Radiation Hazard Analysis

5.5 Meter -
Haleiwa, , Hawaii 96712

Introduction

A radiation hazard anaylsis is presented for a 5.5 meter Ka band aperture antenna to be installed in Haleiwa, Hawaii at the O3b Limited Hawaii mpower Gateway. This Radiation Analysis calculates the non-ionizing radiation levels expected to be emitted from the earth station on a worse cases 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 is 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 maxima can be reached before the field 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

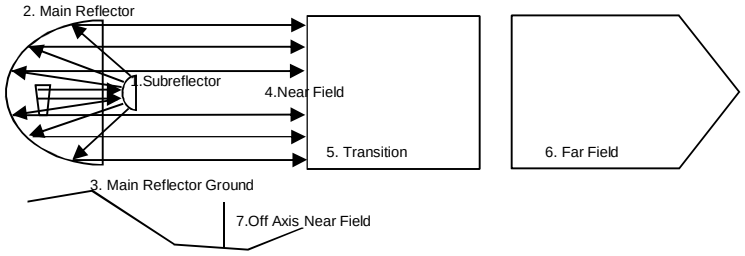

Figure 1 – Analysis Zones

Radiation Hazard Analysis

Operator:	**O3b Limited**		
Location Designation:	**Hawaii mpower Gateway**	FCC ID:	
County:	**Honolulu**	SES ID:	
Town:	**Haleiwa,**	STA:	
State/Zip:	**Hawaii**	**96712**	

Input Values	Value	Unit
D = Aperture Diameter	5.5	Meters
d = Subreflector Diameter	0.914	Meters
η = Apperture Efficeny	72%	percentage
FCC Designation	Ka	Band
F = Frequency	29500	MHz
P = Transmitter Power Watts:	165	Watts
p = Number Transmitters:	1	
R_{ua} = closest point to uncontrolled area	20	meters
Elevation angle at closest point R_{ua}	5	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	165	watts
G = Antenna Gain	$G=\frac{4\pi\eta A}{\lambda^2}$	2062016.991	linear
Antenna Gain dB	$10\log_{10}(G)$	63.14292239	dBi
A = Area of reflector	$\pi(\frac{D}{2})^2$	23.74625	$meters^2$
a = area of subreflector	$\pi(\frac{d}{2})^2$	0.65578586	$meters^2$
R_{nf} = Near-Field Region	$R_{nf}=\frac{D^2}{4\lambda}$	743.65	meters
Transition Region	$>R_{nf}<R_{ff}$	743.6458333 1784.75	>meters <meters
R_{ff} = Far Field Region	$R_{ff}=\frac{0.6\,D^2}{\lambda}$	1784.75 156	meters Meters AGL

	Radiation Analysis Zone	Formula	Level	Value	Exposure Limits: General Public <1mW/cm²	Exposure Limits: Occupational <5mW/cm²
1	Power Subreflector	$\frac{4P_t}{a}$	100.643	mW/cm^2	>FCC MPE See Note 1	>FCC MPE See Note 2
2	Antenna Surface	$\frac{4P_t}{A}$	2.779	mW/cm^2	>FCC MPE See Note 1	<FCC MPE
3	Main Reflector Ground	$\frac{P_t}{A}$	0.695	mW/cm^2	<FCC MPE	<FCC MPE
4	Snf =Near-Field Power Density	$S_{nf}=\frac{16\eta P_t}{p\pi D^2}=4\eta(\frac{P_t}{A})$	3.975	mW/cm^2	>FCC MPE See Note 1	<FCC MPE
5	Max Transition Power Density	$S_t=\frac{S_{nf}R_{nf}}{R_{nf}}$	3.975	mW/cm^2	>FCC MPE See Note 1	<FCC MPE
6	Max Far field Power Density	$S_{ff}=\frac{P_tG}{4\pi R^2}$	0.850	mW/cm^2	<FCC MPE	<FCC MPE
7	Off Access Level Near Field	$S_{ua}=S_{nf}-20dB$	0.03975	mW/cm^2	<FCC MPE	<FCC MPE

Notes

1. *The antenna is installed in a controlled location access is restricted to authorized personnel only. The area is marked with RF Radiation Hazard signage. 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.*
3. *The far field develops 156 meters above ground level at the minimum elevation angle which is not accessable to the general public.*