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

Section 1.0 – Introduction

This Exhibit analyzes the non-ionizing radiation levels for the Swarm45 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) near-field, 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 is provided in Section 3.

Section 2.0 – Summary of Results

The Table below summarize the results for the proposed Swarm45 terminal. The terminal 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 terminal duty cycle would 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 terminal proposed in this application is 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. In addition in a controlled environment personnel with access to the antenna will be trained on the operational modes of the antenna and procedures are put in place to ensure that a safe distance is maintained from the antenna while in operation and that the terminal is turned off prior to any maintenance being conducted. Furthermore, the manuals for these terminals will explicitly indicate that precautions, such has not standing in front of the terminal, that are necessary to prevent radiation exposure.

Region	Distance (m)	Calculated Power Density (mW/cm2)	Limit Controlled Environment ≤ 5 mW/cm2	Limit Uncontrolled Environment ≤ 1 mW/cm2
Near Field	3.4	12.7	Exceeds Limit	Exceeds Limit
Far Field	8.2	4.7	Meets Limit	Exceeds Limit
Transition Region	3.	12.7	Exceeds Limit	Exceeds Limit
Main Reflector	NA	21.6	Exceeds Limit	Exceeds Limit

Section 3.0 – Detailed calculations

Input Parameter	Value	Units	Symbol
Antenna Major Axis Dimension	0.37	m	D
Antenna Transmit Gain	39	dBi	G
Transmit Frequency	30000	MHz	F
Power Input to the Antenna	5	Watts	P
Antenna Surface Area	925	cm²	A
Antenna Efficiency	0.68	Real	η

Calculated Parameter	Value	Units	Symbol	Formula
Gain Factor	7943.28	Real	g	10^(G/10)
Wavelength	0.01	m	Λ	300/f

Antenna Field Distances

Calculated Parameter	Value	Units	Symbol	Formula
Near-Field Distance	3.42	m	Rnf	$D^2/(4\lambda)$
Distance to Far-Field	8.21	m	Rff	$0.6D^2/\lambda$
Distance of Transition Range	3.42	m	Rt	Rt=Rnf

Power Density

Calculated Parameter	Value	Units	Symbol	Formula
Power Density in the Near Field	12.65	mW/cm²	Snf	$16\eta P/(\pi D^2)$
Power Density in the Far Field	4.68	mW/cm²	Sff	$gP/(4\pi Rff^2)$
Power Density in the Transition Region	12.65	mW/cm²	St	Snf*Rnf/Rt
Power Density at Aperture Surface	21.62	mW/cm²	Ssurface	4P/A