Radiation Study Concerning Application of

Radiocraft, Inc.

for a Transmit/Receive Ku Earth Station
in Southborough, Massachusetts

September 22, 2009

1. INTRODUCTION:

This study has been performed to estimate the potential radiation hazard that could exist in the vicinity of Radiocraft's transmit/receive Ku band earth station which employs the Prodelin 2.4 meter Model 1251 antenna.

This study has been prepared in accord with the Commission's Report and Order in General Docket No. 79-144, and follows the procedures described in ANSI Standard C95.3-1973, "Techniques and Instrumentation for the Measurement of Potentially Hazardous Electromagnetic Radiation at Microwave Frequencies," which was adopted by ANSI in 1972. This standard gives methods for predicting and measuring the expected power density levels in the vicinity of an antenna and is used throughout this study.

2. CALCULATION AND RESULTS:

The field in front of an antenna in this portion of the spectrum can be characterized by referring to two separate regions (a third region, the "reactive near-field" is not important at microwave frequencies). The "radiating near-field" is sometimes ccalled the Fresnel region. The approximate value of the maximum power density "W" in the radiating near-field for a circular transmitting antenna is given by the equation:

$$\mathbf{W = 4P/A}$$

Where P= radiated power, A = effective area of antenna

The maximum power reaching the antenna is the 4 Watt power output of the transmitter, minue 0.3 db of remote terminal feed loss. Thus:

$$\mathbf{P = 4W/1.07 = 3.73\ Watts}$$

The area of the 2.4 meter antenna is 5.76 meters^2.

$$\mathbf{W = (4 \times 3.73w)/5.76\ m^2 = 3.24\ W/m^2} \text{ or } \mathbf{W = 0.32\ mW/cm^2}$$

This maximum power density in the near field is below the limit of 5 mW/cm^2.

This maximum power density will not be present beyond the near-field region. The extent of the near-field region can be calculated as follows:

$$\mathbf{D = A/[2(\lambda)]}$$

where λ (lamda) is the wavelength in consistant units.

Thus:

$$\mathbf{D = 5.76/2(0.21)\ meters = 137.1\ meters}$$

The far-field must also be analyzed to determine the expected level of radiation. The approximate free=space power density on the beam axis in the far-field region may be determined by:

$$\mathbf{W = AP/(\lambda)^2\ D^2}$$

where D is the distance from the antenna

By setting W = 5mW/cm^2, and solving for D we can determine the maximum distance from the antenna where the RPGL (Radiation Protection Guidelines) will be exceeded:

$$\mathbf{D = [A\ P/(\lambda)^2\ D^2\ ]\ 1/2}$$

$$\mathbf{= [5.76(3.73)/(0.005)10^4(0.021)^2]\ ½ = 48.7\ meters}$$

Since the maximum distance from the antenna where the RPGL will be exceeded is actually in the near field region, one can omit this particular requirement as it is conclusive that near-field measurements only need to be considered.

Another region to be investigated is the edge of the primary reflector. If the power were evenly distributed over the surface of the dish, that is, if the aperture illumination were uniform, the power density would be:

$$\mathbf{W = P/A = 3.73W/5.76m^2 = 0.64mW/cm^2}$$

This is a level below the RPGL limit. As is the case with all earth station antennas, the illumination is actually tapered to achieve lower sidelobe levels. Tapers on the order of 20 dB are typical. With such an illumination taper, the power density at the edge of the antenna will be considerably below this value.