RADIATION HAZARD ANALYSIS
11.3 meter EARTH STATION

This analysis calculates the non-ionizing radiation levels due to transmission from the earth station. The Office of Engineering and Technology (OET) Bulletin, No. 65 Edition, specifies that the Maximum Permissible Exposure (MPE) limit for persons in a General Population/Uncontrolled environment to non-ionizing radiation is a power density equal to 1 milli-watt per centimeter squared averaged over a thirty minute period, and for a controlled environment is 5 milli-watts per centimetersquared averaged over a six minute period.

The analysis estimates the maximum power density levels in the vicinity of the antenna for six regions: near field; far field; transition zone; near the reflector surface; between the reflector and the ground; and between the sub-reflector and the main reflector.

A brief discussion for each region is given below and the results of the analysis are summarized. The attached table shows the assumptions, formulae and calculations for all cases.

1. NEAR FIELD REGION

The near field (or Fresnel region) is essentially a cylindrical volume with its axis co-incident with the antenna boresight. The base of this volume is the same as the aperture of the antenna. According to OET Bulletin No. 65, its length is equal to the square of the diameter divided by four times the wavelength. Past the boundary of the Near Field region, the power density from the antenna decreases linearly with respect to increasing distance.

2. TRANSITION REGION

The transition region between the near field and the far field regions will have a power density that essentially decreases inversely with increasing distance. In any case, the maximum power density in this region will not exceed the maximum value calculated for the near field region, for the purpose of evaluating potential exposure.

3. FAR FIELD REGION

The far field (or Fraunhofer region) extends outwards from a distance equal to 0.6 times the square of the reflector diameter divided by the wavelength, according to OET Bulletin No. 65. Power density varies inversely as the square of the distance. The maximum value of the power density is calculated using the equation given in the Bulletin.

4. REGION BETWEEN THE MAIN REFLECTOR AND SUB-REFLECTOR

Transmissions from the feed assembly are directed toward the sub-reflector surface and are reflected back toward the main reflector. The most common feed assemblies are waveguide flanges, horns or sub-reflectors. The energy between the sub-reflector surfaces can be calculated by determining the power density at the sub-reflector surface. This is done by taking four times the power divided by the sub-reflector surface area.

5. REGION NEAR MAIN REFLECTOR SURFACE

The power density in the region near the main reflector surface can be estimated as equal to four times the power divided by the area of the main reflector surface, assuming that the illumination is uniform and that it would be possible to intercept equal amounts of energy radiated towards and reflected from the reflector surface.

6. REGION BETWEEN MAIN REFLECTOR AND GROUND

The power density in the region between the main reflector and the ground can be estimated as equal to the power divided by the area of the reflector surface, assuming uniform illumination over the surface of the reflector.

7. RESULTS OF ANALYSIS

The radiation analyses in the following Table were performed in accordance with the discussion from the previous sections and assuming worst case operating conditions. Based on the analysis contained therein it is concluded that levels of radiation in excess of 1 mW/cm2 will exist in regions that could normally be occupied by the public or the earth station's operating personnel. As a consequence of this, the antenna will be placed in a controlled access area so that these areas cannot be accessed by the public and can only be occupied by earth station personnel. In addition, proper warning signs will be posted at access points to this controlled environment and the transmitter will be turned off during antenna maintenance so that the FCC MPE of 5.0 mW/cm2 will be complied with at all times.

RADIATION HAZARD ANALYSIS

Nomenclature	Formula	Value	Unit
INPUT PARAMETERS			
D = Antenna Diameter		11.3	meters
d = Diameter of Subreflector		1.43	meters
P = Max Power into Antenna		384	Watts
η = Apperture Efficiency		60	%
F = Frequency		17550	MHz
λ = Wavelength	300/F	0.0171	meters
CALCULATED VALUES			
A = Area of Reflector	pi*D^2/4	100.29	meters^2
a = Area of Subreflector	pi*d^2/4	1.61	meters^2
l = Length of Near Field	D^2/4λ	1867.47	meters
L = Beginning of Far Field	0.6D^2/λ	4481.92	meters
G = Antenna Gain @ F (n=100% max value)	η(pi*D/λ)^2	2587733.90	linear
Antenna Gain in dB	10*log(G)	64.13	dBi

POWER DENSITY CALCULATIONS

	Max Power Density In Region		Hazard Assessment
Region	Formula	Value (mW/cm^2)	(FCC MPE Limit=1 mW/cm^2)
1. Snf = Max Near Field Power Density	16*P/(pi*η*D^2)	2.55	>FCC MPE Limit (See Text)
2. Sff = Max Far Field Power Density	G*P/(4*pi*L^2)	0.39	<FCC MPE Limit
3. Max Transition Region Power Density	<= Nr Fld Region	2.55	>FCC MPE Limit (See Text)
4. Near Main Reflector Surface	4*P/A	1.53	>FCC MPE Limit (See Text)
5. Between Main Reflector and Subreflector	4*P/a	95.64	>FCC MPE Limit (See Text)
6. Between Main Reflector and Ground	P/A	0.38	<FCC MPE Limit

Note: Results of all calculations scaled to convert W/sq m into mW/sq cm

Note: Near Field Power Density uses updated IEEE Standard (see IEEE Std C95.3-2021, *IEEE Recommended Practice for Measurements and Computations of Electric, Magnetic, and Electromagnetic Fields with Respect to Human Exposure to Such Fields, 0 Hz to 300 GHz*, IEEE Standards Association (approved Mar. 25, 2021)