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

1.0 Introduction

This Exhibit analyzes the non-ionizing radiation levels for the EM Solutions Cobra 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 specify 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 summarizes the results radiation levels for the proposed EM Solutions Cobra terminal. The analysis of the radiation levels, provided in Section 3 assumed the maximum allowed input power to the antenna 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 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 EM Solutions Cobra terminal is for commercial and government use and is not intended for use by the general public. The terminal is cost prohibitive for purchase by the general public, therefore it will only be operated by trained professional personnel. The antenna installers will be aware of the antenna's radiation environment and use measures best suited to maximize protection to anyone who may come into the proximity of the terminal.

The EM Solutions Cobra antenna meets the FCC's MPE levels for controlled environments in the far field of the antenna and slightly exceeds the level in the near field and the transition region as well as on the main reflector. Since the antenna will be enclosed within a radome, the main reflector and feed flange areas will not be accessible while the antenna is in operation. Training of personnel with access to the antenna would include consideration of the operational modes of the antenna and information on how to prevent radiation exposure, including disabling the communications system. When maintenance of the antenna is required and the radome is removed, the trained technicians will turn off the transmit power before performing work in these areas. In addition, the antenna will be installed at an elevation that is not accessible by the general population on the vessels, and any areas where the limits for uncontrolled environments could be exceeded will be restricted to trained personnel. Therefore, the general population will be protected. Furthermore, the manuals for these terminals will provide warnings regarding potential for radiation hazard, including a label attached to the surface of the terminal warning about the potential for radiation hazard.

In conclusion, the results show that the EM Solutions Cobra antenna, in a controlled environment, and under the proper mitigation procedures, meets the guidelines specified in § 1.1310 of the Regulations.

Region	Distance (m)	Calculated Power Density (mW/cm2)	Limit Controlled Environment ≤ 5 mW/cm2	Limit Uncontrolled Environment ≤ 1 mW/cm2
Near Field	28.9	5.4	Exceeds Limit	Exceeds Limit
Far Field	69.3	2.3	Meets Limit	Exceeds Limit
Transition Region	28.9	5.4	Exceeds Limit	Exceeds Limit
Main Reflector	NA	7.1	Exceeds Limit	Exceeds Limit

Section 3.0 – Detailed calculations

Input Parameter	Value	Units	Symbol
Antenna Diameter	1.075	m	D
Antenna Transmit Gain	49.4	dBi	G
Transmit Frequency	30000	MHz	F
Antenna Feed Flange Diameter	5.02	Cm	D
Power Input to the Antenna	16	Watts	P

	Value	Units	Symbol	Formula
Antenna Surface Area	0.9076	m^2	A	$\pi D^2/4$
Area of Antenna Flange	19.7918	cm^2	A	$\pi d^2/4$
Antenna Efficiency	0.7637	real	H	$g\lambda^2/(\pi^2 D^2)$
Gain Factor	87096.3590	real	G	10^(G/10)
Wavelength	0.0100	m	Λ	300/f

	Value	Units	Symbol	Formula
Near-Field Distance	28.891	m	Rnf	$D^2/(4\lambda)$
Distance to Far-Field	69.3	m	Rff	$0.6D^2/\lambda$
Distance of Transition Range	28.89	m	Rt	Rt=Rnf

	Value	Units	Symbol	Formula
Power Density in the Near Field	5.3851	mW/cm^2	Snf	$16\eta P/(\pi D^2)$
Power Density in the Far Field	2.3067	mW/cm^2	Sff	$gP/(4\pi Rff^2)$
Power Density in the Transition Region	5.3851	mW/cm^2	St	Snf*Rnf/Rt
Power Density at the Feed Flange	3233.66	mW/cm^2	Sfa	4P/a
Power Density at Main Reflector	7.0516	mW/cm^2	Ssurface	4P/A
Power Density between Reflector and Ground	1.7629	mW/cm^2	Sg	P/A