ET Docket No. 93-59

UNITED STATES DEPARTMENT OF COMMERCE
National Telecommunications and Information Administration
Washington, D.C. 20230

JAN 17 1992

Dr. Thomas P. Stanley, Chief
Office of Engineering and Technology
Federal Communications Commission
1919 M Street, N.W.
Washington, D.C. 20554

Dear Dr. ~~Stanley~~ Tom:

NTIA has recently completed a process to provide spectrum for Government wind profiler radars. These radars are an important new technology that will provide wind speed and direction as a function of altitude. These radars can serve as an adjunct to a variety of functions including weather prediction, air pollution research, and severe weather warnings. For the majority of these applications, frequencies in the 200-500 MHz range are required. This valuable technology is expected to be used primarily by the Government but some non-Government operations are likely. For example, the National Oceanic and Atmospheric Administration (NOAA), an administration within the Department of Commerce (DOC), plans to operate a national network of wind profilers that will consist initially of 30 units with potential expansion to 200-300 units. In addition, there are non-Government wind profilers operating at universities primarily for research purposes.

To date, the majority of wind profiler radars have been authorized to operate on an experimental basis on the frequency 404.37 MHz. Since these radars point vertically, a number of national and international groups have expressed concerns about potential interference to the COSPAS/SARSAT satellite uplink frequency in the band 406 - 406.1 MHz, particularly objecting to the continuous operation of wind profilers on 404.37 MHz. Several design and operational enhancements have been employed to address this concern, including a feature to automatically inhibit transmission during an overhead pass of the COSPAS and/or SARSAT satellites. Nonetheless, in the U.S. there have been several reported cases of interference resulting from wind profilers using this feature. Therefore, the protection of a vital safety-of-life service would be placed at risk if wind profiler development were to continue at 404.37 MHz. Accordingly, NTIA will phase out existing Federal Government assignments at 404.37 MHz, and will not concur with new assignments, Government or non-Government, on this frequency.

NTIA undertook a study of several candidate frequency bands (see enclosures 1 and 2) to identify a suitable frequency for 200-500 MHz wind profiler operations. In addition, measurements were conducted to determine the impact of various waveforms from representative radars operating in the 420-450 MHz band to the NOAA wind profiler (to be published in February 1992).

Based on the information available and consultation with the agencies of the Interdepartment Radio Advisory Committee (IRAC), NTIA has selected 449 MHz for long-term Government wind profiler operations (see enclosure 3). Since Government radiolocation in the band 440-450 MHz is allocated on a primary basis to the military services and noting that the secondary allocation is to the amateur service, FCC action will be required.

Pursuant to selecting the frequency 449 MHz for Government wind profilers, personnel within the DOC have had discussions with representatives from the American Radio Relay League (ARRL) to develop steps that minimize the impact between wind profilers and the amateur service within the 440-450 MHz band. We will kept you posted of the results of those discussions.

To accommodate this important new technology we request the FCC to:

1. add the footnote GXXX contained in enclosure 3 into the National Table of Frequency Allocations which identifies 449 MHz for Government wind profiler operations,

2. participate in developing technical standards for wind profilers as stated in action 4 of enclosure 3, and

3. take appropriate actions to identify the long-term need for non-Government wind profiler radars.

NTIA stands ready to provide the Commission with whatever further assistance may be required to reach a sound national resolution of the subject concerning wind profiler accommodation. Please call me at (202) ~~377-1850~~ if you have any comments/questions or would like a briefing concerning this subject. 482-1850

Sincerely,

Richard D. Parlow
Associate Administrator
Office of Spectrum Management

Enclosures

enclosure 1 begins on page 14

(enclosure 1 is NTIA Report 91-280, which consists of 113 pages)

EMC ANALYSIS BETWEEN TYPE A WIND PROFILERS AND REMOTE PICKUP BROADCAST STATIONS

BACKGROUND

The Interdepartment Radio Advisory Committee (IRAC) requested the National Telecommunications and Information Administration (NTIA) to conduct a study to assess the 216-225 MHz, 400.15-406 MHz, and 420-450 MHz bands to assist in determining the appropriate part of the spectrum for mid-frequency (200-500 MHz) wind profiler radar operations. The NTIA study (IRAC DOC. 26985/1) was completed and presented to the IRAC in September 1990. The results of the study identified the 440-450 MHz band as the most suitable band for permanent accommodation of Government and non-Government wind profilers nationwide. Within the 440-450 MHz band, two candidate frequencies, 441 MHz (± 1 MHz bandwidth) and 449 MHz (± 1 MHz bandwidth), have been identified for wind profiler operations, each of which has certain advantages and disadvantages depending on the user. After further discussion among the various agencies and based on the information available, NTIA concluded that the frequency 449 MHz is the most suitable frequency for long term Government wind profiler operations.

As a result of the frequency 449 MHz being considered for Government wind profiler operations, the FCC Liaison to the IRAC requested NTIA to conduct an additional study to assess the potential impact between wind profilers and the Remote Pickup Broadcast (RPB) stations operating in the adjacent band 450-460 MHz. According to the National Table of Frequency Allocations, the 450-451 MHz and 455-456 MHz portion of the 450-460 MHz band are allocated to the land mobile service which the RPB stations operate.

ELECTROMAGNETIC COMPATIBILITY (EMC)

General

To determine the potential impact between wind profilers operating on 449 MHz (± 1 MHz bandwidth) and RPB stations operating in the 450-451 MHz and 455-456 MHz frequency bands, an EMC assessment was conducted. The method used to determine EMC was similar to that used in the NTIA report. Specifically, frequency-distance (F-D) curves were generated between wind profilers and environmental systems to show the distance separations necessary to preclude potential interference for given frequency separations. Since the wind profilers and the RPBs operate on known fixed frequencies, only the distance separation necessary to preclude interference for fixed frequency separations are given.

Remote Pickup Broadcast Characteristics (RPB)

The RPB system consists of a base and mobile stations (both ground and airborne). The FCC rules and regulations pertaining to the operation of RPBs are provided in the CFR Title 47 Part 74. The RPB bandwidths stated in the Commission rules range from 10 to 100 kHz for various modulation types. RPB characteristics were assumed similar to those used in land mobile operations. For this study, a typical RPB system with bandwidths of 25 kHz and 100 kHz were used to determine the effects of a narrow and wideband system. The assumed characteristics to represent typical RPBs operations are given in Table 1.

TABLE 1
ASSUMED REMOTE PICKUP BROADCAST CHARACTERISTICS

	Ground		Airborne
Bandwidth	25 kHz	100 kHz	25 kHz
Power	50 dBm Base/Mobile	50 dBm Base/Mobile	42 dBm Mobile
Emission designator	16K0F3	64K0F3	16K0F3
Antenna Gain	3 dBi Base 0 dBi Mobile	3 dBi Base 0 dBi Mobile	0 dBi Mobile
Emission Curve	-3 dB 3 kHz -20 dB 16 kHz -40 dB 18 kHz -60 dB 25 kHz	-3 dB 12 kHz -20 dB 64 kHz -40 dB 72 kHz -60 dB 100 kHz	-3 dB 3 kHz -20 dB 16 kHz -40 dB 18 kHz -60 dB 25 kHz
IF Selectivity Curve	-3 dB 16 kHz -20 dB 25 kHz -40 dB 28 kHz -60 dB 32 kHz	-3 dB 64 kHz -20 dB 100 kHz -40 dB 112 kHz -60 dB 128 kHz	-3 dB 16 kHz -20 dB 25 kHz -40 dB 28 kHz -60 dB 32 kHz
Noise level	-120 dBm Base/Mobile	-114 dBm Base/Mobile	-120 dBm Mobile
Antenna Height	30 m Base, 3 m Mobile	30 m Base, 3 m Mobile	1000 ft

Wind Profiler Characteristics

Only Type A wind profilers are considered in this study. Table 2 summarizes the Type A wind profiler characteristics.

TABLE 2
ASSUMED CHARACTERISTICS FOR TYPE A PROFILERS

	TYPE A	
	High Mode	Low Mode
Frequency (MHz)	404.37	404.37
Peak Transmitter Power (dBm)	72	69
Average Transmitter Power(dBm)	63.1	54.2
PRF (pulses per second)	6500	10,000
Chip Width (μs)	6.67	1.67
Pulse Width (μs)	20	3.35
Pulse Duty Factor (%)	13	3.3
Mainbeam Gain (dBi)	32	32
Antenna Halfpower Beamwidth (deg.)	5	5
Antenna Type	Co-Linear Coaxial	Co-Linear Coaxial
Antenna Beam Elevation Angle (Alternating, East, North, Vertical)	90, 75 deg	90,75 deg
Antenna Polarization	Linear	Linear
Noise Level (dBm)	-124.9	-120.2
Emission Spectra[a]	Figure 1	Figure 1
IF Selectivity Response	Figure 2	Figure 2
Average Antenna Off Axis Gain Values:		
	Angle Range (deg)	Gain (dBi)
	0-2.5	32
	2.5-15	10.7
	15-30	0
	30-60	-10
	60-90[b]	-20
	[85-90][c]	-25

[a] The emission spectra are assumed to be symmetrical about the carrier.

[b] For airborne calculations, antenna off-axis gain value of -20 dBi was used.

[c] The average gain at elevation angles near the horizon (less than 15 degrees, or antenna off-axis angles greater than 85 degrees) is on the order of -25 dBi for Type A profiles. This value is used for determining compatibility with surface systems.

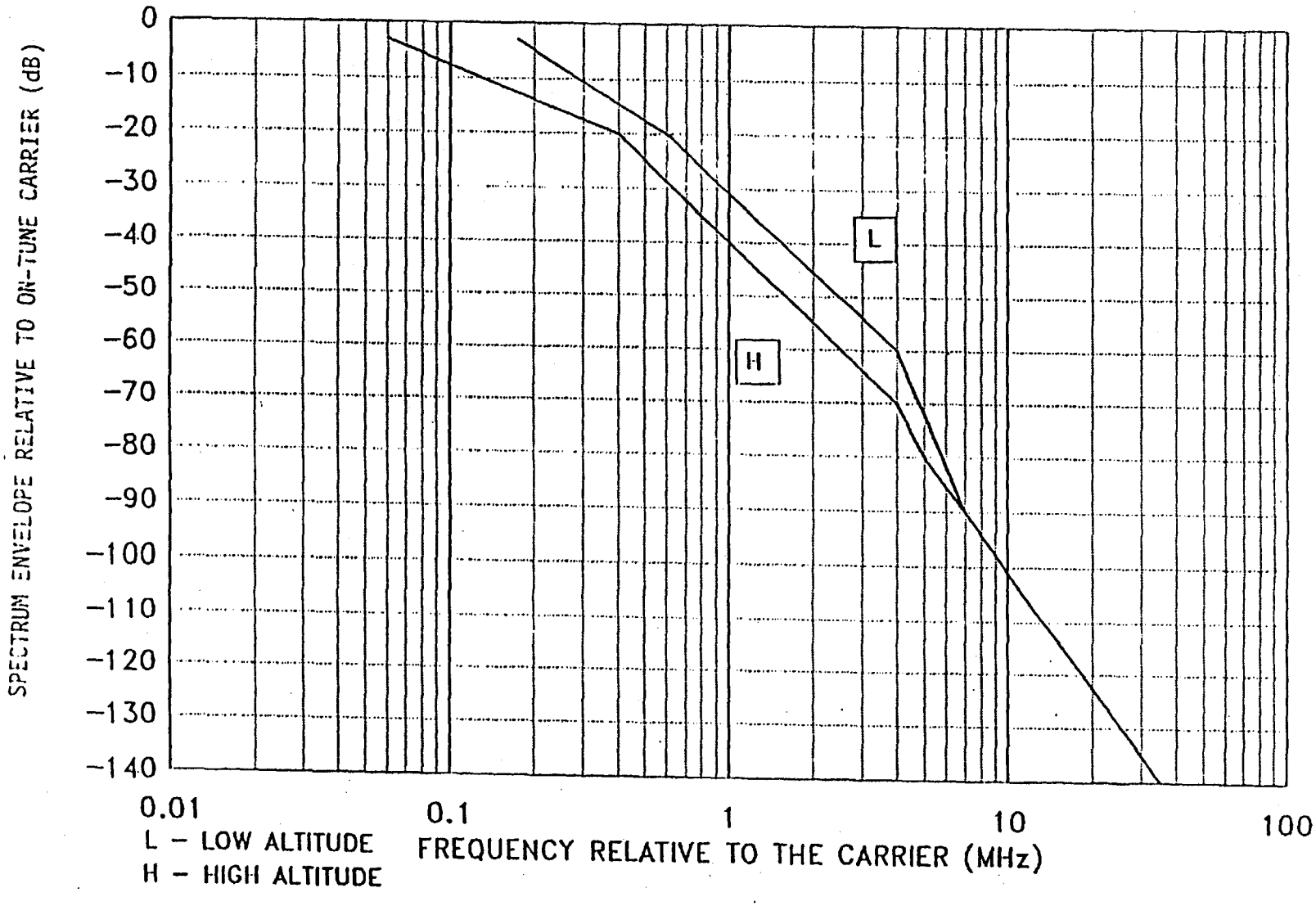

Figure 1. Type A Wind Profiler Emission Spectra.

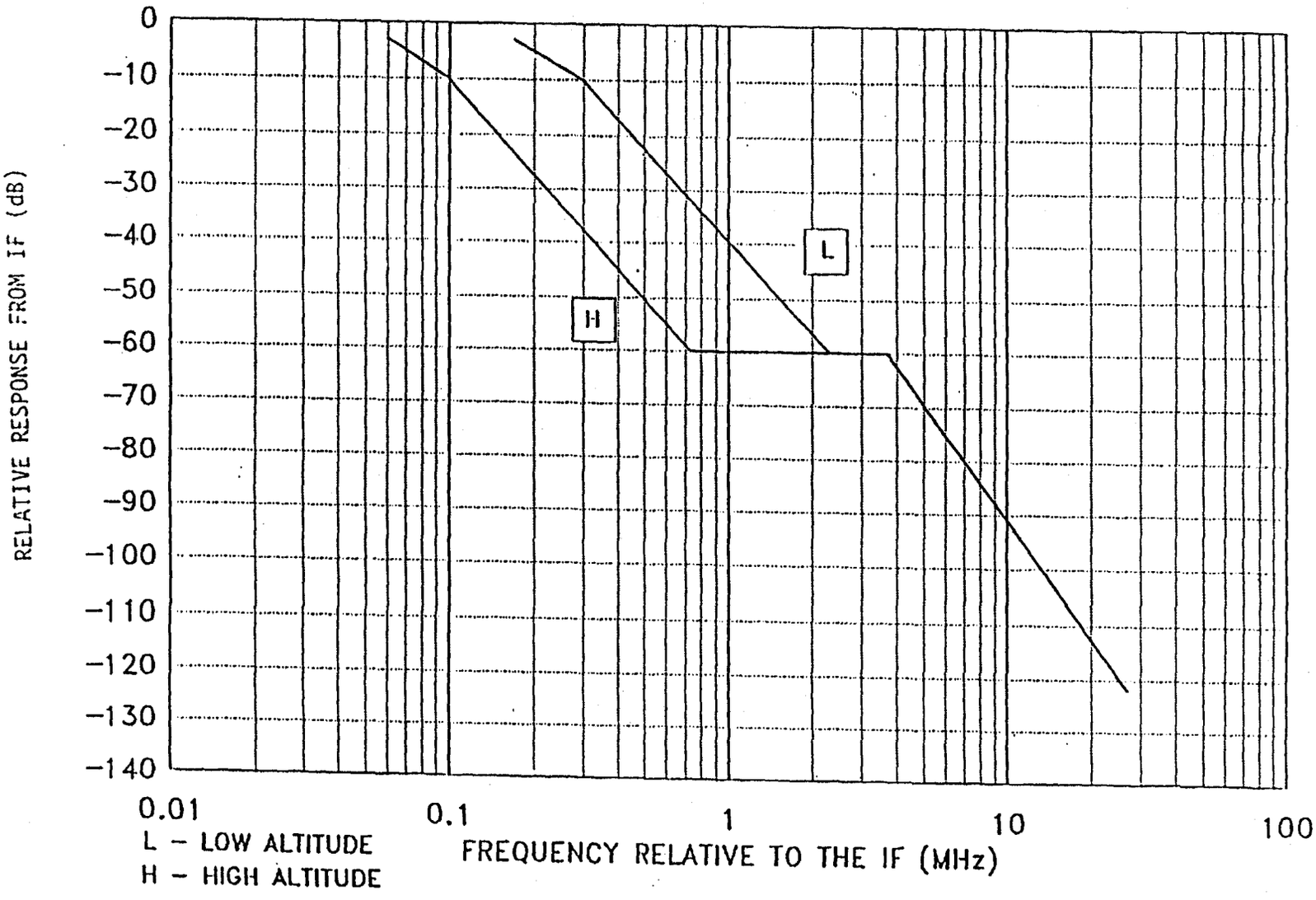

Figure 2. Type A Wind Profiler Selectivity.

EMC RESULTS

Ground Case

For the assumed bandwidths of 25 and 100 kHz the required distance to preclude interference between Type A wind profilers operating on 449 MHz and RPB ground base/mobile stations is 5 km for 1 MHz frequency separation (450 MHz operations) and 2 km for 2 MHz frequency separation (451 MHz operations). For 6 MHz frequency separation (455 MHz operation), no interactions are expected.

Airborne Case

For the assumed bandwidth of 25 kHz and altitude of 1000 feet, the distance necessary to preclude potential interference between Type A wind profilers operating on 449 MHz and RPB airborne stations is 15 km for 1 MHz frequency separation (450 MHz operations) and 5 km for 2 MHz frequency separation (451 MHz operations). In most cases the distance separations required to preclude interference will be satisfied since the location of airborne RPB operations are usually near major cities and wind profilers are expected to operate in remote areas. If interactions due occur, the effect is expected to be transitory in nature and can be reduced by increased frequency separation by the RPB systems (e.g., operate in 455-456 MHz band). However, there may be a potential for transitory front end overload effects at distance separations less than 0.5 km.

Enclosure 3

UNITED STATES DEPARTMENT OF COMMERCE
National Telecommunications and Information Administration
Washington, D.C. 20230

December 11, 1991

MEMORANDUM FOR: Executive Secretary, IRAC

FROM: Richard D. Parlow
Associate Administrator
Office of Spectrum Management

SUBJECT: Accommodation of Wind Profiler Radars

Wind profiler radars are designed to provide wind speed and direction as a function of altitude. They can serve as an adjunct to a variety of functions including weather prediction, air pollution research and severe weather warnings. Although wind profilers can operate over a wide range of frequencies, many of the more critical applications require frequencies in the 200-500 MHz range. It is expected that both Government and non-Government entities will use this technology.

To date, the majority of wind profiler radars has been authorized to operate on an experimental basis on the frequency 404.37 MHz. Since these radars point vertically, a number of both national and international groups has expressed concerns about potential interference to the COSPAS/SARSAT satellite uplink frequency in the band 406-406.1 MHz. Several design and operational enhancements have been employed to address this concern, including a feature to automatically inhibit wind profiler transmissions during an overhead pass of the COSPAS and/or SARSAT system. Nonetheless, in the U.S. there have been several reported cases of interference resulting from wind profilers using this feature. Therefore, the protection of a vital safety-of-life service would be placed at risk if development were to continue at 404.37 MHz.

NTIA studied three candidate bands (216-225 MHz, 400.15-406 MHz, and 420-450 MHz) to help determine where in the 200-500 MHz frequency range the wind profiler operations could be accommodated. The results of this study, IRAC Doc. 26985/1, indicate that there is no single frequency currently available on a primary basis to both Government and non-Government users and, as a result, additional spectrum sharing with current users of the bands and a change to the existing National Table of Frequency Allocations are required.

Same as NTIA Report 91-280

The study of the 216-225 MHz band concluded the frequency 219 MHz (with an authorized bandwidth less than or equal to 2 MHz) could accommodate wind profiler radars in

some geographic locations, subject to successful coordination with authorized users of the band and consideration of adjacent TV broadcast operations.

The NTIA study concluded that the 400.15-406 MHz band for long-term wind profiler operations is not suitable, since it would pose an unacceptable risk of interference to the safety-of-life COSPAS/SARSAT satellite system. Because of this threat, the study recommended that existing assignments of wind profiler radars in the 400.15-406 MHz band should be phased out.

The NTIA study concluded that the most suitable band for permanent accommodation of wind profiler radars nationwide is 440-450 MHz and identified two candidate frequencies (441 MHz and 449 MHz for wind profiler operations), each of which has certain advantages and disadvantages.

Currently, the 440-450 MHz frequency band is one-third of the only band below 1000 MHz (i.e., 420-450 MHz) allocated on a primary basis to the Government military radiolocation service. It is used for a number of major military land-based, shipborne, and airborne systems critical to the national defense. These systems perform functions such as the early warning of ballistic missile attack on the United States and long range search and track of potential hostile aircraft. The band is also allocated on a secondary basis to the amateur service. To accommodate Government non-military wind profiler users, a change to the National Table of Frequency Allocations would be necessary.

Subsequent to the completion of the NTIA study, measurements were conducted to determine the impact of various waveforms to the wind profiler from representative radars operating in the 420-450 MHz band. The results of the measurements indicated that low duty cycle radar signals produced no apparent degradation to wind profiler performance.

Of the three candidate bands studied, there is no agreement among the agencies in selecting a frequency for Government wind profiler operations. For example, the DOD agencies oppose considering the 420-450 MHz band since it is the only 30 MHz of contiguous spectrum below 1 GHz that can be used for future radiolocation operations. The Coast Guard opposes the use of the 400.15-406 MHz band for wind profiler operations because it may cause harmful interference to the safety-of-life COSPAS/SARSAT system. For the 216-225 MHz band, some agencies have suggested the band be given more favorable consideration for long term wind profiler operations. However, one DOD agency opposes considering this band since selecting the frequency 219 MHz has a probability of interference to one of the major DOD systems that currently operates in this band. Furthermore, to grant the requirement of primary status for wind

profiler operations in this band would be difficult due to RR627 which states that no new radiolocation stations may be authorized after January 1, 1990.

Based on the information available, NTIA concludes that the frequency 449 MHz (with an authorized bandwidth less than or equal to 2 MHz) appears to be the most suitable for wind profiler operations.

Accordingly,

1. NTIA will neither authorize additional Government wind profiler radars nor concur to frequency assignments for new non-Government wind profiler radars that operate in the 400.15-406 MHz band.

2. NTIA will revoke all existing Government wind profiler assignments in the 400.15-406 MHz band on September 30, 1993. Exceptions to this termination will be considered on a case-by-case basis.

3. NTIA will authorize Government wind profiler operations on the frequency 449 MHz. A footnote to accomplish this is as follows:

   GXXX - Government wind profiler radars may be authorized to operate on a primary basis in the radiolocation service on the frequency 449 MHz (with an authorized bandwidth less than or equal to 2 MHz) subject to the following conditions: 1) wind profiler locations must be pre-coordinated with the military services to protect fixed military radars, 2) wind profiler operations will receive no protection from military mobile radiolocation stations, and 3) wind profiler stations will provide protection to military mobile radiolocation stations that are engaged in critical national defense operations.

4. NTIA will implement spectrum standards for Government wind profiler radars operating on the frequency 449 MHz. These standards should be developed by the TSC with an effective date of January 1, 1994.

5. In addition, subject to successful coordination within the Frequency Assignment Subcommittee (FAS), Government wind profiler radars can operate on a non-interference basis on the frequency 219 MHz (with an authorized bandwidth less than or equal to 2 MHz).

enclosure 1

NTIA Report 91-280

ASSESSMENT OF BANDS FOR WIND PROFILER ACCOMMODATION

(216-225, 400.15-406, and 420-450 MHz Bands)

report series

U.S. DEPARTMENT OF COMMERCE • National Telecommunications and Information Administration

NTIA TR 91-280

ASSESSMENT OF BANDS FOR WIND PROFILER ACCOMMODATION

(216-225, 400.15-406, and 420-450 MHz Bands)

GARY PATRICK
MICHAEL RICHMOND

U.S. DEPARTMENT OF COMMERCE
Robert A. Mosbacher, Secretary

Janice Obuchowski, Assistant Secretary
for Communications and Information

SEPTEMBER 1991

ABSTRACT

This report presents an assessment of three candidate bands (216-225, 400.15-406, and 420-450 MHz) for the potential accommodation of Wind Profilers nationally, with consideration worldwide. The approach used to evaluate each band was based on two major factors: conformance to current regulations and electromagnetic compatibility (EMC). This report addresses current regulations, spectrum usage, and analyzes the EMC between two types of Wind Profilers and specific environmental systems for potential accommodation in three candidate bands. The results of this study can serve to indicate a suitable band and identify potential frequencies within that band to accommodate Wind Profiler operations.

KEY WORDS

216-225 MHz Band
400.15-406 MHz Band
420-450 MHz Band
Wind Profiler Radars
Electromagnetic Compatibility (EMC) Analysis

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SECTION 1

INTRODUCTION

BACKGROUND

The National Telecommunications and Information Administration (NTIA) is responsible for managing the Federal Government's use of the radio frequency spectrum. NTIA's responsibilities include establishing policies concerning spectrum assignment, allocation and use, and providing the various departments and agencies with guidance to ensure that their conduct of telecommunications activities is consistent with these policies. In discharging these responsibilities, NTIA assesses spectrum utilization, identifies existing and/or potential compatibility problems among the telecommunications systems that belong to various departments and agencies, provides recommendations for resolving any compatibility conflicts that may exist in the use of the frequency spectrum, and recommends changes to promote spectrum efficiency and improve spectrum management procedures. This report is concerned with the assessment of the 216-225, 400.15-406, and 420-450 MHz bands for possible wind profiler accommodation.

The Wind Profiler radar system provides real-time wind speed and direction values as a function of altitude. The primary role of the Wind Profiler is in weather forecasting; however, other applications have been identified including severe wind condition warnings, flight planning, space shuttle support, and pollution studies (acid rain and volcanic ash). Currently, wind speed and direction are determined by the National Weather Service (NWS) and other agencies by tracking the flight path of radiosondes which also provide information on temperature, barometric pressure, and relative humidity in the atmosphere as they rise. Radiosondes are expendable and are usually released twice daily. Although Wind Profilers are not direct replacements of radiosondes, Wind Profilers will provide regular, real-time wind speed and direction information. In addition, the Wind Profilers will also provide long-term cost savings through automated use, not requiring expendable equipment. The National Oceanic and Atmospheric Administration (NOAA), an administration within the Department of Commerce (DOC), plans to operate a national network of Wind Profilers that initially will consist of 30 units with plans for a total of 200-300 units. The Department of Defense (DoD) may share in the meteorological information obtained from the future DOC Wind Profiler network. Other Government and non-Government users of Wind Profilers are expected.

The concern with Wind Profiler operations is the selection of an appropriate operating frequency band(s). Propagation characteristics of the atmosphere require that the Wind Profiler system operate in the range 50-1000 MHz. Currently, there are three frequency ranges of particular interest: around 50 MHz, 200-500 MHz and around 900 MHz, each of which best accommodates a particular application. The Wind Profiler operations to date have been for experimental purposes at several research facilities. Since the DOC is establishing a 200-500 MHz national Wind Profiler network, all efforts to accommodate Wind Profilers have focused around that band.

No single frequency band is available to accommodate 200-500 MHz Wind Profiler operations for all users, Government and non-Government, without a change to the National Table of Frequency Allocations. Furthermore, the selection of any frequency band(s) must take into account potential international impact. For example, the Wind Profiler being developed for DOC at 404.37 MHz might be sold by its manufacturer to other countries where conscientious

attempts to protect operations such as COsmicheskaya Sistyema Poiska Avariynych (COSPAS-USSR acronym for Space System for Search of Distress Vessels) and Search And Rescue Satellite-Aided Tracking (SARSAT) system (406-406.1 MHz band) may not be made. In addition, a frequency band(s) selected solely on the basis of national usage may not be suitable for international usage, and, thus, national trade may be adversely impacted. As a result, the Interdepartment Radio Advisory Committee (IRAC) has requested that NTIA conduct an assessment of the 216-225 MHz, 400.15-406 MHz, and 420-450 MHz bands to assist in determining the appropriate part of the spectrum for mid-frequency (200-500 MHz) Wind Profiler radar operations.

OBJECTIVE

The objective of this task was to assess the 216-225 MHz, 400.15-406 MHz, and 420-450 MHz bands to help determine where in the spectrum Wind Profiler mid-frequency operations could be accommodated.

APPROACH

The approach used to evaluate each band for Wind Profiler operations was based on two major factors: conformance to current regulations and electromagnetic compatibility. These factors may be described briefly as:

1) conformance - The degree to which the Wind Profiler Radar meets National and International Tables of Frequency Allocations and technical standards. The Wind Profiler is a radar assumed to require accommodation on a primary basis for all users as a radiolocation station or as a meteorological radar station. However, it is noted that for some agency requirements, secondary status could be acceptable.

2) electromagnetic compatibility (EMC) - The EMC between Wind Profilers and existing systems was assessed nationally only.

Each frequency band was assessed as being:

<u>Suitable</u> - Conformance and EMC analysis support accommodation of Wind Profilers.

<u>Conditional</u> - Conformance and/or EMC analysis indicate that Wind Profilers may be accommodated under certain conditions.

<u>Unsuitable</u> - Conformance and/or EMC analysis indicate that Wind Profilers cannot be accommodated.