Radiation Hazard Analysis

1.2 Meter

, CONUS, AK, HI, VI, PR

Introduction

A radiation hazard analysis is presented for a 1.2 meter Ku band aperture antenna. This Radiation Analysis calculates the non-ionizing radiation levels expected to be emitted from the earth station on a worse 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. 43.3

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 six zones. The results of this is shown in Radiation Hazard Zones. The Table labelled Input Values provides the input data used to perform the analysis. The table labelled 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. The power at the surface of the antenna
2. The power level between the main reflector and ground
3. The near-field or Fresnel region in which the maxima can be reached before the field starts to diminish with distance
4. The Transition region where power begins to decrease inversely with distance from the antenna
5. 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
6. 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

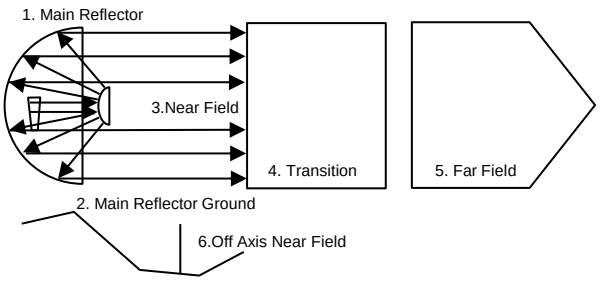

Figure 1 – Analysis Zones

Radiation Hazard Analysis

Operator:	***SES Facility***		
Location Designation:	***VSAT***	*FCC ID:*	
County:		*SES ID:*	
Town:		*STA:*	
State/Zip:	***CONUS, AK, HI, VI, PR***		

Input Values	*Value*	*Unit*
D = Aperture Diameter	*1.2*	*meters*
Antenna Gain	*43.3*	*dBi*
FCC Designation	*Ku*	*Band*
F = Frequency	*14000*	*MHz*
P = Transmitter Power	*4*	*Watts*
Elevation angle at closest point R_{ua}	*5*	*degrees*

Band	*Frequency MHz*
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	*0.0214*	*meters*
G = Antenna Gain	$10^{(G/10)}$	*21379.6*	*linear*
η = Antenna Efficiency	$\frac{G\lambda^2}{4\pi A}$	*69%*	*percentage*
A = Area of reflector	$\pi\left(\frac{D}{2}\right)^2$	*1.13*	*meters²*
R_{nf} = Near-Field Region	$\frac{D^2}{4\lambda}$	*16.80*	*meters*
R_t = Transition Region	$R_{nf} < R_t < R_{ff}$	*16.80* *40.32*	*>meters* *<meters*
R_{ff} = Far Field Region	$\frac{0.6D^2}{\lambda}$	*40.32* *7*	*meters* *meters AGL*

	Radiation Analysis Zone	*Formula*	*Level*	*Value*	*Exposure Limits* *General Public* $<1mW/cm^2$	*Exposure Limits* *Occupational* $<5mW/cm^2$
1	*Antenna Surface*	$\frac{4P_t}{\mathrm{A}}$	*1.415*	mW/cm^2	*>FCC MPE See Note 1*	*<FCC MPE*
2	*Main Reflector Ground*	$\frac{P_t}{\mathrm{A}}$	*0.354*	mW/cm^2	*<FCC MPE*	*<FCC MPE*
3	*S_{nf} = Near-Field Power Density*	$\frac{16P_t}{\pi\eta\mathrm{D}^2} = \frac{4}{\eta}\left(\frac{P_t}{A}\right)$	*2.048*	mW/cm^2	*>FCC MPE See Note 3*	*<FCC MPE*
4	*S_t = Max Transition Power Density*	$\frac{S_{nf}R_{nf}}{R_t}$	*2.048*	mW/cm^2	*>FCC MPE See Note 3*	*<FCC MPE*
5	*S_{ff} = Max Far field Power Density*	$\frac{P_tG}{4\pi R^2}$	*0.419*	mW/cm^2	*<FCC MPE*	*<FCC MPE*
6	*S_{oa} = Off Axis Level Near Field*	$S_{nf} - 20dB$	*0.020*	mW/cm^2	*<FCC MPE*	*<FCC MPE*

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. This area can only be accessed by qualified personnel.*
3. *The applicant will ensure that the main beam of the antenna will be pointed at least one diameter away from any points of interest accessible to the general public. Since one diameter removed from the center of the main beam, the MPE levels are down at least 20 dB or by a factor of 100, and public safety will be ensured.*
4. *The far field develops 7 meters above ground level at the minimum elevation angle which is not accessible to the general public.*

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2. 43

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 six zones. The results of this is shown in Radiation Hazard Zones. The Table labelled Input Values provides the input data used to perform the analysis. The table labelled 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:

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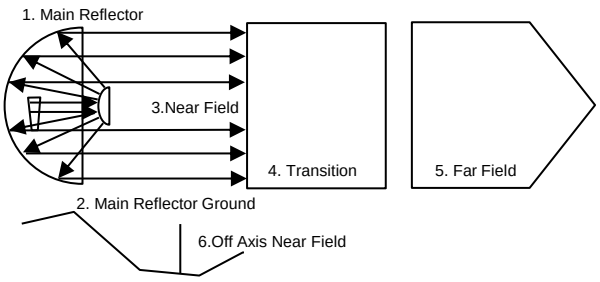

Figure 1 – Analysis Zones

Radiation Hazard Analysis

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County:		*SES ID:*	
Town:		*STA:*	
State/Zip:	***CONUS, AK, HI, VI, PR***		

Input Values	*Value*	*Unit*
D = Aperture Diameter	*1.2*	*meters*
Antenna Gain	*43.0*	*dBi*
FCC Designation	*Ku*	*Band*
F = Frequency	*14000*	*MHz*
P = Transmitter Power	*4*	*Watts*
Elevation angle at closest point R_{ua}	*5*	*degrees*

Band	*Frequency MHz*
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	*0.0214*	*meters*
G = Antenna Gain	$10^{(G/10)}$	*19952.6*	*linear*
η = Antenna Efficiency	$\frac{G\lambda^2}{4\pi A}$	*64%*	*percentage*
A = Area of reflector	$\pi\left(\frac{D}{2}\right)^2$	*1.13*	*meters²*
R_{nf} = Near-Field Region	$\frac{D^2}{4\lambda}$	*16.80*	*meters*
R_t = Transition Region	$R_{nf} < R_t < R_{ff}$	*16.80* *40.32*	*>meters* *<meters*
R_{ff} = Far Field Region	$\frac{0.6D^2}{\lambda}$	*40.32* *7*	*meters* *meters AGL*

	Radiation Analysis Zone	*Formula*	*Level*	*Value*	*Exposure Limits* *General Public* *<1mW/cm²*	*Exposure Limits* *Occupational* *<5mW/cm²*
1	*Antenna Surface*	$\frac{4P_t}{\mathrm{A}}$	*1.415*	*mW/cm²*	*>FCC MPE See Note 1*	*<FCC MPE*
2	*Main Reflector Ground*	$\frac{P_t}{\mathrm{A}}$	*0.354*	*mW/cm²*	*<FCC MPE*	*<FCC MPE*
3	*S_{nf} = Near-Field Power Density*	$\frac{16P_t}{\pi\eta\mathrm{D}^2} = \frac{4}{\eta}\left(\frac{P_t}{A}\right)$	*2.195*	*mW/cm²*	*>FCC MPE See Note 3*	*<FCC MPE*
4	*S_t = Max Transition Power Density*	$\frac{S_{nf}R_{nf}}{R_t}$	*2.195*	*mW/cm²*	*>FCC MPE See Note 3*	*<FCC MPE*
5	*S_{ff} = Max Far field Power Density*	$\frac{P_tG}{4\pi R^2}$	*0.391*	*mW/cm²*	*<FCC MPE*	*<FCC MPE*
6	*S_{oa} = Off Axis Level Near Field*	$S_{nf} - 20dB$	*0.022*	*mW/cm²*	*<FCC MPE*	*<FCC MPE*

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. This area can only be accessed by qualified personnel.*
3. *The applicant will ensure that the main beam of the antenna will be pointed at least one diameter away from any points of interest accessible to the general public. Since one diameter removed from the center of the main beam, the MPE levels are down at least 20 dB or by a factor of 100, and public safety will be ensured.*
4. *The far field develops 7 meters above ground level at the minimum elevation angle which is not accessible to the general public.*

Radiation Hazard Analysis

1.8 Meter

, CONUS, AK, HI, VI, PR

Introduction

A radiation hazard analysis is presented for a 1.8 meter Ku band aperture antenna. This Radiation Analysis calculates the non-ionizing radiation levels expected to be emitted from the earth station on a worse 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. 46.8

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 six zones. The results of this is shown in Radiation Hazard Zones. The Table labelled Input Values provides the input data used to perform the analysis. The table labelled 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. The power at the surface of the antenna
2. The power level between the main reflector and ground
3. The near-field or Fresnel region in which the maxima can be reached before the field starts to diminish with distance
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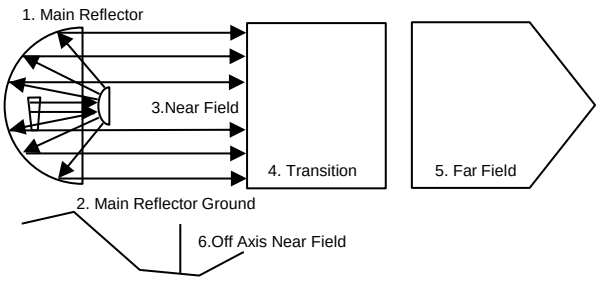

Figure 1 – Analysis Zones

Radiation Hazard Analysis

Operator:	***SES Facility***		
Location Designation:	***VSAT***	*FCC ID:*	
County:		*SES ID:*	
Town:		*STA:*	
State/Zip:	***CONUS, AK, HI, VI, PR***		

Input Values	*Value*	*Unit*
D = Aperture Diameter	*1.8*	*meters*
Antenna Gain	*46.8*	*dBi*
FCC Designation	*Ku*	*Band*
F = Frequency	*14000*	*MHz*
P = Transmitter Power	*5*	*Watts*
Elevation angle at closest point R ua	*5*	*degrees*

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

OET 65 Calculated Values	*Formula*	*Value*	*Unit*
λ= Wavelength	c / F	*0.0214*	*meters*
G = Antenna Gain	$10^{(G/10)}$	*47863.0*	*linear*
η = Antenna Efficiency	$\frac{G\lambda^2}{4\pi A}$	*69%*	*percentage*
A = Area of reflector	$\pi\left(\frac{D}{2}\right)^2$	*2.54*	*meters²*
R_{nf} = Near-Field Region	$\frac{D^2}{4\lambda}$	*37.80*	*meters*
R_t = Transition Region	$R_{nf} < R_t < R_{ff}$	*37.80* *90.72*	*>meters* *<meters*
R_{ff} = Far Field Region	$\frac{0.6D^2}{\lambda}$	*90.72* *16*	*meters* *meters AGL*

	Radiation Analysis Zone	*Formula*	*Level*	*Value*	*Exposure Limits* *General Public* *<1mW/cm²*	*Exposure Limits* *Occupational* *<5mW/cm²*
1	*Antenna Surface*	$\frac{4P_t}{\mathrm{A}}$	*0.786*	*mW/cm²*	*<FCC MPE*	*<FCC MPE*
2	*Main Reflector Ground*	$\frac{P_t}{\mathrm{A}}$	*0.197*	*mW/cm²*	*<FCC MPE*	*<FCC MPE*
3	*S_{nf} = Near-Field Power Density*	$\frac{16P_t}{\pi\eta \mathrm{D}^2} = \frac{4}{\eta}\left(\frac{P_t}{A}\right)$	*1.144*	*mW/cm²*	*>FCC MPE See Note 3*	*<FCC MPE*
4	*S_t = Max Transition Power Density*	$\frac{S_{nf}R_{nf}}{R_t}$	*1.144*	*mW/cm²*	*>FCC MPE See Note 3*	*<FCC MPE*
5	*S_{ff} = Max Far field Power Density*	$\frac{P_t G}{4\pi R^2}$	*0.232*	*mW/cm²*	*<FCC MPE*	*<FCC MPE*
6	*S_{oa} = Off Axis Level Near Field*	$S_{nf} - 20dB$	*0.011*	*mW/cm²*	*<FCC MPE*	*<FCC MPE*

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. This area can only be accessed by qualified personnel.*
3. *The applicant will ensure that the main beam of the antenna will be pointed at least one diameter away from any points of interest accessible to the general public. Since one diameter removed from the center of the main beam, the MPE levels are down at least 20 dB or by a factor of 100, and public safety will be ensured.*
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Radiation Hazard Analysis

1.8 Meter

, CONUS, AK, HI, VI, PR

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2. 46.8

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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

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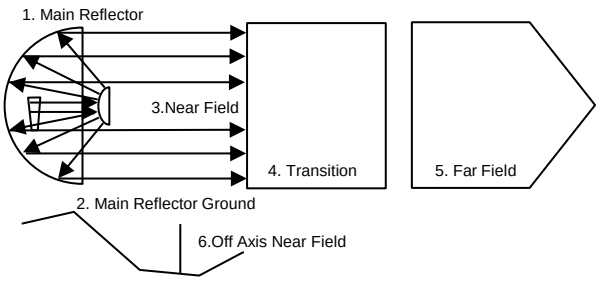

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Input Values	*Value*	*Unit*
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FCC Designation	*Ku*	*Band*
F = Frequency	*14000*	*MHz*
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Elevation angle at closest point R_{ua}	*5*	*degrees*

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OET 65 Calculated Values	*Formula*	*Value*	*Unit*
λ= Wavelength	c / F	*0.0214*	*meters*
G = Antenna Gain	$10^{(G/10)}$	*47863.0*	*linear*
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	Radiation Analysis Zone	*Formula*	*Level*	*Value*	*Exposure Limits*	
					General Public <1mW/cm^2	*Occupational* <5mW/cm^2
1	*Antenna Surface*	$\frac{4P_t}{\mathrm{A}}$	*2.045*	*mW/cm^2*	*>FCC MPE See Note 1*	*<FCC MPE*
2	*Main Reflector Ground*	$\frac{P_t}{\mathrm{A}}$	*0.511*	*mW/cm^2*	*<FCC MPE*	*<FCC MPE*
3	*S_{nf} = Near-Field Power Density*	$\frac{16P_t}{\pi\eta \mathrm{D}^2} = \frac{4}{\eta}\left(\frac{P_t}{A}\right)$	*2.973*	*mW/cm^2*	*>FCC MPE See Note 3*	*<FCC MPE*
4	*S_t = Max Transition Power Density*	$\frac{S_{nf}R_{nf}}{R_t}$	*2.973*	*mW/cm^2*	*>FCC MPE See Note 3*	*<FCC MPE*
5	*S_{ff} = Max Far field Power Density*	$\frac{P_t G}{4\pi R^2}$	*0.602*	*mW/cm^2*	*<FCC MPE*	*<FCC MPE*
6	*S_{oa} = Off Axis Level Near Field*	$S_{nf} - 20dB$	*0.030*	*mW/cm^2*	*<FCC MPE*	*<FCC MPE*

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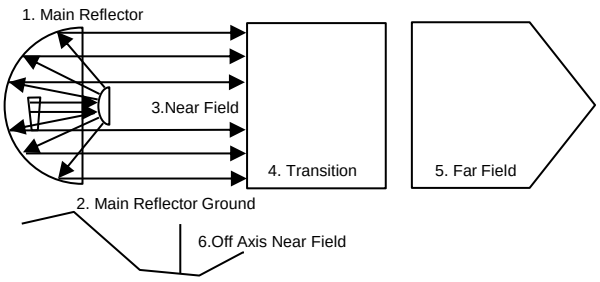

Figure 1 – Analysis Zones

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OET 65 Calculated Values	*Formula*	*Value*	*Unit*
λ= Wavelength	c / F	*0.0214*	*meters*
G = Antenna Gain	$10^{(G/10)}$	*21379.6*	*linear*
η = Antenna Efficiency	$\frac{G\lambda^2}{4\pi A}$	*69%*	*percentage*
A = Area of reflector	$\pi\left(\frac{D}{2}\right)^2$	*1.13*	*meters ^{2}*
R_{nf} = Near-Field Region	$\frac{D^2}{4\lambda}$	*16.80*	*meters*
R_t = Transition Region	$R_{nf} < R_t < R_{ff}$	*16.80* *40.32*	*>meters* *<meters*
R_{ff} = Far Field Region	$\frac{0.6D^2}{\lambda}$	*40.32* *7*	*meters* *meters AGL*

	Radiation Analysis Zone	*Formula*	*Level*	*Value*	*Exposure Limits* *General Public* *<1mW/cm ^{2}*	*Exposure Limits* *Occupational* *<5mW/cm ^{2}*
1	*Antenna Surface*	$\frac{4P_t}{\mathrm{A}}$	*8.493*	*mW/cm ^{2}*	*>FCC MPE See Note 1*	*>FCC MPE See Note 2*
2	*Main Reflector Ground*	$\frac{P_t}{\mathrm{A}}$	*2.123*	*mW/cm ^{2}*	*>FCC MPE See Note 1*	*<FCC MPE*
3	*S_{nf} = Near-Field Power Density*	$\frac{16P_t}{\pi\eta \mathrm{D}^2} = \frac{4}{\eta}\left(\frac{P_t}{A}\right)$	*12.288*	*mW/cm ^{2}*	*>FCC MPE See Note 3*	*>FCC MPE See Note 2*
4	*S_t = Max Transition Power Density*	$\frac{S_{nf}R_{nf}}{R_t}$	*12.288*	*mW/cm ^{2}*	*>FCC MPE See Note 3*	*>FCC MPE See Note 2*
5	*S_{ff} = Max Far field Power Density*	$\frac{P_t G}{4\pi R^2}$	*2.513*	*mW/cm ^{2}*	*>FCC MPE See Note 4*	*<FCC MPE*
6	*S_{oa} = Off Axis Level Near Field*	$S_{nf} - 20dB$	*0.123*	*mW/cm ^{2}*	*<FCC MPE*	*<FCC MPE*

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. This area can only be accessed by qualified personnel.*
3. *The applicant will ensure that the main beam of the antenna will be pointed at least one diameter away from any points of interest accessible to the general public. Since one diameter removed from the center of the main beam, the MPE levels are down at least 20 dB or by a factor of 100, and public safety will be ensured.*
4. *The far field develops 7 meters above ground level at the minimum elevation angle which is not accessible to the general public.*

Radiation Hazard Analysis

2.4 Meter

, CONUS, AK, HI, VI, PR

Introduction

A radiation hazard analysis is presented for a 2.4 meter Ku band aperture antenna. This Radiation Analysis calculates the non-ionizing radiation levels expected to be emitted from the earth station on a worse 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. 49.3

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 six zones. The results of this is shown in Radiation Hazard Zones. The Table labelled Input Values provides the input data used to perform the analysis. The table labelled 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. The power at the surface of the antenna
2. The power level between the main reflector and ground
3. The near-field or Fresnel region in which the maxima can be reached before the field starts to diminish with distance
4. The Transition region where power begins to decrease inversely with distance from the antenna
5. 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
6. 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

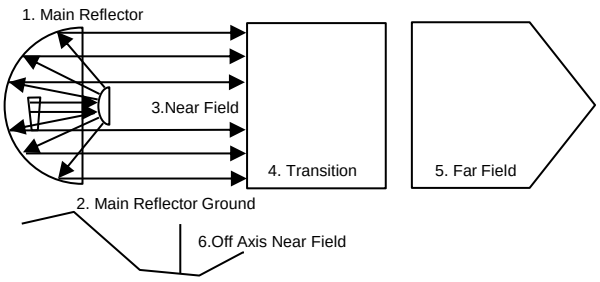

Figure 1 – Analysis Zones

Radiation Hazard Analysis

Operator:	***SES Facility***		
Location Designation:	***VSAT***	*FCC ID:*	
County:		*SES ID:*	
Town:		*STA:*	
State/Zip:	***CONUS, AK, HI, VI, PR***		

Input Values	*Value*	*Unit*
D = Aperture Diameter	*2.4*	*meters*
Antenna Gain	*49.3*	*dBi*
FCC Designation	*Ku*	*Band*
F = Frequency	*14000*	*MHz*
P = Transmitter Power	*4*	*Watts*
Elevation angle at closest point R_{ua}	*5*	*degrees*

Band	*Frequency MHz*
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	*0.0214*	*meters*
G = Antenna Gain	$10^{(G/10)}$	*85113.8*	*linear*
η = Antenna Efficiency	$\frac{G\lambda^2}{4\pi A}$	*69%*	*percentage*
A = Area of reflector	$\pi\left(\frac{D}{2}\right)^2$	*4.52*	*meters²*
R_{nf} = Near-Field Region	$\frac{D^2}{4\lambda}$	*67.20*	*meters*
R_t = Transition Region	$R_{nf} < R_t < R_{ff}$	*67.20* *161.28*	*>meters* *<meters*
R_{ff} = Far Field Region	$\frac{0.6D^2}{\lambda}$	*161.28* *28*	*meters* *meters AGL*

	Radiation Analysis Zone	*Formula*	*Level*	*Value*	*Exposure Limits* *General Public* *<1mW/cm²*	*Exposure Limits* *Occupational* *<5mW/cm²*
1	*Antenna Surface*	$\frac{4P_t}{\mathrm{A}}$	*0.354*	*mW/cm²*	*<FCC MPE*	*<FCC MPE*
2	*Main Reflector Ground*	$\frac{P_t}{\mathrm{A}}$	*0.088*	*mW/cm²*	*<FCC MPE*	*<FCC MPE*
3	*S_{nf} = Near-Field Power Density*	$\frac{16P_t}{\pi\eta \mathrm{D}^2} = \frac{4}{\eta}\left(\frac{P_t}{A}\right)$	*0.514*	*mW/cm²*	*<FCC MPE*	*<FCC MPE*
4	*S_t = Max Transition Power Density*	$\frac{S_{nf}R_{nf}}{R_t}$	*0.514*	*mW/cm²*	*<FCC MPE*	*<FCC MPE*
5	*S_{ff} = Max Far field Power Density*	$\frac{P_t G}{4\pi R^2}$	*0.104*	*mW/cm²*	*<FCC MPE*	*<FCC MPE*
6	*S_{oa} = Off Axis Level Near Field*	$S_{nf} - 20dB$	*0.005*	*mW/cm²*	*<FCC MPE*	*<FCC MPE*

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. This area can only be accessed by qualified personnel.*
3. *The applicant will ensure that the main beam of the antenna will be pointed at least one diameter away from any points of interest accessible to the general public. Since one diameter removed from the center of the main beam, the MPE levels are down at least 20 dB or by a factor of 100, and public safety will be ensured.*
4. *The far field develops 28 meters above ground level at the minimum elevation angle which is not accessible to the general public.*

Radiation Hazard Analysis

3.5 Meter

, CONUS, AK, HI, VI, PR

Introduction

A radiation hazard analysis is presented for a 3.5 meter Ku band aperture antenna. This Radiation Analysis calculates the non-ionizing radiation levels expected to be emitted from the earth station on a worse 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. 52.3

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 six zones. The results of this is shown in Radiation Hazard Zones. The Table labelled Input Values provides the input data used to perform the analysis. The table labelled 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. The power at the surface of the antenna
2. The power level between the main reflector and ground
3. The near-field or Fresnel region in which the maxima can be reached before the field starts to diminish with distance
4. The Transition region where power begins to decrease inversely with distance from the antenna
5. 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
6. 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

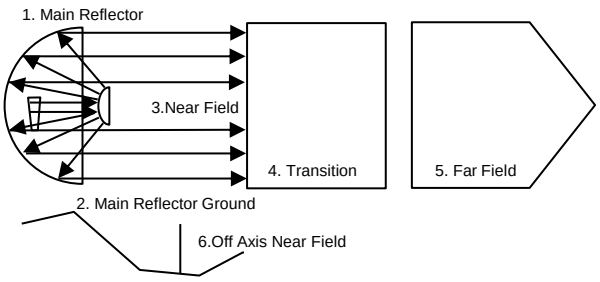

Figure 1 – Analysis Zones

Radiation Hazard Analysis

Operator:	***SES Facility***		
Location Designation:	***VSAT***	*FCC ID:*	
County:		*SES ID:*	
Town:		*STA:*	
State/Zip:	***CONUS, AK, HI, VI, PR***		

Input Values	*Value*	*Unit*
D = Aperture Diameter	*3.5*	*meters*
Antenna Gain	*52.3*	*dBi*
FCC Designation	*Ku*	*Band*
F = Frequency	*14000*	*MHz*
P = Transmitter Power	*2*	*Watts*
Elevation angle at closest point R_{ua}	*5*	*degrees*

Band	*Frequency MHz*
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	*0.0214*	*meters*
G = Antenna Gain	$10^{(G/10)}$	*169824.4*	*linear*
η = Antenna Efficiency	$\frac{G\lambda^2}{4\pi A}$	*65%*	*percentage*
A = Area of reflector	$\pi\left(\frac{D}{2}\right)^2$	*9.62*	*meters²*
R_{nf} = Near-Field Region	$\frac{D^2}{4\lambda}$	*142.92*	*meters*
R_t = Transition Region	$R_{nf} < R_t < R_{ff}$	*142.92* *343.00*	*>meters* *<meters*
R_{ff} = Far Field Region	$\frac{0.6D^2}{\lambda}$	*343.00* *60*	*meters* *meters AGL*

	Radiation Analysis Zone	*Formula*	*Level*	*Value*	*Exposure Limits* *General Public* *<1mW/cm²*	*Exposure Limits* *Occupational* *<5mW/cm²*
1	*Antenna Surface*	$\frac{4P_t}{\mathrm{A}}$	*0.083*	*mW/cm²*	*<FCC MPE*	*<FCC MPE*
2	*Main Reflector Ground*	$\frac{P_t}{\mathrm{A}}$	*0.021*	*mW/cm²*	*<FCC MPE*	*<FCC MPE*
3	*S_{nf} = Near-Field Power Density*	$\frac{16P_t}{\pi\eta \mathrm{D}^2} = \frac{4}{\eta}\left(\frac{P_t}{A}\right)$	*0.129*	*mW/cm²*	*<FCC MPE*	*<FCC MPE*
4	*S_t = Max Transition Power Density*	$\frac{S_{nf}R_{nf}}{R_t}$	*0.129*	*mW/cm²*	*<FCC MPE*	*<FCC MPE*
5	*S_{ff} = Max Far field Power Density*	$\frac{P_t G}{4\pi R^2}$	*0.023*	*mW/cm²*	*<FCC MPE*	*<FCC MPE*
6	*S_{oa} = Off Axis Level Near Field*	$S_{nf} - 20dB$	*0.001*	*mW/cm²*	*<FCC MPE*	*<FCC MPE*

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. This area can only be accessed by qualified personnel.*
3. *The applicant will ensure that the main beam of the antenna will be pointed at least one diameter away from any points of interest accessible to the general public. Since one diameter removed from the center of the main beam, the MPE levels are down at least 20 dB or by a factor of 100, and public safety will be ensured.*
4. *The far field develops 60 meters above ground level at the minimum elevation angle which is not accessible to the general public.*