ORDER

SW 6050.12A

SOUTHWEST REGION SPECTRUM MANAGEMENT HANDBOOK

(Date of Order to be entered at time of ASW-400 signature)

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

Distribution: A-X-5; A-FAF/AT-0 (STD) **Initiated By: ASW-473**

RECORD OF CHANGES

DIRECTIVE NO. **SW 6050.12A**

CHANGE TO BASIC	SUPPLEMENTS			OPTIONAL	CHANGE TO BASIC	SUPPLEMENTS			OPTIONAL

FOREWORD

The radio frequency spectrum is a finite, vital, and very limited natural resource available to all countries of the world. This international resource serves mankind in innumerable ways, and each country exercises its own sovereign rights in the use of the electromagnetic waves. Because the radio spectrum knows no bounds, its use cannot be restricted to individual countries. Requirements for use of this resource generally exceed the amount available; therefore, it is necessary that international, national, and regional spectrum management be rigidly practiced.

The purpose of this spectrum management order is to present radio frequency spectrum information, guidance, and policy to those organizations using or administrating the radio frequency spectrum within the Southwest Region.

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Manager, Airway Facilities Division

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FORMS

SW FORM 6050-1 - FREQUENCY ASSIGNMENT REQUEST

CHAPTER 1. ORGANIZATION, AUTHORITY AND RESPONSIBILITY

1. PURPOSE. This Spectrum Management Handbook provides information and guidance concerning radio frequency management, its organization, authority, responsibilities, and operation. In addition, the appendices contain Southwest (SW) Region's frequencies authorized for the varied functions, whether for aviation services or supporting requirements.

2. DISTRIBUTION. This order is being distributed to all supervisors, SW Region divisions; and all SW Region Air Traffic (AT) and Airway Facilities (AF) field offices. This order is available in published form through established distribution channels.

At a later date this order will also be available electronically on the FAA Intranet. At that time, the various appendices and forms will be individually accessible through use of the file names reflected in the appendix index. Guidance on electronic access will be provided when this service is available.

3. CANCELLATIONS. SW Order 6050.12, SW Region Spectrum Management Handbook, dated March 11, 1994, is canceled.

4. EFFECTIVE DATE. The effective date of this order is shown on the cover page, reflecting the date of signature. The appendices, which are subject to frequent change, reflect correct data as of _____ which is an arbitrary cut-off point for publication.

5. BACKGROUND. Spectrum pollution is becoming very significant in this country, as are the fresh water and fresh air pollution. No longer can inefficient management or utilization of this medium be tolerated. More conscientious effort and cooperation are called for in all areas of the electromagnetic environment to conserve this limited resource wherever and whenever we can.

6. EXPLANATION OF CHANGES. SW Order 6050.12 is out-of-date in terms of recognizing the realigned AF organization. For instance, to eliminate conflict with the new acronym for the System Management Office (SMO), all references to Spectrum Management Office/Officer (SMO) have been changed to Frequency Management Office/Officer (FMO). Additionally, many frequencies have changed and appendices have been updated. Due to the editorial changes necessary to effect currency and the desire to incorporate the updated appendices contained in Change 1 into this order, a single new edition is being issued.

Changes to the appendices, when available electronically, will be updated frequently with the effective date shown on the specific appendix. All changes to the appendices and the basic order will be reissued as a current document and published once a year.

7. ELECTROMAGNETIC SPECTRUM. The control of the spectrum is vested in the International Telecommunications Union (ITU) through international treaties and conventions. Most of the countries of the world are signatories, including the United States (US), and are thus bound by ITU allocations and regulations. The US has its national regulatory function vested in two separate agencies, the National Telecommunications Information Agency (NTIA) and the Federal

Communications Commission (FCC). These agencies were created out of the Communications Act of 1934, as amended, and Executive Orders.

a. The NTIA is situated in the Department of Commerce and exercises its authority through Interdepartment Radio Advisory Committee (IRAC). The NTIA authorizes and controls the use of frequencies by all Federal Government agencies, including the Federal Aviation Administration (FAA) and the Department of Defense (DOD).

b. The FCC is an independent agency whose members are appointed by the President, but whose actions are principally controlled by the Congress. The FCC issues term licenses to all non-Federal users, including state and municipal governments.

c. The electromagnetic spectrum is divided into three categories in the US. The NTIA portions, the FCC portions, and the joint-use portions. Each agency manages its own portions, while joint-use portions are authorized by the appropriate agency (NTIA for Federal, FCC for non-Federal) only after coordination with the other agency.

8. LINE OF AUTHORITY. Within the FAA, frequency management is under the Office of Spectrum Policy and Management, ASR-1. From this organization, the authority and responsibility for the engineering of all new or modified frequency requirements and the enforcement of NTIA frequency and spectrum tolerances are delegated to the FMO. The SW Region FMO is assigned to the Telecommunications and Spectrum Engineering Section, ASW-473.

9. GENERAL.

a. The SW Region FMO is responsible for:

(1) Engineering and procuring IRAC authority for regional frequency requirements and assuring IRAC technical standards are met and maintained.

(2) Engineering and reserving aeronautical use frequencies for other Federal agencies, including military and non-Federal entities licensed by the FCC.

(3) Acting as the focal point for resolution of radio frequency interference (RFI) problems not promptly solved in the field.

(4) Coordination and assistance in phantom controller/pilot resolution.

(5) Conducting ionizing and non-ionizing radiation hazard measurements for the region.

(6) Conducting electromagnetic interference (EMI) studies and measurements.

(7) Operation of the regional EMI vans.

(8) Frequency protection and coverage studies for AT sector boundary realignments.

(9) Obstruction evaluation (OE) studies involving transmission of frequencies.

(10) Ten-year review of all FAA frequency assignments within the SW region.

(11) Coordination and ten-year review of all frequency assignments that are within the SW region for which the FAA is the national coordinator.

(12) Determining frequency protection and power availability for expanded service volumes (ESV).

(13) All functions specified in FAA Order 6050.32, Spectrum Management Regulations and Procedures Manual, Chapter 3, Section 304.

b. The appendices are based on our national spectrum management database and are current as of the date listed on each appendix. A proposed frequency will be marked ppsd. All coordinates are in North American Datum of 1983 (NAD83). Appendices will be updated individually on an as needed basis determined by the FMO.

CHAPTER 2. OPERATIONS

SECTION 1. NEW REQUIREMENTS AND CHANGES

200. NEW FREQUENCY REQUESTS. The FMO will secure and coordinate frequency assignments for all SW Region facilities. Requests for new assignments or for changes of existing assignments shall be on a completed SW Form 6050-1, Frequency Assignment Request (see Figures 2-1 and 2-2), to the FMO. This form is available through Forms and Distribution, ASW-52A4 and electronically at _____. A copy of this form will be retained by the requesting office.

The Resource Management Branch, ASW-420; the NAS Implementation Center, ANI-600; and the Operations Branch, ASW-470, shall be responsible for preparing and submitting SW Form 6050-1 for new or relocated facilities or for any change that affects the parameters of a transmitting facility where they, respectively, have project responsibility. This includes backup emergency communications (BUEC) sites.

The AF SMO shall be responsible for preparing and submitting the SW Form 6050-1 when transmitting facility parameters have been proposed for change. If possible, requests should be submitted at least 120 days prior to the date the service will be required. In the event this lead time is not available, the requesting official, in addition to submitting SW Form 6050-1, shall contact the FMO by telephone to coordinate the request.

If the request is for a change to an existing Facility Transmitting Authorization (FTA), FAA Form 6050-1, a red-lined copy (review for accuracy) of the FTA shall be submitted along with the SW Form 6050-1. When the frequency selection is entered into the Government Master File (GMF), the SW Form 6050-1 will be annotated showing the date of entry for national coordination and an interim copy will be returned to the originator.

When formal IRAC authorization has been obtained, the SW Form 6050-1 will be annotated with the results, and the FTA will be issued, if appropriate, and the SW Form 6050-1 will be returned to the originator. A copy of the SW Form 6050-1 will be retained by the FMO.

A summary of the frequency bands supporting aviation is shown in Figure 2-3. The form (SW 6050-1) should contain a description of the operational requirements for each new frequency or each change of function, including BUEC sites. An itemized list of the data required for frequency engineering purposes is described below. Applicable information, as determined from the list, should be submitted with each request for a frequency assignment.

a. Function; i.e., local control (LC), approach control (AC), air route traffic control center (ARTCC) low or high altitude sector number.

(1) Airport Traffic Control Tower (ATCT) Channels. Provide the type of service volume required; i.e., LC or AC.

(2) ARTCC Channels. Identify the sector number of use; i.e., L-83 or UH-91.

(3) Navigational Aids (NAVAID). Identify the facility classification; i.e., homing beacon (H) with automatic transcribe weather service (H-SAB), terminal (T) very high frequency (VHF) omnidirection range (VOR)(T-VOR), high (H)-VOR collocated with tactical air navigation (TACAN)(VORTAC), etc.

b. SMO; The SMO in which the facility is physically located.

c. Facility Identifier (ID); The three or four letter ID for the facility.

d. Location; The name of the city which the site is located in/near and the state.

e. Facility Type; i.e., remote center air/ground communications facility (RCAG), localizer (LOC), BUEC, radio communications link (RCL), etc. Collocated facilities may also be listed.

f. Frequency;

(1) For an updated FTA, relocated frequency, change of frequency, or frequency to be deleted, give the existing frequency.

(2) For a new frequency, give the frequency range required; such as VHF, 118-137 megahertz (MHz), or give the exact frequency, such as 1030 or 1090 MHz, if part of a national program.

g. Control Facility; If the site is a remote facility, give the name or ID for the control facility.

h. Service Volume; Indicate the maximum service volume in terms of nautical miles (NM) and maximum altitude. Indicate whether the altitude is above mean sea level (AMSL) or above ground level (AGL).

i. Coordinates; Geographical coordinates, to the second, for each transmitter site where the frequencies will be used. Coordinates must be in NAD83. For receiver locations located separately from the transmitters, list all receiver locations on the back of the form or on a separate, attached sheet.

j. Site Elevation; In mean sea level (MSL).

k. Transmitter Type; i.e., AN/GRT-21, FA-10207/1, etc.

l. Transmitter Power; The maximum transmit power.

m. Emission Type; i.e., 6MM1D, 6KA3E, etc. Refer to Paragraph 292.

n. Pulse Repetition Frequency (PRF); For primary and secondary radar.

o. Runway Number; For instrument landing system (ILS), lighting, and monitor systems.

p. Receiver Type; If different from the transmitter.

q. Antenna Type;

(1) Low-frequency NAVAID's. Furnish information as to type of antenna and its dimensions.

(2) ILS LOC. Indicate whether 8-loop, V-ring, traveling wave, or log-periodic (see Figure 2-4).

(3) VHF/Ultra High Frequency (UHF) communications channels. Furnish antenna nomenclature or type; i.e., dipole, DPV-37, TACO.

r. Antenna Height Above Ground; For the transmitter antenna.

s. Antenna Gain; In decibel (dB).

t. Antenna Polarization; Vertical or horizontal.

u. Path Azimuth; For communications link systems or as necessary.

Advance information concerning plans for new communications channels, NAVAID's, or relocations is needed for frequency planning purposes.

Figure 2-1 Frequency Assignment Request Example #1

Frequency Assignment Request

To: Telecommunications/Spectrum Engineering Section, ASW-473 Date: 9/30/98

From: Terminal Platform Section, ANI-640

ACTION REQUESTED (*see note*):

___New Assignment ___Change Frequency X Relocate Frequency
___Delete Frequency ___Update FTA

EXISTING DATA:		**NEW DATA:**
Approach Control	Function	
RRR	SMO	
OKCA	Facility ID	
Oklahoma City, OK	Location	
RTR	Facility Type	ATCT/RTR
118.45 (M)Hz	Frequency	( )Hz
OKC ATCT	Control Facility	
60 NM @ 15000 ft	Service Volume	NM/FL
1920'	Site Elevation (MSL)	1201
AN/GRT-21	Transmitter Type	
	Transmitter Coordinates:	
35 / 22 / 15	Latitude	35 / 23 / 53
97 / 36 / 07	Longitude	97 / 36 / 01
10 WATTS	Transmit Power	
6KA3E	Emission Type	
	PRF (Radar)	
	Runway Number (ILS)	
AN/GRR-23	Receiver Type	
	Receiver Coordinates (if different):	
35 / 22 / 15	Latitude	35 / 23 / 53
97 / 36 / 07	Longitude	97 / 36 / 01
Dipole	Antenna Type	
40 ft	Antenna Height Above Ground	75 ft
0 dB	Antenna Gain	
Vertical	Antenna Polarization	
	Path Azimuth (RCL)	

REMARKS: Example of relocating an RTR frequency from the RTR site to the ATCT.

DATE REQUIRED:

REQUESTED BY:

APPROVED BY:

DATE RECEIVED ASW-473:

DATE SUBMITTED NAT'L ACTION:

APPROVED: **DENIED:** **DATE:**

FTA ISSUED: Number: Date:

cc:

NOTE: Approval by HQ FAA/IRAC requires 120 days from receipt of this form by ASW-473.

SW Form 6050-1 (9/93) Previous Editions Obsolete

FIGURE 2-2 Frequency Assignment Request Example #2

Frequency Assignment Request

To: Telecommunications/Spectrum Engineering Section, ASW-473 Date: 9/30/98

From: Communications/Interfacility Section, ANI-670

ACTION REQUESTED (*see note*):

X New Assignment	Change Frequency	Relocate Frequency
Delete Frequency	Update FTA	

EXISTING DATA:		**NEW DATA:**
	Function	Standard ILS
	SMO	RRR
	Facility	I-DU
	Location	Little Rock, AR
	Facility Type	ILS LOCALIZER
(M)Hz	Frequency	108.3-111.95 M)Hz
	Control Facility	
	Service Volume	18 NMStandard)NM/FL
	Site Elevation (MSL)	253
	Transmitter Type	Mark 1F
	Transmitter Coordinates:	
	Latitude	34 / 44 / 09
	Longitude	92 / 12 / 02
	Transmit Power	15 W
	Emission Type	2K04A1A
	PRF (Radar)	
	Runway Number (ILS)	4R
	Receiver Type	
	Receiver Coordinates (if different):	
	Latitude	34 / 44 / 09
	Longitude	92 / 12 / 02
	Antenna Type	LOG Periodic
	Antenna Height Above Ground	6 ft
	Antenna Gain	17 dB
	Antenna Polarization	Horizontal
	Path Azimuth (RCL)	

REMARKS: Example of installing a new ILS Localizer

DATE REQUIRED:

REQUESTED BY:

APPROVED BY:

DATE RECEIVED ASW-473:

DATE SUBMITTED NAT'L ACTION:

APPROVED: **DENIED:** **DATE:**

FTA ISSUED: Number: Date:

cc:

NOTE: Approval by HQ FAA/IRAC requires 120 days from receipt of this form by ASW-473.

Figure 2-3 Summary of Frequency Bands Supporting Aviation

	9	14 kHz	OMEGA Navigation System
	90	110 kHz	LORAN C Navigation System
*	190	435 kHz	Non Directional Beacon
*	510	535 kHz	Non Directional Beacon
	2100	28,000 kHz	High Frequency Communications
*	74.8	75.2 MHz	NAVAID Marker Beacons
*	108	118 MHz	NAVAID (VOR, ILS Localizer, SCAT-II)
*	118	137 MHz	VHF Air/Ground Communications
	138	150.8 MHz	Fixed, Mobile Communications
	162	174 MHz	Fixed, Mobile Communications
	225.0	328.6 MHz	UHF Air/Ground Communications
*	328.6	335.4 MHz	NAVAID (ILS Glide Slope)
	335.4	399.9 MHz	Air/Ground Communications
	406.0	406.1 MHz	Satellite Emergency Position Indicating Radio Beacon
	406.1	420.0 MHz	Fixed, Mobile Communications
	932	935 MHz	Fixed Communications
	941	944 MHz	Fixed Communications
*	960	1215 MHz	NAVAID (TACAN/DME, etc.)
*	**	1030 MHz	Radar Beacon, TCAS, Mode S, etc.
*	**	1090 MHz	Radar Beacon, TCAS, Mode S, etc.
		1227.6 MHz	Global Positioning System (L2)
**	1215	1400 MHz	Air Route Surveillance Radar
	1544	1545 MHz	Emergency Mobile Satellite Communications
	1545	1559 MHz	Aeronautical Mobile Satellite (R) (Downlink)
		1575.42 MHz	Global Positioning System (L1)
	1645.5	1646.5 MHz	Emergency Mobile Satellite Communications
	1646.6	1660.5 MHz	Aeronautical Mobile Satellite (R) (Uplink)
	1710	1850 MHz	Low Density Microwave Link
**	2700	2900 MHz	Airport Surveillance Radar, Weather Radar
	2900	3000 MHz	Weather Radar
	4200	4400 MHz	Airborne Radio Altimeters
*	5000	5250 MHz	NAVAID (Microwave Landing System)
	5350	5470 MHz	Airborne Weather Radar and Associated Airborne Beacon
	5600	5650 MHz	Terminal Doppler Weather Radar
	7125	8500 MHz	Radio Communication Links
	8750	8850 MHz	Airborne Doppler Radar
**	9000	9200 MHz	Military Precision Approach Radar
	9300	9500 MHz	Airborne Weather Radar
	13.25	13.40 GHz	Airborne Doppler Radar
	14.00	15.35 GHz	Television (Video) Microwave Link
	15.40	15.70 GHz	Airborne Weather Radar

15.70	16.20 GHz	Airport Surface Detection Equipment (ASDE III)
21.20	23.60 GHz	Microwave Link (Multi-Use)

* denotes AAG bands engineered by the FAA; see NTIA Manual

** denotes those bands for which the FAA is the national coordinator, see NTIA Manual

Figure 2-4 Common ILS Localizer Antenna Types

NOMENCLATURE	STYLE	MAINBEAM GAIN (dB)
MK20, FA9913	LPD (14-10)	25
FA5692, FA5693, FA5707, FA5708, FA8001, FA8002, FA8035, FA8036, FA8038, FA8621, FA8622, FA8719, FA8720, FA8843, FA8844.	V RING	12
FA9320	TRVLG WAVE (8EL)	14
FA9325	TRVLG WAVE (14EL)	17
FA9358, FA9708, FA9912 MK2, MK12.	LPD 8 EL ARRAY	17
FA9358, FA9708, FA9912, MK2, MK12.	LPD 14 EL ARRAY	20
FA9759, AN/GRN29, AN/GRN30	LPD	23
AN/GRN-27 (Narrow)	TRVLG WAVE (14/6)	17
AN/GRN-27 (Wide)	PARABOLIC	17
AN/GRN-27	PARABOLIC	17
AN/MRN7	DIPOLE	12
REDLICH	LPD (14-10)	26
MODIFIED V RING	MOD V RING	12
1201	DIPOLE	16
1203	LPD	17
1204	DIPOLE	14
1261	DIPOLE	15
STAN37	DIPOLE	12
55	TWIN TEE	13

SECTION 2. ARTCC SECTOR UTILIZATION CHARTS

201. CHANGES IN ARTCC FREQUENCY USAGE. All planning on any change in the altitude or area of use for frequencies SHALL be coordinated with the FMO to avoid creating harmful interference situations. Whenever ARTCC sector boundaries need changing (service volume changes), a feasibility study will be required. The ARTCC will forward its proposed sector boundary change(s) to the Requirements Branch, ASW-510. ASW-510 will forward the request to ASW-473 (attention FMO) for analysis. ASW-473 will convey its findings to the ARTCC through ASW-510. The analysis may show implement as proposed, implement with proposed changes, or an explanation as to why the ARTCC proposal cannot be implemented. If the ARTCC agrees to the analysis, a formal request for action shall be submitted to ASW-473 through ASW-510.

When the sector charts are updated or sector boundaries are changed, five copies of the low, high, ultra high, and intermediate altitude sector charts, as applicable, shall be forwarded from the ARTCC to ASW-420, through ASW-510. ASW-420, shall then distribute one copy to the FMO, ANI-600, ASW-470, and the appropriate SMO. The primary and secondary use of all frequencies shall be shown and special utilization situations shall be indicated. These sector charts are an essential tool for the FMO and adjacent region FMO's. Reference FAA Order 7210.3, Facility Operation and Administration, for AT requirements for the submission of sector boundary charts.

SECTION 3. COMMUNICATIONS FREQUENCIES

202. VHF FUNCTIONAL BREAKDOWN. The frequency band currently used for communications with all civil and some military aircraft is 118.00-136.975 MHz. Assignment of odd 25 kilohertz (kHz) channels; i.e., 118.025, 118.075 MHz, etc., is authorized. These frequencies are used by all types of FAA air traffic control (ATC) facilities (ARTCC, terminal radar approach control (TRACON), ATCT, automated flight service station (AFSS)). The entire band is shared with non-Federal users, although frequency engineering is done by the FAA and supplied to the FCC for its licensing for non-Federal users. (See Figure 2-5 for a complete VHF air-to-ground (A/G) frequency breakdown.)

203. UHF FUNCTIONAL BREAKDOWN. The limits of the band used by all military services, principally for A/G communications, are 225.000-399.950 MHz. The band is exclusively for military use with few exceptions. To facilitate ATC of tactical aircraft that are normally UHF-only equipped, the military has given certain discrete frequencies to the FAA for ATC within this band (see Figure 2-6 for a complete list). These frequencies are engineered by the FAA for best spectrum utilization. All terminal requirements are met by frequencies separately supplied by the military. A simplified breakdown of FAA use of the band is as follows:

FREQUENCY (MHz)	PRIMARY USE
225.00-328.60	A/G Communications
328.60-335.40	ILS Glide Slope (GS)
335.50-399.90*	A/G Communications
243.00	Military Emergency Search and Rescue (SAR)
255.4, 257.8, 296.7	Military Common Advisory (FSS)

*380.0, 380.1, FAA Flight Inspection/ SMO Ground Personnel

Figure 2-5 VHF Allocations - 118-137 MHz

118.00-121.400 ATC*****
121.425-121.475 Band Protection for 121.500
121.500 Emergency SAR (ELT Operational Check, 5 Sec.)
121.525-121.575 Band Protection for 121.500
121.600-121.925 Airport Utility
121.775 SAR ELT Location Training
121.950 Aviation Support
121.975 FSS Private Aircraft Advisory
122.000-122.050 EFAS
122.075-122.675 FSS Private Aircraft Advisory
122.700-122.725 UNICOM – Uncontrolled Airports
122.750 Fixed Wing Aircraft – Air-to-Air
122.775 Aviation Support
122.800 UNICOM – Uncontrolled Airports
122.825 Domestic VHF
122.850 MULTICOM
122.875 UNICOM – Domestic VHF
122.900 MULTICOM, SAR Training
122.925 MULTICOM – Special Use
122.950 UNICOM – Full Time ATCT, FSS
122.975-123.000 UNICOM – Uncontrolled Airports
123.025 Helicopter – Air-to-Air
123.050-123.075 UNICOM – Uncontrolled Airports
123.100 SAR; Temp. ATCT's & Fly-Ins with SAR Coordination
123.125-123.275 Flight Test
123.300 Aviation Support
123.325-123.475 Flight Test
123.500 Aviation Support
123.525-123.575 Flight Test
123.600-123.650 FSS Air Carrier Advisory
123.675-126.175 ATC*****
126.200 Military Common (Advisory)
126.225-128.800 ATC*****
128.825-132.000 Operational Control
132.025-134.075 ATC
134.100 Military Common (Advisory)
134.125-135.825 ATC
135.850 FAA Flight Inspection
135.875-135.925 ATC
135.950 FAA Flight Inspection
135.975-136.075 ATC
136.100 Reserved for Future AWOS/UNICOM
136.125-136.175 ATC
136.200 Reserved for Future AWOS/UNICOM
136.225-136.250 ATC
136.275 Reserved for Future AWOS/UNICOM
136.300-136.350 ATC
136.375 Reserved for Future AWOS/UNICOM
136.400-136.450 ATC
136.475 Reserved for Future AWOS/UNICOM
136.500-136.875 Domestic VHF
136.900-136.975 International & Domestic VHF

***RESERVED AS NOTED:**

119.675, 120.625 – ATIS
118.325, 118.375, 118.525, 119.025, 119.275, 119.925, 120.000,
121.125, 124.175, 128.325 - AWOS/ASOS

Figure 2-6 UHF Allocations, Specific Frequencies Available

M225.400	M259.100	M270.350	M284.750	M294.700
M229.400	M259.300	M270.800	M285.400	M296.700
M233.700	M263.000	M273.450	M285.425	M298.850
M239.000	M263.025	M273.475	M285.450	M298.875
M239.025	M263.050	M273.500	M285.475	M298.900
M239.050	M263.075	M273.525	M285.500	M298.925
M239.250	M263.100	M273.550	M285.525	M298.950
M239.275	M263.125	M273.575	M285.550	M299.200
M239.300	M263.150	M273.600	M285.575	M299.600
M251.050	M266.800	M275.800	M285.600	M305.200
M251.075	M268.700	M276.400	M285.625	M306.200
M251.100	M269.000	M277.400	M285.650	M306.300
M251.125	M269.025	M278.300	M288.250	M306.900
M251.150	M269.050	M278.800	M288.275	M306.925
M253.500	M269.075	M279.500	M288.300	M306.950
M254.250	M269.100	M279.525	M288.325	M306.975
M254.275	M269.125	M279.550	M288.350	M307.000
M254.300	M269.150	M279.575	M289.400	M307.025
M254.325	M269.175	M279.600	M290.200	M307.050
M254.350	M269.200	M279.625	M290.225	M307.075
M254.375	M269.225	M279.650	M290.250	M307.100
M254.400	M269.250	M281.400	M290.275	M307.125
M255.400	M269.275	M281.425	M290.300	M307.150
M256.700	M269.300	M281.450	M290.325	M307.175
M256.800	M269.325	M281.475	M290.350	M307.200
M256.875	M269.350	M281.500	M290.375	M307.225
M256.900	M269.375	M281.525	M290.400	M307.250
M257.200	M269.400	M281.550	M290.425	M307.275
M257.600	M269.425	M282.200	M290.450	M307.300
M257.625	M269.450	M282.225	M290.475	M307.325
M257.650	M269.475	M282.250	M290.500	M307.350
M257.675	M269.500	M282.275	M290.525	M307.375
M257.700	M269.525	M282.300	M290.550	M307.800
M257.725	M269.550	M282.325	M290.900	M307.900
M257.750	M269.575	M282.350	M291.100	M308.400
M257.775	M269.600	M282.375	M291.600	M310.800
M257.800	M269.625	M284.000	M291.625	M314.000
M257.850	M269.900	M284.600	M291.650	M316.050
M257.875	M270.100	M284.625	M291.675	M316.075
M257.900	M270.250	M284.650	M291.700	M316.100
M257.925	M270.275	M284.675	M291.725	M316.125
M257.950	M270.300	M284.700	M291.750	M316.150
M257.975	M270.325	M284.725	M291.775	M317.400

M317.425	M323.250	M346.400	M354.000	M377.100
M317.450	M323.275	M348.000	M354.025	M377.125
M317.475	M323.300	M348.600	M354.050	M377.150
M317.500	M326.200	M348.625	M354.075	M377.175
M317.525	M327.000	M348.650	M354.100	M377.200
M317.550	M327.025	M348.675	M354.125	M379.100
M317.575	M327.050	M348.700	M354.150	M379.125
M317.600	M327.075	M348.725	M355.600	M379.150
M317.625	M327.100	M348.750	M360.200	M379.175
M317.650	M327.125	M349.000	M360.600	M379.200
M317.675	M327.150	M350.200	M360.625	M379.225
M317.700	M327.800	M350.225	M360.650	M379.250
M317.725	M328.400	M350.250	M360.675	M379.275
M317.750	M335.500	M350.275	M360.700	M379.300
M317.775	M335.525	M350.300	M360.725	M379.900
M317.800	M335.550	M350.325	M360.750	M379.925
M318.100	M335.575	M350.350	M360.775	M379.950
M318.200	M335.600	M351.700	M360.800	M379.975
M318.800	M335.625	M351.800	M360.825	M380.000
M319.000	M335.650	M351.825	M360.850	M380.025
M319.100	M335.800	M351.850	M363.000	M380.050
M319.150	M336.400	M351.900	M363.025	M380.075
M319.200	M338.200	M351.950	M363.050	M380.100
M319.250	M338.225	M352.000	M363.075	M380.125
M322.300	M338.250	M352.050	M363.100	M380.150
M322.325	M338.275	M353.500	M363.125	M380.175
M322.350	M338.300	M353.525	M363.150	M380.200
M322.375	M338.325	M353.550	M363.175	M380.225
M322.400	M338.350	M353.575	M363.200	M380.250
M322.425	M339.800	M353.600	M363.225	M380.275
M322.450	M340.200	M353.625	M363.250	M380.300
M322.475	M341.700	M353.650	M370.850	M380.325
M322.500	M343.600	M353.675	M370.875	M380.350
M322.525	M343.625	M353.700	M370.900	M380.600
M322.550	M343.650	M353.725	M370.925	M381.400
M323.000	M343.675	M353.750	M370.950	M381.425
M323.025	M343.700	M353.775	M371.850	M381.450
M323.050	M343.725	M353.800	M371.875	M381.475
M323.075	M343.750	M353.825	M371.900	M381.500
M323.100	M346.250	M353.850	M371.925	M381.525
M323.125	M346.275	M353.875	M371.950	M381.550
M323.150	M346.300	M353.900	M371.975	M381.575
M323.175	M346.325	M353.925	M372.000	M381.600
M323.200	M346.350	M353.950	M377.050	M381.625
M323.225	M346.375	M353.975	M377.075	M381.650

M382.000	M385.500	M385.650	M387.125	M392.100
M384.400	M385.525	M387.000	M387.150	M397.850
M385.400	M385.550	M387.025	M388.200	M397.875
M385.425	M385.575	M387.050	M390.800	M397.90
M385.450	M385.600	M387.075	M391.900	
M385.475	M385.625	M387.100	M392.000	

SECTION 4. ATCT AND TRACON FREQUENCY ASSIGNMENTS

204. GENERAL. Whenever possible, frequency assignments are engineered to provide a radio service which is free from harmful interference within a prescribed volume of airspace. A certain amount of undesired aircraft-to-aircraft communications will have to be tolerated; however, pilot complaints of hazardous situations resulting from such radio interference should immediately be reported for remedial action.

a. Protection from co-channel and adjacent channel interference is provided by geographic separation of facilities and is dependent on the service volumes normally utilized.

b. The assignments outlined in Appendix 2 are identified by the location and operational function (LC, ground control (GC), etc.). They are afforded a degree of frequency protection based on knowledge of the service volumes normally required for these functions. At locations where ARTCC's provide AC service on terminal frequencies, caution should be exercised by the ARTCC's not to use the frequencies beyond their terminal protected service volume for AC. The following are typical terminal frequency protected service volume (FPSV) dimensions:

Service	FPSV (AGL)	Radius (NM)
Ground Control (GC)	100'	2 - 5
Clearance Delivery (CD)	100'	2 - 5
PAR (Military Radar)	5000'	15
Helicopter (HC)	5000'	30
Local Control (LC)	25,000'	30
Approach Control (AC)	25,000'	60
Departure Control (DC)	25,000'	60
Arrival Automated Terminal Information Service (ATIS)	25,000'	60
Automated Weather Observing System (AWOS)/Automated Surface Observing System (ASOS)	10,000'	25
Departure ATIS	100'	2 - 5

c. If discrepancies are noted between the operational use, location, etc., and that outlined in Appendix 2, they should be brought to the attention of the FMO.

SECTION 5. ARTCC/RCAG FREQUENCY ASSIGNMENTS

205. GENERAL. Frequency assignments are engineered to provide a radio service which is free from harmful interference within a prescribed volume of airspace. A certain amount of undesired aircraft-to-aircraft communications will have to be tolerated. However, pilot complaints of hazardous situations resulting from such radio interference should immediately be reported for remedial action.

a. Protection from co-channel and adjacent channel interference is provided by geographical separation of facilities and is dependent on the service volume.

b. The assignments outlined in Appendix 3 are identified by the RCAG location, altitude use, and controlling ARTCC. They are afforded a degree of frequency protection for use within certain sectors as indicated on sector charts provided by the respective ARTCC.

c. At selected locations, AC service is provided by ARTCC's utilizing the terminal assigned AC frequencies. The ARTCC's are cautioned not to use the ATCT shared frequencies beyond their protected service volumes.

d. If discrepancies are noted between the operational use, location, etc., and those listed in Appendix 3, they should be brought to the attention of the FMO.

206. Examples of En Route Dimensions:

Service	Altitudes (feet)		Radius (NM)
Super High En Route	> 45,000	AMSL	150
High En Route	45,000	AMSL	150
Intermediate En Route	25,000	AMSL	60
Low En Route	18,000	AMSL	60

SECTION 6. FLIGHT SERVICE STATION (FSS) VHF/UHF ASSIGNMENTS

207. FSS. FSS frequencies, including low or high altitude En Route Flight Advisory Service (EFAS), are located either at the FSS or at a nearby remote communications facility (RCF). FSS frequencies are protected as much as possible considering that many sites geographically within the radio line of sight (RLOS) use the same frequency. This is normally accomplished by separating FSS co-channel assignments by at least 100 NM, where possible.

a. Appendix 4 contains a list of frequencies currently available at each AFSS/FSS and at remote communications outlet (RCO) facilities controlled by regional AFSS's. If discrepancies are noted between the actual operating parameters, transmitter locations, facility coordinates, etc., and those listed in Appendix 4, they should be brought to the attention of the FMO.

b. Appendix 10 indicates which VOR facilities transmit either VOR voice and/or hazardous in-flight weather advisory service (HIWAS) information. Any discrepancies with Appendix 10 should also be brought to the attention of the FMO.

c. Noncovered Services. The following VHF aeronautical frequency services are not covered by this chapter, since all are controlled and authorized by the FCC. Refer to FCC Part 87 Rules and Regulations for details and frequencies.

(**1) Aviation Support.** Flying schools, soaring, ballooning, etc.

(2) Aeronautical Advisory (UNICOM). Fixed base operators.

(3) Multiple Use UNICOM (MULTICOM). A special use of UNICOM.

(4) Flight Test. Manufacturer's use for flight tests of aircraft or equipment.

(5) Operational Control. Airline's own use.

(6) SAR. As the name implies.

(7) Airport Utility. Non-FAA vehicles on airports.

SECTION 7. USE OF BASE, PORTABLE AND MOBILE (BP/M)

208. VHF/UHF AERONAUTICAL FREQUENCIES FOR BP/M PURPOSES. This category of operation is currently limited to the range of 118.000-136.975, 225.000-328.600, and 335.400-399.950 MHz. Emission is amplitude modulation (AM) and power is normally limited to 10 watts or less. The function is strictly for control of ground vehicles by the ATCT, communication with ground vehicles by the FSS, and communication between FAA ground personnel/vehicles and FAA Flight Inspection aircraft during a flight inspection. Any other communication in this range by BP/M stations, including vehicle-to-vehicle, is PROHIBITED.

209. FREQUENCY MODULATION (FM) NATIONAL RADIO COMMUNICATIONS SYSTEM (NARACS).

a. FM is limited to 5 kHz deviation, resulting in a 16KF3E emission designator. The separate emission designator 16KF1E is required for digital voice privacy.

b. The SW Regional High Frequency (HF) band frequency assignments are given in Appendix 6.

c. The following frequencies in the VHF band are authorized for any official FAA business where BP/M is required. Any combination of BP/M communications is permitted.

Repeater Frequencies	Repeater Transmit (MHz)	Repeater Receive (MHz)
CH 1	172.925	169.325
CH 2	172.950	169.350
CH 3	172.975	169.375
CH 4	172.850	169.250
CH 5	172.875	169.275
CH 6	172.900	169.300
CH 7	172.825	169.225

Non-Repeater Frequencies

CH 8	172.125
CH 9	172.150
CH 10	172.175
CH 11	166.175
CH 12	172.925
CH 13	172.950
CH 14	172.975
CH 15	172.850
CH 16	172.875
CH 17	172.900
CH 18	172.825

The SW Region's FM NARACS network is outlined in Appendix 6 of this order. If discrepancies are noted between the frequency, location, etc., and that outlined in Appendix 6, they should be brought to the attention of the FMO.

SECTION 8. EMERGENCY

210. HF REGIONAL EMERGENCY NETWORK. To provide for emergencies where catastrophic loss of wire communications might occur, long distance communications capability is needed. The Regional Emergency Network provides communication between ARTCC's, the Regional Office, the regional relocation site, other regions, and Civil Defense offices. This network is a part of the National and Civil Defense Emergency System. Authorized emissions are upper sideband (USB) or lower sideband (LSB), suppressed carrier resulting in a 3K00J3E characteristic or independent sideband (ISB) resulting in a 6K00B9W characteristic. To alleviate confusion, the carrier or dial frequency and the USB, LSB or ISB designator will be used when referring to these frequencies. The following HF frequencies are authorized for use by the FAA in the contiguous US:

a. Fixed point-to-point (PTP) use--1 kilowatt (kW) peak envelope power (PEP)--4055, 4625, 6870, 7475, 7611, 8125, 9914, 11637, 13457, 13630, 15851, 16348, 19410, 20852, and 24550 kHz (ISB, USB, and LSB) and 5860 kHz (USB only).

b. A/G use--1 kW (PEP)--3428, 5571, 8912, 11288, 13312, and 17952 kHz--(USB only).

c. When submitting to headquarters (HQ), each single sideband (SSB) frequency, as authorized by NTIA, is 1.5 kHz above or below the reference carrier frequency. For instance, a reference carrier frequency of 4625 kHz USB is listed by NTIA as 4626.5 kHz. ISB's are assigned on the carrier frequency.

d. The SW Region's HF NARACS network is outlined in Appendix 6 of this order. If discrepancies are noted between the frequency, location, etc., and that outlined in Appendix 6, they should be brought to the attention of the FMO.

211. EMERGENCY LOCATOR TRANSMITTER (ELT) TRAINING. Civil Air Patrol (CAP) and other SAR organizations require training in air search efforts for locating downed aircraft with a radiating ELT. 121.6, 121.65, 121.7, 121.75, 121.8, 121.85, and 121.9 MHz are the only frequencies that may be used for this purpose. The following agreement has been reached between the FAA and the CAP:

a. CAP units will contact the appropriate regional FMO at least seven calendar days prior to the date of intended use.

b. The FMO will notify the affected offices of the planned ELT training.

c. The CAP will coordinate with the appropriate FAA control facility prior to and during ELT training.

Any other SAR organization requiring such test training should be referred to the FMO.

212. SCENE-OF-ACCIDENT COMMUNICATIONS. A group of frequencies has been authorized for communications incident to the scene of an aircraft accident at remote locations. The equipment is packaged in a regional "Fly-Away Kit." Scene-of-accident communications have priority. The exact frequencies are not available for general publication due to the nature of their use.

SECTION 9. NON-DIRECTIONAL BEACONS (NDB)

213. GENERAL.

a. The bands 190-490 kHz and 510-535 kHz are allocated nationally for all low/medium frequency (L/MF) facilities. The specific frequency is selected by standard spectrum engineering criteria. The 285-325 kHz band is primarily allocated to the Maritime Navigation Service and available to the FAA only under certain conditions. NDB voice is not permitted in the bands 190-199.9, 285-324.9, and 415-535 kHz. The band 525-535 kHz is available to aeronautical radionavigation for offshore use only and on a non-interference basis to the Travelers Information Service (TIS).

b. A dual carrier NDB is an SSB system, but with a full carrier. It radiates a continuous wave (CW) carrier on the assigned frequency. The identification signal is provided by an on/off keying of a

second carrier, transmitted at a frequency signal equal to the first carrier plus the frequency of the modulation tone. A dual carrier system will be assigned a frequency equal to the selected frequency plus .51 kHz and its emission designator is 1K12XXA for an identification signal of 1020 hertz (Hz).

c. The NDB's located within the SW Region are listed in Appendices 8 and 9 of this order. NDB's which are solely used as compass locators at outer markers (LOM) are listed in Appendix 9 only. If discrepancies are noted between the frequency, location, etc., and that outlined in Appendices 8 or 9, they should be brought to the attention of the FMO.

214. DEFINITIONS.

a. Low-Power H (MH) - NDB for 25 NM at all altitudes with less than 50 watts power.

b. H - NDB for 50 NM at all altitudes with 50 to 1999 watts power.

c. High-Power H (HH) - NDB for 75 NM at all altitudes with 2000 watts or more power.

d. H-SAB - NDB with automatic transcribe weather service.

e. Compass Locator at Middle Marker (LMM) - Compass locator station installed at a middle marker (MM).

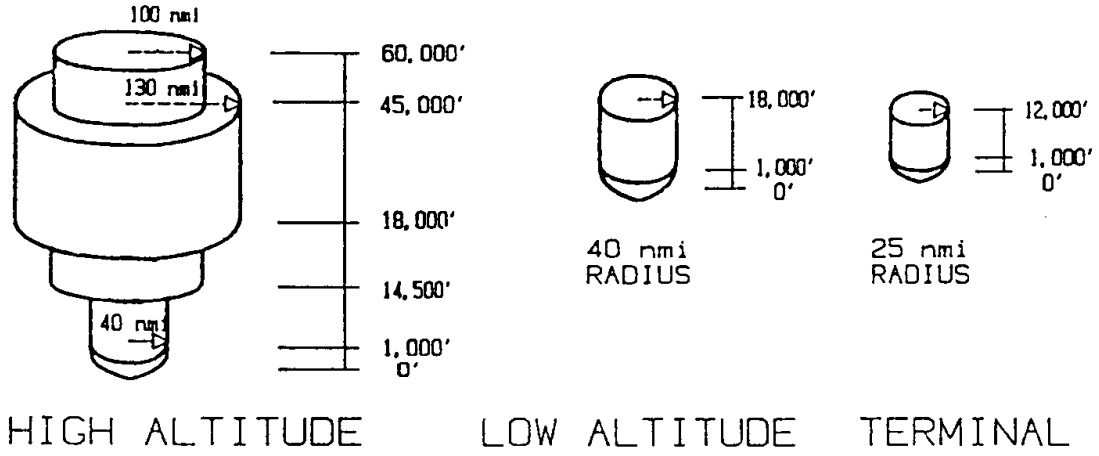
f. LOM - Compass locator station installed at an outer marker (OM).

g. H-SAB Not Authorized for Instrument Flight Rules (IFR) or ATC (SABH) - NDB not authorized for IFR or ATC and provides automatic weather broadcasts.

SECTION 10. VOR/TACAN/Distance Measuring Equipment (DME)/ILS/VOT

215. VOR. VOR's are allocated even-decimal and even-half-decimal frequencies from 108.0 to 111.85 MHz and every decimal and half-decimal frequencies from 112.00 to 117.95 MHz (see Figure 2-8). There are three different standard service volumes for VOR's (see Figure 2-7).

Figure 2-7 Service Volumes for VOR, DME/TACAN



The VOR's and their associated DME or TACAN, located within the SW Region are listed in Appendix 10 of this order. If discrepancies are noted between the frequency, location, etc., and that outlined in Appendix 10, they should be brought to the attention of the FMO.

216. ILS. ILS LOC's are allocated odd-decimal and odd-half-decimal between 108.1 and 111.95 MHz. The GS band is 328.6-335.4 MHz with a mixed paired allocation. A standard ILS has a FPSV of 18 NM from 1,000 up to 4,500 feet. A "super" ILS has an FPSV of 25 NM from 1,000 up to 6,250 feet (see Figure 2-9). ILS's, including markers, located within the SW Region are listed in Appendix 9 of this order. If discrepancies are noted between the frequency, location, etc., and that outlined in Appendix 9, they should be brought to the attention of the FMO.

Figure 2-8 CHANNEL AND FREQUENCY PAIRING WITH DME PULSE TIME/CODES

					DME AIRBORNE INTERROGATE			DME GROUND REPLY			
DME CHN NO.	FREQUENCY---MHz LOC	GS	VOR	MLS	MLS CHN NO.	NORMAL DME FREQ	µs	DME/P IA µs	FA µs	DME FREQ	PC µs
1X	-	-	-	-	-	1025	12	--	--	962	12
1Y	-	-	-	-	-	1025	36	--	--	1088	30
2X	-	-	-	-	-	1026	12	--	--	963	12
2Y	-	-	-	-	-	1026	36	--	--	1089	30
3X	-	-	-	-	-	1027	12	--	--	964	12
3Y	-	-	-	-	-	1027	36	--	--	1090	30
4X	-	-	-	-	-	1028	12	--	--	965	12
4Y	-	-	-	-	-	1028	36	--	--	1091	30
5X	-	-	-	-	-	1029	12	--	--	966	12
5Y	-	-	-	-	-	1029	36	--	--	1092	30
6X	-	-	-	-	-	1030	12	--	--	967	12
6Y	-	-	-	-	-	1030	36	--	--	1093	30
7X	-	-	-	-	-	1031	12	--	--	968	12
7Y	-	-	-	-	-	1031	36	--	--	1094	30
8X	-	-	-	-	-	1032	12	--	--	969	12
8Y	-	-	-	-	-	1032	36	--	--	1095	30
9X	-	-	-	-	-	1033	12	--	--	970	12
9Y	-	-	-	-	-	1033	36	--	--	1096	30
10X	-	-	-	-	-	1034	12	--	--	971	12
10Y	-	-	-	-	-	1034	36	--	--	1097	30
11X	-	-	-	-	-	1035	12	--	--	972	12
11Y	-	-	-	-	-	1035	36	--	--	1098	30
12X	-	-	-	-	-	1036	12	--	--	973	12
12Y	-	-	-	-	-	1036	36	--	--	1099	30
13X	-	-	-	-	-	1037	12	--	--	974	12
13Y	-	-	-	-	-	1037	36	--	--	1100	30
14X	-	-	-	-	-	1038	12	--	--	975	12
14Y	-	-	-	-	-	1038	36	--	--	1101	30
15X	-	-	-	-	-	1039	12	--	--	976	12
15Y	-	-	-	-	-	1039	36	--	--	1102	30
16X	-	-	-	-	-	1040	12	--	--	977	12
16Y	-	-	-	-	-	1040	36	--	--	1103	30
17X	-	-	108.00	-		1041	12	--	--	978	12
17Y	-	-	108.05	5043.0	540	1041	36	36	42	1104	30
18X	108.10	334.70	-	5031.0	500	1042	12	12	18	979	12
18Y	108.15	334.55	-	5043.6	542	1042	36	36	42	1105	30
19X	-	-	108.20	-	-	1043	12	--	--	980	12
19Y	-	-	108.25	5044.2	544	1043	36	36	42	1106	30
20X	108.30	334.10	-	5031.6	502	1044	12	12	18	981	12
20Y	108.35	333.95	-	5044.8	546	1044	36	36	42	1107	30
21X	-	-	108.40	-	-	1045	12	--	--	982	12
21Y	-	-	108.45	5045.4	548	1045	36	36	42	1108	30
22X	108.50	329.90	-	5032.2	504	1046	12	12	18	983	12
22Y	108.55	329.75	-	5046.0	550	1046	36	36	42	1109	30
23X	-	-	108.60	-	-	1047	12	--	--	984	12
23Y	-	-	108.65	5046.6	552	1047	36	36	42	1110	30

Figure 2-8 CHANNEL AND FREQUENCY PAIRING WITH DME PULSE TIME/CODES
(CONTINUED)

					DME AIRBORNE INTERROGATE			DME GROUND REPLY			
DME CHN NO.	FREQUENCY---MHz LOC	GS	VOR	MLS	MLS CHN NO.	NORMAL DME FREQ	µs	DME/P IA µs	FA µs	DME FREQ	PC µs
24X	108.70	330.50	-	5032.8	506	1048	12	12	18	985	12
24Y	108.75	330.35	-	5047.2	554	1048	36	36	42	1111	30
25X	-	-	108.80	-	-	1049	12	--	--	986	12
25Y	-	-	108.85	5047.8	556	1049	36	36	42	1112	30
26X	108.90	329.30	-	5033.4	508	1050	12	12	18	987	12
26Y	108.95	329.15	-	5048.4	558	1050	36	36	42	1113	30
27X	-	-	109.00	-	-	1051	12	--	--	988	12
27Y	-	-	109.05	5049.0	560	1051	36	36	42	1114	30
28X	109.10	331.40	-	5034.0	510	1052	12	12	18	989	12
28Y	109.15	331.25	-	5049.6	562	1052	36	36	42	1115	30
29X	-	-	109.20	-	-	1053	12	--	--	990	12
29Y	-	-	109.25	5050.2	564	1053	36	36	42	1116	30
30X	109.30	332.00	-	5034.6	512	1054	12	12	18	991	12
30Y	109.35	331.85	-	5050.8	566	1054	36	36	42	1117	30
31X	-	-	109.40	-	-	1055	12	--	--	992	12
31Y	-	-	109.45	5051.4	568	1055	36	36	42	1118	30
32X	109.50	332.60	-	5035.2	514	1056	12	12	18	993	12
32Y	109.55	332.45	-	5052.0	570	1056	36	36	42	1119	30
33X	-	-	109.60	-	-	1057	12	--	--	994	12
33Y	-	-	109.65	5052.6	572	1057	36	36	42	1120	30
34X	109.70	333.20	-	5035.8	516	1058	12	12	18	995	12
34Y	109.75	333.05	-	5053.2	574	1058	36	36	42	1121	30
35X	-	-	109.80	-	-	1059	12	--	--	996	12
35Y	-	-	109.85	5053.8	576	1059	36	36	42	1122	30
36X	109.90	333.80	-	5036.4	518	1060	12	12	18	997	12
36Y	109.95	333.65	-	5054.4	578	1060	36	36	42	1123	30
37X	-	-	110.00	-	-	1061	12	--	--	998	12
37Y	-	-	110.05	5055.0	580	1061	36	36	42	1124	30
38X	110.10	334.40	-	5037.0	520	1062	12	12	18	999	12
38Y	110.15	334.25	-	5055.6	582	1062	36	36	42	1125	30
39X	-	-	110.20	-	-	1063	12	--	--	1000	12
39Y	-	-	110.25	5056.2	584	1063	36	36	42	1126	30
40X	110.30	335.00	-	5037.6	522	1064	12	12	18	1001	12
40Y	110.35	334.85	-	5056.8	586	1064	36	36	42	1127	30
41X	-	-	110.40	-	-	1065	12	--	--	1002	12
41Y	-	-	110.45	5057.4	588	1065	36	36	42	1128	30
42X	110.50	329.60	-	5038.2	524	1066	12	12	18	1003	12
42Y	110.55	329.45	-	5058.0	590	1066	36	36	42	1129	30
43X	-	-	110.60	-	-	1067	12	--	--	1004	12
43Y	-	-	110.65	5058.6	592	1067	36	36	42	1130	30
44X	110.70	330.20	-	5038.8	526	1068	12	12	18	1005	12
44Y	110.75	330.05	-	5059.2	594	1068	36	36	42	1131	30

Figure 2-8 CHANNEL AND FREQUENCY PAIRING WITH DME PULSE TIME/CODES (CONTINUED)

					DME AIRBORNE INTERROGATE			DME GROUND REPLY			
DME CHN NO.	FREQUENCY---MHz LOC	GS	VOR	MLS	MLS CHN NO.	NORMAL DME FREQ	µs	DME/P IA µs	FA µs	DME FREQ	PC µs
45X	-	-	110.80	-	-	1069	12	--	--	1006	12
45Y	-	-	110.85	5059.8	596	1069	36	36	42	1132	30
46X	110.90	330.80	-	5039.4	528	1070	12	12	18	1007	12
46Y	110.95	330.65	-	5060.4	598	1070	36	36	42	1133	30
47X	-	-	111.00	-	-	1071	12	--	--	1008	12
47Y	-	-	111.05	5061.0	600	1071	36	36	42	1134	30
48X	111.10	331.70	-	5040.0	530	1072	12	12	18	1009	12
48Y	111.15	331.55	-	5061.6	602	1072	36	36	42	1135	30
49X	-	-	111.20	-	-	1073	12	--	--	1010	12
49Y	-	-	111.25	5062.2	604	1073	36	36	42	1136	30
50X	111.30	332.30	-	5040.6	532	1074	12	12	18	1011	12
50Y	111.35	332.15	-	5062.8	606	1074	36	36	42	1137	30
51X	-	-	111.40	-	-	1075	12	--	--	1012	12
51Y	-	-	111.45	5063.4	608	1075	36	36	42	1138	30
52X	111.50	332.90	-	5041.2	534	1076	12	12	18	1013	12
52Y	111.55	332.75	-	5064.0	610	1076	36	36	42	1139	30
53X	-	-	111.60	-	-	1077	12	--	--	1014	12
53Y	-	-	111.65	5064.6	612	1077	36	36	42	1140	30
54X	111.70	333.50	-	5041.8	536	1078	12	12	18	1015	12
54Y	111.75	333.35	-	5065.2	614	1078	36	36	42	1141	30
55X	-	-	111.80	-	-	1079	12	--	--	1016	12
55Y	-	-	111.85	5065.8	616	1079	36	36	42	1142	30
56X	111.90	331.10	-	5042.4	538	1080	12	12	18	1017	12
56Y	111.95	330.95	-	5066.4	618	1080	36	36	42	1143	30
57X	-	-	112.00	-	-	1081	12	--	--	1018	12
57Y	-	-	112.05	-	-	1081	36	--	--	1144	30
58X	-	-	112.10	-	-	1082	12	--	--	1019	12
58Y	-	-	112.15	-	-	1082	36	--	--	1145	30
59X	-	-	112.20	-	-	1083	12	--	--	1020	12
59Y	-	-	112.25	-	-	1083	36	--	--	1146	30
60X	-	-	-	-	-	1084	12	--	--	1021	12
60Y	-	-	-	-	-	1084	36	--	--	1147	30
61X	-	-	-	-	-	1085	12	--	--	1022	12
61Y	-	-	-	-	-	1085	36	--	--	1148	30
62X	-	-	-	-	-	1086	12	--	--	1023	12
62Y	-	-	-	-	-	1086	36	--	--	1149	30
63X	-	-	-	-	-	1087	12	--	--	1024	12
63Y	-	-	-	-	-	1087	36	--	--	1150	30
64X	-	-	-	-	-	1088	12	--	--	1151	12
64Y	-	-	-	-	-	1088	36	--	--	1025	30
65X	-	-	-	-	-	1089	12	--	--	1152	12
65Y	-	-	-	-	-	1089	36	--	--	1026	30
66X	-	-	-	-	-	1090	12	--	--	1153	12
66Y	-	-	-	-	-	1090	36	--	--	1027	30
67X	-	-	-	-	-	1091	12	--	--	1154	12
67Y	-	-	-	-	-	1091	36	--	--	1028	30

Figure 2-8 CHANNEL AND FREQUENCY PAIRING WITH DME PULSE TIME/CODES (CONTINUED)

					DME AIRBORNE INTERROGATE			DME GROUND REPLY			
DME CHN NO.	FREQUENCY---MHz LOC	GS	VOR	MLS	MLS CHN NO.	NORMAL DME FREQ	µs	DME/P IA µs	FA µs	DME FREQ	PC µs
91X	-	-	114.40	-	-	1115	12	--	--	1178	12
91Y	-	-	114.45	5073.6	642	1115	36	36	42	1052	30
92X	-	-	114.50	-	-	1116	12	--	--	1179	12
92Y	-	-	114.55	5074.2	644	1116	36	36	42	1053	30
93X	-	-	114.60	-	-	1117	12	--	--	1180	12
93Y	-	-	114.65	5074.8	646	1117	36	36	42	1054	30
94X	-	-	114.70	-	-	1118	12	--	--	1181	12
94Y	-	-	114.75	5075.4	648	1118	36	36	42	1055	30
95X	-	-	114.80	-	-	1119	12	--	--	1182	12
95Y	-	-	114.85	5076.0	650	1119	36	36	42	1056	30
96X	-	-	114.90	-	-	1120	12	--	--	1183	12
96Y	-	-	114.95	5076.6	652	1120	36	36	42	1057	30
97X	-	-	115.00	-	-	1121	12	--	--	1184	12
97Y	-	-	115.05	5077.2	654	1121	36	36	42	1058	30
98X	-	-	115.10	-	-	1122	12	--	--	1185	12
98Y	-	-	115.15	5077.8	656	1122	36	36	42	1059	30
99X	-	-	115.20	-	-	1123	12	--	--	1186	12
99Y	-	-	115.25	5078 4	658	1123	36	36	42	1060	30
100X	-	-	115.30	-	-	1124	12	--	--	1187	12
100Y	-	-	115.35	5079.0	660	1124	36	36	42	1061	30
101X	-	-	115.40	-	-	1125	12	--	--	1188	12
101Y	-	-	115.45	5079.6	662	1125	36	36	42	1062	30
102X	-	-	115.50	-	-	1126	12	--	--	1189	12
102Y	-	-	115.55	5080.2	664	1126	36	36	42	1063	30
103X	-	-	115.60	-	-	1127	12	--	--	1190	12
103Y	-	-	115.65	5080.8	666	1127	36	36	42	1064	30
104X	-	-	115.70	-	-	1128	12	--	--	1191	12
104Y	-	-	115.75	5081.4	668	1128	36	36	42	1065	30
105X	-	-	115.80	-	-	1129	12	--	--	1192	12
105Y	-	-	115.85	5082.0	670	1129	36	36	42	1066	30
106X	-	-	115.90	-	-	1130	12	--	--	1193	12
106Y	-	-	115.95	5082.6	672	1130	36	36	42	1067	30
107X	-	-	116.00	-	-	1131	12	--	--	1194	12
107Y	-	-	116.05	5083.2	674	1131	36	36	42	1068	30
108X	-	-	116.10	-	-	1132	12	--	--	1195	12
108Y	-	-	116.15	5083.8	676	1132	36	36	42	1069	30
109X	-	-	116.20	-	-	1133	12	--	--	1196	12
109Y	-	-	116.25	5084.4	678	1133	35	35	42	1070	30
110X	-	-	116.30	-	-	1134	12	--	--	1197	12
110Y	-	-	116.35	5085.0	680	1134	36	36	42	1071	30
111X	-	-	116.40	-	-	1135	12	--	--	1198	12
111Y	-	-	116.45	5085.6	682	1135	36	36	42	1072	30
112X	-	-	116.50	-	-	1136	12	--	--	1199	12
112Y	-	-	116.55	5086.2	684	1136	36	36	42	1073	30
113X	-	-	116.60	-	-	1137	12	--	--	1200	12
113Y	-	-	116.65	5086.8	686	1137	36	36	42	1074	30

Figure 2-8 CHANNEL AND FREQUENCY PAIRING WITH DME PULSE TIME/CODES (CONTINUED)

					DME AIRBORNE INTERROGATE			DME GROUND REPLY			
DME CHN NO.	FREQUENCY---MHz LOC	GS	VOR	MLS	MLS CHN NO.	NORMAL DME FREQ	µs	DME/P IA µs	FA µs	DME FREQ	PC µs
114X	-	-	116.70	-	-	1138	12	--	--	1201	12
114Y	-	-	116.75	5087.4	688	1138	36	36	42	1075	30
115X	-	-	116.80	-	-	1139	12	--	--	1202	12
115Y	-	-	116.85	5088.0	690	1139	36	36	42	1076	30
116X	-	-	116.90	-	-	1140	12	--	--	1203	12
116Y	-	-	116.95	5088.6	692	1140	36	36	42	1077	30
117X	-	-	117.00	-	-	1141	12	--	--	1204	12
117Y	-	-	117.05	5089.2	694	1141	36	36	42	1078	30
118X	-	-	117.10	-	-	1142	12	--	--	1205	12
118Y	-	-	117.15	5089.8	696	1142	36	36	42	1079	30
119X	-	-	117.20	-	-	1143	12	--	--	1206	12
119Y	-	-	117.25	5090.4	698	1143	36	36	42	1080	30
120X	-	-	117.30	-	-	1144	12	--	--	1207	12
120Y	-	-	117.35	-	-	1144	36	--	--	1081	30
121X	-	-	117.40	-	-	1145	12	--	--	1208	12
121Y	-	-	117.45	-	-	1145	36	--	--	1082	30
122X	-	-	117.50	-	-	1146	12	--	--	1209	12
122Y	-	-	117.55	-	-	1146	36	--	--	1083	30
123X	-	-	117.60	-	-	1147	12	--	--	1210	12
123Y	-	-	117.65	-	-	1147	36	--	--	1084	30
124X	-	-	117.70	-	-	1148	12	--	--	1211	12
124Y	-	-	117.75	-	-	1148	36	--	--	1085	30
125X	-	-	117.80	-	-	1149	12	--	--	1212	12
125Y	-	-	117.85	-	-	1149	36	--	--	1086	30
126X	-	-	117.90	-	-	1150	12	--	--	1213	12
126Y	-	-	117.95	-	-	1150	36	--	--	1087	30

Note: An additional 200 channels will be available in 2010.

Figure 2-9 Standard ILS Frequency Protected Service Volume (FPSV)

LOC FRONT COURSE FPSV'S

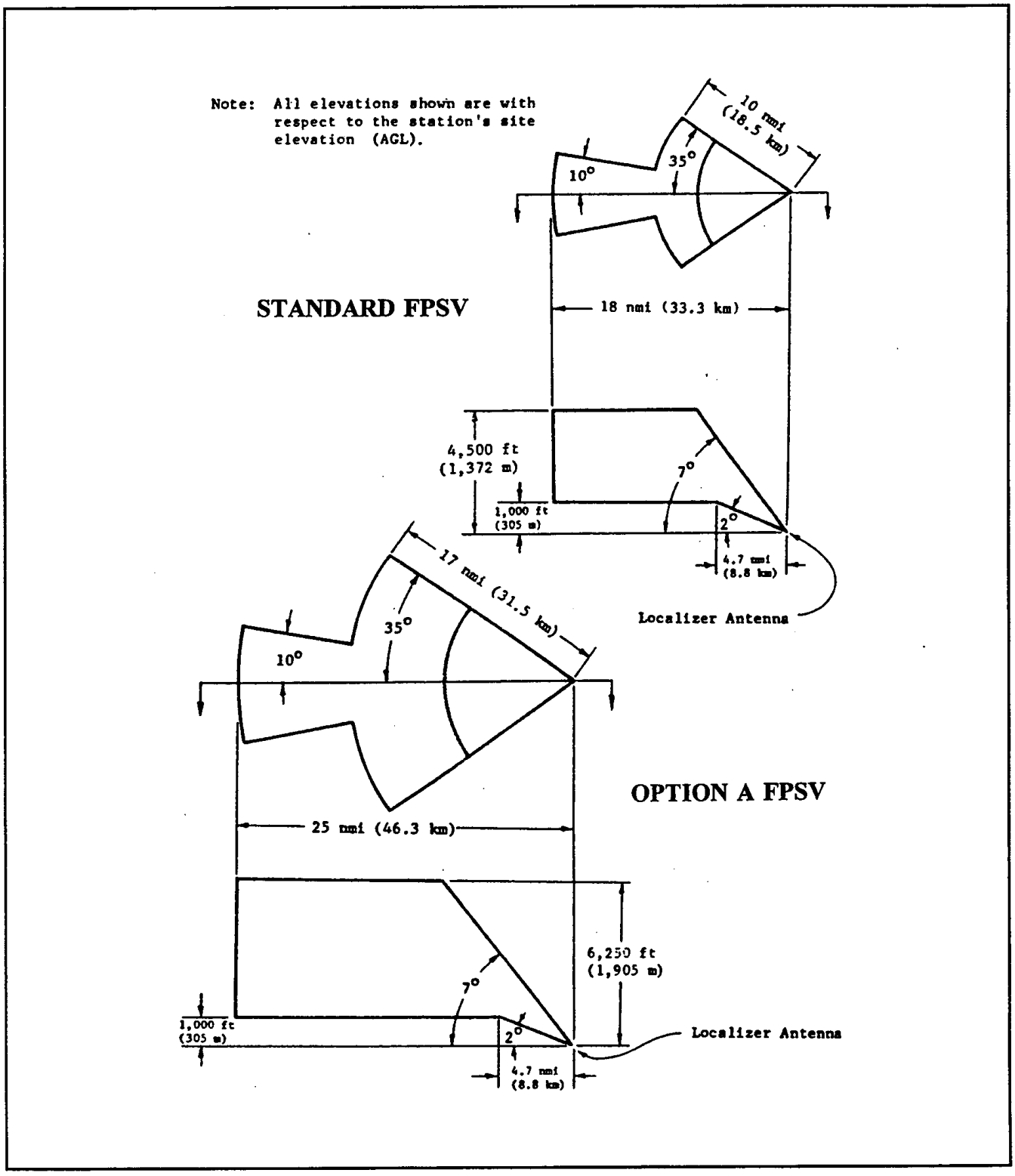


Figure 2-9 Standard ILS FPSV (continued)

LOC BACKCOURSE FPSV'S

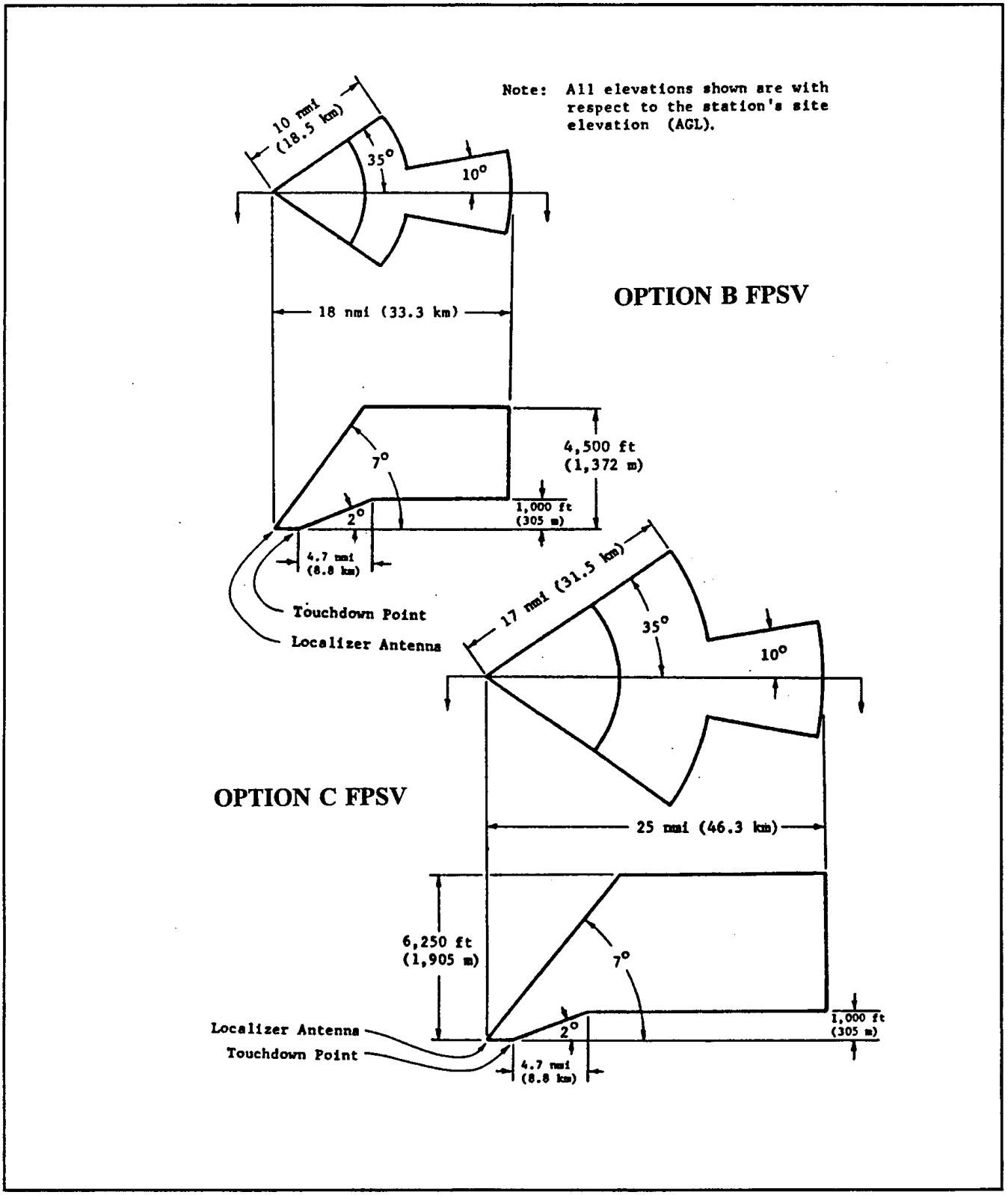
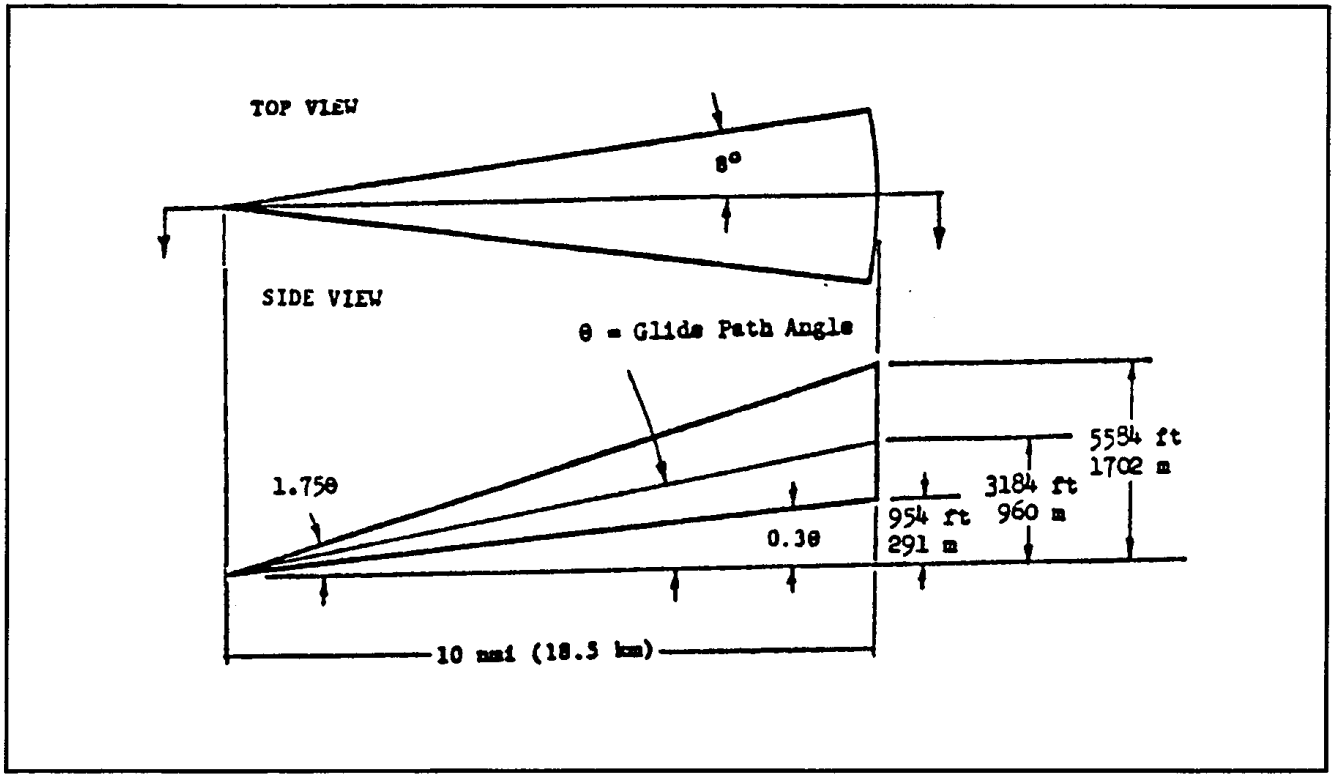
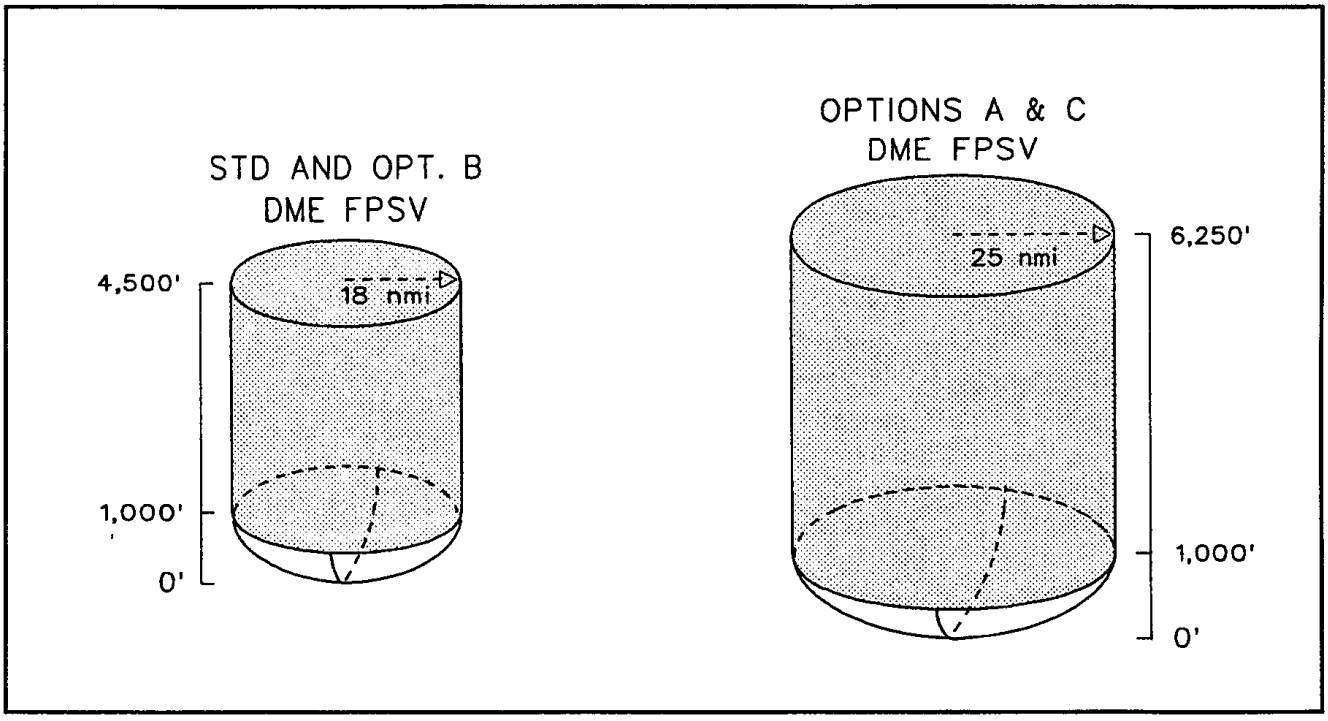


Figure 2-9 Standard ILS FPSV (continued)

FPSV FOR ILS GS



FPSV'S FOR DME'S ASSOCIATED WITH ILS



217. DME/TACAN. DME and TACAN frequencies are paired with ILS/VOR by International Civil Aviation Organization (ICAO) standards, except TACAN channels 1-16 and 60-69 which are unpaired and authorized for tactical military use only. When an ILS LOC or VOR frequency is assigned, the associated DME frequency is protected in the event of future installation. See Figure 2-8 for comprehensive ICAO frequency pairings of the NAVAID's listed above.

218. VHF OMNIDIRECTIONAL RANGE TEST (VOT). VOT's are assigned 108.0 MHz, 108.05 MHz, or a regular VOR frequency. VOR's should not be used for operational control on 108.0 or 108.05 MHz. VOT's located within the SW Region are listed in Appendix 10.

219. SPOT FREQUENCY. Markers are continuously operating low-power transmitters with antennas radiating signals in an upward direction in a fan shape. All markers operate on 75.0 MHz. Inner markers (IM), MM's, OM's, and backcourse markers (BCM) are categorically identified by different Morse Code class identifiers as follows:

a. OM: - - - - - - - - (continuous dashes @ 400 Hz)

b. MM: • - • - • - (alternating dots and dashes @ 1300 Hz)

c. IM: •••••••••••••• (continuous dots @ 3000 Hz)

d. BCM: •• •• •• •• •• (alternating pairs of dots)

SECTION 11. RADAR

220. GENERAL.

a. Most primary radars have two separate transmitters and receivers. Older radars operate only one transmit/receive (T/R) channel at a time. The other channel is normally tuned to another frequency and is used as a backup or an alternate system. For interference protection, it is desirable to separate the two frequencies as much as possible within the band. But in most areas of the country, the frequency congestion is so severe in each band that the two channels must be assigned frequencies that are separated by a few megahertz. Since the used channel is kept "hot", some frequency separation is necessary to prevent interference to the operating channel.

b. Diplex radars operate both channels simultaneously, although their actual transmitting time is usually separated in time so that the transmitted pulse of one is off while the transmitted pulse of the other is firing. The difficulty for the FMO is that the nature of the system requires a minimum frequency separation between the two channels.

c. The pulse repetition rate (PRR) is the number of pulses of energy per second (pps) transmitted by the system and is critical in the assignment of the associated ATC radar beacon system (ATCRBS). In ATC functions, the ATCRBS is usually tied to a primary radar and its PRR is equal to or a sub-multiple of the primary's PRR. In the case of staggered PRR, there is a basic clock relationship between the radar and ATCRBS.

d. Appendix 12 lists all radars, ATCRBS, and remote beacon performance monitors (RBPM) within the SW Region.

221. AIR ROUTE SURVEILLANCE RADAR (ARSR). The band 1240-1370 MHz is allocated exclusively for ARSR service. The ARSR's are generally very high power and long range radars. The coverage for an ARSR is about 200 NM. The ARSR-1 and ARSR-2 may be assigned two frequencies within 5-10 MHz of each other, since only one channel transmits at a time. The ARSR-3 operates in a diplex mode which requires at least 25 MHz separation between the two frequencies assigned. The ARSR-4, a joint US Air Force (USAF)/FAA project, requires less power than older radars, but has increased range. It is a diplex radar with two separate frequencies using a set pairing scheme.

222. AIRPORT SURVEILLANCE RADAR (ASR). The band 2700-2900 MHz is allocated for ASR service, however the band is shared with DOD ASR's and National Weather Service (NWS) radars. Since the FAA is the coordinating authority and responsibility is assigned to the FAA by NTIA, the FMO selects and recommends the frequency upon which all users will operate. Two frequencies are to be assigned, with at least 60 MHz separation, for diplex operations.

223. ATCRBS.

a. The frequency 1030 MHz transmit and 1090 MHz receive are allocated for ATCRBS. The system has had many names: radar beacon, secondary radar (SECRA), and the original identification--friend or foe (IFF) from its World War II origin. The military still uses the nomenclature IFF. A tolerance of ±.2 MHz will be maintained on the 1030 MHz assignment.

b. The entire national airspace system (NAS) automated system is keystoned upon ATCRBS, since it not only reinforces radar reflections, but is the only source of automatic aircraft altitude reporting. It is universally used by all aircraft (civil and military) as a ground interrogate/air transponder system. It is strictly controlled by PRR and power limitations. The legal maximum PRR is 450 pps for all users. A specific PRR is assigned each FAA ATCRBS and cannot be changed except through the FMO. All military IFF's have the same restriction. Enroute ATCRBS/IFF peak power is limited to 1.5 kW or less. Terminal ATCRB/IFF is normally limited to 300 watts peak power or less to minimize interference.

224. MODE-S BEACON SYSTEM. Mode-S beacon system is a combined secondary surveillance radar (beacon) and ground-air-ground data link system capable of providing the aircraft surveillance and communications necessary to support ATC automation. Mode-S systems are similar to ATCRBS in the use of 1030 MHz and 1090 MHz and will have the same PRF's.

225. RBPM. The RBPM program has been allocated the frequency 1090 MHz (± 3 MHz). The transmitters are operating at various locations throughout the region to serve all the ARSR sites and some of the ASR sites at the present time. Included in this category is the calibration performance monitor equipment (CPME) used for the Mode-S beacons.

226. PRECISION APPROACH RADAR (PAR). The band 9000-9200 MHz is allocated for PAR. There are several PAR's in service in the SW Region and are all operated by the military.

227. AIRPORT SURVEILLANCE DETECTION EQUIPMENT (ASDE). The band 15.7-16.2 gigahertz (GHz) is allocated for ASDE. Only a few ASDE's are currently operating. This band is shared with and subject to coordination with DOD as co-equal.

228. NEW SHARED BAND. The 3500-3700 MHz band of frequencies has been reallocated to include Aeronautical Radionavigation, which is the international term for those radars used in ATC. This band is available only when the 2700-2900 MHz band has no frequency available for a requirement.

229. NEXT GENERATION WEATHER RADAR (NEXRAD). NEXRAD is a joint DOD/FAA/NWS weather radar system. NEXRAD operates in the frequency band 2700-3000 MHz. The direction of the antenna beam continuously varies in azimuth and elevation. The NEXRAD utilizes varying PRR's and pulse durations.

230. TERMINAL DOPPLER WEATHER RADAR (TDWR). TDWR is an FAA short range weather radar. It is used for weather radar near airports. TDWR operates in the frequency band of 5600-5650 MHz. It is designed to identify microbursts, windshear, gust fronts, and precipitation. The TDWR antenna also varies in both azimuth and elevation.

SECTION 12. COMMUNICATIONS/VIDEO LINKS

231. GENERAL. Bands currently used by the FAA for radio links are shown in Figure 2-10.

Figure 2-10 Bands Currently Used by FAA for Radio Links

162-174 MHz	Land Mobile*	Very congested band
406.1-420 MHz	Land Mobile*	Very congested band
932-935 MHz	Fixed Station***	LDRCL
941-944 MHz	Fixed Station	LDRCL
1710-1850 MHz	Fixed Station**	LDRCL
7125-8500 MHz	Fixed Station	Radio Communications Link (RCL)
14.4-15.35 GHz	Fixed Station	TV Microwave Link (TML)
21.2-23.6 GHz	Fixed Station	Microwave links

* Specific frequencies are allotted for fixed operations such as Low Level Windshear systems (LLWAS), RMM, MALSR, etc. (See chapter 17.)

** New requirements for radio links will not be satisfied in the 1710-1850 band. Future LDRCL's will utilize 932-935/941-944 MHz, 7125-8500 MHz or 21.2-23.6 GHz. 1710-1755 MHz is to be transferred to the private sector due to Title VI of the Omnibus Reconciliation Act of 1993, on January 1, 1999.

*** New spectrum requirements for LLWAS by 1999.

Note: In addition, there are other bands for fixed radio links, such as 2200-2300 MHz, 4400-4990 MHz, 25.25-27.50 GHz, 36.0-38.6 GHz, etc., which also are available for FAA use.

All frequencies used for links systems, except for remote maintenance system (RMS), remote maintenance monitor (RMM), and AWOS/ASOS are listed in Appendix 7.

232. RCL. The RCL system for the SW region is complete and all frequencies have been assigned in the 7 to 9 GHz band. Any changes to a frequency on the RCL system must be engineered through FAA HQ in advance.

233. FREQUENCY ENGINEERING FOR LOW DENSITY RCL (LDRCL). As directed by Title VI of the Omnibus Budget Reconciliation Act of 1993, the 1710-1755 MHz portion of this band will be transferred to the private sector on January 1, 1999. FAA assignments in the 1710-1850 MHz band which are outside of a 150 kilometer (km) radius of the 25 largest cities in the US are "grandfathered" and will be allowed to remain. However, it is FAA policy that there will be no further FAA assignments in the 1710-1850 MHz band. Present and future assignments will be in the 7125-8500 MHz and 21.2-23.6 GHz bands.

234. TELEVISION MICROWAVE LINK (TML). The only purpose of the TML is to relay scan-converted, television (TV) type video from an indicator site to a monitor point such as a second control tower via the digital bright radar indicator tower equipment (DBRITE). The basic system consists of a transmitter site and a receiver site. Repeater sites are established when it is necessary to expand the remoting distance or avoid obstacles in the line-of-sight transmission path. TML operates in the 14.5000-14.7145 and 15.1365-15.3500 GHz bands.

235. 932-935/941-944 MHz MICROWAVE LINKS. Because of special frequency coordination considerations, three 932-935/941-944 MHz links have been established between the US and Mexico. These links are Brownsville/Matamoros, McAllen/Reynosa and El Paso/Juarez.

236. VHF/UHF Links. Various VHF/UHF link systems have been installed in the Rio Grande SMO. They are normally used to remote the VORTAC control signals to/from the remote maintenance control facility (RMCF) instead of using telephone company (TELCO) lines.

SECTION 13. USE OF AIR NAVIGATION FACILITIES BEYOND THE NORMAL FPSV

237. GENERAL. The usable distance and altitude (service volume) of aeronautical NAVAID's are determined by freedom and protection from RFI caused by co-channel or adjacent channel radio facilities. Geographical separation of NAVAID's is utilized to establish FPSV's. The responsibility for providing these theoretical interference-free service volumes is vested in the FMO. The FMO will also guarantee power availability of the signal at the extremity of the ESV.

238. PROCEDURES TO ACQUIRE AN ESV.

a. When developing new or revised procedures of any type, every effort should be made to develop them within the limits of the FPSV of airspace (normal service volume) associated with the facility class. This airspace is a cylindrical volume for NDB, VOR, DME, VORTAC, and TACAN, and a trapezoidal volume for ILS. The dimensions and latitudes of the various service volumes are defined in Section 10.

b. NAVAID's shall not be certified for use beyond the normal service volume unless the following criteria are satisfied:

(1) The FMO determines that the desired ESV (course, altitude, and distance) is theoretically frequency-protected in accordance with criteria in FAA Order 6050.32.

(2) The FMO determines that the required power availability at the extremity of the ESV can be obtained.

(3) A confirming flight check is accomplished.

(4) Co-channel and adjacent channel facilities which may cause interference are operating.

(5) A check is made with the power output of the facility being reduced to the monitor alarm limit (ILS LOC only).

(6) The ESV is flight checked on the even years (ILS LOC only).

(7) The final certification (course, altitude, and distance) is filed with the FMO and the FMO is informed of subsequent changes.

c. Requests for establishment of flight procedures or general operational use of a NAVAID beyond the normal service volume, an ESV, shall be submitted to the FMO on FAA Form 6050-4, Expanded Service Volume Request.

(1) The originator of the flight procedure or operational requirement shall forward all requests for an ESV on FAA Form 6050-4, Part I, to the FMO or as required per SW Supplement to FAA Order 7400.2, Procedures for Handling Airspace Matters.

(2) The form will then be processed according to SW Supplement to FAA Order 7400.2.

(3) The FMO will determine whether or not the desired theoretical frequency protection and signal strength can be provided and complete Part II of FAA Form 6050-4. The ESV will then be considered pending until the final action by the Flight Inspection Area Office (FIAO).

(4) FIAO will complete Part III of FAA Form 6050-4 and make distribution of the copies as indicated. Upon receipt of final action, the FMO will consider the ESV complete. These same steps will apply to an ESV modification or cancellation.

239. RESPONSIBILITY.

a. The originating offices, upon receipt of this order, will review Appendix 11 to ensure that all ESV requirements are recorded and are still valid. This tabulation does not include SW Region's requirements on other region facilities.

b. The FMO will inform the originating office of any changes in the theoretical frequency protection or areas of possible interference resulting from frequency changes, reclassification, new assignments, etc.

c. The originating office, upon receipt of any changes in the theoretical frequency protection or areas of possible interference resulting from frequency changes, reclassification, new assignments, etc., will take immediate action to limit use of the facility as necessary to assure interference free operation.

d. The FMO shall be responsible for interregional coordination, through channels, of matters concerning frequency interference and service volumes traversing regional boundaries.

SECTION 14. OBSTRUCTION EVALUATION (OE)

240. GENERAL. OE's are reviewed by the FMO when the proposed construction or alteration includes transmission of any frequency. The FMO is tasked with evaluating the proposed frequency in respect to the aeronautical effect from electromagnetic radiation and possible interference with both ground facilities and aircraft using such aids. The screening criteria, shown in Figure 2-11, is used to determine if the proposed frequencies require complete analysis. If the frequency or power of the proponent is other than listed in Figure 2-11, it must be examined.

Figure 2-11 Screening Criteria

Frequency (MHz)	Power	Required Distance (NM)
.535 - 1.605 (AM)	Any	3.0
5.25 - 801.25 (TV)	Any	10.0
88 - 108 (FM)	Any	30.0
150 - 170	up to 1 kW	4.5
400 - 600	up to 1 kW	4.5
800 - 1000	up to 1 kW	3.6

If an FAA facility is found to be within the above stated distances, further analysis shall be made.

SECTION 15. SPECIAL USE

241. TEMPORARY TOWERS. "Fly-ins", air shows, and certain other special AT functions require the use of frequencies at a temporary ATCT operated by AT controllers. Upon AT request, the FMO will authorize the required frequencies. The FMO will notify the appropriate sector of the selected frequencies by issuance of a temporary FTA. Non-Federal entities must apply for an FCC license for an air show frequency.

242. TESTING OF VHF/DIRECTION FINDER (DF) EQUIPMENT. Regular VHF frequencies used in VHF/DF require periodic testing and azimuth calibration. Use of discrete frequencies in portable/mobile transceivers or other low power devices for such testing is permissible without further authorization, provided transmitter radiation is limited to absolute minimum time required and the controlling AT facility is notified and concurs.

243. OTHER SPECIAL USE. The FMO will authorize frequencies for special use as required.

SECTION 16. SPECIAL SIGNIFICANT PROGRAMS

244. AWOS/ASOS Frequency Assignment Criteria. AWOS is an unmanned automatic sensing, processing, and voice-generating system which provides up-to-date information on weather conditions, such as altimeter setting, wind, temperature, dewpoint, etc., at non-tower and part-time airports with published instrument approaches and remote locations requiring updated weather information as an aid to air navigation. AWOS refers to any number of different types of automatic weather observation systems. One such system is the wind, altimeter, voice equipment (WAVE) system.

AWOS is comprised of government (FAA) procured systems or sponsor procured (commercial) systems approved by the FAA. A discrete VHF frequency will be used for the voice broadcast and should be one of the frequencies listed in paragraph 244 a(1)(d). The VHF frequencies for AWOS are limited to a service volume of 25 NM at 10,000 feet. Also, an FM data link may be used to transmit data from the sensors to the central control point; the 406-420 MHz band has been selected for this purpose. The AWOS frequencies are listed in Appendix 5.

ASOS is an NWS sponsored system similar to AWOS but provides additional weather information such as precipitation identification and intensity and freezing rain occurrence. The ASOS system has the same frequency engineering conditions as the AWOS system. The ASOS frequencies are also listed in Appendix 5.

a. The following criteria will be used to the maximum extent possible in selecting AWOS/ASOS voice outlets:

(1) Priority for selecting a frequency to support AWOS/ASOS voice outlets;

(a) At airports with ATCT', the AWOS/ASOS shall utilize the existing automated terminal information service (ATIS) voice outlet, if available. If the tower is operated part-time, the AWOS/ASOS shall operate independently of the ATIS during non-operational hours.

(b) At airports without ATIS, when the AWOS/ASOS facility will be within 3 NM of a non-Doppler VOR or VORTAC site, the AWOS/ASOS shall transmit weather information over the VOR frequency. This only applies to those VOR's that do not currently use the facility for other broadcast signals such as EFAS.

(c) If a VOR is not available, when the AWOS/ASOS facility will be within 3 NM of an NDB, the NDB shall be modified for voice and the AWOS/ASOS placed on the NDB frequency. This does not apply to two-frequency NDB's which are not capable of voice transmission. A frequency change will be required if the existing NDB frequency is not in the 325-425 kHz range.

(d) If no NDB is available, the AWOS/ASOS facility shall be assigned a discrete 25 kHz A/G frequency. To minimize the potential for interference, the following ten frequencies have been designated specifically for AWOS/ASOS use and must be considered before any other discrete frequency in the 118-137 MHz band:

118.325 MHz	119.925 MHz
118.375 MHz	120.000 MHz
118.525 MHz	121.125 MHz
119.025 MHz	124.175 MHz
119.275 MHz	128.325 MHz

(2) Power output of an AWOS/ASOS operating on a discrete VHF frequency channel shall not exceed 2.5 watts.

(3) Service volume of an AWOS/ASOS operating on a discrete VHF is normally limited to 25 NM and 10,000 feet AGL. Requirements in excess of this value must be approved by regional AT. Under no circumstances shall the radius of the service volume exceed the terminal area.

(**4) Frequency protection ratio (D/U)** for an AWOS/ASOS operating on a discrete VHF channel shall be a minimum of :

(a) 14 dB from an aircraft at the edge of the AWOS/ASOS service volume to another co-channel ATIS, AWOS, ASOS or an airborne interferer's air traffic control communications.

(**b) Beyond RLOS separation** from a potential interferer at the edge of an ATC service volume to the transmitter site of the AWOS/ASOS. (**Note**: The minimum separation is inclusive, i.e., both (a) and (b) must be met.)

(5) A letter of justification is submitted by the sponsor to the appropriate FMO identifying the need for a discrete VHF frequency.

(6) If the proposed AWOS/ASOS facility does not conform to requirements 1 through 5 of above, the FAA may not assign a broadcast frequency.

(7) It is highly encouraged that ATC assignments using any of the above frequencies be moved to another channel at the first practical opportunity. AWOS, ASOS, or ATIS assignments outside of the above listed frequencies need not be changed. However, if operational necessities require a frequency change, the new assignment should be made from the channel plan.

245. RMM. The RMM system is for monitoring of various components of the NAS system, i.e., the LOC, DME, GS, etc. A master unit will poll each of the components to be monitored by means of either FAA land lines or a UHF FM link. If a UHF FM link is used, it will be in the 406-420 MHz band. Refer to Appendix 13 for the RMM frequencies.

246. RMS. RMS is similar to RMM in that it has a master unit which polls each of the runway systems. However, the RMS includes the precision approach path indicator (PAPI), runway-end identifier lights (REIL), and medium-intensity approach lighting system with runway alignment indicator lights (MALSR) systems in addition to the ILS RMM system. A UHF FM link is also used in the 406-420 MHz band. Refer to Appendix 13 for the RMS frequencies.

247. LOW LEVEL WINDSHEAR ALERT SYSTEM (LLWAS). LLWAS performs a continuous comparison of the center field wind speed and direction with peripheral wind speed and direction. The system sequentially polls each remote station at a minimum rate of once each 10 seconds. A software defined alarm threshold is used to determine when a windshear alert is necessary. A central station does the interrogating, and the remote stations respond, on UHF FM frequencies normally in the band 406-420 MHz. Some systems that have not been modified are still operating on VHF frequencies in the band 162-174 MHz. (Refer to Appendix 13.)

248. APPROACH LIGHTING SYSTEM (ALS). ALS's can be controlled from aircraft and, in the case of a MALSR system, from ground facilities. The A/G system uses the common traffic advisory frequency (CTAF) and intermittently keys the aircraft transmitter three, five, or seven times. The lighting system will go off automatically 15 minutes later. The ground-to-ground system employs a VHF FM frequency with an encoder and a decoder. The MALSR ground-to-ground frequency is assigned one common frequency of 165.7625 MHz. Some MALSR ground-to-ground frequencies are still operating on other VHF frequencies in the 162-174 MHz frequency band and should be changed as soon as possible. (Refer to Appendix 13.)

249. TEN-YEAR REVIEWS. All FAA frequency assignments must be reviewed every ten years. The ten-year review process is designed to ensure accurate frequency assignments. Frequencies undergoing the ten-year review process must meet all the current criteria for that frequency assignment.

SECTION 17. MILITARY COORDINATION AND ASSIGNMENTS

250. MILITARY COORDINATION. The military must coordinate all frequencies for which the FAA is the national coordinator or conducts the engineering (see Figure 2-3) with the FMO. Once a new frequency, modification, or five/ten-year review assignment has been reviewed, a coordination number beginning with ASW and followed by a 6-digit number will be given to the military representative. The pending assignment, for the coordinated frequency, unless classified, will then be submitted to ASR-1 for approval and further coordination.

251. ELECTRONIC COUNTERMEASURES (ECM) MISSIONS/EXERCISES. Any ECM activity to be employed which will effect FAA frequency bands (other than normal daily routine) shall be coordinated with the FAA. This requirement has been laid down by HQ to prevent undue radio interference of a hazardous nature. Coordination with the FMO is the first step of the approval process. Military obligation in this regard is contained in Air Force Regulation 55-44. The ARTCC will receive the final coordination from the military prior to the ECM mission. The coordination with the ARTCC serves two purposes. The first is to verify that the ARTCC is aware of this activity and that they know the appropriate military personnel to contact in the event of interference. The second

is for the ARTCC to have the ability to deny or delay the ECM operation when safety-of-life or harmful interference is expected during the time frame of the ECM.

SECTION 18. FTA AND DOCUMENTATION

252. GENERAL. Every transmitter, on any frequency, must be properly authorized and registered in accordance with IRAC procedures. To accomplish this requirement, the FMO has established documentation procedures.

253. DOCUMENTATION. Fixed radio transmitters shall be operated only if a current frequency authorization exists as indicated by FAA Form 6050-1 (see Figure 2-12). Operation shall be limited to the power, emission, frequency, and location shown. Power indicated is the maximum permitted and is specified for input to the antenna or power divider. Installed or operating power may be less. An FTA will be issued for the frequency to tune up the new equipment and to permit commissioning thereafter as soon as normal procedures permit. It is the responsibility of the SMO to assure that the FTA is posted at the appropriate facility prior to use of the frequency and that the frequency is not used prior to the effective date. The FTA shall be posted in the transmitter building and mounted in a simple picture frame or placed in a plastic cover.

a. Each document will contain the type of facility authorized and a serial number. Modification of frequency or other parameters will require issuance of a new FTA.

b. When an FTA is issued, it will be sent to the action party or the appropriate SMO. The FTA will be retained by the SMO until transmitter tune-up is imminent. At that time, the new FTA will be posted to cover the transmitters.

c. Upon receipt of an FTA, the action party should check the actual facility installation as proposed against the FTA. Any deviation between the authorized parameters should be brought to the attention of the FMO immediately.

d. Special temporary frequency needs may require that action on frequency authorizations be taken more rapidly than the above procedure will permit. In these cases, the FMO will notify the appropriate parties by telephone/cc:mail and then send by facsimile (FAX) the new FTA to the appropriate SMO. Such telephone/cc:mail or FAXed information will constitute temporary authority to use radio frequencies. Such action will be followed by the original FTA, when the authorization is for a permanent facility.

Figure 2-12 Sample FTA

AUTHORIZATION NUMBER

SW 1053 C

UNITED STATES OF AMERICA
DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

FACILITY TRANSMITTING AUTHORIZATION

In accordance with authority granted the Federal Aviation Administration by the National Telecommunications & Information Administration through the Interdepartmental Radio Advisory Committee, this Authorization is issued for the operation of this facility.

FACILITY: HARLINGEN, TX COORDINATES: 26 13'35"N 097 39'43"W
SMO: GLF ELEVATION: 36'

FREQUENCY	FAC. TYPE	MAX. POWER	CLASS	TYPE OF SERVICE	COST CENTER	IDENT	FAA SERIAL	MISCELLANEOUS REMARKS
124.850 MHz	ATIS	10.0 W	FAB	ATIS/AWOS		HRL	840340	
172.900 MHz	MALSR	5.0 W	FX			SJT	766635	
169.300 MHz	NRCS	100.0 W	FX			HRL	901164	
		100.0 W	FX				901164	
		45.0 W	ML				901164	
		45.0 W	ML				901164	
169.325 MHz	NRCS	100.0 W	FX			HRL	901165	
		100.0 W	FX				901165	
		45.0 W	ML				901165	
		45.0 W	ML				901165	
409.175 MHz	RMM	5.0 W	FX			HRL	980071	
8150.000 MHz	TMLT	.5 W	FX			QU8	860081	
8350.000 MHz	TMLT	.5 W	FX			QU9	860082	

10 Mar 1998 — EFFECTIVE DATE
Southwest — FAA REGION
FREQUENCY MANAGEMENT OFFICER
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FAA Form 6050-1 (10-95) NSN: 0052-00-688-6001

e. Documentation of only the main and standby transmitters is required. Therefore, when a frequency is required at two sites, such as the mains at a remote transmitter (RT) site with the standbys at an ATCT, authorization is required at both sites. However, the emergency transceivers located at the ATCT do not require a separate authorization for use of the frequencies already assigned to the airport and do not need to be listed on the ATCT FTA.

f. If the FTA data needs correction, the AF SMO shall red-line a **copy** of the FTA (review for accuracy), complete SW Form 6050-1, and send it to the FMO.

254. EMISSION. The emission of a transmitted signal is identified by a characteristic symbol. That symbol consists of four parts:

a. A group of up to 5 digits representing the necessary bandwidth followed by one letter which represents the unit of bandwidth as follows:

H = Hertz
K = kiloHertz
M = MegaHertz
G = GigaHertz

b. A letter indicating the type of modulation of the main carrier;

N = Unmodulated carrier

Amplitude-Modulated

A = Double sideband
B = Independent sidebands
C = Vestigial sideband
H = Single sideband, full carrier
J = Single sideband, suppressed carrier
R = Single sideband, reduced or variable level carrier
K = Amplitude
F = Frequency (or phase)
P = Pulse

Angle-Modulated

F = Frequency modulation
G = Phase modulation

Amplitude-Modulation and Angle-Modulated

D = Amplitude and Angle Modulation either simultaneously or in a sequence

Pulse

P = Sequence of unmodulated pulses
K = Sequence of pulses modulated in amplitude
L = Sequence of pulses modulated in width or duration
M = Sequence of pulses modulated in position or phase
Q = Carrier is angle modulated during the period of the pulse
V = Combination of the foregoing produced by other means

Combination

W = Cases not covered above, in which an emission consists of the main carrier modulated, either simultaneously or in a combination of two or more of the following modes: amplitude, angle, pulse

X = Cases not otherwise covered

c. A letter or number indicating the nature of the signal modulating the main carrier;

0 = No modulating signal
1 = A single channel containing quantized or digital signals without the use of a modulating subcarrier. Does not include Time Digital Multiplexing (TDM).
2 = A single channel containing a quantized or a digital signal with the use of a modulating subcarrier.
3 = A single channel containing an analogue signal.
7 = Two or more channels containing quantized or digital signals.
8 = Two or more channels containing analogue signals.
9 = A composite system with one or more channels containing quantized or digital signals, together with one or more channels containing analogue signals.
X = Cases not otherwise covered.

d. A letter indicating the information to be transmitted;

N = No information transmitted
A = Telegraphy -- for aural reception
B = Telegraphy -- for automatic reception
C = FAX
D = Data transmission, telemetry, telecommand; separately or simultaneously
E = Telephony (Audio)
F = Television (Video)
W = Combination of the above
X = Cases not otherwise covered

Examples:

6KA3E (VHF/UHF A/G transmitter)

a. 6 kHz bandwidth
b. Amplitude Modulated (Double-sideband)
c. Analogue Signal
d. Voice telephony

2K04A2A (NDB)

a. 2.04 kHz bandwidth
b. Amplitude Modulated (Double sideband)
c. Containing a digital signal with the use of a modulating subcarrier
d. Telegraphy (aural)

6MM1D (Radar Beacon)

a. 6 MHz bandwidth
b. Sequence of pulses modulated in position or phase
c. Single channel containing quantized or digital data without the use of modulating subcarrier
d. Data transmission

Common FAA emission designators are shown in Figure 2-13.

255. Station Class. Station classes denote the use for which the transmitted signal is intended. Figure 2-14 also indicates the most common station classes versus FAA facility type.

256. FCC Forms. The following forms are to be used for a station license in the Aviation and Maritime Services:

a. FCC Form 405-A, Application for Renewal of Radio Station License.

b. FCC Form 406, Application for Ground Station Authorization in the Aviation Services.

c. FCC Form 503, Application for Land Radio Station in the Maritime Services.

d. FCC Form 1046, Assignment of Authorization.

Forms should be mailed to the Federal Communications Commission, 334 York Street, Gettysburg, Pennsylvania 17325. Inquiries should be directed to the Gettysburg Office at (717) 334-7631 or (717) 334-9167. (Check the internet at WWW.FCC.GOV for more information on this subject).

Figure 2-13 Typical Emission Designators/Station Classes for the FAA

FACILITY TYPE/FREQUENCY BAND	DESIGNATOR	STATION CLASS
NDB (single carrier) (190-535 kHz)	2K04A2A	RLB
NDB (two carrier) (190-535 kHz)	1K12XXA	RLB
Marker Beacon [75 MHz (OM)]	800HA2A	RLA
Marker Beacon [75 MHz (MM)]	2K60A2A	RLA
Marker Beacon [75 MHz (IM/BCM)]	6K00A2A	RLA
Localizer with voice (108.3-111.95 MHz)	6K00A9W	RLL
Localizer without voice (108.3-111.95 MHz)	2K04A1A	RLL
Glide Slope (328.6-335.4 MHz)	300HA1N	RLG
Glide Slope capture effect (328.6-335.4 MHz)	8K30A1N	RLG
DME (960-1215 MHz)	650KM1A	RL
DME/P (960-1215 MHz)	750KM1A	RL
TACAN (960-1215 MHz)	650KV1A	RL
VOR with Voice (108.2-117.9875 MHz)	20K9A9W	RLO
VOR without voice (108.2-117.9875 MHz)	20K9A2A	RLO
MLS (5000-5250 MHz)	150KM1D	RLL/RLG
Radar (TDWR) (5600-5650 MHz)	4M00P0NAN	WXD
Radar (ASR-9) (2700-2900 MHz)	5M00P0N	RLS
Radar (ASR-8) (2700-2900 MHz)	6M00P0N	RLS
Radar (ASR-7) (2700-2900 MHz)	8M00P0N	RLS
Radar (ARSR-4) (1215-1400 MHz)	5M00P0N	RLS
Radar (ARSR-3) (1215-1400 MHz)	6M00P0N	RLS
Radar (ARSR1/2) (1215-1400 MHz)	10M0P0N	RLS
Radar (ASDE-3) (15.7-16.2 GHz)	28M0P0N	LR
ATCRBS [1030 MHz - receive 1090 MHz)	6M00M1D	RL
Voice communications using double sideband (118-137 and 225-400 MHz)	6K00A3E	FA (enroute) FAC (AC, LC, DC, etc.) FAB (ATIS, AWOS, etc.) FLU (GC, CD, etc.)
HF (3-30 MHz)	1K28F1B	FX
	3K00J3E	FA
	2K80J3E	FB
	6K00B9W	etc.
RCL (7125-8500 MHz)	20M0F9W	FX
TML (14.4-15.35 GHz)	27M0F9W	FX

CHAPTER 3. REPORTING AND INVESTIGATING RFI

SECTION 1. RFI PROCEDURES

300. GENERAL. The RFI reporting program is being streamlined. The procedures listed in this chapter follow those in FAA Order 6050.22, Radio Frequency Interference Reporting.

301. PROCEDURES FOR RFI. In order to discharge frequency management responsibilities, the following interim guidelines are provided for RFI reporting.

a. Use the Maintenance Management System (MMS) in lieu of FAA Form 6050-3, Frequency Interference Report.

b. If there is an RFI-associated facility or service interruption, use the Log Interruption Report (LIR).

c. If there is no RFI-associated facility or service interruption, use the Log Line Frequency (LLF).

d. For both LIR and LLF:

(1) Enter 84 in the CODE CAT fields.

(2) Enter the duration of the RFI in the OPEN/START and ENTRY/CLOSE fields

e. RFI Investigation and Resolution:

(1) AF SMO personnel shall attempt to identify the RFI source. If identified, they may try to eliminate the interference by dealing directly with individuals located at the site.

(2) If the source is not immediately identified, the AF SMO involved will immediately notify the SW regional FMO. In all instances, the AF SMO shall report all unresolved cases to the FMO within 24 hours of the initial report.

(3) Regional FMO's will analyze each report and determine the action required to expedite resolution.

(4) If the interference resulted in a facility outage, significantly degraded the facility operation, contributed to an AT operational error, or contributed to a near mid-air accident, the regional FMO will immediately notify the National Maintenance Coordination Center (NMCC) and ASR-1.

(5) ASR-1 will determine whether HQ support will be provided.

(6) All interference cases requiring international coordination, including those with Mexico, shall be referred to ASR-1.

(7) Coordination with the FCC field engineering office and monitoring stations shall be through the regional FMO.

(8) Regional FMO's may request aircraft support from the FIAO directly and from the FAA Technical Center's Navigation/Spectrum/Power Systems Division (ACW-300), or other available resources, through ASR-1. Other types of aircraft support are also available through the FMO.

302. PROCEDURES FOR DELIBERATE RFI (Phantom Controller/Pilot). These procedures supplement the Interagency Task Force Agreement between the FAA, the Federal Bureau of Investigation (FBI), and the FCC dated August 1989 and are paraphrased from FAA Order 6050.22.

a. FAA AT Manager is responsible for all actions described in FAA Order 7210.3.

b. FAA Regional Operations Officer sets up conference call with the parties listed above.

c. AF SMO Manager or designee (Task Force Coordinator) will:

(1) Take action to verify if the reported interference is a valid phantom controller incident (with input provided from the FMO, security officer, and AT supervisor).

(2) If validated, notify the NMCC of the phantom controller situation and activate the task force, if appropriate.

(3) Designate a time and place for the task force to meet.

(4) Notify local FCC personnel if the regional FMO is not available.

d. Regional FMO will:

(1) Assist the task force coordinator in validation of the incident.

(2) Activate the task force if the task force coordinator is not available.

(3) Notify the appropriate FCC district office.

(4) Notify ASR-1.

(5) Participate with the FCC in the on-site investigation.

e. Local AF SMO personnel will:

(1) Provide assistance at airports during the investigation.

(2) Coordinate communications between the direction finding teams and AT.

f. Regional Security Officer will:

(1) Assist the task force coordinator in the validation of the incident.

(2) Activate the task force if the task force coordinator and the regional FMO are not available.

(3) Notify the local FBI personnel of the situation.

g. ASR-1 will:

(1) Notify HQ Security Office.

(2) Notify HQ FCC personnel.

(3) Provide additional guidance and resources to the task force if necessary.

h. HQ Security Office will:

(1) Notify HQ FBI personnel.

(2) Interface with the FBI and other Federal and local law enforcement agencies.

303. FCC LIAISON.

a. Background. In years past, the FCC has periodically requested that liaison contacts with the field be accomplished through a specific point source to prevent a series of requests from various individuals, leading to confusion rather than coordination. To that end, various interagency agreements have ensued.

b. Procedure.

(1) The FMO is the sole contact point in the region for liaison with the FCC for all frequency management, assignment, and interference matters.

(2) In doubtful circumstances, particularly after regular office business hours, contact the Regional Duty Officer for proper channeling of your call.

(3) When the FCC originates action with any field personnel involving problem areas, the problem should be immediately brought to the attention of the FMO directly or through the Regional Duty Officer.

SECTION 2. GENERAL RFI

304. INTERFERENCE PROBLEMS. Interference problems are numerous and endless. No one handbook, regardless of size, could describe symptoms and resolutions of all known problems. Certain basic considerations and procedures should be applied to any interference problem to form a solid basis for resolution.

a. Is the interfering signal "on channel"? In radar, this is usually the case. While the center operating frequency of the source is frequently a few megahertz removed from the affected radar, the source bandwidth will easily "hit" the affected receiver.

b. Is the receiver or interfering transmitter at fault?

(1) Is the transmitter (or interference source) actually radiating on the frequency to which the receiver is tuned? If so, resolution must be concentrated on reducing or eliminating this transmitter spurious radiation.

(2) Is the receiver responding to other than its intended-to-be received frequency? If so, the receiver or receiving conditions must be modified or improved.

(3) Determination of the above is absolutely essential, particularly when an interference source is outside the agency, since the basic premise of "cause must be resolved" is strictly adhered to.

c. The human ear is priceless in identifying interference sources. It is nearly always the sound that gives the source an identity. Careful listening to the signal or reviewing AT tapes can reveal such information as:

(1) Service -- whether it is police business, taxi dispatching, aeronautical, FM radio, etc.

(2) Emission -- pulse modulation such as radar, ATCRBS, and other pulse type emissions are recognizable by their characteristic "buzz".

(3) Nature -- the sweep of a frequency by an industrial heating device, the characteristic of a video field change "buzz", the rhythmic ticking of a timing circuit, and the musical sound of varying telemetry signal are examples.

(4) Duration/Time -- if the interfering signal is constant, varying, or periodic is an important indication as to the source. For example, if a radar is interfering, the exact radar can be determined just by timing the period between each interference pulse.

d. What solutions are possible other than a frequency change?

(1) Because of inevitable chain reactions, a frequency change to eliminate an interference problem will be accomplished **ONLY AS A LAST RESORT.**

(2) There are actions that can be taken at the local level to expedite resolution:

(a) Where the source is known to be FAA equipment, all available site preparations (i.e. relocating antennas, checking equipment, etc.) should be tried.

(b) If the source is other than FAA, make an attempt to identify it.

(3) If the source cannot be identified by monitoring, the FMO should be notified immediately. Only through the FMO, the FCC mobile DF may be available, other DF airborne assistance may be procured, or the FMO may provide direct assistance.

(4) In all cases, a little time spent in serious analysis and evaluation of the problem will save many hours of wasted time later.

e. An EMI van is operated by FMO. It is best used for interference that can be heard from the ground or when the interference source has been narrowed down to a small geographical area. If an unresolved interference problem exists, the EMI van may be used to help find the resolution.

305. NON-FAA TRANSMITTERS ADJACENT TO FAA SITES. Although the FAA does not always procure sufficient land to permit proper separation of undesired transmitters for effective interference prevention, the following three conditions are considered desirable:

a. Transmitter(s) and antenna(s) must be a minimum of 1,000 feet from the FAA equipment and antenna site. Check siting criteria orders for each class of equipment.

b. Antennas or buildings installed so that the top of their tower (including antenna) or buildings shall be below the FAA radiating system.

c. Equipment shall not cause harmful interference. In the event of any interference which occurs to the FAA as a result of the other user's operation, the other user shall cease operation until interference is eliminated and shall stand any expense incurred in the correction thereof.

306. TRANSMITTER OPERATING FREQUENCIES.

a. There are times when a simple solution to an interference problem is to change frequency, such as "exchanging" frequencies end-for-end on a VHF/UHF link. This type of unauthorized operation, while it may solve a local FAA problem, can cause serious repercussions in the form of interference to other FAA and non-FAA radio facilities, possible resultant loss of life and property, and criticism to the FAA.

b. Transmitter power as listed on the FTA is the maximum, not necessarily the operating power, authorized at that particular location and represents the power level when measured at the transmitter output.

307. TESTING ON EMERGENCY CHANNELS.

a. Excessive and unnecessary testing on 121.5/243.0 MHz derogates the basic emergency function of these two frequencies.

b. AF SMO routine maintenance will confine radiation to the barest minimum consistent with effective maintenance. Power and modulation tests will be made with a dummy load. The briefest possible operational check will be made when restoring the channel to normal operation.

SECTION 3. COMMUNICATIONS INTERFERENCE

308. GENERAL. This type of interference is by far the most common and is classified into three basic areas: internal, local, and external.

a. Internal interference is that generated within the communications receiver. "Birdies" are harmonics or spurious emissions generated by internal crystal oscillators or synthesizers used in the superheterodyne action. They manifest themselves as unmodulated carriers on specific frequencies, appearing constantly. You should not assume that because interference suddenly appears that it must be external. An aging crystal, "tweaking" of the oscillator during maintenance, and a change in a receiver voltage bus due to any cause can initiate a spurious signal where none had appeared before. Determination is simple, just remove the antenna from the receiver and ground the input terminal. If the signal remains, the source is internal and the receiver should be repaired.

b. Local interference is that caused by other sources in the same rack, room, or building. It is a signal generated by another transmitter or receiver, which causes a receiver response on the assigned frequency. You should not assume upon receiving an interference report that the interference just started. It could have been present since installation but only recently became noticeable. Problems can be masked by normal squelch settings and then become noticeable only when squelch is lowered or increased traffic on the frequency causes the squelch to be open more frequently. If intermods are suspected, they are easily recognizable by their mixture of two or more local frequencies, other than the victim. Some remedies are:

(1) Antenna relocation (vertical or horizontal separation).

(2) Receiver or transmitter relocation to another site.

(3) Removal of the receiver from the T/R relay in the transmitter.

(4) Cavity or crystal filter installation at the victim receiver input.

(5) Cavity or ferrite isolator installation at the transmitter outputs.

(6) A frequency change is absolutely the last resort, especially considering the ever-present danger that a change will create a new problem.

c. External interference can be caused by a myriad of sources, such things as heater thermostats, broken power pole, insulators, spark ignitors for gas heaters, plastic welders, etc. The problems can be divided into three categories: on channel, adjacent channel, and brute force.

(1) On channel interference occurs when a signal is generated that falls within the receiver bandpass of the assigned frequency. The victim receiver does not know the signal is spurious or a harmonic from a transmitter on an entirely different fundamental frequency. The initial task is to identify the signal (voice, pulse, etc.)

(2) Adjacent channel interference is essentially the same as co-channel, except that the signal is much stronger or much broader, so that part of the signal falls into the bandpass of the victim receiver.

(3) Brute force, also called front-end overload, is an exceedingly strong signal which might be anywhere in the spectrum. As an example, a 50 kW FM broadcast transmitter in the 88-108 MHz band a few hundred feet from an RCAG or remote transmitter/receiver (RTR) may completely overload the receiver. The result is desensitization of the receiver and usually the passing of the FM signal through the receiver. Brute force can also be in-band and near frequency. For instance, a receiver tuned to 125.55 MHz would undoubtedly receive devastating interference from a transmitter on 125.6 MHz in the vicinity. Adjacent channel or brute force problems can normally be cured by relocating the transmitter or receiver to achieve a separation of 1000 feet or more or by installation of a cavity or crystal filter.

SECTION 4. NAVAID INTERFERENCE

309. GENERAL. NAVAID interference is usually more difficult to identify. Generally, any interference is first noticed in the air by a pilot. Unless the source is very strong, there is a good possibility that it cannot be heard on the ground, except in the immediate vicinity of the source. A DF or a receiver with a signal level indicator should be used to locate a NAVAID interference.

a. Interference to a VOR occurring locally may be reported principally on an airport. In this case, it would be worth trying a ground search on and around the airport.

b. Interference to a VOR or LOC frequently is from FM broadcast stations, especially if they are in the upper part of the 88-108 MHz band, creating brute force and intermod problems in the airborne receiver when the aircraft nears the FM transmitter site. Unless the FM station is clearly identified by the reporting pilot, it will be necessary for the FMO or FIAO to observe the signal in the air.

c. Interference to a TACAN can be caused in two ways. Airborne reception can be affected by a source somewhere on the ground or the ground based TACAN receiver can receive interference

from any source nearby. Therefore, it must be determined if the interrogator or transponder frequency is being interfered with before any further investigation can be done.

SECTION 5. RADAR INTERFERENCE

310. PRIMARY RADAR. Interference to a primary radar is often difficult to locate. Primary radar interference is normally due to another search radar, although it can be caused by a harmonic of a lower frequency transmitter. If the interference is caused by another radar, it will appear as dotted spirals called "running rabbits," which appear to "run" as the radar rotates. Interference due to another radar is most likely to occur near a military base where frequent changes of radars are made by transient troop groups.

311. ATCRBS (IFF) INTERFERENCE. This type of interference is very difficult to resolve because all interrogators and transponders work on the same frequency (1030/1090 MHz) and are segregated only by PRR. Interference is usually from another interrogator which could be several hundred miles away. Interference will normally appear as intermittent false targets. This is because an aircraft can be illuminated by two different interrogators at nearly the identical times, resulting in both radars receiving both replies, offset in time. For this reason, ASR-1 is responsible for the assignment of all FAA radar PRR's.

SECTION 6. OTHER/SPECIAL INTERFERENCE

312. POWER LINE INTERFERENCE. When a power line carries interference, it acts as a Beverage antenna and can conduct the RFI for miles along its lines. This type of problem is best solved by "cruising" the lines coming into the facility and other lines nearby.

a. If it sounds like an electric motor, it could be anywhere from next door to several miles away. Driving along the line feeding the facility will show a gradually increasing/decreasing average signal, although there may be peaks as each power pole is passed. Electric motor RF noise can be cured only by fixing the problem at the source, probably with power line filters or additional or better grounding at the motor.

b. If it sounds like intermittent arcing, its probably a cracked or broken insulator on the pole crossarm. The utility company should be notified, stressing the safety of life and property aspect. Insulator arcing may occur at any time, but frequently starts after a long dry period when dust and dirt accumulate on the surfaces. Often the first heavy rain will clear up the problem, but a light rain could make matters worse.

313. VHF AND UHF CAVITIES AND RECEIVER CRYSTAL FILTERS. Where two or more VHF or UHF T/R frequencies are installed in near proximity, intermod or brute force interference may result. Improved selectivity by front-end filtering with cavity or crystal filters normally solves the problem. For interfering frequencies separated by 1 MHz for VHF, or 2 MHz for UHF, tuneable cavity filters are useful. The VHF is National Stock Number (NSN) 5915-00-309-0514. The UHF is NSN 5915-00-163-5690. Crystal filters for VHF frequencies separated by 100 kHz or more are very

effective. Contact the FMO for further details and for information on additional types of filtering devices.

314. RECEIVER LOCAL OSCILLATOR INTERFERENCE. The inexpensive VHF aviation receivers used by the general public often utilize 10.7 MHz as an intermediate frequency. When tuned to a frequency, the necessary superheterodyne conversion requires that the local oscillator frequency be ±10.7 MHz of the frequency tuned. If this ±10.7 MHz of the tuned frequency happens to fall on another aviation frequency utilized in the area, it can be a serious source of interference.

315. TV INTERFERENCE. The 75 MHz markers used in the ILS are frequently located in or very near residential homes. When this is so, interference to TV reception of Channel 5, and sometimes Channel 4, occurs. This is due to frequency adjacency. Channel 4 is 66-72 MHz; Channel 5 is 76-82 MHz. If this type of interference is reported to you, contact the FMO for assistance. DO NOT TOUCH the viewer's TV set.