Exhibit C

Radiation Hazard Study

1.0 Introduction

This study analyzes the radiation hazard environment produced by 1.2 meter Ku-band antenna with a maximum power of 1.7 Watts into the antenna feed. The reference document for this study is OET Bulletin No. 65, Edition 97-01, *Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields*, August 1997.

2.0 Earth Station Antenna Parameters

Major Axis (M) = 1.2 meters

Minor Axis (m) = 1.2 meters

Wavelength (λ) = 0.021 meters at 14.25 GHz

Maximum power to the antenna (P) = 1.7 Watts

1.2 meter antenna gain (G) = 43.3 dBi at 14.25 GHz

1.2 meter antenna efficiency (η) = 0.65

Area of Reflector (A) = 1.13 m^2

Area of the Feed (a) = 0.0167 m^2

3.0 Region Definition

The limit of the near field (R_{nf}) and the beginning of the far field (R_{ff}) are calculated as follows:

Near Field Extent

$$R_{nf} = \frac{M^2}{4\lambda}$$

$$R_{nf} = 1.2^2 / (4 * 0.021) = 17.2 \text{ m}$$

Far Field Extent

$$R_{ff} = 0.6 \frac{M^2}{\lambda}$$

$$R_{ff} = (0.6)(1.2^2)/(0.021) = 41.2 \text{ m}$$

The region between 17.2 m and 41.2 m is designated as the transition region.

4.0 Power Density Calculations

4.1 Near Field Region

The on-axis near field power density is calculated as follows:

$$S_{nf} = \frac{4\eta P}{A}$$

$$S_{nf} = \frac{(4)(0.65)(1.7)}{1.13}$$

$$S_{nf} = 3.9 \text{ W/m}^2 = 0.39 \text{ mW/cm}^2$$

The maximum on-axis power density in the near field region is is $S_{nf} = 0.39$ mW/cm^2. This meets the Uncontrolled Exposure limit of 1.0mW/cm^2 found in Appendix A or OET Bulletin 65. The off-axis power density in the near field will always be less than the on-axis power density and therefore all volumes within the near field will meet the Uncontrolled Exposure limit of 1.0mW/cm^2.

4.2 Transition Region

The on-axis power density in the transition region is calculated as follows:

$$S_t = \frac{S_{nf} R_{nf}}{R}$$

The maximum on-axis power density in the transition region is when $R = R_{nf}$ at which point the power density is $S_t = S_{nf} = 0.39$ mW/cm^2. This meets the Uncontrolled Exposure limit of 1.0mW/cm^2 found in Appendix A or OET Bulletin 65. The off-axis power density in the transition region will always be less than the on-axis power density and therefore all volumes within the transition region will meet the Uncontrolled Exposure limit of 1.0mW/cm^2 found in Appendix A of OET Bulletin 65.

4.3 Far Field Region

The on-axis power density in the far field region is calculated as follows:

$$S_{ff} = \frac{PG}{4\pi R_{ff}^2}$$

$$S_{ff} = \frac{(1.7)(10^{(43.3/10)})}{(4)(3.14)(41.2)^2}$$

$$S_{ff} = 1.70 \text{ W/m}^2 = 0.170 \text{ mW/cm}^2$$

The maximum on-axis power density in the far field region is is $S_{ff} = 0.170$ mW/cm^2. This meets the Uncontrolled Exposure limit of 1.0mW/cm^2 found in Appendix A of OET Bulletin 65. The off-axis power density in the far field will always be less than the on-axis power density and therefore all volumes within the far field will meet the Uncontrolled Exposure limit of 1.0mW/cm^2.

4.4 Region between the Feed Flange and Main Reflector

Transmissions from the feed horn are directed toward the reflector surface. The maximum power density between the feed and reflector surface can be calculated as:

$$S_{fl} = 4P/A$$

$$S_{fl} = (4)(1.7)/0.0167$$

$$S_{fl} = 407.1 \text{ W/m}^2 = 40.7 \text{ mW/cm}^2$$

This value exceeds the Uncontrolled and Controlled Exposure limits of 1.0mW/cm^2 and 5.0mW/cm^2, respectively, found in Appendix A of OET Bulletin 65 and represents a potential hazard. Therefore, a warning label will be affixed to the surface of the reflector to warn people to avoid the region between the antenna feed and the surface of the reflector.

4.5 Reflector Surface Region

The power density at the surface of the reflector is approximated by:

$$S_r = 4P/A$$

$$S_r = (4)(1.7)/(1.13)$$

$S_r = 6.01\ W/m^2 = .601\ mW/cm^2$

This value meets the Uncontrolled Exposure limit of 1.0 mW/cm^2 found in Appendix A of OET Bulletin 65.

4.5 Region Between Antenna and Ground

Assuming uniform illumination of the reflector surface, the power density between the antenna and the ground can be calculated as follows:

$S_g = P/A$

$S_g = 1.7/1.13 = 1.5\ W/m^2 = 0.15\ mW/cm^2$

This value meets the Uncontrolled Exposure limit found in Appendix A of OET Bulletin 65.

5.0 Summary

Table 1. Summary of Expected Radiation Levels

		General Population/Uncontrolled Exposure **Maximum Radiation Level (1.0 mW/cm²)**	**Occupational/Controlled Exposure** **Maximum Radiation Level (5.0 mW/cm²)**
Region	**Radiation Level (mW/cm^2)**	**Hazard Assessment**	**Hazard Assessment**
Near Field R_{nf} = 17.2 m	0.39	Satisfies FCC MPE	Satisfies FCC MPE
Far Field R_{ff} = 41.2 m	0.17	Satisfies FCC MPE	Satisfies FCC MPE
Transition Region $R_{nf} < R_t < R_{ff}$	0.39	Satisfies FCC MPE	Satisfies FCC MPE
Region between Feed and Reflector	40.7	Potential Hazard	Potential Hazard
Reflector Surface	0.601	Satisfies FCC MPE	Satisfies FCC MPE
Region between Antenna and Ground	0.15	Satisfies FCC MPE	Satisfies FCC MPE

6.0 Conclusion

Using the methods outlined in OET Bulletin 65, the 1.2 m antennas meet the Uncontrolled and Controlled Exposure limits in all regions except in the region between the antenna feed and the reflector. A warning label will be affixed to the surface of the reflectors to warn people to avoid the region between the antenna's flange and the surface of the reflector.