air Lines, Inc.
PA	Pan American World Airways, Inc.
PC	Air West
PI	Piedmont Aviation, Inc.
PX	Aspen Airways, Inc.
RD	Airlift International, Inc.
RV	Reeve Aleutian Airways, Inc.
RW	Hughes Air West
SB	Seaboard World Airlines, Inc.
SO	Southern Airways, Inc.
TC	Trans Caribbean Airways, Inc.
TO	Tag Airlines, Inc.
TS	Aloha Airlines, Inc.
TT	Texas International Airlines, Inc.
TW	Trans World Airlines, Inc.
UA	United Air Lines, Inc.
WA	Western Air Lines, Inc.
WE	Wien Consolidated Airlines, Inc.
WK	Western Alaska Airlines, Inc.

CIVIL/MILITARY AIRCRAFT TYPE DESIGNATORS*

Decode

Designator	Name	Manufacturer
A1	Skyraider	McD/Douglas
A3	Skywarrior	McD/Douglas
A4	Skyhawk	McD/Douglas
A5	Vigilante	No. American
A6	Intruder	Grumman
A7	Corsair II	Ling-Temco-Vought
A7D	Model A7D	Ling-Temco-Vought
A37	Dragonfly	Cessna
AA1	Yankee	American Aviation
AA2	Patriot	American Aviation
AC6T	Turbo Commander	Aero Commander
AC10	Darter (100/150)	Aero Commander
AC20	Commander (200)	Aero Commander
AC21	Jet Commander	Aero Commander
AC50	Commander (500)	Aero Commander
AC52	Commander (520)	Aero Commander
AC56	Commander (560)	Aero Commander
AC68	Grand Commander	Aero Commander
AC72	Alt-Cruiser	Aero Commander
AH1	Huey Cobra	Bell
AN12	AN12	Antonov
AP1P	Pregnant Guppy	Aero Spacelines
AP2S	Super Guppy	Aero Spacelines
AP3M	Mini Guppy	Aero Spacelines
AP4M	Mini Guppy Turbo	Aero Spacelines
AR11	Chief/Super Chief	Aeronca
AR15	Sedan	Aeronca
AR58	Aeronca Champion	Aeronca
AV52	Ansom/Federal	Avro
B25	Mitchell	No. American
B26	Invader	McD/Douglas
B45C	Tornado	No. American
B47	Stratojet	Boeing
B50	Super Fortress	Boeing
B52	Stratofortress	Boeing
B57	Canberra	Martin
B58	Hustler	Convair
B66	Destroyer	McD/Douglas
B75	Stearman	Boeing
B377	Stratocruiser	Boeing
B707	Intercontinental 707/100/200/300/400	Boeing

*Contractions," Report 7340.C, Department of Transportation, Air Traffic Service, February 1972

Designator	Name	Manufacturer
B720	Stratoliner 720	Boeing
B72B	Model 720B	Boeing
B727	Model 727	Boeing
B737	Model 737	Boeing
B747	Super Jet 747	Boeing
BA10	BAC VC10	British Acft.
BA11	BAC 111	British Acft.
BA15	BAC Super	British Acft.
BE8S	Super H18	Beech
BE17	Staggerwing	Beech
BE18	Twin Beech 18	Beech
BE23	Musketeer	Beech
BE33	Bonanza	Beech
BE35	Bonanza 35(V-Tail)	Beech
BE36	Bonanza 36	Beech
BE45	Mentor	Beech
BE50	Twin Bonanza	Beech
BE55	Baron	Beech
BE60	Duke 60	Beech
BE65	Queen Air 65/A65/70	Beech
BE80	Queen Air 80	Beech
BE88	Super Queen Air 88	Beech
BE90	King Air 90/100	Beech
BE95	Travel Air	Beech
BE99	Airliner	Beech
BL14	Cruisair Sr./ Cruisemaster	Bellanca
BL26	Viking	Bellanca
BN2	Britton-Norman Islander	British
BR10	Britannia 100	Bristol
BR31	Britannia 310	Bristol
BR75	Britannia 175	Bristol
BT6S	Model 206S	Beagle
BT10	Airdale	Beagle
BU20	Bushmaster	Aircraft Hydro-Forming
C1	Trader	Grumman
C2	Greyhound	Grumman
C3	Model 404	Martin
C5A	Galaxy (C5A)	Lockheed
C9	DC-9	McD/Douglas
C14	Cessna 140	Cessna
C15	Twin Beech 18	Beech
C46	Commando CW20	Curtis-Wright
C47	Skytrain	McD/Douglas
C54	Skymaster	McD/Douglas
C56	Lodestar	Lockheed
C97	Stratocruiser	Boeing
C117	Super DC3	McD/Douglas
C118	Liftmaster	McD/Douglas
C119	Flying Box Car	Fairchild-Hiller
C120	Cessna 120	Cessna

Designator	Name	Manufacturer
C121	Warning Star	Lockheed
C123	Provider C123	Fairchild-Hiller
C124	Globemaster	McD/Douglas
C130	Hercules	Lockheed
C131	Liner/Samaritan	Convair
C133	Cargomaster	McD/Douglas
C135	Stratolifter	Boeing
C137	VC37	Boeing
C140	Jetstar	Lockheed
C141	Starlifter	Lockheed
C142	LTV Hiller-Ryan	Ling-Temco-Vought
C150	Cessna 150	Cessna
C170	Cessna 170	Cessna
C172	Skyhawk	Cessna
C175	Skylark	Cessna
C177	Cardinal	Cessna
C180	Cessna 180	Cessna
C187	Skylane/Super Skylane	Cessna
C185	Skywagon	Cessna
C188	Agwagon	Cessna
C190	Cessna 190	Cessna
C195	Cessna 195	Cessna
C205	Cessna 205	Cessna
C206	Cessna 206	Cessna
C207	Super Skywagon	Cessna
C210	Centurion	Cessna
C305	Bird Dog 305	Cessna
C310	Cessna 310	Cessna
C321	Skynight 320/321	Cessna
C336	Skymaster	Cessna
C337	Super Skymaster	Cessna
C401	Cessna 401	Cessna
C402	Cessna 402	Cessna
C411	Cessna 411	Cessna
C421	Cessna 421	Cessna
CA1	Cadet/Super Cadet	Callair
CC06	Yukon	Canadair
CC08	Caribou	DeHavilland
CC09	Cosmopolitan (Convair 540)	Canadair
CF04	Starfighter Lockheed	Canadair
CH7	Traveler/Tri-Traveler	Champion
CH8	Challenger	Champion
CH9	Citabria 7ECA	Champion
CH10	Citabria	Champion
CH40	Lancer 402	Champion
CJ60	C-Air Carstedt	DeHavilland
CL28	Argus	Canadair
CL44	Yukon	Canadair
CL66	Cosmopolitan	Canadair
CM48	Model 480	Camair
CP07	Argus	Canadair

Designator	Name	Manufacturer
CV13	Valiant 34	Convair
CV14	Canso/Catalina	Convair
CV24	Convair 240	Convair
CV34	Liner/Samaritan	Convair
CV44	Convair 440	Convair
CV54	Cosmopolitan	Convair
CV58	Convair 580	Convair
CV60	Convair 600	Convair
CV64	Convair 640	Convair
CV88	Convair 880	Convair
CV99	Coronado 990	Convair
CW46	Commando CW20	Curtiss-Wright
DART	Dart Herald	Hadley Page
DC3	Skytrain	McD/Douglas
DC3S	Super-DC3	McD/Douglas
DC4	Skymaster	McD/Douglas
DC6	Liftmaster	McD/Douglas
DC6B	DC-6B	McD/Douglas
DC7	DC-7/7B	McD/Douglas
DC7C	Seven Seas/ Speedfreighter	McD/Douglas
DC8	DC-8/10/20/30/40/ 50/62/63	McD/Douglas
DC9	DC-9	McD/Douglas
DC10	DC-10	McD/Douglas
DC86	Super DC-8/61	McD/Douglas
DH2T	Turbo Beaver	DeHavilland
DH1	Chipmunk	DeHavilland
DH2	Beaver	DeHavilland
DH3	Otter	DeHavilland
DH4	Caribou	DeHavilland
DH5	Buffalo	DeHavilland
DH6	Twin Otter	DeHavilland
DH6T	Turbo-Twin Otter	DeHavilland
DH10	Dove (Devon)	DeHavilland
DH11	Heron	DeHavilland
DH60	Gypsy Moth	DeHavilland
DH62	Comet 2	DeHavilland
DH64	Comet 4	DeHavilland
DH80	Puss Moth	DeHavilland
DH82	Tiger Moth	DeHavilland
DH83	Fox Moth	DeHavilland
DH87	Hornet Moth	DeHavilland
DH89	Dragon Rapide	DeHavilland
DH98	Mosquito	DeHavilland
DO27	Dornier	Dornier-Werke
DO28	Dornier	Dornier-Werke
E135	Boeing EC135	Boeing

Designator	Name	Manufacturer
F1	Fury	No. American
F3	Demon	McD/Douglas
F4	Phantom II	McD/Douglas
F5	NATO/Freedom Fighter	Northrop
F6	Skyray	Northrop
F8	Crusader	Ling-Temco-Vought
F9	Cougar G93	Grumman
F10	Skynight	McD/Douglas
F11	Tiger	Grumman
F12	Model A-11	Lockheed
F02	Aircoupe A2	Alan
F04	Aircoupe A4	Alan
F80	Shooting Star	Lockheed
F84	Thunderflash/ Thunderjet/ Thunderstreak	Republic
F86	Sabre	No. American
F89	Scorpion	Northrop
F100	Super Sabre	Northrop
F101	Voodoo	McD/Douglas
F102	Delta Dagger	Convair
F104	Starfighter	Lockheed
F105	Thunderchief	Republic
F106	Delta Dart	Convair
F111	Model F111	Gen. Dynamics
FA22	Model F227	Fairchild/ Hiller
FA24	Flying [illegible] Car	Fairchild/ Hiller
FA25	Heliporte[illegible] [illegible]TOL	Fairchild/ Hiller
FA27	Friendship F27	Fairchild/ Hiller
FA62	Cornell	Fairchild/ Hiller
FFJ	Falcon Mystere/ Fan Jet	Dassault
G2	Gulfstream II	Grumman
G21	Goose/Super Goose	Grumman
G44	Widgeon/Super Widgeon	Grumman
G64	Albatross	Grumman
G73	Mallard	Grumman
G73T	Turbo Mallard	Grumman
G89	Tracker	Grumman
G134	Mohawk	Grumman
G159	Gulfstream I	Grumman
G164	Ag-Cat	Grumman

Designator	Name	Manufacturer
H1	Iroquois 204/205	Bell
H2	Seasprite	Kaman
H3	Sea King S61A,D,L,N,R	Sikorsky
H4	Model 206	Bell
H5	Model 1100	Hiller
H6	Cayuse	Hughes
H13	Sioux/Troope(47G/47J)	Bell
H19	Chikasaw S55	Sikorsky
H21	Shawnee/Workhouse 42/43/44	Boeing/Vertol
H23	Raven	Hiller
H25	Retriever	Boeing/Vertol
H34	Choctaw S58/Seahorse/ Seaboat	Sikorsky
H37	Mojave 556	Sikorsky
H41	Seneca CHIC/Skyhook	Cessna
H43	Huskie 600-315	Kaman
H46	Sea Knight 107	Boeing/Vertol
H47	Chinook 114	Boeing/Vetrol
H52	Model S62	Sikorsky
H53	Seastallion	Sikorsky
H54	Skycrane S64	Sikorsky
H55	OSAG	Hughes
H56	Cheyenne	Lockheed
H57	Jet Ranger	Bell
H58	Kiowa	Bell
HB04	Iroquois 204/205/	Bell
HB09	Huey Cobra	Bell
HB13	Sioux/Trooper	Bell
HB42	Model B-2A/B-2B	Brantly
HB43	Model 305	Brantly
HB47	Jet Ranger 206A	Bell
HB58	Kiowa	Bell
HB61	Model 61	Bell
HC1	Skyhook/Sea Knight	Cessna
HD52	D-10B	Doman
HE1	Courier	Helio
HE2	Strato-Courier	Heilo
HE3	Super Courier	Heilo
HE4	Model 500	Heilo
HH3	L3/SL3	Hiller
HH4	L4/SL4	Hiller
HH12	Model 1100	Hiller
HH99	Model 1099	Hiller
HK60	Huskie 600/3/5	Kaman
HP13	Jetstream	Hadley Page
HR30	Alouette II	Sud-Aviation
HR60	Alouette III	Sud-Aviation
HS21	Trident 1	Hawker-Siddeley
HS25	Model HS125	Hawker Siddeley
HU16	Cayuse	Hughes
HU30	Model 269/300	Hughes
HU50	Pawnee 369/500D, U,M	Hughes
HV07	Chinook 114	Boeing/Vertol
HV18	PV18/HUP	Boeing/Vertol

Designator	Name	Manufacturer
HV44	Shawnee/& Workhorse 42/43/44	Boeing/Vetroi
HW5	Model 500 (WARO)	Howard
IL18	Moskva IL18	Ilyushin
IL62	IL62	Ilyushin
KC97	Stratofreighter	Boeing
KC35	Stratotanker KC135	Boeing
L18	Lodestar	Lockheed
L49	Super Constellation	Lockheed
L100	Hercules	Lockheed
L101	Tri-Star	Lockheed
L164	Starliner	Lockheed
L188	Electra/Orion	Lockheed
L329	Jetstar	Lockheed
L500	Galaxy	Lockheed
L649	Constellation (649)	Lockheed
L749	Constellation (749)	Lockheed
LA4	C2 Skimmer IV	Lake
LANC	Lancaster	Avro
LARK	Lark	Aero Commander
LR18	Learstar L-18	Learjet
LR25	Learjet L-24/25/26	Learjet
M202	Model 202	Martin
M237	Marlin 237	Martin
M272	Canberra	Martin
M404	Model 404	Martin
MART	Martinet	Nord
ME29	Monsun	Messerschmitt
MO2	Mooney/MU2	Mooney
MO10	Mark 10	Mooney
MO20	Mark 20	Mooney
MO21	Mark 21	Mooney
MO22	Mark 22	Mooney
ML4	Bee Dee M4	Maule
M576	Model 760	Moraine Soliner
MU2	MU2	Mitsubishi
N145	Navion	No. American
N265	Model 265 (Sabreliner)	No. American
N300	Branco (NA-300)	No. American
NA1	Rangemaster	Navion
ND16	Transall	Nord
ND26	Super Broussard	Nord
NSTR	North Star	Canadair
NY4	Norseman (MK IV)	Noorduyn
NY5	Norseman (MK V)	Noorduyn

Designator	Name	Manufacturer
O1	Bird Dog 305	Cessna
O2	Super Skymaster	Cessna
OV1	Mohawk	Grumman
OV10	STOL	No. American
P2	Neptune	Lockheed
P3	Electra/Orion	Lockheed
P4	Privateer	Convair
P5	Marlin 237	Martin
P136	Royal Gull	Piaggio
P166	Super Gull	Piaggio
P808	Vespa Jet	Piaggio
PA2	Cub Trainer	Piper
PA3	Cub Trainer	Piper
PA5	Cruiser	Piper
PA11	Cub Special	Piper
PA12	Super Cruiser	Piper
PA14	Family Cruiser	Piper
PA15	Vagabond Trainer	Piper
PA16	Clipper	Piper
PA17	Vagabond	Piper
PA18	Super Cub	Piper
PA20	Pacer	Piper
PA22	Tri Pacer	Piper
PA23	Apache	Piper
PA24	Commanche	Piper
PA25	Pawnee	Piper
PA28	Cherokee	Piper
PA30	Twin Commanche	Piper
PA31	Navajo	Piper
PA32	Cherokee Six	Piper
PARO	Cherokee Arrow (R)	Piper
PAZT	Aztec	Piper
PBY5	Canso/Catalina	Convair
P116	Pathfinder	Piasecki
PL-6	Pilatus Porter	Pilatus
PL6A	Turbo Porter	Pilatus
RC3	Seebee	Republic
RY40	Turbo-Executive/400	
RY65	Model 65/Rocket	Riley
S2	Tracker (Grumman 89)	Grumman
S210	Caravella	Sud Aviation
SC5	Belfast	Short
SCP	Pioneer	Scottish
SCTP	Twin Pioneer	Scottish
SH5	Belfast	Short
SH7	Skyvan	Short
SHC3	Shackleton	Avro
SK51	Model S51	Sikorsky
SK52	Model S52	Sikorsky

Designator	Name	Manufacturer
SK55	Chikasaw	Sikorsky
SK56	Mojave S56	Sikorsky
SK58	Chotcaw S58/Seahorse/ Seaboat	Sikorsky
SK59	Model S59	Sikorsky
SK61	Sea King S61A,D,L,N,R	Sikorsky
SK62	Model 562	Sikorsky
SK64	Skycrane S64	Sikorsky
SL8	Observer/Luscombe8/Silvaire	Silvaire
SP7	7W	Spartan
SR71	Reconnaissance	Lockheed
ST75	Voyager/Station Wagon	Stinson
S177	Reliant (Vultee)	Stinson
SW2	Merlin II	Swearingen
SW3	Merlin III	Swearingen
SW4	Merlin IV	Swearingen
T1	Sea Star	Lockheed
T2	Buckeye T20	No. American
T28	Trojan	No. American
T29	Flying Classroom 240	Convair
T33	Shooting Star	Lockheed
T34	Mentor	Beach
T37	YAT-37/318	Cessna
T38	Talon	Northrop
T39	Sabreliner(Series 265)	No. American
T41	Skyhawk 172	Cessna
T42	Baron	Beech
TC15	Tourist 15A	Taylorcraft
TC19	Sportsman 19	Taylorcraft
TC20	Topper 20A	Taylorcraft
TING	Hastings	Hadley Page
TS60	Aero Star	Ted Smith
U1	Otter	DeHavilland
U2	U2	Lockheed
U3	Model 310	Cessna
U4	Commander (560)	Aero Commander
U6	Beaver	DeHavilland
U7	Super Cub	Piper
U8	Queen Air 65/A65/70	Beech
U9	Grand Commander	Aero Commander
U10	Super Courier	Helio
U11	Aztec	Piper
U17	Skywagon 185	Cessna
U18	Rangemaster	Navian
U20	Cessna 195	Cessna
U21	King Air	Beech

Designator	Name	Manufacturer
V10	Bronco NA300	No. American
VC4	Gulfstream I	Grumman
VC7	Viscount	British Acft.
VC9	Vanguard	British Acft
VC11	Gulfstream II	Grumman
VCTR	Victor	Hadley Page
VLCN	Vulcan	Avro

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APPENDIX A

BEACON-SYSTEM PERFORMANCE AT CENTERS AND CIVIL TOWERS

The performance of the beacon system at civilian facilities is examined in this section. The analysis will focus on installations which reported a minimum of twenty deficiencies and will exclude those centers which were examined in depth previously. For each site considered, the distribution of discrepancy reports by error category will be presented, as well as a tabulation of the deficiency information in terms of the aircraft involved.

TABLE A-1 DISTRIBUTION OF FAULT REPORTS BY ERROR CATEGORY

Facility: Albuquerque ARTCC

Error Category	No. of Occurrences	Percent
Ring Around/Sidelobes	46	46.93
Target Lost Short Time	18	18.36
Target Broken/Intermittent/Chopped	10	10.20
Target Too Wide	6	6.12
Ghosts/Reflections/False Targets	5	5.10
Target Lost Long Time	5	5.10
IDENT Malfunction	4	4.08
Other	3	3.06
Target Never Acquired	1	1.02
Fruit	0	0.00
Target Too Narrow	0	0.00
Mode 3/A Code Incorrect	0	0.00
Altitude Readout Incorrect	0	0.00
False Emergency Replies	0	0.00

TABLE A-2 DISTRIBUTION OF DISCREPANCY REPORTS BY AIRCRAFT INVOLVED

Facility: Albuquerque ARTCC

A/C TYPE	TOTAL	%	RING*	GHOST	FRUIT	WIDE	NARRW	NEVER	LSTSH (ST)	LSTSH (MN)	LSTLN (ST)	LSTLN (MN)	BROKN	MODE	ALTIT	IDENT	OTHER	FALSE
B727	13	13.3	8	0	0	2	0	0	1	0	1	0	0	0	0	0	1	0
B707	12	12.2	11	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
F4	10	10.2	0	1	0	0	0	0	4	1	2	0	0	0	0	1	1	0
A4	8	8.2	0	0	0	0	0	1	0	0	1	0	6	0	0	0	0	0
DC8	6	6.1	5	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
T39	4	4.1	0	1	0	0	0	0	2	0	0	0	1	0	0	0	0	0
F8	4	4.1	0	0	0	0	0	0	2	1	0	0	1	0	0	0	0	0
C135	3	3.1	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0
Unknown	3	3.1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B57	3	3.1	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0
C141	3	3.1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B747	3	3.1	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C54	3	3.1	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B52	2	2.0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0
LR24	2	2.0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
DC9	2	2.0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0
T38	2	2.0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
F105	2	2.0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0
3720	2	2.0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CV88	2	2.0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CV58	1	1.0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
DC87	1	1.0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
AC21	1	1.0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
C411	1	1.0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
A7	1	1.0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
N265	1	1.0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F104	1	1.0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
FFJ	1	1.0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BE90	1	1.0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTALS	98		34	17	0	6	0	1	16	2	5	0	10	0	0	4	3	0

*For key to error code abbreviations see Table 3.4

*For key to error code abbreviations see Table 3-4.

TABLE A-3 DISTRIBUTION OF FAULT REPORTS BY ERROR CATEGORY

Facility: Albuquerque Tower

Error Category	No. of Occurrences	Percent
Ghosts/Reflections/False Targets	32	84.21
Target Lost Short Time	4	10.52
Fruit	1	2.63
Target Lost Long Time	1	2.63
Ring Around/Sidelobes	0	0.00
Target Too Wide	0	0.00
Target Too Narrow	0	0.00
Target Never Acquired	0	0.00
Target Broken/ Intermittent/Chopped	0	0.00
Mode 3/A Code Incorrect	0	0.00
Altitude Readout Incorrect	0	0.00
IDENT Malfunction	0	0.00
Other	0	0.00
False Emergency Replies	0	0.00

TABLE A-4. DISTRIBUTION OF DISCREPANCY REPORTS BY AIRCRAFT INVOLVED

Facility: Albuquerque Tower

A/C TYPE	TOTAL	PERCENT	RING*	GHOST	FRUIT	WIDE	NARRW	NEVER	LSTSH (ST)	LSTSH (MN)	LSTLN (ST)	LSTLN (MN)	BROKN	MODE	ALTIT	IDENT	OTHER	FALSE
DC9	16	42.1	0	13	1	0	0	0	0	1	1	0	0	0	0	0	0	0
B727	9	23.7	0	7	0	0	0	0	0	0	2	0	0	0	0	0	0	0
L188	3	7.9	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B52	2	5.3	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C141	2	5.3	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FFJ	1	2.6	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B720	1	2.6	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C54	1	2.6	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unknown	1	2.6	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C131	1	2.6	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PA31	1	2.6	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
TOTALS	38		0	32	1	0	0	0	0	1	3	1	0	0	0	0	0	0

*For key to error code abbreviations see Table 3-4.

TABLE A-5 DISTRIBUTION OF FAULT REPORTS BY ERROR CATEGORY

Facility: Bradley Tower

Error Category	No. of Occurrences	Percent
Target Lost Short Time	40	35.39
Ghosts/Reflections/False Targets	34	30.08
Ring Around/Sidelobes	16	14.15
Target Lost Long Time	8	7.07
Target Broken/ Intermittent/Chopped	7	6.19
Target Too Narrow	3	2.65
IDENT Malfunction	3	2.65
Target Too Wide	1	0.88
Target Never Acquired	1	0.88
Fruit	0	0.00
Mode 3/A Code Incorrect	0	0.00
Altitude Readout Incorrect	0	0.00
Other	0	0.00
False Emergency Replies	0	0.00

TABLE A-6 DISTRIBUTION OF DISCREPANCY REPORTS BY AIRCRAFT INVOLVED

Facility: Bradley Tower

A/C TYPE	TOTAL	PERCENT	RING*	GHOST	FRUIT	WIDL	NARRW	NEVER	LSTSH (ST)	LSTSH (MN)	LSTLN (ST)	LSTLN (MN)	BROKN	MODE	ALTIT	IDENT	OTHER	FALSE
B727	10	8.8	2	5	0	1	0	0	0	2	0	0	0	0	0	0	0	0
BC9	9	8.0	4	4	0	0	0	0	0	1	0	0	0	0	0	0	0	0
BE55	7	6.2	1	0	0	0	1	0	2	2	0	0	1	0	0	0	0	0
B707	7	6.2	1	2	0	0	0	0	1	0	0	2	1	0	0	0	0	0
Unknown	7	6.2	1	2	0	0	0	0	1	1	1	0	1	0	0	0	0	0
PA28	7	6.2	0	2	0	0	0	0	2	1	1	0	1	0	0	0	0	0
BE33	7	6.2	0	0	0	0	1	1	1	0	1	0	1	0	0	2	0	0
F100	6	5.3	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DC8	6	5.3	0	2	0	0	0	0	1	2	0	0	1	0	0	0	0	0
BA11	5	4.4	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PA32	4	3.5	0	0	0	0	1	0	1	0	1	0	0	0	0	1	0	0
N265	2	1.8	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
C182	2	1.8	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
TS60	2	1.8	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CV58	2	1.8	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
G2	2	1.8	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
PA30	2	1.8	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
PAZT	2	1.8	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0
BE90	2	1.8	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
BE99	2	1.8	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0
C131	2	1.8	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0
PA12	2	1.8	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C124	2	1.8	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0
F227	1	0.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C172	1	0.9	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CV88	1	0.9	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HB7S	1	0.9	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BE50	1	0.9	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PA11	1	0.9	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
U8	1	0.9	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
BE23	1	0.9	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
PARD	1	0.9	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
PA31	1	0.9	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C310	1	0.9	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
BL36	1	0.9	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
G159	1	0.9	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
C206	1	0.9	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
TOTALS	113		16	34	0	1	3	1	18	22	6	2	-	0	0	3	0	0

*For key to error code abbreviations see Table 3-4

TABLE A-7 DISTRIBUTION OF FAULT REPORTS BY ERROR CATEGORY

Facility: Burbank Tower

Error Category	No. of Occurrences	Percent
Target Lost Short Time	14	35.89
Target Lost Long Time	9	23.07
Target Broken/Intermittent/Chopped	6	15.38
Ring Around/Sidelobes	5	12.82
Target Never Acquired	2	5.12
Ghosts/Reflections/False Targets	1	2.56
IDENT Malfunction	1	2.56
Other	1	0.00
Fruit	0	0.00
Target Too Wide	0	0.00
Target Too Narrow	0	0.00
Mode 3/A Code Incorrect	0	0.00
Altitude Readout Incorrect	0	0.00
False Emergency Replies	0	0.00

TABLE A-8 DISTRIBUTION OF DISCREPANCY REPORTS BY AIRCRAFT INVOLVED

Facility: Burbank Tower

A/C TYPE	TOTAL	PERCENT	RING*	GHOST	FRUIT	WIDE	NARRW	NEVER	LSTSH (ST)	LSTSH (MN)	LSTLN (ST)	LSTLN (MN)	BROKN	MODE	ALT.T	IDENT	OTHER	FALSE
PA28	7	17.9	0	0	0	0	0	0	2	1	1	1	2	0	0	0	0	0
BE55	5	12.8	0	0	0	0	0	0	0	0	1	1	2	0	0	0	1	0
B727	5	12.8	2	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0
C310	4	10.3	0	0	0	0	0	1	1	0	1	0	0	0	0	1	0	0
C172	4	10.3	0	0	0	0	0	0	0	2	1	0	1	0	0	0	0	0
C130	2	5.1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C150	2	5.1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
B747	2	5.1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
M020	2	5.1	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0
DC9	1	2.6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B737	1	2.6	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
BE35	1	2.6	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
DC3	1	2.6	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
PA2T	1	2.6	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
DH6	1	2.6	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
TOTALS	39		5	1	0	0	0	2	6	8	5	4	6	0	0	1	1	0

*For key to error code abbreviations see Table 3-4

TABLE A-9 DISTRIBUTION OF FAULT REPORTS BY ERROR CATEGORY

Facility: New York CIFRR

Error Category	No. of Occurrences	Percent
Target Lost Short Time	17	27.86
Target Lost Long Time	16	26.22
Ghosts/Reflections/False Targets	9	14.75
Target Broken/Intermittent/Chopped	9	14.75
Target Too Wide	4	6.55
Ring Around/Sidelobes	3	4.91
Target Never Acquired	2	3.27
Other	1	1.63
Fruit	0	0.00
Target Too Narrow	0	0.00
Mode 3/A Code Incorrect	0	0.00
Altitude Readout Incorrect	0	0.00
IDENT Malfunction	0	0.00
False Emergency Replies	0	0.00

TABLE A-10 DISTRIBUTION OF FAULT REPORTS BY AIRCRAFT INVOLVED
Facility: New York CIFRR

A/C TYPE	TOTAL	PERCENT	RING*	CHOST	FRUIT	WIDE	NARRW	NEVEP	LSTSH (ST)	LSTSH (MN)	LSTLN (ST)	LSTLN (MN)	BROKN	MODE	ALTIT	IDENT	OTHER	FALSE
B707	10	16.4	1	2	0	0	0	0	2	1	1	1	1	0	0	0	1	0
Unknown	10	16.4	1	2	0	0	0	0	1	1	2	1	2	0	0	0	0	0
B727	7	11.5	0	3	0	2	0	0	1	0	0	0	1	0	0	0	0	0
C310	6	9.8	0	0	0	0	0	0	1	1	2	2	0	0	0	0	0	0
B747	5	8.2	0	0	0	0	0	1	1	1	0	0	2	0	0	0	0	0
N265	4	6.5	0	0	0	0	0	0	0	1	0	1	2	0	0	0	0	0
BE90	3	4.9	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0
CV58	3	4.9	0	0	0	0	0	0	0	2	0	0	1	0	0	0	0	0
DC9	3	4.9	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0
DC87	3	4.9	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0
B.K?	2	3.3	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0
DC8	1	1.6	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
GS15	1	1.6	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
B737	1	1.6	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
B720	1	1.6	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
G2	1	1.6	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
TOTALS	61		3	9	0	4	0	2	6	11	7	9	9	0	0	1	0	0

*For key to error code abbreviations see Table 3-4

TABLE A-11 DISTRIBUTION OF FAULT REPORTS BY ERROR CATEGORY
Facility: Orlando Tower

Error Category	No. of Occurrences	Percent
Ghosts/Reflections/False Targets	11	24.44
Target Lost Short Time	11	24.44
Ring Around/Sidelobes	9	20.00
Target Lost Long Time	8	17.77
Target Never Acquired	3	6.66
Target Broken/Intermittent/Chopped	2	4.44
Target Too Wide	1	2.22
Fruit	0	0.00
Target Too Narrow	0	0.00
Mode 3/A Code Incorrect	0	0.00
Altitude Readout Incorrect	0	0.00
IDENT Malfunction	0	0.00
Other	0	0.00
False Emergency Replies	0	0.00

TABLE A-12. DISTRIBUTION OF DISCREPANCY REPORTS BY AIRCRAFT INVOLVED

Facility: Orlando Tower

A/C TYPE	TOTAL	PERCENT	RING*	GHOST	FRUIT	WIDE	NARRW	NEVER	LSTSH (ST)	LSTSH (MN)	LSTLN (ST)	LSTLN (MN)	BROKN	MODE	ALTIT	IDENT	OTHER	FALSE
BE99	8	17.8	1	3	0	1	0	0	1	2	0	0	0	0	0	0	0	0
DC9	5	11.1	0	1	0	0	0	0	0	2	0	2	0	0	0	0	0	0
DH6	5	11.1	1	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0
BE18	4	8.9	0	1	0	0	0	0	1	0	1	0	1	0	0	0	0	0
C135	3	6.7	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
BE35	3	6.7	0	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0
DC8	2	4.4	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PA24	2	4.4	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0
B727	2	4.4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AC58	1	2.2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C337	1	2.2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T29	1	2.2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KC13	1	2.2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C124	1	2.2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T37	1	2.2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
F84	1	2.2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C172	1	2.2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
PA28	1	2.2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
C130	1	2.2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G159	1	2.2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
TOTALS	45		8	12	0	1	0	3	7	4	3	5	2	0	0	0	0	0

*For Key to Error Code Abbreviations see Table 3-4.

TABLE A-13 DISTRIBUTION OF FAULT REPORTS BY ERROR CATEGORY

Facility: Philadelphia Tower

Error Category	No. of Occurrences	Percent
Target Broken/Intermittent/Chopped	30	27.02
Target Lost Long Time	26	23.42
Target Lost Short Time	17	15.31
Ring Around/Sidelobes	11	9.90
Other	11	9.90
Ghosts/Reflections/False Targets	9	8.10
Target Never Acquired	4	3.60
Mode 3/A Code Incorrect	2	1.80
IDENT Malfunction	1	0.90
Fruit	0	0.00
Target Too Wide	0	0.00
Target Too Narrow	0	0.00
Altitude Readout Incorrect	0	0.00
False Emergency Replies	0	0.00

*For key to error code abbreviations see Table 3-4

TABLE A-14 DISTRIBUTION OF DISCREPANCY REPORTS BY AIRCRAFT INVOLVED
Facility: Philadelphia Tower

A/C TYPE	TOTAL	PERCENT	RING*	GHOST	FRUIT	WIDE	NARRW	NEVER	LSTSH (ST)	LSTSH (MN)	LSTLN (ST)	LSTLN (MN)	BROKN	MODE	ALTIT	IDENT	OTHER	FALSE
Unknown	17	15.3	1	4	0	0	0	0	0	0	0	0	5	1	0	0	6	0
DC9	16	14.4	4	0	0	0	0	0	0	1	2	2	5	0	0	0	2	0
B727	10	9.0	3	0	0	0	0	0	1	2	0	0	3	0	0	0	1	0
PA28	8	7.2	0	0	0	0	0	0	2	0	4	0	1	0	0	0	1	0
F9	7	6.3	0	0	0	0	0	0	1	1	2	2	1	0	0	0	0	0
C124	4	3.6	0	0	0	0	0	0	0	1	0	1	1	0	0	1	0	0
C172	4	3.6	0	0	0	0	0	0	1	0	2	0	1	0	0	0	0	0
DC8	4	3.6	0	0	0	0	0	0	0	2	0	0	2	0	0	0	0	0
G159	3	2.7	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0
PV1	3	2.7	0	0	0	0	0	0	0		1	1	1	0	0	0	0	0
A7	3	2.7	0	0	0	0	0	1	0		1	1	0	0	0	0	0	0
BE80	3	2.7	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0
CV88	3	2.7	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
C119	2	1.8	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0
C118	2	1.8	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
P3	2	1.8	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0
A4	2	1.8	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0
CB10	2	1.8	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0
1331	2	1.8	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C170	1	0.9	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
C540	1	0.9	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
PA24	1	0.9	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
M421	1	0.9	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
T41	1	0.9	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
M12	1	0.9	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
C141	1	0.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
BE99	1	0.9	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
CV58	1	0.9	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B707	1	0.9	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FEJ	1	0.9	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BE55	1	0.9	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
SKYV	1	0.9	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
T33	1	0.9	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
TOTALS	111		12	8	0	0	0	4	8	9	16	10	30	2	0	1	11	0

*For key to error code abbreviations see Table 3-4.

TABLE A-15 DISTRIBUTION OF FAULT REPORTS BY ERROR CATEGORY
Facility: Tampa Tower

Error Category	No. of Occurrences	Percent
Ghosts/Reflections/False Targets	25	35.71
Ring Around/Sidelobes	20	28.57
Target Lost Short Time	6	8.57
Target Broken/Intermittent/Chopped	6	8.57
Other	6	8.57
Target Too Wide	3	4.28
Target Too Narrow	1	1.42
Target Never Acquired	1	1.42
Target Lost Long Time	1	1.42
Mode 3/A Code Incorrect	1	1.42
Fruit	0	0.00
Altitude Readout Incorrect	0	0.00
IDENT Malfunction	0	0.00
False Emergency Replies	0	0.00

TABLE A-16 DISTRIBUTION OF DISCREPANCY REPORTS BY AIRCRAFT INVOLVED

Facility: Tampa Tower

A/C TYPE	TOTAL	PERCENT	RING*	GHOST	FRUIT	WIDE	NARRW	NEVER	LSTSH (ST)	LSTSH (MN)	LSTLN (ST)	LSTLN (ST)	BROKN	MODE	ALTIT	IDENT	OTHER	FALSE
B727	14	20.0	4	6	0	0	0	0	1	1	0	0	2	0	0	0	0	0
T33	7	10.0	2	2	0	0	1	0	1	0	0	0	1	0	0	0	0	0
DC9	6	8.6	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DC8	5	7.1	1	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C131	5	7.1	0	1	0	0	0	0	1	0	1	0	0	0	0	0	2	0
B57	4	5.7	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DH6	4	5.7	2	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
PA30	3	4.3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
C130	3	4.3	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0
DHC6	3	4.3	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0
F100	3	4.3	0	1	0	1	0	0	0	0	0	0	0	0	0	0	1	0
C135	2	2.8	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Unknown	2	2.8	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C421	2	2.8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0
LR25	1	1.4	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
C310	1	1.4	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BE95	1	1.4	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
BE99	1	1.4	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C118	1	1.4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HB52	1	1.4	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S2	1	1.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
TOTALS	70		18	27	0	3	1	1	5	1	1	0	6	1	0	0	6	0

*For key to error code abbreviations see Table 3-4

TABLE A-17 DISTRIBUTION OF FAULT REPORTS BY ERROR CATEGORY

Facility: White Plains Tower

Error Category	No. of Occurrences	Percent
Ring Around/Sidelobes	87	70.73
Target Lost Short Time	20	16.26
Ghosts/Reflections/False Targets	6	4.87
Other	5	4.06
Fruit	2	1.62
Target Broken/Intermittent/Chopped	2	1.62
Target Too Wide	1	0.81
Target Too Narrow	0	0.00
Target Never Acquired	0	0.00
Target Lost Long Time	0	0.00
Mode 3/A Code Incorrect	0	0.00
Altitude Readout Incorrect	0	0.00
IDENT Malfunction	0	0.00
False Emergency Replies	0	0.00

TABLE A-18 DISTRIBUTION OF DISCREPANCY REPORTS BY AIRCRAFT INVOLVED

Facility: White Plains Tower

A/C TYPE	TOTAL	PERCENT	RING*	GHOST	FRUIT	WIDE	NARRW	NEVER	LSTSH (ST)	LSTSH (MN)	LSTLN (ST)	LSTLN (MN)	BROKN	MODE	ALTIT	IDENT	OTHER	FALSE
Unknown	19	15.4	14	1	1	0	0	0	0	0	0	0	0	0	0	0	3	0
BA11	10	8.1	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G159	9	7.3	7	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0
DC3	7	5.7	4	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0
FA22	7	5.7	5	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0
LR24	6	4.9	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FFJ	6	4.9	2	0	0	1	0	0	0	2	0	0	1	0	0	0	0	0
BE90	6	4.9	5	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
AC21	6	4.9	3	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
N265	5	4.1	3	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
PA28	4	3.3	1	0	1	0	0	0	0	1	0	0	0	0	0	0	1	0
F22	4	3.3	2	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
LR25	3	2.4	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
PA31	3	2.4	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C'72	3	2.4	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0
BE99	2	1.6	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HS25	2	1.6	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PAZT	2	1.6	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
HF20	2	1.6	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
MU2	2	1.6	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
L329	2	1.6	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C159	2	1.6	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BE95	1	0.8	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FA27	1	0.8	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AC68	1	0.8	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HS12	1	0.8	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BE33	1	0.8	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C182	1	0.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AC6T	1	0.8	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
G2	1	0.8	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C401	1	0.8	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PA30	1	0.8	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NW2	1	0.8	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTALS	123		87	6	2	1	0	0	5	15	0	0	2	0	0	0	5	0

*For key to error code abbreviations see Table 3-4.

APPENDIX B
BEACON-SYSTEM PERFORMANCE AT MILITARY FACILITIES

Attention is focused upon the operational deficiencies experienced with the beacon system at military installations. This analysis is limited to sites which documented a minimum of twenty fault reports, and will exclude Larado Air Force Base since it was treated in Chapter 4. For each site considered, the distribution of discrepancy data by error category is presented, in addition to a tabulation of the deficiency information in terms of the aircraft involved.

TABLE B-1 DISTRIBUTION OF FAULT REPORTS BY ERROR CATEGORY

Facility: Griffiss Air Force Base

ERROR CATEGORY	NO. OF OCCURRENCES	PERCENT
Target Lost Short Time	33	55.93
Ring Around/Sidelobes	14	23.7[illegible]
Ghosts/Reflections/False Targets	7	11.86
Target Too Narrow	2	3.38
Target Never Acquired	1	1.69
Target Lost Long Time	1	1.69
Other	1	1.69
Fruit	0	0.00
Target Too Wide	0	0.00
Target Broken/Intermittent/Chopped	0	0.00
Mode 3/A Code Incorrect	0	0.00
Altitude Readout Incorrect	0	0.00
IDENT Malfunction	0	0.00
False Emergency Replies	0	0.00

TABLE B-2 DISTRIBUTION OF DISCREPANCY REPORTS BY AIRCRAFT INVOLVED

Facility: Griffiss Air Force Base

A/C TYPE	TOT	PERC	RING*	GHOST	FRUIT	WIDE	NARRW	NEVER	(ST) LSTSH	(MN) LSTSH	(ST) LSTLN	(MN) LSTLN	BROKN	MODE	ALTIT	IDENT	OTHER	FALSE
FA22	8	14.5	0	3	0	0	0	0	2	3	0	0	0	0	0	0	0	0
F106	8	14.5	0	2	0	0	2	0	1	3	0	0	0	0	0	0	0	0
L188	7	12.7	0	2	0	0	0	0	2	3	0	0	0	0	0	0	0	0
BA11	7	12.7	0	2	0	0	0	0	3	2	0	0	0	0	0	0	0	0
F22	3	5.4	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0
C195	3	5.4	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0
KC35	3	5.4	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0
KC97	3	5.4	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0
B52	3	5.4	0	1	0	0	0	0	0	2	0	0	0	0	0	0	0	0
C131	2	3.6	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0
C172	2	3.6	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
T33	2	3.5	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0
B57	2	3.6	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0
C118	1	1.8	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Unknown	1	1.8	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTALS	55		0	17	0	0	2	1	14	19	1	0	0	0	0	0	1	0

TABLE B-3 DISTRIBUTION OF FAULT REPORTS BY ERROR CATEGORY
Facility: Hamilton AFB

ERROR CATEGORY	NO. OF OCCURRENCES	PERCENT
Ring Around/Sidelobes	25	30.86
Target Broken/Intermittent/Chopped	13	16.04
Ghosts/Reflections/False Targets	12	14.81
Target Lost Short Time	12	14.81
Fruit	11	13.58
Target Lost Long Time	3	3.70
Target Too Wide	2	2.46
Target Too Narrow	2	2.46
Other	1	1.23
Target Never Acquired	0	0.00
Mode 3/A Code Incorrect	0	0.00
Altitude Readout Incorrect	0	0.00
IDENT Malfunction	0	0.00
False Emergency Replies	0	0.00

TABLE B-4 DISTRIBUTION OF DISCREPANCY REPORTS BY AIRCRAFT INVOLVED

Facility: Hamilton AFB

A/C TYPE	TOT	PERC	RING*	GHOST	FRUIT	WIDE	NARRW	NEVER	(ST) LSTSH	(MN) LSTSH	(ST) LSTLN	(MN) LSTLN	BROKN	MODE	ALTIT	IDENT	OTHER	FALSE
F106	9	15.0	0	1	0	0	0	0	3	0	0	0	5	0	0	0	0	0
PA28	6	10.0	0	1	0	0	0	0	2	0	2	0	1	0	0	0	0	0
Unknown	6	10.0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	1	0
F29	6	10.0	0	1	[illegible]	0	0	0	0	1	0	0	2	0	0	0	0	0
C206	5	8.3	0	2	1	0	1	0	0	0	0	0	1	0	0	0	0	0
C172	4	6.7	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0
BE35	3	5.0	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0
H	2	3.3	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
FA27	2	3.3	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
C124	2	3.3	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
C131	2	3.3	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0
PA2T	2	3.3	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0
T33	2	3.3	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0
MU2	1	1.7	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C182	1	1.7	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
AL56	1	1.7	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PA12	1	1.7	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
P3	1	1.7	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
C180	1	1.7	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
F101	1	1.7	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C135	1	1.7	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
H53	1	1.7	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTALS	60		0	16	11	2	2	0	8	4	3	0	13	0	0	0	1	0

#For key to error code abbreviations see Table 3-4.

TABLE B-5 DISTRIBUTION OF FAULT REPORTS BY ERROR CATEGORY
Facility: LeMoore RATCC

ERROR CATEGORY	NO. OF OCCURRENCES	PERCENT
Target Lost Long Time	38	32.47
Target Lost Short Time	37	31.62
Target Never Acquired	15	12.82
Ring Around/Sidelobes	11	9.40
Ghosts/Reflections/False Targets	8	6.83
Target Broken/Intermittent/Chopped	8	6.83
Fruit	0	0.00
Target Too Wide	0	0.00
Target Too Narrow	0	0.00
Mode 3/A Code Incorrect	0	0.00
Altitude Readout Incorrect	0	0.00
IDENT Malfunction	0	0.00
Other	0	0.00
False Emergency Replies	0	0.00

TABLE B-6 DISTRIBUTION OF DISCREPANCY REPORTS BY AIRCRAFT INVOLVED

Facility: LeMoore RATCC

A/C TYPE	TOT	PERC	RING*	GHOST	FRUIT	WIDE	NARRW	NEVER	(ST) LSTSH	(MN) LSTSH	(ST) LSTLN	(MN) LSTLN	BROKN	MODE	ALTIT	IDENT	OTHER	FALSE
S2	11	10.2	0	0	0	0	0	2	1	0	5	2	1	0	0	0	0	0
BE18	8	7.4	0	1	0	0	0	0	3	1	0	2	1	0	0	0	0	0
A7	7	6.5	0	2	0	0	0	0	1	1	1	2	0	0	0	0	0	0
A4	6	5.5	0	2	0	0	0	0	1	0	1	2	0	0	0	0	0	0
TA4	6	5.5	0	2	0	0	0	0	2	2	0	0	0	0	0	0	0	0
C210	6	5.5	0	0	0	0	0	1	0	0	2	2	1	0	0	0	0	0
PA28	5	4.6	0	0	0	0	0	2	1	0	2	0	0	0	0	0	0	0
BL35	5	4.6	0	0	0	0	0	2	0	0	2	1	0	0	0	0	0	0
C206	5	4.6	0	0	0	0	0	2	0	0	2	1	0	0	0	0	0	0
Unknown	4	3.7	0	1	0	0	0	1	1	1	0	0	0	0	0	0	0	0
C124	4	3.7	0	0	0	0	0	0	0	0	3	0	1	0	0	0	0	0
T29	4	3.7	0	0	0	0	0	0	1	0	1	0	2	0	0	0	0	0
C118	3	2.8	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0
BE99	3	2.8	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0
C1	3	2.8	0	0	0	0	0	1	[illegible]	1	1	0	0	0	0	0	0	0
C131	2	1.8	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0
L18	2	1.8	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
C172	2	1.8	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
F102	2	1.8	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
P3	2	1.8	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
C177	2	1.8	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0
BE23	1	0.9	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
AC	1	0.9	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BESS	1	0.9	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
A3	1	0.9	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
DC9	1	0.9	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
C401	1	0.9	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
PAZT	1	0.9	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
B737	1	0.9	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
F8	1	0.9	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
C121	1	0.9	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
BE33	1	0.9	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
C510	1	0.9	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
T1	1	0.9	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
C130	1	0.9	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
C117	1	0.9	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
PA30	1	0.9	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
TOTALS	108		0	10	0	0	0	15	27	10	24	14	8	0	0	0	0	0

*For key to error code abbreviations see Table 3-4

TABLE B-7 DISTRIBUTION OF FAULT REPORTS BY ERROR CATEGORY

Facility: March Rapcon

ERROR CATEGORY	NO OF OCCURRENCES	PERCENT
Ring Around/Sidelobes	20	28.16
Target Lost Short Time	17	23.94
Target Broken/Intermittent/Chopped	9	12.67
Ghosts/Reflections/False Targets	8	11.26
Target Too Wide	7	9.85
Target Lost Long Time	7	9.85
Fruit	1	1.40
Target Too Narrow	1	1.40
Other	1	1.40
Target Never Acquired	0	0.00
Mode 3/A Code Incorrect	0	0.00
Altitude Readout Incorrect	0	0.00
IDENT Malfunction	0	0.00
False Emergency Replies	0	0.00

TABLE B-8 DISTRIBUTION OF DISCREPANCY REPORTS BY AIRCRAFT INVOLVED

Facility: March RAPCON

A/C TYPE	TOT	PERC	RING*	GHOST	FRUIT	WIDE	NARRW	NEVER	(ST) LSTSH	(MN) LSTSH	(ST) LSTLN	(MN) LSTLN	BROKN	MODE	ALTIT	IDENT	OTHER	FALSE
C141	13	22.4	0	5	0	2	0	0	1	1	2	0	2	0	0	0	0	0
Unknown	9	15.5	0	6	1	1	0	0	0	0	0	0	0	0	0	0	1	0
T38	9	15.5	0	3	0	0	0	0	3	3	0	0	0	0	0	0	0	0
B737	7	12.1	0	1	0	1	0	0	0	1	0	3	1	0	0	0	0	0
C320	3	5.2	0	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0
PA28	3	5.2	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0
BE33	2	3.4	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0
T37	2	3.4	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0
C150	2	3.4	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0
PA30	2	3.4	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
LR25	1	1.7	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
C135	1	1.7	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
FA27	1	1.7	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
T33	1	1.7	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
C130	1	1.7	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
BE35	1	1.7	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
TOTALS	58		0	15	1	7	1	0	8	9	3	4	9	0	0	0	1	0

*For key to error code abbreviations see Table 3-4

TABLE B-9 DISTRIBUTION OF FAULT REPORTS BY ERROR CATEGORY

Facility: Randolf Air Force Base

ERROR CATEGORY	NO.OF OCCURRENCES	PERCENT
Target Lost Long Time	49	48.51
Target Lost Short Time	45	44.55
Target Too Narrow	5	4.95
Ghosts/Reflections/False Targets	1	0.99
Mode 3/A Code Incorrect	1	0.99
Ring Around/Sidelobes	0	0.00
Fruit	0	0.00
Target Too Wide	0	0.00
Target Never Acquired	0	0.00
Target Broken/Intermittent/Chopped	0	0.00
Altitude Readout Incorrect	0	0.00
IDENT Malfunction	0	0.00
Other	0	0.00
False Emergency Replies	0	0.00

TABLE B-10 DISTRIBUTION OF DISCREPANCY REPORTS BY AIRCRAFT INVOLVED

Facility: Randolf Air Force Base

A/C TYPE	TOT	PERC	RING*	GHOST	FRUIT	WIDE	NARRW	NEVER	(ST) LSTSH	(MN) LSTSH	(ST) LSTLN	(MN) LSTLN	BROKN	MODE	ALTIT	IDENT	OTHER	FALSE
T38	70	69.3	0	0	0	0	0	0	3	23	18	25	0	1	0	0	0	0
T37	17	16.8	0	0	0	0	4	0	6	7	0	0	0	0	0	0	0	0
T39	5	4.9	0	1	0	0	0	0	1	0	2	1	0	0	0	0	0	0
T29	4	4.0	0	0	0	0	0	0	0	2	1	1	0	0	0	0	0	0
T33	2	2.0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0
Unknown	2	2.0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0
C54	1	1.0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
TOTALS	101		0	1	0	0	5	0	12	33	22	27	0	1	0	0	0	0

*For key to error code abbreviations see Table 3-4

TABLE B-11 DISTRIBUTION OF FAULT REPORTS BY ERROR CATEGORY

Facility: Tyndall Air Force Base

ERROR CATEGORY	NO OF OCCURRENCES	PERCENT
Target Lost Short Time	22	52.38
Target Lost Long Time	10	23.80
Target Never Acquired	3	7.14
Target Broken/Intermittent/Chopped	2	4.76
IDENT Malfunction	2	4.76
Other	2	4.76
Target Too Narrow	1	2.38
Ring Around/Sidelobes	0	0.00
Ghosts/Reflections/False Targets	0	0.00
Fruit	0	0.00
Target Too Wide	0	0.00
Mode 3/A Code Incorrect	0	0.00
Altitude Readout Incorrect	0	0.00
False Emergency Replies	0	0.00

TABLE B-12 DISTRIBUTION OF DISCREPANCY REPORTS BY AIRCRAFT INVOLVED

Facility: Tyndall Air Force Base

A/C TYPE	TOT	PERC	RING*	GHOST	FRUIT	WIDE	NAPRW	SEVER	(ST) LSTSH	(MN) LS,SH	(ST) LSTLN	(MN) LSTLN	BROKS	MODE	ALTIT	IDENT	OTHER	FALSE
T38	10	23.8	0	0	0	0	0	0	1	6	1	1	0	0	0	1	0	0
F106	7	16.7	0	0	0	0	0	2	0	1	0	3	0	0	0	1	0	0
F101	6	14.3	0	0	0	0	0	0	1	3	1	0	1	0	0	0	0	0
T33	6	14.3	0	0	0	0	0	0	1	3	1	1	0	0	0	0	0	0
BE90	2	4.8	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0
AA1	2	4.8	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0
F4	2	4.8	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0
Unknown	1	2.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
KC13	1	2.4	0	0	0	0	0	0	0	1	0	0	0	0	0	[illegible]	0	0
[illegible]C11	1	2.4	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
C131	1	2.4	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
BE18	1	2.4	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
F102	1	2.4	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
T39	1	2.4	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
TOTALS	42		0	0	0	0	1	3	4	18	5	5	2	0	0	2	2	0

*For key to error code abbreviations see Table 3-4

APPENDIX C

RADAR SYSTEM DATA FOR FACILITIES INVOLVED IN THE SURVEY

TABLE C-1. RADAR SYSTEM DATA FOR FACILITIES INVOLVED IN THE SURVEY - CIVIL INSTALLATIONS ONLY

FACILITY	INTERROGATOR TYPE	DEFRUITER TYPE	DECODER TYPE	DIRECTIONAL ANTENNA	OPERATING WITH SLS?	OPERATING WITH ISLS?	OPERATIONAL POWER OUTPUT Channel 1	Channel 2	INITIAL DEPTH
Albany Tower	ATCBI-3E	FA-7280	ATCBI-3	FA-7201/A	Yes	Yes	500 watts	500 watts	53 db
Albuquerque ARTCC									
1) Amarillo ARSR	UPX-14	FA-7280	ATCBI-3	AT-309	N/A	N/A	1000 watts	N/A	41 db
2) El Paso ARSR	ATCBI-3	FA-6140	ATCBI-3	FA-6112	N/A	N/A	945 watts	N/A	40 db
3) Mesa Rica ARSR	ATCBI-3	FA-6140	ATCBI-3	FA-7201A	N/A	N/A	1150 watts	N/A	43 db
4) Phoenix ARSR	ATCBI-3	FA-6140	ATCBI-3	FA-7201A	N/A	N/A	1500 watts	N/A	40 db
5) Silver City ARSR	ATCBI-3	FA-7220	ATCBI-3	FA-7201B	Yes	No	700 watts	700 watts	40 db
6) West Mesa ARSR	UPX-14	FA-8101	N/A	AT-309	N/A	N/A	N/A	N/A	N/A
Albuq erque Tower	ATCBI-3B	FA-8100	UPX-9B	FA 7202	Yes	No	300 watts	300 watts	50 db
Atlant c City Tower	ATCBI-3	Storage Tube	ATCBI-3	FA-7201	Yes	No	150 watts	150 watts	50 db
Binghamton Tower	ATCBI-3E	FA-7288	FA-7243B	FA-702	Yes	Yes	200 watts	200 watts	50 db
Bradley Tower	ATCBI-3	FA-7228	ATCBI-2J	FA-[illegible]	Yes	No	300 watts	300 watts	45 db
Burbank Tower	ATCBI-3	Storage Tube	ATCBI-3	FA 7202	Yes	Yes	200 watts	200 watts	40 db
El Paso Tower	ATCBI-3	FA-8108	ATCBI-2	FA 7201	Yes	Yes	302 watts	302 watts	40 db
Long Beach Tower	ATCBI-3D	FA-7281	ATCBI-3D	FA-7201A	Yes	Yes	150 watts	150 watts	40 db
Los Angeles ARTCC									
1) Boron ARSR	UPX-14	FA-7280	ATCBI-3	AT 309	Yes	Yes	1500 watts	1500 watts	48 db
2) Cedar City ARSR	ATCBI-3	Type A	ATCBI-3	FA-7201A	Yes	No	750 watts	750 watts	46 db
3) Las Vegas ARSR	UPX-6	FA-6140	ATCBI-3	AT-309A	No	No	1580 watts	1580 watts	33 db
4) Los Angeles ASR	ATCBI-3	FA-7281	ATCBI-3	FA 7201A	Yes	No	407 watts	407 watts	42.4 db
5) Mt. Laguna ARSR	UPX-14	FA-7281	ATCBI-3	AT-309A	Yes	Unknown	1600 watts	1600 watts	30 db
6) Paso Robles ARSR	ATCBI-3	FA-6142	ATCBI-3	FA 7901	Yes	No	1600 watts	1600 watts	46 db
7) San Pedro ARSR	UPX-14	FA-7281	ATCBI-3	FA-7201	Yes	Unknown	1700 watts	1700 watts	30 db
Miami ARTCC									
1) Miami	UPX-14	FA-6140	ATCBI-3	AT 309	Yes	Yes	1500 watts	1500 watts	30 db
2) McDill AFB	UPX-14	FA-7281	ATCBI-3	AT-309A	Yes	No	1500 watts	1500 watts	30 db
Patrick AFB	UPX-14	FA-6140	ATCBI-3	AT-309B	Yes	Yes	1500 watts	1500 watts	N/A

TABLE C-1. RADAR SYSTEM DATA FOR FACILITIES INVOLVED IN THE SURVEY - CIVIL INSTALLATIONS ONLY (CONT.)

FACILITY	INTERROGATOR	DEFRUITER	DECODER TYPE	DIRECTIONAL ANTENNA	SLS?	ISLS?	Operational Power Output Channel 1	Channel 2	STC CURVE (Initial Depth)
New York ARTCC									
1) Benton, Pennsylvania	UPX-14	FA-7281	ATCBI-3	FOX-4	No	No	2240 watts	2240 watts	30 db
2) J.F Kennedy (B)	ATCBI-3B	FA-7281	ATCBI-3	FA-7201A	Yes	Yes	801 watts	891 watts	56 db
3) Trevose, Penn.	ATCBI-3	FA-8101	ATCBI-3	FA-8043	Yes	Yes	1000 watts	1000 watts	44 db
New York CIFRR									
1) J.F. Kennedy (IA)	ATCBI-3B	FA-7281	ATCBI-2	FA-7201A	Yes	Yes	191 watts	191 watts	50 db
2) Newark, N.J.	ATCBI-3	FA-7281	ATCBI-3	FA-7201A	Yes	Yes	190 watts	190 watts	50 db
Orlando Tower	ATCBI-3B	FA-8100	ATCBI-3B	FA-7202	Yes	Yes	250 watts	250 watts	40 db
Philadelphia Tower	ATCBI-3	Storage Tube	ATCBI-3	FA-7201	Yes	Yes	160 watts	160 watts	35 db
Salt Lake City ARTCC*									
1)Ashton, ARSR	ATCBI-3	A-(Delay Line)	FA-7243B	FA-7021B	Yes	No	750 watts	750 watts	46 db
2) Rock Springs ARSR	ATCBI-3	A-(Delay Line)	FA-7243B	FA-7201A	Yes	No	600 watts	600 watts	44 db
Tampa Tower	ATCBI-3B	FA-7281	ATCBI-3	FA-7202	Yes	Yes	240 watts	240 watts	46 db
White Plains Tower	ATCBI-3	FA-8101	ATCBI-2	AT 309A	Yes	Yes	250 watts	250 watts	43 db

N/A: Information not available.

TABLE C-2. RADAR SYSTEM DATA FOR FACILITIES INVOLVED IN THE SURVEY - MILITARY INSTALLATIONS ONLY

FACILITY	INTERROGATOR TYPE	DIPLEXER TYPE	DECODER TYPE	DIRECTIONAL ANTENNA	OPERATING WITH SLS?	OPERATING WITH ISLS?	OPERATIONAL POWER OUTPUT Channel 1	Channel 2	STC CURVE (INITIAL DEPTH)
Castle AFB	UPX-6C	None	KY-545	AT-309C	No	No	1800 watts	1800 watts	N/A
Eglin AFB	AN/UPX-6	None	AN/GPX-9B	AT-309C	No	No	1500 watts	N/A	N/A
Griffiss AFB	UPX-6	None	GPX-9B	AT-309	No	No	250 watts	250 watts	N/A
Hamilton AFB	UPX-6	None	GPX-9	AT-309	No	No	390 watts	390 watts	N/A
Holloman AFB	UPX-6	N/A	GPX-9B	AT 309A	Yes	N/A	1500 watts	1500 watts	20 db
Laredo AFB	UPX-6	None	GPX-8A	AN/GPA-123	Yes	No	1540 watts	1540 watts	N/A
Lemoore RATCC	UPX-1A	FA-8100	UPA-54	FA-7202	No	No	250 watts	250 watts	N/A
March RAPCON	UPX-6	FA-8100	GPX-9	AT-309C	No	No	400 watts	400 watts	18 db
McGuire AFB	UPX-6	None	GPX-9B	AT-309C	No	No	1500 watts	None	N/A
Mt Home AFB	UPX-6	None	GPX-9B	AT-309A	No	No	1500 watts	None	N/A
Myrtle Beach AFB	UPX-6	None	GPX-8	GPA-123	No	No	1800 watts	None	N/A
Patrick AFB	UPX-6	N/A	GPX-9B	AT-309	No	No	2100 watts	2100 watts	N/A
Quonset Point RATCC	UPX 1A	None	UPA-24B	FA-7202	No	No	1290 watts	1290 watts	23 db
Randolf AFB	GPX-8A	N/A	KY-299	GPA-123	No	No	1500 watts	None	N/A
Travis AFB	UPX-6	N/A	GPX-9B	AT-309C	No	No	300 watts	300 watts	N/A
Tyndall AFB	UPX-6	N/A	N/A	AT-309C	No	No	2000 watts	2000 watts	N/A
Vandenburg	UPX-6	N/A	GPX-8A	GPA-123	Yes	N/A	2100	2150 watts	N/A

N/A: Information not available