Final Technical Report

F-A2123

Volume 1

OPERATIONS ANALYSIS OF AIR TRAFFIC DEMANDS AND DELAYS IN THE NEW YORK ARTCC AREA ON January 28 and February 28, 1958

by
O M Patton and G E Cothren

December 2, 1957 to November 1, 1958

Prepared for
OPERATIONS ANALYSIS DIRECTORATE OF THE AIRWAYS MODERNIZATION BOARD
Washington, D.C.

Under
Contract No. AMB-3 (Former FAA/BRD-3)

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FOREWORD

This project was commissioned by the Operations Analysis Directorate of the Airways Modernization Board for the purpose of providing analysis of operational data on air traffic activity under air traffic control at fixes throughout the New York Air Traffic Control Center (ARTCC) area, and to furnish data on the distribution, magnitude, and causes of delays encountered in such air traffic over a period of two designated "test" days: January 28, 1958 and February 28, 1958. The data collection and reduction were done by The Franklin Institute Laboratories under contract AMB-3.

O. M. Patton of the Aeronautics Branch, Franklin Institute Laboratories, was project leader through the contract period. Specific analytical phases reported in the section dealing with delays were performed and written by G. E. Cothren. Engineering services in the analysis of communications recordings were contributed by J. H. Brinton.

This project was supervised by R. S. Barnaby, Principal Engineer, and R. S. Grubmeyer, Head, Aeronautics Branch.

This report is designated F-A2123 by The Franklin Institute Laboratories.

ABSTRACT

This survey was performed for the Operations Analysis Directorate of the Airways Modernization Board to analyze traffic density in the New York Air Route Traffic Control area and to determine reasons for delays.

For the purposes of this survey, the area was divided into two parts: (1) the New York terminal area, comprising the space enclosed approximately by a circle of 50-mile radius centered at Idlewild Airport, and (2) the remainder of the NY ARTC area outside this circle. The area within the circle was surveyed by the Airborne Instruments Laboratory, and that outside by The Franklin Institute Laboratories. This report is confined to the latter.

While the original plan was to study four selected days of normal high density IFR traffic (NYARTC Center strip count over 9000), this was subsequently reduced by the sponsor to two test days plus one additional day of less detailed analysis.

Principal source data for this study were the flight progress strips from the New York Center, and from the peripheral centers of Boston, Cleveland, Pittsburgh, Washington, and Norfolk, supplemented by such routine communications recordings as were available and by Minifon recordings of a qualified observer in each center. The days selected for complete analysis were January 28, 1958, with a strip count of 11,252, and February 28, 1958, with a strip count of 9,650. The third day, investigated less thoroughly, was March 14, 1958, with a strip count of approximately 11,000.

On the days studied, 173 delays to 3418 aircraft occurred. Of those which occurred, 57% were in the Dover, Delaware area and were almost entirely to military aircraft from nearby bases attempting to be introduced into the already congested north-south arteries. In general, the diurnal concentrations of delays conformed to the variations of traffic volume, with the major peak in the late afternoon (1600-1700) and a small peak in midmorning (1000-1100 EST).

Only two cases of delays in the outlying centers caused by NY ARTC conditions were found. These were on the February day, when Boston had 14 New York-bound aircraft delayed and Washington 8, because of saturated altitudes in the New York area.

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SECTION I

Introduction

The objective of this project is to furnish AMB with analytical information that will aid in establishing a realistic concept of the flow of traffic throughout the system to provide source material for setting up simulation problems, and to provide means to better study needs for improvement in airways configuration.

The Franklin Institute Laboratories employed various methods for breaking down and collating data in determining air traffic density, finding delays, where and when they occur, and the reasons for such delays.

Traffic distribution patterns are disclosed by the use of instantaneous count charts made by calculating the position of each aircraft in the system at a given time from fix postings.

SECTION II

Gathering of Data

Data for this survey consisted of flight progress strips, interphone and air-ground-air recordings from the New York Center, and flight progress strips from the peripheral centers of Boston, Cleveland, Pittsburgh, Washington, and Norfolk. This information was supplemented by voice recordings of a qualified controller in each center commenting on the traffic situation during the test period.

The days selected for complete analysis were January 28, with a strip count of 11,252, and February 28, with a strip count of 9,650. The day selected for a less detailed comparison was March 14, with a strip count of approximately 11,000.

SECTION III

Reduction of Data

The survey data obtained from the collection of airport records, ARTC Center flight progress strips and communications recordings were used for both the delay and route density analysis.

The strips were first sorted by fix and hour sequence. With this strip arrangement, the first phase of delay analysis was performed, followed by further details gleaned from the communications recordings. The strips were further sorted into flights where the progress of each aircraft could be followed for the time it was in the system.

A. Instantaneous Count Charts

A series of charts showing the position of all aircraft in the system at 15-minute intervals over a period of 6 hours for the test day of January 28 appear in Volume 2. The legend on the charts shows the aircraft classification (commercial airline, military, civil itinerant), speed class (fast, medium, slow), direction of travel and the altitude block. The coding under the figure is the identity code referring to the line number in the raw data sheets. Since the entries in the data sheets sometimes straddled the hour, identification may have to be made by referring to a sheet labeled an adjacent hour. The digit above the symbol is the cleared altitude shown by the strip posting. The charts are scaled from Coast and Geodetic Survey Chart RF 34.

The hours in which are shown the instantaneous count in each 15-minute interval were chosen to cover a 5-hour build up just before and including the peak hour. Due to the similarity of the distribution pattern and the total traffic count, the 15-minute instantaneous

count charts were plotted for only one day, January 28. Data sheets are complete for both test days January 28 and February 28.

In plotting the charts the aircraft were located by calculating the position from fix postings. While most traffic represented overflights, those that were scheduled to land in the time scale covered by the charts are shown with a down arrow adjacent to the figures, indicating a landing at the next fix on his route within the 15-minute period.

Altitude blocks are indicated by coloring the aircraft symbol: black for altitudes up to 9000 feet, red 10,000 to 14,000, green 15,000 to 19,000, and blue 20,000 and above.

SECTION IV

Traffic Density Analysis

The traffic density analysis is displayed by use of the following material:

1. Data Sheets

Traffic density is determined entirely from the flight progress strips. Data sheets listing raw data transcribed directly from the flight strips are labeled with the hours they represent. Each entry in the fix column shows the strip posting and the cleared altitude. A line through the entry indicates an estimate only. The flight strip data sheets are bound as Volume 2 of this report. The fix postings and aircraft in the system for the two sample days totaled:

January 28	Fix Postings	Aircraft
Commercial Airlines	4611	1264
Military	1211	316
Civil Itinerant	891	274
Total	6713	1854

February 28		
Commercial Airlines	4202	1123
Military	1089	277
Civil Itinerant	793	164
Total	6084	1564

2. Fix Postings

The geographic distribution of fix postings and delays is shown in Volume 2 for 24-hour periods, January 28 and February 28.

3. Traffic Distribution

Traffic by hourly distribution is shown in Volume 2 on charts entitled, Hourly Distribution of Aircraft, center controlled and low altitude, January 28 and February 28.

4. Instantaneous Count Charts

The "instantaneous count," Charts 1 to 24 in Volume 2, show the position of all aircraft under control in the system at each 15-minute division of the hour: 00, 15, 30, 45, for the hours from 1200 through 1745.

5. Weather Sequences

Hourly weather sequences from all reporting points outside the terminal area also are given in Volume 2.

6. Low Altitude Data

Flight strip data, low altitude, January 28, appear in Volume 2.

7. Route Usage

Air route usage, January 28, is in Volume 2.

SECTION V

Delay Investigations and Analysis

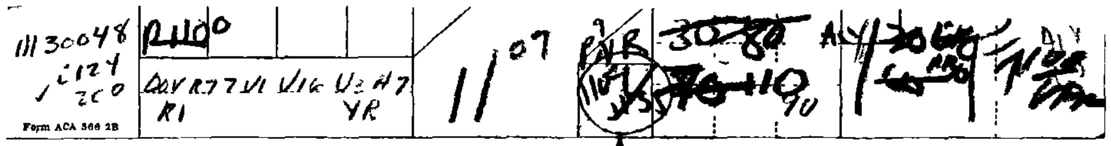
The delay investigations and analysis phase of the program was undertaken to examine the nature of the delays occurring within the NYARTC Center (exclusive of the fifty-mile circle discussed previously) on representative high-density IFR days. The delay investigation was set up to examine the number of delays, duration, cause and/or type, and the distribution of delays within the area. A further analysis was made of delays occurring in the ATC Centers adjacent to and encircling the NYARTC Center. This phase of the analysis was made to measure the effect of traffic and delays within the New York area upon the traffic inbound to the New York area from these surrounding centers.

This part of the report is presented in three sections. The first section outlines the methods utilized during the study. The second section presents the results and analysis and the third section is the conclusions and recommendations.

A. Methods of Analysis

The accumulation of the working data was based primarily on flight strips prepared by the NYARTC Center to control the aircraft within the New York area. Figure 1 is a reproduction of a typical flight strip when a hold was recorded. The circle labeled A indicates that the aircraft arrived at the fix at 1109, was held until 1135 and then departed. This information was the most clear-cut indication of a hold. In some instances, where the markings were incomplete, confusing or unreadable, it was necessary to calculate time intervals between successive fixes based upon aircraft speed to confirm the existence of a hold. It should be noted that the letters H W1RT (Hold West. One Minute Right Turn) on a flight strip indicate only

the possibility of a hold. Frequently, the traffic pattern changes before the aircraft actually arrives at the fix where it is to be held and the aircraft can then be cleared through the fix without being delayed.



AREA CIRCLED AND MARKED "A" INDICATES DELAY "A"

Fig 1 - Typical Flight Strip

A supplementary source of information was the recordings made by the Center senior controllers on "Minifon" wire recorders. These are recordings of comments by the controllers concerning the air traffic flow throughout the day at the NYARTC Center and the outlying Centers.

A third source of information was the land line communications recorded at the NYARTC Center. Both the wire recordings and the land line communications uncovered additional delays that had not been recognized during the initial strip surveys. Correlation of the additional holds noted in the recordings with the flight strips was readily accomplished in most cases.

With the tabulation of the list of delays substantially complete, reasons for the delays were sought using the flight strips, wire recorders, and the land line communications in a complementary manner. The flight strips were used initially to reconstruct the traffic picture as it influenced the delayed aircraft at the time of delay. This procedure proved fruitful in establishing reasons for delay. It was however, subject to limitations. The principal disadvantage was the problem of establishing exact altitudes of all the aircraft involved as a function of time. The procedure of crossing out old altitudes and noting new altitudes serves the controller admirably well as the air traffic picture actually develops, but makes reconstruction of the picture to the desired degree of accuracy impossible in many instances.

When reconstruction of the traffic picture from the flight strips did not yield reasons for the delay, the land line communications and wire recorders were checked for additional information. It was found that the land lines contributed useful information to evaluate reasons for delay but that the wire recordings added relatively little. Unfortunately, one vital link in the overall control process was not supplied by the land lines. This missing link is the intercommunications among controllers at the ATC Center itself. It is apparent from listening to the land line communications that instructions to stand by are frequently given by the Center controller. The controller then checks the current traffic picture with other controllers whereupon he then issues the appropriate clearance. The underlying reasons for the clearance are lost in this interlude. This, of course, is a recognized technique due partly to the desire to minimize conversations and, more importantly, to eliminate that for which there is no need in air traffic control procedures.

A considerable amount of information was obtained from the land lines despite the disadvantage mentioned above, the poor quality of many of the land line recordings, and the tedious, time-consuming process of listening to them. In addition, the land lines contributed to the establishment of the "Probable Reason if UX (unexplainable)" column in the basic working Table I. This column was established as a supplement to the "Type of Delay" column in Table I. In brief, this column indicates the probable type of delay that was encountered when the type of delay column has an unexplainable symbol entered in it. The column is, in essence, an educated guess, based on whatever information was gathered and the general characteristics of the particular fix.

The wire recordings were found to be of little value with the exception of the recordings made in the Boston ATC Center. The recordings made in this center proved to be of value in the studies and indicate that recordings made in this manner can be a useful research tool. A discussion of this approach is given in Section VII, Recommendations, and will not be considered here.

To present the data resulting from this study, the basic working sheet, Table I, was evolved. The key information contained within this table is labeled "Delay Information." The remainder of the table, though pertinent, is of somewhat lesser importance. The descriptive titles used throughout the table are self-explanatory with the exception of the "Type of Delay" column which requires definition.

For the purposes of this presentation, holds are considered in broad classifications such as transition delays and enroute delays. The categories are then broken down into subclassifications to enable a somewhat finer classification of the delays.

The terminology "transition delay" will cover the delays involved when handling departing and arriving aircraft at an airport and will exclude consideration of delays involving either ground handling or approach control operational procedures. When the term transition delay is used in this report, it means that control is primarily in the hands of the Center rather than approach control. The sub-breakdown of transition delays further indicates the intent of the definition. The classification "tower imposed delay" will be used to encompass ground handling and approach control delays.

The enroute delay classification, when initially considered, was designed to identify specific types of enroute delays. It was found that a breakdown of that nature could not be made because of the uncertainty of the precise nature of the holds. Therefore, the enroute delays were broken into the two classifications as shown. The 2B classification could only be inferred from the sense of the land line communications that were listened to, hence, will only be found in the "probable" column (with one exception).

B. Types of Delays

The classes of delay are defined as follows:

1. Transition Delays

   (a) Transition arrival holds: these are holds when, because of existing conditions at the airport, aircraft must hold awaiting clearance to land. This type of hold may occur at the destination or at a fix prior to the destination.

   (b) Transition departure holds: these holds occur when an aircraft is allowed to take off, rather than hold on the ground, cleared generally, to a relatively adjacent fix. At the fix, the aircraft may execute a climbing hold to its desired altitude and then depart, or it may simply hold awaiting further clearance instructions.

2. Enroute Delays

   (a) Converging conflicts: where two (or more) aircraft are approaching a common fix and separation standards require one (or more) aircraft to hold, or to hold while changing altitude in order to proceed.

   (b) Communication holds: where it is thought from the land line communications and the flight strip information available that the delay was basically the time lag required to enable the Center to co-ordinate the clearance.

3. Tower Imposed Holds

   (a) Terminal ground holds: permission to take off denied because of lack of airspace in the ATC system.

   (b) Approach clearance holds: when the particular tower has primary control over the aircraft's approach and the holds were found in the flight strips prepared by the tower.

Delays for which no reason can be ascertained are classified as unexplainable (UX).

It will be noted that delays, as defined above, must be interrelated in many cases. As an example, a hold which is classified as a transition departure hold may also be an enroute converging hold once the aircraft arrives at the hold fix and cannot proceed. This report will assign one reason for the hold. The reasoning behind this philosophy is based upon the thought that a minimum, but adequate, number of basic reasons for delay enables a better overall understanding of the total picture than would a more involved breakdown of the reasons for delay. In the case of the example cited above, it will be readily apparent that a transition delay in excess of about five minutes indicates that airspace is simply not available.

To illustrate the techniques employed in the analysis, specific examples of hold analyses were prepared and are contained in the Appendix. The thought of preparing thumbnail sketches of the reasons for all of the delays was considered and dismissed because of the following. First and foremost was the fact that specific details would be of relatively lesser value for the primary objectives of this report and, furthermore, probably lost in a massive confusion of words. Secondly, though the basic reasons could be deduced with a reasonable degree of accuracy, they could not be verified in every instance because of the uncertainties mentioned previously.

C. Results and Analysis

The primary purpose of this phase of the program was to furnish the Operations Analysis Directorate with data to evaluate the overall structure of delays occurring within the NYARTC Center exclusive of the 50-mile circle around the New York Metropolitan area. An analysis of this nature is intended to uncover inadequacies within the transportation network so that corrective measures may be taken if the results indicate that necessity. Equally important benefits are derived in that the results can be applied to other analogous systems and also can serve as a basis to forecast the probable results if the system were to be expanded to meet future demands upon it.

With these objectives in mind, the delay investigation of the days chosen by AMB for analysis was accomplished. The significant points noted in the analysis are summarized below and are amplified in the ensuing discussion.

The general characteristics of the January 28th and February 28th days were similar and, therefore, are considered as a whole as much as possible. The March 14th day was examined in a "once over lightly" vein. Hence, the data of that day is treated only in a rough comparative manner.

January 28, February 28 Days

1. Of a total of 3418 aircraft flying on these two days, 173 aircraft were delayed, 89 on January 28th and 84 on February 28th. Of this number, 60% were military aircraft, 28% air carrier, and 12% general aviation.
2. 98, or 57% of the total delays occurred in the area bounded roughly by the Coyle (CYN) and Dover (DOV) fixes at the northerly and southerly extremities and by the airways Victor 16 (V16) and Victor 1 (V1) on the west and east.

The delays in this area were predominantly military aircraft (82 of the 98) and were caused by the difficulties of introducing aircraft operating from military air fields such as Dover, into the heavily congested V16 and V1 airways, principal arteries linking New York City with southern terminals.

3. The remaining 43% of the total delays scattered throughout the NYATC Center area was considered to be of a small magnitude in relation to the volume of traffic; 34 delays on January 28th and 41 delays on February 28th.

Neither this total nor the distribution is considered of any significant importance from a practical point of view other than to indicate that the ATC system was performing adequately. The delays were spread over a large geographical area with no significant concentration of delays occurring at any fix or within any localized area.

4. Along the periphery of the 50-mile-radius circle surrounding the New York airports, no holds were given to inbound traffic by the NYARTCC.
5. Delays induced by New York traffic conditions, to aircraft entering the NYARTCC area from the encircling centers, were virtually non-existent with two specific exceptions. The Boston and Washington ARTC Centers had to hold 14 and 8 aircraft, respectively, on February 28 because New York could not accept them.
6. The median length of delay for all holds within the NY Center was found to be 7.6 minutes and the mode was 8 minutes.
7. The distribution of total delays throughout the area as a function of time shows the maximum number of delays per hour occurring from 1600 to 1700 reflecting the time of day when traffic density is greatest, the late afternoon period. During this interval, the January 28 delays totaled 15, the February 28 delays totaled 12.

The March 14th day exhibited the same characteristics as the January 28 and February 28 days with the exception of the traffic pattern in the Coyle-Dover, V16, and V1 area.

8. In the Coyle-Dover area, the number of military delays diminished from about 40 per day to 11. This fact roughly accounts for the differences between the January 28-February 28 days and the March 14 day and appears to delineate the reason for the total number of delays dropping from about 85 to 50 and the percentage of the total delays that were military aircraft dropping from 60 to 30 per cent.

The days chosen for delay analysis by the Airways Modernization Board were high density, IFR days when there were no serious breakdowns in any part of the ATC system nor were there any airports not continually open. These conditions establish an operational framework which would be expected to prevail an appreciable part of the time considering weather conditions in the area and expected heavy density air traffic conditions. Therefore, the significant points summarized above serve as an outline of the delay picture that might be expected from these particular conditions. Of these significant points, two salient characteristics emerge: (1) the small number of total delays and (2) the concentration of a large percentage of the delays in the Coyle-Dover area.

The breakdown of delays by fix, aircraft type, and nature of delay is shown in Table II. This table is a summary of the data shown in Table I. At the bottom of the table, two subtotals and the totals are shown. One subtotal summarizes the total delays in the Coyle-Dover area, the other, the fixes in the remainder of the NYARTCC area. Hereafter, the Coyle-Dover, V16, V1 area will be referred to as the C-D area and the remainder of the New York area will be referred to as the X area for simplicity. Figure 2 shows a map of the entire area where the Coyle-Dover area is delineated by the dashed line. The C-D area will include the following fixes by definition: Salisbury (SBY), Woodstown (OOD), Kenton (ENO), Dover (DOV), Port Norris (PNR), Atlantic City (AIY), Millville (MIV), Newfield (NFD), Elmer (ELR), Vineland (VIN), and Coyle (CYN). These fixes have the common denominator of being affected primarily by the traffic along airways V16 and V1. The delays in area X were relatively few and exhibited no significant characteristics with one minor exception. Hence, the delays in that area are grouped as an entity for discussion purposes.

As can be seen in Table II, the total delays on January 28 and February 28 were 89 and 84, respectively. The overall totals by themselves, are regarded as low. The distribution of the delays into areas C-D and X, however, presents a much clearer perspective of the entire picture. This perspective shows the large number of delays that were concentrated primarily in the C-D area with relatively few occurring in the X-area.

1. Coyle-Dover Area

Within this relatively small geographical area, 57% of all the January 28th and February 28th delays occurred. The aircraft delayed were principally military aircraft operating from military airports in the area. The basic reason for delay was the fact that V16 and V1, the North-South airways shown on Figure 2, were heavily loaded on these days and the military aircraft had to await openings in the airspace before they could depart. Furthermore, the duration of this type of delay was frequently of an appreciable magnitude in contrast to the duration of delays suffered by aircraft that were delayed on overflights.

In the Coyle-Dover area, Table II shows that the Dover airport was the main trouble spot in the area; 46 delays were directly centered at the Dover (DOV) and Port Norris (PNR) fixes. The DOV fix is adjacent to DOV AFB and the PNR fix is 24 nautical miles away from the DOV fix on Red airway 77 which connects the two fixes. The procedure followed by the NYARTC Center and the DOV tower is to use the PNR fix as a supplemental "transition departure fix" to the DOV fix. It may be noted that PNR is used for North and Southbound traffic on both V16 and V1. When air traffic is heavy and the airspace available on V16 and V1 is limited, military aircraft departing (and a few arriving) DOV AFB are cleared to PNR at generally low altitudes, 3000 to 5000 feet, with instructions to hold and await further clearance. When airspace becomes available, the aircraft are cleared to the proper altitude at PNR and injected into the system. Examples of the PNR delays are included in the Appendix.

This method of control apparently works as well as could be expected, especially since the Air Force is not averse to holding in the air in order to be in position to enter the system at the earliest opportunity. However, the number and length of delays at PNR and DOV, plus the contribution to the total density of aircraft on the airways made by the military aircraft operating in this area, focuses attention on this known critical area.

The area is admittedly beset by complex factors. However, it appears that serious attention should be given to the possibilities of establishing a bypass airway around CYN to handle traffic to and from New England. A bypass route, if feasible and properly integrated into the airway structure, could ease appreciably the heavy density on V16 and V1 which is the basic cause of the military delays.

2. X-Area

The delays in the X-area averaged 37 per day and were generally quite scattered throughout the area with no significant concentrations such as occurred at PNR and DOV. This fact is shown by the delay map of the NYARTC Center and the bargraph, Figures 2 and 3, respectively. With the exception of the Harrisburg (HAR), Williamsport (IPT), and Binghamton (BGM) fixes, the delays averaged about one to two per fix per day at those fixes where delays occurred.

The HAR, IPT, and BGM fixes were the only ones in the X area that had more than three delays per fix per day. The delays at these fixes for the two days can be summarized as follows:

		Type	
Fix	Total Delays	Landing	Enroute
HAR	13	8	5
IPT	9	8	1
BGM	7	5	2
Totals	29	21	8

The number of delays occurring at these fixes is considered to be of no important consequence. This is particularly so because of the nature of the delays as well as the limited number. As may be seen above, 21 of the 29 delays were of the landing type. This indicates that the delays were predominantly local-to-the-fix in nature and were caused by the normal problems of landing aircraft in IFR weather rather than delays caused by an inadequate or overloaded ATC system.

The landing delays at the IPT fix were caused by the fact that aircraft landing at the Williamsport Airport had to await landing clearance from the Center, as there is no tower at this airport. It is therefore likely that delays of this nature at the IPT fix will continue. However, the small number of landing delays noted on this survey (4 on each day) on a heavy IFR day is apparently of little concern. The HAR and BGM airports are both controlled by towers, hence, are not affected by this particular problem.

In the Examples of Delay Analysis presented in the Appendix paragraphs e and f, examples of the delays that occurred at the IPT and BGM fixes are given. The IPT delays present an example of backup delays that extended to adjacent fixes. This was the only example of a significant jam occurring within the entire X area on either the January 28 or February 28 day.

The distribution by type of the remaining 46 X area delays is shown below where the HAR, IPT, and BGM delays are included:

Fix	Total Delays	Type* Landing	Enroute	Transition/ Tower Imposed**	UX
HAR, IPT, BGM	29	21	8	0	0
Remaining X-Area	46	7	21	13	5
Total X-Area	75	28	29	13	5

* All delay totals include the probable reasons for delay.

** Transition/Tower Imposed delays other than landing delays.

The entire delay picture of the NYARTCC area by type of delay is shown in Table II.

The delay data were treated using statistical methods, as shown in Figures 4, 5, and 6, to ascertain the trends of the data with respect to the duration of the holds. Figures 4a and 4b show the frequency distribution of the delays on January 28 and February 28, 1958. As may be noted, the modes (equal to 8 minutes) and the medians (equal to 7.6 minutes) were the same on both days. Significance tests performed on the distribution curves showed no significant difference between the curves at the 95% significance level.

The delay data were then broken down into two main catagories, enroute delays and transition/tower imposed delays, as shown in Figures 5a and 5b. The purpose of this breakdown was to determine if there was any appreciable difference in the length of delay when comparing enroute to transition delays. The results were inconclusive. As may be seen, the February 28 enroute and transition delays were different in both the mode, 3 and 8 minutes, respectively, and in the median, 4.8 and 12 minutes, respectively. However, in the January 28 enroute and transition delays, the mode was the same (8 minutes) and the median was the same (7.7 minutes) for each type of

delay. The reason for these differences in the two days is not known and more data of a like nature is required to resolve the discrepancies.

It should be noted that the January transition and enroute data were tested at the 95% confidence level and no significant difference was found. In contrast, the February transition and enroute data were found to be significantly different at the 95% level. The difference between the January data and the February transition data was tested at the 95% level and found to be insignificantly different but only by the barest margin. (At a level of 90%, the data were significantly different.) The February enroute data in comparison to the January data were found to be significantly different at the 95% confidence level.

The frequency distribution of the Port Norris (PNR) delays was plotted in Figure 6. These delays were all transition in nature and of particular interest because of the concentration of delays in that area. In this case, the mode (about 6 to 6-1/2 minutes) is of lesser importance because the curve is somewhat of a flat-top nature. However, the median values, 12.8 minutes of the February day and 10.8 minutes on the January day, are appreciably higher than the median values of 7.6 minutes for the total delays of the January and February days. Furthermore, the PNR median values agree closely with the median value of 12 minutes for the February transition delays, indicating, to some degree, that the February data shown in Figure 5 may be more representative than the January data.

Distribution of the delays as a function of the time of day is shown in Figure 7. The distribution is bimodal in nature with a peak in midmorning during the 1000 to 1100 hours and a peak in late afternoon during the 1600 to 1700 hours. The late afternoon peaks of 15 delays on the January day and 12 delays on the February day are greater than the midmorning peaks of 10 and 6 delays, respectively. The afternoon peaks reflect the time of day when traffic density is greatest.

Delays in the outlying centers caused by NYATC conditions were of an appreciable magnitude only in the Boston and Washington Centers and only on the February day. The Boston Center had 14 aircraft delayed on flights inbound to the New York Airports and over the New York Metropolitan area. The delays were caused by saturated altitudes in the New York area.

At least three of the delayed aircraft could not accept clearances at altitudes of 10,000 feet or higher because of nonpressurized aircraft. However, it should be noted that the Boston wire recording reported moderate to heavy traffic up to 18,000 feet entering the New York area, indicating that regardless of aircraft capabilities, altitude saturation was approached from time to time.

The Washington Center held 8 New York bound aircraft on the February day. The delays were a direct result of the heavy northbound traffic on V16, V1, V123, and the low frequency airways. This condition caused the NYARTC Center to impose a flow restriction of thirty-minute separation between two aircraft at the same altitude before entering the NYARTCC area from the DCA and ORF Centers.

SECTION VI

Conclusions

The results indicate that, on high density IFR days within the NYARTC Center area, exclusive of an area contained within a fifty-mile-radius circle surrounding the New York Metropolitan Airports, an appreciable number of delays occur only along the heavily traversed coastal airways between New York City and southern terminals. Furthermore, the delays in this area were concentrated in the vicinity of the Dover navigational fixes and were characteristically suffered by military aircraft. The delays were basically caused by the difficulties of introducing these military aircraft, operating from military airfields within the area such as Dover AFB, into the highly congested coastal airways of the ATC system.

The number of delays throughout the remainder of the New York Center's geographical area were relatively few and widely scattered, with no significant concentration of delay. Also, delays induced by traffic conditions within the New York Center area to aircraft entering the New York area from the encircling centers, were virtually nonexistent with two relatively minor exceptions. The Boston and Washington Center had to hold 14 and 8 aircraft, respectively, on February 28 because New York could not accept them.

The median length of delay for all holds within the New York Center was found to be 7.6 minutes and the mode was 8 minutes. The maximum number of delays per hour, 15 on the January 28 day and 12 on the February 28 day, occurred during the 1600 to 1700 hour and reflect the time of day when traffic density is greatest, the late afternoon period.

The March 14th day, examined in a "once-over-lightly" vein, exhibited the same characteristics as the January 28 and February 28 days with the exception of the delays in the vicinity of the Dover fix. On this day, the military delays in the Dover Area were 11 instead of 40 which roughly accounted for the total number of delays dropping from around 87 to 50 on the March 14 day.

SECTION VII

Recommendations

The airway structure and traffic patterns in the Coyle-Dover area should be examined thoroughly. Though additional information may be required concerning the frequency of appreciable delays in this area, the area is generally known to be a troublesome region. An analysis of the data contained within this report, possibly emphasizing the origins and destinations of the traffic in this area along with other considerations, would be expected to suggest methods of eliminating or alleviating the basic problems. As an example, a check of the January 28th fix postings over Coyle indicate one possible approach to a solution of the delay problem in this area. Of 345 total aircraft postings over Coyle, approximately one-third of the aircraft involved were going to or coming from the New England area and had no interest in the NY terminal area. This fact suggests that a bypass route around Coyle to handle this traffic should be considered in an exhaustive analysis of the region.

It is recommended that the AMB consider means to secure answers to the following questions that naturally arose upon completion of the investigations reported herein:

1. A delay structure has been established for heavy density IFR days with all ATC system components functioning properly. How often do these conditions occur and are they a function of the season of the year?
2. Has the voluntary filing of flight plans by air carriers and the military since June 1958 affected the basic delay structure on VFR days and if so, how does the structure compare to the heavy density IFR days?
3. How is the delay structure affected when equipment malfunctions occur, such as the loss of a Center's radar or the closing of runways at a heavily used key airport? How often do these various conditions occur individually and collectively?

It is understood that the Operations Analysis Directorate of the AMB is conducting an operations analysis of the ATC system. Such an analysis can be expected to yield parameters and standards of comparison with which the efficiency of the ATC system can be judged. The accomplishment of this work is endorsed by The Franklin Institute Laboratories as no standards of comparison presently exist by which the results of this investigation can be quantitatively and qualitatively judged. In addition, it may be noted that the results of this work will be a valuable aid in the future planning of ATC systems.

Dependent on the scope and objectives of this operations analysis task, some recommendations with respect to this task might be considered by the AMB. Complete study of the complex ATC system will require an appreciable amount of time before applicable results are obtained. Therefore, it may be wise to consider individual elements of the system with the view in mind of providing parameters which can be used in the immediate future when examining the results of this investigation and others of a like nature to be conducted within the next six months. As a brief example of this individual element approach, the Dover-Port Norris delay area may be cited. In this instance, a correlation factor might be found that would predict the number of delays to be expected at Port Norris and Dover as a function of the volume of traffic flowing over the Victor 1 and Victor 16 airways and the amount of traffic emanating from Dover AFB.

This particular example was not chosen because of its effect solely on the New York traffic picture. Rather, it was chosen because the parameters that might result from analyzing this situation, the feeding of aircraft into more or less heavily loaded airways from a nearby military airfield, would be applicable to the other centers that are to be investigated. It would be, of course, imperative that other elements of the system chosen initially for analysis satisfy this criterion.

The methods of analysis employed in this study were adequate to enable a quantitative survey of the number of delays, their magnitude, and the general causes of delay. And the results present a representative picture of the delays and their distribution throughout the area that would be expected on this kind of an IFR day: heavy traffic and all ATC equipment functioning at close to 100% capability.

Future investigations of this nature, however, should consider the limitations noted below when planning analysis of the operations of other ATC Centers.

The flight strip is an operational tool rather than a data gathering instrument. As such, it reveals certain information as to what happened but not, necessarily, when and why. Therefore, additional information must frequently be sought from the land line communications to assist in the analysis. The communications, though helpful, generally did not contribute much more information concerning the causes of delay than did the strips, for the reasons discussed in the Methods of Analysis section. In addition, a relatively tremendous amount of time must be spent to secure whatever information the communications might contain.

In order to make a thorough and exhaustive analysis of the operations of a center, a complete communications monitoring system co-ordinated with a continuous photographic reproduction of flight boards would be desirable. A system of this nature, however, is impractical for many reasons when considered for this particular application. Therefore, the expanded use of senior controllers equipped with wire recorders should be considered when detailed information is required.

The disadvantages of using CAA personnel in this manner are recognized inasmuch as normal operations are interfered with to a certain degree. However, experienced controllers, providing pertinent remarks at known trouble areas (such as the PNR-DOV area in the

NYARTC Center) concerning the delay situations as they are unfolding, would contribute to the operational analysis of delays in two important respects. One, they would allow an appreciable shortening of analysis time by directing attention immediately to the particular aircraft and/or situation involved. And two, qualitatively, the results would be less subject to the interpretations of the analyst where positive knowledge was supplied by the controller.

The wire recordings made by the Boston Center in this investigation indicate the usefulness of this tool. The delays were noted by aircraft identification, fix, and time, from which the strips were quickly located and verified. Also, the cause of delay was noted in each of these instances. Wire recorded information from the New York Center was much more limited in usefulness as far as delay analysis was concerned. This appeared to be due to two factors which should be stressed in further work of this type:

1. The delay analyst should thoroughly indoctrinate the specific individuals who are to do the recording.
2. In a center of the magnitude of the New York Center at least two and possibly as many as four controllers (during the busy part of the day) should be used to thoroughly cover all center activity.

O. M Patton
Project Engineer

Approved by:

R. S. Grubmeyer
Head, Aeronautics Branch

Lewis P. Tabor
Technical Director

Nicol H. Smith
Director of Laboratories

APPENDIX

Examples of Delay Analyses

This section contains summary analyses of various delays that occurred within the NYARTC Center on February 28, 1958. The delays shown are generally regarded as representative of the delays that occurred except as otherwise stated.

The delay numbers refer to Table I. Aircraft identification such as V7198 and MATS 51165, will be written as it appears in Table I when the identification first appears. Subsequently, abbreviations such as V-98 and M-65 will be used.

a. Delay Numbers 3, 4, 12, 13, 14, 41, and Norfolk Center Delay Number 1:

V7198, enroute from Norfolk to Rhode Island, was delayed at NHK (South of SBY in the Norfolk Center) by the 30-minute rule in effect at that time: aircraft entering NYARTC from ORF ATC must be separated by 30 minutes at the same altitude. AF16075 was at SBY 1007 and 9000. V-98 arrived SBY 1037 at 9000 by delaying 9 minutes at NHK.

MATS 51165 departed DOV AFB 1032 cleared to hold at 3000 feet at PNR. MATS 30039 departed DOV 1040 to hold 2000 PNR. The 15-minute delay suffered by M-39 on the ground at DOV would be due, in part, to M-65 plus the controller's knowledge that V7198 would be at AIY at the same altitude and time as M-39, if M-39 had not been held. MATS 30048 departed DOV 1100 to hold 3000 PNR and was initially ground-held because of M-65 and M-39.

M-65 departed PNR 1050 at 10,000 after his 1041 arrival at PNR, indicating a 9-minute delay. The delay was primarily a 7000-foot climb delay. M-39 at PNR 1050 and 2000, departed PNR 1130 and 9000. The initial portion of the 40-minute hold was caused by M-65, V-98, and climbing; the latter stages, by unknown factors.

M-48 at PNR 1109 and 3000, departed PNR 1135 and 11000. The initial portion of delay was caused by M-39 and climbing; the latter stages by E658 CYN bound on V1 at 11000. M-48 was then cleared to AIY VFR on top arriving AIY at 1140 where a 14-minute hold resulted because of X623. X623 was CYN-bound from ENO via V16 at 11000. X623 arrived CYN at 1148 and 11000. M-48 then arrived CYN at 1200 and 11000.

The concise explanation of the delays above is described in somewhat greater detail below. This example serves to illustrate some of the characteristic difficulties that were encountered in attempting to deduce the reasons for delay from the available communications and flight strips.

When M-65 departed PNR at 1050 and 10,000 feet, apparently M-39 could have been immediately cleared to 9000 feet, his desired altitude as indicated on his flight strip. Instead, he was initially cleared to 7000 then later to 9000.

The reasons behind this might have revealed why M-39 was not cleared at approximately 1110 to depart PNR at 9000. As noted, M-39 departed 1130 leaving 20 minutes unaccounted for in the analysis.

The flight strip of M-48 indicated a desired altitude of 9000. However, he was cleared ultimately to 11000 feet where he was delayed twice by heavy density at 11000. If M-48 had remained at 9000, he could have departed PNR 1120 behind M-39.

No hint of the reasons behind the particular handling of these aircraft could be found from the land line communications or the flight strips which illustrates the limitations imposed by this method of analysis. Although two or three satisfactory answers could readily be proposed to fit the example above, they would of necessity be presumptive and of no practical value for the purpose of this report.

b. Delay Numbers 26, 27, 28, and 40:

This delay analysis, involving M30031, M1171, and AF72605, was the only example of a "lost aircraft" delay phenomena affecting the NYATC Center operations on either the January 28 or February 28 days.

M30031 departed DOV 2053 cleared by ATC to HSW PNR maintaining 5000 and arrived PNR 2104. M1171 departed DOV 2059 cleared by ATC to HSW PNR maintaining 4000 and arrived PNR at about 2110. ATC then cleared M-31 to climb to 10,000 VFR whereupon M-31 said no, unable to climb 5 to 7000 VFR. ATC then inquired if MIV or DOV could raise AF72605 coming in from the ocean via the South Milville (XSV) fix; the answer was negative. ATC then cleared M-31 to maintain 5000.

One minute later, AF-05 reported XSV estimating MIV 2131. ATC immediately cleared M-31 to 10,000. M-31 subsequently reported, during his climb, another aircraft at the same altitude over PNR. ATC's immediate reaction was: "What's that?!!". Upon reconfirmation of the two aircraft at the same altitude, ATC went into fast action and (1) cleared M-31 to maintain 6000 and (2) cleared AF-05 to reverse course and return to XSV. During this action, ATC stated that the only other aircraft at PNR now is M-71 and he is at 4000. In the background of the land line communications at this time, a hubbub of activity could be heard that was pertinent but was not intelligble.

M-31 apparently reached 7000 before the ATC clearance to maintain 6000 was delivered. ATC, after being informed of M-31 holding at 7000, then cleared M-31 to the MIV low frequency range station via PNR direct maintaining 7000. AF-05 was then cleared to the MIV low frequency also, maintaining 6000.

The last two clearances indicated that ATC was again in complete cognizance of the situation though no explanation came through on the communications. M-71 was checked on a CYN flight strip as arriving CYN 2130 and 9000. This information, coupled with M-71's DOV departure time (2059), makes it quite certain that M-71 was the aircraft encountered by M-31. It is not known why M-31 was at an altitude other than the 4000 he should have occupied at PNR.

AF-05 was subsequently delayed again at OOD. The cause of this delay was E39 on a southbound flight crossing the ESR fix 2146 at 6000. AF-05 crossed the ESR fix westbound at 2159 and 6000 by delaying five minutes at OOD.

c. Delay Numbers 34 and 37:

A376 held 13 minutes at VIN from 1812 to 1825 at 9000 feet on a northbound flight via V16 and CYN, because of V6538 at CYN 1824 and 9000. A376 would have arrived CYN 1821 at 9000 but arrived 1834 at 9000 because of the hold which maintained required separation.

A324 departed PHL airport 1800 cleared to HSWILT (Hold Southwest One Minute Left Turn) at 4000 feet. A324 arrived OOD 1807 and was cleared to 9000 though 11000 was desired. Clearance could not be given because of OOD traffic at 11000, hence, A324 climbed to 11000 enroute to VIN. (9000 was blocked at VIN because of A376 above necessitating the enroute climb). A324 could not leave OOD to achieve 11000 at VIN and proceed northbound on V16 until S-322, also northbound on V-16 at 11000, was known to be 10 minutes, or more, ahead of A324.

d. Delay Numbers 57, 59, 67, 68, and 69:

P574 arrived SEG 1428 enroute to IPT at an ETA 1438. Land line communications stated that P574 was cleared to HW SEG 1RT (Hold West of SEG, One Minute Right Turn). The SEG strip did not show the duration of the hold at SEG but from his arrival time at IPT 1452, a 10-minute hold at SEG can be calculated. The reason for this delay could not be firmly established but is believed to be associated with an ETA 1445 of L607 landing at IPT. Flight L607 ultimately arrived after P574 at 1455 and had to hold 15 minutes while the center cleared P574.

T484 had a 5-minute delay awaiting clearance to land at IPT because of P574 landing ahead of him.

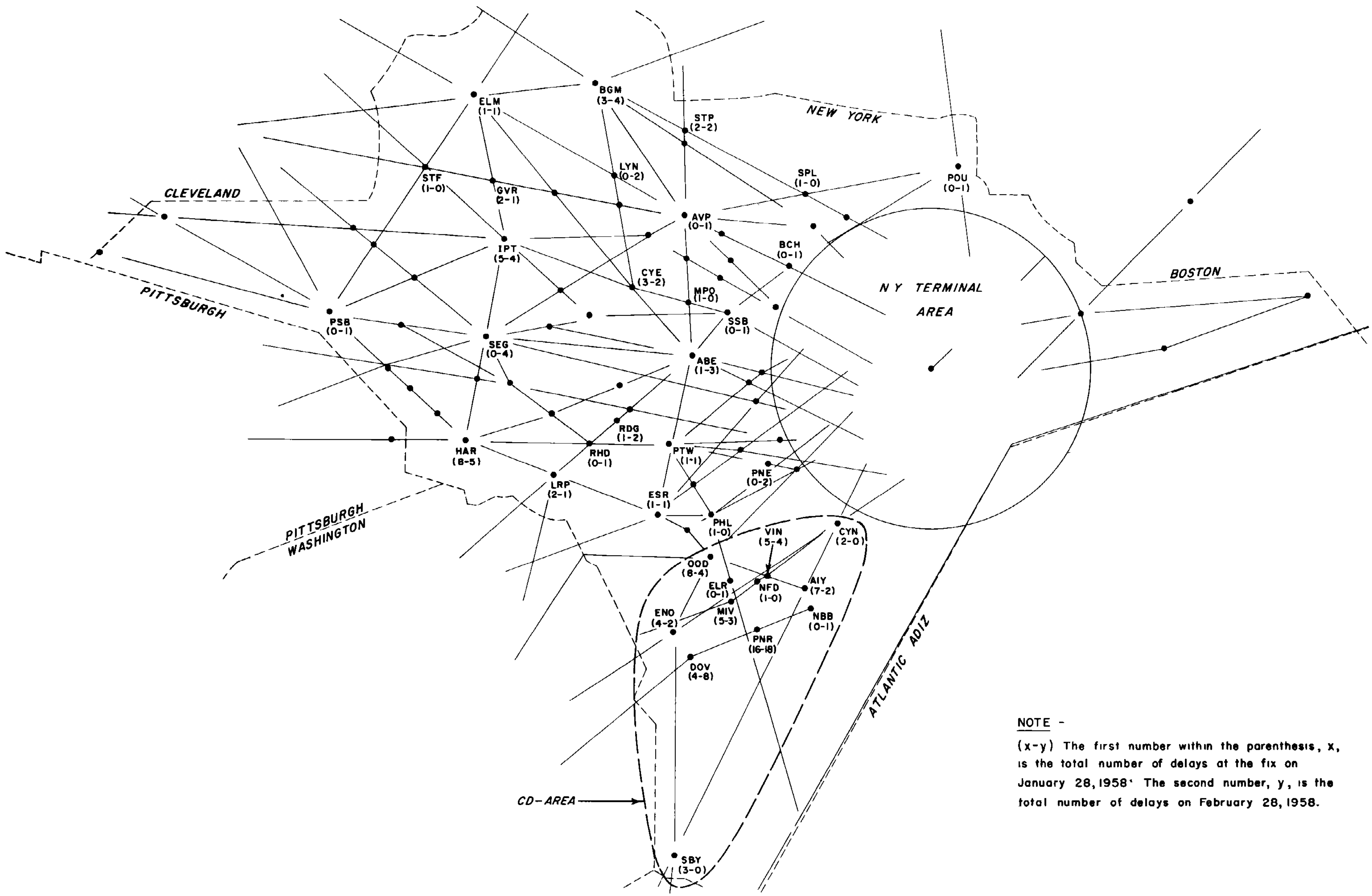
L7 departed HAR 1509 and arrived SEG at about 1523 where he was held for 20 minutes because of P574 and also T484 following P574 as mentioned above. Inasmuch as the center knew that L7 would have to wait an appreciable amount of time, they finally detoured him to Berwick to free the 4000-foot altitude at SEG. (To do this, it was necessary to climb him from 4000 to 5000 feet enroute SEG to BER). Upon arrival at BER at 5000, he was immediately cleared to IPT arriving 1608 at 5000 where he was then held 3 minutes longer awaiting clearance to land. In actuality, L7 was delayed a total of 33 minutes rather than the total of 23 minutes at IPT) shown in the table. The 10-minute difference, of course, being due to the imposed detour.

e. Delay Numbers 66 and 70:

P567 is perhaps not properly classified as a delay in view of the following reconstruction. P567 departed IPT 1806 bound for ROC via GVR. It appears from the strips that he was held over the IPT low frequency range outbound for approximately 10-minutes based on his GVR arrival time of 1825. He then held at GVR 10-minutes whereupon he returned to IPT instead of continuing to Rochester and landed. No reason for this return to origin was obtained from the communications or the flight strips.

f. Delay Numbers 78 and 79:

AF06662 inbound from the west at 6000 feet to land at BGM was cleared to HW BGM omni on V72 at 1651 and 6000 by the NY Center. M5 inbound from the southeast (Newark) at 6000 feet to land at BGM was cleared to HSE of the BGM radio beacon at about 1652 by the center. Both aircraft were then truned over to BGM approach control who cleared M5 to land first. M5 then missed two landings at BGM and apparently gave up as the tower strips then show him departing for Ithaca. BGM approach then cleared AF06662 to land after a delay of 27 minutes.

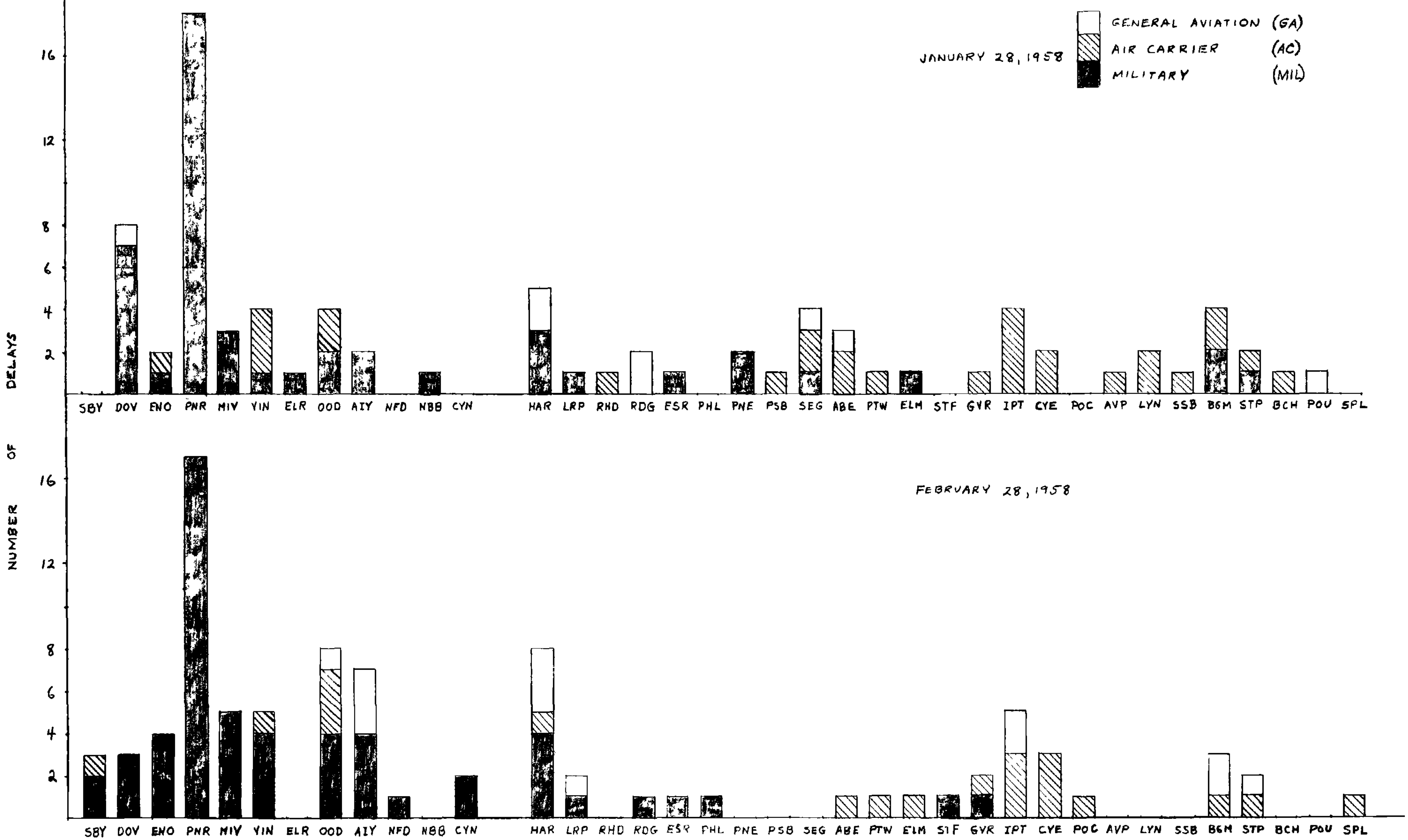


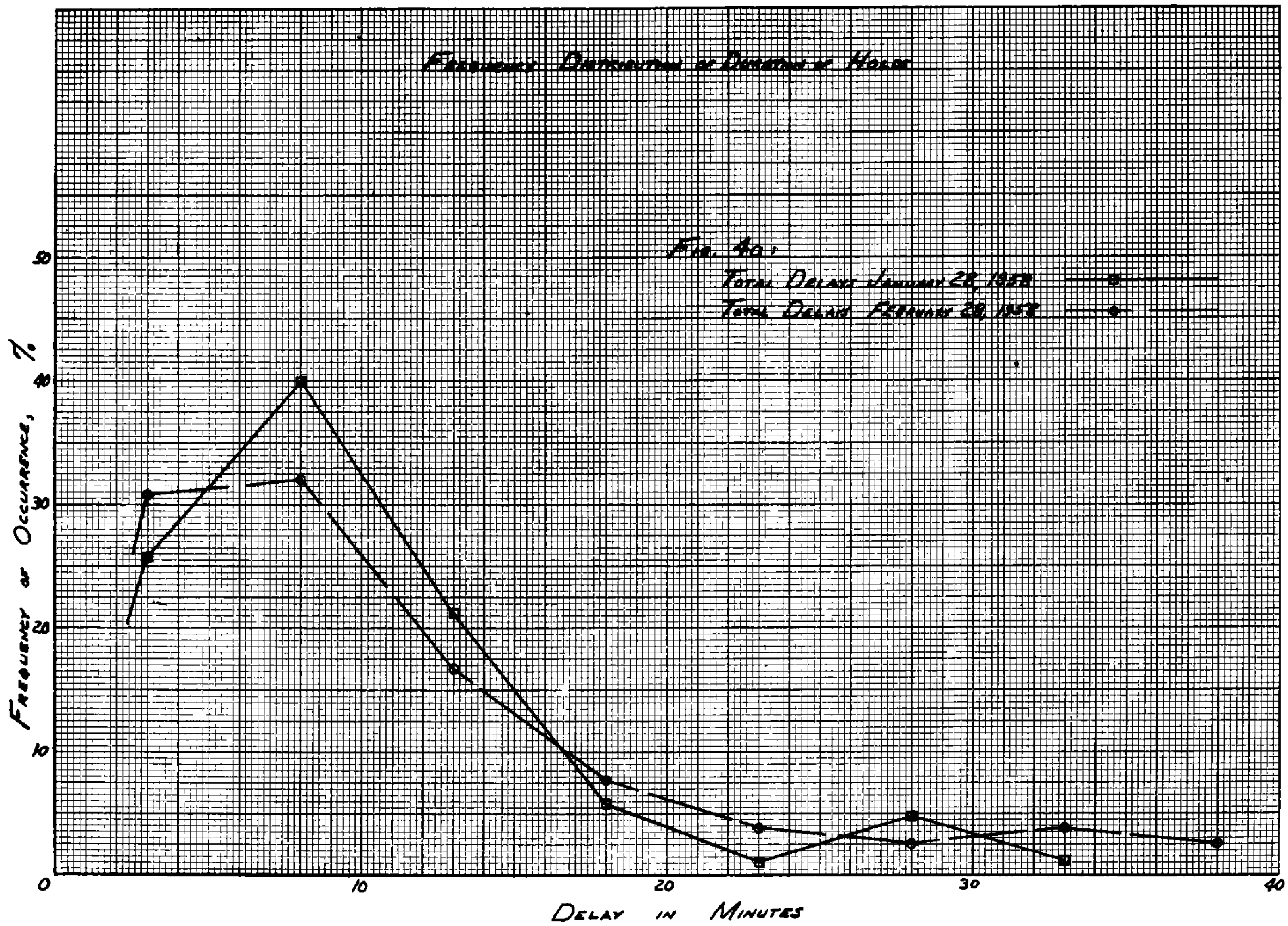
NOTE -

(x-y) The first number within the parenthesis, x, is the total number of delays at the fix on January 28, 1958. The second number, y, is the total number of delays on February 28, 1958.

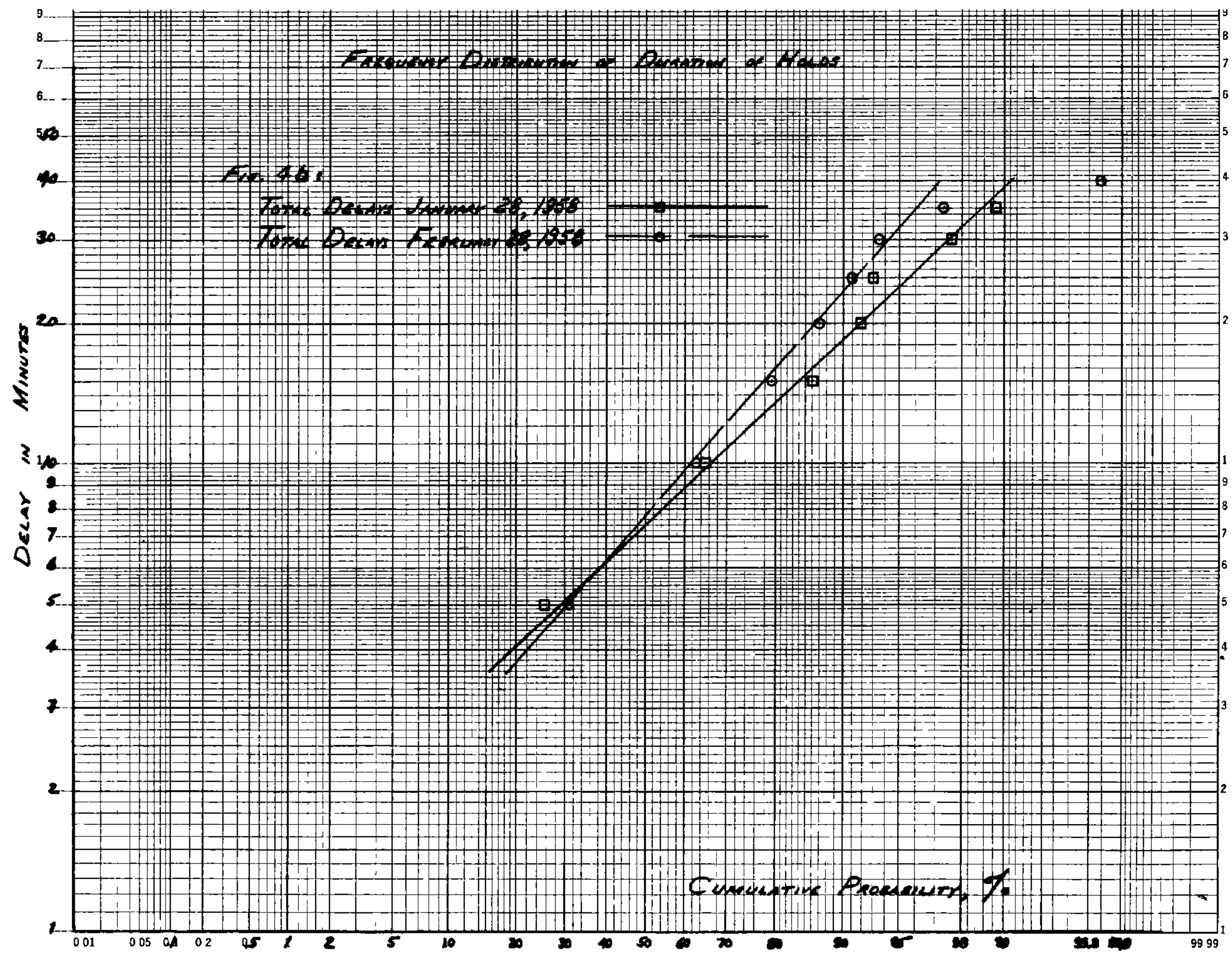
Fig 2 - NYARTCC Delay Map of January 28 and February 28, 1958

FIG 3 DISTRIBUTION OF DELAYS WITH RESPECT TO FIX AND CATEGORY

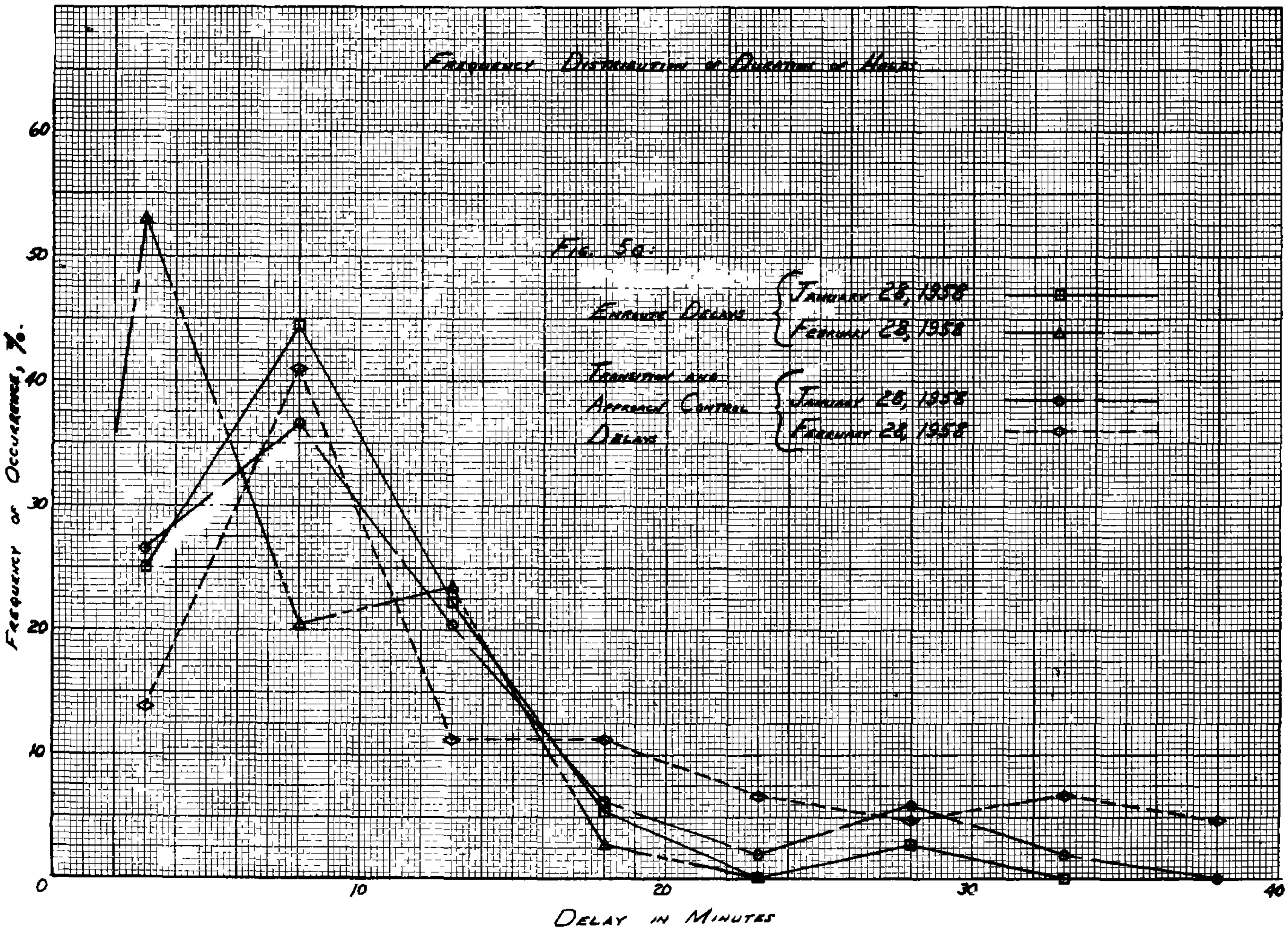




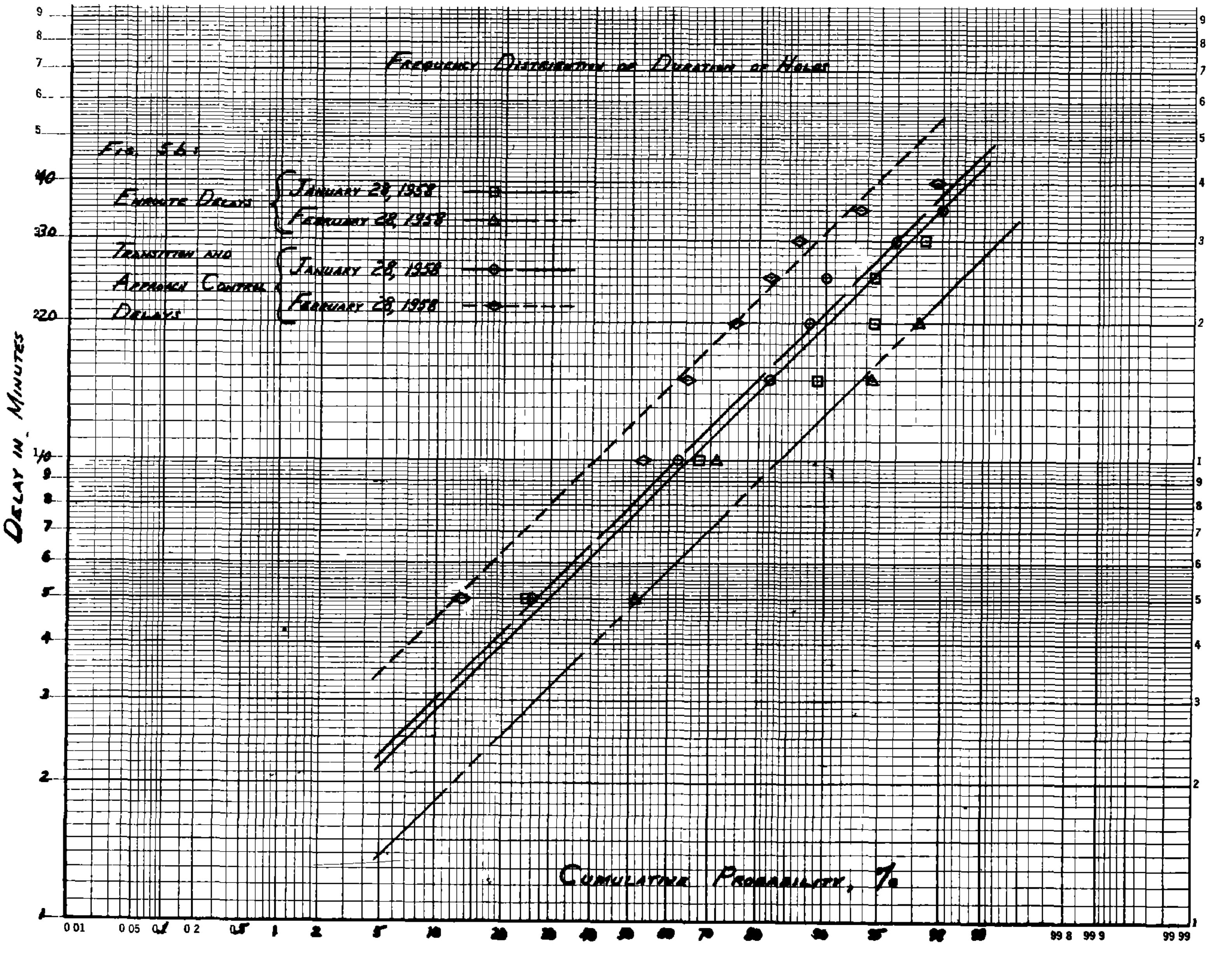
FREQUENCY DISTRIBUTION OF DURATION OF HOLDS
FIG. 4a:
TOTAL DELAYS JANUARY 28, 1958
TOTAL DELAYS FEBRUARY 28, 1958
FREQUENCY OF OCCURRENCE, %
DELAY IN MINUTES
0
10
20
30
40
50



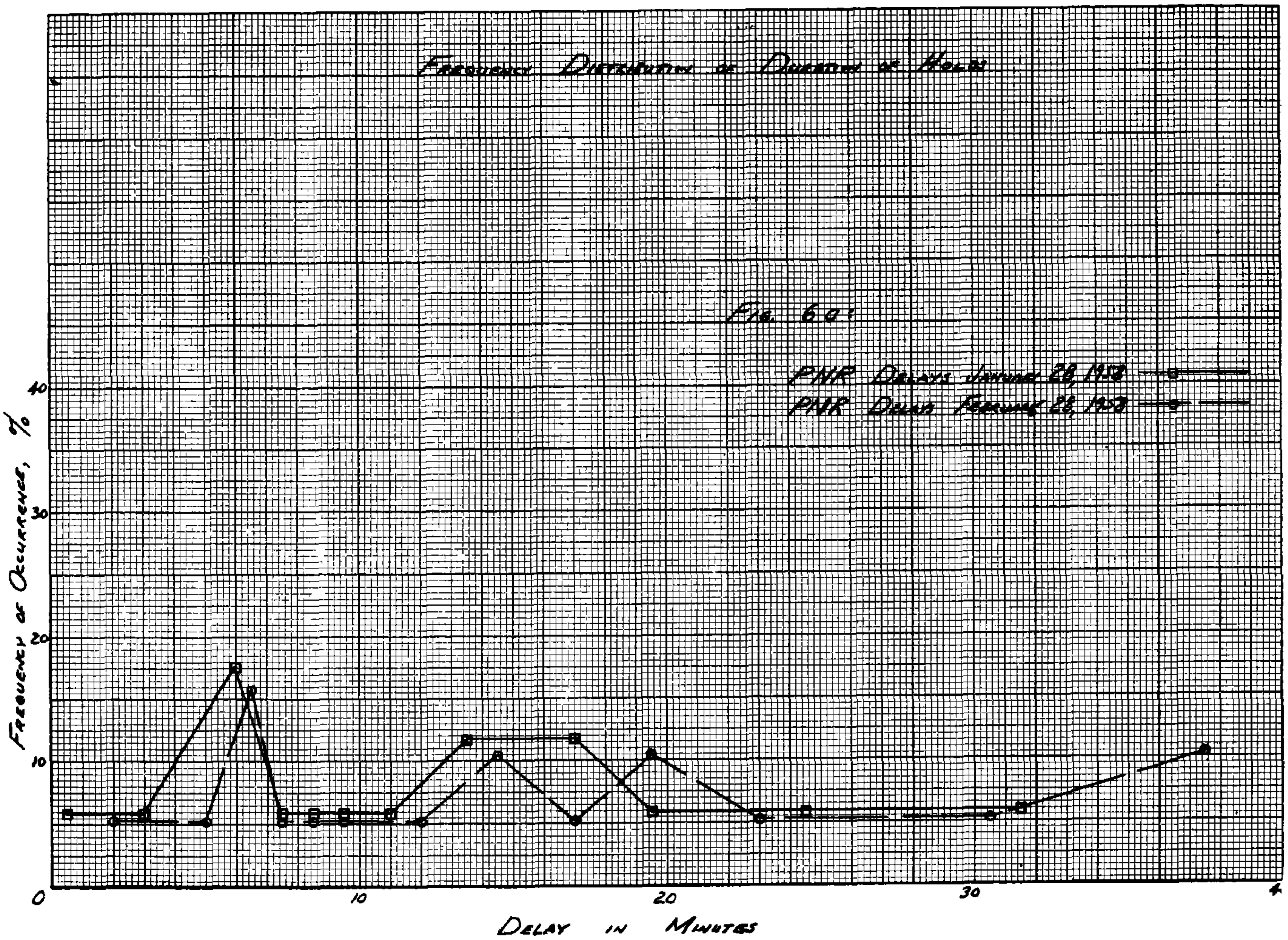
FREQUENCY DISTRIBUTION OF DURATION OF HOLDS
FIG. 4b:
TOTAL DELAYS JANUARY 28, 1958
TOTAL DELAYS FEBRUARY 28, 1958
DELAY IN MINUTES
CUMULATIVE PROBABILITY, %



Frequency Distribution of Duration of Holds
Fig. 5a:
Enroute Delays
January 28, 1958
February 28, 1958
Transition and Approach Control Delays
January 28, 1958
February 28, 1958
Frequency of Occurrence, %.
Delay in Minutes
0
10
20
30
40
50
60



Frequency Distribution of Duration of Holds
Fig. 5b:
Enroute Delays
January 28, 1958
February 28, 1958
Transition and Approach Control Delays
January 28, 1958
February 28, 1958
Delay in Minutes
Cumulative Probability, %


Frequency Distribution of Duration of Holds
Fig. 6a:
PNR Delays January 28, 1958
PNR Delays February 28, 1958
Frequency of Occurrence, %
Delay in Minutes

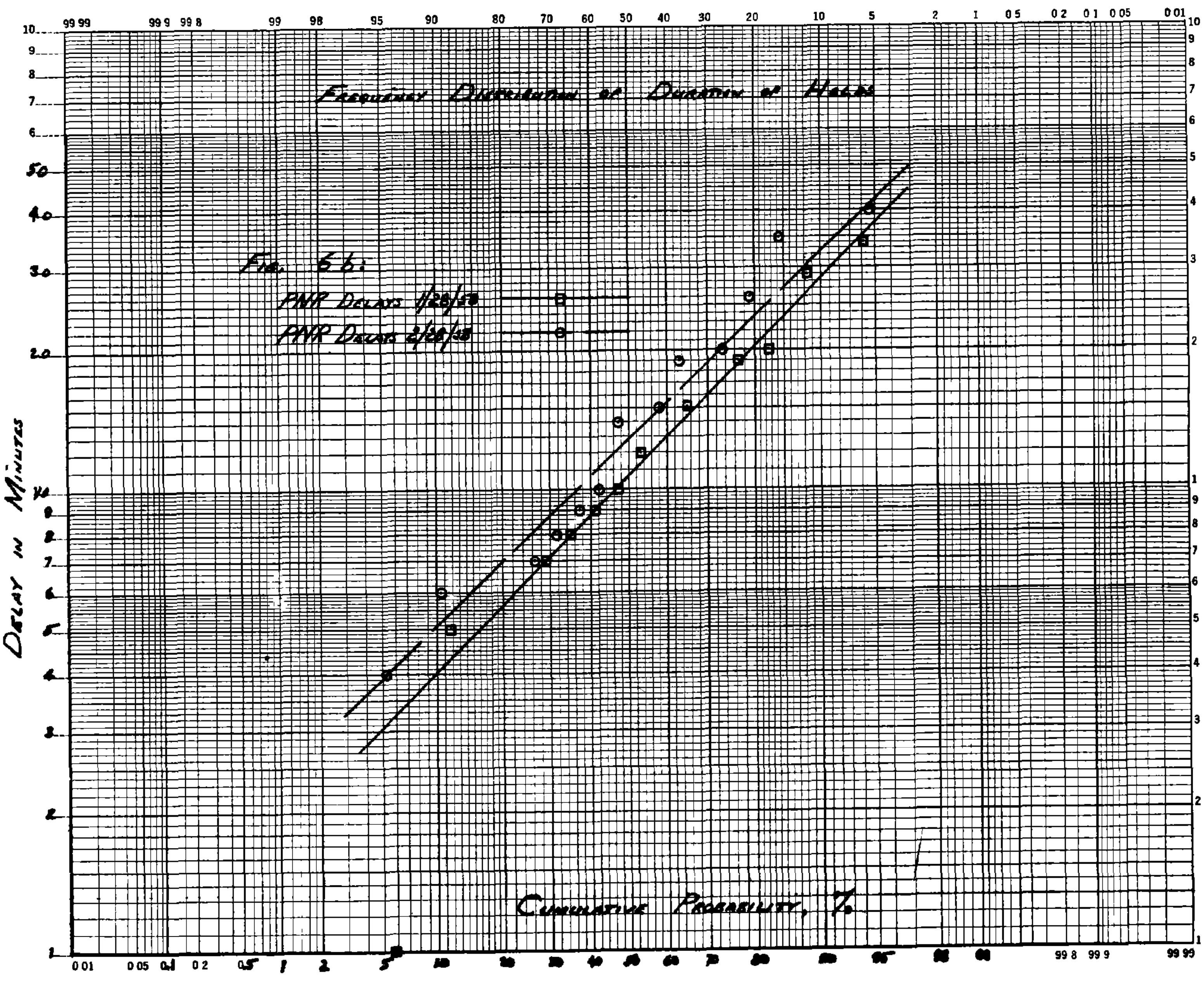

2 CYCLES
Frequency Distribution of Duration of Holds
Fig. 6b:
PNR Delays 1/28/58
PNR Delays 2/28/58
Delay in Minutes
Cumulative Probability, %

FIG. 7 - DISTRIBUTION OF DELAYS PER 24-HOUR PERIOD

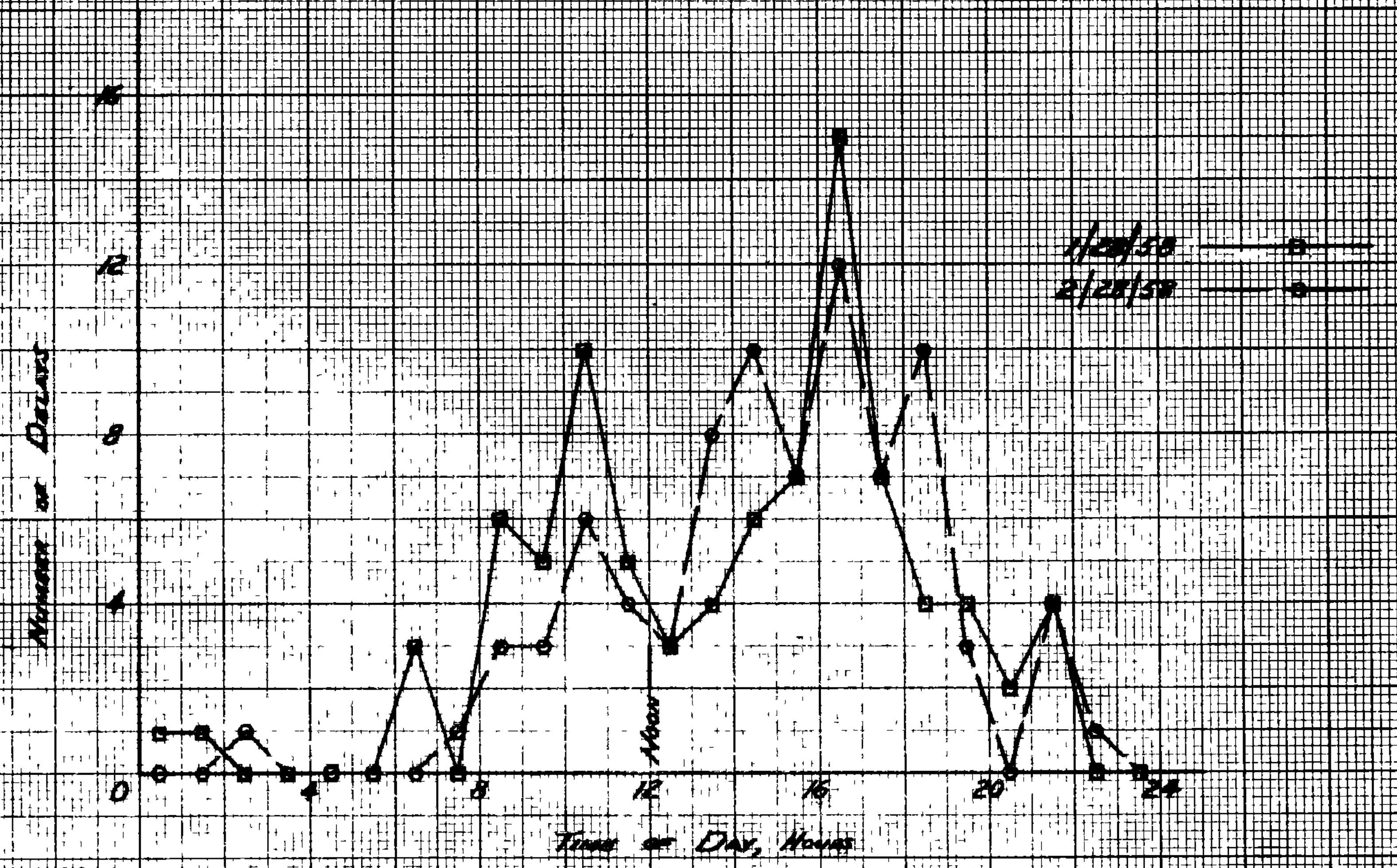


TABLE I - DELAY INVESTIGATION DATA

DELAY DATE JANUARY 28, 1958

	Aircraft Identification			Terminal Cities		Delay Information							
Delay No.	Flight Strip	Type and Speed (knots)	Category	Origin	Destination	Routing in to Fix	Fix and Sector	Routing Out of Fix	Altitude Leaving Fix (x 1000 Ft.)	Initial Time Over Fix	Duration of Hold (min.)	Reason for Hold	Probable Reason in UX
1	S459	G	AC	IDL	JAX	V1	SBY-4	V1		1107	5	UX	
2	AF58886	B25-180	MIL	HEM	BOF	V1	SBY-4	V1	10.0	1426	7	UX	
3	AG28992	C47	MIL	ORF	FBT	V1	SBY-4	V1	7.0	1614	11	2A	
4	AF 20940	C124-200	MIL	DOV	DOV		DOV-4			1000	12	3A	
5	MATS-20980	C124-200	MIL	DOV	BOS		DOV-4				5	1A	
6	MATS-0045	C124-200	MIL	TV	DOV	DIRECT	DOV-4	DEST.	8.0	1659	8	1A	
7	MATS-60549	C130-350	MIL	MGE	DOV	DIRECT	DOV-4	DEST.	18.0	1747	15	1A	
8	MATS-33201	C119-175	MIL	DOV	TUL	DIRECT	ENO-3	V16	10.0	0010	15	1B	
9	LOG A-1309V	C46-165	MIL	DOV	NPT	DIRECT	ENO-3	V29		0634	4	1B	
10	MATS-33198	C119-175	MIL	DOV	MEM	DIRECT	ENO-3	V16	6.0	0634	5	1B	
11	MATS-13835	C118-240	MIL	DOV	CYWG	DIRECT	ENO-3	V29	7↑8	0900	23	1B	
12	MATS-17285	C124-200	MIL	DOV	JT	R77	PNR-4	R77	13.0	0957	19	1A	
13	AF20940	C124-200	MIL	DOV	DOV	R77	PNR-4	R77	11.0	1022	29	1B	
14	AF10153	C124-200	MIL	DOV	LIZ	R77	PNR-4	R77	9.0	1030	20	1B	
15	AF10152	C124-200	MIL	O/PNR	LIZ	O/PNR	PNR-4	R77	8.0	1110	34	1B	
16	AF49111	C119	MIL	DOV	HEM	R77	PNR-4	R77	7.0	1235	7	1B	
17	MATS-21063	C124-200	MIL	DOV	JT	R77	PNR-4	R77	9.0	1256	10	1B	
18	AF20992	C124-200	MIL	DOV	GRE	R77	PNR-4	R77	10.0	1304	12	1B	
19	AF33197	C119-175	MIL	DOV	BIF	R77	PNR-4	R77	10.0	1322	9	1B	
20	MATS-21057	C124-200	MIL	DOV	YR	R77	PNR-4	R77	11.0	1435	7	1B	
21	MATS-21035	C124-200	MIL	DOV	JT	R77	PNR-4	R77	9.0	1508	7	1B	
22	MATS-30010	C124-200	MIL	DOV	JT	R77	PNR-4	R77	11.0	1614	15	1B	
23	MATS-50500	C54-175	MIL	DOV	JT	R77	PNR-4	R77	9.0	1621	15	1B	
24	V-2556	A/D-160	MIL	NHK	AIY	R77	PNR-4	R77	4.0	1716	5	1A	
25	V-2627	A/D-160	MIL	O/NHK	AIY	R77	PNR-4	R77	VFR/⊗	1737	19	1A	
26	MATS-31570	R6D-240	MIL	DOV	JT	R77	PNR-4	R77	15.0	1914	8	1B	
27	M-1610	R6D-240	MIL	DOV	JT	R77	PNR-4	R77	VFR	1912	1	1B	
28	V-3867		MIL			V16	MIV-4	V16		0810	4	UX	2A
29	M-30034	C124-200	MIL	OUTL	DOV	V16	MIV-4	V16	4.0	0815	10	1A	
30	AF45934	C47-135	MIL	ADW	PQI	V16	MIV-4	V16		0950	6	UX	2A
31	AF5927	C47-130	MIL	WRI	WRI	V16	MIV-4	V16	12.0	1051	11	2A	
32	MATS-50576	C54-200	MIL	WRI	DOV	V16	MIV-4	V16	3.0	1926	3	1A	
33	AF50881	C47-145	MIL	ADW	HEM	G5	NFD-4	G5	7.0	1410	15	UX	2A

TABLE I - DELAY INVESTIGATION DATA (CONT.)

DELAY DATE JANUARY 28, 1958

	Aircraft Identification			Terminal Cities		Delay Information							
Delay No.	Flight Strip	Type and Speed (knots)	Category	Origin	Destination	Routing in to Fix	Fix and Sector	Routing Out of Fix	Altitude Leaving Fix (x 1000 Ft.	Initial Time Over Fix	Duration of Hold (min.)	Reason for Hold	Probable Reason in UX
34	E-6573	8-190	AC	IDL	BAL	V16	VIN-4	V16	6.0	1023	1	2A	
35	VM-0405	R5D-180	MIL	NSF	NCO	V16	VIN-4	V16	11.0	1225	11	2A	
36	V-1310		MIL			V16	VIN-4			1408	7	2A	
37	AF-72602	C54-200	MIL	RND	HEM	V16	VIN-4	V16	7.0	1622	8	2A	
38	AF-13843	C121	MIL	ADW	FMH	V16	VIN-4	V16	9.0	1650	6	2A	
39	E-541	9-225	AC	PHL	ATL	V29	OOD-2	V16	12.0	0130	5	1B	
40	LOG-10415	C46	MIL	FFO	DOV	V29	OOD-2	V29	9.0	0835	7	1A	
41	V-2439	R40	MIL	JSV	EYW	V29	OOD-2	V29	10.0	1040	9	UX	2A
42	M-807	6-275	AC	PHL	MIA	V29	OOD-PHL-2	V29	9.0	1037	10	1B	
43	X-40400	2-190	GA	BAL	LGA	V123	OOD-2	V123	7.0	1415	5	UX	2A
44	A-272	6-240	AC	DCA	LGA	V123	OOD-2	V29	10.0	1437	7	UX	2A
45	AF-18140	C119-200	MIL	RAN	DOV	V29	OOD-2	V29	9.0	1501	4	UX	2B
46	AF-54755	C131	MIL	BOF	LGA	V29	OOD-2	V123	9.0	1547	1	UX	2A
47	X-37474	4	GA	MIA	IDL	V1	AIY-4	V1	7.0	1156	6	2A	
48	AF-17170	SA16-170	MIL	MYR	HEM	V1	AIY-4	V1	9.0	1356	19	UX	2A
49	AF-42822	C131-210	MIL	LFI	HEM	V1	AIY-4	V1	7.0	1601	6	UX	2A
50	V-6497	R4D	MIL	NGV	FBT	V1	AIY-4	V1	9 or 7	1606	11	2A	
51	X-100A	5-215	GA	PHF	EWR	V1	AIY-4	V1	6.0	1643	6	2A	
52	AG-28992	C47	MIL	ORF	FBT	V1	AIY-4	V1	7.0	1650	26	2A	
53	X-700E	BCFT-145	GA	PHF	EWR	V1	AIY-4	V1	7.0	1718	15	2A	
54	VM-2425	R4D-200	MIL	BDR	NCA	V16	CYN-4	V1	8.0	1534	9	UX	2A
55	M-0045	C124-200	MIL	XWF	DOV	V16	CYN-4	V16	8.0	1635	12	2A	
56	LA-88709	4	MIL	FFO	MDT	V12	HAR-1	DEST.	4.0	0652	10	3B	
57	X-42013	LLD-200	GA	AGC	PHL	V12	HAR-1	V12	6.0	1026	7	2A	
58	X-41H	T/B-60	GA	YWG	PHL	V12	HAR-1	V12	6.0	1159	14	UX	2A
59	X-650R	T/B-170	GA	BGM	HAG	V31	HAR-1	V223	VFR	1645	18	UX	2A
60	AF-15726	C-47	MIL	AOO	MDT	V12	HAR-1	DEST.	.8	1754	15	3B	
61	L-504	2-190	AC	JST	HAR	V12	HAR-1	DEST.	2.7	1839	8	3B	
62	RE-88891	4	MIL	AOO	MDT	V12	HAR-1	DEST.	3.0	1923	13	3B	
63	AF-72719	C-54	MIL	CYYR	MDT	V12	HAR-1	DEST.	4.0	2026	10	3B	
64	LOG A-1309V	C-46-165	MIL	MDT	LFI	G4	LRP-1	R33	10.0	1000	5	1B	
65	RE-88709	D4-175	GA	MDT	DOV	V12	LRP-1	V12	7.0	1000	28	1B	

TABLE I - DELAY INVESTIGATION DATA (CONT.)

DELAY DATE JANUARY 28, 1958

	Aircraft Identification			Terminal Cities		Delay Information							
Delay No.	Flight Strip	Type and Speed (knots)	Category	Origin	Destination	Routing in to Fix	Fix and Sector	Routing Out of Fix	Altitude Leaving Fix (x 1000 Ft.)	Initial Time Over Fix	Duration of Hold (min.)	Reason for Hold	Probable Reason in UX
66	AG-77882	C-46	MIL	ABE	RDG	V39	RDG-1	Dest.	2.5	2130	7	3B	
67	LOG A-9892F	C-46-170	MIL	MDT	FOX	V12	ESR-2	V29	7↑8	1303	4	1B	
68	V-2439	R4D	MIL	JSV	EYW	A7	PHL-2		8↑VFR	1631	4	2A	
69	L-702	202	AC	AVP	EWR	V29	ABE-11	V168	3.0	1623	8	2A	
70	P-461	4	AC	PHL	ROC	V147	PTW-2	V147	8	0916	9	UX	2A
71	AD-803	3	AC	BGM	ELM	V72	ELM-13	DEST.	3.5	2138	30	3B	
72	AG-77882	C46-160	MIL	RDG	RDG	V35	STF-12	V35	6↑9	2017	8	UX	
73	P-564	3	AC	ELM	IPT	V31	GVR-12	V31	5.0	1540	5	1A	
74	AF-48770	C47-145	MIL	SYR	BOF	V31	GVR-12	V31	10.0	1735	7	2B	
75	X-1046	LKD-150	GA	CMH	BDL	V188	IPT-12	V58	9.0	1102	7	2A	
76	T-484	8-195	AC	PIT	IPT	R8	IPT-12	DEST.	4.0	1548	15	1A	
77	P-564	3	AC	ELM	IPT	V31	IPT-12	DEST.	5.0	1552	1	1A	
78	NC-41H		GA		IPT		IPT-12	DEST.		1641	7	1A	
79	L-377	3-160	AC	PHL	IPT	V31	IPT-12	DEST.	4.0	1740	7	1A	
80	T-487	4	AC	ALB	AVP	V153	CYE-12	DEST.	3.5	0839	5	3B	
81	E-8	4	AC	PHL	AVP	V147	CYE-12	DEST.	3.5	0913	6	3B	
82	T-486	9	AC	IPT	AVP	R8	CYE-12	DEST.	3.5	2157	3	3B	
83	L-609	9	AC	EWR	AVP	V188	MPO-12	V188	3.5	2147	11	3B	
84	N-705M	3	GA	HPN	BGM	V34	BGM	DEST.	4.0	0834	6	3B	
85	N-650R	1	GA	HAG	BGM	V149	BGM	DEST.	3.5	1003	11	3B	
86	T-484	8	AC	BGM	ALB	V72	BGM-SID	V72	9.0	1827	10	2A	
87	X-705M	3-165	GA	BGM	HPN	V34	STP-13	V34	6	1800	3	UX	2B
88	AD-206	5	AC	ELM	EWR	V34	STP-13	V34	7	1816	4	UX	2B
89	AD-202	5	AC	ELM	EWR	V34	SPL-8	V34	6	0855	5	UX	2B

TABLE I - DELAY INVESTIGATION DATA (CONT.)

DELAY DATE JANUARY 28, 1958

	Aircraft Identification			Terminal Cities		Delay Information							
Delay No.	Flight Strip	Type and Speed (knots)	Cate-gory	Origin	Destin-ation	Routing in to Fix	Fix and Sector	Routing Out of Fix	Altitude Leaving Fix (x 1000 Ft.)	Initial Time Over Fix	Duration of Hold (min.)	Reason for Hold	Probable Reason if UX
BOSTON CENTER													
1	X30030	LKHD-160	GA	EHT	IDL	V58	HFD	V16	6	1340	9	2A	
2	R-4676	L19-115	MIL	BDL	AYZ	V130	HFD	V167	6	1311	14	2A	
WASHINGTON CENTER													
3	MATS-30039	C124-210	MIL	TIK	DOV	V-16	ING	V16	7	0636	6	2A	
4	AF-58886	B25-180	MIL	BOF	HEM	V-16	ING	V16	7	1000	9	2A	

TABLE I - DELAY INVESTIGATION DATA (CONT.)

DELAY DATE FEBRUARY 28, 1958

	Aircraft Identification			Terminal Cities		Delay Information							
Delay No.	Flight Strip	Type and Speed (knots)	Category	Origin	Destination	Routing in to Fix	Fix and Sector	Routing Out of Fix	Altitude Leaving Fix (x 1000 Ft.)	Initial Time Over Fix	Duration of Hold (min.)	Reason for Hold	Probable Reason if UX
1	AF20997		MIL	DOV			DOV-4			0830	21	1B	
2	AF51073		MIL	DOV			DOV-4			0945	32	1B	
3*	M30039	C124-200	MIL	DOV	JT		DOV-4			1026	15	3A	
4*	M30048	C124-200	MIL	DOV	YR		DOV-4			1026	15	3A	
5	AF49353	KB50-360	MIL	BHM	DOV	V16	DOV-4	DEST.	4	1723	7	1A	
6	M52598	C124-230	MIL	MGE	DOV	V16	DOV-4	DEST.	7	1723	7	1A	
7	AF48933	C47-130	MIL	o/NHK	HEM	R77	DOV-4	G5	7	1814	14	2A	
8	X1942	DC3-170	GA	RIC	BOS	R77	DOV-4	G5	9	1924	2	2B	
9	S535	6B-250	AC	BOS	DCA	V16	ENO	V16	12	1751	4	2A	
10	AF16277	C47-175	MIL	ENO	WRI	V16	ENO	V16	7	1840	12	2A	
11	M31593	R6D-240	MIL	DOV	JT	R77	PNR-4	R77	9	0749	7	1B	
12*	M51165	C124-200	MIL	DOV	GRE	R77	PNR-4	R77	10	1041	9	1B	
13*	M30039	C124-200	MIL	DOV	ST	R77	PNR-4	R77	9	1050	40	1B	
14*	M30048	C124-200	MIL	DOV	YR	R77	PNR-4	R77	11	1109	26	1B	
15	V1182	SNB-140	MIL	NXX	NKZ	R77	PNR-4	R77	8	1123	19	2A	
16	M200	C133-260	MIL	DOV	YR	R77	PNR-4	R77	17	1145	10	1B	
17	M21054	C124-200	MIL	DOV	JT	R77	PNR-4	R77	9-VFR	1321	6	1B	
18	M21057	C124-200	MIL	DOV	YR	R77	PNR-4	R77	13	1403	14	1B	
19	M21053	C124-200	MIL	DOV	JT	R77	PNR-4	R77	9	1425	4	1B	
20	AF3011	C124	MIL	DOV	CEF	R77	PNR-4	R77	9	1507	35	1B	
21	M21058	V124-200	MIL	DOV	ST	R77	PNR-4	R77	5		20	1B	
22	M0031	C124-200	MIL	CSLA	DOV	R77	PNR-4	R77	9	1627	7	1A	
23	M30039	C124-200	MIL	DOV	JT	R77	PNR-4	R77	9	1650	40	1B	
24	AF17205	C54-180	MIL	DOV	BIX	R77	PNR-4	R77	10	1732	20	1B	
25	M5213	C124-200	MIL	DOV	GRE	R77	PNR-4	R77	10	1830	15	1B	
26*	M30031	C124-200	MIL	DOV	GRK	R77	PNR-4	R77	7	2104	15	1B	
27*	M1171	C124-200	MIL	DOV	JT	R77	PNR-4	R77	9	2110	7	1B	
28*	AF72605	C54-175	MIL	BDAC	HAR	OCEANIC	PNR-XSV-4	OCEANIC	6	2118	8	2A	
29	M20996	C124-200	MIL	LIZ	DOV	V16	MIV-4	V16	12	1520	35	1A	
30	M1009	C124	MIL	JT	DOV	V16	MIV-4	V16	8	1611	7	1A	
31	AF48933	C47-130	MIL	HEM	HEM	G5	MIV-4	G5	6	1618	30	UX	

* Detailed explanation of this delay contained in Appendix A.

TABLE I - DELAY INVESTIGATION DATA (CONT.)

DELAY DATE FEBRUARY 28, 1958

	Aircraft Identification			Terminal Cities		Delay Information							
Delay No.	Flight Strip	Type and Speed (knots)	Cate-gory	Origin	Destin-ation	Routing in to Fix	Fix and Sector	Routing Out of Fix	Altitude Leaving Fix (x 1000 Ft.)	Initial Time Over Fix	Duration of Hold (min.)	Reason for Hold	Probable Reason if UX
32	AF48356	C47	MIL	GRE	HEM	V16	VIN-4	V1	7	1445	8	2A	
33	AER0400	D7-385	AC	IMEX	IDL	V16	VIN-4	V16	17	1712	3	2A	
34*	A376	5-210	AC	DCA	BOS	V16	VIN-4	V16	9	1812	13	2A	
35	A670	D7-400	AC	LAX	IDL	V16	VIN-4	V16	20↓	1851	1	UX	2B
36	AF49188	C119-180	MIL	O/RMT	NXX	B20	ELR-4	B20	6	1340	6	UX	2B
37*	A324	5-210	AC	PHL	BOS	V29	OOD-2	V140	11	1807	17	1B	
38	APAGZ	9-390	AC	ELP	EWR	V29	OOD-2	V29		1839	9	UX	2A
39	M808	DC6-255	AC	PHL	BOS	V29	OOD-2	V140	9	1939	3	1B	
40*	AF72605	C54-275	MIL	BDAC	MDT	V29	OOD-2	V239	6	2143	5	2A	
41*	M30048	C124-200	MIL	DOV	YR	V1	AIY-4	V1	11	1140	14	2A	
42	M21053	C124-200	MIL	DOV	JT	V1	AIY-4	V1	9	1438	12	2A	
43	V6784	C46-170	MIL	NGV	NBB	V1	NBB-4	DEST.	11	1053	5	1A	
44	R6162		GA	BAL	HAR	V223	HAR-1	DEST.	3	1031	10	3B	
45	AF30853	B25	MIL	AOO	HAR	G4	HAR-1	DEST.	4	1234	10	3B	
46	N4888B	CSNA	GA	GPK	HAR	V33	HAR-1	DEST.	3	1259	4	3B	
47	V7333	JRB-145	MIL	JSV	AKR	G4	HAR-1	G4	6	1640	2	UX	2B
48	AF50183	T29-200	MIL	RAN	WRI	V12	HAR-1	V12	11	2259	7	UX	2A
49	AF18045	C119-190	MIL	MSP	WRI	V12	LRP-1	V12	9	1941	8	UX	2A
50	T415	8-196	AC	PHL	PIT	V12	RND-1	V12	10	1830	2	UX	2A
51	X1884	T/BCFT	GA	RDG	RDV	ORIGIN	RDG-1	V162S	8	0918	7	3B	
52	X1201	LKHD	GA	RDG	DAY	ORIGIN	RDG-1	V162S	5	1348	5	3B	
53	V7333	JRB-145	MIL	JSV	AXR	G4	ESR-2	G4	6	1604	5	UX	2A
54	AF72595	C54-175	MIL	NXV			PNE-2			0950	24	UX	1B
55	AF49188	C119-180	MIL	O/RMT	NXX	A7	PNE-2		3↓	1401	8	UX	1A
56	L606	3-145	AC	AOO	PSB	B47	PSB-11	DEST.	5	1622	10	1A	

* Detailed explanation of this delay contained in Appendix A.

TABLE I - DELAY INVESTIGATION DATA (CONT.)

DELAY DATE FEBRUARY 28, 1958

	Aircraft Identification			Terminal Cities		Delay Information							
Delay No.	Flight Strip	Type and Speed (knots)	Category	Origin	Destination	Routing in to Fix	Fix and Sector	Routing Out of Fix	Altitude Leaving Fix (x 1000 Ft.)	Initial Time Over Fix	Duration of Hold (min.)	Reason for Hold	Probable Reason if UX
57*	P574	5-145	AC	HAR	IPT	V31	SEG-11	V31	4	1428	10	1A	
58	X606	LKD-170	GA	PIT	EWR	V106	SEG-11		8	1430	4	UX	2A
59*	L7	3-145	AC	HAR	IPT	V31	SEG-11	V31	4	1523	20	1A	
60	AF100673	C47-140	MIL	HDT	PDG	V31	SEG-11	V106	5	1541	4	UX	2A
61	X5869C	T/B	GA	O/ABE	EWR	V168	ABE-11	V18	8	0823	8	UX	2B
62	E6035	8	AC	O/V10	PHL	V147	ABE-11	V147	6	1422	2	UX	2B
63	P465	4-187	AC	PHL	ROC	V147	ABE-11	V147	9	1635	5	UX	2A
64	P465	4-187	AC	PHL	ROC	V147	PTW-2	V147	5	1620	4	UX	2A
65	DRAPER 21	KC97-230	MIL	PDG	ABE	V35	ELM-13	V72	14	1512	11	UX	2A
66***	P567	3-180	AC	IPT	BUF	ORIGIN	GVR-12	V31	6	1825	10	UX	
67*	L607	3-148	AC	EWR	IPT	R8	IPT-12	DEST.	4	1455	10	1A	
68*	T484	8-215	AC	PIT	IPT	V58	IPT-12	DEST.	7	1544	5	1A	
69*	L7	3-145	AC	HAR	IPT	V31	IPT-12	DEST.	5	1608	15	1A	
70***	P567	3	AC	O/GVR	IPT	V31	IPT-12	DEST.	5	1806	10	UX	
71	E34	9-4	AC	PHL	SYR	V149	CYE-12	V149	4	1317	21	3B	
72	E6035	9-4	AC	SYR	PHL	V149	CYE-12	V149	6	1353	8	3B	
73	M203	5	AC		BGM	V29	AVP-12		3.5	1343	15	3B	
74	E6035	9-4	AC	SYR	PHL	V149	LYN-12	V149	6	1338	5	UX	2A
75	E34	9-4	AC	PHL	SYR	V149	LYN-12	V149	4	1350	3	UX	2A
76	T708	9-195	AC	LGA	LGA	V39	SSB-10	V10	7	1242	4	UX	2A
77	M20A	3	AC	ELM	BGM	V72	BGM-13	DEST.	3.5	1406	16	3B	
78*	AF06662	C47	MIL		BGM	V72	BGM-13	DEST.	3.5	1651	27	1A	
79*	AD5	5-190	AC	EWR	BGM	V29	BGM-13	DEST.	3.5	1652	8	1A	
80	AF10783	C45-135	MIL	ACB	FFO	V270	BGM-13	V72	8	1731	13	UX	2A
81	AT11C	9-240	MIL	O/BGM	EWR	V34	STP-13	V34	10	1553	4	UX	2B
82	AD6A	DC3	AC	ITH	EWR	V34	STP-13	V34	5	1754	4	UX	2B
83	A805	DC6-265	AC	LGA	MDW	V116	BCH-14	V116	20	0203	6	UX	
84	X1503	B24-180	GA	LGA	UL	V91	POU-8	V91	7	0834	11	UX	2A

* Detailed explanation of this delay contained in Appendix A.

**P567 was originally bound for BUF, reversed course and returned to Williamsport.

TABLE I - DELAY INVESTIGATION DATA (CONT.)

DELAY DATE FEBRUARY 28, 1958

DELAYS IN ADJACENT CENTERS CAUSED BY NYATC TRAFFIC CONDITIONS:

	Aircraft Identification			Terminal Cities		Delay Information							
Delay No.	Flight Strip	Type and Speed (knots)	Category	Origin	Destination	Routing in to Fix	Fix and Sector	Routing Out of Fix	Altitude Leaving Fix (x 1000 Ft.)	Initial Time Over Fix	Duration of Hold (min.)	Reason for Hold	Probable Reason if UX
BOSTON CENTER													
1	AF20968	C 124	MIL	CEF	DOV	V203	CEF	V203	10	0818	100	2A	
2	V7111	R4D-8	MIL	NCO	NHK	R21	SLX	V16	12	0824	3	2A	
3	N13302	C.V.	GA	HFD	PBI	V3	HFD	V3	8	0923	2	2A	
4	AF86877	B 25-180	MIL	CEF	BOF		HFD	B53	10	1113	19	2A	
5	AF30075	B 25-180	MIL	CEF	BOF		HFD	B53	10	1313	23	2A	
6	AF28131	T-119	MIL	BED	FTB	V39	COLEBROOK	V39	8	1501	29	2A	
7	E309	9	AC	BOS	EWR	V3	NOD	V146	10	1632	12	2A	
8	AF11448	C 54	MIL	O/FRK	WRI	G5	SLX	G5	10	1632	2	2A	
9	A721	C.V.	AC	BDL	LGA	V3	BDL	V3	10		15	3A	
10	V89484	SNB-150	MIL	BDL	NSF		HFD	V53	7	1733	8	2A	
11	N329	C.V.	AC	BOS	BAL	V16	SLX	V24	10	1722	3	2A	
12	V8391	P2V-190	MIL	NCO	NSF	V16	SLX	V16	8	1713	12	2A	
13	U321	C.V.	AC	BDL	EWR	V146	POU	V39	5	1720	15	2A	
14	N4	SNB	MIL	BDL			HFD	B53	6	1731	14	2A	
PITTSBURGH CENTER													
1	T510	9-242	AC	PIT	LGA	V276	TON	V276	13	1936	1	2A	
NORFOLK CENTER													
1*	V7198	R4D	MIL	NGU	NCO	B23	NHK	V29	9	1019	9	2A	
WASHINGTON CENTER													
1	A338	5-210	AC	DCA	BOS	V123	BAL	V44	17	1250	15	2A	
2	V8391	R2V-190	MIL	NSF	NCO	V123	BAL	V44	13	1250	15	2A	
3	NA530		AC	DCA			DCA			1238	10	3A	
4	V7111	R40	MIL	NSF	NCO		NSF			1249	25	3A	
5	A84	DC 7-310	AC	DAL	IDL	V16	IN6	V16	19	1312	14	2A	
6	AF49336	CH 7-175	MIL	MXF	MDT	V223	HMT	V223	7	1653	10	2A	
7	X770	DC3-190	GA	BAL	ERI		BAL			1630	15	3A	
8	NC3000	DC3-180	GA	DCA		V123	BAL	V44	11	1630	5	2A	

* Detailed explanation of this delay contained in Appendix A.

TABLE I - DELAY INVESTIGATION DATA (CONT.)

DELAY DATE MARCH 14, 1958

	Aircraft Identification			Terminal Cities		Delay Information							
Delay No.	Flight Strip	Type and Speed (knots)	Category	Origin	Destination	Routing in to Fix	Fix and Sector	Routing Out of Fix	Altitude Leaving Fix (x 1000 Ft.)	Initial Time Over Fix	Duration of Hold (min.)	Reason for Hold	Probable Reason in UX
1	E410	DC7B-270	AC	DCA	EWR	A7	PDP-2	A7	6	2155	6		
2	E576	8-200	AC	RIC	LGA	R77	ENO-3	V29	8	1827	6		
3	M808	DC6-240	AC	MIA	PHL	V29	ENO-3	V29	7	1830	16		
4	MATS-21063	C124-200	MIL	DOV	YR	R77	PNR-4	R77	9	0836	5		
5	MATS-21034	C124-200	MIL	DOV	JT	R77	PNR-4	R77	9	0939	4		
6	MATS-21053	C124-200	MIL	DOV	YR	R77	PNR-4	R77	11	1035	15		
7	MATS-1614	R240	MIL	DOV	JT	R77	PNR-4	R77	11	1212	18		
8	MATS-21055	C124-200	MIL	DOV	JT	R77	PNR-4	R77	9	1215	2		
9	AF40145	C133-260	MIL	DOV	DOV	R77	PNR-4	R77	5	1624	10		
10	AF3064	B25-200	MIL	ADW	LIZ	G5	MIV-4	G5	9	0850	5		
11	M30008	C124-200	MIL	TL	DOV	V16	MIV-4	V16	4	1255	11		
12	SAM-42817	C131	GA	AIY	DCA	V238	VIN-4	V238	4	1312	2		
13	V6515	P2V-180	MIL	NXX	NRT	V29	OOD-2	V29	4	1531	8		
14	E607	DC7B-285	AC	PHL	PBI	V29	OOD-2	V29	20	1816	11		
15	X1R	5-220	GA	VRB	LGA	V1	AIY-4	V1	18	1441	5		
16	E634	6B-265	AC	MIA	IDL	V1	AIY-4	V1	14	2147	5		
17	L201	DC3-148	AC	EWR	NBB	V1	CYN-4	V1	3	1225	9		
18	LOG 5130B	C46-170	MIL	MDT	FOK	V16	CYN-4	V16	7	1630	5		
19	S388	5-205	AC	PHL	IDL	V166	CMX-2	V166	12	2222	20		
20	E548	DC-4	AC	PHL	LGA	V166	CMX-2	V166	7	2224	13		
21	R75298	DC4-190	MIL	FFO	MDT	V12	HAR-1	V12	5	1715	15		
22	X2052D	TB-160	GA	TOL	PHL	V12	HAR-1	V12	11	2110	16		
23	L708	DC3	AC	IPT	PHL	V31	HAR-1	V12	6	2216	10		
24	X5686D	T/B-180	GA	WGS	IPT	V170	RHD-1	V170	5	0956	6		
25	AF48381	C47-145	MIL	MDT		V39	LRP-1	V39	10	0912	17		
26	X555CB	T/B	GA	O/GRK	CHS	V12	LRP-1	V12	10	1329	49		
27	X44619	T/B-155	GA	ILG	CMH	V12	LRP-1	V12	10	1646	29		
28	X42A	BCFT	GA	AKR	ILG	V12	LRP-1	V12	6	2343	12		

TABLE I - DELAY INVESTIGATION DATA (CONT.)

DELAY DATE MARCH 14, 1958

	Aircraft Identification			Terminal Cities		Delay Information							
Delay No.	Flight Strip	Type and Speed (knots)	Cate-gory	Origin	Destin-ation	Routing in to Fix	Fix and Sector	Routing Out of Fix	Altitude Leaving Fix (x 1000 Ft.)	Initial Time Over Fix	Duration of Hold (min.)	Reason for Hold	Probable Reason in UX
29		T-B-155	GA	ILG	PKB	R72	ESR-2	V166	10	1229	6		
30	LOG 5130B	C46-170	MIL	MDT	FOK	V12	ESR-2	V29	9	1549	9		
31	U610	DC6	AC	MDW	PHL	V12	ESR-2	V12	11	1649	7		
32	P77	VIC-280	AC	EWR	BHH	V3	ESR-2	V3	14	2102	7		
33	X9941F	4-185	GA	PHL	EWR	A7	PNE-4	A7	7	1527	17		
34	X830		GA	LRP	IPT	V31	SEG-11	V31	4	1141	2		
35	AF52555	C117-145	MIL	SWF	BOF	V31	SEG-11	V31	5	1512	24		
36	L600	2	AC	O/ABE	EWR	V168	ABE-11	V168	4	1023			
37	L2606	DC3	AC	O/ABE	EWR	V168	ABE-11	V168	5	1520	3		
38	T510	9	AC	PIT	LGA	V10	NABE-11	V10	15	2008	19		
39	X310K	3-170	GA	TTN	RML	V256	PTW-2	V256	8	1237	5		
40	A104	DC6-250	AC	YZ	IDL	V147	ELM-13	V147	17	1350	5		
41	A106	DC6	AC	YZ	IDL	V168	COLLY-12	V168	11	1958	5		
42	L10	DC3	AC	BFD	IPT	V188	IPT-12	V188	5	1038	11		
43	X5685D	T/BNZA	GA	WGS	IPT	V31	IPT-12	V31	4	1025	13		
44	X15A	LKHD-185	GA	LGA	DAY	V188	IPT-12	V188	10	1951	8		
45	AT20C	S9H	GA	RML	BGM	V72	BGM-13	DEST.	6	1447			
46	AD20	DC3	AC	BGM	EWR	V34	STP-13	V34	7	1420	5		
47	AD20A	DC3	AC	BGM	EWR	V34	STP-13	V34	4	1440	5		
48	T441	8	AC	BDL	EWR	V146	POU-8	V146	4	2144	10		
49	E61	44-185	AC	BOS	EWR	V3	MIL	V3	8	0821	8		
50	A251	6	AC	BOS	LGA	V3	MIL	V3	6	0826	3		
51	64000	B23	GA	O/ILT	IDL	V16	SLX	V16	9	2009	6		

TABLE II - SUMMARY OF DELAY DATA

	JANUARY 28, 1958											FEBRUARY 28, 1958											MARCH 14, 1958			
	TOTAL	CATEGORY			REASON FOR HOLD*							TOTAL	CATEGORY			REASON FOR HOLD*							TOTAL	CATEGORY		
FIX	DELAYS	MIL	AC	GA	1A	1B	2A	2B	3A	3B	UX	DELAYS	MIL	AC	GA	1A	1B	2A	2B	3A	3B	UX	DELAYS	MIL	AC	GA
SBY	3	2	1		1						2	0											0			
DOV	4	4			3				1			8	7		1	2	2	1	1	2			0			
ENO	4	4				4						2	1	1		2							2		2	
PNR	16	16			3	13						18	18			1	15	2					6	6		
MIV	5	5			2		1(2)				2	3	3			2						1	2	2		
VIN	5	4	1				5					4	1	3		3						1	1			1
ELR	0											1	1									1	0			
OOD	8	4	3	1	1	2(1)	(4)				5	4	2	2			2	1				1	2	1	1	
AIY	7	4		3			5(2)				2	2	2					2					2		1	1
NFD	1	1					(1)				1	0											0			
NBB	0											1	1			1							0			
CYN	2	2					1(1)				1	0											4	2	1	1
Subtotal C-D Area	55	46	5	4	10	19(1)	12(10)	0	1	0	13	43	36	6	1	11	19	6	1	2	0	4	19	11	5	3
HAR	8	4	1	3			1(2)			5	2	5	3		2			(1)	(1)		3	2	3	1	1	1
LRP	2	1		1		2						1	1					(1)				1	4	1		3
RHD	0											1		1				(1)					1			1
RDG	1	1								1		2			2						2		0			
PDP	0											0											1		1	
ESR	1	1				1						1	1					(1)				1	4	1	2	1
PHL	1	1					1					0											0			
PNE	0											2	2			(1)	(1)					1	1			1
CMX	0											0											2		2	
PSB	0											1		1		1							0			
SEG	0											4	1	2	1	2		(2)				2	2	1		1
ABE	1		1				1					3		2	1			(1)	(2)			3	3		3	
PTW	1		1				1(1)				1	1		1				(1)				1	1			1
ELM	1		1							1		1	1					(1)				1	1		1	
COLLY	0											0											1		1	
STF	1	1									1	0											0			
GVR	2	1	1		1			1				1		1								1	0			
IPT	5		3	2	4		1					4		4		3						1	3		1	2
CYE	3		3							3		2		2							2		0			
POC	1		1							1		0											0			
AVP	0											1		1							1		0			
LYN	0											2		2				(2)				2	0			
SSB	0											1		1								1	0			
BGM	3		1	2			1			2		4	2	2		2(1)					1	1	1			2
STP	2		1	1				(2)			2	2	1	1					(2)			2	2		2	
BCH	0											1		1								1	0			
POU	0											1			1			(1)				1	1		1	
SPL	1		1					(1)			1	0											0			
Subtotal X Area	34	10	15	9	5	3	5(3)	1(3)	0	13	7	41	12	22	7	8(2)	(1)	(12)	(5)	0	9	24	31	4	15	12
TOTALS	89	56	20	13	15	22(1)	17(13)	1(3)	1	13	20	84	48	28	8	19(2)	19(2)	6(12)	1(5)	2	9	28	50	15	20	15

* The numbers within parenthesis are the 'probable' totals from Table I.