

# ***Radiation Hazard Analysis***

## ***5.5 Meter - El Mirage, Arizona 20109***

### **Introduction**

A radiation hazard analysis is presented for a 5.5 meter Ka band aperture antenna to be installed in El Mirage Arizona at the SES Networks Phoenix Gateway. This Radiation Analysis calculates the non-ionizing radiation levels expected to be emitted from the earth station on a worst 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.

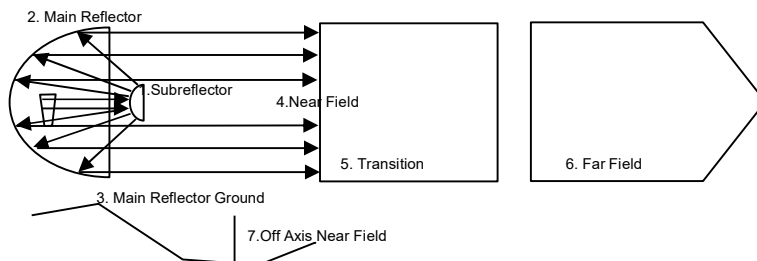
### **Summary**

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: **SES Networks**  
 Location Designation: **Phoenix Gateway**  
 County: **Maricopa**  
 Town: **El Mirage**  
 State/Zip: **Arizona 20109**

FCC ID:   
 SES ID:   
 STA:

Input Values	Value	Unit
$D = \text{Aperture Diameter}$	5.5	Meters
$d = \text{Subreflector Diameter}$	0	Meters
$\eta = \text{Aperture Efficiency}$	60%	percentage
FCC Designation	Ka	Band
$F = \text{Frequency}$	29000	MHz
$P = \text{Transmitter Power Watts}$	500	Watts
$p = \text{Number Transmitters}$	1	
$R_{ua} = \text{closest point to uncontrolled area}$	10	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
$\lambda = \text{Wavelength}$	$c / F$	0.0103	meters
$P_I = \text{Total Antenna Input Power}$	$P * p$	500	watts
$G = \text{Antenna Gain}$	$G = \frac{4\pi\eta A}{\lambda^2}$	1672204.593	linear
Antenna Gain dB	$10 \log_{10}(G)$	62.23289412	dBi
$A = \text{Area of reflector}$	$\pi \left(\frac{D}{2}\right)^2$	23.74625	meters <sup>2</sup>
$a = \text{area of subreflector}$	$\pi \left(\frac{d}{2}\right)^2$	0	meters <sup>2</sup>
$R_{nf} = \text{Near-Field Region}$	$R_{nf} = \frac{D^2}{4\lambda}$	731.04	meters
Transition Region	$> R_{nf} < R_{ff}$	731.0416667 1754.5	>meters <meters
$R_{ff} = \text{Far Field Region}$	$R_{ff} = \frac{0.6 D^2}{\lambda}$	1754.5 153	meters Meters AGL

Radiation Analysis Zone	Formula	Level	Value	Exposure Limits	
				General Public <1mW/cm <sup>2</sup>	Occupational <5mW/cm <sup>2</sup>
1 Power Subreflector	$\frac{4P_t}{a}$	N/A	mW/cm <sup>2</sup>	N/A	N/A
2 Antenna Surface	$\frac{4P_t}{A}$	8.422	mW/cm <sup>2</sup>	>FCC MPE See Note 1	>FCC MPE See Note 2
3 Main Reflector Ground	$\frac{P_t}{A}$	2.106	mW/cm <sup>2</sup>	>FCC MPE See Note 1	<FCC MPE
4 $S_{nf} = \text{Near-Field Power Density}$	$S_{nf} = \frac{16\eta P_t}{\pi D^2} = 4\eta \left(\frac{P_t}{A}\right)$	10.107	mW/cm <sup>2</sup>	>FCC MPE See Note 1	>FCC MPE See Note 2
5 Max Transition Power Density	$S_t = \frac{S_{nf} R_{nf}}{R_{nf}}$	10.107	mW/cm <sup>2</sup>	>FCC MPE See Note 1	>FCC MPE See Note 2
6 Max Far field Power Density	$S_{ff} = \frac{P_t G}{4\pi R^2}$	2.163	mW/cm <sup>2</sup>	>FCC MPE See Note 3	<FCC MPE
7 Off Access Level Near Field	$S_{ua} = S_{nf} - 20\text{dB}$	0.10107	mW/cm <sup>2</sup>	<FCC MPE	<FCC MPE

### Notes

- 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.
- 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.
- The far field develops 153 meters above ground level at the minimum elevation angle which is not accessible to the general public.