EXHIBIT A
Ka band Earth Station on Vessels (ESV) Blanket License Request
Technical Narrative

1 Introduction

By this application, Viasat, Inc. ("Viasat") requests blanket authority to operate up to 15,000 transmit/receive earth stations to provide service to vessels within in the United States and on U.S.-registered vessels outside of the United States using the 28.35-29.1 GHz and 29.5-30.0 GHz portions of the Ka band for uplink communications and the 18.3-19.3 GHz and 19.7-20.2 GHz portions for downlink communications. Viasat will be using three different terminal types, Cobham's Sailor900 1-meter antenna, the Cobham Sailor600 65cm antenna, and the USAT30 75cm antenna. The antenna terminals will be mounted on vessels and will be used to provide two-way, in-motion broadband communications, including Internet access, for passengers and crew.

The terminals will communicate with Ka band satellites ViaSat-1 at 115.1º W.L., ViaSat-2 at 69.9° W.L., WildBlue-1 at 111.1º W.L., and ANIK-F2 at 111.1º W.L. These earth stations will operate throughout the coverage area of these satellites and can be operated with each of the gateway earth stations associated with them.

As detailed below, Viasat's proposed operations (i) are fully consistent with the PFD levels referenced in 25.138, and (ii) are fully consistent with the off-axis-EIRP levels. Moreover, this ESV blanket request has been designed to requirements set forth in 25.138, rules for GSO FSS Ka-band Earth stations and the FCC precedents set by previous Ka-band earth stations in motion blanket license grants.[1] The proposed earth station operations also will conform to the requirements that the FCC has adopted for GSO FSS ESIMs in the 18.3-18.8 GHz, 19.7-20.2 GHz, 28.35-28.6 GHz and 29.5-30 GHz portions of the Ka band, which are pending effectiveness, as well as the proposed rules for GSO FSS ESIMs in the 18.8-19.3 GHz and 28.6-29.1 GHz band segments.[2]

More specifically, Viasat will adhere to the same technical operating requirement the FCC has adopted for ESIMs in general. Namely, the off-axis EIRP density limits of Section 25.138 will be met in the GSO and NGSO plane. In addition, these terminals are self-monitoring and Viasat will ensure that (i) the transmissions from these terminals remain within the applicable EIRP density limits, and (ii) the transmit output of the terminal will be inhibited in less than 100 milliseconds should the EIRP density limits be exceeded (whether by the motion of the vessel or otherwise), and will not resume until the condition that caused the terminal to exceed the authorized EIRP density limits is corrected.

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[1] *See* Viasat, Inc., File No. SES-LIC-20120427-00404, Call Sign E120075 (granted July 17, 2013) (authorizing Ka band aeronautical earth stations communicating with ViaSat-1, WildBlue-1 and ANIK-F2) ("ViaSat-1 Aeronautical Authorization"); Viasat, Inc., File No. SES-LIC-20180123-00055, Call Sign E180006 (granted Apr. 17, 2018) ("ViaSat-2 Aeronautical Authorization") (authorizing Ka band aeronautical earth stations communicating with ViaSat-2); see also ISAT US Inc., File No. SES-LIC-20140224-00098, Call Sign E140029 (granted Sept. 29, 2015) (granting waiver for maritime earth stations at 19.7-20.2 GHz and 29.5-30 GHz).

[2] *See Amendment of Parts 2 and 25 of the Commission's Rules to Facilitate the Use of Earth Stations in Motion Communicating with Geostationary Orbit Space Stations in Frequency Bands Allocated to the Fixed Satellite Service*, IB Docket No. 17-95, Report and Order and Further Notice of Proposed Rulemaking, FCC 17-56 ¶¶ 17-18, 51 n.118, ¶ 91 (rel. May 19, 2017) ("*GSO FSS ESIM Order*").

2 Technical Description

Viasat requests authorization to operate a Ka-band Earth Station on Vessels (ESV) network. There will be up to 15,000 transmit receive earth stations, 5,000 per terminal type, providing service in the 28.35-29.1 GHz and 29.5-30.0 GHz portions of the uplink band and 18.3-19.3 GHz and 19.7-20.2 GHz portions of the downlink band.

Generally, when within the coverage footprint of ViaSat-1, the terminals will operate using ViaSat-1 spot beams to take advantage of its higher power and G/T and thereby enjoy improved throughput. As the vessels moves across areas not supported by ViaSat-1, the ESV will switch to capacity on the ViaSat-2, WildBlue-1 or Anik-F2 spacecraft.

The proposed terminals will operate in the same Ka-band network as residential customers using the fixed VSAT equipment authorized under call signs E100143 and E170088. Building upon its experience with Ku-band based AMSS and ESV mobile broadband, Viasat has incorporated the functions necessary to support mobility into the management functions of the network. The network allows the Vessel to navigate across the service area and seamlessly switch from spot beam to spot beam within the current operational satellite and to switch between satellites as coverage dictates.

Exhibit B contains the EIRP Spectral Density (ESD) envelopes for the antenna terminals versus the 25.138 masks. These plots show that for the worst case ESD the antennas will conform consistent with the Section 25.138(a) off-axis EIRP density levels in the GSO and NGSO plane. Figures 1 through 3 included in Section 4.2 below show the worst case EIRP density plot for each antenna type.

Furthermore, the power flux-density at the earth's surface produced by emissions from each of the satellite points of communication is within the -118 dBW/m^2/MHz limit set forth in Section 25.138(a)(6). In fact, the interference profile of the downlinks to the proposed terminals from the satellite points of communication is no different from that of the "traditional" VSAT terminals already authorized on these satellite networks for consumer broadband services.

3 ESV Network Details

3.1 Antenna Terminals

The antenna terminal specifications are shown in Tables 1 below.

Table 1 - ESV Antenna Terminal Specifications	
Sailor600	
Antenna Type	3-axis stabilized tracking antenna with integrated GNSS
Aperture	Parabolic reflector, sub-reflector
Dimensions	1.03-meter diameter
Polarization	LHCP and RHCP (transmit) LHCP and RHCP (receive)
Gain	43.4 dBi GHz @ 29.5 GHz (incl radome) 40.4 dBi at 19.7 GHz (incl radome)
EIRP	Up to 55.5 dBW
G/T	17.2 dB/K at 19.7 GHz (incl radome)
SSPA	25 W high power BUC
Ship motion ang. Min	Roll +/- 25° in 6 sec, Pitch +/- 15° in 5 sec, Yaw +/- 10° in 8 sec
Sailor900	
Antenna Type	3-axis stabilized tracking antenna with integrated GNSS
Aperture	Parabolic reflector, sub-reflector
Dimensions	65 cm diameter
Polarization	LHCP and RHCP (transmit) LHCP and RHCP (receive)
Gain	47.5 dBi GHz @ 29.5 GHz (incl radome) 43.7 dBi at 19.7 GHz (incl radome)
EIRP	Up to 55.5 dBW
G/T	20.1 dB/K at 19.7 GHz (incl radome)
SSPA	25 W high power BUC
Ship motion ang. Min	Roll +/- 30° in 6 sec, Pitch +/- 15° in 5 sec, Yaw +/- 10° in 8 sec
USAT30	
Antenna Type	Marine stabilized tracking antenna with integrated GNSS
Aperture	Parabolic reflector, sub-reflector
Dimensions	75 cm diameter
Polarization	LHCP and RHCP (transmit) LHCP and RHCP (receive)
Gain	44.7 dBi GHz @ 29.5 GHz (incl radome) 41.2 dBi at 19.7 GHz (incl radome)
EIRP	Up to 55.5 dBW
G/T	18.5 dB/K at 19.7 GHz (incl radome)
SSPA	25 W high power BUC
Ship motion ang. Min	Roll +/- 30° in 6 sec, Pitch +/- 15° in 5 sec, Yaw +/- 10° in 8 sec

3.2 Space Segment

The proposed ESV network will operate at Ka-band on ViaSat-1 at 115.1º W.L., ViaSat-2 at 69.9° W.L., WildBlue-1 at 111.1º W.L., and ANIK-F2 at 111.1º W.L. The service will operate using the 28.35-29.1 GHz and 29.5-30.0 GHz portions of the Ka band for uplink communications and the 18.3-19.3 GHz and 19.7-20.2 GHz portions for downlink communications.[3] Each of these satellites is authorized to serve the United States in these bands. The Commission's Ka-band band plan designates (i) the 18.3-18.8 GHz, 19.7-20.2 GHz, 28.35-28.6 GHz and 29.5-30 GHz portions of the Ka band for GSO FSS on a primary basis, and (ii) the 18.8-19.3 GHz and 28.6-29.1 GHz band segments on a primary basis for NGSO FSS and secondary for GSO FSS.

3.3 Remote Control Network Operations Center (NOC)

The primary network operations center where the ESV network will be controlled is located at:

5970 South Greenwood Plaza, Suite 300
Greenwood Village, Arapahoe County, CO 80111
Phone: 720-554-7575

3.4 ESV Carriers

The network architecture employs adaptive coding and modulation; the terminals can transmit at any code and modulation point within the library of available choices. The available symbol rates are 625,000 symbols per second, or kilobaud (kBd), 1.25 MBd, 2.5 MBd, 5 MBd, 10 MBd and even higher rates between 20 MBd to 80 MBd. The 625 kBd symbol rate is used primarily for network ranging and login, and requires the highest power spectral density. Carriers under 5 MBd are typically only used under rain fade conditions.

The network architecture is designed to always operate at the lowest power density modulation and code point that allows the link to close. The network employs active power control and reduces power when conditions permit, keeping the Es/No margin at 1 dB or less. When the modem has sufficient excess transmit capability, it will automatically switch to the next symbol rate and increase data rate, keeping the e.i.r.p. density at the minimum. This further reduces the likelihood that the system will impact traffic on other satellites.

A summary of the carrier emissions, their frequencies of operation, EIRP and power densities in shown in Table 2 below. The highest-powered carrier happens to be narrowest at 625 kHz with a RF power density of 0.9 dBW/MHz[4]:

[3] Operations with WildBlue-1 and ANIK-F2 will be limited to the 29.5-30 GHz and 19.7-20.2 GHz bands.

[4] It should be noted that the maximum RF power density allowed for a terminal using an antenna compliant with §25.209 antenna radiation is 3.5 dBW/MHz. The Viasat ESV terminals will operate well below the maximum allowed.

Table 2 - Viasat ESV Ka-band Emissions Licensing Data				
Freq. Range (GHz)	**Emission**	**EIRP (dBW)**	**EIRP Density (dBW/4kHz)**	**RF Power Density (dBW/MHz)**
28.35-29.1, 29.5-30.0	80M0G7D	55.5	12.5	-7.0
28.35-29.1, 29.5-30.0	32M0G7D	55.5	16.5	-3.1
28.35-29.1, 29.5-30.0	16M0G7D	55.5	19.5	0.0
28.35-29.1, 29.5-30.0	20M0G7D	46.0	9.0	-10.5
28.35-29.1, 29.5-30.0	10M0G7D	46.0	12.0	-7.5
28.35-29.1, 29.5-30.0	5M00G7D	46.0	15.0	-4.5
28.35-29.1, 29.5-30.0	2M50G7D	46.0	18.0	-1.5
28.35-29.1, 29.5-30.0	1M25G7D	45.4	20.5	0.9
28.35-29.1, 29.5-30.0	625KG7D	42.4	20.5	0.9
18.3-19.3, 19.7-20.2	417MG1D	N/A		

4 Protection of Other Ka-band Operations and Waiver Requests

The proposed ESV operations would be compatible with operations in a two-degree spaced environment and thus will be compatible with the operations of other GSO systems. In addition, the proposed operations in the 18.8-19.3 GHz and 28.6-29.1 GHz band segments would be compatible with and would not cause harmful interference into any primary NGSO FSS operations.

4.1 Waiver Requests

Viasat requests a waiver of the U.S. Table of Frequency Allocations and the FCC's Ka-band band plan to operate GSO FSS ESV terminals in the 18.8-19.3 GHz and 28.6-29.1 GHz band segments designated as primary for NGSO FSS operations in the U.S. To the extent the Commission adopts the rules proposed to allow secondary GSO FSS ESIM operations in these bands, Viasat requests that the proposed earth stations be authorized on that basis.

Out of an abundance of caution, Viasat also requests a waiver to the extent necessary to operate the ESV terminals in the 18.3-18.8 GHz, 19.7-20.2 GHz, 28.35-28.6 GHz and 29.5-30 GHz until the rules adopted in the *GSO FSS ESIM Order* become effective.

4.2 Protection of GSO Systems

Section 25.132(a)(2) provides that transmitting earth stations operating in the 20/30 GHz band must demonstrate compliance with Section 25.138. Consistent with the FCC's rules adopted for mobile operations in the Ka band in the *GSO FSS ESIM Order*, operating the proposed terminals consistent with the technical parameters of Section 25.138 would ensure compatibility with satellite systems operating in the Ka band. This approach is consistent with the ITU's recommendation in Report ITU-R S.2223 that GSO FSS earth stations on mobile platforms in bands from 17.3-30.0 GHz comply with the off-axis e.i.r.p. limits coordinated with neighboring satellite networks.

The Viasat ESV Network will comply with all off-axis emission limits required by 25.138 of the FCC rules. EIRP spectral density (ESD) plots are provided in Exhibit B which show compliance with the co-pol and cross-pol masks.

The worst case ESD is realized for the 625 kHz carrier for the Sailor600 and Sailor900 antennas and 5 MHz for the USAT30. Shown below are plots for the worst case ESD for the Sailor600, Sailor900 and USAT30.

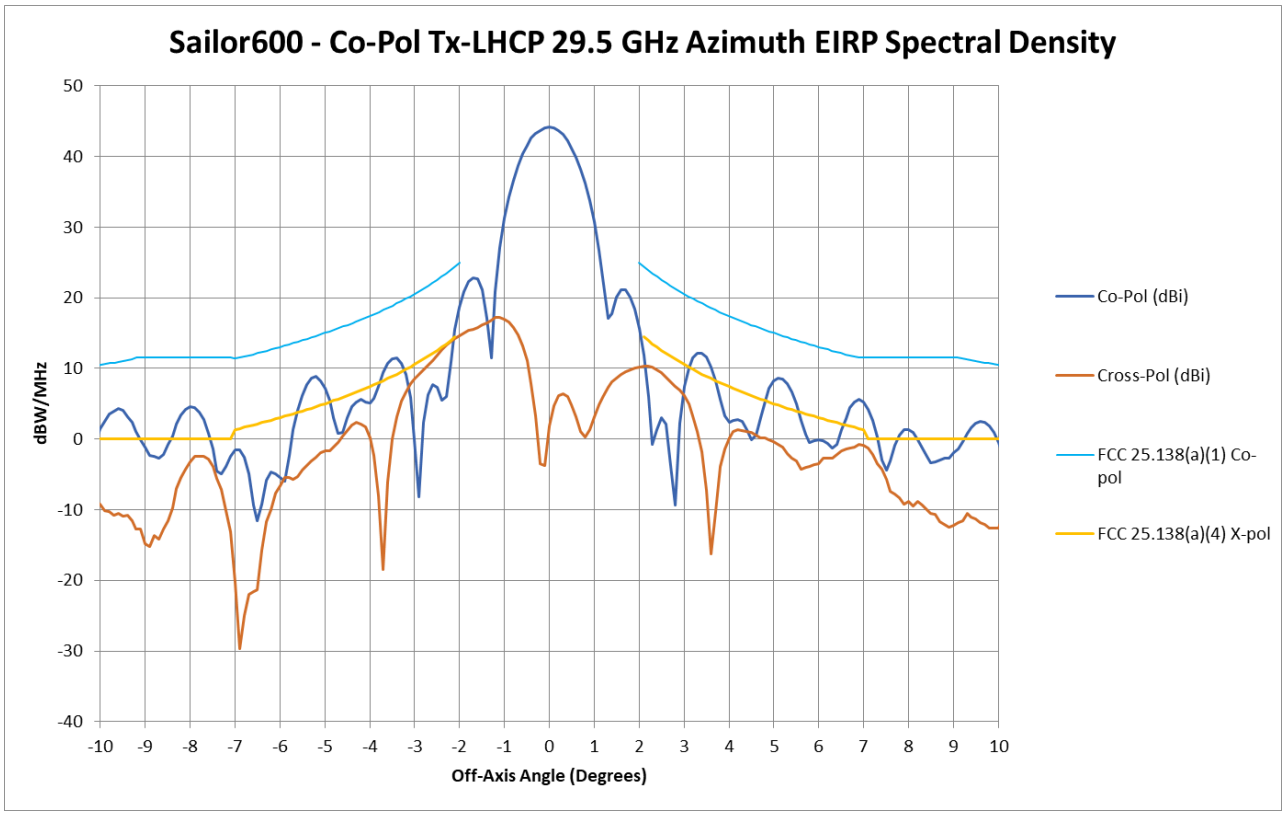

Figure 1 – EIRP Spectral Plot of worst-case emission at 29.5 GHz for Sailor600 Terminals

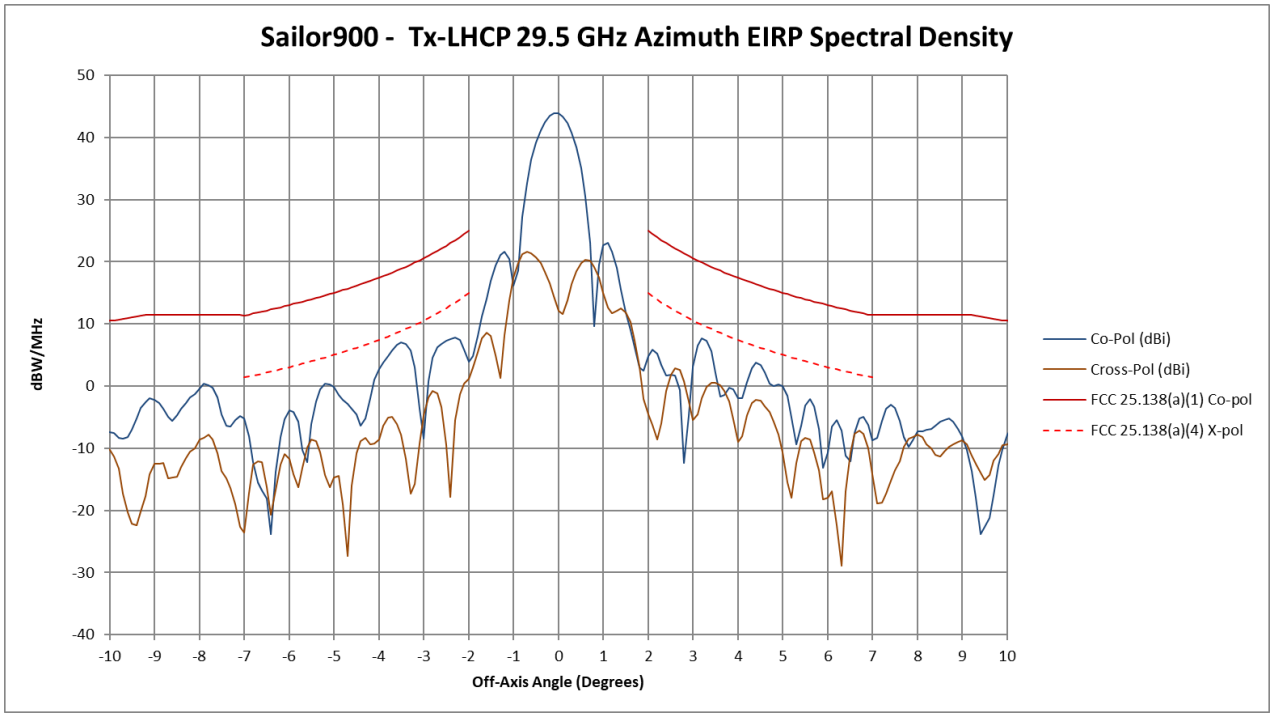

Figure 2 – EIRP Spectral Density of worst-case emission at 29.5 GHz for the Sailor900 terminal

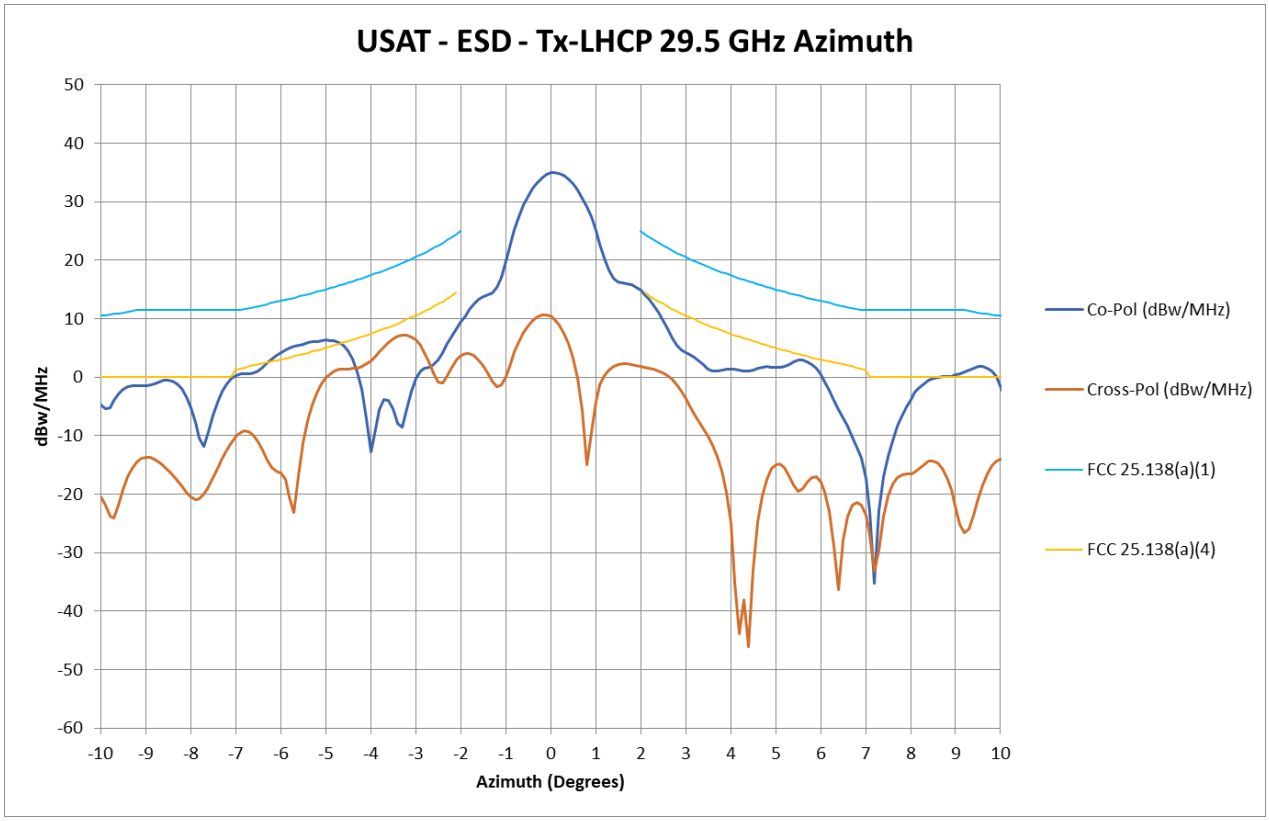

Figure 3 – EIRP Spectral Density of worst-case emission at 29.5 GHz for USAT30 Terminal. Note worst-case operation for the USAT30 will be the 5MSPS carrier operating at 43.5 dBW EIRP.

4.3 Protection of NGSO Systems

Operation of GSO FSS systems in the 28.6-29.1 GHz and 18.8-19.3 GHz bands is on a secondary allocation. The Commission has approved operation of the ViaSat-1 and ViaSat-2 satellite in these bands, and has acknowledged that Viasat can operate in these bands while protecting the primary NGSO FSS operations.[5] The same, previously-approved capability of ViaSat-1 and ViaSat-2 to cease operations in these bands in the event of an in-line event between Viasat's communications and the NGSO system's communications will also avoid interference from communications with proposed terminals into NGSO systems. Each of the proposed terminals will be dynamically controlled and can shut down operations in the bands in which NGSO systems have priority as necessary in cases where the earth station operations could harm NGSO operations. As detailed in Viasat's other applications for earth stations with similar characteristics, the potential for harm to any NGSO satellites is almost nonexistent due to the extremely infrequent and fleeting nature of any in-line events that could exceed an I/N of greater than -12.2 dB toward an NGSO system.

Viasat has, in the past for their ESAA Ka-band in-motion services, coordinated with NGSO service providers and will, as necessary, coordinate the operation of these terminals as well.

4.5 Radiation Hazard Study

A radiation hazard analyses for all of the proposed antenna terminals is attached as Exhibit D. As demonstrated by the results of the analyses, the maximum permissible exposure limits (MPE) for protection of both General Population/Uncontrolled Environment and Occupational/Controlled Environment exposures will be satisfied, because any areas at the antenna surface where the uncontrolled limits may be exceeded are inaccessible due to a radome in which the antenna is housed. The automatic shut-down capabilities described in the analysis, coupled with the terminal's use of uplink power control and non-continuous operation, ensures that the general population will not be exposed to harmful levels of electromagnetic radiation.

6 Conclusion

The document provides detail on the technical operation of the Viasat Earth Station on Vessels (ESV) network remote terminals. The operation of these terminals meets all of the FCC technical requirements and grant of this license will serve the public interest by enabling them access to broadband data services.

[5] See ViaSat-1 Authorization, Call Sign S2747; ViaSat-2 Authorization, Call Sign S2902.