Radiation Hazard Analysis

2.4 Meter - General Dynamics NGSO 40
Pago Pago, American Samoa 96799

Introduction

A radiation hazard anaylsis is presented for a 2.4 meter Ka band aperture antenna to be installed in Pago Pago American Samoa at the NOAA Weather Service Office. 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

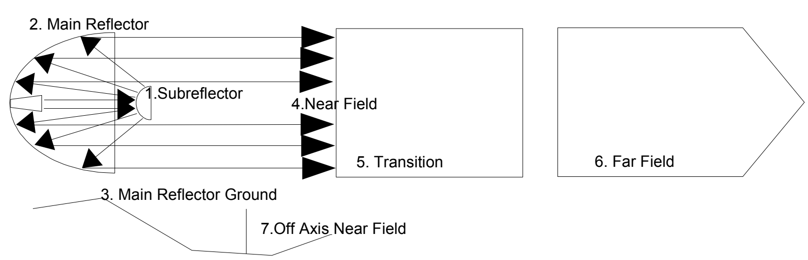

Figure 1 – Analysis Zones

Radiation Hazard Analysis

Operator:	**SES-GS**
Location Designation:	NOAA **Pago Pago**
County:	**Am. Samoa**
Town:	**Paog Pago**
Territory/Zip:	**Am. Samoa** 96799

FCC ID:	
SES-GS ID:	General Dynamics NGSO 40
STA:	

Input Values	Value	Unit
D = Aperture Diameter	2.4	Meters
d = Subreflector Diameter	0.1	Meters
η = Apperture Efficeny	67%	percentage
FCC Designation	Ka	Band
F = Frequency	28709	MHz
P = Transmitter Power Watts:	40	Watts
p = Number Transmitters:	1	
R_{ua} = closest point to uncontrolled area	20	meters
Elevation angle at closest point R_{ua}	29	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	0.0104	meters
P_1 = Total Antenna Input Power	$P*p$	35.9	watts
G = Antenna Gain	$G=\frac{4\pi\eta A}{\lambda^2}$	348457.8105	linear
Antenna Gain dB	$10\log_{10}(G)$	55.42150203	dBi
A = Area of reflector	$\pi(\frac{D}{2})^2$	4.5216	$meters^2$
a = area of subreflector or feed	$\pi(\frac{d}{2})^2$	0.00785	$meters^2$
R_{nf} = Near-Field Region	$R_{nf}=\frac{D^2}{4\lambda}$	137.80	meters
		17	Meters AGL
Transition Region	$>R_{nf}<R_{ff}$	137.8032	>meters
		330.72768	<meters
R_{ff} = Far Field Region	$R_{ff}=\frac{0.6D^2}{\lambda}$	330.72768	meters
		160	Meters AGL

	Radiation Analysis Zone	Formula	Level	Value	Exposure Limits General Public <1mW/cm²	Exposure Limits Occupational <5mW/cm²
1	Power Subreflector	$\frac{4P_t}{a}$	1829.299	mW/cm^2	>FCC MPE See Note 1	>FCC MPE See Note 2
2	Antenna Surface	$\frac{4P_t}{A}$	3.176	mW/cm^2	>FCC MPE See Note 1	<FCC MPE
3	Main Reflector Ground	$\frac{P_t}{A}$	0.794	mW/cm^2	<FCC MPE	<FCC MPE
4	Snf =Near-Field Power Density	$S_{nf}=\frac{16\eta P_t}{pi D^2}=4\eta(\frac{P_t}{A})$	4.256	mW/cm^2	>FCC MPE See Note 1	<FCC MPE
5	Max Transition Power Density	$S_t=\frac{S_{nf}R_{nf}}{R_{nf}}$	4.256	mW/cm^2	>FCC MPE See Note 1	<FCC MPE
6	Max Far field Power Density	$S_{ff}=\frac{P_t G}{4\pi R^2}$	0.911	mW/cm^2	>FCC MPE See Note 3	<FCC MPE
7	Off Access Level Near Field	$S_{ua}=S_{nf}-20dB$	0.04256	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. This area can only be accessed by qualified personnel.
3. The far field develops 41 meters above ground level at the minimum elevation angle which is not accessable to the general public.

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CERTIFICATION

The preceding analysis confirms the presence of potentially hazardous power flux densities at the terminals which will require physical and operation protections to manage General Population and Occupational Exposure.

As appropriate, SES GS will use fencing, signage, and other measures to limit access to the relevant area. Procedures will be in place requiring that transmit power be turned off before work on the 2.4m antennas is performed. Where an enclosed area is necessary, the size of the enclosed area will consider the RF hazards and the surrounding terrain. The signage will clearly state the standard Radiation Hazard warning.

Personnel with access to the antenna will be trained to ensure that the antennas are off before working in the vicinity or on the antenna systems directly.

I hereby certify I have reviewed the engineering information submitted, and that it is complete and accurate to the best of my knowledge.

/s/ Gene McLeod
Gene McLeod
Program Manager
SES Government Solutions
September 23, 2016