FCC 312

Schedule B

Page 1: Location

FEDERAL COMMUNICATIONS COMMISSION

APPLICATION FOR SATELLITE SPACE AND EARTH STATION AUTHORIZATIONS

Technical and Operational Description)

(Place an "X" in one of the blocks below)

STA Request

B1. Location of Earth Station Site. If temporary-fixed, mobile, or VSAT remote facility, specify area of operation and point of contact. If VSAT hub station, give its location For VSAT networks attach individual Schedule B, Page 1 sheets for each hub station and each remote station. Individually provide the Location, Points of Communications, and Destination Points for each hub and remote station.

B1a. Station Call Sign	B1b. Site identifier (HUB, REMOTE1, etc.)	B1c. Telephone Number	B1j. Geographic Coordinates N/S, Deg. - Min. - Sec. - E/W	B1k. Lat./Lon. Coordinates are:
E030115		(917)-750-5358	Lat. 21° - 20' - 8.9" N. Lon. 158° - 05' - 17.8" W.	☐ NAD-27 ☒ NAD-83
B1d. Mailing Street Address of Station or Area of Operation: 91-340 Farrington Highway		B1e. Name of Contact Person: Leeana A. Smith-Ryland		

B1f. City	B1g. County	B1h. State	B1i. Zip Code	B1l. Site Elevation (AMSL)
Kapolei	Honolulu	HI	96707	36.58

B2. Points of Communications: List the names and orbit locations of all satellites with which this earth station will communicate. The entry "ALSAT" is sufficient to identify the names and locations of all satellite facilities licensed by the U.S. All non-U.S. licensed satellites must be listed individually.

Satellite Name and Orbit Location	Satellite Name and Orbit Location	Satellite Name and Orbit Location
Eutelsat 172B at 176º E.L. for IOT testing		

B3. Destination points for communications using non-U.S. licensed satellites. For each non-U.S. licensed satellite facility identified in section B2 above, specify the destination point(s) (countries) where the services will be provided by this earth station via each non-U.S. license satellite system. Use additional sheets as needed.

Satellite Name	List of Destination Points
Eutelsat 176 E IOT testing	

B4. Earth Station Antenna Facilities: Use additional pages as needed.

(a) Site ID*	(b) Antenna ID**	(c) Quantity	(d) Manufacturer	(e) Model	(f) Antenna Size (meters)	(g) Antenna Gain Transmit and/or Receive (_____dBi at_____GHz)
4.5M		1	Andrew Corp	ESA45	4.5M	44.0 dBi @ 4 GHz
						47.1 dBi @ 6 GHz
4.8M		1	Vertex	KPK	4.8M	53.0 dBi @12 GHz
						55.0 dBi @ 14.25 GHz

B5. Antenna Heights and Maximum Power Limits: (The corresponding Antenna ID in tables B4 and B5 applies to the same antenna)

(a) Antenna ID**	(b) Antenna Structure Registration No.	Maximum Antenna Height		(e) Building Height Above Ground Level (meters)***	(f) Maximum Antenna Height Above Rooftop (meters)***	(g) Total Input Power at antenna flange (Watts)	(h) Total EIRP for all carriers (dBW)
		(c) Above Ground Level (meters)	(d) Above Mean Sea Level (meters)				
4.5M		5.0	41.58	N/A	N/A	180	69.65
4.8M		5.8	42.4	N/A	N/A	180	77.55

B6. Frequency Coordination Limits: Use additional pages as needed.

(a) Antenna ID*	(b) Frequency Limits (MHz)	(c) Range of Satellite Arc Eastern Limit**	(d) Range of Satellite Arc Western Limit**	(e) Antenna Elevation Angle Eastern Limit	(f) Antenna Elevation Angle Western Limit	(g) Earth Station Azimuth Angle Eastern Limit	(h) Earth Station Azimuth Angle Western Limit	(i) Maximum EIRP Density toward the Horizon (dBW/4kHz)
4.5M	3700.00 – 4200.00	176.0°E.L.	176.0° E.L.	51.5°	51.5°	233.2°	233.2°	
4.5M	5925.00 – 6425.00	176.0°E.L.	176.0° W.L.	51.5°	51.5°	233.2°	233.2°	-20.3
4.8M	12200.00 – 12700.00	176.0°E.L.	176.0° E.L.	51.5°	51.5°	233.2°	233.2°	
4.8M	14000.00 – 14500.00	176.0°E.L.	176.0° W.L.	51.5°	51.5°	233.2°	233.2°	-20.3

(a) Antenna ID*	(b) Frequency Limits (MHz)	(c) T/R Mode **	(d) Antenna Polarization (H,V,L,R)	(e) Emission Designator	(f) Maximum EIRP per Carrier (dBW)	(g) Maximum EIRP Density per Carrier (dBW/4kHz)	(h) Description of Modulation and Services
4.5M	3700.00 – 4200.00	R	H,V	36M0G7W			Digital Data, Various FEC, Various Mod., Various Information
4.5M	3700.00 – 4200.00	R	H,V	72M0G7W			Digital Data, Various FEC, Various Mod., Various Information
4.5M	5925.00 – 6425.00	T	H,V	36M0G7W	66.64	27.1	Digital Data, Various FEC, Various Mod., Various Information
4.5M	5925.00 – 6425.00	T	H,V	72M0G7W	69.65	27.1	Digital Data, Various FEC, Various Mod., Various Information
4.8M	12200.00 – 12700.00	R	H,V	36M0G7W			Digital Data, Various FEC, Various Mod., Various Information
4.8M	12200.00 – 12700.00	R	H,V	72M0G7W			Digital Data, Various FEC, Various Mod., Various Information
4.8M	14000.00 – 14500.00	T	H,V	36M0G7W	74.54	35.0	Digital Data, Various FEC, Various Mod., Various Information
4.8M	14000.00 – 14500.00	T	H,V	72M0G7W	77.55	35.0	Digital Data, Various FEC, Various Mod., Various Information

B8. If the proposed antenna(s) operate in the Fixed Satellite Service (FSS) with **geostationary** satellites, do(es) the proposed antenna(s) comply with the antenna gain patterns specified in Section 25.209(a) and (b) as demonstrated by the manufacturer's qualification measurements? If NO, provide as an exhibit, a technical analysis showing compliance with two-degree spacing policy.

☒ **YES** ☐ **NO**

B9. If the proposed antenna(s) do not operate in the Fixed Satellite Service (FSS), or if they operate in the Fixed Satellite Service (FSS) with **non-geostationary** satellites, do(es) the proposed antenna(s) comply with the antenna gain patterns specified in Section 25.209(a2) and (b) as demonstrated by the manufacturer's qualification measurement?

☐ **YES** N/A ☐ **NO**

B10. Is the facility operated by remote control? If YES, provide the location and telephone number of the control point.

☐ **YES** ☒ **NO**

Remote Control Point Location:

B10a. Street Address			
B10b. City	B10c. County	B10.d. State/Country	B10e. Zip Code
B10f. Telephone Number	B10g. Call Sign of Control Station (if appropriate)		

B11. Is frequency coordination required? If YES, attach a frequency coordination report as an exhibit.

☒ **YES** ☐ **NO**

B12. Is coordination with another country required? If YES, attach the name of the country(ies) and plot of coordination contours as an exhibit.

☐ **YES** ☒ **NO**

B13. FAA Notification - (See 47 CFR Part 17and 47 CFR Part 25.113(c))
Where FAA notification is required, have you attached a copy of a completed FCC Form 854 and/or the FAA's study regarding the potential hazard of the structure to aviation? EXISTING FACILITY FAILURE TO COMPLY WITH 47 CFR PARTS 17 AND 25 WILL RESULT IN THE RETURN OF THIS APPLICATION

☐ **YES** ☒ **NO**

FREQUENCY COORDINATION AND INTERFERENCE ANALYSIS REPORT

Prepared for
Hawaii Pacific Teleport, L.P.
KAPOLEI, HI
Satellite Earth Station

Prepared By:
COMSEARCH
19700 Janelia Farm Boulevard
Ashburn, VA 20147
August 31, 2017

TABLE OF CONTENTS

1. CONCLUSIONS

An interference study considering all existing, proposed and prior coordinated microwave facilities within the coordination contours of the proposed earth station demonstrates that this site will operate satisfactorily with the common carrier microwave environment. Further, there will be no restrictions of its operation due to interference considerations.

2. SUMMARY OF RESULTS

A number of great circle interference cases were identified during the interference study of the proposed earth station. Each of the cases, which exceeded the interference objective on a line-of-sight basis, was profiled and the propagation losses estimated using NBS TN101 (Revised) techniques. The losses were found to be sufficient to reduce the signal levels to acceptable magnitudes in every case.

The following companies reported potential great circle interference conflicts that did not meet the objectives on a line-of-sight basis. When over-the-horizon losses are considered on the interfering paths, sufficient blockage exists to negate harmful interference from occurring with the proposed transmit-receive earth station.

Company
Hawaii State

No other carriers reported potential interference cases.

3. SUPPLEMENTAL SHOWING

Pursuant to Part 25.203(c) of the FCC Rules and Regulations, the satellite earth station proposed in this application was coordinated by Comsearch using computer techniques and in accordance with Part 25 of the FCC Rules and Regulations.

A temporary earth station coordination was conducted with the below listed carriers. Revised data was forwarded on 08/31/2017.

Company
AT&T Corp.
Federal Communication Commission
Hawaii State
Hawaiian Electric Company, Inc
Hawaiian Telcom, Inc.
Honolulu City & County Dept of Info Tech
Maui, County of
NEXSTAR BROADCASTING, INC.
New Cingular Wireless PCS LLC - Hawaii
University of Hawaii

4. EARTH STATION COORDINATION DATA

This section presents the data pertinent to frequency coordination of the proposed earth station that was circulated to all carriers within its coordination contours.

COMSEARCH

Earth Station Data Sheet

19700 Janelia Farm Boulevard, Ashburn, VA 20147
(703)726-5500 http://www.comsearch.com

Date:	08/31/2017
Job Number:	170831COMSTC03

Administrative Information

Status	TEMPORARY (Operation from 10/01/2017 to 04/01/2018)
Call Sign	E030115
Licensee Name	Hawaii Pacific Teleport, L.P.

Site Information — KAPOLEI, HI

Latitude (NAD 83)	21° 20' 8.9" N
Longitude (NAD 83)	158° 5' 17.8" W
Climate Zone	A
Rain Zone	4
Ground Elevation (AMSL)	36.58 m / 120.0 ft

Link Information

Satellite Type	Geostationary
Mode	TR - Transmit-Receive
Modulation	Digital
Satellite Arc	184° W to 184° West Longitude same as 176° W to 1764° East Longitude
Azimuth Range	233.2° to 233.2°
Corresponding Elevation Angles	51.5° / 51.5°
Antenna Centerline (AGL)	3.0 m / 9.8 ft

Antenna Information

	Receive	Transmit
Manufacturer	Andrew Corp	Andrew Corp
Gain / Diameter	44.0 dBi / 4.5 m	47.1 dBi / 4.5 m
3-dB / 15-dB Beamwidth	0.80° / 1.60°	0.40° / 0.80°

		Transmit 36M0G7W	Transmit 72M0G7W
Max Available RF Power	(dBW/4 kHz)	-20.0	-20.0
	(dBW/MHz)	4.0	4.0
Maximum EIRP	(dBW/4 kHz)	27.1	27.1
	(dBW/MHz)	51.1	51.1
	(dBW)	66.64	69.65

		Receive		Transmit	
Interference Objectives:	Long Term	-156.0 dBW/MHz	20%	-154.0 dBW/4 kHz	20%
	Short Term	-146.0 dBW/MHz	0.01%	-131.0 dBW/4 kHz	0.0025%

Frequency Information

	Receive 4.0 GHz	Transmit 6.1 GHz
Emission / Frequency Range (MHz)	36M0G7W - 72M0G7W / 3700.0 - 4200.0	36M0G7W - 72M0G7W / 5925.0 - 6425.0
Max Great Circle Coordination Distance	285.3 km / 177.2 mi	117.1 km / 72.7 mi
Precipitation Scatter Contour Radius	100.0 km / 62.1 mi	100.0 km / 62.1 mi

COMSEARCH

Earth Station Data Sheet

19700 Janelia Farm Boulevard, Ashburn, VA 20147
(703)726-5500 http://www.comsearch.com

Coordination Values	**KAPOLEI, HI**			
Licensee Name	Hawaii Pacific Teleport, L.P.			
Latitude (NAD 83)	21° 20' 8.9" N			
Longitude (NAD 83)	158° 5' 17.8" W			
Ground Elevation (AMSL)	36.58 m / 120.0 ft			
Antenna Centerline (AGL)	3.0 m / 9.8 ft			
Antenna Mode	Receive 4.0 GHz		Transmit 6.1 GHz	
Interference Objectives: Long Term	-156.0 dBW/MHz	20%	-154.0 dBW/4 kHz	20%
Short Term	-146.0 dBW/MHz	0.01%	-131.0 dBW/4 kHz	0.0025%
Max Available RF Power			-20.0 (dBW/4 kHz)	

			Receive 4.0 GHz		Transmit 6.1 GHz	
Azimuth (°)	Horizon Elevation (°)	Antenna Discrimination (°)	Horizon Gain (dBi)	Coordination Distance (km)	Horizon Gain (dBi)	Coordination Distance (km)
0	9.64	116.51	-10.00	100.00	-10.00	100.00
5	9.59	119.75	-10.00	100.00	-10.00	100.00
10	10.66	123.48	-10.00	100.00	-10.00	100.00
15	10.24	126.22	-10.00	100.00	-10.00	100.00
20	10.74	129.34	-10.00	100.00	-10.00	100.00
25	11.24	132.27	-10.00	100.00	-10.00	100.00
30	11.57	134.82	-10.00	100.00	-10.00	100.00
35	11.13	136.36	-10.00	100.00	-10.00	100.00
40	11.22	137.96	-10.00	100.00	-10.00	100.00
45	9.95	137.79	-10.00	100.00	-10.00	100.00
50	9.28	137.67	-10.00	100.00	-10.00	100.00
55	8.75	137.21	-10.00	100.00	-10.00	100.00
60	7.56	135.63	-10.00	108.35	-10.00	100.00
65	6.87	134.14	-10.00	115.73	-10.00	100.00
70	5.81	131.95	-10.00	127.00	-10.00	100.00
75	4.94	129.65	-10.00	134.41	-10.00	100.00
80	0.00	123.74	-10.00	285.28	-10.00	117.07
85	0.00	121.92	-10.00	285.28	-10.00	117.07
90	0.30	120.09	-10.00	272.92	-10.00	109.07
95	0.00	117.63	-10.00	285.28	-10.00	117.07
100	0.00	115.20	-10.00	285.28	-10.00	117.07
105	0.00	112.62	-10.00	285.28	-10.00	117.07
110	0.00	109.91	-10.00	285.28	-10.00	117.07
115	0.00	107.09	-10.00	285.28	-10.00	117.07
120	0.00	104.17	-10.00	285.28	-10.00	117.07
125	0.00	101.19	-10.00	285.28	-10.00	117.07
130	0.00	98.15	-10.00	285.28	-10.00	117.07
135	0.00	95.07	-10.00	285.28	-10.00	117.07
140	0.00	91.97	-10.00	285.28	-10.00	117.07
145	0.00	88.86	-10.00	285.28	-10.00	117.07
150	0.00	85.75	-10.00	285.28	-10.00	117.07
155	0.00	82.67	-10.00	285.28	-10.00	117.07
160	0.00	79.62	-10.00	285.28	-10.00	117.07
165	0.00	76.62	-10.00	285.28	-10.00	117.07
170	0.00	73.69	-10.00	285.28	-10.00	117.07
175	0.00	70.84	-10.00	285.28	-10.00	117.07
180	0.00	68.09	-10.00	285.28	-10.00	117.07
185	0.00	65.48	-10.00	285.28	-10.00	117.07

COMSEARCH

Earth Station Data Sheet

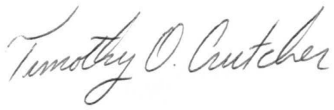
19700 Janelia Farm Boulevard, Ashburn, VA 20147
(703)726-5500 http://www.comsearch.com

Coordination Values	**KAPOLEI, HI**			
Licensee Name	Hawaii Pacific Teleport, L.P.			
Latitude (NAD 83)	21° 20' 8.9" N			
Longitude (NAD 83)	158° 5' 17.8" W			
Ground Elevation (AMSL)	36.58 m / 120.0 ft			
Antenna Centerline (AGL)	3.0 m / 9.8 ft			
Antenna Model	FCC Reference 32-25LOG(THETA)			
Antenna Mode	Receive 4.0 GHz		Transmit 6.1 GHz	
Interference Objectives: Long Term	-156.0 dBW/MHz	20%	-154.0 dBW/4 kHz	20%
Short Term	-146.0 dBW/MHz	0.01%	-131.0 dBW/4 kHz	0.0025%
Max Available RF Power			-20.0 (dBW/4 kHz)	

			Receive 4.0 GHz		Transmit 6.1 GHz	
Azimuth (°)	Horizon Elevation (°)	Antenna Discrimination (°)	Horizon Gain (dBi)	Coordination Distance (km)	Horizon Gain (dBi)	Coordination Distance (km)
190	0.00	63.00	-10.00	285.28	-10.00	117.07
195	0.00	60.71	-10.00	285.28	-10.00	117.07
200	0.00	58.60	-10.00	285.28	-10.00	117.07
205	0.00	56.73	-10.00	285.28	-10.00	117.07
210	0.00	55.10	-10.00	285.28	-10.00	117.07
215	0.00	53.75	-10.00	285.28	-10.00	117.07
220	0.00	52.70	-10.00	285.28	-10.00	117.07
225	0.00	51.97	-10.00	285.28	-10.00	117.07
230	0.00	51.58	-10.00	285.28	-10.00	117.07
235	0.00	51.53	-10.00	285.28	-10.00	117.07
240	0.00	51.83	-10.00	285.28	-10.00	117.07
245	0.00	52.47	-10.00	285.28	-10.00	117.07
250	0.00	53.44	-10.00	285.28	-10.00	117.07
255	0.00	54.71	-10.00	285.28	-10.00	117.07
260	0.00	56.26	-10.00	285.28	-10.00	117.07
265	0.00	58.08	-10.00	285.28	-10.00	117.07
270	0.00	60.12	-10.00	285.28	-10.00	117.07
275	0.00	62.37	-10.00	285.28	-10.00	117.07
280	0.26	64.64	-10.00	277.38	-10.00	111.98
285	0.25	67.25	-10.00	279.15	-10.00	113.13
290	0.54	69.85	-10.00	247.41	-10.00	100.00
295	0.87	72.58	-10.00	227.28	-10.00	100.00
300	1.61	75.32	-10.00	205.12	-10.00	100.00
305	2.28	78.25	-10.00	188.12	-10.00	100.00
310	4.38	81.08	-10.00	142.13	-10.00	100.00
315	5.69	84.32	-10.00	128.18	-10.00	100.00
320	7.82	87.71	-10.00	105.65	-10.00	100.00
325	8.98	91.35	-10.00	100.00	-10.00	100.00
330	9.31	95.05	-10.00	100.00	-10.00	100.00
335	9.85	98.81	-10.00	100.00	-10.00	100.00
340	9.51	102.43	-10.00	100.00	-10.00	100.00
345	9.51	106.04	-10.00	100.00	-10.00	100.00
350	9.50	109.59	-10.00	100.00	-10.00	100.00
355	9.45	113.05	-10.00	100.00	-10.00	100.00

5. CERTIFICATION

I HEREBY CERTIFY THAT I AM THE TECHNICALLY QUALIFIED PERSON RESPONSIBLE FOR THE PREPARATION OF THE FREQUENCY COORDINATION DATA CONTAINED IN THIS APPLICATION, THAT I AM FAMILIAR WITH PARTS 101 AND 25 OF THE FCC RULES AND REGULATIONS, THAT I HAVE EITHER PREPARED OR REVIEWED THE FREQUENCY COORDINATION DATA SUBMITTED WITH THIS APPLICATION, AND THAT IT IS COMPLETE AND CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF.



Timothy O. Crutcher
Frequency Planner
COMSEARCH
19700 Janelia Farm Boulevard
Ashburn, VA 20147

DATED: August 31, 2017

FREQUENCY COORDINATION AND INTERFERENCE ANALYSIS REPORT

Prepared for
Hawaii Pacific Teleport, L.P.
KAPOLEI, HI
Satellite Earth Station

Prepared By:
COMSEARCH
19700 Janelia Farm Boulevard
Ashburn, VA 20147
August 31, 2017

CONCLUSIONS & SUMMARY OF RESULTS

There were no great circle interference cases identified during the interference study of the proposed earth station.

SUPPLEMENTAL SHOWING

There were no great circle interference cases identified during the interference study of the proposed earth station. No carriers were identified in this band.

EARTH STATION COORDINATION DATA

This section presents the data pertinent to the earth station.

Date:	08/31/2017
Job Number:	170831COMSTC04

Administrative Information	
Call Sign	E030115
Licensee Name	Hawaii Pacific Teleport, L.P.

Site Information	**KAPOLEI, HI**
Latitude (NAD 83)	21° 20' 8.9" N
Longitude (NAD 83)	158° 5' 17.8" W
Climate Zone	A
Rain Zone	4
Ground Elevation (AMSL)	36.58 m / 120.0 ft

Link Information	
Satellite Type	Geostationary
Mode	RO - Receive-Only
Modulation	Digital
Satellite Arc	83° W to 194° West Longitude
Azimuth Range	95.5° to 243.3°
Corresponding Elevation Angles	5.2° / 42.6°
Antenna Centerline (AGL)	5.2 m / 17.1 ft

Antenna Information		**Receive**	
Manufacturer		Vertex	
Gain / Diameter		53.0 dBi / 4.8 m	
3-dB / 15-dB Beamwidth		0.34° / 0.68°	
Interference Objectives:	Long Term	-156.0 dBW/MHz	20%
	Short Term	-146.0 dBW/MHz	0.01%

Frequency Information	**Receive 12.2 GHz**
Emission / Frequency Range (MHz)	36M0G7W / 12200.0 - 12700.0 72M0G7W / 12200.0 - 12700.0
Max Great Circle Coordination Distance	551.8 km / 342.9 mi
Precipitation Scatter Contour Radius	418.1 km / 259.7 mi

Timothy O. Crutcher
Frequency Planner
COMSEARCH
19700 Janelia Farm Boulevard
Ashburn, VA 20147

DATED: August 31, 2017

Analysis of Non-Ionizing Radiation for a 4.5-Meter Earth Station System

This report analyzes the non-ionizing radiation levels for a 4.5-meter earth station system. The analysis and calculations performed in this report comply with the methods described in the FCC Office of Engineering and Technology Bulletin, No. 65 first published in 1985 and revised in 1997 in Edition 97-01. The radiation safety limits used in the analysis are in conformance with the FCC R&O 96-326. Bulletin No. 65 and the FCC R&O specifies that there are two separate tiers of exposure limits that are dependant on the situation in which the exposure takes place and/or the status of the individuals who are subject to the exposure. The Maximum Permissible Exposure (MPE) limits for persons in a General Population/Uncontrolled environment are shown in Table 1. The General Population/Uncontrolled MPE is a function of transmit frequency and is for an exposure period of thirty minutes or less. The MPE limits for persons in an Occupational/Controlled environment are shown in Table 2. The Occupational MPE is a function of transmit frequency and is for an exposure period of six minutes or less. The purpose of the analysis described in this report is to determine the power flux density levels of the earth station in the far-field, near-field, transition region, between the subreflector or feed and main reflector surface, at the main reflector surface, and between the antenna edge and the ground and to compare these levels to the specified MPEs.

Table 1. Limits for General Population/Uncontrolled Exposure (MPE)

Frequency Range (MHz)	Power Density (mW/cm^2)
30-300	0.2
300-1500	Frequency (MHz)*(0.8/1200)
1500-100,000	1.0

Table 2. Limits for Occupational/Controlled Exposure (MPE)

Frequency Range (MHz)	Power Density (mW/cm^2)
30-300	1.0
300-1500	Frequency (MHz)*(4.0/1200)
1500-100,000	5.0

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

Parameter	Symbol	Formula	Value	Units
Antenna Diameter	D	Input	4.5	m
Antenna Surface Area	$A_{surface}$	$\pi D^2 / 4$	15.90	m^2
Subreflector Diameter	D_{sr}	Input	60.5	cm
Area of Subreflector	A_{sr}	$\pi D_{sr}{}^2/4$	2874.75	cm^2
Frequency	F	Input	6175	MHz
Wavelength	λ	300 / F	0.048583	m
Transmit Power	P	Input	180.00	W
Antenna Gain (dBi)	G_{es}	Input	47.1	dBi
Antenna Gain (factor)	G	$10^{Ges/10}$	51286.1	n/a
Pi	π	Constant	3.1415927	n/a
Antenna Efficiency	η	$G\lambda^2/(\pi^2D^2)$	0.61	n/a

1. Far Field Distance Calculation

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

Distance to the Far Field Region $R_{ff} = 0.60\ D^2 / \lambda$ (1)
$= 250.1$ m

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

On-Axis Power Density in the Far Field $S_{ff} = G\ P / (4\ \pi\ R_{ff}^{\ 2})$ (2)
$= 11.746$ W/m^2
$= 1.175$ mW/cm^2

2. Near Field Calculation

Power flux density is considered to be at a maximum value throughout the entire length of the defined Near Field region. The region is contained within a cylindrical volume having the same diameter as the antenna. Past the boundary of the Near Field region, the power density from the antenna decreases linearly with respect to increasing distance.

The distance to the end of the Near Field can be determined from the following equation:

Extent of the Near Field $R_{nf} = D^2 / (4\ \lambda)$ (3)
$= 104.2$ m

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

Near Field Power Density $S_{nf} = 16.0\ \eta\ P / (\pi\ D^2)$ (4)
$= 27.420$ W/m^2
$= 2.742$ mW/cm^2

3. Transition Region Calculation

The Transition region is located between the Near and Far Field regions. The power density begins to decrease linearly with increasing distance in the Transition region. While the power density decreases inversely with distance in the Transition region, the power density decreases inversely with the square of the distance in the Far Field region. The maximum power density in the Transition region will not exceed that calculated for the Near Field region. The power density calculated in Section 1 is the highest power density the antenna can produce in any of the regions away from the antenna. The power density at a distance R_t can be determined from the following equation:

Transition Region Power Density $S_t = S_{nf}\ R_{nf} / R_t$ (5)
$= 2.742$ mW/cm^2

Region between the Main Reflector and the Subreflector

Transmissions from the feed assembly are directed toward the subreflector surface, and are reflected back toward the main reflector. The most common feed assemblies are waveguide flanges, horns or subreflectors. The energy between the subreflector and the reflector surfaces can be calculated by determining the power density at the subreflector surface. This can be determined from the following equation:

Power Density at the Subreflector

$$S_{sr} = 4000\ P / A_{sr} \quad (6)$$
$$= 250.456\ mW/cm^2$$

4. Main Reflector Region

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

Power Density at the Main Reflector Surface

$$S_{surface} = 4\ P / A_{surface} \quad (7)$$
$$= 45.271\ W/m^2$$
$$= 4.527\ mW/cm^2$$

5. Region between the Main Reflector and the Ground

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

Power Density between Reflector and Ground

$$S_g = P / A_{surface} \quad (8)$$
$$= 11.318\ W/m^2$$
$$= 1.132\ mW/cm^2$$

6. Summary of Calculations

Table 4. Summary of Expected Radiation levels for Uncontrolled Environment

Region		Calculated Maximum Radiation Power Density Level (mW/cm^2)	Hazard Assessment
1. Far Field (R_{ff} = 250.1 m)	S_{ff}	1.175	Potential Hazard
2. Near Field (R_{nf} = 104.2 m)	S_{nf}	2.742	Potential Hazard
3. Transition Region ($R_{nf} < R_t < R_{ff}$)	S_t	2.742	Potential Hazard
4. Between Main Reflector and Subreflector	S_{sr}	250.456	Potential Hazard
5. Main Reflector	$S_{surface}$	4.527	Potential Hazard
6. Between Main Reflector and Ground	S_g	1.132	Potential Hazard

Table 5. Summary of Expected Radiation levels for Controlled Environment

Region		Calculated Maximum Radiation Power Density Level (mW/cm^2)	Hazard Assessment
1. Far Field (R_{ff} = 250.1 m)	S_{ff}	1.175	Satisfies FCC MPE
2. Near Field (R_{nf} = 104.2 m)	S_{nf}	2.742	Satisfies FCC MPE
3. Transition Region ($R_{nf} < R_t < R_{ff}$)	S_t	2.742	Satisfies FCC MPE
4. Between Main Reflector and Subreflector	S_{sr}	250.456	Potential Hazard
5. Main Reflector	$S_{surface}$	4.527	Satisfies FCC MPE
6. Between Main Reflector and Ground	S_g	1.132	Satisfies FCC MPE

It is the applicant's responsibility to ensure that the public and operational personnel are not exposed to harmful levels of radiation.

7. Conclusions

Based on the above analysis it is concluded that the FCC MPE guidelines have been exceeded (or met) in the regions of Table 4 and 5. The applicant proposes to comply with the MPE limits by one or more of the following methods.

Means of Compliance Uncontrolled Areas

This antenna will be located in a fenced area. The area will be sufficient to prohibit access to the areas that exceed the MPE limited. The general public will not have access to areas within ½ diameter removed from the edge of the antenna.

Since one diameter removed from the main beam of the antenna or ½ diameter removed from the edge of the antenna the RF levels are reduced by a factor of 100 or 20 dB. None of the areas exceeding the MPE levels will be accessible by the general public.

Radiation hazard signs will be posted while this earth station is in operation.

The applicant will ensure that no buildings or other obstacles will be in the areas that exceed the MPE levels.

Means of Compliance Controlled Areas

The earth stations operational will not have access to the areas that exceed the MPE levels while the earth station is in operation.

The transmitters will be turned off during antenna maintenance.

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

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

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Analysis of Non-Ionizing Radiation for a 4.8-Meter Earth Station System

This report analyzes the non-ionizing radiation levels for a 4.8-meter earth station system. The analysis and calculations performed in this report comply with the methods described in the FCC Office of Engineering and Technology Bulletin, No. 65 first published in 1985 and revised in 1997 in Edition 97-01. The radiation safety limits used in the analysis are in conformance with the FCC R&O 96-326. Bulletin No. 65 and the FCC R&O specifies that there are two separate tiers of exposure limits that are dependant on the situation in which the exposure takes place and/or the status of the individuals who are subject to the exposure. The Maximum Permissible Exposure (MPE) limits for persons in a General Population/Uncontrolled environment are shown in Table 1. The General Population/Uncontrolled MPE is a function of transmit frequency and is for an exposure period of thirty minutes or less. The MPE limits for persons in an Occupational/Controlled environment are shown in Table 2. The Occupational MPE is a function of transmit frequency and is for an exposure period of six minutes or less. The purpose of the analysis described in this report is to determine the power flux density levels of the earth station in the far-field, near-field, transition region, between the subreflector or feed and main reflector surface, at the main reflector surface, and between the antenna edge and the ground and to compare these levels to the specified MPEs.

Table 1. Limits for General Population/Uncontrolled Exposure (MPE)

Frequency Range (MHz)	Power Density (mW/cm^2)
30-300	0.2
300-1500	Frequency (MHz)*(0.8/1200)
1500-100,000	1.0

Table 2. Limits for Occupational/Controlled Exposure (MPE)

Frequency Range (MHz)	Power Density (mW/cm^2)
30-300	1.0
300-1500	Frequency (MHz)*(4.0/1200)
1500-100,000	5.0

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

Parameter	Symbol	Formula	Value	Units
Antenna Diameter	D	Input	4.8	m
Antenna Surface Area	$A_{surface}$	$\pi D^2 / 4$	18.10	m^2
Subreflector Diameter	D_{sr}	Input	60.5	cm
Area of Subreflector	A_{sr}	$\pi D_{sr}{}^2/4$	2874.75	cm^2
Frequency	F	Input	14250	MHz
Wavelength	λ	300 / F	0.021053	m
Transmit Power	P	Input	180.00	W
Antenna Gain (dBi)	G_{es}	Input	55.0	dBi
Antenna Gain (factor)	G	$10^{Ges/10}$	316227.8	n/a
Pi	π	Constant	3.1415927	n/a
Antenna Efficiency	η	$G\lambda^2/(\pi^2D^2)$	0.62	n/a

1. Far Field Distance Calculation

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

Distance to the Far Field Region $R_{ff} = 0.60\ D^2 / \lambda$ (1)
$= 656.6$ m

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

On-Axis Power Density in the Far Field $S_{ff} = G\ P / (4\ \pi\ R_{ff}^{\ 2})$ (2)
$= 10.505$ W/m^2
$= 1.051$ mW/cm^2

2. Near Field Calculation

Power flux density is considered to be at a maximum value throughout the entire length of the defined Near Field region. The region is contained within a cylindrical volume having the same diameter as the antenna. Past the boundary of the Near Field region, the power density from the antenna decreases linearly with respect to increasing distance.

The distance to the end of the Near Field can be determined from the following equation:

Extent of the Near Field $R_{nf} = D^2 / (4\ \lambda)$ (3)
$= 273.6$ m

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

Near Field Power Density $S_{nf} = 16.0\ \eta\ P / (\pi\ D^2)$ (4)
$= 24.524$ W/m^2
$= 2.452$ mW/cm^2

3. Transition Region Calculation

The Transition region is located between the Near and Far Field regions. The power density begins to decrease linearly with increasing distance in the Transition region. While the power density decreases inversely with distance in the Transition region, the power density decreases inversely with the square of the distance in the Far Field region. The maximum power density in the Transition region will not exceed that calculated for the Near Field region. The power density calculated in Section 1 is the highest power density the antenna can produce in any of the regions away from the antenna. The power density at a distance R_t can be determined from the following equation:

Transition Region Power Density $S_t = S_{nf}\ R_{nf} / R_t$ (5)
$= 2.452$ mW/cm^2

4. Region between the Main Reflector and the Subreflector

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Power Density at the Subreflector $S_{sr} = 4000\ P / A_{sr}$ (6)
$= 250.456\ mW/cm^2$

5. Main Reflector Region

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

Power Density at the Main Reflector Surface $S_{surface} = 4\ P / A_{surface}$ (7)
$= 39.789\ W/m^2$
$= 3.979\ mW/cm^2$

6. Region between the Main Reflector and the Ground

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

Power Density between Reflector and Ground $S_g = P / A_{surface}$ (8)
$= 9.947\ W/m^2$
$= 0.995\ mW/cm^2$

7. Summary of Calculations

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3. Transition Region ($R_{nf} < R_t < R_{ff}$)	S_t	2.452	Potential Hazard
4. Between Main Reflector and Subreflector	S_{sr}	250.456	Potential Hazard
5. Main Reflector	$S_{surface}$	3.979	Potential Hazard
6. Between Main Reflector and Ground	S_g	0.995	Satisfies FCC MPE

Table 5. Summary of Expected Radiation levels for Controlled Environment

Region		Calculated Maximum Radiation Power Density Level (mW/cm^2)	Hazard Assessment
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5. Main Reflector	$S_{surface}$	3.979	Satisfies FCC MPE
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It is the applicant's responsibility to ensure that the public and operational personnel are not exposed to harmful levels of radiation.

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