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Houston Intercontinental and William P. Hobby Air Traffic Control Systems Analysis

M.S. Huntley Jr.
R.L. Mumford
R. Rudich

Transportation Systems Center
Cambridge MA 02142

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Final Report

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16. Abstract

This report provides a description of the non-surveillance aspects of the FAA air traffic control facility operation at Houston Intercontinental and William P. Hobby Airports from the air traffic controller's point of view. It includes photographs of all controller consoles with all equipment and posted paper identified; descriptions of weather, NOTAMs, flight data and methods for distributing information on equipment status; and controller requirements for this information. In addition the terminal airspace, major arrival and departure routes, aircraft mix, and hourly operation activity levels are briefly described. An appendix describing the application of the Terminal Information Display System concepts to the Houston operation is included.

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PREFACE

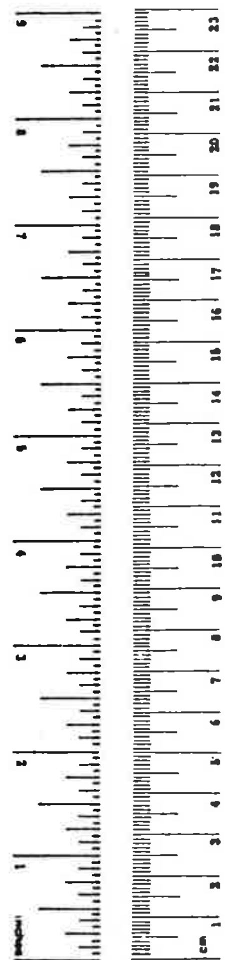
This report documents the operation of the cab, TRACON and TRACAB of Houston International and William P. Hobby air traffic control towers respectively, and applies the Terminal Information Display System (TIDS) concept to these operations. The study was sponsored by the FAA System Research and Development Service and conducted at the Houston facilities between February and August if 1981.

The work was completed with the cooperation of the South-western Region of the FAA, and the air traffic division of that region in particular. Special thanks are due to F.Davis, Chief and D.Schardt, Assistant Chief of the Intercontinental facility; and C.Jenkins, Chief of the Hobby facility for their support and and assistance in the collection and interpretation of the data presented herein.

METRIC CONVERSION FACTORS

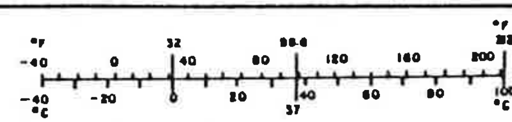
Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
in	inches	2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
	AREA			
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
	MASS (weight)			
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
	VOLUME			
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
	TEMPERATURE (exact)			
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C



Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
	AREA			
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
	MASS (weight)			
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
	VOLUME			
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
	TEMPERATURE (exact)			
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



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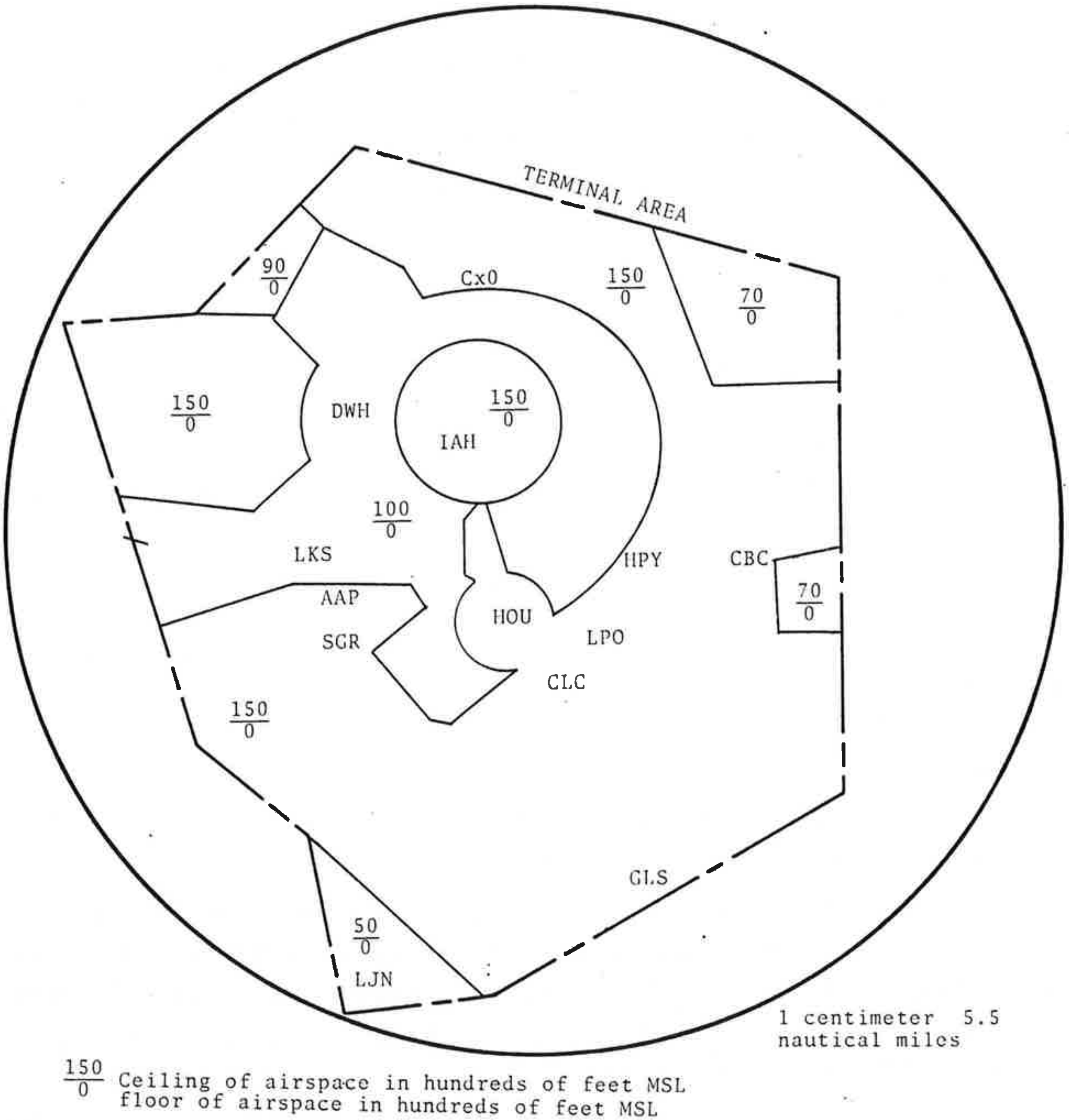
1. INTRODUCTION

This report of air traffic control operations in the Houston terminal area is the fifth of a series of reports documenting and describing the non-surveillance functions and duties of terminal area controllers at selected air traffic control towers. It includes three Level V towers: Boston, Atlanta, and Houston; and two Level III towers: Albuquerque and Buffalo.

The series is conducted to provide operational information to be considered in the design and site application of the Terminal Information Display System (TIDS) currently being developed for deployment in terminal areas across the United States. TIDS is a dual service system composed of relatively independent Flight Data Display (FDD) and Consolidated Cab Display (CCD) subsystems which share a common central processor. The FDD will replace flight progress strips and the aging Flight Data Entry and Printout Equipment (FDEP) by providing selected controllers in cabs, TRACONs, and TRACABs with electronically displayed flight data and keyboards for data updating. The CCD system will consolidate a variety of information on surface weather, equipment status and control, and procedures currently presented by a number of different types of displays, panels and notices. The information will be consolidated and presented electronically on one or two displays at each controller's console.

The present study conducted in the Houston terminal area includes the Houston Intercontinental Airport (IAH) and William P. Hobby Airport (HOU). IAH is a Level V tower and a TRACON. HOU, an older facility, is IAH's largest satellite tower and has a level IV TRACAB. The Houston facilities were selected for study because of their large size, the fact that the satellite and the major tower have FDEP equipment which must eventually be replaced, and the proximity of these facilities to one another.

IAH and HOU facilities provide service to the Houston terminal area depicted in Figure 1-1. The terminal area is an irregularly



$\frac{150}{0}$ Ceiling of airspace in hundreds of feet MSL
floor of airspace in hundreds of feet MSL

FIGURE 1-1. HOUSTON TERMINAL AREA

shaped area at a varying radius of 25 to 45 nautical miles from the Humble Vortac. The altitude is generally from surface to 15,000. Other towered airports in the Houston Terminal area are Ellington Air Force Base (EFB) and David Wayne Hooks (DWH). Within the terminal area IFR aircraft are provided vectors and radar separations to standards of three nautical miles longitudinally and 1,000 feet in altitude. VFR aircraft are provided with Stage III service into IAH and Stage II service into HOU. Generally the TRACON sequences only IFR aircraft into Hobby, but will space and sequence both IFR and VFR Stage IIIs into Hobby if requested. Control of IFR traffic is transferred to/and from the Houston Air Route Traffic Control Center (ARTCC) at the terminal area boundary. Within the terminal area, portions of the airspace surrounding IAH have been designated as a Group 2 Terminal Control Area (TCA) (Figure 1-2). All aircraft are controlled and separated while operating within the TCA, except helicopters which may not be provided separation from other helicopters.

The information for this report was obtained by (a) examining existing written material, (b) photographing controller work space, (c) observing controllers at work, and (d) interviewing journeyman controllers and tower management staff. The written material included Jeppesen Air Manuals, facility SOP's, Letters of Agreement, and a day's sample of tower flight strips from both facilities. Photographs were taken of all controller consoles, posted notices and selected control panels. These photos were used as subject matter for the interviews and serve to document the physical aspects of the tower as it existed during the study. To avoid interfering in TRACON operations, all photographs of TRACON consoles were taken during the midshift. Photographs of cab equipment and consoles were taken during the day to take advantage of natural light.

Journeyman controllers, supervisors, and airway facilities personnel from both towers were interviewed for information on the use of tower equipment, informational requirements, operating practices, potential placement of TIDS displays and the design of

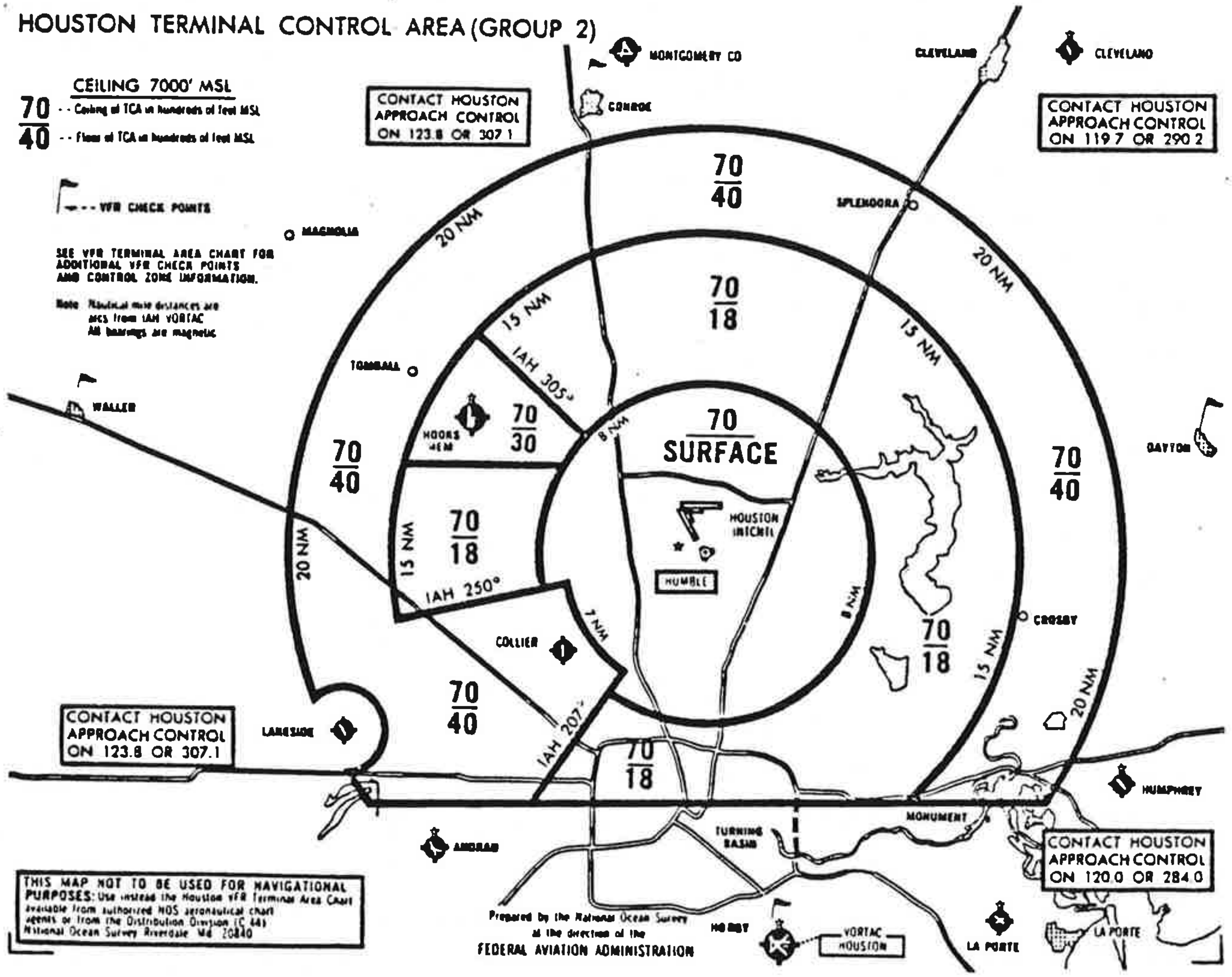


FIGURE 1-2. HOUSTON TERMINAL CONTROL AREA

display formats. Since different subject areas were discussed with different interviewers, some of the information was based on the knowledge of a single person, and so some errors are possible. However, when the interviewer identified information as inconsistent with facility SOPs, practices at other towers, or other data sources, it was verified through observations of controllers at work or in discussions with tower management personnel. Controllers were observed using their equipment, handling flight data, and working traffic in the cab, TRACON, and TRACAB during peak and slack traffic periods over several days. More than 45 hours of observation time were spent at the three facilities for this study.

The description of the IAH operations are presented in Sections 2 through 5 of this report. Section 2 presents an overview of the Houston terminal area TRACON and Tower Cab operations. Section 1 includes a map of the airport, the runway configurations, approach/departure routes used, drawing of the cab and TRACON floor plan, and principal duties and location of each control position in the cab and TRACON. Section 3 presents the operation of the current FDEP and flight progress strip system. This section provides a description of how the strips are used and an analysis of a sample day's flight strips. Section 4 presents a description of the current weather distribution system and use at IAH cab and TRACON. Section 5 presents the location and use of critical display items and how status for this equipment is determined. Sections 6 through 9 present the corresponding information for HOU.

The appendix to this report includes designs for the information formats and placement of the TIDS equipment at the IAH and HOU facilities as an exercies in applying TIDS capabilities to an actual terminal operation. The designs and their deployment are based upon the controller practices and information requirements determined in the present study of Houston Terminal Area operations and the anticipated capabilities of TIDS.

TIDS capabilities were determined from the CCD portion of the Consolidated Cab Display/Remote Maintenance Monitor System (CCD/RMMS) Engineering Requirement (FAA-ER-500-007/1) and the Engineering Requirement (FAA-ER-D-120-011) for the Flight Data Display subsystem portion of the new TIDS. Since this study was initiated, some departures from these engineering requirements have been made in both hardware and operations; however, the changes have been small and the operational support provided terminal area controllers by TIDS remains essentially as discussed herein. Because the application of TIDS concepts to terminal area operations is not equipment specific, the value of the present report is independent of minor changes in displays and the associated differences in the operation of that hardware. Information formats are presented and discussed in the four major sections of the Appendix. An overview of the TIDS is presented in Section A-1 with a description of system objectives and selected display features. The application of the FDD portion of TIDs of Houston is presented in Section A-2 with information on display formats at the controller positions, discussions of controllers' use of the system, and suggestions for modifications of the system from that presented in the TIDS ER. The application of the CCD portion of the TIDS to the Houston operation is presented in Section A-3 with information formats proposed for the different CCD displays. The location of FDD and CCD displays in controller consoles at the two facilities is presented in Section A-4 under ideal conditions where movement of existing equipment is almost unlimited and under limiting conditions where only minimal disturbance of existing equipment is permitted.

2. INTERCONTINENTAL AIR TRAFFIC CONTROL SYSTEM

2.1 QUANTITATIVE SUMMARY OF DAILY AND ANNUAL IAH OPERATIONS

A quantitative summary of IAH operations is provided in the following tables and figures.

Table 2-1. IAH TRACON Operations FY 80
Table 2-2. IAH TRACON Instrument Operations FY 80
Figure 2-1. IAH Operations vs Time of Day

In 1969 Houston Intercontinental, located 16 miles north of downtown Houston, replaced William P. Hobby as Houston's primary airport. The Tower facility houses the Cab and a TRACON with ARTS III equipment. Intercontinental handles 99 percent of Houston's non-intrastate domestic air traffic and all of Houston's international air traffic.

The Houston Intercontinental Tower Cab handled approximately 290,000 aircraft operations (arrivals and departures) in 1980. The traffic mix was as follows:

Air Carrier	59.1%
Air Taxi	17.2%
General Aviation	23.2%
Military	.5%

The Houston TRACON handled approximately 611,000 instrument operations in 1980. Overflights as a percentage of total instrument operations equalled 6%. The traffic mix was a follows:

Air Carrier	36.2%
Air Taxi	12.6%
General Aviation	49.1%
Military	2.1%

Daily Tower traffic begins building at 7 am and stays heavy until 7 pm. The peak is generally from 2:00 to 6:00 pm (see Figure 2-1). Houston TRACON typically handles almost 1700 operations per day.

TABLE 2-1. HOUSTON INTERCONTINENTAL OPERATIONS FY 1980

	AIR CARRIER	AIR TAXI	GENERAL AVIATION	MILITARY	TOTAL	NATIONAL RANK
TOWER OPERATIONS	171,682	50,049	67,329	1,383	290,443	39
INSTRUMENT OPERATIONS	221,018	76,879	300,352	13,069	611,318	7
INSTRUMENT APPROACHES	26,027	9,389	34,565	222	70,203	4

Source: FAA Air Traffic Activity

TABLE 2-2. HOUSTON TRACON INSTRUMENT OPERATIONS

PRIMARY AIRPORT	ANNUAL INSTRUMENT OPERATIONS FY 79	
Houston Intercontinental	291,217	(47.6%)
SECONDARY TOWERED AIRPORTS		
Houston Hobby Ellington AFB David Wayne Hooks	174,490	(28.6%)
SECONDARY NONTOWERED AIRPORTS		
Andrau Air Park Baytown Clear Lake City Cleveland Municipal Conroe Galveston Houston Lakeside Lake Jackson Brazoria LaPorte Municipal League City Liberty Airport Pearland Sugarland	109,714	(17.9%)
OVERFLIGHTS	35,897	(5.9%)
	611,318	(100.0%

Source: FAA Air Traffic Activity.

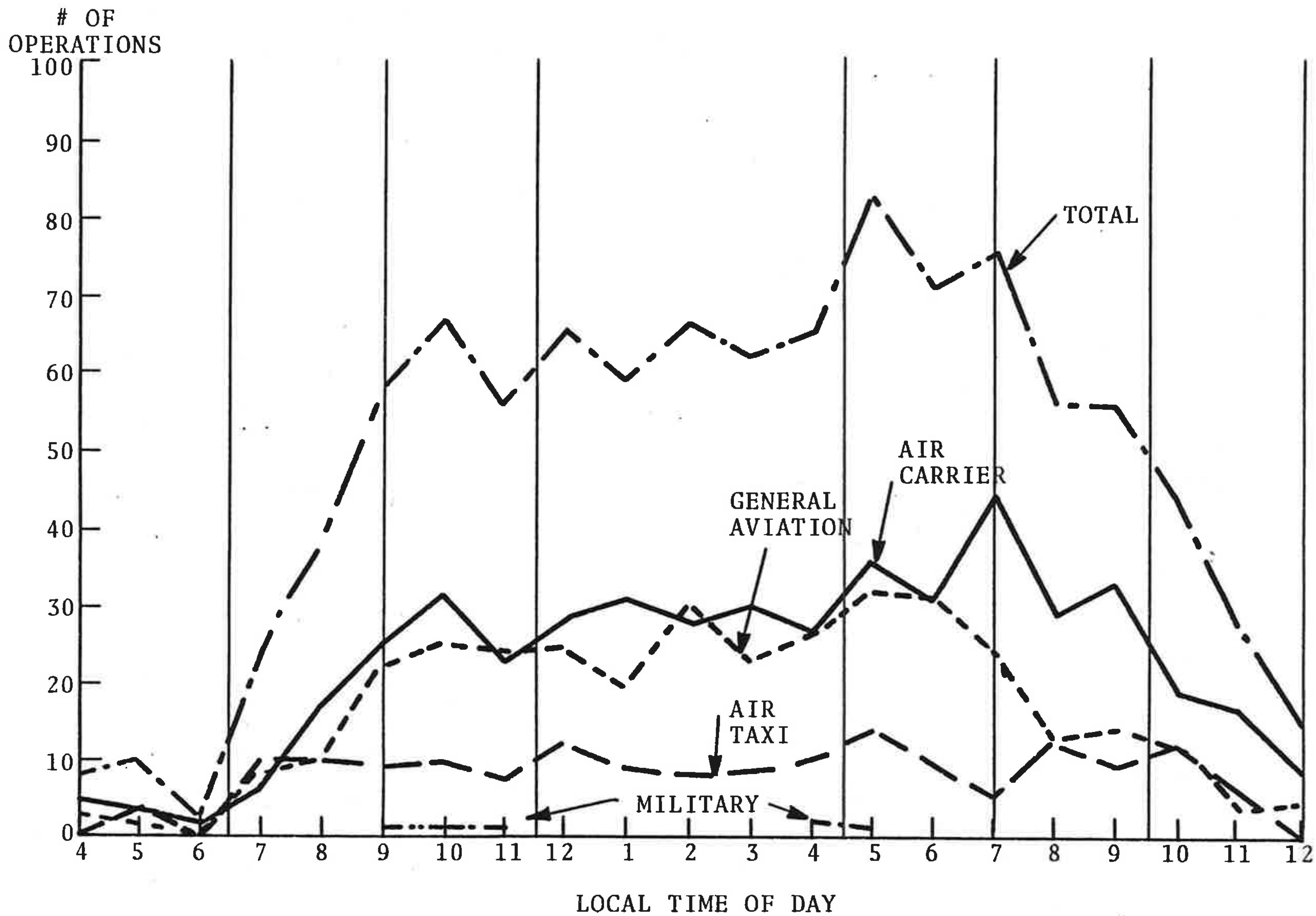


FIGURE 2-1. IAH OPERATIONS VS. TIME OF DAY

As the population of Houston's Standard Consolidated Statistical Area (SCSA) continues to increase faster than the national population it is expected that future traffic levels at IAH will grow rapidly. An expansion program which will provide additional runway and terminal capacity is currently underway to accommodate the expanding needs of passengers and carriers.

2.2 IAH AIRPORT LAYOUT

The following figures and tables describe the operational setting of IAH's air traffic control setting:

Figure 2-2.	Runway Configuration
Figure 2-3.	Typical Taxiway Traffic Patterns
Figure 2-4-7.	Typical Approach Patterns
Figure 2-8-9.	Arrival/Departure Corridors
Figure 2-12.	Departure Gates
Figure 2-16.	Navigation Fixes Surrounding Houston
Table 2-3.	Controllers Working Aircraft At Arrival Coordination Fix

IAH's two major runways form an open "V". The east-west runway 8/26 is 9,400 feet long and 150 feet wide and the northwest-southeast runway 14/32 is 12,000 feet by 150 feet. All four approaches are equipped with high intensity lighting systems and Instrument Landing Systems (ILS). Runway 8 has Category II and Category III systems which facilitate landings below 1800 RVR and 1200 RVR respectively. High speed turnoffs lead to adjacent twin parallel taxiways. IAH facilities also include two Short Take Off and Landing (STOL) runways, 13/31 and 9/27. These runways are available for commuter traffic, but will not be assigned when traffic conditions require the use of the STOL runways for taxiing aircraft. The construction which is currently under way will provide additional runway capacity.

In VFR conditions, the runway configuration most frequently used at IAH is arrivals on 26 or 14 and departures off 14. When conditions become IFR, runway 8, the Category II ILS runway, is often used for arrivals, and 14 is used for departures. In VFR

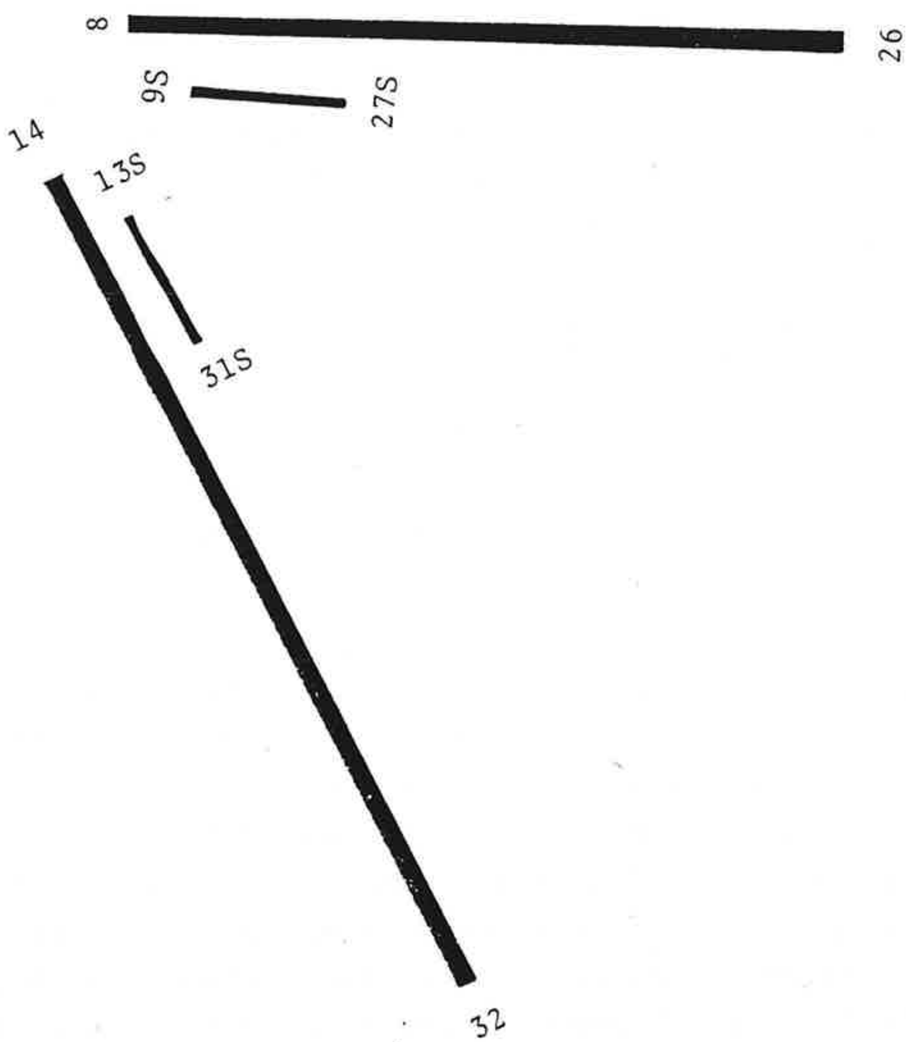


FIGURE 2-2. RUNWAY CONFIGURATION

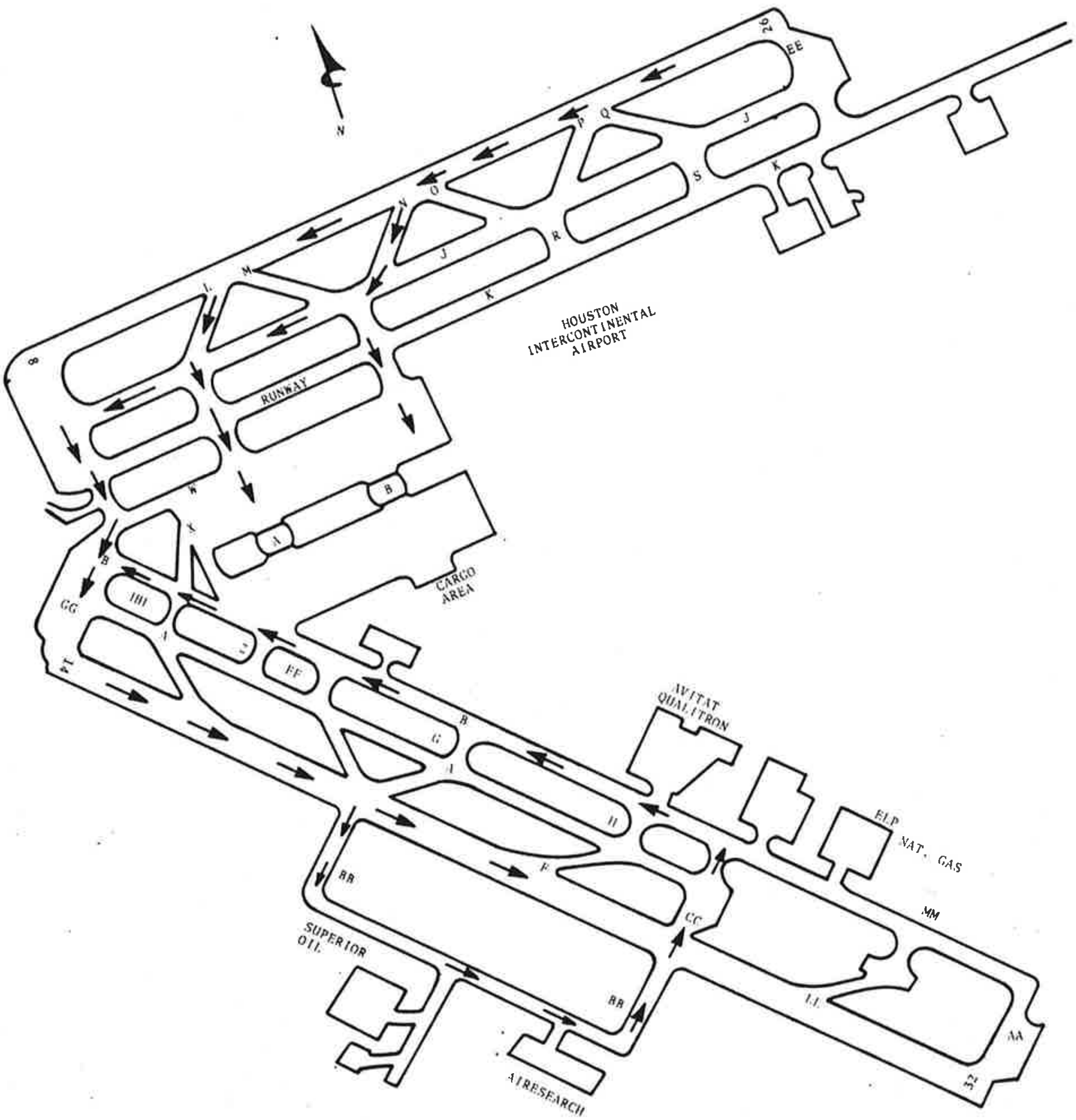


FIGURE 2-3. TAXIWAY TRAFFIC FLOW FOR RUNWAY CONFIGURATION 14/26

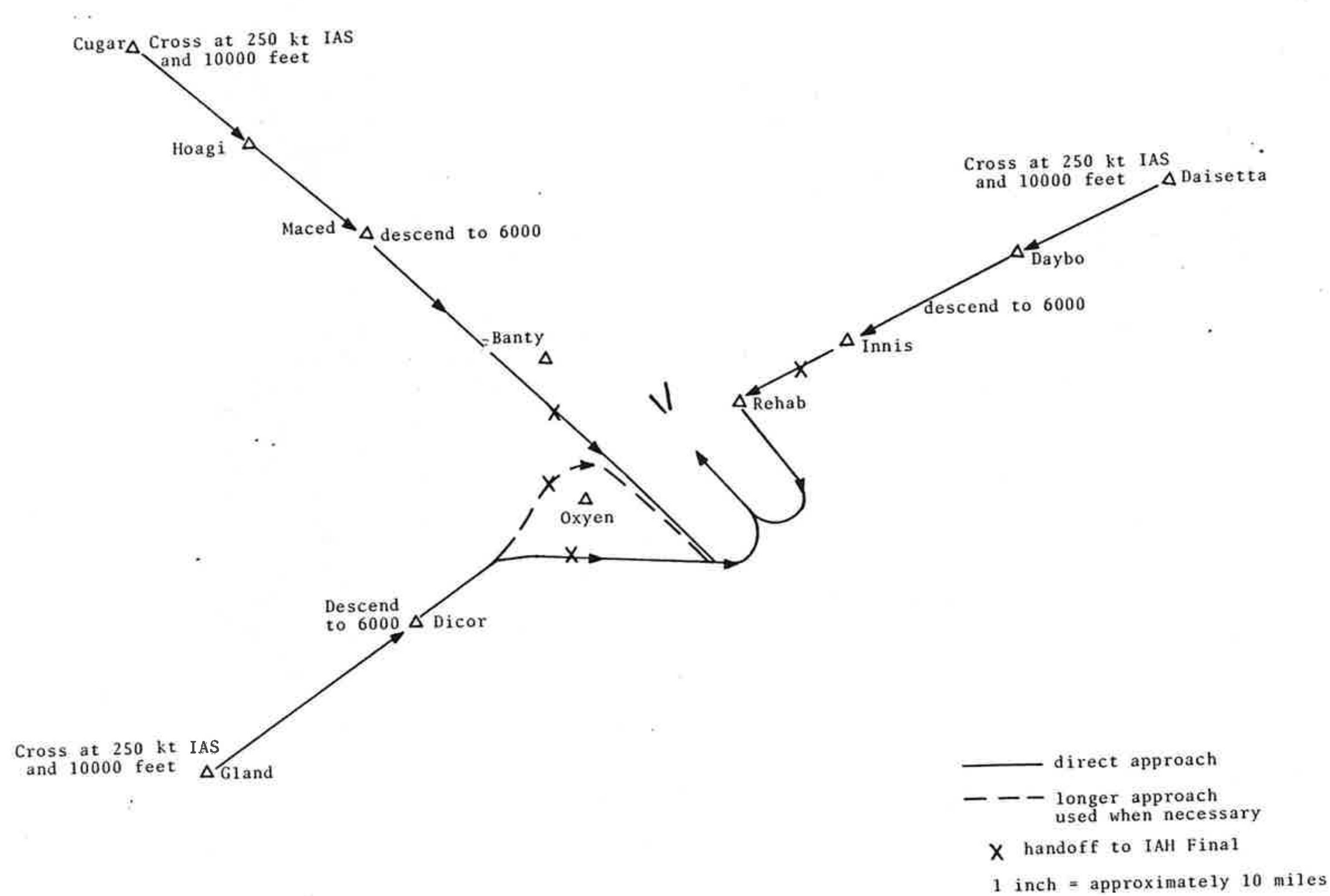


FIGURE 2-4. TYPICAL APPROACH PATTERNS FOR RUNWAY 32

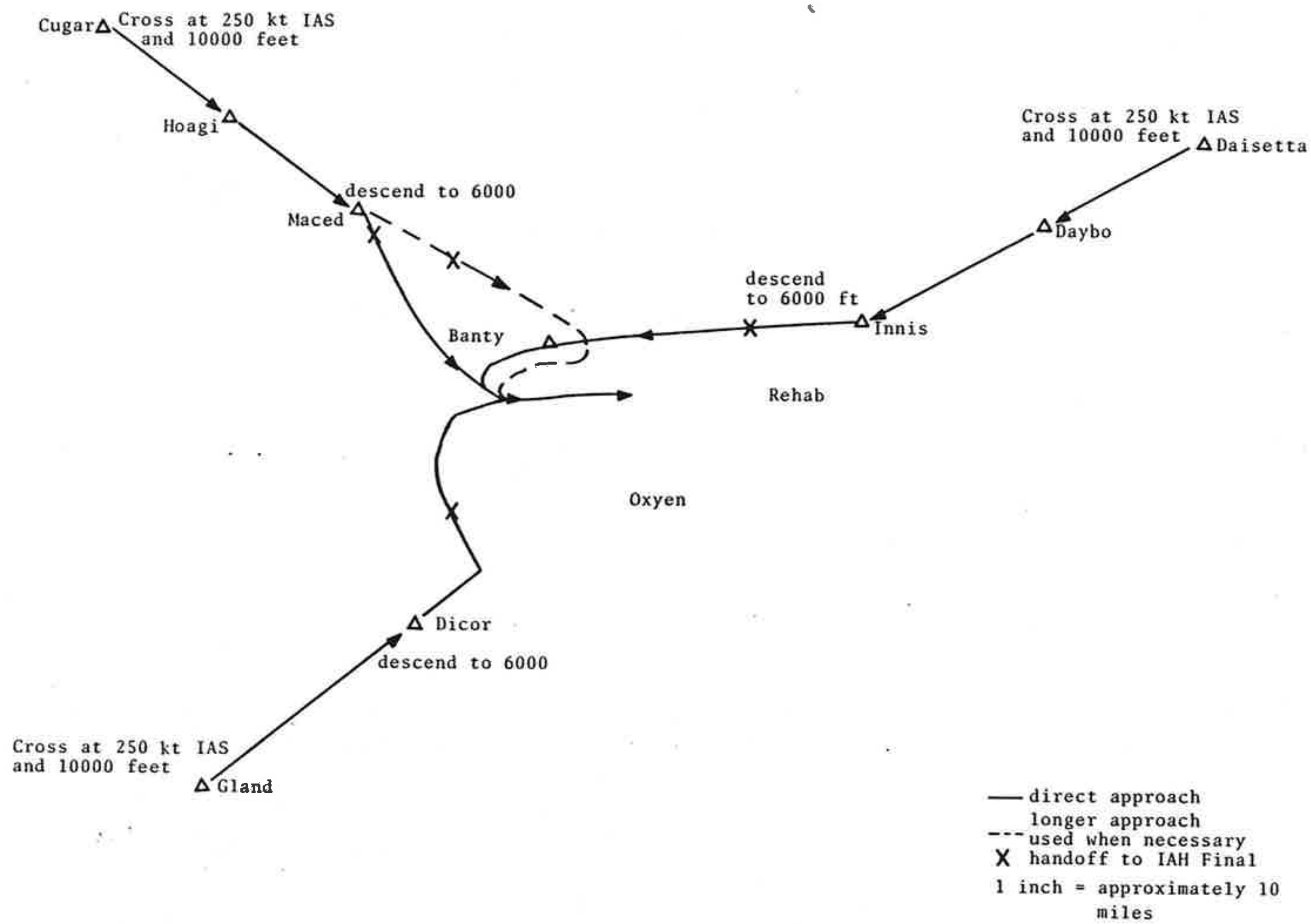


FIGURE 2-5. TYPICAL APPROACH PATTERN FOR RUNWAY 8

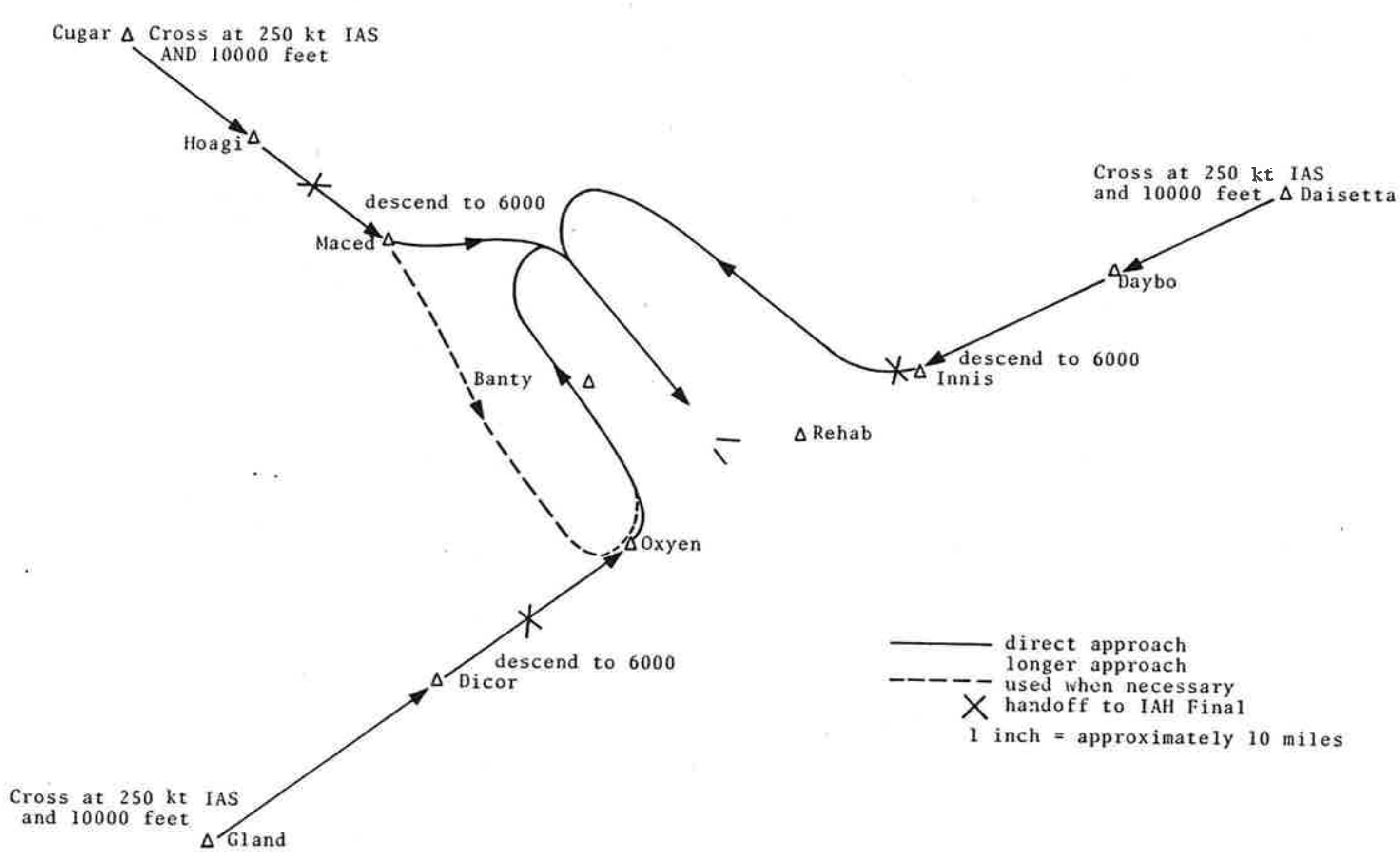


FIGURE 2-6. TYPICAL APPROACH PATTERN FOR RUNWAY 14

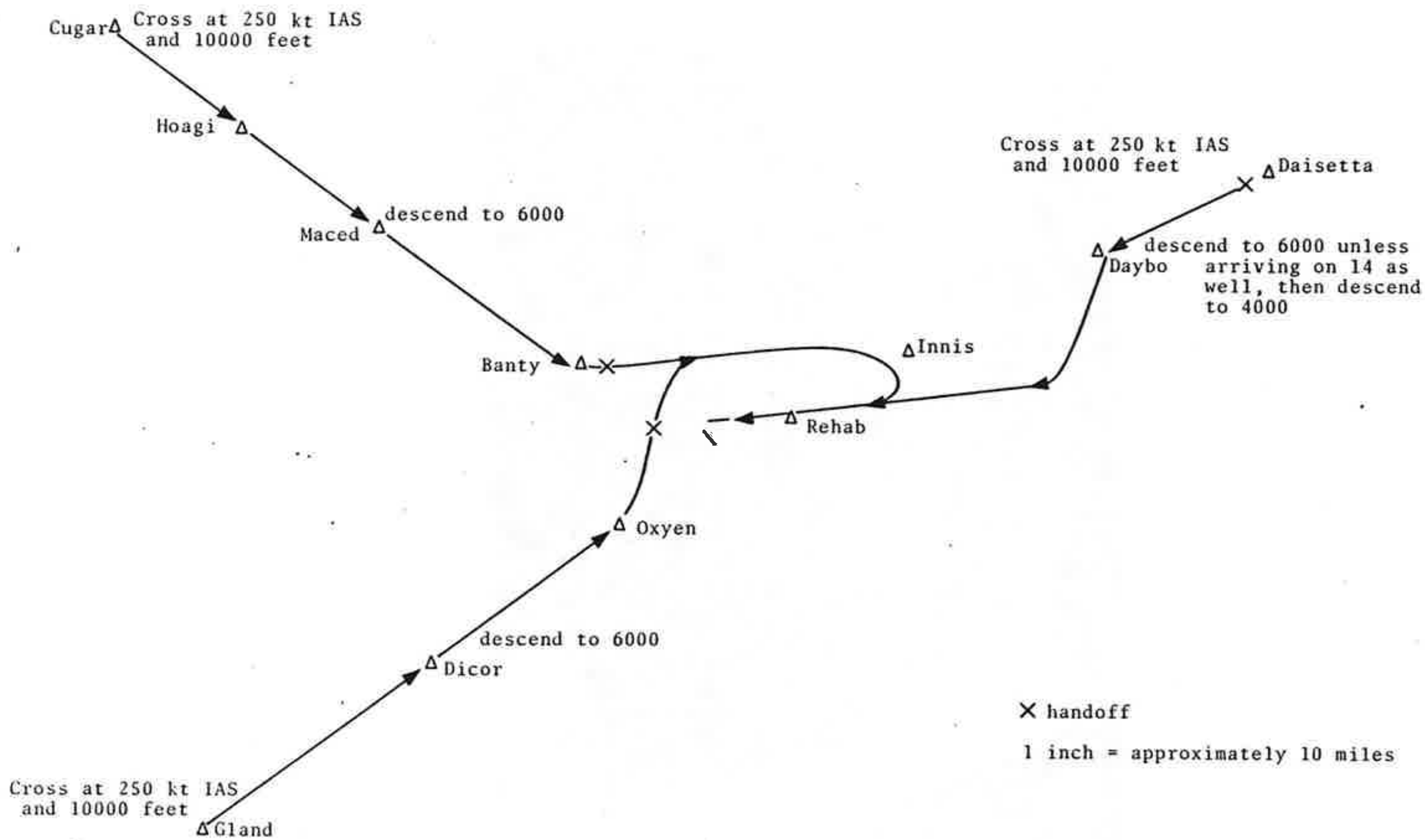


FIGURE 2-7. TYPICAL APPROACH PATTERNS FOR RUNWAY 26

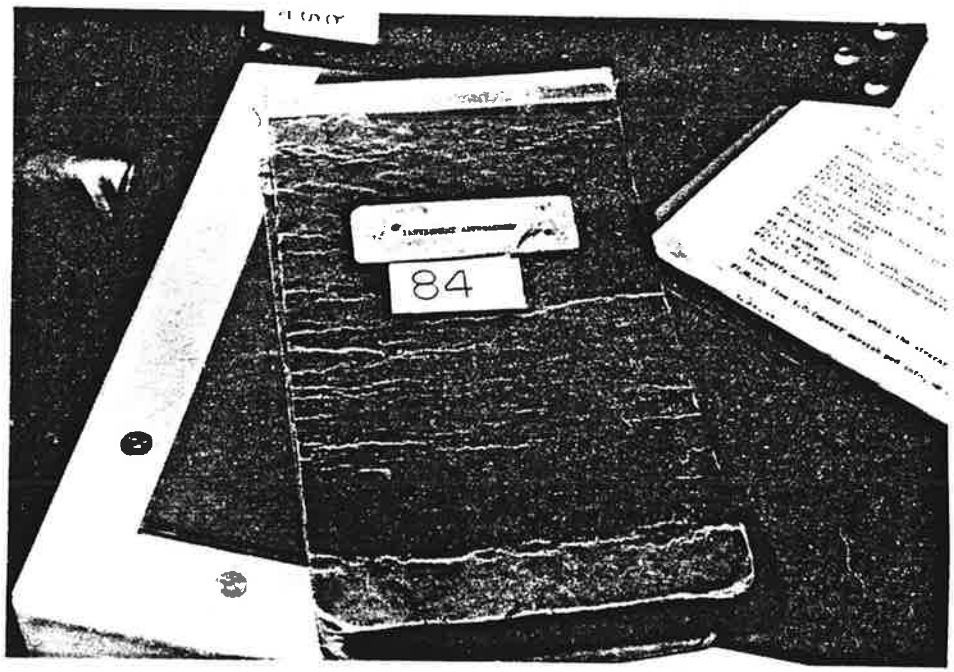


FIGURE 2.8. APPROACH PLATES ON CONSOLE AT RADAR POSITION

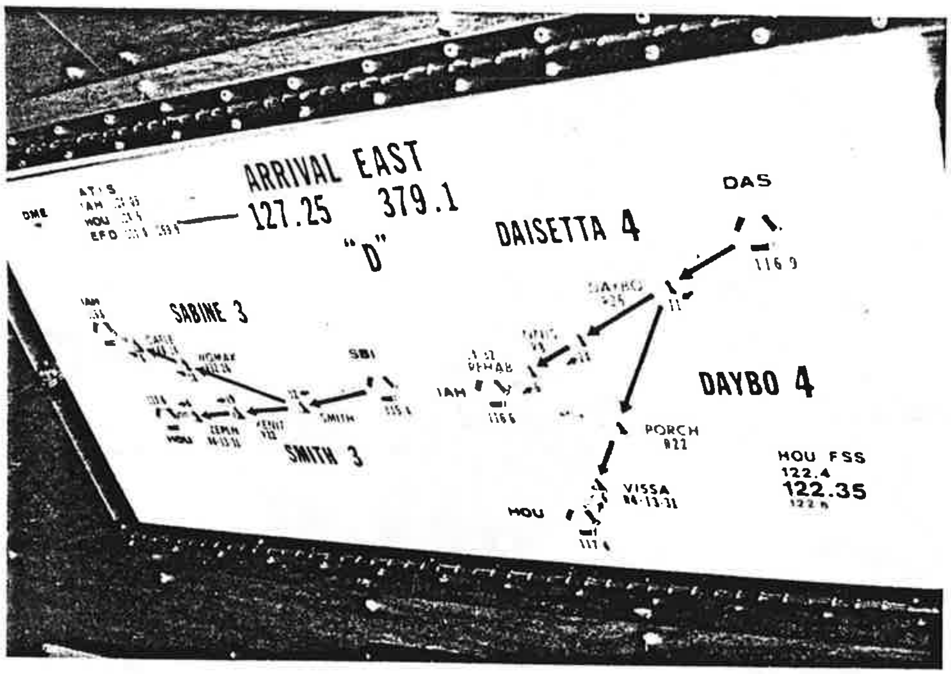


FIGURE 2.9. APPROACH INFORMATION ABOVE ARRIVAL EAST

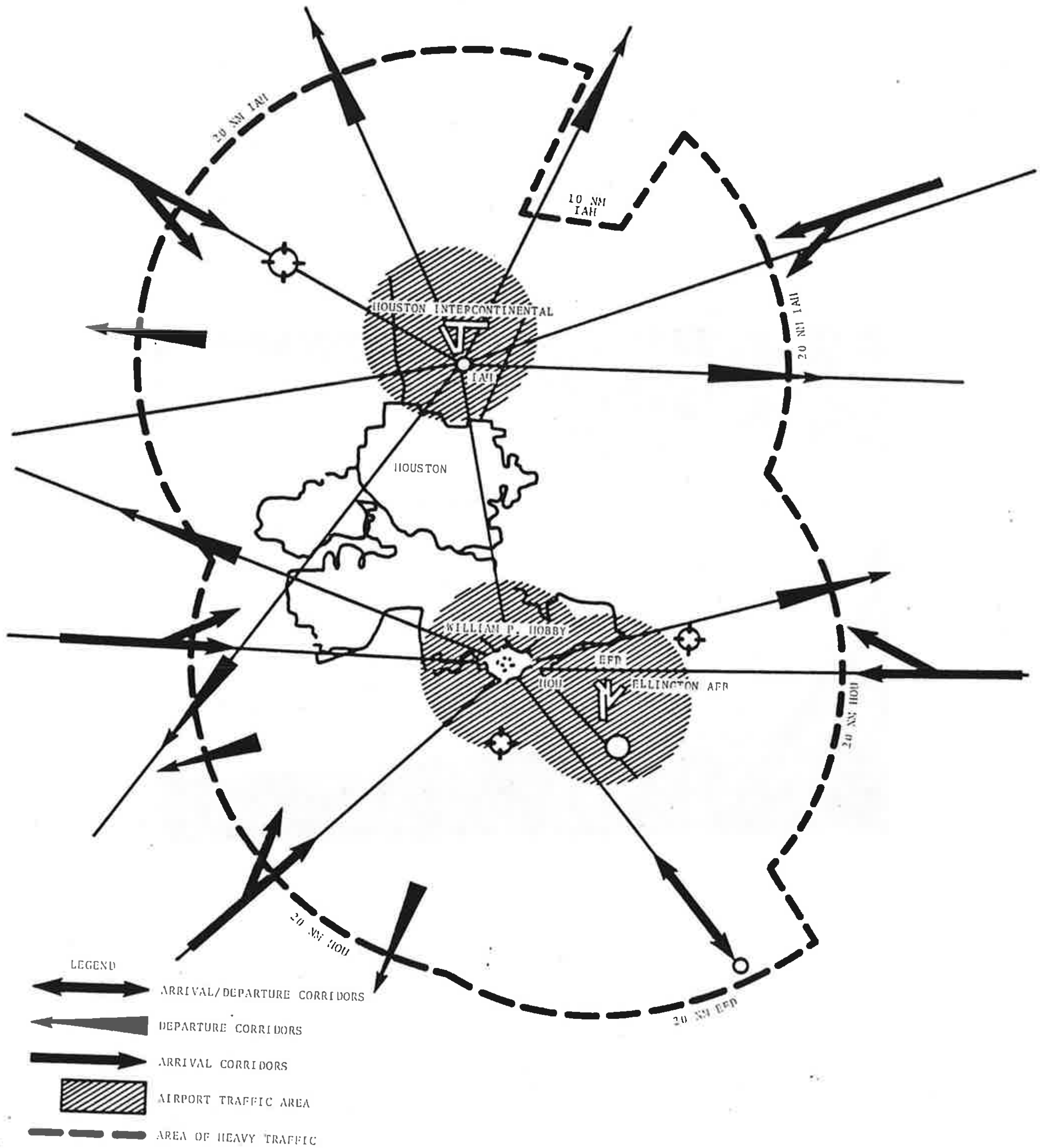


FIGURE 2.10. ARRIVAL/DEPARTURE CORRIDORS

TERMINAL AREA GRAPHIC NOTICE
(NOT TO BE USED FOR NAVIGATION)

Term-31

HOUSTON, TEXAS

THIS CHART DEPICTS THE IFR ARRIVAL/DEPARTURE ROUTES SERVING THE HOUSTON TERMINAL AREA FOR THE INFORMATION AND GUIDANCE OF PILOTS OPERATING VFR WITHIN THE AREA. PILOTS ARE ENCOURAGED TO CONTACT HOUSTON APPROACH CONTROL FOR TRAFFIC ADVISORY SERVICE.

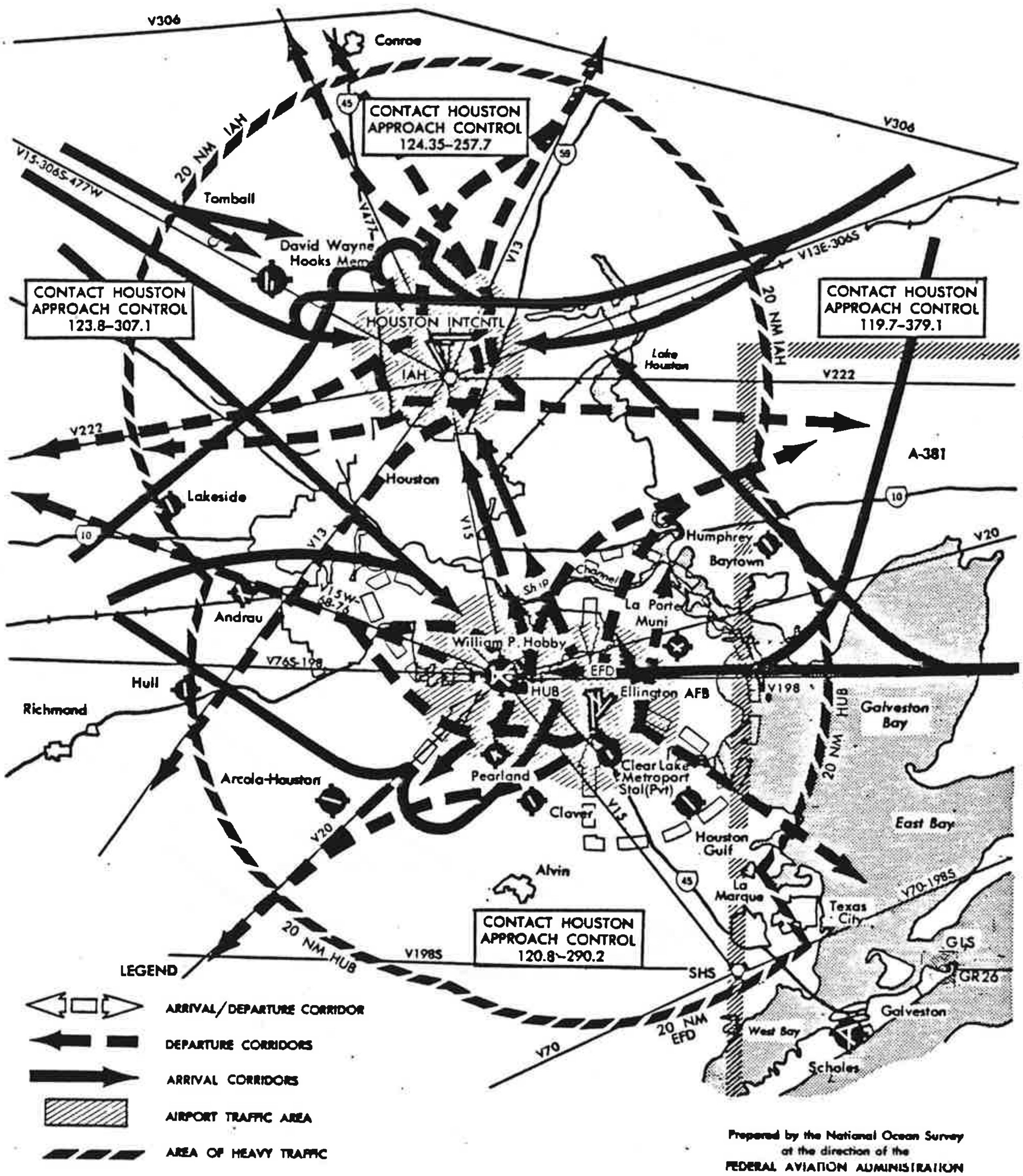


FIGURE 2.11. ARRIVAL/DEPARTURE CORRIDORS

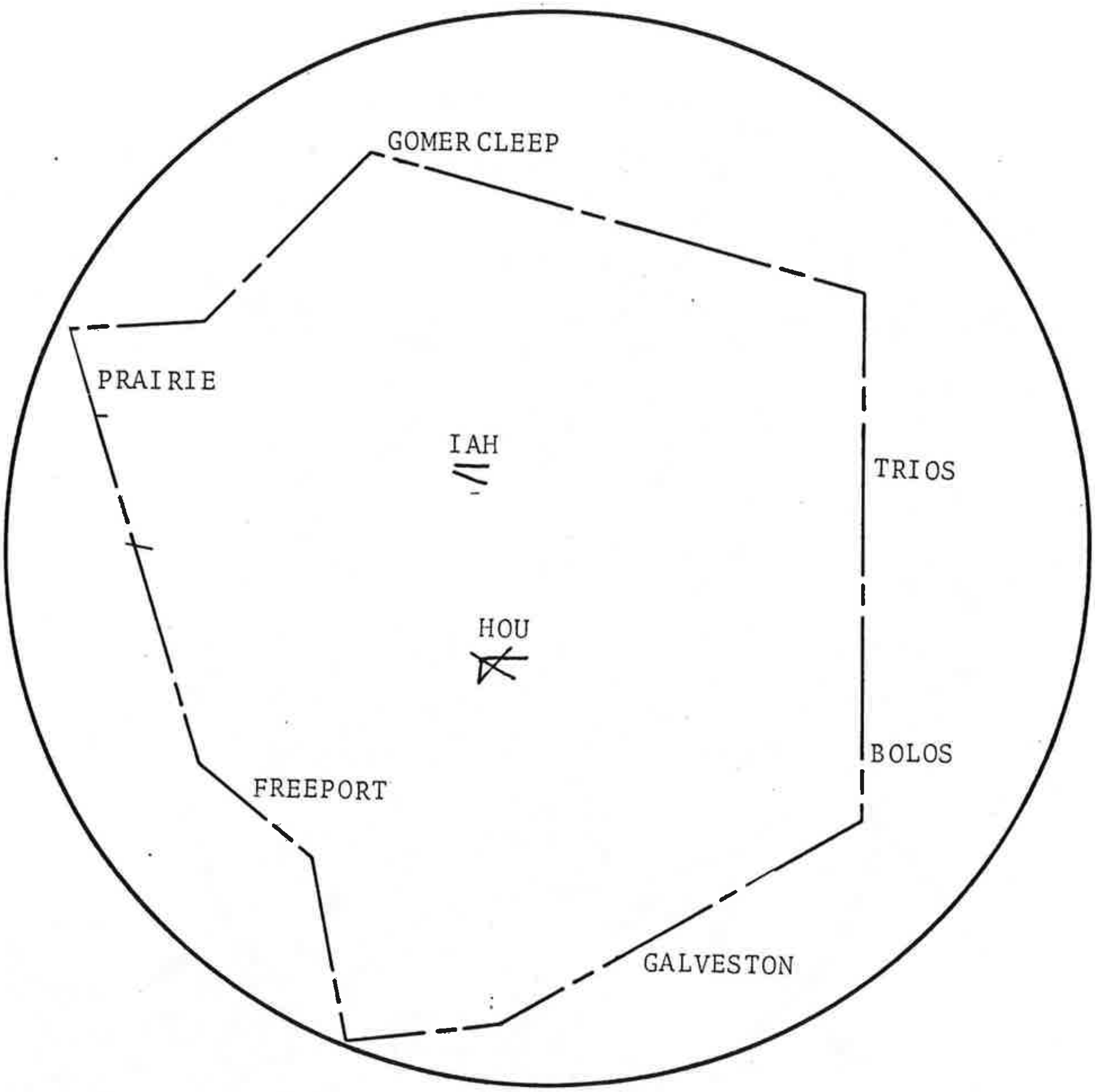


FIGURE 2.12. DEPARTURE GATES

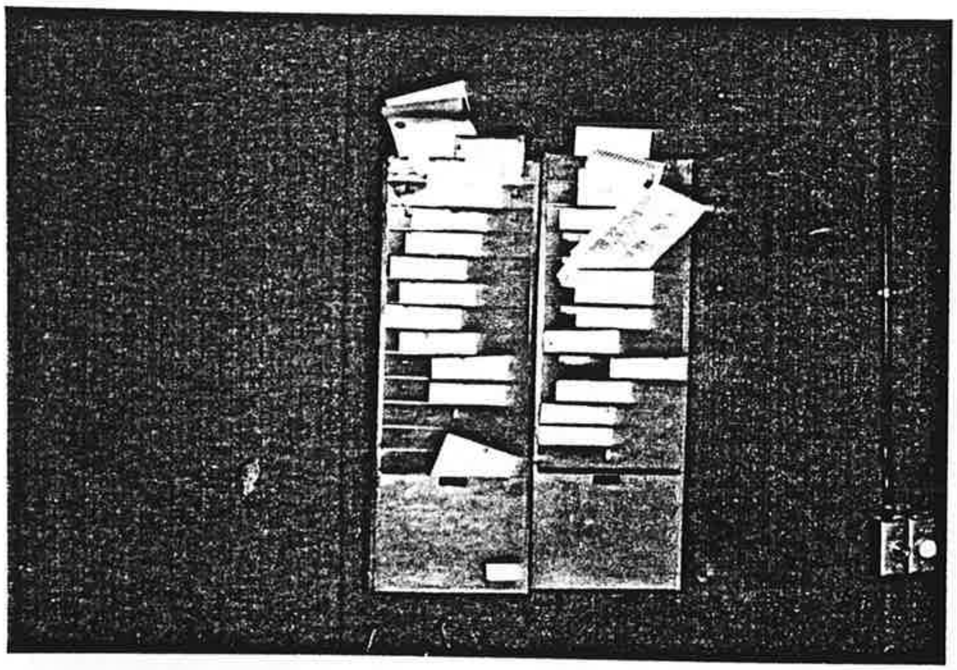


FIGURE 2.13. AERONAUTICAL MAPS OVER TELEPRINTER IN TRACON

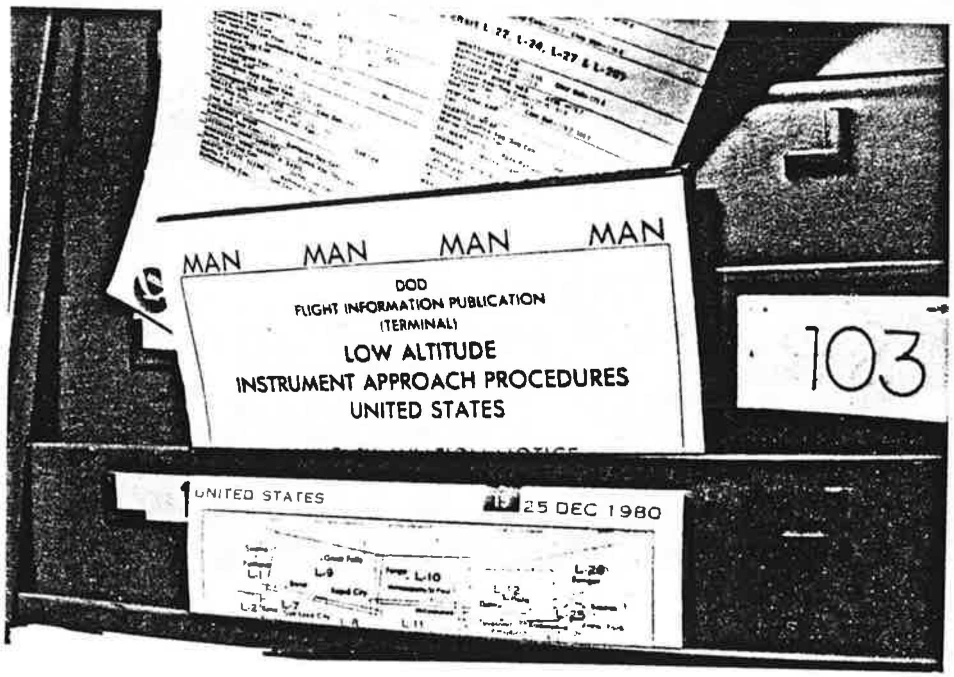


FIGURE 2.14. AERONAUTICAL MAPS ABOVE TELEPRINTER ON TRACON

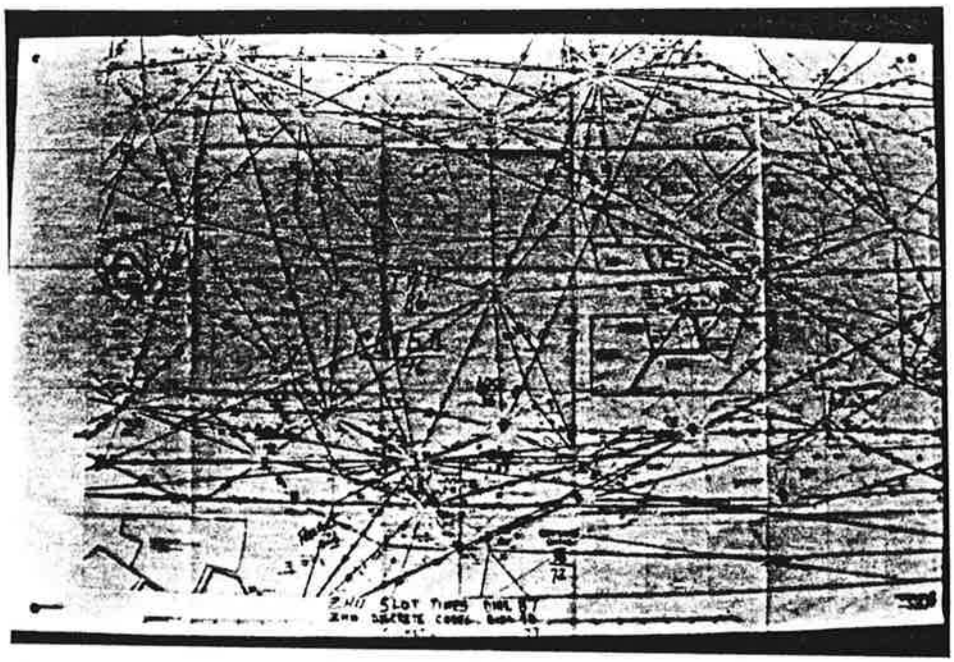


FIGURE 2.15. MAP ABOVE FDEPs AT AD/DD POSITION

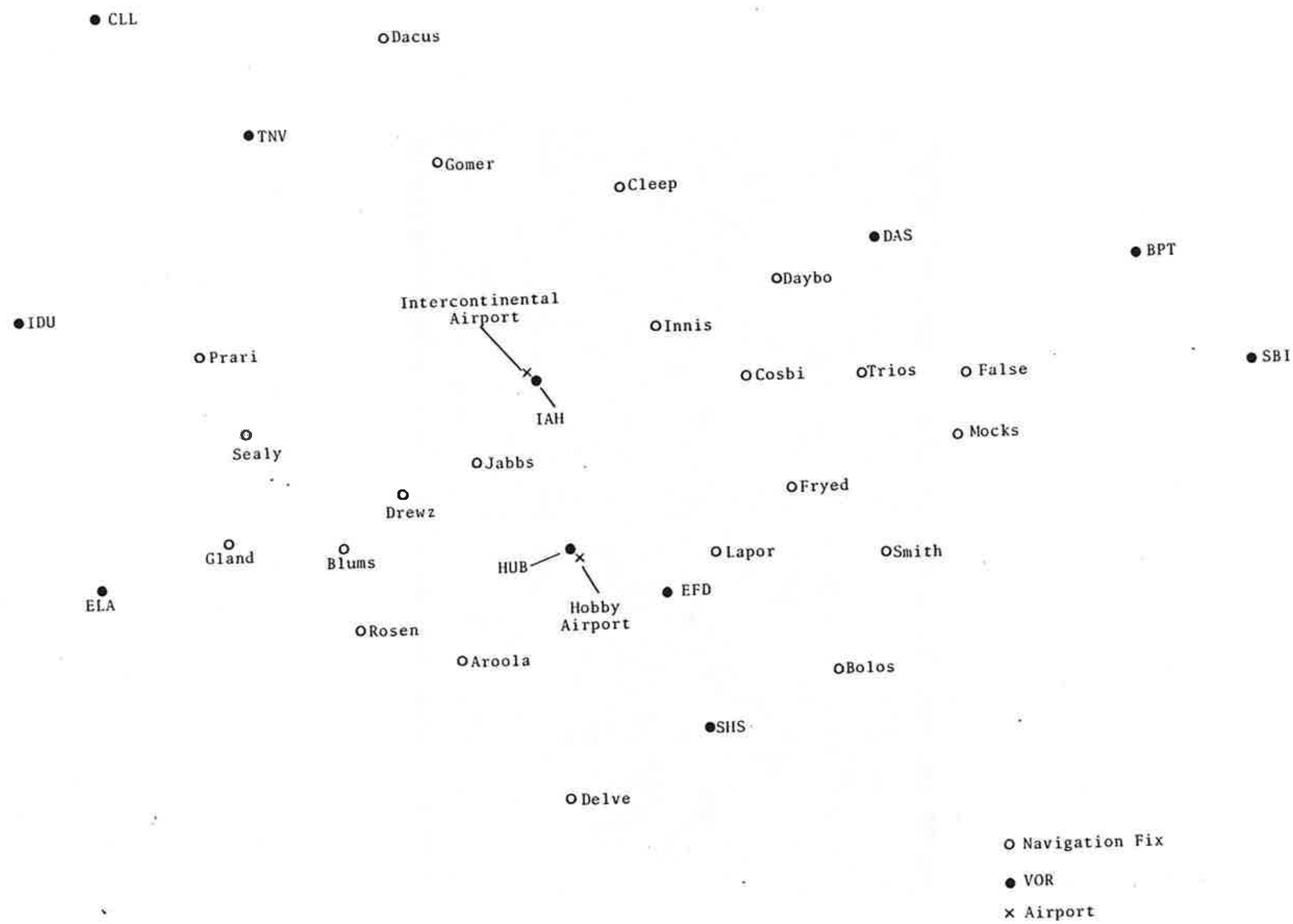


FIGURE 2.16. NAVIGATION FIXES AND VOR'S SURROUNDING HOUSTON

TABLE 2-3. TRACON CONTROLLERS WORKING AIRCRAFT AT ARRIVAL COORDINATION FIX

RADAR POSITION	ARRIVAL COORDINATION FIX
Arrival East	Daisetta Smith Silbe Sabine Pass
Arrival West	Navasota Cugar Gland
South	April Candi Klute Scholes Lake Jackson

conditions with a strong NW wind runways 26 and 32 may each be used for both arrivals and departures. This is not a popular configuration however because the use of 32 causes congestion with Hobby traffic. When two runways are used for arrivals and metering flow is approximately 52 aircraft per hour. With only one runway available for arriving aircraft the metering flow is reduced to 24-30 aircraft per hour. The TRACON Team Supervisor determines the arrival/flow rate and coordinates with the Center to decide metering needs.

The taxiway network connects the three major activity centers: Terminal Buildings A and B near the Tower, Superior Oil and Air Search south of 14/32, and Avitat Qualitron and Elp Natural Gas north of 14/32. Advisory instructions may be issued by the Ground Control position in the Cab but legally the terminal ramp area is uncontrolled (the city and airlines are responsible). A map of the taxiway network is posted at the Ground Control position.

An IFR arrival to IAH will most frequently be vectored by the ARTCC along a STAR to one of three major coordination fixes: Cugar, Gland or Daisetta. These flights will approach the fix at 250 knots and at an altitude of 10,000 feet MSL. Coordinated transfer of control of the flight from the ARTCC to IAH is accomplished via a silent ARTS handoff. The ARTCC controller initiates handoff by a manual entry with the ARTS keyboard. A flashing symbol, indicating handoff status, is displayed on the receiving controller's ARTS display. That controller in turn must make a manual entry using the ARTS keyboard to accept the handoff. His acceptance is indicated on the display of the ARTCC controller who initiated the handoff. The manual key board input functions may be performed by the coordinator position (if staffed), depending on workload and team preferences. The controllers rely on interphone communication for conditions other than those specified in the Letters of Agreement. The aircraft continues toward the runway as depicted in Figures 2-4 through 2-7. Descending to 6000 feet MSL, the aircraft is handed off (in the same manner as for the handoff from ARTCC to IAH) or "dumped" (at the points indicated in Figures 2-4 through 2-7) to IAH Final. Within the "dump box" IAH final sequences the aircraft for landing. Responsibility for the flight is usually transferred from the TRACON to the Tower Cab within 8 DME radius of the Humble Vortac. Local Control is advised of the approaching aircraft by ARTS display and air to ground contact with the pilot. There is no handoff or communication between the TRACON controller and LC.

An approach plate binder is stored at the reference table in the Cab for use by Local Control and on the sector console in the TRACON for shared use by Radar and Coordinator positions (Figure 2.8). The approach plate binder contains information on:

- o Glide slope and path
- o Landing air identifications, locations and frequencies
- o Local obstructions
- o Minimum descent altitudes
- o ILS category
- o Supplemental landing data (e.g., runway maps, elevation, ATC and ATIS frequencies, etc.)

The Standard Instrument Arrival Routes (STAR's) are stored in position binders at sector consoles in the TRACON for shared use by Radar and Coordinator positions. The STARS provide route identification, NAVAID identification, location and frequencies, fix identifiers, radial headings, DME distance, radial headings and airways. A subset of this information is posted above the arrival radar positions for quick reference (Figure 2.9).

A one-day sample of IAH IFR arrival flight strips shows the following planned distribution of arrival aircraft among the 8 coordination fixes:

Daisetta	-	117
Cugar	-	95
Gland	-	30
Silbe	-	8

Klute	-	5
HUB	-	4
HOU	-	3
Smith	-	2
		264

Fixes actually used by the aircraft may be different than those printed on the flight strips.

Table 2-3 shows the controllers that may work aircraft from each arrival fix.

IFR aircraft departing IAH follow the routes described in Figure 2.10. The flight strip which is dropped down the tube notifies the departure controller in the TRACON that an aircraft will be entering his airspace. Soon after, the target is picked up on the ARTS display and the pilot contacts the departure controller. LC does not communicate or handoff to TRACON. Handoffs between TRACON controllers and to the ARTCC are as discussed for arriving aircraft. The Standard Instrument Departure (SID) route information is stored in position binders at sector consoles in the TRACON for shared use by radar and coordinator positions. The published departure routing data contains information similar to that provided by the STARS (discussed above). A subset of this information is posted above the departure radar positions for quick reference. Figure 2-12 shows the location of departure gates.

A one-day sample of IAH IFR departure flight strips shows the following distribution of departure designators:

Gomer	-	74
Cleep	-	67
Trios	-	58
J15	-	29
Freeport	-	29
Prairie	-	25
Landing Beaumont	-	18
J86 or Sabine	-	13

Tower En Route	-	7
V15W	-	5
Local	-	5
Galveston	-	4
Overcourse over Galveston	-	2

When the East Departure position becomes saturated (Trios, Cleep, and Gomer), the Bolos gate, which is handled by the South position, is used.

A map bin located along the side wall, above the teleprinter in the TRACON contains various navigation maps for reference (Figures 2.13 - 2.15). One such chart is posted above the FDEP machines at the AD/DD position (Figure 2.15).

2.3 INTERCONTINENTAL TOWER CAB AND TRACON STAFFING

The layout, staffing, operations and working environment of the Houston Tower Cab and TRACON are presented in the following:

Figure 2-17	IAH Tower
Figures 2-18 - 2-29	TRACON Floor Plan and Controller Positions
Figures 2-30 - 2-38	Tower Cab Floor Plan and Controller Positions
Table 2-4	TRACON Positions and Duties
Table 2-5	Tower Cab Positions and Duties
Table 2-6	TRACON Staffing Hours
Table 2-7 TOWER	Tower Cab Staffing Hours
Figure 2-39 - 2-48	Controller Airspaces

There are 16 positions in the TRACON of which 14 are staffed on a regular basis. Photographs of the position workspace are displayed in Figures 2.19 - 2.29. Specific positional responsibilities are described in Table 2-4. There are two arrival and two departure positions which provide radar service to aircraft. General support for the departure radar controllers is provided as required by traffic loading by coordinator positions situated next to the radar positions. Departure West includes service to Hooks airport. The IAH final is staffed when only one runway is

FIGURE 2.17. HOUSTON INTERCONTINENTAL TOWER

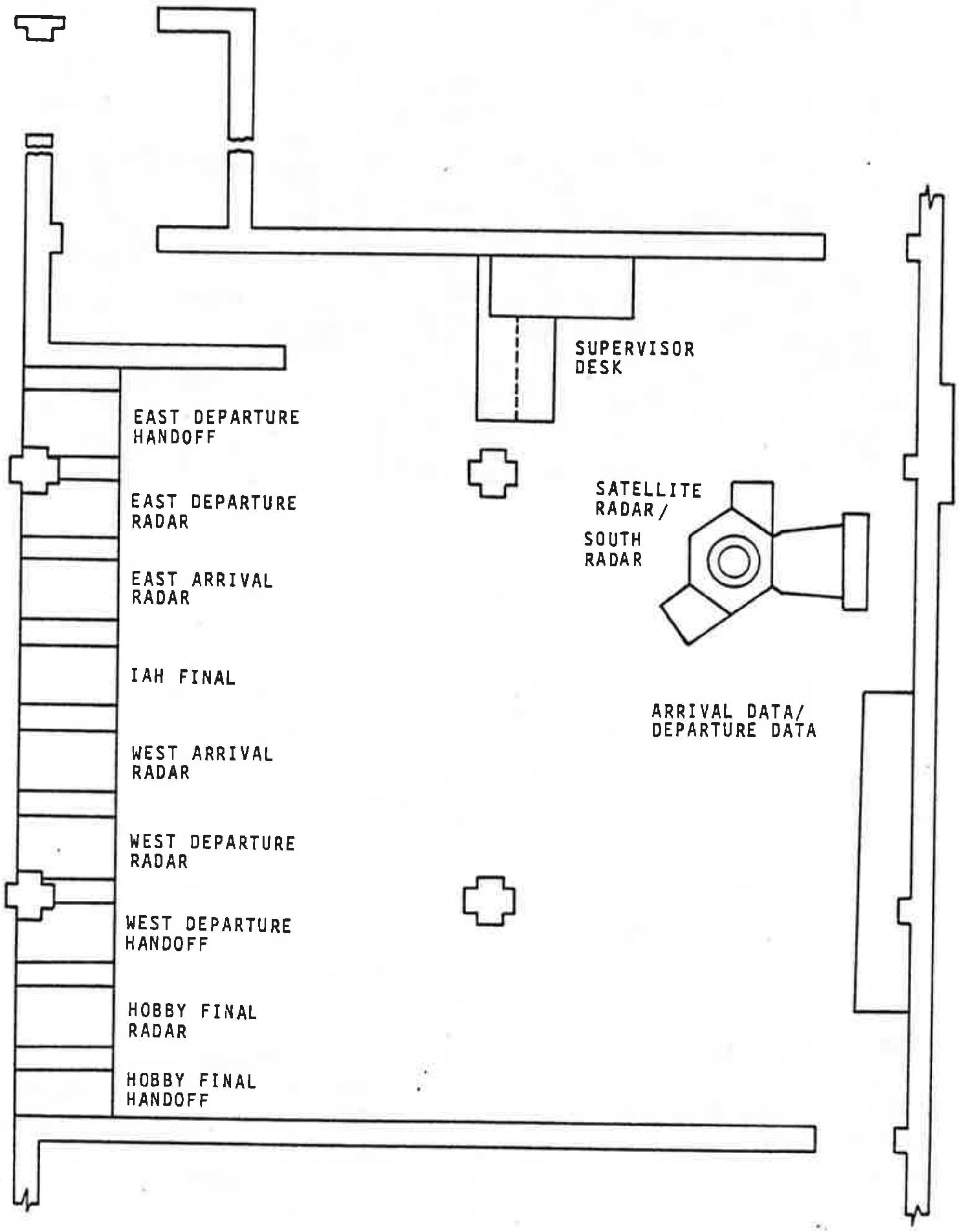
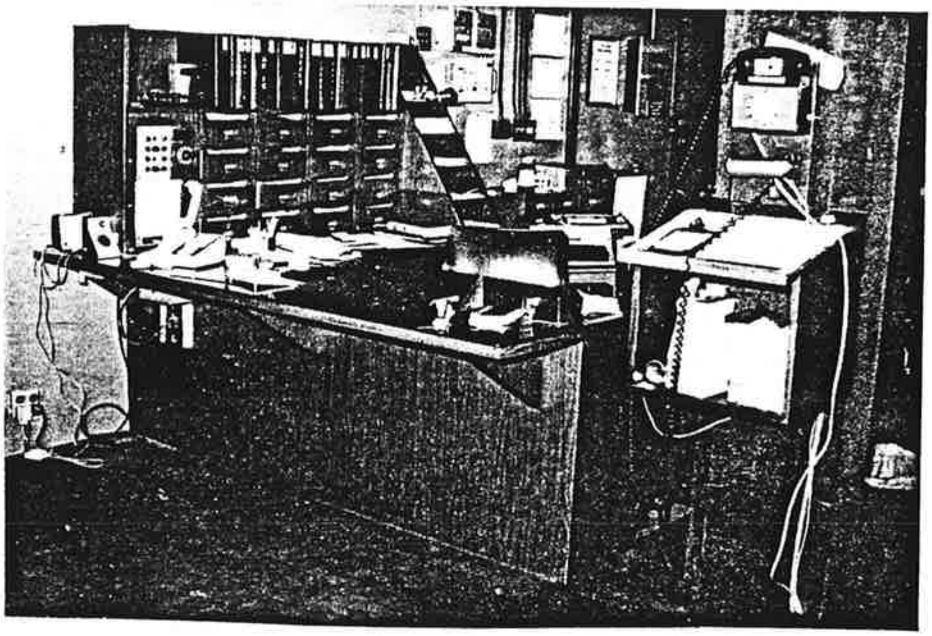
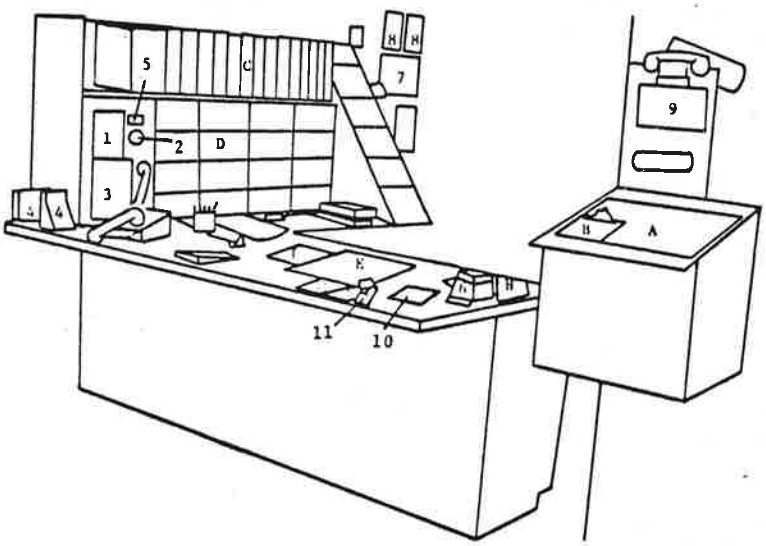


FIGURE 2.18. IAH-TRACON FLOOR PLAN SHOWING CONTROLLER POSITIONS





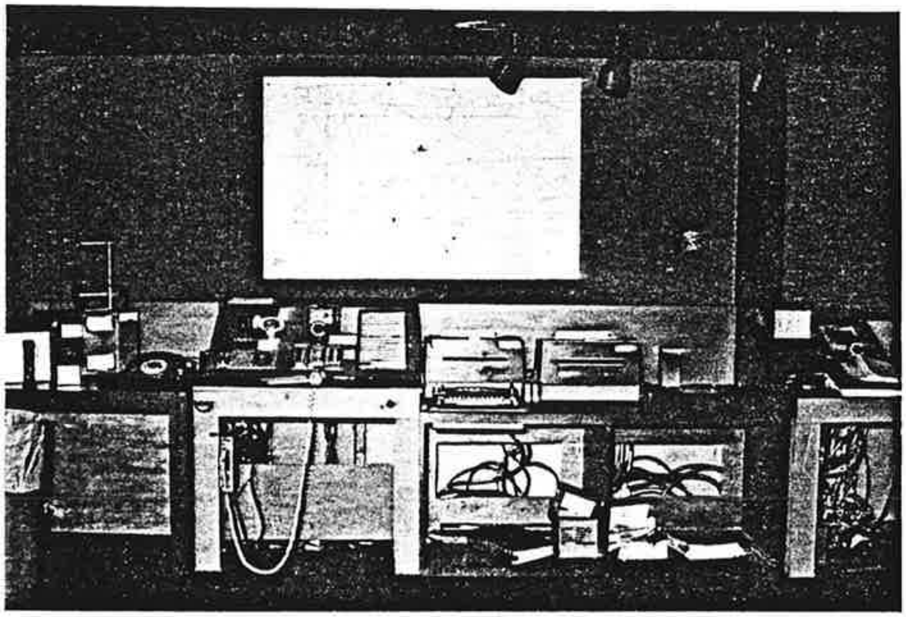
DEVICES

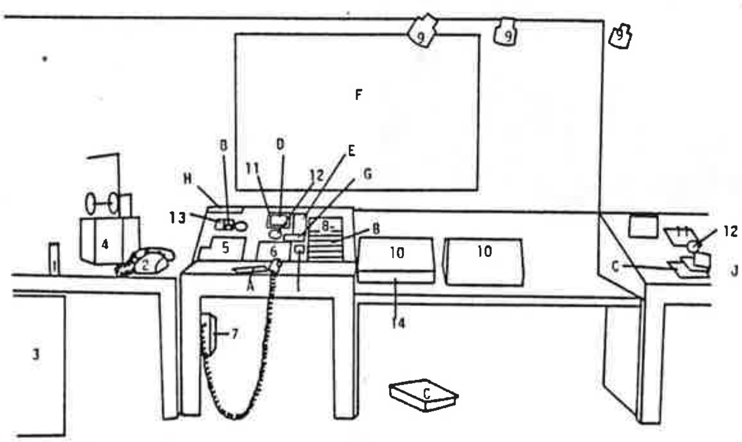
1. RECORDER STATUS PANEL
2. TELCO DIAL
3. TELCO KEYPACK AND HANDSET
4. INTERCOM SPEAKERS
5. DIGITAL CLOCK
6. TELCO SPEAKER
7. AURAL ALARM CONTROL PANEL
8. FIRE ALARM SECURITY SYSTEM
9. TELEPHONE
10. TELEPHONE NUMBERS
11. STAPLER

PAPER

A. TELEPHONE AND INTERPHONE NUMBERS
B. POSITION LOG
C. REFERENCE NOTEBOOKS
D. STORAGE BINS
E. TCA AREA MAP
F. LISTING OF PERSONNEL AND EQUIPMENT ASSIGNMENTS
G. SCHEDULE OF PAY PERIODS
H. LIST OF TELEPHONE NUMBERS
I. RUNWAY CHART

FIGURE 2.19. IAH - WATCH SUPERVISOR'S DESK





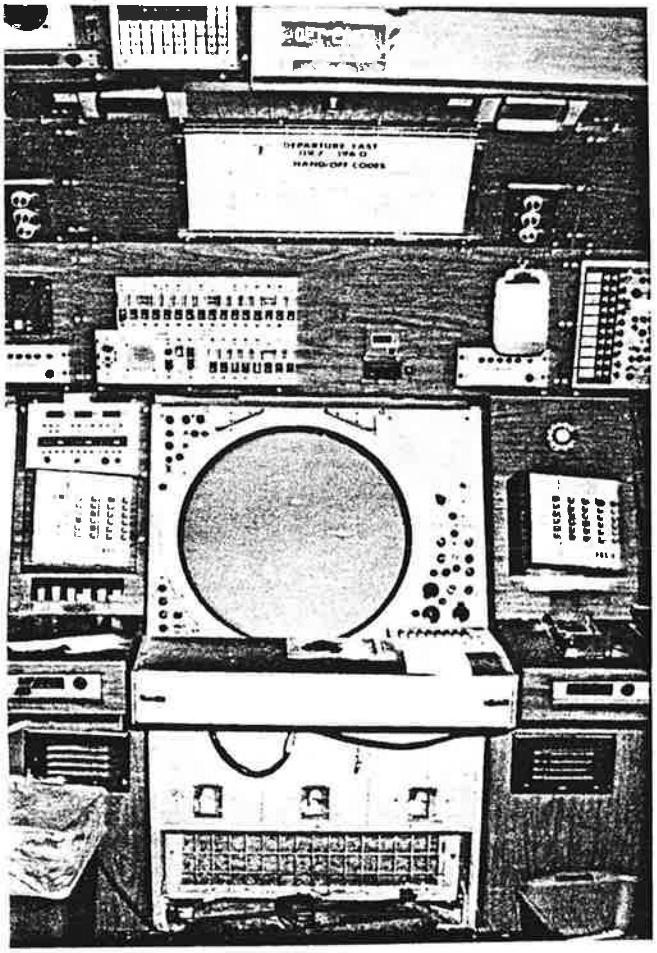
DEVICES

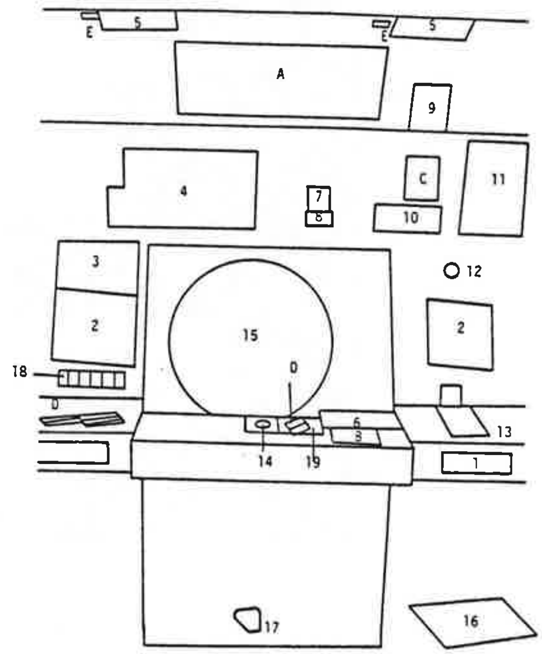
1. FLASHLIGHT
2. TELEPHONE
3. WASTEBASKET
4. ELECTROWRITER
5. FAA COMMUNICATIONS PANEL
6. TELCO KEYPACK
7. TELCO JACK
8. FLIGHT STRIP RACK
9. LIGHT
10. FDEP PRINTER
11. TELCO SPEAKER
12. TELCO DIALER
13. FLIGHT STRIP STORAGE BIN
14. FDEP KEYBOARD

PAPER

A. SCRATCH PAD
B. FLIGHT STRIPS
C. REFERENCE NOTEBOOK
D. POSITION LOG
E. LIST OF AIRPORT ABBREVIATIONS
F. AIR TRAFFIC ROUTE CHART
G. RIBBON CHANGING INSTRUCTIONS
H. SIGMET GLOSSARY
I. LIST OF INTERPHONE NUMBERS

FIGURE 2.20. IAH - ARRIVAL DATA/DEPARTURE DATA





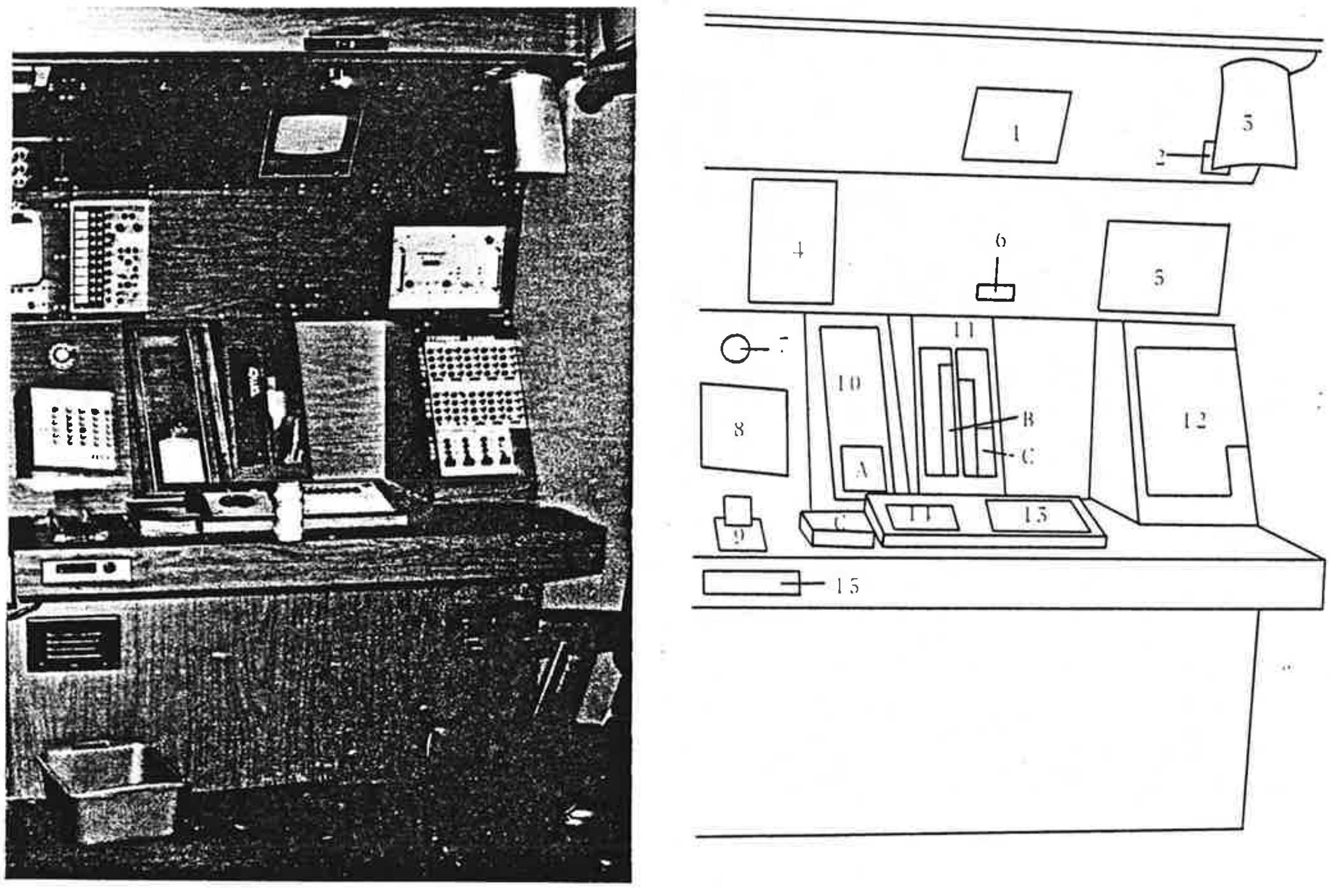
DEVICES

1. TELCO JACK
2. TELCO KEYPACK
3. RVR PANEL
4. FAA COMMUNICATIONS PANEL
5. TELCO SPEAKER
6. ALPHANUMERIC KEYBOARD
7. DIGITAL ALTIMETER
8. DIGITAL CLOCK
9. LIGHT RHEOSTAT
10. VIDEO MAP SELECTOR PANEL
11. TRANSPONDER CONTROLS
12. TELCO DIAL
13. DROP TUBE EXIT FOR FLIGHT STRIPS FROM LOCAL CONTROL
14. ARTS TRACKBALL
15. RADAR DISPLAY AND CONTROL
16. FLIGHT STRIP HOLDER RECEPTACLE
17. FOOT SWITCH FOR FAA MICROPHONE
18. FLIGHT STRIP BIN
19. ARTS QUICK LOOK PANEL

PAPER

A. HANDOFF CODES
B. SCRATCH PAD
C. POSITION LOG
D. FLIGHT STRIPS
E. TELCO SPEAKER LABEL

FIGURE 2.21. IAH - EAST DEPARTURE RADAR



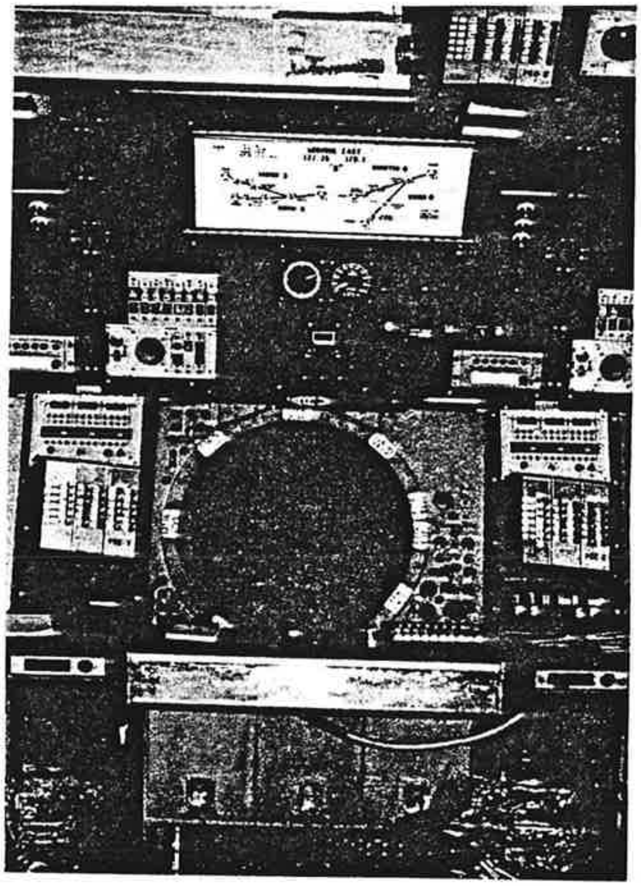
DEVICES

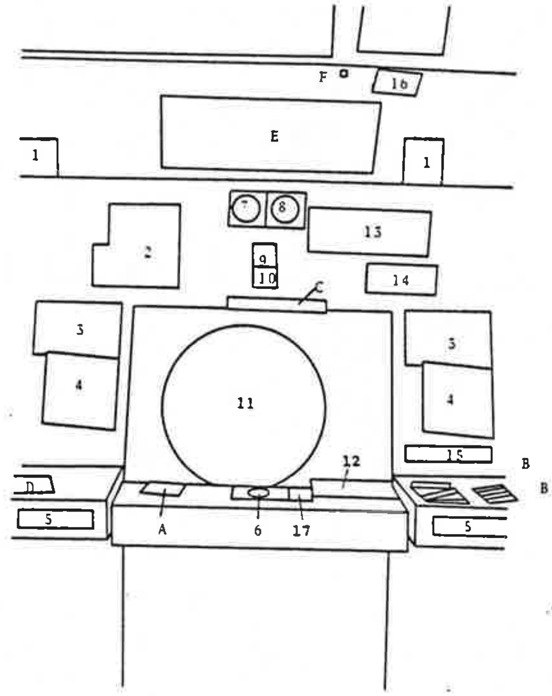
1. CLOSED CIRCUIT TV FOR WEATHER REPORTS PROCESSED IN CAB
2. LIGHT RHEOSTAT
3. LIGHT SHIELD
4. TRANSPONDER CONTROLS
5. MSAW CONTROL PANEL
6. DIGITAL CLOCK
7. TELCO DIAL
8. TELCO KEYPACK
9. DROP TUBE EXIT FOR FLIGHT STRIPS FROM LOCAL CONTROL
10. FLIGHT STRIP RACK
11. STORAGE AREA
12. STANDBY RADIO SELECTOR PANEL
13. ALPHANUMERIC KEYBOARD
14. ARTS TRACKBALL
15. TELCO JACK

PAPER

A. POSITION LOG
B. POSITION BINDER
C. APPROACH PLATES

FIGURE 2.22. IAH - EAST DEPARTURE HANDOFF [COORDINATOR]





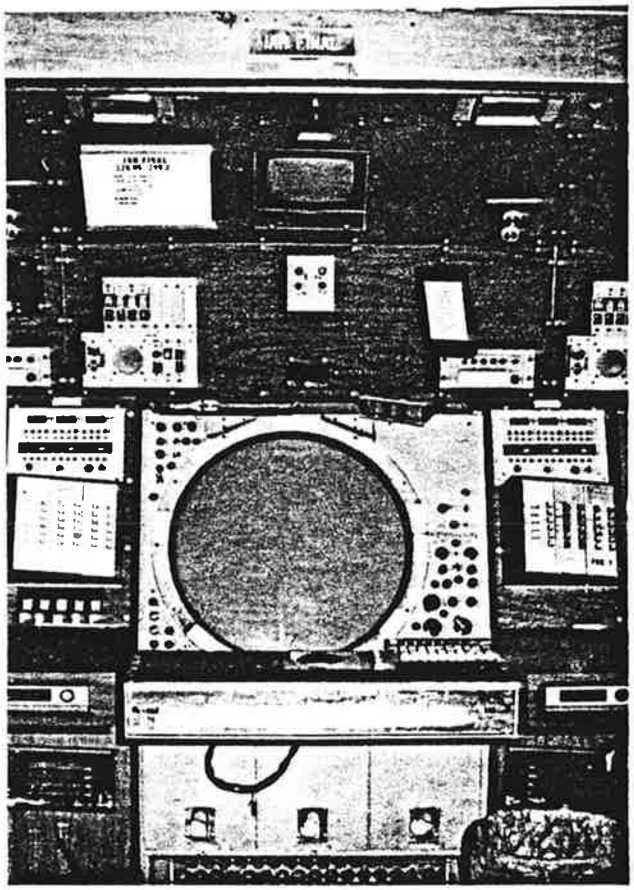
DEVICES

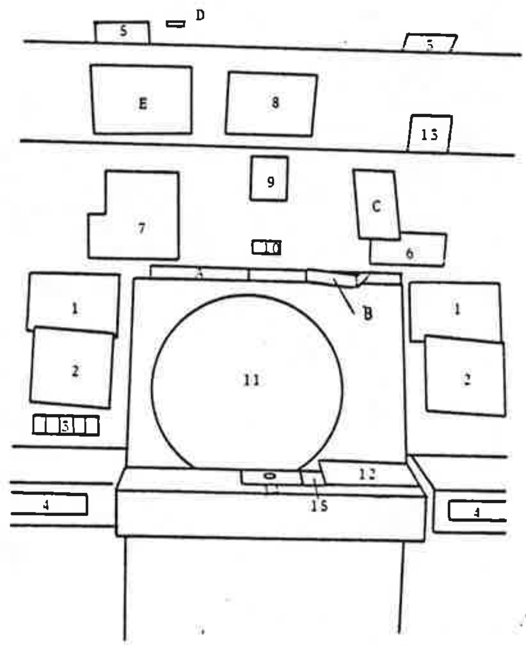
1. LIGHT RHEOSTAT
2. FAA COMMUNICATIONS PANEL
3. RVR PANEL
4. TELCO KEYPACK
5. TELCO JACK
6. ARTS TRACKBALL
7. WIND DIRECTION INDICATOR
8. WIND SPEED INDICATOR
9. DIGITAL ALTIMETER
10. DIGITAL CLOCK
11. RADAR CONTROLS & DISPLAY
12. ALPHANUMERIC KEYBOARD
13. TRACON DISPLAY
14. VIDEO MAP SELECTOR PANEL
15. FLIGHT STRIP BIN
16. TELCO SPEAKER
17. ARTS QUICK LOOK PANEL

PAPER

A. POSITION LOG
B. FLIGHT STRIPS
C. POSITION BINDER
D. SCRATCH PAD
E. ARRIVAL FREQUENCY & ROUTE INFORMATION
F. INTERCOM SPEAKER LABEL

FIGURE 2.23. IAH - EAST ARRIVAL RADAR





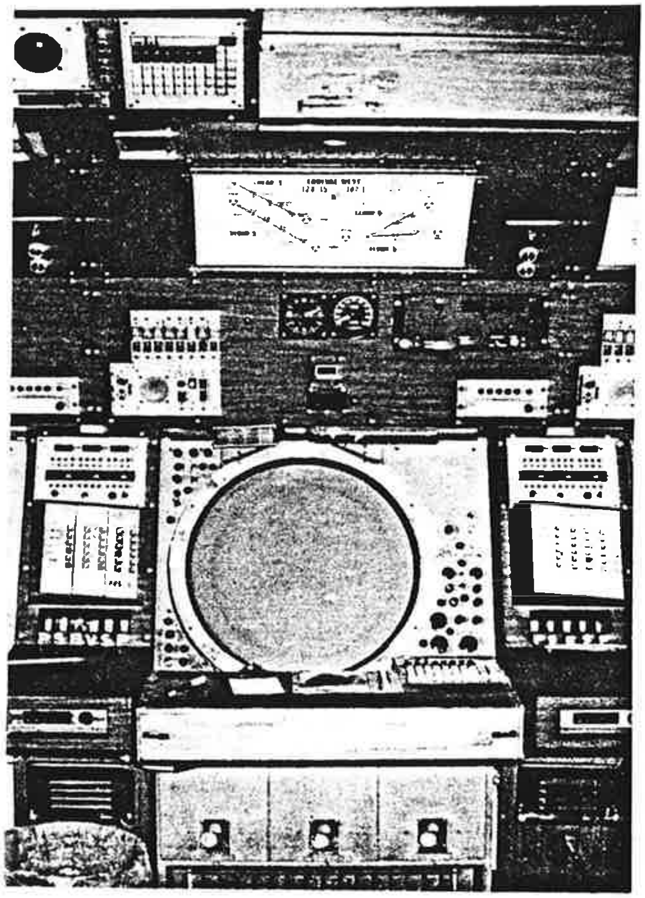
DEVICES

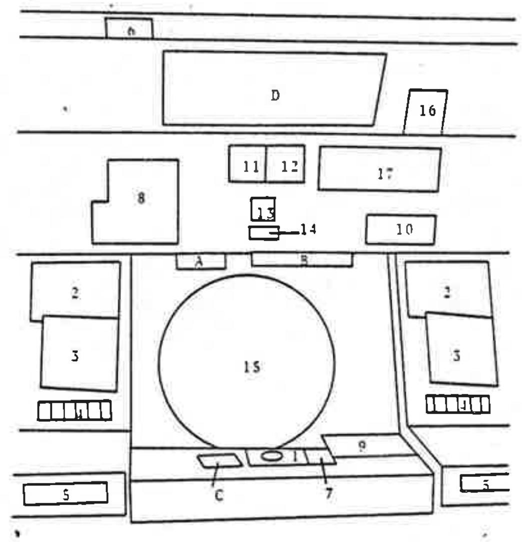
1. RVR PANEL
2. TELCO KEYPACK
3. FLIGHT STRIP BIN
4. TELCO JACK
5. TELCO SPEAKER
6. VIDEO MAP SELECTOR PANEL
7. FAA COMMUNICATIONS PANEL
8. CLOSED CIRCUIT TV FOR WEATHER REPORTS PROCESSED IN CAB
9. ILS INDICATOR PANEL
10. DIGITAL CLOCK
11. RADAR DISPLAY & CONTROLS
12. ALPHANUMERIC KEYBOARD
13. LIGHT RHEOSTAT
14. ARTS TRACKBALL
15. ARTS QUICK LOOK PANEL

PAPER

A. POSITION BINDER
B. APPROACH PLATES
C. POSITION RELIEF BRIEFING GUIDE
D. TELCO SPEAKER LABEL
E. LIST OF RADIO FREQUENCIES

FIGURE 2.24. IAH - IAH FINAL RADAR





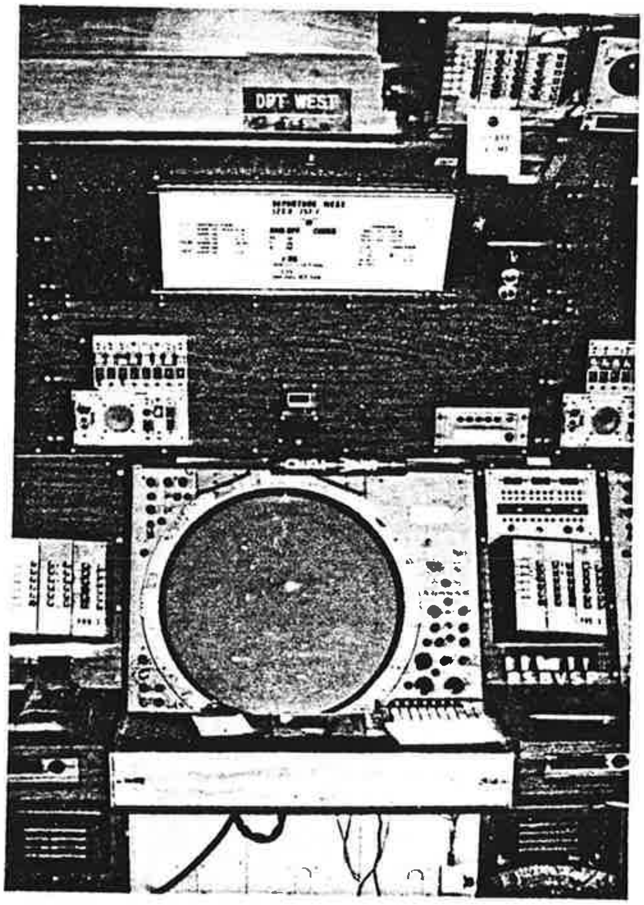
DEVICES

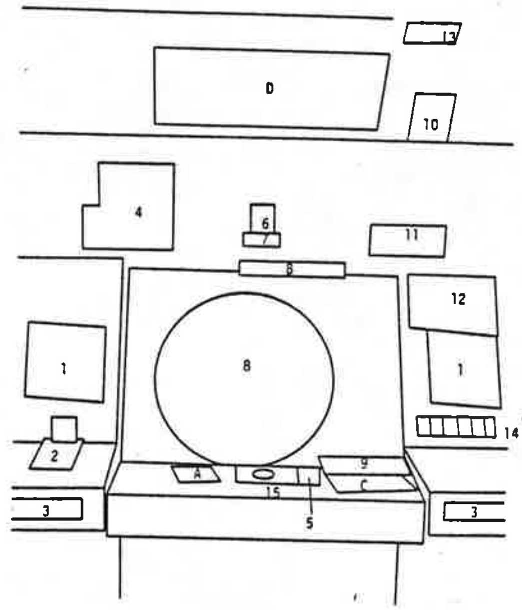
1. ARTS TRACKBALL
2. RVR PANEL
3. TELCO KEYPACK
4. FLIGHT STRIP BIN
5. TELCO JACK
6. TELCO SPEAKER
7. ARTS QUICK LOOK PANEL
8. FAA COMMUNICATIONS PANEL
9. ALPHANUMERIC KEYBOARD
10. VIDEO MAP SELECTOR PANEL
11. WIND DIRECTION INDICATOR
12. WIND SPEED INDICATOR
13. DIGITAL ALTIMETER
14. DIGITAL CLOCK
15. RADAR DISPLAY & CONTROLS
16. LIGHT RHEOSTAT
17. TRÁCON DISPLAY

PAPER

A. APPROACH PLATES
B. POSITION BINDER
C. POSITION LOG
D. ARRIVAL CODING INFORMATION

FIGURE 2.25. IAH - WEST ARRIVAL RADAR





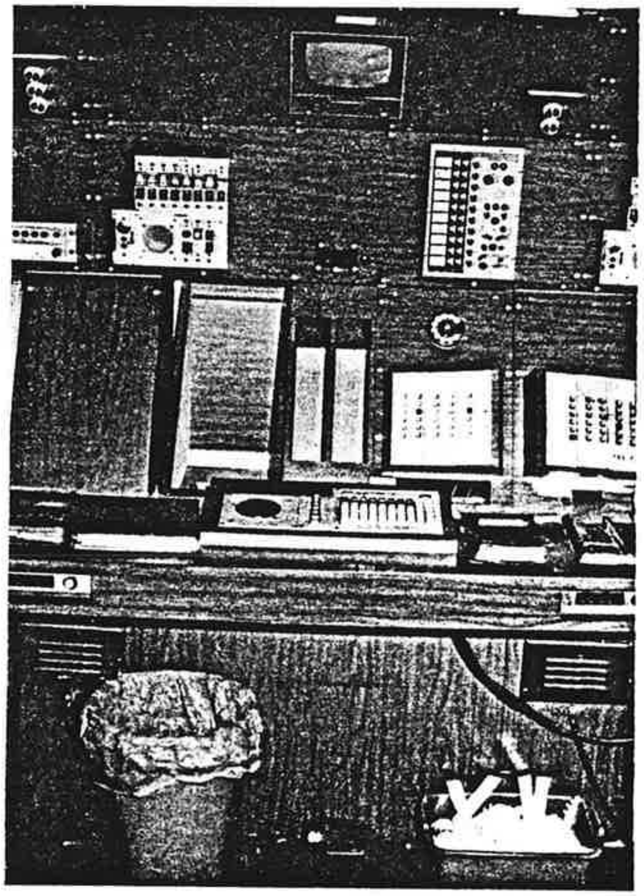
DEVICES

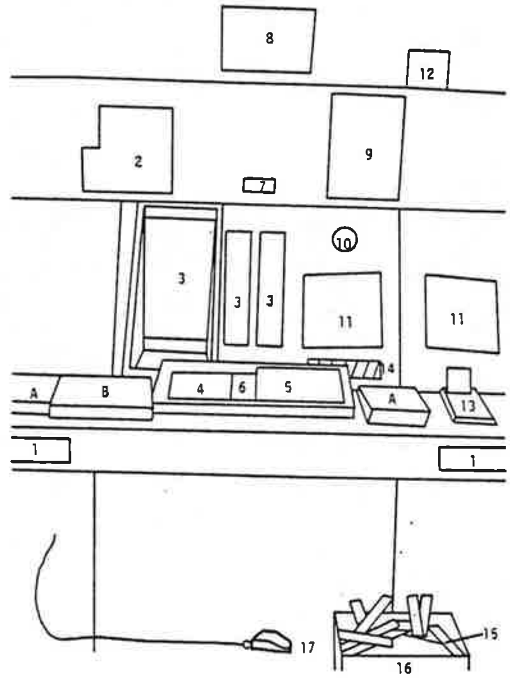
1. TELCO KEYPACK
2. DROP TUBE EXIT FOR FLIGHT STRIPS FROM LOCAL CONTROL
3. TELCO JACK
4. FAA COMMUNICATIONS PANEL
5. ARTS QUICK LOOK PANEL
6. DIGITAL ALTIMETER
7. DIGITAL CLOCK
8. RADAR DISPLAY & CONTROLS
9. ALPHANUMERIC KEYBOARD
10. LIGHT RHEOSTAT
11. VIDEO MAP SELECTOR PANEL
12. RVR PANEL
13. TELCO SPEAKER
14. FLIGHT STRIP BIN
15. ARTS TRACKBALL

PAPER

A. POSITION LOG
B. POSITION BINDER
C. SCRATCH PAD
D. DEPARTURE CODING INFORMATION

FIGURE 2.26. IAH - WEST DEPARTURE RADAR





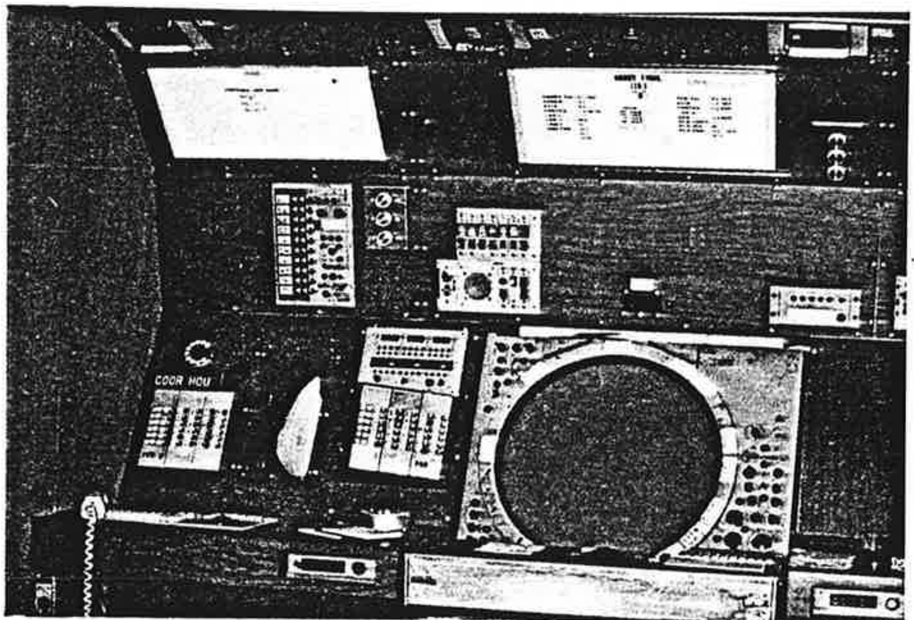
DEVICES

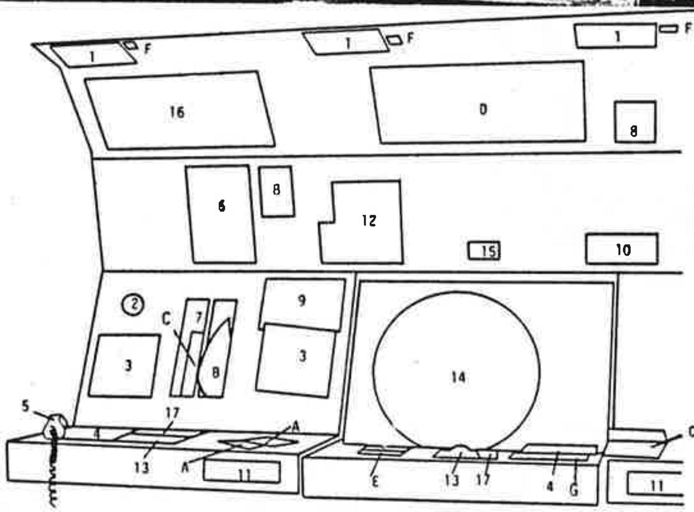
1. TELCO JACK
2. FAA COMMUNICATIONS PANEL
3. STORAGE AREA
4. ARTS TRACKBALL
5. ALPHANUMERIC KEYBOARD
6. ARTS QUICK LOOK PANEL
7. DIGITAL CLOCK
8. CLOSED CIRCUIT TV FOR WEATHER REPORTS PROCESSED IN CAB
9. TRANSPONDER CONTROLS
10. TELCO DIAL
11. TELCO KEYPACK
12. LIGHT RHEOSTAT
13. DROP TUBE EXIT FOR FLIGHT STRIPS FROM LOCAL CONTROL
14. FLIGHT STRIP STORAGE BIN
15. FLIGHT STRIP HOLDERS
16. FLIGHT STRIP HOLDER RECEPTACLE
17. FOOT SWITCH FOR RADIO

PAPER

A. APPROACH PLATES
B. POSITION BINDER

FIGURE 2.27. IAH - WEST DEPARTURE HANDOFF [COORDINATOR]





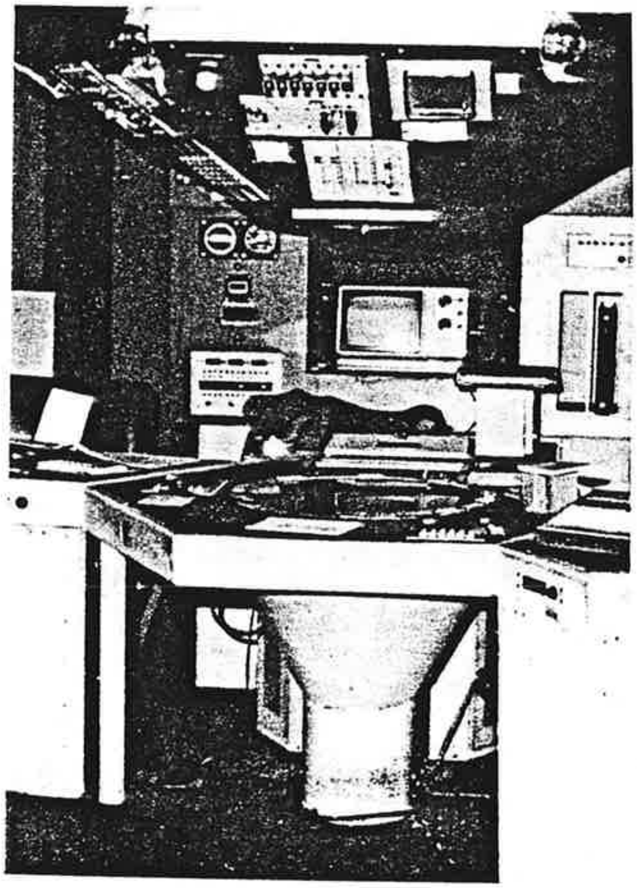
DEVICES

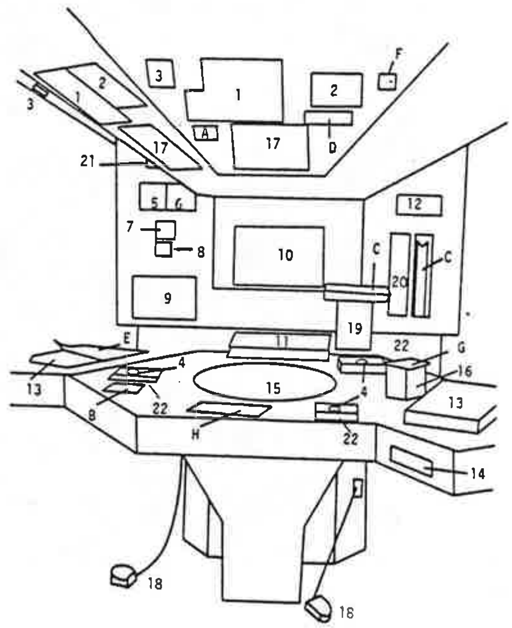
1. TELCO SPEAKER
2. TELCO DIAL
3. TELCO KEYPACK
4. ALPHANUMERIC KEYBOARD
5. TELCO HANDSET
6. TRANSPONDER CONTROLS
7. STORAGE AREA
8. LIGHT RHEOSTAT
9. RVR PANEL
10. VIDEO MAP SELECTOR PANEL
11. TELCO JACK
12. FAA COMMUNICATIONS PANEL
13. ARTS TRACKBALL
14. RADAR DISPLAY & CONTROLS
15. DIGITAL ALTIMETER
16. INFORMATION AREA (BLANK)
17. ARTS QUICK LOOK PANEL

PAPER

A. POSITION LOG
B. UNIDENTIFIED
C. APPROACH PLATES
D. HOBBY RADIO FREQUENCIES
E. STATUS NOTE
F. INTERCOM SPEAKER LABEL
G. SCRATCH PAD

FIGURE 2.28. IAH - HOBBY FINAL RADAR AND HOBBY FINAL HANDOFF





DEVICES

1. FAA COMMUNICATIONS PANEL
2. TELCO SPEAKER
3. LIGHT RHEOSTAT
4. ARTS TRACKBALL
5. WIND DIRECTION INDICATOR
6. WIND SPEED INDICATOR
7. DIGITAL ALTIMETER
8. DIGITAL CLOCK
9. RVR PANEL
10. CLOSED CIRCUIT TV FOR WEATHER REPORTS PROCESSED IN CAB
11. RADAR CONTROLS AND COVER
12. VIDEO MAP SELECTOR PANEL
13. ALPHANUMERIC KEYBOARD
14. TELCO JACK
15. RADAR DISPLAY
16. FLIGHT STRIP BOX
17. TELCO KEYPACK
18. FOOT SWITCH FOR RADIO
19. CONSOLE CLOCK
20. STORAGE AREA
21. TRACON DISPLAY
22. ARTS QUICK LOOK PANEL

PAPER

A. RADIO FREQUENCIES
B. POSITION LOG
C. REFERENCE NOTEBOOK
D. UHF RADIO FREQUENCIES LIST
E. UNIDENTIFIED
F. TELCO SPEAKER LABEL
G. POSITION LOG
H. SCRATCH PAD

FIGURE 2.29. IAH - SATELLITE RADAR/SOUTH RADAR

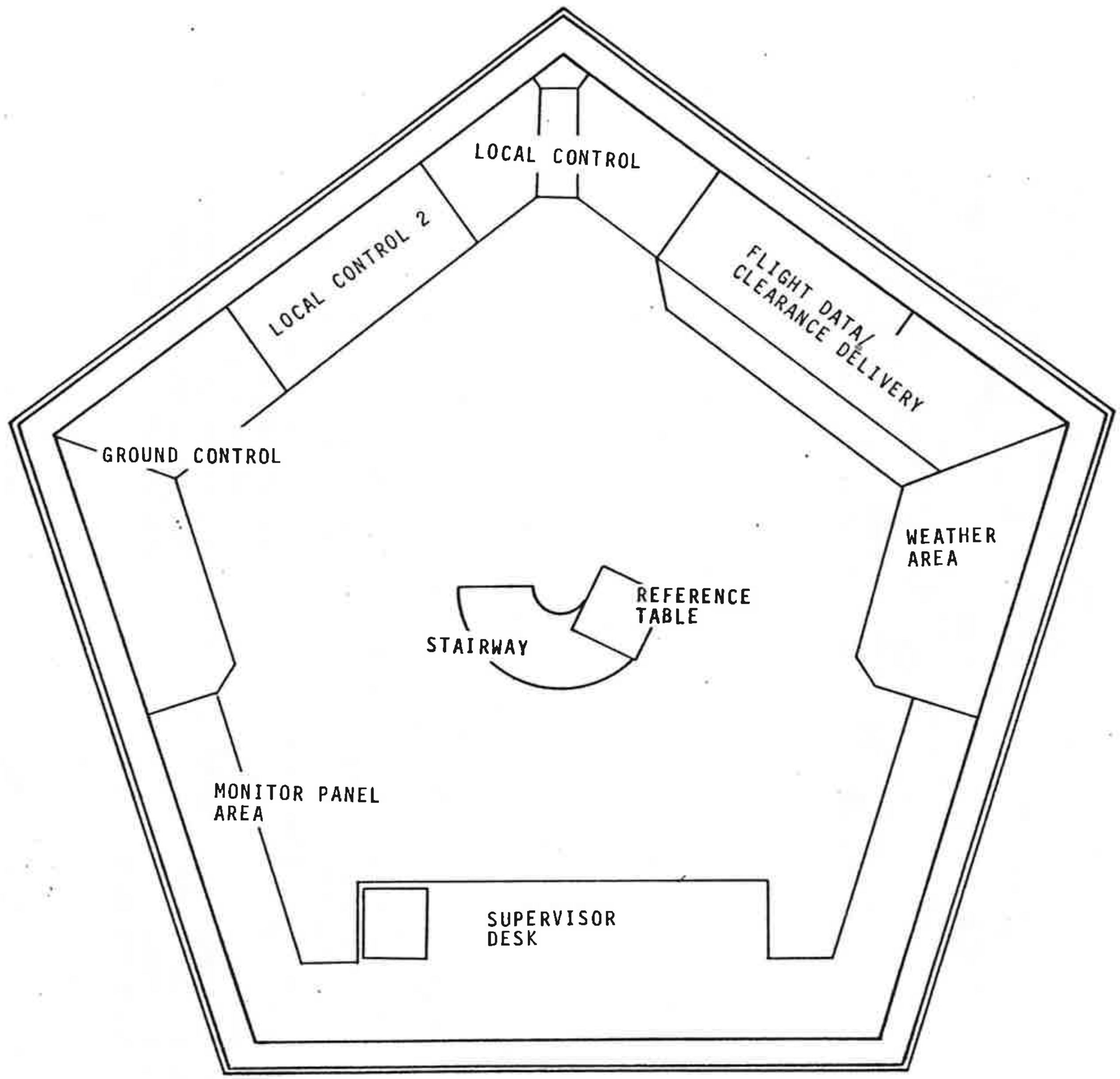
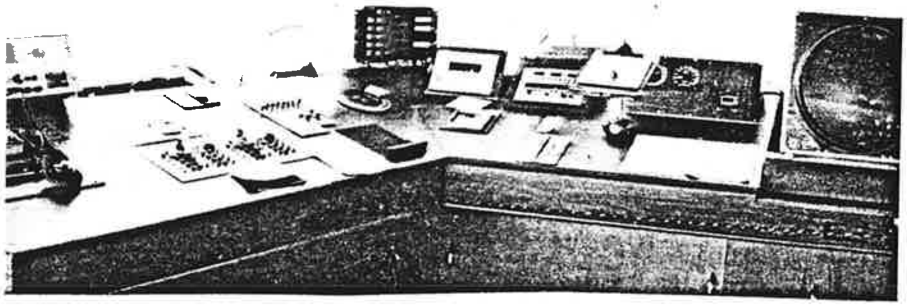
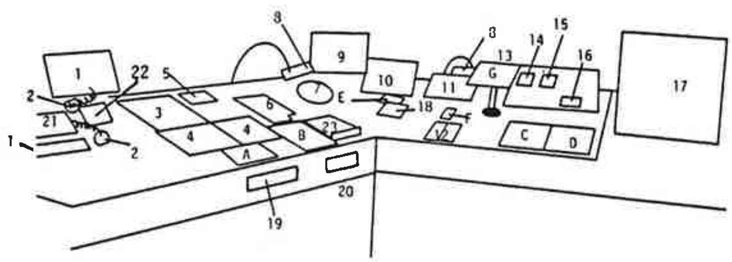


FIGURE 2.30. TOWER CAB FLOOR PLAN SHOWING CONTROLLER POSITIONS





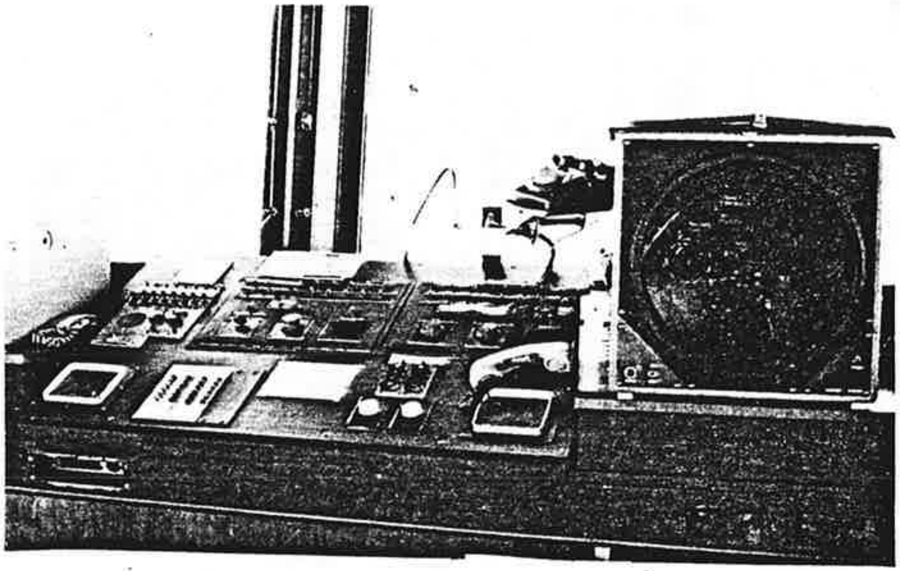
DEVICES

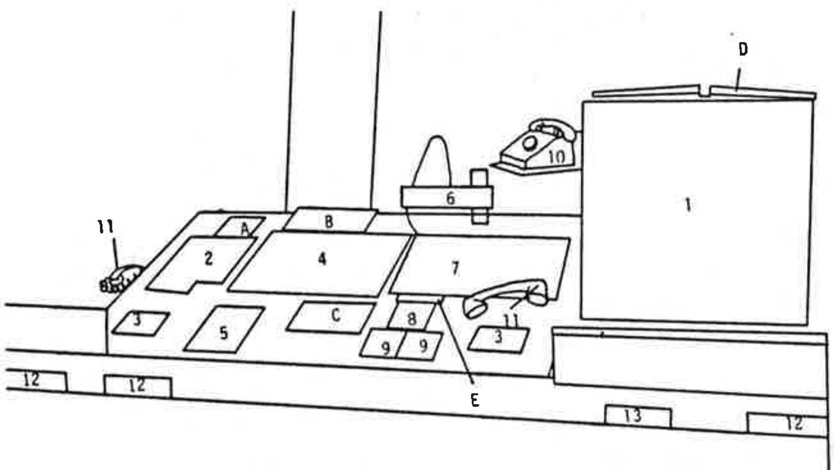
1. BACKUP VHF TRANSCEIVER
2. VHF MICROPHONE
3. INTERCOM SPEAKER CONTROL PANEL
4. ILS INTERLOCK CONTROL PANEL
5. LIGHT RHEOSTAT
6. FAA COMMUNICATIONS PANEL
7. ANALOG ALTIMETER
8. LAMP
9. WIND SHEAR ALERT INDICATOR PANEL
10. DIGITAL CLOCK
11. RVR PANEL
12. TELCO KEY PACK
13. STAND FOR SCRATCH PAD
14. WIND DIRECTION INDICATOR
15. WIND SPEED INDICATOR
16. DIGITAL ALTIMETER
17. BRITE RADAR DISPLAY
18. TELCO SPEAKER
19. STORAGE BIN
20. TELCO JACKS
21. BACKUP UHF TRANSCEIVER
22. LIGHT GUN TEST PANEL
23. LIP FOR BINOCULARS

PAPER

A. ILS PANEL INSTRUCTIONS
B. AIRCRAFT GATE DIAGRAM
C. EMERGENCY INSTRUCTIONS FOR AIRCRAFT INCIDENTS
D. AIRPORT MAP
E. POSITION LOG
F. POSITION RELIEF BRIEFING CHECKLIST
G. SCRATCH PAD

FIGURE 2.31. IAH - GROUND CONTROL





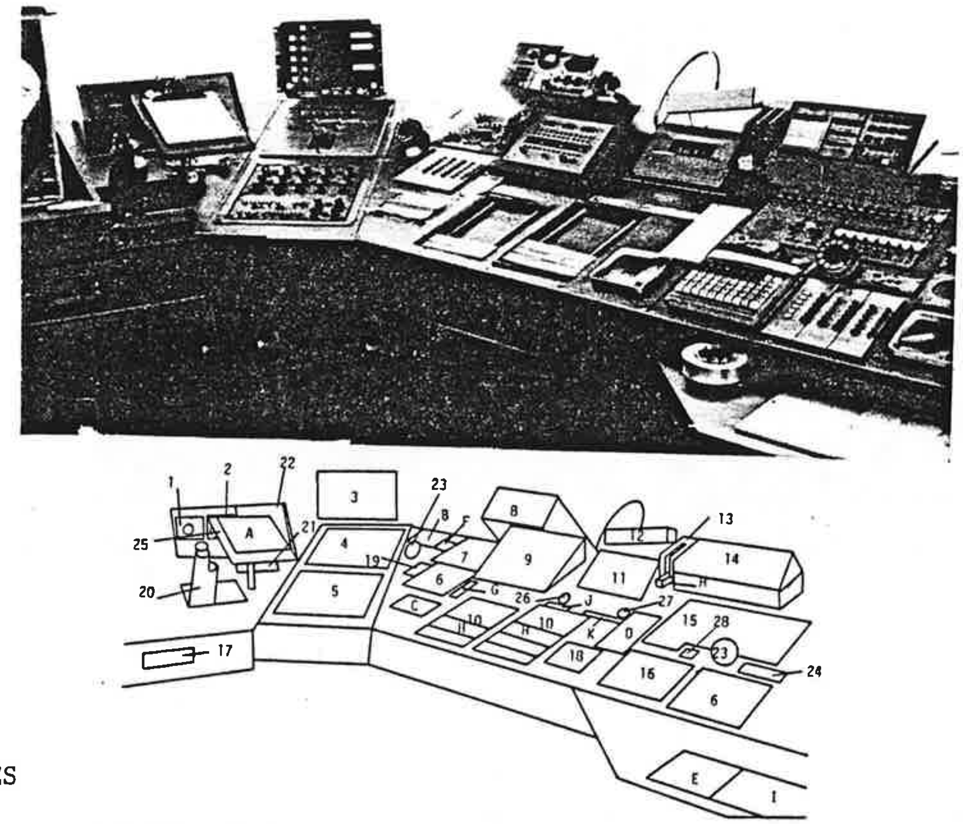
DEVICES

1. BRITE RADAR DISPLAY
2. FAA COMMUNICATIONS PANEL
3. TELCO SPEAKER
4. RUNWAY 14-32 LIGHT CONTROL PANEL
5. TELCO KEYPACK
6. LAMP
7. RUNWAY 8-26 LIGHT CONTROL PANEL
8. BACKUP RADIO SELECTOR PANEL
9. LIGHT RHEOSTAT
10. EMERGENCY TELEPHONE
11. TELEPHONE HANDSET
12. TELCO JACKS
13. FAA MICROPHONE JACK

PAPER

A. POSITION LOG
B. EMERGENCY INSTRUCTIONS FOR AIRCRAFT INCIDENTS
C. LIGHTING INSTRUCTIONS
D. REFERENCE NOTEBOOK
E. FLIGHT STRIPS

FIGURE 2.32. IAH - LOCAL CONTROL 2



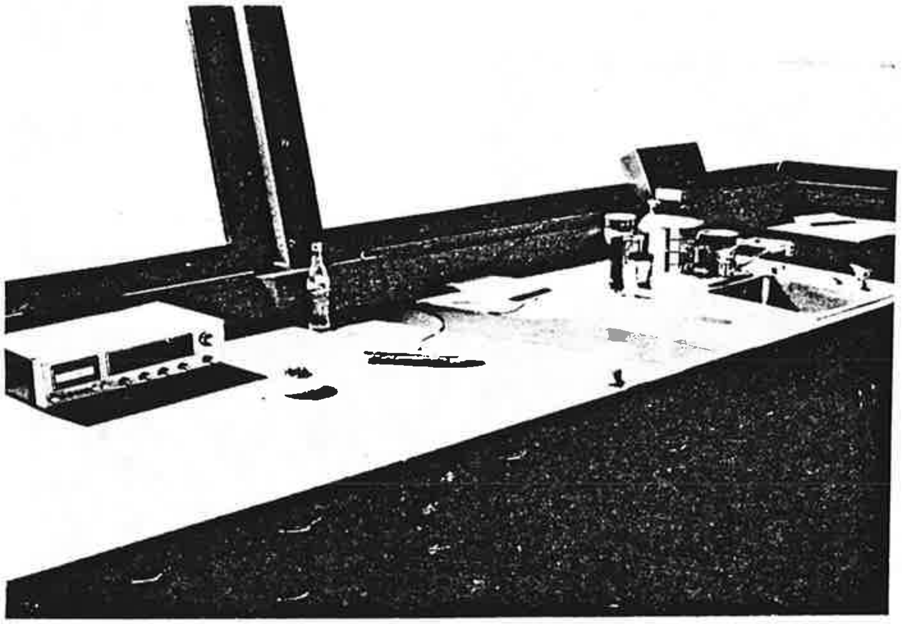
DEVICES

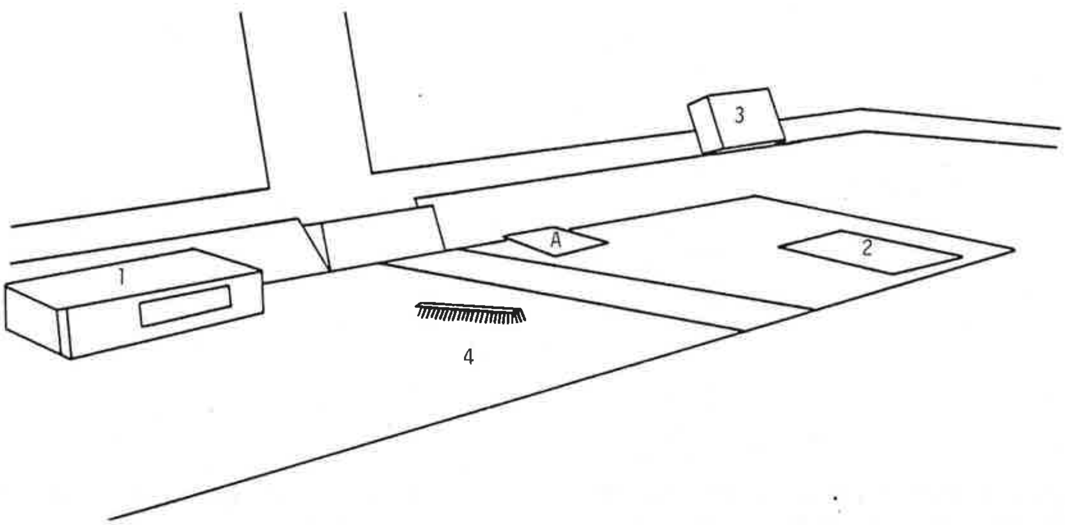
1. WIND DIRECTION INDICATOR
2. WIND SPEED INDICATOR
3. WIND SHEAR ALERT INDICATOR PANEL
4. STOL AND TAXIWAY LIGHTING PANEL
5. BRITE RADAR CONTROL PANEL
6. TELCO KEYPACK
7. LIGHTING CONTROL PANEL (ALS)
8. AUXILIARY VHF TRANSCEIVER
9. RVR PANEL
10. FLIGHT STRIP RACK
11. DIGITAL CLOCK
12. LAMP
13. FLIGHT STRIP BIN
14. MALSR CONTROL PANEL
15. FAA COMMUNICATIONS PANEL
16. ALPHANUMERIC KEYBOARD
17. TELCO JACKS
18. TELCO SPEAKER
19. LIGHT RHEOSTAT
20. BINOCULARS
21. MAP SELECTOR
22. ALTIMETER
23. TELCO DIAL
24. FAA RADIO JACK
25. STAND
26. DEPARTURE WEST DROP TUBE
27. DEPARTURE EAST DROP TUBE
28. ARTS PEM STICK

PAPER

A. SCRATCH PAD
B. LIGHTING INSTRUCTIONS
C. SFL INSTRUCTIONS
D. PLEXIGLASS BOARD FOR METRO FLIGHTS
E. TAB LIST INSTRUCTIONS
F. ALS INSTRUCTIONS
G. DIAL CODES
H. FLIGHT STRIPS
I. MAP OF LOCAL FLIGHT ROUTES
J. DEPARTURE WEST DROP TUBE LABEL
K. DEPARTURE EAST DROP TUBE LABEL

FIGURE 2.33. IAH - LOCAL CONTROL 1





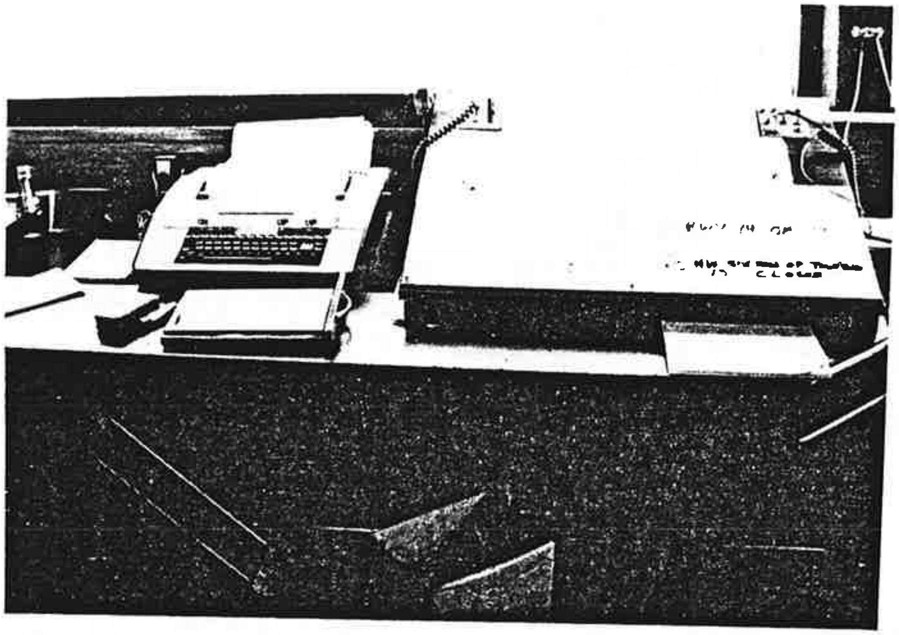
DEVICES

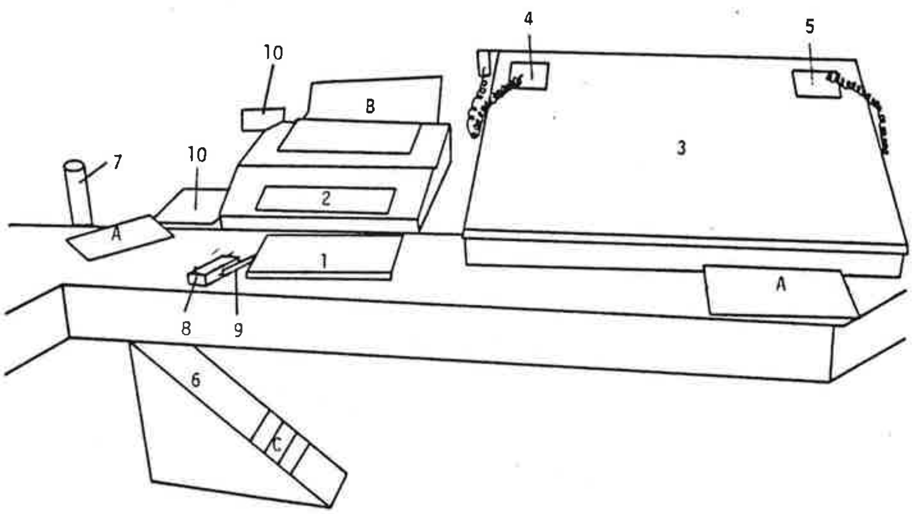
1. STERFO RECEIVER
2. SINK
3. STEREO SPEAKER
4. BRUSH

PAPER

A. SCRATCH PAD

FIGURE 2.34. IAH - SUPERVISOR DESK





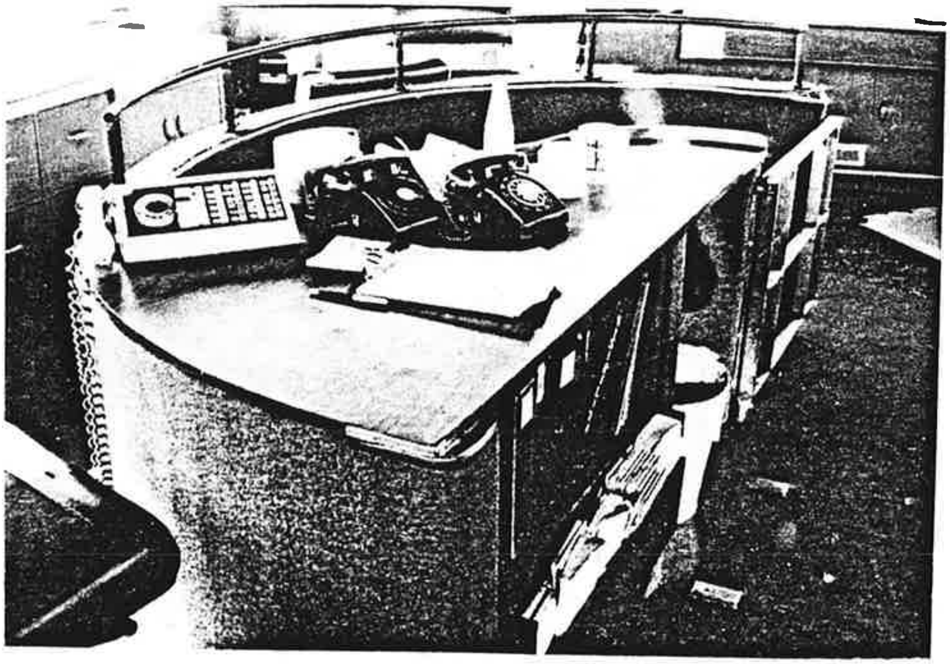
DEVICES

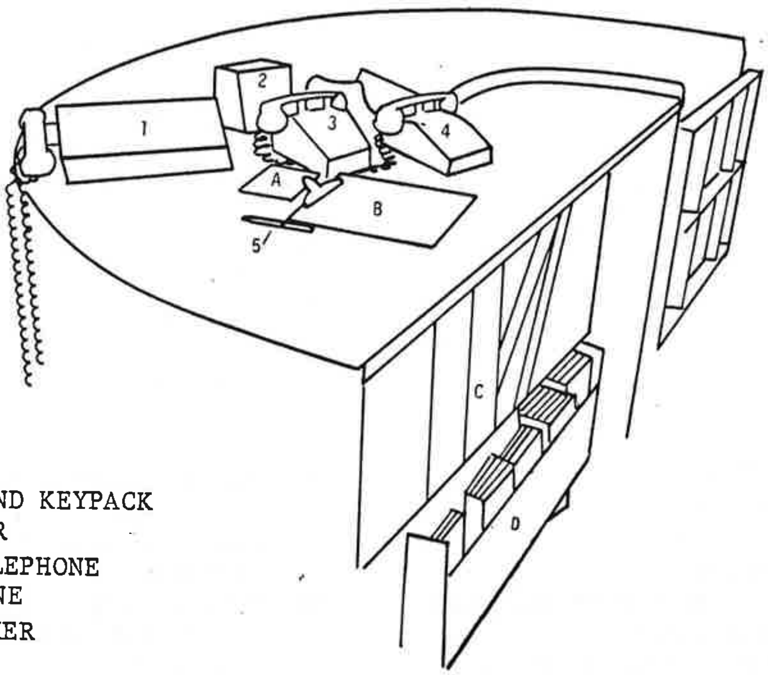
1. WEATHER INFORMATION VIDEO BOARD
2. PRINTER FOR WEATHER INFORMATION
3. WEATHER BOARD
4. ATIS RECORDING PANEL
5. STANDBY ATIS RECORDING PANEL
6. FLIGHT STRIP RACK (PORTABLE)
7. FLASHLIGHT
8. ERASER
9. FELT TIP MARKER
10. DATAPHONE

PAPER

A. SCRATCH PAD
B. WEATHER PRINTOUT
C. FLIGHT STRIPS

FIGURE 2.35. IAH - WEATHER AREA





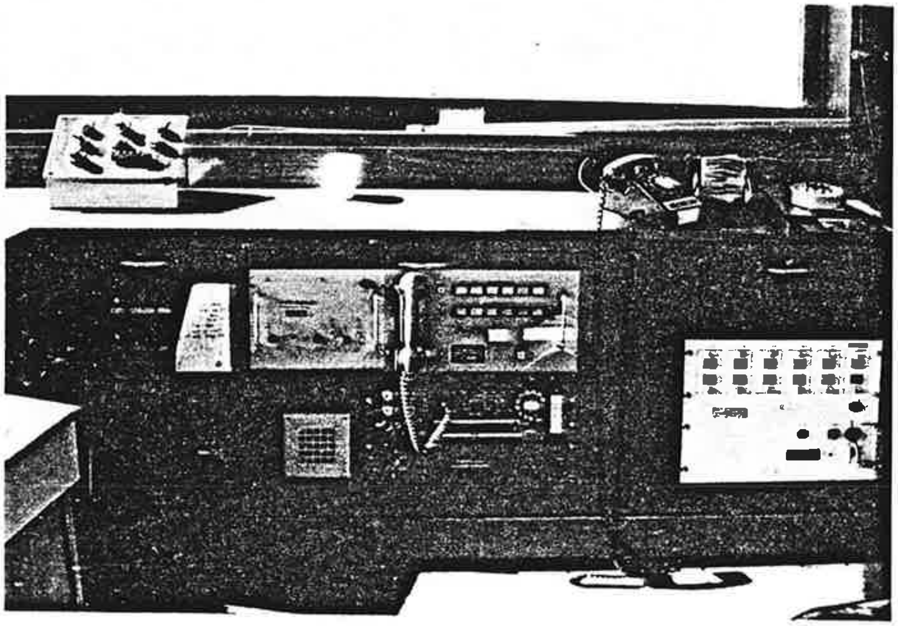
DEVICES

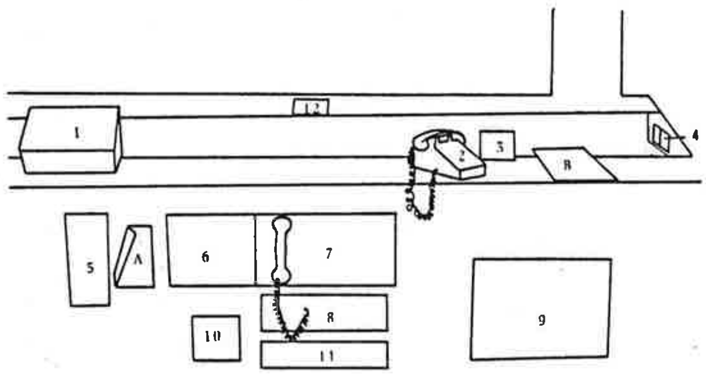
1. TELCO DIAL AND KEYPACK
2. TELCO SPEAKER
3. EMERGENCY TELEPHONE
4. DESK TELEPHONE
5. FELT TIP MARKER

PAPER

A. POSITION LOG
B. TOWER EQUIPMENT CHECK LIST
C. REFERENCE NOTEBOOKS
D. AERONAUTICAL CHARTS AND ENROUTE MAPS

FIGURE 2.36. IAH - REFERENCE TABLE





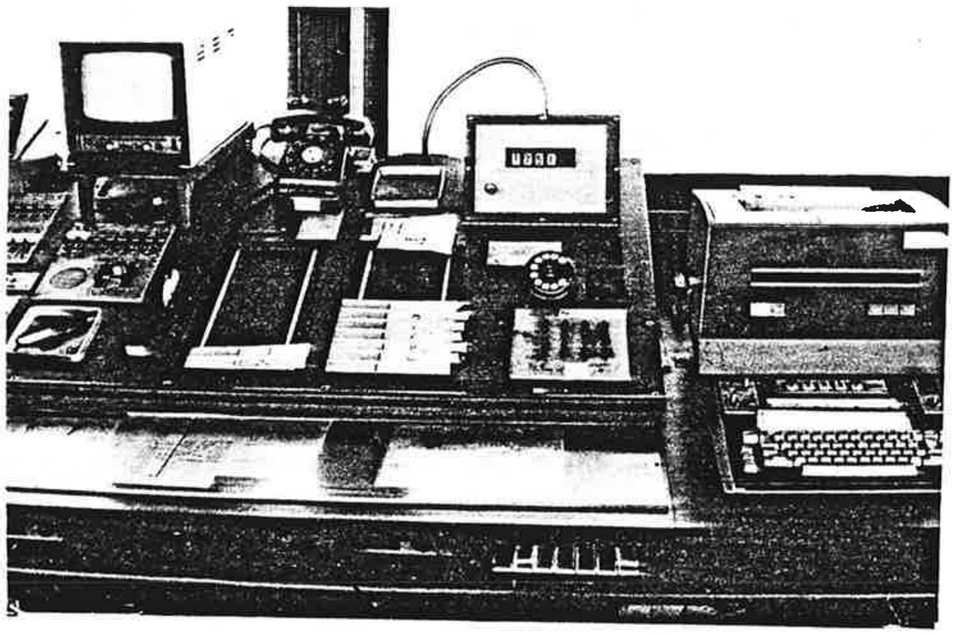
DEVICES

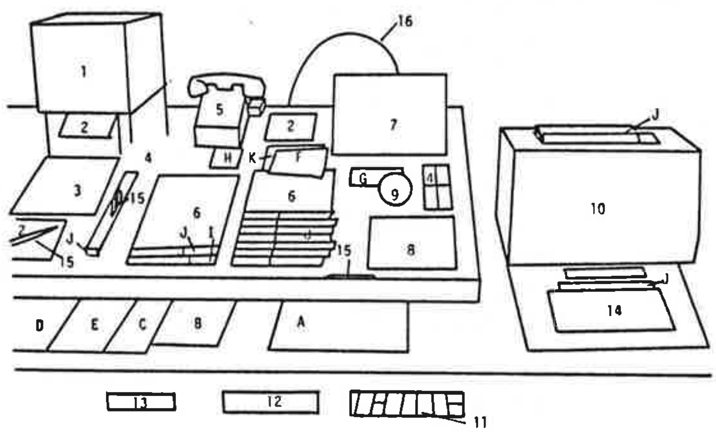
1. WINDOW WASHER CONTROL
2. DESK TELEPHONE
3. ROLODEX
4. LIGHT RHEOSTAT
5. EMERGENCY VENT SYSTEM CONTROLS
6. MSAW CONTROL PANEL
7. ILS MONITOR & CONTROL PANEL (RUNWAY 14)
8. VORTAC MONITOR PANEL
9. ILS MONITOR & CONTROL PANEL (RUNWAY 8)
10. MSAW SPEAKER
11. ALS ENGINE GENERATOR REMOTE CONTROL PANEL
12. TELCO SPEAKER

PAPER

A. EMERGENCY VENT SYSTEM INSTRUCTIONS
B. REFERENCE NOTEBOOK

FIGURE 2.37. IAH - MONITOR PANEL AREA





DEVICES

1. CONRAC MONITOR
2. TELCO SPEAKER
3. FAA COMMUNICATIONS PANEL
4. STORAGE BIN
5. TELEPHONE
6. FLIGHT STRIP RACK
7. DIGITAL CLOCK
8. TELCO KEYPACK
9. TELCO DIAL
10. FDEP PRINTER
11. FLIGHT STRIP HOLDERS
12. TELCO JACK
13. FAA MICROPHONE JACK
14. FDEP KEYBOARD
15. FELT TIP MARKERS
16. LAMP

PAPER

A. SECTOR FREQUENCY CHART
B. DEPARTURE ROUTE CHART
C. LIST OF TELEPHONE NUMBERS AND AIRLINE RADIO FREQUENCIES
D. LOCAL FLIGHT ROUTE CHART
E. FLIGHT DATA CODES
F. POSITION LOG
G. FDEP RIBBON AND PAPER CHANGING INSTRUCTIONS
H. POSITION RELIEF BRIEFING GUIDE
I. NOTAM
J. FLIGHT STRIPS
K. GLS 91 LINE CODES

FIGURE 2.38. IAH - FLIGHT DATA/CLEARANCE DELIVERY

TABLE 2-4. TRACON POSITIONS AND DUTIES

Departure East (E)	o Provides radar service to aircraft in airspace depicted in Figure 2.40 o Ensures IFR departures depart vis a SID/PDR out Trios, Gomer and Cleep gates o Coordinates with Beaumont Tower when climbing aircraft infringes upon their airspace o Work Tower inroute arrivals from Beaumont and handoff to Arrival East o Point out rwy 17 approaches at EFD to Hobby Tower o Vector Prairie, Freeport and V15W departures off East Satellite airports and West Satellite arrivals on a heading to remain clear of hobby descent area at 5000 and handoff to Departure West o When HOU is on rwy 13 or 4 work work LJN departures off IAH and handoff to South
Departure West (W)	o Provides radar service to aircraft in airspace depicted in Figure 2.41 o Ensures IFR departures depart via a SID/PDR out Prairie or Freeport Gate o When HOU is on rwy 22 work GLS, CLC, and LJN departures off IAH and handoff to South. When HOU is on rwy 31 work LJN departures o Vector Gomer and Cleep departures off West Satellite Airports northbound remaining clear of IAH Tower airspace and handoff to Departure East o Vector Trios departures off West Satellite Airports and East Satellite arrivals on a heading to clear Hobby descent area at 4000 and handoff to Departure East; or to South (at 4000 or above 110 if HOU on rwy 22 or Bolos Gate is in use
Coordinator East & Coordinator West (CD-E 7 CD-W)	o Support Departure East & Departure West o Take Telco calls o Perform ARTS keyboard functions for handoffs between sectors and to/from Center
Arrival East (D)	o Provides radar service to aircraft in airspace depicted in Figure 2.42 o Keep arrivals on STAR routes, in an orderly sequence reduced to 210 knots prior to handoff to final

TABLE 2-4. TRACON POSITIONS AND DUTIES (Continued)

Arrival East (Cont.)
(D)

- o When HOU on rwy 22 handoff Smith arrivals to HOU final at 4000
- o Handoff satellite arrivals south of V222 to Departure East (or to South if HOU on rwy 22) at 6000 prior to 15 NM from Hobby

Arrival West
(N)

- o Provides radar service to aircraft in airspace depicted in Figure 2.43
- o Keep arrivals on STAR routes, in an orderly sequence reduced to 210 knots prior to handoff to final
- o Handoff satellite arrivals south of V222 to Departure west at 6000 prior to 15 NM from Hobby

IAH Final
(I)

- o Provide radar service to aircraft in airspace depicted in Figures 2.44-2.46
- o Sequence all arrivals into IAH
- o Instruct aircraft to contact LC prior to the FAF but no more than 10 miles from the runway
- o When IAH is on rwys 8/14 release DWF departures

Hobby Final
(H)

- o Provide radar service to aircraft in airspace depicted in Figures 2.44-2.46
- o Vector aircraft ID the advertised instrument final approach and instruct pilot to contact HOU Tower between eight and nine miles from the airport
- o Vector aircraft requesting visual approaches so as to intercept the final approach course not less than six miles from the airport

Coordinator Hobby
(CH)

- o Support Hobby Final
- o Take Telco calls
- o Perform ARTS keyboard functions for handoffs between sectors and to/from the Center

South
(L)

- o Provide radar service to aircraft in airspace depicted on Figure 2.47
- o Coordinate with Beaumont Tower when climbing aircraft impinge upon their airspace
- o Handoff to Departure East and retain control of all aircraft that will make rwy 17 (EFD) approach
- o Coordinate Clute arrivals w/Arrival West when HOU landing 13/22 or 31; and with Arrival East if HOU landing runway 4

TABLE 2-4. TRACON POSITIONS AND DUTIES (Continued)

South (Cont.) (L)	o When HOU is landing runway 22: - Coordinate local traffic landing Hobby w/Arrival East - Vector departures from satellite airports south of J2 and Hobby departures cleared via the Bolos gate and handoff to Houston Center over or south of Bolos intersection - Vector inbounds from over DAS and Smith landing West Satellite airports, south of Hobby and handoff to Departure West at 5000 - Vector aircraft departing West Satellite airports south of J2 and Hobby departures cleared via Trios gate and handoff to Departure East at 4000 or above 11,000
Coordinator South (CS)	o Support South Radar o Take Telco calls o Perform ARTS keyboard functions for handoffs between sectors and to/from the Center
Satellite (S)	o Provide radar service to aircraft in airspace depicted in Figure 2.30
Overhead (O)	o Performs inter/intra facility coordination and handoffs as necessary to maintain a safe orderly expeditious flow of traffic
Arrival Data/ Departure Data (AD/DD)	o Formulate and issue clearances for departures off uncontrolled satellite airports and EFD o Obtain departure release and restrictions from appropriate controller o Issue clearance and void time via interphone to aircraft being released. o Amend, distribute and update flight strips o Update weather at south position o Either departure times via FDER or interphone for departures off uncontrolled airports that will not automatically acquire o Amend altitude or departure corridor as required (and coordinate change w/controller)

TABLE 2-4. TRACON POSITIONS AND DUTIES (Continued)

Position	Duties
Supervisor (SI)	o Supervise and direct all operations o Determine flow direction o Advise affected facilities of delays o Implement flow control in coordination with Center o Coordinate flows between IAH and HOU with HOU supervisor o Coordinate with Cab Supervisor regarding approach in use (IAH & HOU), field conditions and traffic flow o Solicit and disseminate PIREPS o Delegate duties o Keep Assistant Chief informed of all pertinant data o Monitor and report equipment malfunctions
Assistant Chief (AC)	o Supervise facility o Assure adequate personnel on hand o Ensure restoration of equipment malfunctions o Issue NOTAMS o Complete daily equipment checklist o Ensure personnel briefed on operating procedure changes

TABLE 2-5. TOWER CAB POSITIONS AND DUTIES

Local Control (LC)	o Provides arrival service to aircraft within an 8 DME radius of HC Humble vortac from the surface up to and including 5000 MSL, excluding descent area for runway in use (Figure 2.39) o Provide departure service to all aircraft until radar/vertical separation exists; or if visual separation used until course diverges o Drop flight progress strip down tubes for departure to notify TRACON of aircraft entering airspace (signifies boundary report) o Retain control of VFR aircraft that depart the TCA below 1800 feet and terminate radar service at 8 DME o Operate approach lighting equipment o Has option of utilizing STOL runways (must coordinate with Ground Control)
Ground Control (GC)	o Issues clearances and instructions for aircraft and vehicles operating on taxiways o Operates field lighting equipment o Issues advisory instructions for terminal ramp o Assists Local Control in maintaining traffic vigilance in airport traffic areas
Flight Data/ Clearance Delivery (FD/CD)	o Issues clearances to IFR and Stage III aircraft departing IAH o Prepare departure flight progress strips (as shown in Figures 3-3 - 3-5) o Enters local IFR and Stage III departures into ARTS III system ensuring assignment to appropriate tablist o When gate hold procedures are in effect, determine and advise pilot of expected start time; and track proposed start time, expected start time, actual start time and total delay for each aircraft o Enter departure time, in the FDEP or via interphone, for aircraft that will not automatically acquire o Ensure receipt of weather for IAH, HOU, DWH, and GLS and post closed-circuit TV presentation as shown in Figure 4-4. o Makes ATIS broadcast o Forwards arrival and departure times of all military aircraft to FSS

TABLE 2-5. TOWER CAB POSITIONS AND DUTIES (Continued)

Flight Data/ Clearance Delivery (FD/CD) (Cont.)	o Update ARTS system data (altimeter, ATIS code and approach is use) o Amend altitude or departure corridor assignments as necessary
Supervisor Cab (SC)	o Supervises and directs all operations in Cab o Complete Equipment checklist o Determines runway in use o Takes and relays tower visibility observations o Monitors, restores and reports equipment malfunctions o Solicit and disseminate PIREPs o Answers outside and emergency phones o Ensures posted weather, ATIS and ARTS III system data area are correct o Ensures lighting is on as required o Delegate duties o When RVR < 2000 and/or ceiling < 200 ft, brings up standby power for runway 8 lighting and ALS o Coordinates with TRACON supervisor type of approach, runways, field conditions, traffic flow, etc.

TABLE 2-6. TRACON STAFFING HOURS

Position	Hours
Coordinator East	0700-1000, 1500-1800 (if busy)
Departure East Radar	24 hours
Arrival East Radar	0700-2100
IAH Final	0700-1900 (for one runway operation)
Arrival West Radar	0700-2100
Departure West Radar	0600-2100
Coordinator West	0700-1100, 1400-1800 (if busy)
Hobby Final	0700-2100
Coordinator Hobby	0800-1100, 0800-1900 (if busy)
Team Supervisor	24 hours
Watch Supervisor	0700-2300
Arrival/Departure	0700-2100
South Radar	0700-1900
Coordinator South	During unusual peak traffic
Satellite	rarely manned
Overhead	never manned

TABLE 2-7. TOWER CAB STAFFING HOURS

Position	Hours
Local Control 1	24 hours
Local Control 2	1500-1900 at supervisor preference
Ground Control	0700-2130
Flight Data/Clearance Delivery	24 hours
Cab Team Supervisor	0700-2130

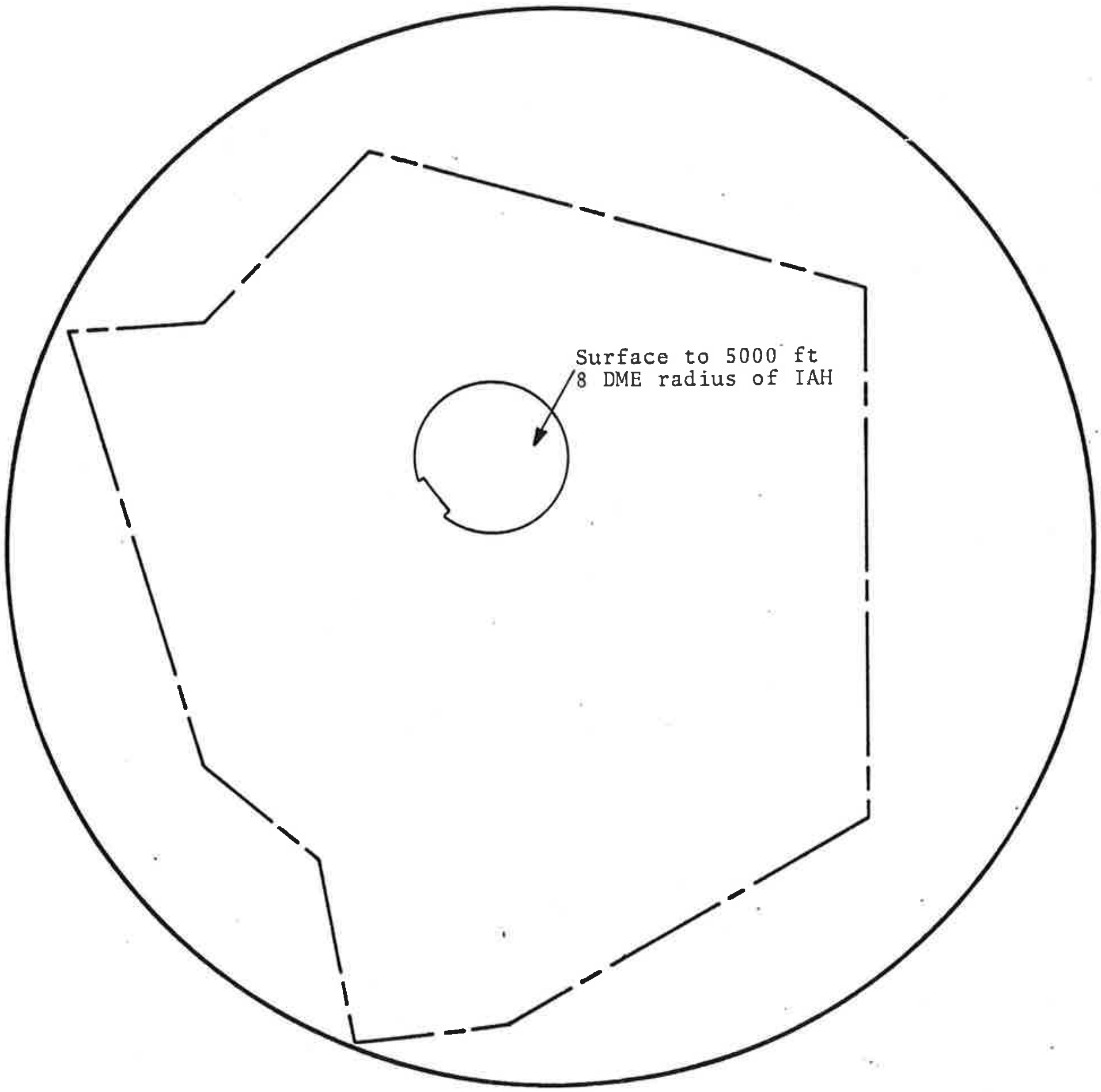
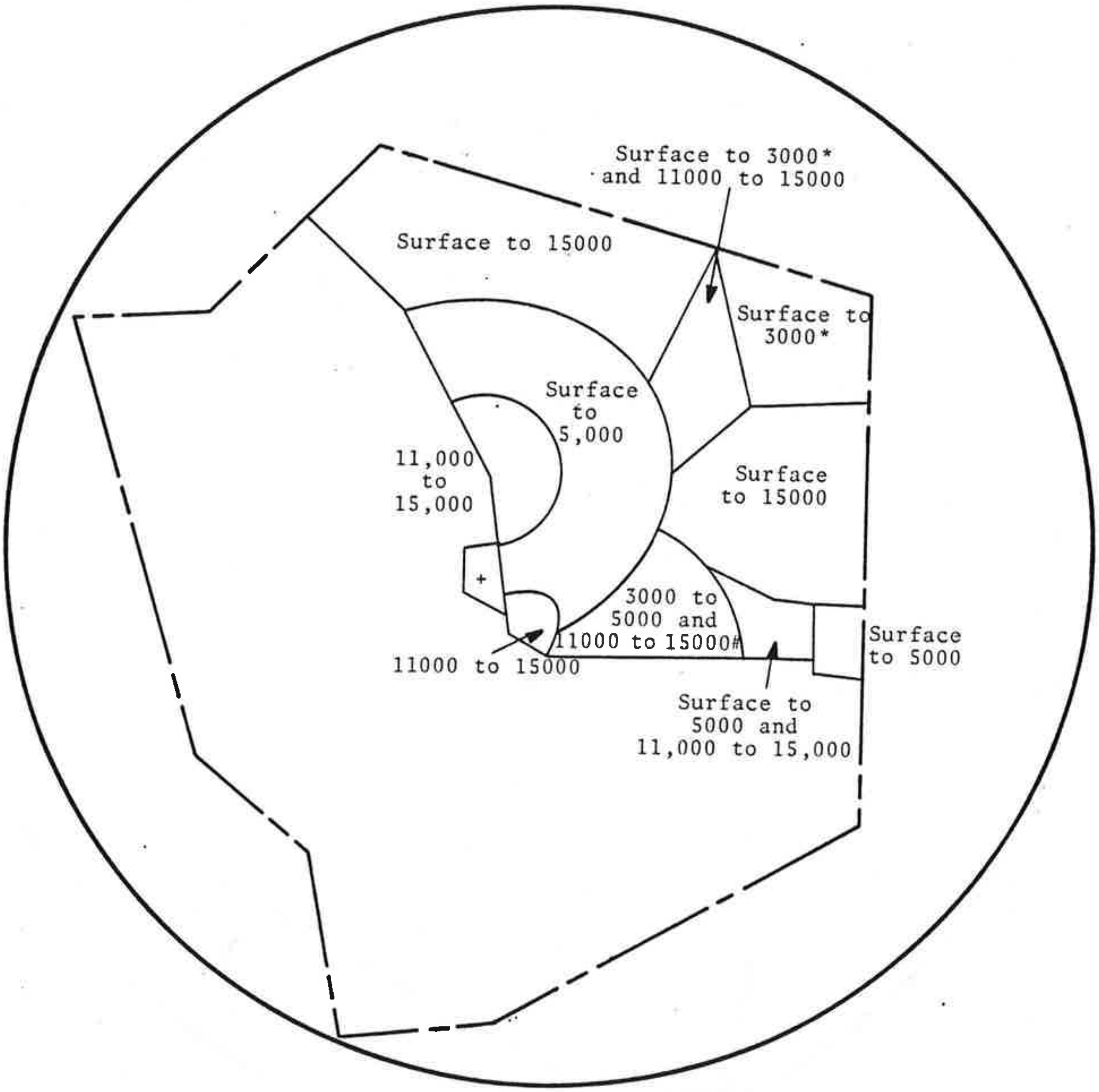


FIGURE 2.39. LOCAL CONTROL JURISDICTION



* 5000 when runway 26 is not in use

\+ surface to 5000 and 11000 to 15000 when runway 22 in use at HOU

\# 11000 to 15000 only when runway 22 in use at HOU

FIGURE 2.40. DEPARTURE EAST JURISDICTION

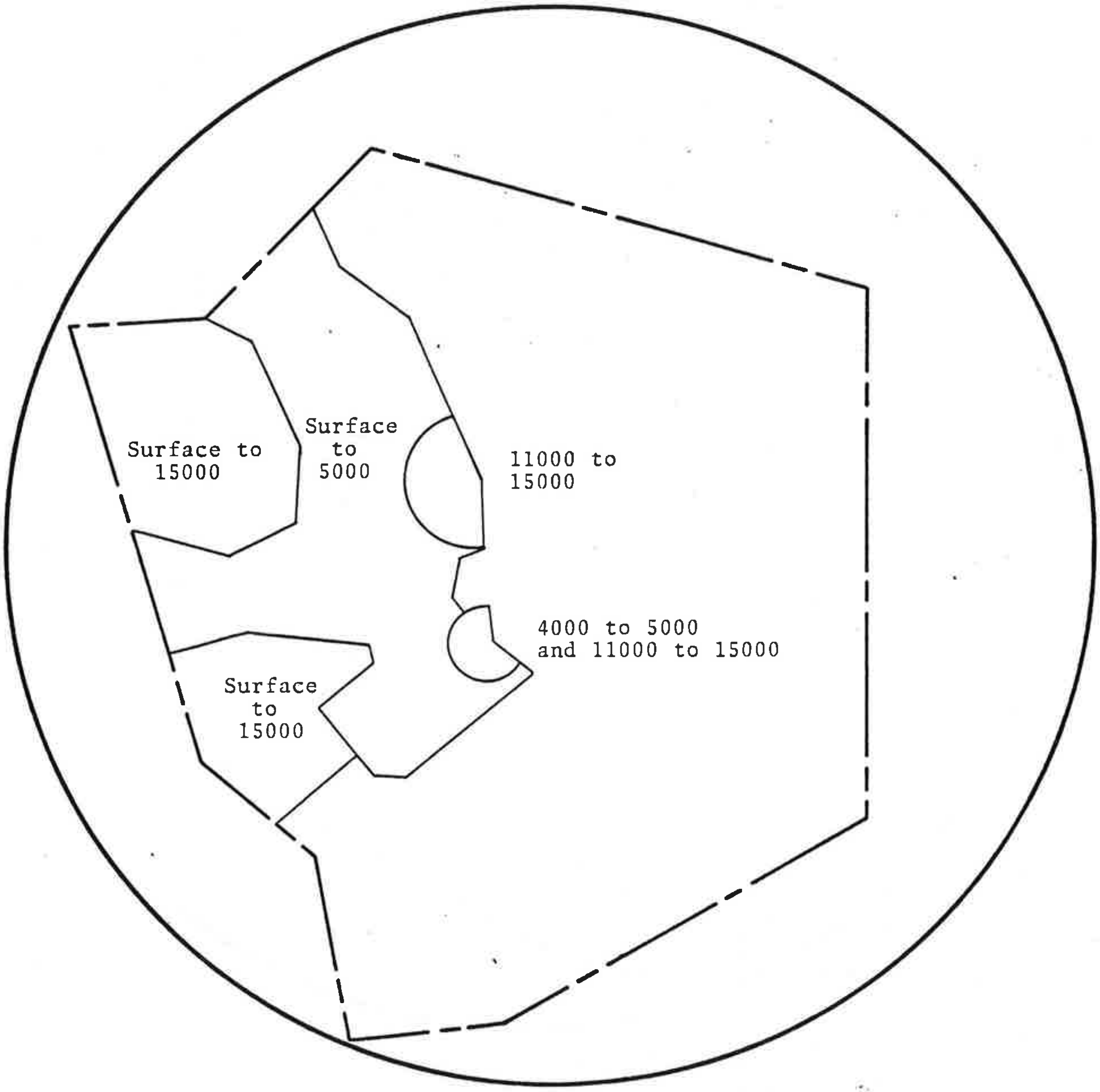
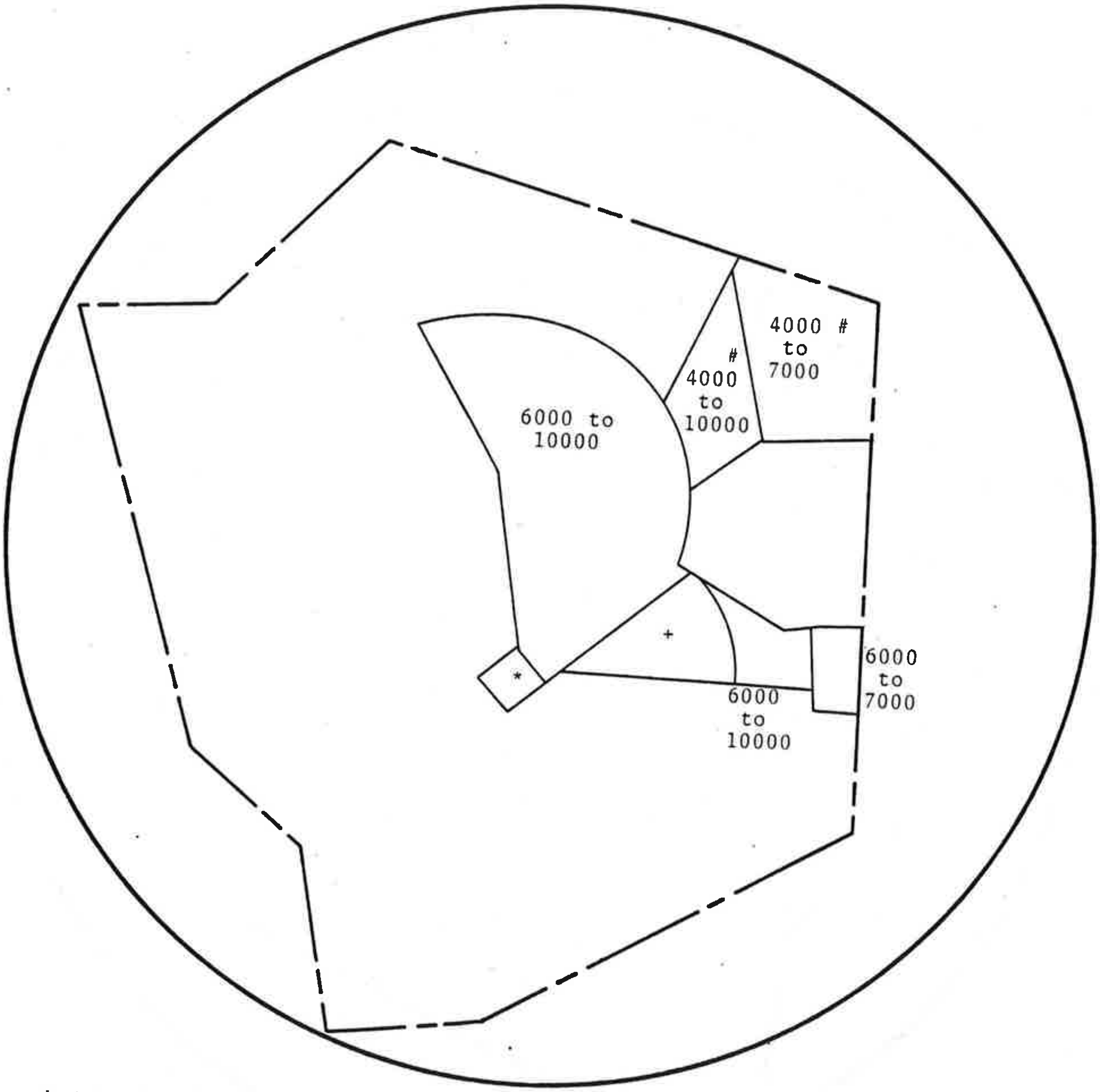


FIGURE 2.41. DEPARTURE WEST JURISDICTION



* 6000 to 10000 when runway 4 in use at HOU

\+ 4000 to 10000 when runway 22 in use at HOU

\# 6000 when runway 26 is noy in use

FIGURE 2.42. ARRIVAL EAST JURISDICTION

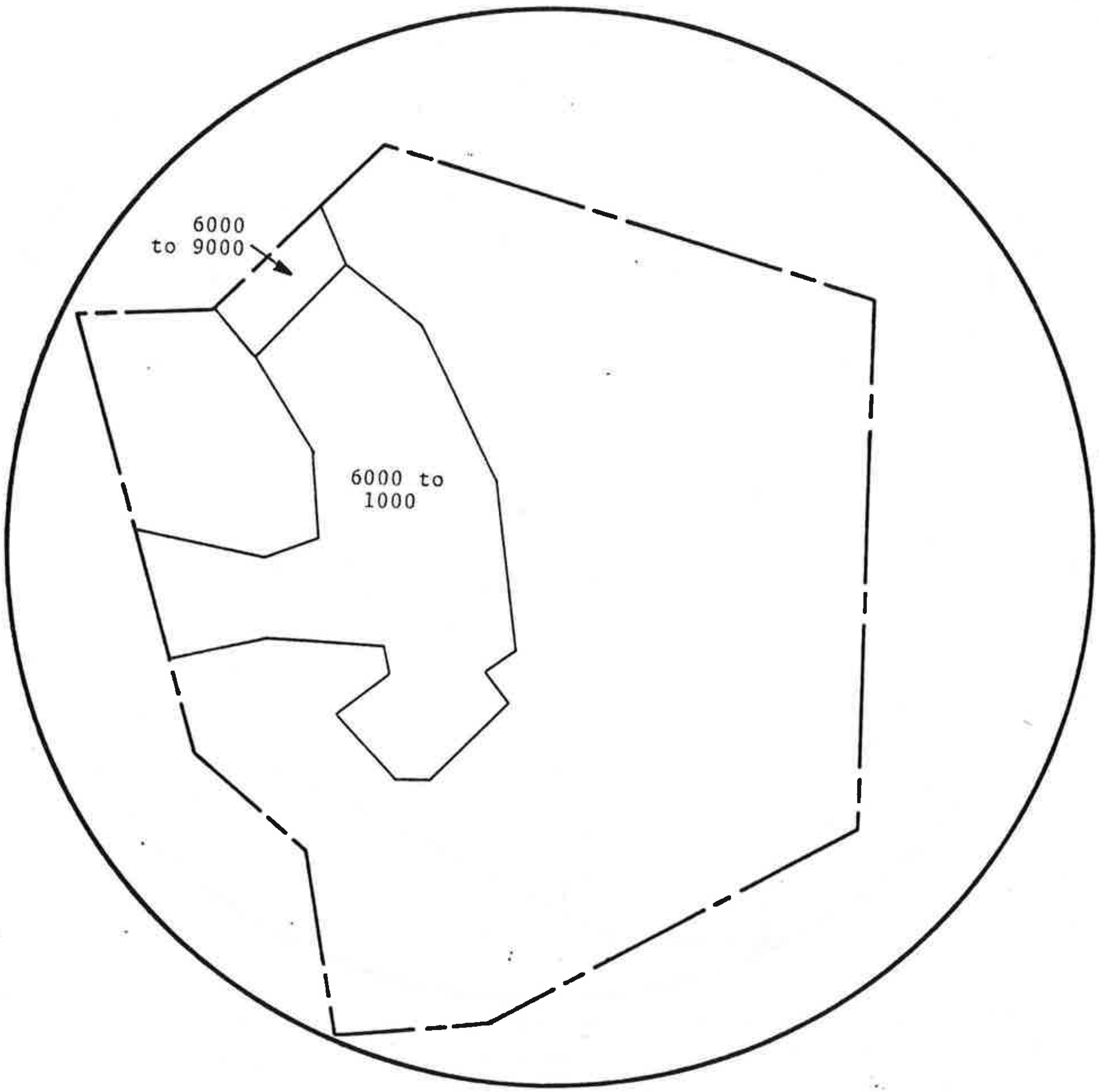
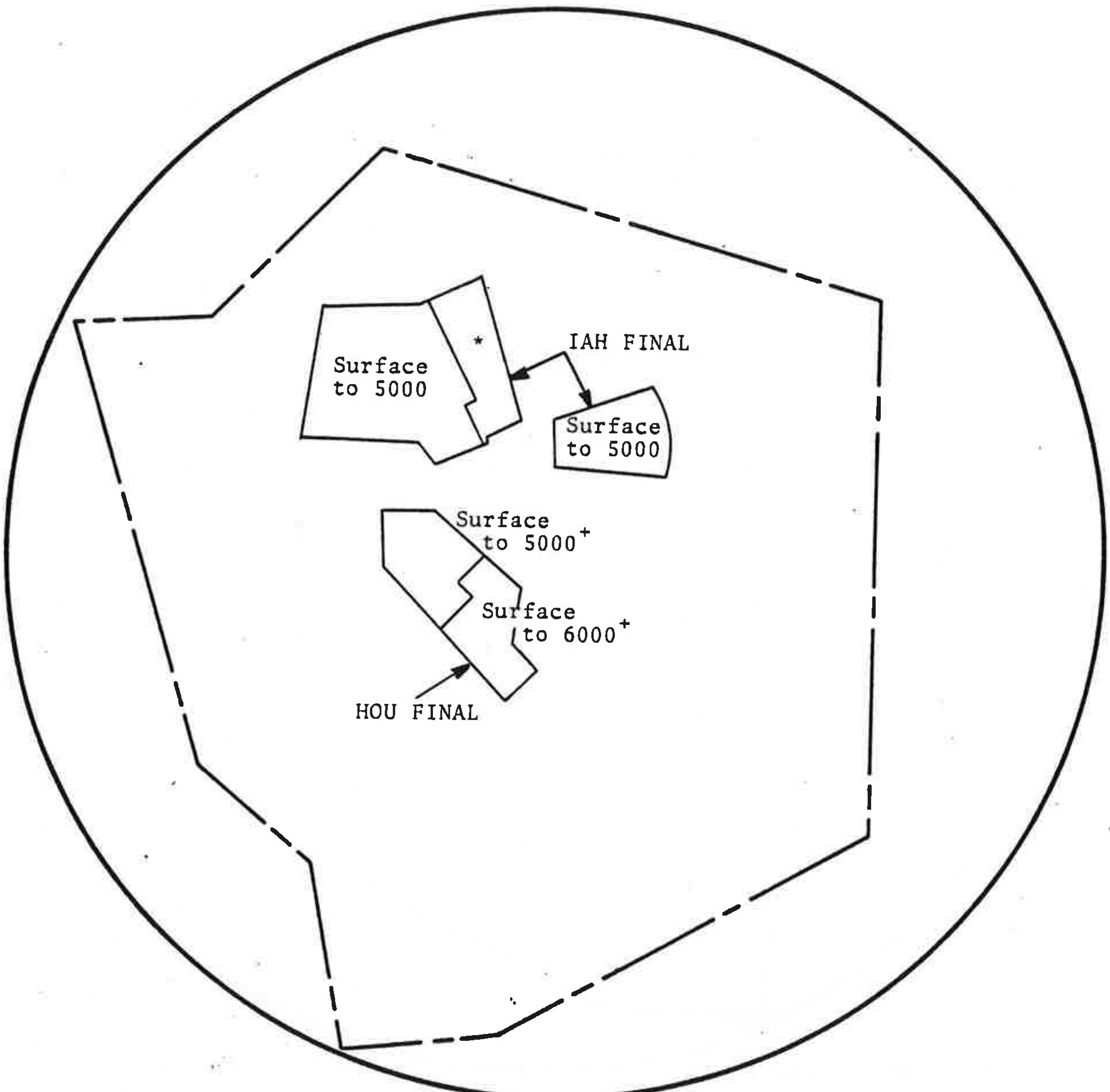


FIGURE 2.43. ARRIVAL WEST JURISDICTION



* Surface to 5000 when on a straight runway 14 operation
+ excluding Hobby Tower Airspace

FIGURE 2.44. IAH AND HOU FINAL JURISDICTION (Sheet 1)

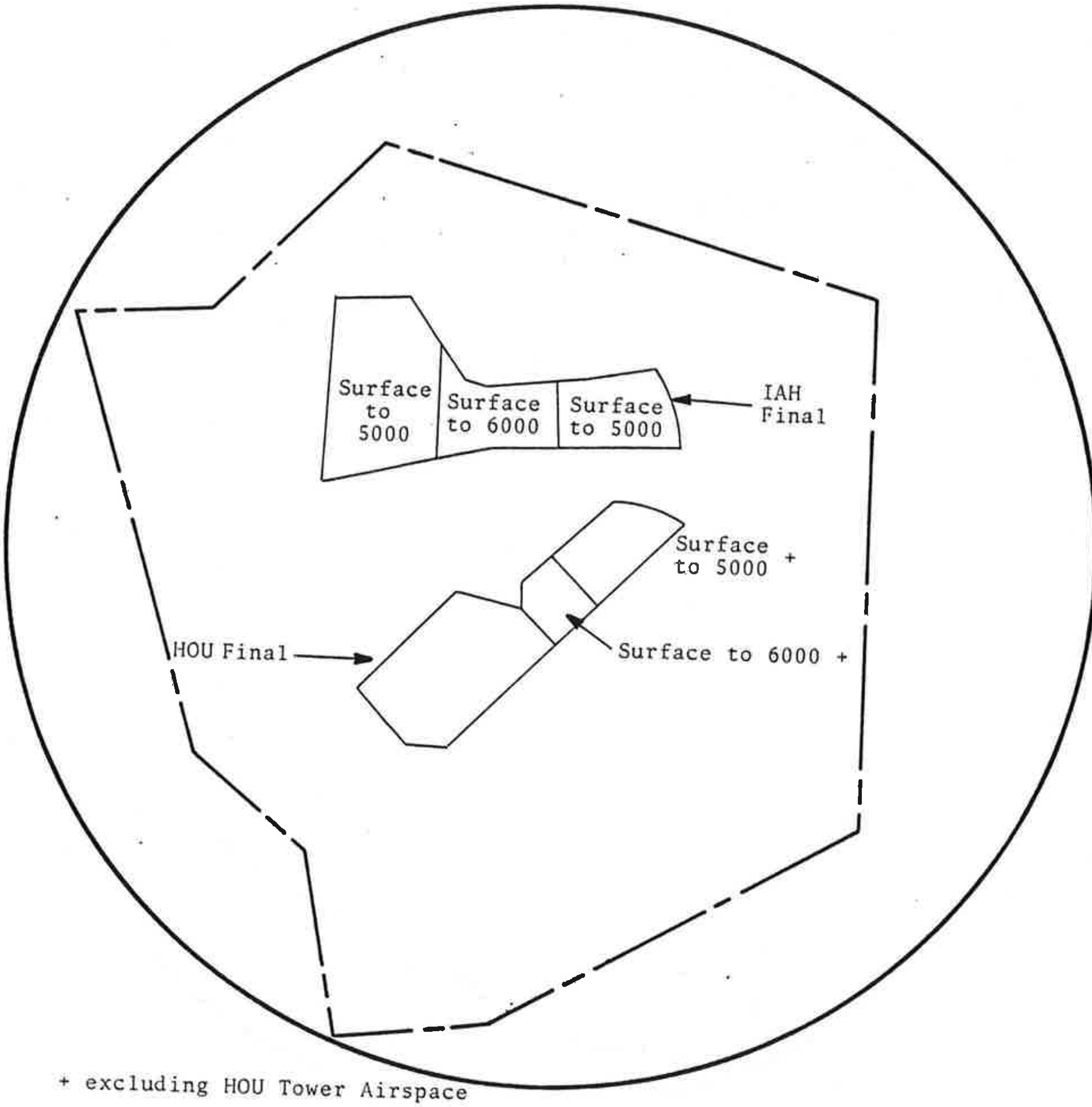
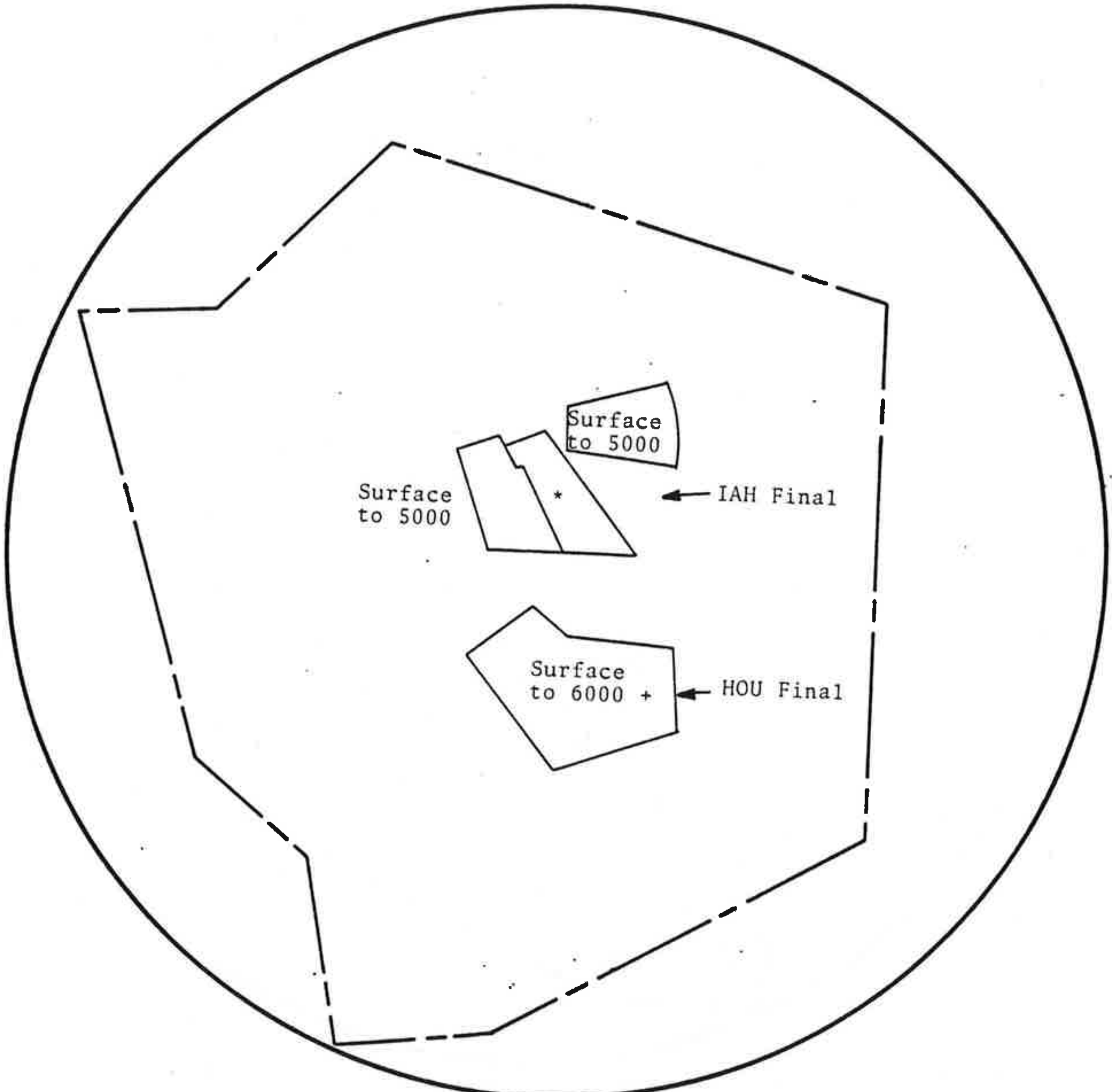


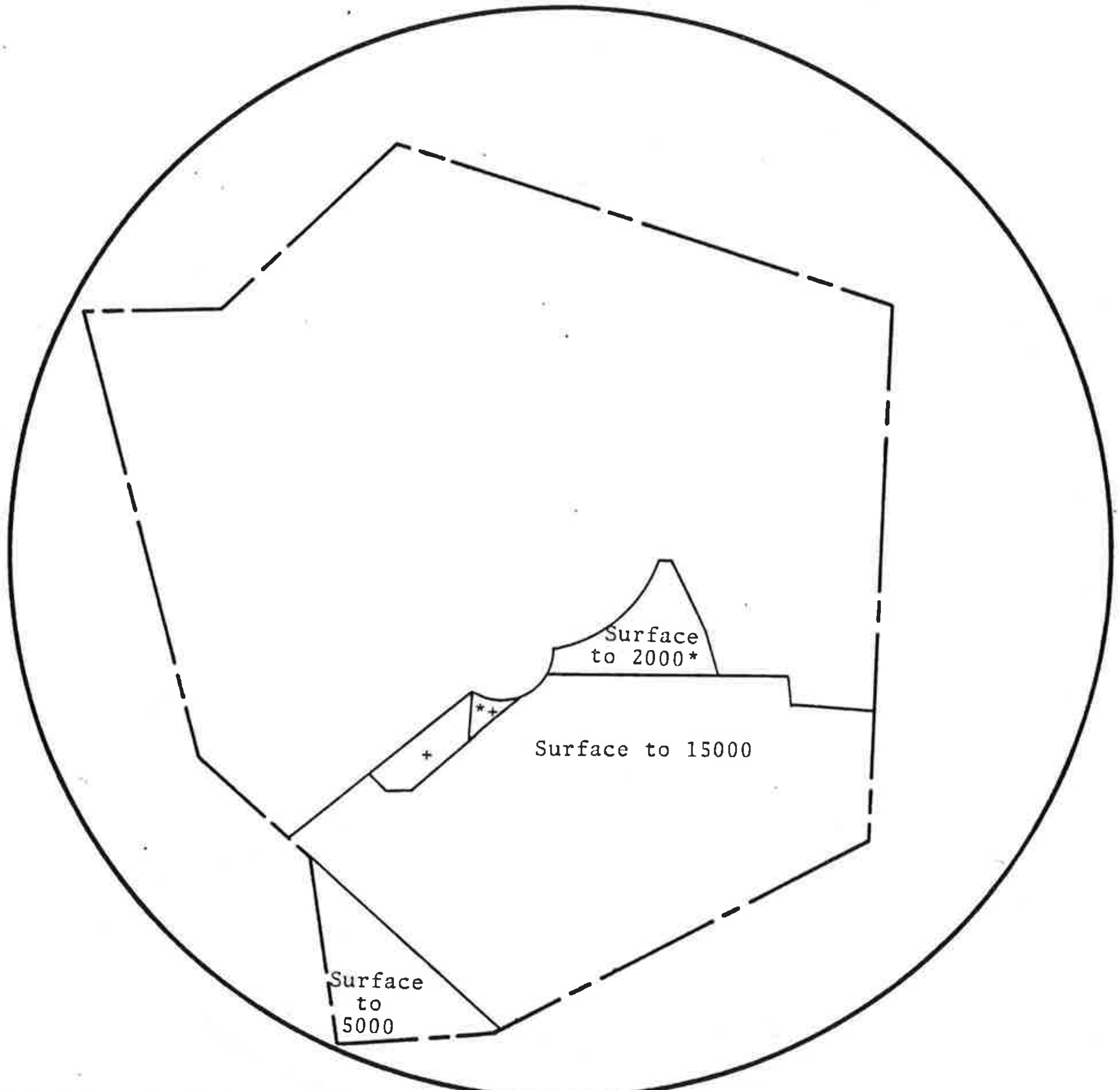
FIGURE 2.45. IAH AND HOU FINAL JURISDICTION (Sheet 2)



* surface to 5000 when on a straight runway 32 operation or a VOP/DME runway 32 approach

\+ excluding Hobby Tower airspace

FIGURE 2.46. IAH AND HOU FINAL JURISDICTION (Sheet 3)



* surface to 3000 when runway 22 in use at HOU
+6000 to 15000 when runway 4 in use at HOU

FIGURE 2.47. SOUTH JURISDICTION

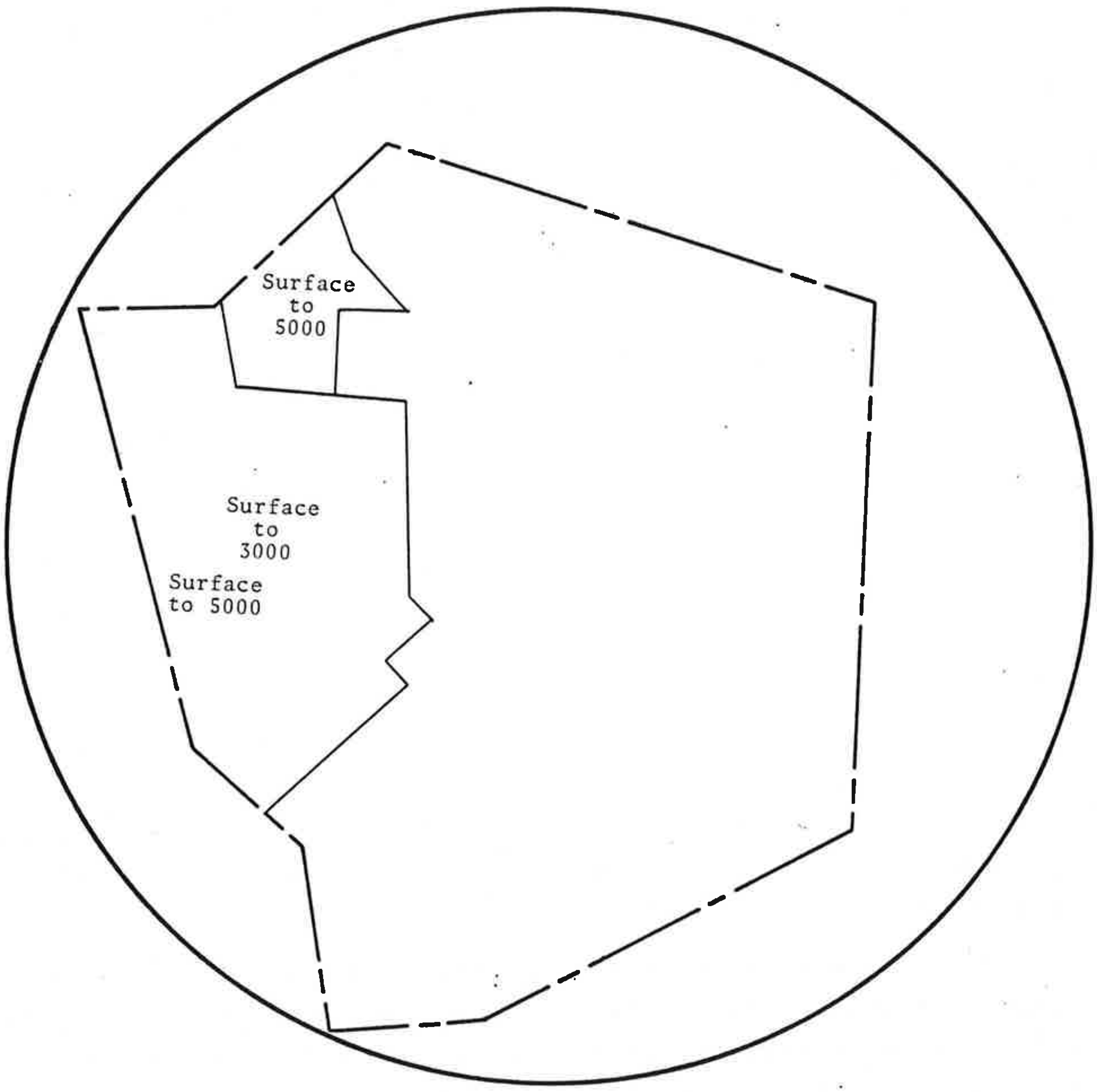


FIGURE 2.48. SATELLITE JURISDICTION

being used for arrivals. The IAH final receives all arrivals, sequences them, and transfers control and communication to Local Control. The Hobby Final handles all arrivals into Hobby with support from Coordinator Hobby. All these positions are located along one wall (Figure 2.18). Above these controllers are two sliding ARTS displays. These are for use by the Overhead position. This position is to provide "over the shoulder" support for radar controllers to facilitate coordination and the expeditious flow of traffic during peak hours. This position is rarely, if ever, staffed. Across from these positions is the South Radar, Satellite Radar, Coordinator South and Arrival Data/Departure Data positions. The Satellite position is rarely staffed. When it is not staffed Departure West covers its airspace. South position includes service to Ellington and Galveston Airports. When this position is not staffed Hobby Final handles the airspace. Support for this position is provided by the South coordinator which is staffed approximately four hours a day depending on traffic level. The Arrival Data/Departure Data position at Intercontinental is occasionally split into two positions during peak conditions. This position delivers clearance and strips for departures off of satellite airports, relays weather from Ellington Air Force Base to South position and provides general flight data support.

Sector boundaries and altitude limits for each controller position are shown in Figure 2.39-2.48 . These sector maps are included in the position binder which are normally stored at at each position.

During the midnight shift the staff is reduced to the Team Supervisor and a radar controller. All Radar positions are consolidated onto Departure East. The 8-hour shifts are staggered so that some controllers come in at 6:00, 7:00 and 8:00 am.

Regular Cab staffing involves four or five positions:

- o Flight Data/Clearance Delivery
- o Ground Control
- o Local Control 1 (or Local Control)

- Local Control 2 (or Local Control West)
- Cab Supervisor

Photographs of the positions are displayed in Figures 2.31 - 2.38. Specific Tower Cab positional responsibilities are described in Table 2-5. The decision to staff two Local Controllers and consequently, how the work should be divided up is a function of Supervisor and team preferences and traffic level. Some teams prefer not to staff a second Local Controller. For those that do, one way to divide the work is by runway. For example, with configuration 14/26 active (discussed in Section 2.2), the responsibilities would be split as follows:

Local Control 1 - works all arrival and departures on 14 above 1500'

Local Control 2 - works all arrivals on 26 and all helicopters Stage III traffic 1500 feet and below, within 8 mile radius

An alternative way to divide the responsibilities is for Local Control 2 to handle specific types of flights such as pipeline aircraft and helicopters and to assist Local Control 1 with pointouts, etc. Flight data and clearance delivery responsibilities are generally handled by one controller. In the case of very heavy workload as during gate hold procedures, the responsibilities may be divided between two controllers. Mid-watch staffing in the Cab unusually involves one Local Controller and the Flight Data/Clearance Delivery position.

At each position in the Tower Cab and in the TRACON is a position log and a position relief checklist (Figures 2.49 - 2.50). The position log keeps track of duty time data. The relief checklist contains a list of items relevant to the position which are to be reviewed during manning change, such as equipment outages, NOTAMS, SIGMETS, PIREPS, switched frequencies, procedural modifications and information pertinent to current and pending traffic.

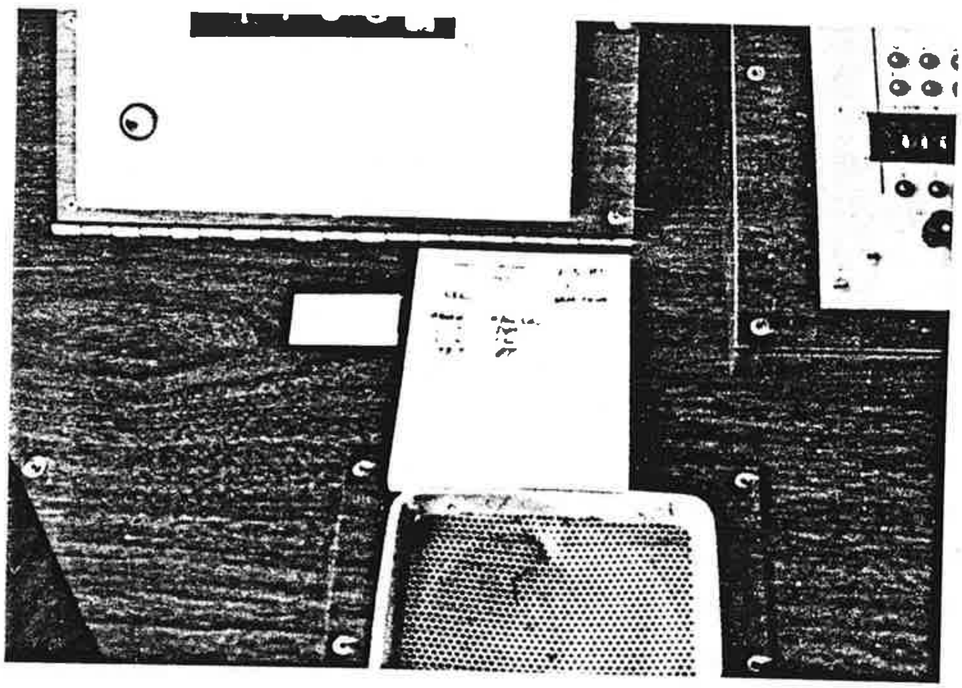


FIGURE 2.49. POSITION LOG AT GC

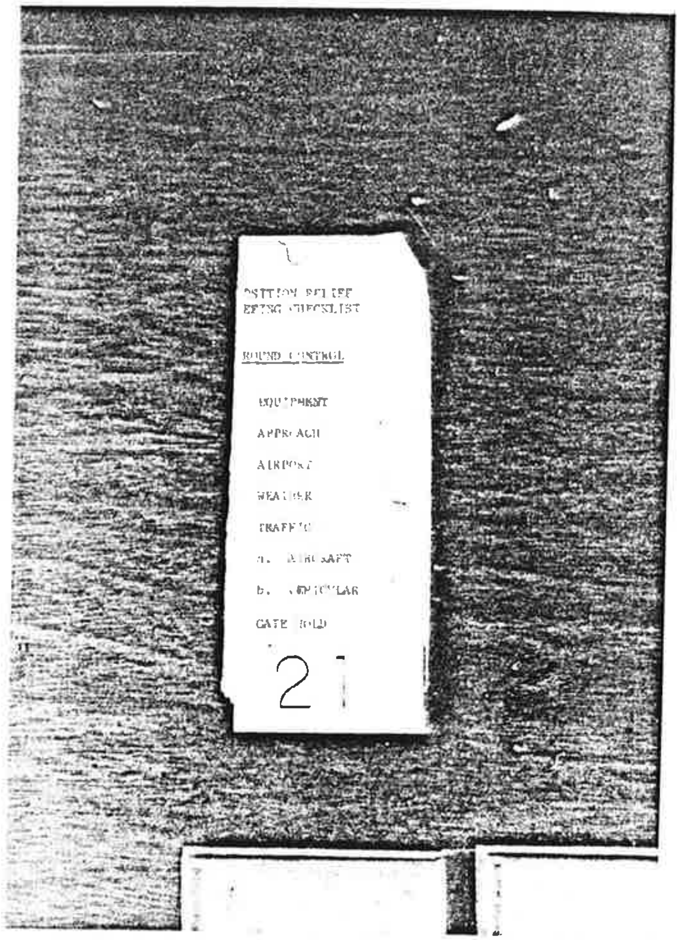


FIGURE 2.50. GROUND CONTROL POSITION RELIEF CHECKLIST

3. INTERCONTINENTAL FLIGHT DATA SYSTEM

This section describes the layout of flight data equipment in the Tower Cab and TRACON, the maintenance and transfer of flight data by controller position for each class of operations, and a description of the flight strips and markings at IAH. This information is presented in the following tables and figures and discussed below:

Figure 3.1 - 3.9	-	Layout of Flight Data Equipment in Tower Cab and TRACON
Table 3.1		Departure Designators
Tables 3.2 - 3.3	-	Analysis of Day's Flight Strips
Figures 3.10- 3.13	-	Flight Strip Formats
Figure 3.14	-	ARTS Data Block
Figure 3.15	-	Arrival/Departure Tab List
Figure 3.16	-	Flight Strip Movement of IAH Departures
Figure 3.17	-	Flight Strip Movement of Satellites

3.1 LAYOUT OF FLIGHT DATA EQUIPMENT

The one FDEP in the Tower Cab is Located at the Flight Data/Clearance Delivery position. It prints out all IFR filed departures from IAH. There is no spare FDEP in the Cab nor is there an extra set of cables to hook up an extra FDEP. In case of an outage the Center must be called to formulate all clearances. If the unit cannot be repaired within 30 minutes a new unit will be temporarily installed. There are two FDEPs in the TRACON; one FDEP prints out all IFR filed IAH arrivals and the other prints out IFR filed IAH overflights and IFR departures from satellite airports. In case of an FDEP outage in the TRACON all strips will be printed on the operating FDEP.

There is a keyboard associated with the FDEP in the Tower Cab and with the FDEP used for overflights and departures in the

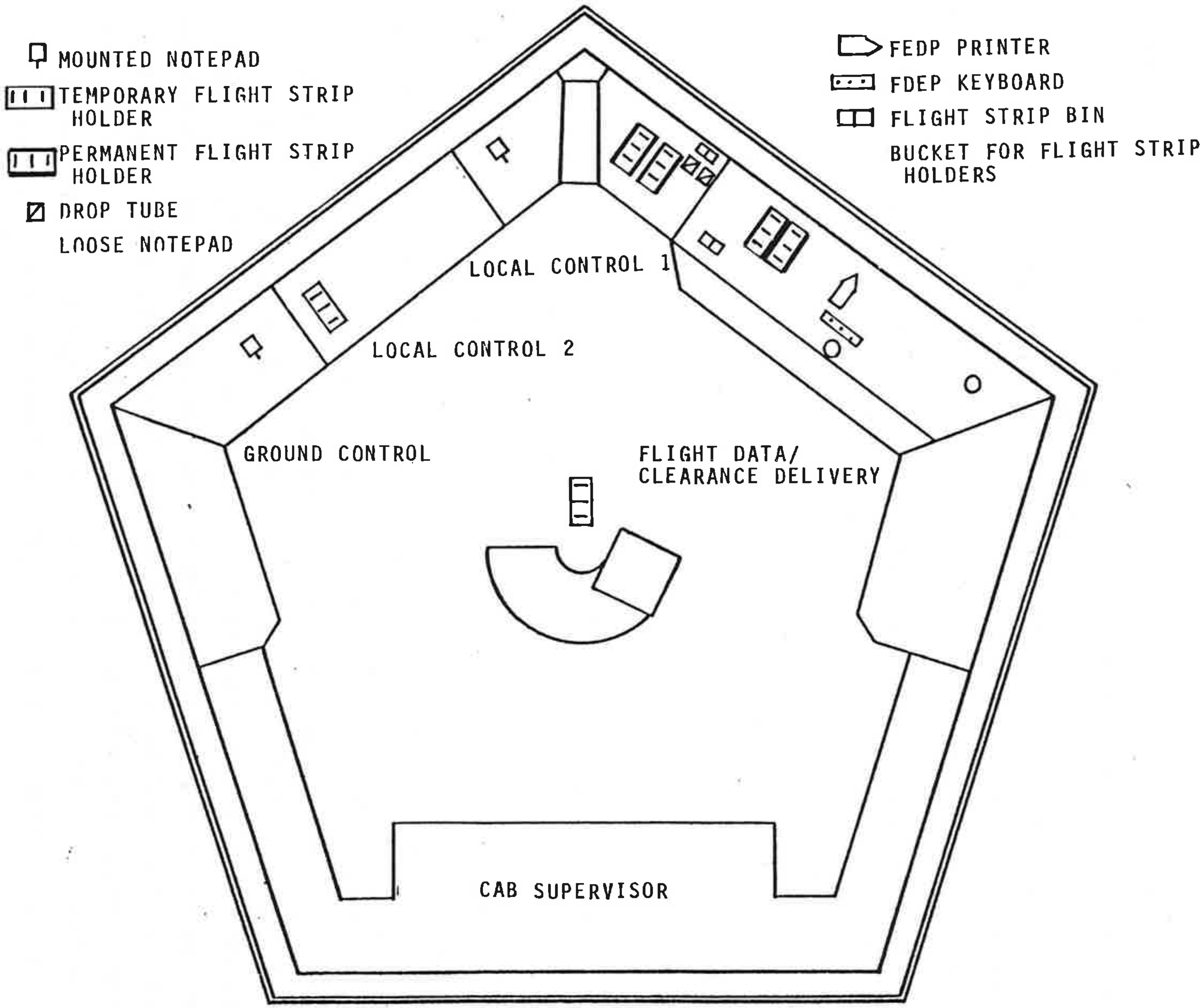


FIGURE 3-1. LAYOUT OF FLIGHT DATA EQUIPMENT IN TOWER CAB

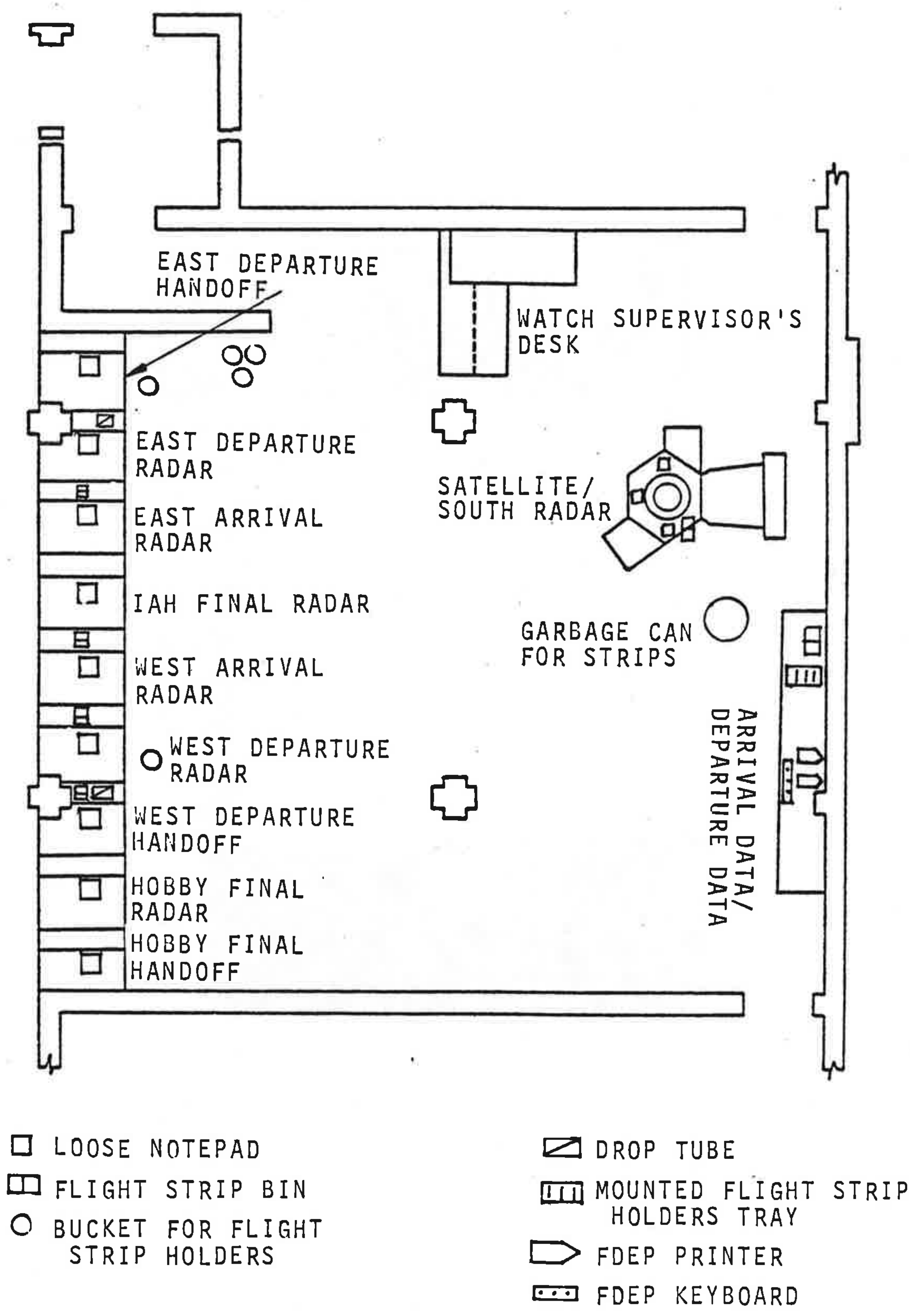


FIGURE 3-2. LAYOUT OF FLIGHT DATA EQUIPMENT IN TRACON

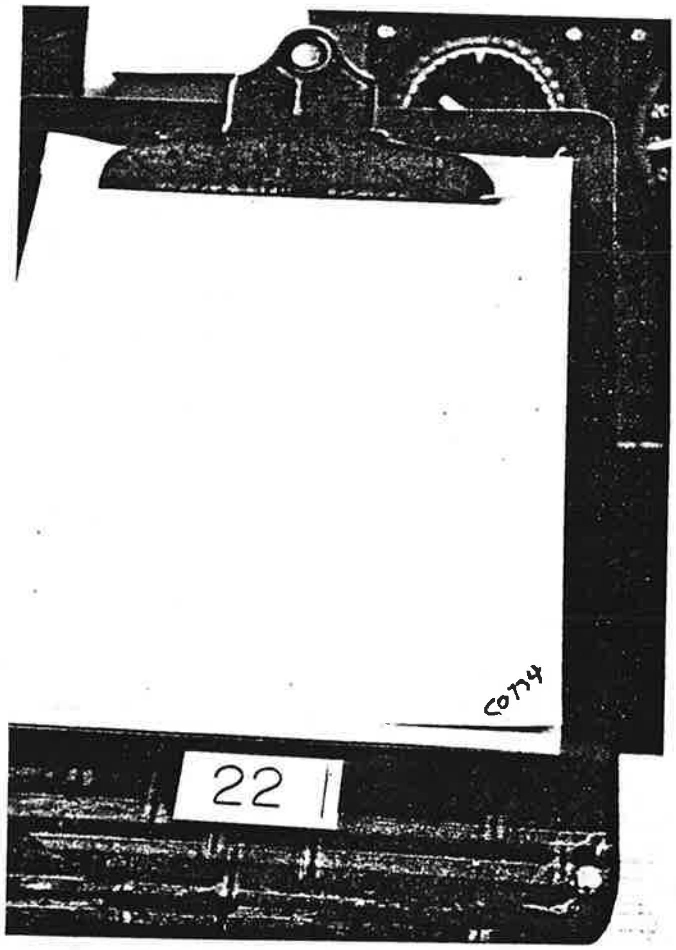


FIGURE 3.3. MOUNTED NOTEPAD AT GROUND CONTROL

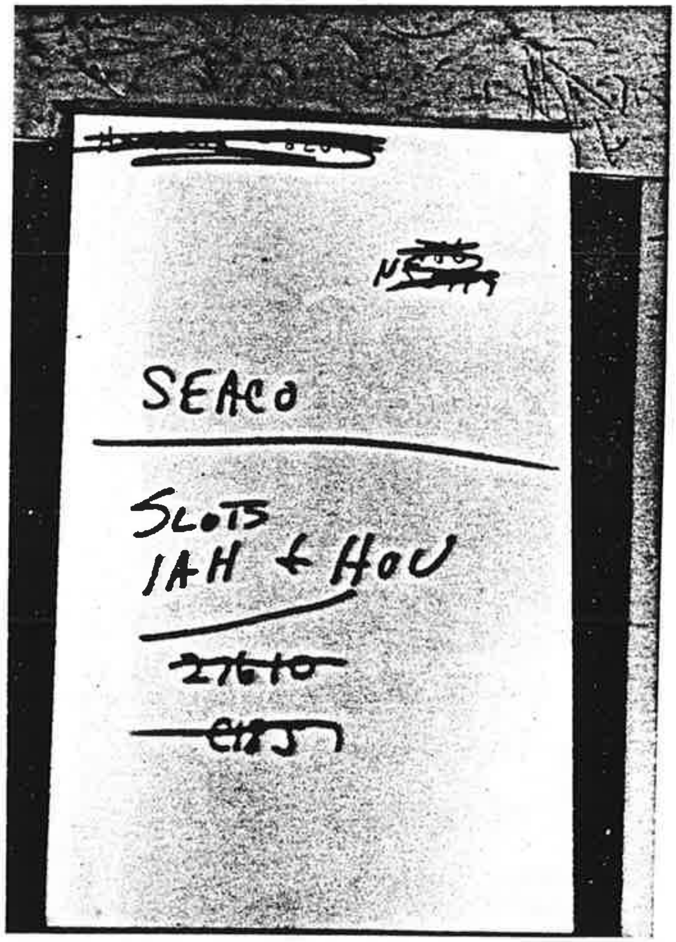


FIGURE 3.4. NOTEPAD AT AD/DD POSITION

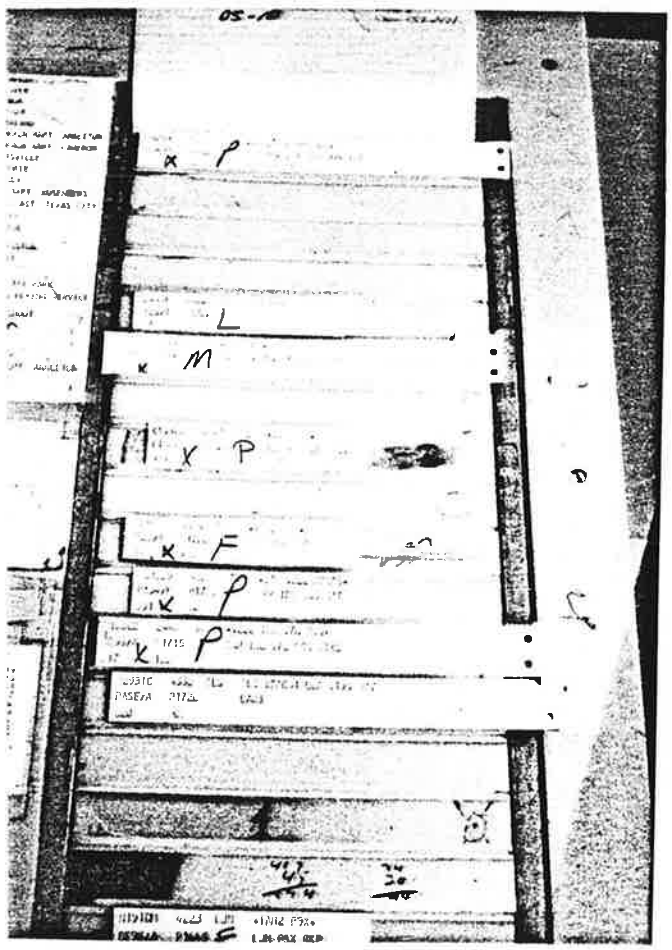


FIGURE 3.5. FLIGHT STRIPS ON RACK AT AD/DD POSITION

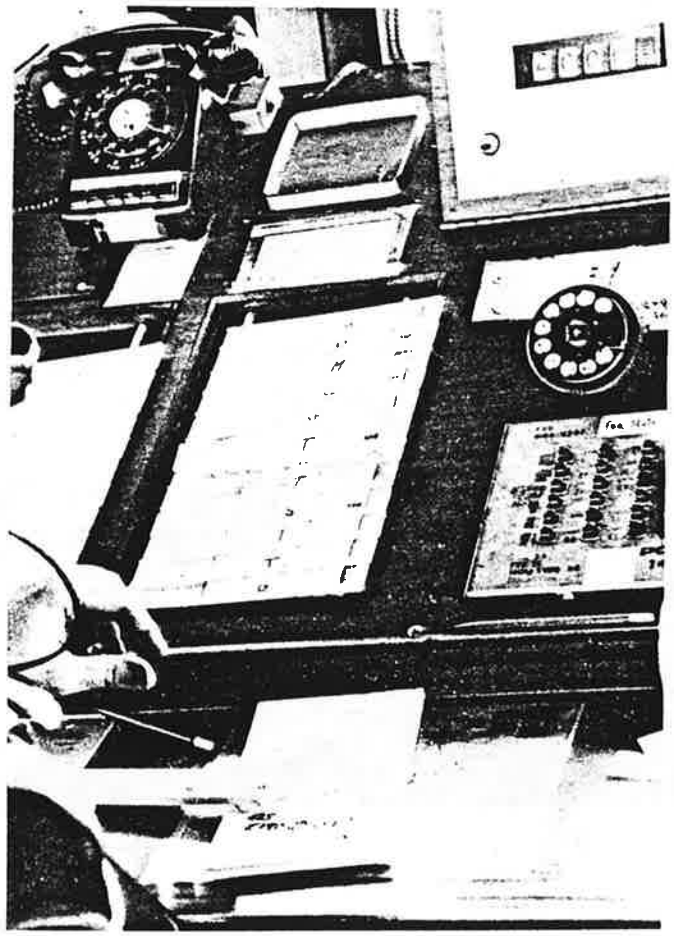


FIGURE 3.6. FLIGHT STRIPS IN TRAY AT FD/CD

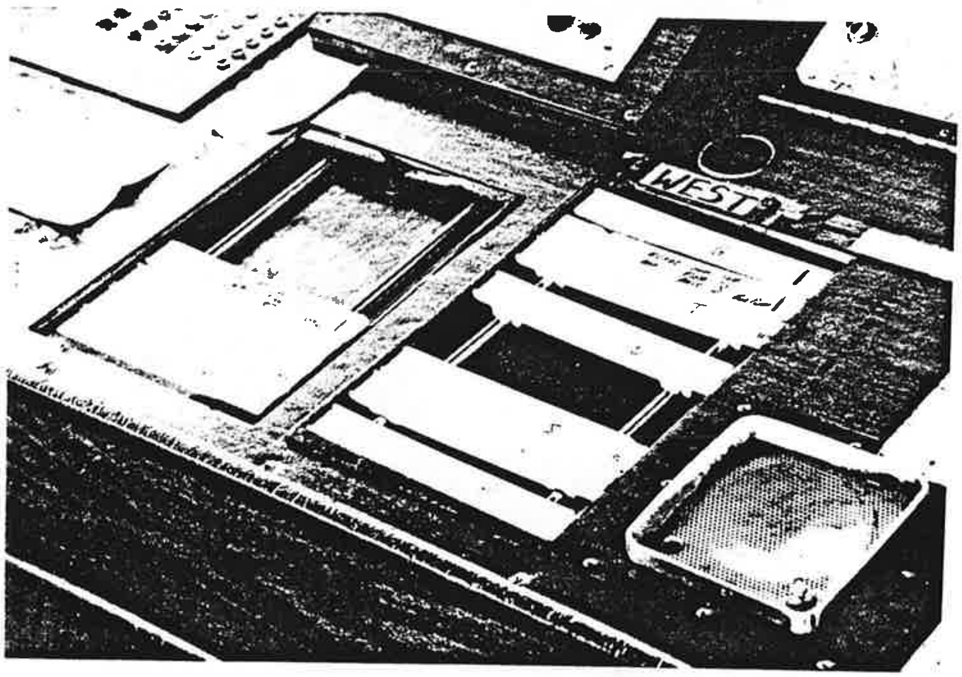


FIGURE 3.7. FLIGHT STRIPS IN TRAY AT LOCAL CONTROL

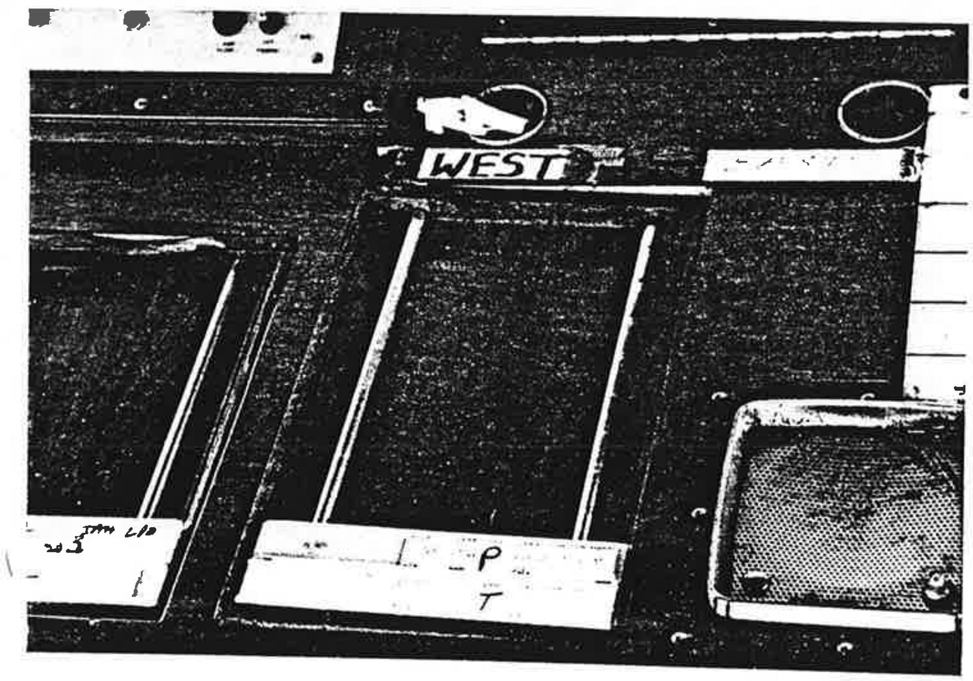


FIGURE 3.8. DROP TUBES AT LOCAL CONTROL POSITION

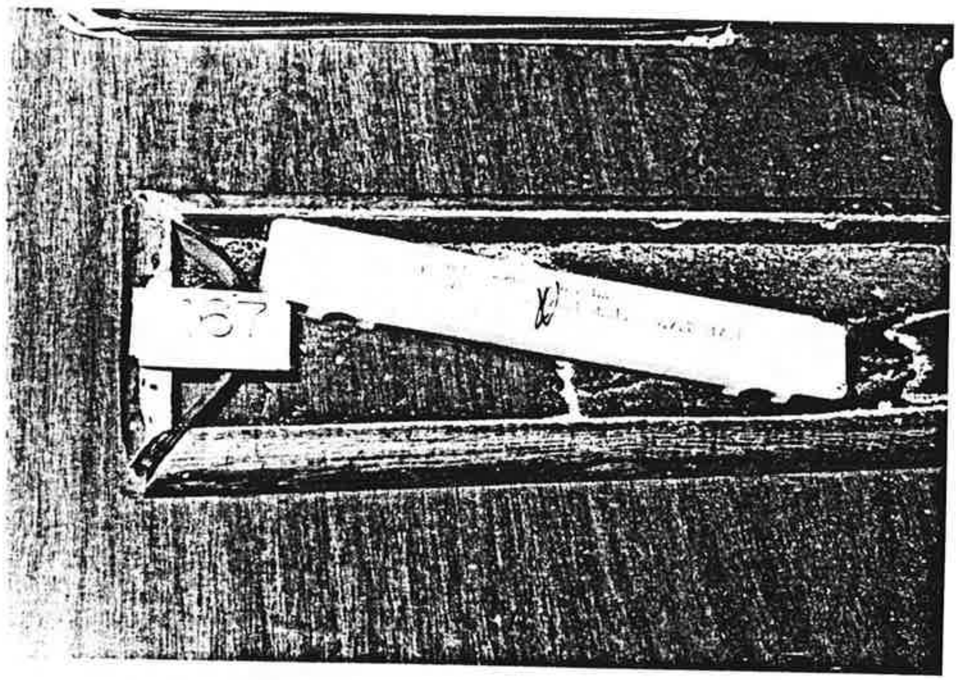


FIGURE 3.9. FLIGHT STRIP IN DROP TUBE TRAY IN TRACON

TABLE 3-1. DEPARTURE DESIGNATORS

M	Gomer
C	Cleep
T	Trios
E	Tower EnRoute
L	Local
B	Bolos
J	J15
N	V15W
P	Prairie
F	Freeport
OC	On Course Over Galveston
S	J86 or Sabine
G	Galveston
V	Overflight
3	Stage III VFR

TABLE 3-2. ANALYSIS OF IAH FLIGHT STRIPS FROM 11/22/80

Coordination Fix	# of Flight Strips
TNV	68
DAS	148
HOU	10
HUB	12
GLAND	78
SMITH	42
CUGAR	98
SHS	26
SBI	6
APRIL	6
CANDI	5
DWH	2
IAH	2
SILBE	8
LJN	1
	512

TABLE 3-3. ANALYSIS OF IAH FLIGHT STRIPS FROM 11/22/80

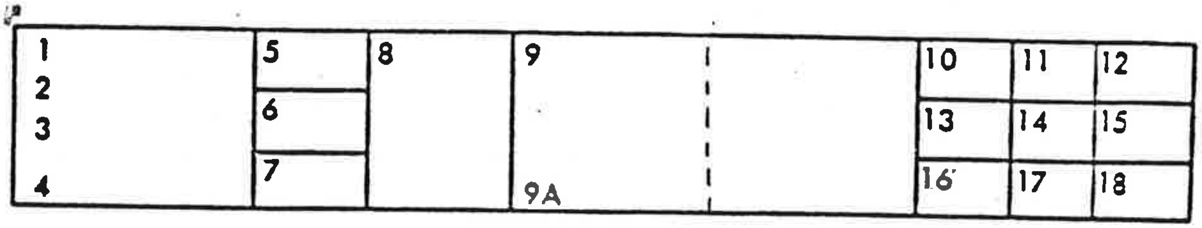
IAH IFR ARRIVAL AND SECONDARY
IFR ARRIVALS BY AIRCRAFT TYPE

IAH		
Air Carrier		179
Air Taxi		18
General Aviation		65
Military		1
	Subtotal	263
HOU		
Air Carrier		55
Air Taxi		7
General Aviation		127
	Subtotal	189
Other Secondary		60
	Total	512

TABLE 3-4. ANALYSIS OF IAH FLIGHT STRIPS FROM 11/22/80

IAH DEPARTURES, SECONDARY DEPARTURES
AND OVERFLIGHTS BY AIRCRAFT TYPE

IAH		
Air Carrier		240
Air Taxi		37
General Aviation		63
Overflights		28
	Subtotal	368
HOU		
Air Carrier		61
Air Taxi		27
General Aviation		136
	Subtotal	224
Other Secondary		107
TCA		45
	Total	744



TYPED OUT INFORMATION

1. Aircraft identification
2. Revision number
3. Number of aircraft (if more than one), type of aircraft, and suffix indicating any special equipment
4. Computer identification
5. Beacon code
6. Proposed departure time
7. Requested altitude
8. Departure airport

9A Filed Routing

9. Changes in filed routing

HANDWRITTEN INFORMATION

1. Below departure airport appropriate designator is marked

m	Gomer	B	Bolos
C	Cleep	T	Trios
F	Freeport	P	Prairie
OC	On Course	L	Local
E	Tower En Route	N	V15W
A	CLL 085	S	J86 or SBI
3	Stage III	G	Galveston
		J	J15

2. Changes in filed plan such as changed beacon code, altitude or filed routing
3. Duplicate satellite departure Strips are marked with an "X"

SAMPLES

```
CL634    2474  IAH    +IAH2 STELL J33 DON
B727/A   P0130   m    IAH J33 CWI15 SCY./
511      240          ⊕SFP 360
```

```
EA489    4621  IAH    +IAH2 TBU V63 TARCS
DC9/A    P0623  OL    IAH IAH2 TBU V222..
993      200          ⊕SFP RV-ISSOT
```

```
N292JC   4616  DWH    +J29 PSX V13+
WW24/F X P1400  F     DWH IAH PSX CRP
525      260
```

```
N673LP   2425  CXO    +J33 STELL IAH310I2
C501/F   P2030  m     CXO IAH310120 MCP29
123      350          CIM320120 GJT
```

83

FIGURE 3.10. IAH IFR DEPARTURE FLIGHT STRIP/SATELLITE DEPARTURE STRIP

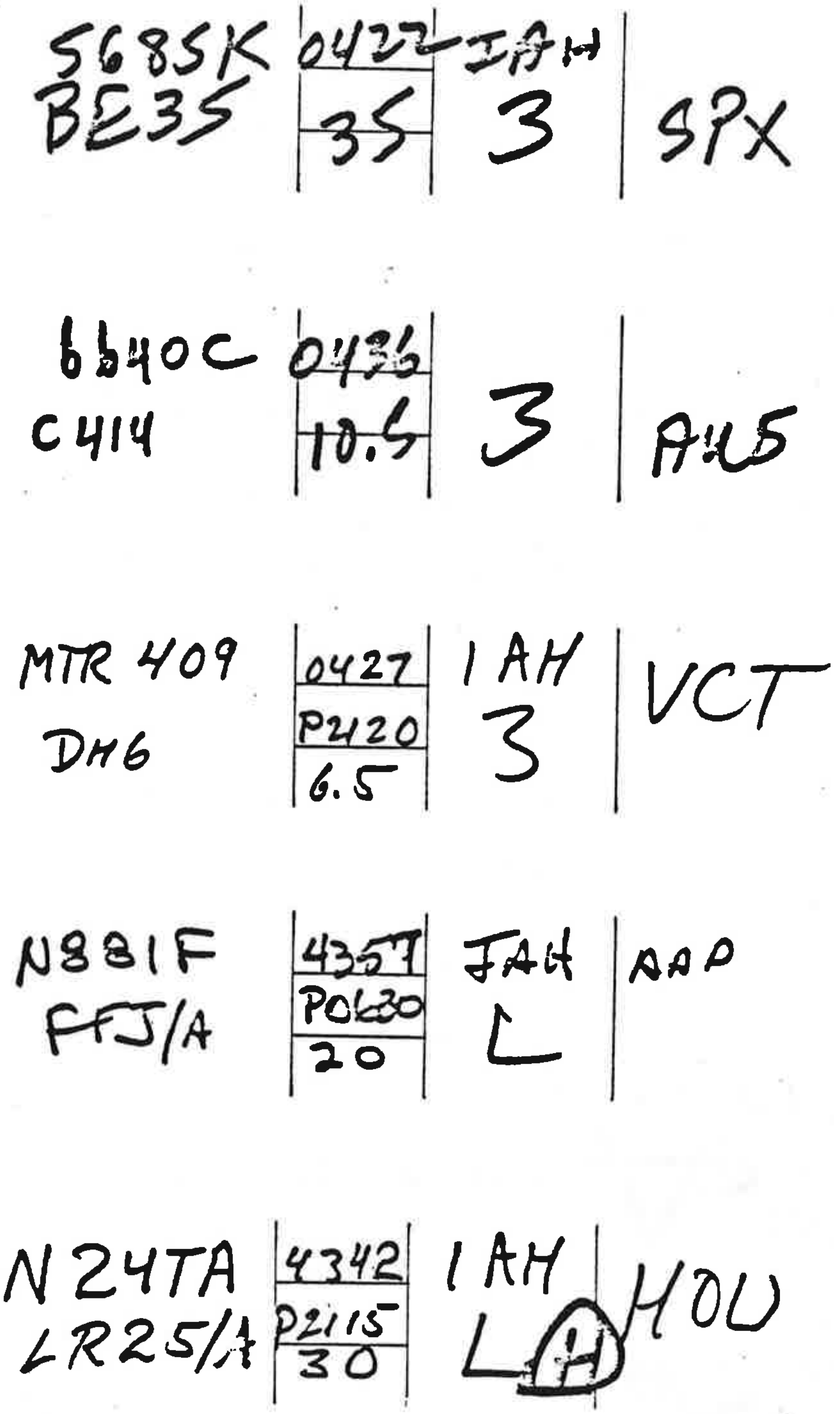
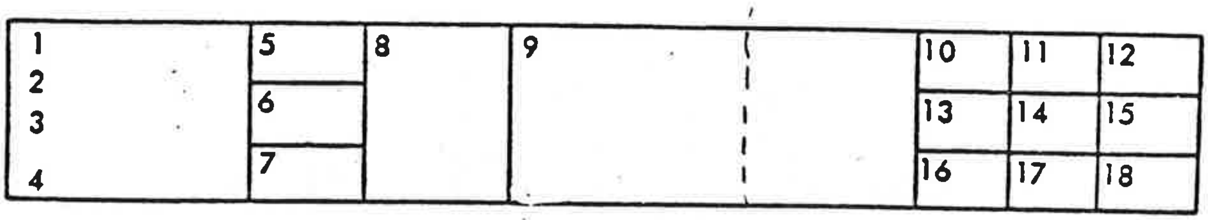


FIGURE 3.11. SAMPLE IAH VFR DEPARTURE FLIGHT STRIPS



TYPE OUT INFORMATION

1. Aircraft identification
2. Revision number
3. Number of aircraft (if more than one), type aircraft, suffix if any special equipment
4. Computer identification number
5. Beacon code
6. Coordination fix
7. Facility to which FD forwarded
8. Estimated time at coordination fix
9. Altitude and route of flight through terminal area

HANDWRITTEN INFORMATION

1. A large V below estimated time with arrow through it indicating route of flight

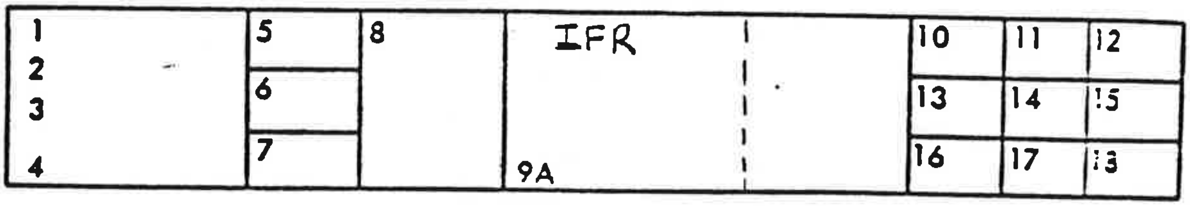
2. Any changes such as changed altitude, beacon code or route of flight

SAMPLES

```
SPRY74   1032   E1917  80
1
C130/A   DAS           EGI./.V306 JCT./.BI
534      XXX
```

```
N5483J   2475   E1[illegible]29  60
C310/A   BPT           BPT DAS LOA./.DAL
009      ZCH
```

FIGURE 3.12. IAH OVERFLIGHT FLIGHT STRIPS



TYPE OUT INFORMATION

1. Aircraft identification
2. Revision number
3. Number of aircraft (if more than one), type aircraft suffix if any special equipment
4. Computer identification number
5. Beacon code
6. Previous fix
7. Coordination fix
8. Estimated arrival time

9A Destination airport

NO HANDWRITTEN INFORMATION

SAMPLES

DL383	3172 AØ521	IFR
B727/A	AEX	
442	DAS	IAH
N3517S	45Ø1 AØ528	IFR
PA31/F	LCH 18Ø/Ø29	
939	SBI	GLS
GBACI	2653 AØ519	IFR
1 HS25/F	ELA	
391	GLAND	HOU

FIGURE 3.13. IAH/SATELLITE ARRIVAL FLIGHT STIPS FORMAT

TYPE FLIGHT	4 SECONDS*		2 SECONDS*	
IAH DEPARTURE	T1928 060 *18	T1928 is aircraft ID 060 is altitude 18 is speed	T1928 33C DC9	T1928 is aircraft ID 33 is final requested altitude C is departure gate DC9 is aircraft
SATELLITE ARRIVAL	T1928 060 *18	Same as above	T1928 HOU DC9	T1928 is aircraft ID HOU is satellite airport DCA is aircraft
IAH ARRIVAL	T1928 060 *18	Same as above	T1928 060 DC9	T1928 is aircraft ID 060 is altitude DC9 is aircraft type

*Time Shared

OTHER FUNCTIONS:

Tower En Route:	T1928 060 *18E	E indicates Enroute (in 4 second display)
VFR	N123 060 *12V	V indicates VFR in TCA (in 4 second display)
Traffic Count	N123 HOU C182Δ	Δ indicates aircraft has been tallied in operation count (in 2 second display)
Heavy	T1928 060 *12H	H indicates aircraft is greater than 3000,000 lbs (in second display)

FIGURE 3.14. ARTS DATA BLOCK

G	CLV100	4647	p
D	DART41	4340	g
M	MTR104	0213	
S	MTR204	0225	
L	MTR302	0204	
N	MTR314	0214	
O	MTR216	8216	
J	N1910M	4223	p
A	N3158M	4761	T
R	NSS26E	4740	
Q	NE1009	45	
I	NASH9SS	4025	B
H	NASA962	2546	P
B	PHM09N	4675	G
C	SWA42	4716	G
F	VG04	4304	G

FROM LEFT TO RIGHT:

Column 1 Indicates alphabetically, sequence on which aircraft will appear in airspace

Column 2 Is aircraft ident.

Column 3 Is beacon code

Column 4 Represents departure gate - this column is blank for arrivals

FIGURE 3.15. ARTS PVD TAB LIST

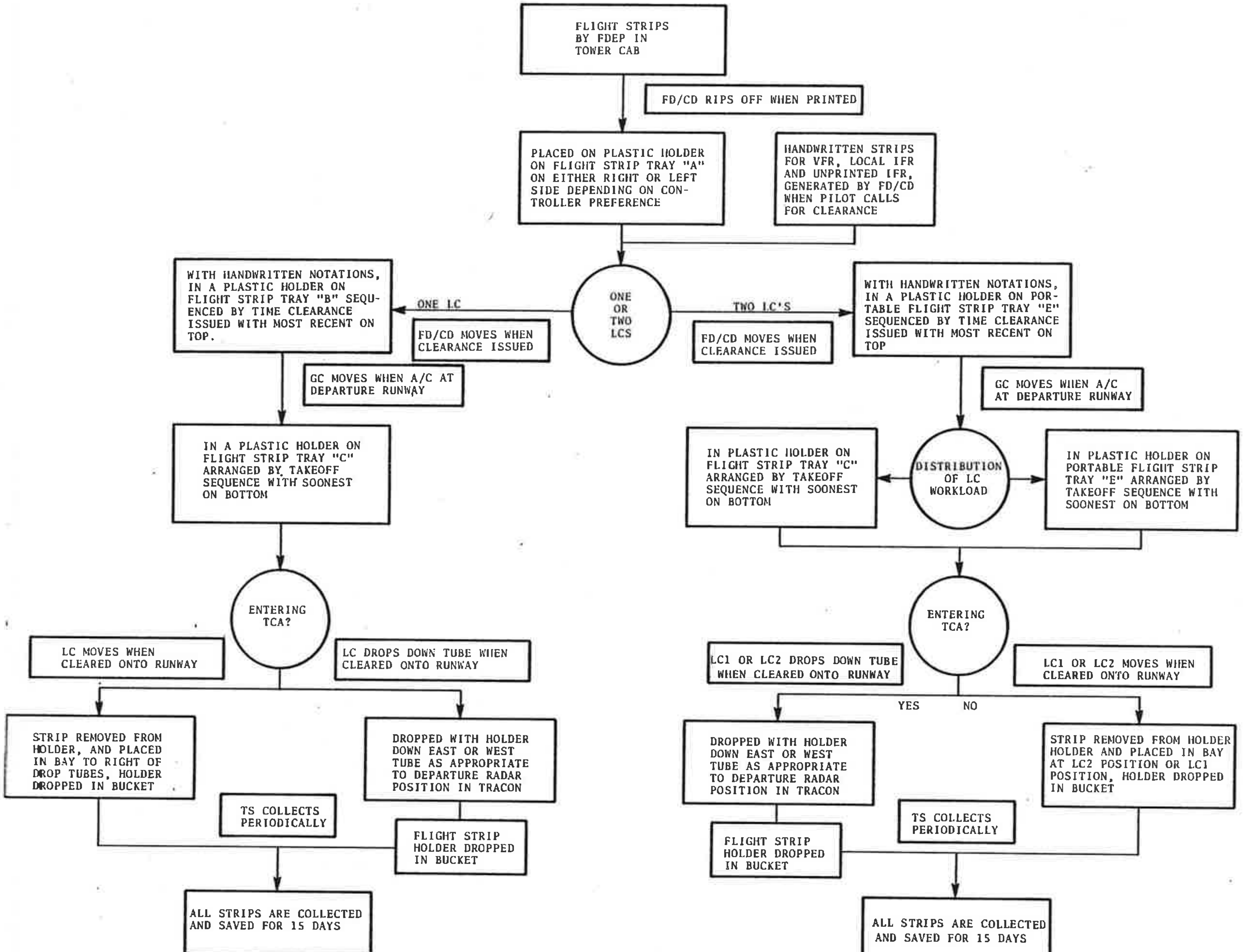


FIGURE 3.16. FLIGHT STRIP MOVEMENT OF IAH DEPARTURES

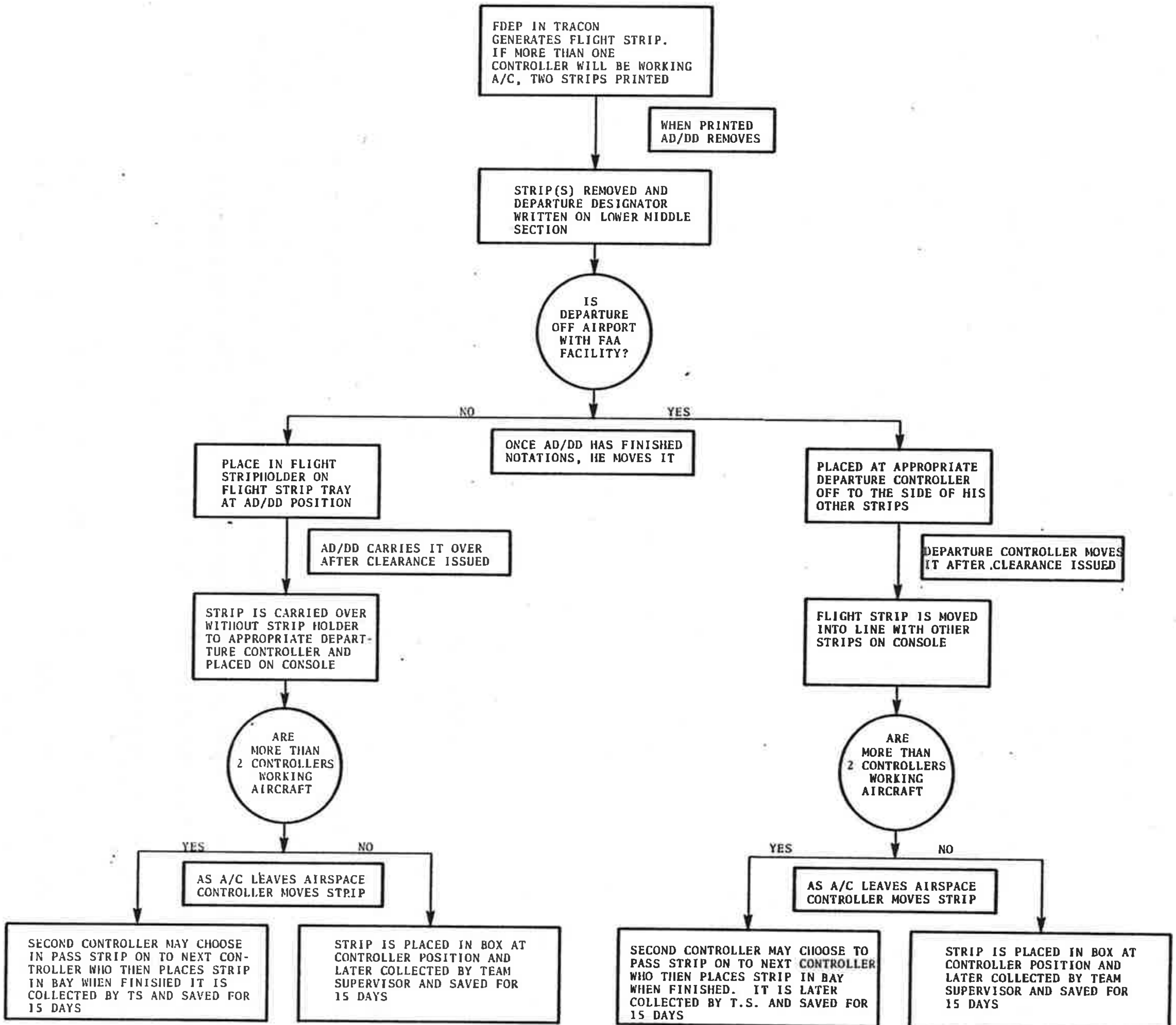


FIGURE 3.17. FLIGHT STRIP MOVEMENT OF SATELLITE DEPARTURES THROUGH TRACON

TRACON. The keyboard is used to communicate with the computer stored flight data base in terms of inputting, requesting and modifying flight data. Mounted notepads are at Local and Ground Control positions (Figure 3.3). Loose paper notepads, used for hand marking pertinent operational information, are used at all other positions (Figure 3.4). Mounted flight strip trays are at Arrival Data/Departure Data, Flight Data/Clearance Delivery, and Local Control positions ((Figure 3.5 - 3.7). When the Cab is operating with 2 Local Controllers, portable flight strip trays are placed on the reference desk and at Local Control 2 position. Flight drop tubes used to transport departure strips from the Tower Cab to the TRACON are located at the Local Control position in the Cab and at the radar departure positions in the TRACON (Figures 3.8-3.9).

3.2 FLIGHT DATA USAGE

Flight data is acquired and maintained by means of printed flight strips, handwritten flight strips, notepads and ARTS PVD displays. The ARTS display provides a data block for each aircraft (Figure 3.14), an arrival and departure tab list for aircraft in a 15-minute radius to TRACON controllers (Figure 3.15) and an arrival list of aircraft by runway for use by Tower Cab controllers. Controllers use the voice radio link with the pilots to supplement, modify and confirm flight data as necessary. The process of transferring the flight data depends upon the type of operation (e.g., departure vs arrival) and the facility staffing (e.g., one or two Local Controllers). Figures 3.16 and 3.17 trace the movement of flight strips through IAH. The following is a description of the maintenance and flow of flight data.

a. IAH IFR Departures

Approximately 30 minutes before planned departure time a flight strip is printed on the FDEP in the Cab. FD/CD rips the flight strip along the perforated edge, throws away the right side and places the remaining half of the strip into a plastic strip holder, then places it on the mounted tray to the left of the FDEP. The plastic holders are stored in a box to the right of FD/CD (Figure 3-18). A few are kept in a bay at the console for easy access (Figure 3-19). The mounted flight strip tray at FD/CD position is split into two sections, and how these two sections are used is totally up to the controller. Some controllers use the two sections to differentiate general aviation flight strips from air carrier flight strips. Other controllers separate IFR flight strips from VFR flight strips. When the pilot calls for clearance FD/CD notes on the flight strip with a black felt pen any flight plan changes such as changed beacon code assignment, changed proposed departure time, or changes in filed routing. FD/CD then marks below the departure airport, one of the designators listed in Table 3-1. If a pilot calls for clearance and no flight strips has been printed, FD/CD handwrites a flight strip. Blank strips are kept in a bay at his position. An IFR departure strip must be handwritten for local flights which do not require IFR flight plans yet fly within the TCA; and for IFR filed flight plans whose flight strips have not been printed when the pilot calls for clearance due to a backup or breakdown of the FDEP printer. Military flight identity and departure times are forwarded to FSS by FD/CD via interphone.

Tower Cab Staffed With One Local Controller	Tower Cab Staffed With Two Local Controllers
After clearance has been issued, FD/CD places the strips in the right section of the mounted tray at GC to transfer to GC frequency.	After clearance has been issued issued, FD/CD places the portable tray on the reference desk, and instructs the pilot to contact GC.
Once the aircraft is taxiing, GC places the strip in departure sequence with other strips in the left of the tray, and instructs the pilot to change to LC frequency.	Once the aircraft is rolling GC places the strip in departure sequence in flight stiip tray at either LC1 or LC2 positions, depending on type of flight and how work is being divided up between the two Local Controllers. He then advises the pilot to contact LC.

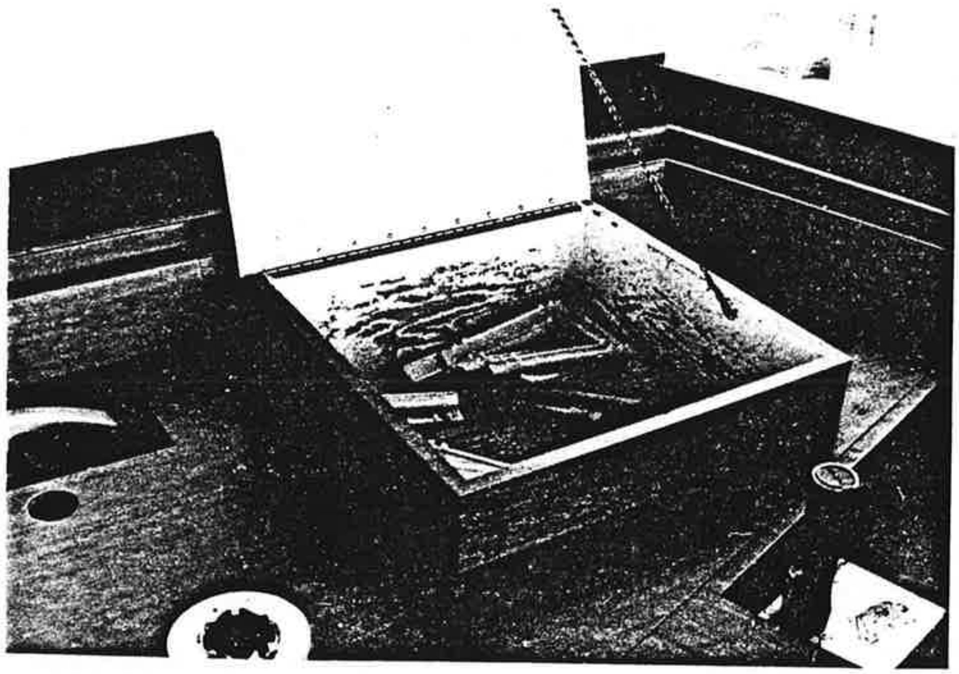


FIGURE 3.18. FLIGHT STRIP HOLDER STORAGE AT FD/CD

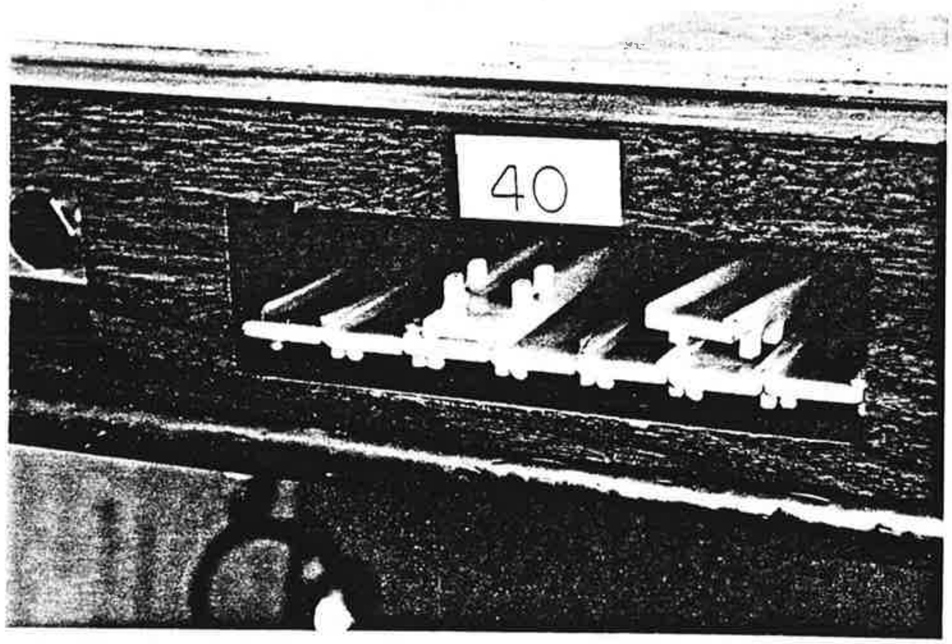


FIGURE 3.19. FLIGHT STRIP HOLDERS IN BAY AT FD/CD

Local Control drops the strip down either the east or west tube as appropriate when the aircraft is rolling and instructs the pilot to contact the TRACON.	LC1 and LC 2 drop the strip down either the east or west tube as appropriate when the aircraft is rolling and instructs the pilot to contact the TRACON.

In the TRACON either Departure East or Departure West receives the strip. The holder is removed and dropped into a nearby bucket (Figure 3-20). These collected holders are periodically taken back to the Tower Cab for reuse. Loose strips are layed out on the controller's console (Figure 3-21). Sequencing of strips is at controller discretion. After the aircraft has been handed off, strips are placed in the bay above the drop tube. The supervisor periodically collects all strips.

b. IAH VFR Departures

When the pilot calls for clearance, FD/CD handwrites a flight strip (as shown in Figure 3-11). This strip is moved through the Tower Cab in the same manner as an IFR departure (discussed above).

If the aircraft will be staying low and not entering the TCA the Local Controller will place the strip in a bay located to the right of the drop tubes (Figure 3-22), otherwise the strip will be dropped down the tubes and employed in the TRACON as for IFR departures.

c. IAH IFR Arrivals

Flight strips are printed on the TRACON FDEP but these strips are not used by the controllers (they are sorted at the AD/DD position and available for backup to ARTS failure). The radar positions generally rely on their BRITE displays as the source of flight data. Fifteen minutes before entering the controller's airspace the aircraft ident and transponder code will appear on the BRITE display in a Tab list (Figure 3.15). The target and accompanying data block provides the arrival controllers with all the flight data pertinent to that aircraft (Figure 3.14). Pads of paper kept at controller positions are used for writing notes and reminders on flight data.

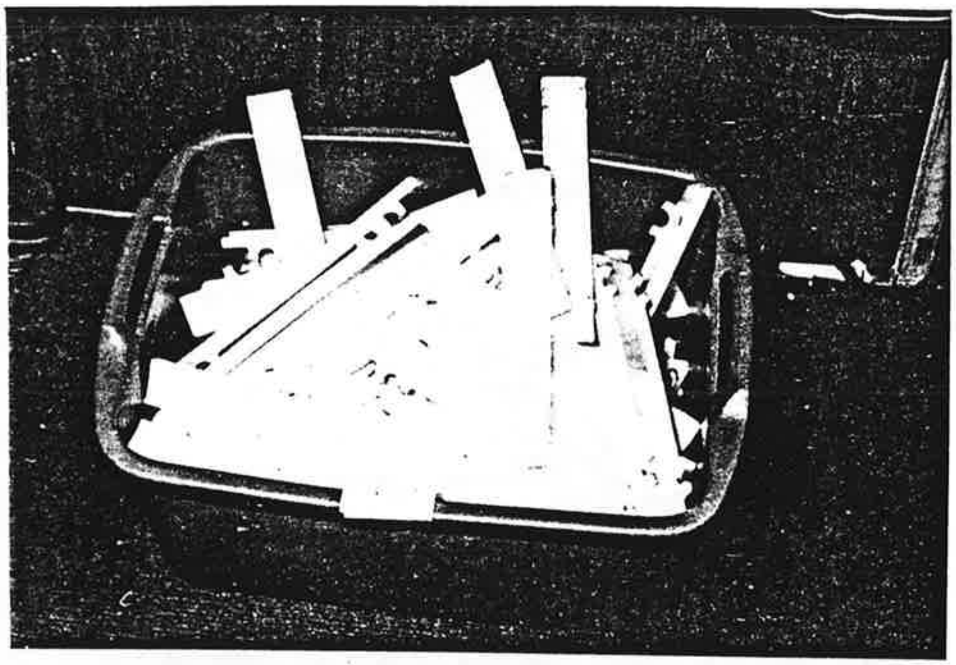


FIGURE 3.20. IAH TRACON FLIGHT STRIP HOLDERS

FIGURE 3.21. FLIGHT STRIPS AT DEPARTURE EAST POSITION

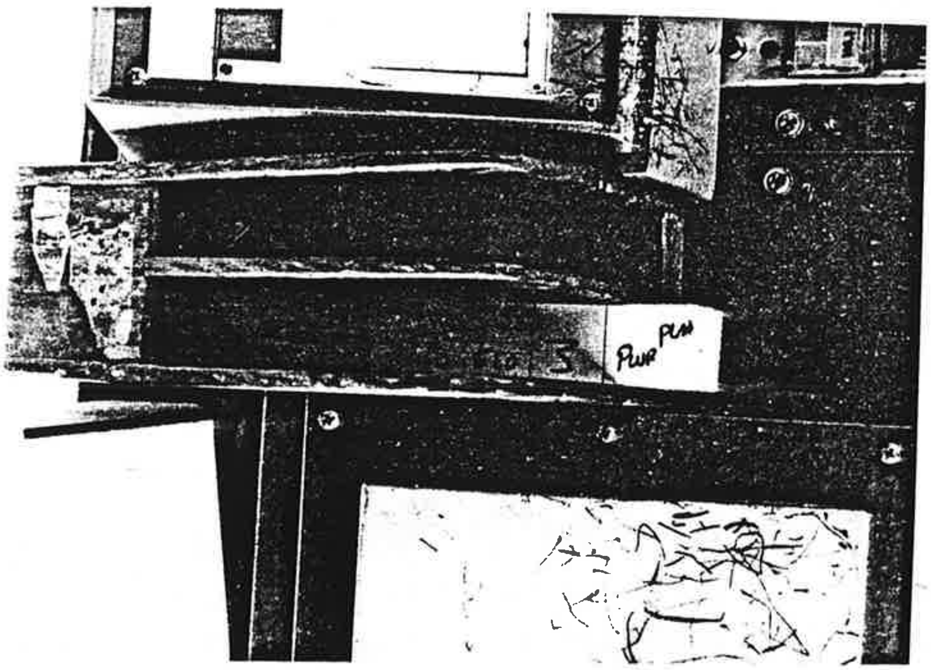


FIGURE 3.22. FLIGHT STRIPS IN BIN AT LOCAL CONTROL POSITION THAT ARE NOT DROPPED TO TRACON

In the Tower Cab both the Local and Ground Controllers watch the BRITE displays then use mounted notepads to keep track of the aircraft idents which they will be handling. When the Tower Cab is staffed with two Local Controllers, responsibility for arriving aircraft may be split up as discussed in Section 2.3. Pilots contact the appropriate LC. The ident is crossed off the list when the controller's responsibility for that aircraft has ended. In addition, Local and Ground controls may use the P1 and P2 list which prints aircraft idents on the BRITE after the ARTS tag has been dropped. No IAH arrival flight strips are received in the Cab. FD/CD forwards military identity and arrival time to FSS via interphone.

d. IAH VFR Arrivals

No flight strip is generated in the TRACON for these aircraft. A/C ident, transponder code, destination and aircraft type are entered in the computer when the pilots contact the TRACON for TCA entrance. The radar controller also manually enters on the keyboard an addition to the traffic count. This entry may be made by the coordinator position if staffed, depending upon workload and personal preference. In the Tower Cab VFR arrivals are handled in the same manner as IFR arrivals discussed above.

e. IFR Satellite Departures and Arrivals

Departure strips are printed by the TRACON FDEP approximately 30 minutes before departure time (Figure 3-23). If more than one controller will be working the aircraft two strips will be printed. Duplicate strips are indicated by a handwritten "X". The AD/DD removes the strip(s), throws away the right side of the strip and places it on the flight strip tray to the left of the FDEPS. When the pilot calls for clearance AD/DD notes and marks any flight plan changes such as changed beacon code assignment, changed proposed departure time or changes in filed routing. AD/DD then marks below the departure airport one of the designators listed in Table 3-1. When clearance has been delivered AD/DD delivers the strip(s) to the appropriate controller(s). If more than two

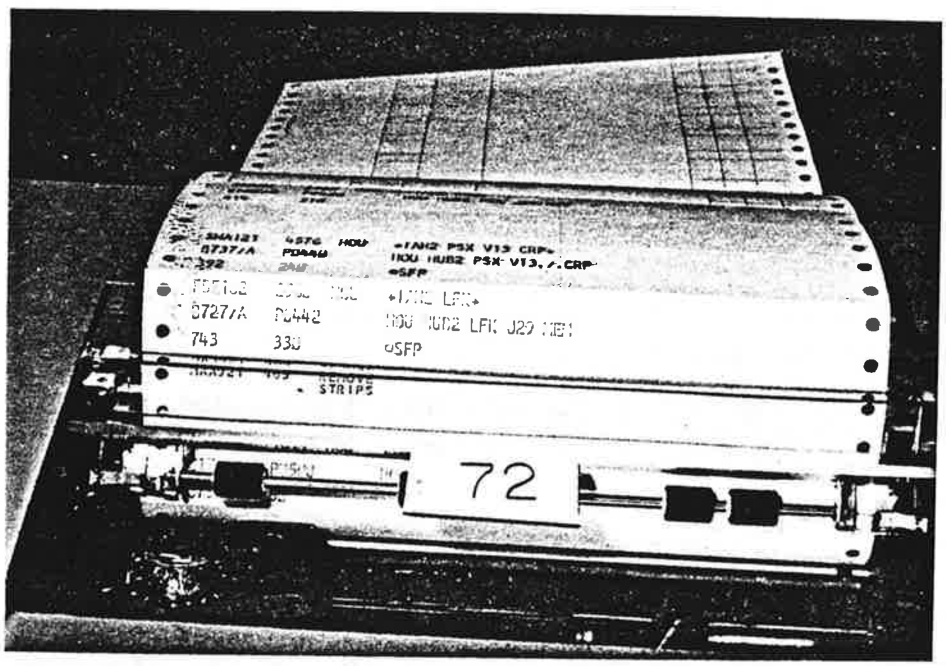


FIGURE 3.23. FLIGHT STRIPS ON FDEP AT AD/DD POSITIONS

controllers will be working the aircraft, the second controller may pass his strip to the third controller. Some controllers prefer to eliminate this action. All flight data information on the aircraft is available to the controller in the ARTS data block (Figure 3.14). Controllers place the strips in the bay at their positions. The Supervisor periodically collects the flight strips.

Strips for arrivals into satellite airports are printed on the FDEP which prints IAH arrival strips at the AD/DD position. The satellite arrival strips are kept at the AD/DD position with the IAH arrival strips to be used in case of an ARTS failure. The ARTS data block provides the controller with flight data information for the aircraft while it is in his airspace.

f. IAH Overflights

A flight strip is printed out on the TRACON FDEP. The AD/DD removes the strip, throws away the right side of the strip, and writes the letter "V" in the lower middle section. An arrow is drawn through the "V" to show the route of flight through the airspace. AD/DD then delivers the strip to the appropriate controller. After the aircraft has left the controller's airspace the strip is placed in the bay until it is collected by the Supervisor.

An IAH overflight entering Tower Cab jurisdiction is worked by LC in the same manner as an arrival. The aircraft ident is noted on his scratch pad and crossed off as the aircraft leaves his airspace.

VFR overflights require a manual ARTS keyboard entry by a TRACON controller of transponder code, aircraft ident, aircraft type, destination and traffic count. If staffed, this entry may be made by the coordinator position depending upon workload and personal preference.

g. Helicopters

Helicopters departing IAH call the FD/CD position in the Tower Cab for TCA clearance. FD/CD handwrites a strip. The helicopter is not controlled by GC. The helicopter proceeds to a helicopter pad for takeoff. FD/CD brings the strip to LC who works the aircraft. Helicopters proceed along predefined routes. LC has a map of the helicopter routes at his position which he occasionally refers to. LC terminates radar service once the helicopter is clear of the TCA and places the strip in the bay or drops the strip down the tube to the TRACON if the helicopter is going to remain in the TCA at a higher altitude. Arriving helicopters are also worked exclusively by LC in the Tower Cab. LC writes the ident down on his notepad as with all arriving aircraft, scratching it off after landing. As with all other VFR arrivals and overflights, A/C ident, transponder code, destination, aircraft type, and traffic count are manually entered into ARTS keyboard by a TRACON controller. If staffed, the coordinator may make this entry depending upon workload and personal preference.

h. Pipeline

The pipeline aircraft fly along pipelines to inspect them for leaks. These may be IFR or VFR and are generally overflights worked exclusively by local control. Local Control keeps track of the aircraft on his notepad and uses a book of pipeline routes located at his position for general reference.

i. Gate Hold Procedures

Gate hold is initiated by the Tower Cab Supervisor when departure delays are anticipated to be in excess of 5 minutes at the runway. FD/CD includes notification that gate-hold is in effect in the ATIS broadcast. FD/CD must determine and advise pilot of expected start time. The expected engine start time is written on the flight progress strip. When the engine may be started FD/CD will issue clearance. FD/CD must keep track of the proposed start time, expected start time, actual start time, and total delay for each aircraft. This delay sequence is maintained and recorded on IAH form 7110.11. Once clearance has been issued, the operation is handled as described in the appropriate section above.

3.3 IAH FLIGHT STRIPS

The flight strips generated by the FDEPs at IAH represent prefiled IFR flight plans. The pilot provides the flight data to the 9020 NAS Stage A computer system at the Enroute Center prior to flight. The flight strip formats are described in Figure 3-10 to 3-13. The typewritten information is standard for all facilities. Relative to other facilities little handwritten information is added to the printed strips at IAH.

No handwritten markings are made on IAH or satellite arrival strips. The days arrival strips are not separated or distributed, but are maintained as one long strip, the half to the right of the perforated edge is thrown away and the remaining half is retained. No handwritten arrival strips are generated.

Changes in printed departure strips such as changed beacon code, changed altitude or changes in filed routing are noted with black felt pen. The strip is torn along the perforated edge and the right side is thrown away. Critical information from the right side is handwritten on the remaining half. The appropriate departure gate designator (Table 3-1) is written in the center near the bottom for all IAH and satellite departures. Most of the filed routing which was ripped off is not needed once the departure designator has been written on the strip. Departures strips which are manually prepared comply with the National Air Traffic Handbook. Format and samples are shown in Figure 3.11. Strips are manually prepared for all departing VFR traffic and for departing IFR traffic calling for clearance for which no flight strip has been printed (discussed above). Approximately 8 percent of the flight strips are handwritten.

Handwritten notations on overflight strips are made in the same context as departure strips.

All flight strips are kept for 15 days for record keeping purposes.

A sample day's flight strips (11/22/80) are analyzed in Tables 3-2 through 3-5. It is important to note that no strips

TABLE 3-5. ANALYSIS OF IAH FLIGHT STRIPS FROM 11/22/80

IAH DEPARTURES, SECONDARY DEPARTURES, AND OVERFLIGHTS BY ROUTE DESIGNATOR

M	178
C	107
T	68
E	42
L	22
B	10
J	58
N	12
P	83
F	70
OC	4
S	13
G	4
V	28
III	45
	744

are generated which represent VFR arrivals or VFR overflights, so that totals do not reflect total traffic levels.

Table 3-6 presents a summary of controllers information requirements for flight data.

TABLE 3.6. SUMMARY INFORMATION REQUIREMENTS ANALYSIS FOR FLIGHT DATA AT IAH

TYPE FLIGHT	SOURCES OF DATA	MACHINE PRINTED DATA	MANUAL NOTATIONS	USE
IAH IFR DEPARTURE	o machine printed strip o ARTS data block o tablist o voice radio link w/pilot	o aircraft ID o revision number o # aircraft, type a/c & suffix for special equip. o computer ID o beacon code o departure time o altitude o departure airport	o departure designator o changes in filed plan such as changed beacon code, altitude or routing	o Flight strips are printed on tower FDEP 30 minutes before departure time, they are manually amended by FD/CD and passed in a plastic holder from FD/CD to GC to LC & down drop tube to Departure Radar. Strips are collected by supervisor and saved for 15 days. Dropping of strip to TRACON serves as boundary report. Once departure designator has been added filed routing info is not needed. All other information is used. ARTS data block is used by all radar positions in TRACON working aircraft o Tablist is 15 minute advance notice of a/c entering airspace-used by all Radar positions in TRACON working a/c o Voice radio link w/pilot is used by FD/CD, GC, LC and TRACON to confirm, modify, identify and issue instructions. Because there is no handoff from tower to TRACON pilot must contact TRACON to notify that he is entering controller airspace
IAH VFR DEPARTURE	o handwritten flight strip o ARTS data block o tablist o voice radio link w/pilot	NONE	o aircraft ID o type a/c and suffix for special equip. o beacon code o planned dep. time o altitude o departure airport o departure designator o routing	o Handwritten strips are generated by FD/CD when pilot makes contact. They are passed in a flight stripholder from FD/CD to GC to LC. They are dropped down the tube to Departure Radar if they will be entering the TCA. Otherwise they are stored in a bin by LC. Dropping of the strip to TRACON serves as boundary report o ARTS data block, tablist, and voice radio link w/pilot is used in the same manner as for IFR departure o FD/CD must enter info for data block and tablist into ARTS system
IAH IFR ARRIVAL	o machine printed strip o ARTS data block o tablist o P1-P2 list o voice radio link w/pilot	o aircraft ID o revision # o # a/c, type a/c, suffix indicating special equip. o computer ID o beacon code o previous fix o coordination fix o time of arrival o destination airport	NONE	o IFR arrival strips are printed in TRACON but are not distributed. They are stored at the FDEP in case of an ARTS failure. o ARTS data block and tablist is used by all Radar positions in TRACON working a/c o LC and GC use ARTS data block to note call sign of incoming aircraft on notepad at their position o LC and GC may also use P1-P2 list which indicates aircraft by assigned runway once ARTS target is dropped o TRACON radar positions, LC and GC use voice radio link to confirm, modify, identify and issue instructions because there is no handoff from TRACON to tower, pilot must contact LC to notify of entering airspace

TABLE 3.6. SUMMARY INFORMATION REQUIREMENTS ANALYSIS FOR FLIGHT DATA AT IAH (Cont.)

TYPE FLIGHT	SOURCES OF DATA	MACHINE PRINTED DATA	MANUAL NOTATIONS	USE
IAH VFR ARRIVAL	o ARTS data block o P1-P2 list o voice radio link w/pilot	NONE	NONE	o Voice radio link and ARTS data block are used by TRACON controllers to identify, confirm, modify and advise o LC and GC use data block to note call sign of incoming aircraft on notepad at their position o LC and GC may use P1-P2 list which indicates aircraft by assigned runway once ARTS target is dropped
SATELLITE IFR DEPARTURE	o machine printed strip o ARTS data block o voice radio link w/pilot	same as IAH IFR departure	o departure designator o changes in filed plan such as changed beacon code, altitude or routing o "X" indicating duplicate strip	o Strip is printed on FDEP in TRACON 30 minutes before departure. Pilot calls AD/DD for clearance. AD/DD calls appropriate radar position for release. AD/DD brings strip to first controller working aircraft. If applicable, duplicate strip is brought to 2nd controller working a/c. If more controllers working aircraft strip may be passed on on o Voice radio link is used to identify, confirm, advise and modify o ARTs data block is used by all radar positions working aircraft
SATELLITE IFR ARRIVAL	o machine printed strip o ARTS data block o voice radio link w/pilot	same as IAH IFR arrival	NONE	o Strip is printed in TRACON but not distributed. They are stored at the FEDP in case of ARTS failure o TRACON radar positions rely on data block and voice link radio for all data
OVERFLIGHT	o machine printed strip o ARTS data block o voice radio link w/pilot	o aircraft ID o revision # o # a/c, type a/c, suffix for special equip. o computer ID o beacon code o coordination fix o facility FD forwarded to	o a large "V" with arrow through it indicating direction of flight o and changes such as changed routing or altitude	o Strip is printed in TRACON. AD/DD manually amends and passes it to TRACON controller working aircraft o ARTS data block and voice link radio are used to supplement information

4. INTERCONTINENTAL WEATHER

4.1 IAH WEATHER TRANSMITTING EQUIPMENT

The Houston Intercontinental Tower Cab and TRACON receive weather information from the Center Weather Service Unit (CWSU) at the Air Route Traffic Control Center (ARTCC) in Houston; the Houston Flight Service Station (FSS); pilots aloft; its satellite airports, and its own on site weather sensors. The information is transmitted to IAH facility by FDEP, teleprinter, electro-writer, interphone and air/ground radio. There is one teleprinter in the Cab and one in the TRACON; and one electrowriter in the TRACON. The communication system is displayed in Figure 4-1.

Information is distributed to the individual controllers via closed circuit TV, console equipment, pieces of paper which are either posted or passed around, and word of mouth. The location of the weather equipment is shown in Figures 4-2 and 4-3.

The closed circuit TV is used to present most of the relevant weather information to the controllers in the TRACON. The FD/CD position assimilates the data received (which will be discussed in the remainder of this section) for Intercontinental and its satellite airports: Hobby, Galveston and David Wayne Hooks, and posts on a white board, using the format depicted in Figure 4-4, the following information:

a. ATIS Code - (IAH and HOU only; DWH runway in use).

b. Weather sequence time (GMT).

c. Sky condition using following symbols):

*0 (Clear) ⦶ (Scattered) ⦷ (Broken) ⊕ (Overcast)

-X (Partially Obscured) X (Obscured) W (Indefinite)

d. Visibility (include restrictions).

e. Temperature (IAH only).

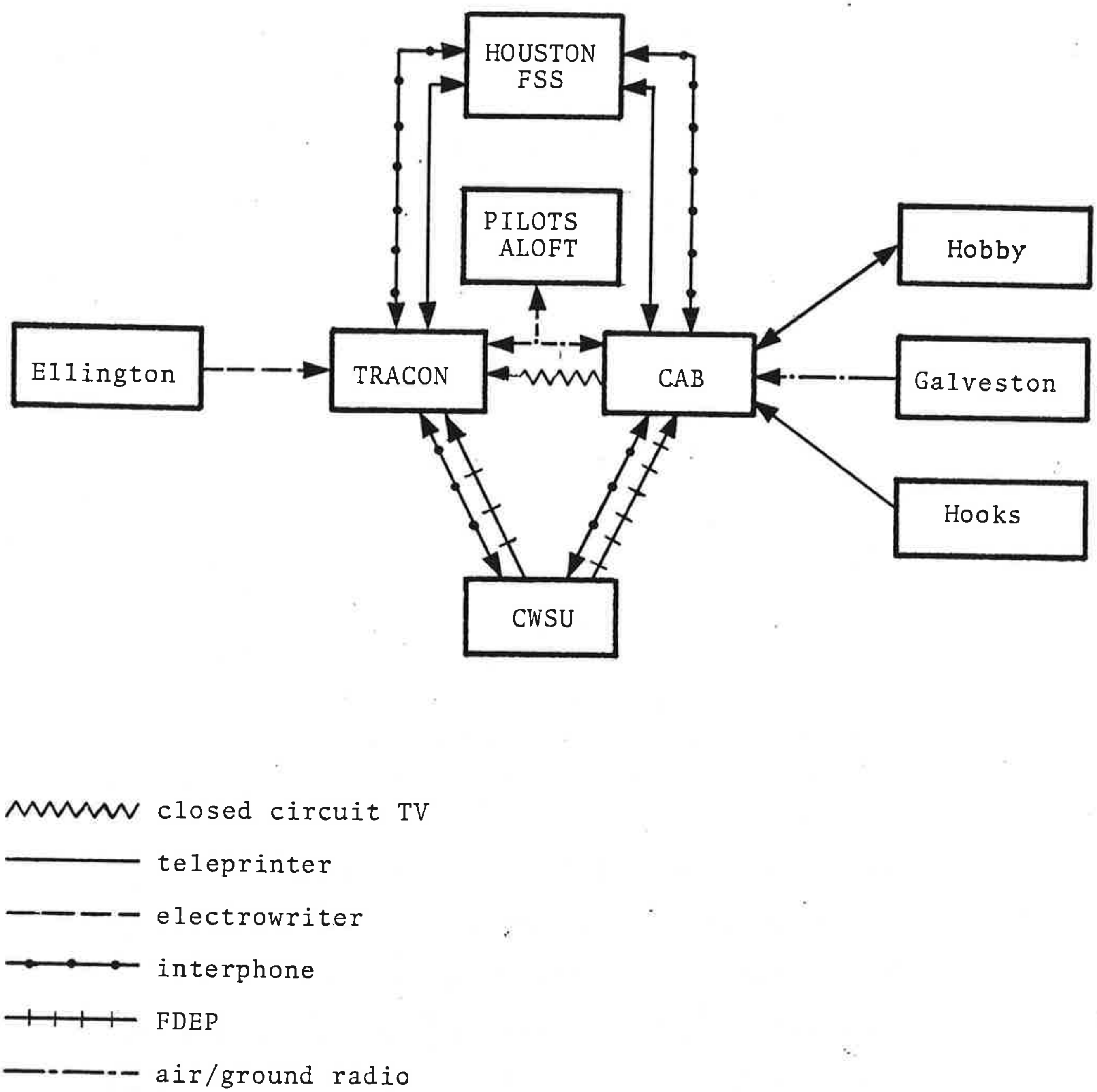


FIGURE 4-1. IAH WEATHER COMMUNICATIONS SYSTEM

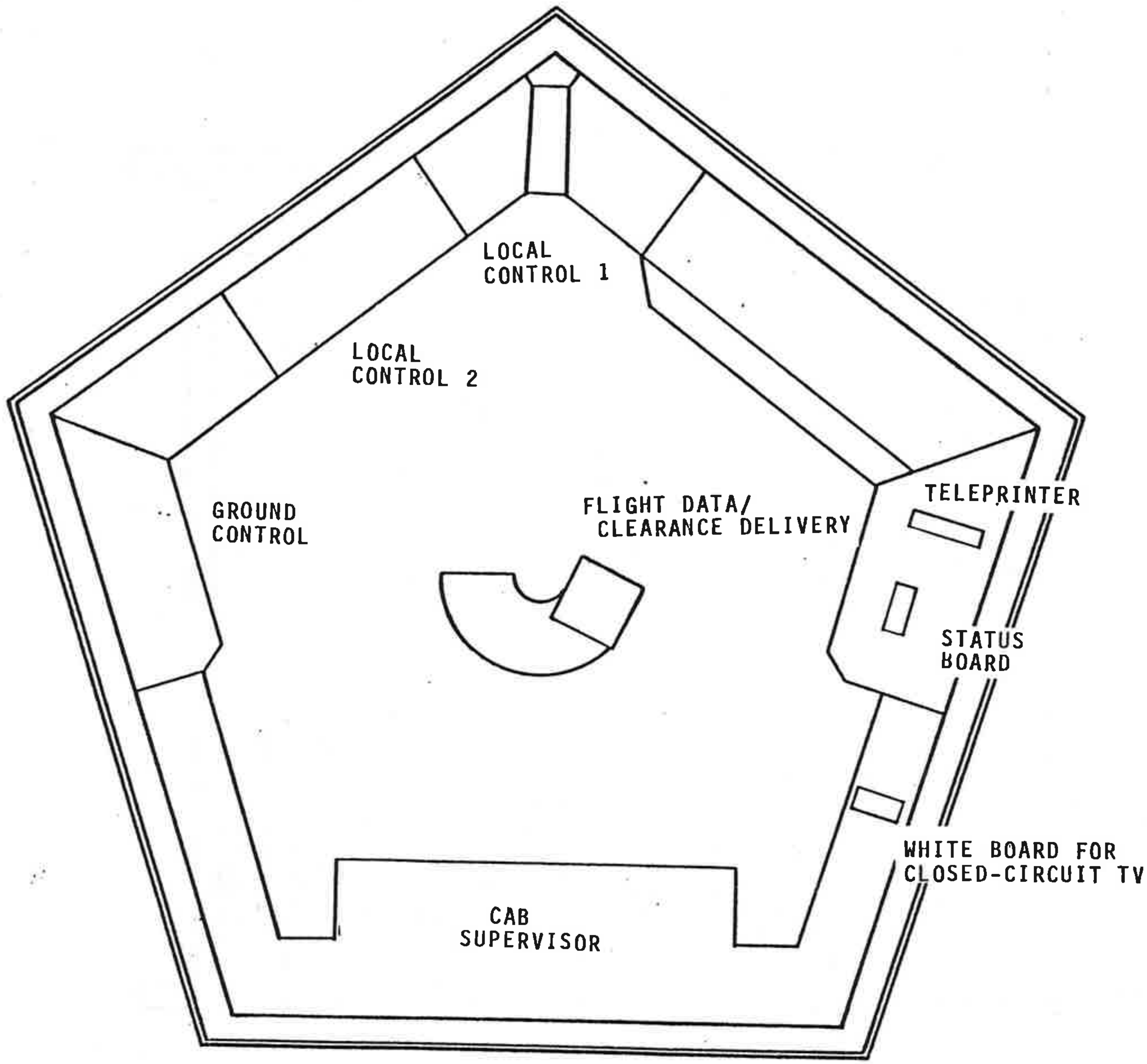


FIGURE 4-2. WEATHER EQUIPMENT LAYOUT IN TOWER CAB

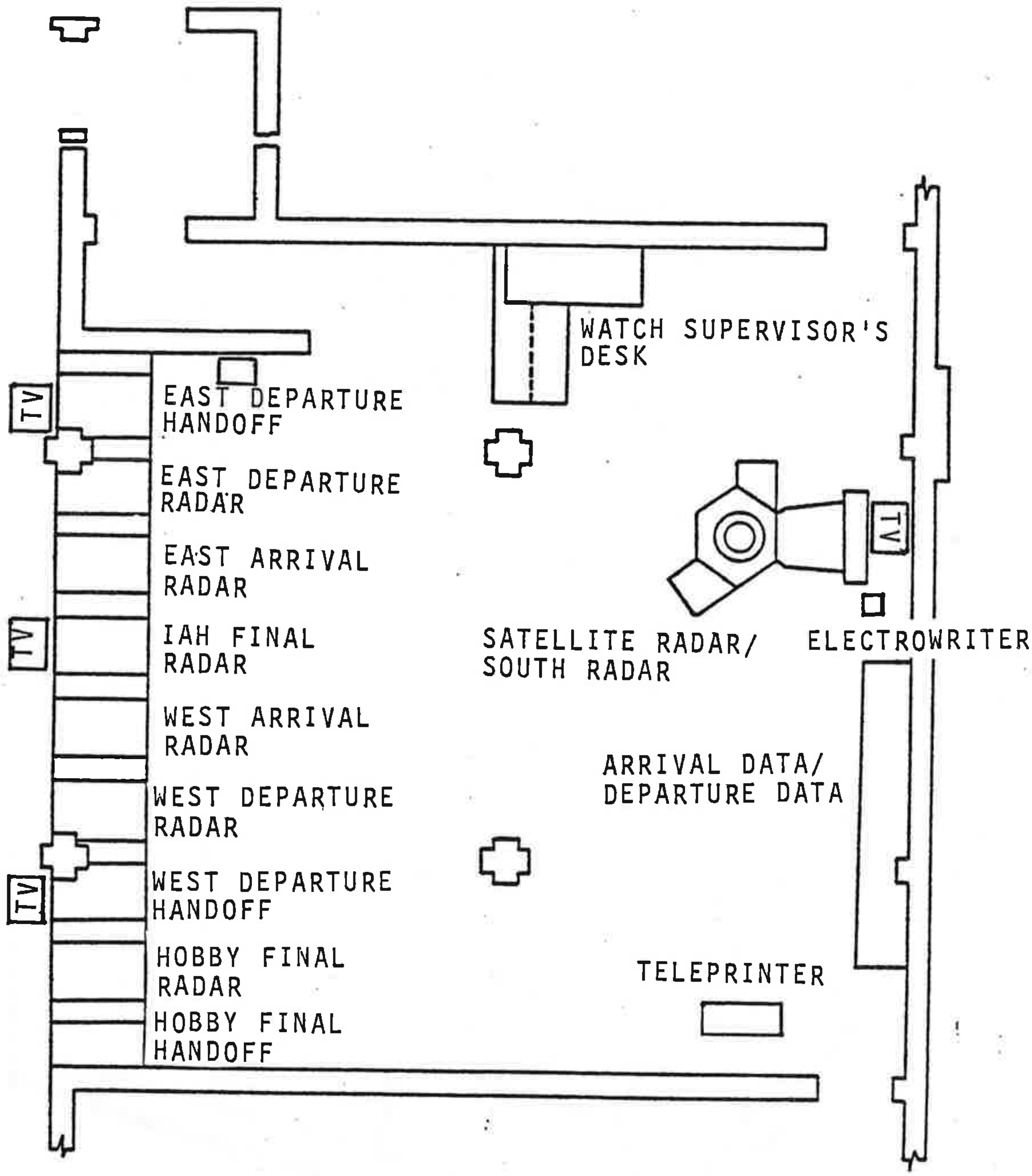


FIGURE 4.3. WEATHER EQUIPMENT LAYOUT IN TRACON

IAH	L	0 3k	78°990
HOU	V	0 4k	1204 009
DWH	17R 18z	0 7	1409 009
GLS	18z	0 8	1211 009

FIGURE 4-4. CLOSED-CIRCUIT WEATHER DISPLAY FORMAT

f. Wind (use 4 digits, ex. 3010) (excluding IAH).

g. Altimeter (use 3 digits, ex. 010).

The image of the white board (Figure 4-5 and 4-6) is transferred by camera to the five TV screens located in the TRACON. FD/CD updates the whiteboard at least once per hour, and more frequently as changing reports necessitate.

Console instruments provide the controllers with IAH wind direction and speed, IAH altimeter setting, IAH Low Level Wind Shear Alert (LLWSAS) and Runway Visual Range (RVR) for IAH or HOU runways as appropriate. These instruments are described in section 5.4: Critical Cab and TRACON Display Items.

The Cab Supervisor determines Tower visibility with a map and a visibility checkpoint list (Figures 4-7 and 4-8). The checkpoint list contains surrounding reference points and their distance from the Tower. The visibility distance is relayed to the FSS and used in determining IFR/VFR conditions.

4.2 CATEGORIES OF WEATHER INFORMATION

The CWSU provides the TRACON via interphone with Center Weather Advisories (CWA) which provide a general overview of weather in the Center area for the day. The frequency with which they are received appears to depend on the workload of the Center personnel. When received, they can be extremely useful to the Supervisor for planning, staffing and scheduling of navigation and runway closures. The information is posted on a clipboard in the outer room (Figure 4-9) for controllers to check as they come on duty. It is also passed on to the on duty controllers for general interest by work of mouth. The CWSU also provides the Tower Cab and TRACON with significant meteorological information SIGMETS); weather hazardous to all aircraft, usually thunderstorms. All SIGMETS for the Center are initially printed simultaneously on the FDEPs at the FSS, in the Tower and the TRACON (entered by CWSU). The FSS then determines whether it is significant to the facility and transmits it either via the teleprinters in the Tower and the TRACON or by interphone to the

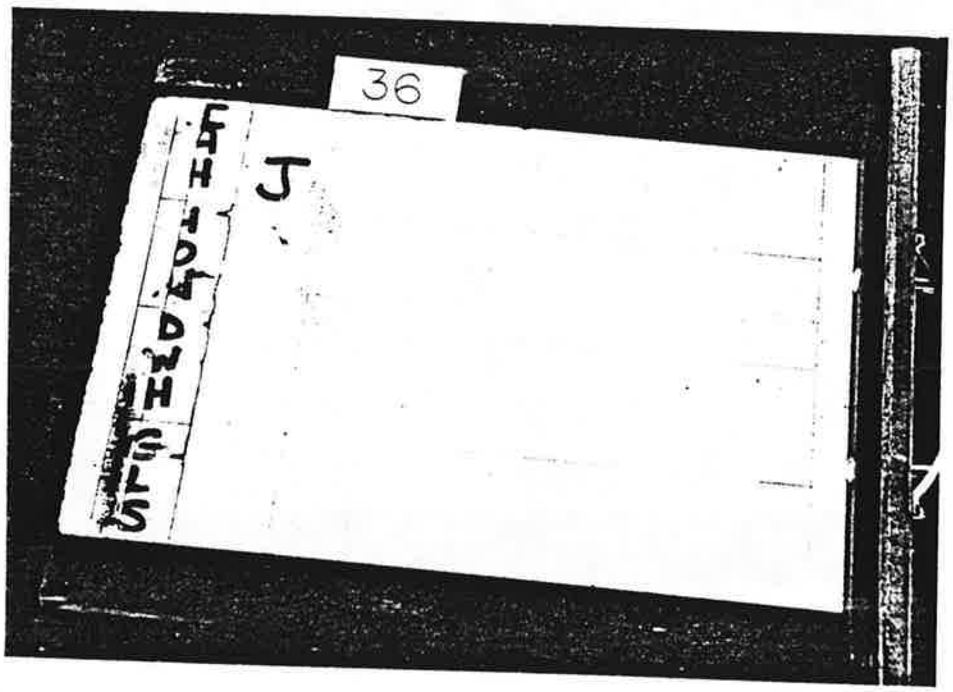


FIGURE 4-5. WEATHER BOARD USED FOR TV

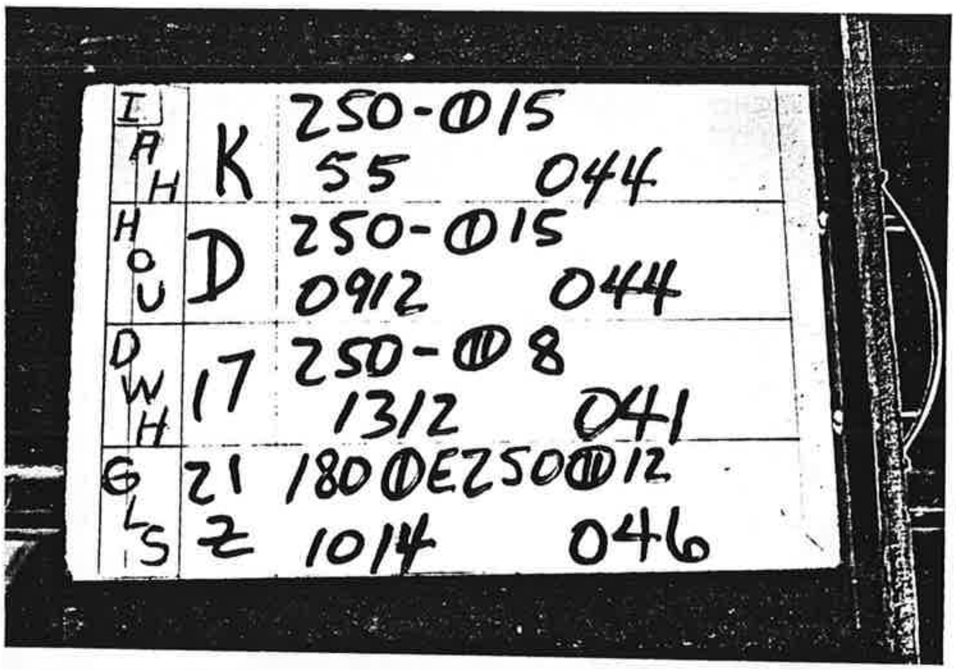


FIGURE 4-6. WEATHER MESSAGES ON TV BOARD

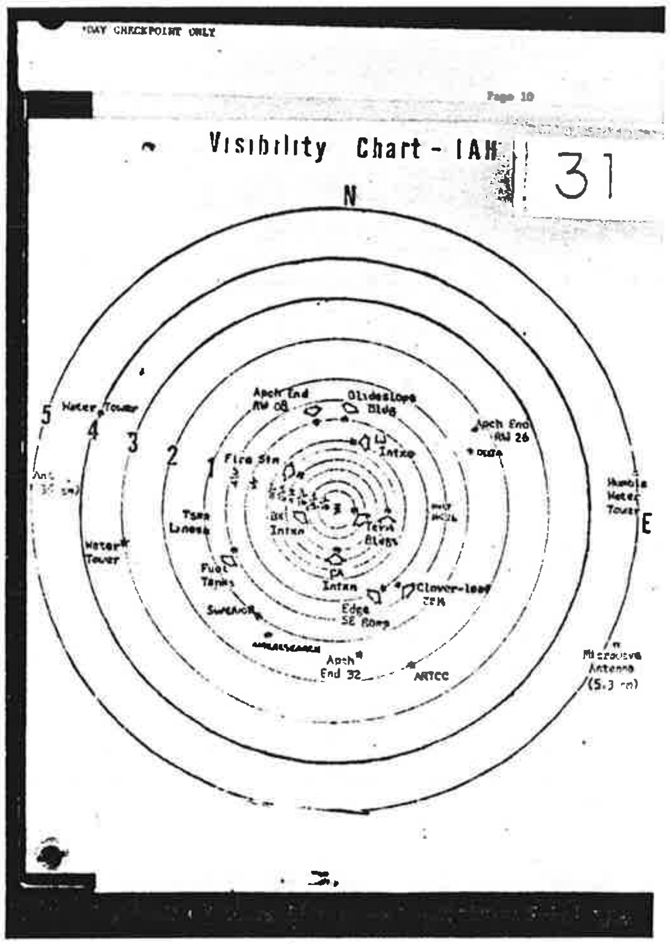


FIGURE 4-7. TOWER VISIBILITY CHART

IAH AIRPORT

VISIBILITY CHECKPOINTS

	MILEAGE
FIRE STATION	1/4
WEST CARGO BLDGS	1/4
INTERSECTION TAXIWAY L & J	3/8
APPROACH END RUNWAY 8	1/2
GLIDE PATH BLDG.	1/2
*CITY STANDBY POWER BLDG. (black) FOR RUNWAY 8-26	1/2
*CHILLED WATER PLANT	1/2
*CITY STANDBY POWER BLDG. (black) FOR RUNWAY 14-32	1/2
GY HOTEL	1/2
ANSMITTER SITE	5/8
CEIVER SITE	5/8
RTH OVERPASS OVER JFK BLVD.	3/4
PERIOR OIL HANGAR	1
RESEARCH HANGAR	1-1/4
LTA MAINTENANCE HANGAR	1-1/2
PROACH END RUNWAY 26	1-3/4
ALIZER ANTENNA	1-7/8
ALIZER BLDG.	1-7/8
1	2
L WATER TANK - WEST 215 MSL	3
HUMBLE WATER TANK 240 MSL	5
MICRO-WAVE TOWERS WEST 352'	6-1/2
RADIO TOWER AT RUNWAY 8 OUTER MARKER 636 MSL	7.3

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*DAY CHECKPOINT ONLY

Page 10

Visibility Chart - IAH

FIGURE 4-8. TOWER VISIBILITY CHECKPOINT GUIDE

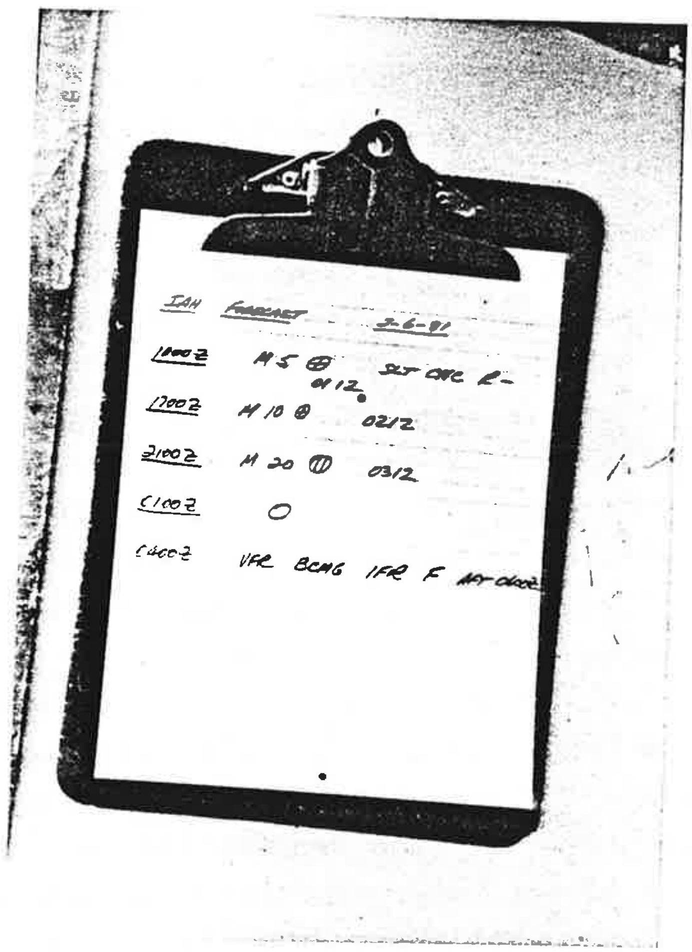


FIGURE 4-9. WEATHER INFORMATION POSTED IN OUTER ROOM OF TRACON

Supervisor in the TRACON. The Supervisor is required to acknowledge receipt of SIGMETs received via teleprinter or interphone. In an attempt to increase the timeliness of the message and because the Supervisor doesn't always agree with FSS's analysis of which SIGMET's are significant, the SIGMETs on the FDEP are continuously monitored at IAH. The disseminated information is circulated by the Supervisor to all controllers in the TRACON via the FDEP strip or teleprinter paper which has been ripped off. The controller initials the paper and passes it on. In the Tower Cab disseminated SIGMETs are passed by word of mouth or by FDEP strip or teleprinter paper as in the TRACON.

The Houston FSS sends Surface Aviation (SA) Weather Reports, Special Surface (SP) Aviation Weather Reports, and Aviation Terminal Forecasts (FT) via teleprinter (Figure 4-10). The SA reports include ceiling, visibility, temperature, dew point, day and time Zulu, sky conditions, atmospheric pressure, altimeter, humidity, and wind speed and direction. It is received minimally once per hour. Updates, referred to as Special Surface Aviation Weather Reports, are received as changing conditions necessitate. The FD/CD includes the sky conditions, visibility, temperature and altimeter on the closed circuit TV for TRACON notification. Tower Cab controllers generally check the teleprinter periodically or are notified orally by FD/CD as a report comes in. TRACON controllers also may check the teleprinter for details. These reports are used by FD/CD as the basis for ATIS updates and to revise the altimeter setting on the ARTS display. The Aviation Terminal Forecasts (FT) are also provided by the FSS. The FSS enters these 24-hour forecasts for the area which is within a five-mile radius of the Tower approximately once every six hours. The controllers may check the teleprinter for the FT as they come on duty for their own information. The Supervisor may use the FT for operation planning, staffing and scheduling navigation and runway closures.

Pilot Reports (PIREPS) are initiated by the Supervisor for information such as cloud top, bird activity, braking action,

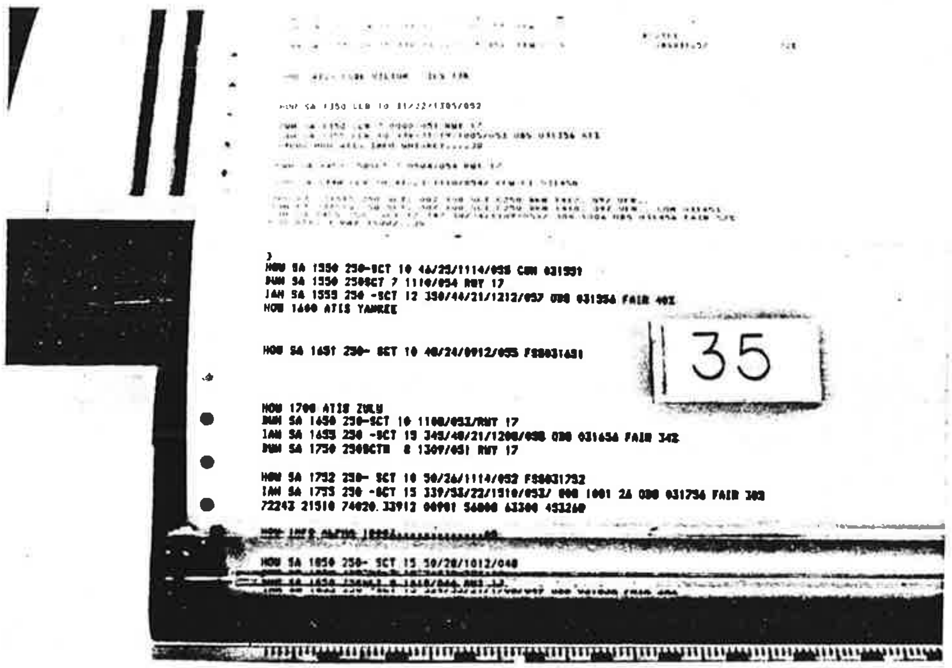


FIGURE 4-10. WEATHER PRINTOUT ON TELEPRINTER IN CAB

wind shear, or turbulence. Whichever controller is handling an aircraft that can provide the information requests the PIREP. The PIREP is then either verbally relayed to the Supervisor or handed to him on a piece of paper. The Supervisor notifies the FSS, indicating aircraft identification, aircraft position at time of report, aircraft type, PIREP data, and any other pertinent data, via interphone or telephone for dissemination to pilots, and logs the PIREP (Figure 4-11) on form 7230-1.

IAH Tower Cab and TRACON receive satellite weather reports from Ellington, Hobby, Galveston and David Wayne Hooks airports at least once per hour and more frequently as changing conditions necessitate. Hobby and David Wayne Hooks send their Surface Aviation reports via the teleprinter (Figure 4-12). Galveston relays its SA report via interphone. As discussed above certain information is elicited from the SA report and included on the closed circuit display. Controllers may examine the teleprinter for the other details of the SA report. Ellington weather is transmitted to IAH TRACON via the electrowriter (Figures 4-13 and 4-14) at the AD/DD position. The AD/DD copies the information onto a piece of paper and carries it over to South Radar/ Satellite positions and lays it on the console for use. Other controllers would like to have access to Ellington weather. Controllers also mentioned that they would like to have weather information for all airports within 100 mile radius of Intercontinental. This information would allow controllers to advise pilots to land at alternate airports when conditions necessitate.

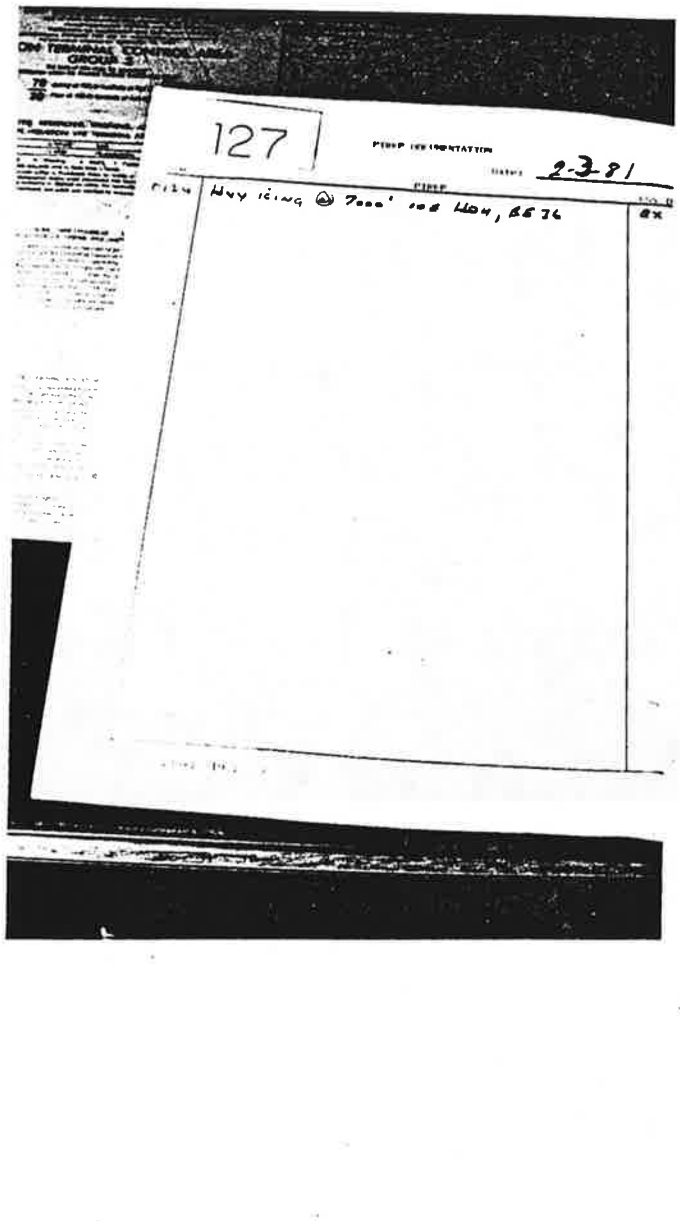


FIGURE 4-11. PIREP LOG ON SUPERVISOR'S DESK IN TRACON

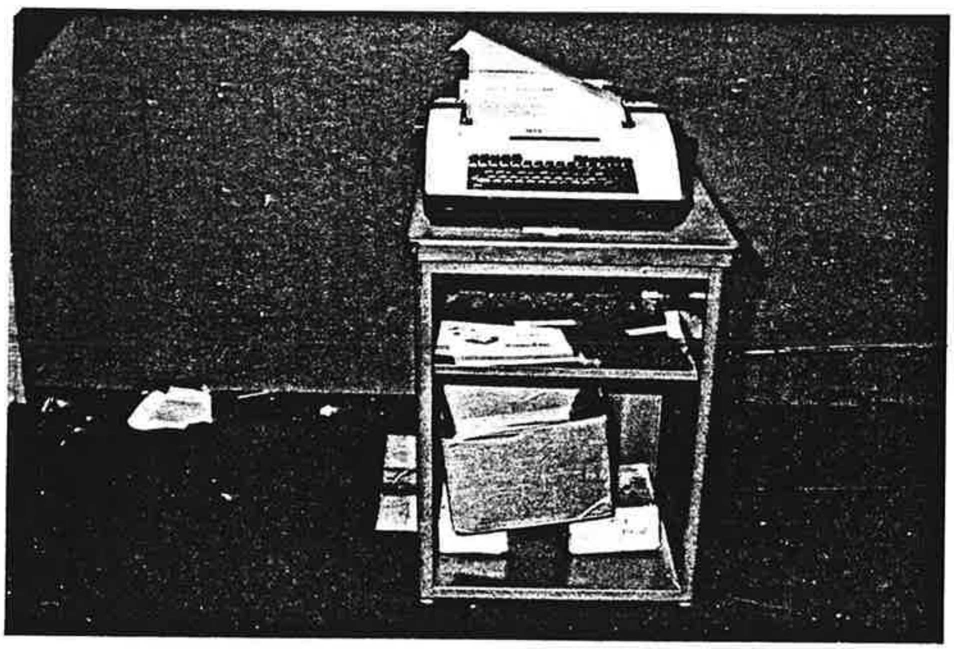


FIGURE 4-12. TELEPRINTER IN TRACON

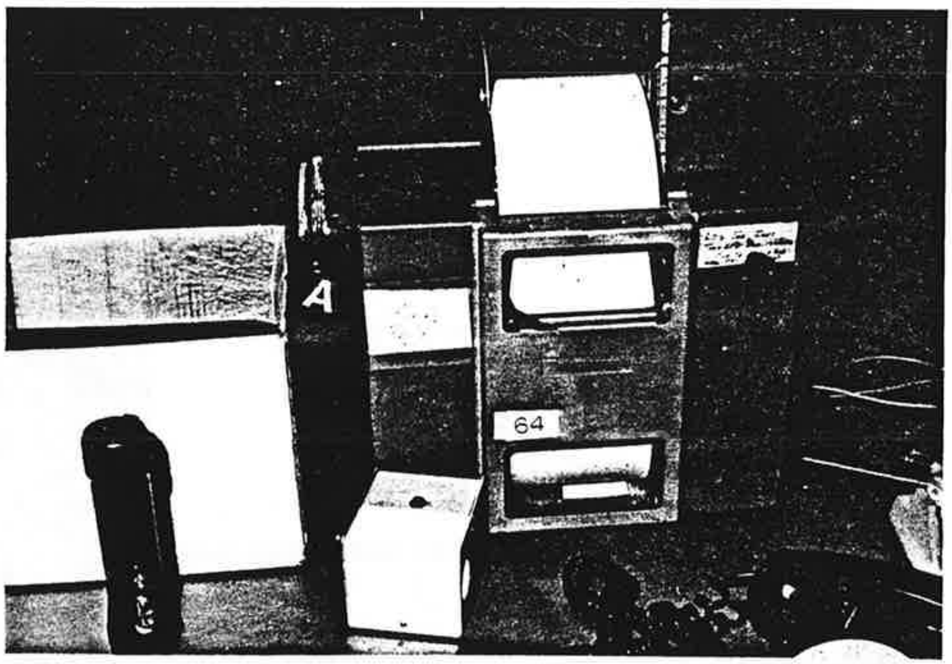


FIGURE 4-13. ELECTROWRITER AT AD/DD

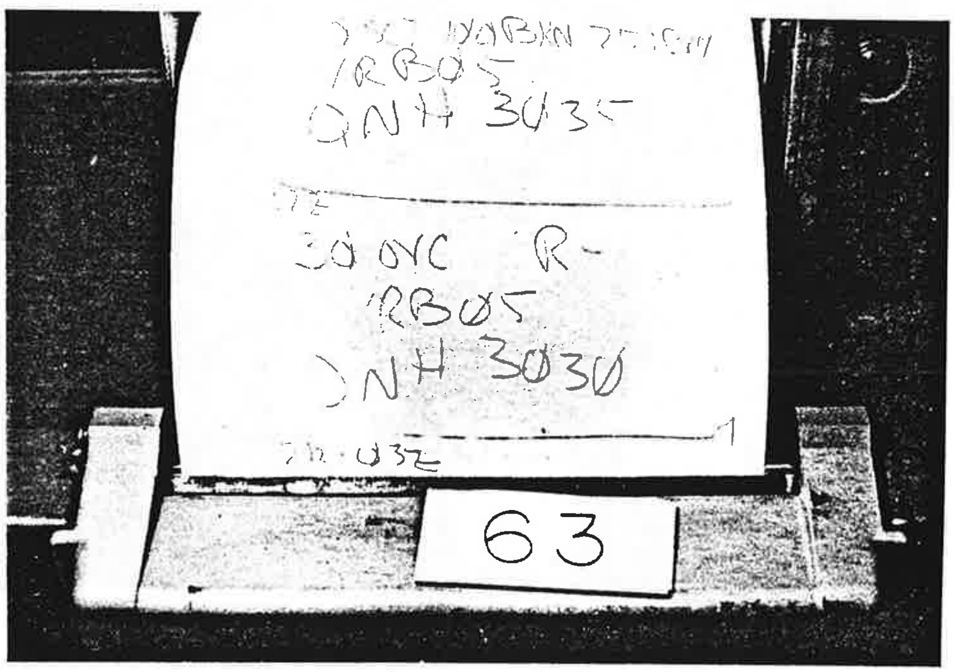


FIGURE 4-14. ELECTROWRITER WEATHER MESSAGES AT AD/DD

5. INTERCONTINENTAL STATUS

This section includes a discussion of the status of equipment important for IAH operations. The primary means of relaying status are Notice to Airmen (NOTAMs); status boards; word of mouth; equipment alarms and paper which is either posted or passed around.

The NOTAMs received by IAH are generally concerned with NAVAID or airport facility outages. They are issued by the facility monitoring the NAVAID (e.g., IAH Cab is responsible for initiating NOTAMs concerned with Humble VOR) or by city operations if it is an airport facility outage. The TRACON Supervisor receives the NOTAMs by telephone, interphone and/or mail. The Supervisor posts the NOTAM in the outer room, notes it on the status board, logs it, then notifies the Cab by interphone. NOTAMs relevant to Cab operations are written on the Cab status board discussed below. The facility which issues the NOTAM is responsible for cancelling it by notifying the FSS when the outage is corrected.

Both the Tower Cab and the TRACON have status boards (Figures 5-2 and 5-3). The status board in the Cab is located to the right of the teleprinter. It is a white board with the airport layout imposed upon it. Messages are written on it with a black grease pencil. Typical messages include ATIS code and runway closures. There are two status boards in the TRACON. One is a blackboard located in the outer room. Controllers check this board for messages as they come on duty. The other status board is on the side wall visible to all controllers, to the right of the teleprinter. It contains a list of terminal area NAVAID's and their radio frequencies. Messages are written on it with black grease pencil.

In order to facilitate discussion, the controllers requirements for status information have been divided into four categories. Within each category, the means for relaying status are

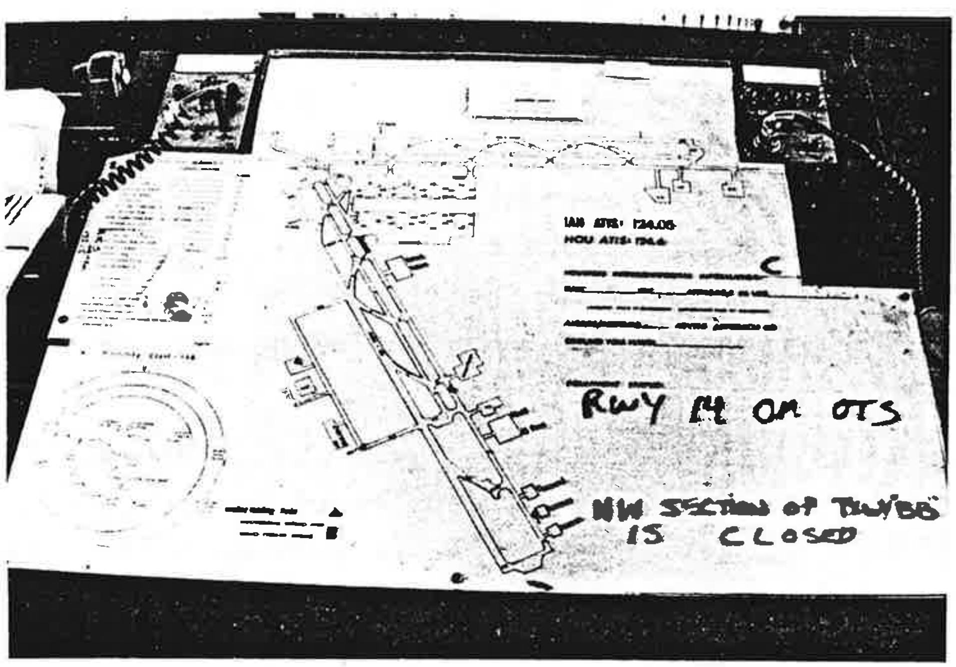


FIGURE 5-1. STATUS BOARD IN CAB

FIGURE 5-2. NOTAM ON BLACKBOARD IN OUTER ROOM

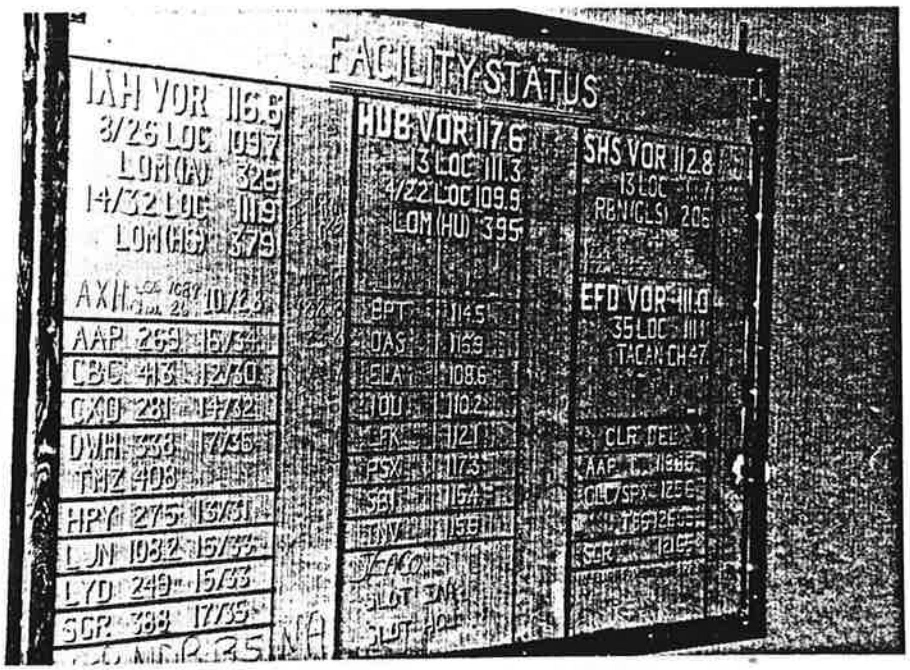


FIGURE 5-3. IAH TRACON STATUS BOARD

discussed; whether it is NOTAMs, the status board, word of mouth, pieces of paper or equipment alarms.

The categories are as follows:

Visual Aids

Terminal Area Radio NAVAIDS

Landing Aids

Cab and TRACON Critical Display Items.

If a status notice is of interest to the pilot it may be included in the ATIS message.

5.1 VISUAL AIDS

The visual aids and their associated runways are displayed in Table 5-1. The Air Traffic Control manual regulates when the various lighting systems should be turned on. They may also be turned on at pilot request. The Supervisor is responsible for ensuring that they are on as required. Each runway has an independent lighting system. The control panels for the taxiway lights, high intensity runway lights, runway centerline system, touchdown zone lights, high speed turnoff lights and runway end identifier lights are located between Ground Control and Local Control positions (Figures 5-4 and 5-5). Ground Control generally switches these lights on, however, depending upon workload either position may turm them on. The control panels for the approach lighting system, the sequenced flashing lights and the STOL lighting systems are located at and operated by the Local Control position (Figures 5-6 through 5-8). This allows immediate response by LC to pilot request for dimming or flashing of lights. For the Medium Approach Lighting System (runways 14, 26, 32) a combination of switches is required for turning the Sequenced Flashing Lights on and off. A different combination is required for each runway. For the High Intensity Approach Lighting System, the Sequenced Flashing Lights may be turned on and off with a toggle switch, however, combinations are needed in order to change

TABLE 5.1. IAH AIRPORT LIGHTING

Visual Aid	Runway/Taxiway
Taxiway Lights	all taxiways
High Intensity Approach Lighting System with Sequenced Flashing Lights	runway 8
Medium Approach Lighting System with Runway Alignment Indicator and Sequenced Flashing Lights (MALSR and SFL)	runways 14,26,32
High Intensity Runway Lights (HIRLS)	all runways
Runway Centerline System (RCLS)	all runways
Touchdown Zone Lights (TDZL)	all runways
High Speed Turnoff Lights	all runways
Runway End Identifier Lights (REILS)	all runways
Visual Approach Slope Indicators (VASI)	runways 14,26
High Intensity STOL Lighting	runways 9,27
STOL Floodlights	runways 13,31
STOL VASI	runways 9,27

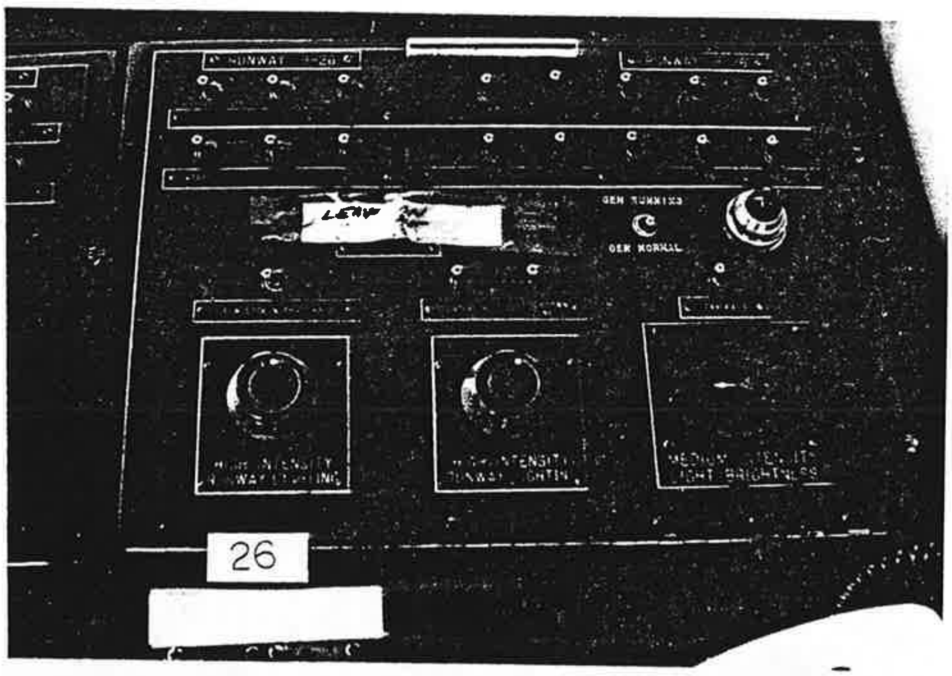


FIGURE 5-4. RUNWAY 8/26 LIGHTING CONTROL PANEL AT LC-2

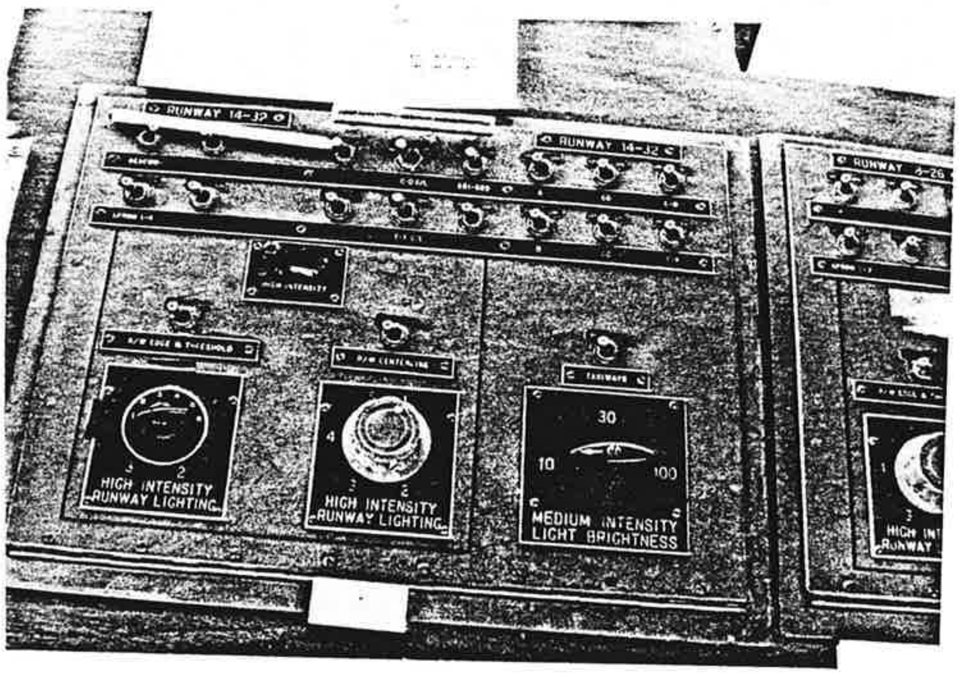


FIGURE 5-5. RUNWAY 14/32 LIGHTING CONTROL PANEL AT LC-2

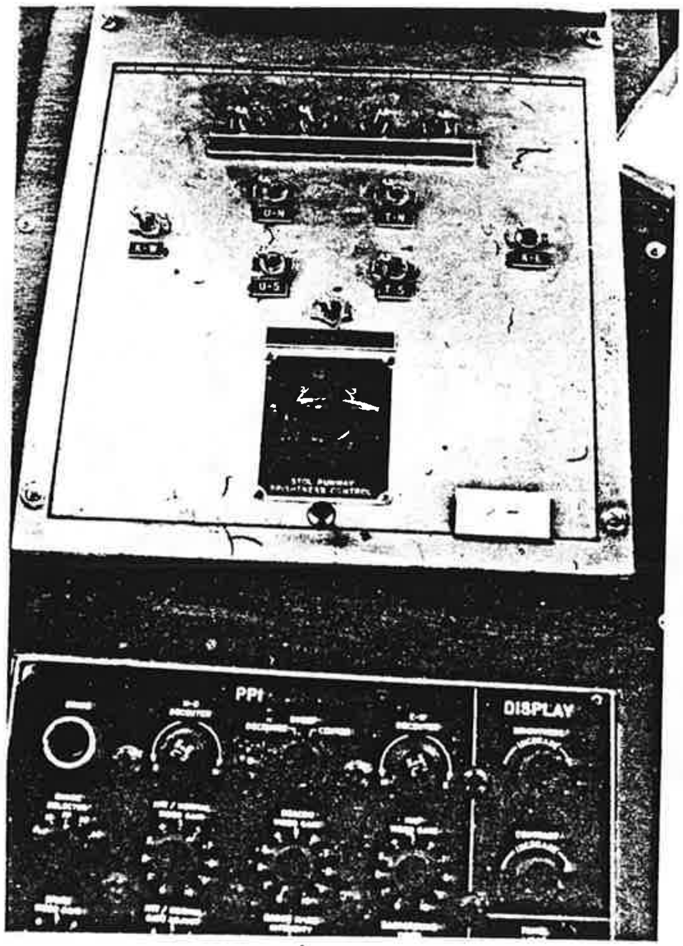


FIGURE 5-6. STOL LIGHTING CONTROL PANEL AT LC-1 POSITION

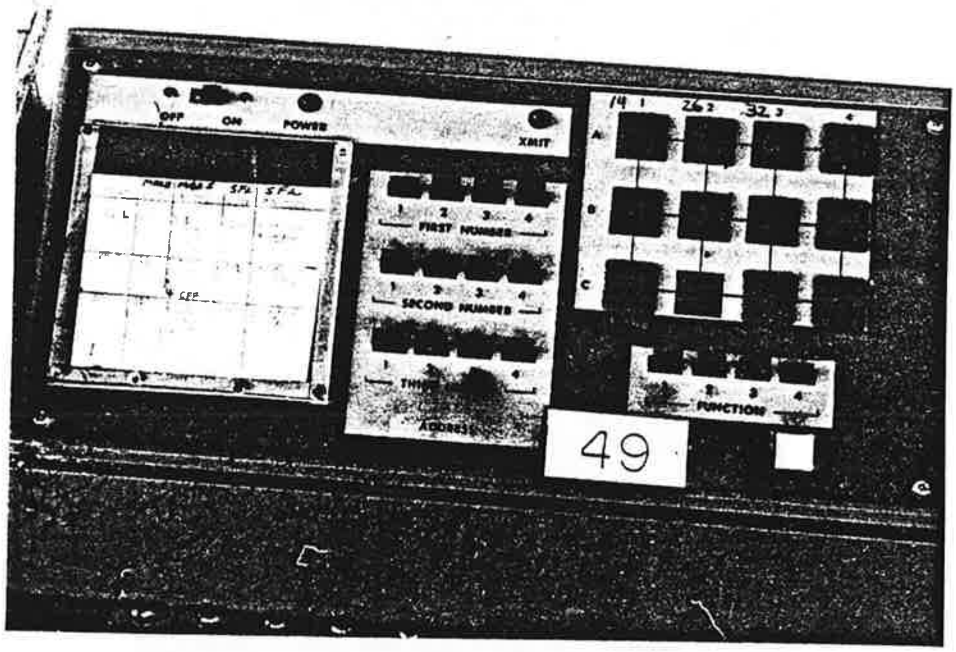


FIGURE 5-7. MALS CONTROL PANEL AT LC-1 POSITION

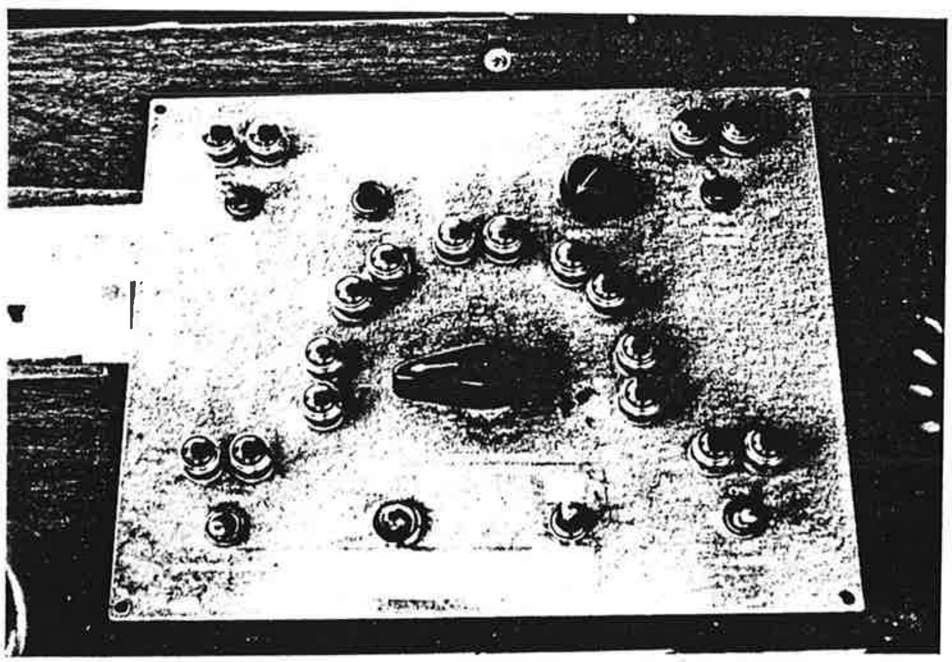


FIGURE 5-8. ALS CONTROL PANEL AT LC-1 POSITION

intensity levels for the High Intensity Approach Lighting System. The combinations must be looked up each time they are needed (directions are posted in Figures 5-9 and 5-10). It is a time consuming process and is not looked upon favorably by the controllers. The lights for STOL runways 9 and 27 are high intensity and also require a complicated combination of switches for use. The floodlights for STOL runways 9 and 27 and the VASI for STOL 9-27 are operated with an on/off toggle switch. The VASI for runways 26 and 14 are independently operated by means of a photo-electric device. This system has no on-off control override feature and operates continuously.

Controller requirements for airport lighting status are presented in Table 5-2. Runway 8 approach lighting system is the only monitor with an alarm. Outages for the other visual aids are determined by controller observation, pilot reports, and Facility Airways staff. Notices of outages determined by Facility Airways may be received as a NOTAM. Visual aid outages are generally written on the Cab status board. When relevant, the appropriate TRACON controllers will be told verbally by the supervisor. Depending on its duration and importance, the controller may make a note of the outage on his notepad to alert relieving controllers arriving for subsequent watches (Figures 5-11 and 5-12).

5.2 TERMINAL AREA RADIO NAVAIDS

Table 5-3 presents the Houston terminal area radio NAVAIDs of interest to each radar position in the TRACON. The status of radio NAVAID equipment is of interest to all controllers working an aircraft which uses the equipment. The monitor for the Humble VORTAC is located in the Southwest corner of the Tower Cab. The Supervisor notified the TRACON immediately by interphone of an equipment failure and issues a NOTAM to other facilities through the FSS. Notices of off-site equipment outages are generally relayed by FSS to the Supervisor as a NOTAM. The Supervisor notes with black grease pencil on the status board that the NAVAID

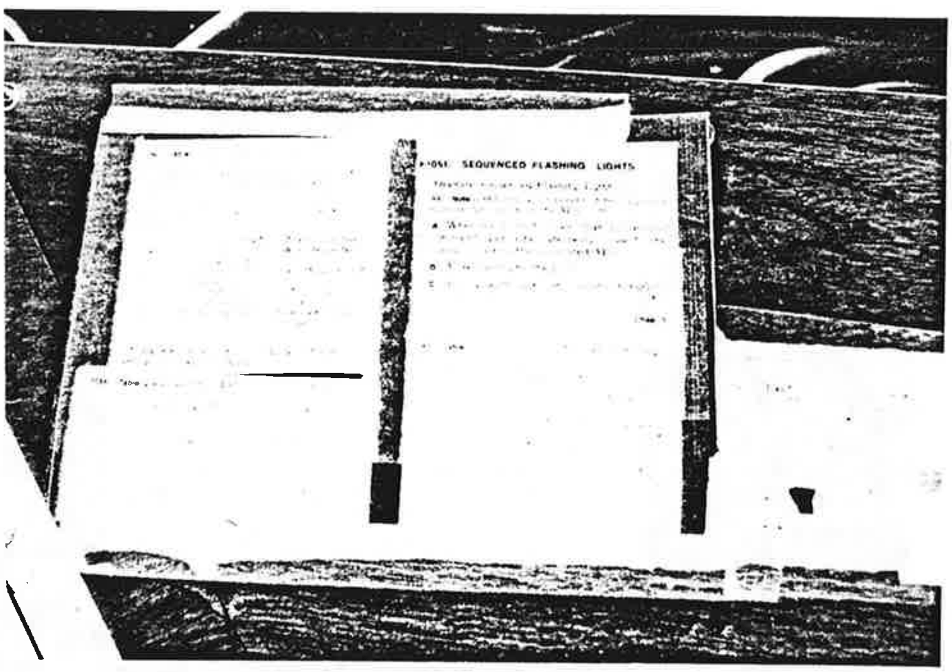


FIGURE 5-9. LIGHTING INSTRUCTIONS FOR MALS AND SFL AT LC-1 POSITION

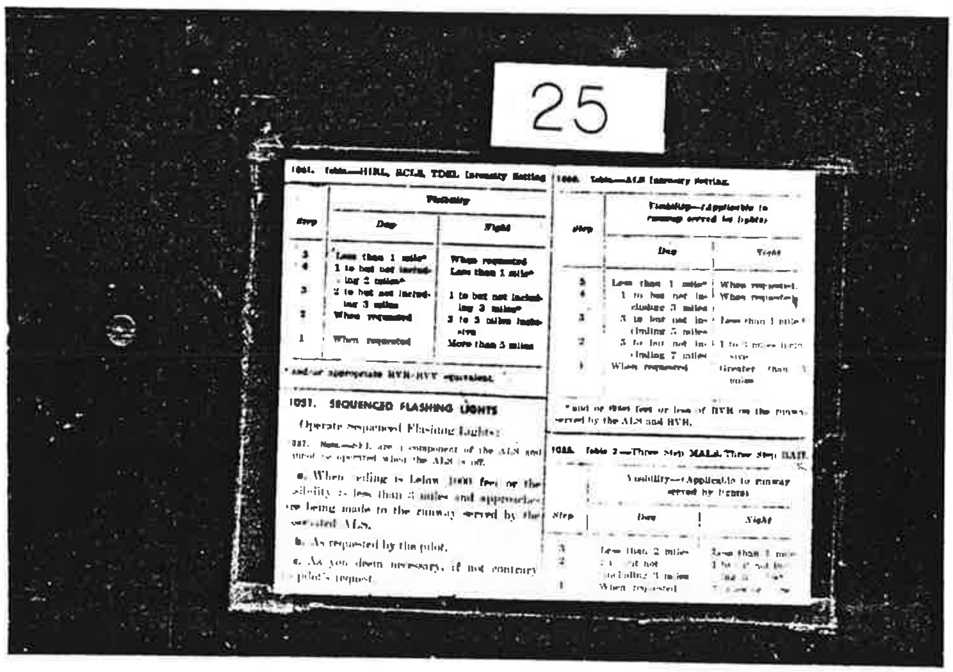


FIGURE 5-10. LIGHTING INSTRUCTIONS POSTED AT LC-2 POSITION

TABLE 5-2. IAH CONTROLLER REQUIREMENTS FOR AIRPORT LIGHTING STATUS

Visual Aid	Controllers Requiring Status
Taxiway Lights	GC/LC
High Intensity Approach Lighting System with Sequenced Flashing Lights Medium Approach Lighting System with Runway Alignment Indicator and Sequenced Flashing Lights (MALSR and SEL)	IAH Final Arrival East Arrival West
High Intensity Runway Lights (HIRLS) Runway Centerline System (RCLS) Touchdown Zone Lights (TDZL) High Speed Turnoff Lights Runway End Identifier Lights (REILS)	GC LC IAH Final Arrival East Arrival West
Visual Approach Slope Indicators (VASI)	LC
High Intensity STOL Lighting STOL Floodlights	IAH Final, Arrival East, Arrival West
STOL VASI	LC

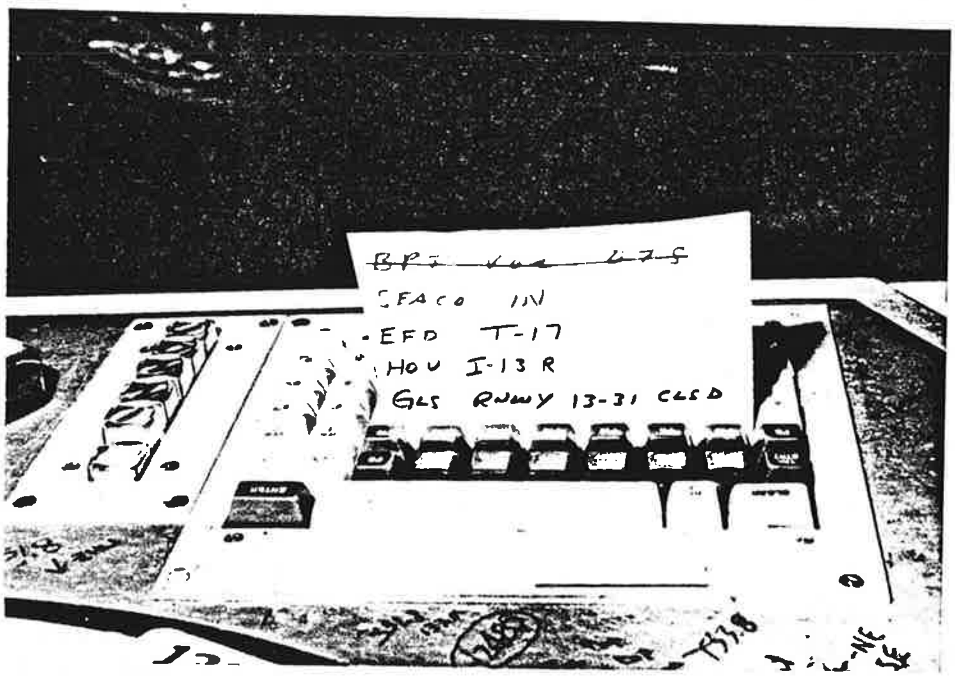


FIGURE 5-11. HANDWRITTEN STATUS INFORMATION AT RADAR POSITION

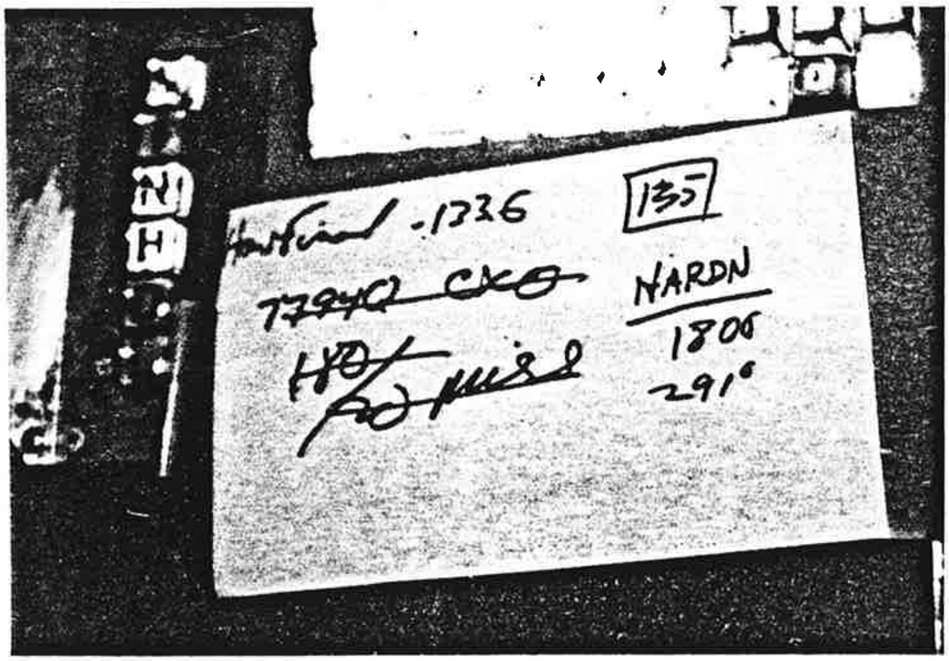


FIGURE 5-12. NOTEPAD AT HOBBY FINAL

TABLE 5-3. TRACON CONTROLLER REQUIREMENTS FOR TERMINAL AREA NAVAID STATUS

	Departure East	Departure West	Arrival East	Arrival West	IAH Final	HOU Final	Satellite	South
Austin Vortac (AUS)		X						
White Lake Vortac (LLA)	X							X
Lafayette Vortac (LFT)	X							X
Galveston Vortac (GLS)	X		X	X	X			X
Leona Vortac (LOA)	X							
Junction Vortac (JCT)		X						
College Station Vortac (CLL)	X	X						
Navasota Vortac (TNV)		X		X			X	
Alexandria Vortac (AEX)	X							
Daisetta Vortac (DAS)	X		X		X			
Lake Charles Vortac (LCH)	X							X
Eagle Lake Vortac (ELA)		X		X			X	
Palachios Vortac (PSK)		X						
Sabine Pass Vortac (SBI)	X		X					X
Industry Vortac (IDV)		X						
Beaumont Vortac (BPT)	X		X					
Lufkin Vortac (LFK)	X							
Humble Vortac (IAH)	X	X	X	X	X			
Hobby Vortac (HUB)	X	X	X	X		X	X	X
Scholes Vortac (SHS)	X							X
Ellington Vortac (EFD)	X	X	X	X		X	X	
Conroe NDB (CXO)	X	X	X	X	X			
David Hooks NDB (DWH)	X	X	X	X	X		X	
Tomball NDB (TMZ)	X	X	X	X	X		X	
Andrau NDB (AAP)		X		X	X	X		
Hull NDB (SGR)		X		X		X		X
Humphrey NDB (HPY)	X		X			X		X

is out of service, and notifies the Cab via interphone. In the Cab FD/CD is the only controller interested in ratio NAVAID outages. When issuing clearances he may issue alternative routing due to an equipment outage.

5.3 LANDING AIDS

Table 5-4 presents the approach equipment of interest to each radar position in the TRACON. In the Tower Cab LC must know status of all approach equipment on IAH runways. The IAH VOR is also of interest to LC when an aircraft is on a VOR/DME approach. All approaches at IAH are equipped with Instrument Landing Systems (ILS). Runway 8 has Category II and Category III systems which facilitate landings below 1800 RVR and 1200 RVR respectively. ILS monitor panels for runways 8 and 14 are located near the GC position in the Tower Cab (Figures 5-13 and 5-14). Four buttons, each representing a runway, are located at IAH Final position in the TRACON (Figure 5-15). The appropriate button lights up when an ILS system is inoperative. Outages of landing aid equipment are posted on the status boards in the Cab and the TRACON, and included in the ATIS broadcast. Pilots compensate by making alternative approaches to landing.

5.4 CAB AND TRACON CRITICAL DISPLAY ITEMS

The location and users of the critical display items in the Cab and TRACON are shown in Table 5-5 and 5-6 and Figures 5-16 and 5-17.

All the controllers in the Cab rely on the digital clocks located at FD/CD, GC, and LC positions for time information (Figure 5-18). The ARTS clock is not as easy to read because of Cab light conditions. In the TRACON the Radar positions generally refer to the ARTS clock for time information because it is often more accurate. The coordinator controllers primarily rely on the digital clocks because they are easier to see from the coordinator position that the BRITE display. AD/DD also relies on the digital clock for time. Every shift the Supervisor checks the time

TABLE 5-4. TRACON CONTROLLER REQUIREMENTS FOR APPROACH EQUIPMENT STATUS

	Arrival East	Departure East	IAH Final	Arrival West	Departure West	HOU Final	South	Satellite
IAH GS LOC MM CADIG OM } 32 ILS	X	X	X	X	X		X	X
GS LOC MM HIKKY OM/INT } 26 ILS	X	X	X	X	X		X	X
GS LOC MM LOM } ILS MARBE NDB } 14	X	X	X	X	X		X	X
GS LOC IM MM LOM } ILS WALKA NDB } 8	X	X	X	X	X		X	X
HOU GS LOC MM LOM } ILS TYTTE NDB } 4	X			X	X		X	X
GS LOC MM PARK OM } 13D ILS	X		X	X	X		X	X
LOC - 22 BK CRS	X			X	X		X	X
ARCOLA ILS	X			X	X	X	X	X
GLS ILS	X			X		X	X	X
BPT ILS	X			X	X	X	X	
EFD ILS	X			X		X	X	
IAH VOR/DME	X	X	X	X	X			X
HUB VOR/DME	X	X		X	X	X	X	X

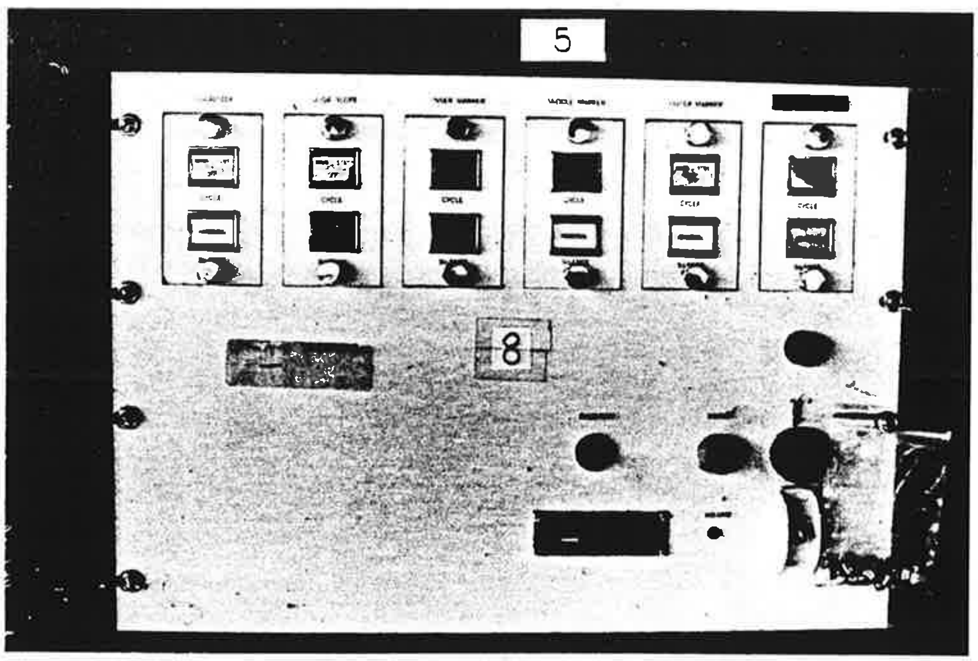


FIGURE 5-13 RUNWAY 8 ILS MONITOR IN TOWER AT GC

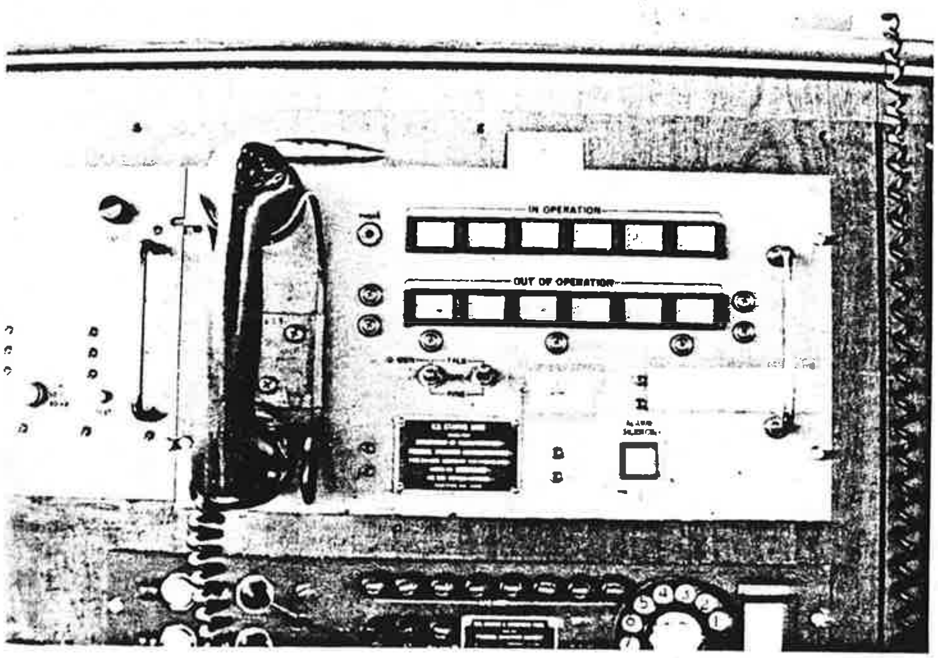


FIGURE 5-14. RUNWAY 14 ILS MONITOR IN TOWER NEAR GC

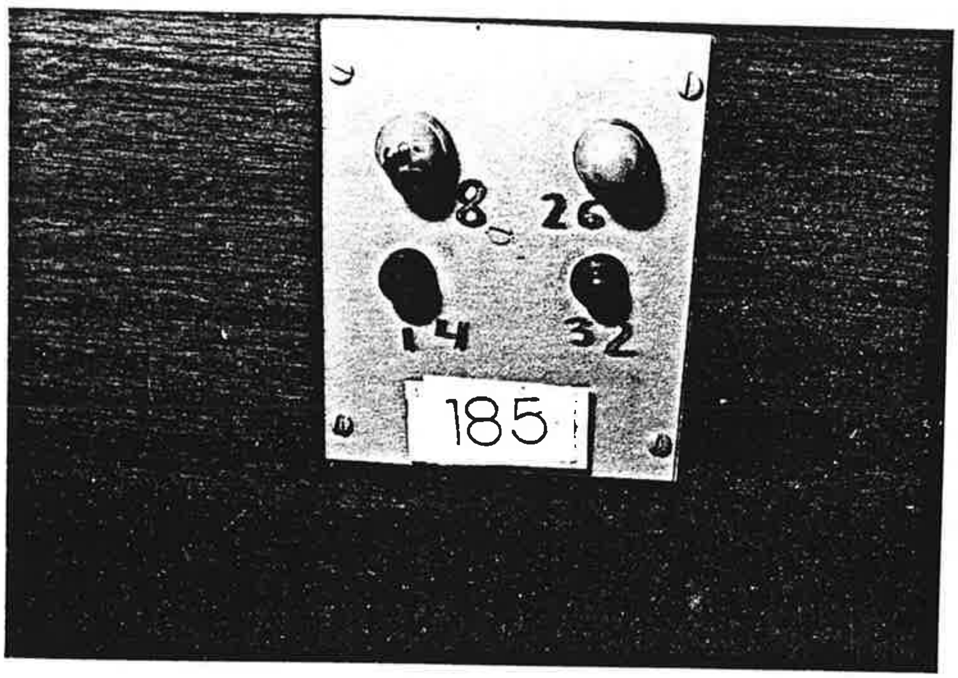


FIGURE 5-15. ILS INDICATORS AT IAH FINAL POSITION

TABLE 5-5. TOWER CAB CRITICAL DISPLAY ITEMS

	FD/CD	GC	LC 1	LC 2	Sup
Digital	ⓧ	ⓧ	ⓧ	○	○
ARTS Clock	○	*	*	*	
Digital Altimeter		ⓧ	ⓧ	○	○
Analog Altimeter		X			
ARTS Altimeter		*	*	*	
RVR Display		ⓧ	ⓧ	○	○
ATIS Code	ⓧ	⊛	⊛	⊛	○
Wind Speed and Direction	○	ⓧ	ⓧ	○	○
LLWSAS		X	X		
MSAW Control Panel		X			○

X - location

○ - user

* - two units-shared by three controllers one is between GC and LC2, the other is between LC1 and LC2

TABLE 5-6. TRACON CRITICAL DISPLAY ITEMS

	Coordinator East	East Departure Radar	East Arrival Radar	IAH Final	West Arrival Radar	West Departure Radar	Coordinator West	Hobby Final	Coordinator Hobby	Team Supervisor	Arrival Data/ Departure Data	South Radar	Coordinator South	Satellite Satellite	Over-head
Digital Clock	(X)	X	X	X	X	X	(X)	X	○	(X)	(X)	X	○		
ARTS Clock		(X)	(X)	(X)	(X)	(X)		(X)				(X)		(X)	(X)
Digital Altimeter		(X)	(X)	○	(X)	(X)				○		(X)		○	○
ARTS Altimeter		X	X	X	X	X		X				X		X	X
TC Altimeter	X			X			X	○				X			
43M Teleprinter Altimeter											X				
LLWSAS			X		X							X			
RVR Display		(*)	(*)	(*)	(*)	(*)		(*)		○		(X)		○	○
MSAW Control Panel										(X)					
ARTS ATIS		(X)	(X)	(X)	(X)	(X)		X				(X)		(X)	(X)
TV ATIS	(X)			X			X	○	○	○	○	X	○		
Wind Speed and Direction		○	X	○	(X)	○				○	○	(X)		○	○

X - location

○- user

* - 4 units shared by 5 positions. There is one unit between each pair of adjacent consoles

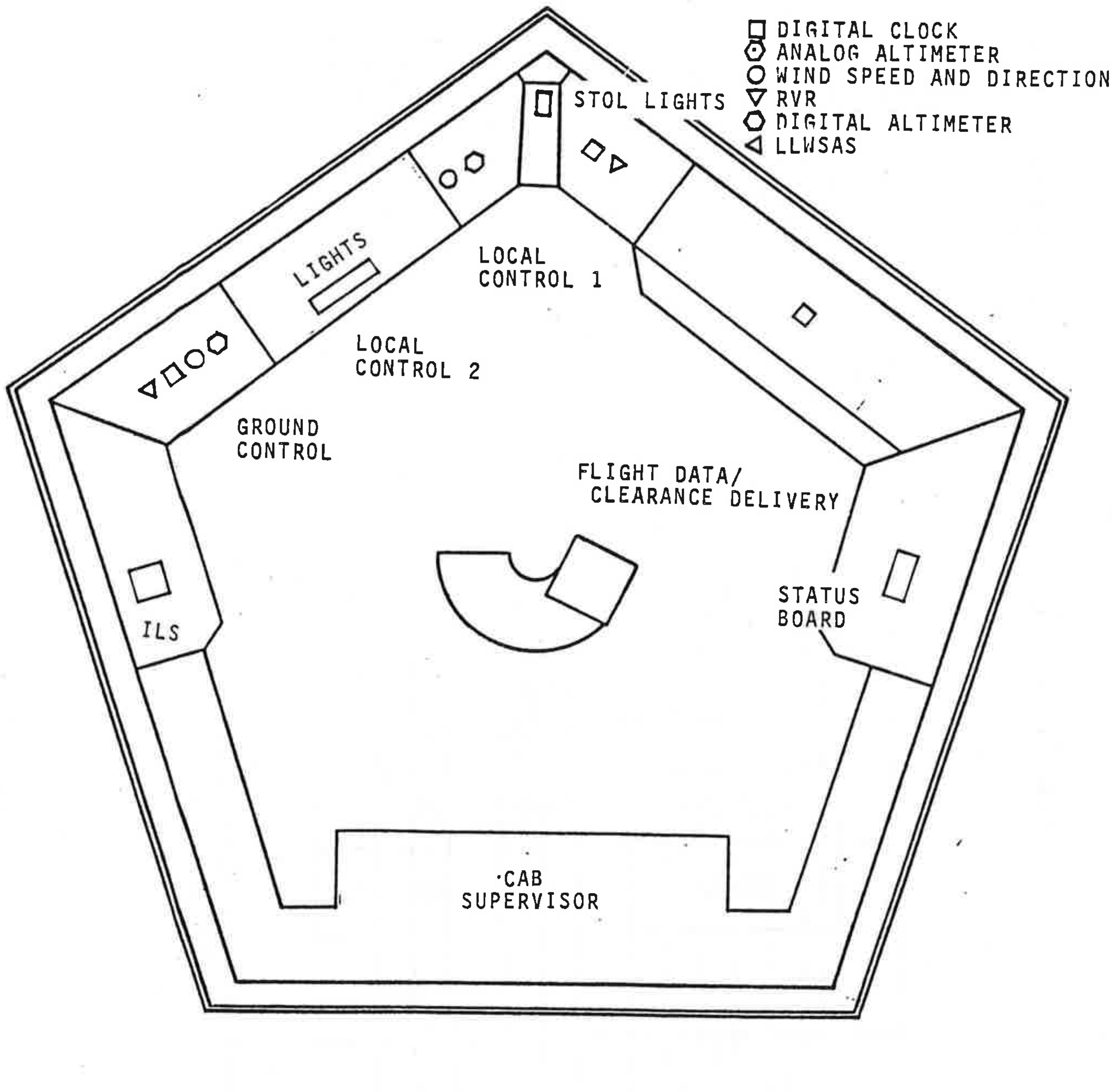


FIGURE 5-16. LAYOUT OF CRITICAL DISPLAY ITEMS IN TOWER CAB

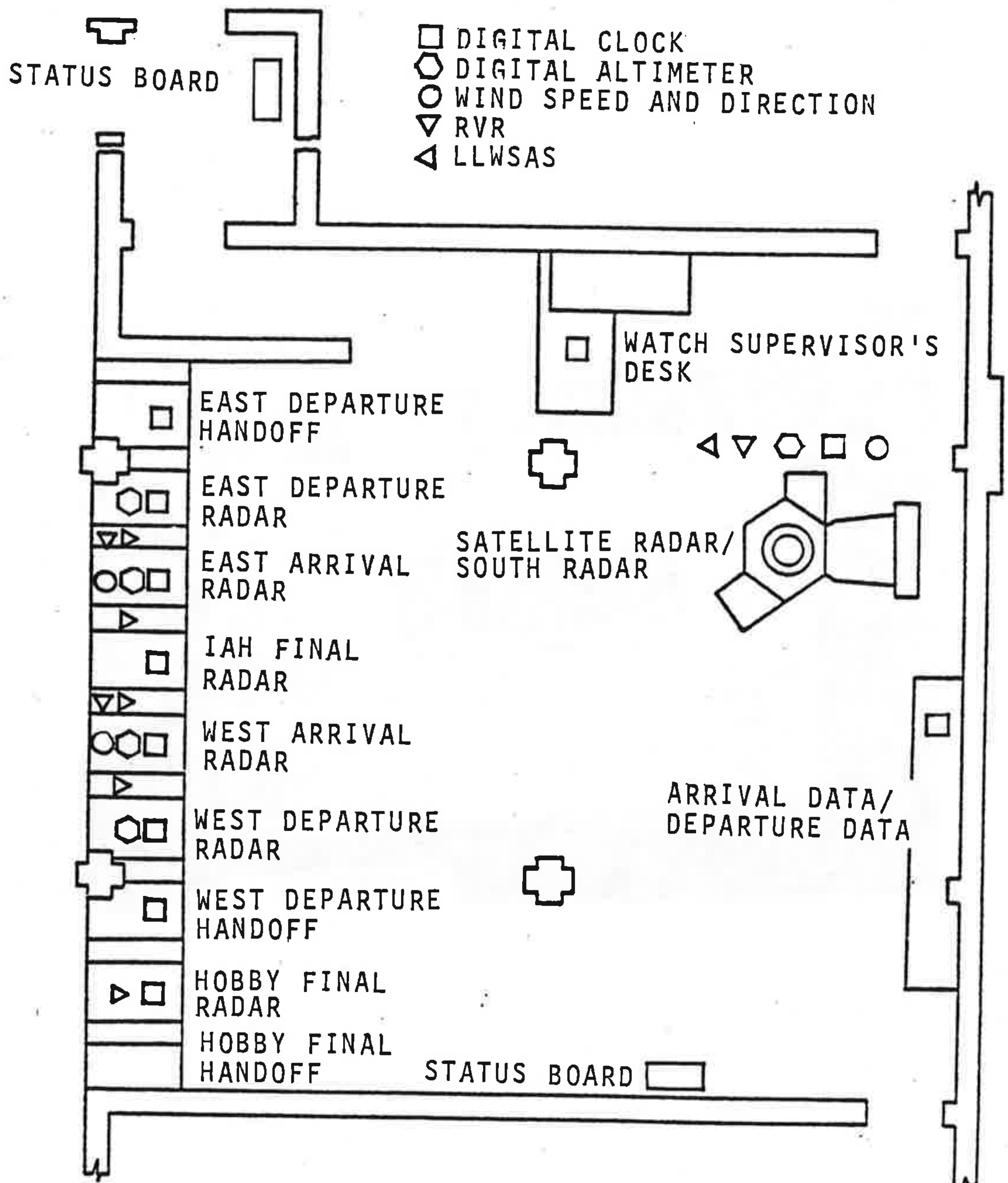


FIGURE 5-17. LAYOUT OF CRITICAL DISPLAY ITEMS IN TRACON

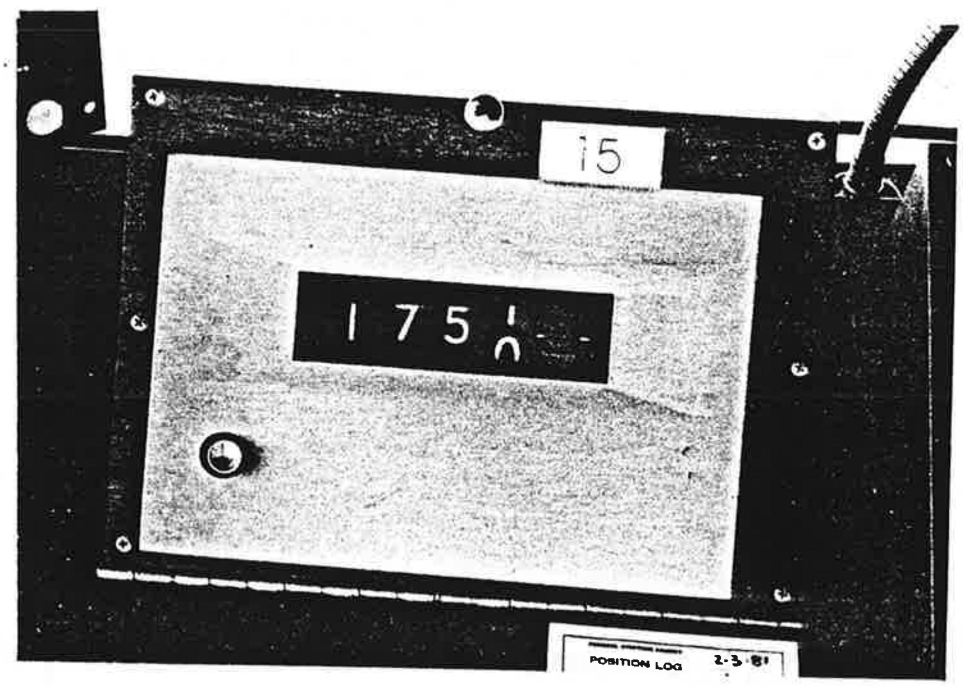


FIGURE 5-18. CLOCK AT GC

against a recording and updates the digital clocks and the ARTS clock as necessary. Time is issued to pilots upon request, and used by controllers for logging duty time. In the TRACON, when issuing clearance to pilots departing uncontrolled airports AD/DD issues a time check to the pilot. In the event of radar being lost, time would be used as the primary means of operation.

The digital altimeter is preferred over either the ARTS display or the analog altimeter in the Cab for barometric pressure readings. The setting on the ARTS display represents hourly updates rather than real time readings and the display in the Cab is difficult to read because of the light conditions. The analog altimeter in the Cab (Figure 5-19) is not conventiently located and does not present the reading as explicitly as the digital altimeter does. TRACON controllers also prefer the real time digital altimeter readings to the hourly inputs displayed on the ARTS. FD/CD compares FSS altimeter readings received via the teleprinter with Tower Cab readings. Incorrect Arts settings are adjusted by FD/CD but discrepancies in the digital and analog altimeters must be reported to maintenance.

The RVR is designed to show the horizontal distance in feet a pilot can see down the runway from approach end for a single selected runway. The decision of which runway to display on each RVR unit is based on the relevance of the runway to controllers in the vicinity. For example, at the Hobby final position, RVR for HOU runway 4 is displayed. Controllers would like to have RVRs for all runways more accessible. There are two RVR displays in the Tower Cab and six in the TRACON (Figure 5-20). In the Cab one is located at Local Control position and the other is at Ground Control. In the TRACON there is one at Hobby Final, one at South Radar and one between each pair of the five other adjacent radar positions. The location of the field units is shown in Figure 5-21. Runway 8/26 has units at rollout, midfield and touchdown points. Runway 14/32 has units at rollout and touchdown. The RVR is calibrated from 1000 to 6100 in 100 feet increments. The maximum value which can be displayed is 6100. Values

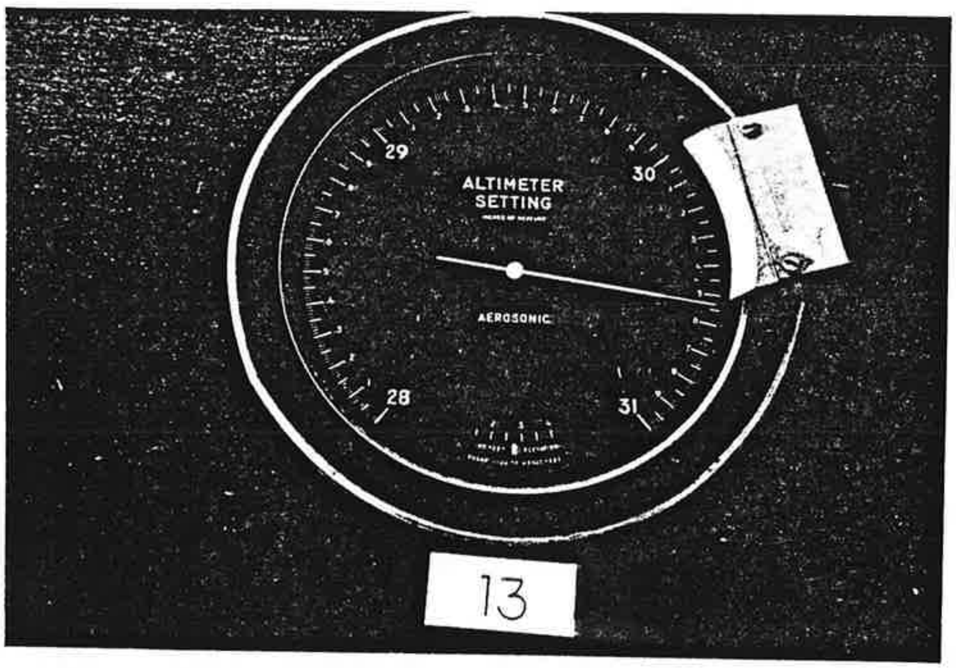


FIGURE 5-19. ANALOG ALTIMETER AT GC

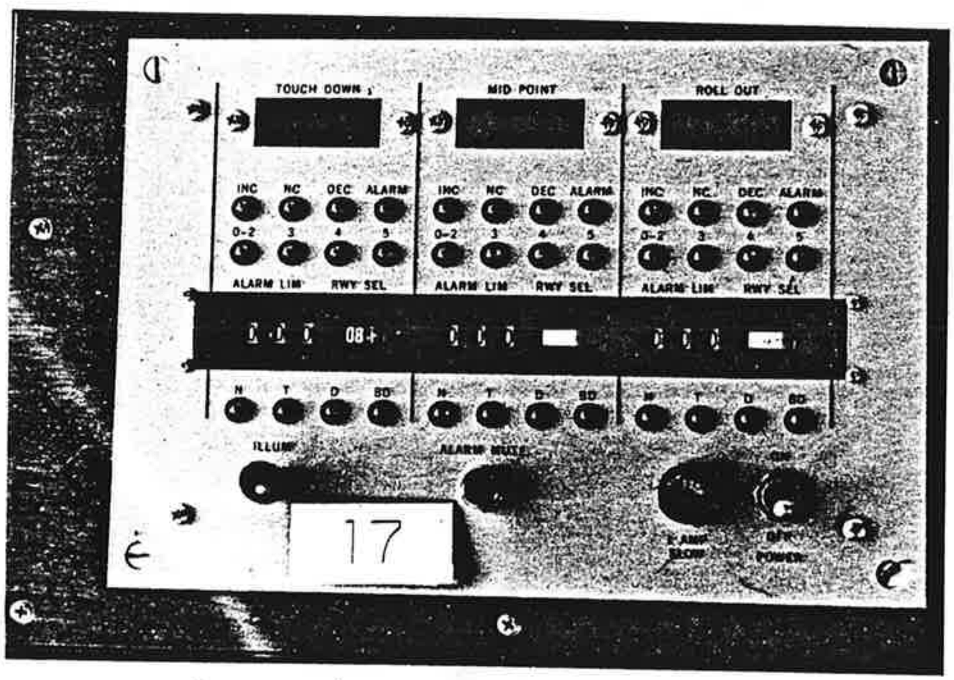
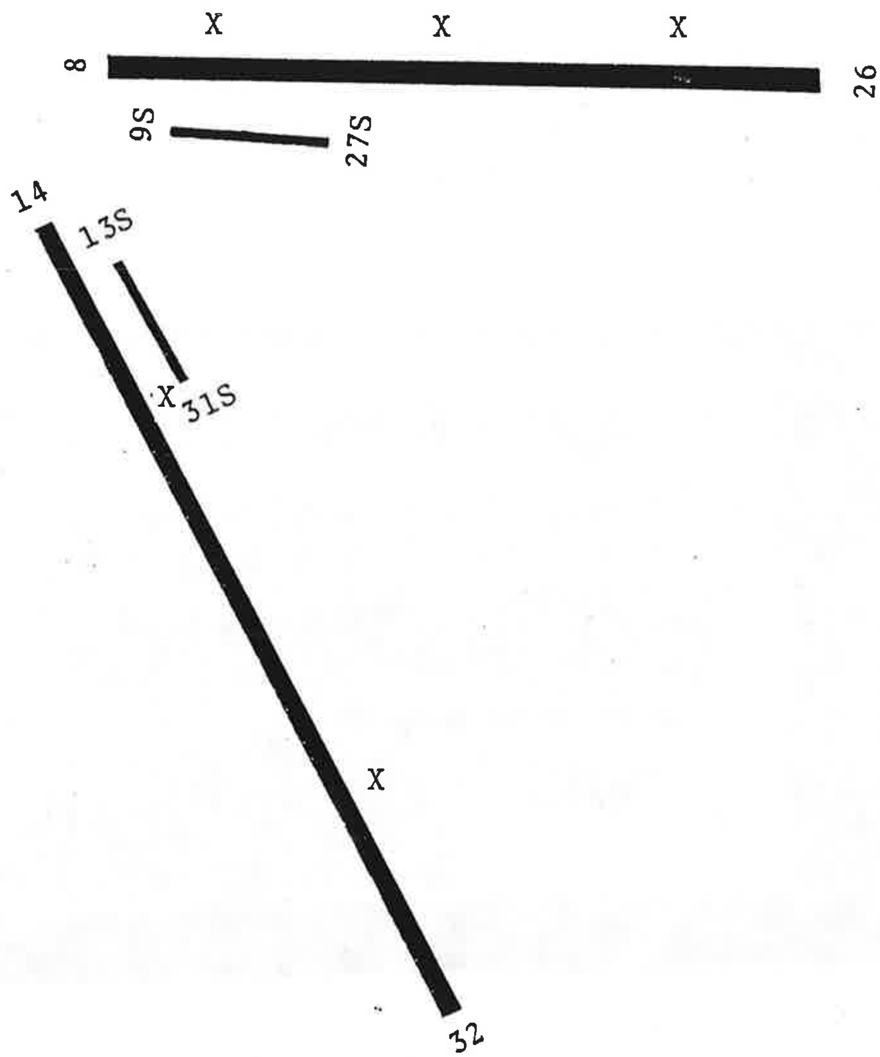


FIGURE 5-20. RVR DISPLAY AT GC



X--Location of Unit

FIGURE 5-21. RVR FIELD UNITS AT IAH

higher than 6100 are not differentiated. Also displayed on the unit are three rows of buttons. The first row indicates whether the RVR is rising, falling or staying constant. The next row identifies the light intensity setting. And the last row tells time of day: night, twilight, day or dawn. In each of the three rows, the one appropriate button is lit up.

There are two Low Level Wind Shear Alert Systems (LLWSAS) displays in the Cab and three in the TRACON (Figure 5-22). In the Cab, one is located at LC position and the other is at the GC position. In the TRACON there is one at each of the two arrival radar positions and at the South console. The LLWSAS at IAH is currently inoperative because an appropriate location for the field units has not been determined. Controllers in the Tower, IAH final and arrival radar positions would like access to this information. Equipment malfunctions are indicated by a string of "8"s across the display.

There is one ATIS unit in the Cab, located at the FD/CD position. The same ATIS is issued to both arrivals and departures. FD/CD records the ATIS once an hour and more frequently as changing conditions necessitate. ATIS messages include: ATIS code (a letter from A to Z), time, weather, sky condition, visibility, temperature, wind, altimeter, approach in use, departure runways, NOTAMs, and instructions to acknowledge ATIS code to FD/CD. In the Cab the current ATIS code is passed by word of mouth, written on the status board and displayed on the BRITE display. Radar controllers in the TRACON primarily rely on their ARTS display to learn the ATIS code. Other controllers usually read the current ATIS code off the closed circuit TV screen. Hobby Final is most interested in the HOU ATIS code. That conceivably could be displayed on his BRITE screen but isn't. He must read the HOU ATIS off the closed circuit TV.

Wind speed and direction indicators are located at LC and GC in the Cab and at East Arrival, West Arrival and South Radar positions in the TRACON (Figures 5-23 and 5-24). The instruments are also monitored by the departure radar controllers. Under the

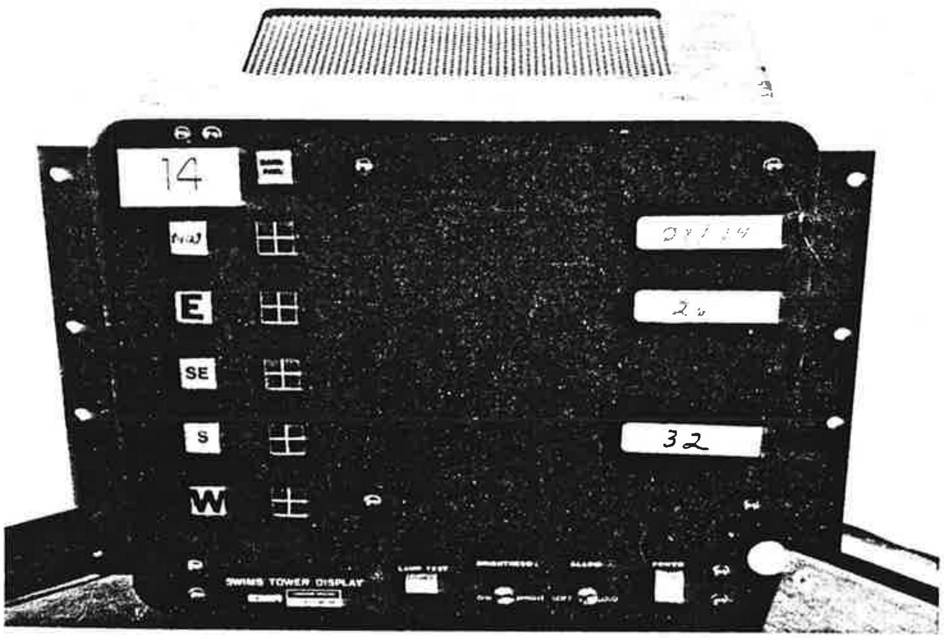


FIGURE 5-22. LLWSAS DISPLAY

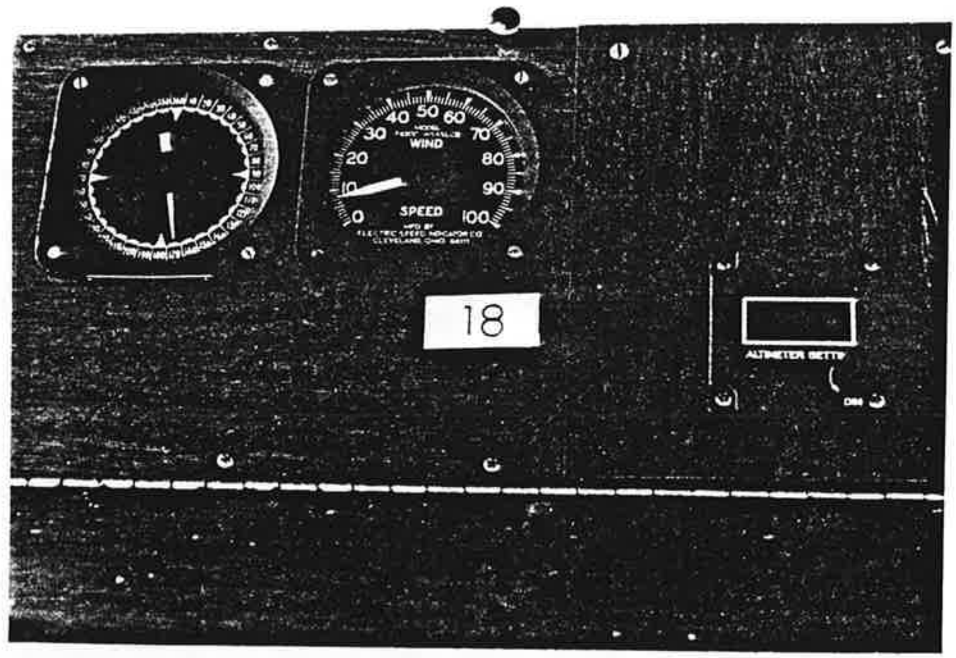


FIGURE 5-23. WIND INSTRUMENTS AND ALTIMETER AT GROUND CONTROL

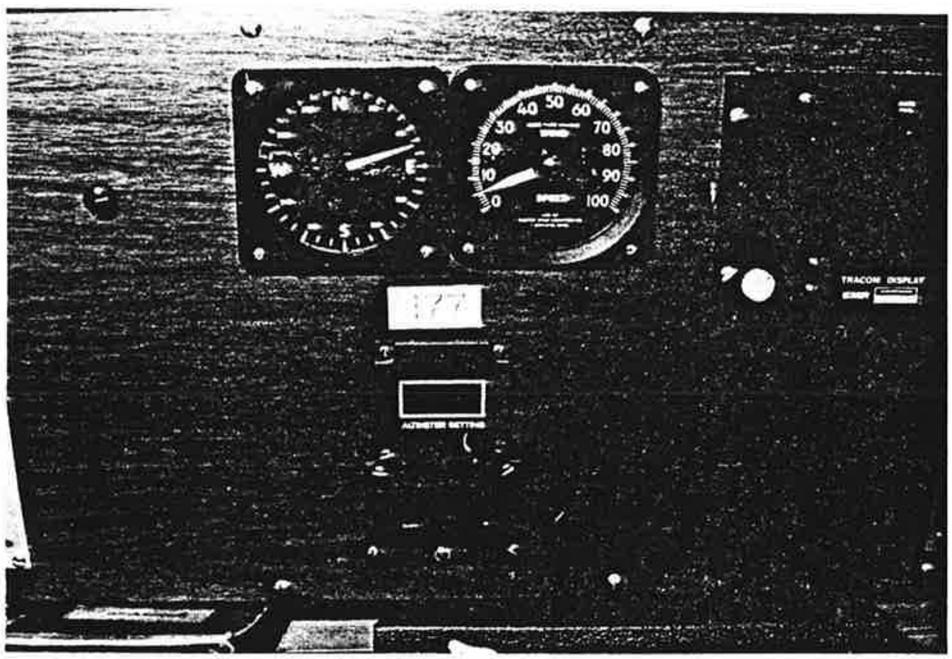


FIGURE 5-21. WIND INSTRUMENTS ALTIMETER AND DIGITAL CLOCK AT ARRIVAL WEST POSITION

following circumstance, wind information may be issued to departures by GC or to arrivals by LC and the arrival radar positions; if pilot doesn't have ATIS, if conditions have changed since current ATIS was recorded, if the facility is operating contrary to wind because the wind is low, or at pilot request.

A Minimum Safe Altitude Warning (MSAW) Control Panel is located by GC in the Cab and near the Supervisor's desk in the TRACON. The MSAW is a function of the ARTS III computer that aids the controller by alerting him when a tracked aircraft is below or is predicted by the computer to go below a predetermined minimum safe altitude. The control panel is equipped with a switch which tests its operational status. It is tested by the supervisor at the beginning of each shift.

Equipment checklists must be completed by supervisors during various watches. Copies of these checklists are shown in Figures 5-25 and 5-26.

A summary of controller requirements for status, control and weather information is presented in Table 5-7.

TOWER EQUIPMENT CHECK-LIST

DATE______

DAILY-EACH WATCH

LIGHT GUN - - - 08____ 16____ 00__

DAILY-0800 WATCH

PRIMARY and STANDBY TRANSMITTERS and RECEIVERS ___
REMARKS ____________________

GONSETS / TRANSCEIVERS - - - ___
REMARKS ____________________

ATIS - - - ___
REMARKS ____________________

MALSR / ALS - - - ___
REMARKS ____________________

ILS SYSTEMS - - - ___
REMARKS ____________________

BRITE / CONRAC - - - ___
REMARKS ____________________

CRASH PHONE - - - ___
REMARKS ____________________

OTHER OUTAGES ____________________

DAILY- 1600 WATCH

ILS RWY 8____ ALS RWY 8____ ALS GENERATOR______

REMARKS ____________________

FIGURE 5-25. TOWER EQUIPMENT CHECK-LIST

AC/TS PRE-DUTY BRIEFING
AND
TRACON EQUIPMENT CHECK-LIST

WATCH______ DATE____

STAFFING______ OJT____________ FAM TRIPS____________

FORECAST____

SIGMETS ____

____

EQUIPMENT/NAVAID STATUS_______________________________

____

APPROACH IN USE--- IAH__________ HOU__________ EFD__________

AIRPORT ACCEPTANCE RATES--- IAH____________ HOU__________

CENTER RESTRICTIONS___________________________________

____

GATE HOLD____

OTHER INFO____

____

____

DAILY-EACH WATCH

ARTS TIME_____ RECORDER TIME______ DATA LINK SETTINGS______

VERIFY REPORTED OUTAGES--- ______

CHECK STANDBY RADIOS for UNREPORTED OUTAGES--- ______

DAILY-0800 WATCH

ALTIMETERS__________ NWS WIND INSTRUMENTS ____________

DAILY-1600 WATCH

RECORDER CHECKS--- ______

WEEKLY- MONDAY 0800 WATCH

121.5- PRI_____ STNBY_____ 243.0- PRI_____ STNBY _____

FIGURE 5-26. AC/TS PRE-DUTY BRIEFING AND TRACON EQUIPMENT CHECK-LIST

TABLE 5-7. SUMMARY OF REQUIREMENTS FOR STATUS; CONTROL AND WEATHER INFORMATION AT IAH

Item	Location	Users	Description/Discussion	Status Determination and Dissemination
CONSOLE CLOCK	FD/CD, GC, LC1, E W, CO-E, CD-W, D, N, I, H, L, AD/DD, SI	FD/CD, GC, LC1, LC2 SD, CD, E, CD-W, CH SI, AD/DD, CS	Because the console clocks are not very accurate radar positions (H, E, W, D, N, I, L, S) use ARTS clock, but because of glare and distance other positions rely on the console clock.	The supervisors check time against a recording every shift and update digital clocks as necessary. FD/CD compares ARTS time with time on weather reports over teleprinter from FSS and updates as necessary.
ALTIMETER	LC1, E, W, D, N, L and 2 at GC	FD/CD, GC, LC1, LC2, SC, E, WP, N, I, L, SI, S, O	There is one analog altimeter at GC and all others are digital. Although there are altimeter settings in the ARTS, controllers prefer digital readings which reflect real time settings	FD/CD compares ARTS with FSS readings received via teleprinter and adjusts periodically - supervisors check digital altimeters as a part of the equipment check list. Differences of more than 0.07 are reported to maintenance.
RVR	GC, LC1, H, L between E&D, D&I, I&W, W&N	GC, LC1, LC2, CS, E, D, I, W, N, H, SI, L, S, O	The field units are located at rollout, midfield and touchdown on S126 and at rollout and touchdown on 14/32. Each RVR unit displays a different runway. IUH also has HOU's RVR.	The status of the RVR is determined by the supervisor and controllers using the equipment. Controllers check the equipment as they use it to make sure the indicator lights show proper setting. An "E" is displayed if there is an error in the system.
WIND SPEED WIND DIRECTION	GC, LC1, D, N, L	FD/CD, GC, LC1, LC2 SC, E, W, D, N, I, SI AD/DD, L, S, O	The supervisor uses wind lead-time and flow and runway in use. Wind is issued to pilots if pilot doesn't have ATIS, if conditions have changed since ATIS, at pilot request, or if facility is operating contrary to wind.	The status of wind instruments is determined by observing the indicators to make sure they're moving and by cross-checking readings with those of FSS that come over the teleprinter hourly.
LLWSAS	GC, LC1, D, N, L	Presently no users	The LLWSAS at IAH is inoperative because an appropriate location for the field units has not been determined.	A string of 8's appears across display when LLWSAS is out of order.
RUNWAY & & TAXIWAY LIGHTS CONTROL PANEL	LC2	GC or LC	There are 2 panels (14/32 and 8/26). Each consists of a series of toggle switches and intensity settings.	These lights are easily seen by tower personnel who report any malfunction to airways facility. The tower also relies on reports from pilots. Outages are written on the status board and included in ATIS.
APPROACH LIGHTS CONTROL PANEL	LC	LC	The panel is located at LC for immediate response to pilot request for flashing or dimming. Complicated combinations which are posted are needed for operating the HLS.	Runway 8 monitor has an alarm which signals outage. Approach lights are checked by CS each shift, and by LC through contact with pilot. Outages are written on the status records and included in ATIS.

TABLE 5-7. SUMMARY OF REQUIREMENTS FOR STATUS; CONTROL AND WEATHER INFORMATION AT IAH (Continued)

Item	Location	Users	Description/Discussion	Status Determination and Dissemination
STOL LIGHTS CONTROL PANEL	LC2	GC or LC2	This panel consists of an intensity control, and a series of toggle switches. The STOL VASI is also operated with a toggle switch.	These lights can be seen by the tower who reports any malfunction to airways facility. The tower also relies on reports from pilots. The outage is written on the status boards and included in ATIS.
NAVAIDS	Southwest Corner	CS	The monitor for Humble Vortac is a square box with an indicator light. CS checks it every shift.	HOU vortac is monitored at the IAH cab. Outages are reported to FSS as a NOTAM. Notices of off-site outages are relayed to SI from FSS by interphone. Outages are posted on status boards or passed on paper.
LANDING AID MONITOR PANEL	GC, I	LC, FD/CD, GC, CS, I, D, N	There are 2 panels at GC for 8 and 14. They consist of indicator lights which light up when a component is inoperative. They are also 4 indicator lights at Final.	All of the ILS components are monitored by the equipment near GC. Additionally, CS checks the equipment each shift. Pilot reports are also useful. Outages are written on status boards, included in ATIS and reported to FSS as NOTAM.
MSAW CONTROL PANEL	GC, SI	SC, SI	A rectangular box equipped with a switch and indicator lights for testing operational status.	The equipment is tested by the supervisors each shift. All radar controllers are notified of outages.
WEATHER RECEIVED	AD/DD, FD/CD	AD/DD, SI, FD/CD, SC	Teleprinters are located at FD/CD and AD/DD, electrowriter at AD/DD, FDEPS at FD/CD and AD/DD	Equipment is monitored by FD/CD and AD/DD. If no message is received after an appropriate time length an attempt will be made to request a message. Outages are reported to maintenance. If repairs cannot be made in less than 1/2 hour, spare units are brought in or telephone is used.
WEATHER SENT	AD/DD, FD/CD	AD/DD, SI, FD/CD, SC	Teleprinters are located at FD/CD and AD/DD.	

6. HOUSTON AIR TRAFFIC CONTROL SYSTEM

6.1 DAILY AND ANNUAL HOU OPERATIONS

A quantitative summary of HOU operations is provided in the following tables and figures:

Table 6-1. HOU Operations FY 80

Table 6-2. HOU Yearly Aircraft/Instrument Operations

Figure 6-1. HOU Operations vs Time of Day

The William P. Hobby Airport, Houston's second major commercial aviation facility is located approximately seven miles south of Houston's central business district. Until IAH was opened in 1969, Hobby was Houston's only airport, enplaning more than two million passengers annually. In 1980 the HOU TRACAB handled approximately 350,000 aircraft operations (arrivals and departures). The traffic mix was as follows:

Air Carrier	13.5%
Air Taxi	6.3%
General Aviation	80.0%
Military	.2%

Hobby handled approximately 174,000 instrument operations in 1980 which were handed off to/from the TRACON. Overflights as a percentage of total instrument operations equalled 1%. No record is kept of VFR overflights. The traffic mix was as follows:

Air Carrier	27.1%
Air Taxi	8.2%
General Aviation	63.4%
Military	1.3%

Daily TRACAB traffic begins building rapidly at 7 am. A plateau is maintained until midafternoon when traffic begins building and finally peaks shortly before dark. At nightfall much traffic drops off. Hobby typically handles about 1000 arrivals and departures per day. No record is kept of VFR overflights which account for much of their traffic.

TABLE 6-1. HOUSTON HOBBY AIRCRAFT OPERATIONS FY 80

	TOTAL	AIR CARRIER	AIR TAXI	GENERAL AVIATION	MILITARY
Itinerant	336,019	47,307	22,153	265,864	695
Local	14,407	0	0	14,379	28
Total	350,426	47,307	22,153	280,243	723

HOUSTON HOBBY INSTRUMENT OPERATIONS FY 80

	TOTAL	AIR CARRIER	AIR TAXI	GENERAL AVIATION	MILITARY
Primary	172,279	47,306	14,121	110,345	507
Overflights	2,211	6	246	294	1,665
Total	174,490	47,312	14,367	110,639	2,172

TABLE 6-2. YEARLY AIRCRAFT/INSTRUMENT OPERATIONS
AIR TRAFFIC CONTROL TOWER
WILLIAM P. HOBBY AIRPORT
HOUSTON, TEXAS

YEAR*	ITINERANT OPERATIONS	LOCAL OPERATIONS	TOTAL ACFT OPERATIONS	INSTRUMENT OPERATIONS
1970	188,647	55,820	244,467	48,308
1971	190,853	53,950	244,803	48,770
1972	188,688	45,425	234,113	60,267
1973	200,346	40,677	241,023	72,973
1974	218,662	50,852	269,167	89,876
1975	237,381	53,933	290,414	102.502
1976	254,869	46,165	301,034	106,507
1977	284,561	37,500	322,061	123,645
1978	295,010	25,750	320,760	138,524
1979	324,876	17,343	342.219	163,220
1980	334,550	12,997	237,547	179,879

*Calendar Years

Source: Hobby Airport Records.

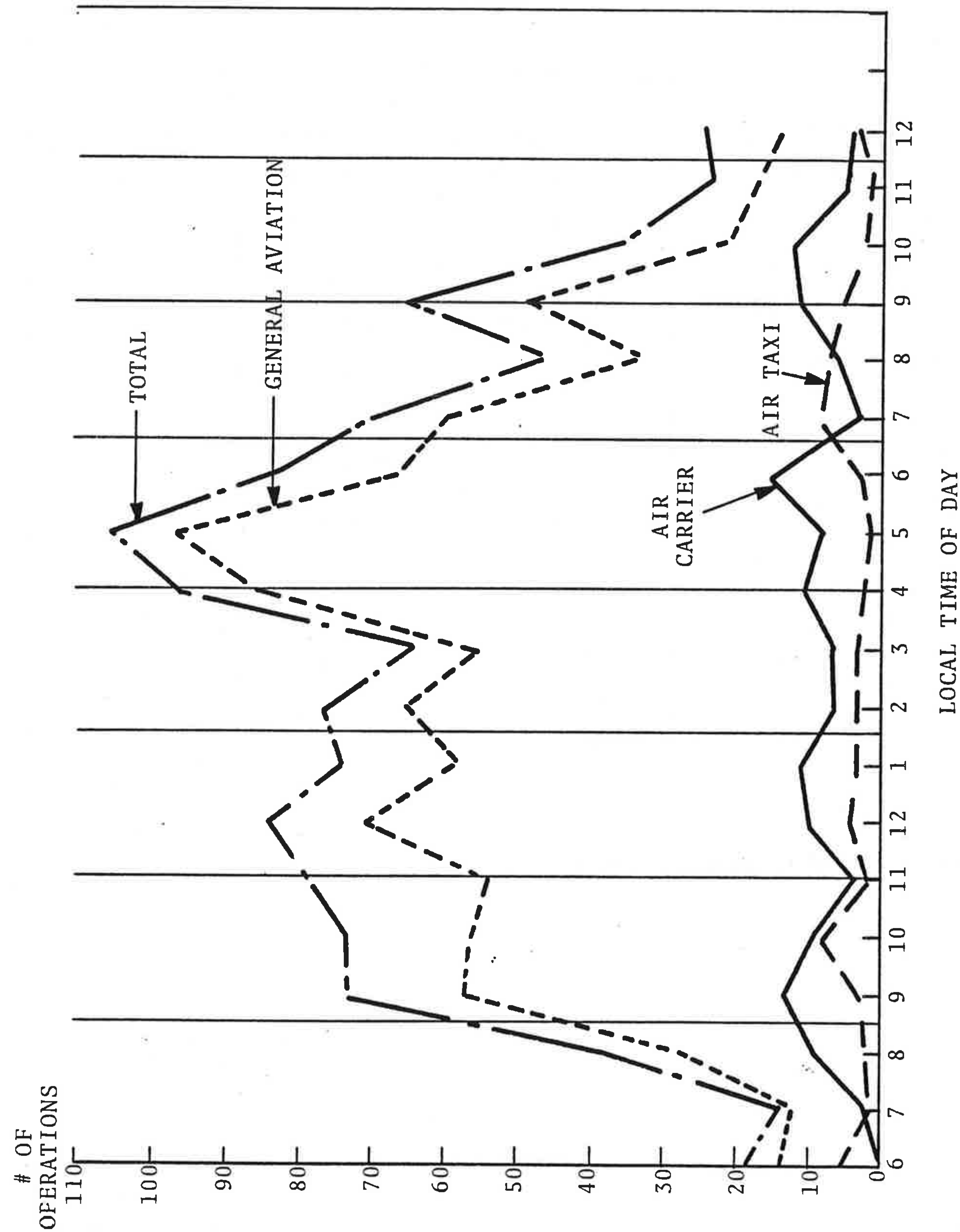


FIGURE 6-1. HOU OPERATIONS VS. TIME OF DAY (11/12/80)

FIGURE 6-1. HOU OPERATIONS VS. TIME OF DAY (11/12/80)

6.2 HOU LAYOUT

The following figures and tables provide summaries of HOU's air traffic control activities.

Figure 6-2.	Hobby Control Zone
Figure 6-3.	Runway Configuration
Figures 6-4 - 6-11.	Runway/Taxiway Patterns
Figures 6-12 - 6-15.	Typical Approach Patterns
Figures 6-16 - 6-17.	Arrival/Departure Corridors

There are four runways at Hobby airport. Their crisscrossing configuration (displayed in Figure 6-3) requires great skill and coordination by controllers for optimal usage. The north-south runway 17/35 is 4500 feet long and 150 feet wide. The northwest-southeast runway 13R/31L and the northeast-southwest runway 4/22 are both 7600 feet long and 150 feet wide. Runway 13L/31R which is situated parallel to the northeast of 13R/31L is 4800 feet long and 100 feet wide. Runways 4/22 and 13R/31L are equipped with Instrument Landing Systems (ILS). The localizer for runway 22 is used for a backcourse approach. There are four different runway flows: North, South, East and West. A North or South flow is preferred and is utilized when conditions permit. The flows are as follows:

<u>South Flow</u>: Arriving aircraft may be sequenced to 22, 13R, or 13L. Aircraft asigned to 22 must be able to hold short of runway 13L. During VFR weather conditions aircraft may depart on runways 13L, 13R, 17, and that portion of runway 22 southwest of 31L. During IFR conditions, in addition to 13L, 13R and 17 aircraft may be permitted to depart from the approach end of runway 22.

<u>North Flow</u>: Arriving aircraft are sequenced to 13R, 31L, and 35. Aircraft depart on 31R, 31L, and 25.

<u>East Flow</u>: Aircraft arrive on runway 4. Runway 31L may be used for special VFR arrivals. Aircraft may depart on runways 4, 35, 31L, and 31R.

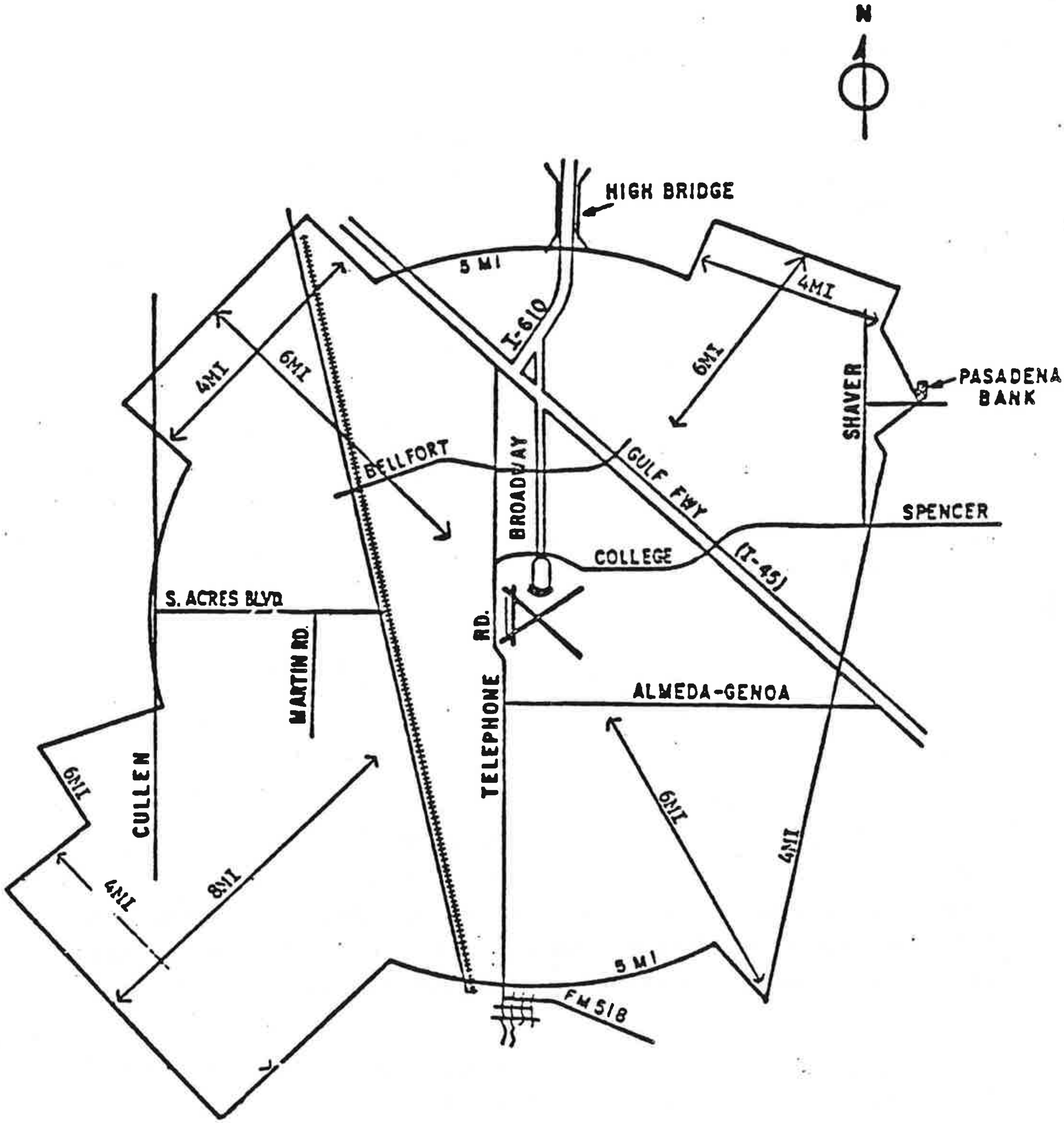


FIGURE 6-2. HOBBY CONTROL ZONE

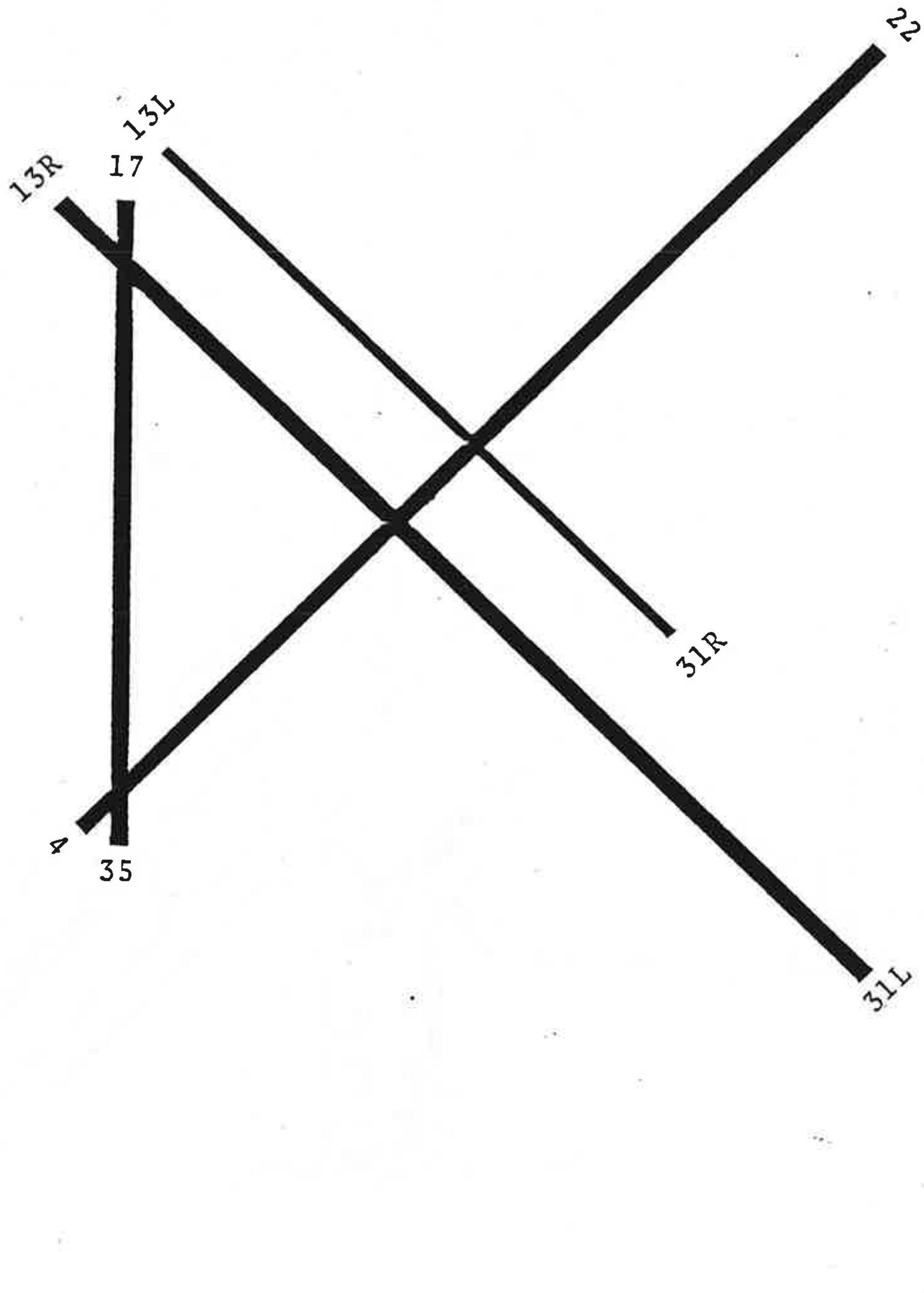


FIGURE 6-3. HOBBY RUNWAY CONFIGURATION

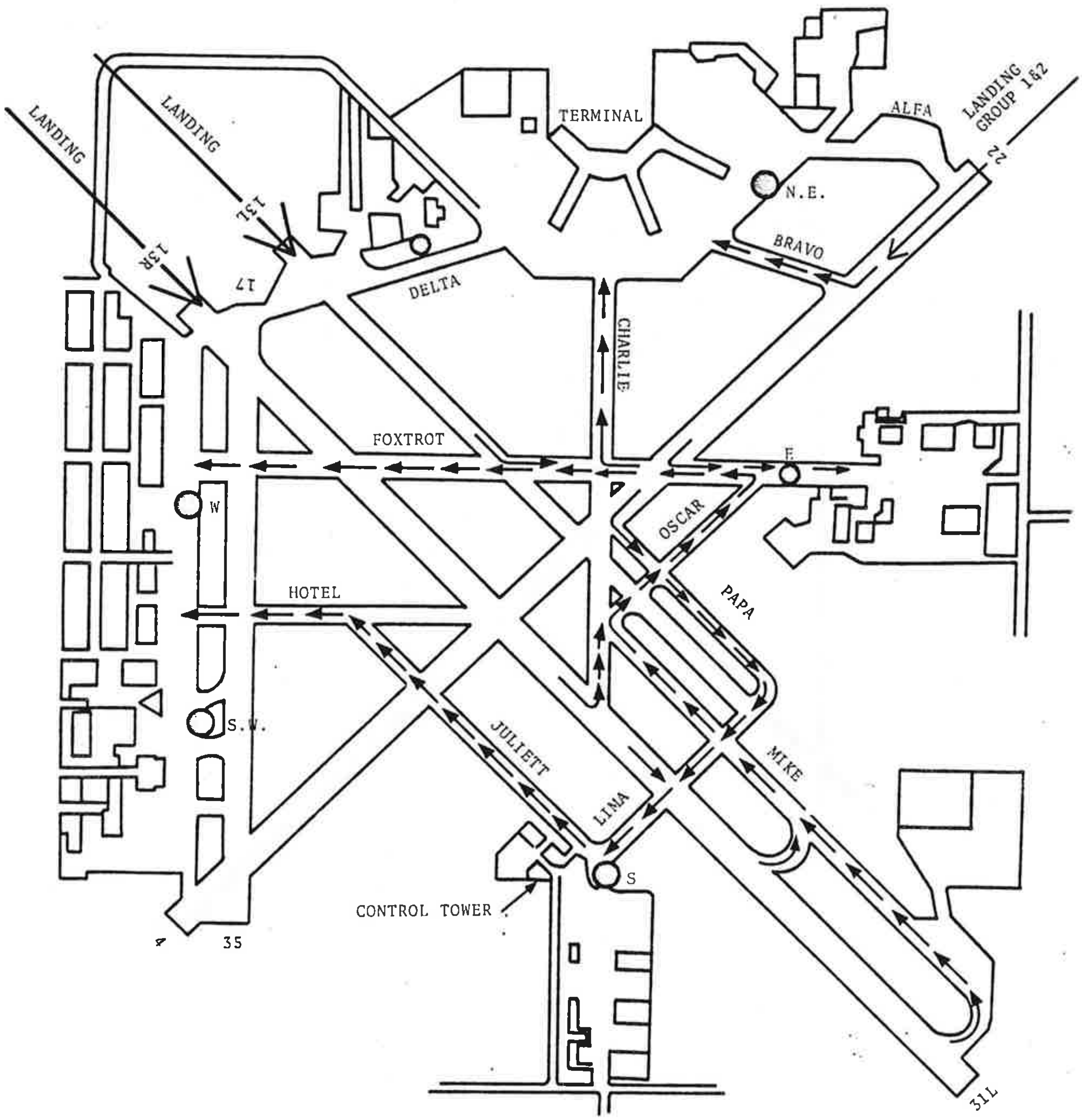


FIGURE 6-4. TAXIWAY TRAFFIC FLOW FOR SOUTH FLOW ARRIVALS

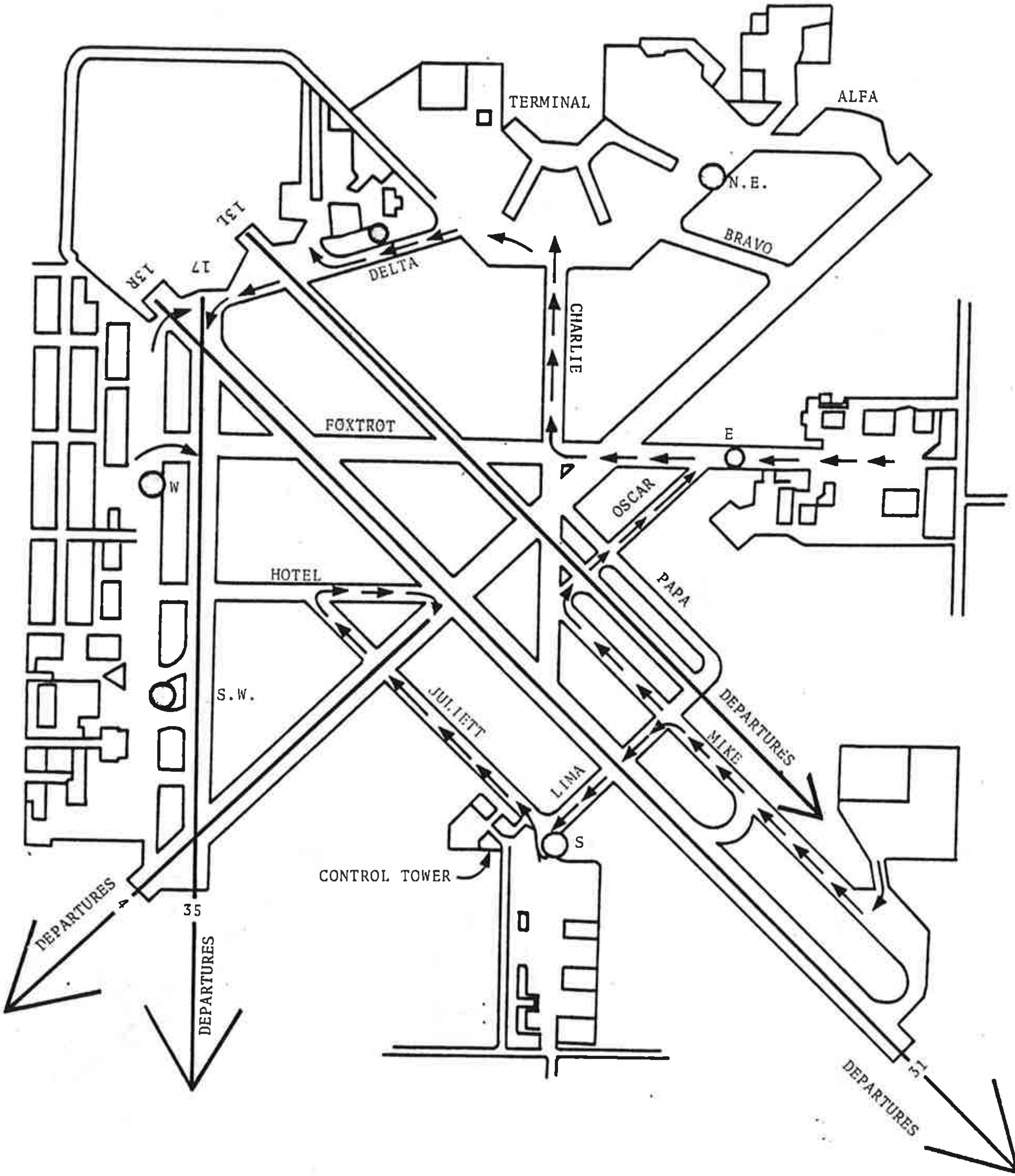


FIGURE 6-5. TAXIWAY TRAFFIC FLOW FOR SOUTH FLOW - DEPARTURES

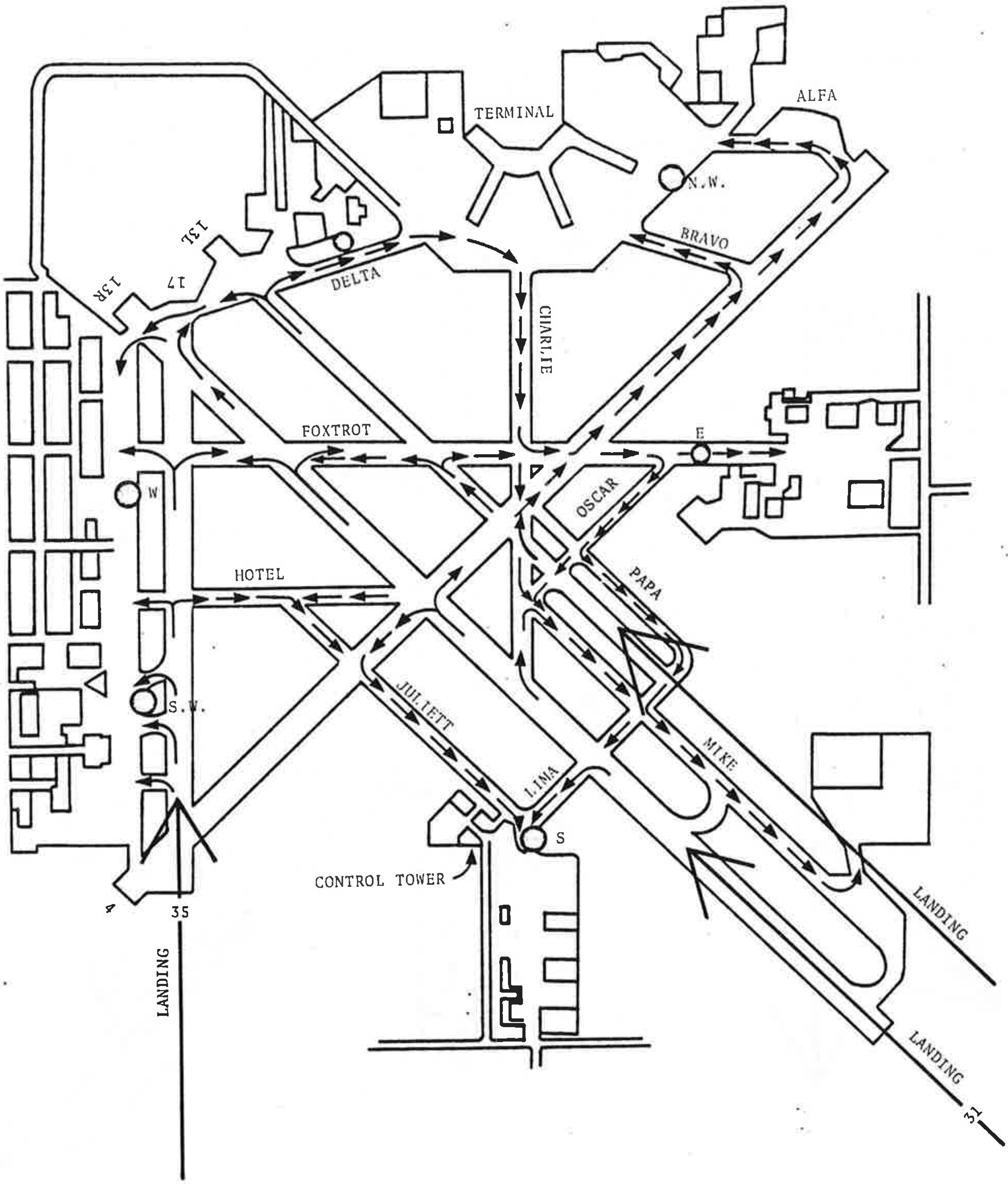


FIGURE 6-6. TAXIWAY TRAFFIC FLOW FOR NORTH FLOW - ARRIVALS

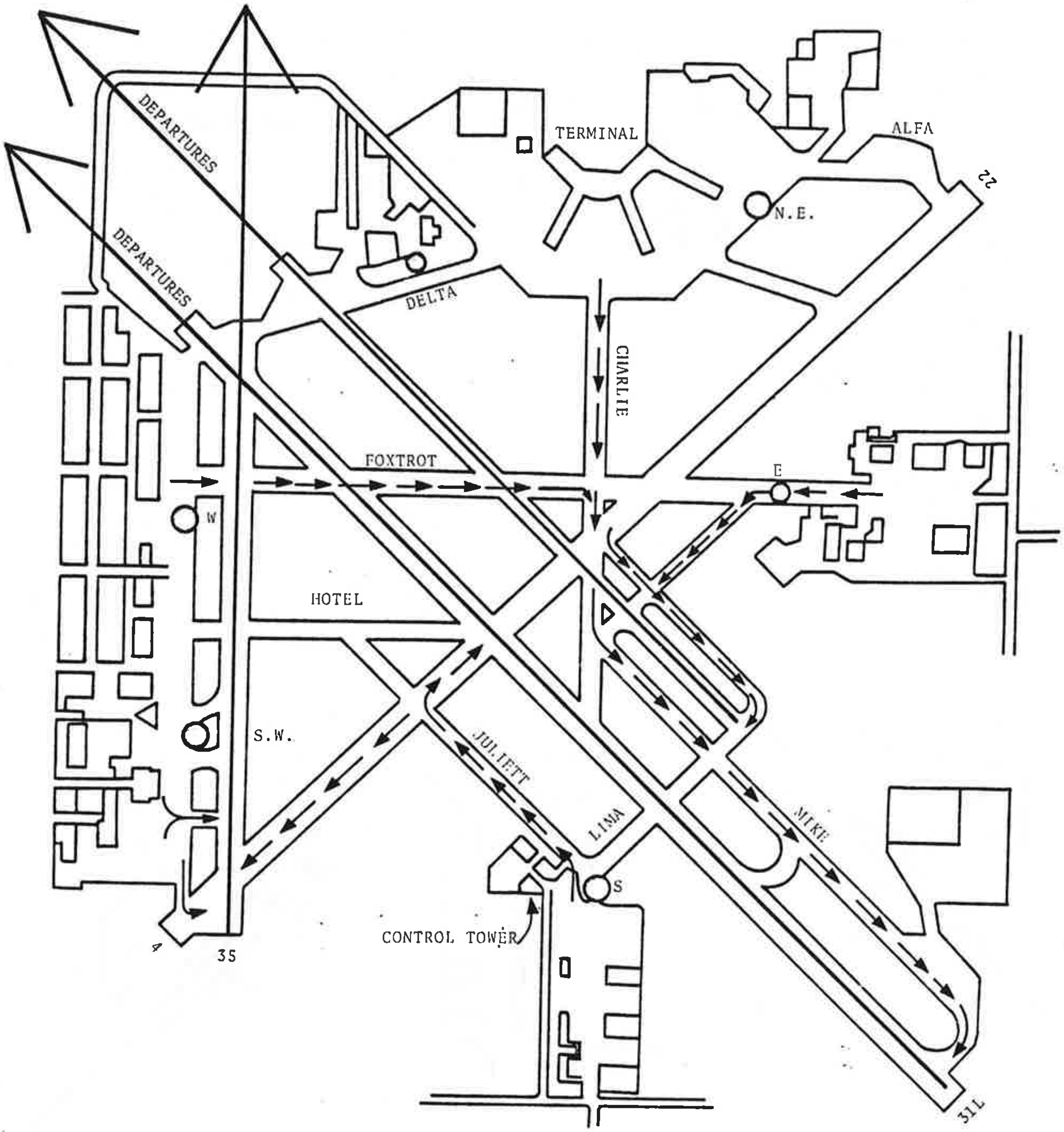


FIGURE 6-7. TAXIWAY TRAFFIC FLOW FOR NORTH FLOW - DEPARTURES

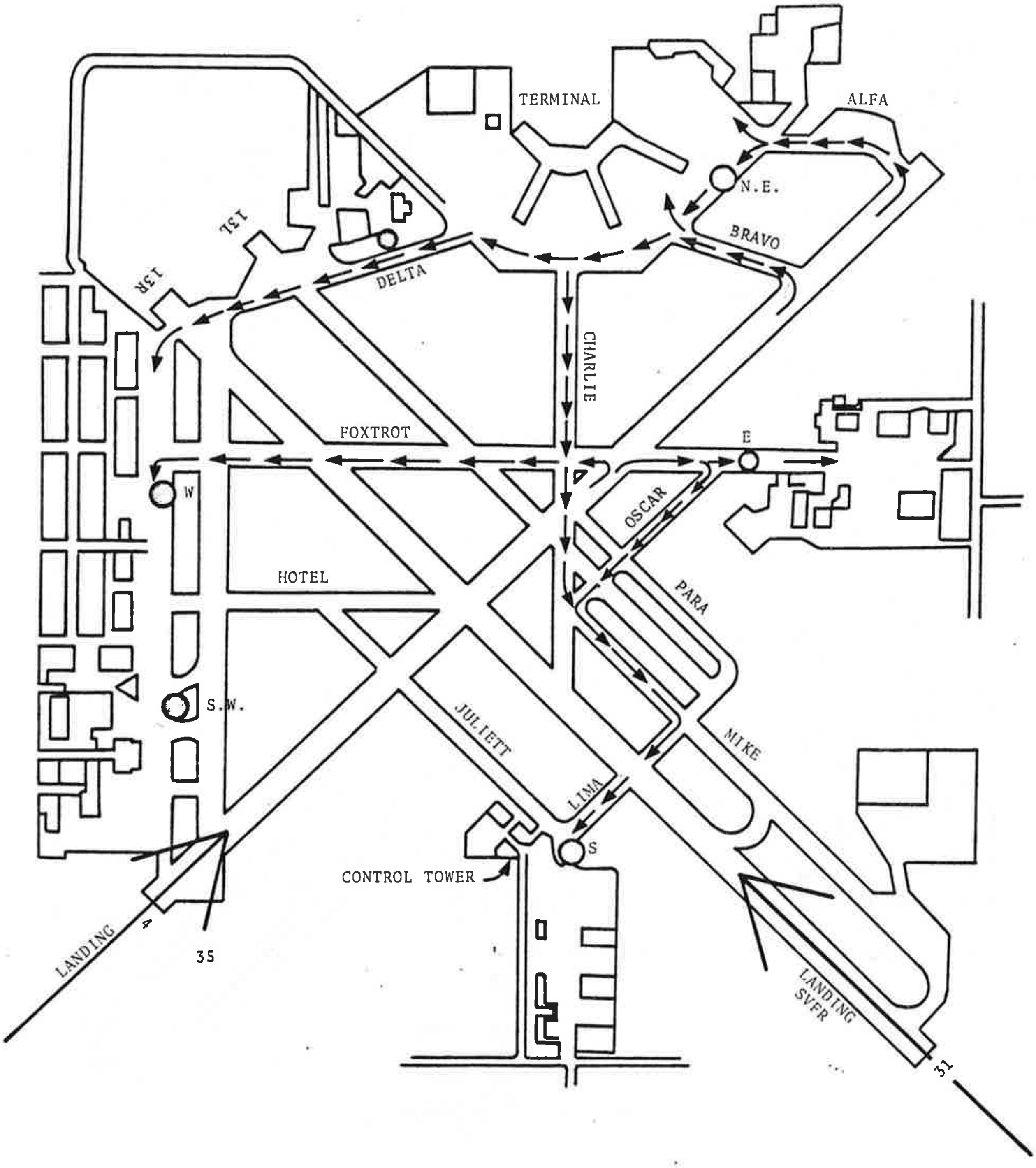


FIGURE 6-8. TAXIWAY TRAFFIC FLOW FOR EAST FLOW - ARRIVALS

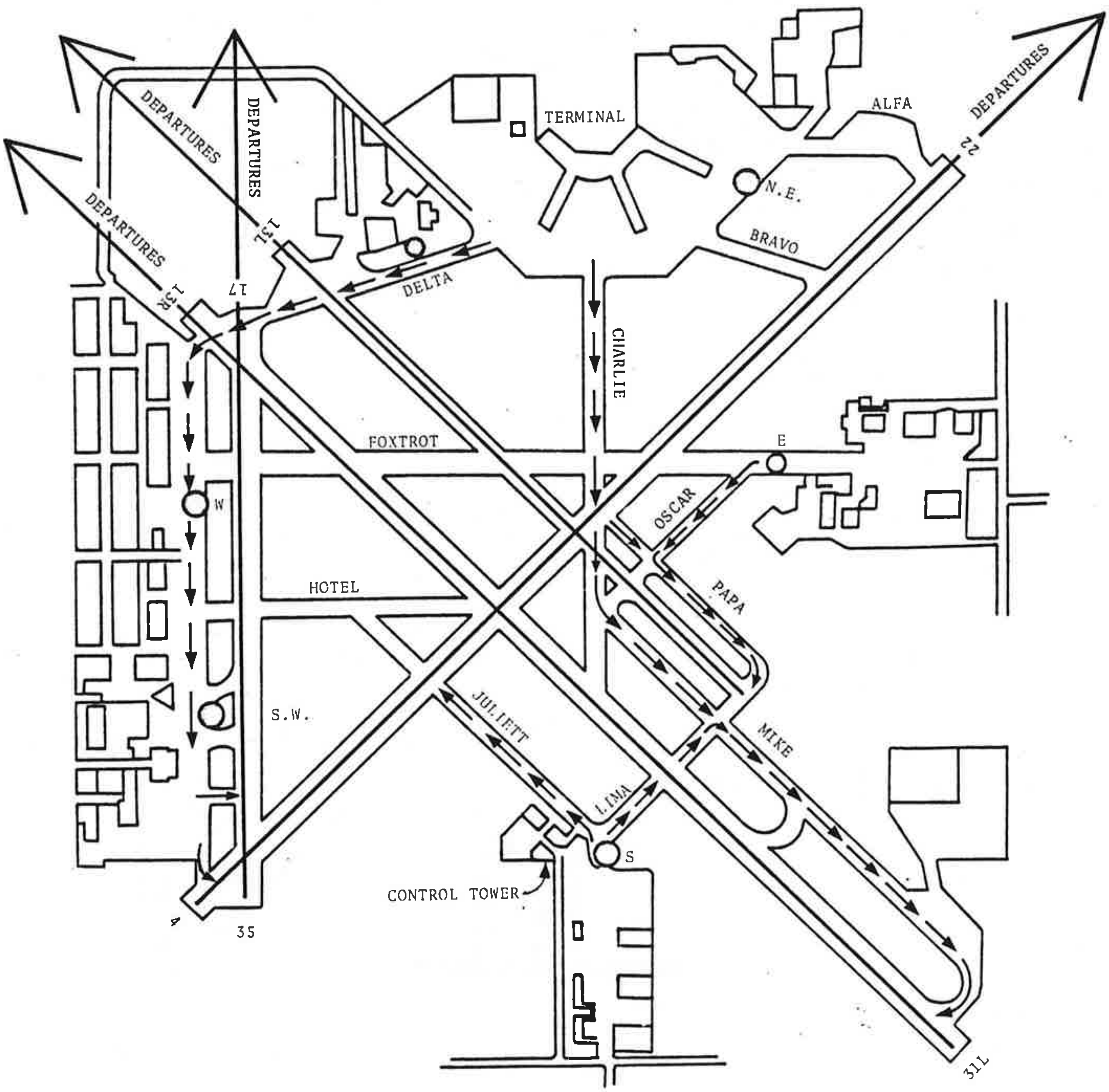


FIGURE 6-9. TAXIWAY TRAFFIC FLOW FOR EAST FLOW - DEPARTURES

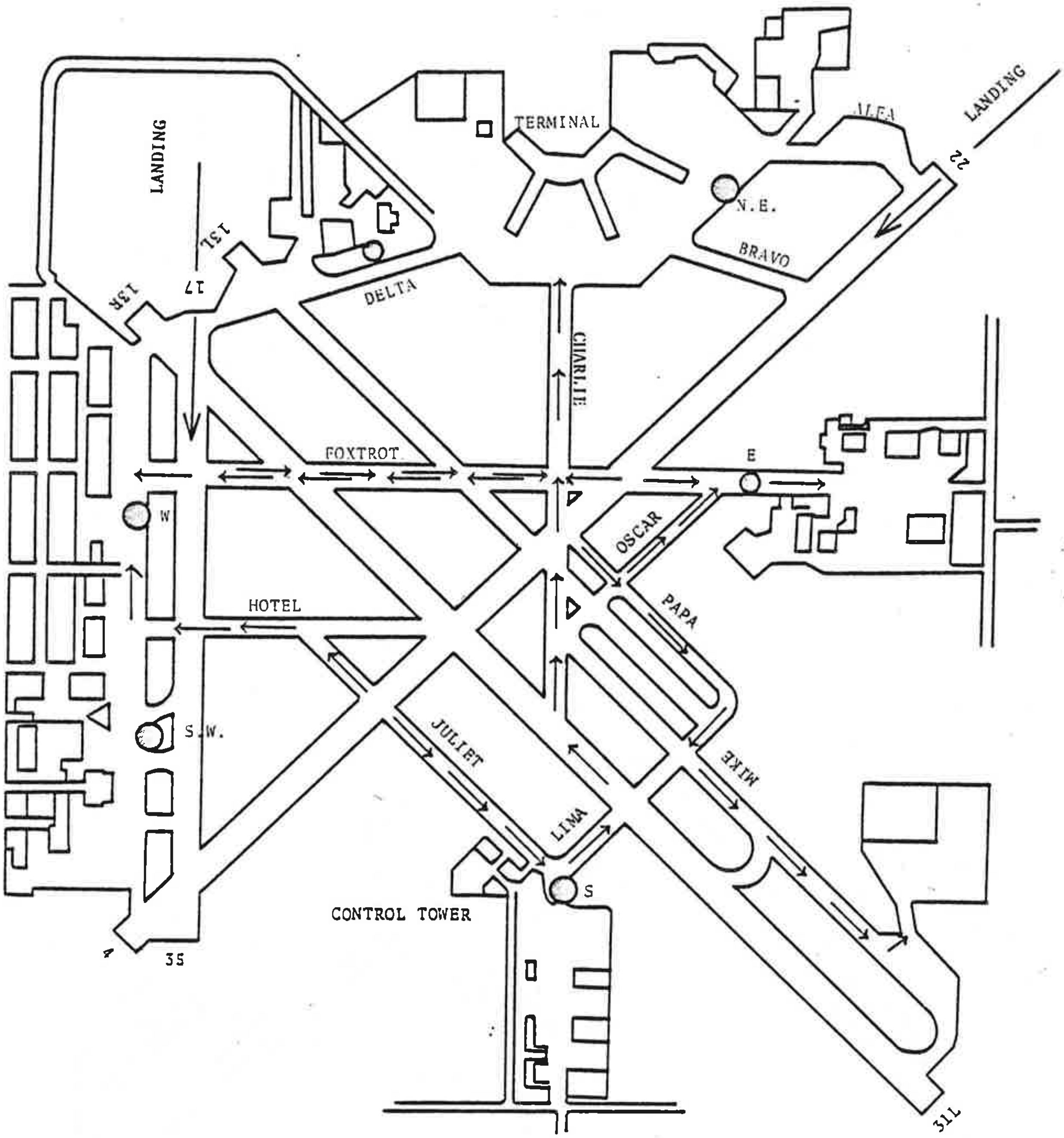


FIGURE 6-10. TAXIWAY TRAFFIC FLOW FOR WEST FLOW - ARRIVALS

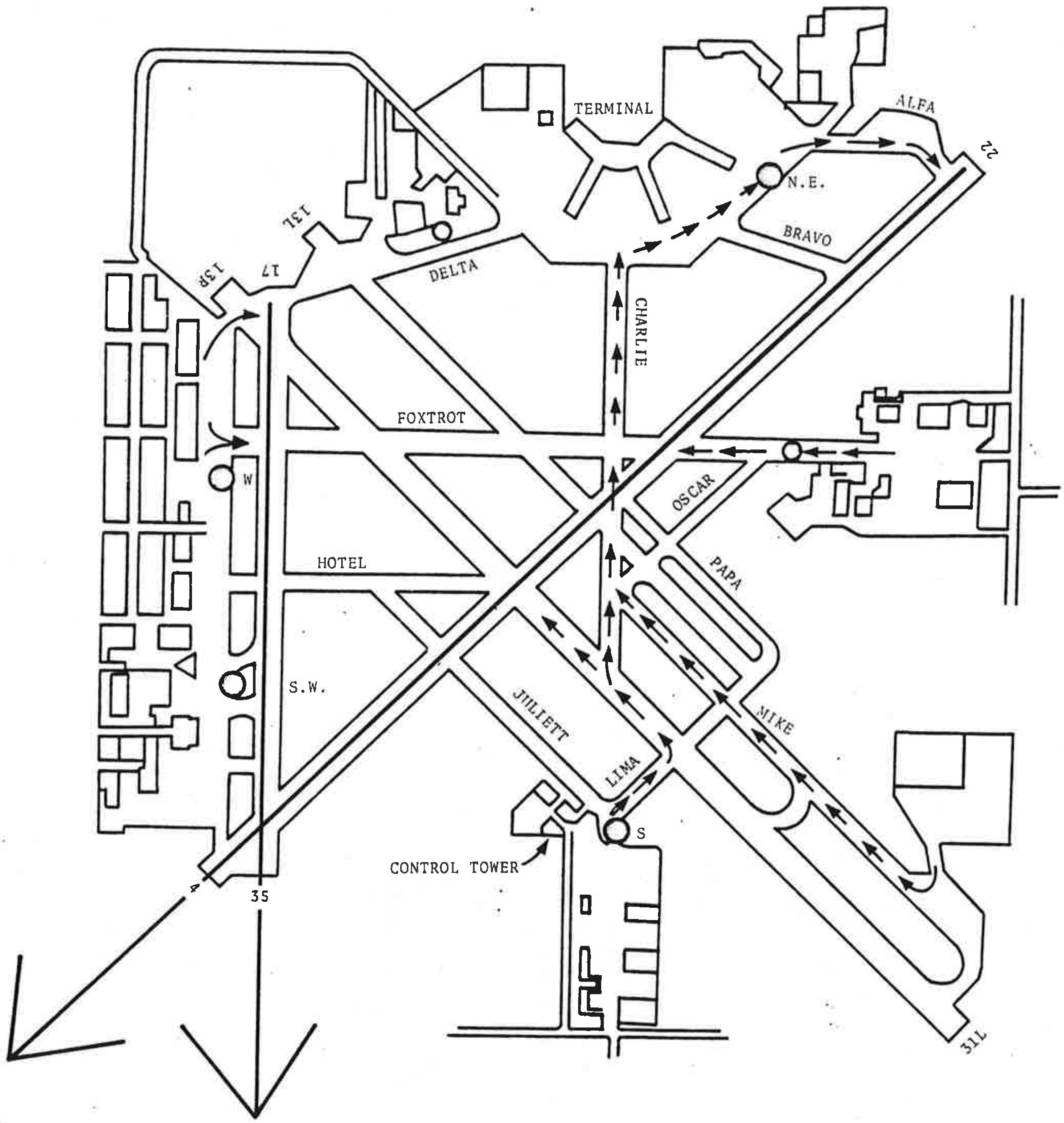


FIGURE 6-11. TAXIWAY TRAFFIC FLOW FOR WEST FLOW - DEPARTURES

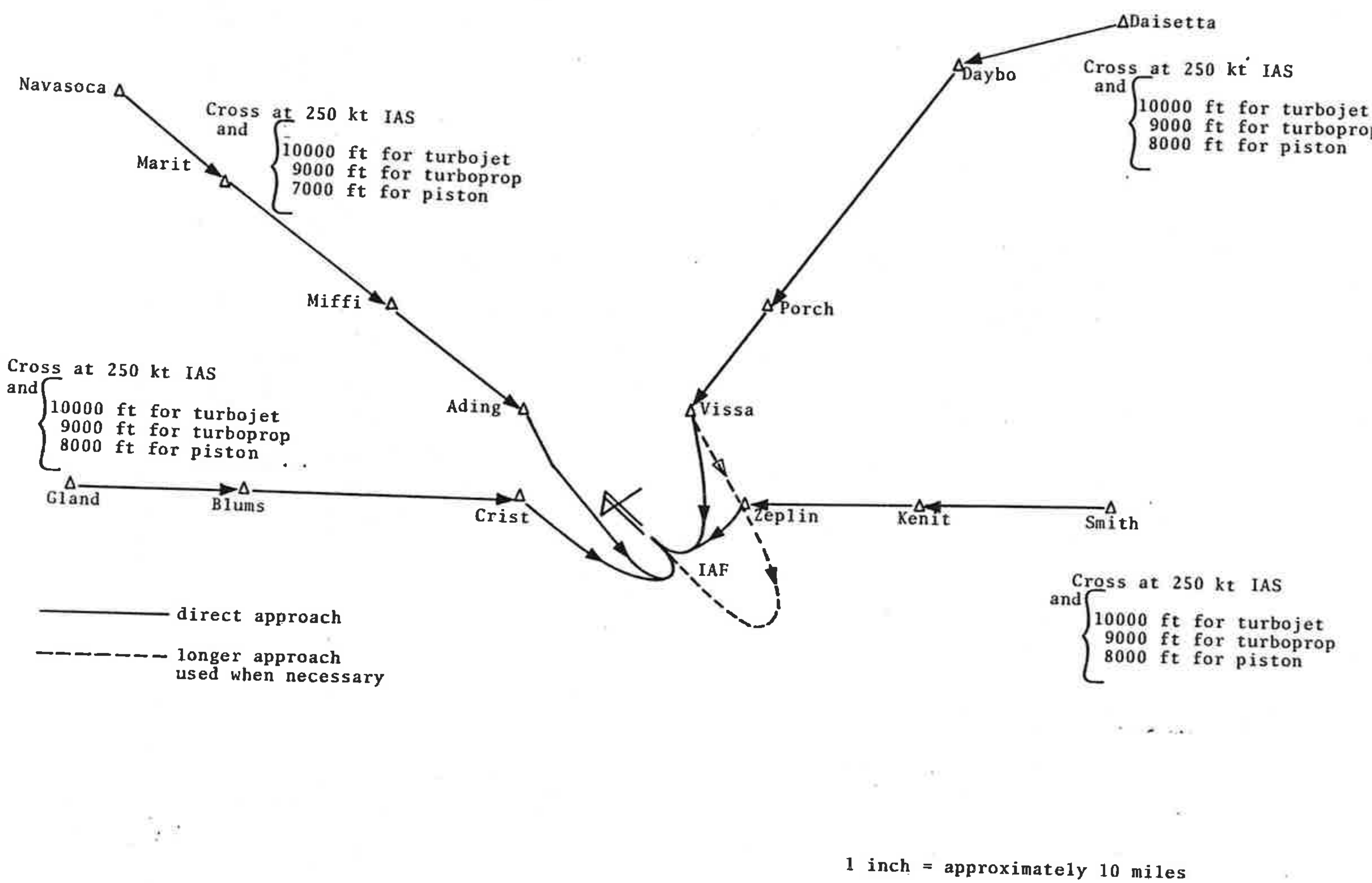


FIGURE 6-12. TYPICAL APPROACH PATTERN FOR RUNWAY 31L

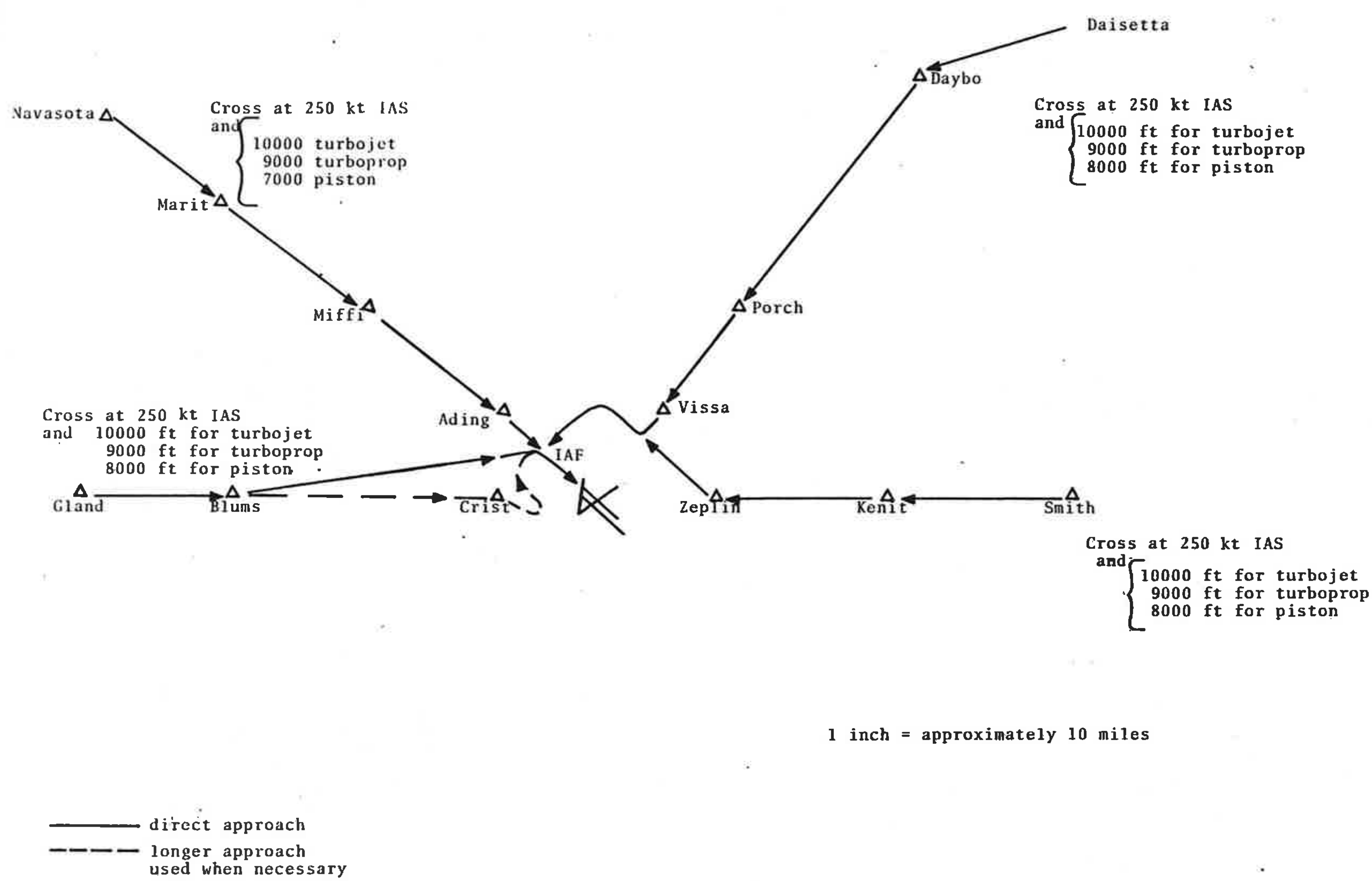


FIGURE 6-13. TYPICAL APPROACH PATTERN FOR RUNWAY 13R

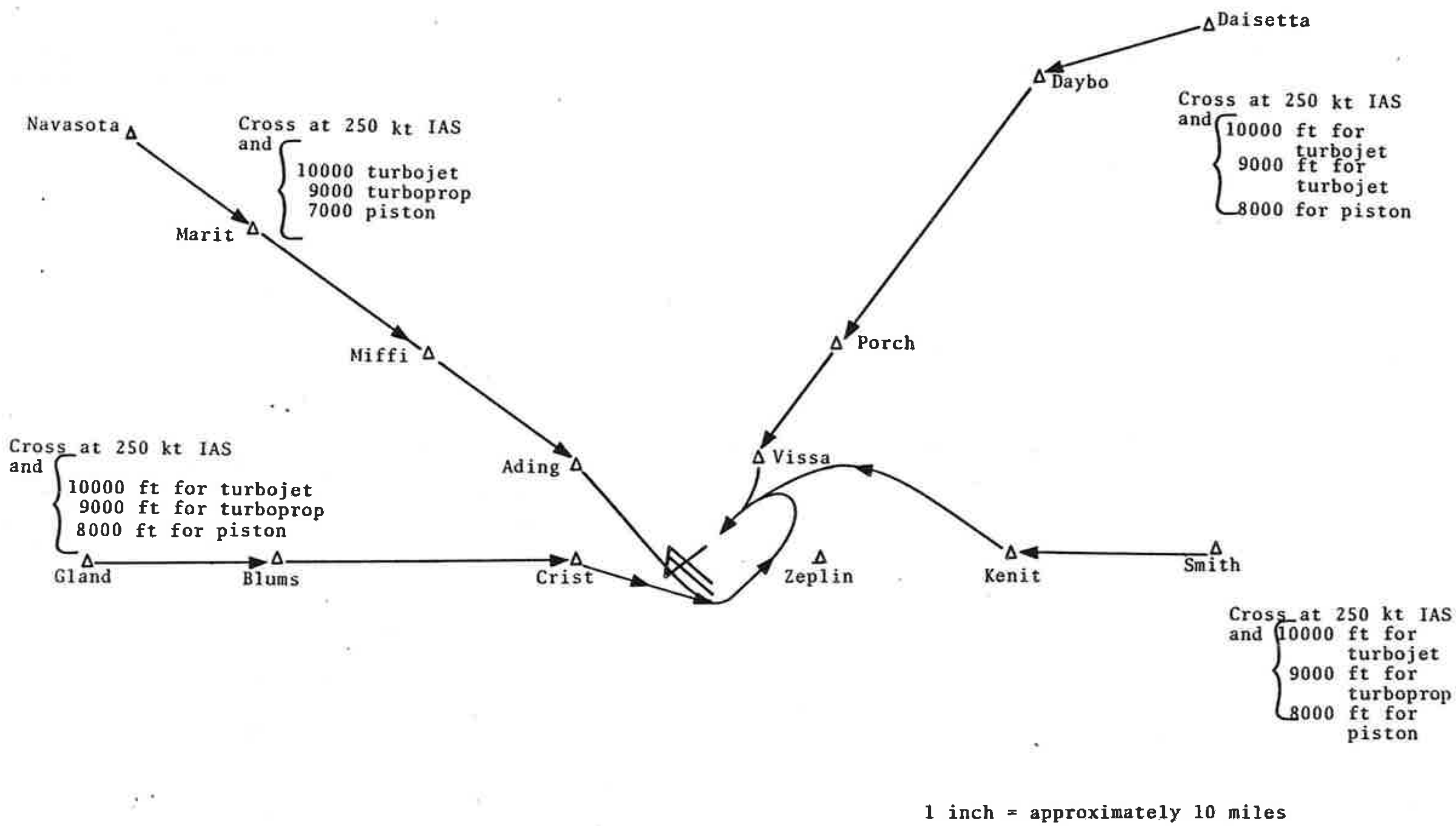


FIGURE 6-14. TYPICAL APPROACH PATTERN FOR RUNWAY 2

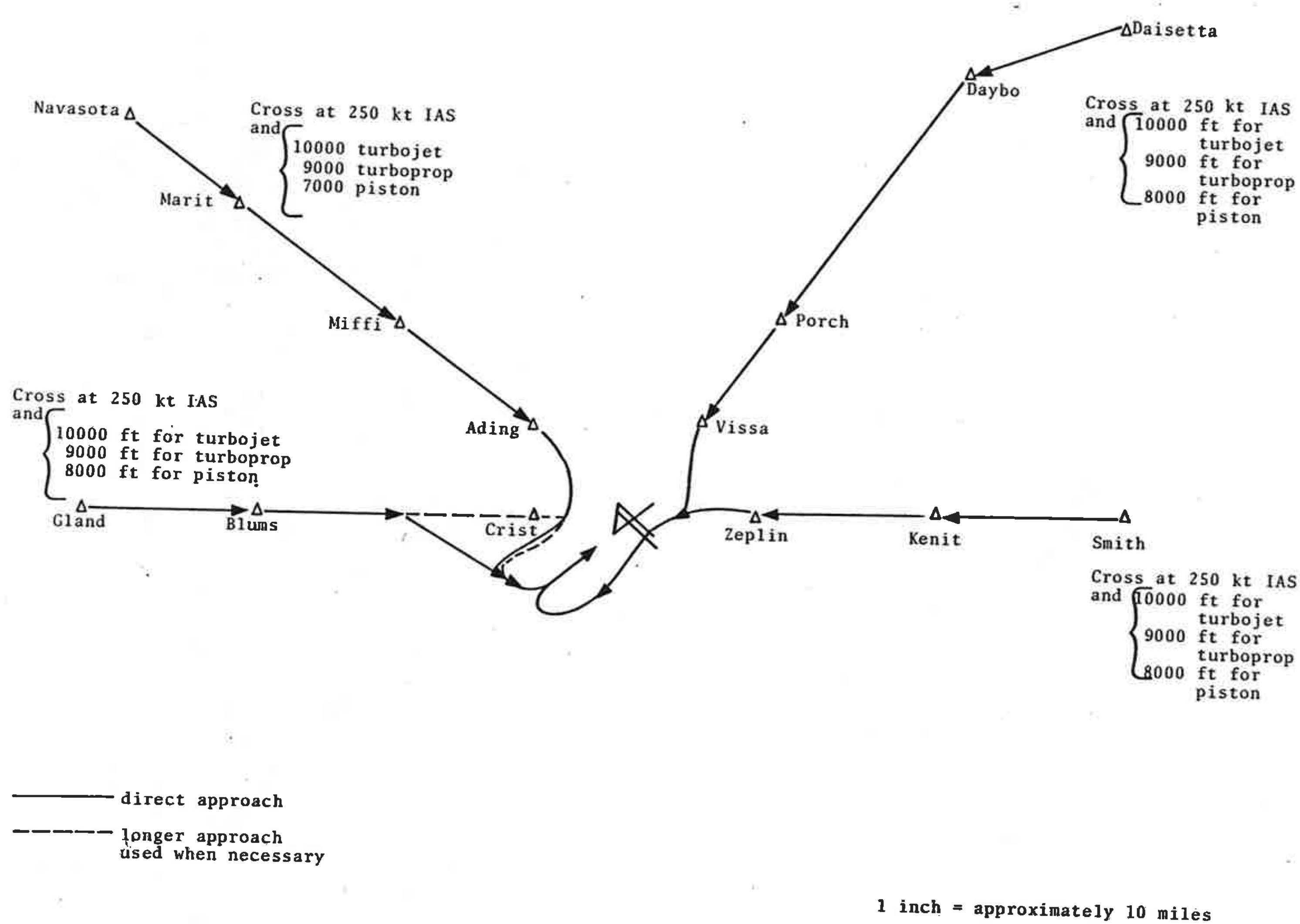


FIGURE 6-15. TYPICAL APPROACH PATTERNS FOR RUNWAY 4

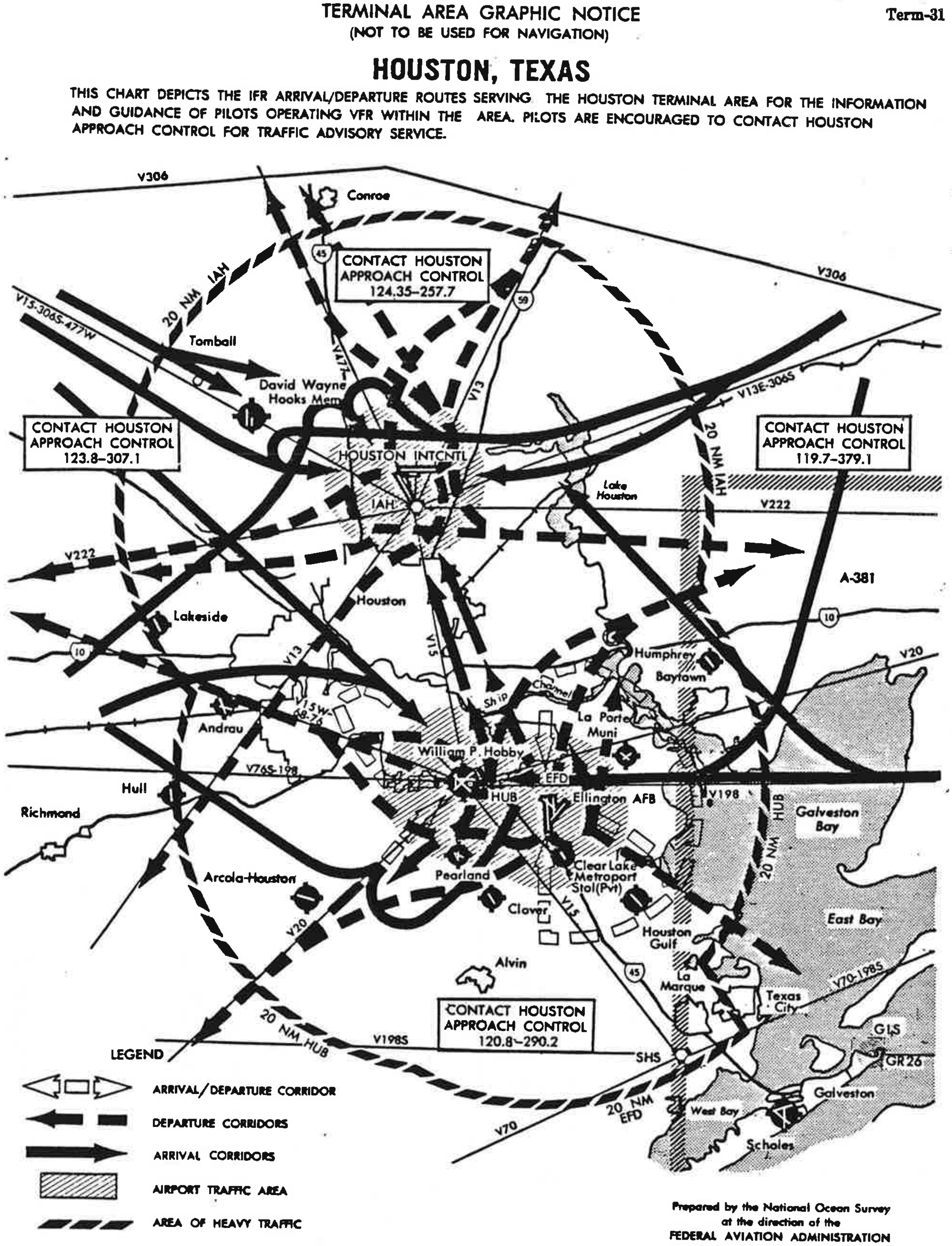


FIGURE 6-16. ARRIVAL/DEPARTURE CORRIDORS

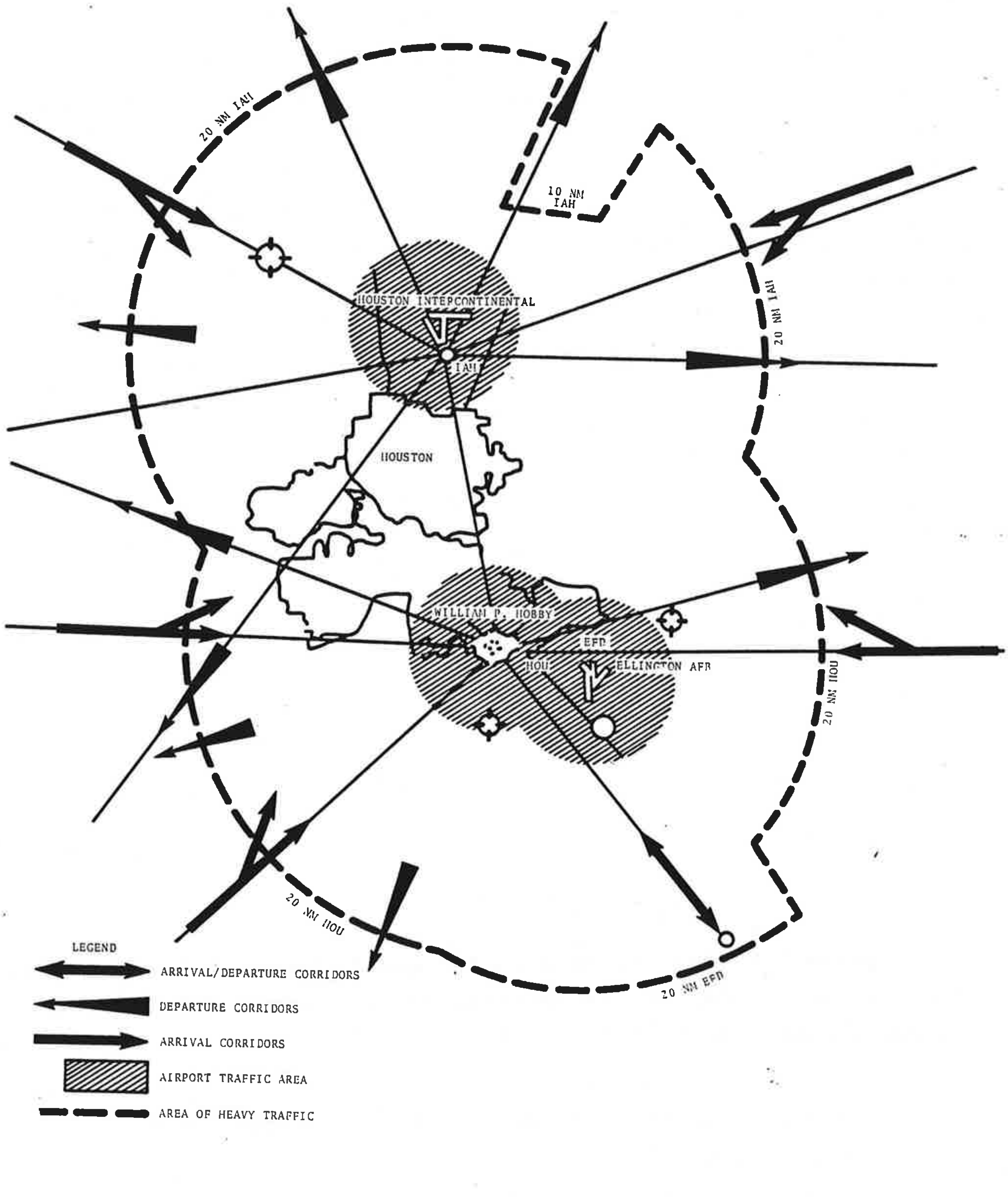


FIGURE 6-17. ARRIVAL/DEPARTURE CORRIDORS

West Flow: Aircraft arrive and depart on runways 17 and 22.

Hobby TRACAB provides Stage II service for arriving aircraft within 8 nautical miles of the airport. IFR aircraft have been separated and sequenced by the TRACON. In the TRACAB Hobby Radar sequences the VFR aircraft between the IFR aircraft. An IFR arrival to HOU will most frequently be vectored by the ARTCC to one of four major fixes: Navasota, Smith, Gland, or Daisetta. These flights approach the fix at 250 knots and at an altitude of 10,000 feet MSL. Coordinated transfer of control of the flight from the ARTCC to the TRACON is accomplished via a silent ARTS handoff (as discussed in Section 2.2). The aircraft continues towards HOU descending to 6000 feet. Responsibility is usually transferred to the TRACAB within 8 DME radius of Hobby. The TRACAB does not have a keyboard with which to accept handoffs. They are essentially forced by Hobby Final. A one day sample of computer generated HOU IFR arrival strips show the following distribution of arrival coordination fixes:

Navasota	90
Smith	79
Cland	62
Daisetta	38
Klute	34
HOU	11
Sabine	4
HUB	3
	321

Approach plates are kept in the Local Control/Hobby Coordinator position binder at the reference table in the TRACAB. The approach plates contain information on:

- glide slope and path
- landing aid identifiers, locations and frequencies
- local obstructions
- minimum descent altitudes

HOU TRACAB provides service to departures until radar separation exists or until courses diverge for VFR aircraft. Control of the aircraft is then transferred to Hobby Final at the TRACON. Departures generally follow the routes described in Figure 6-16.

6.3 HOBBY TRACAB STAFFING

The layout, staffing, operations and working environment of the Hobby TRACAB are presented in the following:

Figure 6-18.	William P. Hobby Tower
Figure 6-19.	TRACAB Floor Plan Showing Controller Position
Table 6-3.	TRACAB Positions and Duties
Table 6-4	TRACAB Staffing Hours

There are 7 positions in the TRACAB of which 5 are staffed on a regular basis. Photographs of the position consoles are displayed in Figures 6-20 through 6-27. Specific positional responsibilities are described in Table 6-3. Hobby Radar and Hobby Coordinator positions are generally combined. The resultant position is responsible for preparing inbound VFR flight strips, sequencing all arrival flight strips (IFR and VFR) at LC position in order of approaching descent, and pointing out all arriving aircraft to LC. Cab Coordinator, the liaison between LC and GC is generally not staffed due to lack of personnel. GC controls aircraft on the ground. All ramp areas are uncontrolled. Advisories are issued during pushback as warranted. LC works all arriving and departing aircraft within 8 DME of the TRACAB. The FD/CD position at Hobby has duties similar to FD/CD at IAH: preparation of flight strips, ATIS broadcasts and monitoring/transmitting of weather information. During the midnight shift staff is reduced to the Supervisor.

A position log and position relief checklist are kept at each position. Duty time data is tracked in the log. The relief checklist contains a list of items relevant to the position, which are to be reviewed during a manning change, such as equipment outages, NOTAMS, SIGMETS, PIREPS, switched frequencies, prodedural modifications, and information pertinent to pending and current traffic.

FIGURE 6-18. WILLIAM P. HOBBY TOWER

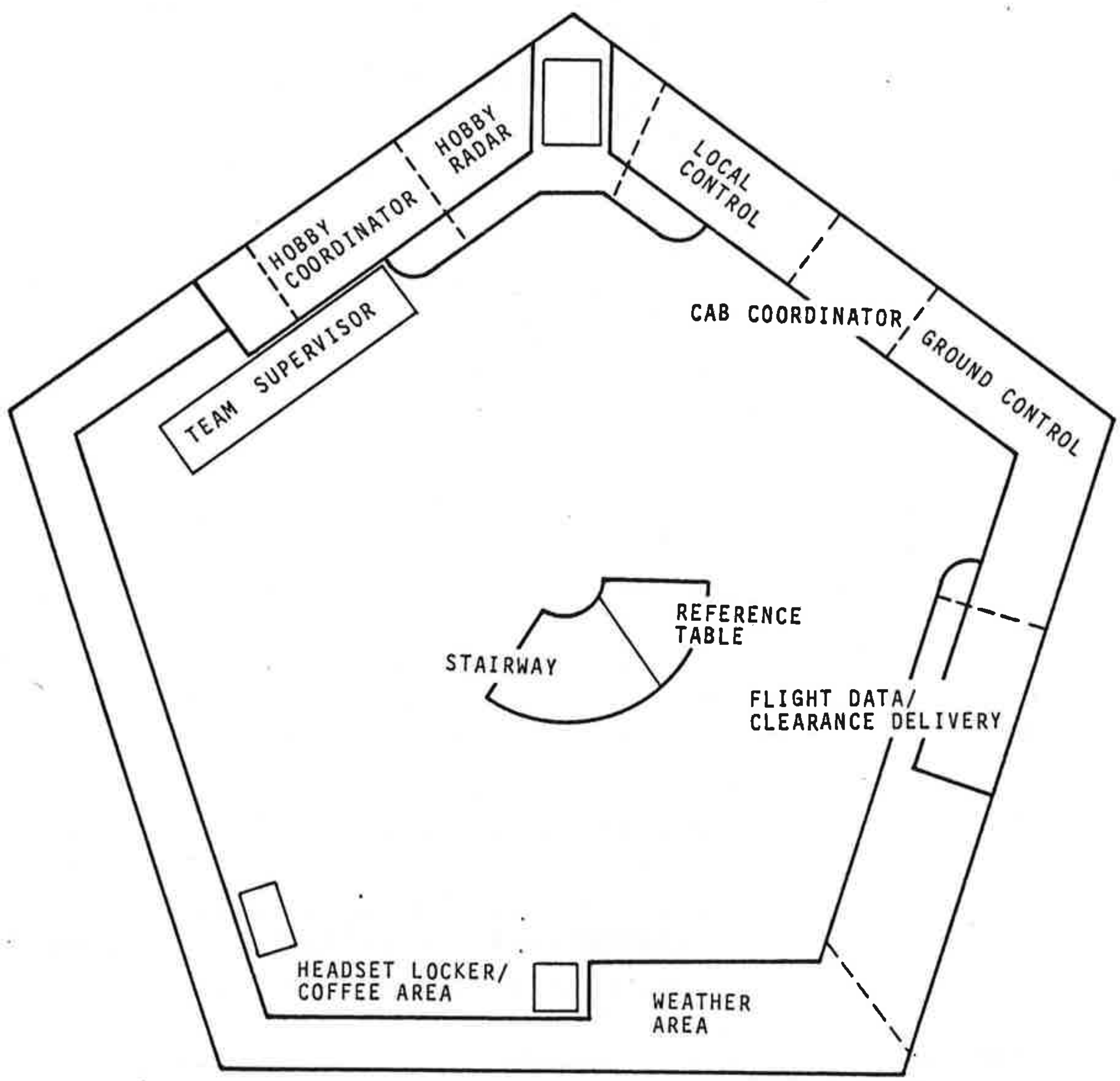


FIGURE 6-19. TRACAB FLOOR PLAN SHOWING CONTROLLER POSITION

TABLE 6-3. TRACAB POSITIONS AND DUTIES

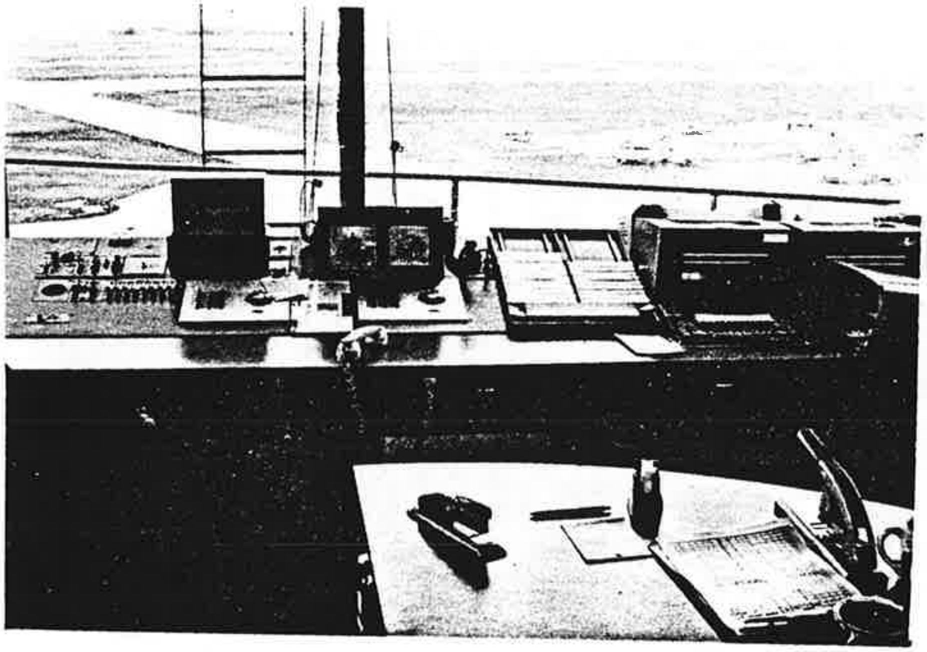
Team Supervisor (TS)	o Assigns personnel to required positions o Coordinates traffic delays with IAH o Monitors, restores and reports equipment malfunctions o Issue and cancel NOTAMS o Provides for ATCs break and relief periods o Coordinates with Facility Chief when necessary o Contacts Facility Chief for authorization to call overtime
Local Control (LC)	o Receives inbound from IAH(IFR) + HR(VFRS) o Ensures landing sequence and provides separation for IFR o Gives "rolling" to TRACON o Makes visibility observations o Requests PIREPS o When required requests IFR release from IAH TRACON o Issues verbal clearance to GC to cross runway when CC not manned o Advises HR, GC and CC of active runways
Hobby Radar (HR)	o Prepares flight strips and provides service for VFR Stage II arrivals o Sequences strips in front of LC o Points out and handsoff to LC 2-3 miles from airport o Provides VFR traffic advisories to departures and overflights on request o Coordinates with LC for any special operation
Hobby Coordinator (HC)	o Sets up inbound IFR flight strips for LC o Points out inbound IFR to LC o Helps HR point out inbound VFR to LC o Assists LC in forwarding "rolling"
Cab Coordinator (CC)	o Monitors LC to determine when GC can cross runway and issues approval to GC

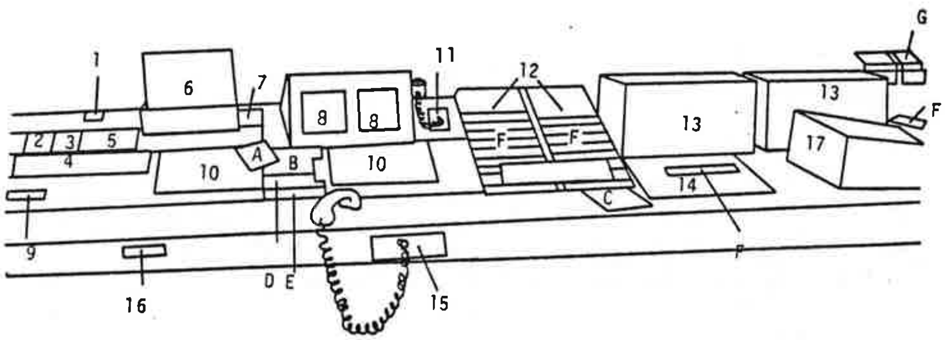
TABLE 6-3. TRACAB POSITIONS AND DUTIES (Continued)

Ground Control (GC)	o Controls aircraft and radio equipped vehicles on ground o Operates field lighting system o Coordinates with HC/LC for runway use
Flight Data/ Clearance Delivery (FD/CD)	o Issues IFR and special VFR clearances o Prepares FDEP arrival and departure strips and VFR departure strips o Forwards visibility information to HOU FSS o Broadcasts ATIS o Records and forwards PIREPS o Tabulates all aircraft operations hourly o Gives military arrival and departure times to HOU FSS o Changes recorder tapes

TABLE 6-4. TRACAB STAFFING HOURS

POSITION	HOURS
Team Supervisor	24 hours
Local Control	0700 - 2400
Hobby Radar	0700 - 2200
Cab Coordinator	0700 - 2100
Ground Control	0700 - 2200
Flight Data/Clearance Delivery	0700 - 2200
Hobby Coordinator	0700 - 2100





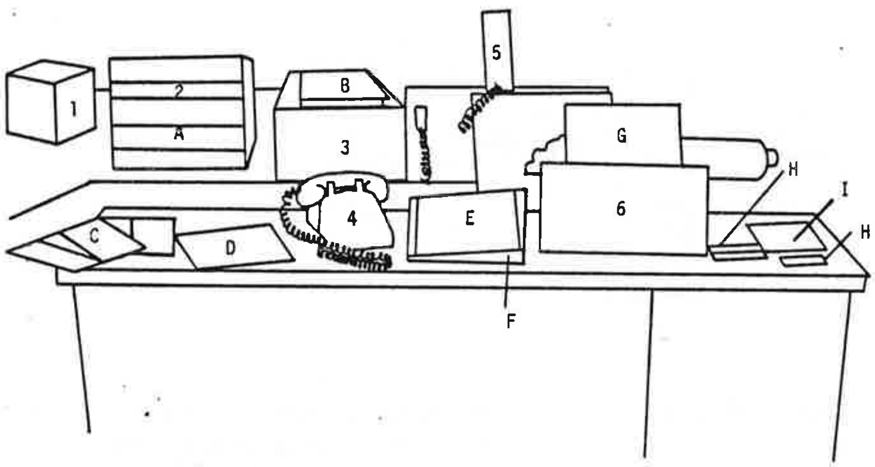
DEVICES

1. BEACON LIGHT CONTROL SWITCHES
2. ILS MONITOR PANEL
3. RECORDER STATUS PANEL
4. FAA COMMUNICATIONS PANEL
5. FDEP SELECTOR SWITCH
6. DIGITAL CLOCK
7. LIGHT RHEOSTAT
8. TELCO SPEAKER
9. FAA MICROPHONE JACK
10. TELCO DIAL & KEYPACK
11. ATIS RECORDING CONTROLS
12. FLIGHT STRIP RACK
13. FDEP PRINTER
14. FDEP KEYBOARD
15. TELCO JACKS
16. FAA RADIO JACK
17. WASTEBASKET FOR EMPTY FLIGHT STRIP HOLDERS

PAPER

A. POSITION LOG
B. DIAL CODES
C. SCRATCH PAD
D. STRIP MARKING REFERENCE GUIDE
E. POSITION RELIEF BRIEFING GUIDE
F. FLIGHT STRIPS
G. APPROACH PLATES

FIGURE 6-20. HOU - FLIGHT DATA/CLEARANCE DELIVERY



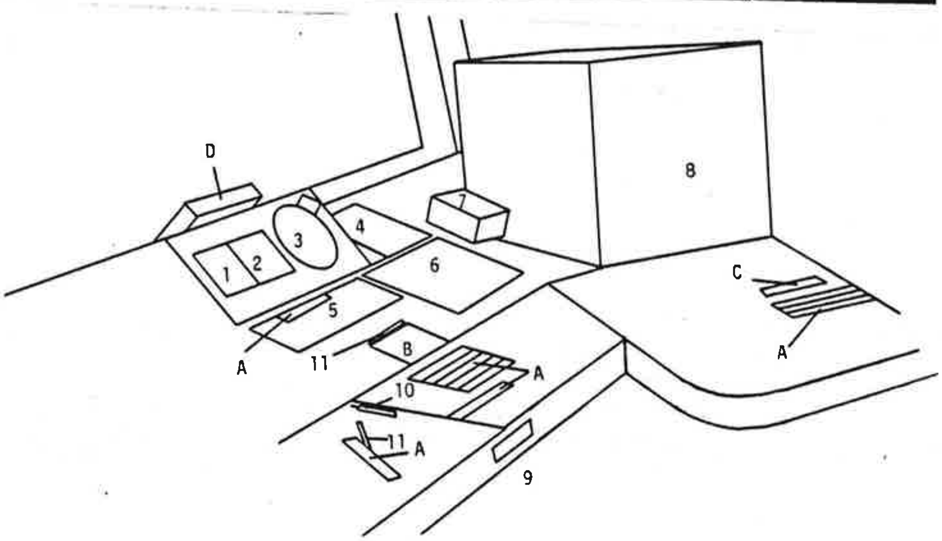
DEVICES

1. DIGITAL CLOCK
2. REFERENCE BIN
3. BACKUP VHF TRANSCEIVER
4. DESK TELEPHONE
5. EMERGENCY TELEPHONE
6. TYPEWRITER

PAPER

A. UNIDENTIFIED
B. SUPERVISOR'S BINDER
C. UNIDENTIFIED
D. UNIDENTIFIED
E. UNIDENTIFIED
F. GENERAL INFORMATION BINDER
G. FORM 7230-4
H. FLIGHT STRIPS
I. UNIDENTIFIED

FIGURE 6-21. HOU - SUPERVISOR DESK



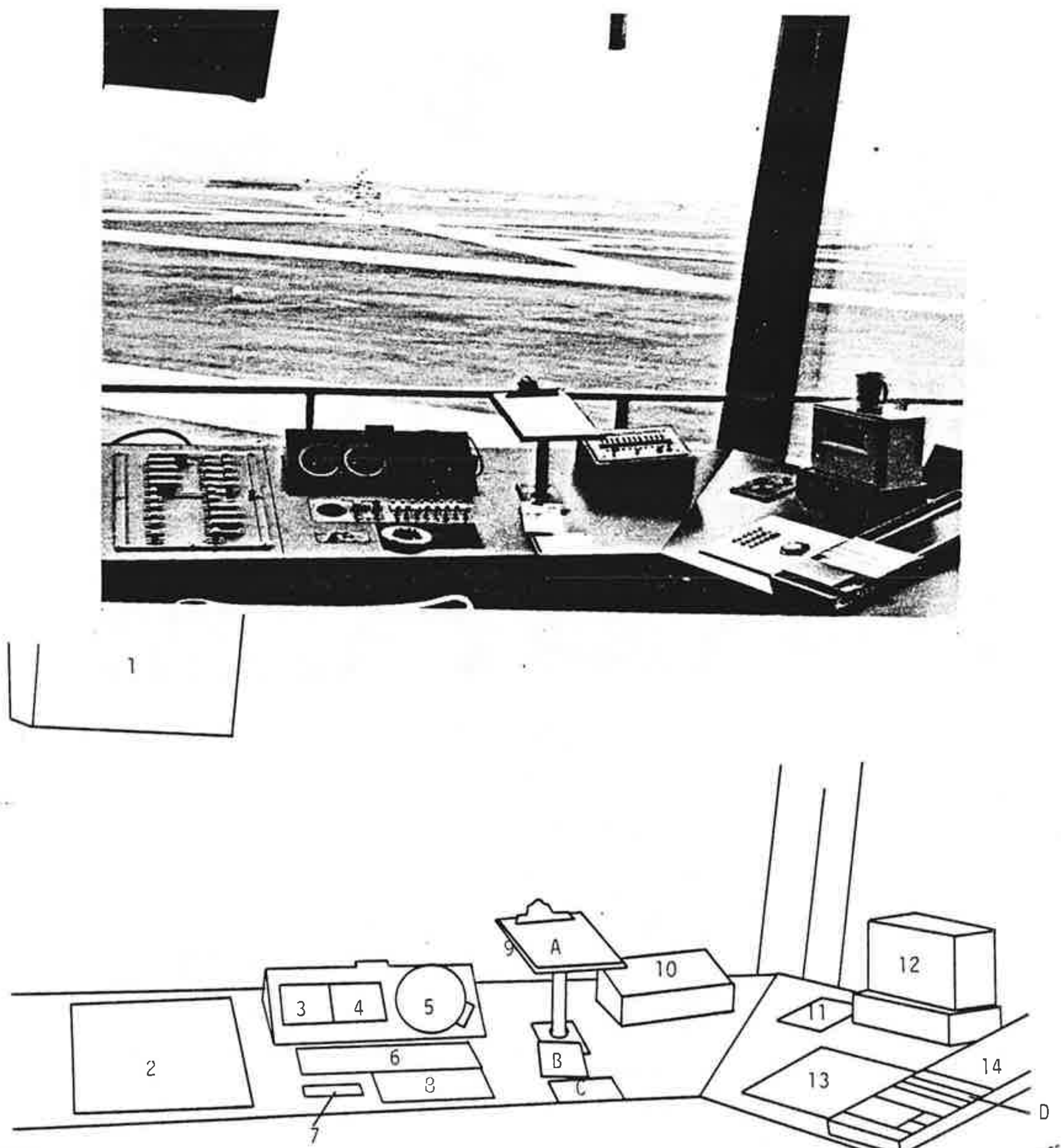
DEVICES

1. WIND DIRECTION INDICATOR
2. WIND SPEED INDICATOR
3. ANALOG ALTIMETER
4. STANDBY SELECTOR PANEL FOR FAA FREQUENCIES
5. FAA COMMUNICATIONS PANEL
6. TELCO DIAL AND KEYPACK
7. RADAR MAP SELECTOR PANEL
8. BRITE RADAR DISPLAY
9. FAA MICROPHONE JACK
10. GREASE PENCIL
11. PEN

PAPER

A. FLIGHT STRIPS
B. POSITION RELIEF CHECKLIST
C. FLIGHT STRIP SEPARATOR
D. BOX OF BLANK FLIGHT STRIPS

FIGURE 6-22. HOU - HOBBY RADAR



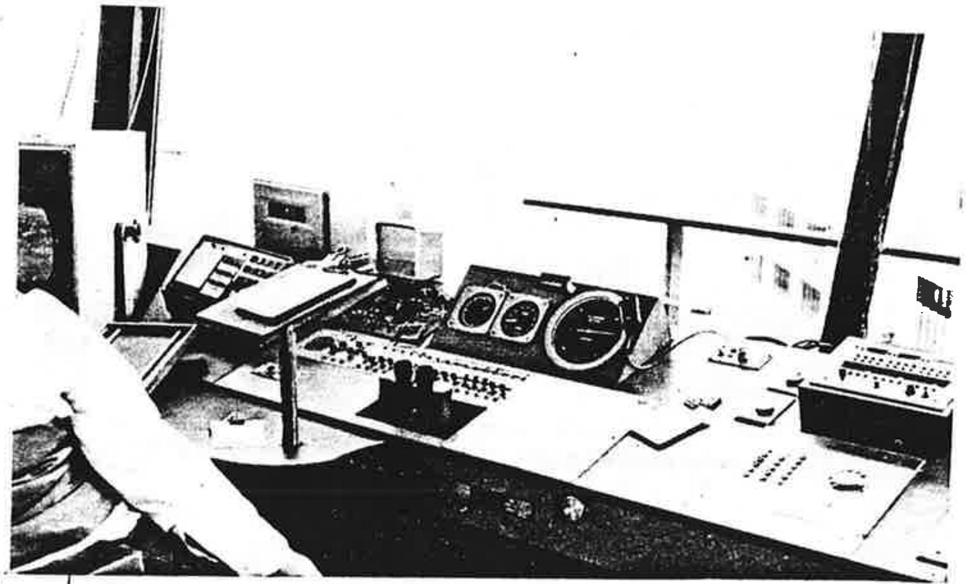
DEVICES

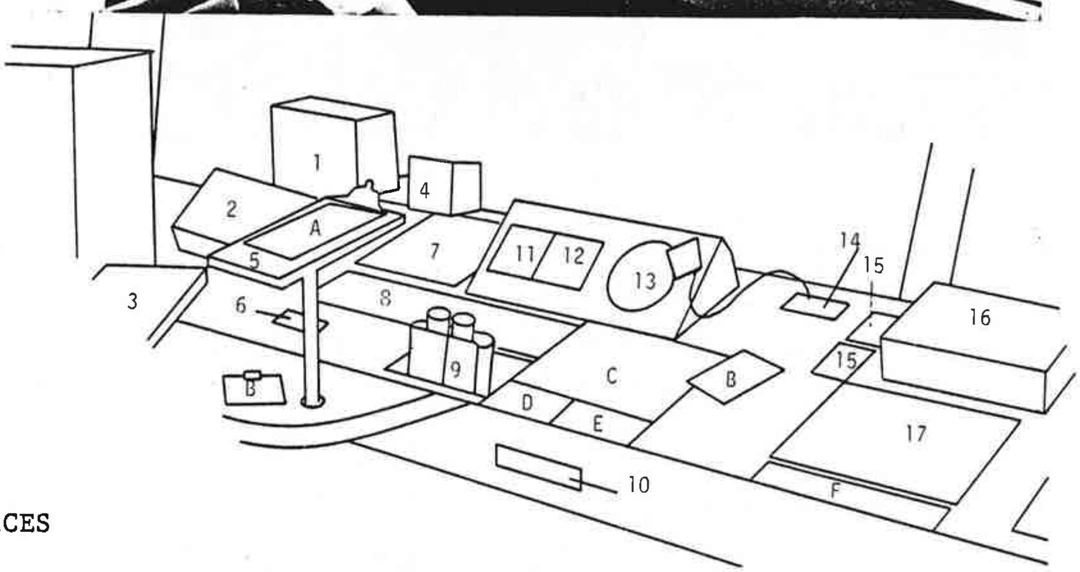
1. BRITE RADAR DISPLAY
2. FIELD LIGHTING CONTROL PANEL
3. WIND DIRECTION INDICATOR
4. WIND SPEED INDICATOR
5. ANALOG ALTIMETER
6. FAA COMMUNICATIONS PANEL
7. FAA MICROPHONE JACK
8. BINOCULAR HOLDER
9. STAND
10. RVR PANEL
11. VASI CONTROL PANEL
12. DIGITAL CLOCK
13. TELCO DIAL AND KEYPACK
14. FLIGHT STRIP RACK

PAPER

A. SCRATCH PAD
B. POSITION LOG
C. POSITION RELIEF BRIEFING GUIDE
D. FLIGHT STRIPS

FIGURE 6-23. HOU - GROUND CONTROL





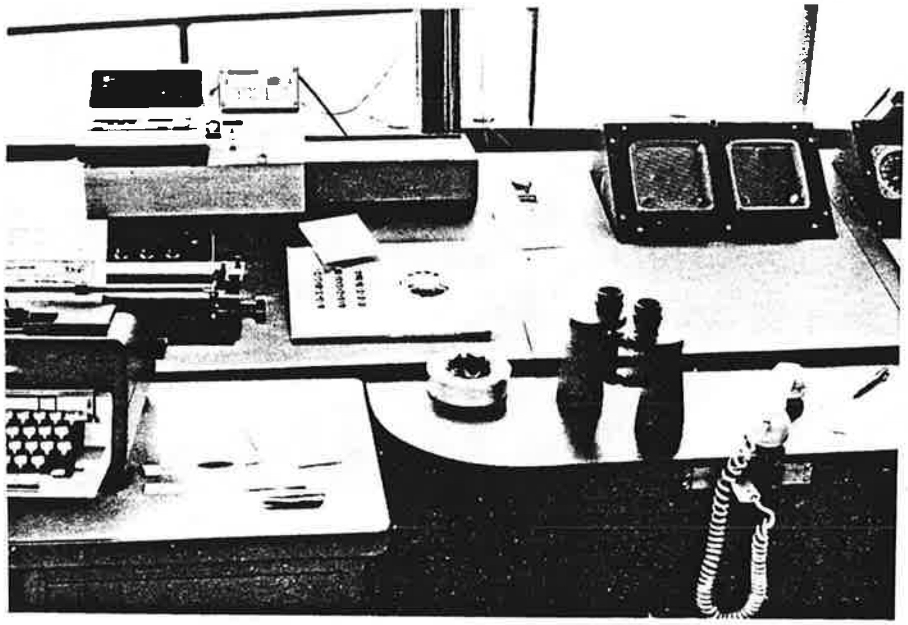
DEVICES

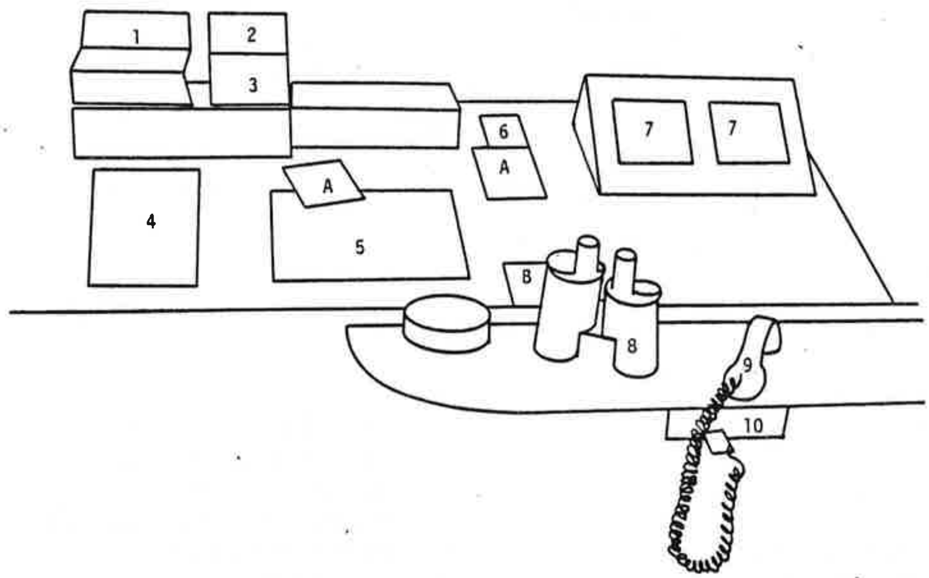
1. DIGITAL CLOCK
2. MALS CONTROL PANEL
3. FLIGHT STRIP RACK
4. TELCO SPEAKER
5. STAND
6. FAA MICROPHONE JACK
7. ALS LIGHT CONTROL PANEL
8. FAA COMMUNICATIONS PANEL
9. BINOCULARS
10. TELCO JACK
11. WIND DIRECTION INDICATOR
12. WIND SPEED INDICATOR
13. ANALOG ALTIMETER
14. ALTIMETER LIGHT SWITCH
15. LIGHT RHEOSTAT
16. RVR PANEL
17. TELCO DIAL AND KEYPACK

PAPER

A. SCRATCH PAD
B. POSITION LOG
C. RUNWAY LENGTH CHART
D. POSITION RELIEF BRIEFING GUIDE - LOCAL CONTROL
E. POSITION RELIEF BRIEFING GUIDE - CAB COORDINATOR
F. RUNWAY LENGTHS AT INTERSECTIONS LIST

FIGURE 6-24. HOU - LOCAL CONTROL AND CAB COORDINATOR





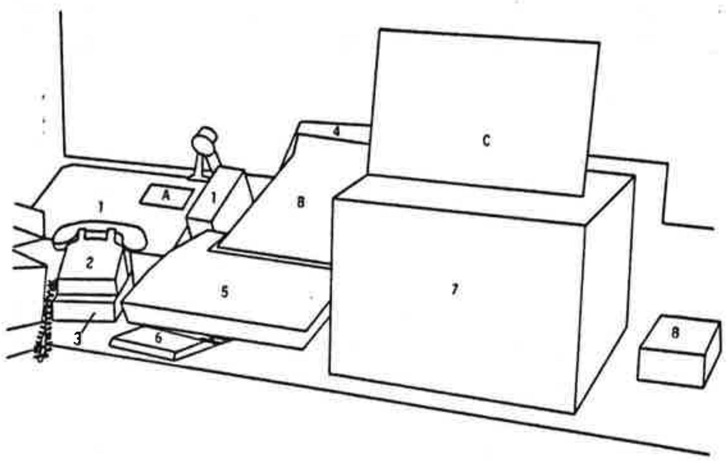
DEVICES

1. INTERCOM SYSTEM
2. RADAR CHANNEL SELECTOR
3. AMPLIFIER FOR CHANNEL SELECTOR
4. FIRE ALARM PANEL
5. TELCO DIAL AND KEYPACK
6. LIGHT RHEOSTAT
7. TELCO SPEAKERS
8. BINOCULARS
9. TELEPHONE HANDSET
10. TELCO JACK

PAPER

A. POSITION LOG
B. POSITION RELIEF CHECKLIST

FIGURE 6-25. HOU - HOBBY COORDINATOR



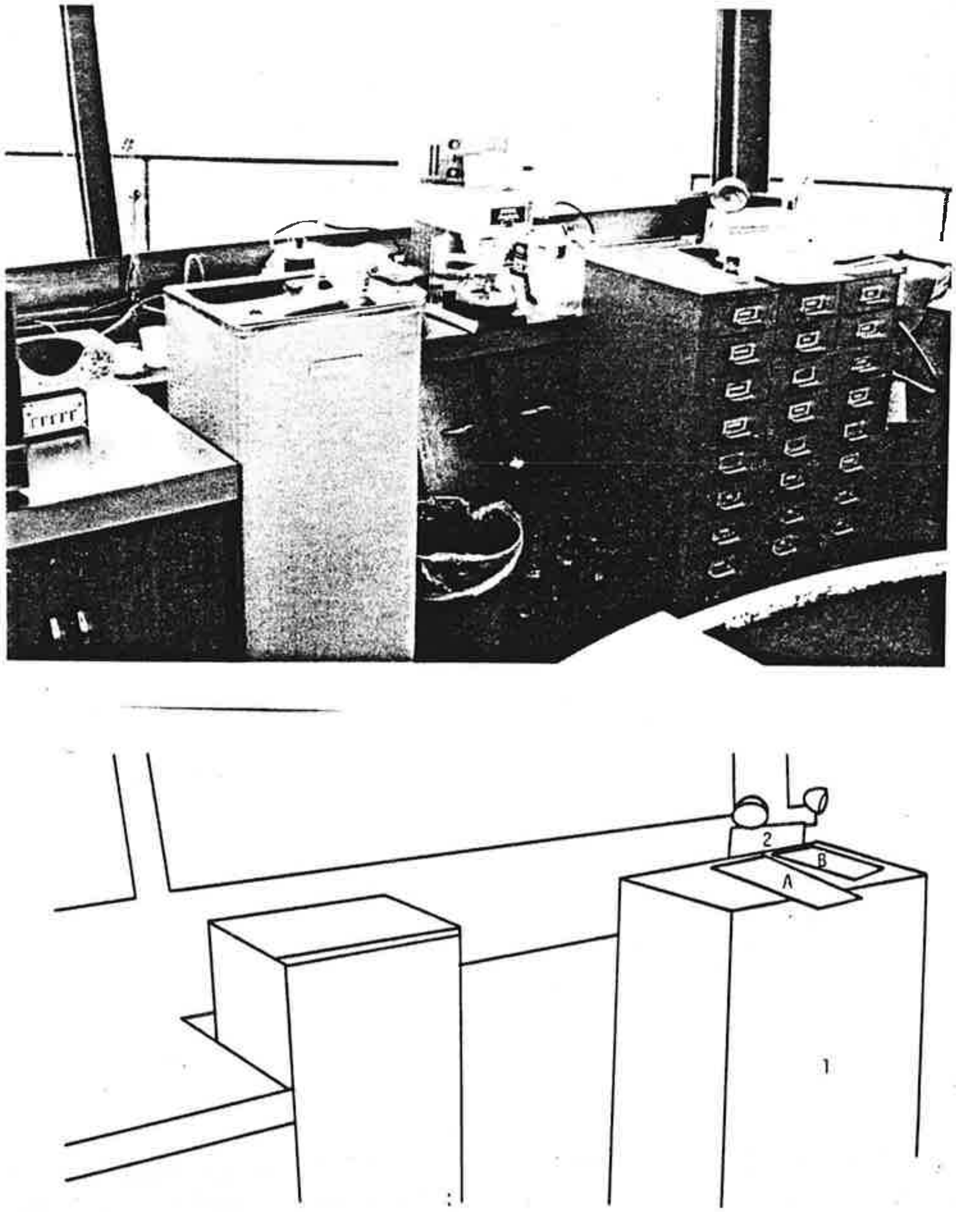
DEVICES

1. RUNWAY 4 ILS MONITOR AND CONTROL PANEL INSTRUCTIONS
2. DESK TELEPHONE
3. DATA PHONE
4. BOX FOR TELETYPE PAPER
5. PRINTER FOR WEATHER INFORMATION
6. TELEPHONE NUMBER DIRECTORY
7. WEATHER INFORMATION DISPLAY
8. CHANNEL SELECTOR FOR WEATHER DISPLAY

PAPER

A. RUNWAY 4 ILS MONITOR AND CONTROL PANEL INSTRUCTIONS
B. WEATHER PRINTOUT
C. PLEXIGLASS BOARD FOR HOU WEATHER AND MISC. INFORMATION

FIGURE 6-26. HOU - WEATHER AREA



DEVICES

1. HEADSET LOCKER
2. BATTERY POWERED LIGHTS

PAPER

A. SIGN-IN SHEET
B. JOB VACANCY ANNOUNCEMENTS

FIGURE 6-27. HOU - COFFEE/HEADSET LOCKER AREA

7. HOBBY FLIGHT DATA SYSTEM

This section describes the layout of flight data equipment in the TRACAB, the maintenance and transfer of flight data by controller position for each class of operations and a description of the flight strips and markings at HOU. This information is presented in the following tables and figures discussed below:

Figure 7.1-7.7	Layout of Flight Data Equipment in TRACAB
Table 7-1	Analysis of Day's Flight Strip
Figure 7.8	Flight Strip Movement of HOU Arrivals
Figure 7.9	Flight Strip Movement of HOU Departures
Figure 7.10	Hobby Flight Strip Holder Container
Figures 7.11/7.17	Flight Strip Formats
Figure 7.18.	Helicopter Routes
Figure 7.19	Gate Hold Markings

7.1 LAYOUT OF FLIGHT DATA EQUIPMENT

There are two FDEP printers in Hobby TRACAB. They are both located at the Flight Data/Clearance Delivery position. The FDEP printer located to the right prints out all IFR filed overflights and arrivals into Hobby. The printer located to the left prints out all IFR filed departures from Hobby. There is a keyboard associated with the FDEP which prints departures. The keyboard is used by FD/CD to communicate with the computer stored flight data base in terms of inputting, requesting and modifying flight data. A raised, mounted notepad is used at GC position for listing arriving aircraft (Figure 7.2). Loose notepads are required at all positions for noting pertinent operational information. Double flight strip trays are at the FD/CD position, to the left of the printers (Figure 7.4). Single flight strip trays are located at Ground and Local Control positions (Figures 7.5 and 7.6).

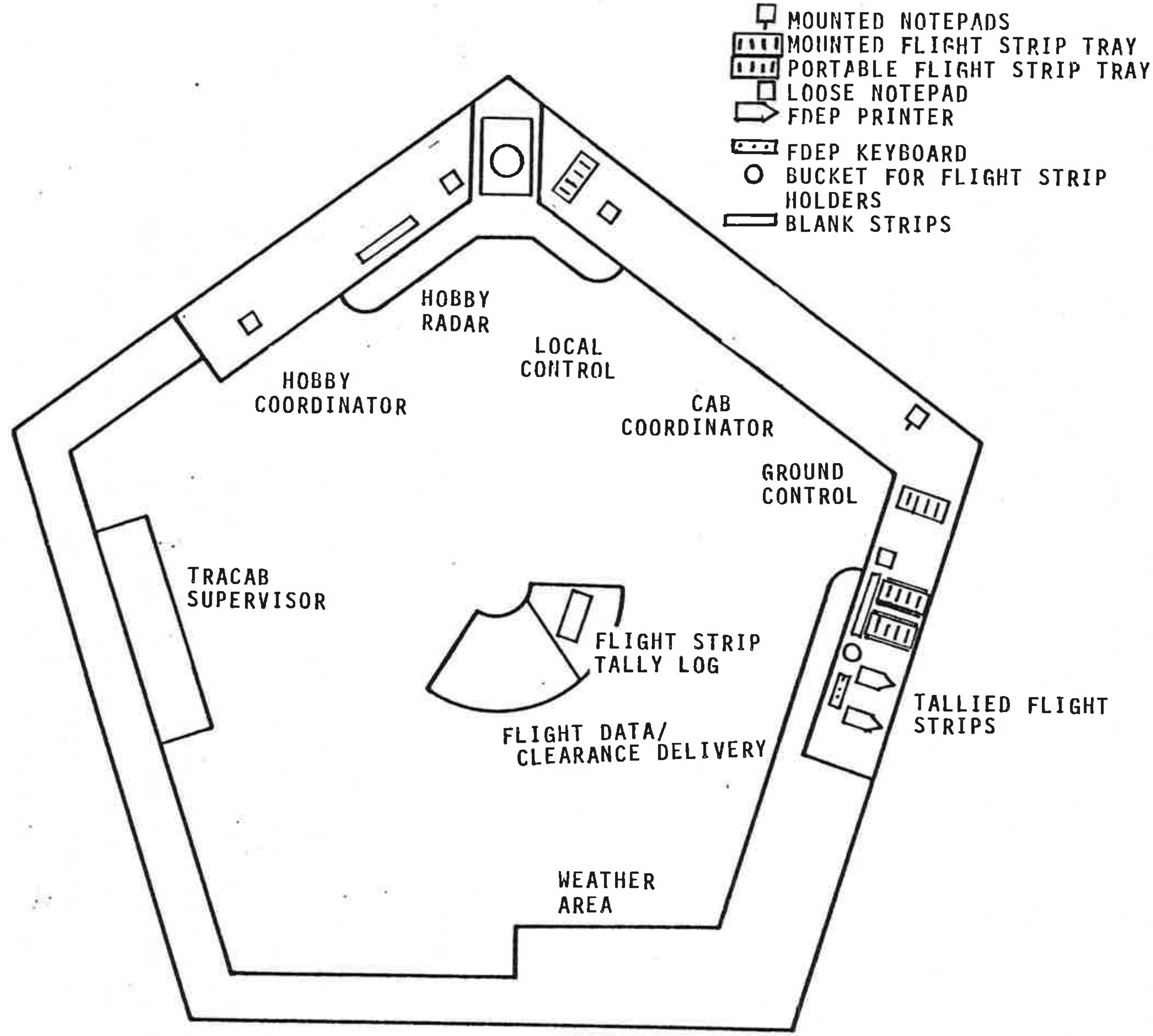


FIGURE 7-1. LAYOUT OF FLIGHT DATA EQUIPMENT IN TRACAB

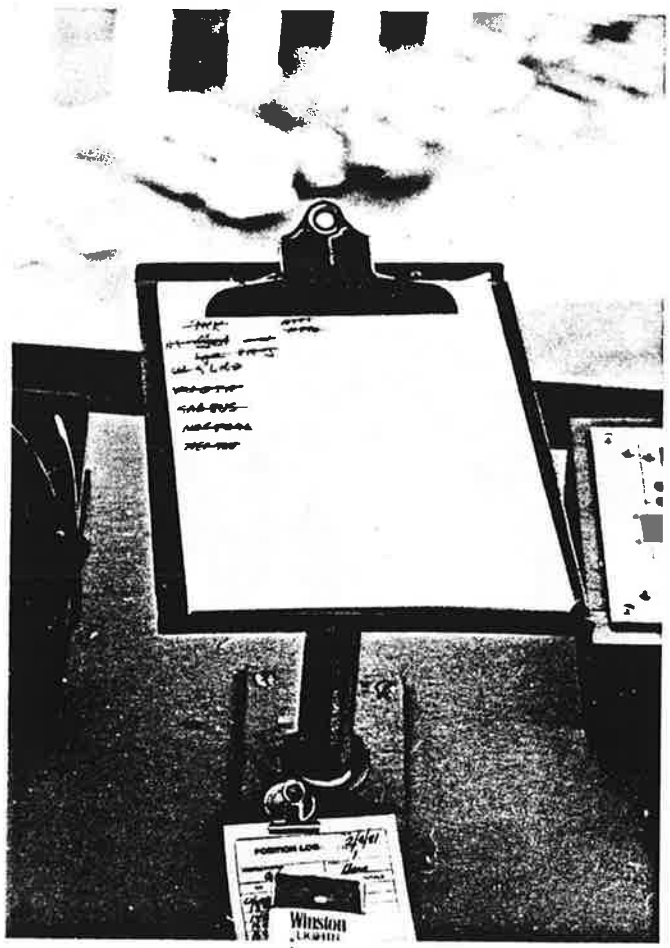


FIGURE 7.2. MOUNTED NOTEPAD AT HOBBY GROUND CONTROL

FIGURE 7.3. NOTEPAD AT LOCAL CONTROL

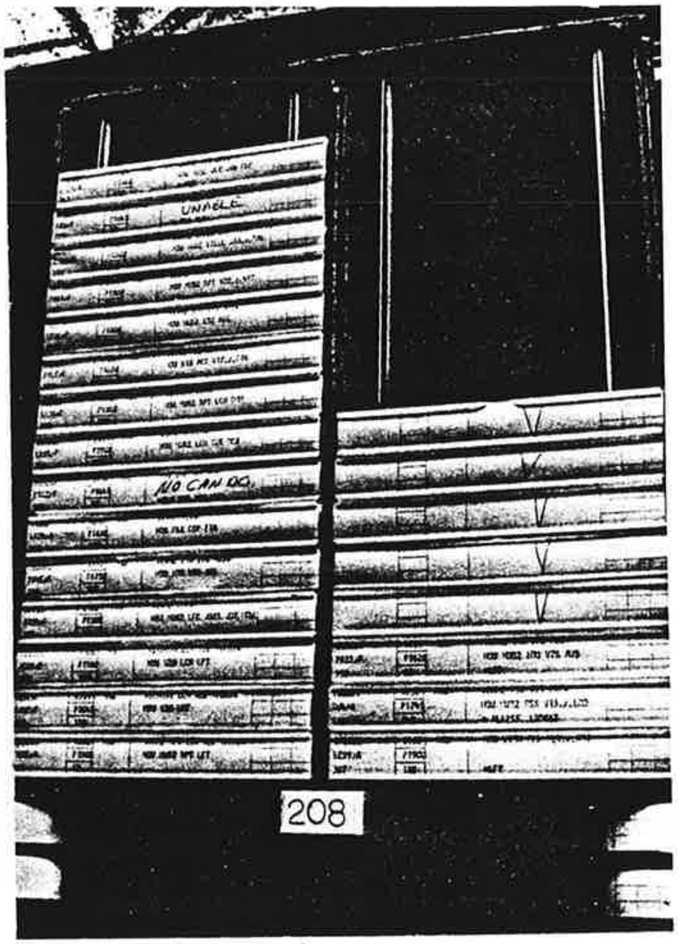


FIGURE 7.4. FLIGHT STRIPS ON RACK AT FD/CD POSITION AT HOBBY

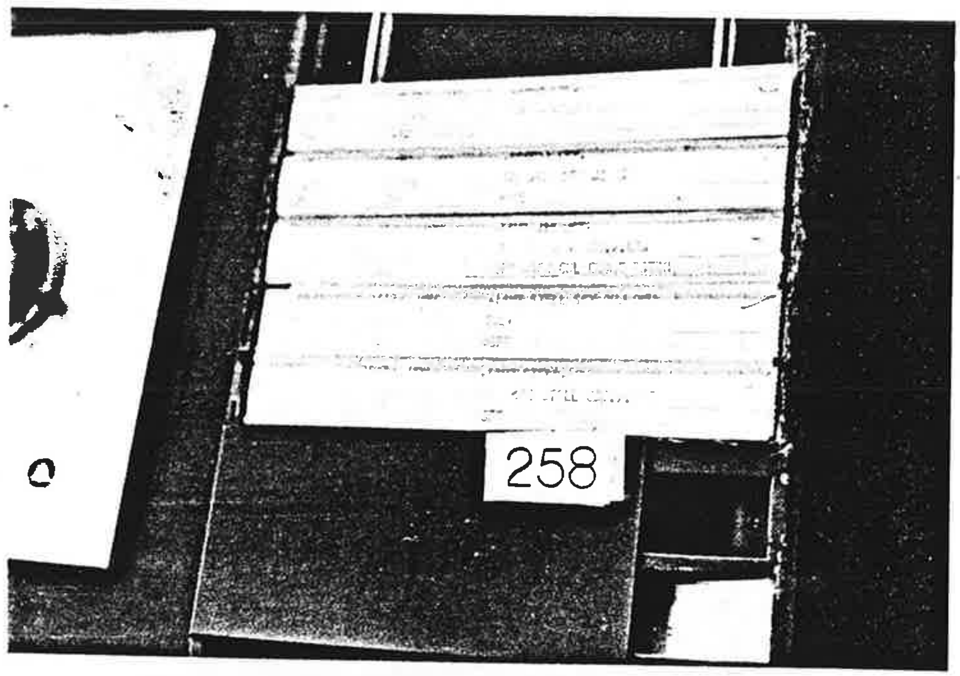


FIGURE 7.5. FLIGHT STRIPS AT GROUND CONTROL POSITION

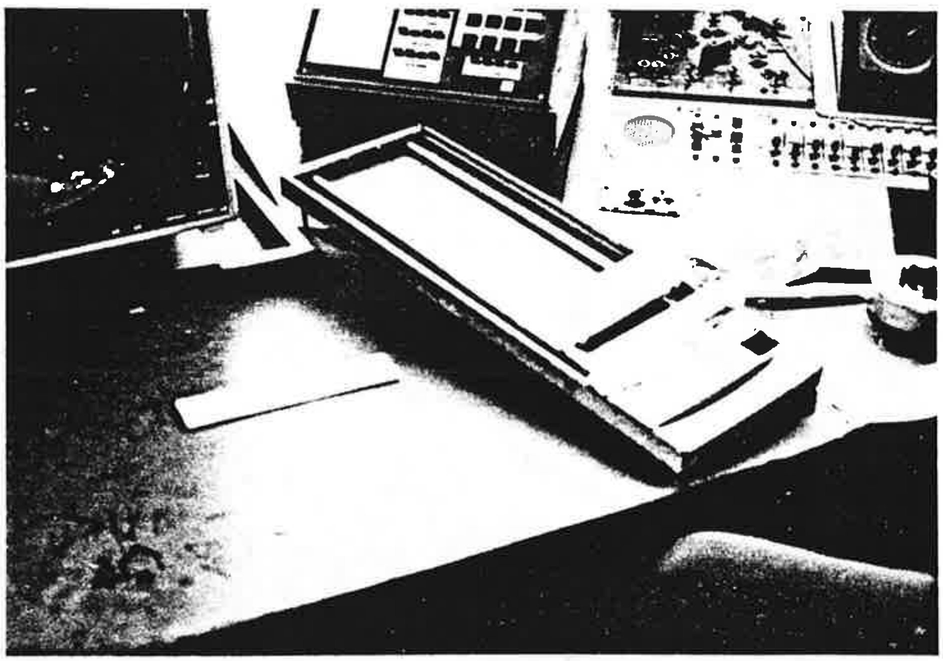


FIGURE 7.6. FLIGHT STRIPS AT LOCAL CONTROL

FIGURE 7.7. FLIGHT STRIPS AT HOBBY RADAR POSITION

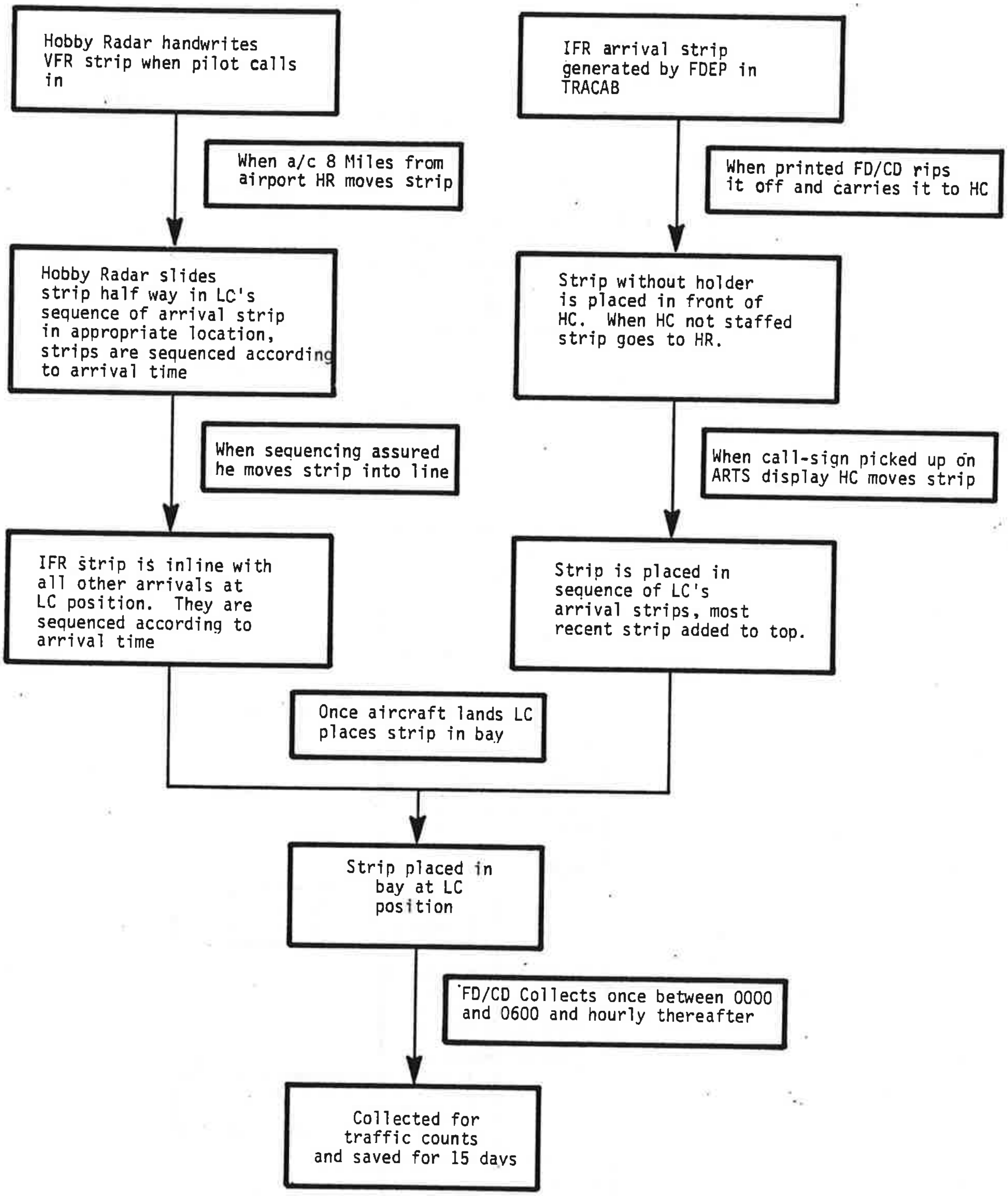


FIGURE 7.8. FLIGHT STRIP MOVEMENT FOR HOU IFR & VFR ARRIVALS THROUGH TRACAB

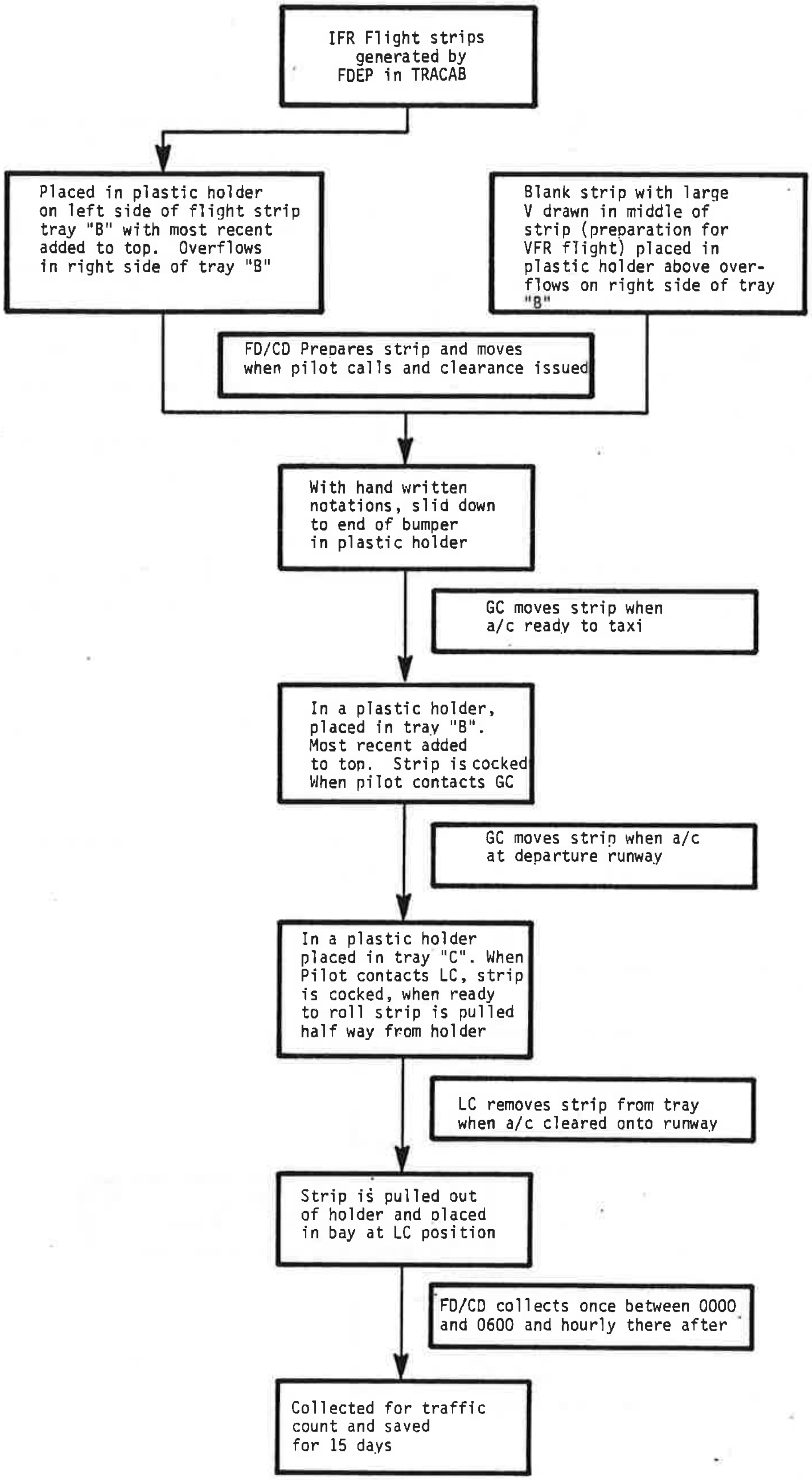


FIGURE 7.9. FLIGHT STRIP MOVEMENT OF HOU DEPARTURES

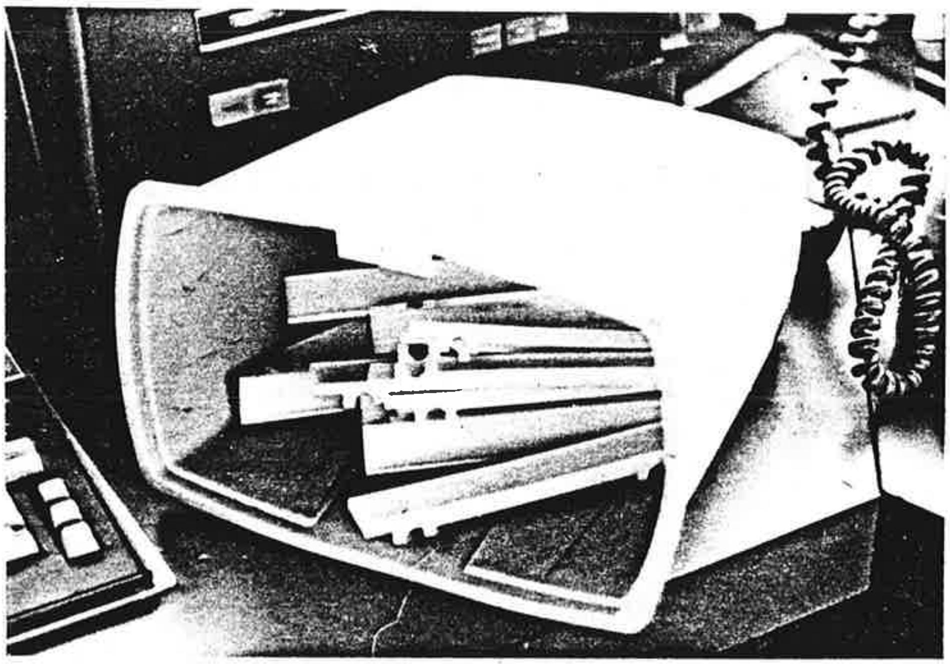
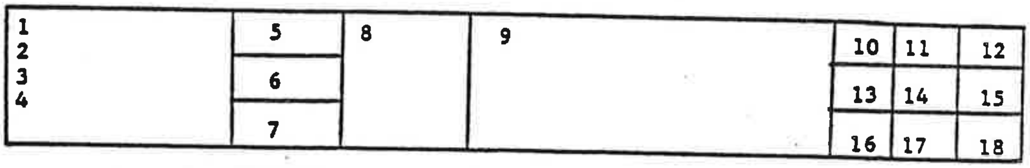


FIGURE 7.10. HOBBY FLIGHT STRIP HOLDER CONTAINER



1. Aircraft identification
2. Revision Number (FDEP only)
3. Type A/C and suffix indicating special equipment
4. Computer identification number, if required
5. Secondary radar beacon code assignment
6. Proposed departure time
7. Requested altitude
8. Departure airport
9. Route, destination and remarks

Samples

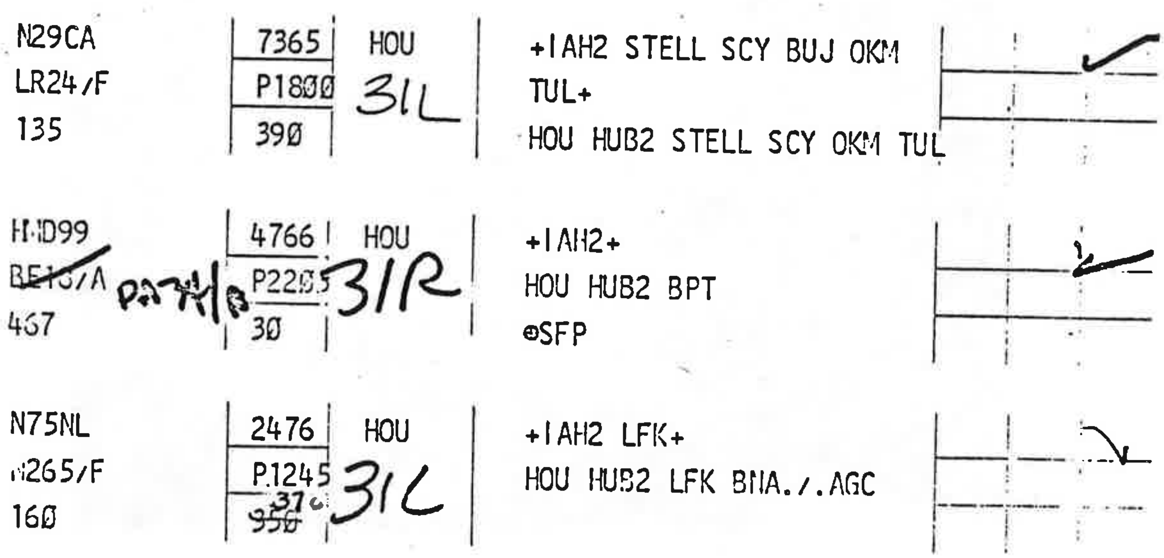
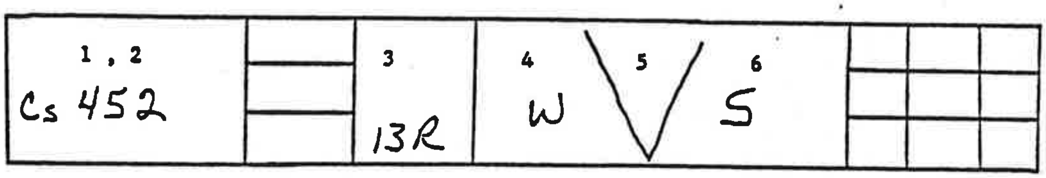
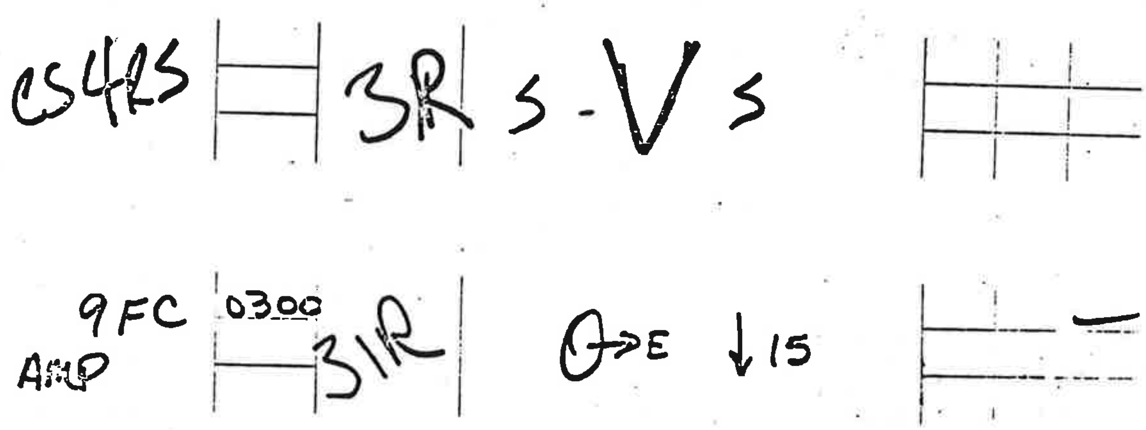


FIGURE 7.11. HOU IFR DEPARTURE FLIGHT STRIP



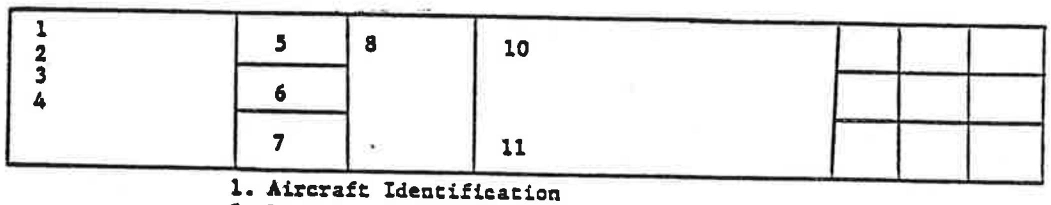
1. Aircraft Call Sign
2. Type Aircraft
3. Runway Assignment
4. Parking Area
5. Denotes Aircraft is VFR
6. Direction of Flight

Samples



Note: This strip represents a special VFR departure eastbound at or below 1500 ft.

FIGURE 7.12. HOU VFR DEPARTURE FLIGHT STRIP



1. Aircraft Identification
2. Revision Number (FDEP only)
3. Type A/C and suffix indicating special equipment
4. Computer identification number, if required
5. Secondary radar beacon code assignment
6. Coordination Fix
7. Handoff Point
8. Estimated time of arrival at Coordination Fix

10. The letters "IFR" appearing here indicate IFR
11. Destination and Remarks

Samples

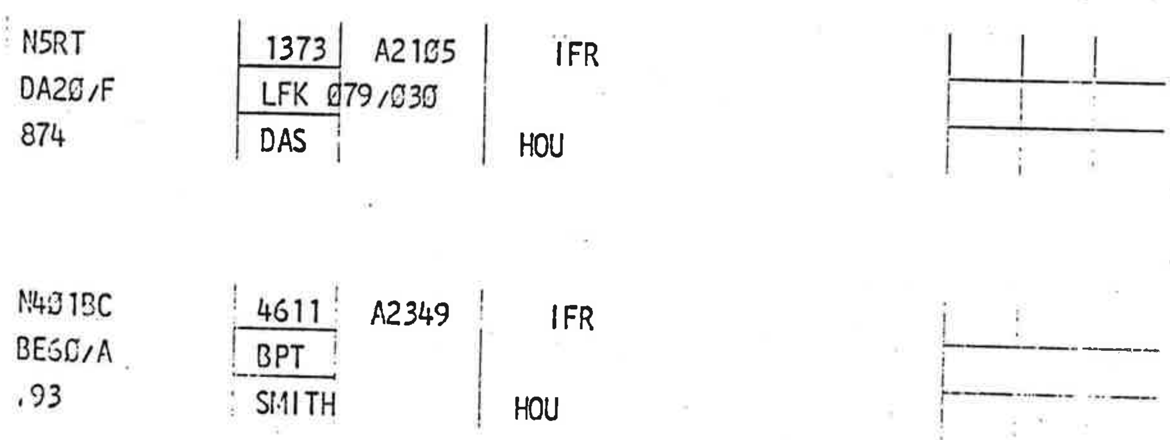


FIGURE 7.13. HOU IFR ARRIVAL FLIGHT STRIP

I13 ✓ +2 Cs 682 260/20

Data as received from the TRACON.

I-13R indicates the instrument approach procedure being flown. "+2" is used to determine local traffic count and is used to indicate a low approach, touch and go or a stop and go. Cs 682 is the A/C type and identification. "260" indicates the heading and "20" indicates the altitude the aircraft should fly in the event of missed approach.

NOTE: A check (✓) after "I-13R" shall be made on IFR arrival strips to denote when a count is to be recorded on the approach data worksheet; that is whenever visibility is less than 3 miles or the ceiling is at or below 1600.

Samples

I 4 \ KA 2Ø44D

I ✓ BRN 335H

FIGURE 7.14. HOU IFR HANDWRITTEN ARRIVAL FLIGHT STRIPS

S/35 KA 36Ø R

S/35 indicates A/C direction from Hobby and the landing runway. KA 360 Is the A/C type and ID. "R" indicates radar contact and Stage II.

SAMPLES

SE/31R CS 59K R

W/4 V SEM 98C ⊙ ↓15 R

Note; This flight represents a special VFR flight southeast-bound at or below 1500.

FIGURE 7.15. HOU VFR ARRIVAL FLIGHT STRIPS

RD H 680

RD represents Randolf Departure
H indicates helicopter
680 is the helicopter ident

H 550 BA

BA represents Broadway Arrival
H indicates helicopter
550 is helicopter ident

ED 643 || ED 944 || BA 984 || EA 680

This strip represents four helicopter flights: two EMSCO departures, one Broadway arrival and one EMSCO arrival

FIGURE 7.16. HOU HELICOPTER FLIGHT STRIPS

2015

MTR 210

An Air Taxi Overflight at 1500 ft

PL Ø1 VS 400'

A General Aviation Overflight at 400 ft

CS 3DP VS 1500'

A General Aviation Overflight at 1500 ft

H 8Ø6 600' VS

A Helicopter Overflight at 600 ft

FIGURE 7.17. HOU VFR OVERFLIGHT FLIGHT STRIPS

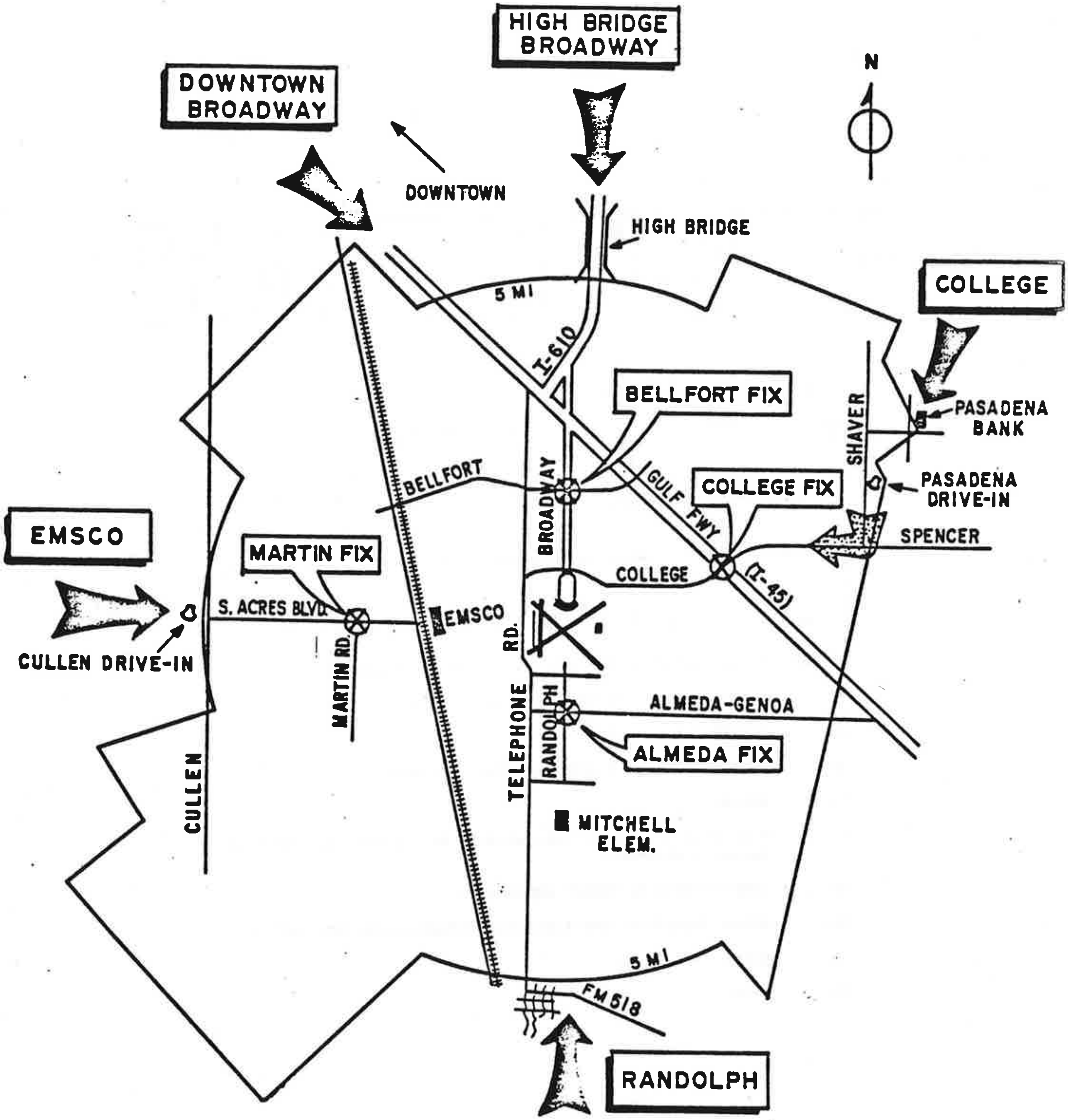


FIGURE 7.18. CODED HELICOPTER ROUTES

<table>
<tr><td rowspan="3">1
2
3
4</td><td>5</td><td rowspan="3">8</td><td rowspan="3">9</td><td>10</td><td>11</td><td>12</td></tr>
<tr><td>6</td><td>13</td><td>14</td><td>15</td></tr>
<tr><td>7</td><td>16</td><td>17</td><td>18</td></tr>
</table>

DEPARTURE STRIP MARKING DURING GATE HOLDS

10	11	12
13	14	15
16	17	18

1 - 9A. As specified in HOU 7110.3I. (Shown in Figure 7.3)

10. Time pilot advises ready to start engine.

11. Expected engine start time.

12. A check mark (✓) when clearance delivered.

13. Blank.

14. Time request release from TRACON or time pilot calls ready for takeoff (optional).

15. Time released by TRACON (optional).

16. Actual departure time (optional, except during Gate Hold).

17. Blank.

18. Blank.

FIGURE 7.19. GATE HOLD MARKINGS

7.2 FLIGHT DATA USAGE

Flight data is acquired and maintained at Hobby TRACAB by means of printed flight strips, handwritten flight strips, notepads and ARTS data blocks. The process of transferring the flight data is a function of the operation (i.e., IFR arrival vs VFR arrival). Figures 7-2 and 7-3 trace the movement of flight strips for arrivals and departures through the TRACAB. The following described the maintenance and flow of flight data by operation.

a. <u>HOU IFR Departures</u>

Approximately 30 minutes before planned departure time a flight progress strip is printed on the FDEP. FD/CD removes the strip and places it in a flight strip holder. A bucket containing several of the plastic strip holders is kept to the right of the FDEP keyboard (Figure 7.10). The strip is then placed on the flight strip tray at the FD/CD position. Most controllers place the strips on the left side, adding new strips to the top of the column and overflowing into the right side of the tray; however, this is not standard. Some FD/CD controllers may alphabetize the flight strips and others place the flight strips indiscriminately in the tray. When the pilot calls for clearance FD/CD takes the strip out of the tray, places it in front of him and notes any changes such as changed beacon code assignment, changed proposed departure time, or changes in filed routing. If a pilot calls for clearance and a flight strip has not been generated by the computer (as discussed in Section 3.2) FD/CD takes a blank strip (stored at the base of the flight strip tray), handwrites the flight data information, and places the strip in a plastic holder. The departure strip (either computer generated or handwritten) is slid down the bumper in its holder to GC. FD/CD instructs the pilot to change frequencies and control is transferred to GC. GC picks the flight strip up from the bumper and places it level in the flight strip tray at his position. The most recently acquired flight strip is added to the top. When the pilot contacts GC, he cocks the strip and writes departure runway in the middle of the strip. As the aircraft is taxiing GC carries the flight progress strip in its holder to the tray at LC position, arranging it in departure order with the other flight strips; the most recent strip is placed on top. Pilot is instructed to change frequencies. When the pilot contacts LC the strip is cocked to the right. LC clears the pilot for takeoff and pulls the strip half way out of the holder. Once the aircraft has cleared the runway, LC pulls the strip out of its holder and places it in the bin at his position until it is collected by FD/CD at hour end. The plastic holder is dropped in a nearby bucket. When the aircraft is rolling LC forwards IFR departure information to the TRACON, by interphone.

b. HOU VFR Departures

During free moments FD/CD often prepares flight strips for VFR and special VFR departures. When the ceiling is less than 1000 feet and visibility is between 1 and 3 nautical miles (less than VFR conditions) ATC may approve a special VFR flight. He places a blank strip in a holder and draws all the symbols on it that are not dependent upon aircraft specific information. He keeps these strips either on the console at the base of his flight strip tray or on the right side of the tray above the computer generated strips. When the pilot calls for clearance FD/CD fills out a strip with call sign, aircraft type, parking area and direction of flight as shown in Figure 7-5. The strip is slid down the bumper to GC and proceeds through the TRACAB in the same manner as an IFR departure discussed above.

c. HOU IFR Arrivals

Flight progress strips are generated by the FDEP. FD/CD rips the strip off the printer and handcarries it over to Hobby Coordinator without a plastic holder. If no flight strip has been generated by the computer (as discussed in Section 3.2) HC handwrites an IFR arrival strip in the format displayed in Figure 7.14. Controllers indicated that HC does not necessarily arrange these flight strips in any specific order. When HC spots the call sign for the aircraft on his radar display he handcarries the flight strip to LC. HC does not communicate with the pilot. HC's responsibilities are most often absorbed by Hobby Radar. LC sequences the strips in arrival order. The flight strips are laid on the console to the left of the flight strip tray. (The aircraft have already been sequenced by the TRACON). Under busy conditions LC may have a different column of strips for each runway. The columns are separated by a plastic holder with runway numbers and arrows drawn on it in order to indicate which column of flight strips will be assigned to which runway. LC does not have a keyboard in order to accept handoffs. They are essentially forced by Hobby Final; the ARTS data block appears on his radar scope. The pilot contacts LC and LC provides the landing clearance. Once the flight has cleared the runway LC instructs the pilot to call GC and control is transferred. LC places the strip in the bin at his position with other flight strips to be collected by FD/CD at hour end. GC has been watching the ARTS display and has noted on his mounted clipboard the call sign of the arriving aircraft. Some Ground Controllers place a check next to the aircraft identity when the pilot makes initial contact. Once the flight has been cleared to the terminal ramp area, the flight identity is crossed off.

d. HOU VFR Arrivals

Hobby Radar begins preparation of a flight progress strip in the format displayed in Figure 7.15 when the pilot contacts him. Seventy to eighty percent of VFR arrivals do not have ARTS tags; are "pop ups". HR writes down the aircraft's call sign and the direction of the aircraft from the airport. When the target is picked up on the ARTS display he adds an "R" to the strip. He then assigns the pilot a runway and writes it down on the strip. When the aircraft is within 8 miles of the airport HR brings the strip (without a holder) to LC. HR sequences the strip in between the other strips which are arranged according to arrival time. If LC has more than one column of strips (different columns reflect different landing runways as discussed above). HR places the strip in the appropriate column. The strip is not aligned with the other strips in the column. It is placed half way in. Until the strip is aligned, HR maintains control of the aircraft. HR points the aircraft out to LC on the radar scope. Upon recognition of the target, LC circles the "R" on the flight strip. HR ensures sequencing of the VFR arrival between the IFR aircrafts which have already been sequenced. He instructs the pilot to change to LC frequency and slides the flight strip in line with the other arrival flight strips at LC position, transferring control of the aircraft from HC to LC. From this point the aircraft and its flight data are handled in the same manner as IFR arrivals discussed above.

e. <u>HOU Helicopter</u>

Helicopters generally contact Local Control when approaching or departing Hobby TRACAB. If Local Control is too busy the helicopter is advised to contact Hobby Radar. Helicopters proceed along designated routes (Figure 7.18). A book describing the routes is kept at LC position for general reference. Upon radio contact with the pilot for both arrivals and departures either LC or HR prepare a handwritten flight strip as shown in Figure 7-9. The following information is included:

- An "H" indicating that it is a helicopter flight
- Helicopter ident
- An initial which represents the route designation
- A "D" or and "A" indicating either departure or arrival.

Some controllers keep track of several helicopters on one flight strip. The flight strip is placed in the bay with other flight strips until it is collected by FD/CD at hour end. Hobby TRACAB handles 10-15 helicopters per hour during much of the day.

f. <u>HOU Overflights</u>

There are seldom any IFR overflights at Hobby TRACAB. There are however, many VFR overflights. Because the flights are not tallied into the daily operational count, procedures for handling the VFR overlights vary from controller to controller. They are generally just handled by HR or LC. Some controllers keep track of the VFR overflights by making sketchy notes on flight strips or notepads. Other controllers formally write out flight strips as shown in Figure 7-12.

g. Gate Hold Procedures

The TRACAB Supervisor initiates gate holds when the cause of delay is internal to Hobby operations. He notifies IAH and the Center via interphone. Notification that gate hold is in effect is included in the ATIS. FC/CD must complete boxes 10,11,12, and 16 of the flight strip (Figure 7-19) with the following information:

- o time pilot calls for clearance
- o expected engine start time (FD/CD advises pilot)
- o a check (✓) indicating clearance has been delivered
- o actual departure time.

All flight strips other than VFR overflights are tallied by FD/CD every hour. Operations from midnight to 6 am are not broken out by hour. The clipboard with the tally sheet is kept on the reference desk in the middle of the room until day end when it is logged by the supervisor (Figures 7-20 through 7-22). Flight strips are stored for 15 days for record keeping purposes. FD/CD reports ident and arrival or departure time of all military aircraft to FSS.

7.3 HOBBY FLIGHT STRIPS

The flight strips generated by the FDEPs at HOU represent prefiled IFR flight plans. As at IAH, the pilot provides the flight data to the 9020 nas Stage A computer system at the Enroute Center prior to flight. The typewritten information is standard for all facilities (Figures 7-11 and 7-13). As at IAH little handwritten information is added to the printed strips.

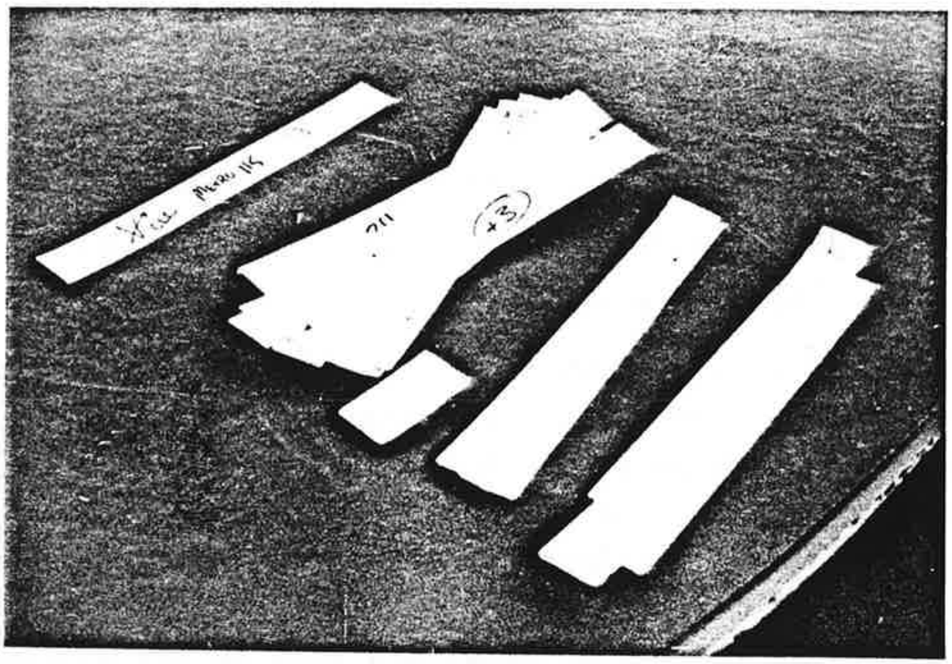


FIGURE 7.20. SORTED HOURLY FLIGHT STRIPS

FIGURE 7.21. TALLIED HOURLY FLIGHT STRIPS IN BIN AT FD/CD

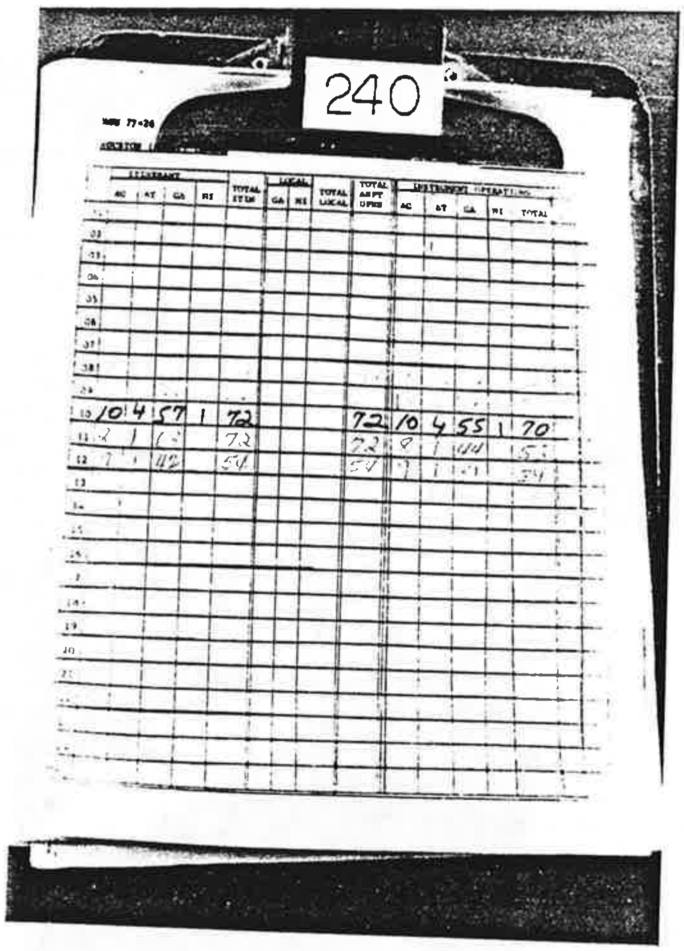


FIGURE 7-22. HOBBY HOURLY TRAFFIC COUNT

Virtually no handwritten markings are made on HOU IFR arrival strips. Occasionally a controller will mark a check (✓) on the strip when the pilot makes initial contact. Flight strips for arriving aircraft are manually prepared for VFR traffic and IFR traffic for which no strip has been generated. Formats and samples are shown in Figures 7-14 and 7-15.

Changes in printed departure strips such as changed beacon code, changed altitude or changes in filed routing are noted by FD/CD. FD/CD also checks box 12 when clearance has been issued. GC writes the departure runway assignment on the strips. Flight strips for departing aircraft are manually prepared for VFR traffic (Figure 7-12) and IFR traffic for which no strips have been generated. Approximately 46 percent of the first strips are hand-written.

Overflights are indicated by a "V" with the altitude inside the "V". An arrow placed next to the "V" indicates climbing or descending (Figure 7-17).

All flight strips are kept for 15 days for record keeping purposes.

A sample day's flight strips (from 1/20/81) are analyzed in Table 7-1. It is important to note that VFR overflights are not tallied into traffic level totals.

Table 7-2 presents a summary of controller information requirements for flight data.

TABLE 7-1. ANALYSIS OF HOU FLIGHT STRIPS FROM 1/20/81

IFR Arrivals		
Air Carrier		83
Air Taxi		26
General Aviation		221
Military		1
	Subtotal	331
Helicopter Arrivals		13
Other VFR Arrivals		85
	Subtotal(Arrivals)	429
IFR Departures		
Air Carrier		80
Air Taxi		23
General Aviation		205
Military		1
	Subtotal	309
Helicopter Departures		21
Other VFR Departures		71
	Subtotal(Departures)	401
VFR Overflights		22
	Total	852

TABLE 7-2. SUMMARY INFORMATION REQUIREMENTS ANALYSIS FOR FLIGHT DATA AT HOBBY

Type Flight	Sources of Data	Machine Printed Data	Manual Notations	Use
DEPARTURE	• machine printed strip • voice radio link w/pilot	• aircraft ID • revision number • type a/c + suffix indicating special equipment • computer-ID, beacon code • departure time • altitude • departure airport • routing	• runway assignment amendments to field plan such as changes in altitude, beacon code or routing	Flight progress strip is generated by FDEP approximately 30 minutes before departure. Pilot calls for clearance and FD/CD confirms and amends flight strip. It is passed to GC in a plastic holder, who works assigned runway on stirp and instructs pilot to taxi to runway via voice radio link. Strip is passed to LC (in plastic holder) who uses the strips (which are in order) to identify aircraft in queue. Pilot is cleared for takeoff by LC via radio. Strip is collected by FD/CD at hour end for operational tally.

HOU VFR DEPARTURE	• handwritten strip
	• voice radio link w/pilot
		NONE	• aircraft ID
			• type aircraft
			• runway assignment
			• if regular VFR
			  • parking area
			  • "V" indicating VFR direction of flight
			• if special VFR circle w/arrow indicating direction of flight and altitude
				Flight progress strip is handwritten by FD/CD when pilot calls via voice radio link with flight data information. The strip is passed to GC in plastic holder to GC who writes assigned runway on the strip and instructs pilot to taxi to runway via voice radio link. Strip is passed in plastic holder to LC who uses the strips (which are in order) to identify aircraft in the queue. Pilot is cleared for take-off by LC. Strip is collected by FD/CD at hour end for operational tally.

HOU IFR ARRIVAL	• machine printed strip • ARTS data block • voice radio link w/pilot	• aircraft ID • revision # • type a/c + suffix for special equipment • computer id, beacon code • coordination fix • handoff point • ETA at coordination fix "IFR" • destination airport	Amendments in filed plan such as changed altitude	Flight progress strips are generated by the FDEP. FD/CD rips the strip off the printer and brings to over to HC. When ARTs target and data block is picked up HC brings strip to LC. Strip is arranged w/other arrival strips in arrival order. Because Hobby Final does not handoff aircraft to LC, LC relies on data block and voice radio contact for notice that aircraft has entered airspace. Once flight has cleared the runway LC instructs pilot to call GC. GC has noted call sign of incoming aircraft from ARTs data block on notepad. Strip is collected from LC by FD/CD at hour end for operational tally.

TABLE 7-2. SUMMARY INFORMATION REQUIREMENTS ANALYSIS FOR FLIGHT DATA AT HOBBY (CONTINUED)

Type Flight	Sources of data	Machine Printed Data	Manual Notations	Use
HOU VFR ARRIVAL	• handwritten strip • voice radio link w/pilot • ARTs data block	NONE	• aircraft direction from Hobby • landing runway • aircraft type • aircraft ID • "R" indicates Radio contact • For special VFR arrow with direction and altitude	- Only 20-30% of VFR arrivals have ARTS tags - the rest are "pop ups." - Hobby Radar prepares a flight strip which pilot contacts him over voice link radio. When the target is identified on the ARTs display HR adds the "R" to the strip. Within 8 miles of the airport he brings it over to LC and sequences it between the other flight strips which are arranged according to arrival times. The strip is placed 1/2 way in indicating HR still has control of a/c. The pilot switches to LC frequency and HR slides the strip in line with LC's other strips. Once flight has cleared runway pilot calls GC. GC has noted call sign from ARTs data back on notepad. Strip is collected from LC by FD/CD at hour end for operational tally.
HOU HELICOPTERS	• handwritten strip • voice radio link	NONE	• coded departure or arrival route • "H" for helicopter • helicopter ID	Helicopters generally contact LC when approaching or departing HOU. If LC is too busy they may contact HR. Upon radio contact when pilot describes planned route LC prepares a handwritten flight strip. Some controllers keep track of several helicopters on one flight strip. The strip is collected by FD/CD at hour end for operational tally.
HOU VFR OVERFLIGHTS	• handwritten strip • voice radio link	NONE	• aircraft ID • altitude • "¥" indicating overflight	Pilots make contact with either HR or LC and advise of all flight data via voice radio link. Flight strip is handwritten with pertinent information. Flight strips are not collected by FD/CD for operational tally.

8. HOBBY WEATHER

The Houston Hobby TRACAB receives weather information from the Houston Flight Service Station (FSS); Intercontinental, Galveston, and David Wayne Hooks airports; pilots aloft; and its own on site weather sensors. The information is transmitted to Hobby by FDEP, teleprinter, interphone, closed circuit TV, console equipment, pieces of paper which are passed around, white plexiglass status board, and word of mouth. The communication system is shown in Figure 8-1 and the location of the weather equipment is shown in Figure 8-2.

A CONRAC closed circuit TV is used to transmit up to date weather from the Flight Service Station/Weather Service located in the Hobby Administration Building. There are five channels (Figure 8-3) which display the following information:

- weather sequence for HOU, IAH and occasionally DWH
- GLS Weather Radar
- the 24 hour prognosis
- PIREPS
- ASR 8 Radar

The weather sequence includes ATIS code, weather sequence time, sky condition, visibility, temperature, wind and altimeter. While the CONRAC is out of service FD/CD writes the HOU weather sequence on the white plexiglass board to the right of the teleprinter.

The model 43 teleprinter is Hobby's primary weather transmitting/receiving equipment. Disseminated SIGMETS, Surface Aviation (SA) Weather Reports, Special Surface (SP) Aviation Weather Reports and Aviation Terminal Forecasts (FT) are received via the teleprinter.

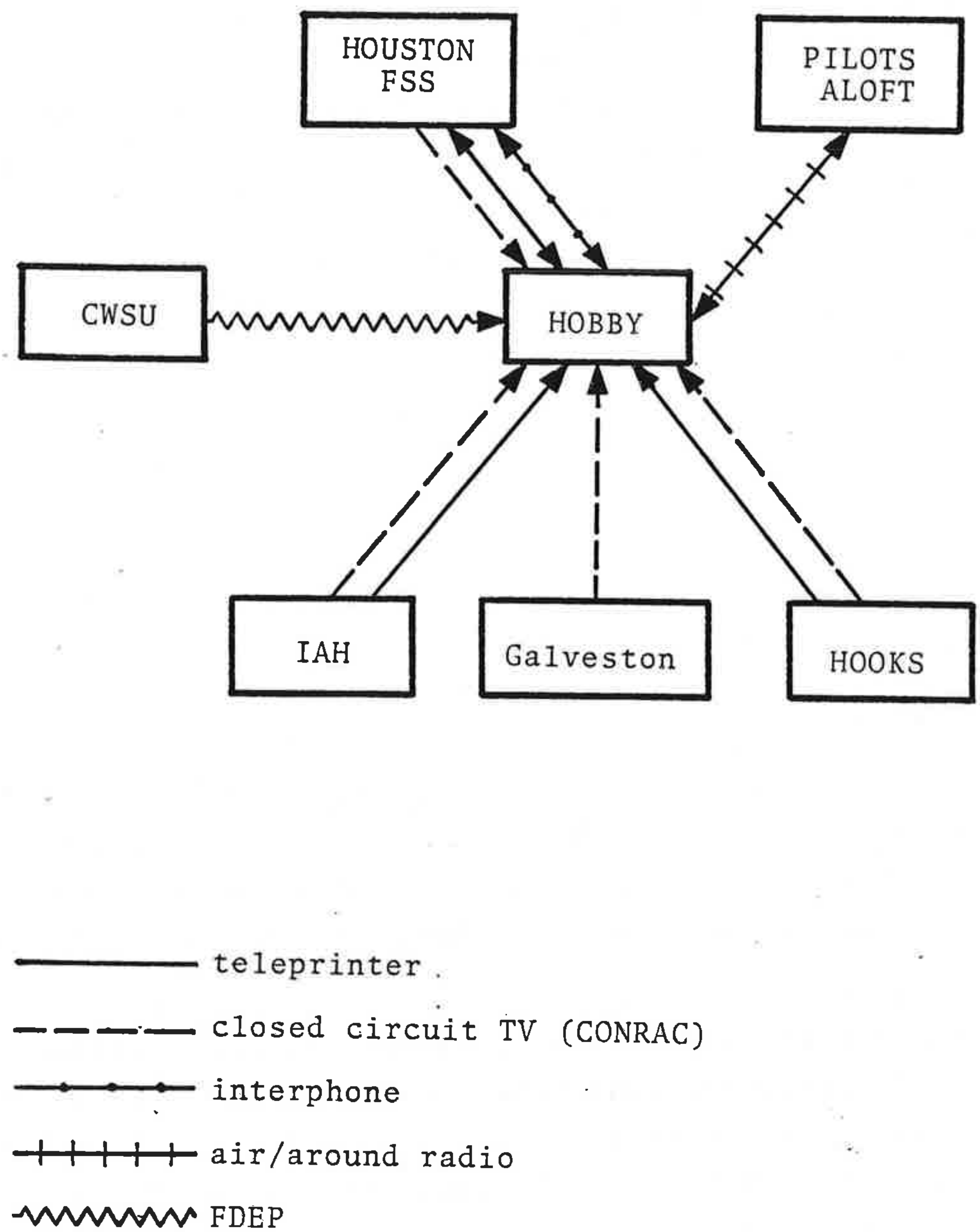


FIGURE 8-1. HOU WEATHER COMMUNICATION SYSTEM

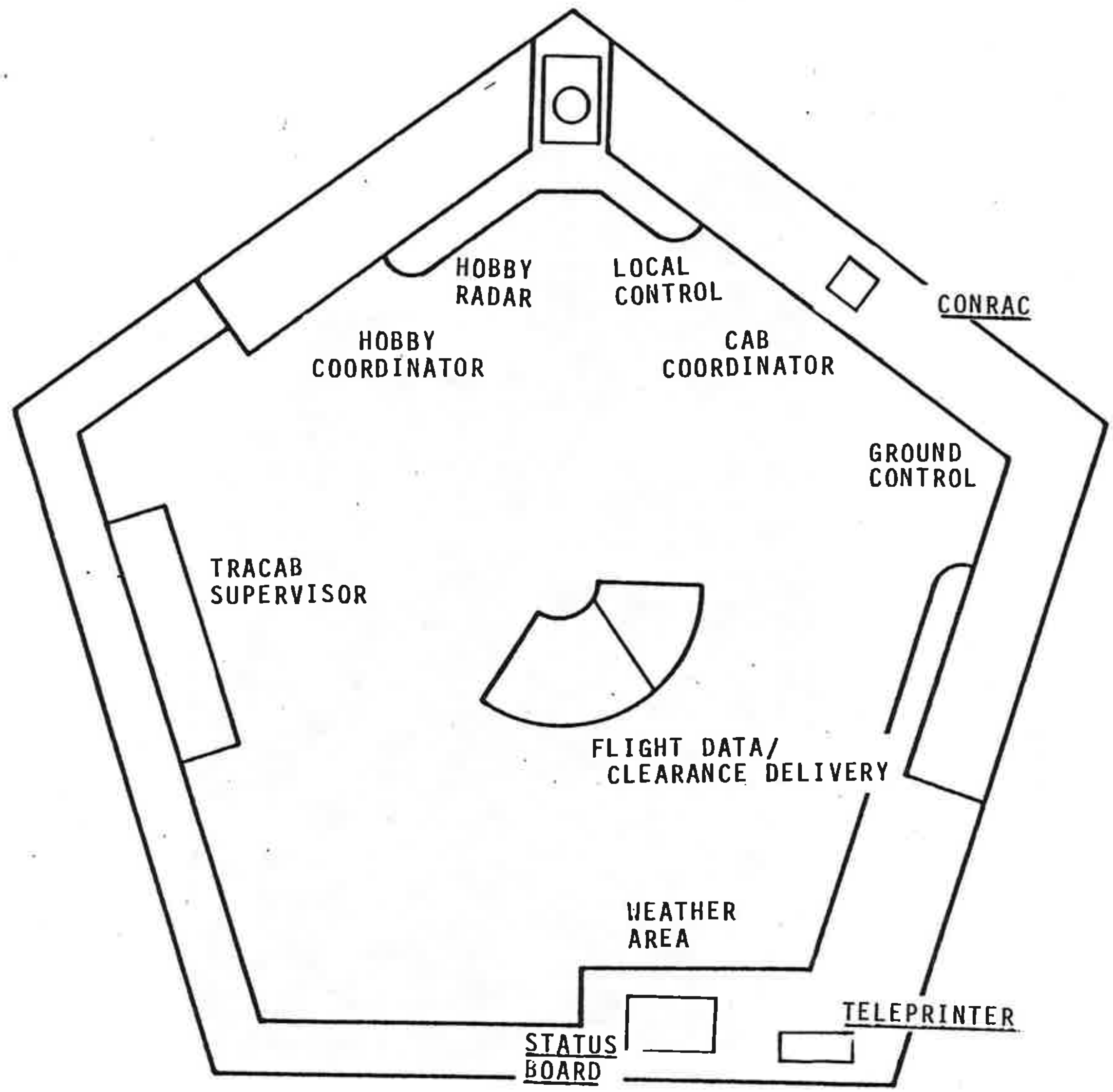


FIGURE 8-2. LAYOUT OF WEATHER EQUIPMENT IN HOU TRACAB

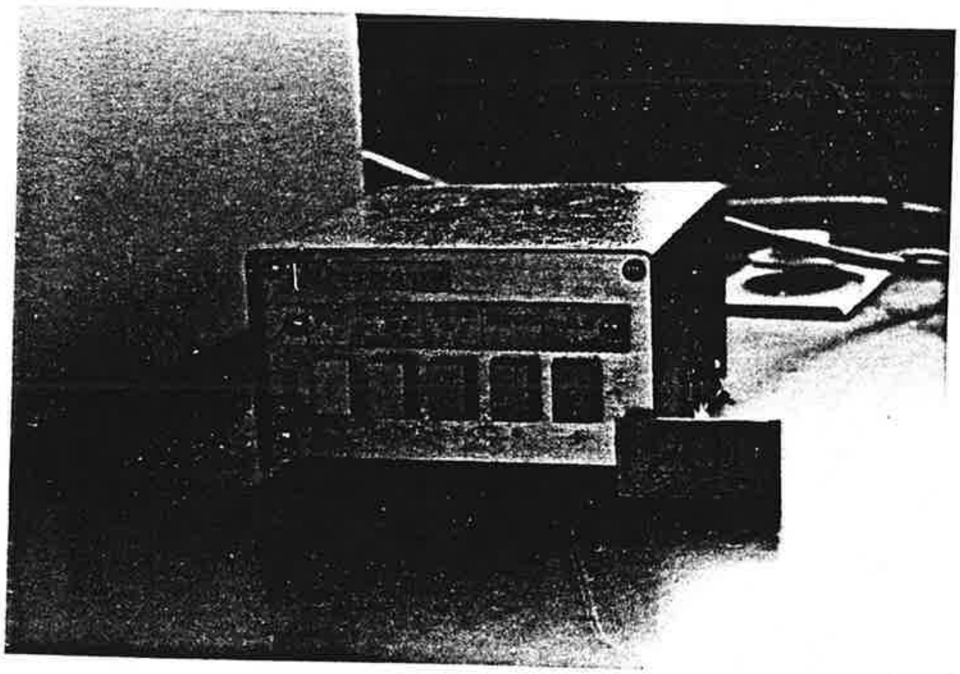


FIGURE 8-3. CONRAC CHANNEL SELECTOR AT HOBBY

The CWSU relays all SIGMETS for the Center area to the FSS via the FDEP. These messages are printed simultaneously on the FDEP at Hobby TRACAB. The FSS determines which SIGMETS shall affect the Houston Metropolitan area, and sends that data to the Hobby TRACAB via the teleprinter. The Hobby Supervisor is required to acknowledge receipt of the SIGMET's received via the teleprinter by entering his facility's identifier on the teleprinter. In an attempt to increase the timeliness of the message and because the Supervisor doesn't always agree with FSS's analysis of which SIGMET's are significant, the SIGMETS on the HOU FDEP are continuously monitored. Occasionally SIGMETS are received from the Center via interphone. Relevant disseminated SIGMETS are written on a piece of paper by FD/CD and passed to HR, LC, and GC. The data is read to pilots over the air/ground radio.

Surface Aviation Weather Reports which include ceiling, visibility, temperature, dew point, time, wind direction and speed, sky condition, atmospheric pressure and humidity are received for IAH, DWH, and HOU on an hourly basis. Special Surface Aviation Weather Reports, updates of the SA reports are issued as changing conditions necessitate. The information from the SA and SP reports is essential to all controllers. It is relayed through the TRACAB orally by FD/CD as reports come in. Controllers wishing to check details of the reports may read them off the teleprinter. These reports are used as a basis for ATIS updates and for checking altimeter accuracy.

Aviation Terminal Forecasts (FT) are made by the Weather Service Forecasting Office (WSFO), relayed to the FSS and transmitted by the teleprinter from FSS to Hobby TRACAB. The FT is a 24 hour forecast for the area which is within 5 miles of the tower. It is sent to Hobby TRACAB twice a day. Controllers check the FT for general information as they come on duty. The Supervisor may use the FT for operation planning, staffing, and scheduling navigation and runway closures.

Pilot Reports (PIREPS) are requested by the controller for information, such as, cloud top, turbulence, bird activity, braking action or wind shear. The Local Controller has basic responsibility for obtaining the report. Other positions may be utilized as directed by the Team Supervisor. The PIREP is either verbally relayed to the Supervisor or handed to him on a piece of paper. The Supervisor logs the PIREP indicating aircraft identification, aircraft position at time of report, aircraft type and any other pertinent data. The PIREP is forwarded to FD/CD for delivery to FSS via interphone. If relevant, LC may request the aircraft to relay the information to the TRACON.

Console instruments provided controllers with HOU wind direction and speed, HOU altimeter setting, and Runway Visual Range (RVR) for HOU runway 4. These instruments are discussed in detail in Section 9.4: Critical TRACAB Display Items.

LC is responsible for determining tower visibility. A map and list of reference points with their distance from the tower is kept in the LC position binder at the reference table. LC relays the visibility to FD/CD who in turn notifies the FSS. The Supervisor also has an interest in tower visibility for determining IFR/VFR conditions.

Controllers at Hobby TRACAB mentioned that they would like to have on line weather information for EFD, because Hobby's airspace jurisdiction changes when EFD goes IFR. The controllers also stated that it would be helpful to have weather information for all airports within 100 mile radius of Hobby. This information would allow controllers to advise pilots to land at alternate airports when conditions necessitate.

9. HOU STATUS

This section includes a discussion of the status of equipment important for Hobby operations. The primary means of relaying status are NOTAMS; status boards; word of mouth; equipment alarms; and paper either posted or passed around.

The NOTAMs received by Hobby are generally concerned with NAVAID or airport facility outages. NAVAID NOTAMs are issued by the facility monitoring the NAVAID. Houston FSS monitors the Hobby VORTAC. City operation or airport management reports airport facility outages to the TRACAB, and the TRACAB Supervisor in turn calls Houston FSS to issue the NOTAM. NOTAMs are received in the TRACAB by interphone, telephone, and/or mail. Relevant NOTAMs are posted on the white plexiglass board by the Supervisor and included in the ATIS broadcast by FD/CD. No log is made of the NOTAM. The facility which issues the NOTAM is responsible for cancelling it.

A white plexiglass board, used for posting weather, status notices, and IAH's active runways, is located to the right of the teleprinter in the TRACAB (Figure 9-1). Messages are written on it with a black grease pencil.

In order to facilitate discussion, the controller requirements for status information have been divided into four categories. Within each category, the means for relaying status is discussed; whether it is NOTAMs, the status board, word of mouth, pieces of paper or equipment alarms. The categories are as follows:

- o Visual Aids
- o Terminal Area Radio NAVAIDS
- o Landing Aids
- o TRACAB Critical Display Items.

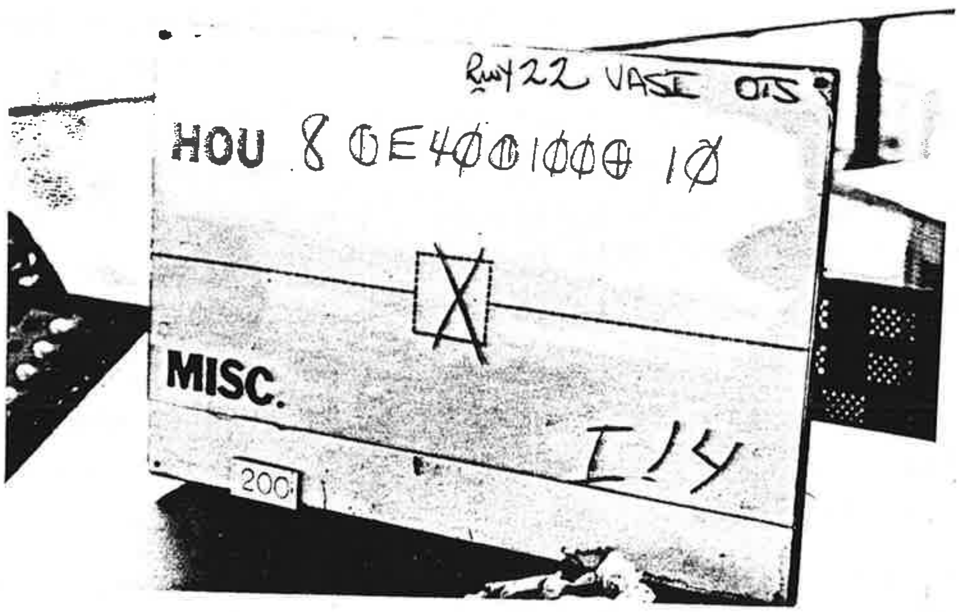


FIGURE 9-1. STATUS BOARD AT HOBBY

If a status notice is of interest to a pilot it may be included in the ATIS message.

9.1 VISUAL AIDS

The visual aids and their associated runways are displayed in Table 9-1. Lights are turned on at pilot request or as regulated in the Air Traffic Control manual. The Supervisor is responsible for ensuring that they are on as required. Each runway has an independent lighting system. The control panels for the taxiway lights, HIRLS, MIRLS, and REILS are located at and operated by GC (Figure 9-2). All taxiway lights are single intensity (on/off) except for "O" and "P" which are three step intensity. The HIRLS are five step and the MIRLs are three step intensities. The SSALS and MALS are located at and operated by LC (Figures 9-3 and 9-4). This allows immediate response by LC to a pilot request for dimming or flashing of lights. The MALS have three step intensity. A combination of switches is required for changing intensities. The SSALS is five step intensity. The SFLs associated with both approach lighting systems are also operated by LC. It is simply an on/off control. The VASIs are not controlled by the controllers. Airway Facility Services is responsible for them. They are kept on continuously. The airport beacon, a green and white light, is used at sunset, sunrise and in IFR conditions. It is controlled by FD/CD. It may be turned on or off (Figure 9-5).

Controller requirements for airport lighting status are presented in Table 9-2. None of the lighting systems have visual or audio indicators or alarms to indicate a failure or outage. The SSALS has a buzzer which sounds when it has been on for five minutes but it does not indicate an outage. Controllers commented that it is difficult to determine if the on/off switches at the GC position are depressed and consequently if they are on. Visual aid outages must be determined by controller observation, pilot reports, and Airways Facility staff. They must be reported to FSS as a NOTAM and are noted on the status board. FD/CD

TABLE 9-1. HOBBY AIRPORT LIGHTING

Visual Aid	Runway/Taxiway
Taxiway Lights	all taxiways
Simplified Short Approach Lighting System with Runway Alignment Indicator Lights (SSALS) and Sequenced Flashing Lights (SFL)	Runway 4
Medium Approach Lighting System (MALS) with Sequenced Flashing Lights (SFL)	Runway 22
Intensity Runway Lights (HIRLS)	Runways 4,22,13R,31L
Medium Intensity Runway Lights (MIRLS)	Runways 13L,31R,17,35
Visual Approach Slope Indicators (VASI)	Runways 13R,31L,17,35,22
Runway End Identifier Lights (REILS)	Runways 13R,31L
Airport Beacon	South End of Property

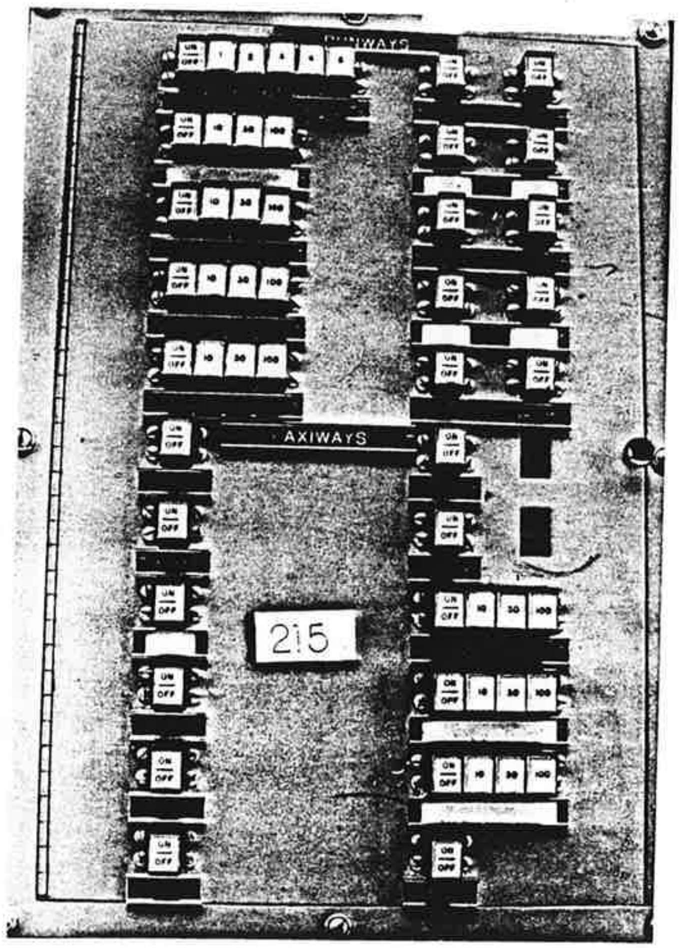


FIGURE 9-2. RUNWAY AND TAXIWAY LIGHTING CONTROL PANEL LOCATED AT GC POSITION

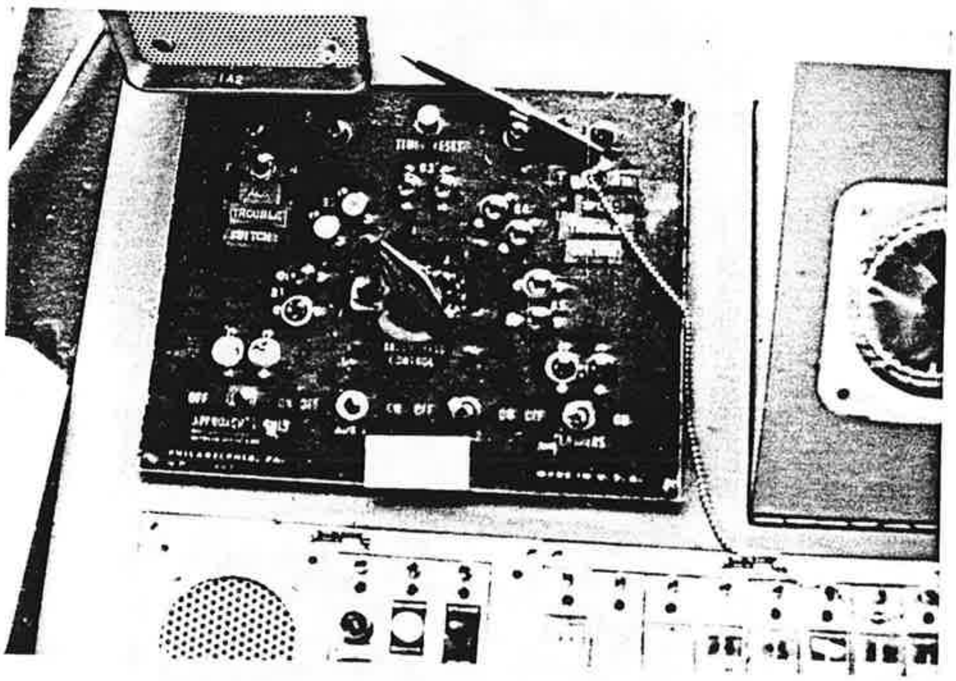


FIGURE 9-3. HOBBY ALS CONTROL PANEL AT LC

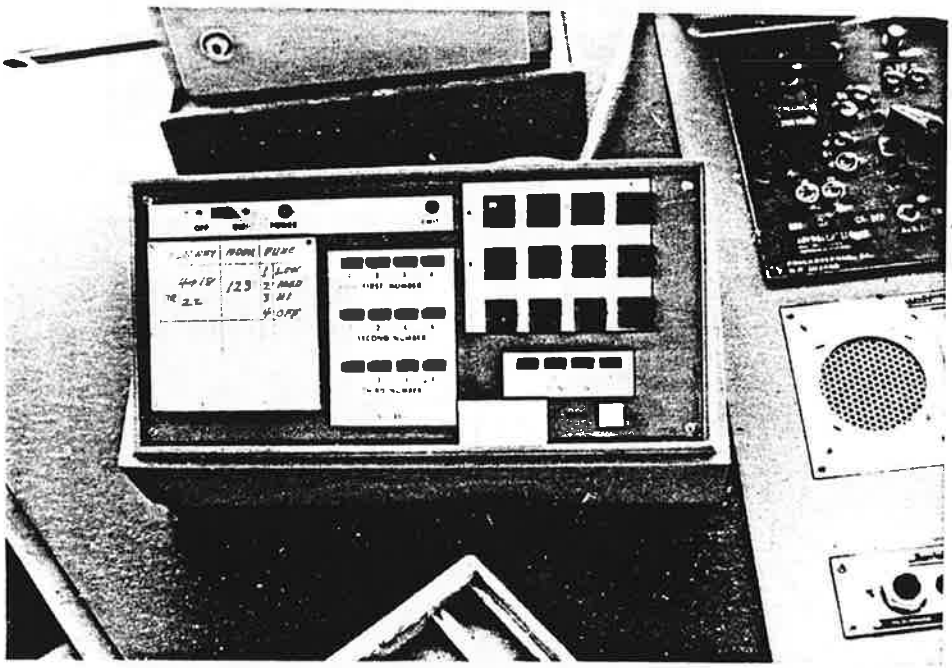


FIGURE 9-4. HOBBY MALS CONTROL PANEL AT LC

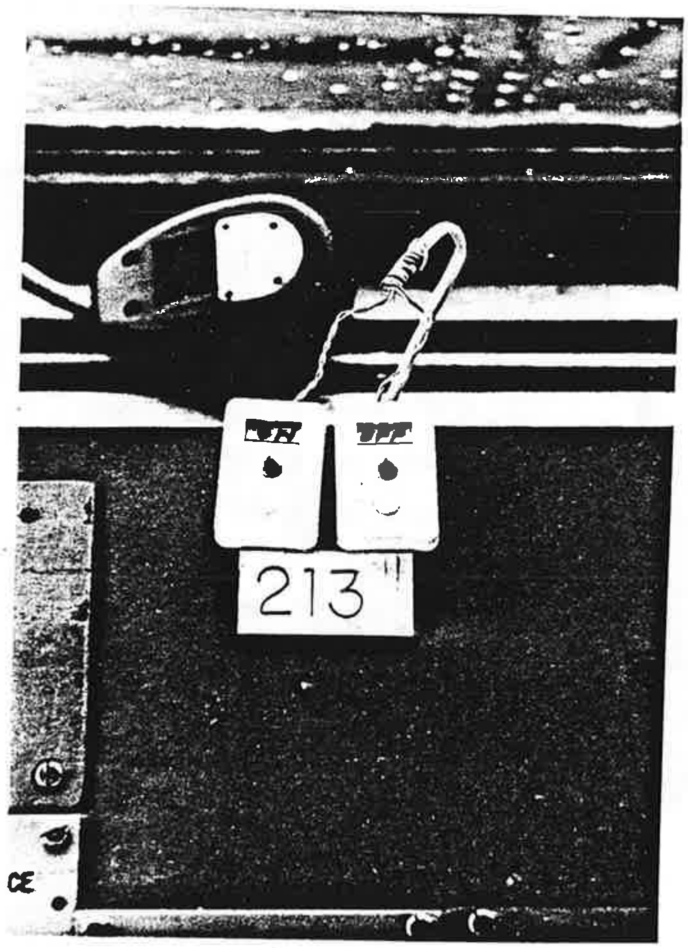


FIGURE 9-5. BEACON LIGHT CONTROL SWITCHES AT FD/CD

TABLE 9-2. HOBBY CONTROLLER REQUIREMENTS FOR AIRPORT LIGHTING STATUS

Visual Aid	Controllers Requiring Status
Taxiway Lights	GC,LC
Simplified Short Approach Lighting System with Runway Alignment Indicator Lights (SSALS) and Sequenced Flashing Lights (SFL)	LC
Medium Approach Lighting System (MALS) with Sequenced Flashing Lights (SFL)	LC
High Intensity Runway Lights (HIRLS)	GC,LC
Medium Intensity Runway Lights (MIRLS)	GC,LC
Visual Approach Slope Indicators (VASI)	LC
Runway End Identifier Lights (REILS)	LC
Airport Beacon	GC, LC

includes notice of visual aid outages in the ATIS broadcast

9.2 TERMINAL AREA RADIO NAVAIDS

Hobby TRACAB does not actually work with aircraft in the vicinity of off-site radio NAVAIDs. It is important, however, for FD/CD to know of all NAVAID outages so that substitutions may be made in routings when issuing clearances if necessary. The TRACAB Supervisor is notified either by IAH TRACON or HOUSTON FSS via interphone. He posts the NAVAID outages on the white board. The status of the Hobby (HUB) Vortax is of interest to LC, GC, HC and HR. It is used by aircraft on a VOR/DME approach to landing, and as a reporting position for VFR traffic. Hobby VORTAC is monitored by Houston FSS, who advises the TRACAB Supervisor via interphone when it is out of service.

9.3 LANDING AIDS

Table 9-3 presents the approach equipment on Hobby's runways. Runways 4 and 13R are equipped with ILS. The localizer for runway 22 is used for a back course approach. VOR/DME approaches are available for 4, 22 and 31L. Aircraft may also make an NDB approach to runway 4 and a VOR approach to runway 13R. The ILS for both 4 and 13R are monitored in the TRACAB by the Supervisor. The monitor panels, located between GC and FD/CD and at FD/CD position, provide visual and audio alarms when the ILS is out of service (Figures 9-6 and 9-7). The Supervisor checks them each shift and asks LC to confirm with aircraft that all components are operational. The Supervisor logs the outage and reports it to FSS via interphone, who then issues a NOTAM which is generally teletyped to all stations on their system. It is important for LC to know the status of all landing aids and for HR to have access to the status of HUB VOR.

TABLE 9-3. HOBBY APPROACH EQUIPMENT

Runway	Landing Aids
4	ILS - GS - LOC - MM - LOM
4	TUTTE NDB
4	HUB/VOR DME
13R	ILS - GC - LOC - MM - PARK OM
13R	HUB VOR
22	BACKCOURSE - LOC
22	HUB VOR/DME
31L	HUB VOR/DME

FIGURE 9-6. RUNWAY 13R ILS MONITOR AT FD/CD

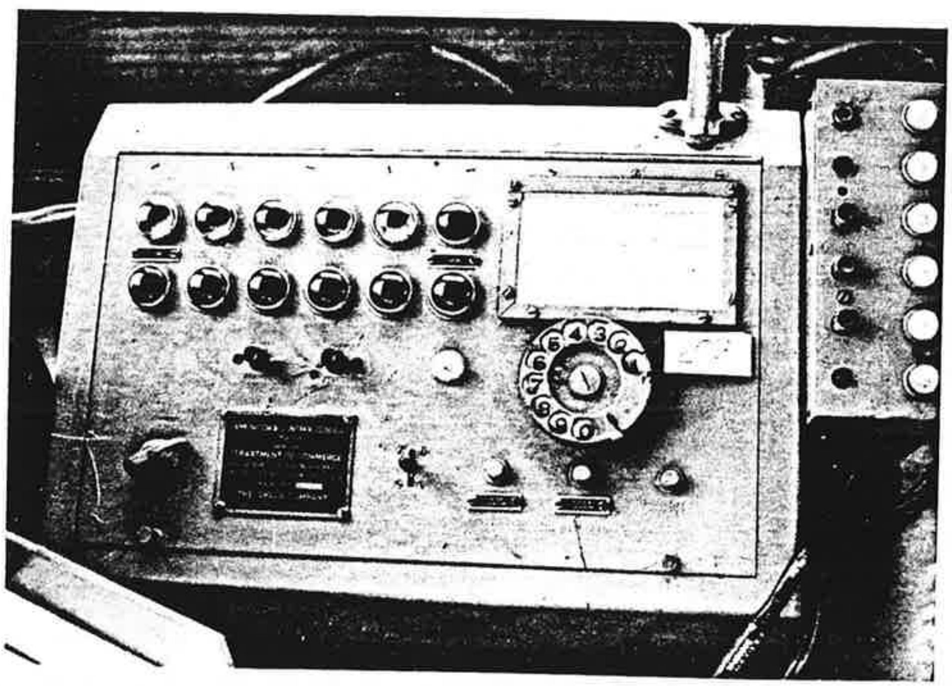


FIGURE 9-7. ILS MONITOR AND CONTROL PANEL

9.4 TRACAB CRITICAL DISPLAY ITEMS

The location and users of the critical display items in the TRACAB are shown in Table 9-4 and Figure 9-8.

All the controllers in the TRACAB rely on the digital clocks at LC, HC, GC and FD/CD positions for time information. The ARTS clock is not very easy to read in TRACAB lighting conditions. The Supervisor uses the FAA communications panel at LC position every shift to perform a time check by tuning in a continuously broadcast time sequence and adjusts the digital clocks as necessary. Time is issued to pilots upon request and used by controllers for logging duty time.

Analog altimeters located at LC, HR and GC positions provide barometric readings for Hobby airport. The settings on the ARTS displays represent IAH's barometric pressure and are not used by controllers at Hobby. The Supervisor compares the facility altimeter settings with the setting issued by HOU FSS via teleprinter at 7:00 am. If an instrument exceeds ± 0.02 from the setting issued by HOU FSS, it is removed from service and maintenance personnel notified.

The Hobby Airport is equipped with an RVR on runway 4. The transmissometers are located southeast of the runway next to the glide path building (Figure 9-9). Two indicators are displayed in the TRACAB (Figure 9-10). One is located at LC and the other is at GC. The RVR is calibrated from 1000 to 6100 in 100 feet increments. The maximum which can be displayed is 6100. Values higher than 6100 are not differentiated. Also displayed on the unit are three rows of buttons. The first row indicates whether the RVR is rising, falling or staying constant. The next row identifies the light intensity setting. The last row tells time of day: night, day, dawn, or dusk. In each of the three rows, the one appropriate button is lighted. Controllers prefer not to use the alarms which signal that the RVR has fallen below a certain level because the noise is annoying. When the RVR is below 6000 it is routinely issued to all aircraft.

TABLE 9-4. TRACAB CRITICAL DISPLAY ITEMS

	Supervisor	Control	Hobby Radar	Hobby Coordinator	Cab Coordinator	Ground Control	FD/ DC
Digital	○	Ⓧ	○	○	○	Ⓧ	Ⓧ
ARTS Clock		*	*			Ⓧ	
HOU Analog Altimeter	○	Ⓧ	Ⓧ			Ⓧ	○
IAH ARTS Altimeter		*	*			X	
RVR Display	○	Ⓧ				Ⓧ	
ATIS Code	○	○	○				Ⓧ
Wind Direction and Speed	○	Ⓧ	Ⓧ			Ⓧ	○

X - location

○ - user

* - one unit located between local control and Hobby Radar positions

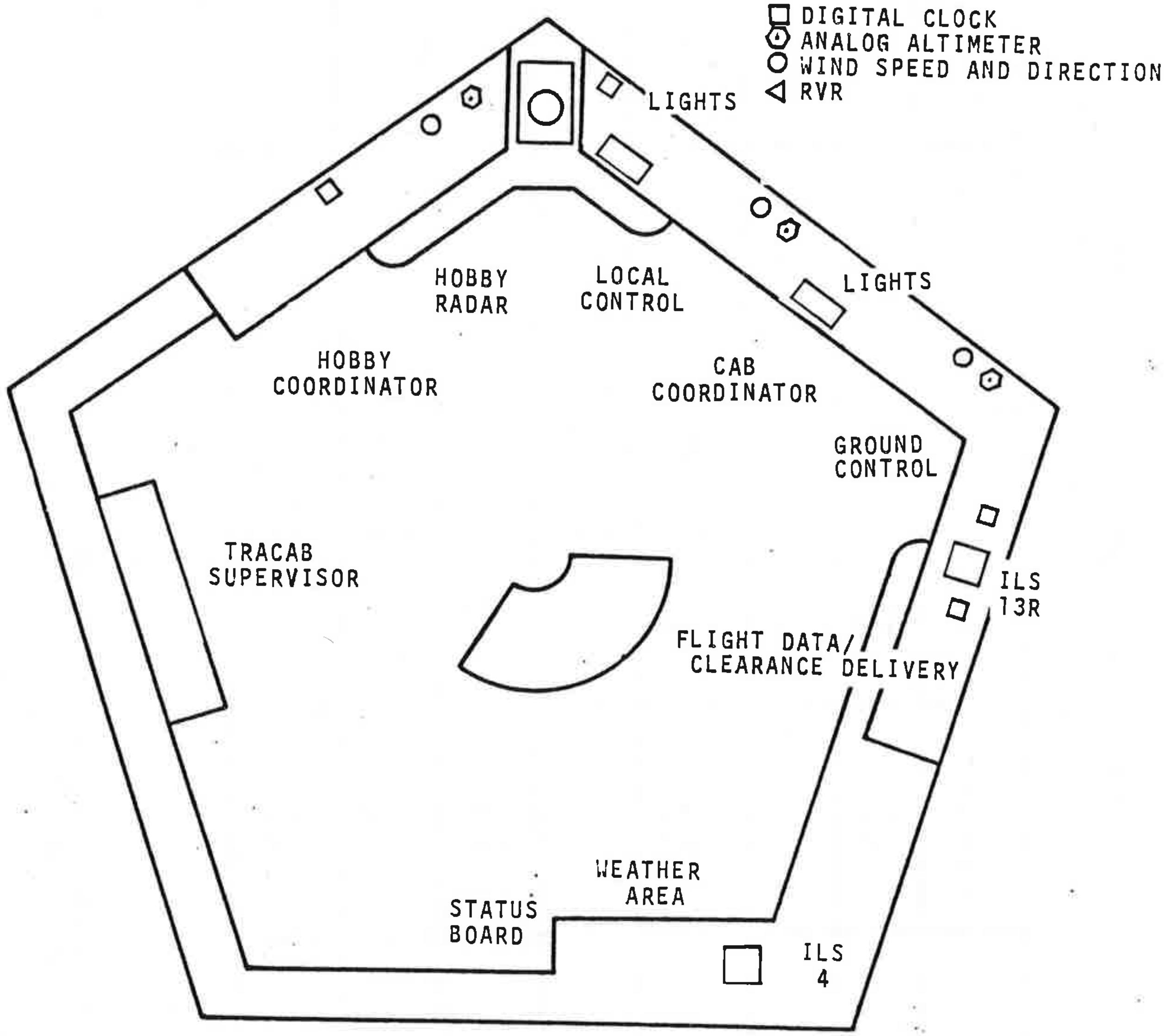


FIGURE 9-8. LAYOUT OF CRITICAL DISPLAY ITEMS IN TRACAB

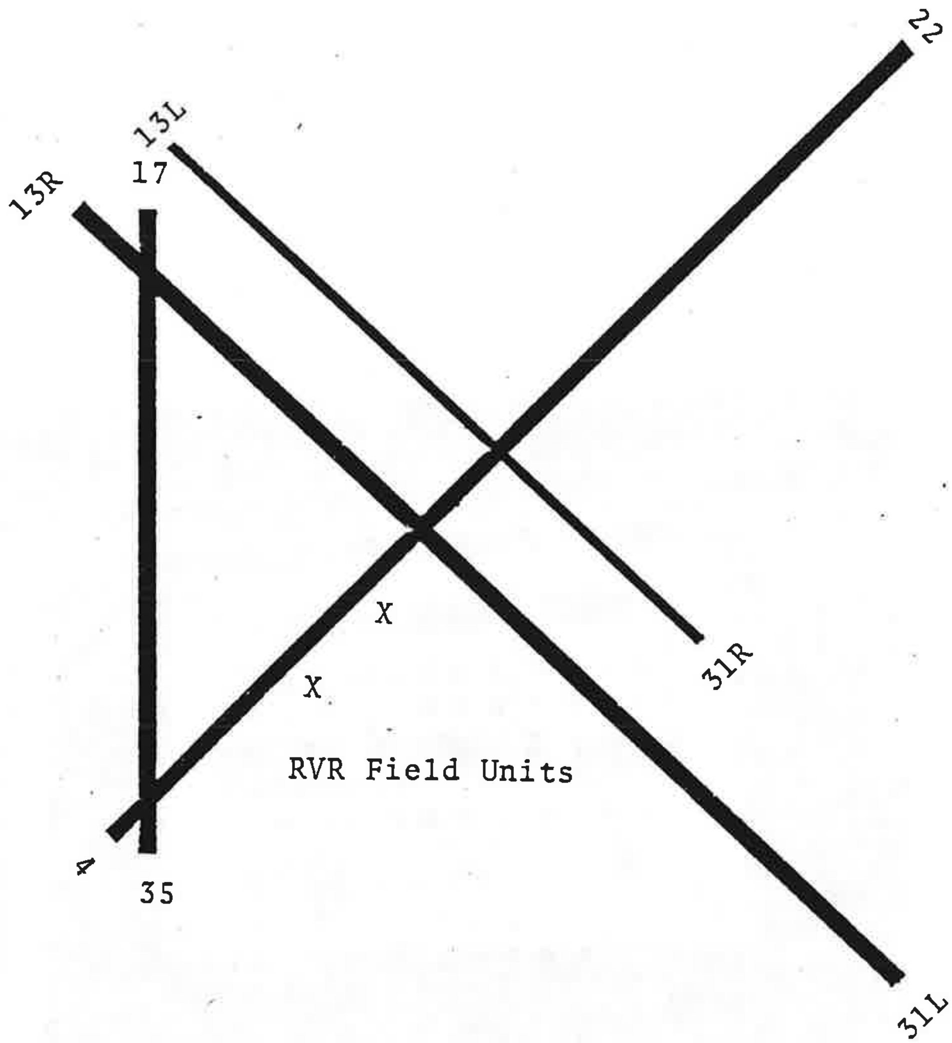


FIGURE 9-9. LOCATION OF RVR FIELD UNITS

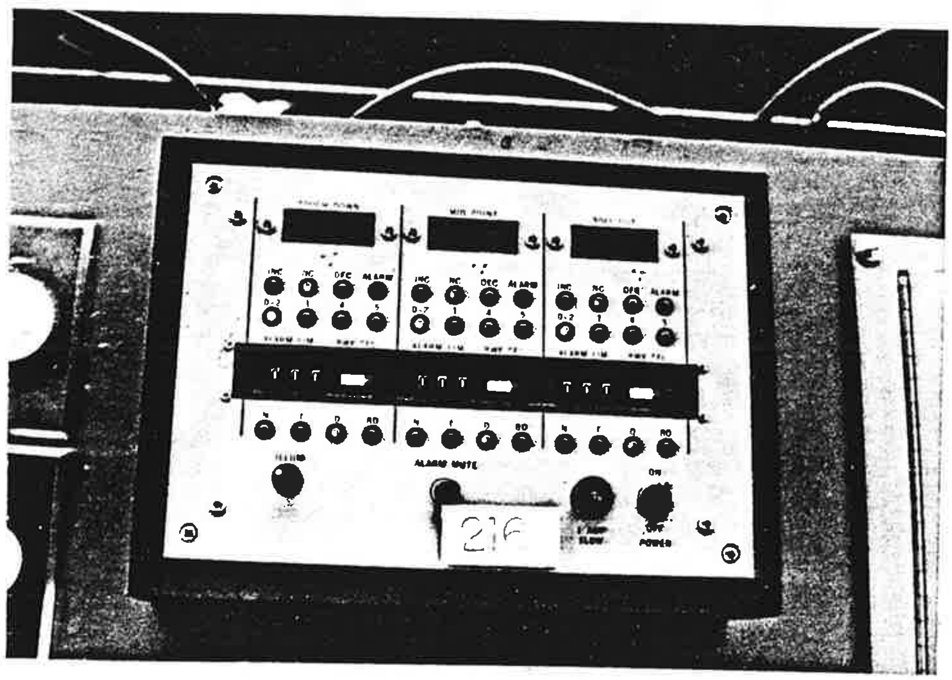


FIGURE 9-10. RVR DISPLAY AT LC

The Hobby TRACAB is also equipped with a Runway Visual Value (RVV) which determines runway visibility in miles. The indicator is located below and behind GC position. The lower console doors must be removed to gain access to this indicator. The RVV is connected to the same field equipment as the RVR, except that it by-passes the computer. In the event that the RVR computer is inoperative, the RVV is used.

There is one ATIS unit in the TRACAB, located at the FD/CD position. The same ATIS is issued to both arrivals and departures. FD/CD records the ATIS once an hour and more frequently as changing conditions necessitate. ATIS messages include: ATIS code (a letter from A to Z), time, weather, sky condition, visibility, temperature, wind, altimeter, approach in use, departure runways, NOTAMs and instructions to acknowledge ATIS code to FD/CD. FD/CD informs IAH of the appropriate ATIS code via teleprinter. Controllers in the TRACAB may learn the ATIS by asking, or by looking at either the teleprinter or the status board.

Wind speed and direction indicators are located at LC, HR, and GC positions (Figure 9-11). Under the following circumstances wind information may be issued to pilots: if pilot does not have ATIS, if conditions have changed since current ATIS was recorded, if facility is operating contrary to wind because wind is low, at pilot request, or if wind is gusting.

An equipment check must be completed by the Supervisor during various watches. A copy of the checklist is shown in Figure 9-12.

Table 9-5 presents a summary of controller information requirements for status, control and weather.

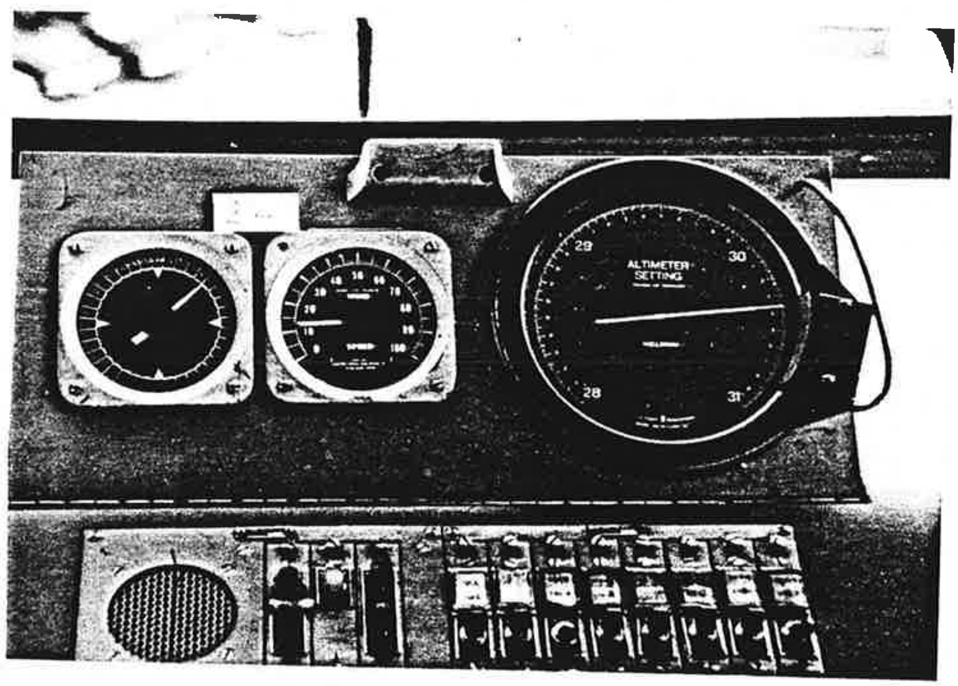


FIGURE 9-11. WIND INSTRUMENTS AND ALTIMETER AT GROUND CONTROL

ORDER

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
AIR TRAFFIC CONTROL TOWER (HOBBY)
HOUSTON, TEXAS

HOU 7210.19B

12/22/80

SUBJ: WATCH DUTIES AND CHECKLIST OF FACILITY EQUIPMENT

1. PURPOSE. This order assigns responsibilities for watch duties and completing routine checks of facility equipment.

2. DISTRIBUTION. This order is distributed to Air Traffic Operations Branch, Airspace and Procedures Branch and Houston TRACAB personnel.

3. CANCELLATION. Order HOU TRACAB 7210.19A, dated 12/09/77, is cancelled.

4. RESPONSIBILITY. The team supervisor shall ensure that the duties and checks listed below are accomplished.

5. REQUIRED DUTIES AND CHECKS.

* a. Each shift:

(1) Obtain time check.

(2) Obtain weather and forecast briefing.

(3) Check ILS monitor.

(4) Check ALS/SFL.

b. Day shift:

(1) Check emergency phone at 0700 LCL.

(2) Compare facility altimeter settings with the setting issued by HOU FSS in the 0700 LCL weather sequence. Note: If an instrument exceeds ± 0.02 from the setting issued by HOU FSS, remove the instrument from service and notify maintenance personnel.

* (3) Change recorder tapes at 0700 LCL.

c. Evening shift:

* (1) Change recorder tapes at 1900 LCL.

* (2) Check recorders. Record results in ink on FAA Form 6670-1, Multi-Channel Recorder Check Record.

* d. Monday day shift: Check all local VHF and UHF backup transmitters.

e. Monday evening shift:

(1) Check all local VHF and UHF backup receivers.

(2) Check battery-powered transceivers on each frequency.

(3) Obtain radio check on 121.5 MHz and 243.0 MHz.

6. DOCUMENTATION REQUIRED.

a. After all required checks are completed, make a notation on FAA Form 7230-4, Daily Record of Facility Operation. (Examples are "Watch checklist completed" or "WCLC".)

b. Enter all malfunctions on FAA Form 7230-4.

FIGURE 9-12. WATCH DUTIES AND CHECKLIST OF FACILITY EQUIPMENT

TABLE 9-5. SUMMARY INFORMATION REQUIREMENTS ANALYSIS FOR STATUS, CONTROL AND WEATHER AT HOBBY

Item	Location	Users	Description/Discussion	Status Determination and Dissemination
CONSOLE CLOCK	LC, HC, GC, FD/CD	TS, LC, HR, HC, CC, GC, FD/CD	Although it is less accurate than the ARTS clock the glare and distance make the ARTS time less readable. All controllers use the console clocks.	The Supervisor uses the selector panel at LC to perform a time check each shift and adjusts the digital clock as necessary.
ALTIMETER	LC, HR, GC	TS, LC, HR, GC, FD/CD	Altimeters are analog - ARTS altimeter reflects IAH and so are not used - Readings are issued to pilots upon request.	Supervisor compares facility altimeter setting with setting issued by HOU FSS via teleprinter at 7:00 am. If an instrument exceed ± .02 from setting issued at HOU FSS, it is removed from service and maintenance is notified.
RVR	LC, GC	TS, LC, GC	The transmission meters for runway 4 are located southeast of the runway next to the glide path building. The RVR is calibrated from 1000 to 6100 in 100-foot intervals. Volumes higher than 6100 are not displayed.	The status of the RVR is determined by the Supervisor and controllers using the equipment. Controllers check the equipment as they use it to make sure the indicator lights show proper setting. An "E" is displayed if there is an error in the system.
WIND SPEED WIND DIRECTION	LC, HR, GC	TS, LC, HR, GC, FD/CD	The TS uses wind to determine runway in use and traffic flow. Wind is issued to pilots if pilot doesn't have ATIS, if conditions have changed since ATIS was recorded, if facility is operating contrary to wind, at pilot request.	The status of the wind instruments is determined by observing the indicators to make sure they're moving and by cross-checking readings with those of FSS that come over the teleprinter hourly.
RUNWAY & TAXIWAY LIGHT CONTROL PANEL	GC	GC	A long panel with buttons which must depressed. Each runway has an on/off button and a series of intensity buttons (3 or 5). Three taxiways are 3-intensity. All others are 1-intensity.	Runway and taxiway outages are determined visually by tower personnel, airway facilities and by pilot reports. Outages are written on the status board and include in the ATIS and reported to FSS as NOTAM.
APPROACH LIGHTS CONTROL PANEL	LC	LC	The ALS are located at LC to provide immediate response to pilot request for flashing or dimming the 5 S&D MALS require posted combination for operation. The 55 ALS are 3-step intensity.	TS checks for ALS/SPL outages each shift. LC also gets reports from pilots of malfunctions. Outages are written on status board, included in ATIS and reported to FSS as NOTAM.
BEACON	FD/CD	FD/CD	There are two rectangular boxes each with one button to be depressed for either on or off.	This is checked by Airways Facility and the TS. Outages may also be reported by pilots. Outages are written on the status board included in ATIS and reported to FSS as NOTAM.

TABLE 9.5 SUMMARY INFORMATION REQUIREMENTS ANALYSIS FOR STATUS, CONTROL & WEATHER AT HOBBY (CONTINUED)

Item	Location	Users	Description/Discussion	Status Determination and Dissemination
NAVAIDS	HOU FSS		Hobby (HUB) Vortac is maintained by HOU FSS	Notice of HUB, and off-site outages are relayed from FSS to TS as NOTAM. HUB outage is included in ATIS. FD/CD is informed of all outages for issuing clearances.
LANDING AID MONITOR PANEL	Between GC & FD/CD and at FD/CD	TS	These panels provide visual (indicator lights) and audio alarms for all components for runway 4 and 13R ILS systems.	The Supervisor checks each shift and asks LC to confirm w/pilot that components are operational. Supervisor logs the outage, reports it to FSS as NOTAM, and includes in ATIS.
WEATHER RECEIVED WEATHER SENT	FD/CD FD/CD	FD/CD FD/CD, TS	Teleprinter at FD/CD, CONRAC at GC, and 2 FDEPs at FD/CD. Teleprinter at FD/CD.	Equipment is monitored by FD/CD. If no message has been received in an appropriate length of time, an attempt is made to request a message. Outages are reported to maintenance. The CONRAC is almost always out of order. The status board is used instead. If the FDEP or teleprinter can't be repaired in a short time, a spare is brought in.

APPENDIX A

A.1 TERMINAL INFORMATION DISPLAY SYSTEM (TIDS) DESCRIPTION

A.1.1 Introduction

The terminal Information Display System (TIDS) will collect, process, store, control, monitor, distribute, and display flight data and other non-radar data for an entire terminal area, including the Terminal Radar Approach Control (TRACON) facility and its associated towers. TIDS will present this data to tower and TRACON controllers on new flight data displays, TRACON displays, consolidated cab displays and control panels. TIDS will also transfer data, control and monitor information within a tower, between towers (regardless of distance between them), between tower(s) and the TRACON, and between a terminal and its host Air Route Traffic Control Center (ARTCC). The TIDS design is applicable to terminal areas with all levels of traffic and to collocated, remote and satellite towers.

TIDS is composed of two subsystems: the Flight Data Display (FDD) and the Consolidated Cab Display (CCD). The FDD provides automated handling of flight data and CCD provides weather and airport equipment status information as well as control of airport lighting. A detailed discussion of FDD and CCD is presented in sections A.2 and A.3 respectively.

A.1.2 System Objectives

TIDS is designed to increase the availability and accessibility of flight data, weather, and status information to the operating positions in the tower and TRACON. It is intended to replace the FDEP and flight strips, and to consolidate information now presented on an increasing number of gauges and control panels being used in the tower.

A primary objective of TIDS/FDD is to increase the availability and currency of flight data for use by tower and TRACON controllers. Currently only IFR flight strips are printed by the FDEP which is plagued with low speed and queuing problems. The ARTS system only presents abbreviated flight data on near term flights. With TIDS, information on both IFR and VFR flights is available at all display positions as soon as it is entered into the TIDS Central Processing Subsystem (CPS) and this information is shared with ARTS through an interface.

A second objective of TIDS is to provide greater support for the increasing demand for VFR services. Currently, several controllers may request the same information from a VFR pilot in the course of handling his flight. TIDS provides this information to all controllers once the information is entered into the TCPS eliminating the need for repeated interrogation of the pilot and providing prior information for planning purposes.

A third objective of TIDS is to reduce workload caused by coordination between controllers. Flight strips require manual distribution between controllers and verbal coordination is often routinely required to exchange flight and control status between the tower and TRACON positions. With TIDS, a single controller message transfers flight data and control status between positions so receiving controllers will have immediate access to this information from their displays as they require it.

The objective of TIDS/CCD is to eliminate the increasing number of separate indicators and processors required to display meteorological information, equipment status, and lighting control information at the operating positions. TIDS provides new consolidated displays supplying meteorological information, equipment status, and lighting status and control on a real time basis. Significant changes in information are brought to the controller's attention through the use of visual and aural alarms.

A.1.3 TIDS Features

TIDS/FDD tabular displays for flight data are located at the operating positions providing control status and selected flight data to the controller continuously. Full flight plan information on individual flights is available on request. The Quick Action

Switches and Keyboard provide simple methods for the controller to perform amendment and transfer functions.

New control panels are provided by TIDS/CCD to consolidate the various control and status panels presently associated with runway lighting. These control panels operate and indicate the status of the approach lighting system (ALS), sequence flasher lights (SFL), runway-edge and center-line lights, and touchdown-zone lights. Capability for on-off control and intensity selection of lighting systems of up to three runways is provided.

Consolidated supplementary and status information is provided by TIDS/CCD in the tower and TRACON. Critical and Supplementary Displays (CD and SD) are provided at ground and local control positions, FD/CD is provided with a Supplementary display only. Each radar position in the TRACON is provided with a TRACON display. The information that can be presented on these displays includes: time (GMT), barometric pressure, wind speed and direction, runway visual range (RVR), low level windshear advisory service values (LLWSAS), automated terminal information service code (ATIS), runway in use, vortex advisory service (VAS) interarrival separation distance, equipment status (ALS, SFL, ILS etc.), ALS intensity level, weather summary, daily log, and other information defined in adaptation. Inputs to the displays from remote sensors allow the display of dynamic, real-time data.

Notification of alarm conditions is provided by the CD, SD, and TD of TIDS/CCD. Adaptable parameters establish the normal ranges for data received from the remote sensors. When such data falls outside the established range, an alarm which requires acknowledgement is activated at the appropriate control position.

A centralized data base containing all flight and operational data is maintained by the TCPS portion of TIDS. This provides a centralized recording and distribution capability for all TIDS equipped facilities within the terminal area. The TCPS also interfaces with the local ARTS and host ARTCC computers providing a dynamic interchange of pertinent data. Figure A-1 illustrates the interchange of data between the three computer systems. This centralization also allows automated compilation of traffic counts and other operational summaries.

Flight data for VFR and local IFR flights may be entered into the TCPS allowing its display at any operating position by TIDS/FDD. The transfer of flight plan information on these flights will occur with transfer of control, reducing the need for the verbal exchange of data between controllers or between the pilot and controller. Other positions which will not control the flight, but desire information for planning may request a full readout of the flight plan.

When control of a flight is transferred, a single message entered by the controller will transfer flight information. This provides the receiving position with sufficient flight and status information to eliminate the need for routine verbal coordination. For those positions which already make an ARTS automated handoff, the transfer of data will be linked to this action. These positions which do not enter handoff messages (e.g., tower positions) are provided transfer functions by TIDS. The need to physically transfer flight strips from position to position is eliminated.

The TIDS interface with ARTS will provide ARTS with greater access to flight data. Modifications to ARTS will allow the temporary replacement of track data displayed on the PVD in data blocks and tabular lists with flight data. This allows the radar controller greater access to flight data without removing attention from the PVD. The ARTS software at Houston has been modified to provide these capabilities already, so this aspect of TIDS is not discussed in this paper.

Controller positions may be combined and decombined to compensate for changes in traffic level by a single supervisory message entered into TIDS. TIDS will automatically display all required data at the resulting position(s).

TIDS is suitable for terminal areas of all levels of traffic. The same hardware and software elements are applicable to all installations. The number of displays and the capacity of the system

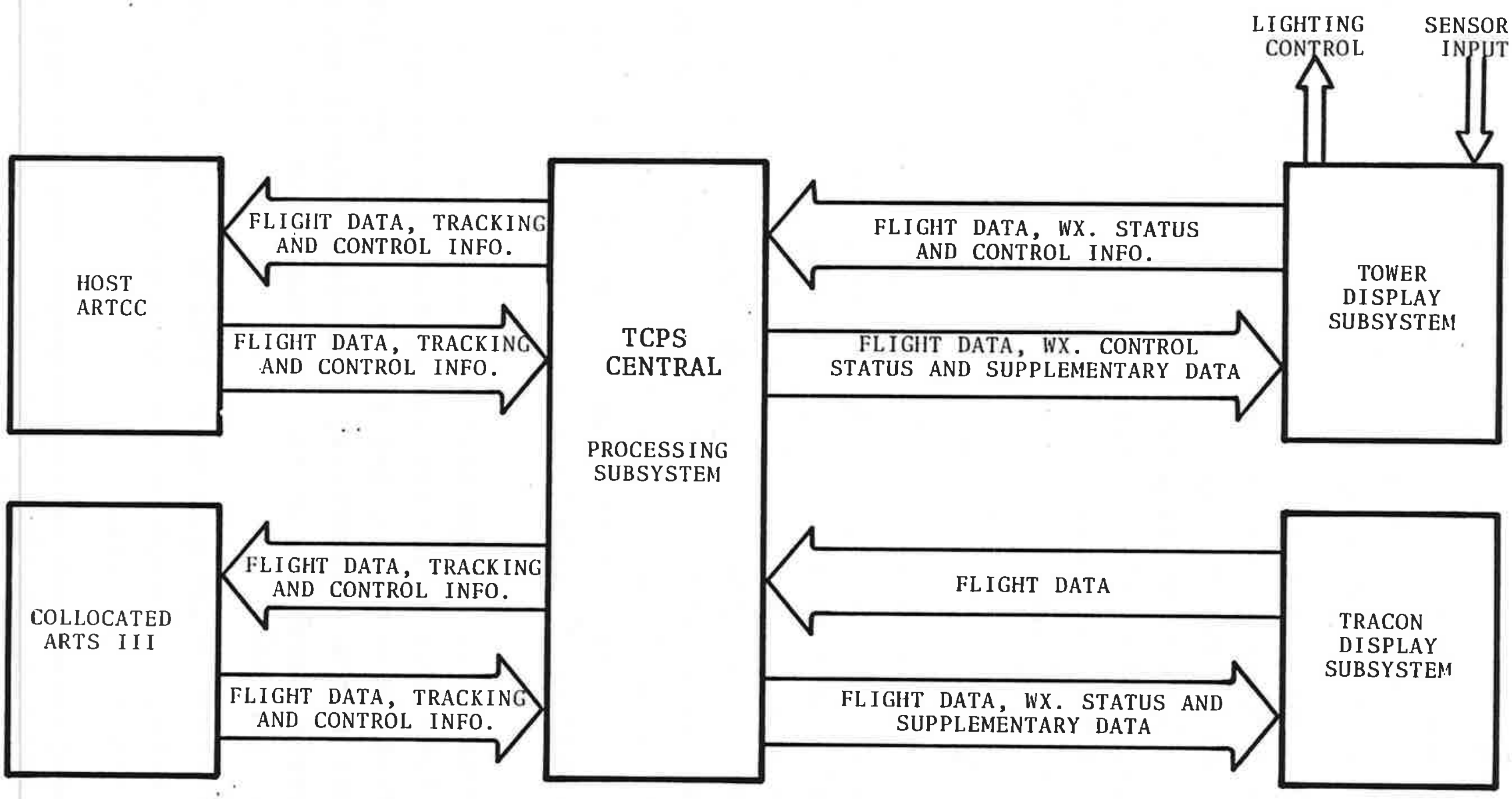


FIGURE A-1. SIMPLIFIED TIDS INFORMATION DIAGRAM is adjusted to traffic level and adaptation software allows application differences among facilities. The system also allows expansion to increase capacity and/or to include smaller satellite towers within the terminal area.

TIDS is designed to provide fail-soft failure mode operations. Failure of the CPS, or communications with it, will not affect information already on the displays. Failure at individual display units will not affect other display units. Failure of a peripheral processor (e.g., a display processor) will allow TIDS to operate at a degraded level. Redundant equipment is used where possible to reduce chance of failure.

A.2 FLIGHT DATA DISPLAY SYSTEM (FDD)

An important major step in the evolution of the flight data system being considered by the FAA is the replacement of the paper flight strip with an electronic flight information display. The Flight Data Display (FDD) is designed to provide this capability in the terminal areas. FDD is the flight data portion of TIDS and is designed to accept, store, process, distribute, and display flight data and limited weather and status information for the entire terminal area. All operating positions will be provided a FDD display in the flight data handling scenarios described in this paper.

The characteristics of FDD will introduce some changes in the handling of flight data at the various operating positions. To better understand these changes and the ability of FDD to provide adequate support to the controllers, this study related the FDD concept to current operations at the IAH Tower, IAH TRACON, and HOU TRACAB. To this end:

1. The current flight data operations for these facilities were surveyed through observations of controllers at work and through interviews.
2. The most recent FDD design documents were reviewed. A summary of the FDD design is provided in Section A.2.1.

3. The FDD display formats were applied to the various Tower and TRACON positions and the support FDD would provide to different operations was analyzed. The details of each position's display are discussed in Section A.2.2. Terminal operations using FDD are discussed in Section A.2.3.

A.2.1 FDD Design Summary

The central element of the system is the TIDS Central Processing Subsystem (CPS). The CPS will maintain a data base of flight and other non-radar data (e.g., NOTAMS, airport status, and weather) and distribute portions to the TRACON and controllers of client towers as required by the operational situation. An interface with the local ARTS and host NAS computers allows the free exchange of pertinent data so updates and amendments from all sources are rapidly integrated and presented to the controller as needed (Figure A-2).

The CPS interfaces with a display subsystem installed in the TRACON and at each client tower within the terminal area. The display subsystem assigns the individual Display/Data Entry Units to the appropriate controller positions (e.g., GC, FD/CD) formats the display presentations for those positions, and processes controller inputs. In the event of failure of the CPS, the display processor will continue to display the most current information available to the controllers at the time of failure.

The FDD Display/Data Entry Units located at each controller position consist of the following components:

1. CRT display

2. Quick Action Data Entry Units

3. Keyboard

The units are shown in Section A.4 in consoles, but they may also be mounted in desktops, or trunion mounts, allowing considerable installation flexibility at the operational positions. Figure A-3 depicts the Display/Data Entry Units.

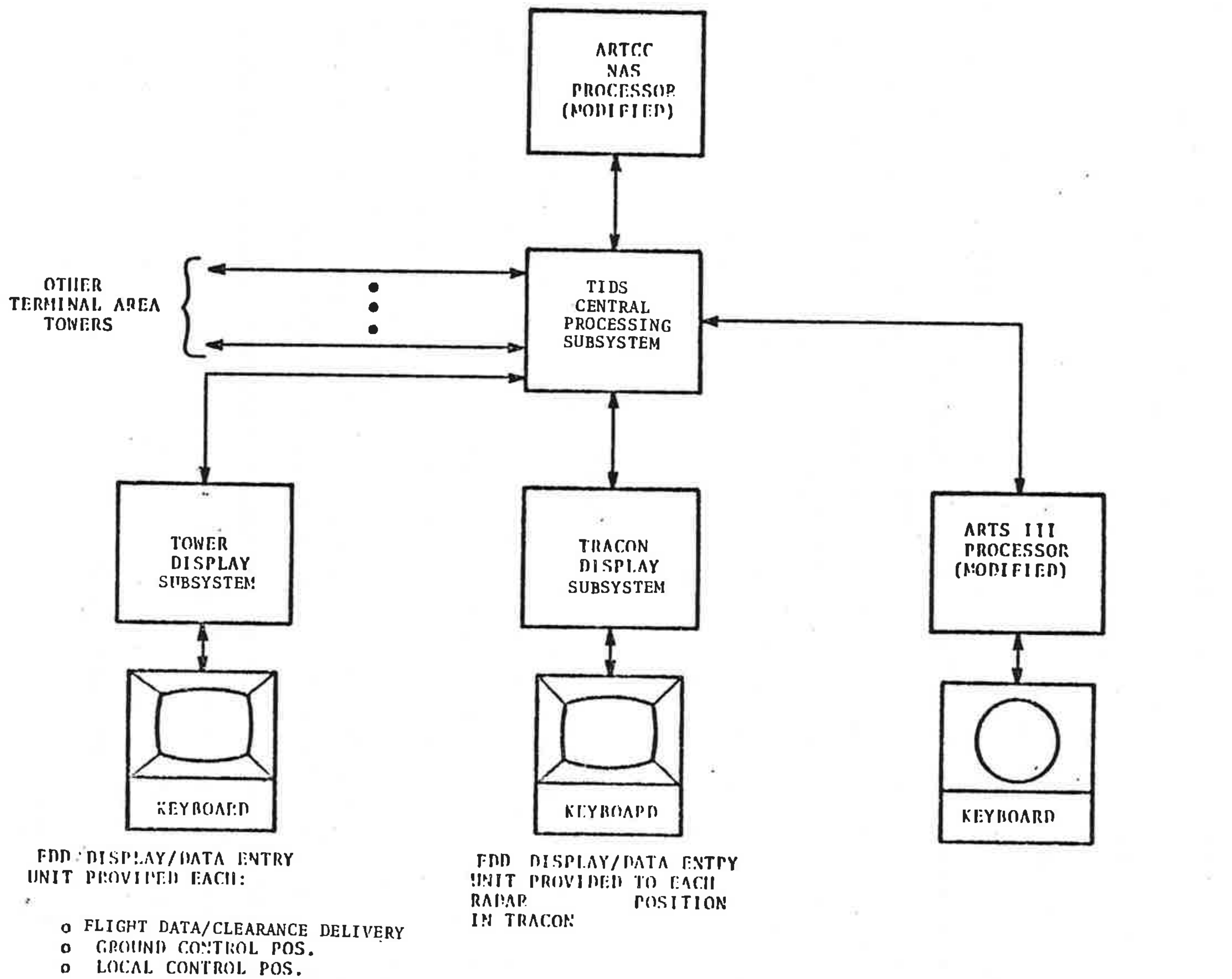
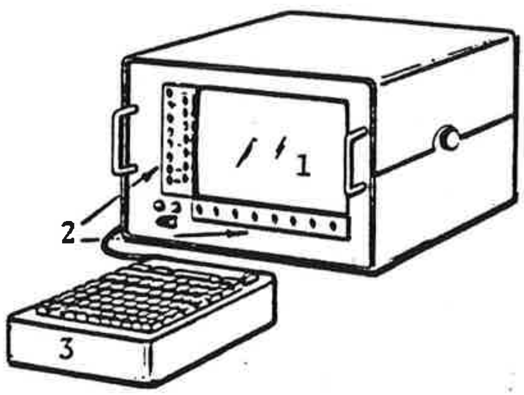


FIGURE A-2. FDD SIMPLIFIED SYSTEM BLOCK DIAGRAM



(1) FDD DISPLAY

(2) FDD QUICK ACTION DATA ENTRY UNIT

(3) FDD KEYBOARD

FIGURE A-3. DISPLAY/DATA ENTRY UNIT

A generalized FDD display format is illustrated by Figure A-4. It consists of the following areas:

1. List area - displays flight data entries
2. Readout area - displays flight plans, weather, and equipment status data on request
3. Preview area - displays controller keyboard inputs for inspection before processing
4. Computer Response area - displays computer response to controller messages and general system information (e.g., GI messages)
5. Status area - displays active runways, NOTAMS, and other status information data
6. Weather area - displays local altimeter setting and weather
7. Time area - displays time in hours, minutes, and seconds
8. Quick Action Function Area (QAF) - displays labels which describe functions associated with adjacent push buttons

The Status, Weather and time areas are redundant with CCD and functions and therefore may only be used as indicated where in satellite towers which are not provided the CCD portion of TIDS.

The list area format is tailored to the operational position while the remaining areas are the same for all positions. A detailed description of the formats for each position is presented in Section A.2.2.

The Quick Action Data Entry Unit is designed to provide a simple, quick method to perform common data control functions. The unit consists of pressure sensitive buttons along the left and bottom margins of the display. Selection of a flight entry requires a button selection first along the left and then the bottom margin to identify the row and column position of the desired entry. Selection of a function reuuires a push of the button adjacent to the function label (see Figure A-5). Thus, all func-

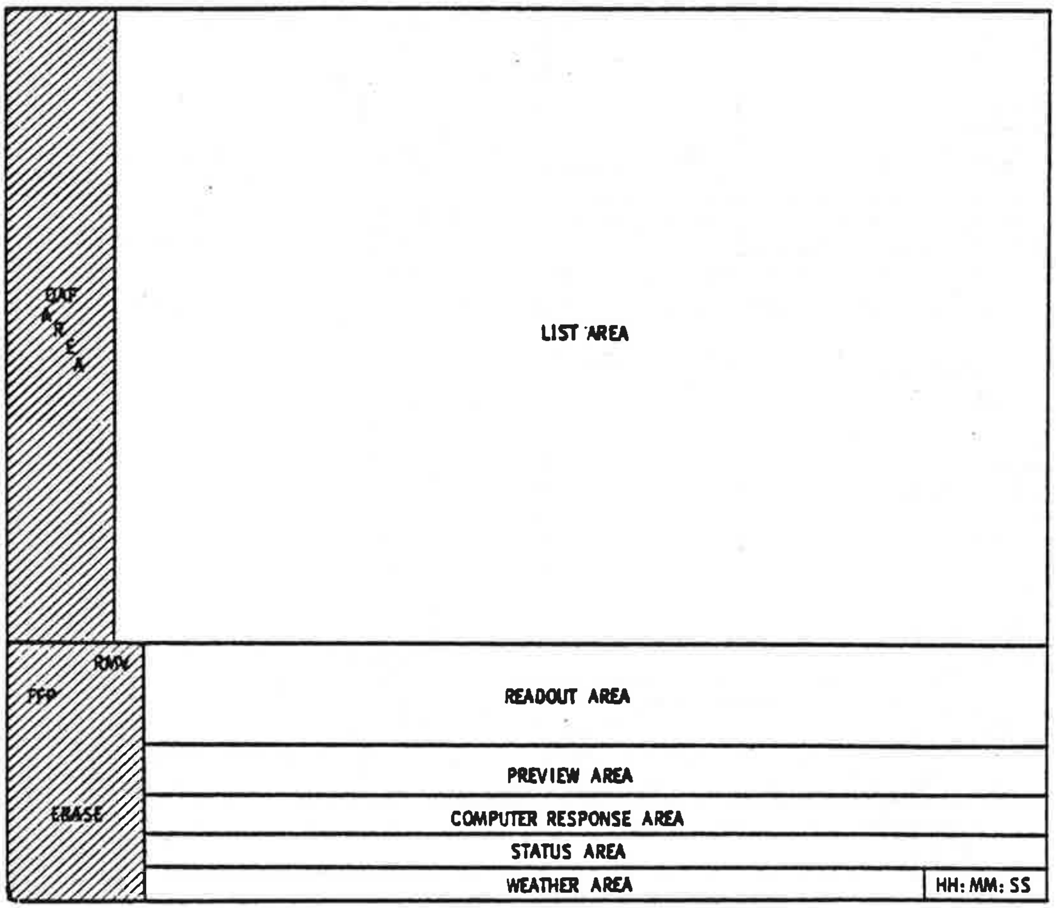


FIGURE A-4. FDD PRESENTATION FORMAT

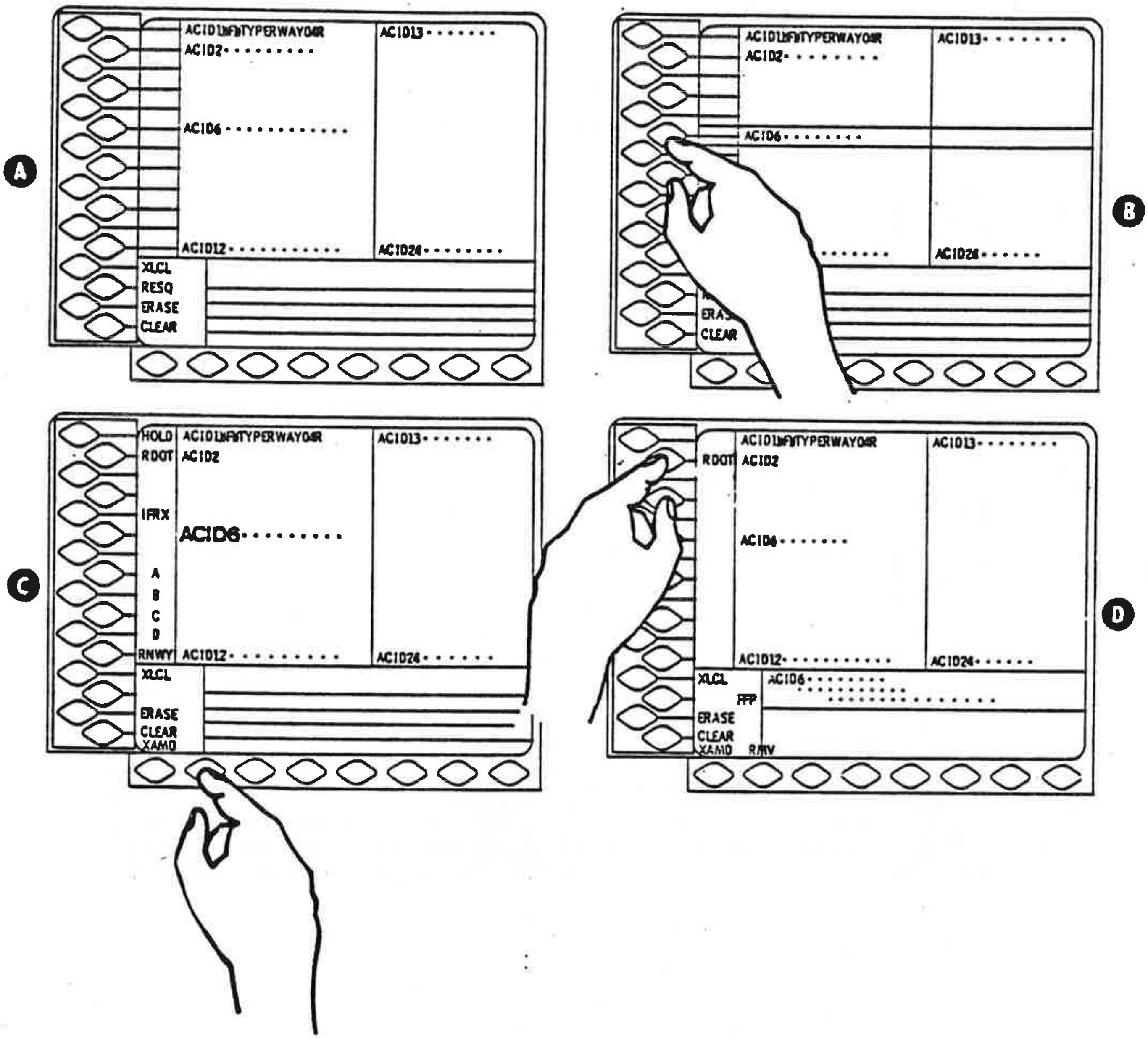


FIGURE A-5. FDD QUICK ACTION DATA ENTRY UNIT AND ITS OPERATION tions except the "switch" and "resequence" functions require three pushes or less to perform. Individual functions have been assigned to the various switches in an arrangement designed to minimize searching, hand movement, and therefore the possibility of error. Function assignments within a facility (e.g., tower cab) are such that no one button is assigned different functions at different positions. Thus, a given button will either select the same function at all positions or select a function at one position only and remain inactive at all others. This is intended to reduce the chance of inadvertent function selection as controllers rotate among positions. Also, when positions are combined, no function will be assigned on the combined display to a better location in a different location than it is on the individual displays.

Functions are grouped so that all functions involving movement of entries (transfers between positions or shifts on the display) are along the bottom row, amendment functions are adjacent to the List area, and the functions affecting Readout, Preview, and Computer Response areas are adjacent to the respective areas. The transfer functions are assigned so that in most situations the button used to identify the column location of the flight entry will actuate the transfer with a second push. Simplification of display operation is achieved further through the use of implied entry functions at the local and ground control displays. The hand-off functions on these displays affects the transfer of the flight entry at the top of list of entries by selecting only the function switch; depression of the switch to identify the row and column of the entry is not required.

The keyboard is used for entry of lengthy messages such as flight plans or amendments to them. The keyboard and its use is based on the ARTS keyboard. The general message entry sequence is:

1) ACID; 2) Function Key; 3) Data; 4) Enter

The keyboard is illustrated in Figure A-6. Keyboard inputs are displayed in the Preview area as they are made. Keyboard cursor controls are used to designate for modification data in the Preview area. They move the Preview area cursor to any displayed

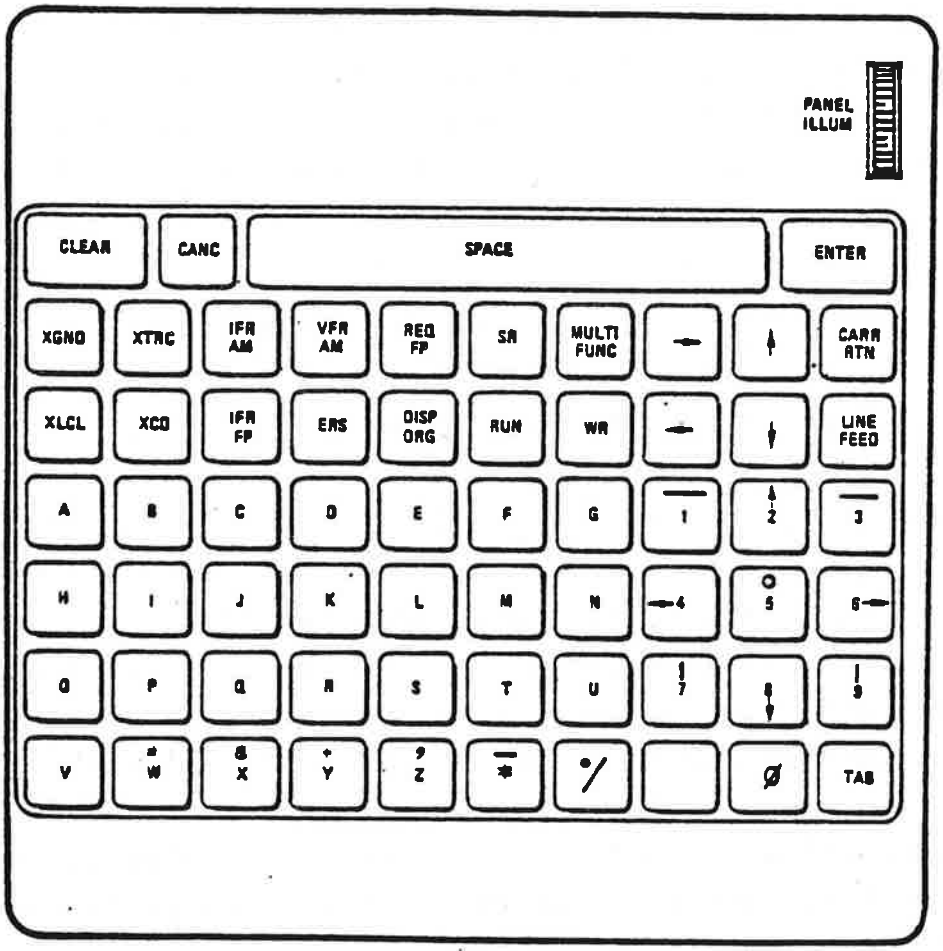


FIGURE A-6. FDD KEYBOARD

character(s) and so facilitate correction or deletion of those character(s) by subsequent keyboard actions.

A.2.2 FDD Display Format by Position

A.2.2.1 FDD Presentation for FD/CD - This proposes installation of FDD units at the following positions: FD/CD, GC, LC-1 and LC-2 at IAH tower; Departure East, Departure West, Arrival East, Arrival West, South/Satellite Radar, IAH Final, and Hobby Final at the IAH TRACON; and FD/CD, GC, LC, and Hobby Radar at the Hobby TRACAB. The following sections describe the formats to be used at these positions.

Figures A-7 and A-8 depict the FDD formats used at the FD/CD positions at IAH and HOU. Flight entries consisting of an ACID, a blank for a prefix character, and a blank for spacing are arranged in five columns. The Pending columns display entries for flights which have not yet been given their clearance. The Standby columns are for flights which have been given clearance but are not yet ready for push back. The Amendment list displays flights which are transferred to the FD/CD position from ground or local control for amendment. The ACIDs on the Pending and Standby lists are prefixed with a character (e.g., an asterisk) to indicate "cleared as filed" or a different character (e.g., an ampersand) to indicate "read full clearance" when either of these situations exist.

The following quick action functions are provided at the FD/CD positions:

IFRX	cancel IFR flight plan for specified flight
FFP	convert abbreviated flight readout to full flight plan readout and page Readout area if flight plan display requires more than four lines
RMV	clear Readout area
CLEAR	clear Preview area and return system to quiescent state

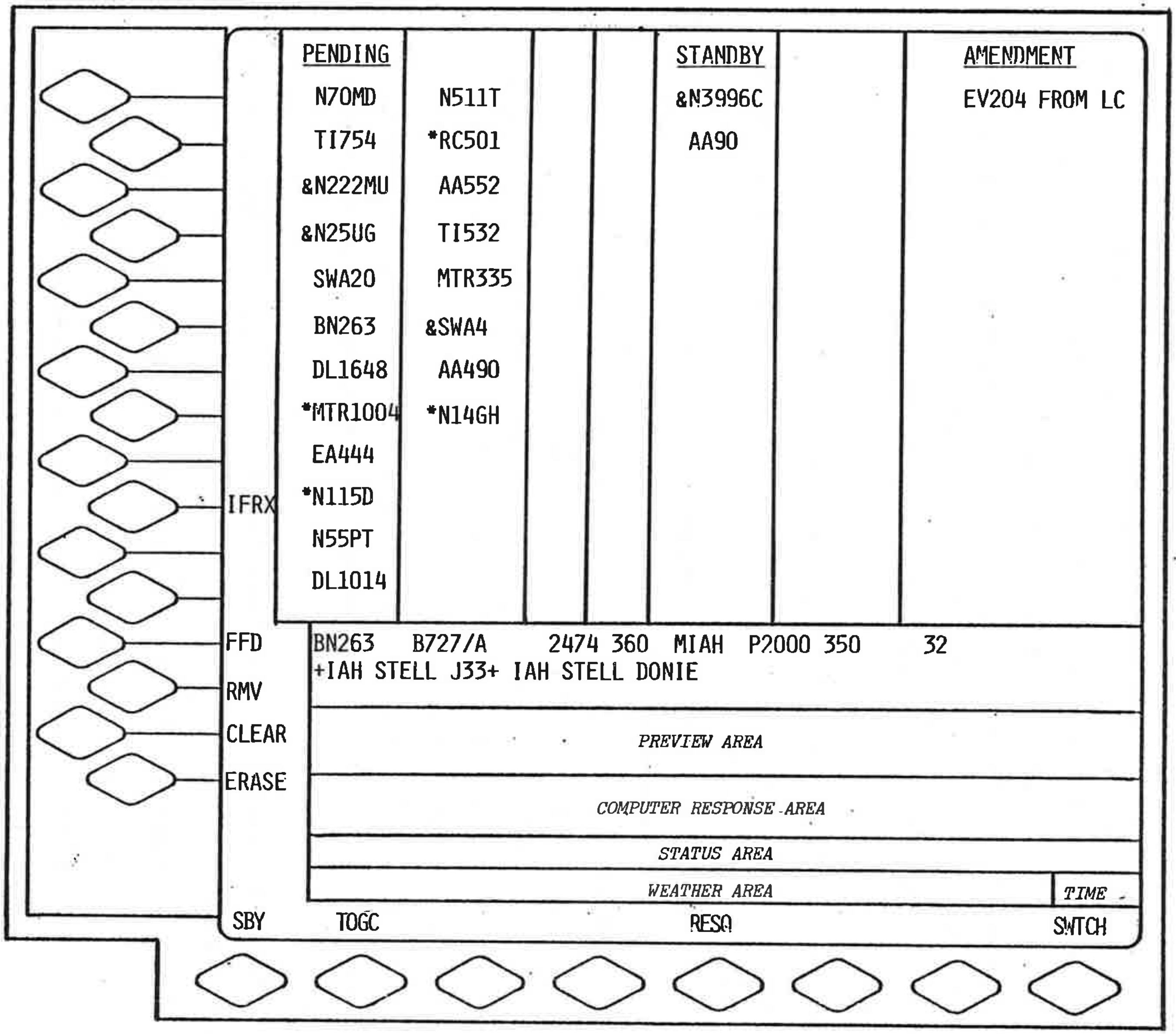


FIGURE A-7. IAH FLIGHT DATA/CLEARANCE DELIVERY

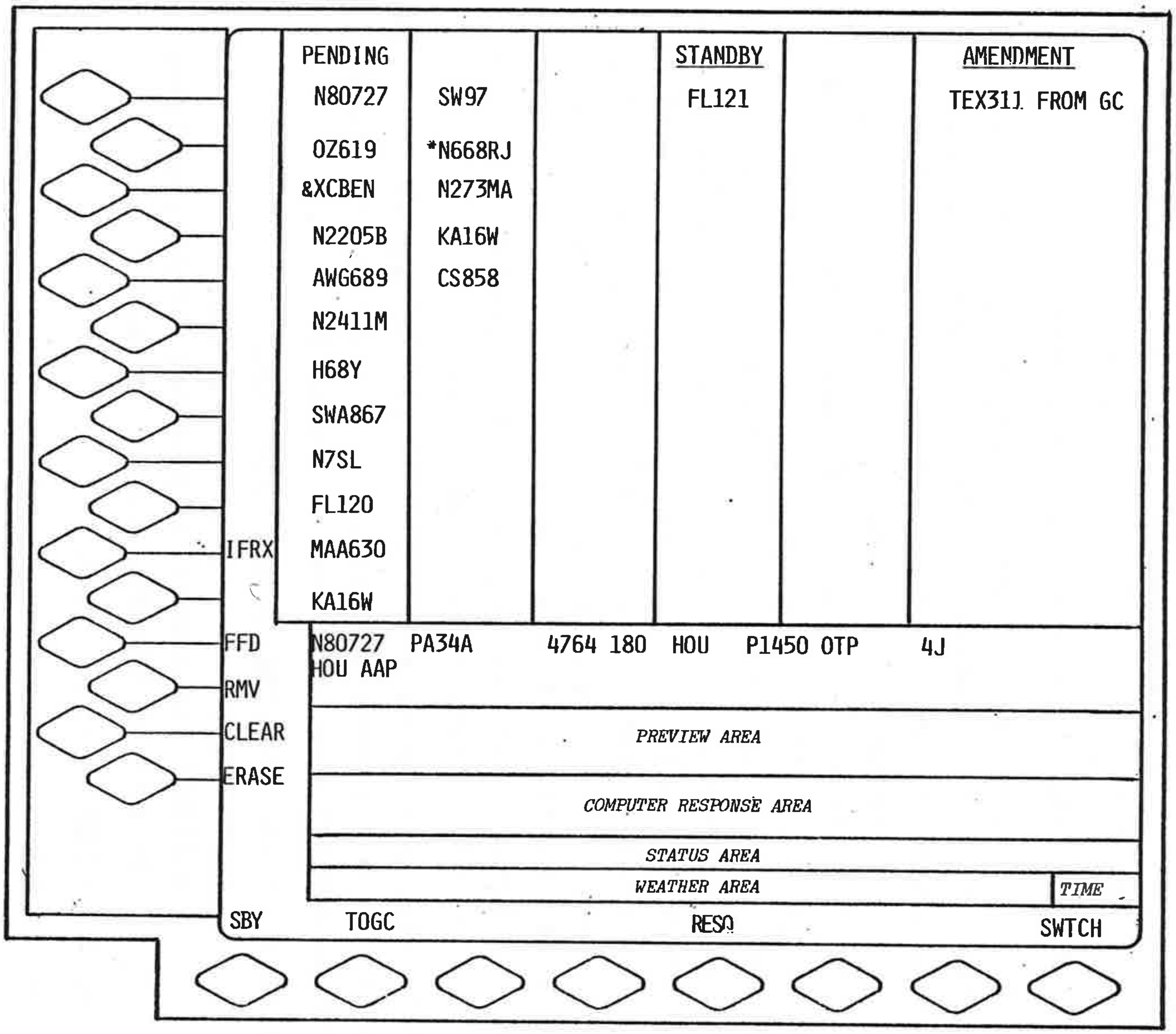


FIGURE A-8. HOU FLIGHT DATA/CLEARANCE DELIVERY

ERASE clear Computer Response area

SBY move selected entry to STANDBY column

TOGC transfer selected departure to CG

RESQ move selected entry to selected position on the display

SWTCH exchange positions of selected entries

Entries are added to the Pending list automatically at a predetermined time before departure. There are several methods of list organization available for controller selection. The one most similar to current practice would list entries in the order they are made available for display, adding new entries to the bottom of the list. Entries are removed when transferred to CG by row and column flight entry and "TOGC" selections or when the flight plan is cancelled. Overflow of any list is provided for through the use of paging. Overflow conditions are indicated by replacing the last flight entry in the list with the label MORE. A row and column selection (same as flight entry selection) of MORE will replace the list with a second page. A RETURN label will be displayed on the second page; a row and column selection of it will return the original page of entries.

Selection of a flight entry from the list by making a row and column selection automatically produces a readout of its flight plan on the Readout area. The readout format is:

Line 1: ACID A/C TYPE BEACON CODE SPEED COORDINATION FIX COORDINATION TIME ALTITUDE (requested for proposed flights, assigned for active) ASSIGNED RUNWAY NOTES

Line 2: + PDR or PDAR + ROUTE

line N: Ø REMARKS

Fields will present stored information or remain blank (as the notes and remarks field are in the example readout) to indicate no data. All flight plan readout fields except the note field utilize the same meaning and format used for flight strips. The note field is used to provide controllers the capability to make notations (currently handwritten) which are not specifically provided by FDD functions (e.g., as amendments).

The Preview, Computer Response, Status, Weather and Time area functions are as described in Section A.2.1 for displays at all positions.

A.2.2.2 FDD Presentation for GC - Figures A-9 and A-10 illustrate the FDD formats for the GC positions at IAH and HOU. The display is divided into two lists; a departure list on the left and an arrival list on the right. The departure list entry format is:

> ACID FLIGHT STATUS INDICATOR (IFR or VFR) A/C TYPE ASSIGNED RUNWAY COORDINATION FIX REMARKS AND NOTE INDICATOR (R INDICATES REMARKS PRESENT, N INDICATES NOTES PRESENT, AND B INDICATES BOTH ARE PRESENT)

The format of the entries in the arrival list is:

> ACID A/C TYPE ASSIGNED RUNWAY REMARKS AND NOTE INDICATOR

The fields in both lists are in fixed positions so that when there is no data, a blank is displayed rather than shifting fields to take up the space.

The following Quick Action functions are provided at the GC position:

RDOT	- display flight plan in Readout area
HOLD	- place hold indicator in assigned runway field
RWY	- initiate assigned runway amendment
F,H,J	- place selected intersection departure indicator in
L,N,C,D,E	- runway field
IFRX	- cancel IFR flight plan
XAMD	- transfer entry to FD/CD for amendment

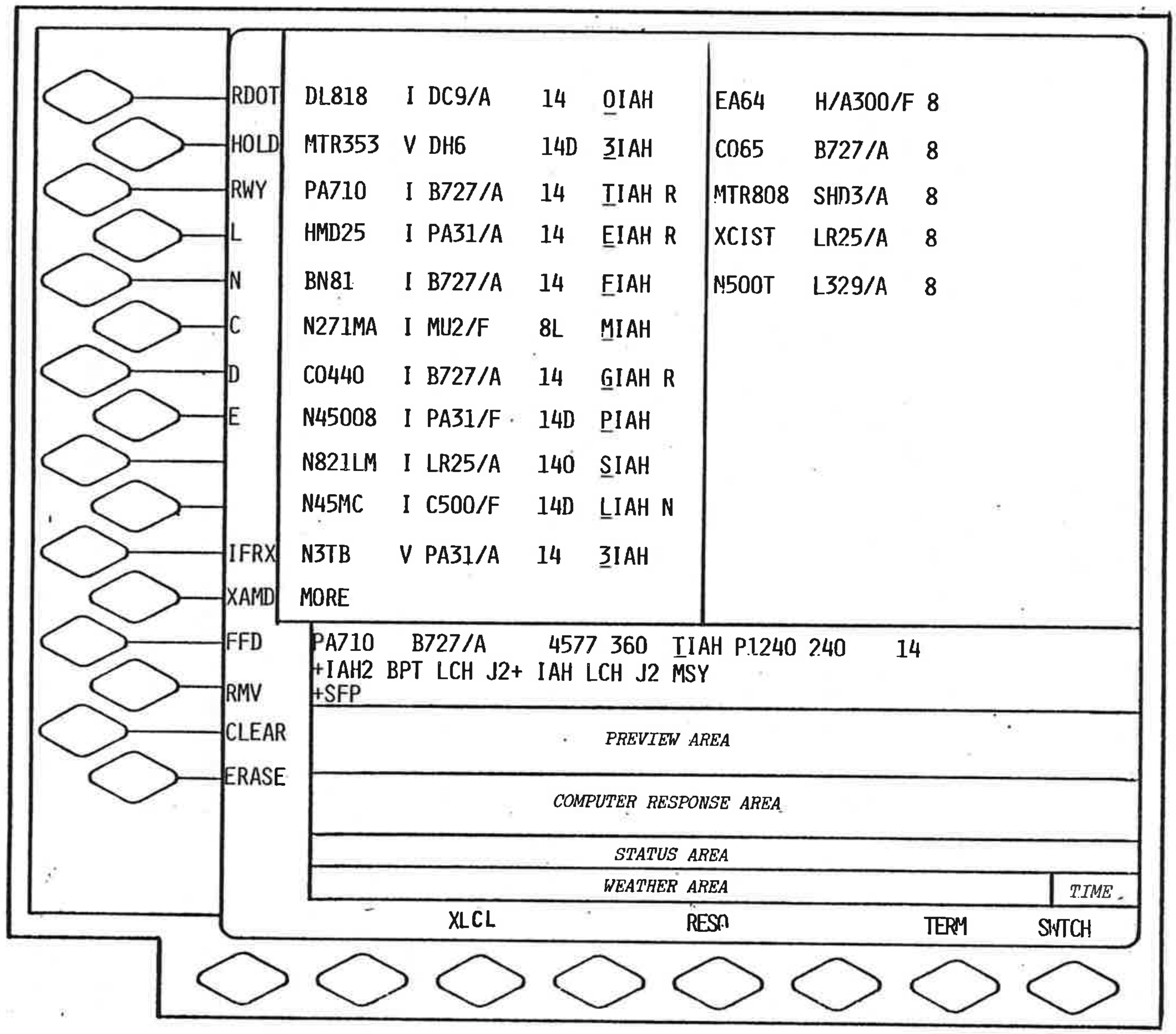


FIGURE A-9. IAH GROUND CONTROL

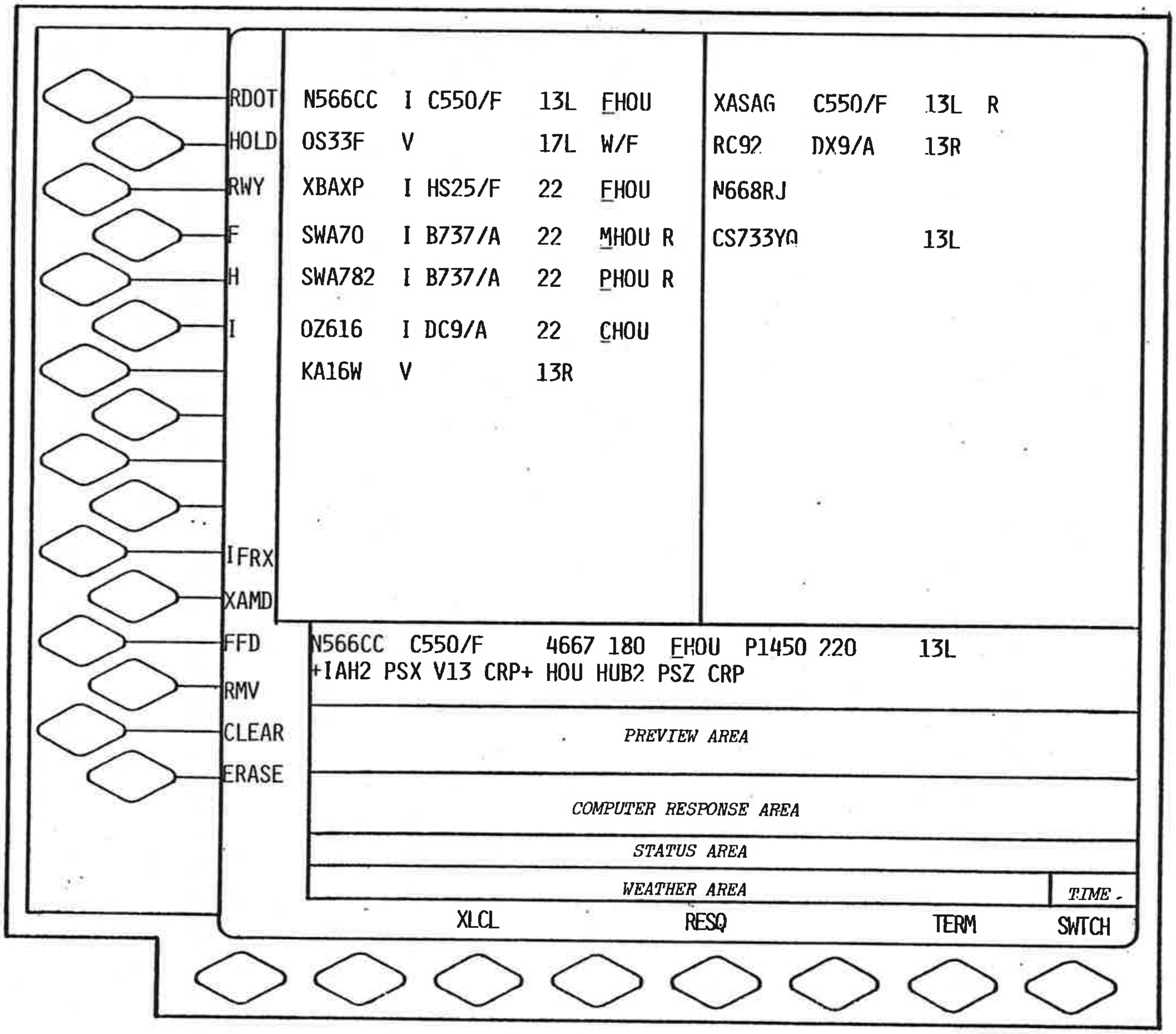


FIGURE A-10. HOU GROUND CONTROL

FFP - page Readout area if flight plan display requires more than four lines

RMV - clear Readout Area

CLEAR - clear Preview area and return display to quiescent state

ERASE - clear Computer Response area

XLCL - transfer selected departure to LC

RESQ - move selected entry to selected position on the display

TERM - terminate selected arrival

SWTCH - exchange positions of selected entries

Entries are added to the departure list as the result of a transfer from FD/CD. Of the several organization options available the one most similar to current practice would display entries in the order received, placing new entries at the bottom of the list. Entries are deleted from the list by transferring the flight to LC with row and column flight entry and "XLCL" selections. Overflow of the departure list is handled by paging the list. Figure A-9 illustrates the overflow of the departure list as indicated by the MORE label displayed in the last entry position. A row and column selection of MORE would display the second page of the departure.

Entries are added to the arrival list as the result of a transfer from LC. Of the several organization options available the most similar to current practice would display entries in the order made available, adding new entries to the bottom of the list. Entries are removed by terminating the flight with row and column flight entry and "TERM" selections. Overflow of the arrival list is handled by paging the list.

The functioning of the Readout, Preview, Computer Response, Status, and Weather areas is as described for the FD/CD position.

A.2.2.3 FDD Presentation for LC - Figures A-11 and A-12 illustrate the FDD format for the LC positions at IAH and HOU. As with the GC display there is a departure list on the left and an arrival list on the right. The departure list entry format is:

ACID FLIGHT STATUS INDICATOR A/C TYPE BEACON CODE
ASSIGNED RUNWAY COORDINATION FIX ASSIGNED ALTITUDE
REMARKS AND NOTE INDICATOR

The format of the entries in the arrival list is:

ACID A/C TYPE BEACON CODE ASSIGNED RUNWAY
APPROACH TYPE REMARKS AND NOTE INDICATOR

The fields in both lists are in fixed positions so that when there is no data, a blank is displayed rather than shifting fields to take up the space.

The Quick Action functions available to the LC position are:

RDOT - display flight plan in Readout Area

RWY - initiate an assigned runway amendment

R - enter radar handoff symbol to selected flight entry (HOU only).

MSAP - return arrival to TRACON for resequencing

IFRX - cancel IFR flight plan

XAMD - transfer entry to FD/CD for amendment

FFP - page Readout area if flight plan display requires more than four lines

RMV - clear Readout area

CLEAR - clear Preview area and return display to quiescent state

ERASE - clear Computer Response area

XTRC - transfer departure entry to TRACON

RESQ - move selected entry to selected position on the display

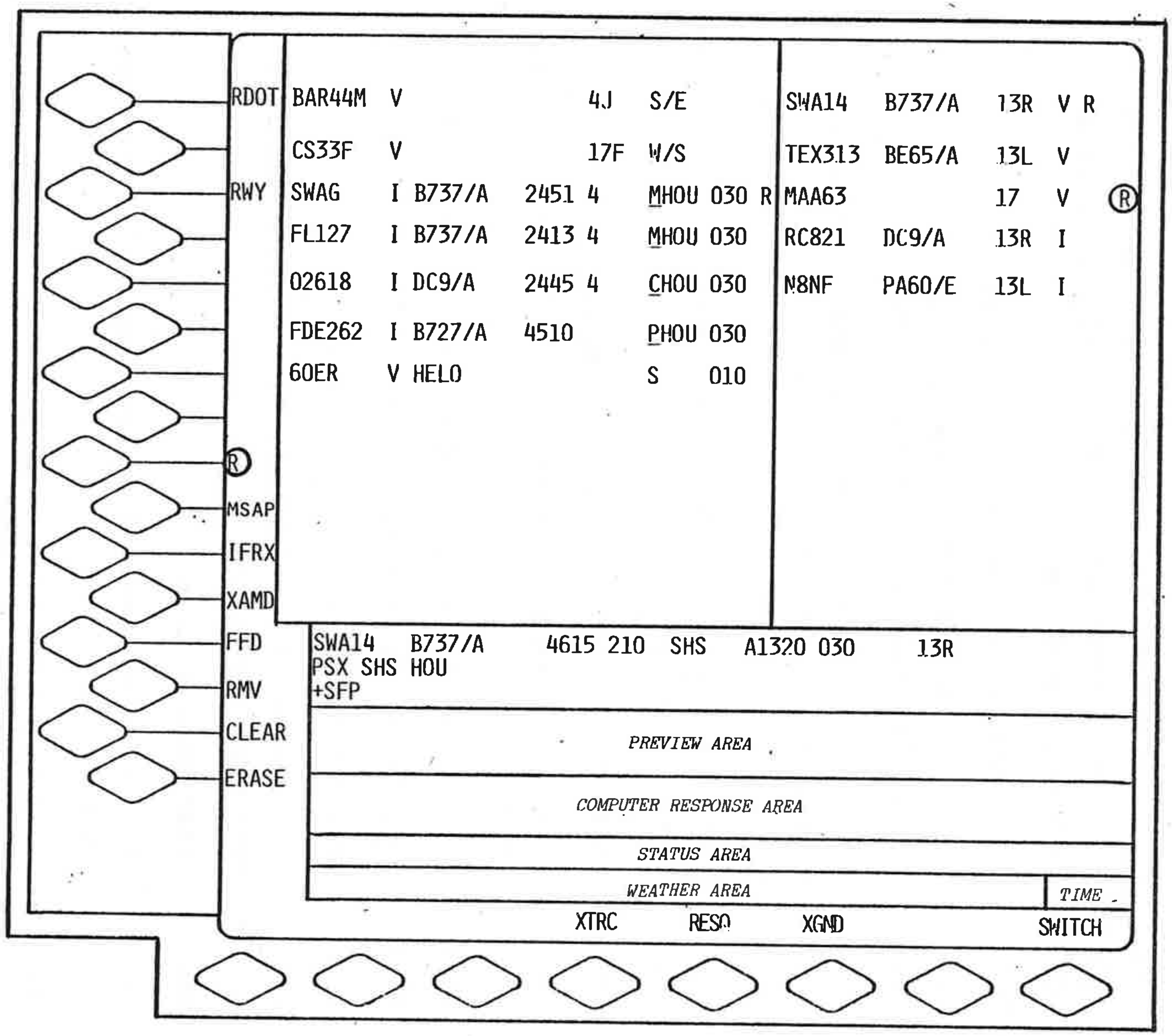


FIGURE A-11. HOU LOCAL CONTROL

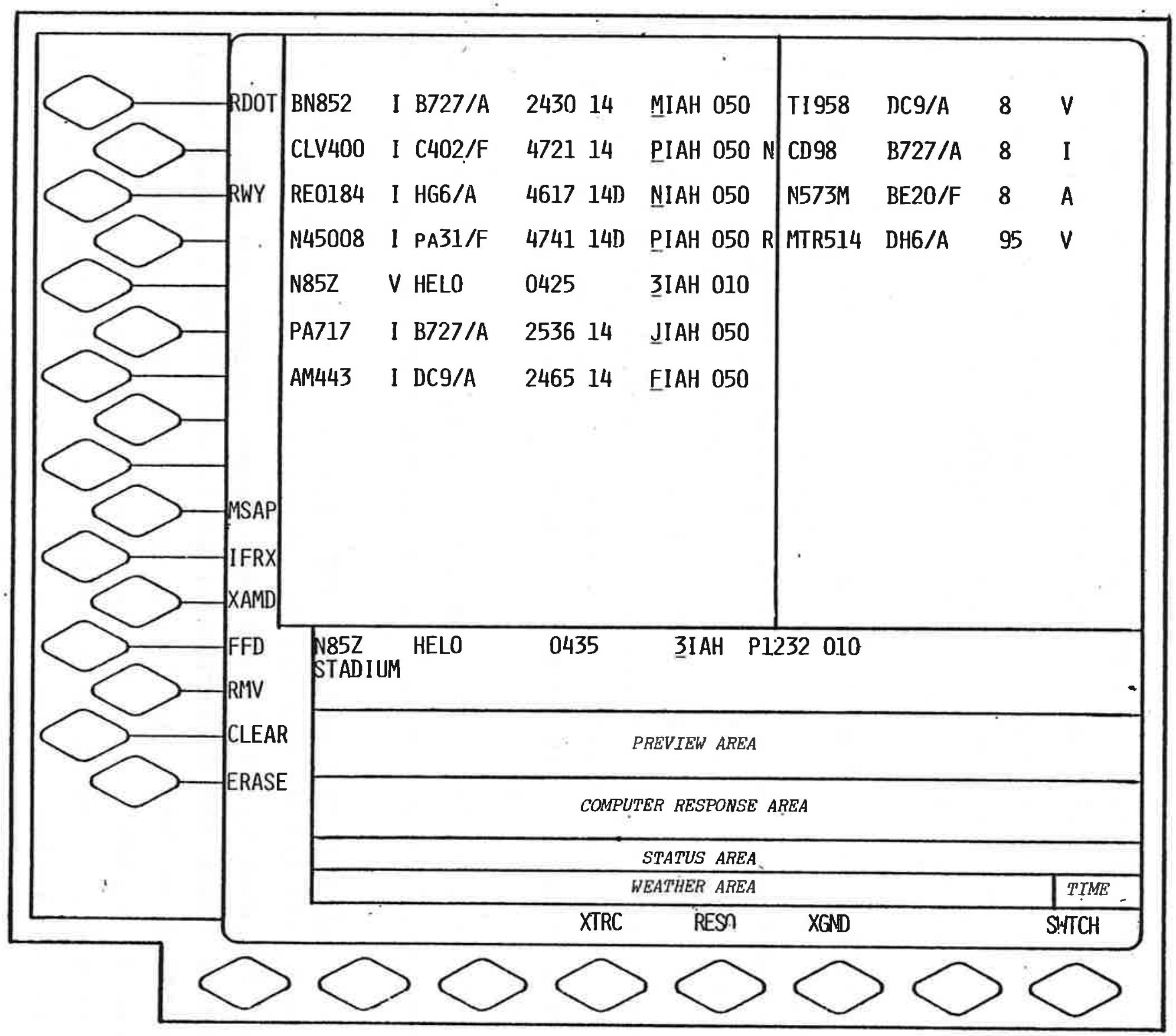


FIGURE A-12. IAH LOCAL CONTROL

XGND - transfer arrival to GC

SWTCH - exchange position of selected entries

Entries are added to the departure list as a result of a transfer from GC. Of the several organization options available the one most similar to current practice displays entries in the order received, placing new entries at the bottom of the list.

Entries are deleted from the list by transferring the flight to the TRACON with row and column flight entry and "XTRC" selections. Overflow of the departure list is handled by paging the list.

Entries are added to the arrival list as the result of a transfer from the TRACON. Of the several organization options available the one most similar to current practice displays entries in the order received from the TRACON, placing new entries at the bottom of the list. Entries are deleted from the list by making a row and column flight entry selection and selecting either "XGND" to transfer the flight to GC or "MSAP" to return a missed approach to the TRACON. Overflow of the arrival list is handled by paging the list.

The functioning of the Readout, Preview, Computer Response, Status, and Weather areas is as described for the FD/CD position.

A.2.2.4 <u>FDD Presentation for Departure East and West</u> - Figures A-13 and A-14 illustrate the FDD formats for Departure East and West. The display is divided into seven columns and they are allocated among the departure airports and TRACON sectors handing off traffic to these radar positions. The space devoted to a particular airport or sector is based on the relative amount of traffic expected to be received from it. The beginning of each list is delineated by an appropriate header. Departure entries consist of the ACID prefixed by an underlined character indicating departure gate (e.g., <u>T</u>-Trios, <u>P</u>-Prarie). Arrival entries consist of the ACID prefixed by a character indicating destination airport (e.g., A-AAF, S-SGR).

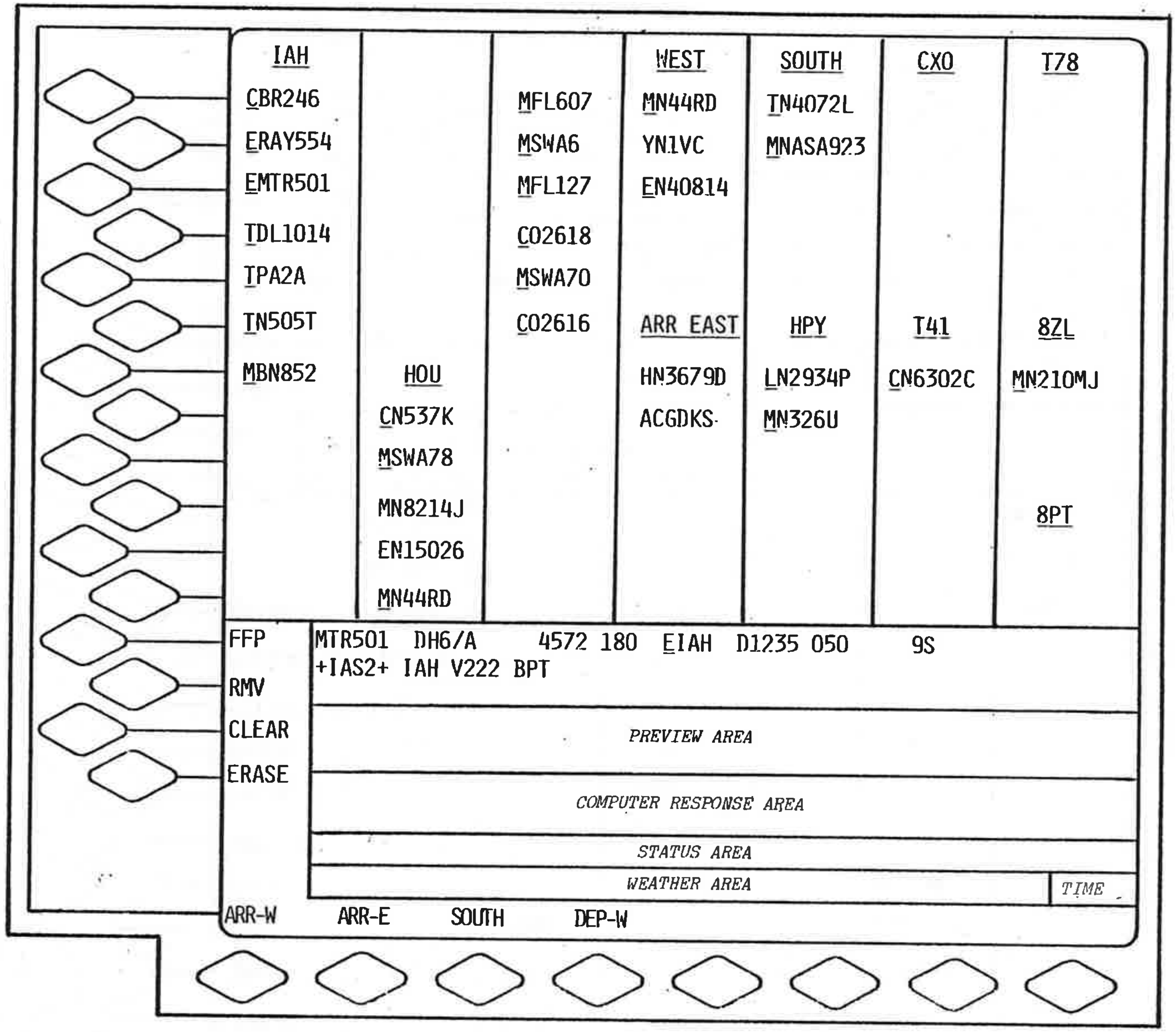


FIGURE A-13. TRACON DEPARTURE EAST

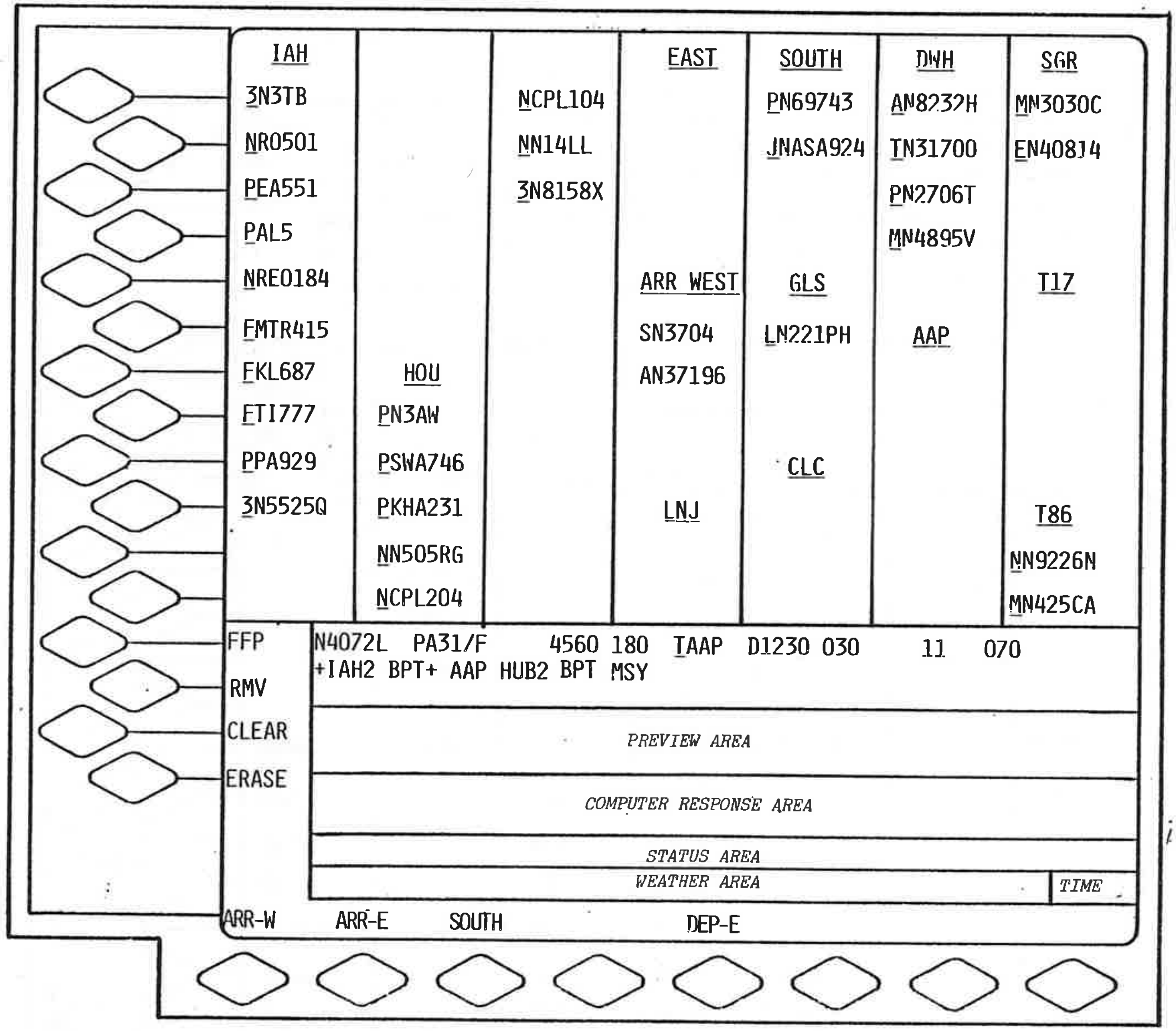


FIGURE A-14. TRACON DEPARTURE WEST

The following Quick Action functions are available at the departure positions:

FFP - page Readout area if flight plan display requires more than four lines

RMV - clear the Readout area

CLEAR - clear the Preview area and return display to quiescent state

ERASE - clear the Computer Response area

ARR-W - display/remove Arrival West Data flight entries

ARR-E - display/remove Arrival East Data flight entries

SOUTH - display/remove South Radar flight entries

DEP-W - display/remove Departure West flight entries (Departure East only)

DEP-E - display/remove Departure East flight entries (Departure West only)

Entries are added automatically to the appropriate departure display upon transfer of a flight from FD/CD to GC for departures from an FDD equipped tower. Entries for prefiled departures from a non-FDD tower are added automatically at a predetermined time prior to proposed departure. Flight entries from other TRACON sectors are added when the flight becomes active in that preceding sector. Of the several methods available for organizing entries on the displays, the one most similar to current practice segregates entries by departure airport and then arranges them by departure or arrival times. Departure entries are removed automatically as a result of the completion of an ARTS handoff of an IFR flight to the ARTCC or a Terminate Beacon message for VFRs. Satellite arrival entries are removed when the ARTS track is stopped. Overflow of the space available for flights from a given airport or sector is handled by paging the area allotted to that airport or sector by making row and column selection of the MORE indicator displayed at the bottom of the list.

The functioning of the Readout, Preview, Computer Response, Status, and Weather areas is as described for the FD/CD position. The example readout in Figure A-14 illustrates the use of the note field to display a reminder that the initial heading assigned to flight N4072L is 070.

A.2.2.5 FDD Presentation for Arrival East and West - Figures A-15 and A-16 illustrate the FDD formats for the Arrival East and Arrival West radar positions respectively. The displays are divided into seven columns and space is allocated among the arrival fixes under the responsibility of each position based on the relative number of arrivals using each fix. Each fix sublist will be labeled by the fix designation and all arrivals over that fix are displayed in that sublist. The flight entries consist of the ACID, a prefix character and a blank for spacing. The prefix character will be blank for IAH arrivals and display a coded indicator for overflights and arrivals to secondary airports (e.g., V for overflights, H for HOU arrivals, D for DWH, G for GLS etc.)

The following Quick Action functions are available at the Arrival positions:

- FFP - page Readout area if flight plan display requires more than four lines
- RMV - clear Readout area
- CLEAR - clear the Preview area and return display to quiescent state
- ERASE - clear the Computer Response area
- DEP-W - display/remove Departure West flight entries
- DEP-E - display/remove Departure East flight entries
- SOUTH - display/remove South radar flight
- ARR-W - display/remove Arrival West flight entries (Arrival East only)
- ARR-E - display/remove Arrival East flight entries (Arrival West only)

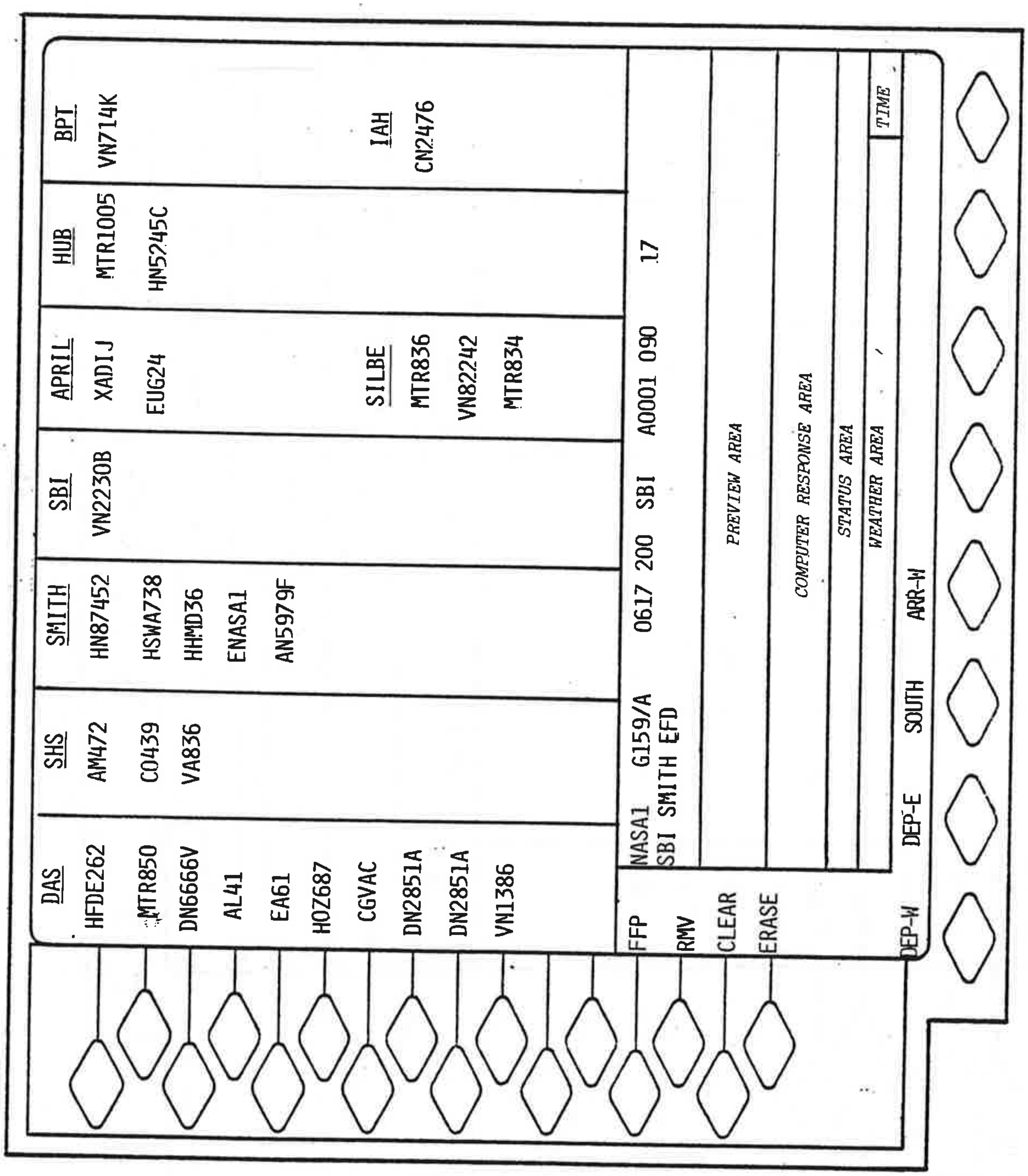


FIGURE A-15. TRACON ARRIVAL EAST

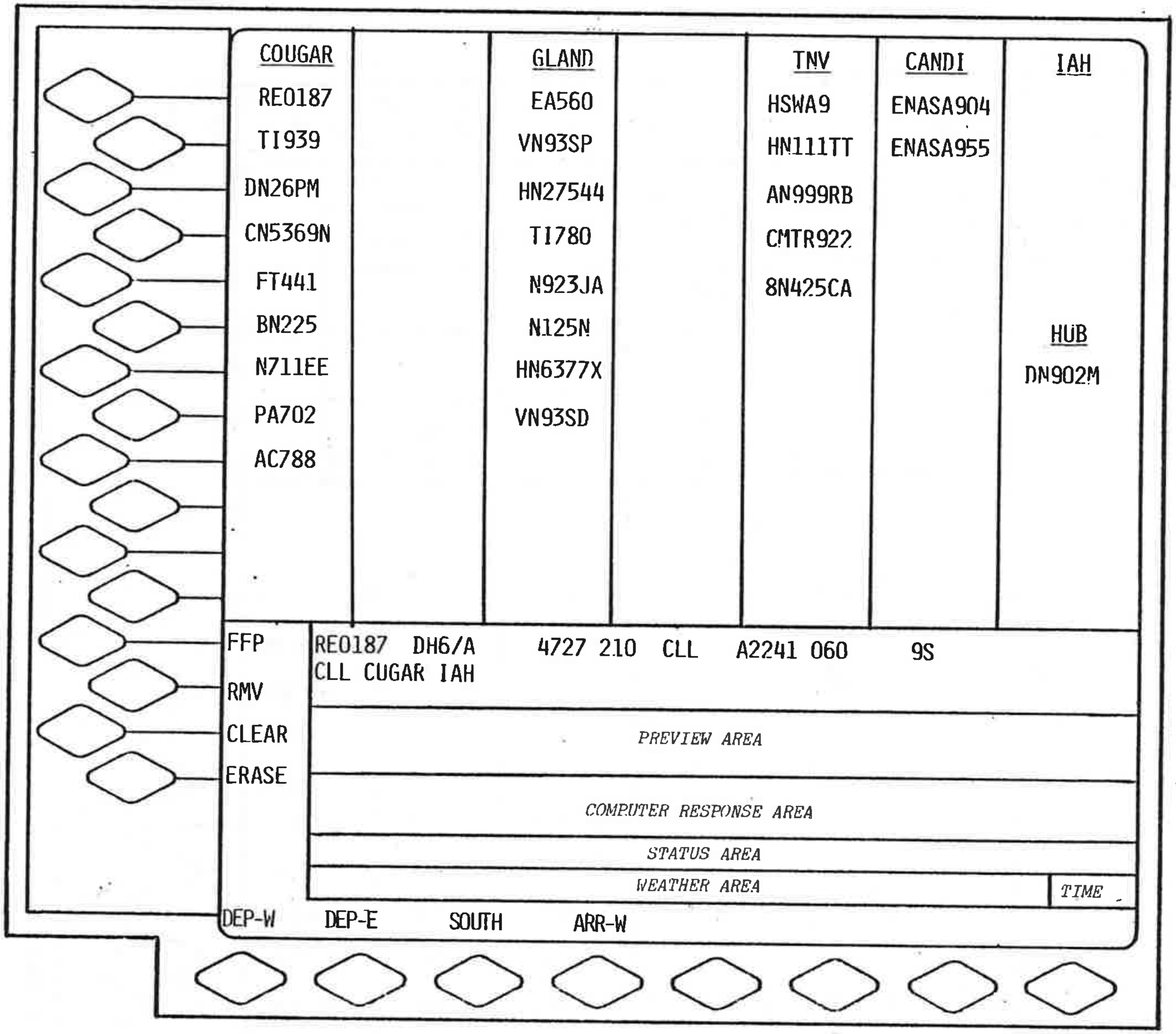


FIGURE A-16. TRACON ARRIVAL WEST

Entries are added to the display automatically when sent from the ARTCC. Entries are displayed under the arrival fix in the order of estimated time of arrival (the most imminent arrival on top). This is the only organization option available, but it is very similar to current practice. Entries are removed as the result of an ARTS transfer of the flight to the tower or termination of tracking for satellite arrivals.

The functioning of the Readout, Preview, Computer Response, Status, and Weather areas is as described for the FD/CD position.

A.2.2.6 South/Satellite Radar - Figure A-17 illustrates the FDD formats for the South/Satellite Radar positions. The display is divided into seven columns with space allocated among airports, adjoining sectors, and arrival fixes according to the amount of traffic entering the sector from those points. Each sublist is headed by a label to designate the origin of the traffic in that sublist. The arrival flight entries consist of the ACID and coded character (e.g., H for Hobby) indicating the destination airport; departure flight entries consist of the ACID and an underlined coded character (e.g., T for Trios) indicating the departure corridor.

The following Quick Action functions are available at the South Radar position:

- FFP - page readout area if flight plan display requires more than four lines
- RMV - clear readout area
- CLEAR - clear the Preview Area and return display to quiescent state
- ERASE - clear Computer Response area
- DEP-W - display/remove Departure West flight entries
- DEP-E - display/remove Departure East flight entries
- ARR-W - display/remove Arrival West flight entries
- ARR-E - display/remove Arrival East flight entries

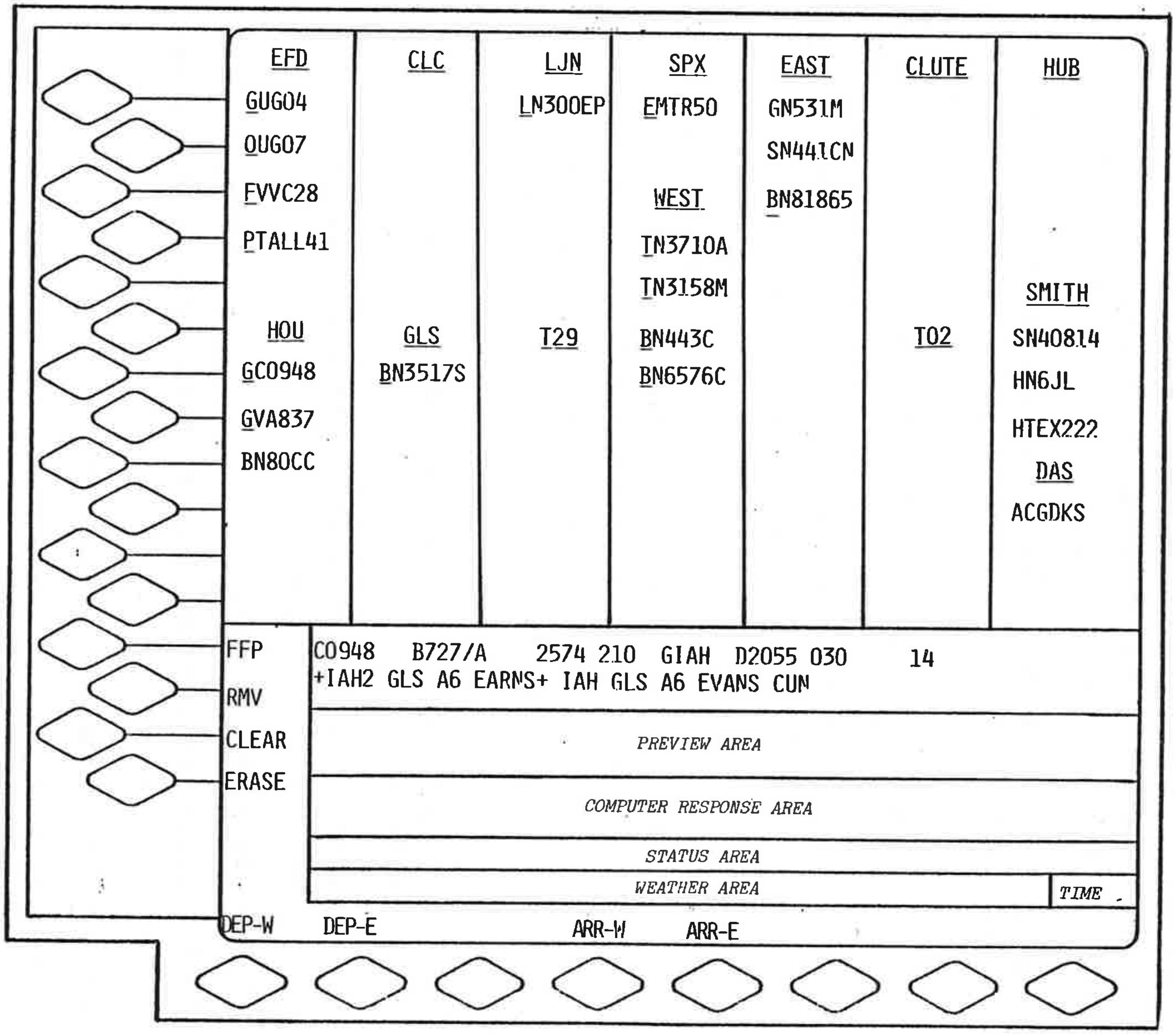


FIGURE A-17. TRACON SOUTH/SATELLITE

Arrival entries are automatically added to the display when sent from the ARTCC. Departure entries from FDD equipped towers appear when the transfer from FD/CD to GC takes place; those from non-FDD towers appear about thirty minutes prior to departure. Entries from other sectors appear on the display when the flight becomes active in that preceeding sector. Entries are displayed in the order received, the only organization option available to the position. Flight entries are removed as a result of an ARTS handoff or termination of ARTS tracking.

The functioning of the Readout, Preview, Computer Response, Status, and Weather areas is as described for the FD/CD position.

A.2.2.7 <u>FDD Presentation for IAH and HOU Final</u> - Figures A-18 and A-19 illustrate the FDD formats for the IAH and HOU final positions respectively. The displays are divided into seven columns and space is allocated among the arrival fixes receiving traffic for each position based on the relative number of arrivals expected from each fix. The entries consist of the ACIDs with Hobby arrivals prefixed by an H to indicate their destination airport. Only entries for arrivals to IAH or HOU will appear on the respective displays.

The following Quick Action functions are available at the Final positions:

- FFD - page Readout area if flight plan display requires more than four lines
- RMV - clear Readout area
- CLEAR - clear the Preview area and return display to quiescent state
- ERASE - clear the Computer Response area
- DEP-W - display/remove Departure West flight entries
- DEP-E - display/remove Departure East flight entries
- SOUTH - display/remove South Radar flight entries

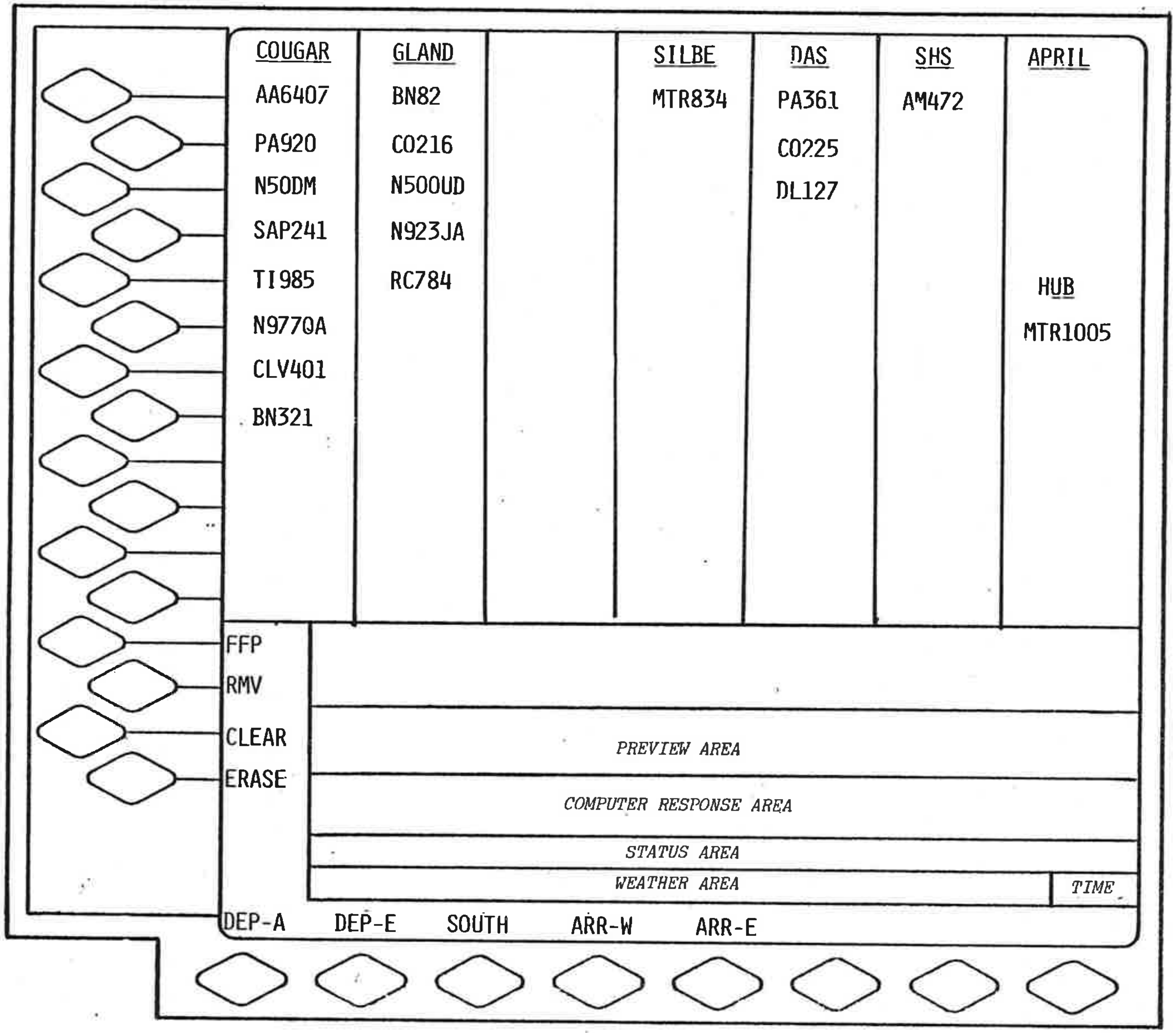


FIGURE A-18. TRACON IAH FINAL

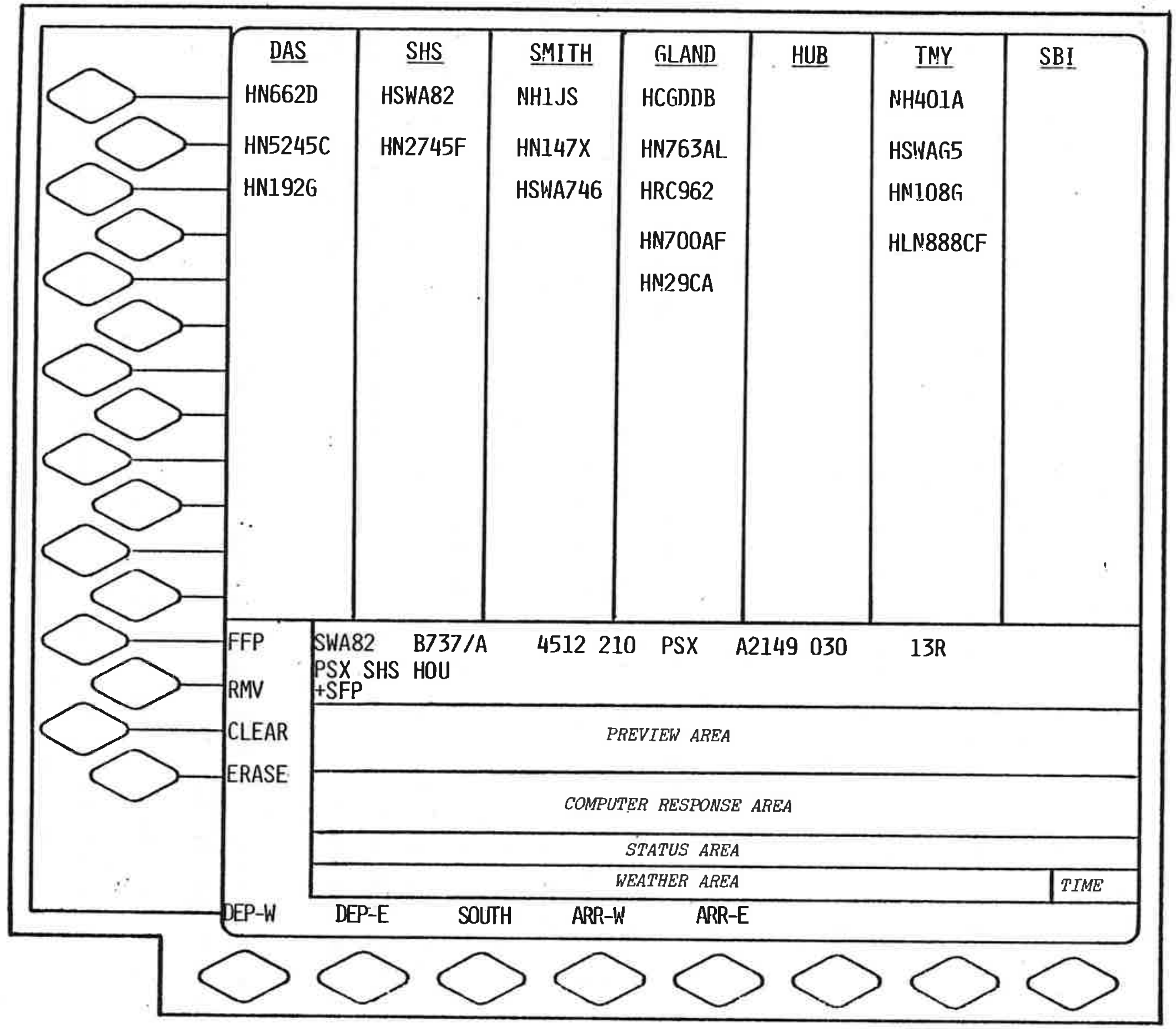


FIGURE A-19. TRACON HOBBY FINAL

ARR-W - display/remove Arrival West Flight entries

ARR-E - display/remove Arrival East flight entries

Entries are added to the display automatically when the flights become active in the arrival sectors. Entries are displayed under the appropriate arrival fix in the order of estimated time of arrival (the most imminent arrival on top). This is the only organization option available. Entries are removed from IAH Final when IAH LC makes an ARTS acceptance. Removal from HOU Final occurs when Hobby Radar transfers the entry to HOU LC. No removal action is required by either Final controller.

The functioning of the Readout, Preview,/Computer Response, Status, and weather areas is as described for the FD/CD position.

A.2.2.8 <u>FDD Presentation for Hobby Radar</u> - Figure A-20 illustrates the FDD formats for the Hobby Radar position (located at Hobby Airport). The display is divided into seven columns with space allocated among the VFR arrival directions and IFR arrival fixes served by the position based on the relative amount of traffic expected to arrive from them. Each sublist is headed by a label designating the direction or fix the flights are arriving from. The flight entries consist of ACIDs. The capability to prefix ACIDs with the radar contact symbol has been implemented as a quick action function at HOU because current facility SOPs specify this action for VFR arrivals when their targets have been identified on the BRITE display.

The following Quick Action functions are available at the Hobby Radar position:

R - prefix selected ACID with radar contact symbol

FFP - page Readout area if flight plan display requires more than four lines

RMV - clear Readout area

CLEAR - clear the Preview area and return display to quiescent state

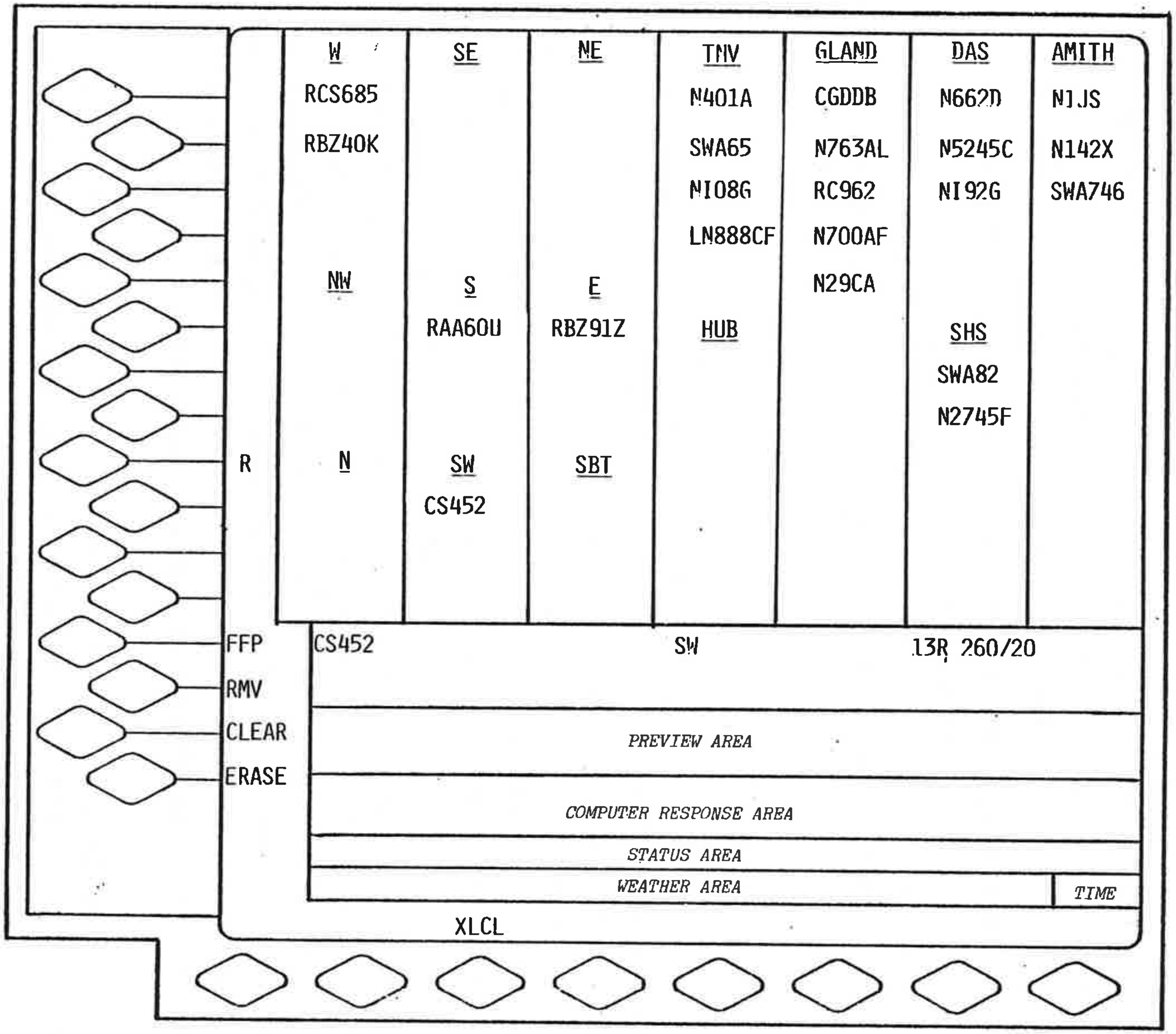


FIGURE A-20. HOBBY RADAR

ERASE - clear Computer Response area

XLCL - transfer flight entry to LC arrival list

Entries are added to the display in the order of estimated time of arrival when the flights become active in the arrival sectors. This is the only organization option available at the position, and it is similar to current sequencing practice. Flight entries are removed by transferring them to LC.

The functioning of the Readout, Preview, Computer Response, Status, and Weather areas is as described for the FD/CD position. The example readout in Figure A-20 illustrates the use of the note area to display the missed approach heading and altitude given the VFR arrival (CS452).

A.2.3 Typical Operations Using FDD

Current use of flight strips and coordination between controllers during routine operations was studied at the Houston facilities to determine the role played by flight data. This section describes the support that FDD will provide during these operations and contrasts this with the present system. Except where specified, operations at the IAH and HOU towers are similar. All descriptions refer to data as it appears on the FDD displays located at the operating positions (i.e., the ARTS PVD and BRITE display capabilities are unchanged). Current use of the Houston ARTS system would be unchanged with the FDD implementation envisioned here. Where possible, FDD actions are linked with current ARTS actions so that increased information can be presented without any increase or change in current controller actions.

A.2.3.1 Departures - The flight entry for a pending IFR departure automatically appear on the FD/CD display at reduced brightness about thirty minutes prior to departure. The current step requiring FD/CD to separate the strip, place it in a holder, and place it in the strip bay is eliminated.

Upon initial contact, FD/CD makes a row and column selection of the appropriate entry to display the flight plan. He verifies the plan and then reads the clearance to the pilot. The readout of the flight plan automatically brings the flight entry to full brightness (recorded on the CPS), indicating that initial clearance has been read to the pilot; eliminating the current need for FD/CD to place a checkmark on the strip. If the call-in is for a VFR flight, FD/CD uses the keyboard to compose and enter a VFR flight plan. After the processing of the VFR flight plan, a row and column selection provides a flight plan readout with a beacon code automatically assigned; the beacon code is then read to the pilot. Currently a VFR call-in requires FD/CD to write out a strip, enter the data into ARTS, and enter a separate beacon code request in order to assign the code to the pilot. The departure corridor designator currently marked on the strip at IAH can be entered in the coordination Fix field (and to the flight entry where appropriate) automatically by FDD based on the routing or during flight plan entry by the controller.

With FDD, FD/CD can transfer the entry to his Standby list if he anticipates a lengthy delay in a taxi request (e.g., gatehold in effect) by row and column flight entry and "SBY" selections or transfer the entry to GC by row and column flight entry and "TOGC" selections. The transfer to GC will: 1) display the flight entry at half brightness on the GC departure list, and 2) display the entry at half brightness on the appropriate TRACON departure FDD display to alert the controller to the pending departure. Currently, FD/CD manually moves the strip to the GC bay after communication-change instructions are issued, the departure controller is alerted to the departure by its addition to his PVD departure list.

Upon pilot call-in, GC makes a row and column flight entry selection (and "RDOT" if more complete flight data is required) bringing it to full brightness, indicating that it is active, and gives taxi instructions. Runways are assigned automatically based on runways in use, so GC need only make amendments for exceptions or intersection departures. When the aircraft reaches takeoff position the flight is transferred to LC by selecting "XLCL". Currently, at IAH, GC makes no marks on the strip and does not handle it until moving it to the LC position. However, at HOU, GC cocks the strip on initial contact to indicate active status and marks the runway assignment on the strip. After the taxi, GC places the strip at LC. With FDD, GC: 1) has an indication of active and pending operations, 2) is no longer required to move the strip around, and 3) no longer has to sequence strips at LC in the order of departure.

Transfer of the flight by GC to LC displays the entry at half brightness on the LC departure list (an indication of pending status). LC makes a row and column selection of the flight entry (and "RDOT" if more complete flight data is desired) upon pilot contact, bringing the entry to full brightness (analogus to cocking the strip) to give an indication that contact has been made and that the aircraft is in place. When take-off clearance and final instructions are given the flight is transferred (analogous to removing the strip) to the TRACON by selecting "XTRC". At IAH, LC's only strip handling other than scanning, is to drop it down a tube to the appropriate departure radar position after takeoff. HOU LC cocks the strips on initial contact and places strips in a bid for counting after takeoff.

Transfer of the flight to the TRACON by LC brings the flight entry to full brightness on the appropriate departure radar display in the TRACON, causes a Departure Message to be generated and sent to the ARTCC for the departing flight and initials ARTS tracking. Satellite departure entries appear at half brightness prior to their departure at all positions which will handle them and go to full brightness when ARTS tracking is started. The current requirement for AD to rip statellite departure strips, mark them with the departure corridor designator, and pass them to the departure controllers is eliminated.

As the departure radar controllers issue instructions, they may enter amendments and any special handling notations via the FDD keyboard. Any amendments entered into ARTS will also be incorporated by FDD. Entries for east bound departures from West satellites (or vice versa) go to the full brightness on the receiving departure controller's display when the ARTS handoffs are completed. The current need to print and distribute dual strips is eliminated. At the approach control boundary, an ARTS/NAS handoff completion (IFRs)or a Terminate Beacon message (VFRs) automatically removes the flight entry and enters a radar handoff or radar service termination notation respectively into the data base.

A.2.3.2 Arrivals - Prior to the arrival of an IFR flight, the ARTCC sends FDD the flight plan causing an entry to be displayed automatically at half brightness on the appropriate fix sublist at all arrival sectors that will handle the flight. Arrivals to airports other than IAH will be prefixed with a coded character to indicate their destination. Allocation to the Arrival East or Arrival West position is performed automatically by FDD. Currently arrival radar controllers depend on flight data displayed on the ARTS PVD data block and tabular lists for information on arrivals.

Upon receipt of the handoff of a flight from the ARTCC, the flight entry on the FDD display will automatically go to full brightness at the receiving sector, indicating that the flight is active. At initial contact the controller makes a row and column selection of the flight entry, displaying the flight plan readout for scanning and verification. Entry of a flight plan is made manually following initial contact with the pilot for VFR flights.. An ARTS handoff of the flight to an adjacent sector or final position displays the flight entry on the FDD display at full brightness at the accepting position. As with current practice at IAH, LC enters a message into ARTS to accept the arrival. This action causes the flight entry to appear on his FDD display. At HOU, the arrival entries appear on the Hobby Radar FDD display at full brightness when the Hobby Final controller (at IAH) accepts the handoffs from the arrival controllers. There is no automated handoff between Hobby Final and Hobby Radar either currently or with FDD. Satellite arrival entries disappear when the ARTS track is dropped. Since all of the TRACON FDD actions are linked to ARTS actions currently performed, there is little change from the current operational practice as far as controller workload is concerned.

Currently Hobby Radar writes up strips for VFR arrivals to HOU and sequences them with IFR strips in the strip bay at the HOU LC position. With FDD, Hobby Radar uses a keyboard to enter VFR flight plans causing them to appear on the Hobby Radar FDD display. Selection of the flight entry and the "R" function after flight plan entry prefixes the selected VFR entry with the radar identification symbol to indicate radar identification of the target on the BRITE display has taken place. Hobby Radar then makes row and column flight entry and "XLCL" selections to transfer entries at half brightness to LC in sequence. All entries at Hobby LC appear as a result of transfers from Hobby Radar only.

LC makes a row and column selection of the flight entry upon initial contact, bringing it to full brightness (indicating the flight is under active control by LC), scans the entry if not already done, and requests a flight plan readout if more information is desired. Additionally at Hobby, LC makes a radar symbol selection after VFR flight entry selection to change the radar contact symbol to a radar handoff symbol upon identifying the flight on the BRITE display. After issuing clearance to land and instructions to contact GC, LC transfers (indicating completion of handling) the entry to GC by selecting "XGND" where it appears at half brightness. Missed approaches at IAH and HOU (currently requiring verbal coordination with approach control) are returned to TRACON final controllers by selecting "MSAP". At present, IAH LC notes arrival ACIDs on a scratchpad based on information from the BRITE display and coordination with the TRACON. Some controllers use check marks and lines through the ACID to indicate active status and completion of handling respectively. HOU LC uses IFR and VFR flight strips sequenced by Hobby Radar and marks VFR strips to indicate a radar handoff from Hobby Radar. After issuing landing clearance, the strip is placed in a bin to be counted later.

Upon receipt of a request for taxi instructions, GC makes a row and column selection of the flight entry, bringing it to full brightness (indicating active control by GC), and issues taxi clearance. After monitoring the plane to the gate the "TERM" function is selected, removing the flight entry from the display (indicating completion of handling) and clearing all flight data from the system. Currently, GC at IAH and HOU gets the ACIDs for flights under his control from the BRITE display and copies them on his scratch pad. Checkmarks are used to indicate active status and the ACID is crossed out when the taxi has been completed.

A.2.3.3 Overflights - The entry for an overflight automatically appears on the appropriate arrival radar display at half brightness and prefixed by the letter "V" when sent by the ARTCC. The readout resulting from a row and column selection of the flight entry is used to determine its route and altitude. VFR overflights require the entry of a flight plan using the keyboard in order to display a flight entry. Upon handoff from the ARTCC, the IFR entry automatically comes up to full brightness when radar tracking by ARTS commences. VFR flight entries appear at full brightness immediately after entry into the system. Other positions can access data on an overflight for coordination with other traffic by displaying the appropriate Arrival Data list with a "ARR-W" or "ARR-E" selection and making a row and column selection of the flight entry or by entering a Flight Plan Request via keyboard. LC can use the keyboard entered Flight Plan Request to display flight data on the Readout area when an overflight enters tower airspace or requires coordination. Brightening of the flight entry on the receiver's display and removal from the sender's display is linked to the ARTS handoffs currently performed. When the flight departs the terminal airspace the entry is removed automatically as the result of an ARTS handoff or ARTS Terminate Beacon message.

Current handling of IFR overflights at Houston begins with the printing of one flight strip, which is removed from the FDEP by AD, marked with a "V" and an arrow indicating direction of flight, and handed to the appropriate radar controller. VFR overflights require entry of a flight plan into the ARTS system by the radar controller. Handoffs to other radar positions require the passing of a flight strip. Coordination with LC is done verbally only. When the overflight exits terminal airspace it is either handed off or radar service is terminated.

Tables A-1 and A-2 summarize current flight data actions and notations and compares them to FDD capabilities.

A.2.3.4 <u>FDD Position Support</u> - In addition to supporting the flow of information during operations (e.g., arrivals and departures), FDD supports the controller in performing the actions required at each operating position, during operations. This section examines the support given the individual controller in performing the tasks at an operating position.

A major FDD function for all positions is the initiation of the transfer of flight data to the next position. In the TRACON the transfer of flight data is linked to the status of ARTS jurisdiction and is performed in response to handoff messages currently entered into ARTS. In the Tower Cab, transfers are initiated and carried out by the controller.

The keypress sequence and assignment of functions to the quick action switches are designed to minimize hand movement and error. For example, the transfer of an entry from FD/CD to GC (see Figure A-7) requires a row and column selection of the flight entry and then depression of the "TOGC" switch. Entries are listed in order by time of expected arrival or departure, so the order on the display should correlate closely with operational order. Thus, the most imminent departures are automatically placed in the first column of the Pending list. Selecting of an entry in this column requires selections to indicate the row and then the column position of the entry. The button designating the first column also

TABLE A-1. SUMMARY OF CURRENT AND FDD FLIGHT DATA ACTIONS

Position	Current Flight Data Action	FDD Action Equivalent	Remarks
IAH Flight Data/ Clearance Delivery	Remove strip from FDEP, discard right half of strip after copying any vital data, and place it in a holder	No	Full flight data made available for display automatically
	Enter VFR or local IFR flight plan using FDEP and enter beacon code request so code can be assigned	Yes	Flight plan entry is accomplished using the keyboard, beacon code is provided automatically with readout of newly entered flight plan
	Read clearance to pilot upon call-in and note any changes on the strip	Yes	Selection of flight entry produces a readout of the flight plan, several amendment functions are available
	Mark strip with with departure designator based on departure route	Yes	Departure designator entered in coordination fix field during flight plan entry, as an amendment, or automatically by FDD
	Place check on strip to indicate that clearance has been delivered	Yes	The flight entry selection which produces the flight plan readout also changes the flight entry from half to full brightness
	Move strip over to GC position	Yes	Transfer action removes flight entry from the display and transfers it to GC

TABLE A-1. SUMMARY OF CURRENT AND FDD FLIGHT DATA ACTIONS (CONT.)

Position	Current Flight Data Action	FDD Action Equivalent	Remarks
IAH Ground Control	Move departure strip to LC position after aircraft has taxied into position	Yes	The XLCL function transfers the flight entry to LC and removes it from GC display
	Copy ACID's for arrival flights from BRITE to scratchpad	No	Arrival flight entries appear on GC display automatically when transferred from LC
	Place checkmark next to ACID on scratchpad after arrival contacts GC	Yes	Selection of the flight entry brings it from half to full brightness
	Cross out ACID when A/C arrives at the terminal gate	Yes	The terminate quick action removes the flight entry from the display and the date base
	Mark strip with departure heading if other than usual one	Yes	Note field of Flight Plan Readout can be used to display this information
IAH Local Control	Drop departure strip down the tube to the appropriate departure radar position	Yes	Selection of the "XTRC" function bring radar position's flight entry to full brightness and removes the entry from LC display
	Copy ACID's of arrivals from BRITE display to scratchpad	No	Flight entries for arrivals are displayed automatically when transferred from the TRACON

TABLE A-1. SUMMARY OF CURRENT AND FDD FLIGHT DATA ACTIONS (CONT.)

Position	Current Flight Data Action	FDD Action Equivalent	Remarks
	Place checkmark next to ACID on scratchpad upon initial contact	Yes	Selection of the flight entry brings it from half to full brightness
	Cross out ACID after landing is completed	Yes	The XGND function removes the entry from the LC display
	Remove over-flight strips from FDEP, separate right half, transcribe any lost data, mark the strip with a "V" and a directional arrow, and distribute	No	Flight entries pre-fixed with a "V" and access to full flight data provided auto-matically at radar positions, the con-troller has the option of adding directional arrows to the note field
TRACON Arrival Departure Data	Remove satellite departure strips from the FDEP, separate right half, transcribe any lost data, mark strip with departure corridor code, generate a second strip if required, mark duplicate strip with an "X", and distribute strips to the appropriate positions	No	Departure flight entries are routed automatically to the proper positions and displayed in lists by departure airport with each flight entry prefixed by the departure corridor code. Full flight plan data is available upon flight entry selection
TRACON Departure Radar	Remove strip from holder and place on console	No	Flight entry appears on departure display at half brightness when FD/ CD to GC transfer takes place and goes to full brightness when LC to TRACON transfer occurs, all auto-matically

TABLE A-1. SUMMARY OF CURRENT AND FDD FLIGHT DATA ACTIONS (CONT.)

Position	Current Flight Data Action	FDD Action Equivalent	Remarks
	Check strip for character designating departure corridor	Yes	Flight entries are prefixed by departure character
	Remove strip from console and place in bin for counting	No	Flight entry is automatically removed when hand-off to off to ARTCC is completed
TRACON Arrival Radar and Final Radar	Strips are currently used only during ARTS failure	---	FDD displays at positions provide constant access to flight data
HOU Flight Data/ Clearance Delivery	Remove printed strips from FDEP place in holders, and move to operating position	No	Flight entries are displayed at FD/CD automatically prior to departure. Arrival flights appear on Hobby Radar FDD display
	Handwrite a strip for VFR and IFR call-ins	Yes	FDD provides functions for IFR and VFR flight plan entry
	Place a check mark on strip to indicate that clearance has been delivered	Yes	Initial selection of the flight entry to produce a flight plan readout also changes flight entry from half to full brightness
	Write pilot call time, engine start time, release time, etc. on strip when gate hold is in effect	Yes	Enter times in note field of flight plan readout as required hold is in effect

TABLE A-1. SUMMARY OF CURRENT AND FDD FLIGHT DATA ACTIONS (CONT.)

Position	Current Flight Data Action	FDD Action Equivalent	Remarks
	Move strip to GC position	Yes	Transfer function (TOGC) moves flight entry to GC display
HOU Ground Control	Place departure strip in tray	No	Flight entries appear on display at half brightness automatically when transferred from FD/CD
	Cock strip on contact with pilot and mark strip with assigned runway	Yes	Initial selection of the flight entry brings it to full brightness. Initial runway assignment performed automatically by FDD, runway assignment amendment is a Quick Action Function.
	Move departure strip to LC position when taxi is complete	Yes	The XLCL transfer function moves the flight entry to the LC display
	Copy arrival ACID's from BRITE to scratchpad	No	Arrival flight entries are displayed automatically when transferred from LC
	Make a checkmark next to ACID after contact with pilot	Yes	Selection of the flight entry upon initial contact brings it from half to full brightness
	Cross off ACID after taxi to terminal is completed	Yes	Selection of the terminate function will remove the flight entry from the display
HOU Local Control	Cock departure strip upon contact with the pilot	Yes	Selection of the flight entry brings it from half to full brightness

TABLE A-1. SUMMARY OF CURRENT AND FDD FLIGHT DATA ACTIONS (CONT.)

Position	Current Flight Data Action	FDD Action Equivalent	Remarks
	Remove strip when takeoff has occured	Yes	The XTRC function removes the flight entry from the LC display
	Forward information on departure to the TRACON	Yes	Flight entries for departures are displayed at TRACON positions as soon as the transfer from FD/CD to GC takes place, verbal coordination may be necessary for unusual circumstances only
	Observe flight strips to determine arrival sequence	Yes	Flight entries are transferred to LC and, therefore, displayed, in landing sequence
	Make radar handoff notation on strip (circle the R) after identifying VFR arrivals on the BRITE	Yes	A Quick Action function selection of the symbol displays it in the selected flight entry
	Remove strip after A/C clears runway	Yes	XGND function removes the flight entry from LC display
	Write up a VFR arrival strip upon contact with pilot	Yes	VFR flight plan entry function allows flight plan entry
Hobby Radar	Mark strip to indicate that radar identification of the VFR has taken place	Yes	Selection of the radar symbol Quick Action function prefixes the flight entry with the appropriate symbol
	Place arrival strips at LC position in sequence of arrival	Yes	This position uses the XLCL functions to transfer flight entries to the LC display

TABLE A-2. SUMMARY OF CURRENT AND FDD NOTATIONS

Table A.2
Summary of Current and FDD Notations

Position	Current Notation	FDD Equivalent	Remarks
IAH Flight/ Data Clearance Delivery	Write departure corridor designator on departure strip	Yes	Added automatically to coordination fix field by FDD for stored flight plans or by controller during flight plan entry.
	Overwrite changes in flight data on strip	Yes	Keyboard and Quick Action amendment functions
	Handwrite flight strip for VFR and local IFR call-ins	Yes	IFR and VFR flight plan entry functions provided on keyboard
IAH Ground Control	Copy arrival ACIDs from BRITE display to note pad	No	Flight entries for arrivals are provided automatically when transferred from LC
	Make a check next to ACID upon contact and cross out ACID upon completion of taxi	Yes	The brightening upon initial flight entry selection and flight entry removal by the terminate function provide equivalent status indicators
IAH Local Control	Copy arrival ACIDs from BRITE display to scratchpad	No	Arrival flight entries are displayed automatically when LC accepts control

TABLE A-2. SUMMARY OF CURRENT AND FDD NOTATIONS (CONT.)

Position	Current Notation	FDD Equivalent	Remarks
	Place check next to ACID upon initial contact and cross it out after landing and transfer to GC	Yes	Brightening of flight entry upon initial selection and removal of flight entry after transfer to GC provide equivalent status indicators
TRACON Arrival/ Departure Data	Mark overflight strips with a "V" and an arrow indicating direction of flight	No	ACIDs of overflights are prefixed with a "V" automatically with the controller option to enter directional arrows to the note field
	Mark satellite departures with departure designator	No	Satellite departure flight entries are prefixed with a departure designator automatically by FDD based on the field routing
	Mark duplicate satellite departure strip with an "X" to prevent counting for traffic	No	Traffic counting function is automated, eliminating the need for this notation
TRACON Departure Radar	No routine notations are made		
TRACON Arrival and Final Radar	No notations are made		
HOU Flight Data/ Clearance	Overwrite printed data on departure strips with amended data	Yes	Quick Action and keyboard functions provide amendment capability
	Write departure strip for VFR and IFR call-ins	Yes	IFR and VFR flight plan entry functions provide on keyboard

TABLE A-2. SUMMARY OF CURRENT AND FDD NOTATIONS (CONT.)

Position	Current Notation	FDD Equivalent	Remarks
	Make check on strip after clearance has been delivered	Yes	Transfer of flight by FD/CD from pending list to standby or GC indicates delivery of clearance
	Mark expected engine start times, release times, etc. when gateholds are in effect	Yes	Note field can be used to display these times
TRACON Departure Radar	No routine notations are made		
TRACON Arrival and Final Radar	No notations are made		
HOU Flight Data/ Clearance Delivery	Overwrite printed data on departure strips with amended data	Yes	Quick action and keyboard functions provide amendment capability
	Write departure strip for VFR and IFR call-ins	Yes	IFR and VFR flight plan entry functions provided on keyboard
	Make check on strip after clearance has been delivered	Yes	Transfer of flight entry by FD/CD from pending list to standby or GC indicates delivery of clearance
	Mark expected engine start times, release times, etc. when gateholds are in effect	Yes	Note field can be used to display these times

TABLE A-2. SUMMARY OF CURRENT AND FDD NOTATIONS (CONT.)

Position	Current Notation	FDD Equivalent	Remarks
	Copy arrival ACIDs from BRITE display to scratchpad	No	Arrival flight entries are displayed at GC automatically when transferred by LC
	Make checkmark next to arrival ACID and draw line through it to indicate active status and completion of handling	Yes	Brightening of the the flight entry upon initial selection and its removal after flight termination provide status indicators
HOU Local Control	Mark radar handoff symbol on VFR arrival strip after pointout from Hobby Radar	Yes	A Quick Action function can be implemented to add the symbol to the LC flight entry
	Write a strip up for helicopter flights	Yes	VFR flight plan entry function provided on keyboard
Hobby Radar	Write up a strip for VFR arrivals to Hobby	Yes	A VFR flight plan function is provided on keyboard
	Mark VFR strip with radar contact symbol after identifying target on BRITE display	Yes	A Quick Action function can be implemented to prefix the flight entry with the radar contact symbol
HOU Ground Control	Mark departure strip with runway assignment	Yes	Runway is assigned automatically by FDD with a Quick Action amendment function if amendment is necessary

serves the "TOGC" function so the controller need not move his finger from the button designating the desired column to select the "TOGC" function. Transfer functions at GC and LC have implied ACID entry capability which permits transfer of the flight entry at the top of the list by selecting the transfer function only (e.g., XTRC, XLCL). The ordering in effect at IAH and HOU would tend to place the most imminent transfer at the top of the list so most transfers at these positions could be performed simply by selection of the transfer function which is located under the affected list (e.g., "XTRC" is under the LC departure list). For transfer of those few entries out of order on the display, the button used to designate the list would initiate the transfer function with a second push as at the CD position, (i.e., all four buttons under the arrival or departure lists serve as column designators for that list). All functions involving the transfer of entries between positions or on the display are grouped along the bottom row of buttons.

FDD supplies both flight data and control status for all positions. As detailed earlier, entries are displayed as they become pertinent to the position. Full flight data including special handling notations is displayed by requesting a flight plan readout for the desired entry. In the tower cab, the initial readout request brings the flight entry to full brightness so that if the readout request is performed during initial contact the brightening can be used as an indicator that the flight is active, that initial contact has been made, that instructions to taxi in place and hold have been given, etc. To provide a planning preview that would not change brightness, the keyboard entered Flight Plan Request can be programmed not to alter flight entry brightness. In the TRACON, the readout request does not alter flight entry brightness, the brightening is performed automatically when ARTS assumes control of a flight. Thus, FDD provides full flight plan information when needed by the controller (e.g., during initial contact) and a positive indication that initial control action has been taken (e.g., initiating ARTS tracking, issuing taxi instructions, etc.). In addition, the final control action is linked with the flight entry transfer to the next position (e.g., "XTRC" action upon LC issuing takeoff clearance) so the removal of an entry from the display becomes an indication that handling is completed.

FDD also provides a simplified means to make critical amendments to flight plans through the Quick Action functions grouped adjacent to the flight entry list area. These functions are assigned to amendments that are critical because of their high frequency or time critical nature. This allows the display to be tailored to fit controller needs at each position. Further, the amendment functions are grouped together in an area adjacent to the target of their actions (flight entries) forming a spatial association which could reduce search time for a particular function.

A.2.4 Discussion of Selected Aspects of FDD

Although FDD has functional equivalency to the present FDEP system, it is not identical. FDD operations may entail procedural changes but operational efficiency should not be affected adversely. For example, unlike the FDEP, displays must be provided at all positions requiring flight data since the portability of flight strips is lost. Also, the full information for all flights provided by strips is replaced by partial flight entries and one-at-a-time flight plan readouts. However, the nature of terminal operations, especially tower operations, is really a sequence of individual operations (e.g., take-offs and landings in sequence) so this can be turned to an advantage by using readout requests as a key to control status since the need to know flight data should correlate well with the need for control action.

While FDD does meet individual position requirements well, the assignment of positions, especially in the TRACON may require changes from the present staffing practice (e.g., reassignment of coordinator positions, elimination of Arrival Data). The present Tower Cab positions can simply have a FDD unit installed with no change in the number of positions. These units will provide flight data on departures and arrivals automatically, eliminating the need to copy ACIDs from the BRITE display.

In the TRACON, however, in order to provide access to complete flight data and FDD input functions at radar positions an FDD display should be located at each radar position to allow direct view of the display (Figure A-21). Currently only the departure radar positions use flight strips routinely; all positions do use strips during ARTS outages. With an FDD display at each position, full and current flight data will be available at the position both routinely and during ARTS outage without any interruption. The departure coordinator positions currently staffed could assist in FDD message entry, especially if they (or separate arrival coordinators) also assist the arrival radar positions. They could assume many data entry messages (e.g., entry of a flight plan for a VFR arrival) now performed by the radar controller thereby freeing the radar controller for more surveillance tasks. These coordinator positions may need staffing only during peak times with radar positions assuming all FDD responsibility during slack times.

Presently, Arrival/Departure Data removes satellite departure and overflight strips from the FDEP (IAH departure strips go to the departure radar positions by drop tubes) marks them with a departure corridor or overflight indicator, and distributes them to the appropriate radar position. This function is entirely automated by FDD. The clearance delivery functions performed by this position for certain satellite airports could be transferred to the appropriate radar and/or coordinator positions. FDD could therefore eliminate this position.

In the Hobby TRACAB, Hobby Radar sequences strips at LC according to time of arrival. His main task is to work VFR arrivals into the sequence established by the Hobby Final controller. Currently he simply inserts the VFR strips into the sequence of IFR strips already at LC. With FDD, all IFR arrivals appear on the Hobby Radar display, as well as newly entered VFR arrivals. Using the transfer function, Hobby Radar transfers the entries to

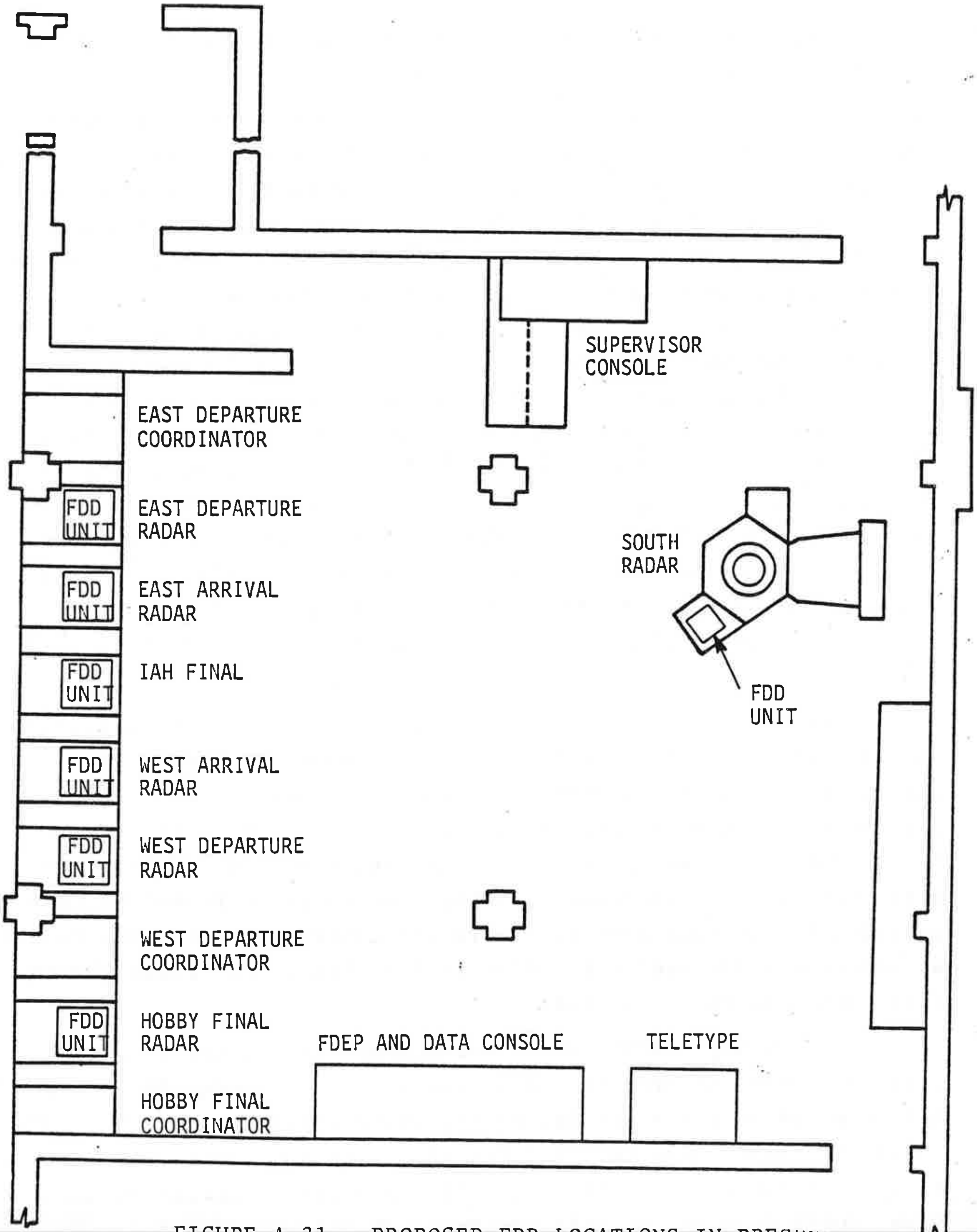


FIGURE A-21. PROPOSED FDD LOCATIONS IN PRESENT TRACON CONFIGURATION

LC in sequence causing the IFR and VFR flights to appear at LC in sequence. The radar identification notations for VFR arrivals made at both positions have been incorporated as Quick Action functions to add the appropriate symbol to the flight entry when required.

A.2.5 Proposed Modifications

A study of current flight data handling at Houston and other airports has pointed out some modifications which could add operating efficiency and enhance the flexibility needed in the FDD to meet the operational differences of the nation's airports. It is suggested that the following changes be made to the FDD engineering requirement to increase its usefulness.

1. Add a note field to the first line of the flight plan readout (a minimum of eleven characters can be provided).
2. Group Quick Action functions on a functional basis and locate functional groups to minimize hand movement and searching.
3. Give the controller highlighting capabilities.
4. Permit automatic readout of flight plans upon flight entry selection at LC and GC positions.
5. Combine the Remove and Erase functions with the Clear function.
6. Add a capability to display a Radar status indicator in certain flight plan entries.
7. Add a NOTE Quick Action key to the keyboard.

The use of the note field and the grouping of Quick Action functions were discussed earlier. The following paragraphs discuss the reasons supporting the remaining suggested modifications.

FDD has the capability to underline data on the display, but it has not been given a use. A Quick Action Function (HLT), allowing the controller to underline a flight entry on the list area, would provide a highlighting action which could be used as flight strip cocking is used today. In conjunction with this, a keyboard function should be provided to allow the underlining of individual fields of the flight plan readout (and of the GC and LC flight entry fields if applicable). Certain highlighting, such as the A/C TYPE field for heavy aircraft, could be performed automatically by the FDD. Both display and keyboard functions should operate on a select/remove basis with the controller capability to remove FDD generated highlights.

All positions except GC and LC are provided an automatic flight plan readout upon selection of a flight entry. While the flight entries at the LC, and GC positions do provide more information than entries at other positions, they are not complete. Especially at airports where many notations are made which pertain to GC and/or LC, these controllers will want to view the full readout and should not be required to perform an extra step to obtain it. This would also free up a Quick Action location for reassignment (e.g., to a highlight function) at these function intensive positions.

The current FDD design uses Remove, Clear, and Erase functions to clear the Readout, Preview and Computer Response areas respectively. The similarity of function and label is bound to cause confusion which can be somewhat mitigated by placing the function and label adjacent to the area affected (as in Figures A-7 - A-20). However, it would be simpler to combine all three functions into the Clear function. The Readout area is cleared automatically after function initiation or by another readout request. The Preview area can be independently cleared by the Clear Key on the keyboard. The need for a controller to clear the Computer Response area without affecting the Readout and Preview areas should be very infrequent and not critical. The independent means for clearing the Readout and Preview areas would allow a combined clear function to meet operational requirements without loss of capability. This would also free up two Quick Action locations for functions with a higher probability of use.

The Hobby Radar and Hobby LC positions are currently required by SOPs to notate VFR arrival strips with notations indicating radar contact. A quick action function (assigned to the same button at both positions since the intent of the action is the same) would prefix the ACID on the Hobby Radar display and appear at the end of the flight entry on the LC display. This allows the radar contact indicator (or lack of it) to be visible at all times and also flags the VFR arrivals. Use of this function would occur when identification or radar handoffs occurs so controllers still have an action requirement to reinforce the actual target identification. This modification would require adding the radar handoff symbol, a circled R, to the character set.

Automation of the display of flight data changes controller notations from handwritten to key board entry actions. A NOTE function key on the keyboard would allow note entry by selection of the flight entry on the display, the NOTE function key, and typing in the rest of the note. Entry of a note message without text would clear the note field, providing controllers the option of erasing a note that no longer applies (e.g., a taxi notation could be erased by GC so LC need not scan the note to see if it applied to him). This procedure for note entry is quicker than requiring the controller to use the flight plan amendment format to enter notations, and combined with the free format nature of the note text should make flight plan notations relatively convenient.

The Consolidated Cab Display (CCD) provided weather and status information to the controller. This makes the FDD display of this information redundant. Therefore, the FDD Weather and Status areas could be eliminated and one line each added to the Preview and Computer Response Areas. This would allow the Preview Area to display lengthy flight plans being entered in their entirety and allow the Computer Response Area to display longer or multiple messages.

All of these modifications can be implemented in the software without great difficulty and they would add to the ease of use and flexibility required of a terminal flight data system. With these modifications FDD should be able to provide all the information in one source that now requires a combination of printed strips, handwritten notations, and scratch pads.

A.3 CONSOLIDATED CAB DISPLAY FORMATS

This section presents information formats for use with the Consolidated Cab Display (CCD) subsystem in the Houston Intercontinental (IAH) cab and TRACON and the William P. Hobby (HOU) TRACAB. These formats were developed from controller information requirements determined in the operations analysis presented in previous sections, a review of the CCD Engineering Requirement (ER) document and controller interviews during which candidate formats were presented and discussed. In some cases, minor deviations were taken from the ER to make the system more useful to controllers.

This section begins with an overview of the CCD equipment. Then example formats and a detailed discussion of each device to be installed in the IAH cab and TRACON and HOU TRACAB are presented. Potential problems caused by the equipment limitations and additional considerations are discussed in the section summary.

A.3.1 Equipment Overview

The CCD system will provide five types of interface devices for controller/supervisor use.

(1) Critical Display (CD), Figure A-22. This display provides information cab controllers need on an immediate or "at a glance" basis including time, wind, altimeter, RVR, LLWSAS and status information for the active runway. The unit is composed of 7 and 16 segment incandescent indicators of various sizes to ensure readability in the high ambient light conditions common in the cab. The scale drawing of the CD in Figure A-22 shows each incandescent indicator location. In operation with no filaments lighted, the panel will appear as a single black face.

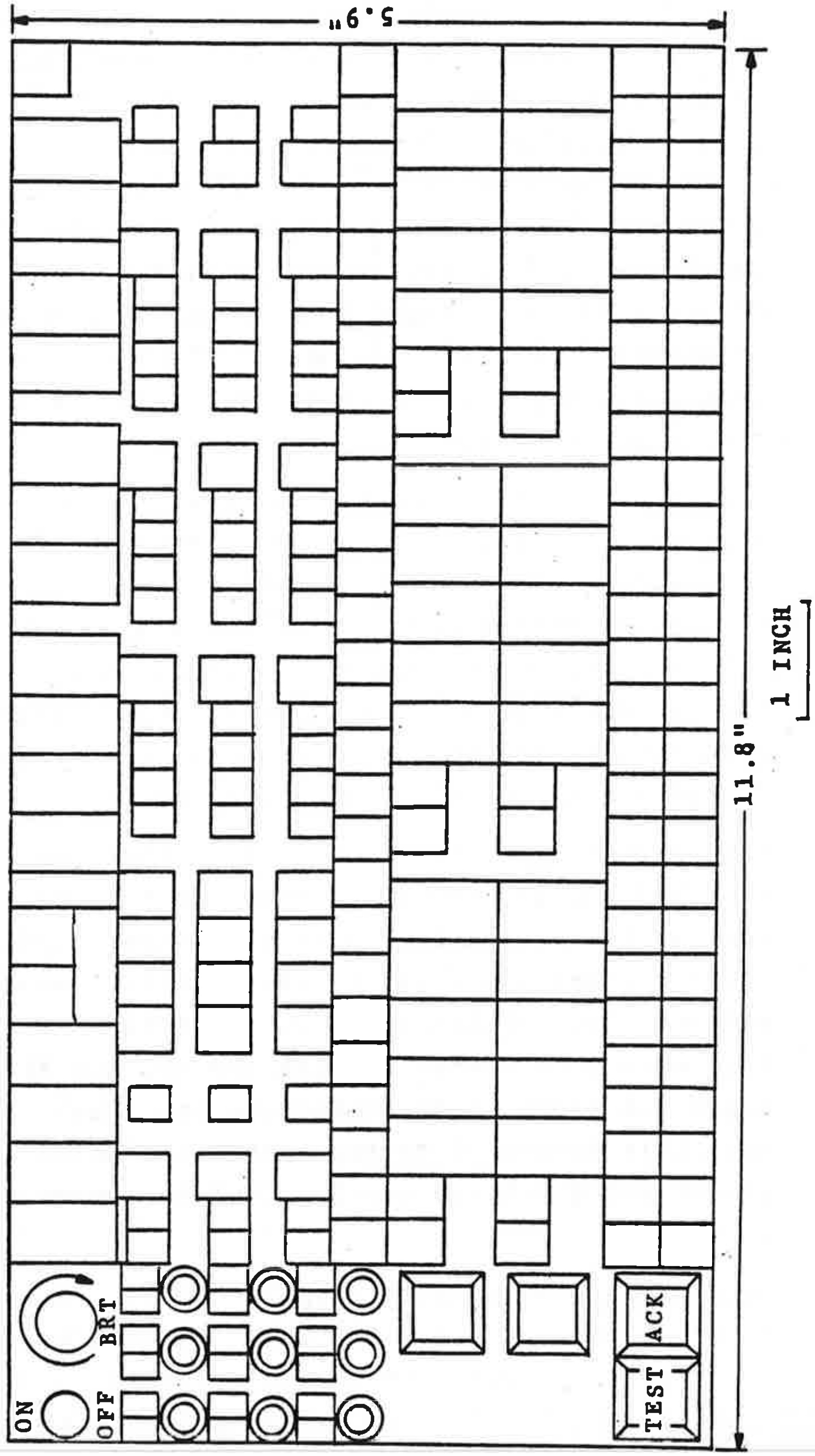


FIGURE A-22. CRITICAL DISPLAY CD SCALE DRAWING

(2) Supplementary Display (SD), Figure A-23. This display provides auxiliary information to the cab controllers as well as providing a back up or second source for critical information shown on the CD. The display will provide available runway lighting and ILS information on all runways and other data of interest to controllers. The SD also provides an alternative to the CD for controllers whose duties do not justify installation of a CD. The SD is a bright Cathode Ray Tube (CRT) with 12 selectable pages of information (16 lines of 32 characters per line). The controller uses the buttons to display a desired page.

(3) Lighting Control Panel (LCP), Figure A-24. Runway and approach lighting systems are controlled with this panel. Tower controlled field lights can be turned on and off and intensity level selected using this unit. The 21 push buttons are rear projection, multi-legend, illuminated indicators which permit unique legends for each device controlled. The bottom row of buttons are for adjusting the light intensity settings.

(4) TRACON Display (TD), Figure A-25. This unit will present information currently shown in the TRACON by digital clocks, altimeters, wind instruments and RVR. The first 4 lines are fixed to show critical weather information. The remaining 12 are controller selectable via page select buttons. As with the SD, the TD has 12 pages (16 lines of 32 characters per line). The information is presented to the controller using a dot matrix planar gas discharge panel. The characters appear green in color.

(5) Supervisory/Maintenance Display (SMD). This unit is used by the supervisors in the cab, TRACON and TRACAB for monitoring and entering information to the CCD system. It enables format changes on controller displays

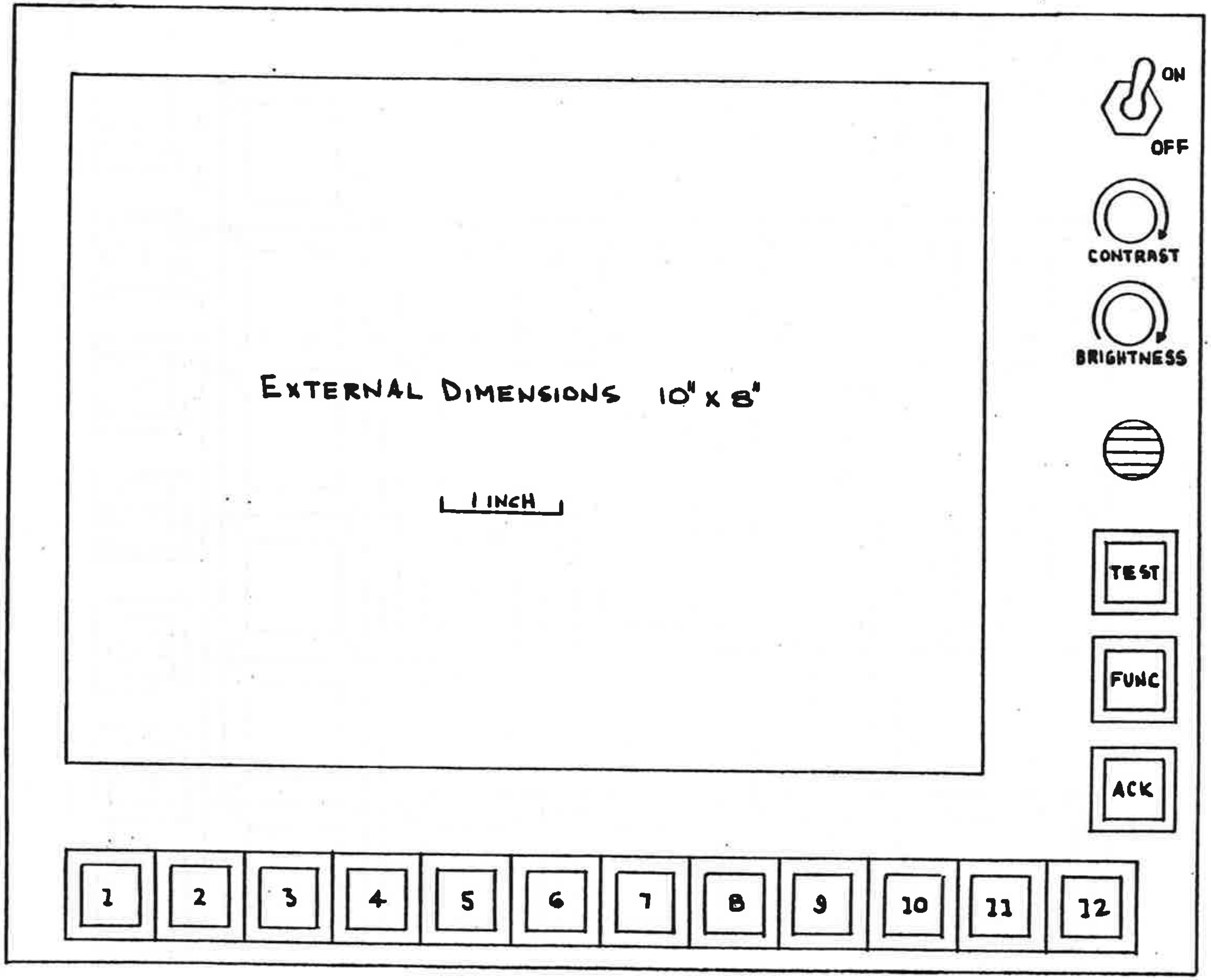


FIGURE A-23. SUPPLEMENTARY DISPLAY (SD) SCALE DRAWING

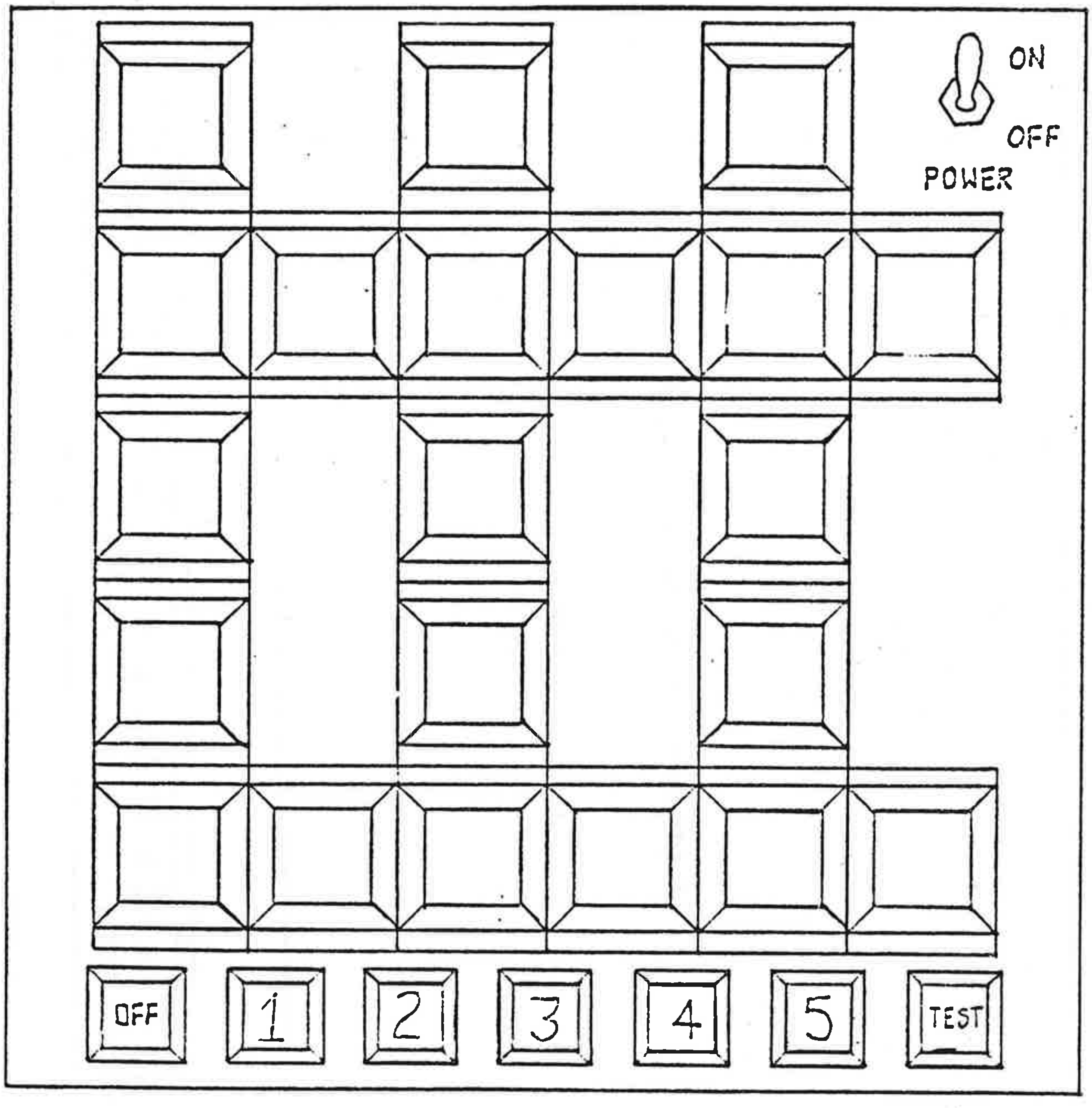


FIGURE A-24. LIGHTING CONTROL PANEL (LCP)
SCALE DRAWING

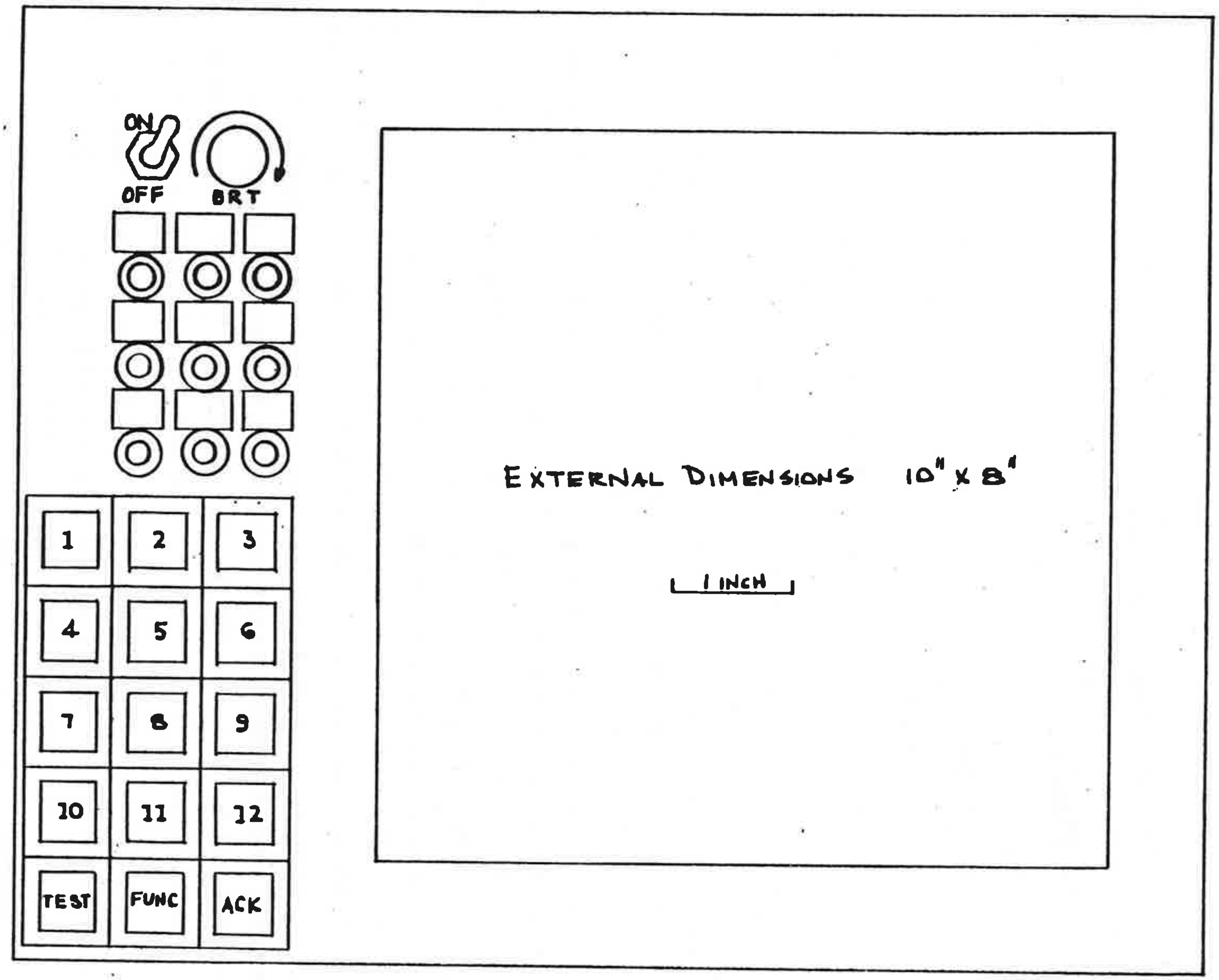


FIGURE A-25. TRACON DISPLAY (TD) SCALE DRAWING and provides Supervisors with status information for their own use. The SMD can display two SD or TD pages simultaneously.

A.3.2 Critical Display Design Formats (Figures A-26 and A-27)

A.3.2.1 Locations

IAH	HOU
Local Control 1 (LC-1)	LC
Ground Control	GC
Local Control 2 (LC-2)	Hobby Radar (HR)

A.3.2.2 Description of Display Capabilities

A.3.2.2.1 Format - Line 1 of the CD presents the actual time (GMT), altimeter reading, wind (direction, speed and gusts if more than 10 knots over the prevailing wind) and ATIS code. The next three lines of the CD equipment status and RVR information for up to three active runways. Since HOU is primarily a two runway operation, line 4 is usually blank. Similarly, IAH operates with two primary runways and two STOLS. The latter have no automatically monitored NAVAIDs or RVRs so they do not require a line on the CD. The information format for each of these three lines is as follows: Runway number (with left or right designator for parallel runways), status information on tower monitored ILS components and approach light system (ALS), RVR readings (with characters that indicate RVR is increasing - "↗"; decreasing - "↘"; or malfunctioning - "F"), and the ALS intensity setting.

Line 5 of the CD presents the overflow of status information from the first three lines above it; a small rectangle (▭), right triangle (◺), or isosceles triangle (△) is displayed both in space 4 of the status information area and before the overflow in line 5 to designate the appropriate line (in the IAH example format, the runway 8 ALS and SFL are OTS).

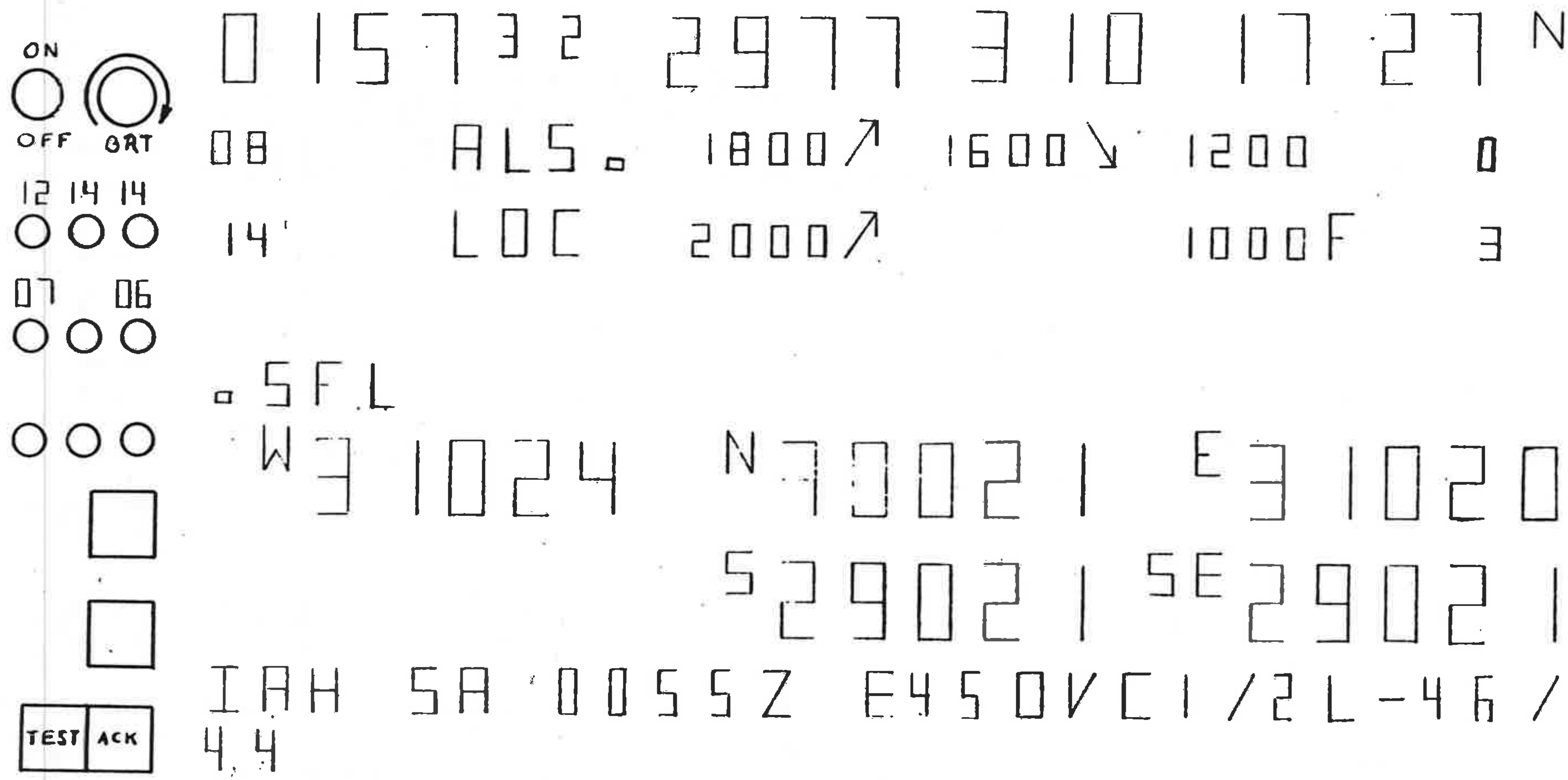


FIGURE A-26. CRITICAL DISPLAY AT IAH

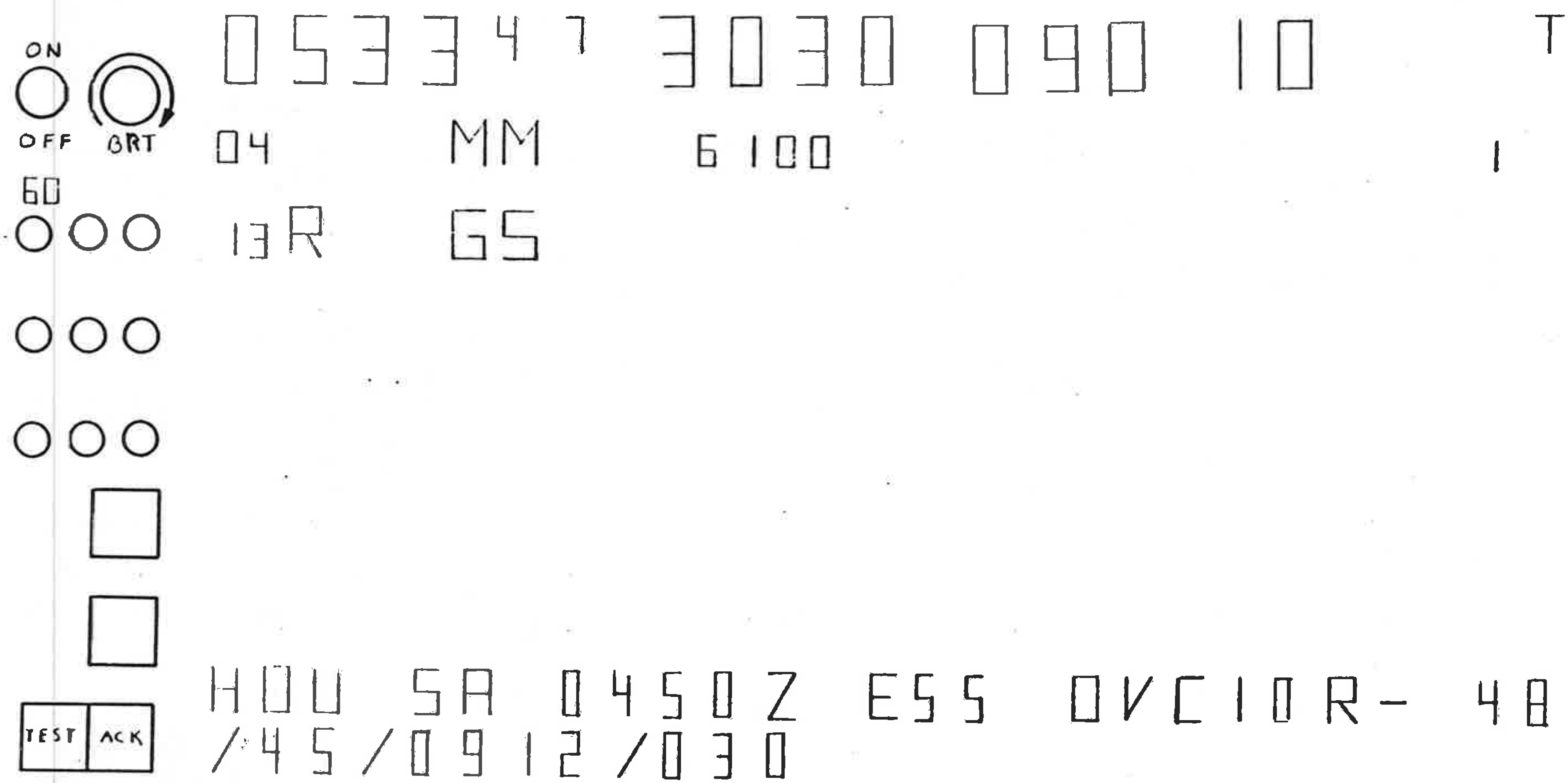


FIGURE A-27. CRITICAL DISPLAY AT HOU

Lines 6 and 7 of the CD show wind information from the 5 boundary wind sensors at IAH (since HOU has no LLWSAS, these lines are not used on that CD). For each wind, the two leading characters show the sensor location and are tinted green to discriminate between the following five characters that show the wind direction and speed. The last two lines of the CD present a summary of the hourly weather report for the airports.

A.3.2.2.2 Controls- The controls for the CD are positioned on the left side of the display. The top row includes a two-position switch for the power and a rotating knob for the brightness controls. The three rows of three switches beside the runway data lines control the RVR alarm thresholds. These are momentary switches that are moved left to lower the alarm threshold and right to increase it. Above each switch are indicators that display the alarm settings in hundreds of feet. The next two switches are for the display of LLWSAS information. Each switch corresponds to the associated line of LLWSAS readings. In one state a LLWSAS reading is shown only if it is in an alarm condition. In the second state, the readings for that line are displayed continuously. The bottom two switches are used to acknowledge alarms, and to perform a filament test of the entire panel.

A.3.2.2.3 Alarms- The CD has alarms for the RVR readings, ILS, ALS and LLWSAS. In this design of the CD, a combination of visual and aural alarms are used. When an ILS or ALS alarm is activated, a buzzer sounds, accompanied by blinking of the appropriate information. This sound continues until each controller depresses the acknowledge button ("ACK") at his display. When the runway 8 ALS is set to step 5, a timer is started. After 14.5 minutes an alarm is activated and the legend "TMR" blinks in the status area. If level 5 is not reselected within 30 seconds, the system automatically drops to level 4. The alarm operates in the same manner as the other status alarms but will cease automatically (and drop from the display) if not acknowledged within 30 seconds. When an LLWSAS alarm condition exists, a buzzer sounds (two 1/2 second tones) and the boundary wind is displayed, blinking until the condition no longer exists.

A.3.2.3 Variations from ER - Four variations from the ER specifications are used above:

(1) The digits for the seconds in the time block on line 1 are smaller than specified.

(2) The VAS character in space 4 of lines 2, 3, and 4 is eliminated.

(3) The "S" before the ALS setting on lines 2, 3, and 4 is eliminated.

A.3.2.4 Rational for Variations from ER

(1) Reducing the size of the seconds units improves display readability as it sets time block apart from the rest of the line and improves recognition of the minutes units of the time.

(2) Controllers at IAH and HOU do not presently use a VAS character to represent aircraft separation minimums. Eliminating this reduces clutter and thus improves readability.

(3) The "S" is eliminated to reduce display clutter and separate the RVR readings from the ALS setting instead of having them run together. Controllers indicated they would remember that the intensity setting is shown for the ALS only, without the "S" being displayed.

A.3.2.5 Critique of Design - Several aspects of the CD design warrant further discussion. From Figure A-27, it is clear that HOU does not fully utilize the space on the CD. The airport has only one RVR sensor (runway 4 touchdown), no LLWSAS, and is primarily a two runway operation. Thus, it is possible, that this satellite airport may need only on SD, if RVR alarm thresholds could be set through some means other than the CD (such as through the Supervisory/Maintenance Display).

As presently designed, approach light status and intensity information will not be displayed on the CD for inactive runways, although the lights are normally left on and are used by pilots. Pilots approaching from the west when runway 26 is active often use the runway 8 ALS for reference before turning to land on runway 26. Therefore, the programming must be such that a configuration change does not automatically turn off lighting on inactive runways. In the present display configuration controllers will need to refer to the appropriate page on the SD for status of lights on inactive runways.

The SA weather reports are edited when entered onto the displays by the Supervisors (using the SMD). This provides only information of interest to controllers, ensures that it fits into the 54 spaces provided on the CD, and minimizes display clutter. The message shown in Figure A-26 illustrates information important to the controllers. It reads: IAH hourly weather report/observations at 0552/estimated ceiling of 4500 feet/overcast/one-half mile visibility in light rain/temp 46^{o}/dew point 44^{o}.

A.3.2.6 Additional Considerations - It should be possible for weather sequences to be entered from the WSFO. This would reduce supervisor workload and the time delays between receipt on the weather printer and its display on the CCD. It would require the WSFO to send weather sequences in at least two forms: an edited version for the airports and the complete sequence for other users.

The RVR threshold switches would be easier to use if they moved up and down instead of left and right. This way it would be obvious which way to move the switch to raise or lower the thresholds.

The ER does not specify how the wind gust information should operate. In this design, it is only shown if gusts are 10 knots higher than the prevailing centerfield winds. Controllers felt that gusts are more likely to recur the more recently they occurred. Therefore, the wind gust information should display gusts of 10 knots over prevailing wind for approximately 60 seconds from their occurrence. If a greater gust occurs during this period, it replaces the previous reading. If a lesser gust occurs (but still at least 10 knots greater than the prevailing wind) it replaces the previous reading after the 60 second period. Otherwise, the gust information is dropped after the time period.

A.3.3 Supplementary Display Information Formats

(Figures A-28 - A-37).

A.3.3.1 Locations

IAH	HOU
LC-1	LC
LC-2	HR
FD/CD	GC
GC	FD/CD

A.3.3.2 Description of Display Capabilities

A.3.3.2.1 Format - The SD provides 12 selectable pages of information with each page capable of showing 16 lines of 32 characters each.

The first five display pages are the following:

Page 1: Backup Critical Display Data Page.

Page 2: RVR Data Page

Page 3: NAVAID Status Page

Page 4: Runway Lighting Page

Page 5: Daily Log Page

Pages 6 through 12 are adaptable to local facility needs.

Among other information, they can be programmed to display NOTAMs, SIGMETs, field lighting instructions, approach plate data and if necessary, continuations of the first five pages.

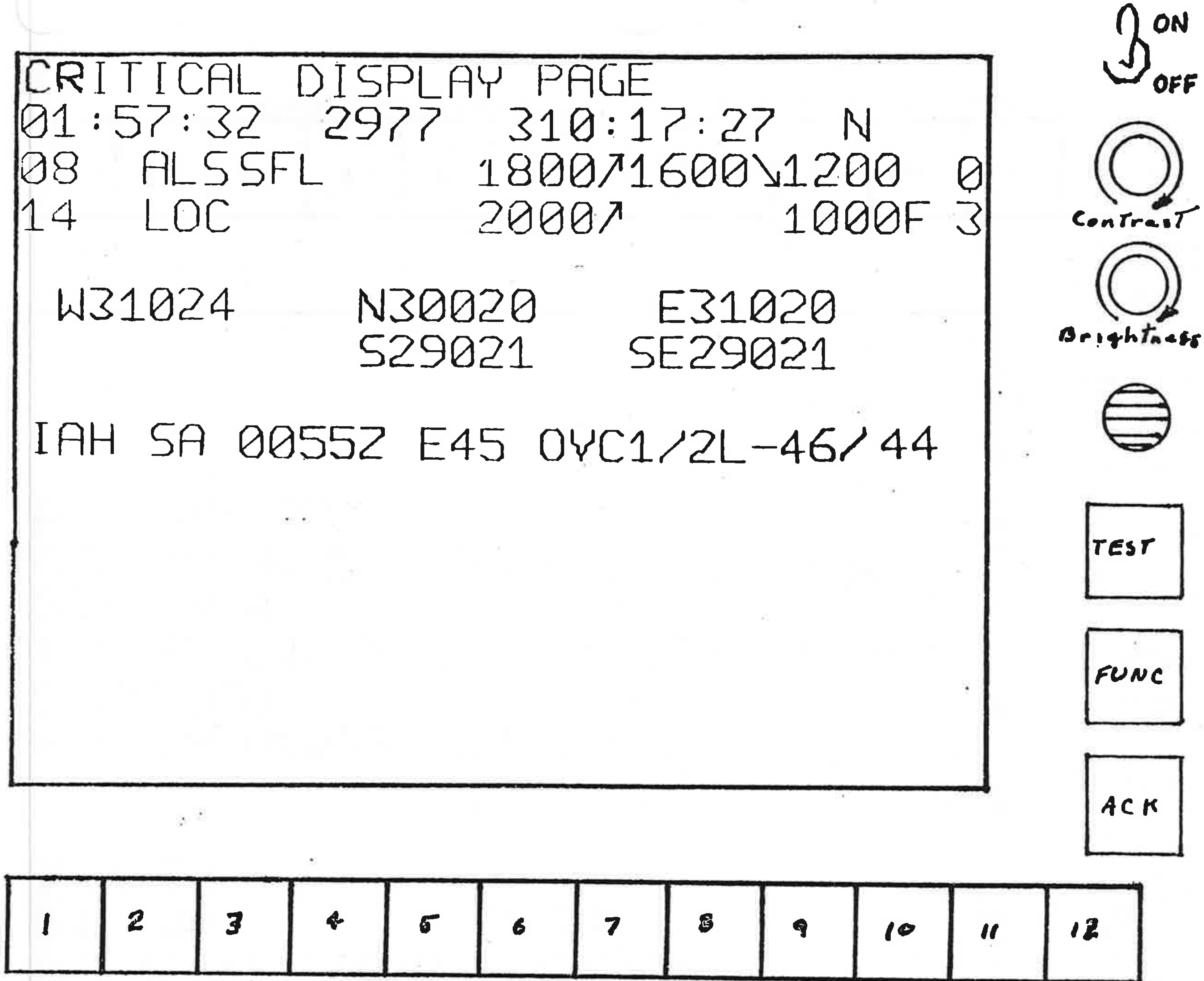


FIGURE A-28. BACKUP CRITICAL DISPLAY DATA PAGE AT IAH

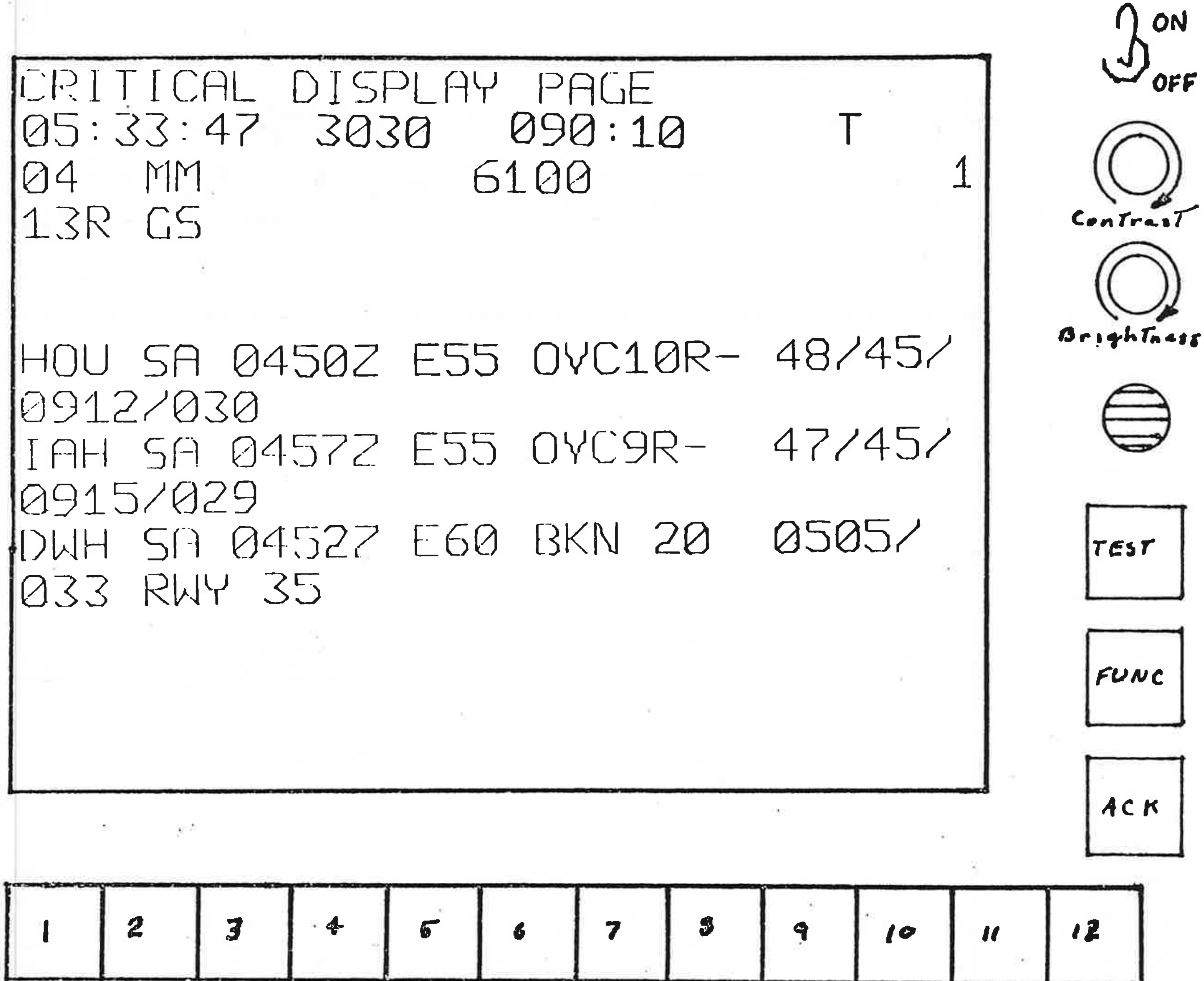


FIGURE A-29. BACKUP CRITICAL DISPLAY DATA PAGE AT HOU

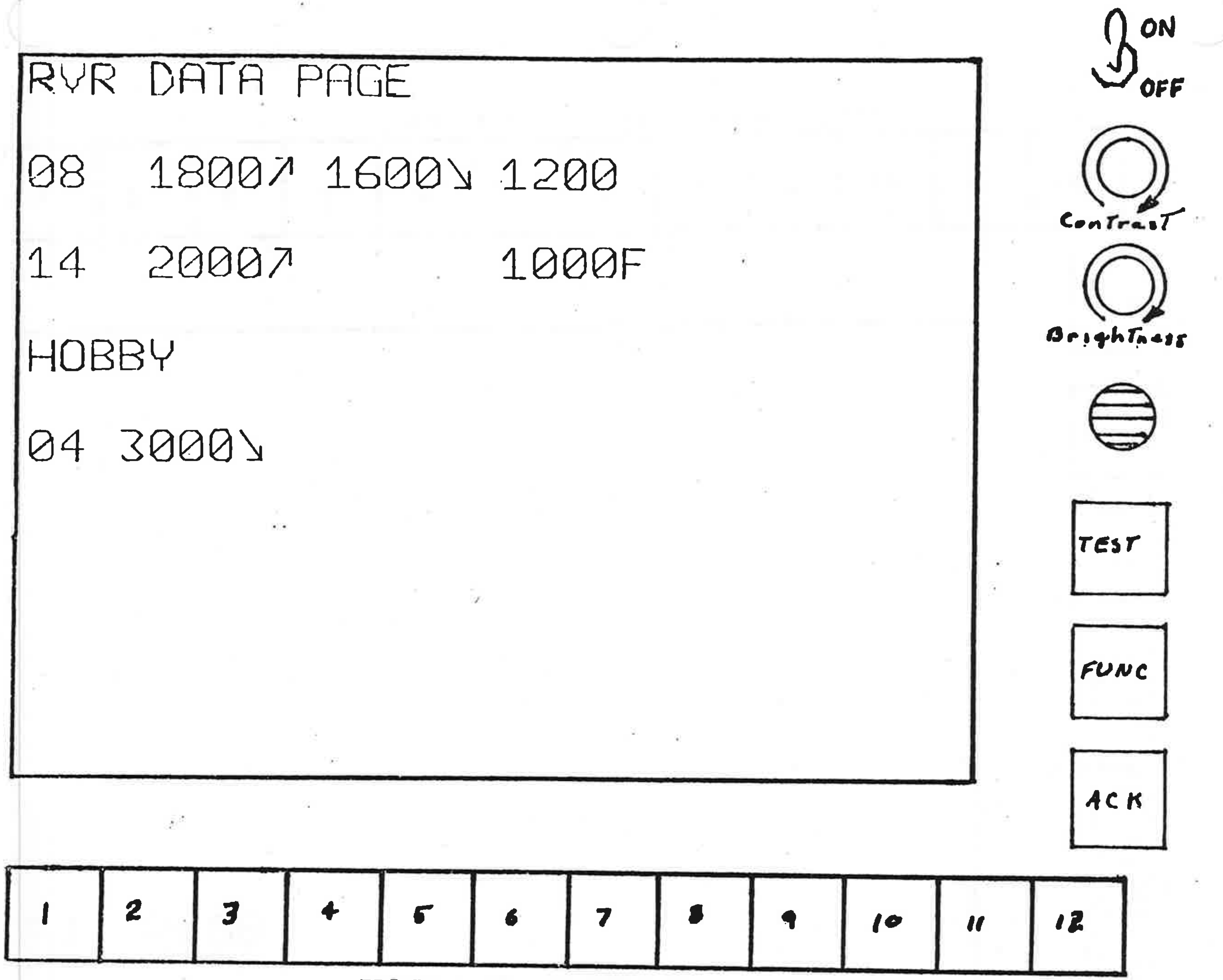


FIGURE A-30. SD RVR DATA PAGE AT IAH

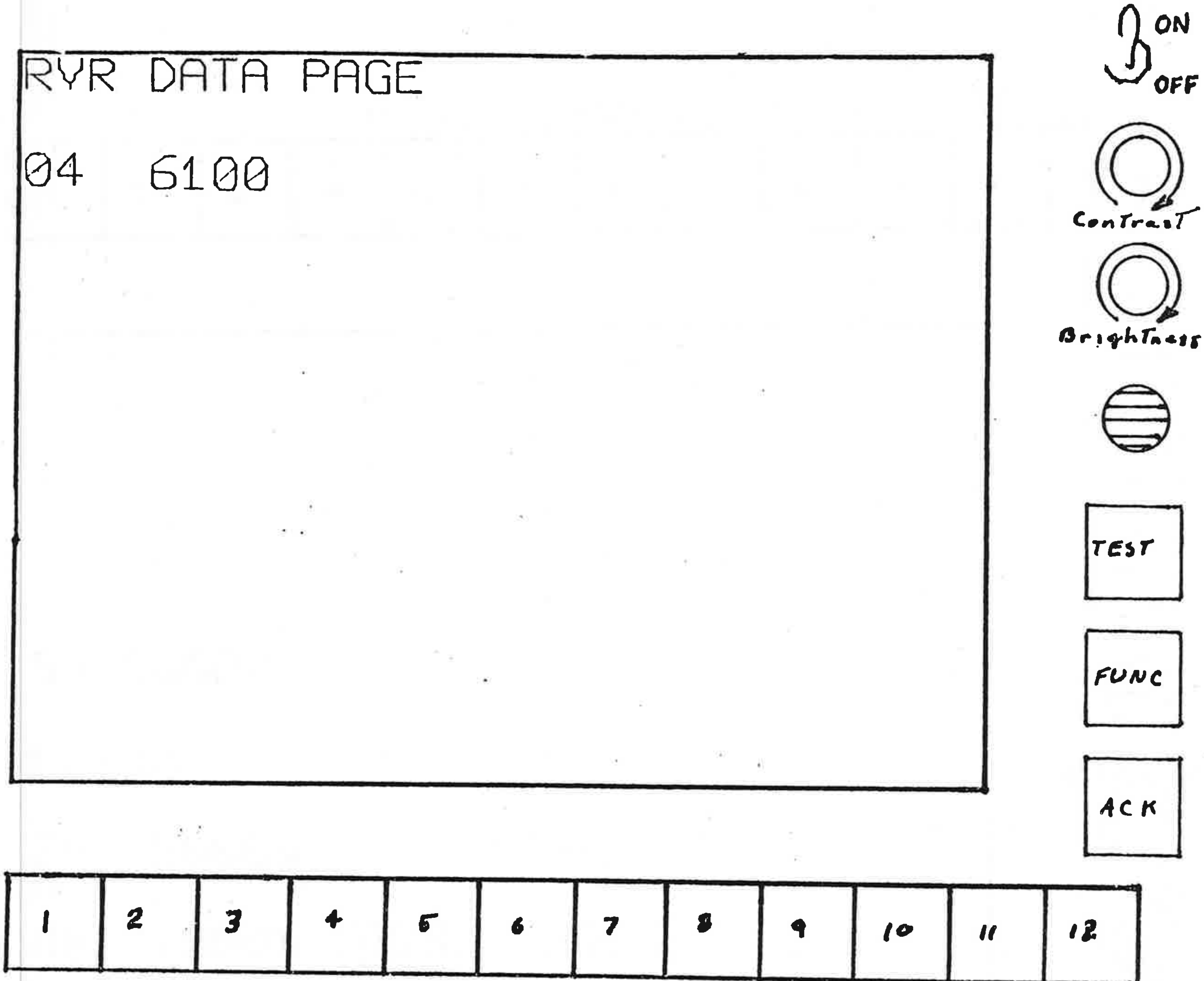


FIGURE A-31. SD RVR DATA PAGE AT HOU

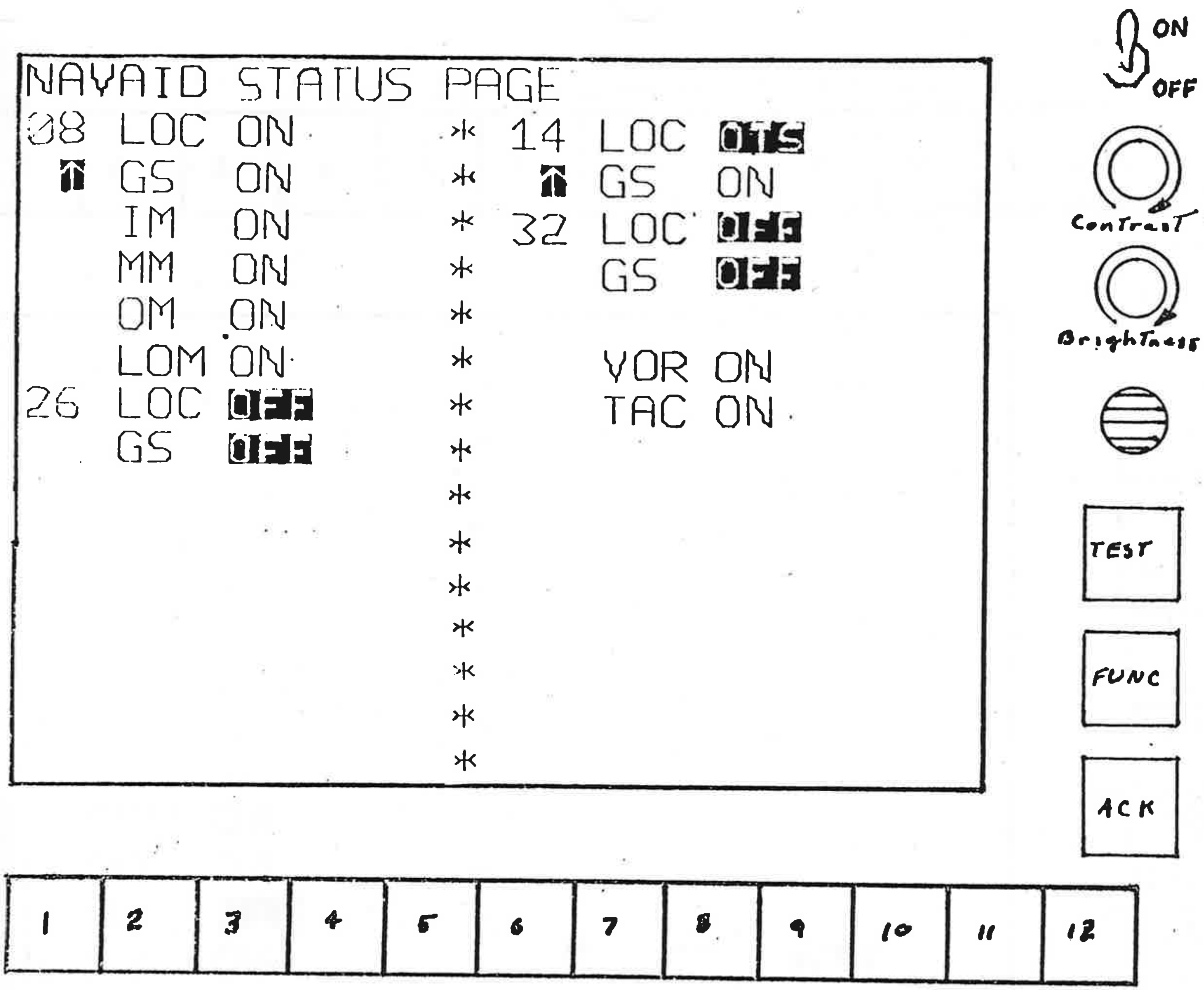


FIGURE A-32. SD NAVAID STATUS PAGE AT IAH

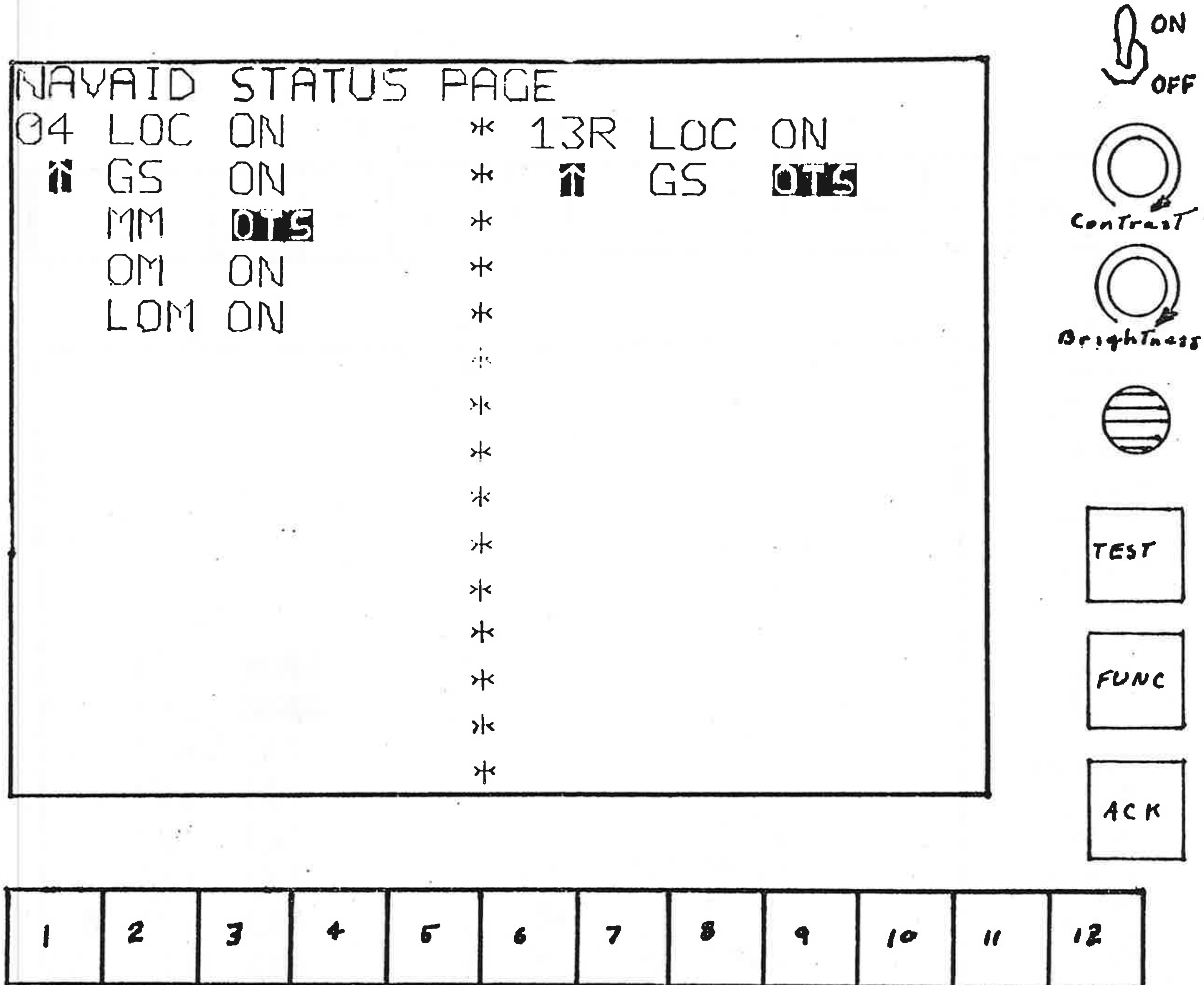


FIGURE A-33. SD NAVAID STATUS PAGE AT HOU

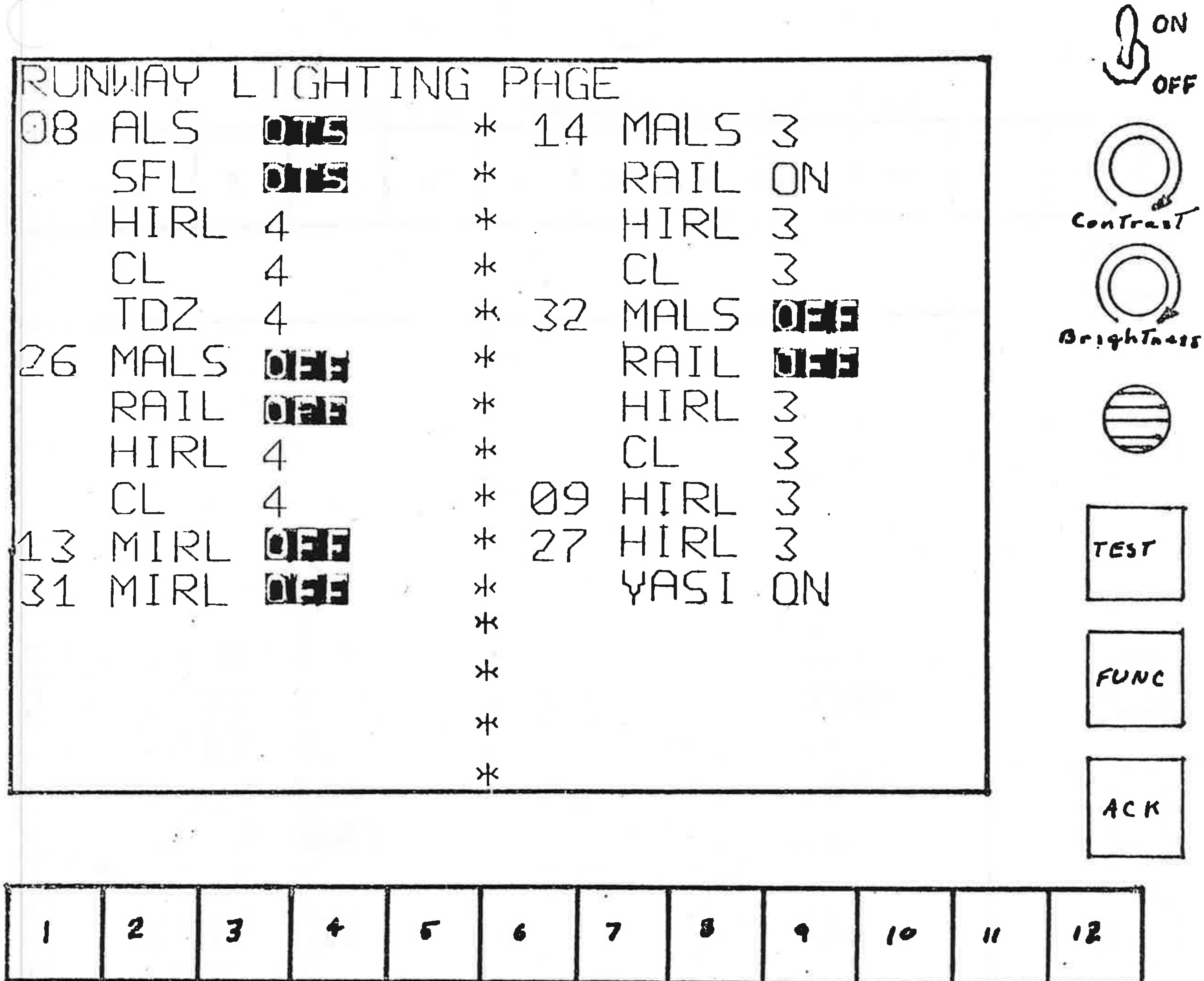


FIGURE A-34. SD RUNWAY LIGHTING PAGE AT IAH

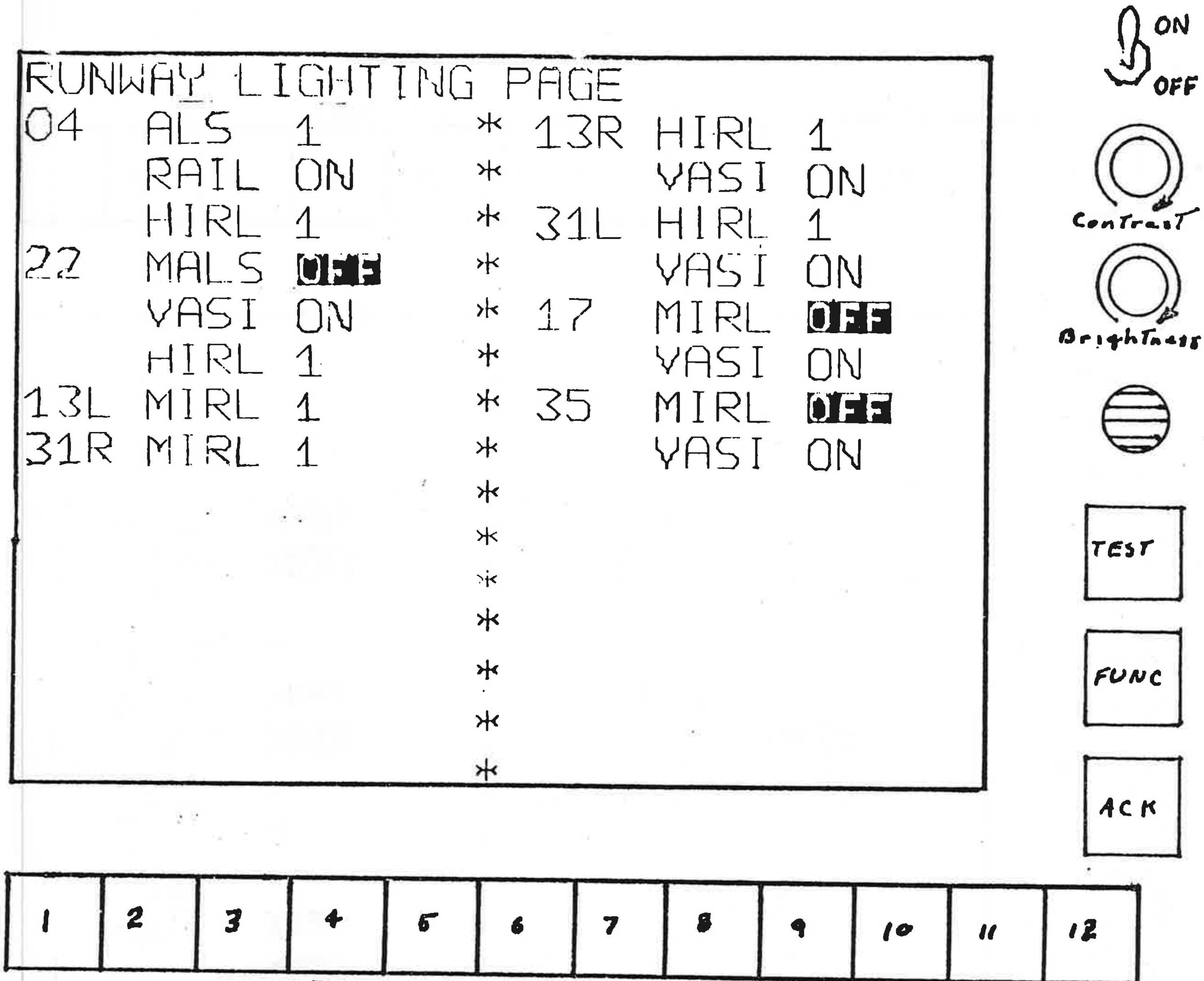


FIGURE A-35. SD RUNWAY LIGHTING PAGE AT HOU

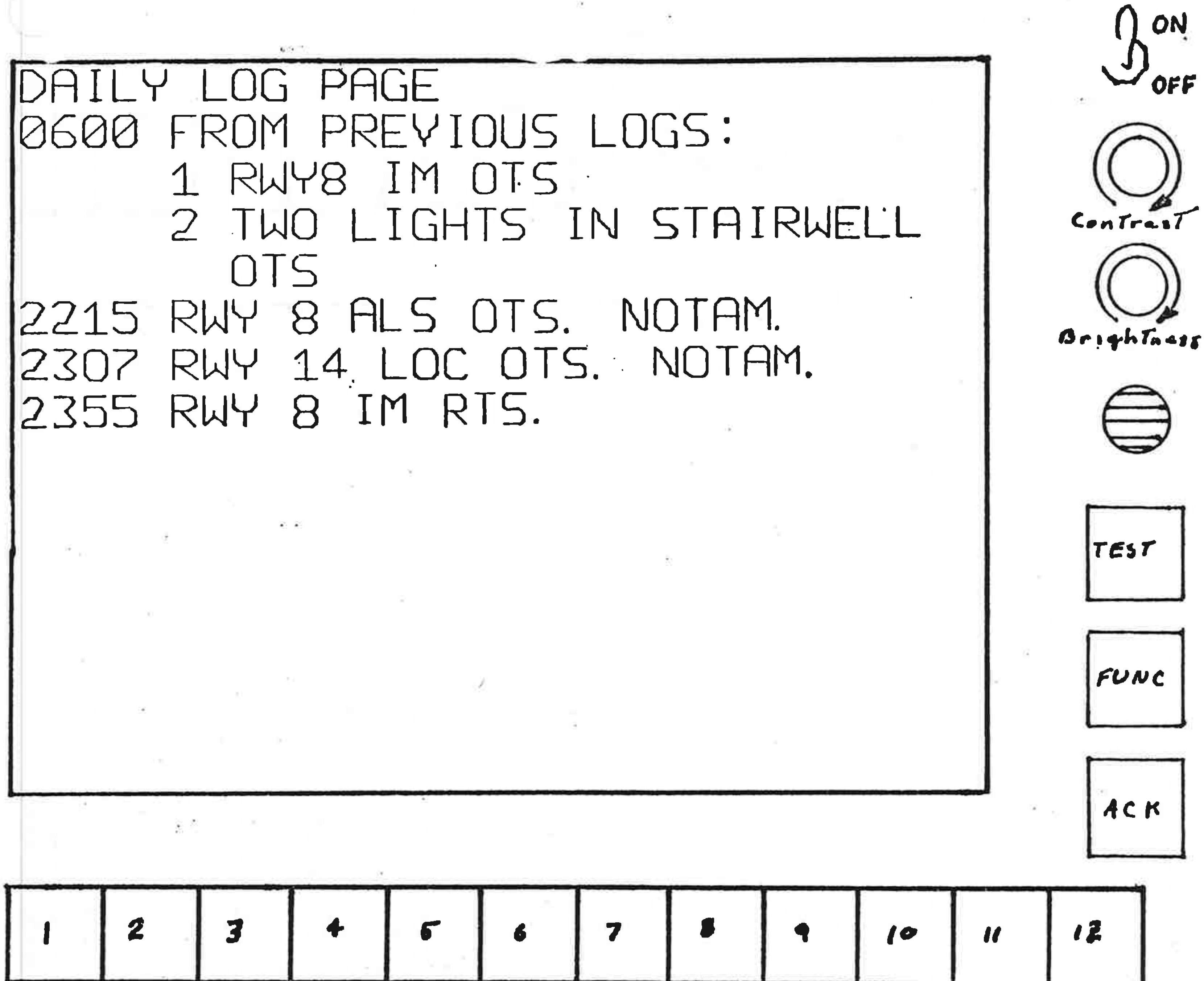


FIGURE A-36. SD DAILY LOG PAGE AT IAH

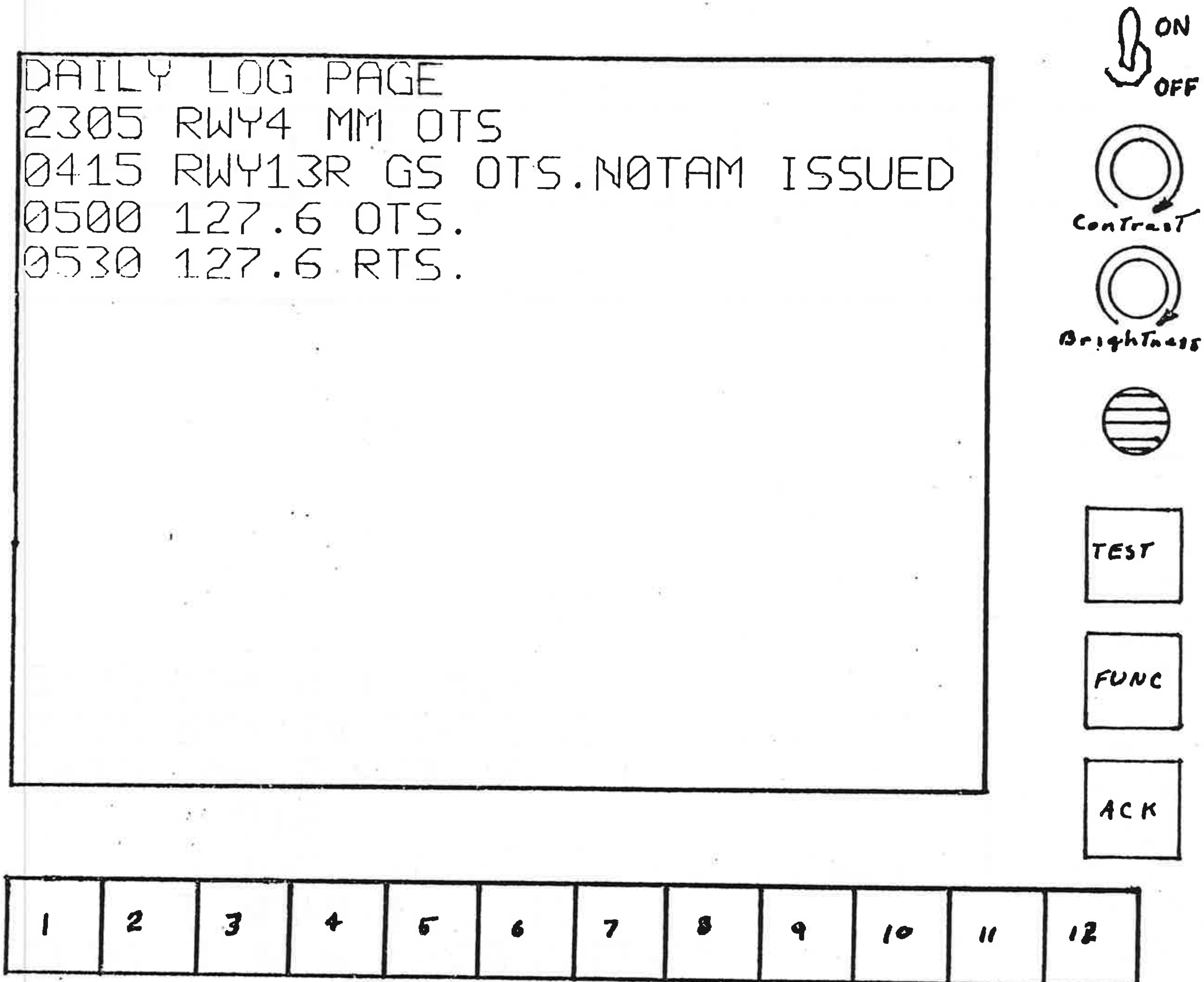


FIGURE A-37. SD DAILY LOG PAGE AT HOU

The formats of the first five pages are as follows:

(1) Backup Critical Display Data Page (Figures A-28 and A-29).

This page displays the information shown on the Critical Display. It serves as a backup for the CD and a primary course of information for positions not assigned a CD. Line 1 is the title line (as it is on all SD pages). Line 2 displays time, altimeter, wind direction and speed and ATIS code. Since all letters on the SD are the same size, colons are used to aide discrimination between the hours, minutes and seconds of the time block and the wind direction, speed and gust speed of the wind block. The next three lines are for status and RVR information on up to three different runways. In this design, 10 spaces are assigned for status information (spaces 5-15 on lines 3, 4, and 5) instead of only four as on the CD, thus no overflow line is used. Lines 6 and 7 of the IAH format displays LLWSAS information on a continuous basis when the page is selected. Lines 9 and 10 of the IAH format is for the hourly weather reports. Lines 6-11 of the HOU format display the SA weater reports from IAH and DWH (David Wayne Hooks) as well as its local report.

(2) RVR Data Page (Figures A-30 and A-31).

The SD RVR Data Page for IAH displays the RVR readings for the sensors at IAH and the sensor at HOU. The runway number, RVR readings in feet (100 foot increments) and arrows or failure indicators are shown.

The SD RVR data page at HOU displays the runway 4 touchdown RVR reading.

(3) NAVAID Status Page (Figures A-32 and A-33).

These pages display available ILS and VORTAC status information at the airports. The formats feature arrows in reverse video indicating the ILS systems that have been selected, and the status of each monitored component (either "on", "off", or "OTS", the latter two in reverse video). In the IAH example shown, the runway

8 and runway 14 ILS have been selected and the runway 14 LOC is malfunctioning. The runway 8 and 32 ILSs are turned off. The VORTAC is either in the "ON" or "OTS" status and is not a NAVAID for a particular runway. Therefore, no runway number or arrow is displayed beside it. The HOU example shows the runway 4 and 13R ILSs selected and the runway 4 middle marker and runway 13R glide slope malfunctioning.

(4) Runway Lighting Page (Figures A-34 and A-35).

This page displays status information on the tower controlled lighting systems. The display shows "off" or the intensity level for the components with multiple intensity levels and "on" or "off" for those with a single intensity level. The display also shows "OTS" if the ALS is malfunctioning.

In the IAH example, the runway 8 and 26 runway lighting components are at step 4 and the runway 8 ALSSFL is OTS and the runway 26 MALSR is turned off. The runway 13 and 31 lights are off. The runway 14 and 32 components are at step 3 with the runway 32 MALSR off and the runway 14 Rail simply being "on". The runway 9 and 27 edge lights are at step 3 and the VASI is on. The HOU example shows all the variable lighting components on step 1 except for the runway 22 MALS and the runway 17 and 36 edge lights. All the single level components are "on".

(5) Daily Log Page (Figures A-36 and A-37).

These pages provide a log of equipment outages, NOTAMs and other items of interest to a controller. If a supervisor wants information from his daily log on the SMD displayed on the SD, he types an asterisk when he enters the line. The line will then be displayed on the SD as it is entered on the SMD.

A.3.3.2.2 Controls - The controls for the SD are along the bottom and on the right side of the panel. On the top right side is the power switch, contrast and brightness controls, and a speaker for the audible alarm. Below these are a test switch (to activate the page button light filaments), a function switch (not used) and an acknowledge button (to acknowledge alarms). Along the bottom of the panel are twelve buttons to select the individual pages.

A.3.3.2.3 Alarms - The SD can be programmed to utilize a combination of aural and visual alarms. In this design, it is assumed that SD alarms occur only at positions that do not have a CD (such as FD/CD) or the information is not available on the CD. Furthermore, the types of alarms (i.e., continuous, two 1/2 second tones or a single 1/2 second tone) are the same as on the CD. If an alarm is sounded on the SD and that particular page is not shown, the appropriate page number is displayed blinking on the title line (line 1 of each SD page). The controller selects the page by pushing one of buttons 1-12, identifies the item that is blinking, and pushes the acknowledge button, if necessary.

A.3.3.3 Variations from ER - The variations from the specifications of the ER are as follows:

(1) The presentation of the IAH and DWH SA reports on the HOU Critical Display Weather Page.

(2) The presentation of the HOU RVR on the IAH RVR data page.

(3) The use of arrows to denote RVR increasing or decreasing.

(4) The presentation of a NAVAID status page.

(5) Omitting status information on standby ILS components on the "NAVAID Status Page".

(6) Combining the "ALS/MALS" and "Field Lighting Pages" into a single "Runway Lighting Page".

(7) The presentation of a "Daily Log Page".

A.3.3.4 Rational for Variations from ER

(1) Currently, HOU controllers refer to IAH and DWH weather reports displayed on a monitor near the rear of the TRACAB. Displaying these on the SD provides controllers with more convenient access to the information and elim-

inates the need for the monitor. Since HOU has no LLWSAS, there is room to present these without cluttering the display.

(2) Displaying the HOU RVR on the IAH RVR page is useful to cab controllers because pilots occasionally request this information if RVR readings at IAH are below required minimums. Currently, cab controllers contact HOU on the interphone for this information. Displaying it on the SD would eliminate the need for this communication.

(3) This design uses arrows to denote RVR increasing or decreasing instead of the "I" and "D" called for in the ER. These notations are consistent with the CD. Furthermore, because the meanings of the arrows are more obvious than letters, this allows for faster recognition of RVR conditions. Additionally, this design uses a blank space (instead of an "O") to denote a steady RVR. The "O" make the RVRs confusing to read and a blank space is appropriate to denote "not changing".

(4) This design has a "NAVAID Status Page" instead of an "ILS Status Page", because the VORTAC status is also provided. Although, it is not part of a single ILS, its status is needed and used by the cab controllers.

(5) Controllers stated that they do not need to know if it is an ILS main or standby component that is active. They simply want to know if the component is operative or not. Supervisors need this information, however, thus it should be available on the SMD. Eliminating this unnecessary information on the SD reduces recognition and processing time required of the controller.

(6) Since HOU and IAH do not have many ALS, there is space to provide information on the ALS and the field lights on the same page. This enables controllers to access complete runway lighting information by selecting a single page.

(7) The Daily Log Page provides a briefing of facility status information that may not be available elsewhere from the CCD system. The supervisors decide what information is relevant to controllers and should be displayed on this page.

A.3.3.5 <u>Critique of Design</u> - It is suggested that two SD pages be devoted to the Daily Log (pages 5 and 6). If the first page is selected the number of the second page will be displayed on the title line (upper right hand corner) to indicate the selected page does not contain all the information. Then the controller pushes the button for the following page. If desired, a similar paging system could be developed for the other SD pages.

When interviewed, controllers and supervisors felt the SD formats would be useful in providing status information. They felt it was important, however, to minimize unnecessary status information. For example, controllers stated that they do not need to know whether an ILS main or standby component is operating. Instead, they need to know only if one or the other is operating, off, or malfunctioning.

Controllers stated that the Daily Log page would be used mainly during relief briefings as it provides a convenient summary of malfunctions and special procedures. Furthermore, the information is of secondary importance. More critical outages are displayed on the CD or pages 1-4 of the SD. Therefore to avoid unnecessary controller actions, new entries to the Daily Log page should not activate an alarm.

Should HOU not receive a CD, controllers felt it would be satisfactory for the supervisors to program the RVR alarm threshold into the SD. This is because HOU has only a single RVR sensor, and the threshold feature is seldomly used. At an airport with more RVRs, different positions set different alarm thresholds for the same RVRs and frequently adjust them during marginal weather conditions.

A.3.3.5 Additional Considerations - As with the CD, a direct link between the WSFO and the SD is desirable to save time and eliminate the requirement for the supervision to enter the weather reports.

Consider adding RVR threshold controls to the SD. This design, similar to the TD, would make the SD a more acceptable alternative to the CD at airports that are not assigned CDs.

A.3.4 Lighting Control Panel Design

(Figures A-38 and A-39).

A.3.4.1 Locations

IAH	HOU
LC-1	LC

A.3.4.2 Description of Display Capabilities

A.3.4.2.1 Format - The top row of buttons are the runway indicators and designate the active runways in a given configuration. They change automatically when there is a configuration change or can be manually changed by a supervisor at the SMD. The tower controlled lighting components for the runway are displayed in the column of buttons below it and offset one column to the right. In addition to displaying the component abbreviation, the following status information is presented.

Single intensity components that are tower controlled but not automatically monitored read either "on" or "off". Variable intensity components display the selected step (1-5) or read "off". Additionally, the ALS and SFL display "OTS" if malfunctioning, and the ALS displays "TMR" when the 14.5-minute time threshold is reached (refer to section A.3.2.2.3).

A.3.4.2.2 Controls - The LCP controls include a power switch, momentary push buttons to select the lighting components, off and intensity selection buttons, and a filament test button. To

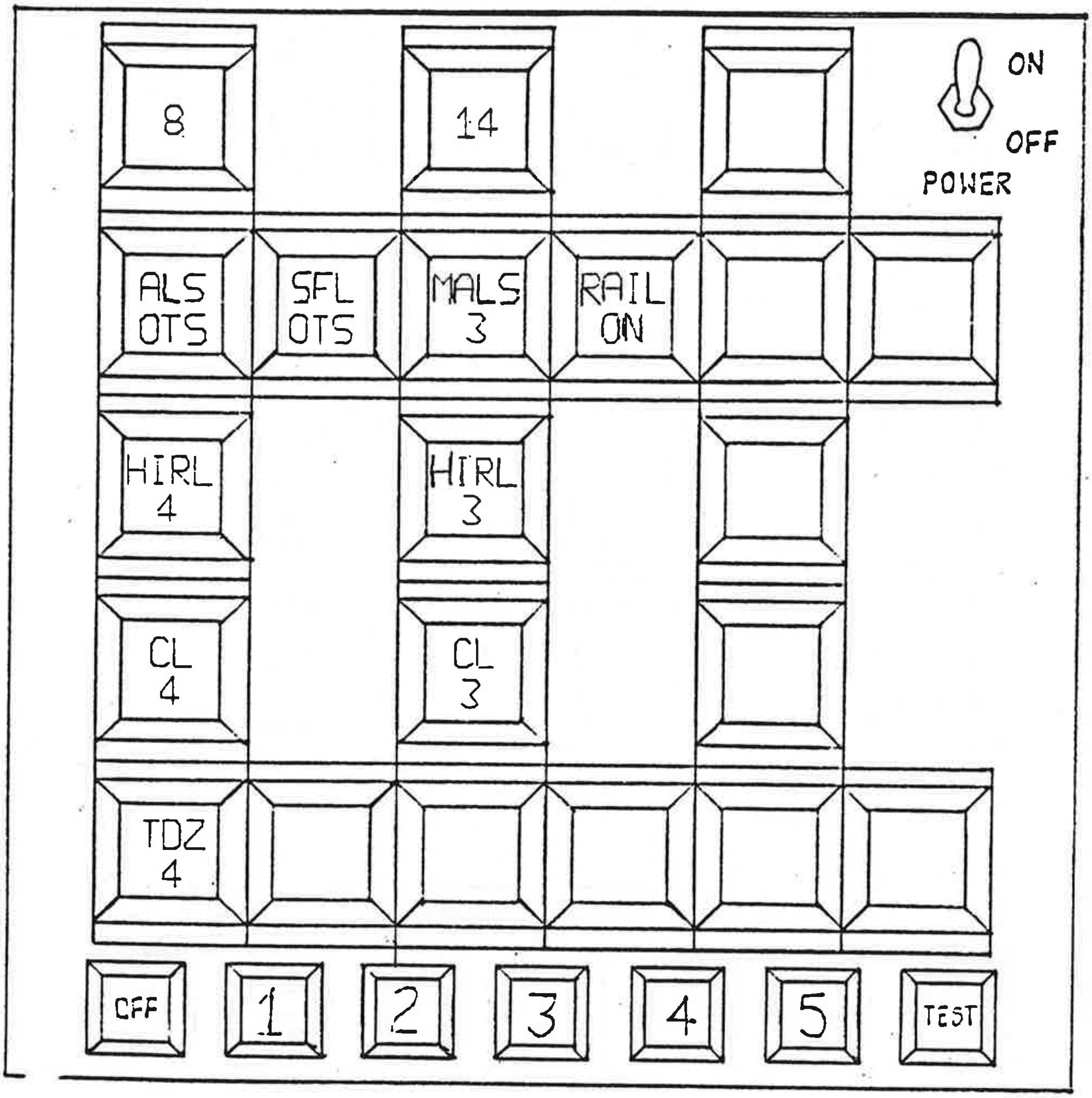


FIGURE A-38. LIGHTING CONTROL PANEL AT IAH

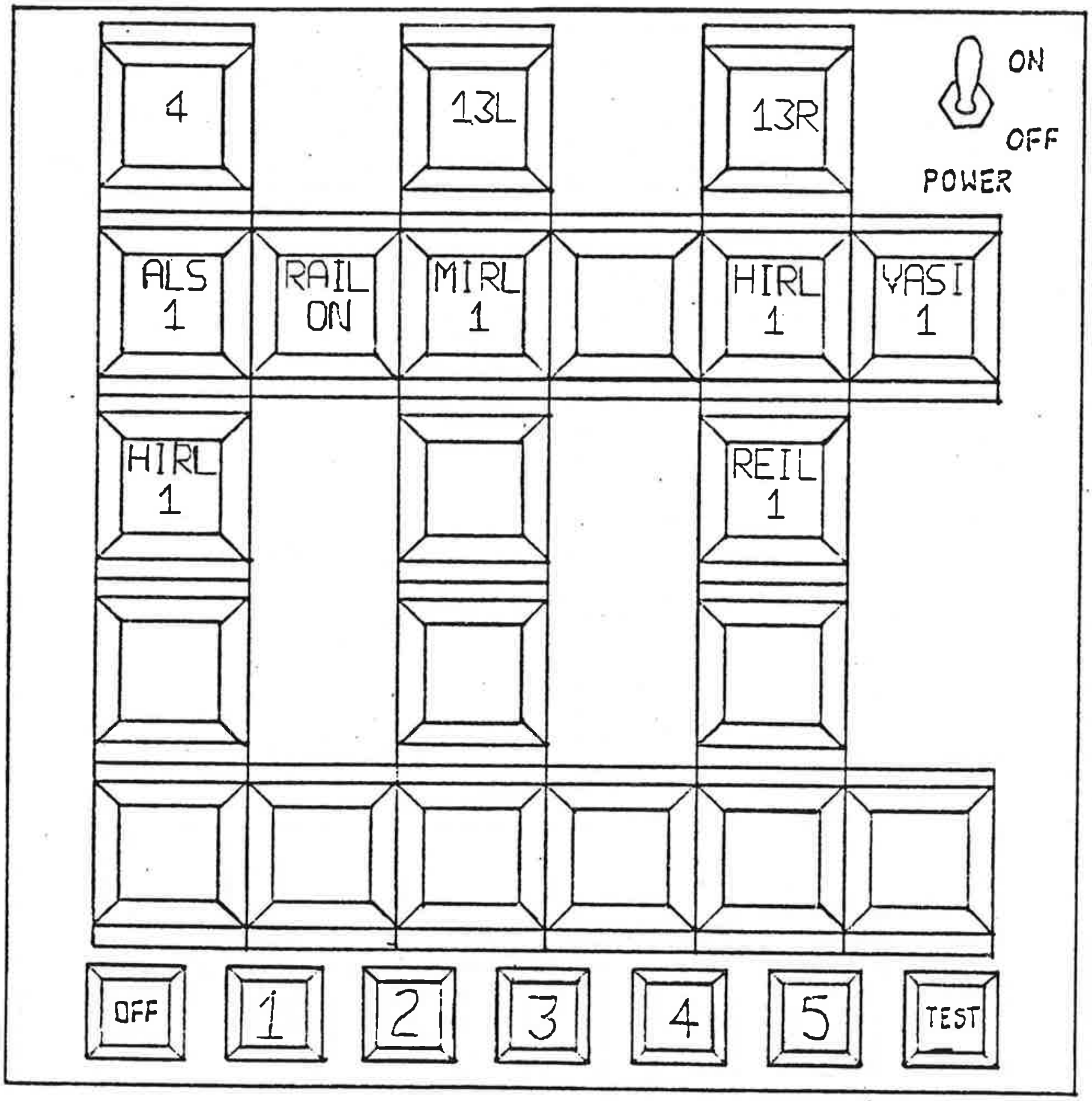


FIGURE A-39. LIGHTING CONTROL PANEL AT HOU activate a variable intensity runway lighting component, the controller selects the desired intensity, then pushes the appropriate button. Single intensity components are turned on and off simply by pushing the desired component's button. For example, if the IAH runway 14 MALSR was off and intensity level 3 was desired, the controller would hit "3" and "MALS". Then, the code under the word MALS would change from "off" to "3". The controller would then push the "RAIL" button. The code under "RAIL" would change from "OFF" to "ON".

If buttons "4" or "5" were pushed when activating a three step lighting system (such as HOU 13L), this action would default to level 3 and a "3" would appear on the "MIRL" switch. The ALSs have automatic timers, so if level 5 is selected, after 15-minutes, if level 5 is not reselected, the intensity automatically drops to level 4. Furthermore, the SFL and RAIL components will not function until the corresponding ALS or MALS components are activated.

A.3.4.2.3 Alarms - Only the ALS and SFL components have alarms on the LCP. These include displaying "TMR" when the ALS have been on level 5 for 14.5-minutes and displaying "OTS" when the ALS or SFL are malfunctioning. No audible signal is activated nor is an acknowledgement necessary on this panel. If the controller wants the ALS to remain on level 5, he pushes "5" and "ALS" to reset the timer. If no action is taken, the ALS automatically drops to level 4.

A.3.4.3 Suggested Variations from ER - The variations from the specifications in the ER are as follows:

(1) The ER specifies that a unique set of legends will be used for each lighting type. It is not clear from the ER that there is a limit on the number of characters which may be used in the legends. Previous reports, however, have shown 3-letter legends on the LCP. In this design, it is assumed up to four characters can be used to denote the lighting type.

(2) The ER specifies that the buttons in rows 2 and 5 and columns 2, 4, and 6 shall read "on" or "off" and display "SFL". In this sesign they also read "OTS" when malfunctioning, and "RAIL".

A.3.4.4 Rationale for Variations from ER

(1) Four characters are used in this design to provide added clarity and ease of recognition to the lighting component. Many components are commonly abbreviated with 4 letters (HIRL, MIRL, MALS, VASI, RAIL) and shortening these would increase recognition time.

(2) The RAIL designation is necessary because these airports have ALS with RAIL and MALS with RAIL. Although these are variations of SFL, controllers refer to them as RAIL. The "OTS" feature is necessary because the SFL components can fail and the ALS remain normal. Therefore, status of the ALS cannot be assumed to be the same as the SFL.

A.3.4.5 Critique of Design - The LCP provides an efficient system for controlling the runway lighting. All tower controlled lighting components are operated by a single panel and adjusting lights requires a minimum of button pushes.

As described in Section A.3.2.5, it is common practice to leave the approach light system on when the runway is not active. This means that the CCD system must be programmed so a configuration change (and consequently the removal of a runway label and its components on the LCP) does not deactivate the runway lights. Furthermore, should these require adjustment after the configuration change, in the absence of displayed lighting controls, the supervisor would have to manually call up the appropriate runway and its lighting components on the LCP (performed at his SMD) to enable the controller to make the change. An alternative to this procedure would be to have up to three LCPs in the tower, so that the inactive runway lighting systems could be adjusted rapidly.

A.3.4.6 Additional Considerations - A variation of the LCP design is shown in Figure A-40. It is larger (approximately 10 inches x 10 inches, if the same buttons are used as those specified in the ER) and would have up to eight runways labelled at the top. Directly below each label are switches for each tower controlled lighting component for that runway.

The advantage of this design is that it provides faster access to any runway lights because both active and inactive runways are displayed. Furthermore, all components are directly below the label and each type of component is on the same row. For example, all runway edge lights are controlled by switches in row 3. Conceivably, this panel could be designed so that buttons are placed only if a runway has that component. Then, it could have removable tabs to easily insert switches if new components were added. The operation of the panel would be as described for the original design.

A.3.5 Supervisory Maintenance Display

(Figures A-41 and A-42).

A.3.5.1 Locations

IAH		HOU	
TRACON:	Watch Supervisor (WS)	TRACAB:	Team Supervisor (TS)
CAB:	Team Supervisor (TS)		

A.3.5.2 Description of Display Capabilities

A.3.5.2.1 Format - The SMD is a flexible format CRT that can be programmed to display and enter status, weather and other information. The ER specifies that the SMD be capable of displaying 24 lines of 80 characters each or two pages from a SD or TD (16 lines of 32 characters each), simultaneously. Up to 256 supplemental data pages can be addressed and displayed on the SMD. As well as including the pages from the SD and TD, these pages include infor-

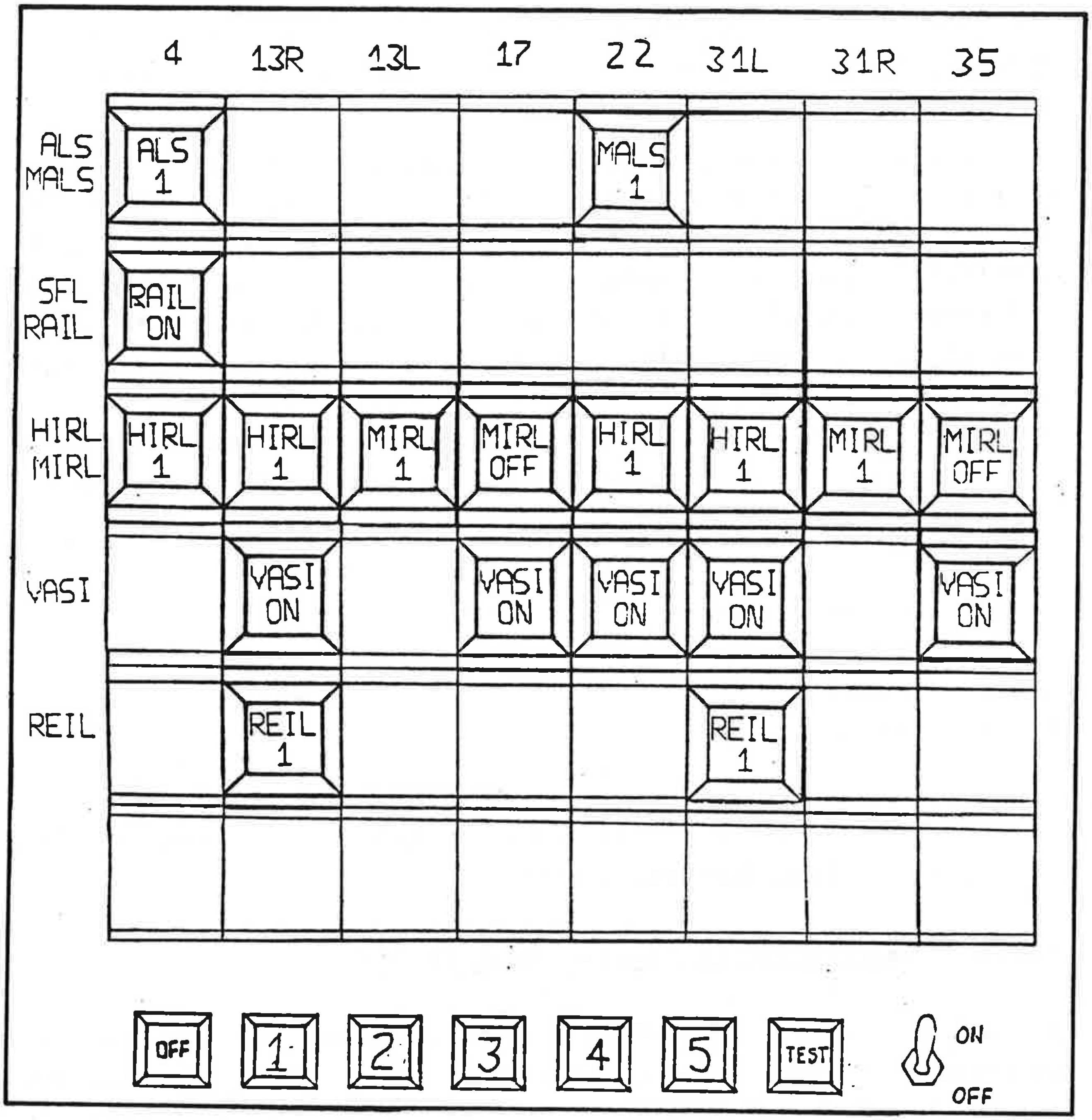


FIGURE A-40. ALTERNATE LCP DESIGN (HOU EXAMPLE)

FACILITY OPERATION LOG - IAH

TIME	REMARKS- PAGE 1	INITIAL
Ø6ØØ	BA ØN. RUNWAY 14-26 OPERATION.WCLC.	
Ø6ØØ	*FROM PREVIOUS LOG:	
	*1 RWY8 IM OTS	
	*2 TWO LIGHTS IN STAIRWELL OTS	
Ø62Ø	TRAFFIC REPORT TO RCC.	
Ø72Ø	ARTS IN MAINT STATUS.	
Ø955	ARTS OPERATIONAL	
E1215	"B" RECORDER TRANSFERRING PRIOR TO END OF TAPE. WILL NOT RESET.	123ØHI
13ØØ	SS ON.	
1435	WCLC.	
21ØØ	DD ON.	
22ØØ	WCLC.	
E2215	*RWY 8 SFL OTS.NOTAM.	2245RR
E23Ø7	*RWY 14 LOC OTS.NOTAM.	231ØBB
E2355	*RWY 8 IM RTS.	

FIGURE A-41. FACILITY OPERATION LOG ON SMD IAH

FACILITY OPERATION LOG HOBBY

TIME	REMARKS- PAGE 1	INITIAL
0600	TJ ON.WCLC.	
1300	AB ON.	
1305	WCLC.	
2100	RR ON.	
E2305	*RWY4 MM OTS	0100JB
E2415	*RWY13R GS OTS.NOTAM ISSUED.	
E0500	*127.6 OTS.	
E0530	*127.6 RTS.	
0559	COB	

FIGURE A-42. FACILITY OPERATION LOG ON SMD AT HOU mation of use primarily to supervisors, and complete status of both ILS main and standby components.

Example SMD formats for IAH and HOU are shown in Figures A-41 and A-42 respectively. These show how the Facility Operation Logs would look if maintained on the SMD. The first line is the page title, line 3 shows the column headings (Time, Remarks, Page number and Airway Facilities (AF) time initial block); the messages start on line 5.

A.3.5.2.2 Controls - Each SMD is equipped with an ASC-II alphanumeric keyboard. Using this keyboard, the supervisor can access specific pages from the SD and TD of any controller position, send messages to other SMDs, override sensor collected data, and enter information to supplemental pages on the controller's displays. ATIS code, weather reports, and entries to the Daily Log are entered manually on the SMD.

A.3.5.2.3 Alarms - Audible and visual alarms are provided by the SMD. The audible alarms are similar to those on the CD but of a different frequency to distinguish between an SMD alarm and the other displays. These can be programmed, as desired, to occur as a result of any type of data change. These alarms are acknowledged, when necessary using the keyboard. If an alarm occurs on a page not displayed, the page number blinks in the upper right corner. The supervisor selects that page and acknowledges the alarm.

A.3.5.3 Variations from ER

(1) The ER does not mention the SMD's Facility Operation Log replacing the need for maintaining the Form 7230-4 on the typewriter. In this design, it is assumed this will be the case. Then, a hard copy could be printed out on a line printer in the equipment room.

A.3.5.4 Rationale for Variations from ER

(1) Maintaining the Facility Operation Log on the SMD will avoid duplication of effort by the supervisors.

A.3.5.5 Critique of Design - Although the SMD will be useful in providing information to supervisors and controllers, of concern is the increase in supervisor workload it requires. The supervisors enter the ATIS code, sensor values when automatic sensors fail, changes in page assignments, weather reports, daily log page entries, and other changes as necessary. In designing this portion of the CCD system, care must be taken to minimize requirements for manual entries by supervisors.

A.3.5.6 Additional Considerations - It is recommended that the SMD be formatted so that a portion of the display is a preview area. This would enable the supervisor to check an entry for accuracy before sending it to the CCD system. It could also provide a means of communicating with other SMDs while simultaneously displaying an information page.

A.3.6 Tracon Display Information Formats

(Figures A-43 - A-46).

A.3.6.1 Locations

IAH	HOU
All radar positions	None

A.3.6.2 Description of Display Capabilities

A.3.6.2.1 Format - The TD provides 12 selectable pages of information with each page consisting of 16 lines of 32 characters each. The upper four lines are fixed, in a sequence useful to the TRACON controllers. These lines are dedicated to showing real-time altimeter wind, ATIS code and RVR for both IAH and HOU, status informa-

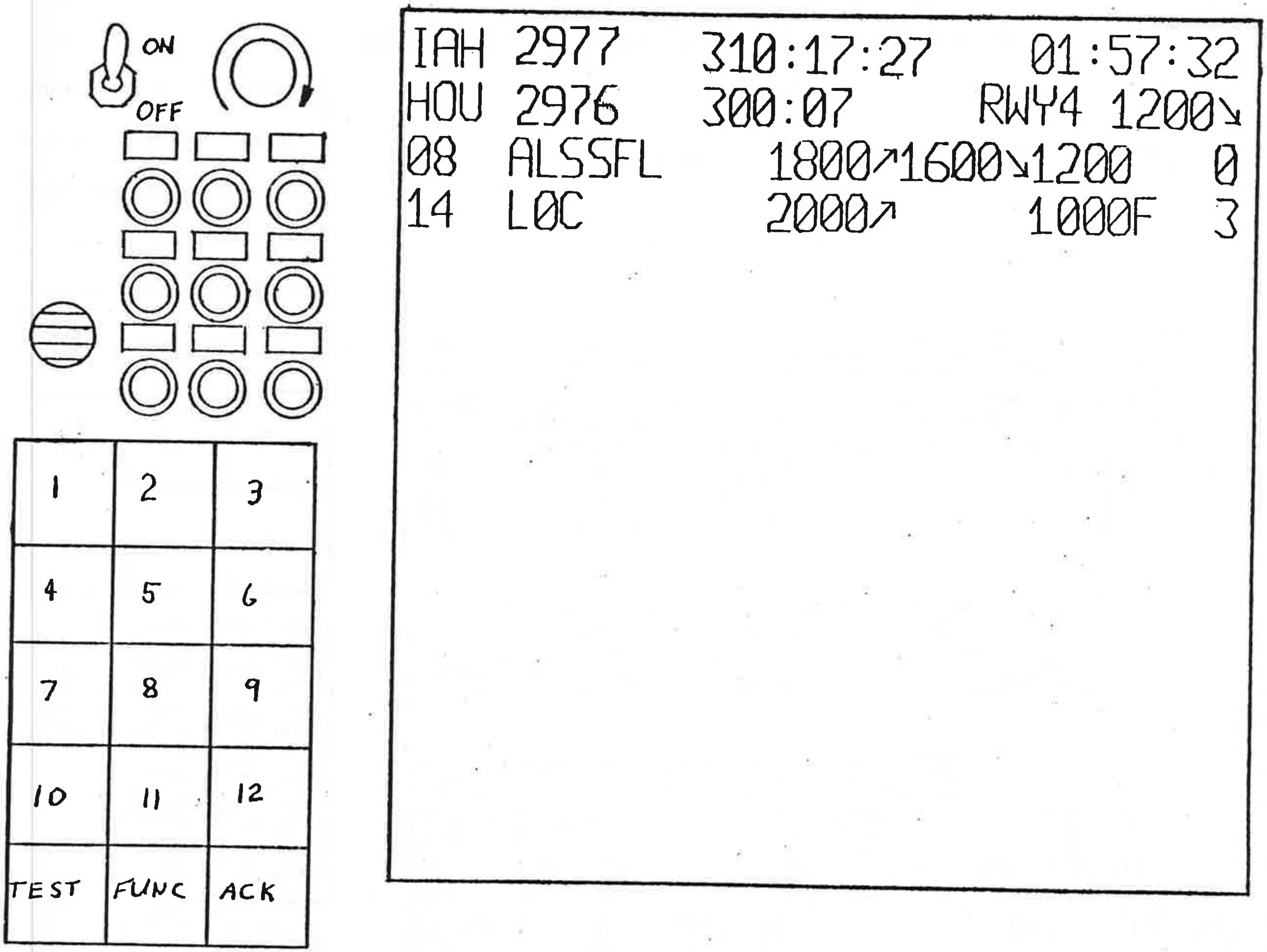


FIGURE A-43. TD FIXED FORMAT PORTION

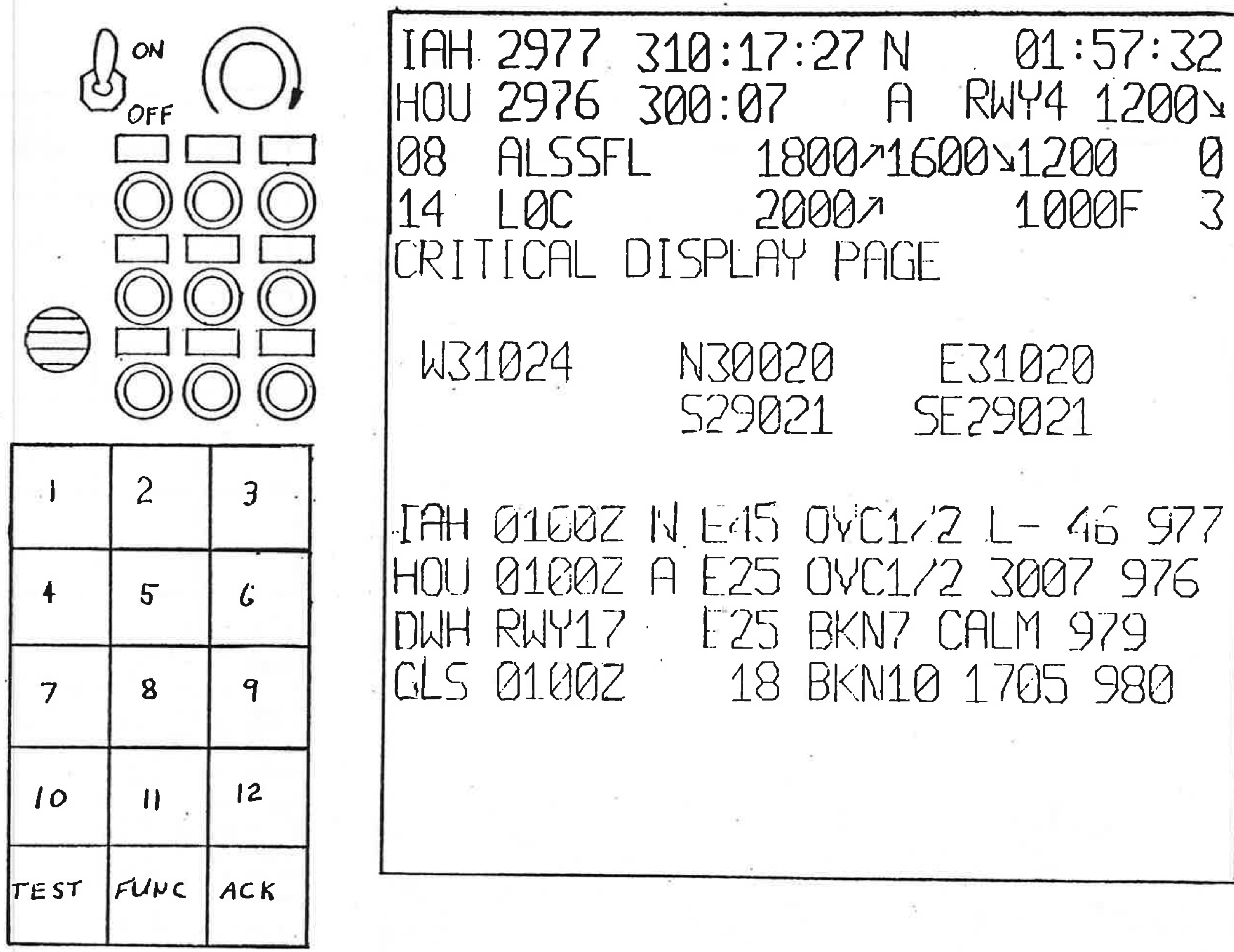


FIGURE A-44. TD CRITICAL DISPLAY WEATHER PAGE

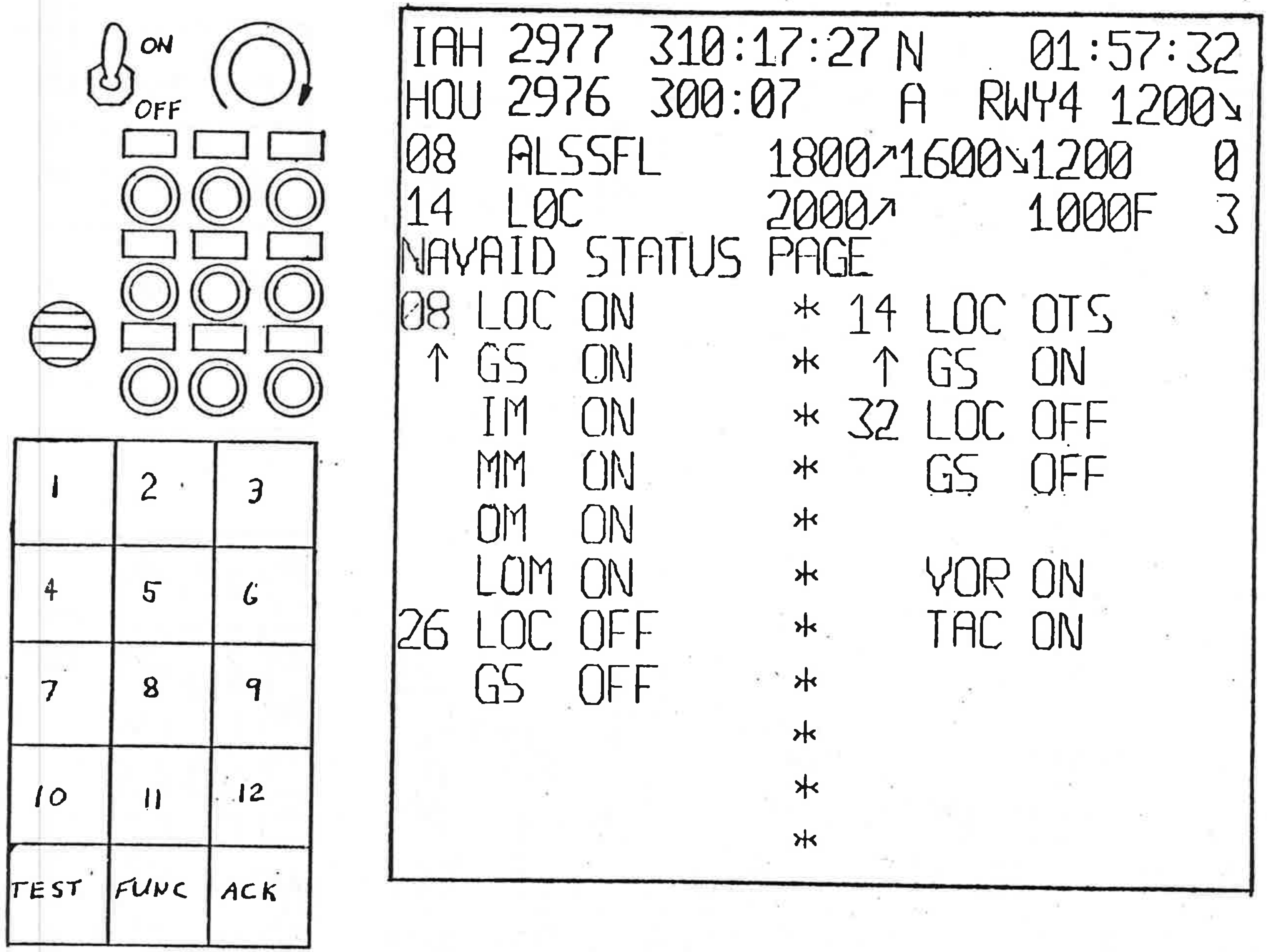


FIGURE A-45. TD NAVAID STATUS PAGE

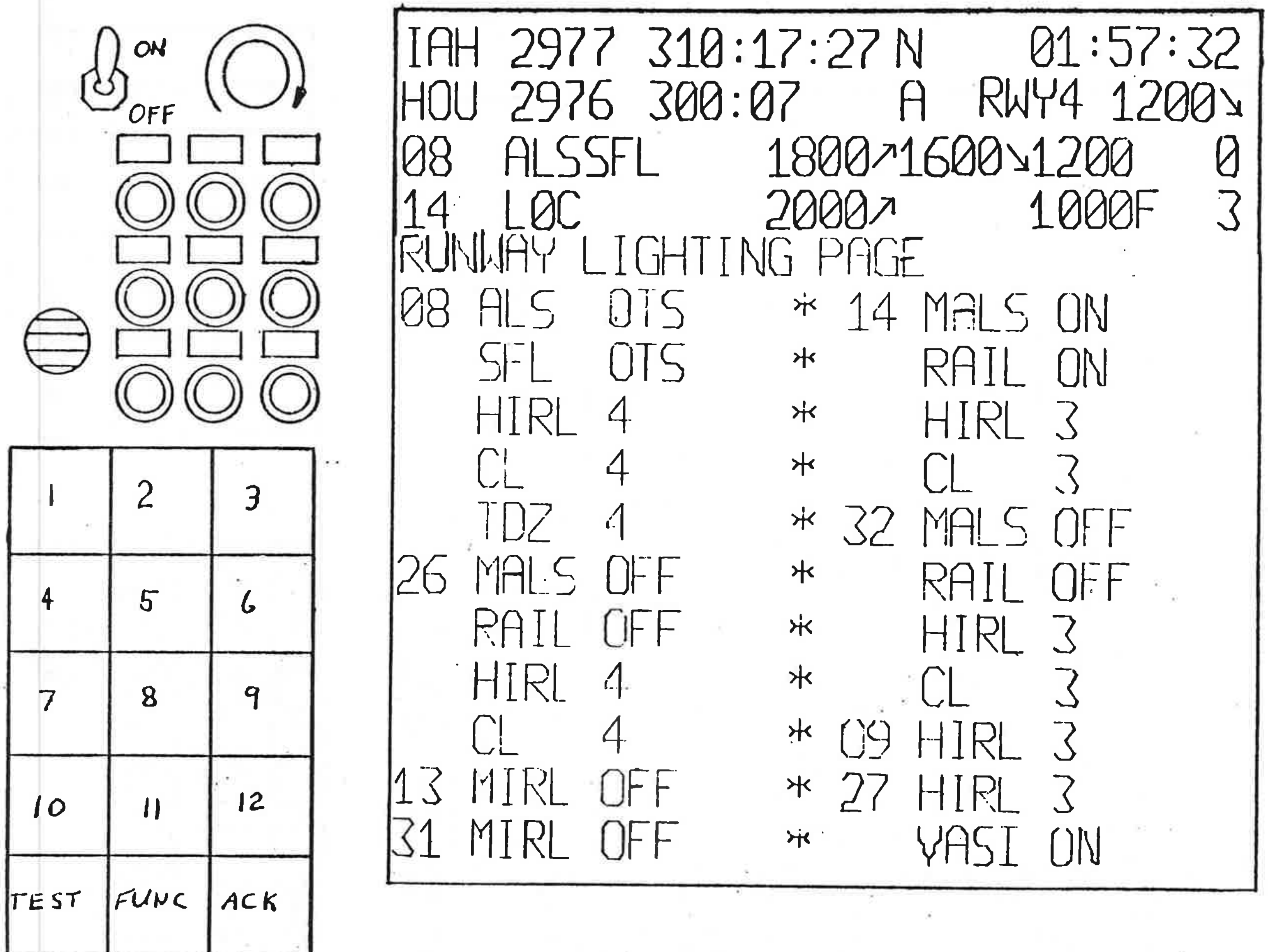


FIGURE A-46. TD RUNWAY LIGHTING PAGE

tion at IAH and GMT. The contents of each line are as follows (Figure A-43):

Line 1: airport designation/altimeter/wind direction, speed and gust speed/ATIS code/time.

Line 2: airport designation/altimeter/wind direction, speed and gust speed/ATIS code/runway 4 RVR.

Line 3 & 4: IAH runway number/status information/RVR/ALS setting.

The remaining 12 lines of the TD are for the individual pages. In this design, the first 5 pages of the TD are similar to the first 5 pages of the SD. The format of the RVR page and the Daily Log Page are identical to the corresponding SD pages and need to further discussion. There are differences between the SD and TD formats for the Critical Display Page, the NAVAID Status Page and the Runway Lighting Page. These are the following:

(1) Critical Display Page (Figure A-44). This page displays LLWSAS information and weather information for IAH, HOU, DWH and GLS. The format of the IAH, HOU and GLS weather reports are as follows: airport designator/time of report/ATIS code (HOU and IAH weather sequences only)/ Ceiling/Sky condition/Visibility/Precipitation/Wind (HOU and GLS weather sequences only)/Temperature (IAH weather sequence only)/Altimeter (last three digits only). The DWH report is the same as those for HOU and GLS, except the active runway is displayed instead of the time. These weather sequence formats are the same as those currently displayed on the closed circuit TV monitors in the TRACON.

(2) & (3) NAVAID Status Page (Figure A-45) and Runway Lighting page (Figure A-46).

These pages are of the same format as the corresponding SD pages except the TD formats do not have reverse video capabilities.

A.3.6.2.2 Controls - The TD controls are on the left side of the panel. They include a power switch, a brightness control knob, RVR threshold controls, page selection buttons, a test switch, function switch and an acknowledge button. The RVR threshold switches and the remaining TD controls operate in the same manner as the CD and SD, respectively.

A.3.6.2.3 Alarms - The TD alarms are the same as the SD alarms except outages shown on the TD are not highlighted by reverse video.

A.3.6.3 Variations from ER - The variations from the ER are the following:

(1) the presentation of a HOU data line on the fixed format portion of the TD.

(2) The location of time information on line 1 of the TD.

(3) The presentation of HOU, DWH and GLS weather reports on the Critical Display page.

A.3.6.4 Rationale for Variations from ER

(1) Any TRACON radar position may handle arrivals to HOU. Therefore, it is useful to have real time wind, altimeter, ATIS code and RVR information. Furthermore, HOU is often used as an alternate when weather conditions at IAH are below landing minimums. Currently, radar controllers get this information from the hourly weather reports displayed on the closed circuit TV or by calling HOU on the interphone for current readings. Providing this line of information does not displace other information needed by controllers. The ER specifies three lines of status information for individual runways. However, of runways 8, 26, 14 and 32, only two are active at a given time and radar controllers are not concerned with status information for the STOL runways, as these are used by VFR aircraft.

(2) Time information is presented to the right because it is used only when the ARTS is down (The ARTS is the primary source of time information for the TRACON controllers). This format makes the first 20 spaces of lines 1 and 2 similar to facilitate recognition.

(3) The HOU, DWH and GLS weather reports are currently displayed on the closed circuit TV monitors in the TRACON.. Providing them on the TD will make the information more accessible and eliminate the need for the TV monitors.

A.3.6.5 Critique of Design - Controllers comments that the TD should display current wind, altimeter and RVR for HOU, hence this variation of the ER specifications was developed. They also stated that time and IAH ATIS code are read from the ARTS and are only needed on the TD when the ARTS is down.

The Runway Lighting Page displays lighting intensity information on the STOL runways which may not be useful to TRACON controllers. It is shown here so the TD and SD pages have the same format. Since this information is of a "nice to know" nature for the radar controllers it could be deleted if the display space were needed for more important information. As noted the supervisors must enter the weather information to be displayed on the CCD equipment. As well as increasing his workload, there may be delays in entering the weather reports and the weather information may at times be over an hour old.

A.3.7 Summary

Tables A-3 and A-4 show the CCD equipment assignment at IAH and HOU, respectively. In the IAH cab, each active controller position is assigned an SD and all but FD/CD have a CD. Additionally, LC-1 has an LCP and the TS has an SMD. In the TRACON, all radar positions have a TD and the WS has an SMD. At HOU, all active controller positions have an SD and all but FD/CD have a CD. As with IAH, LC has an LCP and the TS has an SMD.

TABLE A-3. CCD EQUIPMENT ASSIGNMENT AT IAH

CAB:	CD	SD	LCP	SMD	TD
TS				X	
LC-1	X	X	X		
LC-2	X	X			
GC	X	X			
FD/CD		X			
TRACON:					
WS				X	
DR-E					X
AR-E					X
IAH-F					X
AR-W					X
DR-W					X
HOU-F					X
S/SR					X

TABLE A-4. CCD EQUIPMENT ASSIGNMENT AT HOU

	CD	SD	LCP	SMD
TS				X
LC	X	X	X	
HR	X	X		
GC	X	X		
FD/CD		X		

The main concerns apparent from the CCD analysis at IAH and HOU are the following:

(1) The limited flexibility of the CD. Even minor changes, such as reducing the seconds characters on Line 1, require extensive rewiring.

(2) HOU not fully utilizing its CD. Towers without LLWSAS and limited RVR may not justify installation of CDs.

(3) Controller concern regarding redundant or unnecessary alarms. Alarms should occur on a position SD only if not presented on CD. They should occur for important outages, such as ILS or LLWSAS, not minor ones, such as entries on the "Daily Log Page".

(4) The presentation of information not useful to controllers. Excessive information clutters displays and inhibits recognition of important data. Care must be taken to minimize less useful data, such as status of standby ILS components.

(5) Problems with the display of only three runways on the LCP. This requires considerable controller/supervisor action or several LCPs to adjust runway lights and monitor status of inactive runways.

(6) The increased supervisor workload to enter information into the system. Installing an SMD at the WSFO would reduce supervisor entries considerably, as it appears a great deal of time will be necessary to edit and enter weather reports.

(7) The possible delay in entering weather information to the CCD. Again, this would be reduced if entered directly by the WSFO.

(8) The lack of RVR threshold controls on the SD. The SD would be an acceptable alternative to the CD, at smaller airports, if controllers could individually set the RVR thresholds on the SD. As the SD is presently designed,

the supervisor programs the alarm thresholds from his SMD. The present design may not be acceptable because during poor visibility conditions, controllers adjust the threshold as often as once a minute (and different positions use different settings for the same RFR sensor).

A.4 TIDS INSTALLATION

The installation of the TIDS displays at the IAH cab and TRACON and the HOU TRACAB is discussed in this section. Installations that cause minimal disturbance to existing consoles as well as ideal locations are considered. The locations were determined through the analysis of how the controllers use information that is available to them, the characteristics of the displays as defined in the ER specifications and interviews with facility personnel. Preliminary installations were developed for each position in the cab, TRACAB and TRACON. These were evaluated by placing mockups at selected positions. The layouts were discussed with controllers supervisors and Airway Facilities (AF) personnel. Different alternatives were considered and revisions were made as a result of the data collected.

The following constraints were assumed under the minimal disturbance conditions:

(1) Where feasible, present equipment remains at all consoles where it is now located. This allows their use as backups when necessary. In some situations, present equipment is removed if the same device is accessible at another position.

(2) Where feasible, TELCO equipment is not moved. If moved, it is moved only a short distance to minimize rewiring.

The following constraints were assumed under the ideal conditions:

(1) Equipment replaced by the TIDS equipment (FDEPs, wind instruments, clocks, altimeters, RVRs, LLWSASs) is removed from the consoles.

(2) Movement of TELCO equipment is minimized.

In installing the TIDS equipment an effort was made to achieve the following:

(1) Standardizing display layouts, so that there is a similarity between positions (at least, within a given facility). This allows a more rapid adjustment to a position as controllers rotate during their shifts. The ideal installation would be the FDD, CD and SD in a left to right layout. This enables the controller to scan the displays for information. First he would read Flight Data information, then get critical weather, time or status information and finally glance at the SD for other information.

(2) Installing the keyboard so that it was near the lower right of the FDD. Thus, a controller knows approximately where the keyboard is located without looking and it is available to the right hand of the controller.

(3) Locating displays so that left to right head movement is required, instead of up/down head movement, as less physical effort is required. This was emphasized by controllers and AF during interviews concerning display console designs and is consistent with good human factors principles of design. Both groups stated lateral head movement are preferable as they require less effort and, thus, are less tiring. Furthermore, overhead displays require considerable head movement when bifocals are worn.

(4) Minimize reach required to operate displays. This involves locating each display so that it can be accessed from the controller's usual location at the position without requiring movements of the operator's torso.

(5) Locate the FDD so that it is near the center of the position. For most positions, this is the most important of the TIDS displays and should be the most accessible.

(6) Locate the displays so that they can be scanned in a standard left to right direction from the most important displays to those of lesser importance.

(7) Place displays so that they are perpendicular to the line of sight of the controller from the usual standing or sitting position, without obstructing necessary visibility outside the tower. This means that controllers that usually stand at their position (IAH-GC, LC-1 and LC-2; HOU-FD/CD) have displays presented at smaller angles from horizontal than those that normally sit (IAH-FD/CD and all TRACON; HOU-HR and LC).

(8) Place FDD so that it is near BRITE.

A.4.1 IAH Cab Installation

In the cab and TRACAB installations, the TIDS displays are shown so they are perpendicular to the line of sight of where the controllers is normally positioned. In the final installation, however, these will probably be adjustable (swivel mounted) so controllers can tilt them depending on personal preference. Although not shown in these displays, it is assumed a mount will be placed near each FDD, for the hand controls (reference Section A.2.1).

A.4.1.1 Minimal Disturbance - Figure A-47 shows the locations of the TIDS equipment in the cab under minimal disturbance conditions. Each of the active controller positions is assigned its own FDD and keyboard, FD/CD has an SD but no CD, the two local controllers share a CD and SD and LC-1 assigned an LCP.

(1) FD/CD (Figure A-48).

In this design, the flight strip racks are removed and the FDD is set on the console in their place. The TELCO speaker is left behind the FDD. The keyboard is installed on the flat portion of the console in front and to the right of the FDD (it is offset to the right to avoid moving the TELCO jack). The FDEP is

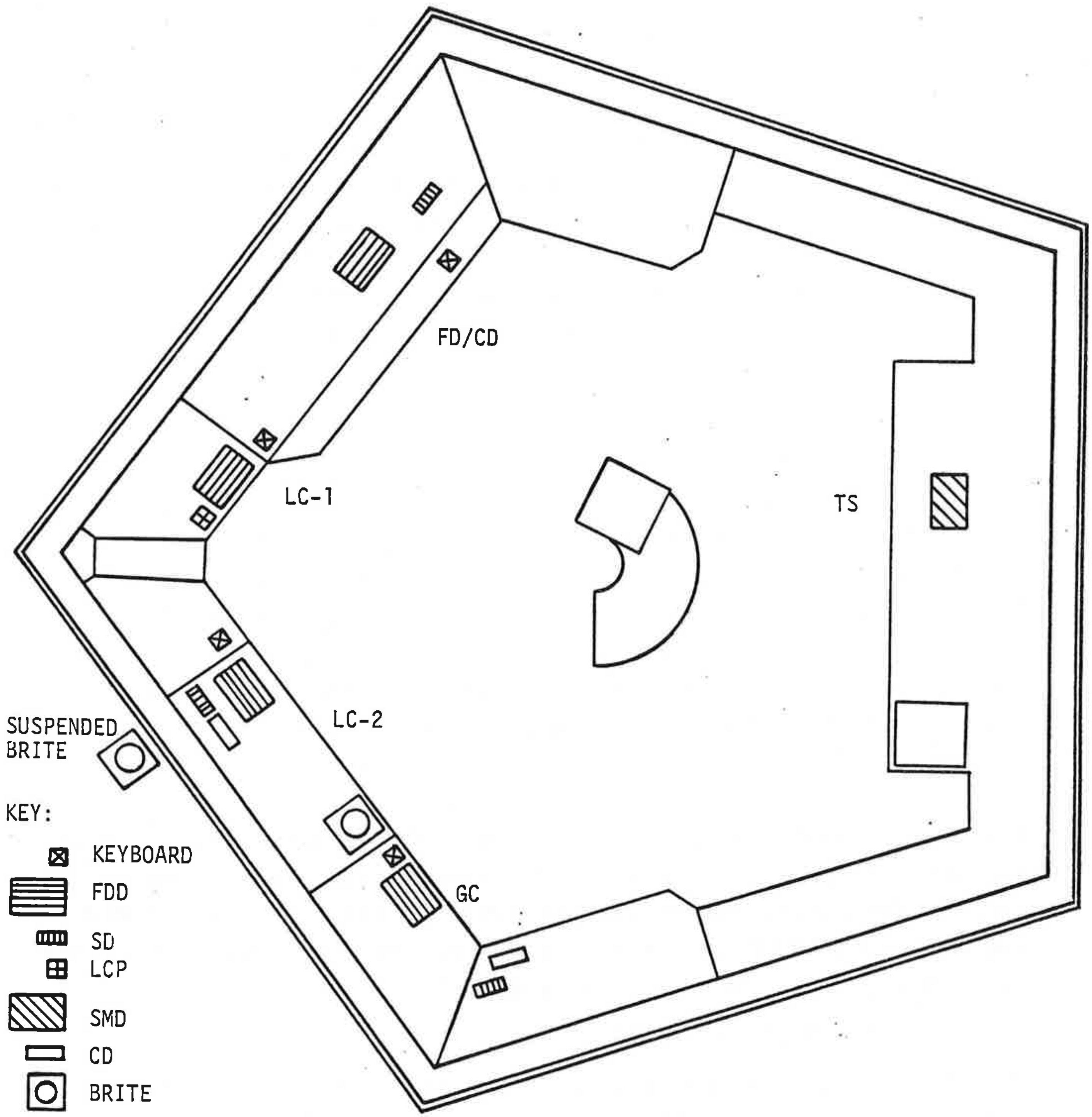


FIGURE A-47. MINIMAL DISTURBANCE TIDS LOCATIONS AT IAH CAB

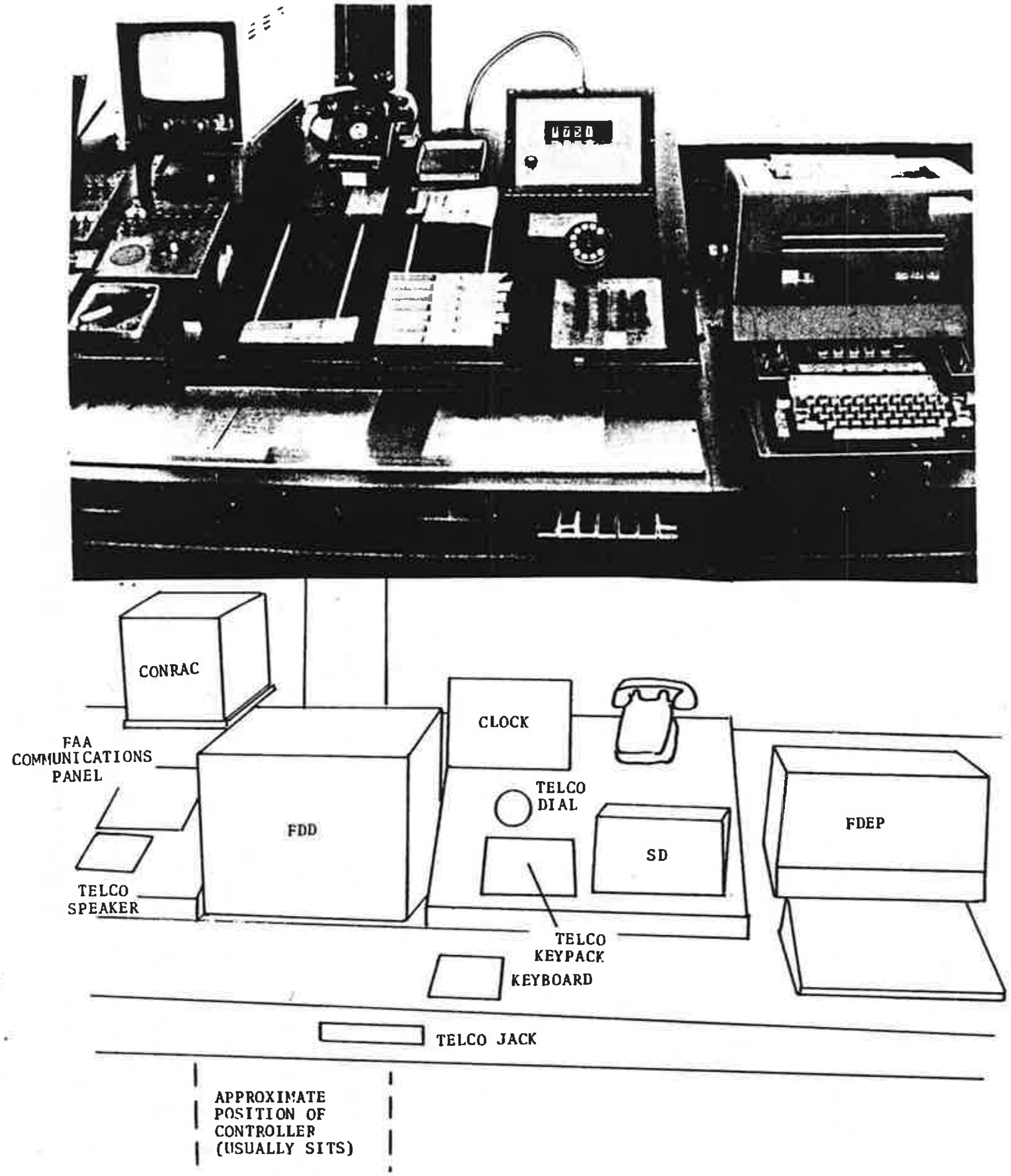


FIGURE A-48. MINIMAL DISTURBANCE TIDS INSTALLATION AT IAH FD/CD moved to the right approxiamtely one foot and the sloping portion of the console is extended to provide room for the SD. The telephone is repositioned on the console behind the SD.

Disadvantages of arrangement:

- o FDEP must be relocated.
- o Sloped portion of console must be extended.
- o Telephone must be relocated.
- o FDD and SD not side by side, so head movement to scan display is not minimized.

Advantages of arrangement:

- o FDD is centrally located at position.
- o FDD and SD screens viewable and accessible to seated controller.
- o FDEP accessible as a backup.

(2) LC (Figure A-49).

In this design, the flight strip racks are removed and the FDD is installed, sloping up at a slightly steeper angle than the console. The TELCO speaker is moved toward the back of the console so the keyboard can be placed to the right of the FDD.

Disadvantages of arrangement:

- o LC-1 shares CD and SD with LC-2.
- o FDD not adjacent to BRITE, requires greater head movement to scan both displays.
- o TELCO speaker must be relocated.

Advantages of arrangement:

- o FDD is readable and accessible to standing controller.
- o FDD located where flight data information currently obtained.

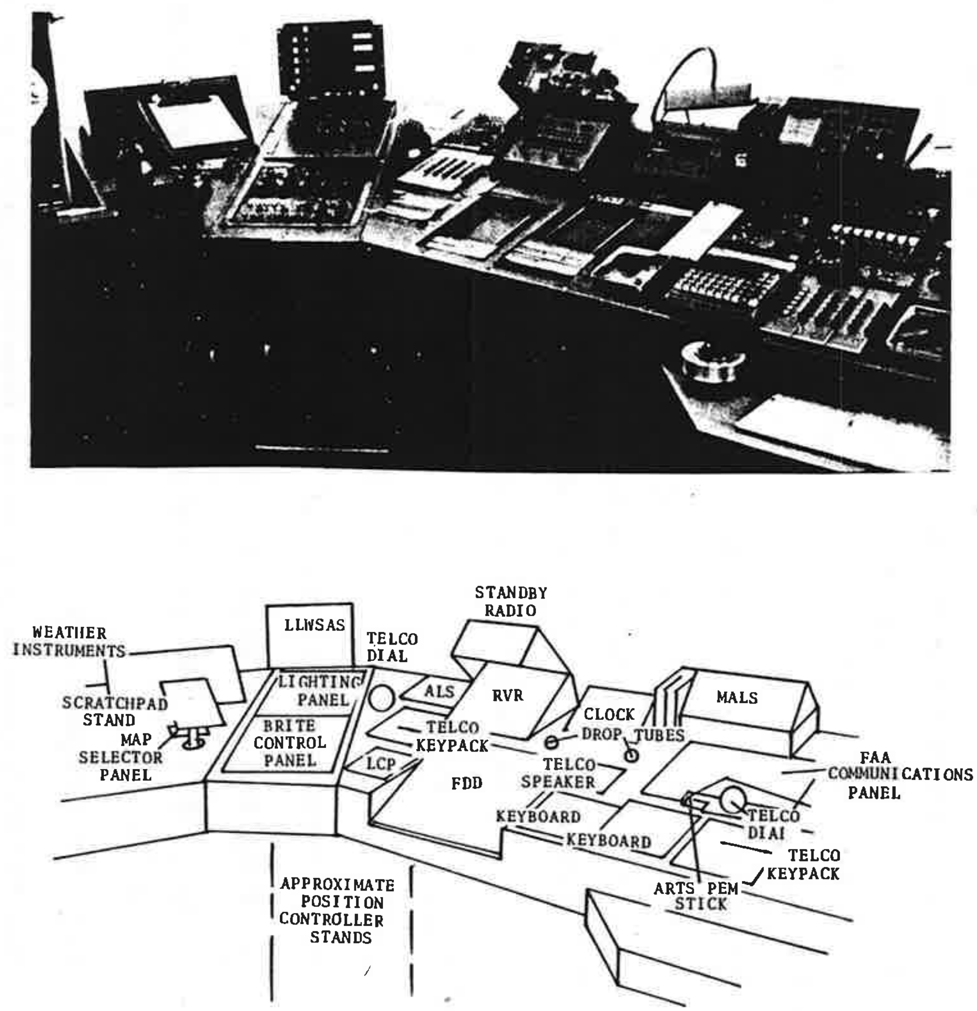


FIGURE A-49. MINIMAL DISTURBANCE TIDS INSTALLATION AT LC-1

- o Requires only minimal disturbance of present equipment, only a TELCO speaker is repositioned to accommodate the keyboard.
- o Cost savings as a result of shared CD and SD.
- o FDD located near where controller frequently looks out window of cab to monitor aircraft.

(3) LC-2 (Figure A-50).

The BRITE display is placed on an overhead rack and the FDD, CD, SD and keypack are below it as shown. The FDD is placed at a slightly steeper angle than the console. The CD and SD are placed behind the FDD. The keyboard is placed to the right of the FDD.

Disadvantages of arrangement:

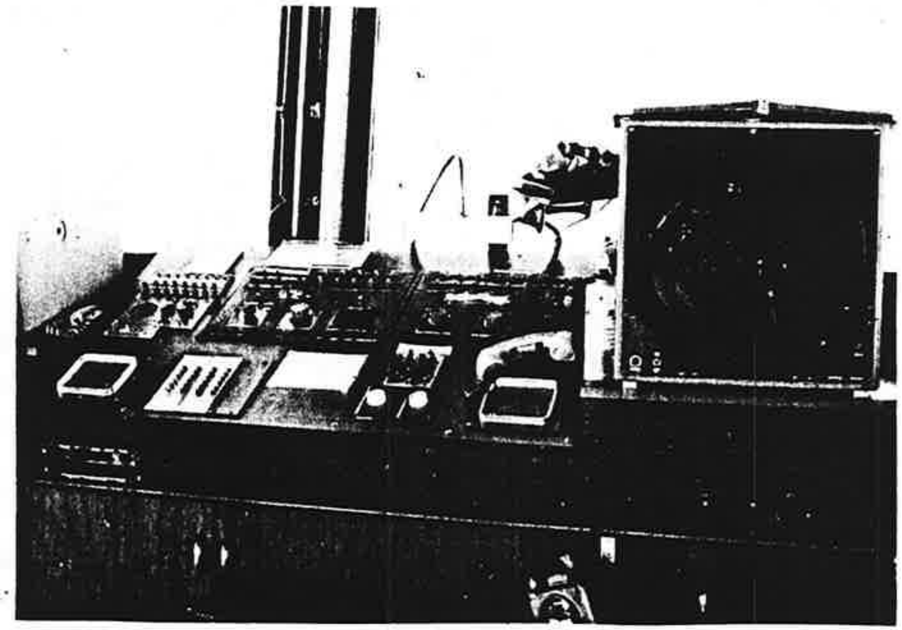
- o BRITE located overhead - requires significant head motion to scan displays and brightness accommodation because of background illumination.
- o LC-2 and LC share CD and SD.

Advantages of arrangement:

- o No disturbance of TELCO equipment.
- o Minimal disturbance of present equipment.
- o Displays readable and accessible by standing controller.
- o CD, SD and FDD all colocated for efficient scanning by LC-2.

(4) GC (Figure A-51).

The TELCO keypacks are moved approximately six inches to the left and the FDD and keyboard are placed into the console below the weather cluster. The scratch pad stand is moved left a few inches. The analog altimeter is removed (or relocated on the left side of the console) and the SD and CD are placed to the right and below the FAA communications panel, respectively. The TIDS equipment is sloped up slightly from the console to permit efficient viewing by a standing controller.



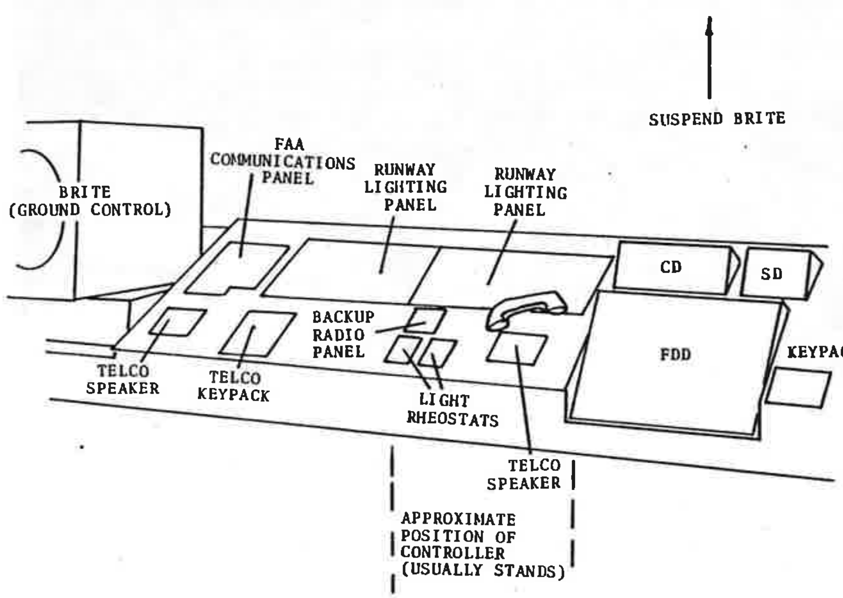


FIGURE A-50. MINIMAL DISTURBANCE TIDS INSTALLATION AT LC-2

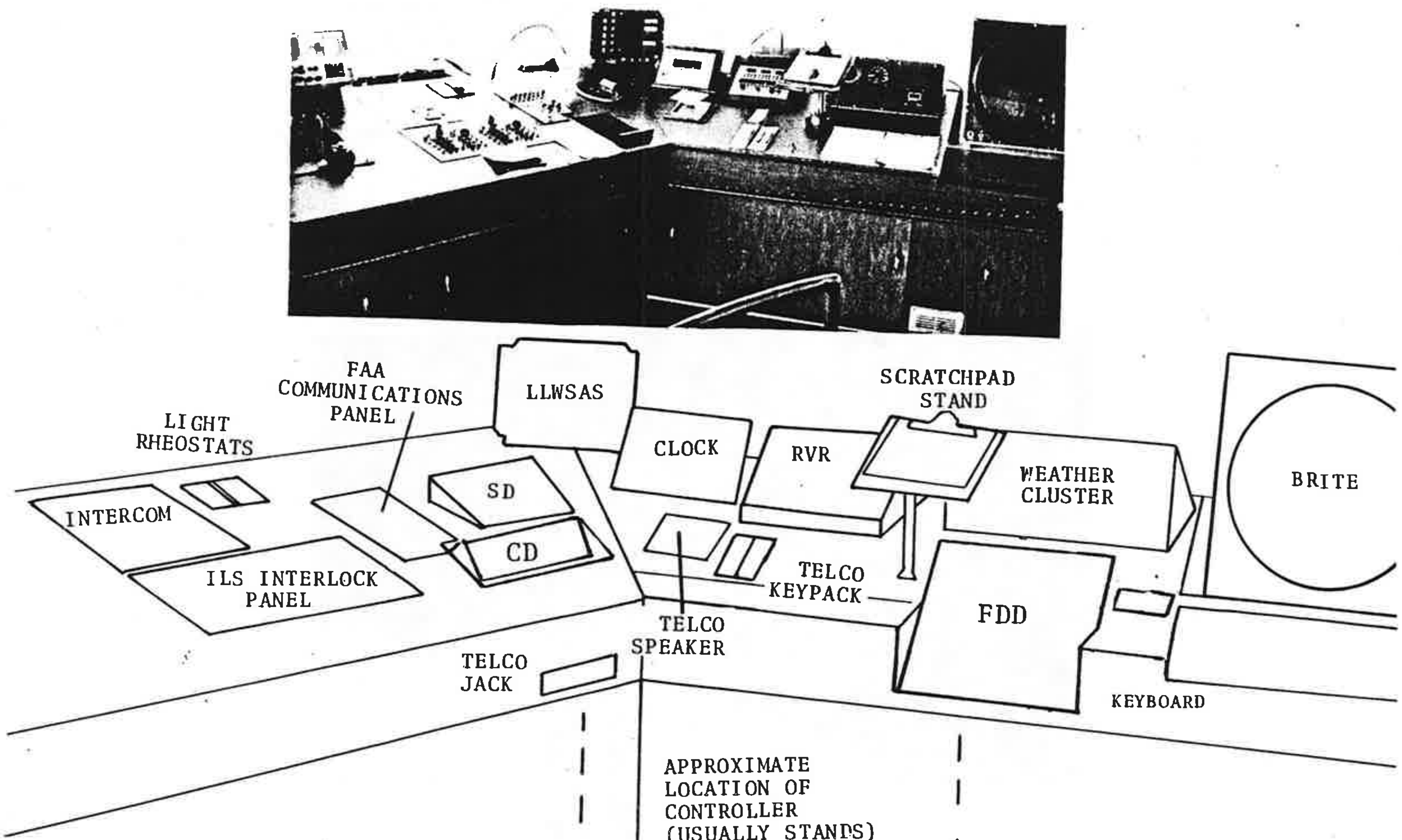


FIGURE A-51. MINIMAL DISTURBANCE TIDS INSTALLATION AT GC

Disadvantages of arrangement:

- o Displays not located near enough to one another to permit efficient scanning.
- o TELCO keypack must be relocated.

Advantages of arrangement:

- o FDD adjacent to BRITE for efficient scanning.
- o Displays readable and accessible by standing controller.
- o FDD located low in console and so sheltered from sunlight.

(5) TS (Figure A-52).

The SMD is placed on the TS desk. It is centrally located to where he is usually positioned.

Disadvantages of arrangement:

- o TS moves around cab during shift and may have to return to the desk to operate the SMD.

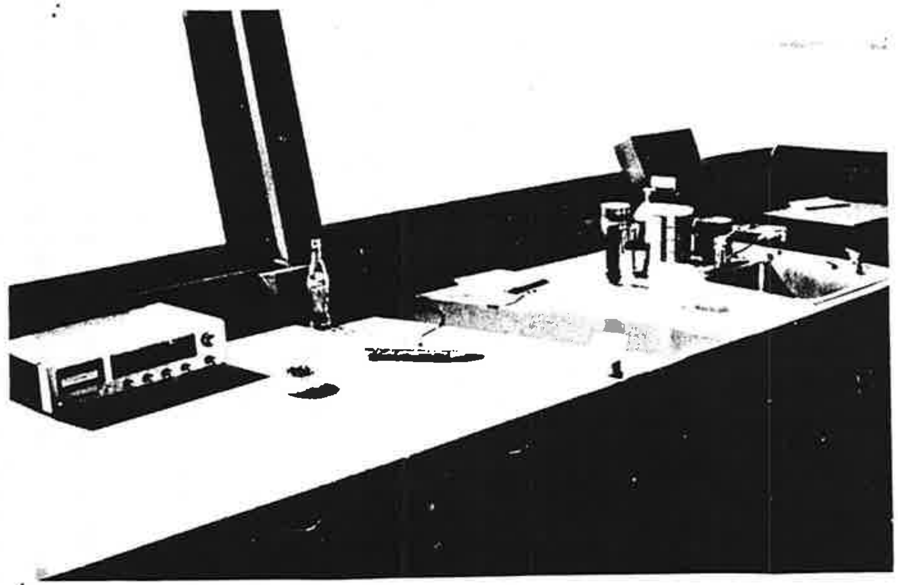
Advantages of arrangement:

- o In front of post to minimize blocking view outside the cab.
- o Minimal disturbance of present equipment.
- o SMD not permanently installed, can be relocated if desired.
- o Area for supervisor to work beside SMD.

A.4.1.2 Ideal - Figure A-53 shows the locations of the TIDS equipment in the cab under ideal conditions. In this design, each active controller position except FD/CD has an FDD, keyboard, CD and SD. FD/CD has only an FDD, keyboard and SD. Location of equipment are as similar as possible among the positions to promote efficiency of use as the controllers rotate through these work stations.

(1) FD/CD (Figure A-54).

The FDEP is removed and the locations of the TELCO keypack and dial and the SD are reversed as compared with the minimal dis-



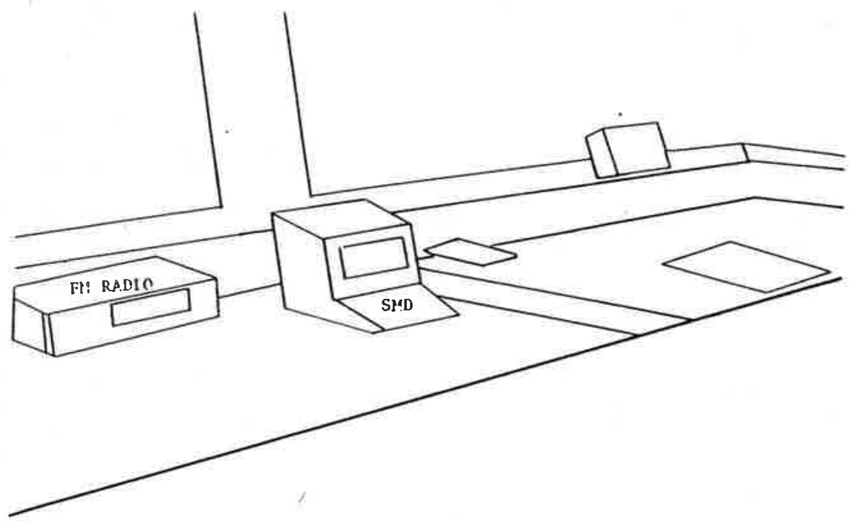


FIGURE A-52. SMD INSTALLATION AT IAH T.S. DESK

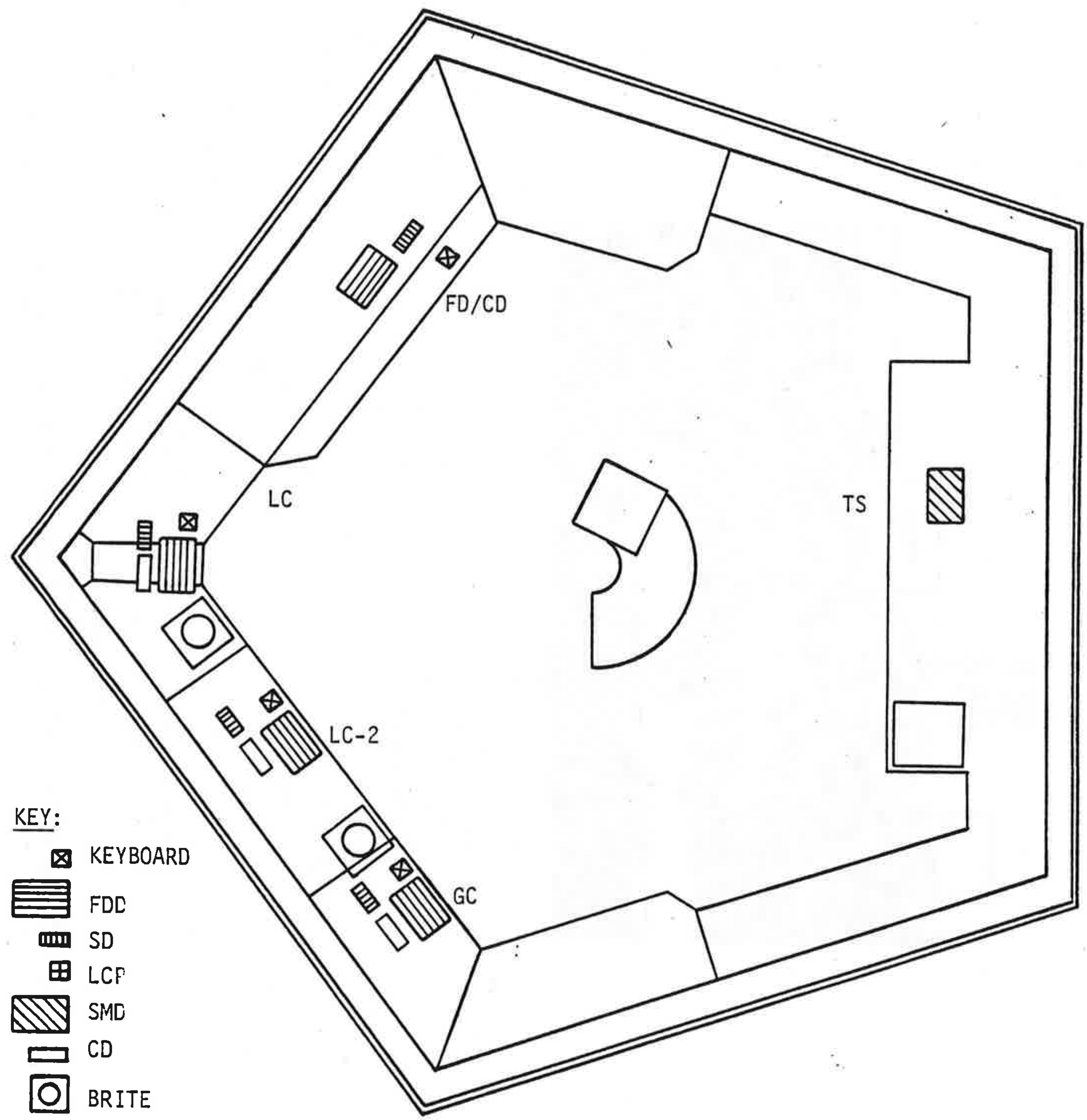
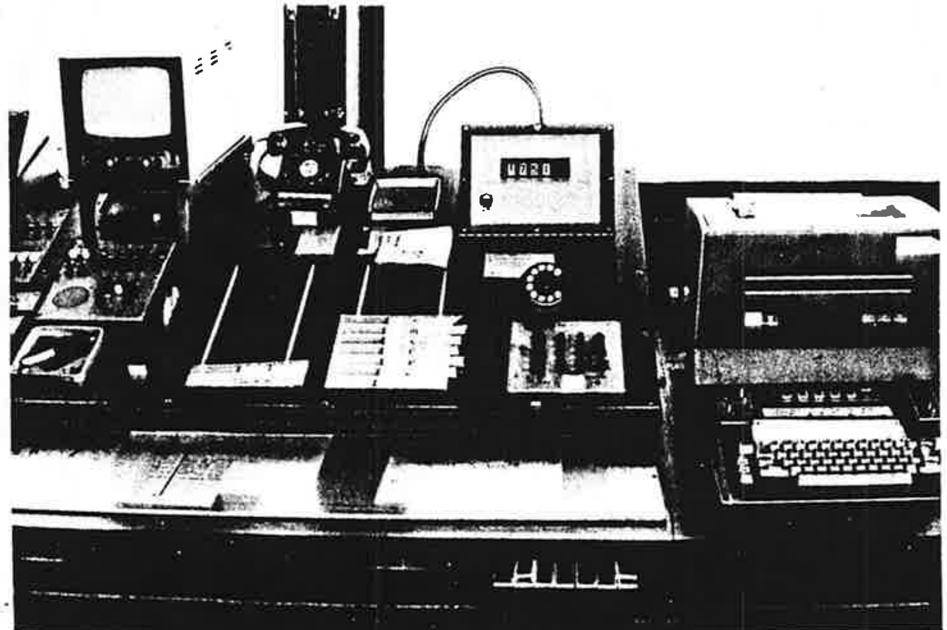


FIGURE A-53. IDEAL TIDS LOCATIONS AT IAH



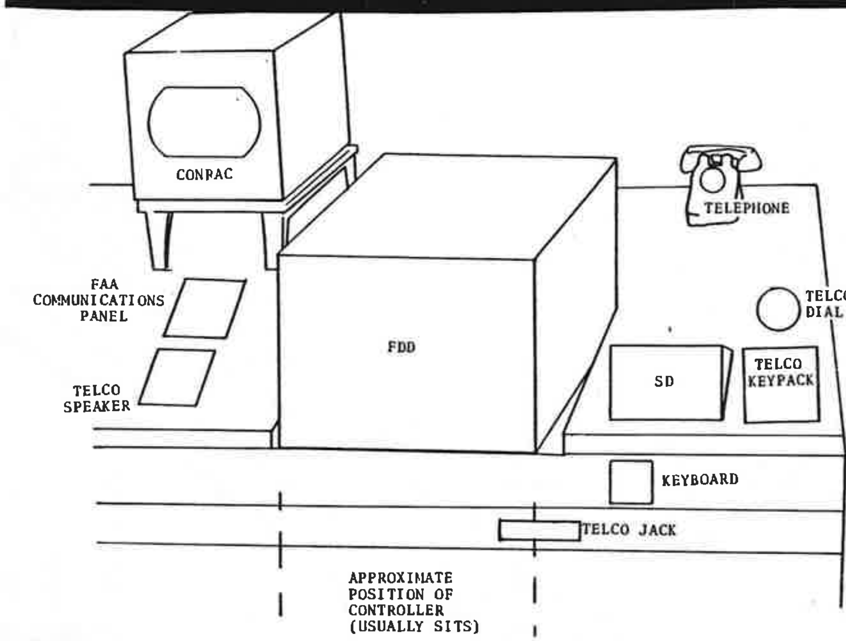


FIGURE A-54. IDEAL TIDS INSTALLATION AT IAH FD/CD turbance installation. The FDD and keyboard are left as installed under minimal disturbance conditions.

Disadvantages of arrangement:

- o Relocation of TELCO equipment required.

Advantages of arrangement:

- o Displays readable and accessible by sitting controller.
- o FDD and SD colocated for efficient left to right scanning by seated controller.
- o TELCO equipment clustered in one part of console.

(2) LC-1 (Figure A-55).

In this design, the BRITE is moved approximately 16 inches to the right. The weather instruments, LLWSAS, ALS panel, MALS panel, RVR and clock are removed. The taxiway lighting panel is moved to the right. The TELCO dial and keypack are moved lower on the console and to the left of the TELCO speaker. The map selector panel and the light rheostat are moved a few inches to the left and right respectively. The BRITE controls are moved to the LC-2 position (refer to Figure A-56). The FDD is placed to the right of the BRITE and the CD and SD are placed above it. The keyboard and LCP are to the right of the FDD.

Disadvantages of arrangement:

- o Significant modification of console is required.

Advantages of arrangement:

- o FDD located near BRITE.
- o TIDS displays located to provide efficient left to right and up/down scanning.
- o All displays are readable and accessible to standing controller.
- o Displays centrally located at position.
- o BRITE controls remain located near BRITE.

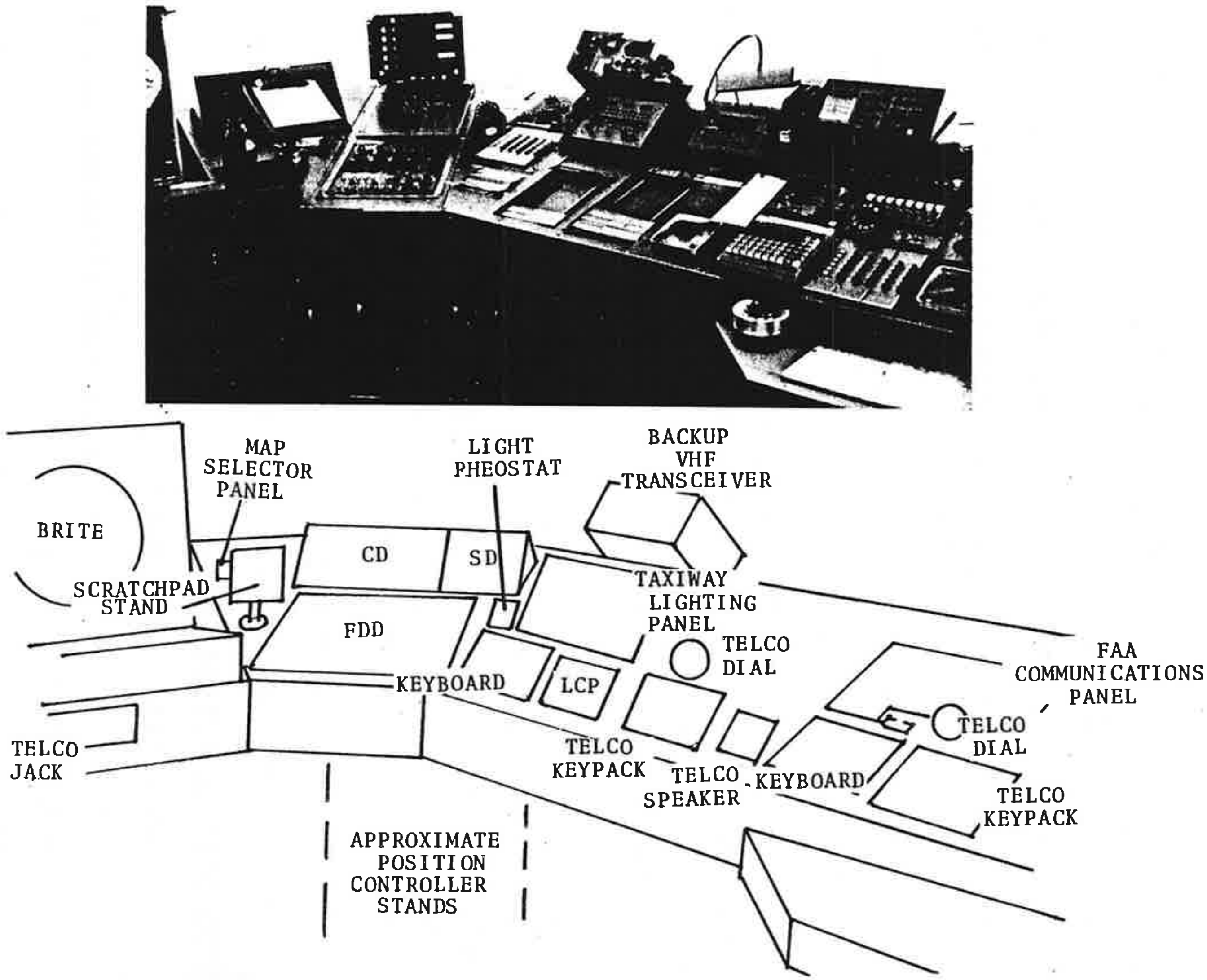
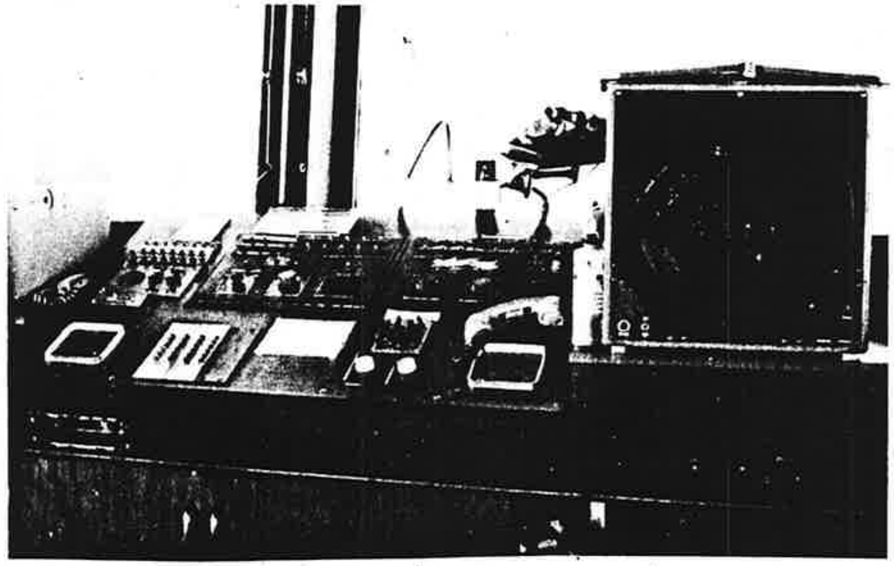


FIGURE A-55. IDEAL TIDS INSTALLATION AT IAH LC-1



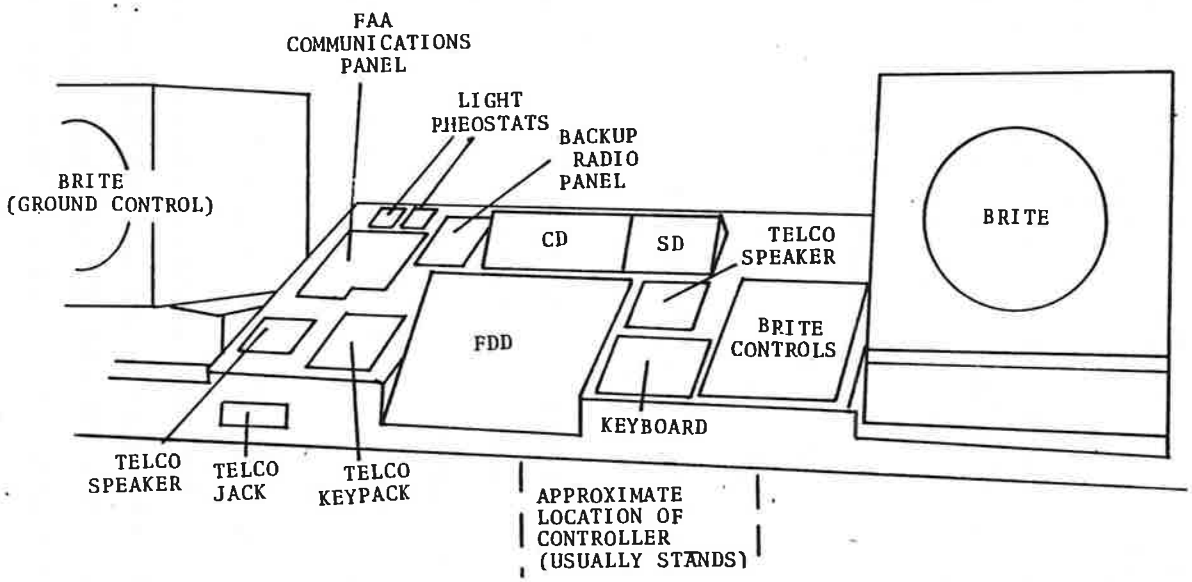


FIGURE A-56. IDEAL TIDS INSTALLATION AT IAH GC

(c) LC-2 (Figure A-56).

The runway lighting control panels are removed and the back-up radio selector panel and light rheostats are moved further back on the console. The right TELCO speaker is moved higher on the console. The FDD, keyboard, CD and SD are installed as shown adjacent to the BRITE control panel. Since LC-2 is staffed less often than LC-1, it is less important for this position's FDD to be near the BRITE than LC-1's. Therefore, it was decided to install the BRITE control panel at LC-2, making it necessary for the FDD to be placed slightly further away from the BRITE.

Disadvantages of arrangement:

- o Requires significant modification of console.
- o FDD not adjacent to BRITE.

Advantages of arrangement:

- o Displays readable and accessible to standing controller.
- o Displays located to provide efficient left to right and up/down scanning by standing controller.
- o Only one TELCO item is moved.
- o BRITE controls located near BRITE.
- o Allows LC-1's FDD to be located adjacent to BRITE.

(4) GC (Figure A-57).

The RVR and weather cluster are removed. The FDD and keyboard are located as installed under minimal disturbance conditions. The CD and SD are installed where the RVR and weather cluster were previously. The scratch pad stand is moved to the left part of the console.

Disadvantages of arrangement:

- o Slight relocation of TELCO keypack may be required.

Advantages of arrangement:

- o TIDS displays adjacent to BRITE.

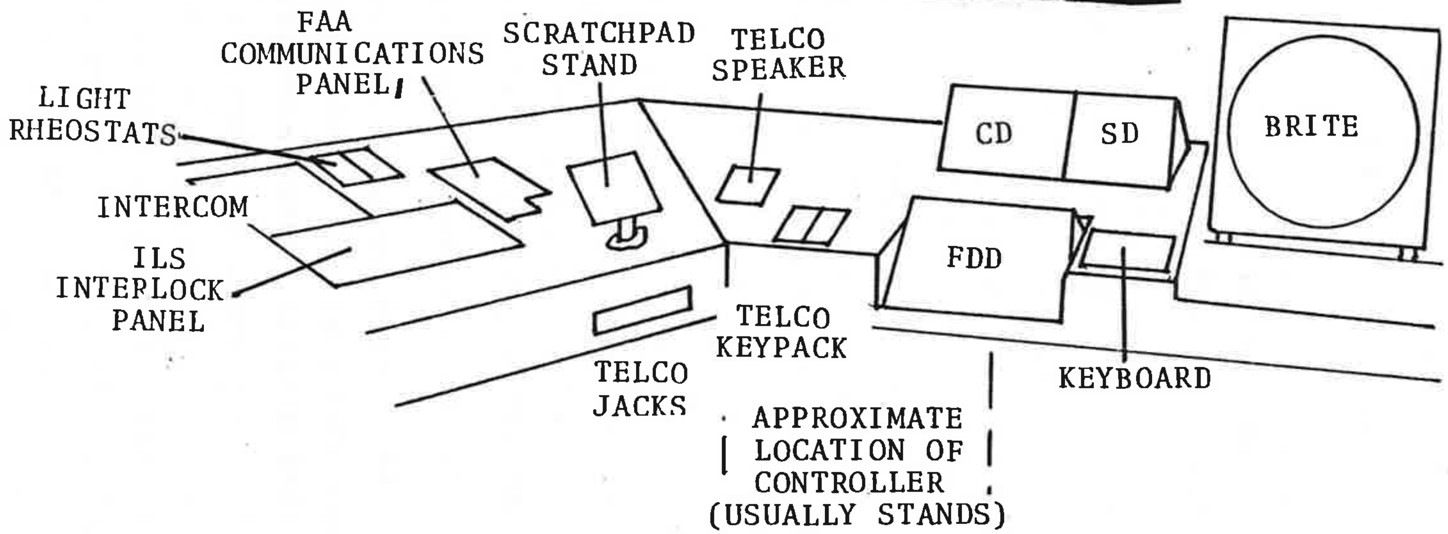


FIGURE A-57. IDEAL TIDS INSTALLATION AT IAH GC

- o Displays readable and accessible to standing controller.
- o Displays positioned for efficient left to right and up/down scanning by standing controller.
- o Little movement of existing equipment is necessary, primarily the removal of devices TIDS replaces.

(5) TS

Same installation as under minimal disturbance conditions. (Reference Figure A-52).

A.4.2 IAH TRACON Installation

Installation of the TIDS equipment in the IAH TRACON is discussed in this section. The devices installed in the TRACON include the TD, FDD and SMD. Example installations are discussed under minimal disturbance and ideal conditions. Each of the radar positions with upright screens are standard with only minor differences. Therefore, a representative position is discussed under minimal disturbance and ideal conditions.

A.4.2.1 Minimal Disturbance - Figure A-58 shows the locations of the TIDS equipment in the TRACON under minimal disturbance conditions. Each radar position is assigned an FDD, keyboard, and TD; and the Watch Supervisor (WS) is assigned an SMD.

(1) Radar Consoles (Vertical ARTS, Figure A-59).

The example shown is the console for Arrival West. In this design, the position information panel is moved to the left, and the wind display, wind instruments, altimeter and clock are moved to the upper panel as shown. The FDD is installed above the ARTS and the TD is adjacent to the FDD on its right. The keyboard is placed below the TELCO keypack on the right. It is slightly raised on the console because of the TELCO jack underneath it and it is angled towards the seated controller.

This installation is similar for HOU Final, Departure West, IAH Final, Departure East and Arrival East. The differences are:

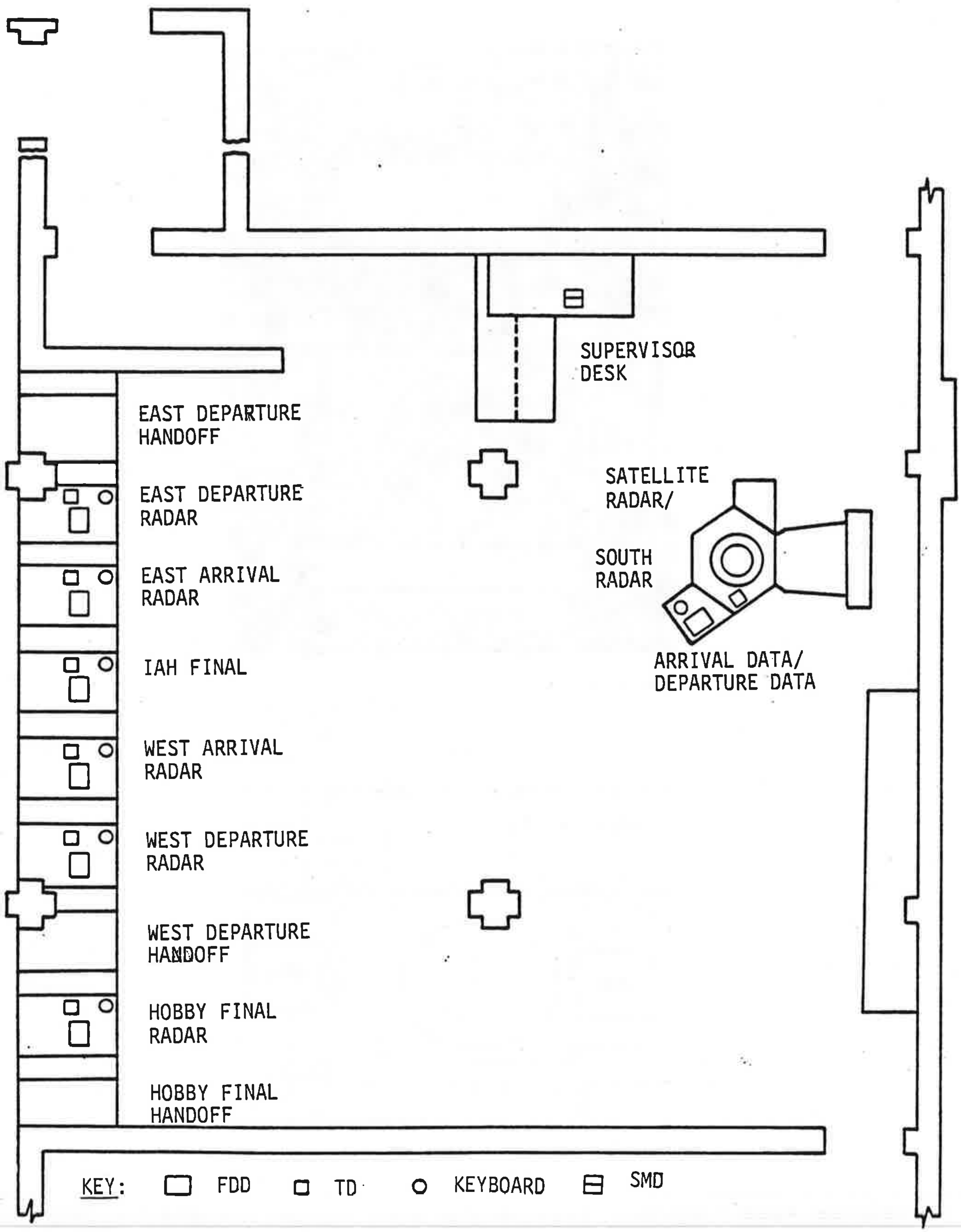


FIGURE A-58. MINIMAL DISTURBANCE TIDS LOCATIONS AT IAH TRACON

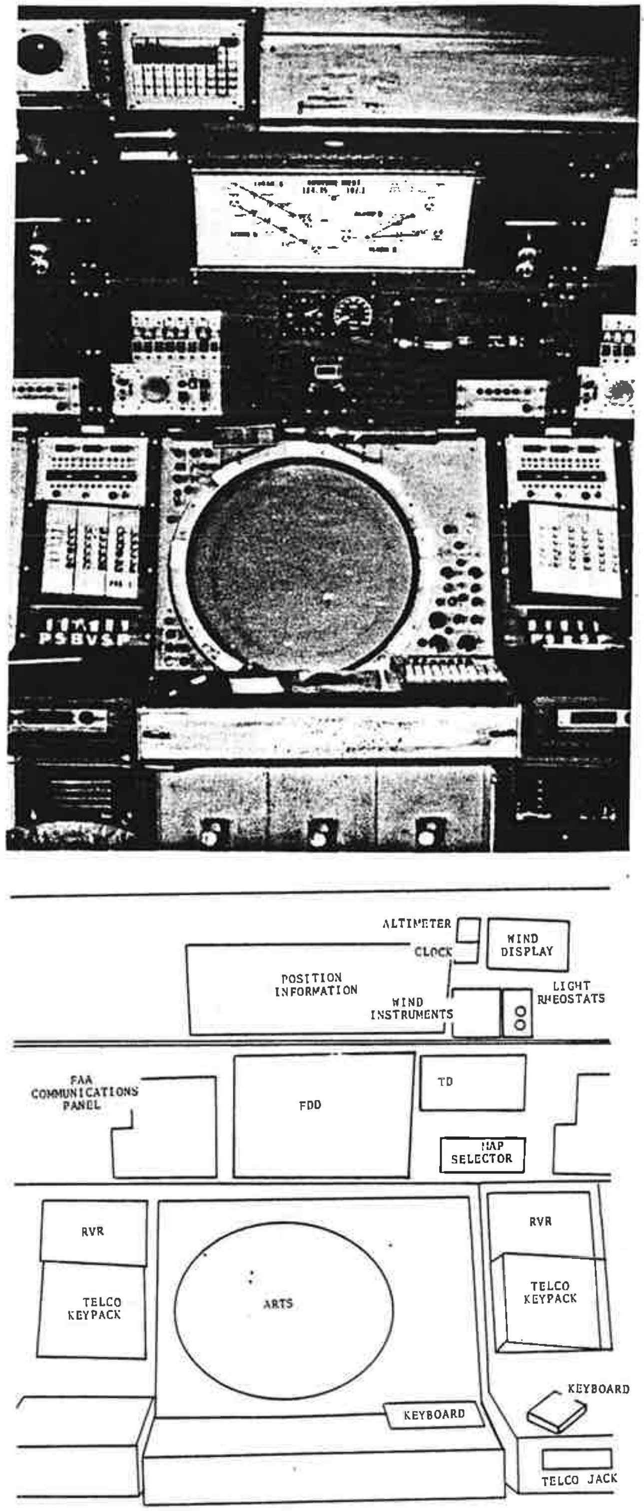


FIGURE A-59. MINIMAL DISTURBANCE TIDS INSTALLATION AT TRACON RADAR POSITION (VERTICAL ARTS) at HOU Final, only a clock is moved; at Departure West, only a clock and altimeter are moved; at IAH Final, only an ILS indicator panel and altimeter are moved; and at Departure East an altimeter, clock, and FAA communications panel are moved (the latter position has a larger FAA communications panel because it is the consolidated position during the mid shift).

Disadvantages of arrangement:

- o A long reach is required to manipulate FDD and TD controls.
- o Considerable up and down head movement is required to scan ARTS, FDD and TD, well beyond the range considered comfortable by most human factors engineers.
- o At Departure East, a long reach is required to adjust the radio selector panel.
- o The ARTS keyboard and FDD keyboard are located side by side, creating the possibility of inadvertently operating the wrong one.

Advantages of arrangement:

- o Displays readable and accessible by seated controller.
- o Efficient left to right scanning of FDD and TD.
- o No movement of TELCO equipment.
- o Minimal disturbance of present equipment.
- o FDD located centrally in console.
- o Relocated equipment (except radio panel at Departure East) are display devices, requiring little manipulation. Thus, the requirement for reaching to highest panel is minimized.
- o Raised FDD keyboard reduces chance of inadvertently selecting wrong one.

(2) Satellite/South Radar (Figure A-60).

In this design, the part of the console containing the ARTS keyboard is widened and extended slightly, and the FDD and TD are mounted upright as shown. The ARTS keyboard is moved to the edge

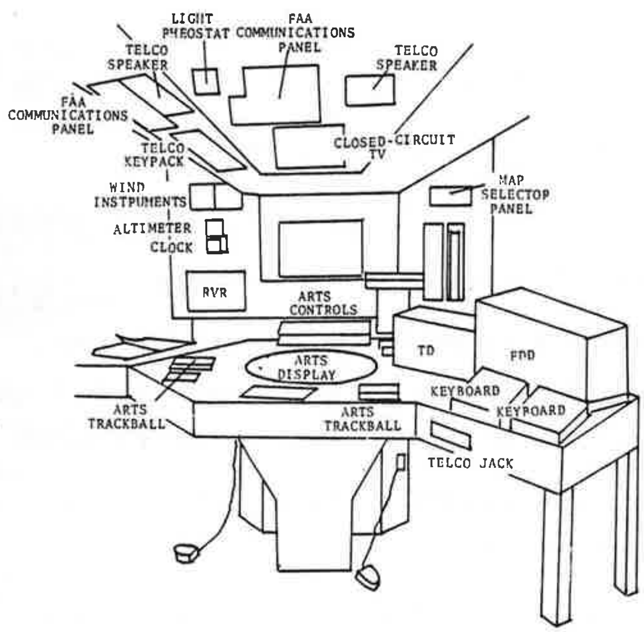


FIGURE A-60. MINIMAL DISTURBANCE TIDS INSTALLATION AT SATELLITE SOUTH RADAR (HORIZONTAL ARTS) of the console and the TIDS keyboard for the FDD is mounted on its right. The FDD is mounted higher than the keyboard so the push buttons on the FDD are accessible. This position is usually staffed by a single controller. If additional staffing becomes more frequent, a similar set-up would be necessary on the left "arm" of this console.

Disadvantages of arrangement:

- Lack of a hand rest near keyboards.
- Controller must switch eye focus from horizontal ARTS to vertical FDD and TD screens when scanning displays.
- TD located to left of FDD, opposite of minimal disturbance installations at other TRACON positions.

Advantages of arrangement:

- Displays readable by seated controller.
- Minimal disturbance of existing equipment.
- FDD, TD and keyboard easily accessible.
- TIDS equipment colocated.

(3) Watch Supervisor (Figure A-61).

In this design, the storage bins are removed and relocated (such as behind the WS desk). The SMD is installed in this area, to the right of the WS seated at the desk.

Disadvantages of arrangement:

- Requires relocation of storage bins.

Advantages of arrangement:

- Does not interfere with Supervisors vision of controller positions or entrance to TRACON.
- Easily accessible by seated Supervisor.

A.4.2.2 Ideal - Figure A-62 shows the locations of the TIDS equipment in the TRACON under ideal conditions. Equipment assignment is the same as under minimal disturbance conditions, with each

FIGURE A-61. MINIMAL DISTURBANCE TIDS INSTALLATION AT WATCH SUPERVISOR DESK

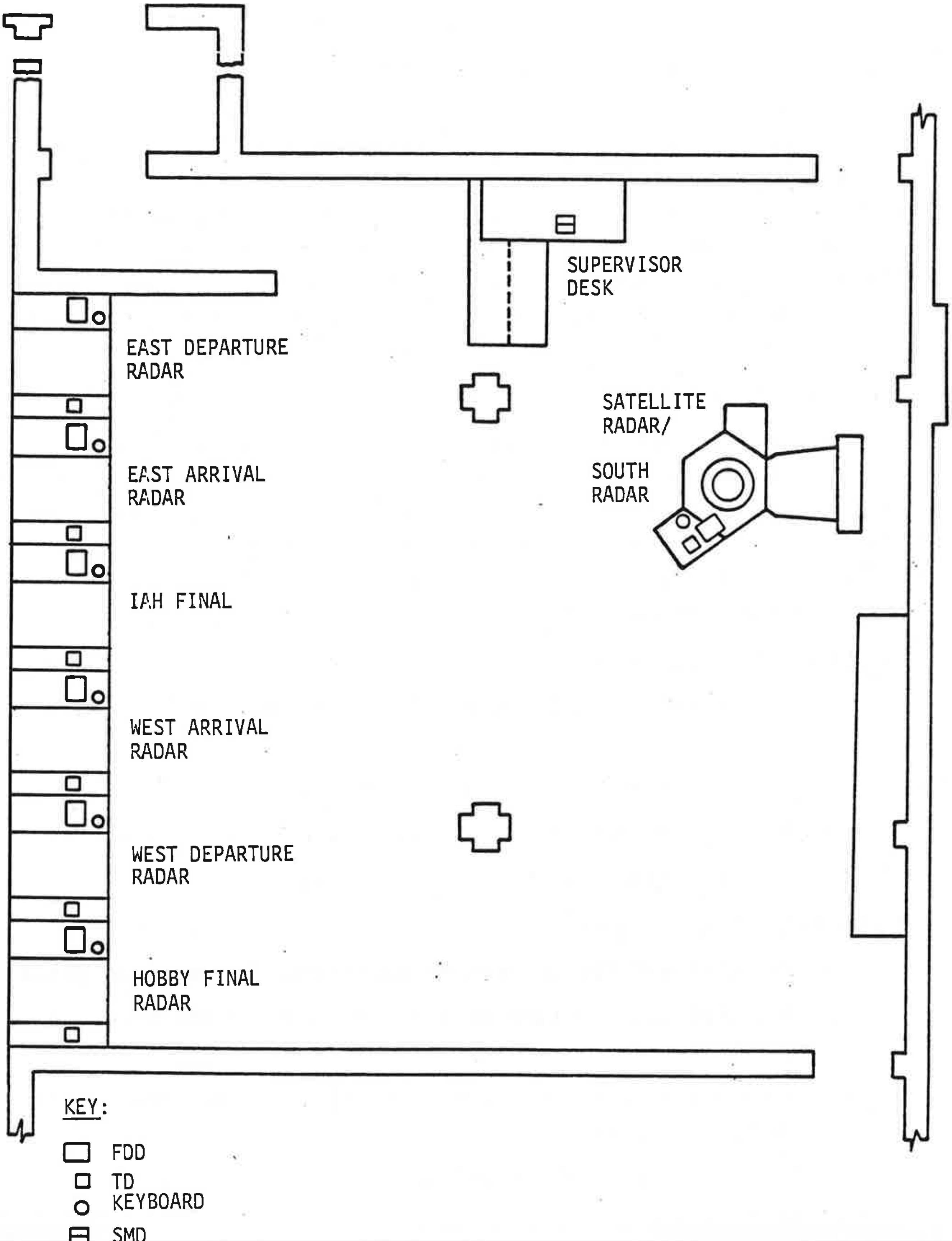


FIGURE A-62. IDEAL TIDS LOCATIONS AT IAH TRACON radar position having an FDD, TD and keyboard and the supervisor having an SMD. The key difference is that the data positions are eliminated and each radar console is provided additional space to the right of its ARTS display to accommodate the FDD. During interviews, controllers stated the data (coordinator) positions are currently staffed when the traffic is heavy (see Table 2-5). Observations indicated these are rarely staffed. If their staffing is desirable during traffic peaks, they could be positioned beside any radar console (reference Section A.2.4).

(1) Radar Consoles (Vertical ARTS, Figure A-63).

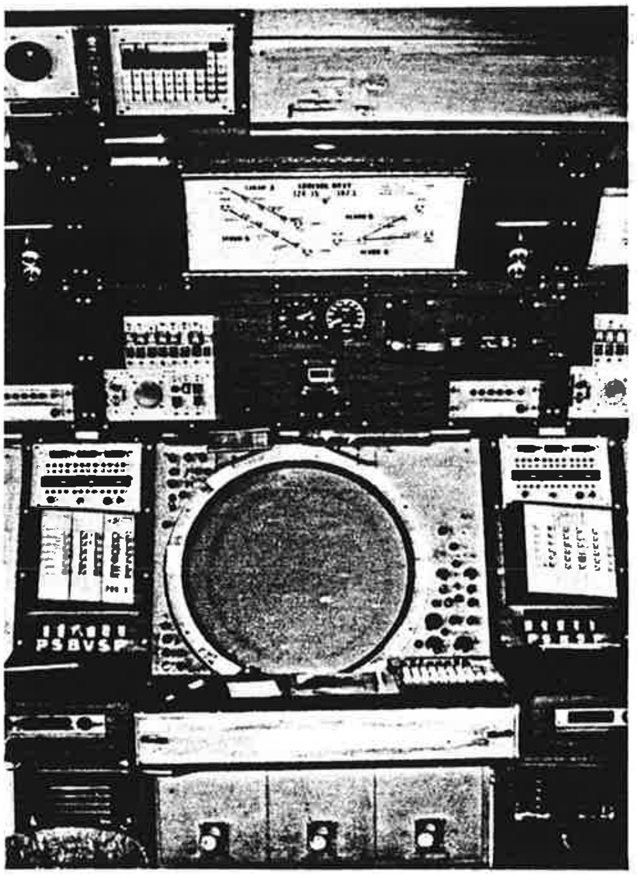
In this design, each radar position is widened by approximately 24 inches so the FDD can be installed to the right of the ARTS display. The TD is installed above the TELCO keypacks, where the RVR is now at most positions. Both the FDD and TD are sloped outward from the far edges to aide viewing. The FDD keyboard is positioned on the controllers right side, below the FDD.

Disadvantages of arrangement:

- TD and FDD not colocated and so provide a broad area to be monitored.
- Requires significant modification of TRACON.
- Further separation of controller consoles is required.
- Assumes elimination of data positions.

Advantages of arrangement:

- TD, ARTS and FDD located on approximately the same plane.
- TD, ARTS and FDD located at approximately the same eye level.
- Scanning displays require only left to right head movement, not up/down.
- FDD controls easily accessible.
- TD controls easily accessible.
- Displays readable by seated controller.



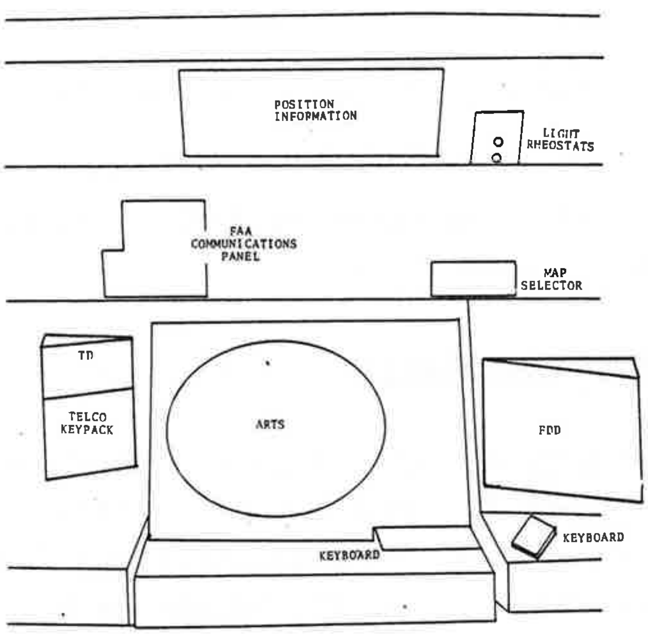


FIGURE A-63. IDEAL TIDS INSTALLATION AT TRACON RADAR POSITION (VERTICAL ARTS)

(2) Satellite/South Radar (Figure A-64).

In this design, the FDD is installed near the ARTS and the screen is angled up slightly and the TD is placed in a similar fashion on the right of the FDD. The keyboard is placed adjacent to the bottom right corner of the FDD. The ARTS keyboard is placed on the left side of the ARTS display. This installation requires the removal of the data position's equipment (ARTS trackball and quick look panel) presently located where the FDD is shown.

Disadvantages of arrangement:

- o ARTS keyboard on left of ARTS display (different from other radar console installations).
- o Assumes removal of data position.

Advantages of arrangement:

- o Allows efficient scanning of ARTS, FDD and TD using left to right head movement.
- o Displays readable and easily accessible by seated controller.
- o Displays located on approximately the same plane.

(3) Watch Supervisor

Same installation as under minimal disturbance considerations (reference Figure A-61).

A.4.3 HOU TRACAB Installation

A.4.3.1 Minimal Disturbance - Figure A-65 shows the locations of the TIDS equipment in the TRACAB under minimal disturbance conditions. HR, LC and GC are assigned their own FDD, CD, SD and keyboard. FD/CD is assigned an FDD, SD and keyboard and the TS is assigned an SMD. Since the TRACAB has smaller consoles than the IAH Cab, in some circumstances it is necessary to remove some present equipment to provide space for the TIDS equipment. This

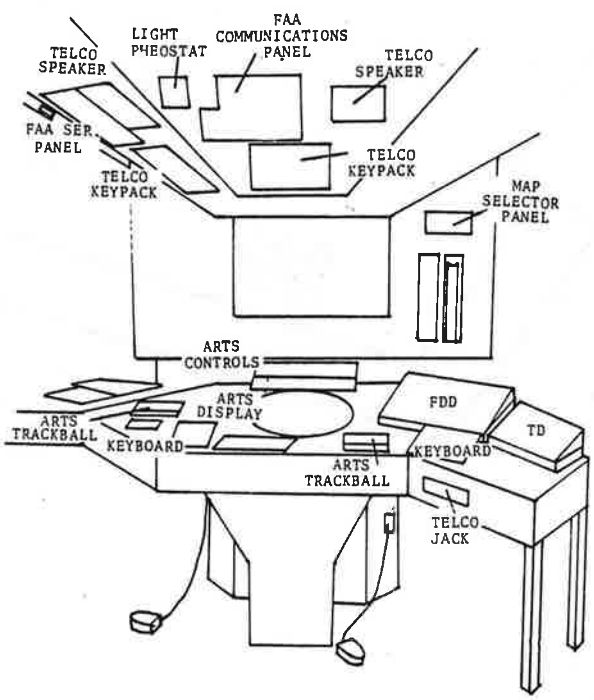


FIGURE A-64. IDEAL TIDS INSTALLATION AT SATELLITE/ SOUTH RADAR POSITION

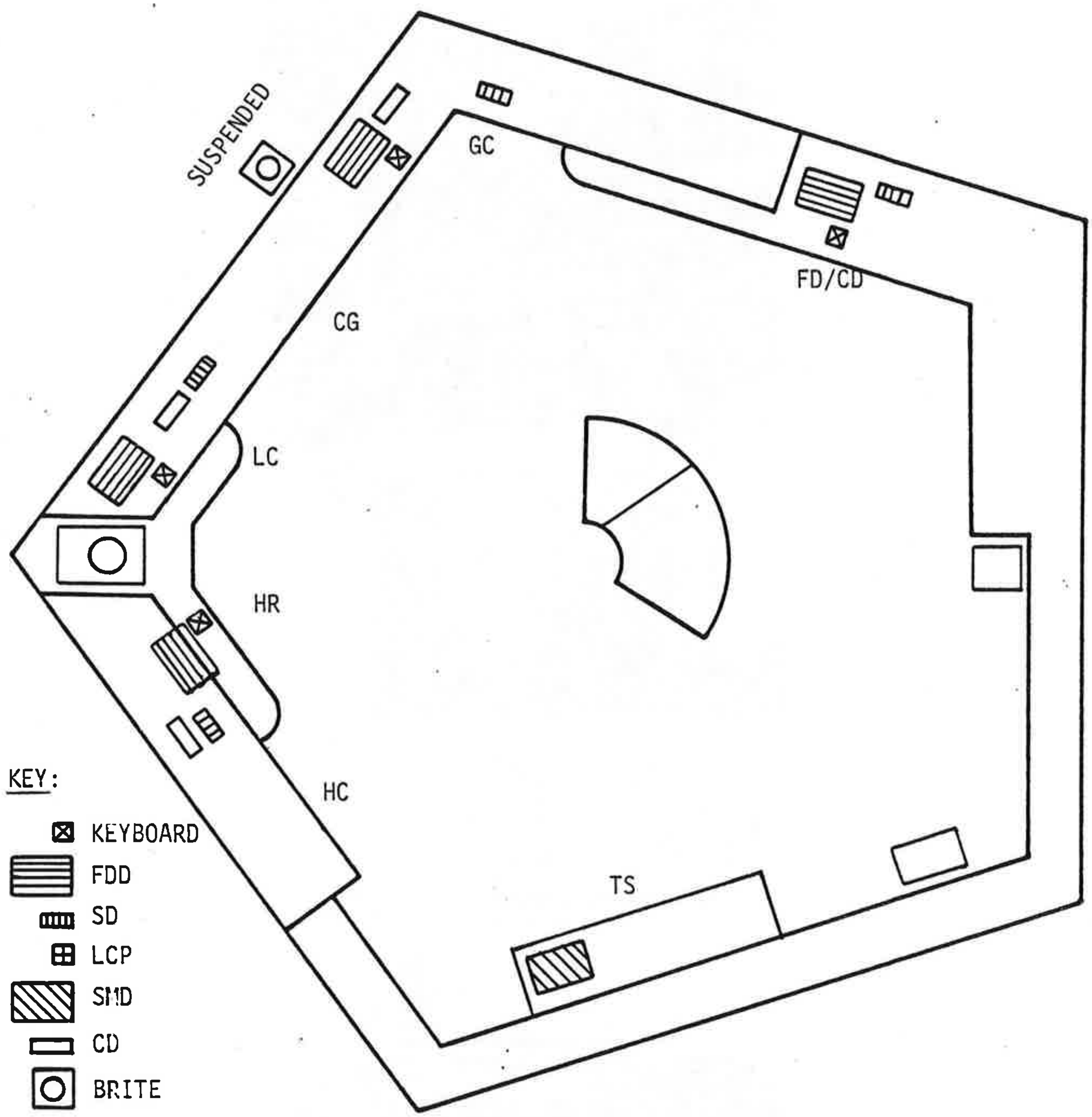


FIGURE A.65. MINIMAL DISTURBANCE TIDS LOCATIONS AT HOU TRACAB is done only if no workable alternative exists and if identical equipment remains at another position.

(1) FD/CD (Figure A-66).

The spare FDEP is removed and the main FDEP is moved approximately one foot to the right. The FDD is installed where the flight strip racks are presently located. The keyboard is installed to the lower right of the FDD. The SD is installed between the FDD and FDEP.

Disadvantages of installation:

- o Requires console modifications.

Advantages of installation:

- o TELCO equipment not disturbed.
- o Minimal disturbance of existing equipment.
- o Displays readable and accessible by standing controller.
- o Flight data is displayed where it is currently obtained.
- o Allows efficient left to right scanning of displays by controller.

(2) GC (Figure A-67).

In this installation, the weather cluster, RVR, clock and VASI panel are removed. Alternative sources for this information are:

- o Clock at FD/CD position or overhead BRITE display.
- o Weather cluster at local control position.
- o RVR at Cab coordinator position.
- o VASI panel - (not currently operational).

Removal of this equipment allows space for the FDD, CD, SD and keyboard. The FAA communications panel and microphone jack are moved to the right and the FDD is installed in their place. The keyboard is placed below it. The CD is placed to the right where the RVR was and the SD is placed where the clock was.

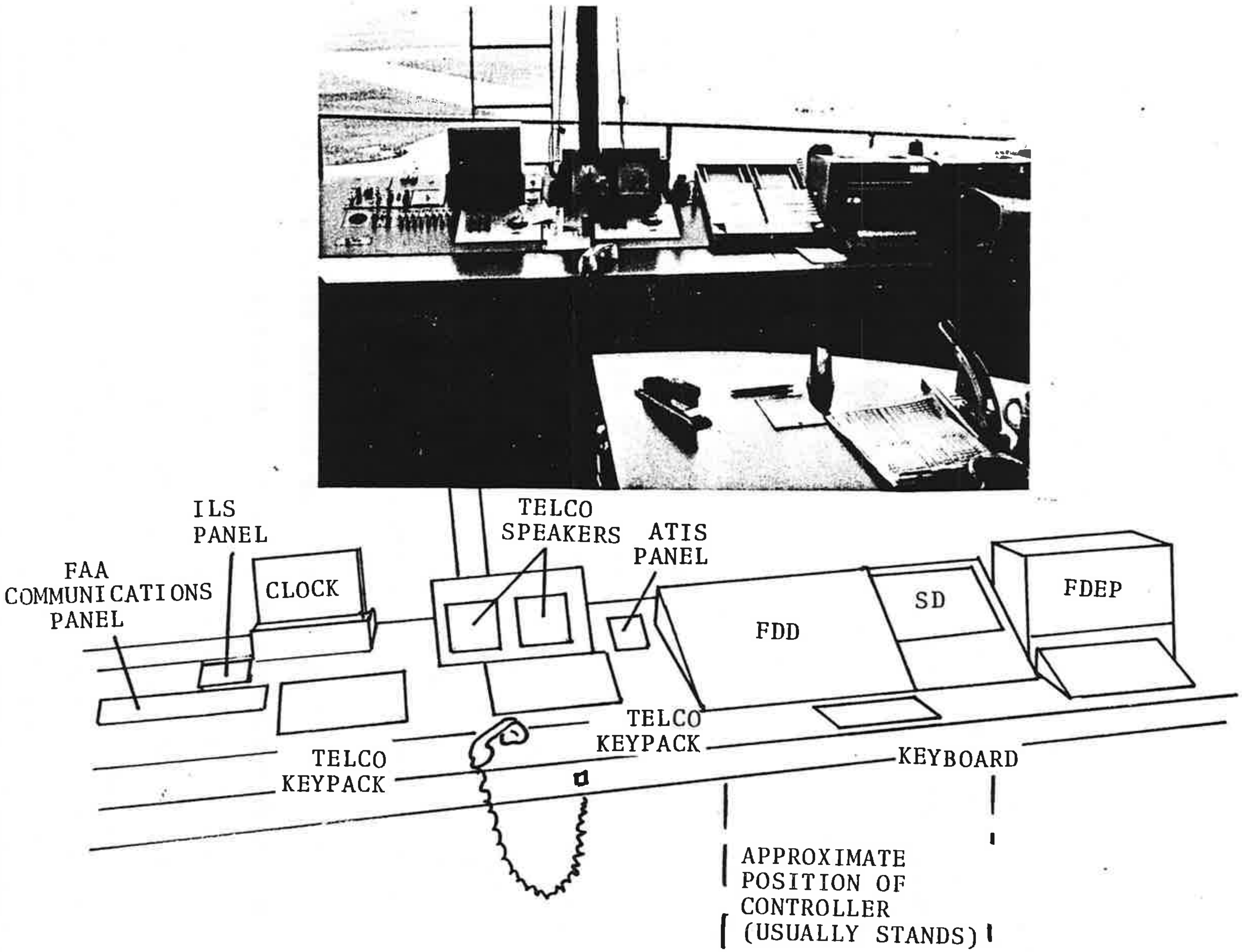


FIGURE A-66. MINIMAL DISTURBANCE TIDS INSTALLATION AT HOU FD/CD

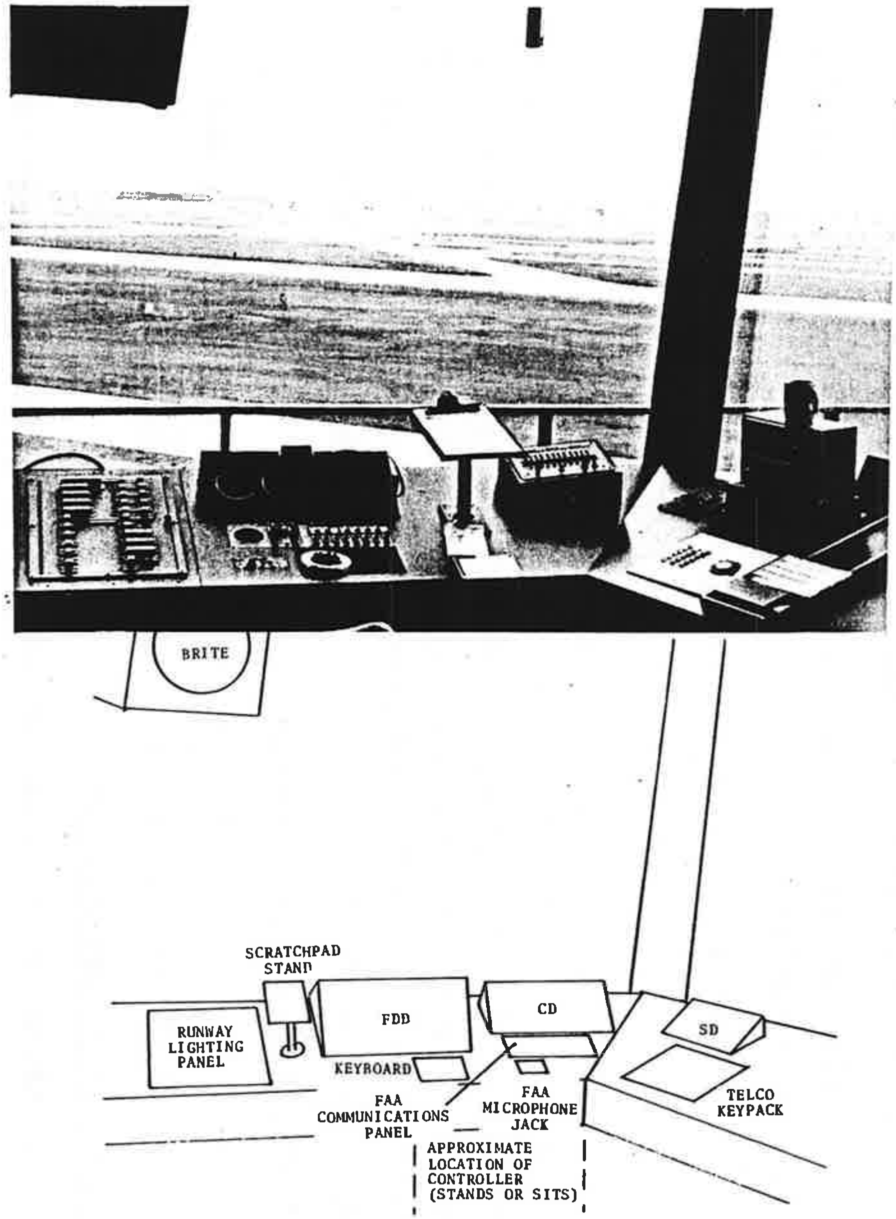


FIGURE A-67. MINIMAL DISTURBANCE TIDS INSTALLATION AT HOU GC

Disadvantages of arrangement:

- o Requires significant disturbance of equipment.
- o Requires removal of equipment.
- o Up/down head movement required to scan BRITE and FDD.

Advantages of arrangement:

- o TELCO equipment not disturbed.
- o FDD is located near BRITE
- o Displays readable and accessible by standing or seated controller.
- o Allows efficient left to right scanning of displays.

(c) LC (Figure A-68).

In this installation, the TELCO speaker is moved to the left of the clock, the MALS panel is moved to the left of the light rheostat, the weather gauges are moved to the right of the FAA communications panel and the ALS panel is moved to the left of the TELCO keypack. The FDD and keyboard are installed to the right of the BRITE and the CD and SD are to the right of the FDD.

Disadvantages of arrangement:

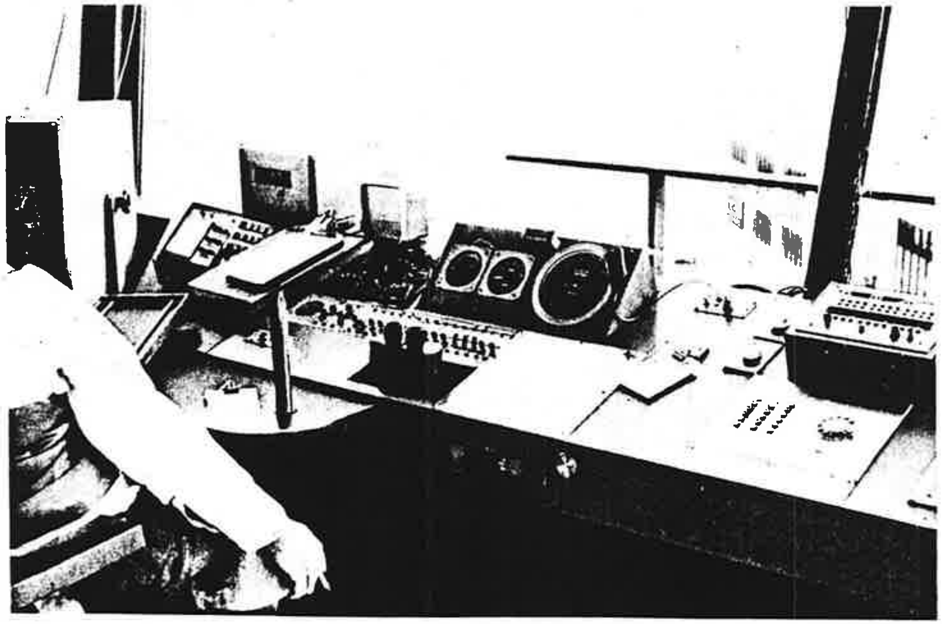
- o Requires significant relocation of present equipment.
- o Clock may be partially obstructed by FDD.

Advantages of arrangement:

- o BRITE, FDD, CD and SD arranged for efficient left to right scanning.
- o Displays are viewable and accessible by seated controller.
- o FDD adjacent to BRITE.

(4) HR (Figure A-69).

In this design, the TELCO speakers are moved lower and to the left side of the console. The CD is placed to the left of the



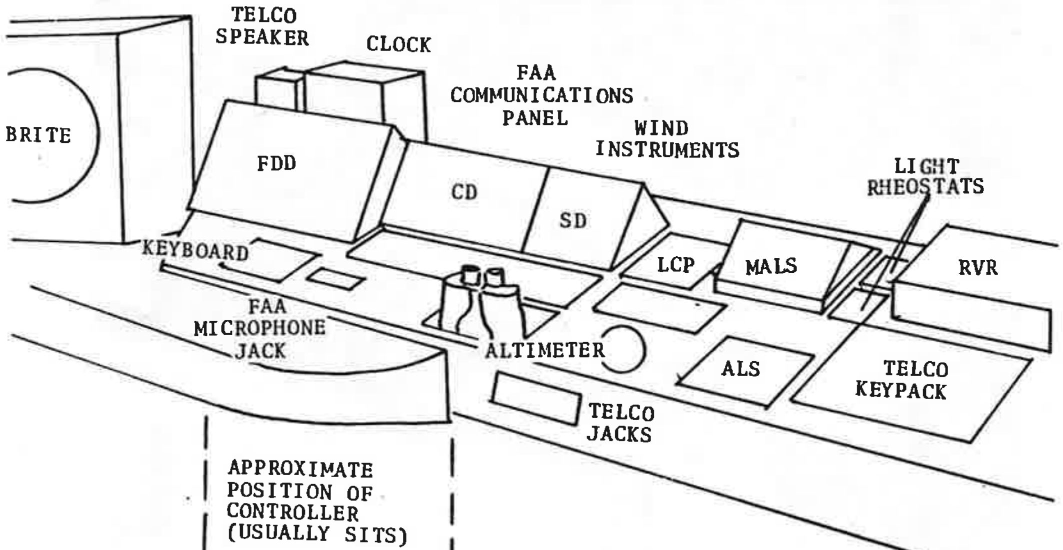


FIGURE A-68. MINIMAL DISTURBANCE TIDS INSTALLATION AT HOU LC

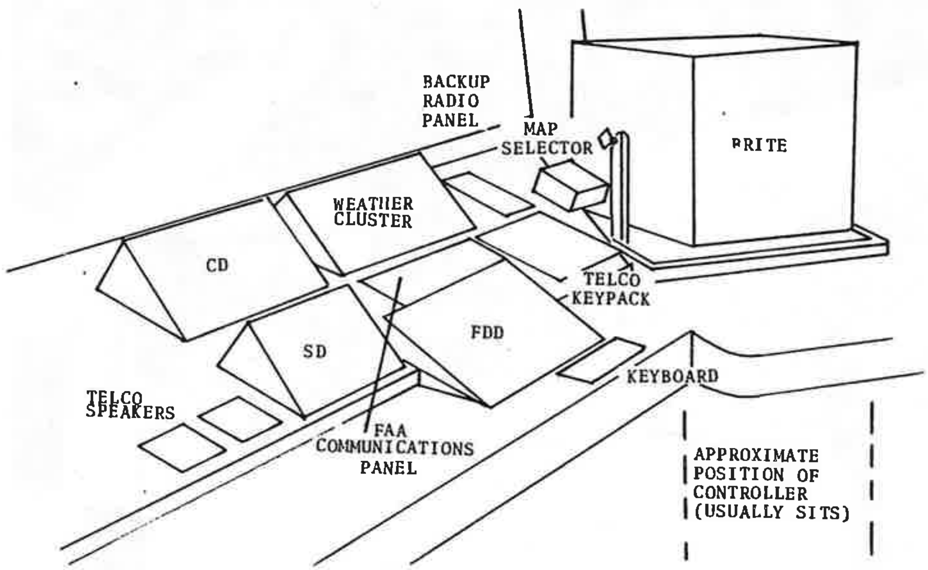


FIGURE A-69. MINIMAL DISTURBANCE TIDS INSTALLATION AT HOU HR weather cluster. The SD is installed in front of the CD. The FDD and keyboard are below the FAA communications panel, extending onto the horizontal portion of the console.

Disadvantages of arrangement:

- o FDD and keyboard inhibit counter space.
- o Long reach required to operate CD.

Advantages of arrangement:

- o Displays readable and accessible by seated controller.
- o Weather cluster SD and CD not obstructed by FDD.
- o Minimal disturbance of existing equipment.
- o Present equipment accessible by seated controller.
- o FDD near BRITE display.

(5) Team Supervisor (Figure A-70).

The SMD is placed on the TS desk.

Disadvantages of arrangement:

- o Takes up available desk space.

Advantages of arrangement:

- o At Supervisor's work area.
- o Easily accessible.

A.4.3.2 Ideal - Figure A-71 shows the locations of the TIDS equipment in the TRACAB under ideal conditions. Equipment assignments are the same as under minimal disturbance conditions. The main difference is that the displays are relocated to improve accessibility and readability.

(1) FD/CD (Figure A-72).

The clock and FDEP are removed from the console and the TELCO speakers are relocated where the clock was. The light rheostats are moved to the right to provide room for the TELCO speakers.

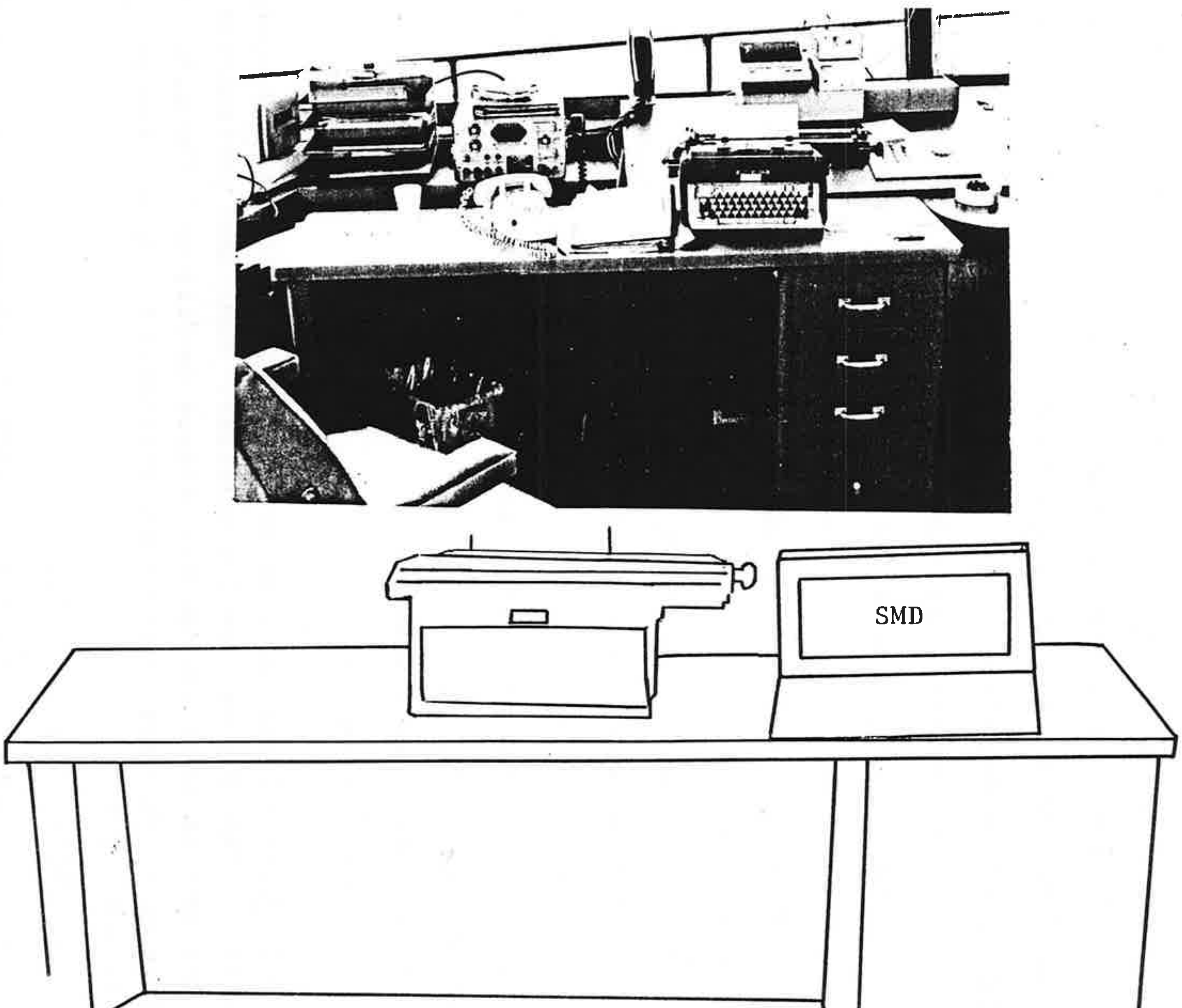


FIGURE A-70. MINIMAL DISTURBANCE TIDS INSTALLATION AT HOU TS DESK

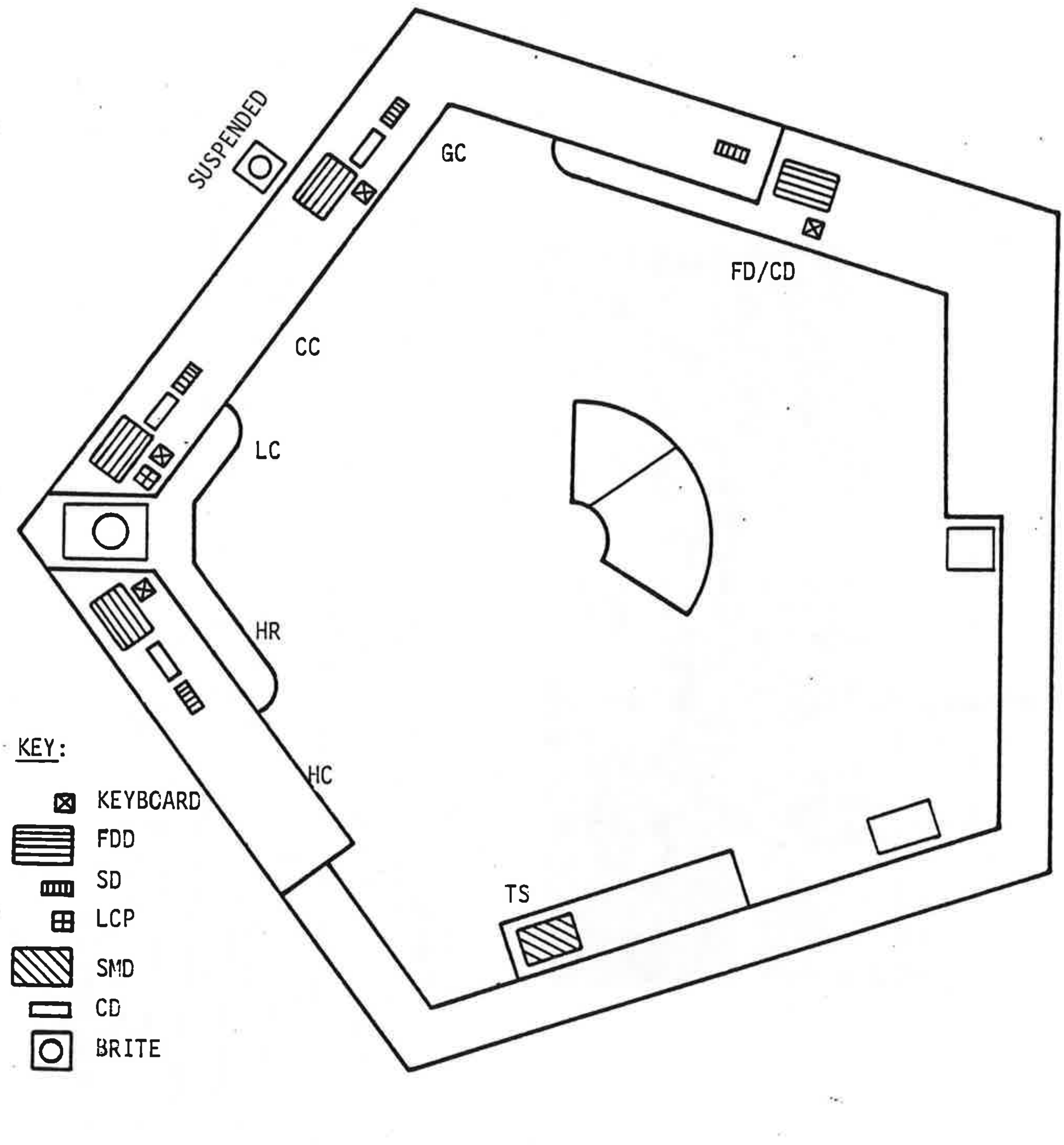
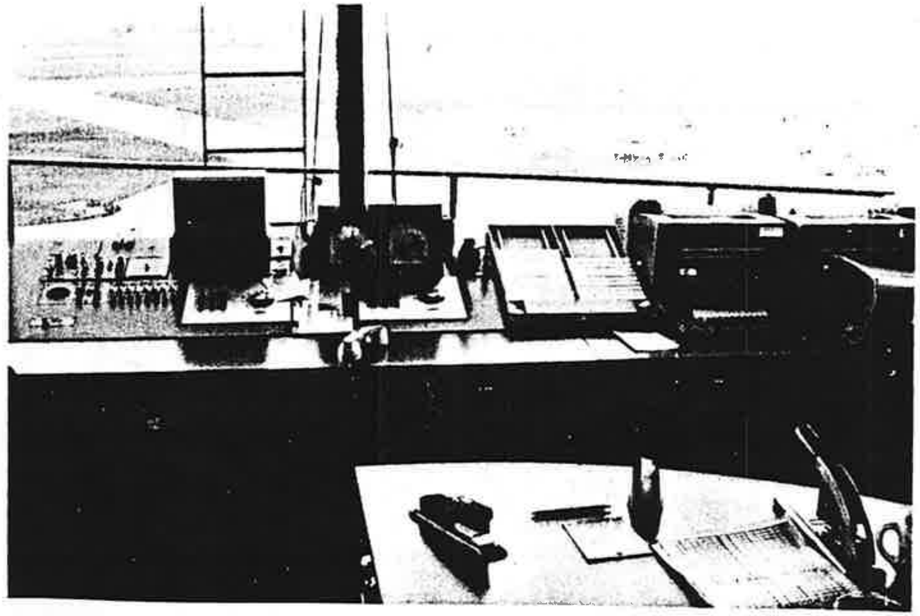


FIGURE A-71. IDEAL TIDS LOCATIONS AT HOU TRACAB



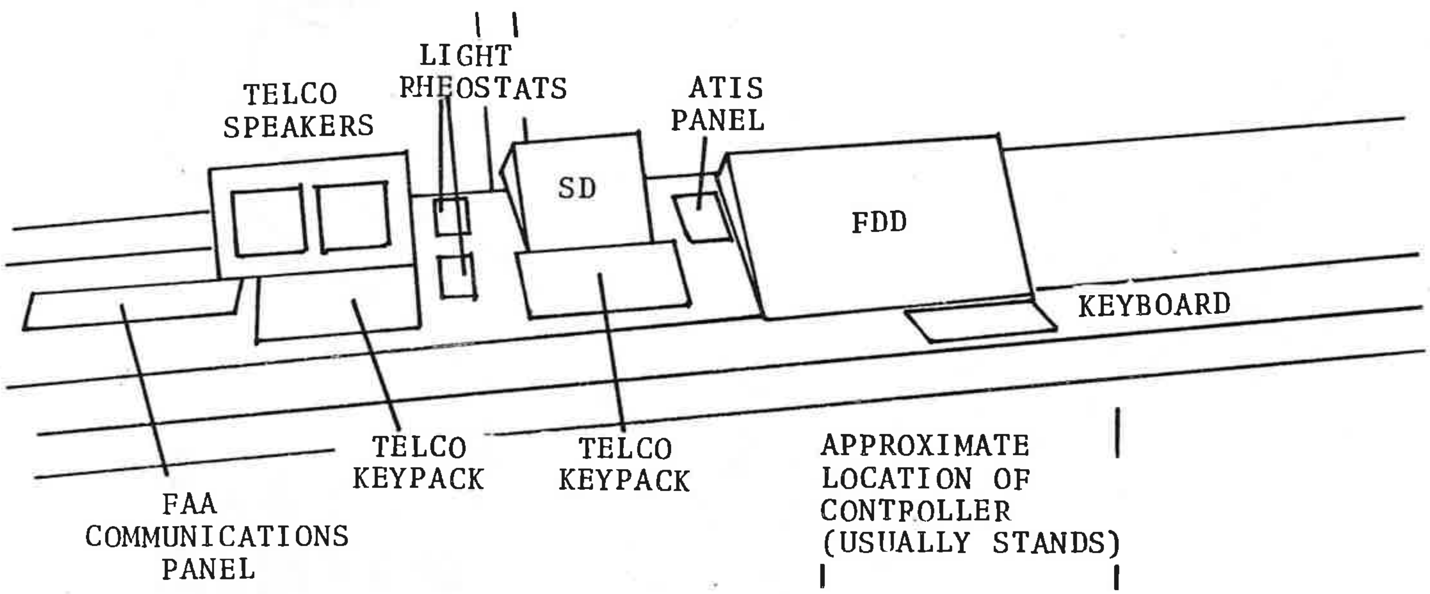


FIGURE A-72. IDEAL TIDS INSTALLATION AT HOU FD/CD

The FDD and keyboard remain as installed under minimal disturbance conditions. The SD is placed where the TELCO speakers were.

Disadvantages of arrangement:

- o The SD is located to the left of FDD.
- o The FDD not centrally located in console.

Advantages of arrangement:

- o Displays readable and accessible by seated controller.
- o Allows efficient left to right scanning of displays.
- o Avoids moving either TELCO keypack.
- o SD is centrally located in console.

(2) GC (Figure A-73).

In this installation, the taxiway lighting panel is moved to the left after the RVRs are removed and the adjacent TELCO keypack is moved closer to LC (see Figure A-74). The weather cluster, clock, and VASI panel are removed. The FDD and keyboard are placed below the BRITE. The CD and SD are located to the right of the FDD. The radio selector panel and FAA microphone jack are placed below the CD and SD.

Disadvantages of arrangement:

- o Up/down head movement required to scan BRITE and TIDS displays.

Advantages of arrangement:

- o TIDS displays located for efficient left to right scanning by controller.
- o TELCO equipment not disturbed.
- o FDD near the BRITE.

(3) LC (Figure A-74).

In this design, the ALS, MALS, clock and RVR equipment are removed. The TELCO speaker and TELCO keypack are moved further

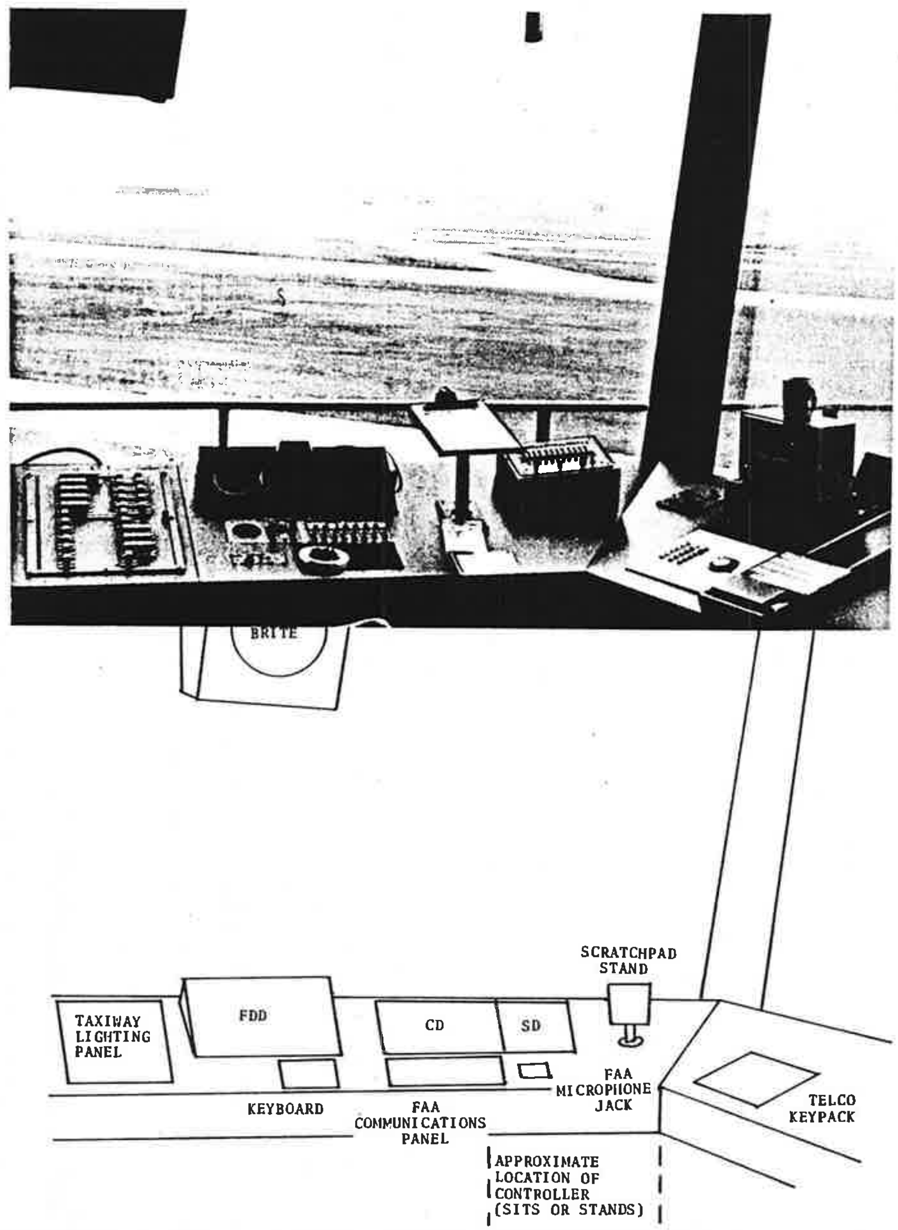


FIGURE A-73. IDEAL TIDS INSTALLATION AT HOU GC to the left and the FAA communications panel and microphone jack are moved to the right. This allows room for the FDD, LCP and keyboard to be installed as shown. The FDD is moved higher on the console to provide room for the LCP and keyboard below it. The CD and SD are to the right of the FDD.

Disadvantages of arrangement:

- o Slightly greater reach is required to operate FDD than installation under minimal disturbance condition.

Advantages of arrangement:

- o Displays are located for efficient left to right scanning by seated controller.
- o LCP readable and accessible by controller seated in front of BRITE and FDD.

(4) HR (Figure A-75).

The weather cluster is removed, the standby radio panel is moved to the lower left of the console and the TELCO speakers and the keypack are moved left on the console. The FDD is installed higher on the console and slightly more to the right than under minimal disturbance conditions. The keyboard is to the lower right of the FDD. The CD and SD are to the left of the FDD.

Disadvantages of arrangement:

- o FDD, CD and SD arranged in opposite order of standard layout.

Advantages of arrangement:

- o Displays readable and accessible by seated controller.
- o TIDS displays sloped higher than under minimal disturbance conditions for easier viewing.
- o FDD adjacent to BRITE.
- o Does not interfere with horizontal counter space.
- o Equipment located such that displays located nearest BRITE in order of importance.

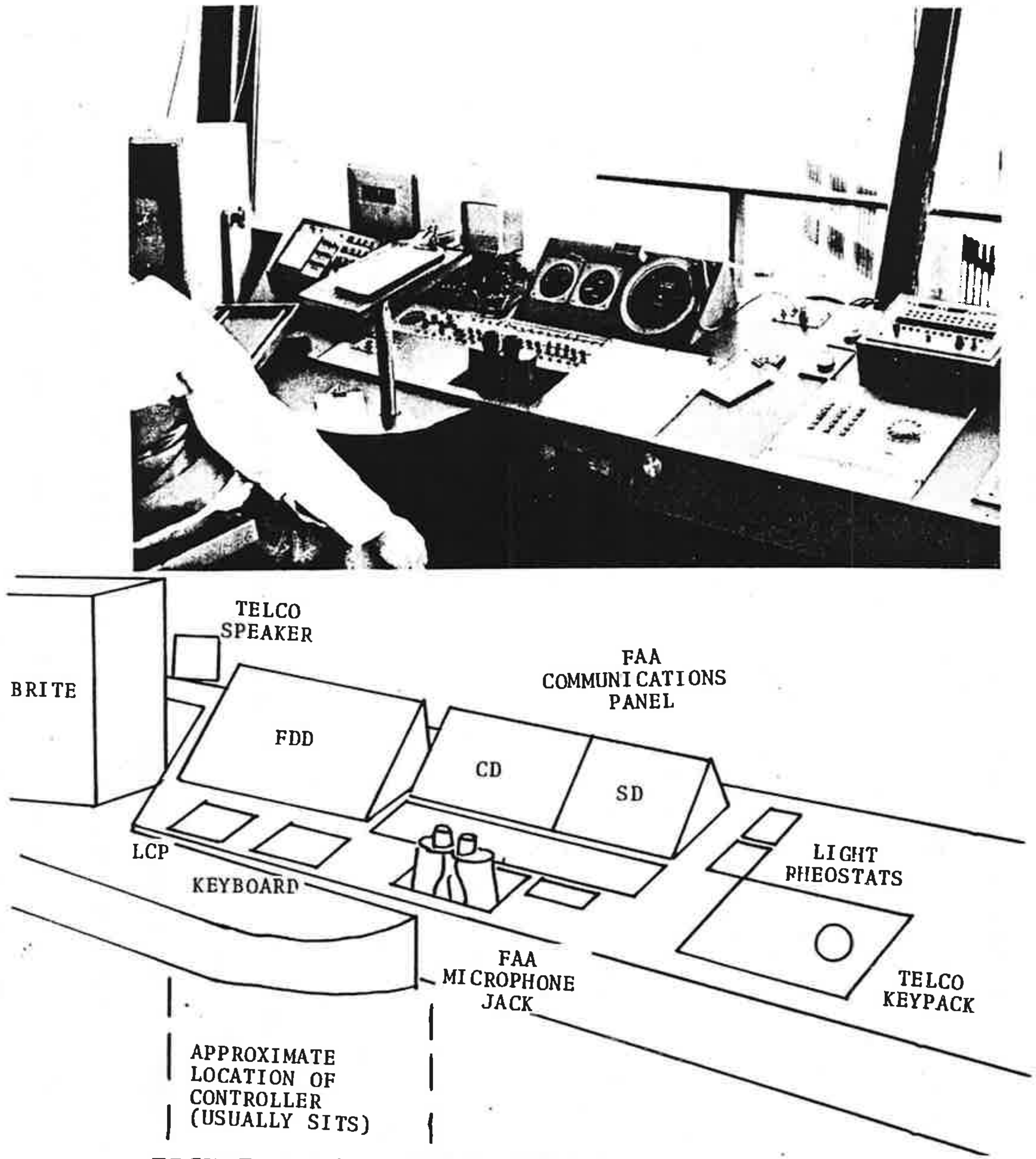


FIGURE A-74. IDEAL TIDS INSTALLATION AT HOU LC

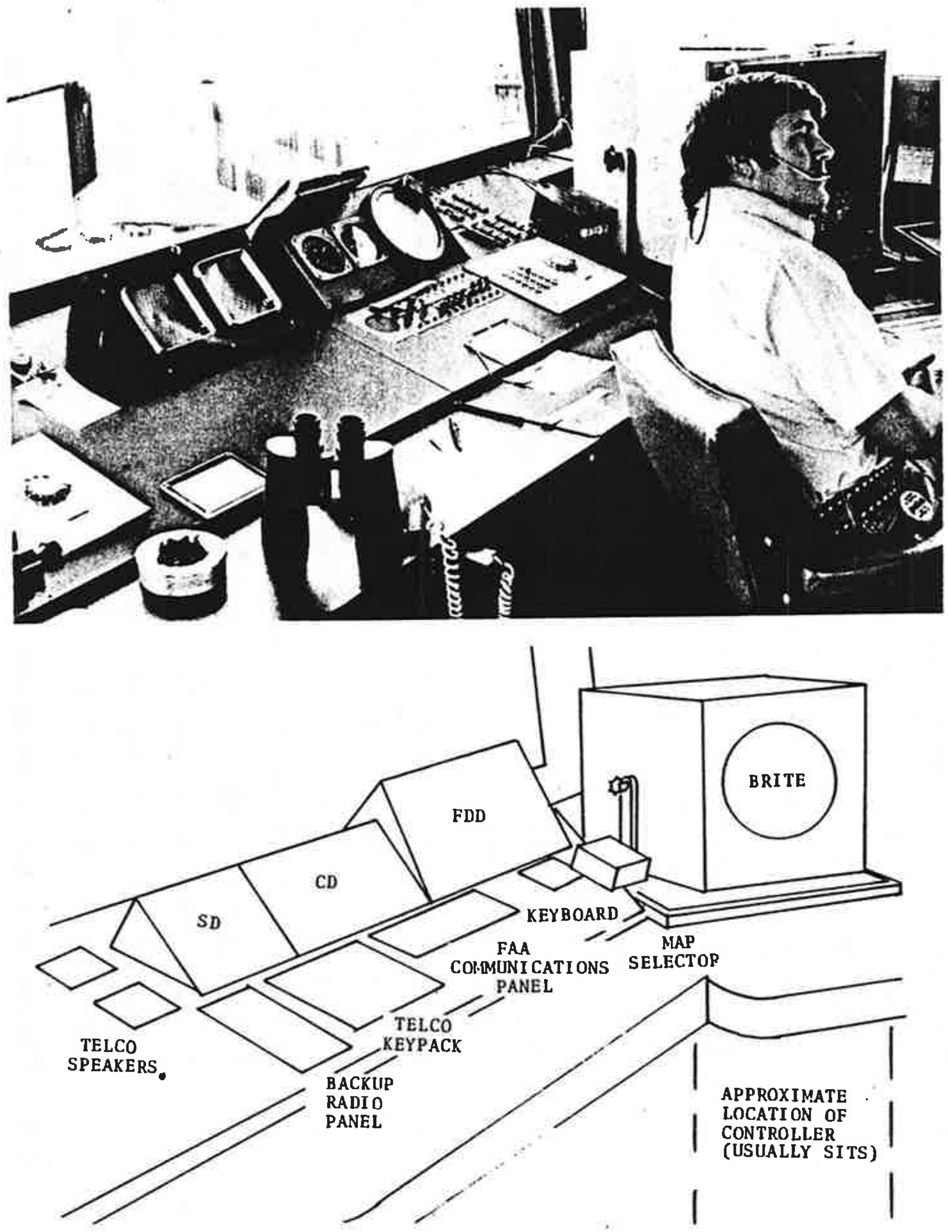


FIGURE A-75. IDEAL TIDS INSTALLATION AT HOU NR

(5) TS

The ideal installation for the SMD is the same as the minimal disturbance conditions (reference Figure A-70). If the daily log is maintained on the SMD, the typewriter may not be necessary, and its removal will make more desk space available.

A.4.4.1 Issues

(1) In certain situations, the options for TIDS locations were quite limited because of existing equipment and the lack of console space. This is especially true at HOU GC, as the console is only 24 inches wide.

(2) At some positions, such as HOU LC, whether the controller sits or stands appears to depend on traffic, time of day (because of glare from sunlight), and personal preference. This means the angle of the displays must be adjustable to accommodate a standing or seated controller.

(3) LC and GC at IAH move around a great deal to monitor the taxiways and runways on different sides of the cab. When doing so, they often pick up one or two flight strips and refer to them when communicating with pilots. With TIDS, difficulties may arise because the controllers need to return to the displays to get flight data. They may compensate by writing key information on scratch pads that they carry with them.

(4) Glare may be a problem at certain positions in the cab and TRACAB. The CD is the only display specifically designed to compensate for high illumination condition in the cab other displays may have to be shaded or rotated out of the way of direct lighting to be readable. The degree to which the shades or cab will preserve the readability of the CRT display has yet to be determined.

A.4.4.2 Further Considerations

(1) Swivel mounts for the displays. This would require more mounting space, which is limited at certain positions. It would enable the controller to adjust the displays to fit his line of sight as well as minimizing glare on the screens.

(2) Shades for the displays to shield them from direct sunlight when necessary.