Analysis of Non-Ionizing Radiation for a 6.3-Meter Earth Station

This report analyzes the non-ionizing radiation levels for TerreStar's 6.3-meter North Las Vegas backup Feeder Link earth station. The analyses performed herewith comply with the methods described in the FCC Office of Engineering and Technology Bulletin, No. 65 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 dependent on whether 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 sub-reflector 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.

Limits for General Population/Uncontrolled Exposure (MPE)

Frequency Range (MHz)	**Power Density (mW/cm^2)**
30-300	0.2
300-1500	Frequency (MHz) * (0.8 / 1200)
1500-100,000	1.0
Calculated Limit for General Population/Uncontrolled Exposure (F =12875)	1.000

Limits for Occupational/Controlled Exposure (MPE)

Frequency Range (MHz)	**Power Density (mW/cm^2)**
30-300	1.0
300-1500	Frequency (MHz) * (4.0 / 1200)
1500-100,000	5.0
Calculated Limit for General Population/Uncontrolled Exposure (F =12875)	5.000

Formulas and Parameters Used for Determining Power Flux Density

Parameter	Symbol	Formula	Value	Units
Antenna Diameter	D	Input	6.300	m
Subreflector Diameter	D_{sr}	Input	98.000	cm
Frequency	F	Input	12875.00	MHz
Transmit Power	P	Input	125.893	W
Antenna Gain (dBi)	Ges	Input	57.000	dBi
Antenna Surface Area	Asurface	$\pi D^2 / 4$	31.172	m^2
Area of Subreflector	A_{sr}	$\pi D_{sr}^2/4$	7542.964	cm^2
Wavelength	λ	299.79245 / F	0.023	m^2
Antenna Gain (factor)	G	10Ges/10	501187.2	N/A
Antenna Efficiency	η	$G \lambda^2 / (\pi^2 D^2)$	0.694	N/A

Far Field Distance Calculation

Parameter	Symbol	Formula	Value	Units
Distance to the Far Field Region	Rff	$0.60 D^2 / \lambda$	1022.725	m
On-Axis Power Density in the Far Field	Sff	$G P / (4 \pi Rff^2)$	4.800	W/m^2
			0.480	mW/cm^2

Near Field Distance Calculation

Parameter	Symbol	Formula	Value	Units
Extent of the Near Field	Rnf	$D^2 / (4 \lambda)$	426.135	m
Near Field Power Density	Snf	$16.0 \eta P / (\pi D^2)$	11.206	W/m^2
			1.121	mW/cm^2

Transition Region Calculation

Parameter	Symbol	Formula	Value	Units
Transition Region Power Density	St	Snf Rnf / Rt	0.467	mW/cm^2

Region between the Main Reflector and the Subreflector

Parameter	Symbol	Formula	Value	Units
Power Density at the Subreflector	S_{sr}	$4000 P / A_{sr}$	66.760	mW/cm^2

Main Reflector Region

Parameter	Symbol	Formula	Value	Units
Power Density at the Main Reflector Surface	Ssurface	4 P / $A_{surface}$	16.154	W/m^2
			1.615	mW/cm^2

Region between the Main Reflector and the Ground

Parameter	Symbol	Formula	Value	Units
Power Density between Reflector and Ground	Sg	P / $A_{surface}$	4.039	W/m^2
			0.404	mW/cm^2

Summary of Calculations

Summary of Expected Radiation levels for Uncontrolled Environment

Region	Symbol	Max Power Density		Hazard Assessment
Far Field (Rff= 1022.72505528408m)	Sff	0.480	mW/cm^2	Satisfies FCC MPE
Near Field (Rnf = 426.1354397017m)	Snf	1.121	mW/cm^2	Potential Hazard
Transition Region (Rnf < Rt < Rff)	St	0.467	mW/cm^2	Satisfies FCC MPE
Between Main Reflector and Subreflector	S_{sr}	66.760	mW/cm^2	Potential Hazard
Main Reflector	Ssurface	1.615	mW/cm^2	Potential Hazard
Between Main Reflector and Ground	Sg	0.404	mW/cm^2	Satisfies FCC MPE

Summary of Expected Radiation levels for Controlled Environment

Region	Symbol	Max Power Density		Hazard Assessment
Far Field (Rff= 1022.72505528408m)	Sff	0.480	mW/cm^2	Satisfies FCC MPE
Near Field (Rnf = 426.1354397017m)	Snf	1.121	mW/cm^2	Satisfies FCC MPE
Transition Region (Rnf < Rt < Rff)	St	0.467	mW/cm^2	Satisfies FCC MPE
Between Main Reflector and Subreflector	S_{sr}	66.760	mW/cm^2	Potential Hazard
Main Reflector	Ssurface	1.615	mW/cm^2	Satisfies FCC MPE
Between Main Reflector and Ground	Sg	0.404	mW/cm^2	Satisfies FCC MPE

Summary of Results

The results of analyses shown above for the 6.3 meter antenna indicate that the maximum power density in the near field exceeds the FCC's safety limit by 0.1 mW/cm^2 for uncontrolled environments. The antenna is located within a fenced area limited to individuals who work at the site. Visitors can enter through a locked gate with a key card which must be obtained at a separate building which requires identification before providing the key card. Visitors are advised not to enter the area of the antennas without being accompanied by staff. In addition, there are hazard signs in and around all areas near the antennas.

The region between the main reflector and the subreflector exceeds the limit by 65.76 mW/cm^2, however no personnel are permitted in this area during any transmissions.

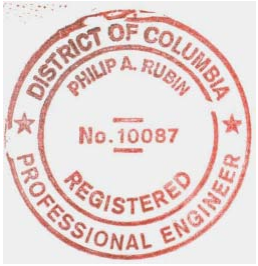
Besides monitoring visitors, the antenna elevation angle to the satellite is at 30.4° in a direction not looking towards any buildings or towers. At this elevation angle, there no one could get close to the actual transmitted beam. As the frequency for transmission is at Ku-Band, the beam is 0.26°.

CERTIFICATION OF PERSON RESPONSIBLE FOR PREPARING THE ENGINEERING INFORMATION SUBMITTED IN THIS EXHIBIT

I hereby certify that I am a technically qualified person responsible for the preparation of engineering information contained in this filing, that I am familiar with Part 2, 25 and 101 of the Commission's rules, that I have prepared or reviewed the engineering information submitted in these reply comments, and that it is complete and accurate to the best of my knowledge. I am a registered Professional Engineer. My seal is attached.

By: _____

Philip A. Rubin, P.E.
President
RKF Engineering, LLC
Washington, DC



Analysis of Non-Ionizing Radiation for a 9.3-Meter Earth Station

This report analyzes the non-ionizing radiation levels for TerreStar's 9.3-meter North Las Vegas Feeder Link earth station. The analyses performed herewith comply with the methods described in the FCC Office of Engineering and Technology Bulletin, No. 65 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 dependent on whether 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 sub-reflector 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.

Limits for General Population/Uncontrolled Exposure (MPE)

Frequency Range (MHz)	**Power Density (mW/cm^2)**
30-300	0.2
300-1500	Frequency (MHz) * (0.8 / 1200)
1500-100,000	1.0
Calculated Limit for General Population/Uncontrolled Exposure (F =12875)	1.000

Limits for Occupational/Controlled Exposure (MPE)

Frequency Range (MHz)	**Power Density (mW/cm^2)**
30-300	1.0
300-1500	Frequency (MHz) * (4.0 / 1200)
1500-100,000	5.0
Calculated Limit for General Population/Uncontrolled Exposure (F =12875)	5.000

Formulas and Parameters Used for Determining Power Flux Density

Parameter	Symbol	Formula	Value	Units
Antenna Diameter	D	Input	9.300	m
Subreflector Diameter	Dsr	Input	118.000	cm
Frequency	F	Input	12875.000	MHz
Transmit Power	P	Input	128.825	W
Antenna Gain (dBi)	Ges	Input	60.200	dBi
Antenna Surface Area	Asurface	π D2 / 4	67.929	m2
Area of Subreflector	Asr	πDsr2/4	10935.884	cm2
Wavelength	λ	299.79245 / F	0.023	m2
Antenna Gain (factor)	G	10Ges/10	1047128.548	N/A
Antenna Efficiency	η	G λ2 / (π2 D2)	0.665	N/A

Far Field Distance Calculation

Parameter	Symbol	Formula	Value	Units
Distance to the Far Field Region	Rff	0.60 D2 / λ	2228.659	m
On-Axis Power Density in the Far Field	Sff	G P / (4 π Rff2)	2.161	W/m2
			0.216	mW/cm2

Near Field Distance Calculation

Parameter	Symbol	Formula	Value	Units
Extent of the Near Field	Rnf	D2 / (4 λ)	928.608	m
Near Field Power Density	Snf	16.0 η P / (π D2)	5.045	W/m2
			0.505	mW/cm2

Transistion Region Calculation

Parameter	Symbol	Formula	Value	Units
Transition Region Power Density	St	Snf Rnf / Rt	0.210	mW/cm2

Region between the Main Reflector and the Subreflector

Parameter	Symbol	Formula	Value	Units
Power Density at the Subreflector	Ssr	4000 P / Asr	47.120	mW/cm2

Main Reflector Region

Parameter	Symbol	Formula	Value	Units
Power Density at the Main Reflector Surface	Ssurface	4 P / Asurface	7.586	W/m2
			0.759	mW/cm2

Region between the Main Reflector and the Ground

Parameter	Symbol	Formula	Value	Units
Power Density between Reflector and Ground	Sg	P / Asurface	1.896	W/m2
			0.190	mW/cm2

Summary of Calculations

Summary of Expected Radiation levels for Uncontrolled Environment

Region	Symbol	Max Power Densityl		Hazard Assessment
Far Field (Rff= 2228.65936083447m)	Sff	0.216	mW/cm2	Satisfies FCC MPE
Near Field (Rnf = 928.608067014363m)	Snf	0.505	mW/cm2	Satisfies FCC MPE
Transition Region (Rnf < Rt < Rff)	St	0.210	mW/cm2	Satisfies FCC MPE
Between Main Reflector and Subreflector	Ssr	47.120	mW/cm2	Potential Hazard
Main Reflector	Ssurface	0.759	mW/cm2	Satisfies FCC MPE
Between Main Reflector and Ground	Sg	0.190	mW/cm2	Satisfies FCC MPE

Summary of Expected Radiation levels for Controlled Environment

Region	Symbol	Max Power Density		Hazard Assessment
Far Field (Rff= 2228.65936083447m)	Sff	0.216	mW/cm2	Satisfies FCC MPE
Near Field (Rnf = 928.608067014363m)	Snf	0.505	mW/cm2	Satisfies FCC MPE
Transition Region (Rnf < Rt < Rff)	St	0.210	mW/cm2	Satisfies FCC MPE
Between Main Reflector and Subreflector	Ssr	47.120	mW/cm2	Potential Hazard
Main Reflector	Ssurface	0.759	mW/cm2	Satisfies FCC MPE
Between Main Reflector and Ground	Sg	0.190	mW/cm2	Satisfies FCC MPE

Summary of Results

The results of the analyses shown above for the 9.3 meter antenna indicate that the maximum power density exceeds the FCC's safety limit for uncontrolled environments in only one area, the region between the main reflector and the subreflector where it exceeds the limit by 46.12 mW/cm^2, however no personnel are permitted in this area during any transmissions.

The antenna is located within a fenced area limited to individuals who work at the site. Visitors can enter through a locked gate with a key card which must be obtained at a separate building which requires identification before providing the key card. Visitors are advised not to enter the area of the antennas without being accompanied by staff. In addition, there are hazard signs in and around all areas near the antennas.

Besides monitoring visitors, the antenna elevation angle to the satellite is at 30.4° in a direction not looking towards any buildings or towers. At this elevation angle, there no one could get close to the actual transmitted beam. As the frequency for transmission is at Ku-Band, the beam is 0.18°.

CERTIFICATION OF PERSON RESPONSIBLE FOR PREPARING THE ENGINEERING INFORMATION SUBMITTED IN THIS EXHIBIT

I hereby certify that I am a technically qualified person responsible for the preparation of engineering information contained in this filing, that I am familiar with Part 2, 25 and 101 of the Commission's rules, that I have prepared or reviewed the engineering information submitted in these reply comments, and that it is complete and accurate to the best of my knowledge. I am a registered Professional Engineer. My seal is attached.

By: _____

Philip A. Rubin, P.E.
President
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Washington, DC