ISAT US Inc.
FCC Form 312
Exhibit C
Radiation Hazard Analysis

1. Introduction

This Exhibit analyzes the non-ionizing radiation levels for the earth station included in this application. The analysis and calculations performed in this Exhibit comply with the methods described in the FCC Office of Engineering and Technology Bulletin, No. 65 first published in 1985 and revised in 1997 in Edition 97-01.

Bulletin No. 65 and the FCC R&O 96-326 specifies two Maximum Permissible Exposure (MPE) limits that are dependent on the situation in which the exposure takes place and/or the status of the individuals who are subject to the exposure. These are described below:

- General Population/Uncontrolled environment MPE limit is 1 mW/cm^2. The General Population / Uncontrolled MPE is a function of transmit frequency and is for an exposure period of thirty minutes or less.

- Occupational/Controlled environment MPE limit is 5 mW/cm^2. The Occupational MPE is a function of transmit frequency and is for an exposure period of six minutes or less.

The analysis determined the power flux density levels of the earth station in the 1) far-field, 2) nearfield, 3) transition region, 4) region between the feed and main reflector surface, 5) at the main reflector surface, and 6) between the antenna edge and the ground. The summary of results and discussion is provided in Section 2 and the detailed analyses are provided in Section 3.

2. Summary of Results

The terminals proposed in this application are for commercial and government uses and intended to be operated by professional personnel. The analysis of the non-ionizing radiation levels provided in Section 3 assumed the maximum allowed input power to antenna of 5W and a 100% duty cycle resulting in worst-case radiation levels. In a significant number of deployments the terminals duty cycle will be below 100% and the actual power required would be lower than the 5W maximum resulting in lower radiation levels than those calculated. As with any directional antenna the maximum level of non-ionizing radiation is in the main beam of the antenna that is pointed to the satellite. As one moves around the antenna to the side lobes and back lobes the radiation levels decrease significantly. Thus, the maximum radiation level from an antenna occurs in a limited area in the direction the antenna is pointed to. The terminals proposed in this application are designed to cease transmitting if the receive signal from the satellite is blocked, which could be caused by a person standing in front of the terminal or from other blockage. If the receive signal is blocked, the transmitter is shut down and will not resume operating until the signal from the satellite is reacquired. This operational feature of the terminal minimizes the potential for human radiation exposure. The terminals will be turned off prior to any maintenance being conducted when a person may need to be in close proximity to the feed flange and main reflector.

The Table below summarizes the result. As shown, the controlled environment limit of $\leq$ 5 mW/cm^2 is met except at the feed flange. In a controlled environment technicians are trained and procedures are put in place to ensure that a safe distance is maintained from the antenna while in operation. These procedures can include fencing around the terminal, limits on the operation of the terminal, warning signs and other means of alerting workers, as appropriate, for the specific deployment scenario.

The terminals when operating with maximum input power and a 100% duty cycle exceed the uncontrolled environment limit of ≤ 1 mW/cm^2 except in the far field. As described above the maximum radiation levels occur in a limited area in the direction the antenna is pointed to and the automatic shut off capability of the terminal when the satellite receive signal is blocked will reduce potential human exposure. In addition, the terminals proposed in this application are for commercial and government use and, given the price points, are not intended to be used by consumers or widely deployed for use by the general public. Personnel operating these terminals will be trained in how to operate the terminal safely. Furthermore, the manuals for these terminals will explicitly indicate that precautions, such has not standing in front of the terminal, that are necessary to limit potential exposure. The terminals will also clearly be marked to ensure that the terminal operator and the general public are aware of the potential radiation exposure and the need to avoid physical proximity to the terminal. It is noted that the highest radiation levels are at the feed flange and main reflector. The feed flange is a very small area of the terminal antenna and it is extremely unlikely that a person would be near the feed flange or the main reflector while the terminal is in operation. Any blockage of the signal from the satellite in these areas would cause the terminal to cease transmitting until the blockage is removed and the signal from the satellite is reacquired.

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Region	Distance (m)	Calculated Power Density (mW/cm2)	Limit Controlled Environment ≤ 5 mW/cm2	Limit Uncontrolled Environment ≤ 1 mW/cm2
Near Field	13.7	2.3	Meets Limit	Exceeds Limit
Far Field	32.9	1.0	Meets Limit	Meets Limit
Transition Region	13.7	2.3	Meets Limit	Exceeds Limit
Feed Flange	NA	1370.9	Exceeds Limit	Exceeds Limit
Main Reflector	NA	4.7	Meets Limit	Exceeds Limit

3. Detailed calculations

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"Input Parameters" Table from page 51

Input Parameter	Value	Units	Symbol
Antenna Diameter	0.74	m	D
Antenna Transmit Gain	44.2	dBi	G
Transmit Frequency	30000	MHz	f
Antenna Feed Flange Diameter	4.31	cm	d
Power Input to the Antenna	5	Watts	P

"Calculated Parameters" table from page 52

Calculated Parameter	Value	Units	Symbol	Formula
Antenna Surface Area	0.4301	m^2	A	$\pi D^2/4$
Area of Antenna Flange	14.5892	cm^2	a	$\pi d^2/4$
Antenna Efficiency	0.4867	real	η	$g\lambda^2/(\pi^2 D^2)$
Gain Factor	26302.6799	real	g	10^(G/10)
Wavelength	0.0100	m	λ	300/f

"Antenna Field Definitions" table from page 54

Calculated Parameter	Value	Units	Symbol	Formula
Near-Field Distance	13.69	m	Rnf	$D^2/(4\lambda)$
Distance to Far-Field	32.856	m	Rff	$0.6D^2/\lambda$
Distance of Transition Range	13.69	m	Rt	Rt=Rnf

Power Flux Density table from page 54

Calculated Parameter	Value	Units	Symbol	Formula
Power Density in the Near Field	2.2634	mW/cm^2	Snf	$16\eta P/(\pi D^2)$
Power Density in the Far Field	0.9695	mW/cm^2	Sff	$gP/(4\pi Rff^2)$
Power Density in the Transition Region	2.2634	mW/cm^2	St	Snf*Rnf/Rt

Flange Power Density table from page 54

Calculated Parameter	Value	Units	Symbol	Formula
Power Density at the Feed Flange	1370.8767	mW/cm^2	Sfa	4P/a

Main Reflector Power Density table from page 54

Calculated Parameter	Value	Units	Symbol	Formula
Power Density at Main Reflector	4.6504	mW/cm^2	Ssurface	4P/A

Main Reflector Power Density table from page 54

Calculated Parameter	Value	Units	Symbol	Formula
Power Density between Reflector and Ground	1.1626	mW/cm^2	Sg	P/A