Radiation Hazard Analysis

0.9 Meter -

Introduction

A radiation hazard analysis is presented for a 0.9 meter Ka band aperture antenna to be installed in at theSES (0.9m Ka-band)CONUS. This Radiation Analysis calculates the non-ionizing radiation levels expected to be emitted from the earth station on a worst case basis and is performed in accordance with the Federal Communications Commissions Office of Engineering and Technology (OET) Bulletin, No. 65.

Requirements

OET 65 outlines the maximum permissible exposure limits in two cases for operation in this frequency range.

1. The first case is the maximum level that a person may be exposed to in the general population. The exposure limit is defined as a non-ionizing power level equal to 1 milliwatt per centimeter squared averaged over a thirty minute period.
2. The second case is a controlled environment where the maximum permissible exposure limit must not exceed 5 milliwatts per centimeter squared averaged over any six minute period.

Summary

The results indicate that no significant hazard will be presented to the general population and will be fully mitigated in the controlled area by the use of procedures that require the removal of transmit power before accessing the area around the main reflector.

Analysis

This analysis was performed on seven zones. The results of this analysis are shown in Radiation Hazard Zones. The Table labeled Input Values provides the input data used to perform the analysis. The table labeled OET 65 Calculated Values provides the intermediate calculation used to perform the assessment in accordance with OET 65. The analysis is performed for each of the seven radiation zones as shown in figure 1 – Analysis Zones. These zones are:

1. Point between the feed and the sub-reflector
2. The power at the surface of the antenna
3. The power level between the main reflector and ground
4. The near-field or Fresnel region in which the maximum power can be reached before it starts to diminish with distance
5. The transition region where power begins to decrease inversely with distance from the antenna
6. The far field or Fraunhofer region where power decreases inversely with the square of the distance. This is the point at which the antenna beam is fully collimated
7. The off axis level in the near field. This is defined as the area outside of the main beam removed and at least one antenna diameter removed from the main beam

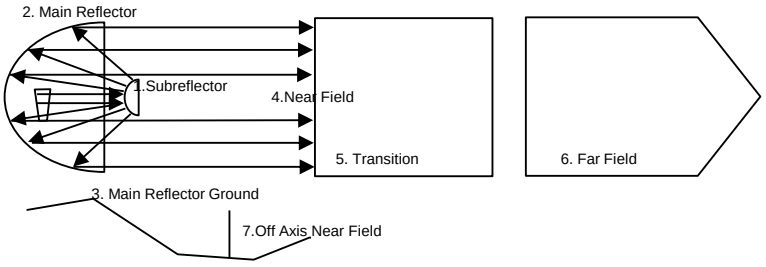

Figure 1 – Analysis Zones

Radiation Hazard Analysis

Operator:	***SES (0.9m Ka-band)***		
Location Designation:	***CONUS***	*FCC ID:*	
County:		*SES ID:*	
Town:		*STA:*	
State/Zip:			

Input Values	*Value*	*Unit*
D = Aperture Diameter	*0.9*	*Meters*
d = Subreflector Diameter	*N/A*	*Meters*
η = Apperture Efficeny	*60%*	*percentage*
FCC Designation	*Ka*	*Band*
F = Frequency	*29500*	*MHz*
P = Transmitter Power Watts:	*20*	*Watts*
p = Number Transmitters:	*1*	
R_{ua} *= closest point to uncontrolled area*	*10*	*meters*
Elevation angle at closest point R_{ua}	*10*	*Degrees*

Band	*Frequency GHz*
L	*1000-2000*
S	*2000-4000*
C	*4000-8000*
X	*8000-12500*
Ku	*12500-18000*
K	*18000-25500*
Ka	*26500-40000*
O	*40000-50000*
V	*50000-75000*

OET 65 Calculated Values	*Formula*	*Value*	*Unit*
λ= Wavelength	c / F	*0.0102*	*meters*
P_1 *= Total Antenna Input Power*	*P*p*	*20*	*watts*
G = Antenna Gain	$G=\frac{4\pi\eta A}{\lambda^2}$	*46333.71126*	*linear*
Antenna Gain dB	$10\log_{10}(G)$	*46.65897088*	*dBi*
A = Area of reflector	$\pi(\frac{D}{2})^2$	*0.63585*	*meters* ^{2}
a = area of subreflector	$\pi(\frac{d}{2})^2$	*N/A*	*meters* ^{2}
R_{nf} *= Near-Field Region*	$R_{nf}=\frac{D^2}{4\lambda}$	*19.91*	*meters*
Transition Region	$>R_{nf}<R_{ff}$	*19.9125* *47.79*	*>meters* *<meters*
R_{ff} *= Far Field Region*	$R_{ff}=\frac{0.6\,D^2}{\lambda}$	*47.79*	*meters*
		8	*Meters AGL*

	Radiation Analysis Zone	*Formula*	*Level*	*Value*	*Exposure Limits* *General Public* $<1mW/cm^2$	*Occupational* $<5mW/cm^2$
1	*Power Subreflector*	$\frac{4P_t}{a}$	*N/A*	*mW/cm* ^{2}	*N/A*	*N/A*
2	*Antenna Surface*	$\frac{4P_t}{A}$	*12.582*	*mW/cm* ^{2}	*>FCC MPE See Note 1*	*>FCC MPE See Note 2*
3	*Main Reflector Ground*	$\frac{P_t}{A}$	*3.145*	*mW/cm* ^{2}	*>FCC MPE See Note 1*	*<FCC MPE*
4	*Snf =Near-Field Power Density*	$S_{nf}=\frac{16\eta P_t}{pi\,D^2}=4\eta(\frac{P_t}{A})$	*7.549*	*mW/cm* ^{2}	*>FCC MPE See Note 3*	*>FCC MPE See Note 2*
5	*Max Transition Power Density*	$S_t=\frac{S_{nf}R_{nf}}{R_{nf}}$	*7.549*	*mW/cm* ^{2}	*>FCC MPE See Note 3*	*>FCC MPE See Note 2*
6	*Max Far field Power Density*	$S_{ff}=\frac{P_tG}{4\pi R^2}$	*3.230*	*mW/cm* ^{2}	*>FCC MPE See Note 3*	*<FCC MPE*
7	*Off Access Level Near Field*	$S_{ua}=S_{nf}-20dB$	*0.07549*	*mW/cm* ^{2}	*<FCC MPE*	*<FCC MPE*

Notes

1. *The antenna is installed in a controlled location and access is restricted to authorized personnel only. The area is marked with RF Radiation Hazard signage. The area not accessible to the general public.*
2. *Inside the controlled area, MPE levels exceed the MPE exposure for occupational levels. The levels will be reduced to safe MPE by removing power to the transmitters when work is performed on or around the antenna. This area can only be accessed by qualified personnel.*
3. *Antenna tracking geometry will maintains angular limits which equates to at least one antenna diameter of separation between the antenna's main beam and points of interest accessible to the General Public. In addition, SES commits to ensuring the protection of the general public is monitored on an ongoing basis.*