STA Extension Request

Hawaii Pacific Teleport (HPT) requests an extension of the special temporary authority ("STA") to operate a Ka-band earth station to provide in-orbit testing ("IOT") services for a BIU mission. Pursuant to the authority in File Number SES-STA-20160323-00268, HPT is providing IOT of the Nimiq-2 at 148° E.L. orbital location in the 29.5 – 30.0 GHz (Earth-to-space) frequency band. The testing involves 30-45 minute spectrum plots either once per day or once per week.

Attached is an Exhibit 1 – Technical Exhibit (Schedule B of Form 312) – detailing the requested operating parameters and an Exhibit 2 – Radiation Hazard Report.

STA Request – Technical Exhibit

B1. Location of Earth Station Site.

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:
		917-750-5358	Lat. 21-20-09.0 N. Lon. 158-05-19.0 W.	☐ 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	36.42

B2. Points of Communications: .

Satellite Name and Orbit Location
Nimiq-2 at 148°E / 212 W

B3. Destination points for communications using non-U.S. licensed satellites.

Satellite Name	List of Destination Points
Nimiq-2 at 148°E / 212 W	Canada

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)
1.2M	1.2M	1	AVL	1.2M	1.2	49.5 @ 29.750

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)				
1.2M		2.0	38.42			142*	71*

***1 MHz spectrum plots at up to 20 center frequencies distributed across the aggregate 500 MHz uplink**

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)
1.2M	29,500 – 30,000	212.0	212.0	25.4	25.4	255.1	255.1	-18.3

B7. Particulars of Operation (Full particulars are required for each r.f. carrier): Use additional pages as needed.

(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
1.2M	29,500 – 30,000	T	H,V	1M00G7W	58.0	34.0	Digital traffic

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

This report analyzes the non-ionizing radiation levels for a 1.2-meter earth station system. The analysis and calculations performed in this report comply with the methods described in the FCC Office of Engineering and Technology Bulletin, No. 65 first published in 1985 and revised in 1997 in Edition 97-01. The radiation safety limits used in the analysis are in conformance with the FCC R&O 96-326. Bulletin No. 65 and the FCC R&O specifies that there are two separate tiers of exposure limits that are dependant on the situation in which the exposure takes place and/or the status of the individuals who are subject to the exposure. The Maximum Permissible Exposure (MPE) limits for persons in a General Population/Uncontrolled environment are shown in Table 1. The General Population/Uncontrolled MPE is a function of transmit frequency and is for an exposure period of thirty minutes or less. The MPE limits for persons in an Occupational/Controlled environment are shown in Table 2. The Occupational MPE is a function of transmit frequency and is for an exposure period of six minutes or less. The purpose of the analysis described in this report is to determine the power flux density levels of the earth station in the far-field, near-field, transition region, between the subreflector or feed and main reflector surface, at the main reflector surface, and between the antenna edge and the ground and to compare these levels to the specified MPEs.

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

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

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

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

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

Parameter	Symbol	Formula	Value	Units
Antenna Diameter	D	Input	1.2	m
Antenna Surface Area	$A_{surface}$	$\pi D^2 / 4$	1.13	m^2
Feed Flange Diameter	D_{fa}	Input	9.1	cm
Area of Feed Flange	A_{fa}	$\pi D_{fa}{}^2/4$	65.04	cm^2
Frequency	F	Input	29500	MHz
Wavelength	λ	300 / F	0.010169	m
Transmit Power	P	Input	142.00	W
Antenna Gain (dBi)	G_{es}	Input	49.5	dBi
Antenna Gain (factor)	G	$10^{Ges/10}$	89125.1	n/a
Pi	π	Constant	3.1415927	n/a
Antenna Efficiency	η	$G\lambda^2/(\pi^2 D^2)$	0.65	n/a

1. Far Field Distance Calculation

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

Distance to the Far Field Region $R_{ff} = 0.60\ D^2 / \lambda$ (1)
$= 85.0$ 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)
$= 139.524\ W/m^2$
$= 13.952\ mW/cm^2$

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)
$= 35.4$ 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)
$= 325.711\ W/m^2$
$= 32.571\ mW/cm^2$

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)
$= 32.571\ mW/cm^2$

4. Region between the Feed Assembly and the Antenna Reflector

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

Power Density at the Feed Flange $S_{fa} = 4000\ P / A_{fa}$ (6)

$= 8733.245\ mW/cm^2$

5. Main Reflector Region

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

Power Density at the Reflector Surface $S_{surface} = 4\ P / A_{surface}$ (7)

$= 502.222\ W/m^2$

$= 50.222\ mW/cm^2$

6. Region between the Reflector and the Ground

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

Power Density between Reflector and Ground $S_g = P / A_{surface}$ (8)

$= 125.556\ W/m^2$

$= 12.556\ mW/cm^2$

7. Summary of Calculations

Table 4. Summary of Expected Radiation levels for Uncontrolled Environment

Region	Calculated Maximum Radiation Power Density Level (mW/cm^2)		Hazard Assessment
1. Far Field (R_{ff} = 85.0 m)	S_{ff}	13.952	Potential Hazard
2. Near Field (R_{nf} = 35.4 m)	S_{nf}	32.571	Potential Hazard
3. Transition Region ($R_{nf} < R_t < R_{ff}$)	S_t	32.571	Potential Hazard
4. Between Feed Assembly and Antenna Reflector	S_{fa}	8733.245	Potential Hazard
5. Main Reflector	$S_{surface}$	50.222	Potential Hazard
6. Between Reflector and Ground	S_g	12.556	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} = 85.0 m)	S_{ff}	13.952	Potential Hazard
2. Near Field (R_{nf} = 35.4 m)	S_{nf}	32.571	Potential Hazard
3. Transition Region ($R_{nf} < R_t < R_{ff}$)	S_t	32.571	Potential Hazard
4. Between Feed Assembly and Antenna Reflector	S_{fa}	8733.245	Potential Hazard
5. Main Reflector	$S_{surface}$	50.222	Potential Hazard
6. Between Reflector and Ground	S_g	12.556	Potential Hazard

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

8. Conclusions

Based 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.

This antenna will be located in a fenced area. The fenced area will be sufficient to prohibit the general public from having access the areas that exceed the MPE limits

Since one diameter removed from the main beam of the antenna or ½ diameters 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.

Means of Compliance Controlled Areas

The earth station's operational staff 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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