RF Radiation Hazard Analysis

PSSI 9.1M Antenna

Antenna Diameter (D) = 9.1 meters, 910 cm
Antenna Surface Area (SA) = 650,388 sq cm
Sub-reflector Diameter (DS) = 163.80 cm
Sub-reflector Surface Area (AS) = 21,072.60 sq cm
C-Band Wavelength at 6.175 GHz Center Band, LAMBDA = .049 meters, 4.90 cm
Power at output at HPA = 750 watts
Path Loss to OMT (IL) = 4.980648 dB
Power at OMT Flange (P) = 238.23 watts
Antenna Gain at 6.1750 GHz (G) = 53.9 dBi
Antenna Gain given in Power Ratio (GES) = $2.45470\text{-}10^{5}$
Antenna Aperture Efficiency (N) = .627 or 62.7%

Region	*Radiation Level*	*Hazard Assessment*
Far Field (RF) = 101,400 cm, 1014.0 meters	0.45259 mW/cm²	Satisfies ANSI
Near Field (RN) = 65,898 cm, 65.898 meters	9.186 mW/cm²	Potential Hazard
Transition Region (RT) ≤	9.186 mW/cm²	Potential Hazard
Sub-Reflector Region (WS)	40.76 mW/cm²	Potential Hazard
Main Reflector Region (WM)	0.7325 mW/cm²	Satisfies ANSI
Power Density between Reflector and Ground	0.36628 mW/cm²	Satisfies ANSI
Power Density between Reflector Edge and Ground	0.0004025 mW/cm²	Satisfies ANSI

Conclusion:

Based on the above analysis, harmful areas of radiation do exist in areas around the antenna and in the path of the antenna toward the satellite that it is pointed. The area occupied by the public, "uncontrolled environment", will not exceed the ANSI limit of 1mW/cm² because precautions will be taken to warn, educate and limit the access of personnel around the areas of the antenna and its path that may pose a radiation hazard. The bottom edge of the antenna is 12 feet high which moves the hazard away from the public. In addition, the antenna is within a fenced off and secured compound, with no public access. Normal look angles for domestic operation move the potential hazard even further away from the public. During operation no maintenance personnel will have access to the area around the sub-reflector region. This area has the greatest concentration of radiation, but fortunately is not accessible during operation due to the operational angle of the antenna and the height above ground level. In addition, the antenna will be marked with the standard radiation hazard signs. To ensure compliance with safety limits, the Earth Station transmitters will be turned off and marked to remain off whenever maintenance and repair personnel are required to work in the areas of potential hazard as defined in the above study. Additionally, all Earth Station personnel will be trained to ensure that the antenna path is clear at all times while the transmitter is in operation.

Note: See the following sheet for how the above calculations were made.

Analysis of Non-Ionizing Radiation

PSSI 9.1M Antenna – Supporting Calculations

Antenna Diameter, (D) = ………………	D = 9.1 m D = 910 cm
Antenna Surface Area, (Sa) =…………	$Sa = \pi \cdot (D \cdot D/4)$ Sa = 65.0388 sq m Sa = 650,388.00 cm^2
Sub Reflector Diameter, (Ds) =………..	Ds = 1.220 m Ds = 122.0 cm
Sub Reflector Area, (As) =…………….	$As = \pi \cdot (Ds \cdot Ds/4)$ As = 1.1689 m^2 As = 11,689.0 cm^2
Center Frequency, (Cf) =………………	Cf = 6.175 GHz
Wavelength at (Cf), (λ) =……….	λ = .049 meters λ = 4.9 cm
Transmit Power at HPA Flange, (P1) =...	P1 = 750 Watts $P2 = \log(P1) \cdot 10$ P2 = 28.75 dBw
Path Loss from HPA to OMT, (Loss) =...	Loss = 1.980648 dB
HPA Back off from Saturation, (Loss2) =.	Loss 2 = 3.0 dB
Power at OMT, (P) =……	P3 = P2-Loss-Loss2 P3 = 23.77 dBw (OMT power in dBw) $P = 10^{P3/10}$ P = 238.23 Watts (OMT in Watts)
Antenna Gain at (Cf), (Gain) =…………	Gain = 53.9 dBi
Antenna Gain/ Power Ratio, (Ges) =…...	$Ges = 10^{Gain/10}$ $Ges = 2.45470\text{-}10^5$ Ratio
Antenna Aperture Efficiency, (n) =…….	n = .627 or n = 62.7%

Far Field (Rf) = $Rf = (0.6 \cdot (D \cdot D))/\lambda$ Rf = 1014.00 meters Rf = 101,400 cm

Far Field Pwr Density (Wf) = $Wf = (Ges \cdot P)/(4 \cdot \pi) \cdot (Rf \cdot Rf)$ Wf = 0.00045259 W/cm^2 Wf = 0.45259 mW/cm^2

Near Field (Rn) = $Rn = (D \cdot D)/4 \cdot \lambda$ Rn = 65,898 cm

Near Field Pwr Density (Wn) = $Wn = ((16 \cdot n \cdot P)/\pi \cdot (D \cdot D))$ Wn = 0.009186 W/cm^2 Wn = 9.186 mW/cm^2

Transition Region (Rt) = $Rt = Wn \cdot 1$ $Rt \leq 9.186$ mW/cm^2

Pwr Density at Sub Reflector (Ws) = $Ws = (2 \cdot P)/As$ Ws = .04076 W/cm^2 Ws = 40.76 mW/cm^2

Main Reflector Region Pwr Density (Wm) = $Wm = (2 \cdot P)/Sa$ Wm = 0.0007325 W/cm^2 Wm = 0.7325 mW/cm^2

Pwr Density / Main Reflector and Ground (Wg) = $Wg = (P/Sa)$ Wg = 0.36628 mW/cm^2

Pwr Density / Reflector Edge and Ground (WI) = $WI = Wg/D$ WI = 0.0004025 mW/cm^2