ANALYSIS OF NON-IONIZING RADIATION
FOR GLOBAL SKYWARE MODEL 988 ANTENNA (.98M)
Completed 10/27/21

This report analyzes the non-ionizing radiation levels for an earth station antenna 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 entitled "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields" - first published in 1985 and revised in 1997 in Edition 97-01. Bulletin No. 65 specifies that there are two separate tiers of exposure limits that are dependent 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, below. The General Population/Uncontrolled MPE is a function of the transmit frequency and is for an exposure period of thirty (30) minutes or less. The MPE limits for persons in an Occupational/Controlled environment are shown in Table 2, below. The Occupational/Controlled MPE is a function of the transmit frequency and is for an exposure period of six (6) 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 the main reflector surface, and at the main reflector surface and to compare these levels to the specified MPE limits.

The results of this analysis are summarized in Table 3 on the last page of this analysis.

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)/1500
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)/300
1500-100,000	5.0

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

Location:	Location	
Latitude:	Various	°N
Longitude:	Various	°W
Operating Frequency:	30000	MHz
Wavelength (λ)	0.00999	meters
Antenna Diameter (D):	0.98	meters
Antenna Area (A):	0.75	meters^2
Transmit Antenna Gain:	47.6	dBi
Transmit Antenna Gain (G):	57544.0	numeric
Maximum 5° Off Axis Gain:	36.1	dBi
Maximum 5° Off Axis Gain ($G_{5°}$):	4049.7	numeric
Antenna Efficiency (η):	0.606	numeric
Feed Power (P):	40	Watts

1. Antenna/Main Reflector Surface Calculation

The power density in the main reflector region can be estimated by:

		Antenna Diameter	
		0.98	meters
Power Density at Reflector Surface,	$S_{surface}$ =	4P/A	
	$S_{surface}$ =	212.12	W/m^2
	$S_{surface}$ =	**21.21**	**mW/cm^2**

$S_{surface}$ = maximum power density at antenna surface
P = power fed to the antenna
A = physical area of the antenna

2. Near Field Calculations

In the near field region, of the main beam, the power density can reach a maximum before it begins to decrease with distance. The magnitude of the on axis (main beam) power density varies according to location in the near-field.

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

		Antenna Diameter	
		0.98	meters
Extent of Near Field,	R_{nf} =	$D^2/4(\lambda)$	
	R_{nf} =	**24.03**	**meters**

R_{nf} = extent of near field
D = maximum dimension of antenna (diameter if circular)
λ = wavelength

The maximum near-field, on-axis, power density is determined by:

		Antenna Diameter	
		0.98	meters
On Axis Near Field Power Density,	S_{nf} =	$16\eta P/\pi D^2$	
	S_{nf} =	128.60	W/m^2
	S_{nf} =	**12.86**	**mW/cm^2**

The maximum near-field, 5° off-axis, power density is determined by:

		Antenna Diameter	
		0.98	meters
Power Density at 5° Off Axis	$S_{nf\,5°}$=	$(S_{nf}/G)*G_{5°}$	
	$S_{nf\,5°}$=	**0.9050**	**mW/cm^2**

S_{nf}= maximum near-field power density
$S_{nf\,5°}$ = maximum near-field power density (5° off axis)
η = aperture efficiency
P = power fed to antenna
D = maximum dimension of antenna (diameter if circular)

3. Far Field Calculations

The power density in the far-field region decreases inversely with the square of the distance.

The distance to the beginning of the far field region can be found by the following equation:

		Antenna Diameter	
		0.98	meters
Distance to the Far Field Region,	R_{ff} =	$0.6D^2/\lambda$	
	R_{ff} =	**57.66**	**meters**

R_{ff} = distance to beginning of far field
D = maximum dimension of antenna (diameter if circular)
λ = wavelength

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

		Antenna Diameter	
		0.98	meters
On-Axis Power Density in the Far Field,	S_{ff} =	$(P)(G)/4\pi(R_{ff})^2$	
	S_{ff} =	55.09	W/m^2
	S_{ff} =	**5.51**	**mW/cm^2**

The maximum far-field, 5° off-axis, power density is determined by:

		Antenna Diameter	
		0.98	meters
Power Density at 5° Off Axis	$S_{ff\,5°}$=	$(S_{ff}/G)*G_{5°}$	
	$S_{ff\,5°}$=	**0.3877**	**mW/cm^2**

S_{ff}= power density (on axis)
$Sff_{5°}$= power density (5° off axis)
P= power fed to antenna
G= power gain of antenna in the direction of interest relative to an isotropic radiator
R_{ff} = distance to beginning of far field

4. Transition Region Calculations

The transition region is located between the near and far field regions. The power density decreases inversely with distance in the transition region, while the power density decreases inversely with the *square* of the distance in the far-field region. The maximum power density in the transition region will not exceed that calculated for the near-field region. The power density in the near field region, as shown above will not exceed:

	Antenna Diameter	
	0.98	meters
S_t=	$(S_{nf}*R_{nf})/R$	
$S_{t\,5°}$ =	$(S_{nf\,5°}*R_{nf})/R$	
S_t=	**12.86**	**mW/cm²**
$S_{t\,5°}$ =	**0.9050**	**mW/cm²**

Table 3

Summary of Expected Radiation Levels

Region	Calculated Maximum Radiation Level (mW/cm²	Distance to Region (m)	Maximum Permissible Exposure (MPE) Occupational	General Population
0.98 m Earth Station Antenna				
1. Antenna Surface	$S_{surface}$= 21.21		Potential Hazard	Potential Hazard
2. Near Field	S_{nf}= 12.86	24.0	Potential Hazard	Potential Hazard
3. Far Field	S_{ff}= 5.51	57.7	Potential Hazard	Potential Hazard
4. Transition Region	S_t= 12.86		Potential Hazard	Potential Hazard
5. Near Field 5° Off Axis	$S_{nf\,5°}$= 0.9050		Satisfies MPE	Satisfies MPE
6. Far Field 5° Off Axis	$S_{ff\,5°}$= 0.39		Satisfies MPE	Satisfies MPE
7. Transition Region 5° Off Axis	$S_{t\,5°}$ = 0.9050		Satisfies MPE	Satisfies MPE

7. Conclusions

Based on the above analysis, it is concluded that the OET/FCC Radiofrequency Electromagnetic Fields guidelines for Maximum Permissible Exposure (MPE) have been exceeded in the region(s) specified in Table 3. However, it should be noted that General Population/Uncontrolled MPE limit is always satisfied at angles 5° off of boresight or greater for all antenna apertures. As these earth station antennas will never be operated with elevation angles of less than the minimum specified in 47 C.F.R. Ch. 1 §25.205 (namely 5°), then the MPE associated with the General Population/Uncontrolled limits will always be satisfied. GCI will post appropriate RF Radiation Hazard placards and other signage in the areas near these antennas and/or will restrict access to the antenna by means of fencing or other appropriate devices. Finally, access to the antenna surface, as well as the region between the feedhorn and the antenna surface will be restricted to qualified personnel and the transmitter will be disabled during maintenance activities in these areas to protect personnel from exposure.

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ANALYSIS OF NON-IONIZING RADIATION
FOR CPI MODEL C100FM / C100FMA ANTENNA (1.0M)
Completed 10/27/21

This report analyzes the non-ionizing radiation levels for an earth station antenna 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 entitled "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields" - first published in 1985 and revised in 1997 in Edition 97-01. Bulletin No. 65 specifies that there are two separate tiers of exposure limits that are dependent 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, below. The General Population/Uncontrolled MPE is a function of the transmit frequency and is for an exposure period of thirty (30) minutes or less. The MPE limits for persons in an Occupational/Controlled environment are shown in Table 2, below. The Occupational/Controlled MPE is a function of the transmit frequency and is for an exposure period of six (6) 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 the main reflector surface, and at the main reflector surface and to compare these levels to the specified MPE limits.

The results of this analysis are summarized in Table 3 on the last page of this analysis.

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)/1500
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)/300
1500-100,000	5.0

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

Location:	Location	
Latitude:	Various	°N
Longitude:	Various	°W
Operating Frequency:	30000	MHz
Wavelength (λ)	0.00999	meters
Antenna Diameter (D):	1.00	meters
Antenna Area (A):	0.79	meters^2
Transmit Antenna Gain:	46.6	dBi
Transmit Antenna Gain (G):	45708.8	numeric
Maximum 5° Off Axis Gain:	35.1	dBi
Maximum 5° Off Axis Gain ($G_{5°}$):	3216.8	numeric
Antenna Efficiency (η):	0.462	numeric
Feed Power (P):	60	Watts

1. Antenna/Main Reflector Surface Calculation

The power density in the main reflector region can be estimated by:

		Antenna Diameter	
		1.00	meters
Power Density at Reflector Surface,	$S_{surface}$ =	4P/A	
	$S_{surface}$ =	305.58	W/m^2
	$S_{surface}$ =	**30.56**	**mW/cm^2**

$S_{surface}$ = maximum power density at antenna surface
P = power fed to the antenna
A = physical area of the antenna

2. Near Field Calculations

In the near field region, of the main beam, the power density can reach a maximum before it begins to decrease with distance. The magnitude of the on axis (main beam) power density varies according to location in the near-field.

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

Extent of Near Field,

		Antenna Diameter	
		1.00	meters
	R_{nf} =	$D^2/4(\lambda)$	
	R_{nf} =	**25.02**	**meters**

R_{nf} = extent of near field
D = maximum dimension of antenna (diameter if circular)
λ = wavelength

The maximum near-field, on-axis, power density is determined by:

On Axis Near Field Power Density,

		Antenna Diameter	
		1.00	meters
	S_{nf} =	$16\eta P/\pi D^2$	
	S_{nf} =	141.33	W/m^2
	S_{nf} =	**14.13**	**mW/cm^2**

The maximum near-field, 5° off-axis, power density is determined by:

Power Density at 5° Off Axis

		Antenna Diameter	
		1.00	meters
	$S_{nf\ 5°}$=	$(S_{nf}/G)*G_{5°}$	
	$S_{nf\ 5°}$=	**0.9946**	**mW/cm^2**

S_{nf}= maximum near-field power density
$S_{nf\ 5°}$ = maximum near-field power density (5° off axis)
η = aperture efficiency
P = power fed to antenna
D = maximum dimension of antenna (diameter if circular)

3. Far Field Calculations

The power density in the far-field region decreases inversely with the square of the distance.

The distance to the beginning of the far field region can be found by the following equation:

Distance to the Far Field Region,

		Antenna Diameter	
		1.00	meters
	R_{ff} =	$0.6D^2/\lambda$	
	R_{ff} =	**60.04**	**meters**

R_{ff} = distance to beginning of far field
D = maximum dimension of antenna (diameter if circular)
λ = wavelength

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

On-Axis Power Density in the Far Field,

		Antenna Diameter	
		1.00	meters
	S_{ff} =	$(P)(G)/4\pi(R_{ff})^2$	
	S_{ff} =	60.54	W/m^2
	S_{ff} =	**6.05**	**mW/cm^2**

The maximum far-field, 5° off-axis, power density is determined by:

Power Density at 5° Off Axis

		Antenna Diameter	
		1.00	meters
	$S_{ff\ 5°}$=	$(S_{ff}/G)*G_{5°}$	
	$S_{ff\ 5°}$=	**0.4261**	**mW/cm^2**

S_{ff}= power density (on axis)
$Sff_{5°}$= power density (5° off axis)
P= power fed to antenna
G= power gain of antenna in the direction of interest relative to an isotropic radiator
R_{ff} = distance to beginning of far field

4. Transition Region Calculations

The transition region is located between the near and far field regions. The power density decreases inversely with distance in the transition region, while the power density decreases inversely with the *square* of the distance in the far-field region. The maximum power density in the transition region will not exceed that calculated for the near-field region. The power density in the near field region, as shown above will not exceed:

	Antenna Diameter	
	1.00	meters
S_t=	$(S_{nf}*R_{nf})/R$	
$S_{t\,5°}$ =	$(S_{nf\,5°}*R_{nf})/R$	
S_t=	**14.13**	**mW/cm²**
$S_{t\,5°}$ =	**0.9946**	**mW/cm²**

Table 3

Summary of Expected Radiation Levels

Region	**Calculated Maximum Radiation Level (mW/cm²)**	**Distance to Region (m)**	**Maximum Permissible Exposure (MPE) Occupational**	**General Population**
1 m Earth Station Antenna				
1. Antenna Surface	$S_{surface}$= 30.56		Potential Hazard	Potential Hazard
2. Near Field	S_{nf}= 14.13	25.0	Potential Hazard	Potential Hazard
3. Far Field	S_{ff}= 6.05	60.0	Potential Hazard	Potential Hazard
4. Transition Region	S_t= 14.13		Potential Hazard	Potential Hazard
5. Near Field 5° Off Axis	$S_{nf\,5°}$= 0.9946		Satisfies MPE	Satisfies MPE
6. Far Field 5° Off Axis	$S_{ff\,5°}$= 0.43		Satisfies MPE	Satisfies MPE
7. Transition Region 5° Off Axis	$S_{t\,5°}$ = 0.9946		Satisfies MPE	Satisfies MPE

7. Conclusions

Based on the above analysis, it is concluded that the OET/FCC Radiofrequency Electromagnetic Fields guidelines for Maximum Permissible Exposure (MPE) have been exceeded in the region(s) specified in Table 3. However, it should be noted that General Population/Uncontrolled MPE limit is always satisfied at angles 5° off of boresight or greater for all antenna apertures. As these earth station antennas will never be operated with elevation angles of less than the minimum specified in 47 C.F.R. Ch. 1 §25.205 (namely 5°), then the MPE associated with the General Population/Uncontrolled limits will always be satisfied. GCI will post appropriate RF Radiation Hazard placards and other signage in the areas near these antennas and/or will restrict access to the antenna by means of fencing or other appropriate devices. Finally, access to the antenna surface, as well as the region between the feedhorn and the antenna surface will be restricted to qualified personnel and the transmitter will be disabled during maintenance activities in these areas to protect personnel from exposure.

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ANALYSIS OF NON-IONIZING RADIATION
FOR CPI MODEL C125FM / C125FA ANTENNA (1.25M)
Completed 10/27/21

This report analyzes the non-ionizing radiation levels for an earth station antenna 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 entitled "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields" - first published in 1985 and revised in 1997 in Edition 97-01. Bulletin No. 65 specifies that there are two separate tiers of exposure limits that are dependent 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, below. The General Population/Uncontrolled MPE is a function of the transmit frequency and is for an exposure period of thirty (30) minutes or less. The MPE limits for persons in an Occupational/Controlled environment are shown in Table 2, below. The Occupational/Controlled MPE is a function of the transmit frequency and is for an exposure period of six (6) 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 the main reflector surface, and at the main reflector surface and to compare these levels to the specified MPE limits.

The results of this analysis are summarized in Table 3 on the last page of this analysis.

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)/1500
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)/300
1500-100,000	5.0

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

Location:	Location	
Latitude:	Various	°N
Longitude:	Various	°W
Operating Frequency:	30000	MHz
Wavelength (λ)	0.00999	meters
Antenna Diameter (D):	1.25	meters
Antenna Area (A):	1.23	$meters^2$
Transmit Antenna Gain:	49.5	dBi
Transmit Antenna Gain (G):	89125.1	numeric
Maximum 5° Off Axis Gain:	38.0	dBi
Maximum 5° Off Axis Gain ($G_{5°}$):	6272.3	numeric
Antenna Efficiency (η):	0.577	numeric
Feed Power (P):	70	Watts

1. Antenna/Main Reflector Surface Calculation

The power density in the main reflector region can be estimated by:

		Antenna Diameter	
		1.25	meters
Power Density at Reflector Surface,	$S_{surface}$ =	4P/A	
	$S_{surface}$ =	228.16	W/m^2
	$S_{surface}$ =	**22.82**	**mW/cm^2**

$S_{surface}$ = maximum power density at antenna surface
P = power fed to the antenna
A = physical area of the antenna

2. Near Field Calculations

In the near field region, of the main beam, the power density can reach a maximum before it begins to decrease with distance. The magnitude of the on axis (main beam) power density varies according to location in the near-field.

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

		Antenna Diameter	
		1.25	meters
Extent of Near Field,	R_{nf} =	$D^2/4(\lambda)$	
	R_{nf} =	**39.09**	**meters**

R_{nf} = extent of near field
D = maximum dimension of antenna (diameter if circular)
λ = wavelength

The maximum near-field, on-axis, power density is determined by:

		Antenna Diameter	
		1.25	meters
On Axis Near Field Power Density,	S_{nf} =	$16\eta P/\pi D^2$	
	S_{nf} =	131.68	W/m^2
	S_{nf} =	**13.17**	**mW/cm^2**

The maximum near-field, 5° off-axis, power density is determined by:

		Antenna Diameter	
		1.25	meters
Power Density at 5° Off Axis	$S_{nf\,5°}$=	$(S_{nf}/G)*G_{5°}$	
	$S_{nf\,5°}$=	**0.9267**	**mW/cm^2**

S_{nf}= maximum near-field power density
$S_{nf\,5°}$ = maximum near-field power density (5° off axis)
η = aperture efficiency
P = power fed to antenna
D = maximum dimension of antenna (diameter if circular)

3. Far Field Calculations

The power density in the far-field region decreases inversely with the square of the distance.

The distance to the beginning of the far field region can be found by the following equation:

		Antenna Diameter	
		1.25	meters
Distance to the Far Field Region,	R_{ff} =	$0.6D^2/\lambda$	
	R_{ff} =	**93.81**	**meters**

R_{ff} = distance to beginning of far field
D = maximum dimension of antenna (diameter if circular)
λ = wavelength

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

		Antenna Diameter	
		1.25	meters
On-Axis Power Density in the Far Field,	S_{ff} =	$(P)(G)/4\pi(R_{ff})^2$	
	S_{ff} =	56.41	W/m^2
	S_{ff} =	**5.64**	**mW/cm^2**

The maximum far-field, 5° off-axis, power density is determined by:

		Antenna Diameter	
		1.25	meters
Power Density at 5° Off Axis	$S_{ff\,5°}$=	$(S_{ff}/G)*G_{5°}$	
	$S_{ff\,5°}$=	**0.3970**	**mW/cm^2**

S_{ff}= power density (on axis)
$Sff_{5°}$= power density (5° off axis)
P= power fed to antenna
G= power gain of antenna in the direction of interest relative to an isotropic radiator
R_{ff} = distance to beginning of far field

4. Transition Region Calculations

The transition region is located between the near and far field regions. The power density decreases inversely with distance in the transition region, while the power density decreases inversely with the *square* of the distance in the far-field region. The maximum power density in the transition region will not exceed that calculated for the near-field region. The power density in the near field region, as shown above will not exceed:

	Antenna Diameter	
	1.25	meters
S_t=	$(S_{nf}*R_{nf})/R$	
$S_{t\,5°}$ =	$(S_{nf\,5°}*R_{nf})/R$	
S_t=	**13.17**	**mW/cm²**
$S_{t\,5°}$ =	**0.9267**	**mW/cm²**

Table 3

Summary of Expected Radiation Levels

Region	**Calculated Maximum Radiation Level (mW/cm²**	**Distance to Region (m)**	**Maximum Permissible Exposure (MPE) Occupational**	**General Population**
1.25 m Earth Station Antenna				
1. Antenna Surface	$S_{surface}$= 22.82		Potential Hazard	Potential Hazard
2. Near Field	S_{nf}= 13.17	39.1	Potential Hazard	Potential Hazard
3. Far Field	S_{ff}= 5.64	93.8	Potential Hazard	Potential Hazard
4. Transition Region	S_t= 13.17		Potential Hazard	Potential Hazard
5. Near Field 5° Off Axis	$S_{nf\,5°}$= 0.9267		Satisfies MPE	Satisfies MPE
6. Far Field 5° Off Axis	$S_{ff\,5°}$= 0.40		Satisfies MPE	Satisfies MPE
7. Transition Region 5° Off Axis	$S_{t\,5°}$ = 0.9267		Satisfies MPE	Satisfies MPE

7. Conclusions

Based on the above analysis, it is concluded that the OET/FCC Radiofrequency Electromagnetic Fields guidelines for Maximum Permissible Exposure (MPE) have been exceeded in the region(s) specified in Table 3. However, it should be noted that General Population/Uncontrolled MPE limit is always satisfied at angles 5° off of boresight or greater for all antenna apertures. As these earth station antennas will never be operated with elevation angles of less than the minimum specified in 47 C.F.R. Ch. 1 §25.205 (namely 5°), then the MPE associated with the General Population/Uncontrolled limits will always be satisfied. GCI will post appropriate RF Radiation Hazard placards and other signage in the areas near these antennas and/or will restrict access to the antenna by means of fencing or other appropriate devices. Finally, access to the antenna surface, as well as the region between the feedhorn and the antenna surface will be restricted to qualified personnel and the transmitter will be disabled during maintenance activities in these areas to protect personnel from exposure.

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ANALYSIS OF NON-IONIZING RADIATION
FOR CPI MODEL 3122 ANTENNA (1.2Ma)
Completed 10/27/21

This report analyzes the non-ionizing radiation levels for an earth station antenna 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 entitled "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields" - first published in 1985 and revised in 1997 in Edition 97-01. Bulletin No. 65 specifies that there are two separate tiers of exposure limits that are dependent 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, below. The General Population/Uncontrolled MPE is a function of the transmit frequency and is for an exposure period of thirty (30) minutes or less. The MPE limits for persons in an Occupational/Controlled environment are shown in Table 2, below. The Occupational/Controlled MPE is a function of the transmit frequency and is for an exposure period of six (6) 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 the main reflector surface, and at the main reflector surface and to compare these levels to the specified MPE limits.

The results of this analysis are summarized in Table 3 on the last page of this analysis.

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)/1500
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)/300
1500-100,000	5.0

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

Location:	Location	
Latitude:	Various	°N
Longitude:	Various	°W
Operating Frequency:	30000	MHz
Wavelength (λ)	0.00999	meters
Antenna Diameter (D):	1.20	meters
Antenna Area (A):	1.13	meters^2
Transmit Antenna Gain:	49.4	dBi
Transmit Antenna Gain (G):	87096.4	numeric
Maximum 5° Off Axis Gain:	37.9	dBi
Maximum 5° Off Axis Gain ($G_{5°}$):	6129.5	numeric
Antenna Efficiency (η):	0.612	numeric
Feed Power (P):	60	Watts

1. Antenna/Main Reflector Surface Calculation

The power density in the main reflector region can be estimated by:

		Antenna Diameter	
		1.20	meters
Power Density at Reflector Surface,	$S_{surface}$ =	4P/A	
	$S_{surface}$ =	212.21	W/m^2
	$S_{surface}$ =	**21.22**	**mW/cm^2**

$S_{surface}$ = maximum power density at antenna surface
P = power fed to the antenna
A = physical area of the antenna

2. Near Field Calculations

In the near field region, of the main beam, the power density can reach a maximum before it begins to decrease with distance. The magnitude of the on axis (main beam) power density varies according to location in the near-field.

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

		Antenna Diameter	
		1.20	meters
Extent of Near Field,	R_{nf} =	$D^2/4(\lambda)$	
	R_{nf} =	**36.02**	**meters**

R_{nf} = extent of near field
D = maximum dimension of antenna (diameter if circular)
λ = wavelength

The maximum near-field, on-axis, power density is determined by:

		Antenna Diameter	
		1.20	meters
On Axis Near Field Power Density,	S_{nf} =	$16\eta P/\pi D^2$	
	S_{nf} =	129.87	W/m^2
	S_{nf} =	**12.99**	**mW/cm^2**

The maximum near-field, 5° off-axis, power density is determined by:

		Antenna Diameter	
		1.20	meters
Power Density at 5° Off Axis	$S_{nf\ 5°}$=	$(S_{nf}/G)*G_{5°}$	
	$S_{nf\ 5°}$=	**0.9139**	**mW/cm^2**

S_{nf}= maximum near-field power density
$S_{nf\ 5°}$ = maximum near-field power density (5° off axis)
η = aperture efficiency
P = power fed to antenna
D = maximum dimension of antenna (diameter if circular)

3. Far Field Calculations

The power density in the far-field region decreases inversely with the square of the distance.

The distance to the beginning of the far field region can be found by the following equation:

		Antenna Diameter	
		1.20	meters
Distance to the Far Field Region,	R_{ff} =	$0.6D^2/\lambda$	
	R_{ff} =	**86.46**	**meters**

R_{ff} = distance to beginning of far field
D = maximum dimension of antenna (diameter if circular)
λ = wavelength

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

		Antenna Diameter	
		1.20	meters
On-Axis Power Density in the Far Field,	S_{ff} =	$(P)(G)/4\pi(R_{ff})^2$	
	S_{ff} =	55.63	W/m^2
	S_{ff} =	**5.56**	**mW/cm^2**

The maximum far-field, 5° off-axis, power density is determined by:

		Antenna Diameter	
		1.20	meters
Power Density at 5° Off Axis	$S_{ff\ 5°}$=	$(S_{ff}/G)*G_{5°}$	
	$S_{ff\ 5°}$=	**0.3915**	**mW/cm^2**

S_{ff}= power density (on axis)
$Sff_{5°}$= power density (5° off axis)
P= power fed to antenna
G= power gain of antenna in the direction of interest relative to an isotropic radiator
R_{ff} = distance to beginning of far field

4. Transition Region Calculations

The transition region is located between the near and far field regions. The power density decreases inversely with distance in the transition region, while the power density decreases inversely with the *square* of the distance in the far-field region. The maximum power density in the transition region will not exceed that calculated for the near-field region. The power density in the near field region, as shown above will not exceed:

	Antenna Diameter	
	1.20	meters
S_t=	$(S_{nf}*R_{nf})/R$	
$S_{t\,5°}$ =	$(S_{nf\,5°}*R_{nf})/R$	
S_t=	**12.99**	**mW/cm²**
$S_{t\,5°}$ =	**0.9139**	**mW/cm²**

Table 3

Summary of Expected Radiation Levels

Region	Calculated Maximum Radiation Level (mW/cm²)	Distance to Region (m)	Maximum Permissible Exposure (MPE) Occupational	General Population
1.2 m Earth Station Antenna				
1. Antenna Surface	$S_{surface}$= 21.22		Potential Hazard	Potential Hazard
2. Near Field	S_{nf}= 12.99	36.0	Potential Hazard	Potential Hazard
3. Far Field	S_{ff}= 5.56	86.5	Potential Hazard	Potential Hazard
4. Transition Region	S_t= 12.99		Potential Hazard	Potential Hazard
5. Near Field 5° Off Axis	$S_{nf\,5°}$= 0.9139		Satisfies MPE	Satisfies MPE
6. Far Field 5° Off Axis	$S_{ff\,5°}$= 0.39		Satisfies MPE	Satisfies MPE
7. Transition Region 5° Off Axis	$S_{t\,5°}$ = 0.9139		Satisfies MPE	Satisfies MPE

7. Conclusions

Based on the above analysis, it is concluded that the OET/FCC Radiofrequency Electromagnetic Fields guidelines for Maximum Permissible Exposure (MPE) have been exceeded in the region(s) specified in Table 3. However, it should be noted that General Population/Uncontrolled MPE limit is always satisfied at angles 5° off of boresight or greater for all antenna apertures. As these earth station antennas will never be operated with elevation angles of less than the minimum specified in 47 C.F.R. Ch. 1 §25.205 (namely 5°), then the MPE associated with the General Population/Uncontrolled limits will always be satisfied. GCI will post appropriate RF Radiation Hazard placards and other signage in the areas near these antennas and/or will restrict access to the antenna by means of fencing or other appropriate devices. Finally, access to the antenna surface, as well as the region between the feedhorn and the antenna surface will be restricted to qualified personnel and the transmitter will be disabled during maintenance activities in these areas to protect personnel from exposure.

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ANALYSIS OF NON-IONIZING RADIATION
FOR GLOBAL SKYWARE TYPE 127 ANTENNA (1.2Mb)
Completed 10/27/21

This report analyzes the non-ionizing radiation levels for an earth station antenna 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 entitled "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields" - first published in 1985 and revised in 1997 in Edition 97-01. Bulletin No. 65 specifies that there are two separate tiers of exposure limits that are dependent 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, below. The General Population/Uncontrolled MPE is a function of the transmit frequency and is for an exposure period of thirty (30) minutes or less. The MPE limits for persons in an Occupational/Controlled environment are shown in Table 2, below. The Occupational/Controlled MPE is a function of the transmit frequency and is for an exposure period of six (6) 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 the main reflector surface, and at the main reflector surface and to compare these levels to the specified MPE limits.

The results of this analysis are summarized in Table 3 on the last page of this analysis.

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)/1500
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)/300
1500-100,000	5.0

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

Location:	Location	
Latitude:	Various	°N
Longitude:	Various	°W
Operating Frequency:	30000	MHz
Wavelength (λ)	0.00999	meters
Antenna Diameter (D):	1.20	meters
Antenna Area (A):	1.13	meters^2
Transmit Antenna Gain:	49.5	dBi
Transmit Antenna Gain (G):	89125.1	numeric
Maximum 5° Off Axis Gain:	38.0	dBi
Maximum 5° Off Axis Gain ($G_{5°}$):	6272.3	numeric
Antenna Efficiency (η):	0.626	numeric
Feed Power (P):	60	Watts

1. Antenna/Main Reflector Surface Calculation

The power density in the main reflector region can be estimated by:

		Antenna Diameter	
		1.20	meters
Power Density at Reflector Surface,	$S_{surface}$ =	4P/A	
	$S_{surface}$ =	212.21	W/m^2
	$S_{surface}$ =	**21.22**	**mW/cm^2**

$S_{surface}$ = maximum power density at antenna surface
P = power fed to the antenna
A = physical area of the antenna

2. Near Field Calculations

In the near field region, of the main beam, the power density can reach a maximum before it begins to decrease with distance. The magnitude of the on axis (main beam) power density varies according to location in the near-field.

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

		Antenna Diameter	
		1.20	meters
Extent of Near Field,	R_{nf} =	$D^2/4(\lambda)$	
	R_{nf} =	**36.02**	**meters**

R_{nf} = extent of near field
D = maximum dimension of antenna (diameter if circular)
λ = wavelength

The maximum near-field, on-axis, power density is determined by:

		Antenna Diameter	
		1.20	meters
On Axis Near Field Power Density,	S_{nf} =	$16\eta P/\pi D^2$	
	S_{nf} =	132.89	W/m^2
	S_{nf} =	**13.29**	**mW/cm^2**

The maximum near-field, 5° off-axis, power density is determined by:

		Antenna Diameter	
		1.20	meters
Power Density at 5° Off Axis	$S_{nf\,5°}$=	$(S_{nf}/G)*G_{5°}$	
	$S_{nf\,5°}$=	**0.9352**	**mW/cm^2**

S_{nf}= maximum near-field power density
$S_{nf\,5°}$ = maximum near-field power density (5° off axis)
η = aperture efficiency
P = power fed to antenna
D = maximum dimension of antenna (diameter if circular)

3. Far Field Calculations

The power density in the far-field region decreases inversely with the square of the distance.

The distance to the beginning of the far field region can be found by the following equation:

		Antenna Diameter	
		1.20	meters
Distance to the Far Field Region,	R_{ff} =	$0.6D^2/\lambda$	
	R_{ff} =	**86.46**	**meters**

R_{ff} = distance to beginning of far field
D = maximum dimension of antenna (diameter if circular)
λ = wavelength

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

		Antenna Diameter	
		1.20	meters
On-Axis Power Density in the Far Field,	S_{ff} =	$(P)(G)/4\pi(R_{ff})^2$	
	S_{ff} =	56.93	W/m^2
	S_{ff} =	**5.69**	**mW/cm^2**

The maximum far-field, 5° off-axis, power density is determined by:

		Antenna Diameter	
		1.20	meters
Power Density at 5° Off Axis	$S_{ff\,5°}$=	$(S_{ff}/G)*G_{5°}$	
	$S_{ff\,5°}$=	**0.4006**	**mW/cm^2**

S_{ff}= power density (on axis)
$Sff_{5°}$= power density (5° off axis)
P= power fed to antenna
G= power gain of antenna in the direction of interest relative to an isotropic radiator
R_{ff} = distance to beginning of far field

4. Transition Region Calculations

The transition region is located between the near and far field regions. The power density decreases inversely with distance in the transition region, while the power density decreases inversely with the *square* of the distance in the far-field region. The maximum power density in the transition region will not exceed that calculated for the near-field region. The power density in the near field region, as shown above will not exceed:

	Antenna Diameter	
	1.20	meters
S_t=	$(S_{nf}*R_{nf})/R$	
$S_{t\,5°}$ =	$(S_{nf\,5°}*R_{nf})/R$	
S_t=	**13.29**	**mW/cm²**
$S_{t\,5°}$ =	**0.9352**	**mW/cm²**

Table 3

Summary of Expected Radiation Levels

Region	Calculated Maximum Radiation Level (mW/cm²	Distance to Region (m)	Maximum Permissible Exposure (MPE) Occupational	General Population
1.2 m Earth Station Antenna				
1. Antenna Surface	$S_{surface}$= 21.22		Potential Hazard	Potential Hazard
2. Near Field	S_{nf}= 13.29	36.0	Potential Hazard	Potential Hazard
3. Far Field	S_{ff}= 5.69	86.5	Potential Hazard	Potential Hazard
4. Transition Region	S_t= 13.29		Potential Hazard	Potential Hazard
5. Near Field 5° Off Axis	$S_{nf\,5°}$= 0.9352		Satisfies MPE	Satisfies MPE
6. Far Field 5° Off Axis	$S_{ff\,5°}$= 0.40		Satisfies MPE	Satisfies MPE
7. Transition Region 5° Off Axis	$S_{t\,5°}$ = 0.9352		Satisfies MPE	Satisfies MPE

7. Conclusions

Based on the above analysis, it is concluded that the OET/FCC Radiofrequency Electromagnetic Fields guidelines for Maximum Permissible Exposure (MPE) have been exceeded in the region(s) specified in Table 3. However, it should be noted that General Population/Uncontrolled MPE limit is always satisfied at angles 5° off of boresight or greater for all antenna apertures. As these earth station antennas will never be operated with elevation angles of less than the minimum specified in 47 C.F.R. Ch. 1 §25.205 (namely 5°), then the MPE associated with the General Population/Uncontrolled limits will always be satisfied. GCI will post appropriate RF Radiation Hazard placards and other signage in the areas near these antennas and/or will restrict access to the antenna by means of fencing or other appropriate devices. Finally, access to the antenna surface, as well as the region between the feedhorn and the antenna surface will be restricted to qualified personnel and the transmitter will be disabled during maintenance activities in these areas to protect personnel from exposure.

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ANALYSIS OF NON-IONIZING RADIATION
FOR CPI MODEL C180FM ANTENNA (1.8Ma)
Completed 10/27/21

This report analyzes the non-ionizing radiation levels for an earth station antenna 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 entitled "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields" - first published in 1985 and revised in 1997 in Edition 97-01. Bulletin No. 65 specifies that there are two separate tiers of exposure limits that are dependent 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, below. The General Population/Uncontrolled MPE is a function of the transmit frequency and is for an exposure period of thirty (30) minutes or less. The MPE limits for persons in an Occupational/Controlled environment are shown in Table 2, below. The Occupational/Controlled MPE is a function of the transmit frequency and is for an exposure period of six (6) 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 the main reflector surface, and at the main reflector surface and to compare these levels to the specified MPE limits.

The results of this analysis are summarized in Table 3 on the last page of this analysis.

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)/1500
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)/300
1500-100,000	5.0

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

Location:	Location	
Latitude:	Various	°N
Longitude:	Various	°W
Operating Frequency:	30000	MHz
Wavelength (λ)	0.00999	meters
Antenna Diameter (D):	1.80	meters
Antenna Area (A):	2.54	$meters^2$
Transmit Antenna Gain:	52.3	dBi
Transmit Antenna Gain (G):	169824.4	numeric
Maximum 5° Off Axis Gain:	40.8	dBi
Maximum 5° Off Axis Gain ($G_{5°}$):	11951.6	numeric
Antenna Efficiency (η):	0.530	numeric
Feed Power (P):	150	Watts

1. Antenna/Main Reflector Surface Calculation

The power density in the main reflector region can be estimated by:

		Antenna Diameter	
		1.80	meters
Power Density at Reflector Surface,	$S_{surface}$ =	4P/A	
	$S_{surface}$ =	235.79	W/m^2
	$S_{surface}$ =	**23.58**	**mW/cm^2**

$S_{surface}$ = maximum power density at antenna surface
P = power fed to the antenna
A = physical area of the antenna

2. Near Field Calculations

In the near field region, of the main beam, the power density can reach a maximum before it begins to decrease with distance. The magnitude of the on axis (main beam) power density varies according to location in the near-field.

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

		Antenna Diameter	
		1.80	meters
Extent of Near Field,	R_{nf} =	$D^2/4(\lambda)$	
	R_{nf} =	**81.06**	**meters**

R_{nf} = extent of near field
D = maximum dimension of antenna (diameter if circular)
λ = wavelength

The maximum near-field, on-axis, power density is determined by:

		Antenna Diameter	
		1.80	meters
On Axis Near Field Power Density,	S_{nf} =	$16\eta P/\pi D^2$	
	S_{nf} =	125.05	W/m^2
	S_{nf} =	**12.50**	**mW/cm^2**

The maximum near-field, 5° off-axis, power density is determined by:

		Antenna Diameter	
		1.80	meters
Power Density at 5° Off Axis	$S_{nf\ 5°}$=	$(S_{nf}/G)*G_{5°}$	
	$S_{nf\ 5°}$=	**0.8800**	**mW/cm^2**

S_{nf}= maximum near-field power density
$S_{nf\ 5°}$ = maximum near-field power density (5° off axis)
η = aperture efficiency
P = power fed to antenna
D = maximum dimension of antenna (diameter if circular)

3. Far Field Calculations

The power density in the far-field region decreases inversely with the square of the distance.

The distance to the beginning of the far field region can be found by the following equation:

		Antenna Diameter	
		1.80	meters
Distance to the Far Field Region,	R_{ff} =	$0.6D^2/\lambda$	
	R_{ff} =	**194.53**	**meters**

R_{ff} = distance to beginning of far field
D = maximum dimension of antenna (diameter if circular)
λ = wavelength

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

		Antenna Diameter	
		1.80	meters
On-Axis Power Density in the Far Field,	S_{ff} =	$(P)(G)/4\pi(R_{ff})^2$	
	S_{ff} =	53.57	W/m^2
	S_{ff} =	**5.36**	**mW/cm^2**

The maximum far-field, 5° off-axis, power density is determined by:

		Antenna Diameter	
		1.80	meters
Power Density at 5° Off Axis	$S_{ff\ 5°}$=	$(S_{ff}/G)*G_{5°}$	
	$S_{ff\ 5°}$=	**0.3770**	**mW/cm^2**

S_{ff}= power density (on axis)
$Sff_{5°}$= power density (5° off axis)
P= power fed to antenna
G= power gain of antenna in the direction of interest relative to an isotropic radiator
R_{ff} = distance to beginning of far field

4. Transition Region Calculations

The transition region is located between the near and far field regions. The power density decreases inversely with distance in the transition region, while the power density decreases inversely with the *square* of the distance in the far-field region. The maximum power density in the transition region will not exceed that calculated for the near-field region. The power density in the near field region, as shown above will not exceed:

	Antenna Diameter	
	1.80	meters
S_t=	$(S_{nf}*R_{nf})/R$	
$S_{t\,5°}$ =	$(S_{nf\,5°}*R_{nf})/R$	
S_t=	**12.50**	**mW/cm²**
$S_{t\,5°}$ =	**0.8800**	**mW/cm²**

Table 3

Summary of Expected Radiation Levels

Region	Calculated Maximum Radiation Level (mW/cm²	Distance to Region (m)	Maximum Permissible Exposure (MPE) Occupational	General Population
1.8 m Earth Station Antenna				
1. Antenna Surface	$S_{surface}$= 23.58		Potential Hazard	Potential Hazard
2. Near Field	S_{nf}= 12.50	81.1	Potential Hazard	Potential Hazard
3. Far Field	S_{ff}= 5.36	194.5	Potential Hazard	Potential Hazard
4. Transition Region	S_t= 12.50		Potential Hazard	Potential Hazard
5. Near Field 5° Off Axis	$S_{nf\,5°}$= 0.8800		Satisfies MPE	Satisfies MPE
6. Far Field 5° Off Axis	$S_{ff\,5°}$= 0.38		Satisfies MPE	Satisfies MPE
7. Transition Region 5° Off Axis	$S_{t\,5°}$ = 0.8800		Satisfies MPE	Satisfies MPE

7. Conclusions

Based on the above analysis, it is concluded that the OET/FCC Radiofrequency Electromagnetic Fields guidelines for Maximum Permissible Exposure (MPE) have been exceeded in the region(s) specified in Table 3. However, it should be noted that General Population/Uncontrolled MPE limit is always satisfied at angles 5° off of boresight or greater for all antenna apertures. As these earth station antennas will never be operated with elevation angles of less than the minimum specified in 47 C.F.R. Ch. 1 §25.205 (namely 5°), then the MPE associated with the General Population/Uncontrolled limits will always be satisfied. GCI will post appropriate RF Radiation Hazard placards and other signage in the areas near these antennas and/or will restrict access to the antenna by means of fencing or other appropriate devices. Finally, access to the antenna surface, as well as the region between the feedhorn and the antenna surface will be restricted to qualified personnel and the transmitter will be disabled during maintenance activities in these areas to protect personnel from exposure.

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ANALYSIS OF NON-IONIZING RADIATION
FOR CPI MODEL C180FM ANTENNA (1.8Mb)
Completed 10/27/21

This report analyzes the non-ionizing radiation levels for an earth station antenna 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 entitled "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields" - first published in 1985 and revised in 1997 in Edition 97-01. Bulletin No. 65 specifies that there are two separate tiers of exposure limits that are dependent 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, below. The General Population/Uncontrolled MPE is a function of the transmit frequency and is for an exposure period of thirty (30) minutes or less. The MPE limits for persons in an Occupational/Controlled environment are shown in Table 2, below. The Occupational/Controlled MPE is a function of the transmit frequency and is for an exposure period of six (6) 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 the main reflector surface, and at the main reflector surface and to compare these levels to the specified MPE limits.

The results of this analysis are summarized in Table 3 on the last page of this analysis.

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)/1500
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)/300
1500-100,000	5.0

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

Location:	Location	
Latitude:	Various	°N
Longitude:	Various	°W
Operating Frequency:	30000	MHz
Wavelength (λ)	0.00999	meters
Antenna Diameter (D):	1.80	meters
Antenna Area (A):	2.54	$meters^2$
Transmit Antenna Gain:	52.4	dBi
Transmit Antenna Gain (G):	173780.1	numeric
Maximum 5° Off Axis Gain:	40.9	dBi
Maximum 5° Off Axis Gain ($G_{5°}$):	12230.0	numeric
Antenna Efficiency (η):	0.543	numeric
Feed Power (P):	150	Watts

1. Antenna/Main Reflector Surface Calculation

The power density in the main reflector region can be estimated by:

		Antenna Diameter	
		1.80	meters
Power Density at Reflector Surface,	$S_{surface}$ =	4P/A	
	$S_{surface}$ =	235.79	W/m^2
	$S_{surface}$ =	**23.58**	**mW/cm^2**

$S_{surface}$ = maximum power density at antenna surface
P = power fed to the antenna
A = physical area of the antenna

2. Near Field Calculations

In the near field region, of the main beam, the power density can reach a maximum before it begins to decrease with distance.
The magnitude of the on axis (main beam) power density varies according to location in the near-field.

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

		Antenna Diameter	
		1.80	meters
Extent of Near Field,	R_{nf} =	$D^2/4(\lambda)$	
	R_{nf} =	**81.06**	**meters**

R_{nf} = extent of near field
D = maximum dimension of antenna (diameter if circular)
λ = wavelength

The maximum near-field, on-axis, power density is determined by:

		Antenna Diameter	
		1.80	meters
On Axis Near Field Power Density,	S_{nf} =	$16\eta P/\pi D^2$	
	S_{nf} =	127.96	W/m^2
	S_{nf} =	**12.80**	**mW/cm^2**

The maximum near-field, 5° off-axis, power density is determined by:

		Antenna Diameter	
		1.80	meters
Power Density at 5° Off Axis	$S_{nf\,5°}$=	$(S_{nf}/G)*G_{5°}$	
	$S_{nf\,5°}$=	**0.9005**	**mW/cm^2**

S_{nf}= maximum near-field power density
$S_{nf\,5°}$ = maximum near-field power density (5° off axis)
η = aperture efficiency
P = power fed to antenna
D = maximum dimension of antenna (diameter if circular)

3. Far Field Calculations

The power density in the far-field region decreases inversely with the square of the distance.

The distance to the beginning of the far field region can be found by the following equation:

		Antenna Diameter	
		1.80	meters
Distance to the Far Field Region,	R_{ff} =	$0.6D^2/\lambda$	
	R_{ff} =	**194.53**	**meters**

R_{ff} = distance to beginning of far field
D = maximum dimension of antenna (diameter if circular)
λ = wavelength

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

		Antenna Diameter	
		1.80	meters
On-Axis Power Density in the Far Field,	S_{ff} =	$(P)(G)/4\pi(R_{ff})^2$	
	S_{ff} =	54.81	W/m^2
	S_{ff} =	**5.48**	**mW/cm^2**

The maximum far-field, 5° off-axis, power density is determined by:

		Antenna Diameter	
		1.80	meters
Power Density at 5° Off Axis	$S_{ff\,5°}$=	$(S_{ff}/G)*G_{5°}$	
	$S_{ff\,5°}$=	**0.3858**	**mW/cm^2**

S_{ff}= power density (on axis)
$Sff_{5°}$= power density (5° off axis)
P= power fed to antenna
G= power gain of antenna in the direction of interest relative to an isotropic radiator
R_{ff} = distance to beginning of far field

4. Transition Region Calculations

The transition region is located between the near and far field regions. The power density decreases inversely with distance in the transition region, while the power density decreases inversely with the *square* of the distance in the far-field region. The maximum power density in the transition region will not exceed that calculated for the near-field region. The power density in the near field region, as shown above will not exceed:

	Antenna Diameter	
	1.80	meters
S_t=	$(S_{nf}*R_{nf})/R$	
$S_{t\,5°}$ =	$(S_{nf\,5°}*R_{nf})/R$	
S_t=	**12.80**	**mW/cm²**
$S_{t\,5°}$ =	**0.9005**	**mW/cm²**

Table 3

Summary of Expected Radiation Levels

Region	Calculated Maximum Radiation Level (mW/cm²	Distance to Region (m)	Maximum Permissible Exposure (MPE) Occupational	General Population
1.8 m Earth Station Antenna				
1. Antenna Surface	$S_{surface}$= 23.58		Potential Hazard	Potential Hazard
2. Near Field	S_{nf}= 12.80	81.1	Potential Hazard	Potential Hazard
3. Far Field	S_{ff}= 5.48	194.5	Potential Hazard	Potential Hazard
4. Transition Region	S_t= 12.80		Potential Hazard	Potential Hazard
5. Near Field 5° Off Axis	$S_{nf\,5°}$= 0.9005		Satisfies MPE	Satisfies MPE
6. Far Field 5° Off Axis	$S_{ff\,5°}$= 0.39		Satisfies MPE	Satisfies MPE
7. Transition Region 5° Off Axis	$S_{t\,5°}$ = 0.9005		Satisfies MPE	Satisfies MPE

7. Conclusions

Based on the above analysis, it is concluded that the OET/FCC Radiofrequency Electromagnetic Fields guidelines for Maximum Permissible Exposure (MPE) have been exceeded in the region(s) specified in Table 3. However, it should be noted that General Population/Uncontrolled MPE limit is always satisfied at angles 5° off of boresight or greater for all antenna apertures. As these earth station antennas will never be operated with elevation angles of less than the minimum specified in 47 C.F.R. Ch. 1 §25.205 (namely 5°), then the MPE associated with the General Population/Uncontrolled limits will always be satisfied. GCI will post appropriate RF Radiation Hazard placards and other signage in the areas near these antennas and/or will restrict access to the antenna by means of fencing or other appropriate devices. Finally, access to the antenna surface, as well as the region between the feedhorn and the antenna surface will be restricted to qualified personnel and the transmitter will be disabled during maintenance activities in these areas to protect personnel from exposure.

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11/10/2021

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ANALYSIS OF NON-IONIZING RADIATION
FOR GLOBAL SKYWARE MODEL 1815 ANTENNA (1.8Mc)
Completed 10/27/21

This report analyzes the non-ionizing radiation levels for an earth station antenna 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 entitled "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields" - first published in 1985 and revised in 1997 in Edition 97-01. Bulletin No. 65 specifies that there are two separate tiers of exposure limits that are dependent 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, below. The General Population/Uncontrolled MPE is a function of the transmit frequency and is for an exposure period of thirty (30) minutes or less. The MPE limits for persons in an Occupational/Controlled environment are shown in Table 2, below. The Occupational/Controlled MPE is a function of the transmit frequency and is for an exposure period of six (6) 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 the main reflector surface, and at the main reflector surface and to compare these levels to the specified MPE limits.

The results of this analysis are summarized in Table 3 on the last page of this analysis.

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)/1500
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)/300
1500-100,000	5.0

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

Location:	Location	
Latitude:	Various	°N
Longitude:	Various	°W
Operating Frequency:	30000	MHz
Wavelength (λ)	0.00999	meters
Antenna Diameter (D):	1.80	meters
Antenna Area (A):	2.54	$meters^2$
Transmit Antenna Gain:	52.5	dBi
Transmit Antenna Gain (G):	177827.9	numeric
Maximum 5° Off Axis Gain:	41.0	dBi
Maximum 5° Off Axis Gain ($G_{5°}$):	12514.8	numeric
Antenna Efficiency (η):	0.555	numeric
Feed Power (P):	150	Watts

1. Antenna/Main Reflector Surface Calculation

The power density in the main reflector region can be estimated by:

		Antenna Diameter	
		1.80	meters
Power Density at Reflector Surface,	$S_{surface}$ =	4P/A	
	$S_{surface}$ =	235.79	W/m^2
	$S_{surface}$ =	**23.58**	**mW/cm^2**

$S_{surface}$ = maximum power density at antenna surface
P = power fed to the antenna
A = physical area of the antenna

2. Near Field Calculations

In the near field region, of the main beam, the power density can reach a maximum before it begins to decrease with distance. The magnitude of the on axis (main beam) power density varies according to location in the near-field.

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

		Antenna Diameter	
		1.80	meters
Extent of Near Field,	R_{nf} =	$D^2/4(\lambda)$	
	R_{nf} =	**81.06**	**meters**

R_{nf} = extent of near field
D = maximum dimension of antenna (diameter if circular)
λ = wavelength

The maximum near-field, on-axis, power density is determined by:

		Antenna Diameter	
		1.80	meters
On Axis Near Field Power Density,	S_{nf} =	$16\eta P/\pi D^2$	
	S_{nf} =	130.94	W/m^2
	S_{nf} =	**13.09**	**mW/cm^2**

The maximum near-field, 5° off-axis, power density is determined by:

		Antenna Diameter	
		1.80	meters
Power Density at 5° Off Axis	$S_{nf\ 5°}$=	$(S_{nf}/G)*G_{5°}$	
	$S_{nf\ 5°}$=	**0.9215**	**mW/cm^2**

S_{nf}= maximum near-field power density
$S_{nf\ 5°}$ = maximum near-field power density (5° off axis)
η = aperture efficiency
P = power fed to antenna
D = maximum dimension of antenna (diameter if circular)

3. Far Field Calculations

The power density in the far-field region decreases inversely with the square of the distance.

The distance to the beginning of the far field region can be found by the following equation:

		Antenna Diameter	
		1.80	meters
Distance to the Far Field Region,	R_{ff} =	$0.6D^2/\lambda$	
	R_{ff} =	**194.53**	**meters**

R_{ff} = distance to beginning of far field
D = maximum dimension of antenna (diameter if circular)
λ = wavelength

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

		Antenna Diameter	
		1.80	meters
On-Axis Power Density in the Far Field,	S_{ff} =	$(P)(G)/4\pi(R_{ff})^2$	
	S_{ff} =	56.09	W/m^2
	S_{ff} =	**5.61**	**mW/cm^2**

The maximum far-field, 5° off-axis, power density is determined by:

		Antenna Diameter	
		1.80	meters
Power Density at 5° Off Axis	$S_{ff\ 5°}$=	$(S_{ff}/G)*G_{5°}$	
	$S_{ff\ 5°}$=	**0.3947**	**mW/cm^2**

S_{ff}= power density (on axis)
$Sff_{5°}$= power density (5° off axis)
P= power fed to antenna
G= power gain of antenna in the direction of interest relative to an isotropic radiator
R_{ff} = distance to beginning of far field

4. Transition Region Calculations

The transition region is located between the near and far field regions. The power density decreases inversely with distance in the transition region, while the power density decreases inversely with the *square* of the distance in the far-field region. The maximum power density in the transition region will not exceed that calculated for the near-field region. The power density in the near field region, as shown above will not exceed:

	Antenna Diameter	
	1.80	meters
S_t=	$(S_{nf}*R_{nf})/R$	
$S_{t\,5°}$ =	$(S_{nf\,5°}*R_{nf})/R$	
S_t=	**13.09**	**mW/cm²**
$S_{t\,5°}$ =	**0.9215**	**mW/cm²**

Table 3

Summary of Expected Radiation Levels

Region	Calculated Maximum Radiation Level (mW/cm²)	Distance to Region (m)	Maximum Permissible Exposure (MPE) Occupational	General Population
1.8 m Earth Station Antenna				
1. Antenna Surface	$S_{surface}$= 23.58		Potential Hazard	Potential Hazard
2. Near Field	S_{nf}= 13.09	81.1	Potential Hazard	Potential Hazard
3. Far Field	S_{ff}= 5.61	194.5	Potential Hazard	Potential Hazard
4. Transition Region	S_t= 13.09		Potential Hazard	Potential Hazard
5. Near Field 5° Off Axis	$S_{nf\,5°}$= 0.9215		Satisfies MPE	Satisfies MPE
6. Far Field 5° Off Axis	$S_{ff\,5°}$= 0.39		Satisfies MPE	Satisfies MPE
7. Transition Region 5° Off Axis	$S_{t\,5°}$ = 0.9215		Satisfies MPE	Satisfies MPE

7. Conclusions

Based on the above analysis, it is concluded that the OET/FCC Radiofrequency Electromagnetic Fields guidelines for Maximum Permissible Exposure (MPE) have been exceeded in the region(s) specified in Table 3. However, it should be noted that General Population/Uncontrolled MPE limit is always satisfied at angles 5° off of boresight or greater for all antenna apertures. As these earth station antennas will never be operated with elevation angles of less than the minimum specified in 47 C.F.R. Ch. 1 §25.205 (namely 5°), then the MPE associated with the General Population/Uncontrolled limits will always be satisfied. GCI will post appropriate RF Radiation Hazard placards and other signage in the areas near these antennas and/or will restrict access to the antenna by means of fencing or other appropriate devices. Finally, access to the antenna surface, as well as the region between the feedhorn and the antenna surface will be restricted to qualified personnel and the transmitter will be disabled during maintenance activities in these areas to protect personnel from exposure.

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ANALYSIS OF NON-IONIZING RADIATION
FOR CPI MODEL 3244 ANTENNA (1.8Ma)
Completed 10/27/21

This report analyzes the non-ionizing radiation levels for an earth station antenna 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 entitled "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields" - first published in 1985 and revised in 1997 in Edition 97-01. Bulletin No. 65 specifies that there are two separate tiers of exposure limits that are dependent 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, below. The General Population/Uncontrolled MPE is a function of the transmit frequency and is for an exposure period of thirty (30) minutes or less. The MPE limits for persons in an Occupational/Controlled environment are shown in Table 2, below. The Occupational/Controlled MPE is a function of the transmit frequency and is for an exposure period of six (6) 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 the main reflector surface, and at the main reflector surface and to compare these levels to the specified MPE limits.

The results of this analysis are summarized in Table 3 on the last page of this analysis.

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)/1500
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)/300
1500-100,000	5.0

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

Location:	Location	
Latitude:	Various	°N
Longitude:	Various	°W
Operating Frequency:	30000	MHz
Wavelength (λ)	0.00999	meters
Antenna Diameter (D):	2.40	meters
Antenna Area (A):	4.52	$meters^2$
Transmit Antenna Gain:	54.3	dBi
Transmit Antenna Gain (G):	269153.5	numeric
Maximum 5° Off Axis Gain:	42.8	dBi
Maximum 5° Off Axis Gain ($G_{5°}$):	18942.0	numeric
Antenna Efficiency (η):	0.473	numeric
Feed Power (P):	300	Watts

1. Antenna/Main Reflector Surface Calculation

The power density in the main reflector region can be estimated by:

		Antenna Diameter	
		2.40	meters
Power Density at Reflector Surface,	$S_{surface}$ =	4P/A	
	$S_{surface}$ =	265.26	W/m^2
	$S_{surface}$ =	**26.53**	**mW/cm^2**

$S_{surface}$ = maximum power density at antenna surface
P = power fed to the antenna
A = physical area of the antenna

2. Near Field Calculations

In the near field region, of the main beam, the power density can reach a maximum before it begins to decrease with distance. The magnitude of the on axis (main beam) power density varies according to location in the near-field.

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

		Antenna Diameter	
		2.40	meters
Extent of Near Field,	R_{nf} =	$D^2/4(\lambda)$	
	R_{nf} =	**144.10**	**meters**

R_{nf} = extent of near field
D = maximum dimension of antenna (diameter if circular)
λ = wavelength

The maximum near-field, on-axis, power density is determined by:

		Antenna Diameter	
		2.40	meters
On Axis Near Field Power Density,	S_{nf} =	$16\eta P/\pi D^2$	
	S_{nf} =	125.41	W/m^2
	S_{nf} =	**12.54**	**mW/cm^2**

The maximum near-field, 5° off-axis, power density is determined by:

		Antenna Diameter	
		2.40	meters
Power Density at 5° Off Axis	$S_{nf\,5°}$=	$(S_{nf}/G)*G_{5°}$	
	$S_{nf\,5°}$=	**0.8826**	**mW/cm^2**

S_{nf}= maximum near-field power density
$S_{nf\,5°}$ = maximum near-field power density (5° off axis)
η = aperture efficiency
P = power fed to antenna
D = maximum dimension of antenna (diameter if circular)

3. Far Field Calculations

The power density in the far-field region decreases inversely with the square of the distance.

The distance to the beginning of the far field region can be found by the following equation:

		Antenna Diameter	
		2.40	meters
Distance to the Far Field Region,	R_{ff} =	$0.6D^2/\lambda$	
	R_{ff} =	**345.84**	**meters**

R_{ff} = distance to beginning of far field
D = maximum dimension of antenna (diameter if circular)
λ = wavelength

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

		Antenna Diameter	
		2.40	meters
On-Axis Power Density in the Far Field,	S_{ff} =	$(P)(G)/4\pi(R_{ff})^2$	
	S_{ff} =	53.72	W/m^2
	S_{ff} =	**5.37**	**mW/cm^2**

The maximum far-field, 5° off-axis, power density is determined by:

		Antenna Diameter	
		2.40	meters
Power Density at 5° Off Axis	$S_{ff\,5°}$=	$(S_{ff}/G)*G_{5°}$	
	$S_{ff\,5°}$=	**0.3781**	**mW/cm^2**

S_{ff}= power density (on axis)
$Sff_{5°}$= power density (5° off axis)
P= power fed to antenna
G= power gain of antenna in the direction of interest relative to an isotropic radiator
R_{ff} = distance to beginning of far field

4. Transition Region Calculations

The transition region is located between the near and far field regions. The power density decreases inversely with distance in the transition region, while the power density decreases inversely with the *square* of the distance in the far-field region. The maximum power density in the transition region will not exceed that calculated for the near-field region. The power density in the near field region, as shown above will not exceed:

	Antenna Diameter	
	2.40	meters
S_t=	$(S_{nf}*R_{nf})/R$	
$S_{t\,5°}$ =	$(S_{nf\,5°}*R_{nf})/R$	
S_t=	**12.54**	**mW/cm²**
$S_{t\,5°}$ =	**0.8826**	**mW/cm²**

Table 3

Summary of Expected Radiation Levels

Region	Calculated Maximum Radiation Level (mW/cm²	Distance to Region (m)	Maximum Permissible Exposure (MPE) Occupational	General Population
2.4 m Earth Station Antenna				
1. Antenna Surface	$S_{surface}$= 26.53		Potential Hazard	Potential Hazard
2. Near Field	S_{nf}= 12.54	144.1	Potential Hazard	Potential Hazard
3. Far Field	S_{ff}= 5.37	345.8	Potential Hazard	Potential Hazard
4. Transition Region	S_t= 12.54		Potential Hazard	Potential Hazard
5. Near Field 5° Off Axis	$S_{nf\,5°}$= 0.8826		Satisfies MPE	Satisfies MPE
6. Far Field 5° Off Axis	$S_{ff\,5°}$= 0.38		Satisfies MPE	Satisfies MPE
7. Transition Region 5° Off Axis	$S_{t\,5°}$ = 0.8826		Satisfies MPE	Satisfies MPE

7. Conclusions

Based on the above analysis, it is concluded that the OET/FCC Radiofrequency Electromagnetic Fields guidelines for Maximum Permissible Exposure (MPE) have been exceeded in the region(s) specified in Table 3. However, it should be noted that General Population/Uncontrolled MPE limit is always satisfied at angles 5° off of boresight or greater for all antenna apertures. As these earth station antennas will never be operated with elevation angles of less than the minimum specified in 47 C.F.R. Ch. 1 §25.205 (namely 5°), then the MPE associated with the General Population/Uncontrolled limits will always be satisfied. GCI will post appropriate RF Radiation Hazard placards and other signage in the areas near these antennas and/or will restrict access to the antenna by means of fencing or other appropriate devices. Finally, access to the antenna surface, as well as the region between the feedhorn and the antenna surface will be restricted to qualified personnel and the transmitter will be disabled during maintenance activities in these areas to protect personnel from exposure.

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ANALYSIS OF NON-IONIZING RADIATION
FOR GLOBAL SKYWARE MODEL 2415 ANTENNA (2.4Mb)
Completed 10/27/21

This report analyzes the non-ionizing radiation levels for an earth station antenna 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 entitled "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields" - first published in 1985 and revised in 1997 in Edition 97-01. Bulletin No. 65 specifies that there are two separate tiers of exposure limits that are dependent 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, below. The General Population/Uncontrolled MPE is a function of the transmit frequency and is for an exposure period of thirty (30) minutes or less. The MPE limits for persons in an Occupational/Controlled environment are shown in Table 2, below. The Occupational/Controlled MPE is a function of the transmit frequency and is for an exposure period of six (6) 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 the main reflector surface, and at the main reflector surface and to compare these levels to the specified MPE limits.

The results of this analysis are summarized in Table 3 on the last page of this analysis.

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)/1500
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)/300
1500-100,000	5.0

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

Location:	Location	
Latitude:	Various	°N
Longitude:	Various	°W
Operating Frequency:	30000	MHz
Wavelength (λ)	0.00999	meters
Antenna Diameter (D):	2.40	meters
Antenna Area (A):	4.52	$meters^2$
Transmit Antenna Gain:	54.5	dBi
Transmit Antenna Gain (G):	281838.3	numeric
Maximum 5° Off Axis Gain:	43.0	dBi
Maximum 5° Off Axis Gain ($G_{5°}$):	19834.7	numeric
Antenna Efficiency (η):	0.495	numeric
Feed Power (P):	300	Watts

1. Antenna/Main Reflector Surface Calculation

The power density in the main reflector region can be estimated by:

		Antenna Diameter	
		2.40	meters
Power Density at Reflector Surface,	$S_{surface}$ =	4P/A	
	$S_{surface}$ =	265.26	W/m^2
	$S_{surface}$ =	**26.53**	**mW/cm^2**

$S_{surface}$ = maximum power density at antenna surface
P = power fed to the antenna
A = physical area of the antenna

2. Near Field Calculations

In the near field region, of the main beam, the power density can reach a maximum before it begins to decrease with distance. The magnitude of the on axis (main beam) power density varies according to location in the near-field.

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

		Antenna Diameter	
		2.40	meters
Extent of Near Field,	R_{nf} =	$D^2/4(\lambda)$	
	R_{nf} =	**144.10**	**meters**

R_{nf} = extent of near field
D = maximum dimension of antenna (diameter if circular)
λ = wavelength

The maximum near-field, on-axis, power density is determined by:

		Antenna Diameter	
		2.40	meters
On Axis Near Field Power Density,	S_{nf} =	$16\eta P/\pi D^2$	
	S_{nf} =	131.32	W/m^2
	S_{nf} =	**13.13**	**mW/cm^2**

The maximum near-field, 5° off-axis, power density is determined by:

		Antenna Diameter	
		2.40	meters
Power Density at 5° Off Axis	$S_{nf\,5°}$=	$(S_{nf}/G)*G_{5°}$	
	$S_{nf\,5°}$=	**0.9242**	**mW/cm^2**

S_{nf}= maximum near-field power density
$S_{nf\,5°}$ = maximum near-field power density (5° off axis)
η = aperture efficiency
P = power fed to antenna
D = maximum dimension of antenna (diameter if circular)

3. Far Field Calculations

The power density in the far-field region decreases inversely with the square of the distance.

The distance to the beginning of the far field region can be found by the following equation:

		Antenna Diameter	
		2.40	meters
Distance to the Far Field Region,	R_{ff} =	$0.6D^2/\lambda$	
	R_{ff} =	**345.84**	**meters**

R_{ff} = distance to beginning of far field
D = maximum dimension of antenna (diameter if circular)
λ = wavelength

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

		Antenna Diameter	
		2.40	meters
On-Axis Power Density in the Far Field,	S_{ff} =	$(P)(G)/4\pi(R_{ff})^2$	
	S_{ff} =	56.26	W/m^2
	S_{ff} =	**5.63**	**mW/cm^2**

The maximum far-field, 5° off-axis, power density is determined by:

		Antenna Diameter	
		2.40	meters
Power Density at 5° Off Axis	$S_{ff\,5°}$=	$(S_{ff}/G)*G_{5°}$	
	$S_{ff\,5°}$=	**0.3959**	**mW/cm^2**

S_{ff}= power density (on axis)
$Sff_{5°}$= power density (5° off axis)
P= power fed to antenna
G= power gain of antenna in the direction of interest relative to an isotropic radiator
R_{ff} = distance to beginning of far field

4. Transition Region Calculations

The transition region is located between the near and far field regions. The power density decreases inversely with distance in the transition region, while the power density decreases inversely with the *square* of the distance in the far-field region. The maximum power density in the transition region will not exceed that calculated for the near-field region. The power density in the near field region, as shown above will not exceed:

	Antenna Diameter	
	2.40	meters
S_t=	$(S_{nf}*R_{nf})/R$	
$S_{t\,5°}$ =	$(S_{nf\,5°}*R_{nf})/R$	
S_t=	**13.13**	**mW/cm²**
$S_{t\,5°}$ =	**0.9242**	**mW/cm²**

Table 3

Summary of Expected Radiation Levels

Region	Calculated Maximum Radiation Level (mW/cm²	Distance to Region (m)	Maximum Permissible Exposure (MPE) Occupational	General Population
2.4 m Earth Station Antenna				
1. Antenna Surface	$S_{surface}$= 26.53		Potential Hazard	Potential Hazard
2. Near Field	S_{nf}= 13.13	144.1	Potential Hazard	Potential Hazard
3. Far Field	S_{ff}= 5.63	345.8	Potential Hazard	Potential Hazard
4. Transition Region	S_t= 13.13		Potential Hazard	Potential Hazard
5. Near Field 5° Off Axis	$S_{nf\,5°}$= 0.9242		Satisfies MPE	Satisfies MPE
6. Far Field 5° Off Axis	$S_{ff\,5°}$= 0.40		Satisfies MPE	Satisfies MPE
7. Transition Region 5° Off Axis	$S_{t\,5°}$ = 0.9242		Satisfies MPE	Satisfies MPE

7. Conclusions

Based on the above analysis, it is concluded that the OET/FCC Radiofrequency Electromagnetic Fields guidelines for Maximum Permissible Exposure (MPE) have been exceeded in the region(s) specified in Table 3. However, it should be noted that General Population/Uncontrolled MPE limit is always satisfied at angles 5° off of boresight or greater for all antenna apertures. As these earth station antennas will never be operated with elevation angles of less than the minimum specified in 47 C.F.R. Ch. 1 §25.205 (namely 5°), then the MPE associated with the General Population/Uncontrolled limits will always be satisfied. GCI will post appropriate RF Radiation Hazard placards and other signage in the areas near these antennas and/or will restrict access to the antenna by means of fencing or other appropriate devices. Finally, access to the antenna surface, as well as the region between the feedhorn and the antenna surface will be restricted to qualified personnel and the transmitter will be disabled during maintenance activities in these areas to protect personnel from exposure.

DocuSigned by:
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11/10/2021

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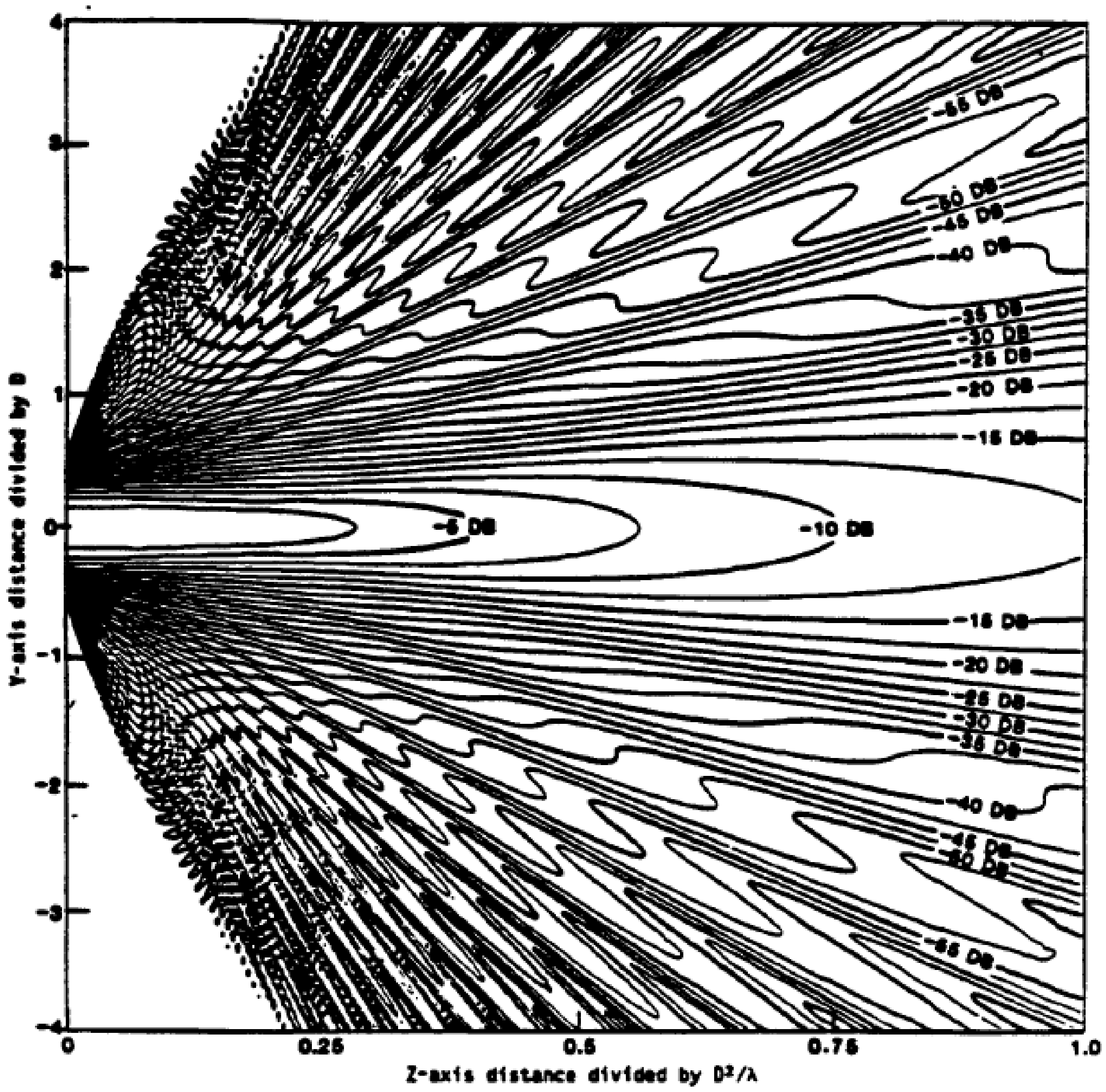

Figure 14. Relative Power Density Contours for a Circular Aperture Antenna. Contours are Shown in the y-z Plane for the Case $D \geq 30\lambda$, where $-4D \leq y \leq 4D$ and $0 \leq z \leq D^2/\lambda$. The Aperture Illumination is $[1-(\rho/a)^2]^2$, where ρ is the Radial Distance Variable, $0 \leq \rho \leq a$, and $a = D/2$. Each Contour Corresponds to an Increment of -2.5dB.