Analysis of Non-Ionizing Radiation
for a 7.2 Meter Earth Station System

This report analyzes the non-ionizing radiation levels for a 7.2 meter earth station system. The analysis and calculations performed in this report are in compliance 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. The radiation safety limits used in the analysis are in conformance with the FCC R&O 96-326. Bulletin No. 65 and the FCC R&O specifies that there are two separate tiers of exposure limits that are dependant on the situation in which the exposure takes place and/or the status of the individuals who are subject to the exposure. The Maximum Permissible Exposure (MPE) limits for persons in a General Population/ Uncontrolled environment are shown in Table 1. The General Population/ Uncontrolled MPE is a function of transmit frequency and is for an exposure period of thirty minutes or less. The MPE limits for persons in an Occupational/Controlled environment are shown in Table 2. The Occupational MPE is a function of transmit frequency and is for an exposure period of six minutes or less. The purpose of the analysis described in this report is to determine the power flux density levels of the earth station in the far-field, near-field, transition region, between the subreflector or feed and main reflector surface, at the main reflector surface, and between the antenna edge and the ground and to compare these levels to the specified MPEs.

Table 1. Limits for General Population/Uncontrolled Exposure(MPE)

Frequency Range (MHz)	Power Density (mWatts/cm**2)
30-300	0.2
300-1500	Frequency(MHz)*(0.8/1200)
1500-100,000	1.0

Table 2. Limits for Occupational/Controlled Exposure(MPE)

Frequency Range (MHz)	Power Density (mWatts/cm**2)
30-300	1.0
300-1500	Frequency(MHz)*(4.0/1200)
1500-100,000	5.0

Table 3 contains the parameters that are used to calculate the various power densities for the earth stations.

Table 3. Formulas and Parameters Used for Determining Power Flux Densities

Parameter	Abbreviation	Value	Units
Antenna Diameter	D	7.2	meters
Antenna Surface Area	Sa	II * D**2/4	meters**2
Subreflector Diameter	Ds	101.0	cm
Area of Subreflector	As	II * Ds**2/4	cm**2
Frequency	Frequency	6175	MHz
Wavelength	lambda	300/frequency(MHz)	meters
Transmit Power	P	1122.00	Watts
Antenna Gain	Ges	51.2	dBi
Pi	II	3.1415927	n/a
Antenna Efficiency	n	0.61	n/a

1. <u>Far Field Distance Calculation</u>

The distance to the beginning of the far field can be determined from the following equation:(1)

    Distance to the Far Field Region,(Rf) = 0.60 * D**2 / lambda   (1)
                                     = 640.2 meters

The maximum main beam power density in the Far Field can be determined from the following equation:(2)

    On-Axis Power Density in the Far Field,(Wf) = Ges * P / 4 * II * Rf**2 (2)
                                     = 28.716 Watts/meters**2
                                     = 2.872 mWatts/cm**2

2. <u>Near Field Calculation</u>

Power flux density is considered to be at a maximum value throughout the entire length of the defined Near Field region. The region is contained within a cylindrical volume having the same diameter as the antenna. Past the boundary of the Near Field region the power density from the antenna decreases linearly with respect to increasing   distance.

The distance to the end of the Near Field can be determined from the following equation:(3)

    Extent of the Near Field,(Rn) = D**2 / (4 * lambda)   (3)
                                     = 266.8 meters

The maximum power density in the Near Field can be determined from the following equation:(4)

    Near Field Power Density,(Wn) = 16.0 * n * P / II * D**2   (4)
                                     = 67.035 Watts/meters**2
                                     = 6.704 mWatts/cm**2

3. <u>Transition Region Calculations</u>

The Transition region is located between the Near and Far Field regions.
The power density begins to decrease linearly with increasing distance
in the Transition region. While the power density decreases inversely
with distance in the Transition region, the power density decreases
inversely with the square of the distance in the Far Field region. The
maximum power density in the Transition region will not exceed that
calculated for the Near Field region. The power density calculated in
Section 1 is the highest power density the antenna can produce in any of
the regions away from the antenna. The power density at a distance Rt
can be determined from the following equation:(5)

      Transition region Power Density,(Tt) = Wn * Rn / Rt   (5)
                                           = 6.704 mWatts/cm**2

4. <u>Region between Main Reflector and Subreflector</u>

Transmissions from the feed assembly are directed toward the subreflector
surface, and are reflected back toward the main reflector. The most common
feed assemblies are waveguide flanges, horns or subreflectors. The energy
between the subreflector and the reflector surfaces can be calculated by
determining the power density at the subreflector surface. This can be
determined from the following equation:(6)

      Power Density at Feed Flange,(Ws) = 4 * P / As   (6)
                                        = 560.170 mWatts/cm**2

5. <u>Main Reflector Region</u>

The power density in the main reflector is determined in the same manner
as the power density at the subreflector. The area is now the area of
the main reflector aperture and can be determined from the following
equation:(7)

      Power Density at the Main Reflector Surface,(Wm) = 4 * P / Sa   (7)
                                                       = 110.230 Watts/meters**2
                                                       = 11.023 mWatts/cm**2

6. <u>Region between Main Reflector and Ground</u>

Assuming uniform illumination of the reflector surface, the power density
between the antenna and ground can be determined from the following
equation:(8)

      Power Density between Reflector and Ground,(Wg) = P / Sa   (8)
                                                      = 27.557 Watts/meters**2
                                                      = 2.756 mWatts/cm**2

Table 4. Summary of Expected Radiation levels for Uncontrolled Environment

Region	Calculated Maximum Radiation Power Density Level (mWatts/cm**2)	Hazard Assessment
1. Far Field (Rf) = 640.2 meters	2.872	Potential Hazard
2. Near Field (Rn) = 266.8 meters	6.704	Potential Hazard
3. Transition Region Rn < Rt < Rf, (Rt)	6.704	Potential Hazard
4. Between Main Reflector and Subreflector	560.170	Potential Hazard
5. Main Reflector	11.023	Potential Hazard
6. Between Main Reflector and Ground	2.756	Potential Hazard

Table 5. Summary of Expected Radiation levels for Controlled Environment

Region	Calculated Maximum Radiation Power Density Level (mWatts/cm**2)	Hazard Assessment
1. Far Field (Rf) = 640.2 meters	2.872	Satisfies FCC MPE
2. Near Field (Rn) = 266.8 meters	6.704	Potential Hazard
3. Transition Region Rn < Rt < Rf, (Rt)	6.704	Potential Hazard
4. Between Main Reflector and Subreflector	560.170	Potential Hazard
5. Main Reflector	11.023	Potential Hazard
6. Between Main Reflector and Ground	2.756	Satisfies FCC MPE

It is the applicant's responsibility to ensure that the public and operational personnel are not exposed to harmful levels of radiation.

7. Conclusions

 Based upon the above analysis, it is concluded that harmful levels of radiation may exist in those regions noted for the Uncontrolled (Table 4) and Controlled (Table 5) Environments.

This earth station will be placed next to their existing earth station, and is located on the roof of a 36 foot building. Public access to that roof is restricted.

BT Americas, Inc., will ensure that the main beam of the antenna will be pointed at least one diameter away from any buildings, or other obstacles in those areas that exceed the MPE levels. Since one diameter removed from the center of the main beam the levels are down at least 20 dB, or by a factor of 100, public safety will be ensured.

The earth station will marked with the standard radiation hazard warnings, as well as the area in the vicinity of the earth station, to inform those in the general population, who may be working, or otherwise present on the roof, and in or near, the main beam of the antenna.

Finally, occupational exposure will be limited, and the transmitter will be turned off during periods of maintenance, so that the MPE standard of 5.0 mw/cm**2 will be complied with for those regions in close proximity to the main reflector, and subreflector, which could be occupied by operating personnel.