TECHNICAL APPENDIX

Intelsat License LLC
ESAA Blanket License Modification Application

I. Technical Description

A. Overview

The Intelsat License LLC ("Intelsat") earth station aboard aircraft ("ESAA") network is comprised of: (i) ESAA terminals mounted on private, commercial, and government aircraft; (ii) a fleet of commercial Ku-band traditional and HTS satellites part of the IntelsatOne® Flex network; and (iii) Intelsat-owned or leased teleport antennas which provide uplink and downlink connectivity to iDirect hubs. Intelsat has fully described the Intelsat ESAA network in a prior submission and hereby incorporates by reference the technical showing regarding the control functionality and other operational characteristics previously submitted.[1]

In this modification application, Intelsat seeks to add two (2) new terminal types – the Astronics AeroSat T-310 ("HR129") and F-310 ("HR6400") – to its *ESAA Blanket License* for operations with previously authorized satellite points of communication and any U.S.-licensed or non-U.S. licensed satellite on the Commission's Permitted Space Station List. Below, Intelsat provides additional information its proposed terminal operations. The information provided herein satisfies the Commission's requirements for both VMES and ESAA operations.

In addition, as part of this application, Intelsat seeks to add vehicle mounted earth stations ("VMES") operating authority to its license to conduct ongoing terminal evaluation on stationary and in-motion vehicles in the United States.

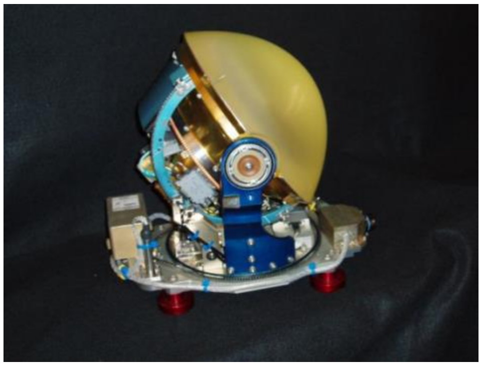
B. HR129 Terminal

1. Technical Parameters

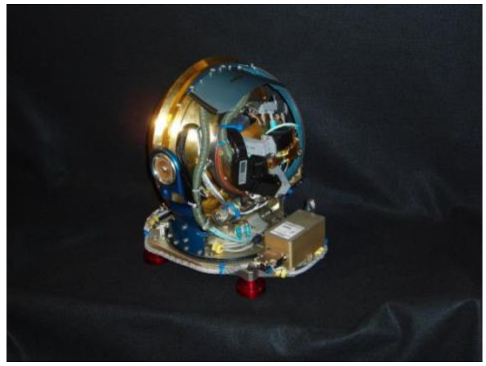
The HR129 terminal is a tail-mounted ESAA terminal that will enable Intelsat to provide two-way broadband communications in Ku-band FSS spectrum consistent with the Commission's ESAA rules, 47 C.F.R. §25.227, and other applicable Commission rules and policies. Moreover, when operating the terminal on vehicles, Intelsat will comply with the Commission's VMES rules, 47 C.F.R. §25.226, governing Ku-band VMES operations. The HR129 terminal is shown in Figure 1 and the basic characteristics of the HR129 terminal are summarized in Tables 1 and 2, below.

[1] *See* Intelsat License LLC, File No. SES-LIC-20170626-00682, Call Sign E170121, Technical Description.

Figure 1: HR129 Terminal



Side View



Back View

Table 1 – Summary of Technical Parameters (HR129)

Parameter	Performance
Antenna Diameter	29 cm
Type of Antenna	Circular Rexolite® Fresnel lens
Peak Input Power	10 watts
Gain	30.3 dBi @ 11.7 GHz 31.4 dBi @ 14.25 GHz
Maximum EIRP	40.2 dBW
Transmit Frequency Range	14.0 GHz to 14.5 GHz
Receive Frequency Range	10.95 GHz to 12.75 GHz
Receive Bandwidth	1800 MHz (10.95-12.75 GHz)
Polarization	Linear Tx/Dual Pol Rx, Dual Pol Circular Rx only

Table 2 – Summary of Control Parameters (HR129)

Azimuth	Continuous, 360º
Elevation	0º to 90º
Pointing Accuracy Azimuth: Elevation:	 0.2º 0.2º
Azimuth, Elevation, Polarization Rates of Change	7.0º sec
Azimuth, Elevation, Polarization Acceleration	7.0º sec^2

2. HR129 Terminal Components and Characteristics

The HR129 Ku-band terminal is comprised of the following components:

- Antenna Tail Mount Unit ("TMU")
- Antenna Control and Modem Unit ("ACMU")
- Low Power Transceiver ("LPT")
- Power Amplifier Unit ("PAU")
- Diplexer

The TMU affixes the terminal to the aircraft tail and has been certified for in-flight use. The terminal will not transmit until it receives the appropriate outbound signal from the satellite and it has validated antenna pointing within 0.2° and will cease transmission immediately in certain instances to avoid causing interference. The ACMU controls the antenna pointing accuracy to a pointing error of less than 0.2° between the target satellite and the axis of the antenna's main lobe. The ACMU continuously monitors the pointing error and will mute the transmitter if the pointing error exceeds 0.5°. All emissions automatically cease within 100 milliseconds if the angle between the orbital location of the target satellite and the axis of the main lobe of the antenna exceeds 0.5°, and transmission is not resumed until the pointing error is less than 0.2°.

The terminal also will cease transmissions automatically if:

- the ACMU loses communication with the aircraft inertial navigation system ("INS");
- the modem loses receive signal;
- there is a failure of the ACMU itself; or
- the reference oscillator fails.

The LPT allows accurate power control, and the ACMU ensures compliance with applicable power spectral density ("PSD") limits. The power detector within the LPT is stable over frequency and temperature and reports the Ku-band transmit power from the PAU. In this way, Intelsat can maintain accurate power control at the PAU output regardless of variations in PAU gain over temperature and frequency.

3. Off-Axis EIRP Spectral Density

Intelsat is applying for ESAA operating authority under Sections 25.226(a)(1) and 25.227(a)(1) of the Commission's rules, 47 C.F.R. §§ 25.226(a)(1) and 25.227(a)(1), designed to facilitate Ku-band VMES and ESAA operations in a two-degree spacing environment. The HR129 terminal will operate at off-axis EIRP spectral density ("ESD") levels well below the off-axis ESD masks set forth in the relevant rule sections, and thus will protect co-frequency operations from harmful interference.

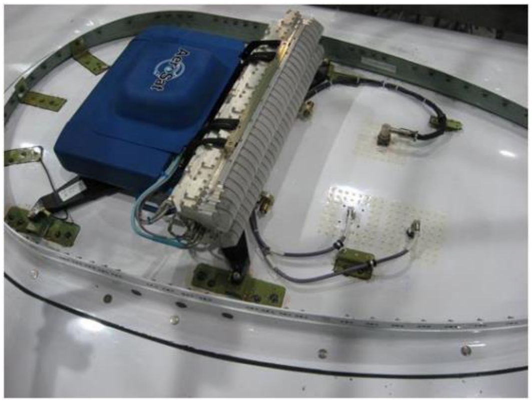
At all times, Intelsat will conduct HR129 operations in the United States consistent with the identical off-axis EIRP spectral density levels along the geostationary arc specified in Sections 25.226(a)(1) and 25.227(a)(1) (*i.e.*, consistent with two-degree spacing levels). Intelsat will control off-axis EIRP spectral density emissions from the HR129 terminal through limitations on the transmit power spectral density and control of pointing error. In § IV, below, Intelsat provides the off-axis ESD plots pursuant to Section 25.115(g)(1) of the Commission's rules, 47 C.F.R. § 25.115(g)(1). The charts show that the HR129 terminal ESD remains below permitted limits in all cases.

C. HR6400 Terminal

1. Technical Parameters

The HR6400 terminal is a low profile, aerodynamic antenna system designed to support high transmit and receive data rates, and will be used to provide broadband Internet access and connectivity to passengers and crew aboard private, commercial and government aircraft consistent with the Commission's ESAA rules, 47 C.F.R. §25.227. Moreover, when operating the HR6400 terminal on vehicles, Intelsat will comply with the Section 25.226 of the Commission's rules, 47 C.F.R. §25.226, governing Ku-band VMES operations. The HR6400 terminal, a Fuselage Mount Unit ("FMU"), is shown in Figure 2 and the basic characteristics of the HR6400 terminal are summarized in Tables 3 and 4, below.

Figure 2: HR6400 Terminal



HR6400 Terminal installed on aircraft

Table 3 – Summary of Technical Parameters (HR6400)

Parameter	Performance
Antenna Diameter	24.375 in x 6.8 in
Type of Antenna	Horn antenna with lenses
Peak Input Power	10 watts
Gain	31.8 dBi @ 11.7 GHz 32.5 dBi @ 14.25 GHz
Maximum EIRP	42.0 dBW
Transmit Frequency Range	14.0 GHz to 14.5 GHz
Receive Frequency Range	10.95 GHz to 12.75 GHz
Receive Bandwidth	1800

	(10.95-12.75 GHz)
Polarization	Horizontal or Vertical

Table 4 – Summary of Control Parameters (HR6400)

Azimuth	Continuous, 360º
Elevation	0º to 90º
Pointing Accuracy Azimuth: Elevation:	 0.2º 0.2º
Azimuth, Elevation, Polarization Rates of Change	7.0º sec
Azimuth, Elevation, Polarization Acceleration	7.0º sec^2

2. HR6400 Terminal Components and Characteristics

The HR6400 FMU Ku-band antenna consists of the following components:

- A mechanically steered antenna array
- ACMU
- Low Noise Amplifier ("LNA")
- High Power Transceiver ("HPT")
- Polarization Converter Unit
- Antenna Driver and Position Encoders

The HPT includes a power detector and a power amplifier, as well as an interconnection with the antenna and the ACMU. The ACMU consists of an iDirect modem and its associated interconnections (*i.e.*, D-TDMA modulator and DVB-S2 de-modulator), an interconnection with the on-board Inertial Navigation System, and an interconnection with the HPT. The on-board INS provides information on the aircraft's position, attitude and related factors to the ACMU, and, using the aircraft navigational data, the ACMU controls the antenna's position. The ACMU updates the positioner controls continuously to maintain accurate pointing toward the target satellite.

The ACMU controls the antenna pointing accuracy to a pointing error of less than 0.2° between the target satellite and the axis of the antenna's main lobe. The ACMU continuously monitors the pointing error and will mute the antenna transmitter if the pointing error exceeds 0.5°. All emissions automatically cease within 100 milliseconds if the angle between the orbital location of the target satellite and the axis of the main lobe of the antenna exceeds 0.5°, and transmission is not resumed until the pointing error is less than 0.2°. The antenna will not transmit until it receives the appropriate outbound signal from the satellite and it has validated antenna pointing within 0.2°.

The antenna transmitter also will cease transmissions automatically if:

- the ACMU loses communication with the aircraft INS;
- the modem loses receive signal;
- there is a failure of the ACMU itself; or
- the reference oscillator fails.

The HPT allows accurate power control, and the ACMU ensures compliance with the PSD limits. The power detector within the HPT is stable over frequency and temperature and reports the Ku-band transmit power from the Power Amplifier ("PA"). In this way, Intelsat can maintain accurate power control at the PA output regardless of variations in PA gain over temperature and frequency.

3. Off-Axis EIRP Spectral Density

Intelsat is applying for ESAA operating authority under Sections 25.226(a)(2) and 25.227(a)(2) of the Commission's rules, 47 C.F.R. §§ 25.226(a)(2) and 25.227(a)(2), applicable to ESAA terminals that use transmitters with off-axis ESD levels in excess of those in paragraph (a)(1)(i) of the rule sections. The HR6400 terminal utilizes a low-profile antenna that is narrower in the elevation plane than in the azimuth plane and, as a result, the HR6400 antenna exceeds off-axis ESD limits specified in Sections 25.226(a)(1)(i)(B) and 25.227(a)(1)(i)(B) in the plane perpendicular to the GSO arc at certain power levels and skew angles.

In the Legal Narrative portion of this application, Intelsat seeks a limited waiver of Sections 25.226(a)(1)(i)(B) and 25.227(a)(1)(i)(B) of the Commission's rules to permit operation of the HR6400 terminal at off-axis ESD limits in the plane perpendicular to the GSO arc in excess of those set forth in the rule sections. Although no Ku-band NGSO FSS systems are currently licensed or operating, in the event a future NGSO network is deployed, Intelsat will coordinate with the new network as required in order to facilitate co-frequency operations, and will modify its ESAA and/or VMES operations as necessary to reflect any coordination agreement reached. In § V, below, Intelsat provides the off-axis ESD plots pursuant to Section 25.115(g)(1) of the Commission's rules, 47 C.F.R. § 25.115(g)(1).

D. <u>Space Segment</u>

The space segment utilized by Intelsat's ESAA network will consist of capacity on the U.S.-licensed satellites specified in § VI, Table 1 of this Technical Appendix. In addition, in order to afford Intelsat operational flexibility, the Legal Narrative seeks authority for the HR129 and HR6400 terminals to communicate with other satellites appearing on the FCC's Permitted List. Although Intelsat is seeking authority for the HR6400 terminal under Sections 25.226(a)(2) and 25.227(a)(2) because the terminal will exceed the off-axis ESD limit in the plane perpendicular to the GSO arc, Permitted List authority is still appropriate because Intelsat will operate the HR6400 at all times within the relevant off-axis ESD limits in the plane tangent to the GSO arc (*i.e.*, consistent with two-degree spacing levels). As noted, Intelsat seeks a waiver to the extent required to permit HR6400 terminal operations with Permitted List satellites.

Intelsat's proposed ESAA and VMES operations are consistent with the coordination agreements it has reached with adjacent satellites located within +/- 6 degrees of each serving satellite.[2] At all times, Intelsat will operate its terminals pursuant to the relevant coordination agreements and otherwise consistent with the Commission's rules governing ESAAs and VMESs.

E. Ground Segment

The gateway earth stations associated with terminal operations are listed in § VI, Table 2 of the Technical Appendix. Teleport earth stations are licensed by the teleport operator and are not part of this application. Control and monitoring of Intelsat ESAA and VMES operations will be provided by the Intelsat Secure Operating Center ("ISOC") in Ellenwood, Georgia, United States on a 24/7 basis. The ISOC can be reached at:

ISOC – Intelsat Secure Operating Center
Phone: +1 (404) 381-2727 / Email: ISOC@intelsatgeneral.com

Primary Point of Contact:
Angela Wheeler, Manager, Network Operations
Phone: +1 (404) 381-2727, Email: Angela.Wheeler@IntelsatGeneral.com

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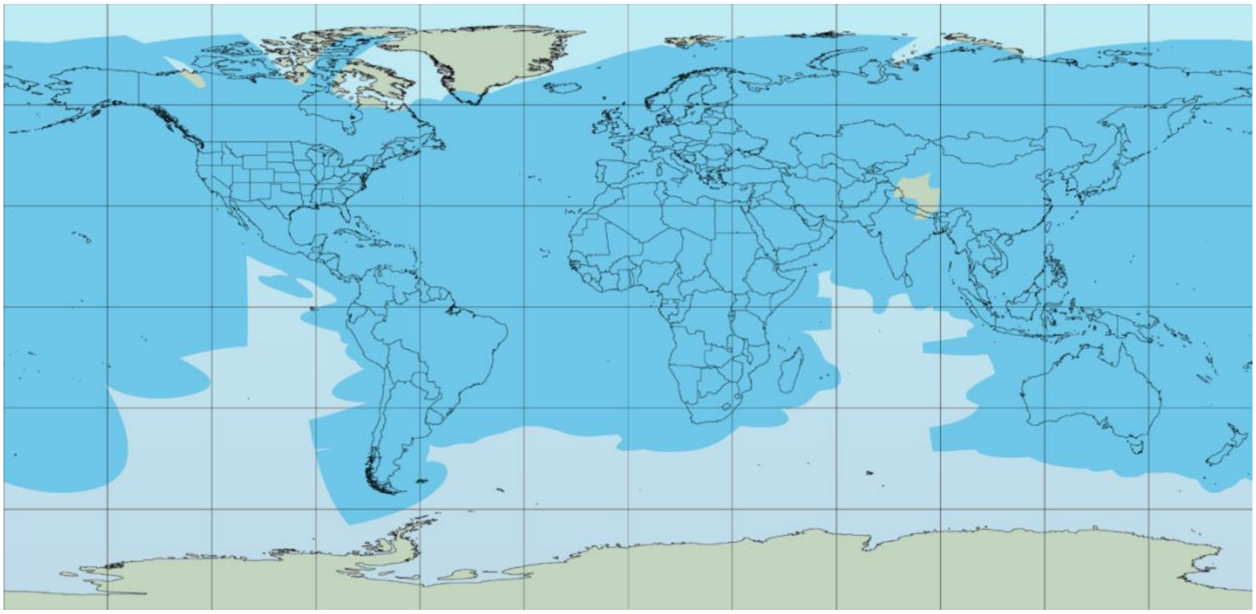
2 *See* Technical Appendix, III.

II. Coverage Maps

The geographic coverage of the Intelsat ESAA operations is depicted below.



Intelsat will conduct VMES operations only within the United States.

III. Satellite Operator Certification Letter

February 8, 2018

Federal Communications Commission
International Bureau
445 12th Street, SW
Washington, D.C. 20554

Re: Statement of Intelsat in Support of ESAA/VMES Application

To Whom It May Concern:

This letter supports Intelsat License LLC's ("Intelsat") application for an earth stations aboard aircraft ("ESAA")/vehicle mounted earth stations ("VMES") blanket license from the Federal Communications Commission ("FCC") to operate two satellite earth station terminal types, the Astronics AeroSat T-310 terminal ("HR129") and F-310 terminal ("HR6400"). The aircraft-mounted and vehicle-mounted satellite earth station terminals are planned to be operated with a total of 17 satellites under the requested blanket license, as specified below in Table 1. Intelsat is filing this application pursuant to the FCC's rules governing VMES and ESAA operations, including Sections 25.226 and 25.227.

Table 1: List of Satellites

Satellite	Orbital location
IS-23	53°EL
IS-17	66°EL
IS-20	68.5°EL
IS-22	72.1°EL
IS-19	166°EL
H-3e	169°EL
IS-18	180°EL
IS-37e	18°WL
IS-35e	34.5°WL
IS-14	45°WL
IS-29e	50°WL
IS-34	55.5°WL
IS-21	58°WL
IS-33e	60°WL
H-1	127°WL
G-19	97°WL
Sky-B1	43.15°WL

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Intelsat confirms and hereby certifies that the power density levels of the proposed operations are consistent with existing satellite coordination agreements between Intelsat and the operators of satellites within +/- 6 degrees of the above-listed satellites' orbit locations, and that the proposed operation of the aircraft-mounted satellite earth station terminals have the potential to create and receive harmful interference from adjacent satellite networks that may be unacceptable.

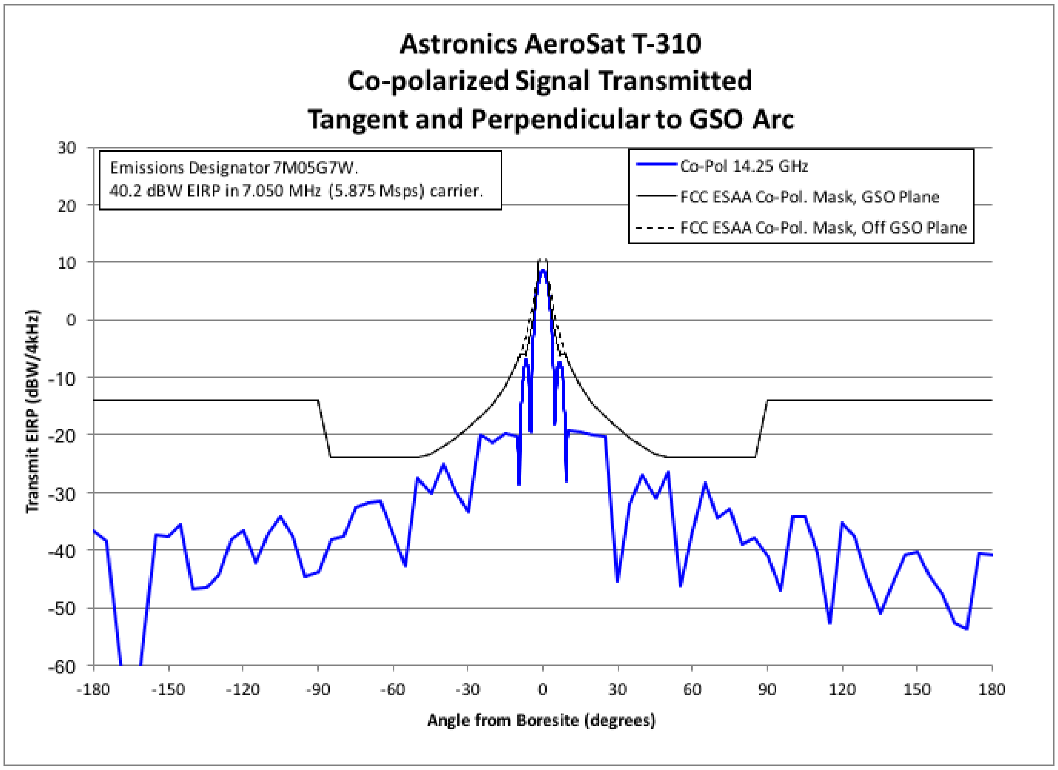
If the FCC authorizes the operations as proposed, Intelsat will include the power density levels in all future satellite network coordination agreements with operators of future satellites that are adjacent (within +/- 6 degrees) to the satellites addressed by this statement.

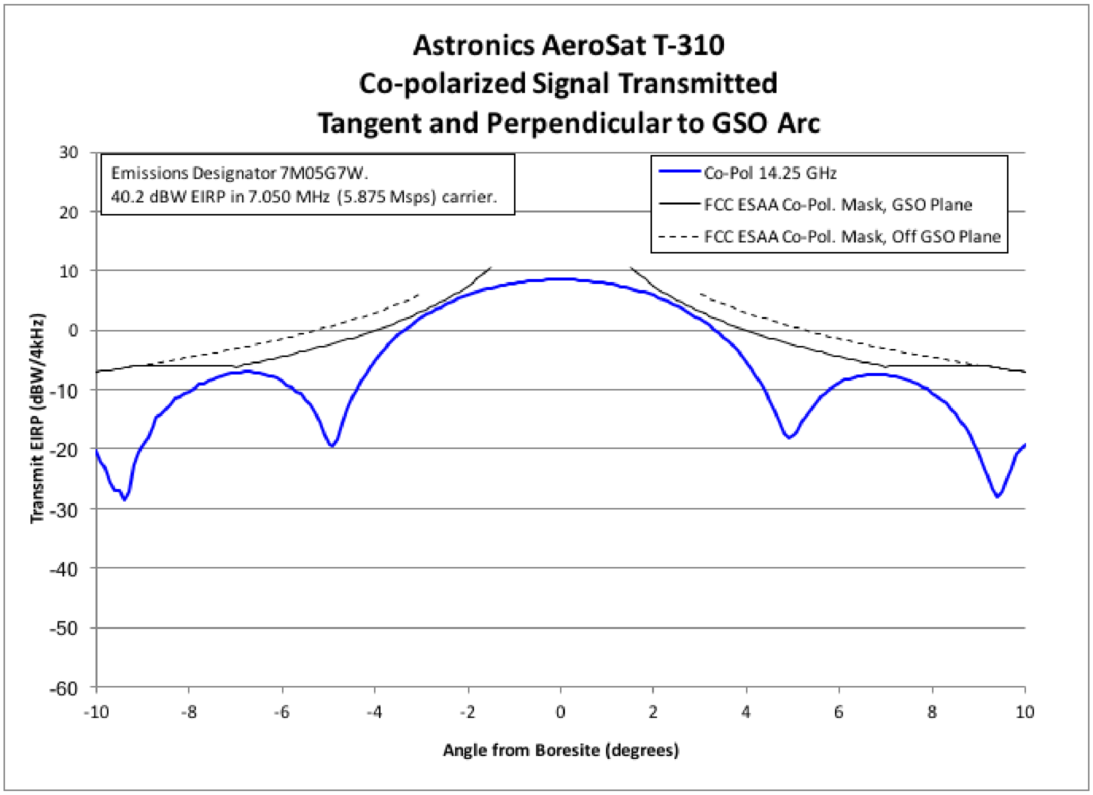
Sincerely,

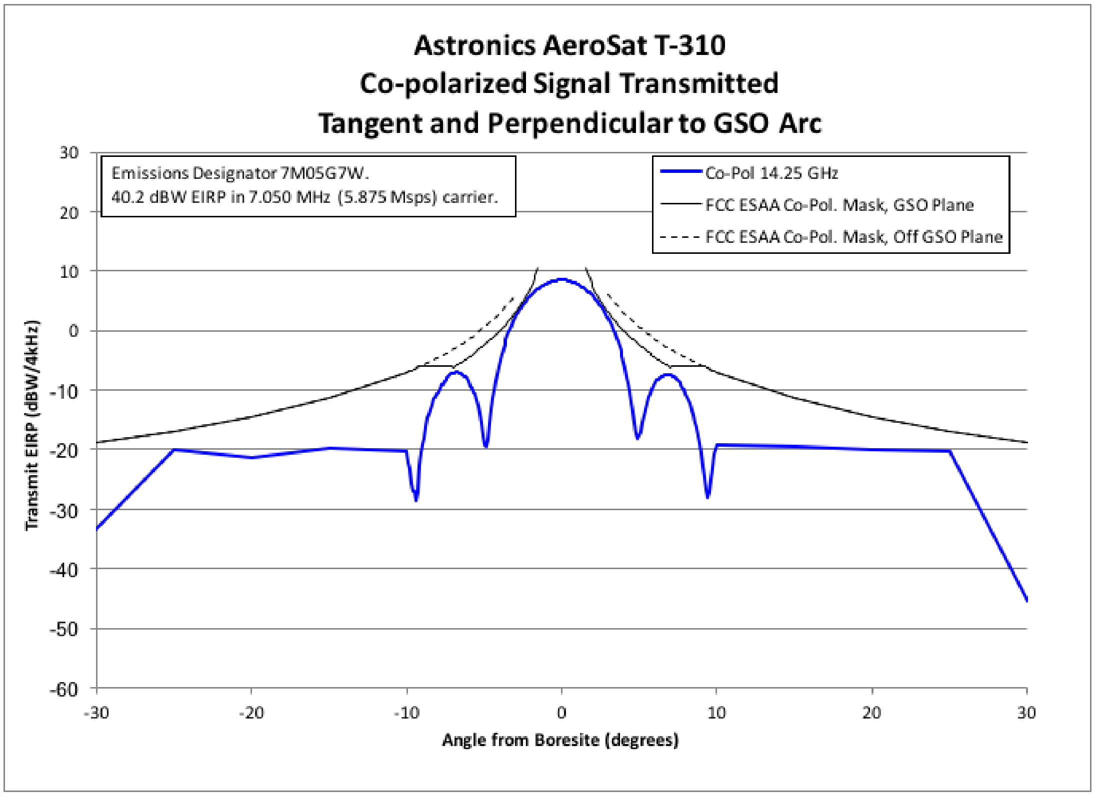
/s/ *Alexander Gerdenitsch* February 8, 2018
Alexander Gerdenitsch Date
Manager, Spectrum Policy, Americas
Intelsat Corporation

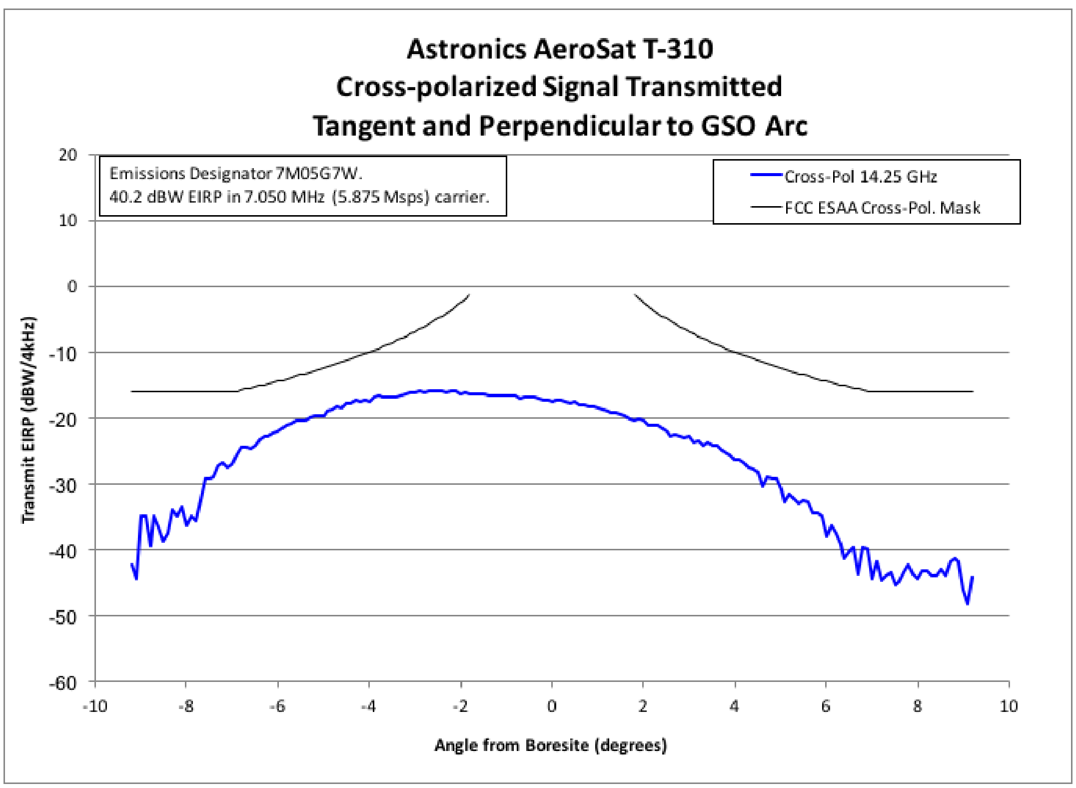
IV. Astronics AeroSat FliteStream™ T-310 (HR129)

A. *Off-Axis EIRP Spectral Density Plots*






Astronics AeroSat T-310
Co-polarized Signal Transmitted
Tangent and Perpendicular to GSO Arc
Emissions Designator 7M05G7W.
40.2 dBW EIRP in 7.050 MHz (5.875 Msps) carrier.
Co-Pol 14.25 GHz
FCC ESAA Co-Pol. Mask, GSO Plane
FCC ESAA Co-Pol. Mask, Off GSO Plane
Transmit EIRP (dBW/4kHz)
Angle from Boresite (degrees)


Astronics AeroSat T-310
Cross-polarized Signal Transmitted
Tangent and Perpendicular to GSO Arc
Emissions Designator 7M05G7W.
40.2 dBW EIRP in 7.050 MHz (5.875 Msps) carrier.
Cross-Pol 14.25 GHz
FCC ESAA Cross-Pol. Mask
Transmit EIRP (dBW/4kHz)
Angle from Boresite (degrees)

B. HR129 Radiation Hazard Analysis

FCC RF Hazard Compliance Analysis for HR129

In connection with a license application by Intelsat License, LLC ("Intelsat"). for operation of a 0.29 Meter Ku-band aircraft remote antenna, the following assessment is provided of compliance with the FCC limits for maximum permissible exposure (MPE) to RF fields.

Based on the mathematical analyses described herein, the potential RF exposure levels in the areas of possible interest for antenna operation can be considered in compliance with the applicable FCC limits for controlled or occupational exposure (access to the earth station antenna is restricted to trained personnel) and for protection of the general population. The proposed operation is therefore in compliance with the FCC regulations and exposure limits.

The sections that follow provide the analysis and conclusions regarding compliance.

1. Operational Data

The relevant data for the subject operation is summarized as follows:

Transmitting Frequency Band:	14.0 – 14.5 GHz
Antenna Manufacturer / Model:	Astronics Aerosat / HR 129, aka T-310
Antenna Type:	Fresnel Lens
Antenna Dimension:	0.29 meters (diameter) (11.4 inches)
Antenna Efficiency:	80 %
Net Power Input to Antenna (at flange):	10.0 Watts
Antenna Height AGL:	7.5 meters (24.6 feet) nominal

2. Applicable MPE Limits

The MPE limits are described in the FCC Rules and Regulations. For the frequency range of interest here, the applicable limit for acceptable, continuous exposure of the general population is 1.0 milliwatt per square centimeter (mW/cm2), and for "controlled" occupational exposure, it is 5.0 mW/cm2. Access to the antenna is restricted to trained personnel, and thus the latter limit is generally applicable. However, it is possible that untrained members of the general population could be within certain distances from the aircraft. Therefore, the MPE limit for the general population has also been examined.

3. FCC Formulas and Calculations

FCC Bulletin OET 65 provides standardized formulas for calculating the power density in the areas of interest here. Using the formulas from Bulletin OET 65, we report the exposure levels (1) directly in front of the antenna, (2) in the main beam at the transition from near to far field, and (3) farther away but still in the main beam where the MPE limit is met for both controlled and general population exposure; and (4) to the side of the antenna. Each area of interest will be addressed below and the results of the calculations are given.

3.1 Potential exposure level directly in front of the antenna

The worst-case possible exposure occurs right at the surface (aperture) of the antenna. According to Bulletin OET 65, the applicable formula for power density, **S**, at the antenna surface is as follows:

Ssurface = 4 * P / A

Where: **P** represents the antenna input power; and
A is the surface area of the antenna.

In this case, with 10 Watts antenna of input power at the flange, an antenna diameter of 0.29 m (11.4 inches), the power density at the antenna surface is 60.56 mW/cm2, which exceeds the 5.0 mW/cm2 MPE limit for controlled access. However, there is no way to approach this close to the antenna when in operation.

In normal operation, this antenna is mounted on the top of the aircraft's tail. It is also possible to mount it on the aircraft fuselage. In both installations, the main beam points toward the sky at a typical elevation angle of 25 degrees such that human exposure is not possible. Additionally, any blockage (human or otherwise) will cause the transmitter to be disabled within milliseconds seconds as the system does not transmit unless it can receive the downlink carrier from the satellite.. Finally, normal TDMA operation uses a duty cycle of 10% or less, reducing maximum near field exposure by an order of magnitude. Therefore, prolonged exposure not possible in normal operation.

The antenna will be switched off completely (i.e. unpowered) when a technician needs to perform work in this area (which is more than 24 feet above ground level). Standard RF safety procedures will be applied and the power to the antenna will be removed during the period of the work.

The formula for near-field, on-axis power density, directly in front of the antenna is as follows:

$$\mathbf{Snf = 16 * I * P / (\pi * D^2)}$$

Where: **P** represents the antenna input power;
I represents the antenna illumination efficiency; and
D is the antenna diameter.

In this case, when we apply an illumination efficiency of 80 %, the result of the calculation is 48.53 mW/cm2, which exceeds the occupational MPE limit. This is the exposure level directly in front of the antenna at a distance of 1 m. For the reasons stated above, there is no way for a technician or the general public to approach this close to the antenna while it is transmitting.

We can calculate the distance at which the antenna emissions would meet the MPE limits for controlled access and for the general population using the following formula:

$$R_{MPE} = SQRT \{ (G * P) / (4 * \pi * MPE) \}$$

Where: **G** represents the Gain of the antenna; [31.9 dBi @ 14.500 GHz]
P represents the antenna aperture input power: and
MPE represents the maximum permissible exposure limit.

The results of the analysis show that the MPE for controlled access are met at 5.0 m (16.3 feet) directly in front of the antenna. The MPE for the general population is met at 11.1 m (36.5 feet) directly in front of the antenna.

The results of this calculation are also used in the analysis of potential exposure to the immediate side of the antenna, which is addressed in the subsection that follows.

3.2 Potential exposure level to the side of the antenna

The near-field power density drops off dramatically outside the imaginary cylinder extending from the surface along the axis of the main beam of an aperture antenna. According to Bulletin OET 65, if the point of interest is at least one antenna diameter removed from the center of the main beam, the power density at that point would be at least a factor of 100 lower (20 dB) than the value calculated for the equivalent distance in the main beam.

In this particular case, the antenna will be mounted 7.5 m (29 feet) above the ground. Therefore, the closest that ground personnel and passengers could approach an operational antenna would be at the very least 26 antenna diameters below the main beam.

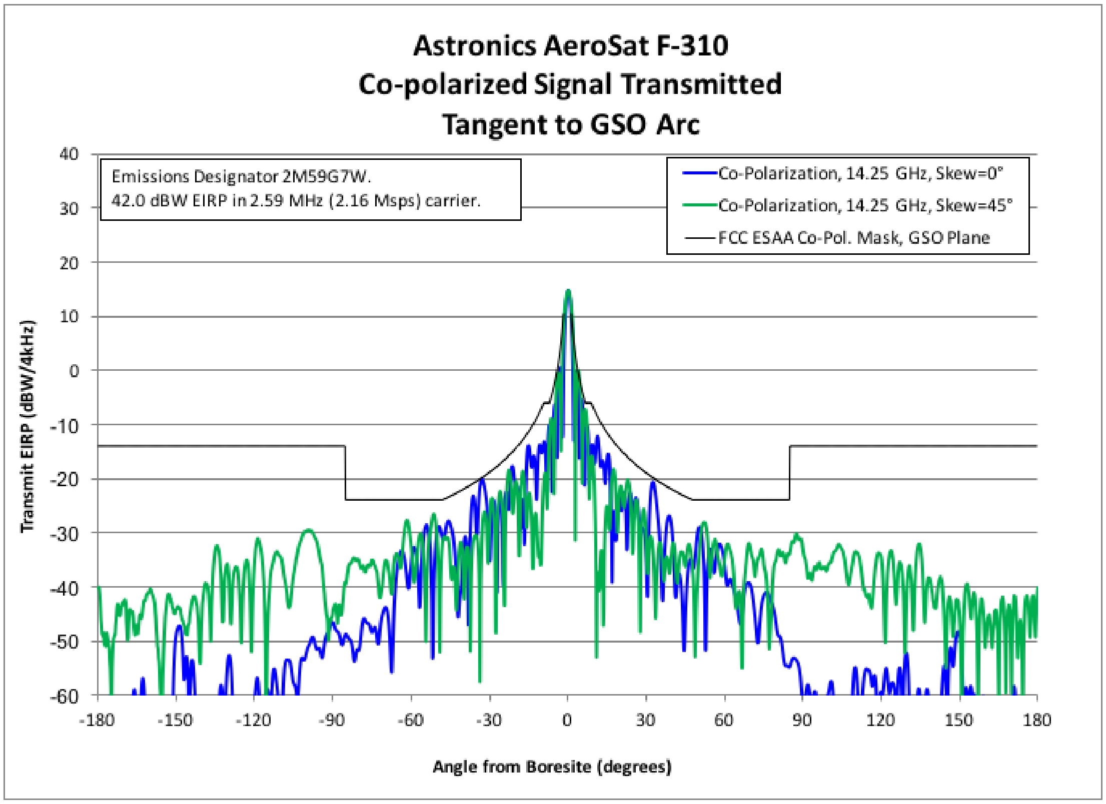
The previous calculation of the power density immediately in the near field in front of the antenna) resulted in a value of 48.53 mW/cm2. Using the analysis provided in Bulletin OET 65, standing more than 26 antenna diameters off axis would decrease the exposure level by at least 34 dB to where the power density on the ground below the tail mounted antenna was less than 2.5% of the MPE for the general population. It is highly unlikely that the general population would ever be permitted to approach the tail of an operational aircraft that closely. Even so, the exposure level at that distance complies with the MPE requirements. At any greater distance (such as boarding the aircraft), the exposure level would be lower still.

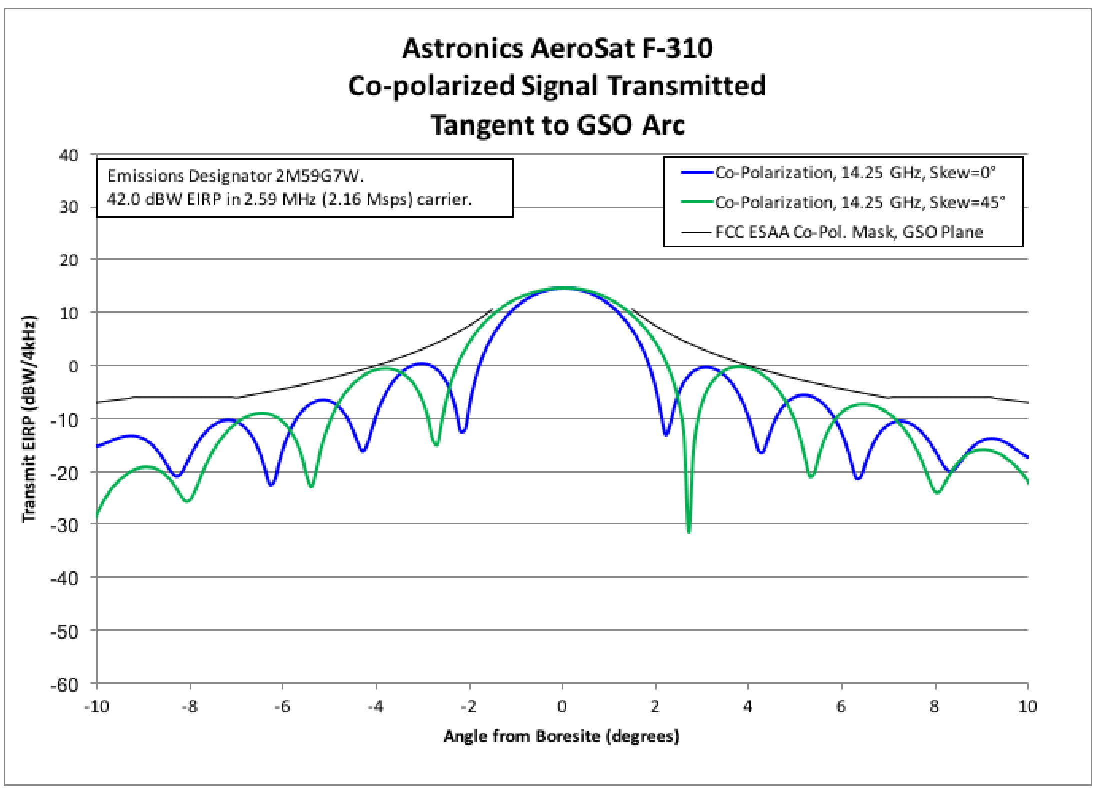
4. Compliance Conclusion

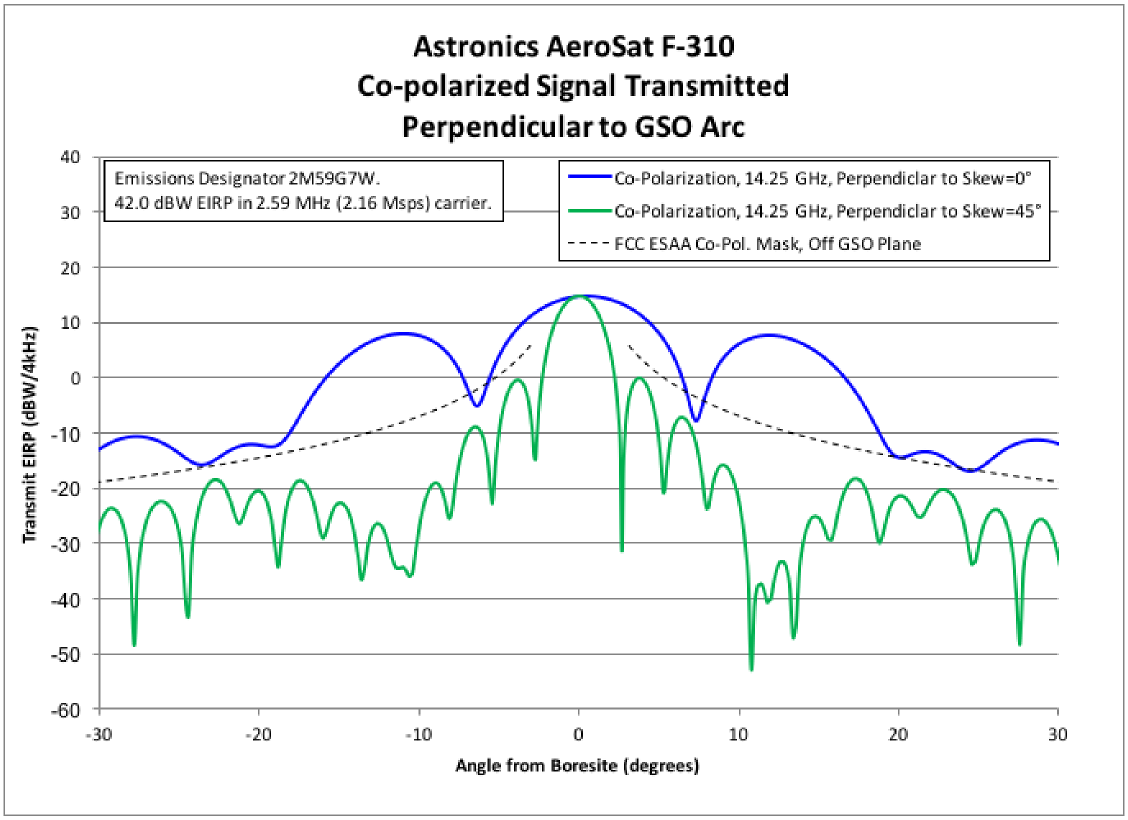
Intelsat and end users will observe standard safety precautions with respect to operations and maintenance of the HR129 / T-310 antenna, including powering the antenna off in advance of maintenance activities. In addition, given the location of the antenna and automatic muting of transmissions with a blockage, there is no possibility that members of the general public will be located in regions where MPE values may be exceeded. Based on the result of the analysis with regard to the potential exposure levels in all respects – directly in front of the antenna, to the side of the antenna, and at ground level – and taking into account the access restrictions for both trained and un-trained persons and standard safety procedures, the operation of the Astronics AeroSat 0.29 meter Ku-band antenna as a tail-mounted aircraft antenna satisfies the MPE compliance requirements in the FCC regulations.

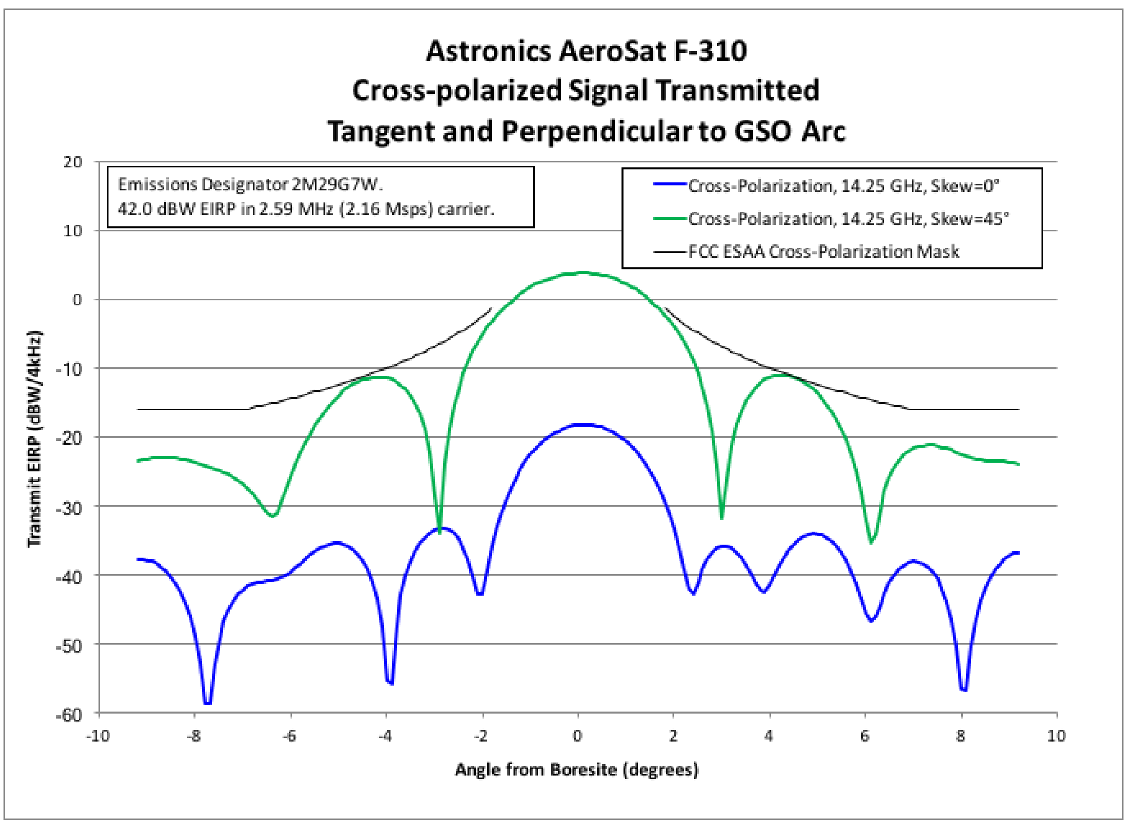
V. Astronics AeroSat FliteStream™ F-310 (HR6400)

A. Off-Axis EIRP Spectral Density Plots






Astronics AeroSat F-310
Co-polarized Signal Transmitted
Perpendicular to GSO Arc
Emissions Designator 2M59G7W.
42.0 dBW EIRP in 2.59 MHz (2.16 Msps) carrier.
Co-Polarization, 14.25 GHz, Perpendiclar to Skew=0°
Co-Polarization, 14.25 GHz, Perpendiclar to Skew=45°
FCC ESAA Co-Pol. Mask, Off GSO Plane
Transmit EIRP (dBW/4kHz)
Angle from Boresite (degrees)
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-30
-20
-10
0
10
20
30


Astronics AeroSat F-310
Cross-polarized Signal Transmitted
Tangent and Perpendicular to GSO Arc
Emissions Designator 2M29G7W.
42.0 dBW EIRP in 2.59 MHz (2.16 Msps) carrier.
Cross-Polarization, 14.25 GHz, Skew=0°
Cross-Polarization, 14.25 GHz, Skew=45°
FCC ESAA Cross-Polarization Mask
Transmit EIRP (dBW/4kHz)
Angle from Boresite (degrees)
20
10
0
-10
-20
-30
-40
-50
-60
-10
-8
-6
-4
-2
0
2
4
6
8
10

B. Supplemental Off-Axis EIRP Density Table

Astronics AeroSat Model F-310 (HR6400)

47 C.F.R. § 25.115(g)(1)(viii)

Co-Polarized Signal Perpendicular to the GSO Arc from
minus 30.6° to plus 31.4°

Angle	**Off-Axis EIRP Density (dBW/4 kHz)**
-30.60	-14.32
-30.40	-13.86
-30.20	-13.43
-30.00	-13.03
-29.80	-12.66
-29.60	-12.32
-29.40	-12.01
-29.20	-11.74
-29.00	-11.49
-28.80	-11.28
-28.60	-11.10
-28.40	-10.96
-28.20	-10.85
-28.00	-10.77
-27.80	-10.73
-27.60	-10.72
-27.40	-10.75
-27.20	-10.82
-27.00	-10.91
-26.80	-11.05
-26.60	-11.21
-26.40	-11.42
-26.20	-11.65
-26.00	-11.92
-25.80	-12.23
-25.60	-12.57
-25.40	-12.93
-25.20	-13.32
-25.00	-13.73
-24.80	-14.16
-24.60	-14.57
-24.40	-14.97
-24.20	-15.32
-24.00	-15.60
-23.80	-15.78
-23.60	-15.84
-23.40	-15.79
-23.20	-15.62
-23.00	-15.37
-22.80	-15.04
-22.60	-14.67
-22.40	-14.29
-22.20	-13.91
-22.00	-13.54

-21.80	-13.21
-21.60	-12.91
-21.40	-12.66
-21.20	-12.46
-21.00	-12.30
-20.80	-12.20
-20.60	-12.14
-20.40	-12.14
-20.20	-12.18
-20.00	-12.26
-19.80	-12.36
-19.60	-12.47
-19.40	-12.55
-19.20	-12.58
-19.00	-12.50
-18.80	-12.28
-18.60	-11.89
-18.40	-11.32
-18.20	-10.58
-18.00	-9.73
-17.80	-8.80
-17.60	-7.82
-17.40	-6.84
-17.20	-5.87
-17.00	-4.92
-16.80	-4.00
-16.60	-3.13
-16.40	-2.30
-16.20	-1.51
-16.00	-0.76
-15.80	-0.05
-15.60	0.61
-15.40	1.24
-15.20	1.84
-15.00	2.40
-14.80	2.93
-14.60	3.43
-14.40	3.90
-14.20	4.34
-14.00	4.76
-13.80	5.15
-13.60	5.51
-13.40	5.85
-13.20	6.17
-13.00	6.45
-12.80	6.72
-12.60	6.95

-12.40	7.16
-12.20	7.34
-12.00	7.50
-11.80	7.63
-11.60	7.73
-11.40	7.80
-11.20	7.85
-11.00	7.87
-10.80	7.86
-10.60	7.82
-10.40	7.76
-10.20	7.66
-10.00	7.53
-9.90	7.45
-9.80	7.36
-9.70	7.27
-9.60	7.16
-9.50	7.04
-9.40	6.92
-9.30	6.78
-9.20	6.63
-9.10	6.46
-9.00	6.29
-8.90	6.10
-8.80	5.89
-8.70	5.67
-8.60	5.44
-8.50	5.18
-8.40	4.91
-8.30	4.62
-8.20	4.30
-8.10	3.97
-8.00	3.61
-7.90	3.22
-7.80	2.80
-7.70	2.36
-7.60	1.88
-7.50	1.37
-7.40	0.82
-7.30	0.23
-7.20	-0.39
-7.10	-1.06
-7.00	-1.75
-6.90	-2.47
-6.80	-3.20
-6.70	-3.89
-6.60	-4.50

-6.50	-4.96
-6.40	-5.19
-6.30	-5.15
-6.20	-4.84
-6.10	-4.30
-6.00	-3.60
-5.90	-2.81
-5.80	-1.98
-5.70	-1.16
-5.60	-0.35
-5.50	0.42
-5.40	1.16
-5.30	1.86
-5.20	2.52
-5.10	3.14
-5.00	3.74
-4.90	4.30
-4.80	4.83
-4.70	5.33
-4.60	5.81
-4.50	6.26
-4.40	6.69
-4.30	7.11
-4.20	7.50
-4.10	7.87
-4.00	8.23
-3.90	8.57
-3.80	8.90
-3.70	9.21
-3.60	9.51
-3.50	9.80
-3.40	10.07
-3.30	10.33
-3.20	10.59
-3.10	10.83
-3.00	11.06
-2.90	11.28
-2.80	11.49
-2.70	11.70
-2.60	11.90
-2.50	12.08
-2.40	12.26
-2.30	12.44
-2.20	12.60
-2.10	12.76
-2.00	12.91
-1.90	13.05

-1.80	13.19
-1.70	13.32
-1.60	13.45
-1.50	13.56
-1.40	13.68
-1.30	13.78
-1.20	13.88
-1.10	13.98
-1.00	14.06
-0.90	14.15
-0.80	14.22
-0.70	14.29
-0.60	14.36
-0.50	14.41
-0.40	14.47
-0.30	14.51
-0.20	14.55
-0.10	14.59
0.00	14.62
0.10	14.64
0.20	14.66
0.30	14.67
0.40	14.68
0.50	14.68
0.60	14.67
0.70	14.66
0.80	14.64
0.90	14.62
1.00	14.59
1.10	14.56
1.20	14.52
1.30	14.48
1.40	14.43
1.50	14.37
1.60	14.31
1.70	14.24
1.80	14.17
1.90	14.09
2.00	14.01
2.10	13.92
2.20	13.82
2.30	13.72
2.40	13.61
2.50	13.50
2.60	13.38
2.70	13.25
2.80	13.12
2.90	12.98

3.00	12.83
3.10	12.68
3.20	12.52
3.30	12.35
3.40	12.17
3.50	11.99
3.60	11.79
3.70	11.59
3.80	11.38
3.90	11.16
4.00	10.93
4.10	10.70
4.20	10.45
4.30	10.19
4.40	9.92
4.50	9.63
4.60	9.34
4.70	9.03
4.80	8.71
4.90	8.37
5.00	8.02
5.10	7.65
5.20	7.26
5.30	6.85
5.40	6.43
5.50	5.97
5.60	5.50
5.70	5.00
5.80	4.47
5.90	3.90
6.00	3.30
6.10	2.66
6.20	1.98
6.30	1.24
6.40	0.45
6.50	-0.39
6.60	-1.31
6.70	-2.29
6.80	-3.34
6.90	-5.56
7.00	-4.45
7.10	-6.60
7.20	-7.44
7.30	-7.88
7.40	-7.81
7.50	-7.27
7.60	-6.43

7.70	-5.45
7.80	-4.45
7.90	-3.49
8.00	-2.58
8.10	-1.75
8.20	-0.99
8.30	-0.28
8.40	0.36
8.50	0.95
8.60	1.49
8.70	1.99
8.80	2.45
8.90	2.88
9.00	3.28
9.10	3.64
9.20	3.98
9.30	4.30
9.40	4.59
9.50	4.86
9.60	5.12
9.70	5.35
9.80	5.57
9.90	5.78
10.00	5.97
10.20	6.31
10.40	6.60
10.60	6.85
10.80	7.05
11.00	7.22
11.20	7.35
11.40	7.45
11.60	7.52
11.80	7.55
12.00	7.55
12.20	7.53
12.40	7.47
12.60	7.38
12.80	7.27
13.00	7.13
13.20	6.96
13.40	6.77
13.60	6.55
13.80	6.30
14.00	6.04
14.20	5.74
14.40	5.43
14.60	5.09

14.80	4.72
15.00	4.32
15.20	3.90
15.40	3.45
15.60	2.97
15.80	2.45
16.00	1.90
16.20	1.31
16.40	0.69
16.60	0.03
16.80	-0.68
17.00	-1.42
17.20	-2.21
17.40	-3.04
17.60	-3.92
17.80	-4.85
18.00	-5.82
18.20	-6.84
18.40	-7.90
18.60	-9.00
18.80	-10.10
19.00	-11.19
19.20	-12.21
19.40	-13.11
19.60	-13.82
19.80	-14.29
20.00	-14.51
20.20	-14.53
20.40	-14.41
20.60	-14.21
20.80	-13.99
21.00	-13.79
21.20	-13.63
21.40	-13.52
21.60	-13.47
21.80	-13.48
22.00	-13.56
22.20	-13.69
22.40	-13.88
22.60	-14.13
22.80	-14.43
23.00	-14.78
23.20	-15.16
23.40	-15.56
23.60	-15.95
23.80	-16.33
24.00	-16.65

24.20	-16.88
24.40	-17.00
24.60	-16.99
24.80	-16.84
25.00	-16.58
25.20	-16.22
25.40	-15.80
25.60	-15.34
25.80	-14.87
26.00	-14.41
26.20	-13.97
26.40	-13.55
26.60	-13.16
26.80	-12.81
27.00	-12.50
27.20	-12.23
27.40	-12.00
27.60	-11.80
27.80	-11.64
28.00	-11.52
28.20	-11.43
28.40	-11.38
28.60	-11.35
28.80	-11.36
29.00	-11.40
29.20	-11.46
29.40	-11.56
29.60	-11.68
29.80	-11.83
30.00	-12.01
30.20	-12.22
30.40	-12.46
30.60	-12.73
30.80	-13.03
31.00	-13.37
31.20	-13.73
31.40	-14.13

C. HR6400 Radiation Hazard Study

Radiation Hazard Analysis for HR6400 Antenna System

This report analyzes the non-ionizing radiation levels for the HR6400 Antenna System. This report is developed in accordance with the prediction methods contained in OET Bulletin No. 65, Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields, 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 General Population/ Uncontrolled Environment and the Controlled Environment, where the general population does not have access.

The maximum level of non-ionizing radiation to which individuals may be exposed is limited to a power density level of 5 milliwatts per square centimeter (5 mW/cm2) averaged over any 6-minute period in a controlled environment, and the maximum level of non-ionizing radiation to which the general public is exposed is limited to a power density level of 1 milliwatt per square centimeter (1 mW/cm2) averaged over any 30 minute period in a uncontrolled environment.

In the normal range of transmit powers for satellite antennas, the power densities at or around the antenna radiating surface is expected to exceed safe levels. This area will not be accessible to the general public. Operators and technicians will receive training specifying this area as a high exposure area. Procedures will be established to ensure that all transmitters are turned off before this area may be accessed by operators, maintenance or other authorized personnel.

Near Field and Transition Region Exposure

Near and far field boundaries are calculated using OET Bulletin No. 65 formulas and the HR6400's effective diameter. The effective diameter is calculated based upon a measured efficiency value of 70%.

The HR6400 Antenna potentially exceeds MPE limits in the near field within the rectangular volume directly in front of the panels (11.75 mW/cm2). For this calculation, it was assumed that all 16.8 watts from the SSPA are uniformly distributed across the surface area of the panel. 16.8 W are required at the aperture flange to achieve the maximum EIRP capability, 45.5 dBW, of the HR6400. This is a reasonable assumption for a waveguide fed horn with lens array with minimal sidelobe tapering.

The HR6400 Antenna potentially exceeds MPE limits at the near field boundary of 1.6m with a power density value 44.6 mW/cm2. The HR6400 Antenna potentially exceeds MPE limits at the far field boundary of 3.9m with a power density value 19.1 mW/cm2.

In normal operation, this antenna is mounted on the top of an aircraft fuselage with the main beam pointed toward the sky at a typical elevation angle of 25 degrees such that human exposure in the near field is not possible. Furthermore, normal TDMA operation uses a duty cycle of 10% or less, reducing maximum near field and transition region exposures by an order of magnitude to, respectively, 1.2 4.5 and 1.9 mW/cm^2 at the surface, near field boundary, and the far field bouondary.

Additionally, in normal operation, any blockage in the near field (human or otherwise) will cause the transmitter to be disabled within milliseconds seconds as the system does not transmit unless it can receive the downlink carrier from the satellite. Therefore, prolonged exposure in the near field is not possible in normal operation.

Far Field Exposure

At a distance of 7.5 meters, the maximum power density of the HR6400 is 5 mW/cm2. At a distance of 16.8m, the maximum power density is 1.0 mW/cm^2, which is within the limits of General Population/Uncontrolled Exposure (MPE) even in the direction of the main beam of the antenna. As noted previously, the antenna will be mounted on the top of an aircraft with the main beam pointed to the sky at a minimum elevation angle of 25 degrees. In this case, maximum far field exposure to humans would be due to a sidelobe which is at least 7 dB below the main beam. At a distance of 7.5 meters, the exposure to humans would be less than 1.0 mW/cm^2.

Table 1: Parameters Used for Determining PFD (HR6400)

Antenna Width	34 in	0.8636 m
Antenna Height	6.5 in	0.1651 m
Antenna Surface Area		0.14258 m^2
Frequency		14250 MHz
Wavelength		0.02091 m
Transmit Power (at aperture flange)		16.8 W
Antenna Aperture Gain		33.2 dBW
Aperture Efficiency		70%
Aperture Effective Diameter	14.415 in	0.3661 m
EIRP (maximum)		45.5 dBW
Power Density at Aperture Surface		11.75 mW/cm^2
Near Field Distance		1.6 m
Near Field Power Density (Azimuth)		44.6 mW/cm^2
Far Field Boundary		3.85 m
Power Density at far field boundary (Azimuth)		19.1 mW/cm^2
Safe Far Field Distance (Azimuth) for 5 mW/cm^2 For 1 mW/cm^2	24.7 feet 55.1 feet	7.5 m 16.8 m
Elevation side lobe level (worst case)		-7 dB
Power Density at far field boundary (Elevation)		3.81 mW/cm^2

Safe Far Field Distance (Elevation) for 5 mW/cm2	3.85m, the far field boundary Power density is below value
Safe Far Field Distance (Elevation) for 1 mW/cm2	24.6 feet 7.5 m

Conclusions

Intelsat and end users will observe standard safety precautions with respect to operations and maintenance of the HR6400 / F-310 antenna, including powering the antenna off in advance of maintenance activities. Given the location of the antenna (top of aircraft) and automatic muting of transmissions with a blockage, there is no possibility that members of the general public will be located in regions where MPE values may be exceeded.

Based on the result of the analysis with regard to the potential exposure levels in all respects – directly in front of the antenna, to the side of the antenna, and at ground level – and taking into account the access restrictions for both trained and un-trained persons and standard safety procedures, the operation of the Astronics AeroSat HR6400 / F-310 Ku-band antenna satisfies the MPE compliance requirements in the FCC regulations.

VI. Satellite and Gateway Table

Table 1. ESAA/VMES System Satellites

Satellite	FCC Call Sign	Orbital Location	Downlink Freq. (GHz)[3]	ITU Region	Service To U.S.[4]
Galaxy-19	S2647	97° W	11.7-12.2	2	Yes
Horizons-1	S2475	127° W	11.7-12.2	2, 3	Yes
Horizons-3e	S2947	169° E	10.95-11.2; 11.45-11.7; 12.2-12.25; 12.25-12.75	2, 3	Yes
IS-14	S2785	45° W	11.45-11.95	1, 2	Yes
IS-17	S2814	66° E	10.95-11.2; 11.45-11.7; 12.5-12.75	1, 3	No
IS-18	S2817	180° E	10.95-11.2; 11.45-11.7; 12.25-12.75	2, 3	Yes
IS-19	S2850	166° E	12.25-12.75	2, 3	Yes
IS-20	S2847	68.5° E	10.95-11.2; 11.45-11.7; 12.5-12.75	1, 3	No
IS-21[5]	S2863	58° W	11.45 - 11.7	1, 2	Yes
IS-22	S2846	72.1° E	11.45-11.7; 12.25-12.75	1, 3	No

[3] ESAA operations in the 12.2-12.75 GHz band will occur an unprotected, non-harmful interference basis outside the United States (principally in Regions 1 and 3) only, subject to any necessary authorizations from foreign administrations. The 12.5-12.75 GHz band is allocated for FSS downlinks in Region 1 and the 12.2-12.75 GHz band is allocated for FSS downlinks in Region 3.

[4] "Yes" indicates that the relevant satellite may be used for Intelsat's ESAA System operations in U.S. territory, in accordance with any conditions imposed by the underlying Commission license. "No" indicates that Intelsat's operations will be conducted outside U.S. territory, even if the satellite may have some coverage of the United States.

[5] IS-21 uplink operations are limited to the 14.0-14.25 GHz band.

Satellite	FCC Call Sign	Orbital Location	Downlink Freq. (GHz)[3]	ITU Region	Service To U.S.[4]
IS-23	S2831	53° W	11.45-11.7; 11.7-12.2	2	Yes
IS-29e	S2913	50° W	10.95-11.2; 11.45-11.7; 11.7-12.2	1, 2	Yes
IS-32e (Sky B-1)[6]	S2922	43.15° W	11.7-12.2	1, 2	Yes
IS-33e	S2939	60° E	10.95-11.2; 11.45-11.7; 11.7-12.2	1, 3	No
IS-34[7]	S2915	55.5° W	11.45-11.7	1, 2	Yes
IS-35e	S2959	34.5° W	10.95-11.2; 11.45-11.7	1, 2	Yes
IS-37e	S2972	18° W	10.95-11.2; 11.45-11.7; 11.7-11.95; 12.50-12.75	1, 2, 3	Yes

Table 2. Intelsat Network Gateway Earth Stations

Satellite	Gateway Operator	Gateway Earth Station Location	Country	FCC Call Sign
Galaxy-19	Intelsat	Hagerstown, MD	U.S.	E040141
Horizons-1	Intelsat	Atlanta, GA	U.S.	E990092
Horizons-3e	TBD	TBD	TBD	TBD
IS-14	Intelsat	Atlanta, GA	U.S.	E090093

[6] This satellite is licensed to DIRECTV Enterprises, LLC. Pursuant to a contract dated October 12, 2015 with DTVLA B.V., Intelsat holds transponder capacity for the payload with which the ESAA terminals will communicate. *See* Letter from Jennifer Hindin, Counsel for DIRECTV Enterprises, LLC, Application for Authority to Launch and Operate a Ku-Band Satellite at 43.1° W.L.; File No. SAT-AMD-20150806-00054, Call Sign S2922 (filed Nov. 3, 2015) (Request for Confidential Treatment and contract submitted therewith).

[7] IS-34 uplink operations are limited to the 14.0-14.25 GHz band.

Satellite	Gateway Operator	Gateway Earth Station Location	Country	FCC Call Sign
IS-17	Intelsat	Fuchsstadt	Germany	N/A
IS-18	Telstra	Oxford Falls	Australia	N/A
IS-19	Intelsat	Napa, CA	U.S.	E980460
IS-20	Intelsat	Fuchsstadt	Germany	N/A
IS-21	Intelsat	Hagerstown, MD	U.S.	E120051
IS-22	Intelsat	Fuchsstadt	Germany	N/A
IS-22	KTSat	Kumsan	Korea	N/A
IS-23	Intelsat	Nuevo, CA	U.S.	E020191
IS-29e	Intelsat Intelsat Speedcast	Hagerstown, MD Hagerstown, MD Macae	U.S. U.S. Brazil	E150002 E140121 N/A
IS-32e	Intelsat	Hagerstown, MD	U.S.	TBD
IS-33e	Intelsat KTSat Neotel/Liquid Telecom	Fuchsstadt Kumsan Johannesburg	Germany Korea South Africa	N/A N/A N/A
IS-34	Intelsat	Hagerstown, MD	U.S.	E070139
IS-35e	Intelsat Intelsat	Hagerstown, MD Fuchsstadt	U.S. Germany	TBD N/A
IS-37e	Intelsat Intelsat	Hagerstown, MD Fuchsstadt	U.S. Germany	TBD N/A

VII. Section 25.226 Certification

Intelsat License LLC ("Intelsat"), pursuant to Section 25.226 of the FCC's rules, hereby certifies the following:

1. In accordance with Section 25.226(b)(7), Intelsat certifies that its proposed operations comply with the following requirements of Section 25.226:

   Per Section 25.226(a)(6), for each VMES transmitter, Intelsat will keep a record of the vehicle location (i.e., latitude/longitude), transmit frequency, channel bandwidth and satellite used shall be time annotated and maintained for a period of not less than one (1) year. Records shall be recorded at time intervals no greater than every five (5) minutes while the VMES is transmitting. Intelsat will make this data available upon request to a coordinator, fixed system operator, Fixed-Satellite Service system operator, NTIA, or the Commission within 24 hours of the request.

By: __/s/ *Susan Crandall*____________
Susan Crandall
Associate General Counsel
Intelsat Corporation

February 8, 2018

VIII. <u>Section 25.227 Certifications</u>

Intelsat License LLC ("Intelsat"), pursuant to Section 25.227 of the FCC's rules, hereby certifies the following:

2. In accordance with Section 25.227(a)(15), as the operator of an ESAA system operating over international waters, Intelsat has confirmed with its target space station operators that its existing and proposed operations are within coordinated parameters for adjacent satellites up to six degrees away (+/- 6°) on the geostationary arc.

3. In accordance with Section 25.227(b)(7), Intelsat certifies that its proposed operations comply with the following requirements of Section 25.227:

- Per Section 25.227(a)(6), for each ESAA transmitter, Intelsat will time annotate and maintain a record for a period of not less than one year of the vehicle location (i.e., latitude/longitude/altitude), transmit frequency, channel bandwidth and satellite used. Records will be recorded at time intervals no greater than one (1) minute while the ESAA is transmitting. Intelsat will make this data available in the requisite format within 24 hours of a request from the Commission, NTIA, or a frequency coordinator for purposes of resolving harmful interference events.
- Per Section 25.227(a)(9), each ESAA terminal will automatically cease transmitting within 100 milliseconds upon loss of reception of the satellite downlink signal or when it detects that unintended satellite tracking has happened or is about to happen.
- Per Section 25.227(a)(10), each ESAA terminal will be subject to the monitoring and control by an NCMC or equivalent facility. Each terminal will be able to receive "enable transmission" and "disable transmission" commands from the NCMC and must automatically cease transmissions immediately on receiving any "parameter change command", which may cause harmful interference during the change, until it receives an "enable transmission" command from its NCMC. In addition, the NCMC will be able to monitor the operation of an ESAA terminal to determine if it is malfunctioning.
- Per Section 25.227(a)(11), each ESAA terminal shall be self-monitoring and, should a fault which can cause harmful interference to FSS networks be detected, the terminal will automatically cease transmissions.

By: __/s/ *Susan Crandall*____________
Susan Crandall
Associate General Counsel
Intelsat Corporation

February 8, 2018

IX. Section 25.226 Compliance Matrix

Rule	Text	Application Citation
§ 25.226	**§ 25.226 Blanket licensing provisions for domestic, U.S. VMESs operating with GSO FSS space stations in the 10.95-11.2 GHz, 11.45-11.7 GHz, 11.7-12.2 GHz, and 14.0-14.5 GHz bands.**	
§ 25.226(a)	(a) The following ongoing requirements govern all VMES licensees and operations in the 10.95-11.2 GHz (space-to-Earth), 11.45-11.7 GHz (space-to-Earth), 11.7-12.2 GHz (space-to-Earth) and 14.0-14.5 GHz (Earth-to-space) bands receiving from and transmitting to geostationary orbit satellites in the Fixed-Satellite Service. VMES licensees shall comply with the requirements in either paragraph (a)(1), (a)(2) or (a)(3) of this section and all of the requirements set forth in paragraphs (a)(4) through (a)(9) and paragraphs (c), (d), and (e) of this section. Paragraph (b) of this section identifies items that shall be included in the application for VMES operations to demonstrate that these ongoing requirements will be met.	
§ 25.226(a)(1)	(1) The following requirements shall apply to a VMES that uses transmitters with off-axis EIRP spectral-densities lower than or equal to the levels in paragraph (a)(1)(i) of this section. A VMES, or VMES system, operating under this section shall provide a detailed demonstration as described in paragraph (b)(1) of this section. The VMES transmitter also shall comply with the antenna pointing and cessation of emission requirements in paragraphs (a)(1)(ii) and (a)(1)(iii) of this section.	Intelsat complies for all terminal operations in two-degree spacing environments.
§ 25.226(a)(1)(i)(A)	(A) EIRP spectral density emitted in the plane tangent to the GSO arc, as defined in §25.103, must not exceed the following values: 15 - 25 log10(θ) dBW/4 kHz For $1.5° \leq \theta \leq 7°$ -6 dBW/4 kHz For $7° < \theta \leq 9.2°$ 18 - 25 log10(θ) dBW/4 kHz For $9.2° < \theta \leq 19.1°$ -14 dBW/4 kHz For $19.1° < \theta \leq 180°$ Where theta (θ) is the angle in degrees from a line from the earth station antenna to the assigned orbital location of the target satellite. The EIRP density levels specified for $\theta > 7°$ may be exceeded by up to 3 dB in up to 10% of the range of theta (θ) angles from ±7-180°, and by up to 6 dB in the region of main reflector spillover energy.	*See* Technical Appendix, IV.A & V.A.

§ 25.226(a)(1)(i)(B)	(B) The EIRP spectral density of co-polarized signals must not exceed the following values in the plane perpendicular to the GSO arc, as defined in §25.103: 18 - 25 log(θ) dBW/4 kHz For 3° ≤ θ ≤ 19.1° -14 dBW/4 kHz For 19.1° < θ ≤ 180° Where θ is as defined in paragraph (a)(1)(i)(A) of this section. These EIRP density levels may be exceeded by up to 6 dB in the region of main reflector spillover energy and in up to 10% of the range of θ angles not included in that region, on each side of the line from the earth station to the target satellite.	*Id.* Intelsat seeks a waiver of §25.226(a)(1)(i)(B) for HR6400 terminal operations (*see* Legal Narrative, III.A).
§ 25.226(a)(1)(i)(C)	(C) The off-axis EIRP spectral-density of cross-polarized signals must not exceed the following values in the plane tangent to the GSO arc or in the plane perpendicular to the GSO arc 5 - 25 log10(θ) dBW/4 kHz For 1.8° ≤ θ ≤ 7° Where θ is as defined in paragraph (a)(1)(i)(A) of this section.	*See* Technical Appendix, IV.A & V.A.
§ 25.226(a)(1)(ii)	(ii) Each VMES transmitter must meet one of the following antenna pointing error requirements: (A) Each VMES transmitter shall maintain a pointing error of less than or equal to 0.2° between the orbital location of the target satellite and the axis of the main lobe of the VMES antenna, or (B) Each VMES transmitter shall declare a maximum antenna pointing error that may be greater than 0.2° provided that the VMES does not exceed the off-axis EIRP spectral-density limits in paragraph (a)(1)(i) of this section, taking into account the antenna pointing error.	*See* Technical Appendix, I; Legal Narrative, II.B.i (HR129 terminal).
§ 25.226(a)(1)(iii)	(iii) Each VMES transmitter must meet one of the following cessation of emission requirements: (A) For VMESs operating under paragraph (a)(1)(ii)(A) of this section, all emissions from the VMES shall automatically cease within 100 milliseconds if the angle between the orbital location of the target satellite and the axis of the main lobe of the VMES antenna exceeds 0.5°, and transmission shall not resume until such angle is less than or equal to 0.2°, or (B) For VMES transmitters operating under paragraph (a)(1)(ii)(B) of this section, all emissions from the VMES shall automatically cease within 100 milliseconds if the angle between the orbital location of the target satellite and the axis of the main lobe of the VMES antenna exceeds the declared maximum antenna pointing error and shall not resume transmissions until such angle is less than or equal to the declared maximum antenna pointing error.	*Id.*

25.226(a)(2)	(2) The following requirements apply to VMES systems that operate with off-axis EIRP spectral-densities in excess of the levels in paragraph (a)(1)(i) or (a)(3)(i) of this section under licenses granted based on certifications filed pursuant to paragraph (b)(2) of this section. (i) A VMES or VMES system licensed based on certifications filed pursuant to paragraph (b)(2) of this section must operate in accordance with the off-axis EIRP density specifications provided to the target satellite operator in order to obtain the certifications. (ii) Any VMES transmitter operating under a license granted based on certifications filed pursuant to paragraph (b)(2) of this section must be self-monitoring and capable of shutting itself off and must cease or reduce emissions within 100 milliseconds after generating off-axis EIRP-density in excess of the specifications supplied to the target satellite operator. (iii) A system with variable power control of individual VMES transmitters must monitor the aggregate off- axis EIRP density from simultaneously transmitting VMES transmitters at the system's network control and monitoring center. If simultaneous operation of two or more VMES transmitters causes aggregate off-axis EIRP density to exceed the off-axis EIRP density specifications supplied to the target satellite operator, the network control and monitoring center must command those transmitters to cease emissions or reduce the aggregate EIRP density to a level at or below those specifications, and the transmitters must comply within 100 milliseconds of receiving the command.	*See* Technical Appendix, I & III; Legal Narrative, II.B.ii (HR6400 terminal).
§ 25.226(a)(3)	(3) The he following requirements apply to a VMES system that uses variable power control of individual VMES earth stations transmitting simultaneously in the same frequencies to the same target satellite, unless the system operates pursuant to paragraph (a)(2) of this section. (i) Aggregate EIRP density from co-frequency earth stations in each target satellite receiving beam, not resulting from colliding data bursts transmitted pursuant to a contention protocol, will not exceed the limits defined in paragraph (a)(1)(i) this section. (ii) Each VMES transmitter must be self-monitoring and capable of shutting itself off and must cease or reduce emissions within 100 milliseconds after generating off-axis EIRP density in excess of the limit in paragraph (a)(3)(i) of this section. (iii) Aggregate power density from simultaneously transmitting VMES transmitters must be monitored at the system's network control and monitoring center. If simultaneous operation of two or more transmitters in a VMES network causes aggregate off-axis EIRP density to exceed the off-axis EIRP density limit in paragraph (a)(3)(i) of this section, the network control and monitoring center must command those transmitters to cease emissions or reduce the aggregate EIRP density to a level at or below that limit, and those transmitters must comply within 100 milliseconds of receiving the command.	N/A

§ 25.226(a)(4)	(4) An applicant filing to operate an VMES terminal or system and planning to use a contention protocol shall certify that its contention protocol use will be reasonable.	N/A
§ 25.226(a)(5)	(5) There shall be a point of contact in the United States, with phone number and address, available 24 hours a day, seven days a week, with authority and ability to cease all emissions from the VMESs.	*See* Technical Appendix, I.
§ 25.226(a)(6)	(6) For each VMES transmitter, a record of the vehicle location (i.e., latitude/longitude), transmit frequency, channel bandwidth and satellite used shall be time annotated and maintained for a period of not less than one (1) year. Records shall be recorded at time intervals no greater than every five (5) minutes while the VMES is transmitting. The VMES operator shall make this data available upon request to a coordinator, fixed system operator, Fixed-Satellite Service system operator, NTIA, or the Commission within 24 hours of the request.	*See* Technical Appendix, VII.
§ 25.226(a)(7)	(7) In the 10.95-11.2 GHz (space-to-Earth) and 11.45-11.7 GHz (space-to-Earth) frequency bands VMESs shall not claim protection from interference from any authorized terrestrial stations to which frequencies are either already assigned, or may be assigned in the future.	Applicable regulatory status and protection provision. Intelsat complies.
§ 25.226(a)(8)	(8) A VMES terminal receiving in the 10.95-11.2 GHz (space-to-Earth), 11.45-11.7 GHz (space-to-Earth) and 11.7-12.2 GHz (space-to-Earth) bands shall receive protection from interference caused by space stations other than the target space station only to the degree to which harmful interference would not be expected to be caused to anearth station employing an antenna conforming to the referenced patterns defined in § 25.209(a) and (b) and stationary at the location at which any interference occurred.	Applicable regulatory status and protection provision. Intelsat complies.
§ 25.226(a)(9)	(9) Each VMES terminal shall automatically cease transmitting upon the loss of synchronization or within 5 seconds upon loss of reception of the satellite downlink, whichever is the shorter time frame.	*See* Technical Appendix, I.
§ 25.226(b)	(b) Applications for VMES operation in the 14.0-14.5 GHz (Earth-to-space) band to GSO satellites in the FSS shall include, in addition to the particulars of operation identified on FCC Form 312, and associated Schedule B, the applicable technical demonstrations in paragraphs (b)(1), (b)(2), or (b)(3), and the documentation identified in paragraphs (b)(4) through (b)(8) of this section.	
§ 25.226(b)(1)	(1) An VMES applicant proposing to implement a transmitter under paragraph (a)(1) of this section must	

	provide the information required by §25.115(g)(1). An applicant proposing to implement a transmitter under paragraph (a)(1)(ii)(A) of this section must also provide the certifications identified in paragraph (b)(1)(iii) of this section. An applicant proposing to implement a transmitter under paragraph (a)(1)(ii)(B) of this section must also provide the demonstrations identified in paragraph (b)(1)(iv) of this section. (i)-(ii) [Reserved] (iii) An VMES applicant proposing to implement a transmitter under paragraph (a)(1)(ii)(A) of this section shall: (A) Demonstrate that the total tracking error budget of their antenna is within 0.2° or less between the orbital location of the target satellite and the axis of the main lobe of the VMES antenna. As part of the engineering analysis, the VMES applicant must show that the antenna pointing error is within three sigma () from the mean value, *i.e.,* that there is a 0.997 probability the antenna maintains a pointing error within 0.2°; and (B) Demonstrate that the antenna tracking system is capable of ceasing emissions within 100 milliseconds if the angle between the orbital location of the target satellite and the axis of the main lobe of the VMES antenna exceeds 0.5°. (iv) An VMES applicant proposing to implement a transmitter under paragraph (a)(1)(ii)(B) of this section shall: (A) Declare, in its application, a maximum antenna pointing error and demonstrate that the maximum antenna pointing error can be achieved without exceeding the off-axis EIRP spectral-density limits in paragraph (a)(1)(i) of this section; and (B) Demonstrate that the VMES transmitter can detect if the transmitter exceeds the declared maximum antenna pointing error and can cease transmission within 100 milliseconds if the angle between the orbital location of the target satellite and the axis of the main lobe of the VMES antenna exceeds the declared maximum antenna pointing error, and will not resume transmissions until the angle between the orbital location of the target satellite and the axis of the main lobe of the VMES antenna is less than or equal to the declared maximum antenna pointing error.	*See* Technical Appendix, I, IV.A (HR129 terminal plots); Legal Narrative, II.B.i.

§ 25.226(b)(2)	(2) An VMES applicant proposing to operate with off-axis EIRP density in excess of the levels in paragraph (a)(1)(i) or (a)(3)(i) of this section must provide the following in exhibits to its earth station application: (i) Off-axis EIRP density data pursuant to §25.115(g)(1); (ii) The certifications required by §25.220(d); and (iii) A detailed showing that each VMES transmitter in the system will automatically cease or reduce emissions within 100 milliseconds after generating EIRP density exceeding specifications provided to the target satellite operator; and (iv) A detailed showing that the aggregate power density from simultaneously transmitting VMES transmitters will be monitored at the system's network control and monitoring center; that if simultaneous operation of two or more VMES transmitters causes the aggregate off-axis EIRP density to exceed the off-axis EIRP density specifications supplied to the target satellite operator, the network control and monitoring center will command those transmitters to cease emissions or reduce the aggregate EIRP density to a level at or below those specifications; and that those transmitters will comply within 100 milliseconds of receiving the command.	*See* Technical Appendix, I, V.A (HR6400 terminal plots) & III (operator certification letters); Legal Narrative, II.B.ii.
§ 25.226(b)(3)	(3) An applicant proposing to implement an VMES system subject to paragraph (a)(3) of this section must provide the following information in exhibits to its earth station application: (i) Off-axis EIRP density data pursuant to §25.115(g)(1); (ii) A detailed showing of the measures that will be employed to maintain aggregate EIRP density at or below the limit in paragraph (a)(3)(i) of this section; (iii) A detailed showing that each VMES terminal will automatically cease or reduce emissions within 100 milliseconds after generating off-axis EIRP density exceeding the limit in paragraph (a)(3)(i) of this section; and (iv) A detailed showing that the aggregate power density from simultaneously transmitting VMES transmitters will be monitored at the system's network control and monitoring center; that if simultaneous operation of two or more transmitters in the VMES network causes aggregate off-axis EIRP density to exceed the off-axis density limit in paragraph (a)(3)(i) of this section, the network control and monitoring center will command those transmitters to cease emissions or reduce the aggregate EIRP density to a level at or below that limit; and that those transmitters will comply within 100 milliseconds of receiving the command.	N/A

§ 25.226(b)(4)	(4) There shall be an exhibit included with the application describing the geographic area(s) in which the VMES will operate.	*See* Technical Appendix, II.
§ 25.226(b)(5)	(5) Any VMES applicant filing for an VMES terminal or system and planning to use a contention protocol shall include in its application a certification that will comply with the requirements of paragraph (a)(4) of this section.	N/A
§ 25.226(b)(6)	(6) The point of contact referred to in paragraph (a)(5) of this section shall be included in the application.	*See* Technical Appendix, I.
§ 25.226(b)(7)	(7) Any VMES applicant filing for a VMES terminal or system shall include in its application a certification that will comply with the requirements of paragraph (a)(6) of this section.	*See* Technical Appendix, VII.
§ 25.226(b)(8)	(8) All VMES applicants shall submit a radio frequency hazard analysis determining via calculation, simulation, or field measurement whether VMES terminals, or classes of terminals, will produce power densities that will exceed the Commission's radio frequency exposure criteria. VMES applicants with VMES terminals that will exceed the guidelines in § 1.1310 of this chapter for radio frequency radiation exposure shall provide, with their environmental assessment, a plan for mitigation of radiation exposure to the extent required to meet those guidelines. All VMES licensees shall ensure installation of VMES terminals on vehicles by qualified installers who have an understanding of the antenna's radiation environment and the measures best suited to maximize protection of the general public and persons operating the vehicle and equipment. A VMES terminal exhibiting radiation exposure levels exceeding 1.0 mW/cm 2 in accessible areas, such as at the exterior surface of the radome, shall have a label attached to the surface of the terminal warning about the radiation hazard and shall include thereon a diagram showing the regions around the terminal where the radiation levels could exceed 1.0 mW/cm 2. All VMES applicants shall demonstrate that their VMES terminals are capable of automatically ceasing transmissions upon the loss of synchronization or within 5 seconds upon loss of reception of the satellite	*See* Technical Appendix, I, IV.B & V.C.
§ 25.226(b)(9)	(9) Except for VMES systems operating pursuant to paragraphs (a)(2) and (a)(3)(ii) of this section, VMES systems authorized pursuant to this section shall be eligible for a license that lists Permitted List as an authorized point of communication.	*See* Legal Narrative, II.B.iii.

§ 25.226(c)	(c)(1) Operations of VMESs in the 14.0-14.2 GHz (Earth-to-space) frequency band in the radio line-of- sight of the NASA TDRSS facilities on Guam (latitude 13° 36' 55" N, longitude 144° 51' 22" E) or White Sands, New Mexico (latitude 32° 20' 59" N, longitude 106° 36' 31" W and latitude 32° 32' 40" N, longitude 106° 36' 48" W) are subject to coordination with the National Aeronautics and Space Administration (NASA) through the National Telecommunications and Information Administration (NTIA) Interdepartment Radio Advisory Committee (IRAC). Licensees shall notify the International Bureau once they have completed coordination. Upon receipt of such notification from a licensee, the International Bureau will issue a public notice stating that the licensee may commence operations within the coordination zone in 30 days if no party has opposed the operations. (2) When NTIA seeks to provide similar protection to future TDRSS sites that have been coordinated through the IRAC Frequency Assignment Subcommittee process, NTIA will notify the Commission's International Bureau that the site is nearing operational status. Upon public notice from the International Bureau, all Ku-band VMES licensees shall cease operations in the 14.0-14.2 GHz band within radio line-of-sight of the new TDRSS site until the licensees complete coordination with NTIA/IRAC for the new TDRSS facility. Licensees shall notify the International Bureau once they have completed coordination for the new TDRSS site. Upon receipt of such notification from a licensee, the International Bureau will issue a public notice stating that the licensee may commence operations within the coordination zone in 30 days if no party has opposed the operations. The VMES licensee then will be permitted to commence operations in the 14.0-14.2 GHz band within radio line-of-sight of the new TDRSS site, subject to any operational constraints developed in the coordination process.	Intelsat will not transmit in the radio line-of-sight of the subject facilities. In the event Intelsat seeks to operate within the relevant zone, it will coordinate as necessary.
§ 25.226(d)	(d)(1) Operations of VMESs in the 14.47-14.5 GHz (Earth-to-space) frequency band in the radio line-of- sight of radio astronomy service (RAS) observatories observing in the 14.47-14.5 GHz band are subject to coordination with the National Science Foundation (NSF). The appropriate NSF contact point to initiate coordination is Electromagnetic Spectrum Manager, NSF, 4201 Wilson Blvd., Suite 1045, Arlington VA 22203, fax 703-292-9034, email esm@nsf.gov. Licensees shall notify the International Bureau once they have completed coordination. Upon receipt of the coordination agreement from a licensee, the International Bureau will issue a public notice stating that the licensee may commence operations within the coordination zone in 30 days if no party has opposed the operations. (2) Table 1 provides a list of each applicable RAS site, its location, and the applicable coordination zone. (3) When NTIA seeks to provide similar protection to future RAS sites that have been coordinated through the IRAC Frequency Assignment Subcommittee process, NTIA will notify the Commission's International Bureau that the site is nearing operational status. Upon public notice from the International Bureau, all Ku-band VMES licensees shall cease operations in the 14.47-14.5 GHz band within the relevant geographic zone of the new RAS site until the licensees complete coordination for the new RAS facility. Licensees shall notify the International Bureau once they have completed coordination for the new RAS site and shall submit the coordination agreement to the Commission. Upon receipt of such notification from a licensee, the International Bureau will issue a public notice stating that the licensee may commence operations within the coordination zone in 30 days if no party has opposed the operations. The VMES licensee then will be permitted to commence operations in the 14.47-14.5 GHz band within the relevant coordination distance around the new RAS site, subject to any operational constraints developed in the coordination process.	Intelsat will not transmit in the radio line-of-sight of the subject facilities. In the event Intelsat seeks to operate, it will coordinate as necessary.

§ 25.226(e)	(e) VMES licensees shall use Global Positioning Satellite-related or other similar position location technology to ensure compliance with paragraphs (c) and (d) of this section.	Applicable regulatory status and protection provision. Intelsat complies.

X. Section 25.227 Compliance Matrix

Rule	Text	Application Citation
§ 25.227	**§25.227 Blanket licensing provisions for ESAAs operating with GSO FSS space stations in the 10.95-11.2 GHz, 11.45-11.7 GHz, 11.7-12.2 GHz, and 14.0-14.5 GHz bands.**	
§ 25.227(a)	(a) The following ongoing requirements govern all ESAA licensees and operations in the 10.95-11.2 GHz (space-to-Earth), 11.45-11.7 GHz (space-to-Earth), 11.7-12.2 GHz (space-to-Earth) and 14.0-14.5 GHz (Earth-to-space) frequency bands receiving from and transmitting to geostationary orbit satellites in the Fixed-Satellite Service. ESAA licensees shall comply with the requirements in either paragraph (a)(1), (a)(2) or (a)(3) of this section and all of the requirements set forth in paragraphs (a)(4) through (a)(16) and paragraphs (c), (d), and (e) of this section. Paragraph (b) of this section identifies items that shall be included in the application for ESAA operations to demonstrate that these ongoing requirements will be met.	
§ 25.227(a)(1)	(1) The following requirements shall apply to an ESAA that uses transmitters with off-axis EIRP spectral-densities lower than or equal to the levels in paragraph (a)(1)(i) of this section. ESAA licensees operating under this section shall provide a detailed demonstration as described in paragraph (b)(1) of this section. The ESAA transmitter also shall comply with the antenna pointing and cessation of emission requirements in paragraphs (a)(1)(ii) and (iii) of this section.	Intelsat complies for all ESAA terminal operations in two-degree spacing environments.
§ 25.227(a)(1)(i)(A)	(A) EIRP spectral density emitted in the plane tangent to the GSO arc, as defined in §25.103, must not exceed the following values: 15 - 25 log10(θ) dBW/4 kHz For 1.5° ≤ θ ≤ 7° -6 dBW/4 kHz For 7° < θ ≤ 9.2° 18 - 25 log10(θ) dBW/4 kHz For 9.2° < θ ≤ 19.1° -14 dBW/4 kHz For 19.1° < θ ≤ 180° Where theta (θ) is the angle in degrees from a line from the earth station antenna to the assigned orbital location of the target satellite. The EIRP density levels specified for θ > 7° may be exceeded by up to 3 dB in up to 10% of the range of theta (θ) angles from ±7-180°, and by up to 6 dB in the region of main reflector spillover energy.	*See* Technical Appendix, IV.A & V.A.

§ 25.227(a)(1)(i)(B)	(B) The EIRP spectral density of co-polarized signals must not exceed the following values in the plane perpendicular to the GSO arc, as defined in §25.103: 18 - 25 log(θ) dBW/4 kHz For 3° ≤ θ ≤ 19.1° -14 dBW/4 kHz For 19.1° < θ ≤ 180° Where θ is as defined in paragraph (a)(1)(i)(A) of this section. These EIRP density levels may be exceeded by up to 6 dB in the region of main reflector spillover energy and in up to 10% of the range of θ angles not included in that region, on each side of the line from the earth station to the target satellite.	*Id.* Intelsat seeks a waiver of §25.227(a)(1)(i)(B) for HR6400 terminal operations (*see* Legal Narrative, III.A).
§ 25.227(a)(1)(i)(C)	(C) The off-axis EIRP spectral-density of cross-polarized signals must not exceed the following values in the plane tangent to the GSO arc or in the plane perpendicular to the GSO arc 5 - 25 log10(θ) dBW/4 kHz For 1.8° ≤ θ ≤ 7° Where θ is as defined in paragraph (a)(1)(i)(A) of this section.	*See* Technical Appendix, IV.A & V.A.
§ 25.227(a)(1)(ii)	(ii) Each ESAA transmitter shall meet one of the following antenna pointing requirements: (A) Each ESAA transmitter shall maintain a pointing error of less than or equal to 0.2° between the orbital location of the target satellite and the axis of the main lobe of the ESAA antenna; or (B) Each ESAA transmitter shall declare a maximum antenna pointing error that may be greater than 0.2° provided that the ESAA does not exceed the off-axis EIRP spectral-density limits in paragraph (a)(1)(i) of this section, taking into account the antenna pointing error.	*See* Technical Appendix, I; Legal Narrative, II.B.i (HR129 terminal).
§ 25.227(a)(1)(iii)	(iii) Each ESAA transmitter shall meet one of the following cessation of emission requirements: (A) For ESAAs operating under paragraph (a)(1)(ii)(A) of this section, all emissions from the ESAA shall automatically cease within 100 milliseconds if the angle between the orbital location of the target satellite and the axis of the main lobe of the ESAA antenna exceeds 0.5°, and transmission shall not resume until such angle is less than or equal to 0.2°, or (B) For ESAA transmitters operating under paragraph (a)(1)(ii)(B) of this section, all emissions from the ESAA shall automatically cease within 100 milliseconds if the angle between the orbital location of the target satellite and the axis of the main lobe of the ESAA antenna exceeds the declared maximum antenna pointing error and shall not resume transmissions until such angle is less than or equal to the declared maximum antenna pointing error.	*Id.*

25.227(a)(2)	(2) The following requirements apply to ESAA systems that operate with off-axis EIRP spectral-densities in excess of the levels in paragraph (a)(1)(i) or (a)(3)(i) of this section under licenses granted based on certifications filed pursuant to paragraph (b)(2) of this section. (i) An ESAA or ESAA system licensed based on certifications filed pursuant to paragraph (b)(2) of this section must operate in accordance with the off-axis EIRP density specifications provided to the target satellite operator in order to obtain the certifications. (ii) Any ESAA transmitter operating under a license granted based on certifications filed pursuant to paragraph (b)(2) of this section must be self-monitoring and capable of shutting itself off and must cease or reduce emissions within 100 milliseconds after generating off-axis EIRP-density in excess of the specifications supplied to the target satellite operator. (iii) A system with variable power control of individual ESAA transmitters must monitor the aggregate off-axis EIRP density from simultaneously transmitting ESAA transmitters at the system's network control and monitoring center. If simultaneous operation of two or more ESAA transmitters causes aggregate off-axis EIRP density to exceed the off-axis EIRP density specifications supplied to the target satellite operator, the network control and monitoring center must command those transmitters to cease emissions or reduce the aggregate EIRP density to a level at or below those specifications, and the transmitters must comply within 100 milliseconds of receiving the command.	*See* Technical Appendix, I & III; Legal Narrative, II.B.ii (HR6400 terminal).
§ 25.227(a)(3)	(3) The following requirements apply to an ESAA system that uses variable power-density control of individual ESAA earth stations transmitting simultaneously in the same frequencies to the same target satellite, unless the system operates pursuant to paragraph (a)(2) of this section. (i) Aggregate EIRP density from co-frequency earth stations in each target satellite receiving beam, not resulting from colliding data bursts transmitted pursuant to a contention protocol, will not exceed the limits specified in paragraph (a)(1)(i) of this section. (ii) Each ESAA transmitter must be self-monitoring and capable of shutting itself off and must cease or reduce emissions within 100 milliseconds after generating off-axis EIRP density in excess of the limit in paragraph (a)(3)(i) of this section. (iii) A system with variable power control of individual ESAA transmitters must monitor aggregate power density from simultaneously transmitting ESAA transmitters at the network control and monitoring center. If simultaneous operation of two or more transmitters causes aggregate off-axis EIRP density to exceed the off-axis EIRP density limit in paragraph (a)(3)(i) of this section, the network control and monitoring center must command those transmitters to cease emissions or reduce the aggregate EIRP density to a level at or below	N/A

	that limit, and those transmitters must comply within 100 milliseconds of receiving the command.	
§ 25.227(a)(4)	(4) An applicant filing to operate an ESAA terminal or system and planning to use a contention protocol shall certify that its contention protocol use will be reasonable.	N/A
§ 25.227(a)(5)	(5) There shall be a point of contact in the United States, with phone number and address, available 24 hours a day, seven days a week, with authority and ability to cease all emissions from the ESAA.	*See* Technical Appendix, I.
§ 25.227(a)(6)	(6) For each ESAA transmitter, a record of the vehicle location (i.e., latitude/longitude/altitude), transmit frequency, channel bandwidth and satellite used shall be time annotated and maintained for a period of not less than one year. Records shall be recorded at time intervals no greater than one (1) minute while the ESAA is transmitting. The ESAA operator shall make this data available, in the form of a comma delimited electronic spreadsheet, within 24 hours of a request from the Commission, NTIA, or a frequency coordinator for purposes of resolving harmful interference events. A description of the units (i.e., degrees, minutes, MHz ….) in which the records values are recorded will be supplied along with the records.	*See* Technical Appendix, VII.
§ 25.227(a)(7)	(7) In the 10.95-11.2 GHz (space-to-Earth) and 11.45-11.7 GHz (space-to-Earth) frequency bands ESAAs shall not claim protection from interference from any authorized terrestrial stations to which frequencies are either already assigned, or may be assigned in the future.	Applicable regulatory status and protection provision. Intelsat complies.
§ 25.227(a)(8)	(8) An ESAA terminal receiving in the 11.7-12.2 GHz (space-to-Earth) bands shall receive protection from interference caused by space stations other than the target space station only to the degree to which harmful interference would not be expected to be caused to an earth station employing an antenna conforming to the referenced patterns defined in paragraphs (a) and (b) of section 25.209 and stationary at the location at which any interference occurred.	Applicable regulatory status and protection provision. Intelsat complies.
§ 25.227(a)(9)	(9) Each ESAA terminal shall automatically cease transmitting within 100 milliseconds upon loss of reception of the satellite downlink signal or when it detects that unintended satellite tracking has happened or is about to happen.	*See* Technical Appendix, VII.
§ 25.227(a)(10)	(10) Each ESAA terminal should be subject to the monitoring and control by an NCMC or equivalent facility. Each terminal must be able to receive at least "enable transmission" and "disable transmission" commands from the NCMC and must automatically cease transmissions immediately on receiving any "parameter change command", which may cause harmful interference during the change, until it receives an "enable transmission"	*Id.*

§ 25.227(a)(11)	(11) Each ESAA terminal shall be self-monitoring and, should a fault which can cause harmful interference to FSS networks be detected, the terminal must automatically cease transmissions.	*Id.*
§ 25.227(a)(12)	(12) Unless otherwise stated all ESAA system that comply with the off-axis EIRP spectral-density limits in paragraph (a)(1)(i) of this section may request Permitted List authority.	Applicable regulatory status and protection provision.
§ 25.227(a)(13)	(13) ESAA providers operating in the international airspace within line-of-sight of the territory of a foreign administration where fixed service networks have primary allocation in this band, the maximum power flux density (pfd) produced at the surface of the Earth by emissions from a single aircraft carrying an ESAA terminal should not exceed the following values unless the foreign Administration has imposed other conditions for protecting its fixed service stations: $-132+0.5 \cdot \theta$ dB(W/(m2 · MHz)) For $\theta \leq 40°$ -112 dB(W/(m2 · MHz)) For $40° < \theta \leq 90°$ Where: θ is the angle of arrival of the radio-frequency wave (degrees above the horizontal) and the aforementioned limits relate to the pfd and angles of arrival would be obtained under free-space propagation conditions.	Applicable regulatory status and protection provision.
§ 25.227(a)(14)	(14) All ESAA terminals operated in U.S. airspace, whether on U.S.-registered civil aircraft or non-U.S.-registered civil aircraft, must be licensed by the Commission. All ESAA terminals on U.S.-registered civil aircraft operating outside of U.S. airspace must be licensed by the Commission, except as provided by Section 303(t) of the Communications Act.	Applicable regulatory status and protection provision.
§ 25.227(a)(15)	(15) For ESAA systems operating over international waters, ESAA operators will certify that their target space station operators have confirmed that proposed ESAA operations are within coordinated parameters for adjacent satellites up to 6 degrees away on the geostationary arc.	*See* Technical Appendix, III.
§ 25.227(a)(16)	(16) Prior to operations within the foreign nation's airspace, the ESAA operator will ascertain whether the relevant administration has operations that could be affected by ESAA terminals, and will determine whether that administration has adopted specific requirements concerning ESAA operations. When the aircraft enters foreign airspace, the ESAA terminal would be required to operate under the Commission's rules, or those of the foreign administration, whichever is more constraining. To the extent that all relevant administrations have identified geographic areas from which ESAA operations would not affect their radio operations, ESAA operators would be free to operate within those identified areas without further action. To the extent that the foreign administration has not adopted requirements regarding ESAA operations, ESAA operators would be required to coordinate their operations with any potentially affected operations.	Intelsat complies (no specific certification required).
§ 25.227(b)	(b) Applications for ESAA operation in the 14.0-14.5 GHz (Earth-to-space) band to GSO satellites in the FSS shall include, in addition to the particulars of operation identified on FCC Form 312, and associated Schedule B, the applicable technical demonstrations in paragraphs (b)(1), (b)(2), or (b)(3), and the documentation identified in paragraphs (b)(4) through (b)(8) of this section.	
§ 25.227(b)(1)	(1) An ESAA applicant proposing to implement a transmitter under paragraph (a)(1) of this section must	

	provide the information required by §25.115(g)(1). An applicant proposing to implement a transmitter under paragraph (a)(1)(ii)(A) of this section must also provide the certifications identified in paragraph (b)(1)(iii) of this section. An applicant proposing to implement a transmitter under paragraph (a)(1)(ii)(B) of this section must also provide the demonstrations identified in paragraph (b)(1)(iv) of this section. (i)-(ii) [Reserved] (iii) An ESAA applicant proposing to implement a transmitter under paragraph (a)(1)(ii)(A) of this section shall: (A) Demonstrate that the total tracking error budget of their antenna is within 0.2° or less between the orbital location of the target satellite and the axis of the main lobe of the ESAA antenna. As part of the engineering analysis, the ESAA applicant must show that the antenna pointing error is within three sigma () from the mean value, *i.e.*, that there is a 0.997 probability the antenna maintains a pointing error within 0.2°; and (B) Demonstrate that the antenna tracking system is capable of ceasing emissions within 100 milliseconds if the angle between the orbital location of the target satellite and the axis of the main lobe of the ESAA antenna exceeds 0.5°. (iv) An ESAA applicant proposing to implement a transmitter under paragraph (a)(1)(ii)(B) of this section shall: (A) Declare, in its application, a maximum antenna pointing error and demonstrate that the maximum antenna pointing error can be achieved without exceeding the off-axis EIRP spectral-density limits in paragraph (a)(1)(i) of this section; and (B) Demonstrate that the ESAA transmitter can detect if the transmitter exceeds the declared maximum antenna pointing error and can cease transmission within 100 milliseconds if the angle between the orbital location of the target satellite and the axis of the main lobe of the ESAA antenna exceeds the declared maximum antenna pointing error, and will not resume transmissions until the angle between the orbital location of the target satellite and the axis of the main lobe of the ESAA antenna is less than or equal to the declared maximum antenna pointing error.	*See* Technical Appendix, I & IV.A (HR129 terminal); Legal Narrative, II.B.i.

§ 25.227(b)(2)	(2) An ESAA applicant proposing to operate with off-axis EIRP density in excess of the levels in paragraph (a)(1)(i) or (a)(3)(i) of this section must provide the following in exhibits to its earth station application: (i) Off-axis EIRP density data pursuant to §25.115(g)(1); (ii) The certifications required by §25.220(d); and (iii) A detailed showing that each ESAA transmitter in the system will automatically cease or reduce emissions within 100 milliseconds after generating EIRP density exceeding specifications provided to the target satellite operator; and (iv) A detailed showing that the aggregate power density from simultaneously transmitting ESAA transmitters will be monitored at the system's network control and monitoring center; that if simultaneous operation of two or more ESAA transmitters causes the aggregate off-axis EIRP density to exceed the off-axis EIRP density specifications supplied to the target satellite operator, the network control and monitoring center will command those transmitters to cease emissions or reduce the aggregate EIRP density to a level at or below those specifications; and that those transmitters will comply within 100 milliseconds of receiving the command.	*See* Technical Appendix, I, V.A (HR6400 terminal plots) & III (operator certification letters); Legal Narrative, II.B.ii.
§ 25.227(b)(3)	(3) An applicant proposing to implement an ESAA system subject to paragraph (a)(3) of this section must provide the following information in exhibits to its earth station application: (i) Off-axis EIRP density data pursuant to §25.115(g)(1); (ii) A detailed showing of the measures that will be employed to maintain aggregate EIRP density at or below the limit in paragraph (a)(3)(i) of this section; (iii) A detailed showing that each ESAA terminal will automatically cease or reduce emissions within 100 milliseconds after generating off-axis EIRP density exceeding the limit in paragraph (a)(3)(i) of this section; and (iv) A detailed showing that the aggregate power density from simultaneously transmitting ESAA transmitters will be monitored at the system's network control and monitoring center; that if simultaneous operation of two or more transmitters in the ESAA network causes aggregate off-axis EIRP density to exceed the off-axis density limit in paragraph (a)(3)(i) of this section, the network control and monitoring center will command those transmitters to cease emissions or reduce the aggregate EIRP density to a level at or below that limit; and that those transmitters will comply within 100 milliseconds of receiving the command.	N/A

§ 25.227(b)(4)	(4) There shall be an exhibit included with the application describing the geographic area(s) in which the ESAA will operate.	*See* Technical Appendix, II.
§ 25.227(b)(5)	(5) Any ESAA applicant filing for an ESAA terminal or system and planning to use a contention protocol shall include in its application a certification that will comply with the requirements of paragraph (a)(4) of this section.	N/A
§ 25.227(b)(6)	(6) The point of contact referred to in paragraph (a)(5) of this section shall be included in the application.	*See* Technical Appendix, I.
§ 25.227(b)(7)	(7) Any ESAA applicant filing for an ESAA terminal or system shall include in its application a certification that will comply with the requirements of paragraph (a)(6), (a)(9), (a)(10), (a)(11) of this section.	*See* Technical Appendix, VIII.
§ 25.227(b)(8)	(8) All ESAA applicants shall submit a radio frequency hazard analysis determining via calculation, simulation, or field measurement whether ESAA terminals, or classes of terminals, will produce power densities that will exceed the Commission's radio frequency exposure criteria. ESAA applicants with ESAA terminals that will exceed the guidelines in Section 1.1310 for radio frequency radiation exposure shall provide, with their environmental assessment, a plan for mitigation of radiation exposure to the extent required to meet those guidelines. All ESAA licensees shall ensure installation of ESAA terminals on aircraft by qualified installers who have an understanding of the antenna's radiation environment and the measures best suited to maximize protection of the general public and persons operating the vehicle and equipment. An ESAA terminal exhibiting radiation exposure levels exceeding 1.0 mW/cm^2 in accessible areas, such as at the exterior surface of the radome, shall have a label attached to the surface of the terminal warning about the radiation hazard and shall include thereon a diagram showing the regions around the terminal where the radiation levels could exceed 1.0 mW/cm^2.	*See* Technical Appendix, IV.B & V.C.

§ 25.227(c)	(c)(1) Operations of ESAAs in the 14.0-14.2 GHz (Earth-to-space) frequency band in the radio line-of- sight of the NASA TDRSS facilities on Guam (latitude 13° 36' 55" N, longitude 144° 51' 22" E) or White Sands, New Mexico (latitude 32° 20' 59" N, longitude 106° 36' 31" W and latitude 32° 32' 40" N, longitude 106° 36' 48" W) are subject to coordination with the National Aeronautics and Space Administration (NASA) through the National Telecommunications and Information Administration (NTIA) Interdepartment Radio Advisory Committee (IRAC). Licensees shall notify the International Bureau once they have completed coordination. Upon receipt of such notification from a licensee, the International Bureau will issue a public notice stating that the licensee may commence operations within the coordination zone in 30 days if no party has opposed the operations. (2) When NTIA seeks to provide similar protection to future TDRSS sites that have been coordinated through the IRAC Frequency Assignment Subcommittee process, NTIA will notify the Commission's International Bureau that the site is nearing operational status. Upon public notice from the International Bureau, all Ku-band ESAA licensees shall cease operations in the 14.0-14.2 GHz band within radio line-of-sight of the new TDRSS site until the licensees complete coordination with NTIA/IRAC for the new TDRSS facility. Licensees shall notify the International Bureau once they have completed coordination for the new TDRSS site. Upon receipt of such notification from a licensee, the International Bureau will issue a public notice stating that the licensee may commence operations within the coordination zone in 30 days if no party has opposed the operations. The ESAA licensee then will be permitted to commence operations in the 14.0-14.2 GHz band within radio line-of-sight of the new TDRSS site, subject to any operational constraints developed in the coordination process.	Intelsat will not transmit in the radio line-of-sight of the subject facilities. In the event Intelsat seeks to operate within the relevant zone, it will coordinate as necessary.
§ 25.227(d)	(d)(1) Operations of ESAA in the 14.47-14.5 GHz (Earth-to-space) frequency band in the radio line-of- sight of radio astronomy service (RAS) observatories observing in the 14.47-14.5 GHz band are subject to coordination with the National Science Foundation (NSF). The appropriate NSF contact point to initiate coordination is Electromagnetic Spectrum Manager, NSF, 4201 Wilson Blvd., Suite 1045, Arlington VA 22203, fax 703-292-9034, email esm@nsf.gov. Licensees shall notify the International Bureau once they have completed coordination. Upon receipt of the coordination agreement from a licensee, the International Bureau will issue a public notice stating that the licensee may commence operations within the coordination zone in 30 days if no party has opposed the operations. (2) A list of applicable RAS sites and their locations can be found in 25.226(d)(2) Table 1. (3) When NTIA seeks to provide similar protection to future RAS sites that have been coordinated through the IRAC Frequency Assignment Subcommittee process, NTIA will notify the Commission's International Bureau that the site is nearing operational status. Upon public notice from the International Bureau, all Ku-band ESAA licensees shall cease operations in the 14.47-14.5 GHz band within the relevant geographic zone of the new RAS site until the licensees complete coordination for the new RAS facility. Licensees shall notify the International Bureau once they have completed coordination for the new RAS site and shall submit the coordination agreement to the Commission. Upon receipt of such notification from a licensee, the International Bureau will issue a public notice stating that the licensee may commence operations within the coordination zone in 30 days if no party has opposed the operations. The ESAA licensee then will be permitted to commence operations in the 14.47-14.5 GHz band within the relevant coordination distance around the new RAS site, subject to any operational constraints developed in the coordination process.	Intelsat will not transmit in the radio line-of-sight of the subject facilities. In the event Intelsat seeks to operate, it will coordinate as necessary.

XI. Technical Certification

I, Christopher M. Hudson, hereby certify that I am the technically qualified person responsible for the preparation of the technical information contained in the Intelsat License LLC blanket license application for ESAA operating authority and the accompanying Technical Appendix, that I am familiar with Part 25 of the Commission's Rules (47 C.F.R. Part 25), and that I have either prepared or reviewed the technical information submitted in this application and found it to be complete and accurate to the best of my knowledge and belief.

By: _/s/ *Christopher M. Hudson*______
Christopher M. Hudson
Senior Technical Advisor
Intelsat General Corporation

February 8, 2018