Radiation Hazard Study

Intellian v100

This study analyzes the potential Radio Frequency (RF) human exposure levels caused by the Electro Magnetic (EM) fields of the above-captioned antenna. The mathematical analysis performed below complies with the methods described in the Federal Communications Commission Office of Engineering and Technology Bulletin No. 65 (1985 rev. 1997) R&O 96-326.

Maximum Permisible Exposure

There are two separate levels of exposure limits. The first applies to persons in the general population who are in an uncontrolled environment. The second applies to trained personnel in a controlled environment. According to 47 C.F.R. § 1.1310, the Maximum Permissible Exposure (MPE) limits for frequencies above 1.5 GHz are as follows:

- General Population / Uncontrolled Exposure 1.0 mW/cm2
- Occupational / Controlled Exposure 5.0 mW/cm2

The purpose of this study is to determine the power flux density levels for the earth station under study as compared with the MPE limits. This comparison is done in each of the following regions:

1. Far-field region
2. Near-field region
3. Transition region
4. The region between the feed and the antenna surface
5. The main reflector region
6. The region between the antenna edge and the ground

Input Parameters

The following input parameters were used in the calculations:

Parameter	Value	Unit	Symbol
Atenna Diameter:	1.03	m	D
Antenna Transmit Gain:	41.60	dBi	G
Trasmit Frequency:	14125	MHz	f
Feed Flange Diameter:	5.20	cm	d
Power Input to the Antenna:	16.00	W	P

Calculated Parameters

The following values were calculated using the above input parameters and the corresponding formulas.

Parameter	Value	Unit	Symbol	Formula
Anenna Surface Area:	0.83	m^2	A	$\pi D^2/4$
Area of Feed Flange:	21.24	cm^2	a	$\pi d^2/4$
Antenna Efficiency:	0.62		η	$G\lambda^2/(\pi^2 D^2)$
Gain Factor:	14454.40		g	$10^{G/10}$
Wavelength:	0.0212	m	λ	$300/f$

Behavior of EM Fields as a Function of Distance

The behavior of the characteristics of EM fields varies depending on the distance from the radiating antenna. These characteristics are analyzed in three primary regions: the near-field region, the far-field region and the transition region. Of interest also are the region between the antenna main reflector and the subreflector, the region of the main reflector area and the region between the main reflector and ground.

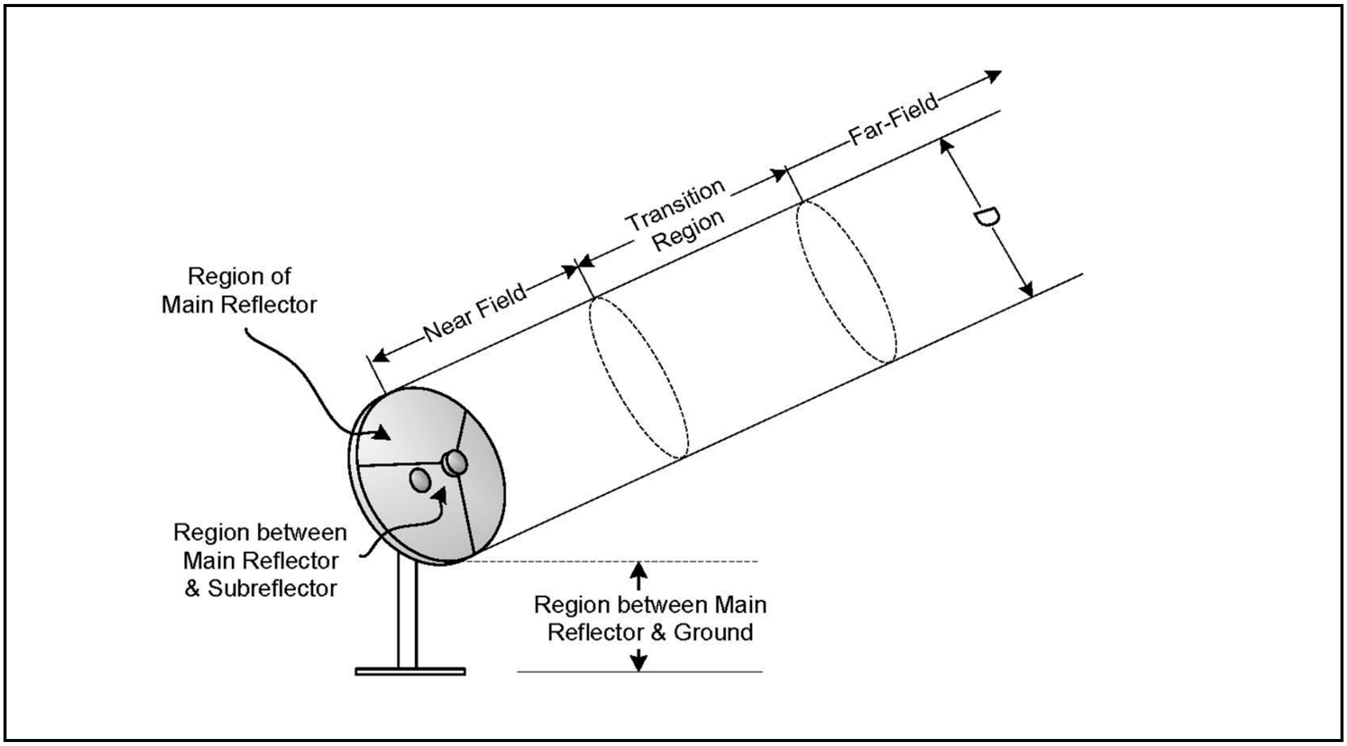

Figure 1. EM Fields as a Function of Distance

For parabolic aperture antennas with circular cross sections, such as the antenna under study, the near-field, far-field and transition region distances are calculated as follows:

Parameter	Value	Unit	Formula
Near Field Distance:	12.488	m	$R_{nf} = D^2/(4\lambda)$
Distance to Far Field:	29.970	m	Rff = 0.60D2/(λ)
Distance of Trasition Region	12.488	m	Rt = Rnf

The distance in the transition region is between the near and far fields. Thus, Rnf ≤ Rt ≤ Rff . However, the power density in the transition region will not exceed the power density in the near-field. Therefore, for purposes of the present analysis, the distance of the transition region can equate the distance to the near-field.

Power Flux Density Calculations

The power flux density is considered to be at a maximum through the entire length of the near-field. This region is contained within a cylindrical volume with a diameter, D, equal to the diameter of the antenna. In the transition region and the far-field, the power density decreases inversely with the square of the distance. The following equations are used to calculate power density in these regions.

Parameter	Value	Unit	Symbol	Formula
Power Density in the Near-Field	4.783	mW/cm^2	S_{nf}	$16.0\ \eta P/(\pi D^2)$
Power Density in the Far-Field	2.049	mW/cm^2	S_{ff}	$GP/(4\pi R_{ff}^2)$
Power Density in the Trans. Region	4.783	mW/cm^2	S_t	$S_{nf} R_{nf} /(R_t)$

The region between the main reflector and the subreflector is confined within a conical shape defined by the feed assembly. The most common feed assemblies are waveguide flanges. This energy is determined as follows:

Parameter	Value	Unit	Symbol	Formula
Power Density at the Feed Flange	3013.6	mW/cm^2	S_{fa}	$4P / a$

The power density in the main reflector is determined similarly to the power density at the feed flange; except that the area of the reflector is used.

Parameter	Value	Unit	Symbol	Formula
Power Density at Main Reflector	7.681	mW/cm^2	$S_{surface}$	$4P / A$

The power density between the reflector and ground, assuming uniform illumination of the reflector surface, is calculated as follows:

Parameter	Value	Unit	Symbol	Formula
Power Density between Reflector and Ground	1.920	mW/cm^2	S_g	P / A

Table 1 summarizes the calculated power flux density values for each region. In a controlled environment, the only regions that exceed FCC limitations are shown below. These regions are only accessible by trained technicians who, as a matter of procedure, turn off transmit power before performing any work in these areas.

Power Densities	**mW/cm2**	**Controlled Environment (5 mW/cm2)**
Far Field Calculation	2.049	Satisfies FCC Requirements
Near Field Calculation	4.783	Satisfies FCC Requirements
Transition Region	4.783	Satisfies FCC Requirements
Region between Main and Subreflector	3013.6	Exceeds Limitations
Main Reflector Region	7.681	Exceeds Limitations
Region between Main Reflector and Ground	1.920	Satisfies FCC Requirements

Table 1. Power Flux Density for Each Region

In conclusion, the results show that the antenna, in a controlled environment, and under the proper mitigation procedures, meets the guidelines specified in 47 C.F.R. § 1.1310.

Radiation Hazard Study

Intellian V130

This study analyzes the potential Radio Frequency (RF) human exposure levels caused by the Electro Magnetic (EM) fields of the above-captioned antenna. The mathematical analysis performed below complies with the methods described in the Federal Communications Commission Office of Engineering and Technology Bulletin No. 65 (1985 rev. 1997) R&O 96-326.

Maximum Permisible Exposure

There are two separate levels of exposure limits. The first applies to persons in the general population who are in an uncontrolled environment. The second applies to trained personnel in a controlled environment. According to 47 C.F.R. § 1.1310, the Maximum Permissible Exposure (MPE) limits for frequencies above 1.5 GHz are as follows:

- General Population / Uncontrolled Exposure 1.0 mW/cm2
- Occupational / Controlled Exposure 5.0 mW/cm2

The purpose of this study is to determine the power flux density levels for the earth station under study as compared with the MPE limits. This comparison is done in each of the following regions:

1. Far-field region
2. Near-field region
3. Transition region
4. The region between the feed and the antenna surface
5. The main reflector region
6. The region between the antenna edge and the ground

Input Parameters

The following input parameters were used in the calculations:

Parameter	Value	Unit	Symbol
Atenna Diameter:	1.25	m	D
Antenna Transmit Gain:	43.20	dBi	G
Trasmit Frequency:	14125	MHz	f
Feed Flange Diameter:	6.70	cm	d
Power Input to the Antenna:	16.00	W	P

Calculated Parameters

The following values were calculated using the above input parameters and the corresponding formulas.

Parameter	Value	Unit	Symbol	Formula
Anenna Surface Area:	1.23	m^2	A	$\pi D^2/4$
Area of Feed Flange:	35.26	cm^2	a	$\pi d^2/4$
Antenna Efficiency:	0.61		η	$G\lambda^2/(\pi^2 D^2)$
Gain Factor:	20892.96		g	$10^{G/10}$
Wavelength:	0.0212	m	λ	$300/f$

Behavior of EM Fields as a Function of Distance

The behavior of the characteristics of EM fields varies depending on the distance from the radiating antenna. These characteristics are analyzed in three primary regions: the near-field region, the far-field region and the transition region. Of interest also are the region between the antenna main reflector and the subreflector, the region of the main reflector area and the region between the main reflector and ground.

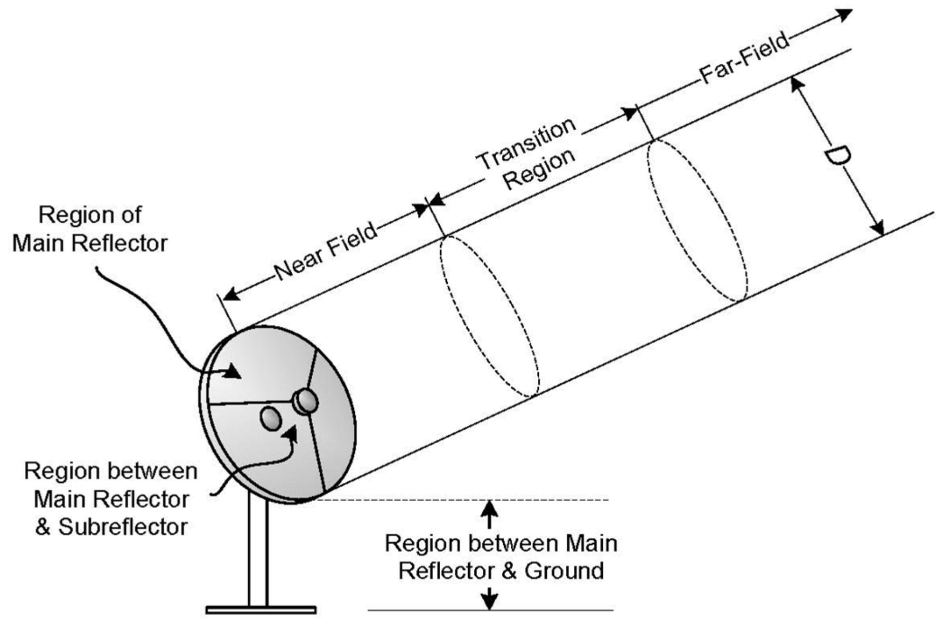

Figure 1. EM Fields as a Function of Distance

For parabolic aperture antennas with circular cross sections, such as the antenna under study, the near-field, far-field and transition region distances are calculated as follows:

Parameter	Value	Unit	Formula
Near Field Distance:	18.392	m	$R_{nf} = D^2/(4\lambda)$
Distance to Far Field:	44.141	m	Rff = 0.60D2/(λ)
Distance of Trasition Region	18.392	m	Rt = Rnf

The distance in the transition region is between the near and far fields. Thus, Rnf ≤ Rt ≤ Rff . However, the power density in the transition region will not exceed the power density in the near-field. Therefore, for purposes of the present analysis, the distance of the transition region can equate the distance to the near-field.

Power Flux Density Calculations

The power flux density is considered to be at a maximum through the entire length of the near-field. This region is contained within a cylindrical volume with a diameter, D, equal to the diameter of the antenna. In the transition region and the far-field, the power density decreases inversely with the square of the distance. The following equations are used to calculate power density in these regions.

Parameter	Value	Unit	Symbol	Formula
Power Density in the Near-Field	3.187	mW/cm^2	S_{nf}	$16.0\ \eta P/(\pi D^2)$
Power Density in the Far-Field	1.365	mW/cm^2	S_{ff}	$GP/(4\pi R_{ff}^2)$
Power Density in the Trans. Region	3.187	mW/cm^2	S_t	$S_{nf} R_{nf} /(R_t)$

The region between the main reflector and the subreflector is confined within a conical shape defined by the feed assembly. The most common feed assemblies are waveguide flanges. This energy is determined as follows:

Parameter	Value	Unit	Symbol	Formula
Power Density at the Feed Flange	1815.3	mW/cm^2	S_{fa}	$4P / a$

The power density in the main reflector is determined similarly to the power density at the feed flange; except that the area of the reflector is used.

Parameter	Value	Unit	Symbol	Formula
Power Density at Main Reflector	5.215	mW/cm^2	$S_{surface}$	$4P / A$

The power density between the reflector and ground, assuming uniform illumination of the reflector surface, is calculated as follows:

Parameter	Value	Unit	Symbol	Formula
Power Density between Reflector and Ground	1.304	mW/cm^2	S_g	P / A

Table 1 summarizes the calculated power flux density values for each region. In a controlled environment, the only regions that exceed FCC limitations are shown below. These regions are only accessible by trained technicians who, as a matter of procedure, turn off transmit power before performing any work in these areas.

Power Densities	**mW/cm2**	**Controlled Environment (5 mW/cm2)**
Far Field Calculation	1.365	Satisfies FCC Requirements
Near Field Calculation	3.187	Satisfies FCC Requirements
Transition Region	3.187	Satisfies FCC Requirements
Region between Main and Subreflector	1815.3	Exceeds Limitations
Main Reflector Region	5.215	Exceeds Limitations
Region between Main Reflector and Ground	1.304	Satisfies FCC Requirements

Table 1. Power Flux Density for Each Region

In conclusion, the results show that the antenna, in a controlled environment, and under the proper mitigation procedures, meets the guidelines specified in 47 C.F.R. § 1.1310.

Radiation Hazard Study

Sailor 800

This study analyzes the potential Radio Frequency (RF) human exposure levels caused by the Electro Magnetic (EM) fields of the above-captioned antenna. The mathematical analysis performed below complies with the methods described in the Federal Communications Commission Office of Engineering and Technology Bulletin No. 65 (1985 rev. 1997) R&O 96-326.

Maximum Permisible Exposure

There are two separate levels of exposure limits. The first applies to persons in the general population who are in an uncontrolled environment. The second applies to trained personnel in a controlled environment. According to 47 C.F.R. § 1.1310, the Maximum Permissible Exposure (MPE) limits for frequencies above 1.5 GHz are as follows:

- General Population / Uncontrolled Exposure 1.0 mW/cm2
- Occupational / Controlled Exposure 5.0 mW/cm2

The purpose of this study is to determine the power flux density levels for the earth station under study as compared with the MPE limits. This comparison is done in each of the following regions:

1. Far-field region
2. Near-field region
3. Transition region
4. The region between the feed and the antenna surface
5. The main reflector region
6. The region between the antenna edge and the ground

Input Parameters

The following input parameters were used in the calculations:

Parameter	Value	Unit	Symbol
Atenna Diameter:	0.83	m	D
Antenna Transmit Gain:	40.60	dBi	G
Trasmit Frequency:	14250	MHz	f
Feed Flange Diameter:	5.00	cm	d
Power Input to the Antenna:	6.00	W	P

Calculated Parameters

The following values were calculated using the above input parameters and the corresponding formulas.

Parameter	Value	Unit	Symbol	Formula
Anenna Surface Area:	0.54	m^2	A	$\pi D^2/4$
Area of Feed Flange:	19.63	cm^2	a	$\pi d^2/4$
Antenna Efficiency:	0.75		η	$G\lambda^2/(\pi^2 D^2)$
Gain Factor:	11481.54		g	$10^{G/10}$
Wavelength:	0.0211	m	λ	$300/f$

Behavior of EM Fields as a Function of Distance

The behavior of the characteristics of EM fields varies depending on the distance from the radiating antenna. These characteristics are analyzed in three primary regions: the near-field region, the far-field region and the transition region. Of interest also are the region between the antenna main reflector and the subreflector, the region of the main reflector area and the region between the main reflector and ground.

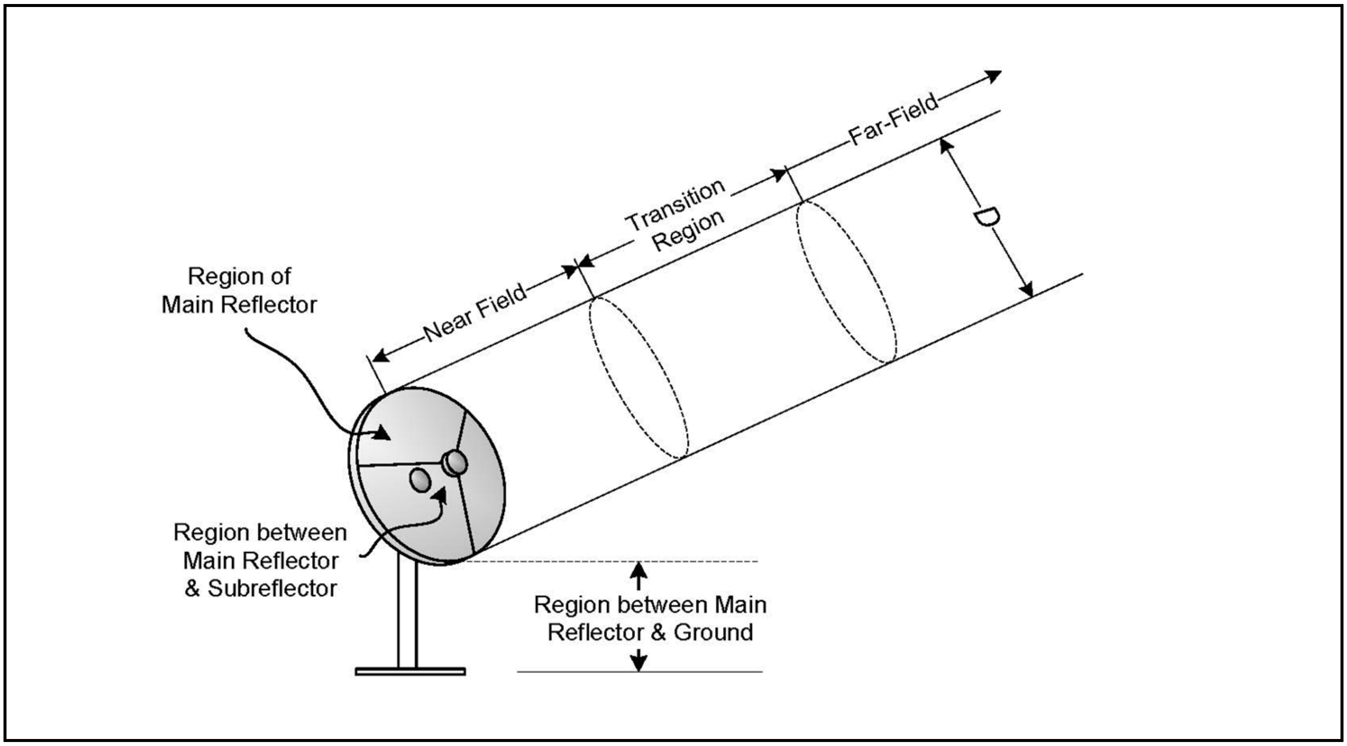

Figure 1. EM Fields as a Function of Distance

For parabolic aperture antennas with circular cross sections, such as the antenna under study, the near-field, far-field and transition region distances are calculated as follows:

Parameter	Value	Unit	Formula
Near Field Distance:	8.181	m	$R_{nf} = D^2/(4\lambda)$
Distance to Far Field:	19.634	m	Rff = 0.60D2/(λ)
Distance of Trasition Region	8.181	m	Rt = Rnf

The distance in the transition region is between the near and far fields. Thus, Rnf ≤ Rt ≤ Rff . However, the power density in the transition region will not exceed the power density in the near-field. Therefore, for purposes of the present analysis, the distance of the transition region can equate the distance to the near-field.

Power Flux Density Calculations

The power flux density is considered to be at a maximum through the entire length of the near-field. This region is contained within a cylindrical volume with a diameter, D, equal to the diameter of the antenna. In the transition region and the far-field, the power density decreases inversely with the square of the distance. The following equations are used to calculate power density in these regions.

Parameter	Value	Unit	Symbol	Formula
Power Density in the Near-Field	3.320	mW/cm^2	S_{nf}	$16.0\ \eta\ P/(\pi D^2)$
Power Density in the Far-Field	1.422	mW/cm^2	S_{ff}	$GP/(4\pi\ R_{ff}^2)$
Power Density in the Trans. Region	3.320	mW/cm^2	S_t	$S_{nf}\ R_{nf}\ /(R_t)$

The region between the main reflector and the subreflector is confined within a conical shape defined by the feed assembly. The most common feed assemblies are waveguide flanges. This energy is determined as follows:

Parameter	Value	Unit	Symbol	Formula
Power Density at the Feed Flange	1222.3	mW/cm^2	S_{fa}	$4P\ /\ a$

The power density in the main reflector is determined similarly to the power density at the feed flange; except that the area of the reflector is used.

Parameter	Value	Unit	Symbol	Formula
Power Density at Main Reflector	4.436	mW/cm^2	$S_{surface}$	$4P\ /\ A$

The power density between the reflector and ground, assuming uniform illumination of the reflector surface, is calculated as follows:

Parameter	Value	Unit	Symbol	Formula
Power Density between Reflector and Ground	1.109	mW/cm^2	S_g	$P\ /\ A$

Table 1 summarizes the calculated power flux density values for each region. In a controlled environment, the only regions that exceed FCC limitations are shown below. These regions are only accessible by trained technicians who, as a matter of procedure, turn off transmit power before performing any work in these areas.

Power Densities	**mW/cm2**	**Controlled Environment (5 mW/cm2)**
Far Field Calculation	1.422	Satisfies FCC Requirements
Near Field Calculation	3.320	Satisfies FCC Requirements
Transition Region	3.320	Satisfies FCC Requirements
Region between Main and Subreflector	1222.3	Exceeds Limitations
Main Reflector Region	4.436	Satisfies FCC Requirements
Region between Main Reflector and Ground	1.109	Satisfies FCC Requirements

Table 1. Power Flux Density for Each Region

In conclusion, the results show that the antenna, in a controlled environment, and under the proper mitigation procedures, meets the guidelines specified in 47 C.F.R. § 1.1310.

Radiation Hazard Study

Sailor 900B

This study analyzes the potential Radio Frequency (RF) human exposure levels caused by the Electro Magnetic (EM) fields of the above-captioned antenna. The mathematical analysis performed below complies with the methods described in the Federal Communications Commission Office of Engineering and Technology Bulletin No. 65 (1985 rev. 1997) R&O 96-326.

Maximum Permisible Exposure

There are two separate levels of exposure limits. The first applies to persons in the general population who are in an uncontrolled environment. The second applies to trained personnel in a controlled environment. According to 47 C.F.R. § 1.1310, the Maximum Permissible Exposure (MPE) limits for frequencies above 1.5 GHz are as follows:

- General Population / Uncontrolled Exposure 1.0 mW/cm2
- Occupational / Controlled Exposure 5.0 mW/cm2

The purpose of this study is to determine the power flux density levels for the earth station under study as compared with the MPE limits. This comparison is done in each of the following regions:

1. Far-field region
2. Near-field region
3. Transition region
4. The region between the feed and the antenna surface
5. The main reflector region
6. The region between the antenna edge and the ground

Input Parameters

The following input parameters were used in the calculations:

Parameter	Value	Unit	Symbol
Atenna Diameter:	1.03	m	D
Antenna Transmit Gain:	41.40	dBi	G
Trasmit Frequency:	14250	MHz	f
Feed Flange Diameter:	5.30	cm	d
Power Input to the Antenna:	8.00	W	P

Calculated Parameters

The following values were calculated using the above input parameters and the corresponding formulas.

Parameter	Value	Unit	Symbol	Formula
Anenna Surface Area:	0.83	m^2	A	$\pi D^2/4$
Area of Feed Flange:	22.06	cm^2	a	$\pi d^2/4$
Antenna Efficiency:	0.58		η	$G\lambda^2/(\pi^2 D^2)$
Gain Factor:	13803.84		g	$10^{G/10}$
Wavelength:	0.0211	m	λ	$300/f$

Behavior of EM Fields as a Function of Distance

The behavior of the characteristics of EM fields varies depending on the distance from the radiating antenna. These characteristics are analyzed in three primary regions: the near-field region, the far-field region and the transition region. Of interest also are the region between the antenna main reflector and the subreflector, the region of the main reflector area and the region between the main reflector and ground.

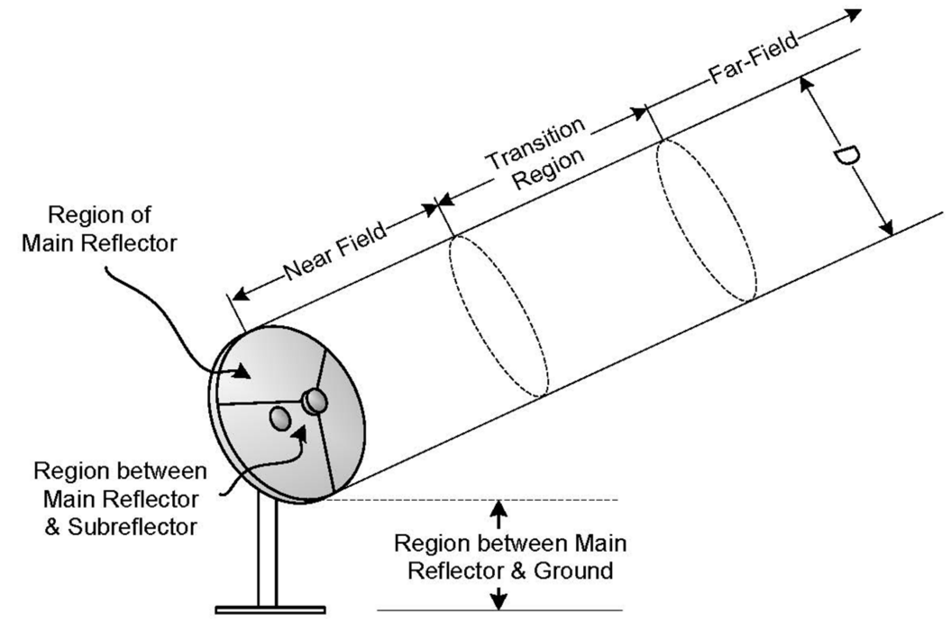

Figure 1. EM Fields as a Function of Distance

For parabolic aperture antennas with circular cross sections, such as the antenna under study, the near-field, far-field and transition region distances are calculated as follows:

Parameter	Value	Unit	Formula
Near Field Distance:	12.598	m	$R_{nf} = D^2/(4\lambda)$
Distance to Far Field:	30.236	m	Rff = 0.60D2/(λ)
Distance of Trasition Region	12.598	m	Rt = Rnf

The distance in the transition region is between the near and far fields. Thus, Rnf ≤ Rt ≤ Rff . However, the power density in the transition region will not exceed the power density in the near-field. Therefore, for purposes of the present analysis, the distance of the transition region can equate the distance to the near-field.

Power Flux Density Calculations

The power flux density is considered to be at a maximum through the entire length of the near-field. This region is contained within a cylindrical volume with a diameter, D, equal to the diameter of the antenna. In the transition region and the far-field, the power density decreases inversely with the square of the distance. The following equations are used to calculate power density in these regions.

Parameter	Value	Unit	Symbol	Formula
Power Density in the Near-Field	2.244	mW/cm^2	S_{nf}	$16.0\ \eta P/(\pi D^2)$
Power Density in the Far-Field	0.961	mW/cm^2	S_{ff}	$GP/(4\pi R_{ff}^2)$
Power Density in the Trans. Region	2.244	mW/cm^2	S_t	$S_{nf} R_{nf} /(R_t)$

The region between the main reflector and the subreflector is confined within a conical shape defined by the feed assembly. The most common feed assemblies are waveguide flanges. This energy is determined as follows:

Parameter	Value	Unit	Symbol	Formula
Power Density at the Feed Flange	1450.5	mW/cm^2	S_{fa}	$4P / a$

The power density in the main reflector is determined similarly to the power density at the feed flange; except that the area of the reflector is used.

Parameter	Value	Unit	Symbol	Formula
Power Density at Main Reflector	3.840	mW/cm^2	$S_{surface}$	$4P / A$

The power density between the reflector and ground, assuming uniform illumination of the reflector surface, is calculated as follows:

Parameter	Value	Unit	Symbol	Formula
Power Density between Reflector and Ground	0.960	mW/cm^2	S_g	P / A

Table 1 summarizes the calculated power flux density values for each region. In a controlled environment, the only regions that exceed FCC limitations are shown below. These regions are only accessible by trained technicians who, as a matter of procedure, turn off transmit power before performing any work in these areas.

Power Densities	**mW/cm2**	**Controlled Environment (5 mW/cm2)**
Far Field Calculation	0.961	Satisfies FCC Requirements
Near Field Calculation	2.244	Satisfies FCC Requirements
Transition Region	2.244	Satisfies FCC Requirements
Region between Main and Subreflector	1450.5	Exceeds Limitations
Main Reflector Region	3.840	Satisfies FCC Requirements
Region between Main Reflector and Ground	0.960	Satisfies FCC Requirements

Table 1. Power Flux Density for Each Region

In conclusion, the results show that the antenna, in a controlled environment, and under the proper mitigation procedures, meets the guidelines specified in 47 C.F.R. § 1.1310.

Radiation Hazard Study

SeaTel 9711 (C-band)

This study analyzes the potential Radio Frequency (RF) human exposure levels caused by the Electro Magnetic (EM) fields of the above-captioned antenna. The mathematical analysis performed below complies with the methods described in the Federal Communications Commission Office of Engineering and Technology Bulletin No. 65 (1985 rev. 1997) R&O 96-326.

Maximum Permisible Exposure

There are two separate levels of exposure limits. The first applies to persons in the general population who are in an uncontrolled environment. The second applies to trained personnel in a controlled environment. According to 47 C.F.R. § 1.1310, the Maximum Permissible Exposure (MPE) limits for frequencies above 1.5 GHz are as follows:

- General Population / Uncontrolled Exposure 1.0 mW/cm2
- Occupational / Controlled Exposure 5.0 mW/cm2

The purpose of this study is to determine the power flux density levels for the earth station under study as compared with the MPE limits. This comparison is done in each of the following regions:

1. Far-field region
2. Near-field region
3. Transition region
4. The region between the feed and the antenna surface
5. The main reflector region
6. The region between the antenna edge and the ground

Input Parameters

The following input parameters were used in the calculations:

Parameter	Value	Unit	Symbol
Atenna Diameter:	2.4	m	D
Antenna Transmit Gain:	41.70	dBi	G
Trasmit Frequency:	6180	MHz	f
Feed Flange Diameter:	5.60	cm	d
Power Input to the Antenna:	92.00	W	P

Calculated Parameters

The following values were calculated using the above input parameters and the corresponding formulas.

Parameter	Value	Unit	Symbol	Formula
Anenna Surface Area:	4.52	m^2	A	$\pi D^2/4$
Area of Feed Flange:	24.63	cm^2	a	$\pi d^2/4$
Antenna Efficiency:	0.61		η	$G\lambda^2/(\pi^2 D^2)$
Gain Factor:	14791.08		g	$10^{G/10}$
Wavelength:	0.0485	m	λ	$300/f$

Behavior of EM Fields as a Function of Distance

The behavior of the characteristics of EM fields varies depending on the distance from the radiating antenna. These characteristics are analyzed in three primary regions: the near-field region, the far-field region and the transition region. Of interest also are the region between the antenna main reflector and the subreflector, the region of the main reflector area and the region between the main reflector and ground.

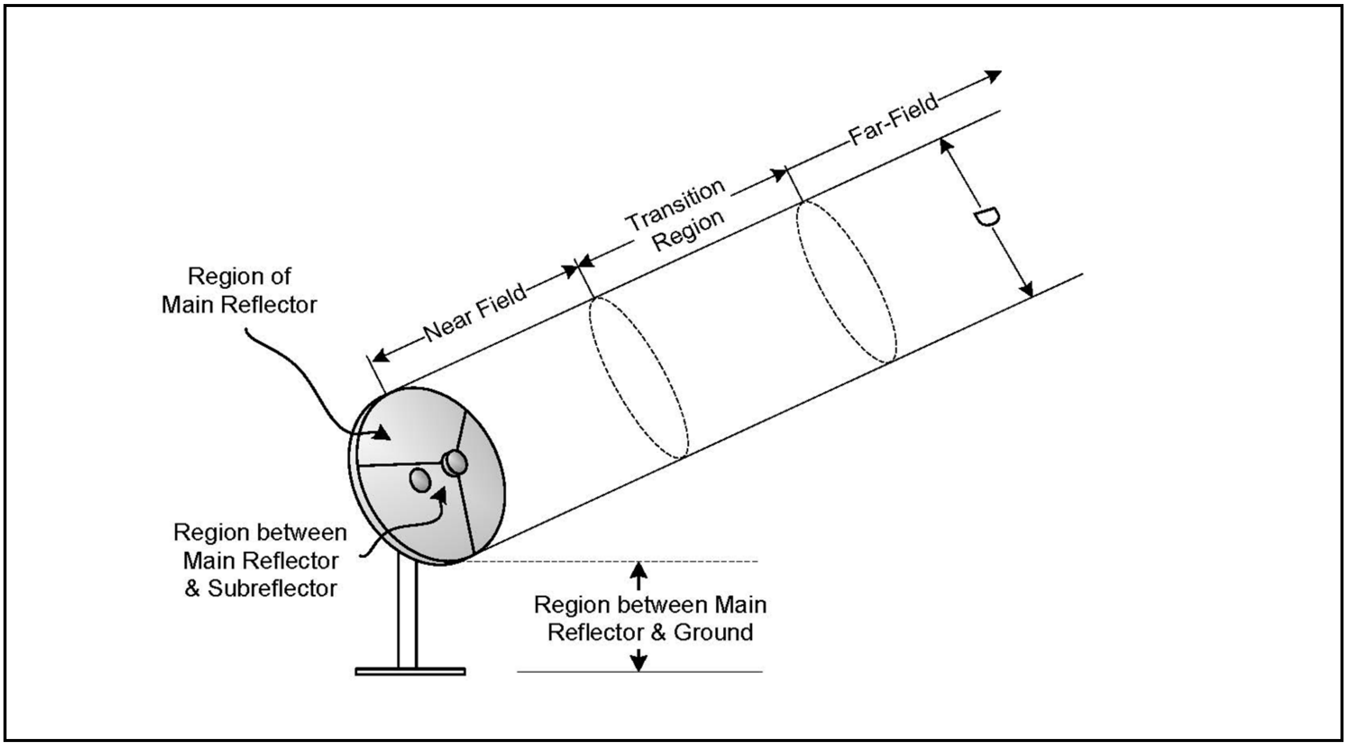

Figure 1. EM Fields as a Function of Distance

For parabolic aperture antennas with circular cross sections, such as the antenna under study, the near-field, far-field and transition region distances are calculated as follows:

Parameter	Value	Unit	Formula
Near Field Distance:	29.664	m	$R_{nf} = D^2/(4\lambda)$
Distance to Far Field:	71.194	m	Rff = 0.60D2/(λ)
Distance of Trasition Region	29.664	m	Rt = Rnf

The distance in the transition region is between the near and far fields. Thus, Rnf ≤ Rt ≤ Rff . However, the power density in the transition region will not exceed the power density in the near-field. Therefore, for purposes of the present analysis, the distance of the transition region can equate the distance to the near-field.

Power Flux Density Calculations

The power flux density is considered to be at a maximum through the entire length of the near-field. This region is contained within a cylindrical volume with a diameter, D, equal to the diameter of the antenna. In the transition region and the far-field, the power density decreases inversely with the square of the distance. The following equations are used to calculate power density in these regions.

Parameter	Value	Unit	Symbol	Formula
Power Density in the Near-Field	4.987	mW/cm^2	S_{nf}	$16.0\ \eta P/(\pi D^2)$
Power Density in the Far-Field	2.136	mW/cm^2	S_{ff}	$GP/(4\pi R_{ff}^2)$
Power Density in the Trans. Region	4.987	mW/cm^2	S_t	$S_{nf} R_{nf} / (R_t)$

The region between the main reflector and the subreflector is confined within a conical shape defined by the feed assembly. The most common feed assemblies are waveguide flanges. This energy is determined as follows:

Parameter	Value	Unit	Symbol	Formula
Power Density at the Feed Flange	14941.1	mW/cm^2	S_{fa}	$4P / a$

The power density in the main reflector is determined similarly to the power density at the feed flange; except that the area of the reflector is used.

Parameter	Value	Unit	Symbol	Formula
Power Density at Main Reflector	8.135	mW/cm^2	$S_{surface}$	$4P / A$

The power density between the reflector and ground, assuming uniform illumination of the reflector surface, is calculated as follows:

Parameter	Value	Unit	Symbol	Formula
Power Density between Reflector and Ground	2.034	mW/cm^2	S_g	P / A

Table 1 summarizes the calculated power flux density values for each region. In a controlled environment, the only regions that exceed FCC limitations are shown below. These regions are only accessible by trained technicians who, as a matter of procedure, turn off transmit power before performing any work in these areas.

Power Densities	**mW/cm2**	**Controlled Environment (5 mW/cm2)**
Far Field Calculation	2.136	Satisfies FCC Requirements
Near Field Calculation	4.987	Satisfies FCC Requirements
Transition Region	4.987	Satisfies FCC Requirements
Region between Main and Subreflector	14941.1	Exceeds Limitations
Main Reflector Region	8.135	Exceeds Limitations
Region between Main Reflector and Ground	2.034	Satisfies FCC Requirements

Table 1. Power Flux Density for Each Region

In conclusion, the results show that the antenna, in a controlled environment, and under the proper mitigation procedures, meets the guidelines specified in 47 C.F.R. § 1.1310.

Radiation Hazard Study

SeaTel 6012

This study analyzes the potential Radio Frequency (RF) human exposure levels caused by the Electro Magnetic (EM) fields of the above-captioned antenna. The mathematical analysis performed below complies with the methods described in the Federal Communications Commission Office of Engineering and Technology Bulletin No. 65 (1985 rev. 1997) R&O 96-326.

Maximum Permisible Exposure

There are two separate levels of exposure limits. The first applies to persons in the general population who are in an uncontrolled environment. The second applies to trained personnel in a controlled environment. According to 47 C.F.R. § 1.1310, the Maximum Permissible Exposure (MPE) limits for frequencies above 1.5 GHz are as follows:

- General Population / Uncontrolled Exposure 1.0 mW/cm2
- Occupational / Controlled Exposure 5.0 mW/cm2

The purpose of this study is to determine the power flux density levels for the earth station under study as compared with the MPE limits. This comparison is done in each of the following regions:

1. Far-field region
2. Near-field region
3. Transition region
4. The region between the feed and the antenna surface
5. The main reflector region
6. The region between the antenna edge and the ground

Input Parameters

The following input parameters were used in the calculations:

Parameter	Value	Unit	Symbol
Atenna Diameter:	1.5	m	D
Antenna Transmit Gain:	45.10	dBi	G
Trasmit Frequency:	14250	MHz	f
Feed Flange Diameter:	5.60	cm	d
Power Input to the Antenna:	33.00	W	P

Calculated Parameters

The following values were calculated using the above input parameters and the corresponding formulas.

Parameter	Value	Unit	Symbol	Formula
Anenna Surface Area:	1.77	m^2	A	$\pi D^2/4$
Area of Feed Flange:	24.63	cm^2	a	$\pi d^2/4$
Antenna Efficiency:	0.65		η	$G\lambda^2/(\pi^2 D^2)$
Gain Factor:	32359.37		g	$10^{G/10}$
Wavelength:	0.0211	m	λ	$300/f$

Behavior of EM Fields as a Function of Distance

The behavior of the characteristics of EM fields varies depending on the distance from the radiating antenna. These characteristics are analyzed in three primary regions: the near-field region, the far-field region and the transition region. Of interest also are the region between the antenna main reflector and the subreflector, the region of the main reflector area and the region between the main reflector and ground.

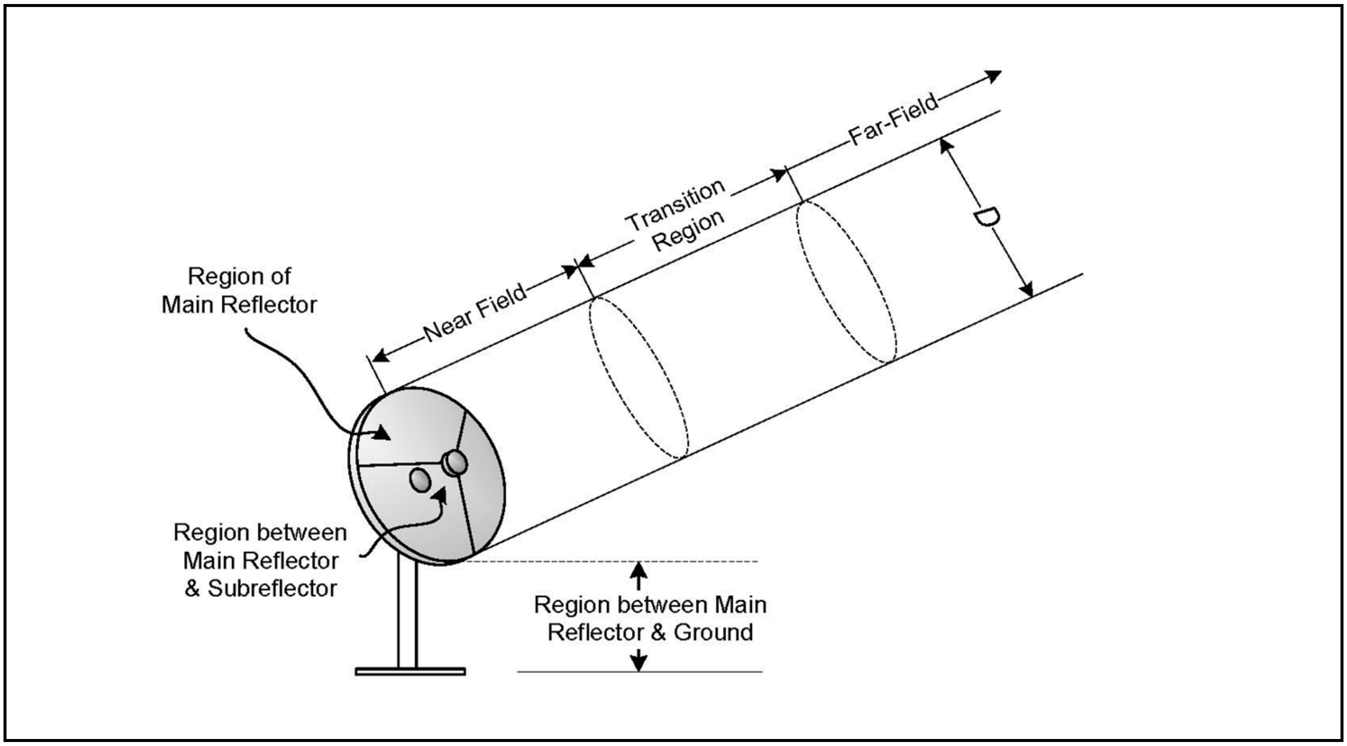

Figure 1. EM Fields as a Function of Distance

For parabolic aperture antennas with circular cross sections, such as the antenna under study, the near-field, far-field and transition region distances are calculated as follows:

Parameter	Value	Unit	Formula
Near Field Distance:	26.719	m	$R_{nf} = D^2/(4\lambda)$
Distance to Far Field:	64.125	m	Rff = 0.60D2/(λ)
Distance of Trasition Region	26.719	m	Rt = Rnf

The distance in the transition region is between the near and far fields. Thus, Rnf ≤ Rt ≤ Rff . However, the power density in the transition region will not exceed the power density in the near-field. Therefore, for purposes of the present analysis, the distance of the transition region can equate the distance to the near-field.

Power Flux Density Calculations

The power flux density is considered to be at a maximum through the entire length of the near-field. This region is contained within a cylindrical volume with a diameter, D, equal to the diameter of the antenna. In the transition region and the far-field, the power density decreases inversely with the square of the distance. The following equations are used to calculate power density in these regions.

Parameter	Value	Unit	Symbol	Formula
Power Density in the Near-Field	4.824	mW/cm^2	S_{nf}	$16.0\ \eta\ P/(\pi D^2)$
Power Density in the Far-Field	2.067	mW/cm^2	S_{ff}	$GP/(4\pi\ R_{ff}^2)$
Power Density in the Trans. Region	4.824	mW/cm^2	S_t	$S_{nf}\ R_{nf}\ /(R_t)$

The region between the main reflector and the subreflector is confined within a conical shape defined by the feed assembly. The most common feed assemblies are waveguide flanges. This energy is determined as follows:

Parameter	Value	Unit	Symbol	Formula
Power Density at the Feed Flange	5359.3	mW/cm^2	S_{fa}	$4P\ /\ a$

The power density in the main reflector is determined similarly to the power density at the feed flange; except that the area of the reflector is used.

Parameter	Value	Unit	Symbol	Formula
Power Density at Main Reflector	7.470	mW/cm^2	$S_{surface}$	$4P\ /\ A$

The power density between the reflector and ground, assuming uniform illumination of the reflector surface, is calculated as follows:

Parameter	Value	Unit	Symbol	Formula
Power Density between Reflector and Ground	1.867	mW/cm^2	S_g	$P\ /\ A$

Table 1 summarizes the calculated power flux density values for each region. In a controlled environment, the only regions that exceed FCC limitations are shown below. These regions are only accessible by trained technicians who, as a matter of procedure, turn off transmit power before performing any work in these areas.

Power Densities	**mW/cm2**	**Controlled Environment (5 mW/cm2)**
Far Field Calculation	2.067	Satisfies FCC Requirements
Near Field Calculation	4.824	Satisfies FCC Requirements
Transition Region	4.824	Satisfies FCC Requirements
Region between Main and Subreflector	5359.3	Exceeds Limitations
Main Reflector Region	7.470	Exceeds Limitations
Region between Main Reflector and Ground	1.867	Satisfies FCC Requirements

Table 1. Power Flux Density for Each Region

In conclusion, the results show that the antenna, in a controlled environment, and under the proper mitigation procedures, meets the guidelines specified in 47 C.F.R. § 1.1310.

Radiation Hazard Study

SeaTel 9711 (C-band)

This study analyzes the potential Radio Frequency (RF) human exposure levels caused by the Electro Magnetic (EM) fields of the above-captioned antenna. The mathematical analysis performed below complies with the methods described in the Federal Communications Commission Office of Engineering and Technology Bulletin No. 65 (1985 rev. 1997) R&O 96-326.

Maximum Permisible Exposure

There are two separate levels of exposure limits. The first applies to persons in the general population who are in an uncontrolled environment. The second applies to trained personnel in a controlled environment. According to 47 C.F.R. § 1.1310, the Maximum Permissible Exposure (MPE) limits for frequencies above 1.5 GHz are as follows:

- General Population / Uncontrolled Exposure 1.0 mW/cm2
- Occupational / Controlled Exposure 5.0 mW/cm2

The purpose of this study is to determine the power flux density levels for the earth station under study as compared with the MPE limits. This comparison is done in each of the following regions:

1. Far-field region
2. Near-field region
3. Transition region
4. The region between the feed and the antenna surface
5. The main reflector region
6. The region between the antenna edge and the ground

Input Parameters

The following input parameters were used in the calculations:

Parameter	Value	Unit	Symbol
Atenna Diameter:	2.4	m	D
Antenna Transmit Gain:	41.70	dBi	G
Trasmit Frequency:	6180	MHz	f
Feed Flange Diameter:	5.60	cm	d
Power Input to the Antenna:	92.00	W	P

Calculated Parameters

The following values were calculated using the above input parameters and the corresponding formulas.

Parameter	Value	Unit	Symbol	Formula
Anenna Surface Area:	4.52	m^2	A	$\pi D^2/4$
Area of Feed Flange:	24.63	cm^2	a	$\pi d^2/4$
Antenna Efficiency:	0.61		η	$G\lambda^2/(\pi^2 D^2)$
Gain Factor:	14791.08		g	$10^{G/10}$
Wavelength:	0.0485	m	λ	$300/f$

Behavior of EM Fields as a Function of Distance

The behavior of the characteristics of EM fields varies depending on the distance from the radiating antenna. These characteristics are analyzed in three primary regions: the near-field region, the far-field region and the transition region. Of interest also are the region between the antenna main reflector and the subreflector, the region of the main reflector area and the region between the main reflector and ground.

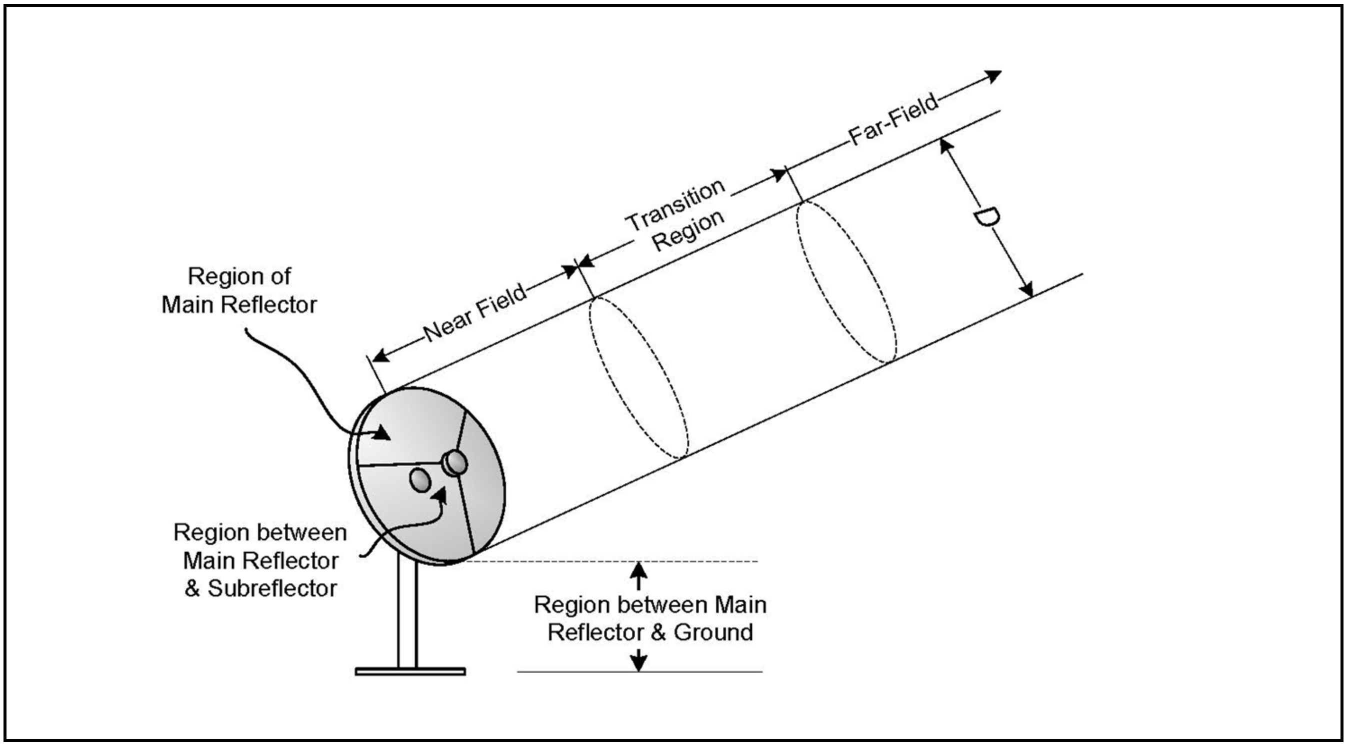

Figure 1. EM Fields as a Function of Distance

For parabolic aperture antennas with circular cross sections, such as the antenna under study, the near-field, far-field and transition region distances are calculated as follows:

Parameter	Value	Unit	Formula
Near Field Distance:	29.664	m	$R_{nf} = D^2/(4\lambda)$
Distance to Far Field:	71.194	m	Rff = 0.60D2/(λ)
Distance of Trasition Region	29.664	m	Rt = Rnf

The distance in the transition region is between the near and far fields. Thus, Rnf ≤ Rt ≤ Rff . However, the power density in the transition region will not exceed the power density in the near-field. Therefore, for purposes of the present analysis, the distance of the transition region can equate the distance to the near-field.

Power Flux Density Calculations

The power flux density is considered to be at a maximum through the entire length of the near-field. This region is contained within a cylindrical volume with a diameter, D, equal to the diameter of the antenna. In the transition region and the far-field, the power density decreases inversely with the square of the distance. The following equations are used to calculate power density in these regions.

Parameter	Value	Unit	Symbol	Formula
Power Density in the Near-Field	4.987	mW/cm^2	S_{nf}	$16.0\ \eta\ P/(\pi D^2)$
Power Density in the Far-Field	2.136	mW/cm^2	S_{ff}	$GP/(4\pi\ R_{ff}^2)$
Power Density in the Trans. Region	4.987	mW/cm^2	S_t	$S_{nf}\ R_{nf}\ /(R_t)$

The region between the main reflector and the subreflector is confined within a conical shape defined by the feed assembly. The most common feed assemblies are waveguide flanges. This energy is determined as follows:

Parameter	Value	Unit	Symbol	Formula
Power Density at the Feed Flange	14941.1	mW/cm^2	S_{fa}	$4P\ /\ a$

The power density in the main reflector is determined similarly to the power density at the feed flange; except that the area of the reflector is used.

Parameter	Value	Unit	Symbol	Formula
Power Density at Main Reflector	8.135	mW/cm^2	$S_{surface}$	$4P\ /\ A$

The power density between the reflector and ground, assuming uniform illumination of the reflector surface, is calculated as follows:

Parameter	Value	Unit	Symbol	Formula
Power Density between Reflector and Ground	2.034	mW/cm^2	S_g	$P\ /\ A$

Table 1 summarizes the calculated power flux density values for each region. In a controlled environment, the only regions that exceed FCC limitations are shown below. These regions are only accessible by trained technicians who, as a matter of procedure, turn off transmit power before performing any work in these areas.

Power Densities	**mW/cm2**	**Controlled Environment (5 mW/cm2)**
Far Field Calculation	2.136	Satisfies FCC Requirements
Near Field Calculation	4.987	Satisfies FCC Requirements
Transition Region	4.987	Satisfies FCC Requirements
Region between Main and Subreflector	14941.1	Exceeds Limitations
Main Reflector Region	8.135	Exceeds Limitations
Region between Main Reflector and Ground	2.034	Satisfies FCC Requirements

Table 1. Power Flux Density for Each Region

In conclusion, the results show that the antenna, in a controlled environment, and under the proper mitigation procedures, meets the guidelines specified in 47 C.F.R. § 1.1310.

Radiation Hazard Study

SeaTel 9711 (Ku-band)

This study analyzes the potential Radio Frequency (RF) human exposure levels caused by the Electro Magnetic (EM) fields of the above-captioned antenna. The mathematical analysis performed below complies with the methods described in the Federal Communications Commission Office of Engineering and Technology Bulletin No. 65 (1985 rev. 1997) R&O 96-326.

Maximum Permisible Exposure

There are two separate levels of exposure limits. The first applies to persons in the general population who are in an uncontrolled environment. The second applies to trained personnel in a controlled environment. According to 47 C.F.R. § 1.1310, the Maximum Permissible Exposure (MPE) limits for frequencies above 1.5 GHz are as follows:

- General Population / Uncontrolled Exposure 1.0 mW/cm2
- Occupational / Controlled Exposure 5.0 mW/cm2

The purpose of this study is to determine the power flux density levels for the earth station under study as compared with the MPE limits. This comparison is done in each of the following regions:

1. Far-field region
2. Near-field region
3. Transition region
4. The region between the feed and the antenna surface
5. The main reflector region
6. The region between the antenna edge and the ground

Input Parameters

The following input parameters were used in the calculations:

Parameter	Value	Unit	Symbol
Atenna Diameter:	2.4	m	D
Antenna Transmit Gain:	49.30	dBi	G
Trasmit Frequency:	14250	MHz	f
Feed Flange Diameter:	18.00	cm	d
Power Input to the Antenna:	56.00	W	P

Calculated Parameters

The following values were calculated using the above input parameters and the corresponding formulas.

Parameter	Value	Unit	Symbol	Formula
Anenna Surface Area:	4.52	m^2	A	$\pi D^2/4$
Area of Feed Flange:	254.47	cm^2	a	$\pi d^2/4$
Antenna Efficiency:	0.66		η	$G\lambda^2/(\pi^2 D^2)$
Gain Factor:	85113.80		g	$10^{G/10}$
Wavelength:	0.0211	m	λ	$300/f$

Behavior of EM Fields as a Function of Distance

The behavior of the characteristics of EM fields varies depending on the distance from the radiating antenna. These characteristics are analyzed in three primary regions: the near-field region, the far-field region and the transition region. Of interest also are the region between the antenna main reflector and the subreflector, the region of the main reflector area and the region between the main reflector and ground.

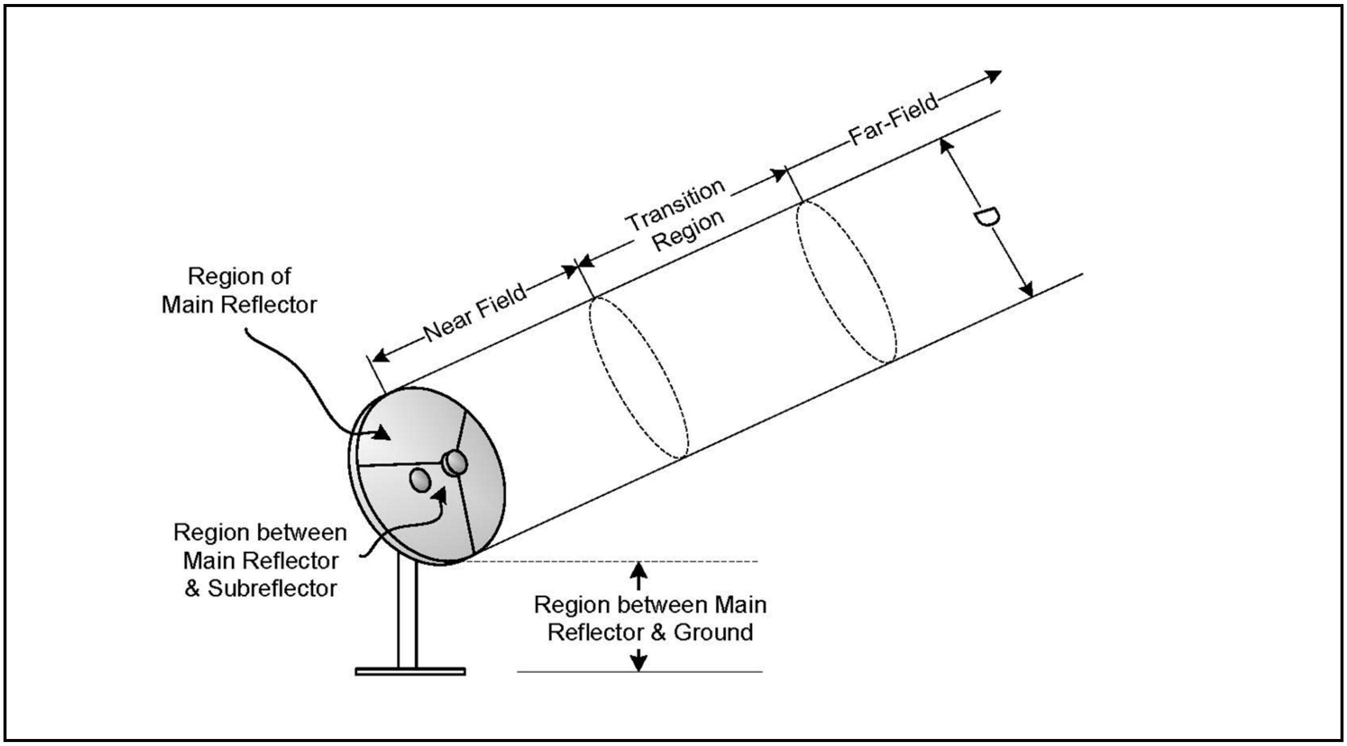

Figure 1. EM Fields as a Function of Distance

For parabolic aperture antennas with circular cross sections, such as the antenna under study, the near-field, far-field and transition region distances are calculated as follows:

Parameter	Value	Unit	Formula
Near Field Distance:	68.400	m	$R_{nf} = D^2/(4\lambda)$
Distance to Far Field:	164.160	m	Rff = 0.60D2/(λ)
Distance of Trasition Region	68.400	m	Rt = Rnf

The distance in the transition region is between the near and far fields. Thus, Rnf ≤ Rt ≤ Rff . However, the power density in the transition region will not exceed the power density in the near-field. Therefore, for purposes of the present analysis, the distance of the transition region can equate the distance to the near-field.

Power Flux Density Calculations

The power flux density is considered to be at a maximum through the entire length of the near-field. This region is contained within a cylindrical volume with a diameter, D, equal to the diameter of the antenna. In the transition region and the far-field, the power density decreases inversely with the square of the distance. The following equations are used to calculate power density in these regions.

Parameter	Value	Unit	Symbol	Formula
Power Density in the Near-Field	3.286	mW/cm^2	S_{nf}	$16.0\ \eta\ P/(\pi D^2)$
Power Density in the Far-Field	1.407	mW/cm^2	S_{ff}	$GP/(4\pi\ R_{ff}^2)$
Power Density in the Trans. Region	3.286	mW/cm^2	S_t	$S_{nf}\ R_{nf}\ /(R_t)$

The region between the main reflector and the subreflector is confined within a conical shape defined by the feed assembly. The most common feed assemblies are waveguide flanges. This energy is determined as follows:

Parameter	Value	Unit	Symbol	Formula
Power Density at the Feed Flange	880.3	mW/cm^2	S_{fa}	$4P\ /\ a$

The power density in the main reflector is determined similarly to the power density at the feed flange; except that the area of the reflector is used.

Parameter	Value	Unit	Symbol	Formula
Power Density at Main Reflector	4.951	mW/cm^2	$S_{surface}$	$4P\ /\ A$

The power density between the reflector and ground, assuming uniform illumination of the reflector surface, is calculated as follows:

Parameter	Value	Unit	Symbol	Formula
Power Density between Reflector and Ground	1.238	mW/cm^2	S_g	$P\ /\ A$

Table 1 summarizes the calculated power flux density values for each region. In a controlled environment, the only regions that exceed FCC limitations are shown below. These regions are only accessible by trained technicians who, as a matter of procedure, turn off transmit power before performing any work in these areas.

Power Densities	**mW/cm2**	**Controlled Environment (5 mW/cm2)**
Far Field Calculation	1.407	Satisfies FCC Requirements
Near Field Calculation	3.286	Satisfies FCC Requirements
Transition Region	3.286	Satisfies FCC Requirements
Region between Main and Subreflector	880.3	Exceeds Limitations
Main Reflector Region	4.951	Satisfies FCC Requirements
Region between Main Reflector and Ground	1.238	Satisfies FCC Requirements

Table 1. Power Flux Density for Each Region

In conclusion, the results show that the antenna, in a controlled environment, and under the proper mitigation procedures, meets the guidelines specified in 47 C.F.R. § 1.1310.

Radiation Hazard Study

SeaTel 9797

This study analyzes the potential Radio Frequency (RF) human exposure levels caused by the Electro Magnetic (EM) fields of the above-captioned antenna. The mathematical analysis performed below complies with the methods described in the Federal Communications Commission Office of Engineering and Technology Bulletin No. 65 (1985 rev. 1997) R&O 96-326.

Maximum Permisible Exposure

There are two separate levels of exposure limits. The first applies to persons in the general population who are in an uncontrolled environment. The second applies to trained personnel in a controlled environment. According to 47 C.F.R. § 1.1310, the Maximum Permissible Exposure (MPE) limits for frequencies above 1.5 GHz are as follows:

- General Population / Uncontrolled Exposure 1.0 mW/cm2
- Occupational / Controlled Exposure 5.0 mW/cm2

The purpose of this study is to determine the power flux density levels for the earth station under study as compared with the MPE limits. This comparison is done in each of the following regions:

1. Far-field region
2. Near-field region
3. Transition region
4. The region between the feed and the antenna surface
5. The main reflector region
6. The region between the antenna edge and the ground

Input Parameters

The following input parameters were used in the calculations:

Parameter	Value	Unit	Symbol
Atenna Diameter:	2.4	m	D
Antenna Transmit Gain:	48.45	dBi	G
Trasmit Frequency:	14250	MHz	f
Feed Flange Diameter:	13.00	cm	d
Power Input to the Antenna:	56.00	W	P

Calculated Parameters

The following values were calculated using the above input parameters and the corresponding formulas.

Parameter	Value	Unit	Symbol	Formula
Anenna Surface Area:	4.52	m^2	A	$\pi D^2/4$
Area of Feed Flange:	132.73	cm^2	a	$\pi d^2/4$
Antenna Efficiency:	0.55		η	$G\lambda^2/(\pi^2 D^2)$
Gain Factor:	69984.20		g	$10^{G/10}$
Wavelength:	0.0211	m	λ	$300/f$

Behavior of EM Fields as a Function of Distance

The behavior of the characteristics of EM fields varies depending on the distance from the radiating antenna. These characteristics are analyzed in three primary regions: the near-field region, the far-field region and the transition region. Of interest also are the region between the antenna main reflector and the subreflector, the region of the main reflector area and the region between the main reflector and ground.

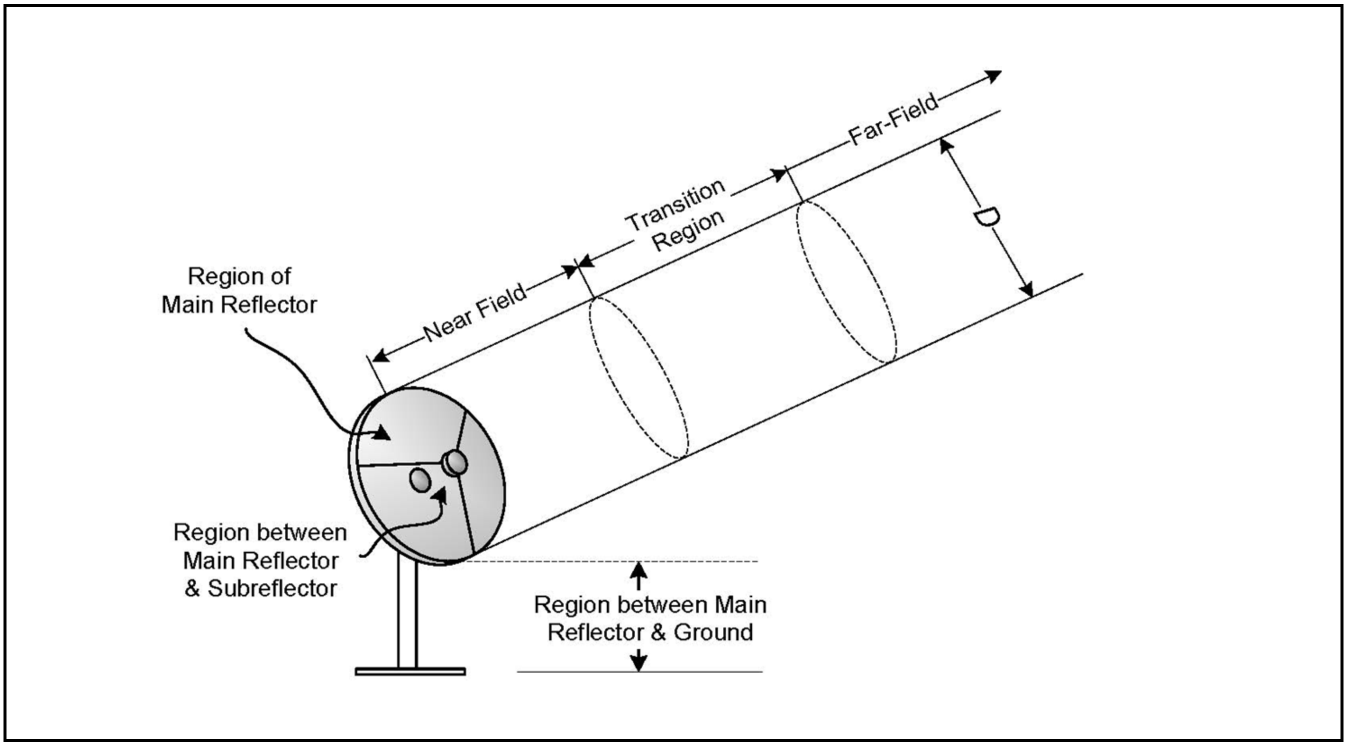

Figure 1. EM Fields as a Function of Distance

For parabolic aperture antennas with circular cross sections, such as the antenna under study, the near-field, far-field and transition region distances are calculated as follows:

Parameter	Value	Unit	Formula
Near Field Distance:	68.400	m	$R_{nf} = D^2/(4\lambda)$
Distance to Far Field:	164.160	m	Rff = 0.60D2/(λ)
Distance of Trasition Region	68.400	m	Rt = Rnf

The distance in the transition region is between the near and far fields. Thus, Rnf ≤ Rt ≤ Rff . However, the power density in the transition region will not exceed the power density in the near-field. Therefore, for purposes of the present analysis, the distance of the transition region can equate the distance to the near-field.

Power Flux Density Calculations

The power flux density is considered to be at a maximum through the entire length of the near-field. This region is contained within a cylindrical volume with a diameter, D, equal to the diameter of the antenna. In the transition region and the far-field, the power density decreases inversely with the square of the distance. The following equations are used to calculate power density in these regions.

Parameter	Value	Unit	Symbol	Formula
Power Density in the Near-Field	2.702	mW/cm^2	S_{nf}	$16.0\ \eta P/(\pi D^2)$
Power Density in the Far-Field	1.157	mW/cm^2	S_{ff}	$GP/(4\pi R_{ff}^2)$
Power Density in the Trans. Region	2.702	mW/cm^2	S_t	$S_{nf} R_{nf} /(R_t)$

The region between the main reflector and the subreflector is confined within a conical shape defined by the feed assembly. The most common feed assemblies are waveguide flanges. This energy is determined as follows:

Parameter	Value	Unit	Symbol	Formula
Power Density at the Feed Flange	1687.6	mW/cm^2	S_{fa}	$4P / a$

The power density in the main reflector is determined similarly to the power density at the feed flange; except that the area of the reflector is used.

Parameter	Value	Unit	Symbol	Formula
Power Density at Main Reflector	4.951	mW/cm^2	$S_{surface}$	$4P / A$

The power density between the reflector and ground, assuming uniform illumination of the reflector surface, is calculated as follows:

Parameter	Value	Unit	Symbol	Formula
Power Density between Reflector and Ground	1.238	mW/cm^2	S_g	P / A

Table 1 summarizes the calculated power flux density values for each region. In a controlled environment, the only regions that exceed FCC limitations are shown below. These regions are only accessible by trained technicians who, as a matter of procedure, turn off transmit power before performing any work in these areas.

Power Densities	**mW/cm2**	**Controlled Environment (5 mW/cm2)**
Far Field Calculation	1.157	Satisfies FCC Requirements
Near Field Calculation	2.702	Satisfies FCC Requirements
Transition Region	2.702	Satisfies FCC Requirements
Region between Main and Subreflector	1687.6	Exceeds Limitations
Main Reflector Region	4.951	Satisfies FCC Requirements
Region between Main Reflector and Ground	1.238	Satisfies FCC Requirements

Table 1. Power Flux Density for Each Region

In conclusion, the results show that the antenna, in a controlled environment, and under the proper mitigation procedures, meets the guidelines specified in 47 C.F.R. § 1.1310.