

Exhibit 2: 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 ensure compliance with the FCC maximum exposure limits, standard analysis procedures were used in accordance with the FCC's guidelines as specified in §1.1310.¹

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 unfocused 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 document². In Ku 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 unfocused, the result of the near field analysis is based on the maximum power level within that area.³ 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.⁴

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 boundary⁵ and associated power densities within the far field

¹ 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*), in compliance with the current FCC rules. This analysis is consistent with rules adopted, but not yet in effect, in *Reassessment of Federal Communications Commission Radiofrequency Exposure Limits and Policies*, ET Docket No. 13-84, First Report and Order, FCC 13-39 (rel. Mar. 29, 2013).

² *OET Bulletin 65*, Reference formula (12), page 27

³ *Id.* Reference formula (13), page 28.

⁴ *Id.* Reference formula (11), page 27

⁵ *Id.* Reference formula (16) page 29.

region⁶ 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.

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 65.⁷

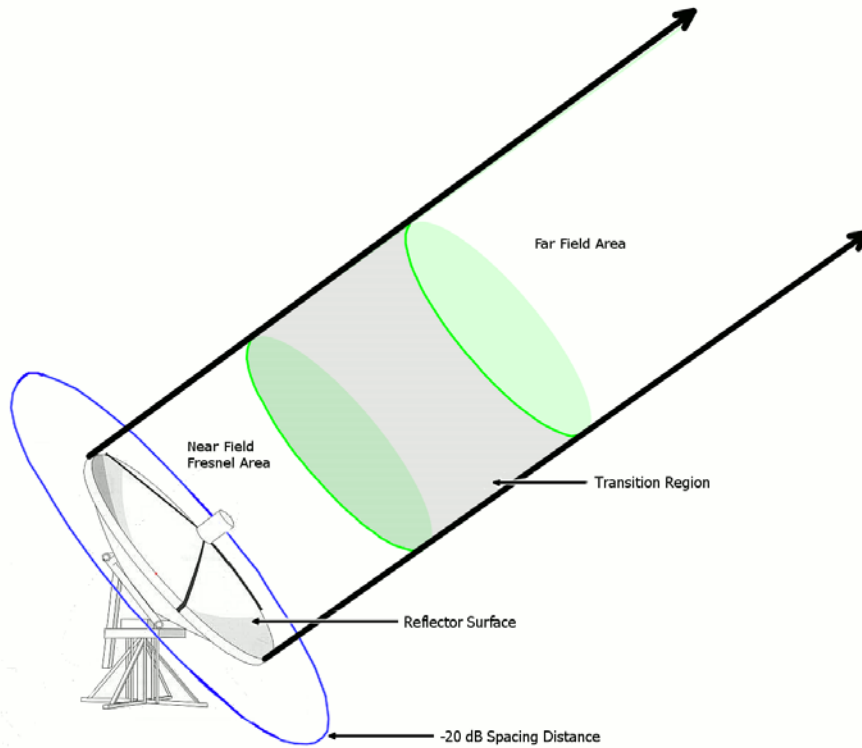


Diagram 1

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 that may be 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 §25.209.⁸ 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.

⁶ *Id.* Reference formula (18), page 29.

⁷ *Id.* Reference formula (17), page 29.

⁸ 47 C.F.R §25.209 (a),(2)

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 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.⁹

This analysis calculates the RFR compliance of 6 antennas which are to be deployed as ESV antennas on static platforms and vessels. 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/cm².

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: $S_{ff} = P*G/4\pi R^2$

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

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

Where:

η = Aperture efficiency.

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

λ = Wavelength (cm).

D = Antenna diameter (cm).

P = Power fed to the antenna.

A = Physical area of antenna (cm²).

R_{nf} = Extent of near field from antenna surface, R_{ff} = Extent of far field from antenna surface.

S_{nf} = Power density at near field extent distance, S_{ff} = Power density at far field extent distance.

S = Power density at surface.

⁹ Ibid. Page 30.

R = Distance to the point of interest.

For the Intellian V60 antenna, using the maximum proposed power and bandwidth:

Summary:			
Dish Model:	Intellian V60		
Transmit Frequency	14.25	GHz	
Flange power	3.03	Watts	
Antenna Diameter	0.6	Meters	
Antenna Gain	38.1	dBi	
Efficiency	80.54%	Calculated	
Power Density at Reflector Surface	4.287	mW/cm ²	Result: Within Limits
Maximum Power Density Within Near Field	3.45	mW/cm ²	Result: Within Limits
Distance to Edge of Near Field	4.28	Meters	
Maximum Power Density at Transition Zone Boundary with Far Field	1.44	mW/cm ²	Result: Within Limits
Distance to Boundary of Transition Zone with Far Field	10.26	Meters	
Power Density at 1 Diameter Distance from Center of Dish.	0.0345	mW/cm ²	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.

For the Intellian V80 antenna, using the maximum proposed power and bandwidth:

Summary:			
Dish Model:	Intellian V80		
Transmit Frequency	14.25	GHz	
Flange power	5	Watts	
Antenna Diameter	0.83	Meters	
Antenna Gain	39.5	dBi	
Efficiency	58.10%	Calculated	
Power Density at Reflector Surface	3.696	mW/cm ²	Result: Within Limits
Maximum Power Density Within Near Field	2.15	mW/cm ²	Result: Within Limits
Distance to Edge of Near Field	8.18	Meters	
Maximum Power Density at Transition Zone Boundary with Far Field	0.89	mW/cm ²	Result: Within Limits
Distance to Boundary of Transition Zone with Far Field	19.63	Meters	

Power Density at 1 Diameter Distance from Center of Dish.	0.0215	mW/cm ^2	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.

For the Intellian V110 antenna, using the maximum proposed power and bandwidth:

Summary:			
Dish Model:	Intellian V110		
Transmit Frequency	14.25	GHz	
Flange power	12.35	Watts	
Antenna Diameter	1.05	Meters	
Antenna Gain	41.7	dBi	
Efficiency	60.25%	Calculated	
Power Density at Reflector Surface	5.705	mW/cm ^2	Result: Exceeding Limit
Maximum Power Density Within Near Field	3.44	mW/cm ^2	Result: Within Limits
Distance to Edge of Near Field	13.09	Meters	
Maximum Power Density at Transition Zone Boundary with Far Field	1.43	mW/cm ^2	Result: Within Limits
Distance to Boundary of Transition Zone with Far Field	31.42	Meters	
Power Density at 1 Diameter Distance from Center of Dish.	0.0344	mW/cm ^2	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 antenna exceeds the occupational standards only at the surface of the antenna dish reflector, which is completely shielded from public access by a permanently installed radome. Therefore this radome protects the public from RF radiation exposure. The dish surface area is restricted from access to all except certified field engineers and technicians who are specifically trained in RF radiation hazards and are required to disable and lockout any transmitting equipment prior to working in areas which are subject to occupational RF radiation limitations. This proposed antenna installation fully complies with the occupational RF radiation hazard limits, according to the summary of calculations and personnel and area restrictions as described above.

For the Intellian V100 antenna, using the maximum proposed power and bandwidth:

Summary:	
Dish Model:	Intennial V 100

Transmit Frequency	14.25	GHz	
Flange power	11.11	Watts	
Antenna Diameter	1.03	Meters	
Antenna Gain	41.3	dBi	
Efficiency	57.10%	Calculated	
Power Density at Reflector Surface	5.333	mW/cm ^2	Result: Exceeding Limit
Maximum Power Density Within Near Field	3.05	mW/cm ^2	Result: Within Limits
Distance to Edge of Near Field	12.60	Meters	
Maximum Power Density at Transition Zone Boundary with Far Field	1.27	mW/cm ^2	Result: Within Limits
Distance to Boundary of Transition Zone with Far Field	30.24	Meters	
Power Density at 1 Diameter Distance from Center of Dish.	0.0305	mW/cm ^2	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 antenna exceeds the occupational standards only at the surface of the antenna dish reflector, which is completely shielded from public access by a permanently installed radome. Therefore this radome protects the public from RF radiation exposure. The dish surface area is restricted from access to all except certified field engineers and technicians who are specifically trained in RF radiation hazards and are required to disable and lockout any transmitting equipment prior to working in areas which are subject to occupational RF radiation limitations. This proposed antenna installation fully complies with the occupational RF radiation hazard limits, according to the summary of calculations and personnel and area restrictions as described above.

For the Intellian V240 antenna, using the maximum proposed power and bandwidth:

Summary:			
Dish Model:	Intellian V 240		
Transmit Frequency	14.25	GHz	
Flange power	8	Watts	
Antenna Diameter	2.4	Meters	
Antenna Gain	49.1	dBi	
Efficiency	63.37%	Calculated	
Power Density at Reflector Surface	0.707	mW/cm ^2	Result: Within Limits
Maximum Power Density Within Near Field	0.45	mW/cm ^2	Result: Within Limits
Distance to Edge of Near Field	68.40	Meters	
Maximum Power Density at Transition Zone Boundary with Far Field	0.19	mW/cm ^2	Result: Within Limits
Distance to Boundary of Transition Zone with Far Field	164.16	Meters	
Power Density at 1 Diameter Distance from Center of Dish.	0.0045	mW/cm ^2	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.

For the Seatel 4010 antenna, using the maximum proposed power and bandwidth:

Summary:			
Dish Model:	Seatel 4010		
Transmit Frequency	14.25	GHz	
Flange power	12.07	Watts	
Antenna Diameter	1	Meters	
Antenna Gain	40.6	dBi	
Efficiency	51.56%	Calculated	
Power Density at Reflector Surface	6.147	mW/cm ²	Result: Exceeding Limit
Maximum Power Density Within Near Field	3.17	mW/cm ²	Result: Within Limits
Distance to Edge of Near Field	11.88	Meters	
Maximum Power Density at Transition Zone Boundary with Far Field	1.32	mW/cm ²	Result: Within Limits
Distance to Boundary of Transition Zone with Far Field	28.50	Meters	
Power Density at 1 Diameter Distance from Center of Dish.	0.0317	mW/cm ²	Result: Within Limits

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 antenna exceeds the occupational standards only at the surface of the antenna dish reflector, which is completely shielded from public access by a permanently installed radome. Therefore this radome protects the public from RF radiation exposure. The dish surface area is restricted from access to all except certified field engineers and technicians who are specifically trained in RF radiation hazards and are required to disable and lockout any transmitting equipment prior to working in areas which are subject to occupational RF radiation limitations. This proposed antenna installation fully complies with the occupational RF radiation hazard limits, according to the summary of calculations and personnel and area restrictions as described 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".

Submitted April 16, 2013

/Robert W. Fisher/

Robert W. Fisher
Principal Solutions Development Engineer | FSS/MW
Inmarsat
1201 Louisiana St. Suite 2700
Houston, TX, 77002
USA