

### **Exhibit #3: Radio Frequency Radiation Hazard Compliance Analysis.**

In compliance with the requirements of 47 C.F.R. §1.1310 of the FCC Rules, Inmarsat is submitting an analysis of the calculated RF radiation levels generated with an assessment of any possible worker or general public exposure to excessive radiation levels. In order to assure compliance with the FCC maximum exposure limits, standard analysis procedures were used in accordance with the FCC's guidelines as specified in §1.1310<sup>1</sup>.

This RF Radiation Hazard Compliance analysis (RFR analysis) is limited in scope to the use of ground and maritime based satellite dishes using fixed dishes or mobile stabilized Earth Stations on Vessel (ESV) type antennas. There are three types of antenna installations: large antenna teleport installations, VSAT fixed installations on ground or locations on offshore oil and gas platforms and mobile stabilized ESV antennas. Although the construction, design and personnel access control is different for the three types of antennas, the analysis of the potential hazard for each of these types is identical.

In all of the antenna types, there are common characteristics of antenna gain and antenna design which require analysis. Under the guidelines of FCC OET Bulletin 65 for satellite dish analysis, the following antenna radiation areas were analyzed:

As shown in diagram 1, there are three primary areas of radiation with a satellite dish:

The first area is the unfocussed energy of the near field which is characterized by a signal strength which can reach a maximum power density that doesn't decrease with distance. The distance from the antenna surface to the edge of the near field is determined through use of the formulas in the OET 65 document<sup>2</sup>. In Ku and C Band the near field areas extend to the front of the antenna to a distance of 30 or more feet for the average antenna. This is the area most likely to affect personnel in the vicinity of the antenna and is the primary focus of the study. Because the power in this area is unfocussed, the result of the near field analysis is based on the maximum power level within that area<sup>3</sup>. Also within the near field is an area of special interest consisting of the surface of the antenna. The power density at the antenna surface was calculated based on the OET 65 guidelines.<sup>4</sup>

The second area is the far field region where the full gain and directionality pattern is realized for the antenna. In this area, the signal decreases inversely as a function of the square of the distance. This area starts typically at a distance of hundreds of feet or more from the surface of the antenna. The far field radiation is generally directed into sky areas which cannot be easily accessed and this radiation is not as likely to cause impermissible levels of RFR in personnel areas. In accordance with the guidelines of OET 65, the distance to the closest far field boundary<sup>5</sup> and associated power densities within the far field region<sup>6</sup> were calculated. As an intermediary step to the power density formulas, the antenna dish aperture efficiency was calculated from manufacturer supplied gain as per formula 14 of the OET document.

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<sup>1</sup> This document is based on the guidelines and formulas of OST/OET Bulletin Number 65, "Evaluating Compliance with FCC-Specified Guidelines for Human Exposure to Radiofrequency Radiation." (*OET Bulletin 65 Edition 97-01, August 1997*)

<sup>2</sup> Id. Reference formula (12), page 27

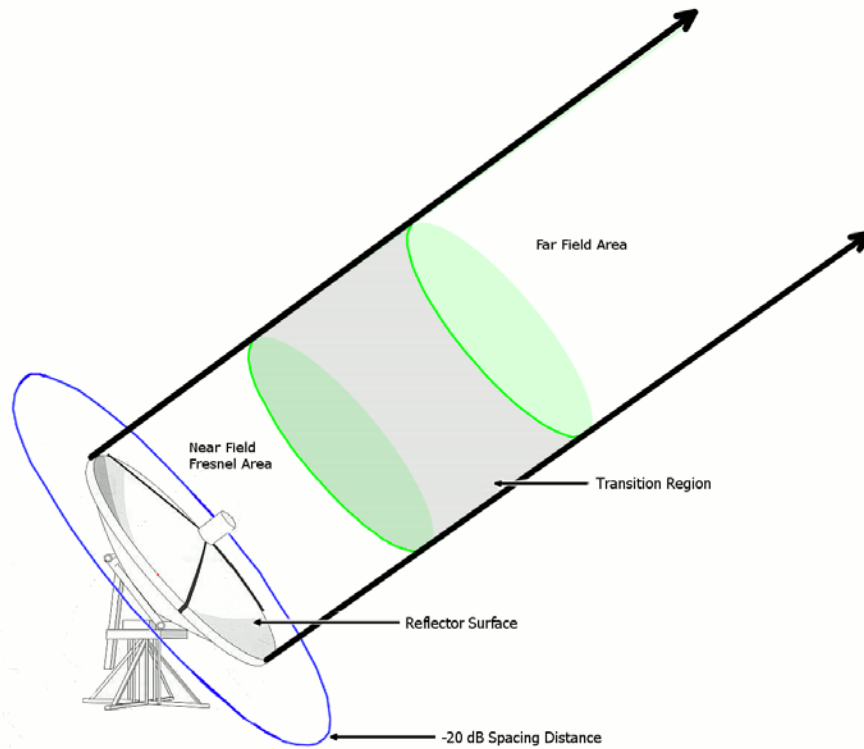
<sup>3</sup> Id. Reference formula (13), page 28.

<sup>4</sup> Id. Reference formula (11), page 27

<sup>5</sup> Id. Reference formula (16) page 29.

<sup>6</sup> Id. Reference formula (18), page 29.

The transition region is located between the near field and the far field areas and is characterized as a semi-focused area where the power density decreases inversely with distance from the antenna. As a matter of characterizing the worst case scenario, the power density was calculated at the boundary between the near field and the transition zone and also at the boundary of the transition zone with the far field area, in accordance with the guidelines of OET 65<sup>7</sup>.



**Diagram 1**

Although the majority of the radiated power is contained within a cylinder extending from the surface of the antenna dish, an additional area of interest is within locations that are off axis from the main radiation beam and in areas more easily accessed by personnel. According to the guidelines of OET 65, an estimation of off-axis far field power density can be made using the antenna minimum sidelobe performance data as defined under §25.209<sup>8</sup>. In this analysis, the “first cut” calculations are run using the worst case far field power density to determine if the main beam radiation exceeds the permissible RFR power density levels. In the event that the main beam exceeds the RFR standards, only then will the sidelobe radiation pattern be considered for analysis. If the main beam creates less power than the maximum permissible exposure level, it is known that the sidelobe radiation will be less than the main beam and sidelobe radiation will therefore be compliant as well.

In near field areas close to the antenna dish, the OET 65 guidelines indicate that an assumption can be made in radial distances extending beyond one antenna diameter from the antenna center point. Within areas of interest outside this “one antenna diameter” boundary it can be presumed that a reduction of 20

<sup>7</sup> Id. Reference formula (17), page 29.

<sup>8</sup> 47 C.F.R §25.209 (a),(2)

dB or more can be calculated as a basis of RFR hazard protection. The analysis results reflect this calculation as per the guidelines of the OET 65 document<sup>9</sup>.

This analysis calculates the RFR compliance of an antenna type which is to be deployed as an ESV antenna on static platforms and vessels in the coastal and deep water areas of the U.S. In all of the proposed deployments, the analyzed antennas are to be mounted on elevated pedestals in locations which are on the top of vessel wheelhouses, flying bridges or quarters areas which are restricted and where only authorized personnel have access. In this environment, the RFR exposure limits are indicated to be the Occupational / Controlled Exposure levels. The maximum permissible exposure levels are to not exceed 5 mW/cm<sup>2</sup>.

Applying the methods provided in OET 65, using the proposed maximum BUC power specified for these dishes as a worst case, the results are as follows:

Calculations:

Power density at reflector surface:  $S = 4P/A$

Calculated antenna efficiency:  $\eta = (G\lambda^2/4\pi)/(\pi D^2)$

Maximum power density within near field:  $S_{nf} = 16\eta P/\pi D^2$

Maximum power density at transition zone boundary with far field:  $S_{ff} = P \cdot G/4\pi R^2$

Distance to boundary of transition zone with far field:  $R_{ff} = 0.6 D^2/\lambda$

Power density within the transition region:  $S_t = S_{nf} \cdot R_{nf}/R$

Where:

$\eta$  = Aperture efficiency.

G = Power gain in direction of interest (isotropic).

$\lambda$  = Wavelength (cm).

D = Antenna diameter (cm).

P = Power fed to the antenna.

A = Physical area of antenna (cm<sup>2</sup>).

R<sub>nf</sub> = Extent of near field from antenna surface, R<sub>ff</sub> = Extent of far field from antenna surface.

S<sub>nf</sub> = Power density at near field extent distance, S<sub>ff</sub> = Power density at far field extent distance.

S = Power density at surface.

R = Distance to the point of interest.

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<sup>9</sup> ibid. Page 30.

Analysis of Seatel 9797 Ku Band Stabilized ESV antenna, using the maximum proposed power and bandwidth:

Maximum exposure                      5 m/W cm<sup>2</sup>    Occupational

Summary:			
Dish Model:	Seatel 9797C Band Stabilized Antenna		
Transmit Frequency	6.175	GHz	
Flange power	30	Watts	
Antenna Diameter	2.4	Meters	
Antenna Gain	41.7	dBi	
Efficiency	61.41%	Calculated	
Power Density at Reflector Surface	2.653	mW/cm <sup>2</sup>	Result: Within Limits
Maximum Power Density Within Near Field	1.63	mW/cm <sup>2</sup>	Result: Within Limits
Distance to Edge of Near Field	29.64	Meters	
Maximum Power Density at Transition Zone Boundary with Far Field	0.68	mW/cm <sup>2</sup>	Result: Within Limits
Distance to Boundary of Transition Zone with Far Field	71.14	Meters	
Power Density at 1 Diameter Distance from Center of Dish.	0.0163	mW/cm <sup>2</sup>	Result: Within Limits

**Compliance Statement:**

This antenna is proposed to be used as described on page 3 in an area which has restricted access and only accessible to authorized personnel. This proposed antenna installation fully complies with the occupational RF radiation hazard limits, according to the summary of calculations above.

Summary:

According to the calculations presented within this analysis and the access and personnel restrictions as described in the RF radiation analysis, the proposed antennas comply with the FCC's RF radiation guidelines as described in OET Bulletin 65, "Evaluating Compliance with FCC-Specified Guidelines for Human Exposure to Radiofrequency Radiation".

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