ANALYSIS OF NON-IONIZING RADIATION FOR A 5.6 METER EARTH STATION ANTENNA

This report analyzes the non-ionizing radiation levels for a 5.6 meter earth station. The Office of Engineering and Technology Bulletin No. 65, Edition 97-01 (August, 1997) specifies that the maximum level of non-ionizing radiation that a person may be exposed to, for Occupational/Controlled environments, over any one-tenth hour (six minute) period for frequencies above 1,500 MHz is an average power density of 5 mW/cm^2. The report will determine the power flux densities of the proposed earth station in the near field, transition region, far field, between the feed and reflector surface, at the reflector surface, and between the edge of the antenna and the ground.

The following parameters were used to calculate the various power flux densities for this earth station:

Antenna Diameter, (D)	=	5.6	meters
Antenna surface area, (A_s)	=	$\pi D^2/4$ = 24.63	m^2
Feed Flange Diameter, (D_f)	=	21.5	cm
Area of Feed Flange, (F_a)	=	$\pi D_f{}^2/4$ = 363.05	cm^2
Wavelength at 14.25 GHz, (λ)	=	0.021	meters
Transmit Power at Flange, (P)	=	5	Watts
Antenna Gain, (G)	=	512,861	
Antenna Aperture efficiency, (n)	=	55	%

1. Near Field Calculation

Power flux density is considered to be at a maximum value within a cylindrical volume having the same diameter as the antenna and throughout the entire length of the of the defined region. Beyond the near field region, the power density decreases linearly with distance from the antenna reflector.

Extent of the near (R_{nf}) = $D^2/4\lambda$ = 373.3 meters

The maximum power density in the near field is determined by:

Near field power density (S_{nf}) = $(16\eta P)/\pi D^2$ = 0.4 mW/cm^2

2. Transition Region Calculation

The transition region is located between the near field and far field regions. The power density in the transition region (S_t) decreases inversely with distance, thus the maximum power density in the transition region will not exceed that calculated for the near field region, or 0.4 mW/cm^2.

3. Far Field Calculation

The distance to the beginning of the far field region is calculated as follows:

Distance to the Far Field Region (R_{ff}) = $0.6D^2/\lambda$ = 896 meters

Far field power density (S_{ff}) = $G*P/4\pi R_{ff}^2$ = 0.3 mW/cm^2

4. Region Between Feed Flange and Reflector

Transmitter power from the feed horn is directed toward the antenna reflector surface and is generally confined within a conical shape defined by the feed horn geometry. The power density between the feed and the surface of the antenna reflector is greatest at the feed flange and is calculated as follows:

Power Density at Feed Flange (S_f) = $4P / F_a$ = 55.1 mW/cm^2

5. Antenna Reflector Surface

The power density at the antenna reflector surface is determined in the same manner as the power density at the feed flange, but using the area of the reflector surface rather than the feed flange area.

Power Density at the Reflector Surface (S_s) = $4P / A_s$ = 0.81 mW/cm^2

6. Region between the Reflector and the Ground

The power density between the antenna reflector and the ground depends on the angle of incidence and the vertical distance from the main beam, but in no event will exceed the power density at the antenna reflector surface, or 0.81 mW/cm^2.

SUMMARY OF CALCULATIONS

REGION	CALCULATED	MAXIMUM PERMISSIBLE EXPOSURE	
1. Near Field power density (S_{nf})	0.4 mW/cm^2	5 mW/cm^2	No Hazard
2. Transition Region power density (S_t)	0.4 mW/cm^2	5 mW/cm^2	No Hazard
3. Far Field power density (S_{ff})	0.3 mW/cm^2	5 mW/cm^2	No Hazard
4. Between Feed Flange and Reflector	55.1 mW/cm^2	5 mW/cm^2	Potential Hazard
5. Reflector Surface (S_s)	0.8 mW/cm^2	5 mW/cm^2	No Hazard
6. Between Antenna Reflector and Ground	0.8 mW/cm^2	5 mW/cm^2	No Hazard

7. Conclusions

Based on the above analysis, it is concluded that the radiofrequency emissions from the proposed earth station will be above the maximum permissible exposure (MPE) limits for Occupational/Controlled environments only for the region between the feed flange and the reflector. The area surrounding the earth station will be controlled and signs posted in order to extablish the environment as "Occupational/Controlled." Further, in order to limit exposure to the MPE limit, the transmitter will be turned off during antenna maintenance and the area will be restricted.

8. Certification

I hereby certify that I am the technically qualified person responsible for the preparation of this radiation hazard assessment, that this assessment complies with OET Bulletin No. 65, 97-01, and that it is complete and correct to the best of my knowledge.

BY: /signed/ Randall D. Young

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