

EXHIBIT WITH RADIATION HAZARD REPORTS

INCLUDES RADIATION HAZARD REPORTS FOR:

SEA TEL 2.4 METER C-BAND ANTENNA (Model 9707, 9797, 9711 AND C-BAND SIDE OF 9711 QOR) WITH 50 WATT BUC

SEA TEL 2.4 METER C-BAND ANTENNA (Model 9707, 9797, 9711 AND C-BAND SIDE OF 9711 QOR) WITH 100 WATT BUC

SEA TEL 1.2 METER KU-BAND ANTENNA (KU-BAND SIDE OF MODEL 9711 QOR) WITH 25 WATT BUC

INTELLIAN 2.4 METER C-BAND ANTENNA (Model V240) WITH 100 WATT BUC

INTELLIAN 1.06 METER KU-BAND ANTENNA (Model V100) WITH 16 WATT BUC

INTELLIAN 1.25 METER KU-BAND ANTENNA (Model V130) WITH 16 WATT BUC

MITSUBISHI 0.60 METER KU-BAND ANTENNA (Model MVA60) WITH 8WATT BUC

MITSUBISHI 1.20 METER KU-BAND ANTENNA (Model MVA120) WITH 8 WATT BUC

Analysis of Non-Ionizing Radiation for a 2.4-Meter Earth Station System

This report analyzes the non-ionizing radiation levels for a 2.4-meter earth station system. The analysis and calculations performed in this report comply 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 (mW/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 (mW/cm ²)
30-300	1.0
300-1500	Frequency (MHz)*(4.0/1200)
1500-100,000	5.0

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

Parameter	Symbol	Formula	Value	Units
Antenna Diameter	D	Input	2.4	m
Antenna Surface Area	A _{surface}	$\pi D^2 / 4$	4.52	m ²
Feed Flange Diameter	D _{fa}	Input	5.6	cm
Area of Feed Flange	A _{fa}	$\pi D_{fa}^2 / 4$	24.63	cm ²
Frequency	F	Input	6175	MHz
Wavelength	λ	$300 / F$	0.048583	m
Transmit Power	P	Input	44.60	W
Antenna Gain (dBi)	G _{es}	Input	41.7	dBi
Antenna Gain (factor)	G	$10^{G_{es}/10}$	14791.1	n/a
Pi	π	Constant	3.1415927	n/a
Antenna Efficiency	η	$G\lambda^2 / (\pi^2 D^2)$	0.61	n/a

1. Far Field Distance Calculation

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

$$\begin{aligned} \text{Distance to the Far Field Region} \quad R_{ff} &= 0.60 D^2 / \lambda \\ &= 71.1 \text{ m} \end{aligned} \quad (1)$$

The maximum main beam power density in the far field can be determined from the following equation:

$$\begin{aligned} \text{On-Axis Power Density in the Far Field} \quad S_{ff} &= G P / (4 \pi R_{ff}^2) \\ &= 10.374 \text{ W/m}^2 \\ &= 1.037 \text{ mW/cm}^2 \end{aligned} \quad (2)$$

2. Near Field Calculation

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:

$$\begin{aligned} \text{Extent of the Near Field} \quad R_{nf} &= D^2 / (4 \lambda) \\ &= 29.6 \text{ m} \end{aligned} \quad (3)$$

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

$$\begin{aligned} \text{Near Field Power Density} \quad S_{nf} &= 16.0 \eta P / (\pi D^2) \\ &= 24.217 \text{ W/m}^2 \\ &= 2.422 \text{ mW/cm}^2 \end{aligned} \quad (4)$$

3. Transition Region Calculation

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 R_t can be determined from the following equation:

$$\begin{aligned} \text{Transition Region Power Density} \quad S_t &= S_{nf} R_{nf} / R_t \\ &= 2.422 \text{ mW/cm}^2 \end{aligned} \quad (5)$$

4. Region between the Feed Assembly and the Antenna Reflector

Transmissions from the feed assembly are directed toward the antenna reflector surface, and are confined within a conical shape defined by the type of feed assembly. The most common feed assemblies are waveguide flanges, horns or subreflectors. The energy between the feed assembly and reflector surface can be calculated by determining the power density at the feed assembly surface. This can be determined from the following equation:

$$\begin{aligned} \text{Power Density at the Feed Flange} \quad S_{fa} &= 4000 P / A_{fa} & (6) \\ &= 7243.174 \text{ mW/cm}^2 \end{aligned}$$

5. Main Reflector Region

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

$$\begin{aligned} \text{Power Density at the Reflector Surface} \quad S_{\text{surface}} &= 4 P / A_{\text{surface}} & (7) \\ &= 39,435 \text{ W/m}^2 \\ &= 3.944 \text{ mW/cm}^2 \end{aligned}$$

6. Region between the Reflector and the Ground

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

$$\begin{aligned} \text{Power Density between Reflector and Ground} \quad S_g &= P / A_{\text{surface}} & (8) \\ &= 9.859 \text{ W/m}^2 \\ &= 0.986 \text{ mW/cm}^2 \end{aligned}$$

7. Summary of Calculations

Table 4. Summary of Expected Radiation levels for Uncontrolled Environment

Region	Calculated Maximum Radiation Power Density Level (mW/cm ²)		Hazard Assessment
	Symbol	Value	
1. Far Field ($R_{ff} = 71.1$ m)	S_{ff}	1.037	Potential Hazard
2. Near Field ($R_{nf} = 29.6$ m)	S_{nf}	2.422	Potential Hazard
3. Transition Region ($R_{nf} < R_t < R_{ff}$)	S_t	2.422	Potential Hazard
4. Between Feed Assembly and Antenna Reflector	S_{fa}	7243.174	Potential Hazard
5. Main Reflector	$S_{surface}$	3.944	Potential Hazard
6. Between Reflector and Ground	S_g	0.986	Satisfies FCC MPE

Table 5. Summary of Expected Radiation levels for Controlled Environment

Region	Calculated Maximum Radiation Power Density Level (mW/cm ²)		Hazard Assessment
	Symbol	Value	
1. Far Field ($R_{ff} = 71.1$ m)	S_{ff}	1.037	Satisfies FCC MPE
2. Near Field ($R_{nf} = 29.6$ m)	S_{nf}	2.422	Satisfies FCC MPE
3. Transition Region ($R_{nf} < R_t < R_{ff}$)	S_t	2.422	Satisfies FCC MPE
4. Between Feed Assembly and Antenna Reflector	S_{fa}	7243.174	Potential Hazard
5. Main Reflector	$S_{surface}$	3.944	Satisfies FCC MPE
6. Between Reflector and Ground	S_g	0.986	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.

8. 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) environment.

The earth station will be mounted aboard a ship, and it is recommended that the lower edge of the antenna should be at least 2 meters above the deck. If this is not the case, additional procedures will be instituted to ensure the safety of the Public in the vicinity of the antenna.

The applicant 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 be 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 deck, 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.

The applicant agrees to abide by the conditions specified in Condition 5208 provided below:

Condition 5208 - The licensee shall take all necessary measures to ensure that the antenna does not create potential exposure of humans to radiofrequency radiation in excess of the FCC exposure limits defined in 47 CFR 1.1307(b) and 1.1310 wherever such exposures might occur. Measures must be taken to ensure compliance with limits for both occupational/controlled exposure and for general population/uncontrolled exposure, as defined in these rule sections. Compliance can be accomplished in most cases by appropriate restrictions such as fencing. Requirements for restrictions can be determined by predictions based on calculations, modeling or by field measurements. The FCC's OET Bulletin 65 (available on-line at www.fcc.gov/oet/rfsafety) provides information on predicting exposure levels and on methods for ensuring compliance, including the use of warning and alerting signs and protective equipment for worker.

Analysis of Non-Ionizing Radiation for a 2.4-Meter Earth Station System

This report analyzes the non-ionizing radiation levels for a 2.4-meter earth station system. The analysis and calculations performed in this report comply 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 (mW/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 (mW/cm ²)
30-300	1.0
300-1500	Frequency (MHz)*(4.0/1200)
1500-100,000	5.0

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

Parameter	Symbol	Formula	Value	Units
Antenna Diameter	D	Input	2.4	m
Antenna Surface Area	A _{surface}	$\pi D^2 / 4$	4.52	m ²
Feed Flange Diameter	D _{fa}	Input	5.6	cm
Area of Feed Flange	A _{fa}	$\pi D_{fa}^2 / 4$	24.63	cm ²
Frequency	F	Input	6425	MHz
Wavelength	λ	$300 / F$	0.046693	m
Transmit Power	P	Input	87.14	W
Antenna Gain (dBi)	G _{es}	Input	42.3	dBi
Antenna Gain (factor)	G	$10^{G_{es}/10}$	16982.4	n/a
Pi	π	Constant	3.1415927	n/a
Antenna Efficiency	η	$G\lambda^2 / (\pi^2 D^2)$	0.65	n/a

1. Far Field Distance Calculation

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

$$\begin{aligned} \text{Distance to the Far Field Region} \quad R_{ff} &= 0.60 D^2 / \lambda \\ &= 74.0 \text{ m} \end{aligned} \quad (1)$$

The maximum main beam power density in the far field can be determined from the following equation:

$$\begin{aligned} \text{On-Axis Power Density in the Far Field} \quad S_{ff} &= G P / (4 \pi R_{ff}^2) \\ &= 21.496 \text{ W/m}^2 \\ &= 2.150 \text{ mW/cm}^2 \end{aligned} \quad (2)$$

2. Near Field Calculation

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:

$$\begin{aligned} \text{Extent of the Near Field} \quad R_{nf} &= D^2 / (4 \lambda) \\ &= 30.8 \text{ m} \end{aligned} \quad (3)$$

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

$$\begin{aligned} \text{Near Field Power Density} \quad S_{nf} &= 16.0 \eta P / (\pi D^2) \\ &= 50.181 \text{ W/m}^2 \\ &= 5.018 \text{ mW/cm}^2 \end{aligned} \quad (4)$$

3. Transition Region Calculation

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 R_t can be determined from the following equation:

$$\begin{aligned} \text{Transition Region Power Density} \quad S_t &= S_{nf} R_{nf} / R_t \\ &= 5.018 \text{ mW/cm}^2 \end{aligned} \quad (5)$$

4. Region between the Feed Assembly and the Antenna Reflector

Transmissions from the feed assembly are directed toward the antenna reflector surface, and are confined within a conical shape defined by the type of feed assembly. The most common feed assemblies are waveguide flanges, horns or subreflectors. The energy between the feed assembly and reflector surface can be calculated by determining the power density at the feed assembly surface. This can be determined from the following equation:

$$\begin{aligned} \text{Power Density at the Feed Flange} \quad S_{fa} &= 4000 P / A_{fa} & (6) \\ &= 14151.797 \text{ mW/cm}^2 \end{aligned}$$

5. Main Reflector Region

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

$$\begin{aligned} \text{Power Density at the Reflector Surface} \quad S_{\text{surface}} &= 4 P / A_{\text{surface}} & (7) \\ &= 77.049 \text{ W/m}^2 \\ &= 7.705 \text{ mW/cm}^2 \end{aligned}$$

6. Region between the Reflector and the Ground

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

$$\begin{aligned} \text{Power Density between Reflector and Ground} \quad S_g &= P / A_{\text{surface}} & (8) \\ &= 19.262 \text{ W/m}^2 \\ &= 1.926 \text{ mW/cm}^2 \end{aligned}$$

7. Summary of Calculations

Table 4. Summary of Expected Radiation levels for Uncontrolled Environment

Region	Calculated Maximum Radiation Power Density Level (mW/cm ²)		Hazard Assessment
1. Far Field ($R_{ff} = 74.0$ m)	S_{ff}	2.150	Potential Hazard
2. Near Field ($R_{nf} = 30.8$ m)	S_{nf}	5.018	Potential Hazard
3. Transition Region ($R_{nf} < R_t < R_{ff}$)	S_t	5.018	Potential Hazard
4. Between Feed Assembly and Antenna Reflector	S_{fa}	14151.797	Potential Hazard
5. Main Reflector	$S_{surface}$	7.705	Potential Hazard
6. Between Reflector and Ground	S_g	1.926	Potential Hazard

Table 5. Summary of Expected Radiation levels for Controlled Environment

Region	Calculated Maximum Radiation Power Density Level (mW/cm ²)		Hazard Assessment
1. Far Field ($R_{ff} = 74.0$ m)	S_{ff}	2.150	Satisfies FCC MPE
2. Near Field ($R_{nf} = 30.8$ m)	S_{nf}	5.018	Potential Hazard
3. Transition Region ($R_{nf} < R_t < R_{ff}$)	S_t	5.018	Potential Hazard
4. Between Feed Assembly and Antenna Reflector	S_{fa}	14151.797	Potential Hazard
5. Main Reflector	$S_{surface}$	7.705	Potential Hazard
6. Between Reflector and Ground	S_g	1.926	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.

8. 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.

The earth station will be mounted aboard a ship, and it is recommended that the lower edge of the antenna should be at least 2 meters above the deck. If this is not the case, additional procedures will be instituted to ensure the safety of the Public in the vicinity of the antenna.

The applicant 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 be 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 deck, 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/cm² will be complied with for those regions in close proximity to the main reflector, and subreflector, which could be occupied by operating personnel.

The applicant agrees to abide by the conditions specified in Condition 5208 provided below:

Condition 5208 - The licensee shall take all necessary measures to ensure that the antenna does not create potential exposure of humans to radiofrequency radiation in excess of the FCC exposure limits defined in 47 CFR 1.1307(b) and 1.1310 wherever such exposures might occur. Measures must be taken to ensure compliance with limits for both occupational/controlled exposure and for general population/uncontrolled exposure, as defined in these rule sections. Compliance can be accomplished in most cases by appropriate restrictions such as fencing. Requirements for restrictions can be determined by predictions based on calculations, modeling or by field measurements. The FCC's OET Bulletin 65 (available on-line at www.fcc.gov/oet/rfsafety) provides information on predicting exposure levels and on methods for ensuring compliance, including the use of warning and alerting signs and protective equipment for worker.

Analysis of Non-Ionizing Radiation for a 1.2-Meter Earth Station System

This report analyzes the non-ionizing radiation levels for a 1.2-meter earth station system. The analysis and calculations performed in this report comply 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 (mW/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 (mW/cm ²)
30-300	1.0
300-1500	Frequency (MHz)*(4.0/1200)
1500-100,000	5.0

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

Parameter	Symbol	Formula	Value	Units
Antenna Diameter	D	Input	1.2	m
Antenna Surface Area	A _{surface}	$\pi D^2 / 4$	1.13	m ²
Feed Flange Diameter	D _{fa}	Input	5.1	cm
Area of Feed Flange	A _{fa}	$\pi D_{fa}^2 / 4$	20.43	cm ²
Frequency	F	Input	14250	MHz
Wavelength	λ	$300 / F$	0.021053	m
Transmit Power	P	Input	21.19	W
Antenna Gain (dBi)	G _{es}	Input	43.0	dBi
Antenna Gain (factor)	G	$10^{G_{es}/10}$	19952.6	n/a
Pi	π	Constant	3.1415927	n/a
Antenna Efficiency	η	$G\lambda^2 / (\pi^2 D^2)$	0.62	n/a

1. Far Field Distance Calculation

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

$$\begin{aligned} \text{Distance to the Far Field Region} \quad R_{ff} &= 0.60 D^2 / \lambda \\ &= 41.0 \text{ m} \end{aligned} \quad (1)$$

The maximum main beam power density in the far field can be determined from the following equation:

$$\begin{aligned} \text{On-Axis Power Density in the Far Field} \quad S_{ff} &= G P / (4 \pi R_{ff}^2) \\ &= 19.976 \text{ W/m}^2 \\ &= 1.998 \text{ mW/cm}^2 \end{aligned} \quad (2)$$

2. Near Field Calculation

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:

$$\begin{aligned} \text{Extent of the Near Field} \quad R_{nf} &= D^2 / (4 \lambda) \\ &= 17.1 \text{ m} \end{aligned} \quad (3)$$

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

$$\begin{aligned} \text{Near Field Power Density} \quad S_{nf} &= 16.0 \eta P / (\pi D^2) \\ &= 46.633 \text{ W/m}^2 \\ &= 4.663 \text{ mW/cm}^2 \end{aligned} \quad (4)$$

3. Transition Region Calculation

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 R_t can be determined from the following equation:

$$\begin{aligned} \text{Transition Region Power Density} \quad S_t &= S_{nf} R_{nf} / R_t \\ &= 4.663 \text{ mW/cm}^2 \end{aligned} \quad (5)$$

4. Region between the Feed Assembly and the Antenna Reflector

Transmissions from the feed assembly are directed toward the antenna reflector surface, and are confined within a conical shape defined by the type of feed assembly. The most common feed assemblies are waveguide flanges, horns or subreflectors. The energy between the feed assembly and reflector surface can be calculated by determining the power density at the feed assembly surface. This can be determined from the following equation:

$$\begin{aligned} \text{Power Density at the Feed Flange} \quad S_{fa} &= 4000 P / A_{fa} & (6) \\ &= 4149.165 \text{ mW/cm}^2 \end{aligned}$$

5. Main Reflector Region

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

$$\begin{aligned} \text{Power Density at the Reflector Surface} \quad S_{\text{surface}} &= 4 P / A_{\text{surface}} & (7) \\ &= 74.944 \text{ W/m}^2 \\ &= 7.494 \text{ mW/cm}^2 \end{aligned}$$

6. Region between the Reflector and the Ground

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

$$\begin{aligned} \text{Power Density between Reflector and Ground} \quad S_g &= P / A_{\text{surface}} & (8) \\ &= 18.736 \text{ W/m}^2 \\ &= 1.874 \text{ mW/cm}^2 \end{aligned}$$

7. Summary of Calculations

Table 4. Summary of Expected Radiation levels for Uncontrolled Environment

Region	Calculated Maximum Radiation Power Density Level (mW/cm ²)		Hazard Assessment
1. Far Field ($R_{ff} = 41.0$ m)	S_{ff}	1.998	Potential Hazard
2. Near Field ($R_{nf} = 17.1$ m)	S_{nf}	4.663	Potential Hazard
3. Transition Region ($R_{nf} < R_t < R_{ff}$)	S_t	4.663	Potential Hazard
4. Between Feed Assembly and Antenna Reflector	S_{fa}	4149.165	Potential Hazard
5. Main Reflector	$S_{surface}$	7.494	Potential Hazard
6. Between Reflector and Ground	S_g	1.874	Potential Hazard

Table 5. Summary of Expected Radiation levels for Controlled Environment

Region	Calculated Maximum Radiation Power Density Level (mW/cm ²)		Hazard Assessment
1. Far Field ($R_{ff} = 41.0$ m)	S_{ff}	1.998	Satisfies FCC MPE
2. Near Field ($R_{nf} = 17.1$ m)	S_{nf}	4.663	Satisfies FCC MPE
3. Transition Region ($R_{nf} < R_t < R_{ff}$)	S_t	4.663	Satisfies FCC MPE
4. Between Feed Assembly and Antenna Reflector	S_{fa}	4149.165	Potential Hazard
5. Main Reflector	$S_{surface}$	7.494	Potential Hazard
6. Between Reflector and Ground	S_g	1.874	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.

8. 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.

The earth station will be mounted aboard a ship, and it is recommended that the lower edge of the antenna should be at least 2 meters above the deck. If this is not the case, additional procedures will be instituted to ensure the safety of the Public in the vicinity of the antenna.

The applicant 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 be 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, deck, 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/cm² will be complied with for those regions in close proximity to the main reflector, and subreflector, which could be occupied by operating personnel.

The applicant agrees to abide by the conditions specified in Condition 5208 provided below:

Condition 5208 - The licensee shall take all necessary measures to ensure that the antenna does not create potential exposure of humans to radiofrequency radiation in excess of the FCC exposure limits defined in 47 CFR 1.1307(b) and 1.1310 wherever such exposures might occur. Measures must be taken to ensure compliance with limits for both occupational/controlled exposure and for general population/uncontrolled exposure, as defined in these rule sections. Compliance can be accomplished in most cases by appropriate restrictions such as fencing. Requirements for restrictions can be determined by predictions based on calculations, modeling or by field measurements. The FCC's OET Bulletin 65 (available on-line at www.fcc.gov/oet/rfsafety) provides information on predicting exposure levels and on methods for ensuring compliance, including the use of warning and alerting signs and protective equipment for worker.

Analysis of Non-Ionizing Radiation for a 2.4-Meter Earth Station System

This report analyzes the non-ionizing radiation levels for a 2.4-meter earth station system. The analysis and calculations performed in this report comply 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 (mW/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 (mW/cm ²)
30-300	1.0
300-1500	Frequency (MHz)*(4.0/1200)
1500-100,000	5.0

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

Parameter	Symbol	Formula	Value	Units
Antenna Diameter	D	Input	2.4	m
Antenna Surface Area	A _{surface}	$\pi D^2 / 4$	4.52	m ²
Feed Flange Diameter	D _{fa}	Input	2.9	cm
Area of Feed Flange	A _{fa}	$\pi D_{fa}^2 / 4$	6.61	cm ²
Frequency	F	Input	6175	MHz
Wavelength	λ	$300 / F$	0.048583	m
Transmit Power	P	Input	79.43	W
Antenna Gain (dBi)	G _{es}	Input	41.7	dBi
Antenna Gain (factor)	G	$10^{G_{es}/10}$	14791.1	n/a
Pi	π	Constant	3.1415927	n/a
Antenna Efficiency	η	$G\lambda^2 / (\pi^2 D^2)$	0.61	n/a

1. Far Field Distance Calculation

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

$$\begin{aligned} \text{Distance to the Far Field Region} \quad R_{ff} &= 0.60 D^2 / \lambda \\ &= 71.1 \text{ m} \end{aligned} \quad (1)$$

The maximum main beam power density in the far field can be determined from the following equation:

$$\begin{aligned} \text{On-Axis Power Density in the Far Field} \quad S_{ff} &= G P / (4 \pi R_{ff}^2) \\ &= 18.475 \text{ W/m}^2 \\ &= 1.848 \text{ mW/cm}^2 \end{aligned} \quad (2)$$

2. Near Field Calculation

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:

$$\begin{aligned} \text{Extent of the Near Field} \quad R_{nf} &= D^2 / (4 \lambda) \\ &= 29.6 \text{ m} \end{aligned} \quad (3)$$

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

$$\begin{aligned} \text{Near Field Power Density} \quad S_{nf} &= 16.0 \eta P / (\pi D^2) \\ &= 43.130 \text{ W/m}^2 \\ &= 4.313 \text{ mW/cm}^2 \end{aligned} \quad (4)$$

3. Transition Region Calculation

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 R_t can be determined from the following equation:

$$\begin{aligned} \text{Transition Region Power Density} \quad S_t &= S_{nf} R_{nf} / R_t \\ &= 4.313 \text{ mW/cm}^2 \end{aligned} \quad (5)$$

4. Region between the Feed Assembly and the Antenna Reflector

Transmissions from the feed assembly are directed toward the antenna reflector surface, and are confined within a conical shape defined by the type of feed assembly. The most common feed assemblies are waveguide flanges, horns or subreflectors. The energy between the feed assembly and reflector surface can be calculated by determining the power density at the feed assembly surface. This can be determined from the following equation:

$$\begin{aligned} \text{Power Density at the Feed Flange} \quad S_{fa} &= 4000 P / A_{fa} & (6) \\ &= 48101.506 \text{ mW/cm}^2 \end{aligned}$$

5. Main Reflector Region

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

$$\begin{aligned} \text{Power Density at the Reflector Surface} \quad S_{\text{surface}} &= 4 P / A_{\text{surface}} & (7) \\ &= 70.232 \text{ W/m}^2 \\ &= 7.023 \text{ mW/cm}^2 \end{aligned}$$

6. Region between the Reflector and the Ground

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

$$\begin{aligned} \text{Power Density between Reflector and Ground} \quad S_g &= P / A_{\text{surface}} & (8) \\ &= 17.558 \text{ W/m}^2 \\ &= 1.756 \text{ mW/cm}^2 \end{aligned}$$

7. Summary of Calculations

Table 4. Summary of Expected Radiation levels for Uncontrolled Environment

Region	Calculated Maximum Radiation Power Density Level (mW/cm ²)		Hazard Assessment
1. Far Field ($R_{ff} = 71.1$ m)	S_{ff}	1.848	Potential Hazard
2. Near Field ($R_{nf} = 29.6$ m)	S_{nf}	4.313	Potential Hazard
3. Transition Region ($R_{nf} < R_t < R_{ff}$)	S_t	4.313	Potential Hazard
4. Between Feed Assembly and Antenna Reflector	S_{fa}	48101.506	Potential Hazard
5. Main Reflector	$S_{surface}$	7.023	Potential Hazard
6. Between Reflector and Ground	S_g	1.756	Potential Hazard

Table 5. Summary of Expected Radiation levels for Controlled Environment

Region	Calculated Maximum Radiation Power Density Level (mW/cm ²)		Hazard Assessment
1. Far Field ($R_{ff} = 71.1$ m)	S_{ff}	1.848	Satisfies FCC MPE
2. Near Field ($R_{nf} = 29.6$ m)	S_{nf}	4.313	Satisfies FCC MPE
3. Transition Region ($R_{nf} < R_t < R_{ff}$)	S_t	4.313	Satisfies FCC MPE
4. Between Feed Assembly and Antenna Reflector	S_{fa}	48101.506	Potential Hazard
5. Main Reflector	$S_{surface}$	7.023	Potential Hazard
6. Between Reflector and Ground	S_g	1.756	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.

8. 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.

The earth station will be mounted aboard a ship, and it is recommended that the lower edge of the antenna should be at least 2 meters above the deck. If this is not the case, additional procedures will be instituted to insure the safety of the Public in the vicinity of the antenna.

The applicant 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 be 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 ship, 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/cm² will be complied with for those regions in close proximity to the main reflector, and subreflector, which could be occupied by operating personnel.

The applicant agrees to abide by the conditions specified in Condition 5208 provided below:

Condition 5208 - The licensee shall take all necessary measures to ensure that the antenna does not create potential exposure of humans to radiofrequency radiation in excess of the FCC exposure limits defined in 47 CFR 1.1307(b) and 1.1310 wherever such exposures might occur. Measures must be taken to ensure compliance with limits for both occupational/controlled exposure and for general population/uncontrolled exposure, as defined in these rule sections. Compliance can be accomplished in most cases by appropriate restrictions such as fencing. Requirements for restrictions can be determined by predictions based on calculations, modeling or by field measurements. The FCC's OET Bulletin 65 (available on-line at www.fcc.gov/oet/rfsafety) provides information on predicting exposure levels and on methods for ensuring compliance, including the use of warning and alerting signs and protective equipment for worker.

Analysis of Non-Ionizing Radiation for a 1.06-Meter Earth Station System

This report analyzes the non-ionizing radiation levels for a 1.06-meter earth station system. The analysis and calculations performed in this report comply 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 (mW/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 (mW/cm ²)
30-300	1.0
300-1500	Frequency (MHz)*(4.0/1200)
1500-100,000	5.0

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

Parameter	Symbol	Formula	Value	Units
Antenna Diameter	D	Input	1.06	m
Antenna Surface Area	A _{surface}	$\pi D^2 / 4$	0.88	m ²
Feed Flange Diameter	D _{fa}	Input	0.502	cm
Area of Feed Flange	A _{fa}	$\pi D_{fa}^2 / 4$	0.20	cm ²
Frequency	F	Input	14250	MHz
Wavelength	λ	300 / F	0.021053	m
Transmit Power	P	Input	13.80	W
Antenna Gain (dBi)	G _{es}	Input	41.2	dBi
Antenna Gain (factor)	G	10 ^{Ges/10}	13182.6	n/a
Pi	π	Constant	3.1415927	n/a
Antenna Efficiency	η	$G\lambda^2 / (\pi^2 D^2)$	0.53	n/a

1. Far Field Distance Calculation

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

$$\begin{aligned} \text{Distance to the Far Field Region} \quad R_{ff} &= 0.60 D^2 / \lambda \\ &= 32.0 \text{ m} \end{aligned} \quad (1)$$

The maximum main beam power density in the far field can be determined from the following equation:

$$\begin{aligned} \text{On-Axis Power Density in the Far Field} \quad S_{ff} &= G P / (4 \pi R_{ff}^2) \\ &= 14.117 \text{ W/m}^2 \\ &= 1.412 \text{ mW/cm}^2 \end{aligned} \quad (2)$$

2. Near Field Calculation

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:

$$\begin{aligned} \text{Extent of the Near Field} \quad R_{nf} &= D^2 / (4 \lambda) \\ &= 13.3 \text{ m} \end{aligned} \quad (3)$$

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

$$\begin{aligned} \text{Near Field Power Density} \quad S_{nf} &= 16.0 \eta P / (\pi D^2) \\ &= 32.956 \text{ W/m}^2 \\ &= 3.296 \text{ mW/cm}^2 \end{aligned} \quad (4)$$

3. Transition Region Calculation

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 R_t can be determined from the following equation:

$$\begin{aligned} \text{Transition Region Power Density} \quad S_t &= S_{nf} R_{nf} / R_t \\ &= 3.296 \text{ mW/cm}^2 \end{aligned} \quad (5)$$

4. Region between the Feed Assembly and the Antenna Reflector

Transmissions from the feed assembly are directed toward the antenna reflector surface, and are confined within a conical shape defined by the type of feed assembly. The most common feed assemblies are waveguide flanges, horns or subreflectors. The energy between the feed assembly and reflector surface can be calculated by determining the power density at the feed assembly surface. This can be determined from the following equation:

$$\begin{aligned} \text{Power Density at the Feed Flange} \quad S_{fa} &= 4000 P / A_{fa} & (6) \\ &= 278895.660 \text{ mW/cm}^2 \end{aligned}$$

5. Main Reflector Region

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

$$\begin{aligned} \text{Power Density at the Reflector Surface} \quad S_{\text{surface}} &= 4 P / A_{\text{surface}} & (7) \\ &= 62.551 \text{ W/m}^2 \\ &= 6.255 \text{ mW/cm}^2 \end{aligned}$$

6. Region between the Reflector and the Ground

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

$$\begin{aligned} \text{Power Density between Reflector and Ground} \quad S_g &= P / A_{\text{surface}} & (8) \\ &= 15.638 \text{ W/m}^2 \\ &= 1.564 \text{ mW/cm}^2 \end{aligned}$$

7. Summary of Calculations

Table 4. Summary of Expected Radiation levels for Uncontrolled Environment

Region	Calculated Maximum Radiation Power Density Level (mW/cm ²)		Hazard Assessment
1. Far Field ($R_{ff} = 32.0$ m)	S_{ff}	1.412	Potential Hazard
2. Near Field ($R_{nf} = 13.3$ m)	S_{nf}	3.296	Potential Hazard
3. Transition Region ($R_{nf} < R_t < R_{ff}$)	S_t	3.296	Potential Hazard
4. Between Feed Assembly and Antenna Reflector	S_{fa}	278895.660	Potential Hazard
5. Main Reflector	$S_{surface}$	6.255	Potential Hazard
6. Between Reflector and Ground	S_g	1.564	Potential Hazard

Table 5. Summary of Expected Radiation levels for Controlled Environment

Region	Calculated Maximum Radiation Power Density Level (mW/cm ²)		Hazard Assessment
1. Far Field ($R_{ff} = 32.0$ m)	S_{ff}	1.412	Satisfies FCC MPE
2. Near Field ($R_{nf} = 13.3$ m)	S_{nf}	3.296	Satisfies FCC MPE
3. Transition Region ($R_{nf} < R_t < R_{ff}$)	S_t	3.296	Satisfies FCC MPE
4. Between Feed Assembly and Antenna Reflector	S_{fa}	278895.660	Potential Hazard
5. Main Reflector	$S_{surface}$	6.255	Potential Hazard
6. Between Reflector and Ground	S_g	1.564	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.

8. 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.

The earth station will be mounted aboard a ship, and it is recommended that the lower edge of the antenna should be at least 2 meters above the deck. If this is not the case, additional procedures will be instituted to insure the safety of the Public in the vicinity of the antenna.

The applicant 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 be 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 ship, 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/cm² will be complied with for those regions in close proximity to the main reflector, and subreflector, which could be occupied by operating personnel.

The applicant agrees to abide by the conditions specified in Condition 5208 provided below:

Condition 5208 - The licensee shall take all necessary measures to ensure that the antenna does not create potential exposure of humans to radiofrequency radiation in excess of the FCC exposure limits defined in 47 CFR 1.1307(b) and 1.1310 wherever such exposures might occur. Measures must be taken to ensure compliance with limits for both occupational/controlled exposure and for general population/uncontrolled exposure, as defined in these rule sections. Compliance can be accomplished in most cases by appropriate restrictions such as fencing. Requirements for restrictions can be determined by predictions based on calculations, modeling or by field measurements. The FCC's OET Bulletin 65 (available on-line at www.fcc.gov/oet/rfsafety) provides information on predicting exposure levels and on methods for ensuring compliance, including the use of warning and alerting signs and protective equipment for worker.

Analysis of Non-Ionizing Radiation for a 1.25-Meter Earth Station System

This report analyzes the non-ionizing radiation levels for a 1.25-meter earth station system. The analysis and calculations performed in this report comply 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 (mW/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 (mW/cm ²)
30-300	1.0
300-1500	Frequency (MHz)*(4.0/1200)
1500-100,000	5.0

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

Parameter	Symbol	Formula	Value	Units
Antenna Diameter	D	Input	1.25	m
Antenna Surface Area	A _{surface}	$\pi D^2 / 4$	1.23	m ²
Feed Flange Diameter	D _{fa}	Input	0.675	cm
Area of Feed Flange	A _{fa}	$\pi D_{fa}^2 / 4$	0.36	cm ²
Frequency	F	Input	14250	MHz
Wavelength	λ	300 / F	0.021053	m
Transmit Power	P	Input	13.18	W
Antenna Gain (dBi)	G _{es}	Input	43.2	dBi
Antenna Gain (factor)	G	10 ^{Ges/10}	20893.0	n/a
Pi	π	Constant	3.1415927	n/a
Antenna Efficiency	η	$G\lambda^2 / (\pi^2 D^2)$	0.60	n/a

1. Far Field Distance Calculation

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

$$\begin{aligned} \text{Distance to the Far Field Region} \quad R_{ff} &= 0.60 D^2 / \lambda \\ &= 44.5 \text{ m} \end{aligned} \quad (1)$$

The maximum main beam power density in the far field can be determined from the following equation:

$$\begin{aligned} \text{On-Axis Power Density in the Far Field} \quad S_{ff} &= G P / (4 \pi R_{ff}^2) \\ &= 11.050 \text{ W/m}^2 \\ &= 1.105 \text{ mW/cm}^2 \end{aligned} \quad (2)$$

2. Near Field Calculation

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:

$$\begin{aligned} \text{Extent of the Near Field} \quad R_{nf} &= D^2 / (4 \lambda) \\ &= 18.6 \text{ m} \end{aligned} \quad (3)$$

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

$$\begin{aligned} \text{Near Field Power Density} \quad S_{nf} &= 16.0 \eta P / (\pi D^2) \\ &= 25.796 \text{ W/m}^2 \\ &= 2.580 \text{ mW/cm}^2 \end{aligned} \quad (4)$$

3. Transition Region Calculation

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 R_t can be determined from the following equation:

$$\begin{aligned} \text{Transition Region Power Density} \quad S_t &= S_{nf} R_{nf} / R_t \\ &= 2.580 \text{ mW/cm}^2 \end{aligned} \quad (5)$$

4. Region between the Feed Assembly and the Antenna Reflector

Transmissions from the feed assembly are directed toward the antenna reflector surface, and are confined within a conical shape defined by the type of feed assembly. The most common feed assemblies are waveguide flanges, horns or subreflectors. The energy between the feed assembly and reflector surface can be calculated by determining the power density at the feed assembly surface. This can be determined from the following equation:

$$\begin{aligned} \text{Power Density at the Feed Flange} \quad S_{fa} &= 4000 P / A_{fa} & (6) \\ &= 147325.515 \text{ mW/cm}^2 \end{aligned}$$

5. Main Reflector Region

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

$$\begin{aligned} \text{Power Density at the Reflector Surface} \quad S_{\text{surface}} &= 4 P / A_{\text{surface}} & (7) \\ &= 42.960 \text{ W/m}^2 \\ &= 4.296 \text{ mW/cm}^2 \end{aligned}$$

6. Region between the Reflector and the Ground

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

$$\begin{aligned} \text{Power Density between Reflector and Ground} \quad S_g &= P / A_{\text{surface}} & (8) \\ &= 10.740 \text{ W/m}^2 \\ &= 1.074 \text{ mW/cm}^2 \end{aligned}$$

7. Summary of Calculations

Table 4. Summary of Expected Radiation levels for Uncontrolled Environment

Region	Calculated Maximum Radiation Power Density Level (mW/cm ²)		Hazard Assessment
1. Far Field ($R_{ff} = 44.5$ m)	S_{ff}	1.105	Potential Hazard
2. Near Field ($R_{nf} = 18.6$ m)	S_{nf}	2.580	Potential Hazard
3. Transition Region ($R_{nf} < R_t < R_{ff}$)	S_t	2.580	Potential Hazard
4. Between Feed Assembly and Antenna Reflector	S_{fa}	147325.515	Potential Hazard
5. Main Reflector	$S_{surface}$	4.296	Potential Hazard
6. Between Reflector and Ground	S_g	1.074	Potential Hazard

Table 5. Summary of Expected Radiation levels for Controlled Environment

Region	Calculated Maximum Radiation Power Density Level (mW/cm ²)		Hazard Assessment
1. Far Field ($R_{ff} = 44.5$ m)	S_{ff}	1.105	Satisfies FCC MPE
2. Near Field ($R_{nf} = 18.6$ m)	S_{nf}	2.580	Satisfies FCC MPE
3. Transition Region ($R_{nf} < R_t < R_{ff}$)	S_t	2.580	Satisfies FCC MPE
4. Between Feed Assembly and Antenna Reflector	S_{fa}	147325.515	Potential Hazard
5. Main Reflector	$S_{surface}$	4.296	Satisfies FCC MPE
6. Between Reflector and Ground	S_g	1.074	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.

8. 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) environment.

The earth station will be mounted aboard a ship, and it is recommended that the lower edge of the antenna should be at least 2 meters above the deck. If this is not the case, additional procedures will be instituted to insure the safety of the Public in the vicinity of the antenna.

The applicant 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 be 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 ship, 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/cm² will be complied with for those regions in close proximity to the main reflector, and subreflector, which could be occupied by operating personnel.

The applicant agrees to abide by the conditions specified in Condition 5208 provided below:

Condition 5208 - The licensee shall take all necessary measures to ensure that the antenna does not create potential exposure of humans to radiofrequency radiation in excess of the FCC exposure limits defined in 47 CFR 1.1307(b) and 1.1310 wherever such exposures might occur. Measures must be taken to ensure compliance with limits for both occupational/controlled exposure and for general population/uncontrolled exposure, as defined in these rule sections. Compliance can be accomplished in most cases by appropriate restrictions such as fencing. Requirements for restrictions can be determined by predictions based on calculations, modeling or by field measurements. The FCC's OET Bulletin 65 (available on-line at www.fcc.gov/oet/rfsafety) provides information on predicting exposure levels and on methods for ensuring compliance, including the use of warning and alerting signs and protective equipment for worker.

Analysis of Non-Ionizing Radiation for a 0.6-Meter Earth Station System

This report analyzes the non-ionizing radiation levels for a 0.6-meter earth station system. The analysis and calculations performed in this report comply 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 (mW/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 (mW/cm ²)
30-300	1.0
300-1500	Frequency (MHz)*(4.0/1200)
1500-100,000	5.0

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

Parameter	Symbol	Formula	Value	Units
Antenna Diameter	D	Input	0.6	m
Antenna Surface Area	A _{surface}	$\pi D^2 / 4$	0.28	m ²
Feed Flange Diameter	D _{fa}	Input	5.1	cm
Area of Feed Flange	A _{fa}	$\pi D_{fa}^2 / 4$	20.43	cm ²
Frequency	F	Input	14250	MHz
Wavelength	λ	$300 / F$	0.021053	m
Transmit Power	P	Input	6.18	W
Antenna Gain (dBi)	G _{es}	Input	38.4	dBi
Antenna Gain (factor)	G	$10^{G_{es}/10}$	6966.3	n/a
Pi	π	Constant	3.1415927	n/a
Antenna Efficiency	η	$G\lambda^2 / (\pi^2 D^2)$	0.87	n/a

1. Far Field Distance Calculation

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

$$\begin{aligned} \text{Distance to the Far Field Region} \quad R_{ff} &= 0.60 D^2 / \lambda \\ &= 10.3 \text{ m} \end{aligned} \quad (1)$$

The maximum main beam power density in the far field can be determined from the following equation:

$$\begin{aligned} \text{On-Axis Power Density in the Far Field} \quad S_{ff} &= G P / (4 \pi R_{ff}^2) \\ &= 32.545 \text{ W/m}^2 \\ &= 3.254 \text{ mW/cm}^2 \end{aligned} \quad (2)$$

2. Near Field Calculation

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:

$$\begin{aligned} \text{Extent of the Near Field} \quad R_{nf} &= D^2 / (4 \lambda) \\ &= 4.3 \text{ m} \end{aligned} \quad (3)$$

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

$$\begin{aligned} \text{Near Field Power Density} \quad S_{nf} &= 16.0 \eta P / (\pi D^2) \\ &= 75.974 \text{ W/m}^2 \\ &= 7.597 \text{ mW/cm}^2 \end{aligned} \quad (4)$$

3. Transition Region Calculation

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 R_t can be determined from the following equation:

$$\begin{aligned} \text{Transition Region Power Density} \quad S_t &= S_{nf} R_{nf} / R_t \\ &= 7.597 \text{ mW/cm}^2 \end{aligned} \quad (5)$$

4. Region between the Feed Assembly and the Antenna Reflector

Transmissions from the feed assembly are directed toward the antenna reflector surface, and are confined within a conical shape defined by the type of feed assembly. The most common feed assemblies are waveguide flanges, horns or subreflectors. The energy between the feed assembly and reflector surface can be calculated by determining the power density at the feed assembly surface. This can be determined from the following equation:

$$\begin{aligned} \text{Power Density at the Feed Flange} \quad S_{fa} &= 4000 P / A_{fa} & (6) \\ &= 1210.092 \text{ mW/cm}^2 \end{aligned}$$

5. Main Reflector Region

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

$$\begin{aligned} \text{Power Density at the Reflector Surface} \quad S_{\text{surface}} &= 4 P / A_{\text{surface}} & (7) \\ &= 87.429 \text{ W/m}^2 \\ &= 8.743 \text{ mW/cm}^2 \end{aligned}$$

6. Region between the Reflector and the Ground

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

$$\begin{aligned} \text{Power Density between Reflector and Ground} \quad S_g &= P / A_{\text{surface}} & (8) \\ &= 21.857 \text{ W/m}^2 \\ &= 2.186 \text{ mW/cm}^2 \end{aligned}$$

7. Summary of Calculations

Table 4. Summary of Expected Radiation levels for Uncontrolled Environment

Region	Calculated Maximum Radiation Power Density Level (mW/cm ²)		Hazard Assessment
1. Far Field ($R_{ff} = 10.3$ m)	S_{ff}	3.254	Potential Hazard
2. Near Field ($R_{nf} = 4.3$ m)	S_{nf}	7.597	Potential Hazard
3. Transition Region ($R_{nf} < R_t < R_{ff}$)	S_t	7.597	Potential Hazard
4. Between Feed Assembly and Antenna Reflector	S_{fa}	1210.092	Potential Hazard
5. Main Reflector	$S_{surface}$	8.743	Potential Hazard
6. Between Reflector and Ground	S_g	2.186	Potential Hazard

Table 5. Summary of Expected Radiation levels for Controlled Environment

Region	Calculated Maximum Radiation Power Density Level (mW/cm ²)		Hazard Assessment
1. Far Field ($R_{ff} = 10.3$ m)	S_{ff}	3.254	Satisfies FCC MPE
2. Near Field ($R_{nf} = 4.3$ m)	S_{nf}	7.597	Potential Hazard
3. Transition Region ($R_{nf} < R_t < R_{ff}$)	S_t	7.597	Potential Hazard
4. Between Feed Assembly and Antenna Reflector	S_{fa}	1210.092	Potential Hazard
5. Main Reflector	$S_{surface}$	8.743	Potential Hazard
6. Between Reflector and Ground	S_g	2.186	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.

8. 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.

The earth station will be mounted aboard a ship, and it is recommended that the lower edge of the antenna should be at least 2 meters above the deck. If this is not the case, additional procedures will be instituted to ensure the safety of the Public in the vicinity of the antenna.

The applicant 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 be 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, deck, 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.

The applicant agrees to abide by the conditions specified in Condition 5208 provided below:

Condition 5208 - The licensee shall take all necessary measures to ensure that the antenna does not create potential exposure of humans to radiofrequency radiation in excess of the FCC exposure limits defined in 47 CFR 1.1307(b) and 1.1310 wherever such exposures might occur. Measures must be taken to ensure compliance with limits for both occupational/controlled exposure and for general population/uncontrolled exposure, as defined in these rule sections. Compliance can be accomplished in most cases by appropriate restrictions such as fencing. Requirements for restrictions can be determined by predictions based on calculations, modeling or by field measurements. The FCC's OET Bulletin 65 (available on-line at www.fcc.gov/oet/rfsafety) provides information on predicting exposure levels and on methods for ensuring compliance, including the use of warning and alerting signs and protective equipment for worker.

Analysis of Non-Ionizing Radiation for a 1.2-Meter Earth Station System

This report analyzes the non-ionizing radiation levels for a 1.2-meter earth station system. The analysis and calculations performed in this report comply 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 (mW/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 (mW/cm ²)
30-300	1.0
300-1500	Frequency (MHz)*(4.0/1200)
1500-100,000	5.0

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

Parameter	Symbol	Formula	Value	Units
Antenna Diameter	D	Input	1.2	m
Antenna Surface Area	A _{surface}	$\pi D^2 / 4$	1.13	m ²
Feed Flange Diameter	D _{fa}	Input	7.2	cm
Area of Feed Flange	A _{fa}	$\pi D_{fa}^2 / 4$	40.72	cm ²
Frequency	F	Input	14250	MHz
Wavelength	λ	300 / F	0.021053	m
Transmit Power	P	Input	6.31	W
Antenna Gain (dBi)	G _{es}	Input	42.7	dBi
Antenna Gain (factor)	G	10 ^{Ges/10}	18706.8	n/a
Pi	π	Constant	3.1415927	n/a
Antenna Efficiency	η	$G\lambda^2 / (\pi^2 D^2)$	0.58	n/a

1. Far Field Distance Calculation

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

$$\begin{aligned} \text{Distance to the Far Field Region} \quad R_{ff} &= 0.60 D^2 / \lambda \\ &= 41.0 \text{ m} \end{aligned} \quad (1)$$

The maximum main beam power density in the far field can be determined from the following equation:

$$\begin{aligned} \text{On-Axis Power Density in the Far Field} \quad S_{ff} &= G P / (4 \pi R_{ff}^2) \\ &= 5.577 \text{ W/m}^2 \\ &= 0.558 \text{ mW/cm}^2 \end{aligned} \quad (2)$$

2. Near Field Calculation

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:

$$\begin{aligned} \text{Extent of the Near Field} \quad R_{nf} &= D^2 / (4 \lambda) \\ &= 17.1 \text{ m} \end{aligned} \quad (3)$$

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

$$\begin{aligned} \text{Near Field Power Density} \quad S_{nf} &= 16.0 \eta P / (\pi D^2) \\ &= 13.019 \text{ W/m}^2 \\ &= 1.302 \text{ mW/cm}^2 \end{aligned} \quad (4)$$

3. Transition Region Calculation

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 R_t can be determined from the following equation:

$$\begin{aligned} \text{Transition Region Power Density} \quad S_t &= S_{nf} R_{nf} / R_t \\ &= 1.302 \text{ mW/cm}^2 \end{aligned} \quad (5)$$

4. Region between the Feed Assembly and the Antenna Reflector

Transmissions from the feed assembly are directed toward the antenna reflector surface, and are confined within a conical shape defined by the type of feed assembly. The most common feed assemblies are waveguide flanges, horns or subreflectors. The energy between the feed assembly and reflector surface can be calculated by determining the power density at the feed assembly surface. This can be determined from the following equation:

$$\begin{aligned} \text{Power Density at the Feed Flange} \quad S_{fa} &= 4000 P / A_{fa} & (6) \\ &= 619.918 \text{ mW/cm}^2 \end{aligned}$$

5. Main Reflector Region

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

$$\begin{aligned} \text{Power Density at the Reflector Surface} \quad S_{\text{surface}} &= 4 P / A_{\text{surface}} & (7) \\ &= 22.317 \text{ W/m}^2 \\ &= 2.232 \text{ mW/cm}^2 \end{aligned}$$

6. Region between the Reflector and the Ground

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

$$\begin{aligned} \text{Power Density between Reflector and Ground} \quad S_g &= P / A_{\text{surface}} & (8) \\ &= 5.579 \text{ W/m}^2 \\ &= 0.558 \text{ mW/cm}^2 \end{aligned}$$

7. Summary of Calculations

Table 4. Summary of Expected Radiation levels for Uncontrolled Environment

Region	Calculated Maximum Radiation Power Density Level (mW/cm ²)		Hazard Assessment
1. Far Field ($R_{ff} = 41.0$ m)	S_{ff}	0.558	Satisfies FCC MPE
2. Near Field ($R_{nf} = 17.1$ m)	S_{nf}	1.302	Potential Hazard
3. Transition Region ($R_{nf} < R_t < R_{ff}$)	S_t	1.302	Potential Hazard
4. Between Feed Assembly and Antenna Reflector	S_{fa}	619.918	Potential Hazard
5. Main Reflector	$S_{surface}$	2.232	Potential Hazard
6. Between Reflector and Ground	S_g	0.558	Satisfies FCC MPE

Table 5. Summary of Expected Radiation levels for Controlled Environment

Region	Calculated Maximum Radiation Power Density Level (mW/cm ²)		Hazard Assessment
1. Far Field ($R_{ff} = 41.0$ m)	S_{ff}	0.558	Satisfies FCC MPE
2. Near Field ($R_{nf} = 17.1$ m)	S_{nf}	1.302	Satisfies FCC MPE
3. Transition Region ($R_{nf} < R_t < R_{ff}$)	S_t	1.302	Satisfies FCC MPE
4. Between Feed Assembly and Antenna Reflector	S_{fa}	619.918	Potential Hazard
5. Main Reflector	$S_{surface}$	2.232	Satisfies FCC MPE
6. Between Reflector and Ground	S_g	0.558	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.

8. 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) environment.

The earth station will be mounted aboard a ship, and it is recommended that the lower edge of the antenna should be at least 2 meters above the deck. If this is not the case, additional procedures will be instituted to ensure the safety of the Public in the vicinity of the antenna.

The applicant 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 be 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, deck, 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.

The applicant agrees to abide by the conditions specified in Condition 5208 provided below:

Condition 5208 - The licensee shall take all necessary measures to ensure that the antenna does not create potential exposure of humans to radiofrequency radiation in excess of the FCC exposure limits defined in 47 CFR 1.1307(b) and 1.1310 wherever such exposures might occur. Measures must be taken to ensure compliance with limits for both occupational/controlled exposure and for general population/uncontrolled exposure, as defined in these rule sections. Compliance can be accomplished in most cases by appropriate restrictions such as fencing. Requirements for restrictions can be determined by predictions based on calculations, modeling or by field measurements. The FCC's OET Bulletin 65 (available on-line at www.fcc.gov/oet/rfsafety) provides information on predicting exposure levels and on methods for ensuring compliance, including the use of warning and alerting signs and protective equipment for worker.