time during which the radar antenna's main lobe was aimed directly at the RSMS. Of course, if operational constraints allow it, the radar can be continuously pointed at the RSMS, permitting a very short dwell time, reducing the time required to complete the measurement. As the measurements are made, the measured data are graphed. The operator may add or subtract rf attenuation in 10-dB steps as required to keep the signal within the linear measurement range of the system. Software compensates for rf attenuation so that the graphed data are continuous and appear to have been measured by a system with larger dynamic range. In some extreme situations where the combination of preelection and attenuation did not' provide sufficient dynamic range, a notch filter--tuned to the radar center frequency--was inserted at the measurement system input. The insertion loss of the filter is compensated by the noise diode system calibration routine to give a correct center frequency power measurement for the radar spectra. Whenever operational constraints permitted, sequential frequency segments were measured until the received radar signal fell below system noise as illustrated by Figure 3a.

3. DATA ANALYSIS

The RSEC was established to help ensure an acceptable degree of electromagnetic compatibility among radar systems. A detailed explanation of the RSEC is found in section 5.3. of the Manual of Regulations and Procedures for Federal Radio Frequency Management (NTIA, 1980).

The RSEC bases an allowable emission bandwidth, B, on certain radar operational parameters including the radar type, transmitted power, pulse characteristics, frequency, and procurement or major overhaul date. For purposes of technical comparability, the same RSEC was applied to the spectra of all radars presented in this report, even though a different RSEC category may correctly apply to the spectra. For the -40 dB bandwidth we selected:

$$B_{(-40\ dB)} = \frac{7.6}{\sqrt{t\ t_r}}\ ,\ \text{or}\ \frac{64}{t}\ ,\ \text{whichever is less,}$$

where t = radar pulse width and t_r = radar pulse risetime.

It will be noted, Figure 5, for example, that the RSEC limit often starts several decibels above the peak response of the radar. This difference is from a correction factor that was added because the measurement bandwidth was larger than the emission bandwidth.

The data in the emission spectra measurements must be converted to power density (dBm/kHz) before the measurements can be compared to the RSEC. Since the RSEC is in relative terms (sidebands must be suppressed a certain number of dB below the power level at the fundamental frequency), it might seem reasonable to apply the RSEC directly to the measured and graphed emission spectra. This may be incorrect, however, if the radar is measured with bandwidths larger than l/t, because the peak detector operates on a different pulse shape at the fundamental than it does at the sidebands.

The net result of this phenomenon is that the peak energy in the sidebands is sometimes measured several decibels too high compared to the energy measured at the fundamental frequency.

The RSEC limits are shown as dashed lines on the emission spectra presented in sections 4, 5, 6, and 7. Additional information concerning the RSEC selection and computation is contained in the Appendix. Values from tables 1 through 4 were used to compute the RSEC for all of the radar spectra presented.

It should be noted that some of the parameters in the tables were not obtained by direct measurements on the listed radar. Logistic and time constraints did not permit the RSMS crew opportunities to make all of the measurements at every radar site. In the tables, wherever a measured parameter is required, a code letter from the following list is used to indicate where the value was obtained.

CODE

M - Measured by RSMS personnel

E - Estimated from best data available (radar operators or maintenance personnel, Radar Standards Handbook, etc.)

G - Government Master File (GMF) listings.

4. SPECTRA OF S-BAND SURVEILLANCE RADARS

The S-band surveillance radars represent the largest population of fixed radars in the United States. They are the primary users of the crowded 2700-2900 MHz band, and are the radars typically seen at most large airports and military air bases.

In this section are several spectra of older airport surveillance radars (ASR'S) using conventional magnetrons and one example of a more recent ASR using a klystron amplifier. Also included in this section is one example of a military tactical 3D surveillance radar. Note that, except for the GPN-20, all of the radars using a conventional magnetron exhibit the characteristic "porch", on