RADIATION HAZARD ANALYSIS

Exhibit A

Studies were conducted to predict radiation levels around the proposed earth station. The level of RF radiation calculated below has been compared to a maximum safe level of 5 mW per square cm as defined by OET Bulletin No. 65 (August 1997).

Antenna main beam gain	(G)	=	56.5	(dBi)
Power into feed	(P)	=	162	(watts)
Antenna diameter	(D)	=	6.1	(meter)
Wavelength	(h)	=	.0214	(meter)
Frequency	(f)	=	14.000	(GHz)
Efficiency	(n)	=	0.65	

NEAR FIELD RADIATION

The extent of the near field can be described by the equation:

$$R = \frac{D^2}{4h}$$

WHERE:

R	=	Extent of near-field
D	=	Antenna diameter
h	=	Wavelength

$$R = \frac{6.1^2}{4\,(.0214)} = 434.7 \text{ meters}$$

The maximum value of the near field on-axis (main beam) power density is given by the equation:

$$S = \frac{16\,np}{\pi D^2}$$

WHERE:

S	=	Maximum near-field power density.
n	=	Aperture efficiency
p	=	Power into feed
D	=	Antenna diameter

$$\frac{16\quad(.65)\,(162)}{\pi\,(6.1)^2} = 14.41 \text{ W/m}^2 \text{ or } 1.44 \text{ mW/cm}^2$$

FAR FIELD RADIATION

The distance to the beginning of the far field region can be expressed by the equation:

$$R = \frac{0.6D^2}{h}$$

WHERE:

R	=	Distance to beginning of far field
D	=	Antenna diameter
h	=	Wavelength

$$\frac{.60\,(6.1)^2}{.0214} = 1043.3 \text{ meters}$$

TRANSITION REGION

On-axis power density will decrease inversely with distance in the transition region. The power density can be expressed by the equation.

$$S = \frac{S(nf)\ \ R(nf)}{R}$$

WHERE:

S	=	Power density
S(nf)	=	Maximum power density for near field
R(nf)	=	Extent of near field
R	=	Distance to point of interest

At the beginning of the transition region, i.e., at a distance of 434.7 meters, the power density is:

$$S = \frac{1.44\ (434.7)}{434.7} = 1.44\ \text{mW/cm}^2$$

At the beginning of the far field, i.e., at a distance of 1043.3 meters, the power density is:

$$S = \frac{1.44\ (434.7)}{1043.3} = 0.6\ \text{mW/cm}^2$$

WITHIN ANTENNA

The maximum power density between the main reflector and subreflector is taken as the power density at the subreflector. This can be described from the equation:

$$S = \frac{P}{\pi r^2}$$

WHERE:

S	=	Power density
P	=	Power into feed
r	=	Radius of subreflector (cm)

$$S = \frac{162}{\pi\ (17.32)^2} = 0.1719\ \text{W/cm}^2 = 171.9\ \text{mW/cm}^2$$

The power density at the reflector is expressed by the equation:

$$S = \frac{P}{\pi r^2}$$

WHERE:

S	=	Power density
P	=	Power into feed
r	=	Radius of reflector

$$S = \frac{162}{\pi\ (3.05)^2} = 5.54\ \text{W/m}^2 = 0.55\ \text{mW/cm}^2$$

BETWEEN ANTENNA AND GROUND

As suggested by OET Bulletin 65, Edition 97-01 (August 1997) the level of RF fields in the off-axis vicinity of aperture antennas may be estimated by use of the specifications for maximum allowable gain for antenna sidelobes not within the plane of the Geostationary Orbit, as follows:

$$32 - \{25 \log_{10}(\theta)\} \text{ dBi} \quad \textit{for} \quad 1° \leq \theta \leq 48°$$

$$\text{and:} \quad -10 \text{ dBi} \quad \textit{for} \quad 48° < \theta \leq 180°$$

WHERE: θ = the angle in degrees from the axis of the main lobe
dBi = dB relative to an isotropic radiator

Therefore, utilizing a value of -10 dBi for sidelobe gain at all vicinities on the ground near the antenna and equation (18) for far field power density,

$$S = \frac{P(-10 \text{ dBi})}{4\pi R^2}$$

where S = Power Density
P = Power Into Feed
R = Distance from Feed to Ground

$$S = \frac{162\ (0.1)}{4\pi(4.9)^2} = 0.054 \text{ W/m}^2 = 0.0054 \text{ mW/cm}^2$$

Summary Table

Region	Radiation Level (mW/cm^2)	Hazard Assessment
Far Field, Rf = 1043.3m	0.6	Complies with Guidelines
Near Field, Rn = 434.7m	1.44	Complies with Guidelines
Transition Region, Rt Rn < Rt < Rf	<1.44	Complies with Guidelines
Between Main Reflector and Subreflector	171.9	Potential Hazard
Reflector Surface	0.55	Complies with Guidelines
Between Antenna and Ground	0.0054	Complies with Guidelines

CONCLUSION:

Based on the above analysis it is concluded that harmful levels of radiation will not exist in regions normally occupied by the public or the earth station's operating personnel. The earth station will be marked with the standard radiation hazard warnings, on the antenna itself, warning personnel to avoid the area in front of the reflector when the transmitter is operational. To ensure compliance with the safety limits, the earth station transmitter will be turned off whenever maintenance and repair personnel are required to work in an area where the radiation level exceeds the level recommended by applicable guidelines. Additionally, the earth station is secured and access is controlled.