

ANALYSIS OF NON-IONIZING RADIATION  
for TeleCommunication Systems Inc.  
Site: Guam Earth Station State: GU  
Latitude: 13 25 58.0 Longitude: 144 42 47.0 (NAD83)  
01-18-2019

The Office of Science and Technology Bulletin, No. 65, October 1985 and revised August 1997, specifies that the maximum level of non-ionizing radiation that a person may be exposed to over a six minute period is an average power density equal to 5 mW/cm\*\*2 (five milliwatts per centimeter squared) for a controlled environment. For an uncontrolled environment, the maximum level of non-ionizing radiation that a person may be exposed to over a thirty minute period is an average power density equal to 1 mW/cm\*\*2 (one milliwatt per centimeter squared). It is the purpose of this report to determine the maximum power flux densities of the earth station in the far zone, near zone, transition zone, at the main reflector surface, and between the antenna edge and the ground.

Parameters which were used in the calculations:

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Antenna Diameter, (D) = 2.4000 m  
Antenna Surface Area (Sa) = pi(D\*\*2)/4 = 4.5239 m\*\*2  
Wavelength at 6.1750 GHz (lambda) = 0.0485 m  
Transmit Power at Flange (P) = 100.0000 Watts  
Antenna Gain at Earth Site (GES) = 42.2000 dBi = 16595.8691  
Power Ratio:  
AntiLog(GES/10)  
pi = 3.1415927  
Antenna Aperture Efficiency (n) = 0.6000

### 1. FAR ZONE CALCULATIONS

$$\text{Distance to the Far Zone} \quad (Df) = \frac{(n) (D^{**2})}{\text{lambda}} = 71.2577 \text{ m}$$

$$\text{Far Zone Power Density} \quad (Rf) = \frac{(GES) (P)}{4 * \text{pi} * (Df^{**2})} = 26.0091 \text{ W/m}^{**2}$$
$$= 2.6009 \text{ mW/cm}^{**2}$$

### 2. NEAR ZONE CALCULATIONS

Power Flux Density is considered to be at a maximum value throughout the entire length of this Zone. The Zone is contained within a cylindrical volume which has the same diameter as the antenna. Beyond the Near Zone, the Power Flux Density will decrease with distance from the Antenna.

$$\text{Distance to the Near Zone} \quad (Dn) = \frac{D^{**2}}{4 * \text{lambda}} = 29.6907 \text{ m}$$

$$\text{Near Zone Power Density} \quad (Rn) = \frac{16.0 (n) P}{\text{pi} (D^{**2})} = 53.0516 \text{ W/m}^{**2}$$
$$= 5.3052 \text{ mW/cm}^{**2}$$

### 3. TRANSITION ZONE CALCULATIONS

The Power Density begins to decrease with distance in the Transition Zone. While the Power Density decreases inversely with distance in the Transition Zone, the Power Density decreases inversely with the square of the distance in the Far Zone. Since the maximum Power Density in the Transition Zone will not exceed the Near Zone values, it is not calculated.

4. MAIN REFLECTOR ZONE  
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$$\begin{aligned} \text{Main Reflector Power Density} &= \frac{2(P)}{S_a} = 44.2097 \text{ W/m}^{**2} \\ &= 4.4210 \text{ mW/cm}^{**2} \end{aligned}$$

5. ZONE BETWEEN THE MAIN REFLECTOR AND THE GROUND  
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Applying uniform illumination of the Main Reflector Surface:

$$\begin{aligned} \text{Main to Ground Power Density} &= \frac{P}{S_a} = 22.1049 \text{ W/m}^{**2} \\ &= 2.2105 \text{ mW/cm}^{**2} \end{aligned}$$

CALCULATED SAFETY MARGINS SUMMARY  
AND EVALUATION

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Controlled Safety Margin = 5.0 - Calculated Zone Value (mW/cm\*\*2)  
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Zones	Safety Margins (mW/cm**2)	Conclusions
1. Far Zone	2.3991	Complies with ANSI
2. Near Zone	-0.3052	POTENTIALLY HAZARDOUS
3. Transition Zone	Rf < Rt < Rn	Complies with ANSI
4. Main Reflector Surface	0.5790	Complies with ANSI
5. Main Reflector to Ground	2.7895	Complies with ANSI

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Uncontrolled Safety Margin = 1.0 - Calculated Zone Value (mW/cm\*\*2)  
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Zones	Safety Margins (mW/cm**2)	Conclusions
1. Far Zone	-1.6009	POTENTIALLY HAZARDOUS
2. Near Zone	-4.3052	POTENTIALLY HAZARDOUS
3. Transition Zone	Rf < Rt < Rn	Complies with ANSI
4. Main Reflector Surface	-3.4210	POTENTIALLY HAZARDOUS
5. Main Reflector to Ground	-1.2105	POTENTIALLY HAZARDOUS

6. EVALUATION  
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A. Controlled Environment

The NEAR ZONE does not comply with the ANSI standards!  
WARNING SIGNS will be posted for the affected Zone indicating danger while the system is in use. Additionally, the system will be shut down for servicing.

B. Uncontrolled Environment

The FAR ZONE does not comply with the ANSI standards!  
WARNING SIGNS will be posted for the affected Zone indicating danger while the system is in use. Additionally, the system will be shut down for servicing.

The NEAR ZONE does not comply with the ANSI standards!  
WARNING SIGNS will be posted for the affected Zone indicating danger while

the system is in use. Additionally, the system will be shut down for servicing.

The MAIN Reflector Surface ZONE does not comply with the ANSI standards! WARNING SIGNS will be posted for the affected Zone indicating danger while the system is in use. Additionally, the system will be shut down for servicing.

The MAIN Reflector to GROUND ZONE does not comply with the ANSI standards! WARNING SIGNS will be posted for the affected Zone indicating danger while the system is in use. Additionally, the system will be shut down for servicing.