ANALYSIS OF NON-IONIZING RADIATION FOR A 2.4 METER EARTH STATION

This report analyzes the non-ionizing radiation levels for a 2.4 meter earth station. The Office of Science and Technology Bulletin, No. 65, October 1985, specifies that the maximum level of non-ionizing radiation that a person may be exposed to over a six minute period is an average power density equal to 5 mW/cm**2 (five milliwatts per centimeter squared). It is the purpose of this report to determine the power flux densities of the earth station in the far field, near field, transition region, between the feed and reflector surface, at the reflector surface, and between the antenna edge and the ground.

The following parameters were used to calculate the various power flux densities for this earth station:

Antenna Diameter, (D)	= 2.4 meters	
Antenna surface area, (Sa)	= pi (D**2) / 4	= 4.52 m**2
Feed Flange Diameter, (Df)	= 19.0 cm	
Area of Feed Flange, (Fa)	= pi (Df**2) / 4	= 283.53 cm**2
Wavelength at 14.2500 GHz, (lambda)		= 0.021 meters
Transmit Power at Flange, (P)	= 2.00 Watts	
Antenna Gain, (Ges)	Antenna Gain at 14.2500 GHz = 49.2 dBi Converted to a Power Ratio Given By: AntiLog (49.2 / 10)	= 0.832E+05
pi, (pi)	= 3.1415927	
Antenna aperture efficiency, (n)	= 0.55	

1. Far Field Calculations

The distance to the beginning of the far field region can be found b the following equation: (1)

$$\text{Distance to the Far Field Region, (Rf)} = \frac{0.60(D^{**}2)}{\text{lambda}}$$

$$= 164.2 \text{ m}$$

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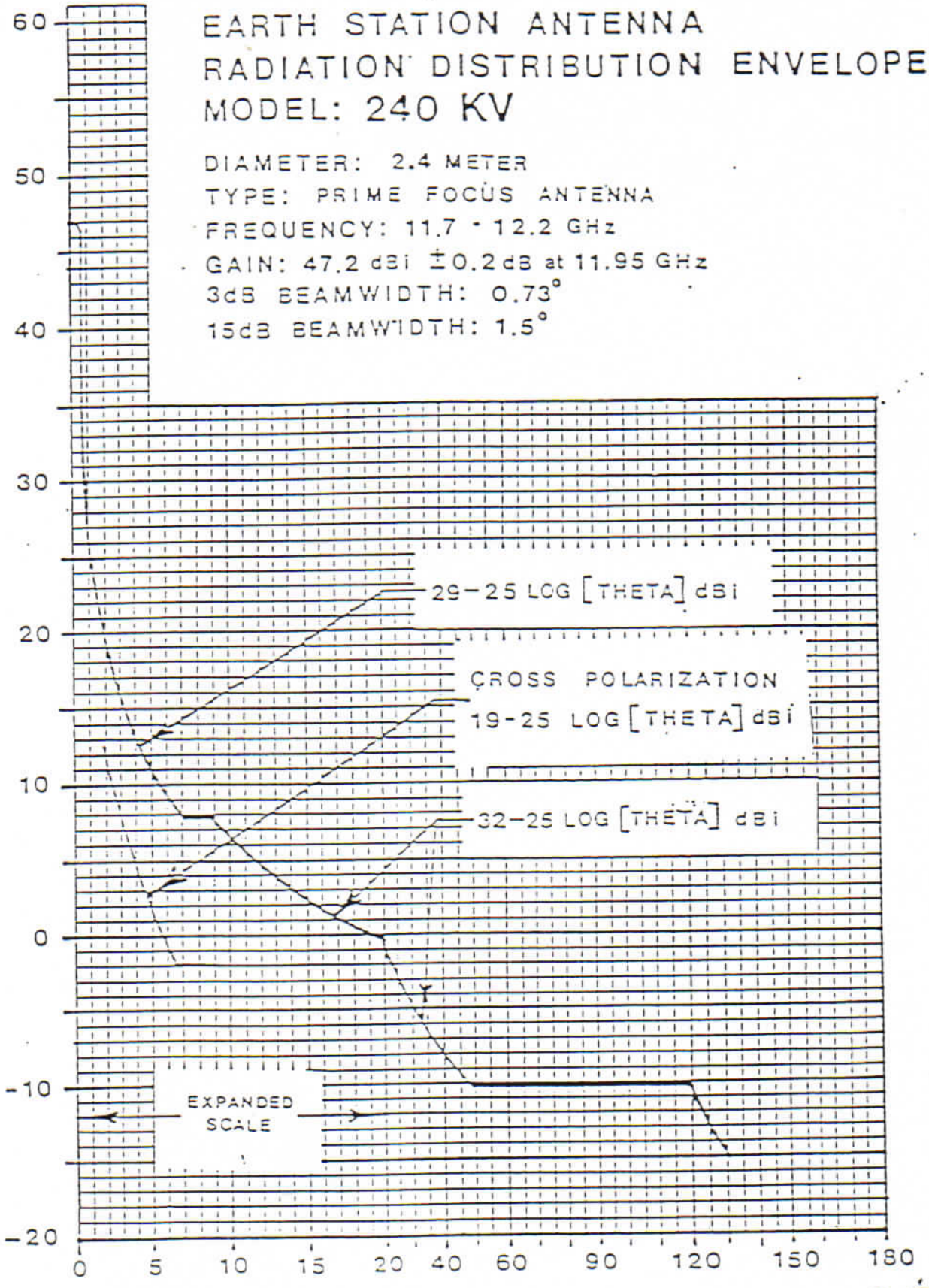
(1) Federal Communications Commission, Public Notice of January 28, 1986, "Further Guidance for Broadcasters Regarding Radiofrequency Radiation and the Environment", pp. 17 & 18.

EARTH STATION ANTENNA
RADIATION DISTRIBUTION ENVELOPE
MODEL: 240 KV

DIAMETER: 2.4 METER
TYPE: PRIME FOCUS ANTENNA
FREQUENCY: 11.7 - 12.2 GHz
GAIN: 47.2 dBi ±0.2 dB at 11.95 GHz
3dB BEAMWIDTH: 0.73°
15dB BEAMWIDTH: 1.5°



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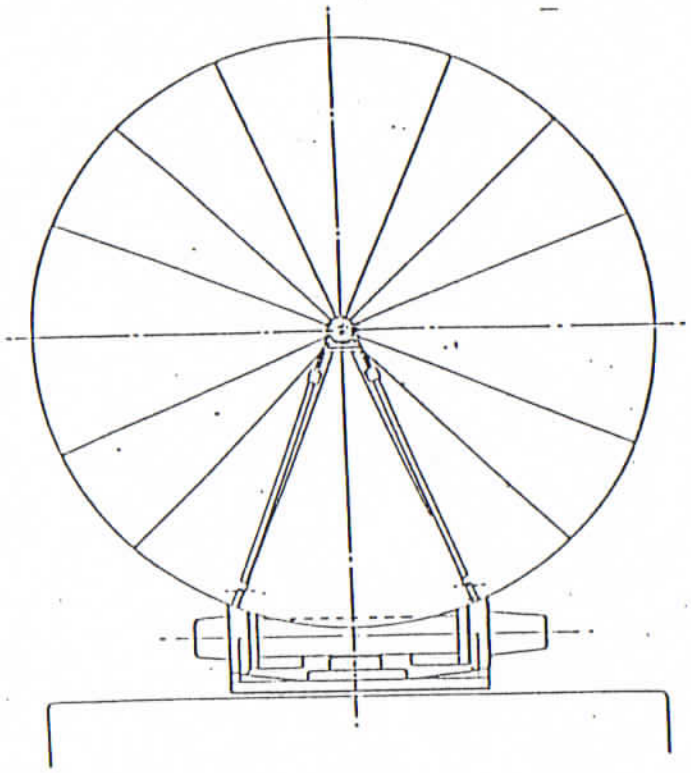
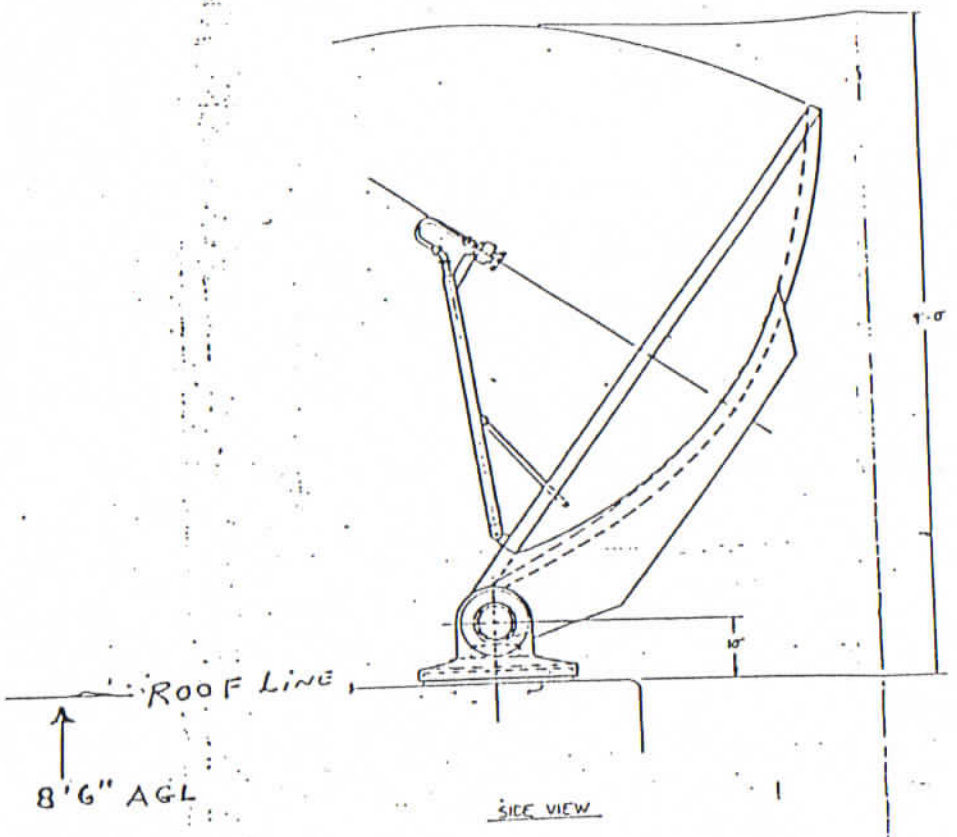
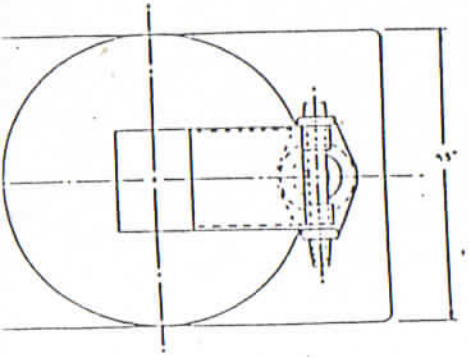


FRONT VIEW

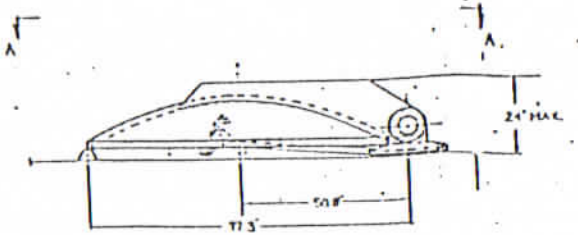


SIDE VIEW

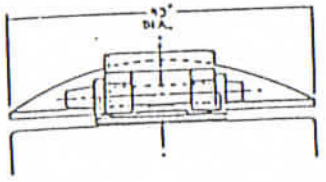
DEPLOYED CONFIGURATION



VIEW A-A
(TOP VIEW)



SIDE VIEW



REAR VIEW

STOWED CONFIGURATION

Figure 2

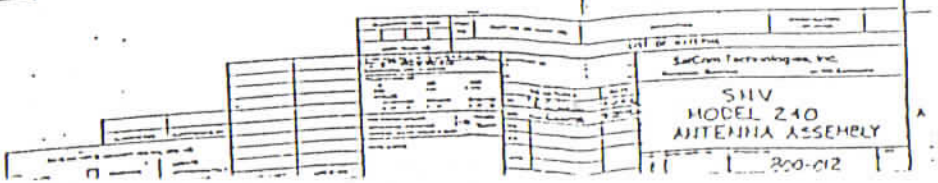


Table 1

Summary of Expected Radiation Levels

Region	Calculated Maximum Radiation Level (mW/cm**2)	Hazard Assessment
1. Far Field, (Rf)= 164.2m	0.05	SATISFIES ANSI
2. Near Field, (Rn)= 68.40m	0.10	SATISFIES ANSI
3. Transition Region, (Rt) Rn < Rt < Rf	0.10	SATISFIES ANSI
4. Between Reflector and Feed	14.11	POTENTIAL HAZARD
5. Reflector Surface	0.09	SATISFIES ANSI
6. Between Antenna and Ground	0.04	SATISFIES ANSI

7. Conclusions

Based on the above analysis it is concluded that harmful levels o: radiation will not exist in regions normally occupied by the public o: the earth station's operating personnel. The transmitter will b turned off during antenna maintenance so that the ANSI Standard of 5.(mW/cm**2 will be complied with for those regions with close proximit to the reflector that exceed acceptable levels.

The maximum main beam power density in the far field can be calculated as follows: (1)

$$\text{On-Axis Power Density in the Far Field, (Wf)} = \frac{(GES)\ (P)}{4(pi)(Rf^{**}2)}$$

$$= 0.49\ W/m^{**}2$$

$$= 0.05\ mW/cm^{**}2$$

2. Near Field Calculations

Power flux density is considered to be at a maximum value throughout the entire length of the defined region. The region is contained within a cylindrical volume having the same diameter as the antenna. Past the extent of the near field region the power density decreases with distance from the transmitting antenna.

The distance to the end of the near field can be determined by the following equation: (1)

$$\text{Extent of near field, (Rn)} = D^{**}2 / 4(lambda) = 68.40\ m$$

The maximum power density in the near field is determined by: (1)

$$\text{Near field Power Density, (Wn)} = \frac{16.0(n)P}{pi(D^{**}2)}\ mW/cm^{**}2$$

$$= 0.97\ W/m^{**}2$$

$$= 0.10\ mW/cm^{**}2$$

3. Transition Region Calculations

The transition region is located between the near and far field regions. As stated above, the power density begins to decrease with 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 in the near field region, as shown above, will not exceed 0.10 $mW/cm^{**}2$

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(1) IBID

4. Region Between Feed Flange and Reflector

Transmissions from the feed horn are directed toward the reflector surface, and are confined within a conical shape defined by the feed. The energy between the feed and reflector surface can be calculated by determining the power density at the feed flange. This can be accomplished as follows:

Power Density at Feed Flange, (Wf) = 2(P) / Fa

= 14.11 mW/cm**2

5. Main Reflector Region

The power density in the main reflector region is determined in the same manner as the power density at the feed flange, above, but the area is now the area of the reflector aperture:

Power Density at Reflector Surface, (Ws) = (2(P) / Sa)

= 0.88 W/m**2

= 0.09 mW/cm**2

6. Region between Reflector and Ground

Assuming uniform illumination of the reflector surface, the power density between the antenna and ground can be calculated as follows:

Power density between Reflector and Ground, (Wg) = (P / Sa)

= 0.44 W/m**2

= 0.04 mW/cm**2

EXHIBIT II

TECHNICAL SUMMARY

1.0 Applicant's Name: Satellite Communications Systems

2.0 Site Location: N/A - Transportable

3.0 Service: A) Domestic

B) Temporary Fixed Earth Station

C) Private

D) Transmit

4.1 Latitude: Degrees, Minutes, Seconds N.: N/A - Transportable

4.2 Longitude: Degrees, Minutes, Seconds W.: N/A - Transportable

5.0 Operating Bands: 14.05 - 14.4 GHz (transmit)

6.0 Points of Communication: All KU Band Satellites

7.0 Site Elevation: N/A - Transportable

8.0 Range of Satellite Arc: ° to ° W. Longitude at 14 GHz

N/A - Transportable

9.0 Elevation Angle Arc: ° to ° at 14 GHz

N/A - Transportable

10.0 Earth Station Azimuth Arc: ° to ° at 14 GHz

N/A - Transportable

11.0 Max. E.I.R.P. Density Toward the Horizon: dBW/4 kHz at 14 GHz

N/A - Transportable

12.0 Transmitter Equipment:

12.1 Quanity: 2

12.2 Mfr/model: MCL/ Model 10852

12.3 Power: 300 Watts

12.4 Frequency Range: 14.05 - 14.5 GHz

12.5 Frequency Stability: 2.5×10^{-7} per day

12.6 Emission Control: Emissions will be limited per Sections 25.202(g)(1), (2) and (3) of FCC Rules.

13.0 Receiving Equipment:

13.1 Mfr/model: N/A

13.2 Frequency Range: N/A

14.0 Antenna Facilities:

14.1 Communications

14.2 Size: 2.4 Meters in Diameter

14.3 Type of Feed: Prime Focus, 0.5 db attenuation

14.4 Mfr/ Model: Satcom Technology; 240KV

14.5 Gain:

	Frequency	Gain
Transmit	14.25	49.0 +- 0.2 db

14.6 Maximum Height: 16 Feet, 4.9 Meters AGL

14.7 3 dB Beamwidth: Transmit 0.61°

15.0 Remote Control: NO

16.0 Receiving System Noise Temperature: N/A

17.0 Coordination Frequencies:

Frequency Band	Pol	Emission	Max. E.I.R.P.	Max. E.I.R.P Density
14050-14400 MHz	V,H	36000F9	73.97	44.27 dBW/4 k

18.0 Environmental Consideration: Minor

19.0 Frequency Coordination : See Narrative portion of application, Section C.

20.0 FAA Notification: Not Required