Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
	)	
SES AMERICOM, INC.	)	File No. SAT-MOD-___________
	)	Call Sign S2162
Application for Modification of AMC-3 Fixed-Satellite Space Station License	)	

APPLICATION OF SES AMERICOM, INC.

SES Americom, Inc. ("SES Americom," doing business as "SES") hereby respectfully requests a modification of its license for the AMC-3 fixed-satellite service ("FSS") space station to reassign the spacecraft to 67º W.L., where it will be co-located with AMC-4. Specifically, SES requests authority to (a) perform Telemetry, Tracking and Command ("TT&C") using certain C-band and Ku-band frequencies[1] in order to relocate AMC-3 from 86.9º W.L. to 67º W.L., and (b) operate both the TT&C and Ku-band communications payloads on AMC-3 after it has arrived at 67º W.L. SES will operate AMC-3 at 67º W.L. in accordance with the International Telecommunication Union ("ITU") filings of the Colombian Administration, as Notifying Administration for the Andean Community ("CAN"). Grant of the requested authority will serve the public interest by allowing SES to use AMC-3 to expand the service being made available from 67º W.L.

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[1] The AMC-3 TT&C frequencies are as follows:
Command: 6423.5 MHz (vertical polarization; uplink)
Telemetry: 3700.5 MHz (vertical polarization; downlink), 4199.5 MHz (horizontal polarization; downlink), and 12198.0 MHz (horizontal polarization; downlink).

A completed FCC Form 312 is attached, and SES incorporates by reference the technical information previously provided in support of AMC-3.[2] In addition, SES is providing here technical information relating to the proposed modification to the AMC-3 license on Schedule S and in narrative form pursuant to Section 25.114 of the Commission's Rules.

MODIFICATION

AMC-3 is a C/Ku-band hybrid satellite licensed to operate at the nominal 87º W.L. orbital location.[3] AMC-3 was replaced earlier this year by the SES-2 spacecraft.[4] To simplify stationkeeping at the nominal 87º W.L. orbital location, SES requested and received temporary authority to relocate AMC-3 to an offset position at 86.9º W.L. and operate the spacecraft as an in-orbit spare.[5]

SES now proposes to relocate AMC-3 to 67º W.L. At its new location, AMC-3 will be collocated with AMC-4[6] and will operate in the conventional Ku-band with coverage of the southern U.S., Mexico and parts of the Caribbean. SES is not seeking authorization to

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2 *See* File No. SAT-LOA-19950215-00028.

3 AMC-3 is licensed to operate in the conventional C-band (3700-4200 MHz and 5925-6425 MHz) and conventional Ku-band (11.7-12.2 GHz and 14.0-14.5 GHz) frequencies. The current AMC-3 license term expires September 30, 2012, but the satellite has sufficient fuel to continue to operate well beyond that date. SES will accordingly be seeking an extension of the AMC-3 license term in a subsequent filing.

4 *See* File Nos. SAT-RPL-20110429-00082 & SAT-AMD-20110613-00107 (Call Sign S2826), grant-stamped Sept. 1, 2011.

5 *See* File Nos. SAT-STA-20111031-00210 (Call Sign S2162), grant-stamped Nov. 9, 2011; SAT-STA-20111205-00234, grant-stamped Dec. 20, 2011..

6 AMC-4 was relocated to 67º W.L. in July 2010 pursuant to Commission authority. *See* Call Sign S2135, File Nos. SAT-STA-20100525-00108 (granted in part July 12, 2010 and in part on July 28, 2010); SAT-STA-20100824-00182 (granted Sept. 8, 2010); SAT-MOD-20100623-00144 (the "AMC-4 Modification Application") (granted Nov. 4, 2010).

operate the AMC-3 C-band communications payload at 67º W.L., but proposes to use certain C-band frequencies for TT&C. Operations of AMC-4 at 67º W.L. are subject to a number of conditions specified in the grant of the AMC-4 Modification Application, and SES is willing to accept imposition of comparable conditions with respect to the proposed operations of AMC-3.

Operations of AMC-3 at 67º W.L. will be in accordance with ITU filings of the Colombian Administration as Notifying Administration for the Andean Community, whose members are Bolivia, Colombia, Ecuador, and Peru (the "Andean Community"). The Andean Community has granted SES Americom's affiliate, New Skies Satellites B.V. ("New Skies"), exclusive authorization for commercial utilization of the 67º W.L. orbital location for a thirty-year term.[7]

Grant of the requested authority to relocate and operate AMC-3 will serve the public interest and is consistent with Commission precedent. The Commission has repeatedly observed that its policy is to allow "satellite operators to rearrange satellites in their fleet to reflect business and customer considerations where no public interest factors are adversely affected."[8] As the International Bureau has explained:

> the Commission attempts, when possible, to leave spacecraft design decisions to the space station licensee because the licensee is in a better position to determine how to tailor its system to meet the particular needs of its customers. Consequently the Commission will generally grant a licensee's request to modify its system, provided

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[7] New Skies and SES Americom are under common ownership and have made intra-company arrangements to allow deployment of AMC-3 to 67° W.L. for use under the New Skies authorization from the Andean Community. A copy of the unofficial English translation of Decision 725, the Andean Community's grant of authority to New Skies, was submitted as Attachment 1 to the AMC-4 Modification Application.

[8] *SES Americom, Inc.*, Order and Authorization, DA 06-757 (IB rel. Apr. 7, 2006) at 4, ¶ 8, *citing Amendment of the Commission's Space Station Licensing Rules and Policies,* Second Report and Order, 18 FCC Rcd 12507, 12509, ¶ 7 (2003).

> there are no compelling countervailing public interest considerations.[9]

Here, the proposed change will allow SES to make efficient use of AMC-3, a spacecraft that is currently operating as an in-orbit spare, in order to expand SES's provision of capacity to the southern U.S., Mexico and parts of the Caribbean, including capacity for direct-to-home video services, in order to meet customer demand for those services. Because AMC-3 has been replaced by the recently launched SES-2 at 87º W.L., the relocation of AMC-3 will not have any impact on service at 87º W.L. Further, SES will operate AMC-3 in conformance with the ITU filings and the applicable coordination agreements of Colombia, ITU notifying Administration for the Andean Community, regarding operations at 67° W.L. Thus, the requested modification will not adversely affect any party. Under these circumstances, grant of the requested modification is consistent with the Commission's policy of allowing satellite operators to maximize the efficient use of spectrum and orbital resources consistent with customer requirements.

WAIVER REQUESTS

SES requests limited waivers of the Commission's requirements in connection with the instant modification application. Grant of these waivers is consistent with Commission policy:

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[9] *AMSC Subsidiary Corp.*, Order and Authorization, DA 98-493, 13 FCC Rcd 12316 (IB 1998) ("*AMSC Modification Order*") at 12318, ¶ 8 (footnote omitted). Although AMSC never implemented the relocation authorized in this case, the Commission has repeatedly reaffirmed its policy of allowing licensees to change their fleet configurations to accommodate customer requirements. *See, e.g., Space Station Licensing Rules and Policies,* First Reconsideration Order and Fifth Report and Order, FCC 04-147, 19 FCC Rcd 12637, 12653, ¶ 39 ("we generally permit licensees to modify their systems to adapt to changing business and customer needs," citing *AMSC Modification Order* and other cases).

> The Commission may waive a rule for good cause shown. Waiver is appropriate if special circumstances warrant a deviation from the general rule and such deviation would better serve the public interest than would strict adherence to the general rule. Generally, the Commission may grant a waiver of its rules in a particular case if the relief requested would not undermine the policy objective of the rule in question and would otherwise serve the public interest.[10]

<u>Section 25.114(d)(3)</u>: SES requests a limited waiver of Section 25.114(d)(3) of the Commission's rules. That provision requires submission of predicted antenna gain contours for each transmit and receive antenna beam and specifies that for geostationary orbit satellites, the information must be provided in a .gxt format. As discussed in the Technical Appendix, SES has provided antenna gain information in the required .gxt format with one exception. The gain characteristics for the global horn antenna are not provided as a .gxt file because the .gxt data is not available from the spacecraft manufacturer. Instead, gain versus off-set angle information is provided as Figure 1 in the Technical Appendix.

The Commission has previously waived the requirements of Section 25.114(d)(3) in similar factual circumstances.[11] In acting on these requests, the Commission recognized that the purpose of the rule is to ensure that adequate information is available to allow evaluation of the potential for harmful interference.[12] Here, in lieu of the single .gxt file that cannot be provided, SES has submitted alternative data sufficient to permit the Commission and any

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[10] *PanAmSat Licensee Corp.*, 17 FCC Rcd 10483, 10492 (Sat. Div. 2002) (footnotes omitted).

[11] *See, e.g.*, Application of PanAmSat Licensee Corp., File No. SAT-RPL-20061219-00155, Call Sign S2715, grant stamp dated April 24, 2007 ("*Galaxy 17 Grant*") at ¶ 5 (waiving Section 25.114(d)(3) to allow submission of gain information for omni antenna in non-.gxt format where manufacturer did not provide .gxt data); *see also Spectrum Five, LLC*, Order and Authorization, DA 06-2439, 21 FCC Rcd 14023, 14033 at ¶ 17 (IB 2006) (conditionally accepting antenna gain information not filed in .gxt format).

[12] *Galaxy 17 Grant* at n.5.

interested party to evaluate the antenna's interference potential. Accordingly, SES requests that the Commission grant a limited waiver of Section 25.114(d)(3).

Sections 25.114(d)(14)(ii) and 25.283(c): Sections 25.114(d)(14)(ii) and 25.283(c) address requirements relating to venting stored energy sources at the spacecraft's end of life.[13] AMC-3 is a Lockheed Martin A2100A model spacecraft and was constructed and launched in 1997 before the venting requirement in Section 25.283(c) was even proposed. As described in more detail in the attached Technical Appendix, the oxidizer tanks on the spacecraft were sealed following completion of the launch phase and will therefore retain residual pressure at end of life. Given the spacecraft design, it is physically impossible for SES to vent the oxidizer tanks in order to comply with Section 25.283(c).

Under Commission precedent, grant of a waiver is warranted. In a number of cases involving various spacecraft models with similar limitations, the Commission has waived Section 25.283(c) to permit launch and operation of spacecraft that do not allow for full venting of pressure vessels at end of life, based on a finding that modifying the space station design at a late stage of construction would pose an undue hardship.[14] In the case of AMC-3, which was launched and operational before the venting requirements were even proposed, there is no

13 Section 25.283(c) contains the substantive venting requirement, and Section 25.114(d)(14)(ii) requires applicants to submit information that addresses "whether stored energy will be removed at the spacecraft's end of life." 47 C.F.R. § 25.114(d)(14)(ii).

14 *See, e.g.*, *EchoStar Satellite Operating Corp.*, File No. SAT-LOA-20071221-00183, Call Sign S2746, grant-stamped Mar. 12, 2008, Attachment at ¶ 4 (granting a partial waiver of Section 25.283(c) for AMC-14, a Lockheed Martin A2100 model spacecraft, on grounds that requiring modification of satellite would present an undue hardship); *DIRECTV Enterprises LLC*, File No. SAT-LOA-20090807-00086, Call Sign S2797, grant-stamped Dec. 15, 2009, Attachment at ¶ 4 (same for DIRECTV 12, a Boeing 702 model spacecraft); *PanAmSat Licensee Corp.*, File Nos. SAT-MOD-20070207-00027, SAT-AMD-20070716-00102, Call Sign S2237, grant-stamped Oct. 4, 2007, Attachment at ¶ 7 (same for Intelsat 11, an Orbital Sciences Star model spacecraft).

question of bringing the satellite into compliance with the rule. The Commission has expressly recognized this, finding a waiver of Section 25.283(c) to be justified for in-orbit spacecraft that cannot satisfy the rule's requirements. For example, in a decision involving the SES AMC-2 satellite, which like AMC-3 was launched before Section 25.283(c) was adopted, the Commission waived the rule on its own motion, observing that venting the spacecraft's sealed oxidizer tanks "would require direct retrieval of the satellite, which is not currently possible."[15]

The same practical obstacle is present here. Because AMC-3 is already in orbit, SES can do nothing to enable full venting of residual pressure in the oxidizer tanks. Given this reality, waiver is clearly warranted; there is no possible public interest benefit in requiring strict adherence to a rule with which the licensee is incapable of complying.

Section 25.202(g): SES also requests any necessary waiver of Section 25.202(g) of the Commission's rules. That rule provides that "[t]elemetry, tracking and telecommand functions for U.S. domestic satellites shall be conducted at either or both edges of the allocated band(s)."[16] The Commission has explained that:

> The purpose of this rule is to simplify the coordination process for satellite systems, to provide an incentive for an operator to maximize the efficiency of its system's TT&C operations, and to minimize the constraints placed on other satellite operations.[17]

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15 File No. SAT-MOD-20101215-00261, Call Sign S2134, grant-stamped Mar. 8, 2011, Attachment at ¶ 4. *See also XM Radio Inc.*, File No. SAT-MOD-20100722-00165, Call Sign S2616, grant-stamped Oct. 14, 2010, Attachment at ¶ 2 (waiving Section 25.283(c) for XM-4, a Boeing 702 model spacecraft, because "modification of the spacecraft would present an undue hardship, since XM-4 is an in-orbit space station and venting XM-4's helium and xenon tanks would require direct retrieval of the satellite, which is not currently possible").

16 47 C.F.R. § 25.202(g).

17 *Orbcomm License Corp.*, 23 FCC Rcd 4804 at ¶ 20 (IB & OET 2008).

Here, SES does not propose to operate the AMC-3 C-band communications payload while the spacecraft is located at 67º W.L., but does propose to use limited C-band frequencies for TT&C. SES submits that this configuration conforms to Section 25.202(g), which does not require TT&C to be conducted in a space station's operating bands but simply in "either or both ends of the allocated bands for the service."[18] SES's intention to perform TT&C functions at the edge of the C-band, which is allocated for FSS service and for which AMC-3 has been licensed, is therefore consistent with the plain language of Section 25.202(g).[19]

SES is aware, however, that in some decisions the Commission has characterized Section 25.202(g) as requiring "FSS systems to operate their tracking, telemetry, and command (TT&C) links at the edges of the frequency bands *in which they are providing service*."[20] Accordingly, SES requests grant of any necessary waiver of Section 25.202(g) to allow use of AMC-3 C-band channels for TT&C at 67º W.L.

Grant of a waiver will not undermine the objectives of the rule, which include facilitating coordination, avoiding undue constraints on other satellite operations, and ensuring efficient use of spectrum for TT&C. As discussed in the Technical Appendix, the proposed AMC-3 TT&C operations in the C-band have been coordinated with Star One, which operates the adjacent C-band spacecraft: Star One C1 at 65º W.L. and Star One B2 at 68º W.L. Thus, no

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[18] *DIRECTV Enterprises, LLC*, DA 06-1493, 21 FCC Rcd 8028 (Sat. Div. 2006) at ¶ 11.

[19] It is also consistent with the Commission's prior action in a similar factual scenario involving AMC-2. Specifically, the Commission authorized SES to use C-band channels for TT&C during interim operations of AMC-2 at 105º W.L. but did not authorize use of the spacecraft's C- band communications payload. *See SES Americom, Inc.*, DA 03-2197, 18 FCC Rcd 13143 (Sat. Div. 2003). There is no suggestion in that decision that the use of C-band for TT&C only required a waiver of Section 25.202(g).

[20] *See, e.g., Northrop Grumman Space & Mission Systems Corp.*, DA 09-428, 24 FCC Rcd 2330 (IB 2009) at ¶ 94 (emphasis added).

concerns about coordination or constraining other satellite operations are raised here.[21] Furthermore, AMC-3 was designed to operate with both service links and TT&C functions in the C-band. As a result, SES had every incentive to ensure that the AMC-3 TT&C subsystem uses spectrum efficiently, and grant of a waiver now will not impair that efficiency.

Grant of a waiver will also serve the public interest. By allowing SES to use diverse TT&C frequencies, the waiver will enhance the reliability of TT&C functions, facilitating the safe operation of AMC-3 at 67º W.L.

CONCLUSION

For the foregoing reasons, SES seeks a modification of the AMC-3 license to permit relocation of the spacecraft from 86.9º W.L. to 67º W.L. and operations in the conventional Ku-band, as described in the attached materials.

Respectfully submitted,

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21 *See, e.g.*, *INTELSAT LLC*, FCC 00-287, 15 FCC Rcd 15460 (2000) at ¶¶ 95-100 (granting a waiver of § 25.202(g) where TT&C operations were already coordinated with adjacent operators).

ATTACHMENT A

TECHNICAL APPENDIX

IN SUPPORT OF AMC-3 (67°W.L.)

TECHNICAL APPENDIX

1.0 Overall Description

This technical appendix is submitted in support of the modification application of SES Americom, Inc. ("SES Americom," doing business as SES) seeking reassignment of AMC-3 to 67°W.L. Technical information regarding AMC-3 is already on file with the Commission and is incorporated by reference herein.[1] However, because the original documents submitted to the FCC to describe AMC-3 were filed more than sixteen years ago, SES is providing for the Commission's convenience a more extensive Technical Attachment and Schedule S than would otherwise be required for a modification application. *See* 47 C.F.R. § 25.117(d)(1) (requiring submission of "only those items of information listed in § 25.114 that change").

AMC-3 is a hybrid C and Ku-band communications satellite to be operated at 67° W.L., where it will be collocated with the AMC-4 satellite and offer Ku-band coverage of the Southern USA, Mexico and parts of the Caribbean. The satellite's C-band payload has coverage of Continental USA, Mexico, and parts of Central America and the Caribbean, but the C-band communications transponders of AMC-3 will not be used at 67°W.L.

AMC-3 will operate in the following frequency bands:

- Conventional Ku-band frequencies with downlink frequencies from 11.7 to 12.2 GHz and uplink frequencies from 14.0 to 14.5 GHz
- Telecommand carriers in the conventional C-band at 6423.5 MHz and telemetry beacons in the Ku-band at 12198.0 MHz and in the C-band at 3700.5 MHz and 4199.5 MHz. The telecommand and telemetry carriers have been coordinated with adjacent satellite operations.
- SES is not seeking authority to operate the C-band communications payload (3700-4200 MHz and 5925-6425 MHz) at 67°W.L. However, the general characteristics of the C-band payload are described herein and in the attached Schedule S in order to present a complete technical summary of the spacecraft.

Dual linear polarization is used in both the C- and Ku-bands. Tables 1 and 2 show the frequency plan of the satellite. The frequency bands are divided into 24 C-band transponders of 36 MHz bandwidth each and 24 Ku-band transponders of 36 MHz bandwidth each.

[1] *See* File No. SAT-LOA-19950215-00028.

2.0 Schedule S

The Schedule S database is attached as an electronic file. The following items supplement the information provided in Schedule S.

1. *Transponder frequency plan.*

Sections S9 and S10 of Schedule S show the transponder frequency plans. Beams with IDs KRV, KTV, KRH and KTH provide coverage over Southern USA, Mexico and parts of the Caribbean. Beams with IDs CRV, CTV, CRH and CTH provide coverage of CONUS, Mexico, and parts of Central America and the Caribbean, however they will not be operated at 67°W.L. Transponders K01 to K24 connect beams KRV and KTH, and KRH and KTV. Transponders C01 to C24 connect beams CRV and CTH, and CRH and CTV.

Table 1: Ku-band Frequency Plan

Channel	**Receive Frequency (MHz)**	**Polarization**	**Transmit Frequency (MHz)**	**Polarization**
1	14020	H	11720	V
2	14040	V	11740	H
3	14060	H	11760	V
4	14080	V	11780	H
5	14100	H	11800	V
6	14120	V	11820	H
7	14140	H	11840	V
8	14160	V	11860	H
9	14180	H	11880	V
10	14200	V	11900	H
11	14220	H	11920	V
12	14240	V	11940	H
13	14260	H	11960	V
14	14280	V	11980	H
15	14300	H	12000	V
16	14320	V	12020	H
17	14340	H	12040	V
18	14360	V	12060	H
19	14380	H	12080	V
20	14400	V	12100	H
21	14420	H	12120	V
22	14440	V	12140	H
23	14460	H	12160	V
24	14480	V	12180	H

Table 2: C-band Frequency Plan

Channel	**Receive Frequency (MHz)**	**Polarization**	**Transmit Frequency (MHz)**	**Polarization**
1	5945	V	3720	H
2	5965	H	3740	V
3	5985	V	3760	H
4	6005	H	3780	V
5	6025	V	3800	H
6	6045	H	3820	V
7	6065	V	3840	H
8	6085	H	3860	V
9	6105	V	3880	H
10	6125	H	3900	V
11	6145	V	3920	H
12	6165	H	3940	V
13	6185	V	3960	H
14	6205	H	3980	V
15	6225	V	4000	H
16	6245	H	4020	V
17	6265	V	4040	H
18	6285	H	4060	V
19	6305	V	4080	H
20	6325	H	4100	V
21	6345	V	4120	H
22	6365	H	4140	V
23	6385	V	4160	H
24	6405	H	4180	V

2. TWTA redundancy.

Ku-band

The communications receivers are configured in a 4-for-2 redundancy (as a minimum) with cross-strapping between polarizations. Twenty-four (24) operational frequencies utilizing 36 MHz bandwidth are provided by thirty-two (32) High Power Amplifiers (HPAs) arranged in two groups of 18-for-12.

C-band

The communications receivers are configured in a 4-for-2 redundancy (as a minimum) with cross-strapping between polarizations. Twenty-four (24) operational frequencies utilizing 36 MHz bandwidth are provided by thirty-two (32) High Power Amplifiers (HPAs) arranged in two groups of 16-for-12.

3. Saturation Flux Density values.

SFD values can be obtained by using the expression:

Ku-band

SFD = -92– (G/T) +Transponder Gain Setting, dBW/m^2

C-band

SFD = -98– (G/T) +Transponder Gain Setting, dBW/m^2

4. *Transponder frequency response.*

The frequency response and total group delay, specified over the transponder bandwidth, are provided in Tables 3 to 6 below.

Table 3: Ku-band Transponder Frequency Response

	Frequency Offset (MHz)	dB p-p
36 MHz channel	±14	1.7
	±16	2.5
	±18	5.5

Table 4: C-band Transponder Frequency Response

	Frequency Offset (MHz)	dB p-p
36 MHz channel	±14	1.3
	±16	1.7
	±18	3.2

Table 5: Ku-band Transponder Total Group Delay

	Frequency Offset (MHz)	Relative Group Delay (ns p-p)
36 MHz channel	0	5.0
	±8	13.0
	±12	22.0
	±16	60.0
	±18	120.0

Table 6: C-band Transponder Total Group Delay

	Frequency Offset (MHz)	Relative Group Delay (ns p-p)
36 MHz channel	0	4.0
	±8	11.0
	±12	16.0
	±16	41.0
	±18	74.0

5. Telemetry and Telecommand (TT&C) frequencies and beams.

Table 7 shows the TT&C carrier center frequencies and bandwidths. The command carrier uses a global horn at all times. The beacon transmitters use communication antennas during normal operations and global horn during contingency operations. The telemetry carriers use communication antennas during normal operation.

Table 7: TT&C Carrier Frequencies

	Frequency, MHz	Nominal polarization
Command carriers (bandwidth: 1.0 MHz, capture range)		
C-band	6423.5	V
Beacons/Telemetry (bandwidth: 400 KHz)		
C-band pair	3700.5	V
	4199.5	H
Ku-band	12198	V

Note: The C-band telemetry reverts to vertical polarization during contingency operations.

5.1 Command carrier characteristics and link budgets

1 Bandwidth (2-sided): 1.0 MHz

2 Capture range (2-sided): 2.0 MHz

3 Transmit Earth Station sidelobe envelope: 29 – 25 log θ, dB

4 Uplink power flux at the satellite:

$-77 dBW/m^2$ to $-60 dBW/m^2$

A typical plot of the global horn used for the command function is shown in Figure 1 below.

Figure 1. Global Horn Characteristics

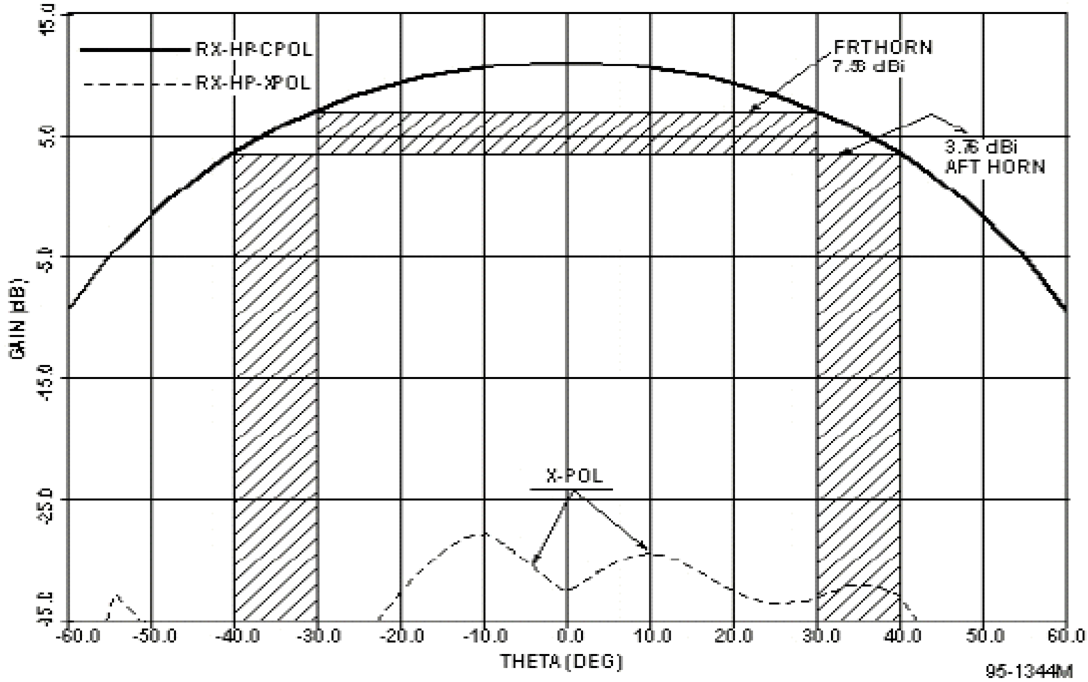

Figure 2.3-4. Measured Performance of Command Horn

Table 8 shows the command carrier link budgets.

Table 8: C-band Command Carrier Link Budgets

	C-band
Tx ES dia (typical), m	13
Tx ES gain, dBi	57.0
Tx ES antenna input power, dBW	10
Tx ES EIRP, dBW	67.0
Link loss, dB	200.1
Satellite G/T, dB/K	2
Command carrier bandwidth, MHz	1
Tx ES antenna input power density, dBW/Hz	-50
Carrier-to-Noise Ratio, dB	37.5
Required CNR, dB	10
Margin	27.5

5.2 Telemetry/Beacon carrier link budgets

Table 9 shows telemetry link budgets with an EIRP minimum of 10 dBW in the coverage area.

Table 9: C-band & Ku-band Telemetry Link Budgets

	Ku-band	**C-band**
EIRP, dBW	17	12
Carrier bandwidth, MHz	0.5	0.5
EIRP density, dBW/4kHz	-3.97	-8.97
Tx ES dia (typical), m	5.7	4.5
Rx ES antenna gain, dB	55.0	43.0
Rx ES G/T, dB/K	33.2	23
Rain fade, dB	8	1
CNR, dB	11.1	11.5
CNR (required), dB	9	9
Margin, dB	2.1	2.5

3.0 Satellite Antenna Gain Contours

Annex 1 shows the antenna gain contours for 8 different cases: transmit and receive beams, H- and V-polarizations for Ku- and C-bands. Table 10 shows the correspondence between peak gains of the antennas and maximum EIRP or G/T values.

Table 10: Maximum Co-pol Gain, EIRP and G/T Value

		Ku-band		C-band	
		H-pol	V-pol	H-pol	V-pol
Transmit beam	Gain (max.), dBi	33.61	33.14	29.89	30.67
	EIRP (max.), dBW	50.58	50.34	41.08	42.02
Receive beam	Gain (max.), dBi	35.12	33.93	33.00	31.91
	G/T (max), dB/K	6.77	5.39	5.7	4.81

These files with co-pol data are also provided as gxt files in Schedule S:

1. CRV.gxt (V-pol, C-band receive beam)
2. CTV.gxt (V-pol, C-band transmit beam)
3. KRH.gxt (H-pol, Ku-band receive beam)
4. KTH.gxt (H-pol, Ku-band transmit beam)
5. CRH.gxt (H-pol, C-band receive beam)
6. CTH.gxt (H-pol, C-band transmit beam)
7. KRV.gxt (V-pol, Ku-band receive beam)
8. KTV.gxt (V-pol, Ku-band transmit beam)

In addition, section S7 of Schedule S shows the maximum gains of the receive and transmit antennas, maximum EIRP, and maximum G/T values.

4.0 Emission Designators and Link Budgets

The services provided by AMC-3 will be wide ranging, including digital TV and digital transmission services ranging from 56 KBPS to high-speed. Sample link budgets for these services follow. Table 11 provides the characteristics of the earth stations used for this analysis and estimated link margins for Ku-band carriers. Table 12 shows similar results for C-band carriers.

Table 13 shows analog TV/FM (emission designator 36M0F3F) link budgets for Ku-band and C-band carriers.

Table 11: Ku-band Link Budgets for 7 Typical Links

Parameter	Digital TV MCPC 40 Mbps QPSK ¾ RS	Digital TV MCPC 32 Mbps QPSK ¾ RS	Digital TV SCPC QPSK ¾ RS	Digital TV SCPC QPSK ¾ RS	56 Kbps QPSK ¾ RS	1.544 Mbps QPSK ¾ RS	Digital TV MCPC 50 Mbps 8PSK ⅔ RS
Carrier designation	36M0G7W	27M0G7W	6M95G1W	5M00G1W	100KG1W	1M60G1W	36M0G7W
Data Rate (dB-Hz)	76	75	69	67.6	47.5	61.9	77
Throughput rate (Mbps)	40	32	8	6	0.056	1.544	50
Symbol rate (Msps)	28.8	22.9	5.7	4.2	0.041	1.117	27.2
Uplinks:							
Transmit Power (dBW)	20	20	8.9	8.9	-2	8	20
Transmit Loss (dB)	-2.5	-2.5	-2.5	-2.5	-2.5	-2.5	-2.5
Antenna diameter	6.1	6.1	3.7	3.7	1.8	1.8	6.1
Antenna Gain (dBi)	57.3	57.3	53.0	53.0	46.7	46.7	57.3
Ground Station EIRP (dBW)	74.8	74.8	59.4	59.4	42.2	52.2	74.8
Uplink Rain Loss (dB)	-2	-2	-2	-2	-2	-2	-2
Free Space Loss (dB)	-207	-207	-207	-207	-207	-207	-207
Satellite G/T (dB/K)	3	3	3	3	3	3	3
Boltzmann's Constant (dBW/K-Hz)	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6
Eb/N0 (dB)	21.4	22.4	13.0	14.4	17.3	12.9	20.4
Eb/I0 (dB)	18	18	16	16	16	16	18
Total Eb/(N0 + I0) (dB)	16.4	16.7	11.2	12.1	13.6	11.2	16.0

Table 11 (cont'd): Ku-band Link Budgets for 7 Typical Links

Parameter	Digital TV MCPC 40 Mbps QPSK ¾ RS	Digital TV MCPC 32 Mbps QPSK ¾ RS	Digital TV SCPC QPSK ¾ RS	Digital TV SCPC QPSK ¾ RS	56 Kbps QPSK ¾ RS	1.544 Mbps QPSK ¾ RS	Digital TV MCPC 50 Mbps 8PSK ⅔ RS
Carrier designation	36M0G7W	27M0G7W	6M95G1W	5M00G1W	100KG1W	1M60G1W	36M0G7W
Downlinks:							
Satellite Carrier EIRP (dBW)	48.5	47.3	37.4	35.9	18.9	31.0	44.5
Interference bandwidth (MHz)	36	27	6.95	5	0.1	1.6	36
Satellite EIRP density (dBW/4KHz)	8.96	8.96	4.96	4.96	4.96	4.96	4.96
Downlink Rain Loss (dB)	-3	-3	-3	-3	-3	-3	-3
Free Space Loss (dB)	-205.4	-205.4	-205.4	-205.4	-205.4	-205.4	-205.4
Ground station antenna dia, m	1.2	1.2	2.4	2.4	1.2	2.4	2.4
Ground Station G/T (dB/K)	20.9	20.9	26.9	26.9	20.9	26.9	26.9
Eb/N0 (dB)	13.6	13.4	15.5	15.5	12.5	16.2	14.6
C/IM			18	18	18	18	
Eb/Imo (dB)			16.6	16.6	16.6	16.6	
C/I	15	15	15	15	15	15	15
Eb/I0 (ASI) (dB)	13.6	13.6	13.6	13.6	13.6	13.6	12.3
Eb/I0 (dB)	13.6	13.6	13.6	13.6	13.6	13.6	12.3
Eb/(N0 + I0) (dB)	10.6	10.5	10.3	10.3	9.2	10.5	10.3
Total Up/Down Eb/(N0+Io)(dB)	9.6	9.5	7.7	8.1	7.8	7.8	9.3
Required Eb/N0	5.4	5.4	5.4	5.4	5.4	5.4	7.2
Margin	4.2	4.1	2.3	2.7	2.4	2.4	2.1

Table 12: C-band Link Budgets for 7 Typical Links

Parameter	Digital TV MCPC 40 Mbps QPSK ¾ RS	Digital TV MCPC 32 Mbps QPSK ¾ RS	Digital TV SCPC QPSK ¾ RS	Digital TV SCPC QPSK ¾ RS	56 Kbps QPSK ¾ RS	1.544 Mbps QPSK ¾ RS	Digital TV MCPC 50 Mbps 8PSK ⅔ RS
Carrier designation	36M0G7W	27M0G7W	6M95G1W	5M00G1W	100KG1W	1M60G1W	36M0G7W
Data Rate (dB-Hz)	76	75	69	67.6	47.5	61.9	77
Throughput rate (Mbps)	40	32	8	6	0.056	1.544	50
Symbol rate (Msps)	28.8	22.9	5.7	4.2	0.041	1.117	27.2
Uplinks:							
Transmit Power (dBW)	25.1	20	9.6	12	-3.4	11.8	25.1
Transmit Loss (dB)	-2.5	-2.5	-2.5	-2.5	-2.5	-2.5	-2.5
Antenna diameter (m)	9	9	9	9	4.5	4.5	9
Antenna Gain (dBi)	53.5	53.5	53.5	53.5	47.5	47.5	53.5
Ground Station EIRP (dBW)	76.1	71.0	60.6	63.0	41.6	56.8	76.1
Uplink Rain Loss (dB)	-1	-1	-1	-1	-1	-1	-1
Free Space Loss (dB)	-199.7	-199.7	-199.7	-199.7	-199.7	-199.7	-199.7
Satellite G/T (dB/K)	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Boltzmann's Constant (dBW/K-Hz)	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6
Eb/No (dB)	29.3	25.2	20.8	23.2	23.3	24.1	28.3
Eb/Io (dB)	18	18	18	16	16	16	18
Total Eb/(No + Io) (dB)	17.7	17.2	16.2	15.2	15.3	15.4	17.6

Table 12 (cont'd): C-band Link Budgets for 7 Typical Links

Parameter	Digital TV MCPC 40 Mbps QPSK ¾ RS	Digital TV MCPC 32 Mbps QPSK ¾ RS	Digital TV SCPC QPSK ¾ RS	Digital TV SCPC QPSK ¾ RS	56 Kbps QPSK ¾ RS	1.544 Mbps QPSK ¾ RS	Digital TV MCPC 50 Mbps 8PSK ⅔ RS
Carrier designation	36M0G7W	27M0G7W	6M95G1W	5M00G1W	100KG1W	1M60G1W	36M0G7W
Downlinks:							
Satellite Carrier EIRP (dBW)	37	35.8	25.9	24.4	7.4	19.5	33
Interference bandwidth (MHz)	36	27	6.95	5	0.1	1.6	36
Satellite EIRP density (dBW/4KHz)	-2.54	-2.54	-6.54	-6.54	-6.54	-6.54	-6.54
Downlink Rain Loss (dB)	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
Free Space Loss (dB)	-195.8	-195.8	-195.8	-195.8	-195.8	-195.8	-195.8
Ground station antenna dia, m	3.8	3.8	3.8	3.8	3.8	3.8	3.8
Ground Station G/T (dB/K)	22.1	22.1	22.1	22.1	22.1	22.1	22.1
Eb/No (dB)	15.4	15.1	11.2	9.8	14.3	11.9	10.4
C/IM			18	18	18	18	
Eb/Imo (dB)			16.6	16.6	16.6	16.6	
C/I(ASI)	16	16	16	16	16	16	16
Eb/Io(ASI)	14.6	14.6	14.6	14.6	14.6	14.6	13.3
Eb/Io (dB)	14.6	14.6	14.6	14.6	14.6	14.6	13.3
Eb/(No + Io) (dB)	11.9	11.8	8.8	7.9	10.3	9.2	8.6
Total Up/Down Eb/(No+Io)(dB)	10.9	10.7	8.1	7.2	9.1	8.3	8.1
Required	5.4	5.4	5.4	5.4	5.4	5.4	5.4
Margin	5.5	5.3	2.7	1.8	3.7	2.9	2.7

Table 13: Ku-band & C-band Link Budgets for TV/FM

Parameter	Ku-band Typical TV/FM link	C-band Typical TV/FM link
Carrier designation	36M0F3F	36M0F3F
Uplinks:		
Transmit Power (dBW)	22	25
Transmit Loss (dB)	-1	-0.5
Antenna diameter	6.1	9
Antenna Gain (dBi)	57.3	53.5
Ground Station EIRP (dBW)	78.3	78.0
Uplink Rain Loss (dB)	-2	-1
Free Space Loss (dB)	-207	-199.7
Satellite G/T (dB/K)	3	1.3
Bandwidth (dB-Hz)	75.6	75.6
Boltzmann's Constant (dBW/K-Hz)	-228.6	-228.6
C/N, uplink (dB)	25.4	31.7
Downlinks:		
Satellite Carrier EIRP (dBW)	48.2	39.7
Downlink Rain Loss (dB)	-3	-0.5
Free Space Loss (dB)	-205.4	-195.8
Ground station antenna dia, m	1.2	3.8
Ground Station G/T (dB/K)	20.9	22.1
C/N, DL (dB)	13.7	18.5
C/I ASI (dB)	18	16
C/Ntot, dB	12.3	14.1
Required (dB)	11	11
Margin (dB)	1.3	3.1

5.0 Power Flux Density Limits

Section 25.208 of the Commission's Rules specifies the maximum allowed pfd in C-band. Table 14 shows the pfd and margin computations. The margins are all positive.

Table 14: C-band pfd and Margin Values

Elevation angle, deg	5.00	10.00	15.00	20.00	25.00	Max. EIRP
Max. EIRP, dBW	42.02	42.02	42.02	42.02	42.02	42.02
EIRP at elevation angle, dBW	36.32	36.82	37.57	38.22	39.27	42.02
Min. spreading loss, dB/m2	-163.27	-163.15	-163.06	-162.94	-162.84	-162.10
25.208 PFD limit	-152.00	-149.50	-147.00	-144.50	-142.00	-142.00
Digital Carriers						
Carrier bandwidth, MHz	36.00	36.00	36.00	36.00	36.00	36.00
PFD, dBW/m2/4KHz	-166.52	-165.90	-165.05	-164.28	-163.13	-159.6
Margin, dB, relative to 25.208	14.52	16.40	18.05	19.78	21.13	17.64
Analog TV/FM(2 MHz spreading)						
Carrier bandwidth, MHz	2.00	2.00	2.00	2.00	2.00	2.00
PFD, dBW/m2/4KHz	-153.96	-153.34	-152.50	-151.73	-150.58	-147.09
Margin, dB, relative to 25.208	1.96	3.84	5.50	7.23	8.58	5.09

* The maximum EIRP values shown are in V-pol. The maximum EIRP values in H-pol are 0.94 dB lower.

6.0 Cessation of Emissions

Each TWTA is commandable to apply or remove RF drive of the associated amplifier as required under § 25.207. Each TWTA can also be commanded on and off, although they are normally powered for the entire mission, after the satellite arrives on station.

7.0 Interference Analysis

Annex 2 shows the results of an interference analysis for C- and Ku-band operations in a 2-degree spacing environment. Using C/I metrics, the analysis shows that the interference can be restricted to no more than 6% of the noise plus interference at threshold.[2]

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[2] The interference analysis is done assuming digital wanted and interfering carriers. Analog carriers will be coordinated on a case-by-case basis, and are not addressed here.

8.0 Mitigation of Orbital Debris

This section provides the information required under Section 25.114(d)(14) of the Commission's Rules.

§ 25.114(d)(14)(i): SES has assessed and limited the amount of debris released in a planned manner during normal operations of AMC-3. No debris is generated during normal on-station operations, and the spacecraft will be in a stable configuration. On-station operations require stationkeeping within the +/- 0.05 degree N-S and E-W control box, thereby ensuring adequate collision avoidance distance from other satellites in geosynchronous orbit. SES proposes to collocate AMC-3 with AMC-4 using the proven Inclination-Eccentricity (I-E) separation method. This strategy is presently in use by SES to ensure proper operation and safety of multiple satellites within one orbital box.

SES has also assessed and limited the probability of the space station becoming a source of orbital debris by collisions with small debris or meteoroids that could cause loss of control and prevent post-mission disposal. The spacecraft design locates all sources of stored energy within the body of the structure, which provides protection from small orbital debris. SES requires that spacecraft manufacturers assess the probability of micrometeorite damage that can cause any loss of functionality. This probability is then factored into the ultimate spacecraft probability of success. Any significant probability of damage would need to be mitigated in order for the spacecraft design to meet SES's required probability of success of the mission. SES has taken steps to limit the effects of any collisions through shielding, the placement of components, and the use of redundant systems.

§ 25.114(d)(14)(ii): SES has assessed and limited the probability of accidental explosions during and after completion of mission operations. As part of the Safety Data Package submission for SES spacecraft, an extensive analysis is completed by the spacecraft manufacturer, reviewing each potential hazard relating to accidental explosions. A matrix is generated indicating the worst-case effect, the hazard cause, and the hazard controls available to minimize the severity and the probability of occurrence. Each subsystem is analyzed for potential hazards, and the Safety Design Package is provided for each phase of the program running from design phase, qualification, manufacturing and operational phase of the spacecraft. Also, the spacecraft manufacturer generates a Failure Mode Effects and Criticality Analysis for the spacecraft to identify all potential mission failures. The risk of accidental explosion is included as part of this analysis. This analysis indicates failure modes, possible causes, methods of detection, and compensating features of the spacecraft design.

The design of the AMC-3 spacecraft is such that the risk of explosion is minimized both during and after mission operations. In designing and building the spacecraft, the manufacturer took steps to ensure that debris generation will not result from the conversion of energy sources on board the satellite into energy that fragments the satellite. All propulsion subsystem pressure vessels, which have high margins of safety at launch, have even higher margins in orbit, since use of propellants and pressurants during launch decreases the propulsion system pressure. Burst tests are performed on all pressure vessels during qualification testing to demonstrate a margin of safety against burst. Bipropellant mixing is prevented by the use of valves that prevent backwards flow in propellant and pressurization lines. All pressures, including those of the batteries, are monitored by telemetry.

At the end of operational life, after the satellite has reached its final disposal orbit, onboard sources of stored energy will be depleted or secured, and the batteries will be discharged. However, at the end of AMC-3's operational life, there will be oxidizer remaining in the tanks that cannot be vented. As with all Lockheed A2100 series spacecraft, the oxidizer tanks on AMC-3 were sealed using pyrotechnic valves at the end of transfer orbit and therefore cannot be vented at spacecraft end-of-life. This is a design feature of the Lockheed A2100 series spacecraft that cannot now be changed or remedied. Information regarding the residual oxidizer in the tanks is as follows:

Tank	Volume [l]	pressure [bar]	temp. [deg C]	Oxidizer mass [kg]
Ox 1	229.1	17.84	26.5	6.525
Ox 2	229.1	17.84	24.1	6.525

The oxidizer tanks are well shielded, and the residual pressure in the tanks will be well below their maximum rating. In the narrative portion of this application, SES seeks any necessary waiver of Section 25.283(c) in connection with the residual oxidizer that will remain in the tanks at end of life.

§ 25.114(d)(14)(iii): SES has assessed and limited the probability of the space station becoming a source of debris by collisions with large debris or other operational space stations. Specifically, SES has assessed the possibility of collision with satellites located at, or reasonably expected to be located at, the requested orbital location or assigned in the vicinity of that location. Regarding avoidance of collisions with controlled objects, in general, if a geosynchronous satellite is controlled within its specified longitude and latitude stationkeeping limits, collision with another controlled object (excluding where the satellite is collocated with another object) is the direct result of that object entering the allocated space.

The instant application seeks authority for operation of AMC-3 at the 67° W.L. orbital location, where it will be flown in formation with SES's AMC-4 spacecraft. SES is not aware of any other FCC- or non-FCC licensed spacecraft that are operational or planned to be deployed at 67° W.L. or to nearby orbital locations such that there would be an overlap with the requested stationkeeping volume of AMC-3.

SES uses the Space Data Center ("SDC") system from the Space Data Association to monitor the risk of close approach of its satellites with other objects. Any close encounters (separation of less than 10 km) are flagged and investigated in more detail. If required, avoidance maneuvers are performed to eliminate the possibility of collisions.

During any relocation, the moving spacecraft is maneuvered such that it is at least 30 km away from the synchronous radius at all times. In most cases, much larger deviation from the synchronous radius is used. In addition, the SDC system is used to ensure no close encounter occurs during the move. When de-orbit of a spacecraft is required, the initial phase is treated as a satellite move, and the same precautions are used to ensure collision avoidance.

§ 25.114(d)(14)(iv): Post-mission disposal of the satellite from operational orbit will be accomplished by carrying out maneuvers to a higher orbit. The upper stage engine remains part of the satellite, and there is no re-entry phase for either component. The fuel budget for elevating the satellite to a disposal orbit is included in the satellite design. SES plans to maneuver AMC-3 to a disposal orbit with a minimum perigee of 150 km above the normal operational altitude. Fuel gauging uncertainty has been taken into account in these calculations, as discussed below. However, there is no mechanism that allows precise measurement of the amount of fuel left on a spacecraft once it is in-orbit, and therefore it is possible that the AMC-3 spacecraft will not reach the targeted minimum de-orbit altitude.

AMC-3 is not subject to the minimum perigee requirement of Section 25.283(a) of the Commission's Rules because the satellite was launched prior to March 18, 2002. For the Commission's information, however, the disposal orbit altitude resulting from the IADC formula would be 287.6 km above the geostationary arc based on the following calculation:

Area of the satellite (average aspect area): 55.6 m^2

Mass of the spacecraft: 1311 kg

C_R (solar radiation pressure coefficient): 1.24

Therefore the Minimum Disposal Orbit Perigee Altitude, as calculated under the IADC formula is:

36,021 km + (1000 x C_R x A/m) = 36073.6 km, or 287.6 km above the GSO arc (35,786 km)

SES intends to reserve 11.6kg of fuel in order to account for post-mission disposal of AMC-3. SES has assessed fuel-gauging uncertainty and has provided an adequate margin of fuel reserve to address the assessed uncertainty.

ANNEX 1

COVERAGE MAPS

Figure 1: C-band, Receive beam, H-pol (CRH)
G/T max.5.7 dB/K, Antenna gain max.33.00dBi

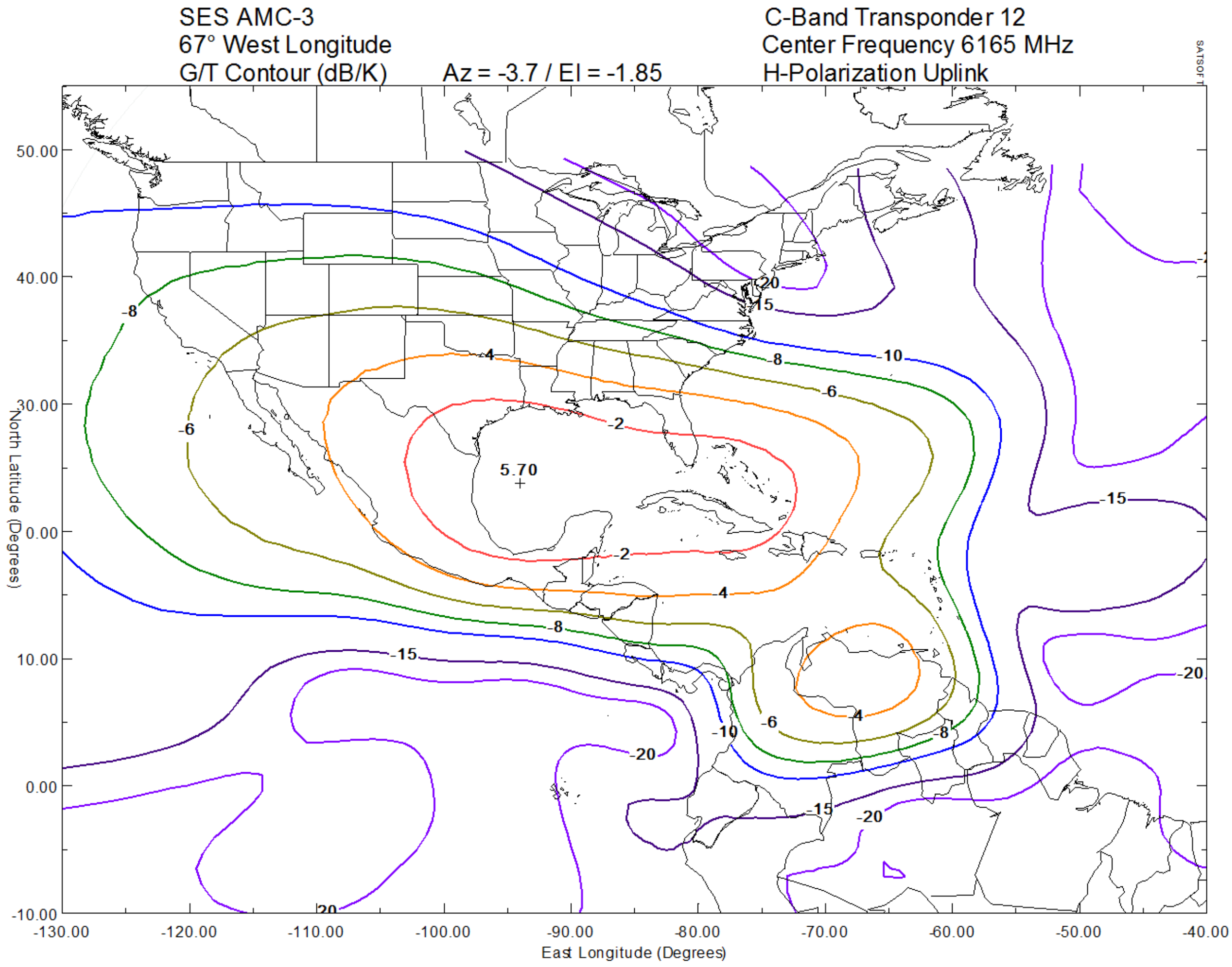


Figure 2: C-band, Receive beam, V-pol (CRV)
G/T max.4.81 dB/K, Antenna gain max.31.91 dBi

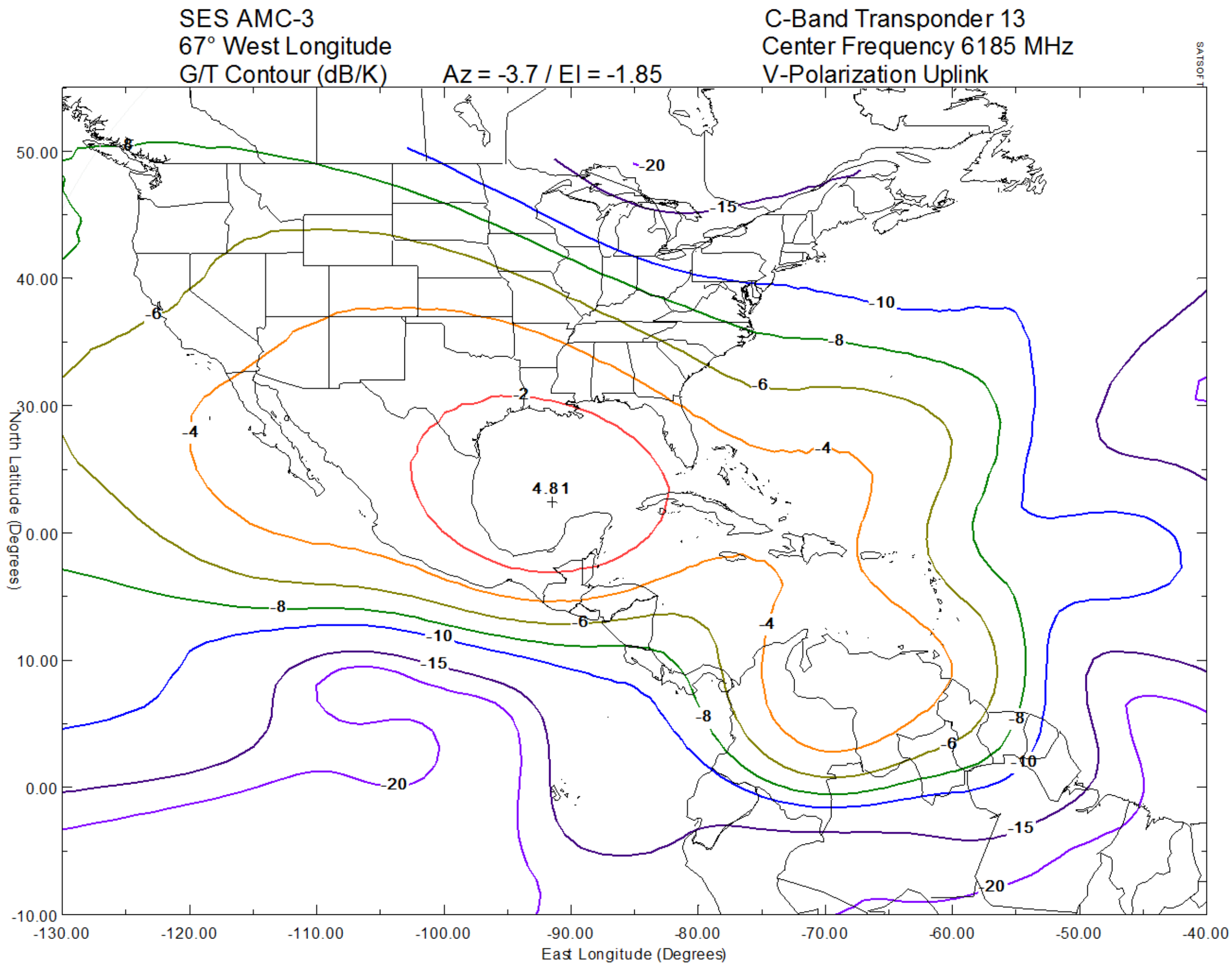


Figure 3: C-band, Transmit beam, H-pol (CTH)
EIRP max.41.08 dBW, Antenna gain max.29.89dBi

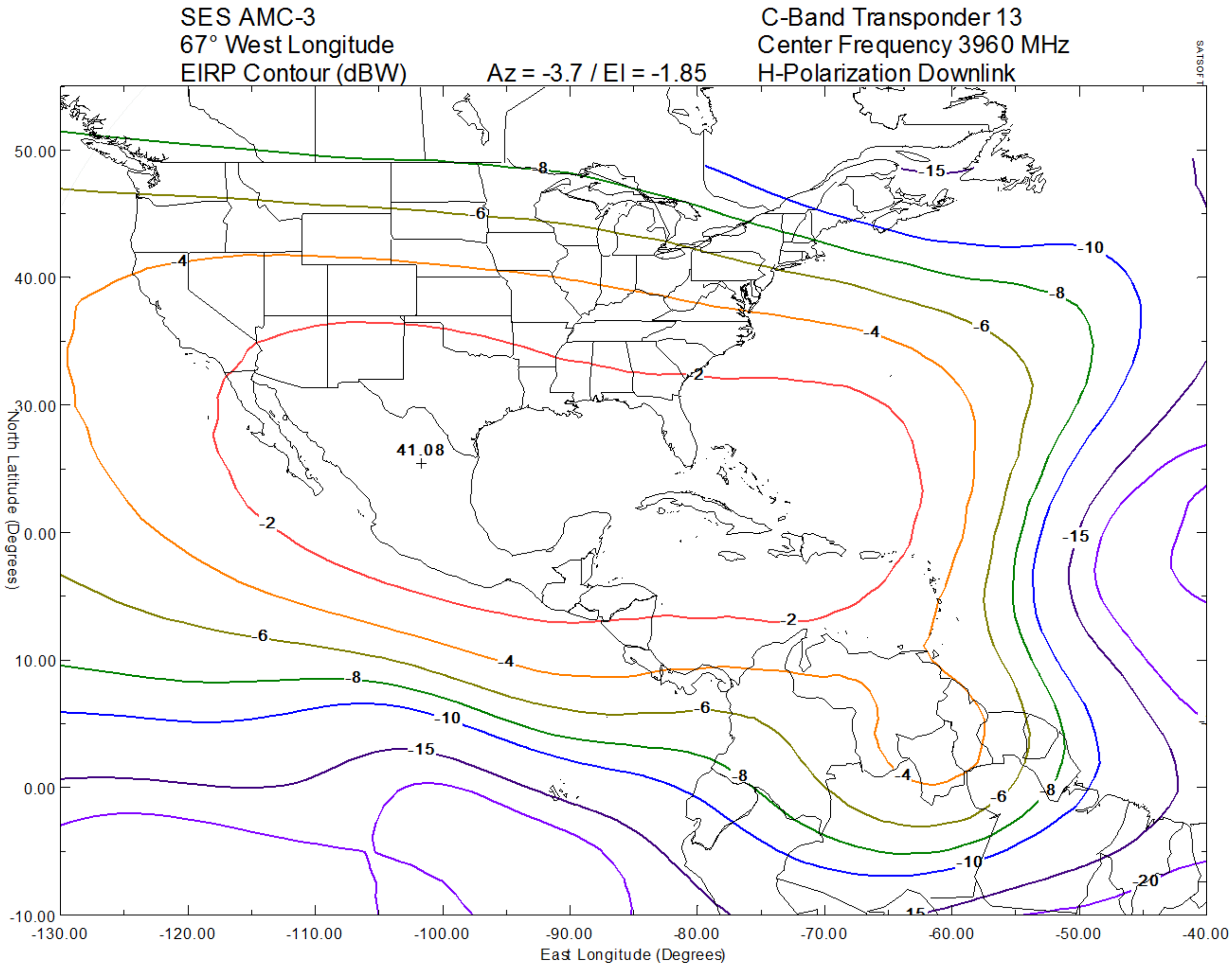


Figure 4: C-band, Transmit beam, V-pol (CTV)
EIRP max.42.02 dBW, Antenna gain max.30.67dBi

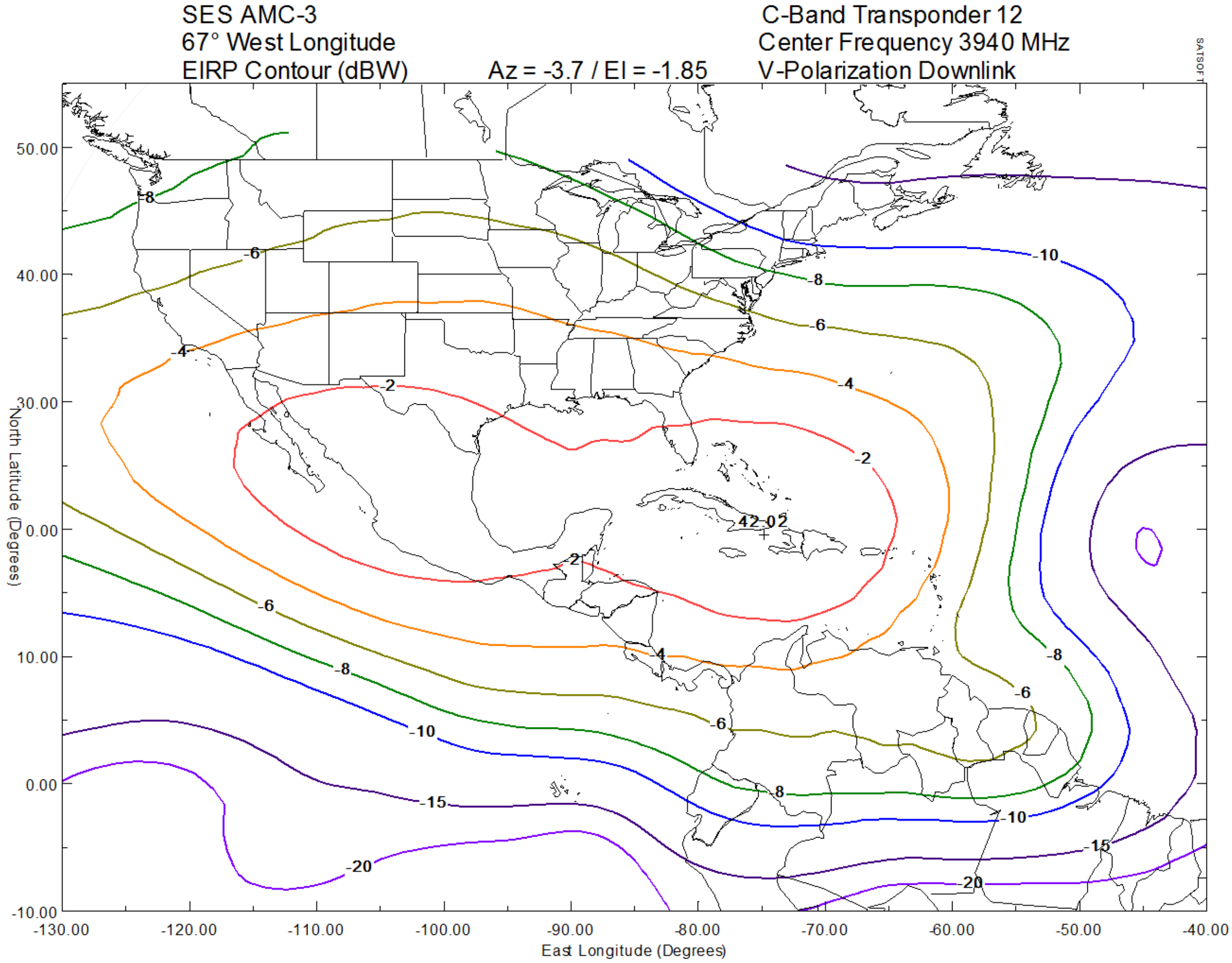


Figure 5: Ku-band, Receive beam, H-pol (KRH)
G/T max.6.77 dB/K, Antenna Gain max.35.12dBi

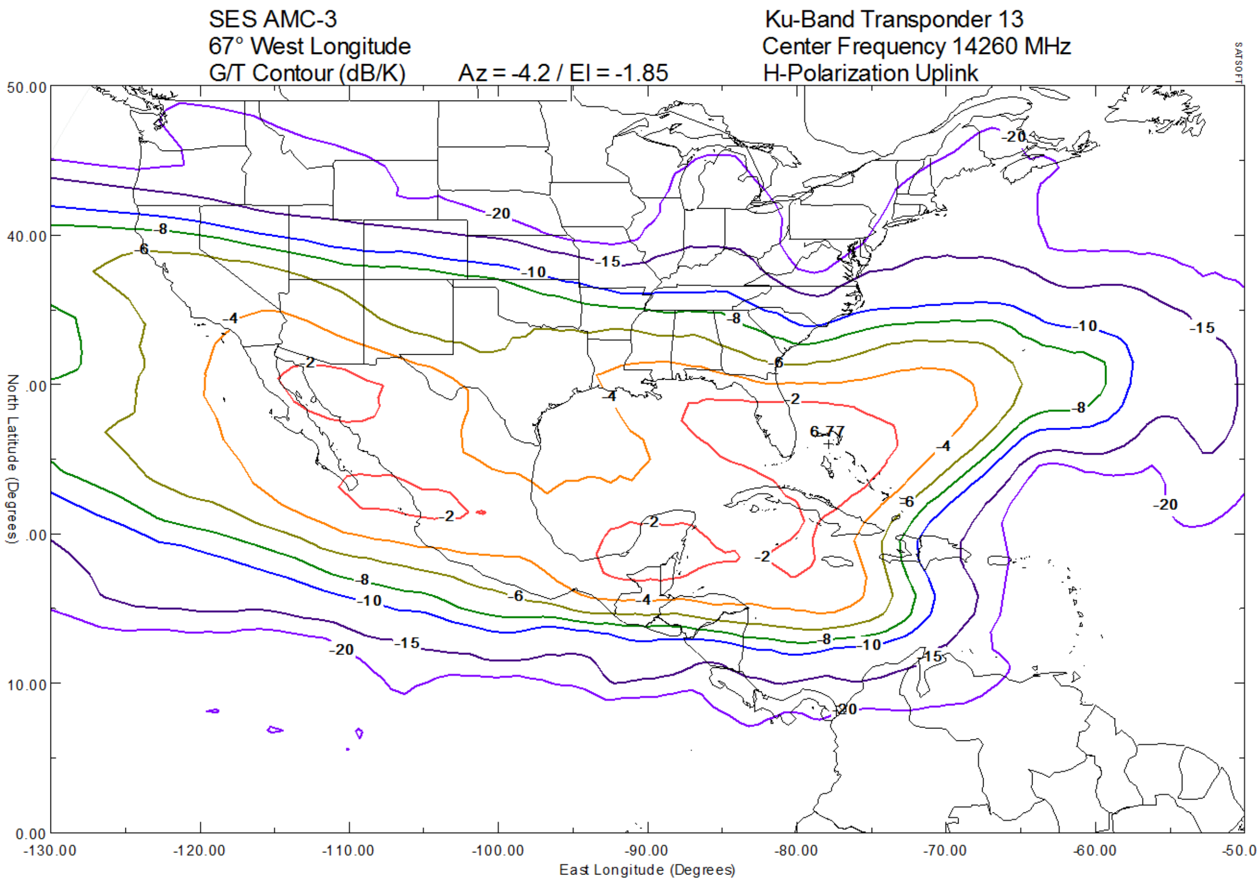


Fig. 6. Ku-band, Receive beam, V-pol (KRV)
G/T max 5.39 dB/K, Antenna Gain max.33.93dBi

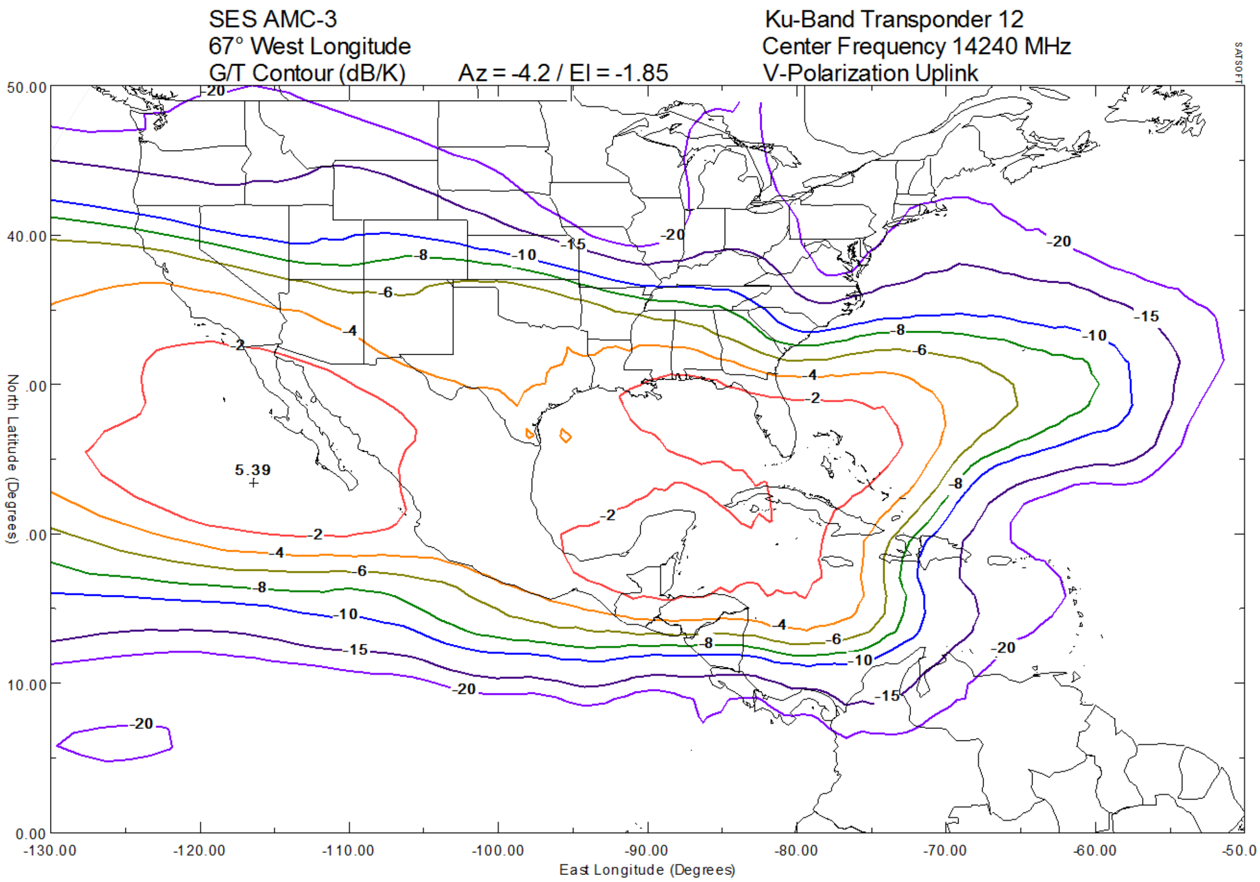


Fig. 7. Ku-band, Transmit beam, H-pol (KTH)
EIRP max.50.58 dBW, Antenna Gain max.33.61dBi

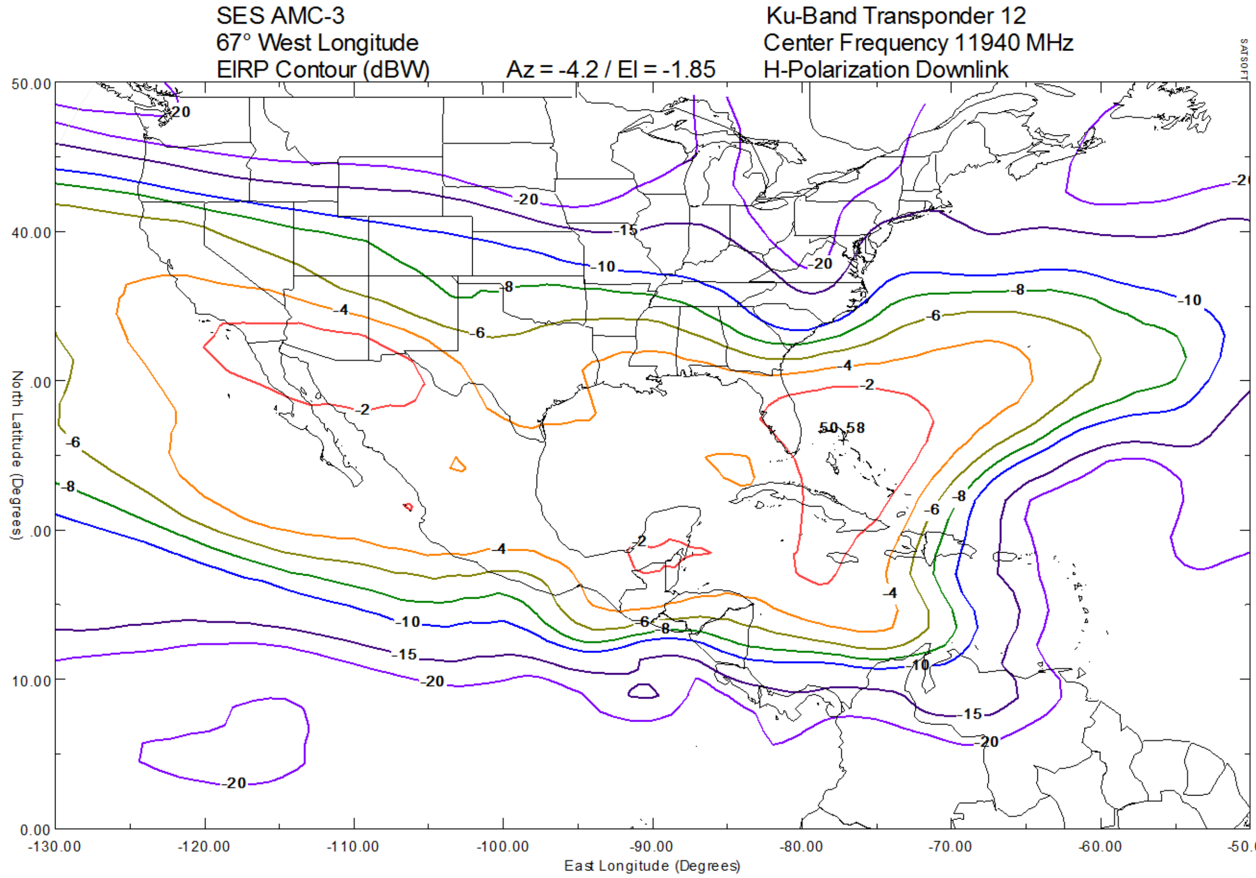
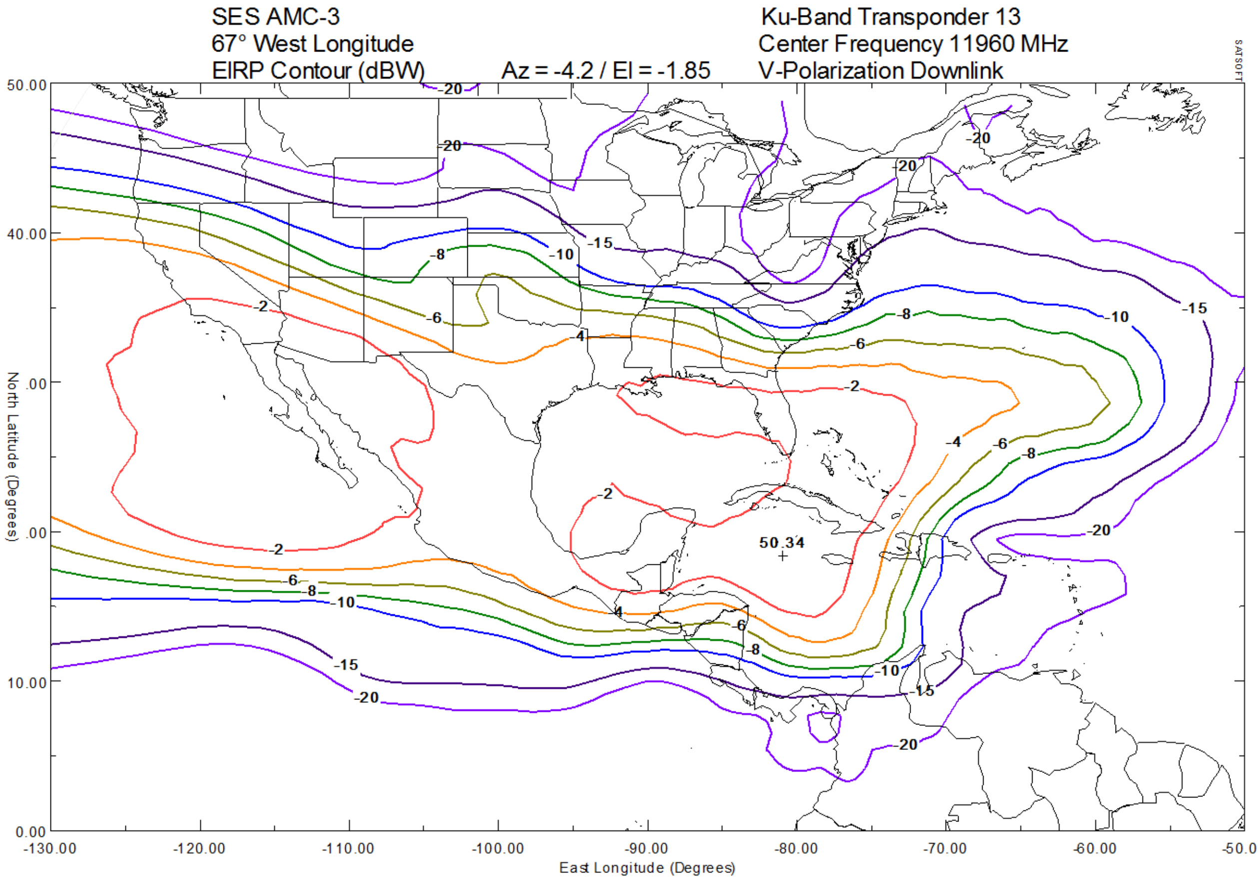


Fig. 8.Ku-band, Transmit beam, V-pol (KTV)
EIRP max.50.34 dBW, Antenna Gain max.33.14dBi



ANNEX 2

INTERFERENCE ANALYSIS

IN SUPPORT OF AMC-3

Two-degree Spacing Analysis

SES has previously demonstrated that the AMC-3 network is compatible with a co-coverage, co-frequency satellite, spaced two degrees away.[1] The instant analysis has been performed for operations of AMC-3 at the proposed 67° W.L. orbital location assuming digital signals in both networks. Operations of AMC-3 at 67° W.L. will conform to existing and future coordination arrangements with neighboring spacecraft.

SES notes that the Star One C1 space station, licensed by Brazil, is authorized to operate in the C-band and the Ku-band at the 65°W.L. orbital location and the Star One B2 (Brasilsat B2) space station, also licensed by Brazil, is authorized to operate at the 68° W.L. orbital location in C-band.[2] Star One C1 is on the Commission's Permitted Space Station List. Also licensed by Brazil is Star One C2 at the 70° W.L. orbital location, in both C-band and Ku-band. Because of greater orbital separation from AMC-3's proposed 67° W.L. orbital location, results of this analysis would be improved for this neighbor.

1 Two Degree Spacing Analysis for C-band

Details of the AMC-3 C-band TT&C operations have been provided in Section 2.5 of this Technical Appendix. To ensure that the AMC-3 satellite C-band TT&C operations do not cause harmful interference into the adjacent satellite networks, coordination of the TT&C channels has been completed with Star One, the adjacent satellite operator. This approach is consistent with industry practice, in which TT&C operations are typically addressed with adjacent satellite licensees on a case-by-case basis considering the actual characteristics of the respective networks. Except for TT&C carriers, SES does not propose to operate the C-band communications payload of AMC-3 at 67° W.L.

Section 25.140(b)(2) of the Commission's rules specifies the information applicants must provide to "demonstrate the compatibility of their proposed system two degrees from any authorized space

[1]*See* File No. SAT-LOA-19950215-00028, Technical Appendix Attachments C and D. SES incorporates that showing by reference herein.

[2]The Brazilian-licensed Star One B1 (Brasilsat B1) spacecraft that previously operated at the nominal 68° W.L. orbital location has been retired and removed to a disposal orbit.

station."[3] The required information includes link noise budgets, modulation parameters, and overall link performance analysis. The details of theAMC-3 C-band TT&C operations provided in Section 2.5 of this Technical Appendix respond to these requirements.

The Commission also requires an analysis of the potential for interference into and from carriers of adjacent satellites at two-degree spacing.[4] In the typical case, the analysis addresses adjacent satellites operating their communications payloads on a co-frequency basis. In contrast, managing interference potential from TT&C carriers is done on a case-by-case basis, as noted above, and relies on frequency diversity, polarization diversity and other tools to ensure avoidance of interference. The analysis below describes the specific factors that allow the AMC-3 C-band TT&C operations proposed herein to operate in a two-degree spacing environment without causing or experiencing harmful adjacent satellite interference.

1.1. C-band Uplink Interference Assessment

1.1.1. C-band Uplink Interference Assessment – Brasilsat B2 at 68° W.L.

For this analysis, the command carrier of the target satellite AMC-3 is assumed to be operating at -4 dBW/4 kHz at the antenna flange. The analysis is based on a worst case scenario: the interfered with satellite is assumed to operate cofrequency at the lower level of -12 dBW/4 kHz. Even though there is a difference between the input power density levels at the antenna flange for the operation of the two satellite systems because the Star One satellite operates through its higher gain communications antenna, the difference is mitigated by the satellite beam antenna gain isolation and the earth station gain isolation. This C/I value calculated in Table 1 below is comparable to or higher than what can be achieved for regular communications operations for systems compliant with the FCC rules operating in the Ku-band, as indicated in section 2.1 of this Annex.

[3] 47 C.F.R. § 25.140(b)(2). *See also* International Bureau Satellite Division, Clarification of 47 C.F.R. § 25.140(b)(2), Space Station Application Interference Analysis, Public Notice No. SPB-195, DA 03-3863, Dec. 3, 2003 ("Interference Analysis Notice").

[4] Interference Analysis Notice at 2. These are also provided in Section 2.5 of the Technical Appendix.

Table 1. Uplink Command C/I between AMC-3 at 67° W.L. and Brasilsat B2 at 68° W.L.

Topocentric orbital separation:		0.99				
	Earth station size (m)	Earth station on-axis gain (dBi)	Input power density (dBW/4 kHz)	Earth station off-axis gain (dBi)	Receive beam isolation (dB)	C/I (dB)
AMC-3	9	53	-4	29.1	-2.0	33.9
Brasilsat B2	9	53	-12	29.1	-20.0	35.9

However, as indicated above management of the interference potential from TT&C carriers is done on a case-by-case basis. Therefore the uplink interference environment has been addressed through coordination of the proposed AMC-3 C-band TT&C operations with Star One, taking into account the following mitigating factors:

1 The AMC-3 C-band command carrier will have frequency diversity from the Star One satellites' command carrier frequencies.

2 Significant geographic separation exists between the SES satellite command sites and the Star One coverage area.

3 SES's use of large (9 and 13 meter) transmit antennas for the command functions of the AMC-3 satellite, combined with a topocentric angle of approximately 1 degree[5] will result in ample gain isolation towards the neighboring satellite.

SES and Star One have coordinated the AMC-3 C-band command carriers taking these factors into account. The planned operations of their respective satellites are compatible and will not result in harmful interference to either operator.

1.1.2. C-band Uplink Interference Assessment – Brasilsat C1 at 65° W.L.

Many of the factors described in Section 1.1.1 above are also applicable in this situation, together with increased earth station gain isolation due to the greater orbital separation. Again, the C/I analysis shows that the TT&C carriers of the respective satellites are compatible and will not result in harmful interference to either operator.

[5] The referenced topocentric angle corresponds to a geocentric separation of one degree.

Table 2. Uplink Command C/I between AMC-3 at 67° W.L. and Brasilsat C1 at 65° W.L.

Topocentric orbital separation:	2.09					
	Earth station size (m)	Earth station on-axis gain (dBi)	Input power density (dBW/4kHz)	Earth station off-axis gain (dBi)	Receive beam isolation (dB)	C/I (dB)
AMC-3	9	53	-4	21.0	-2.0	42.0
Brasilsat C1	9	53	-12	21.0	-20.0	44.0

1.2. C-band Downlink Interference Assessment

1.2.1. C-band Downlink Interference Assessment – Brasilsat B2 at 68° W.L.

For this analysis, the telemetry carrier for the target satellite AMC-3 is assumed to be operating at an EIRP density of -7.0 dBW/4 kHz. The interfered with satellite is assumed to operate cofrequency at the same level of -7.0 dBW/4 kHz. Due to the antenna gain isolation achieved by the large receive antenna, the resulting C/I value is very high, taking into account the satellite antenna beam isolation and the earth station off-axis gain isolation. The C/I value here is comparable to or higher than what can be achieved for regular communications operations for systems compliant with the FCC rules operating in the Ku-band as indicated in section 2.1 of this Annex.

Table 3. Downlink Telemetry C/I between AMC-3 at 67° W.L. and Brasilsat B2 at 68° W.L.

Topocentric orbital separation:	0.99						
	Earth station size (m)	Earth station on-axis gain (dBi)	EIRP density (dBW/4kHz)	Relative gain contour towards wanted satellite's Earth station (dBi)	Relative gain contour towards other satellite's Earth station (dBi)	Earth station off-axis gain (dBi)	C/I (dB)
AMC-3	9	49	-7	-6	-20.0	29.1	33.9
Brasilsat B2	9	49	-7	-1	-20.0	29.1	38.9

However, as indicated above management of the interference potential from TT&C carriers is done on a case-by-case basis. Therefore the downlink interference environment has been addressed through coordination of the proposed AMC-3 C-band TT&C operations with Star One, taking into account the following mitigating factors:

1 AMC-3 and Brasilsat B2 have coverage areas that are geographically diverse, therefore the resulting beam spatial separation significantly reduces interference between the two satellites.

2 The Brasilsat B2 beam covers South America, with low energy into AMC-3's coverage of North America, resulting in low interference into North America.

SES and Star One have coordinated the AMC-3 C-band telemetry carriers taking these factors into account. The planned operations of their respective satellites are compatible and will not result in harmful interference to either operator.

1.2.2. C-band Downlink Interference Assessment – Brasilsat C1 at 65° W.L.

Many of the factors described in Section 1.2.1 above are also applicable in this situation, together within increased earth station gain isolation due to the greater orbital separation. Again, the C/I analysis shows that the TT&C carriers of the respective satellites are compatible and will not result in harmful interference to either operator.

Table 4. Downlink Telemetry C/I between AMC-3 at 67° W.L. and Brasilsat C1 at 65° W.L.

Topocentric orbital separation:	2.09						
	Earth station size (m)	Earth station on-axis gain (dBi)	EIRP density (dBW/4kHz)	Relative gain contour towards wanted satellite's Earth station (dBi)	Relative gain contour towards other satellite's Earth station (dBi)	Earth station off-axis gain (dBi)	C/I (dB)
AMC-3	9	49	-7	-6	-20.0	21.0	42.0
Brasilsat C1	9	49	-7	-1	-20.0	21.0	47.0

2. Two Degree Spacing Analysis for Ku-band

The operational Ku-band satellites adjacent to the 67°W.L. position are Star One C1 at 65°W.L., and Star One C2 at 70°W.L.

2.1 Ku-band Uplink Interference Assessment

This scenario addresses uplink interference between digital carriers in both the wanted and victim satellite networks. The analysis assumes that the transponder gains can be matched to give similar wanted input signal spectral density levels at the two satellites. The Uplink C/I will be a function of the difference between the gain of the transmitting earth stations at boresight and the gain at the off-axis (topocentric) angle.

The topocentric angle for a geocentric separation of 2º is approximately 2.1º. The sidelobe envelope at 2.1º off boresight for an antenna that meets the 29-25 log (θ) reference pattern is 20.9 dBi. The boresight gain will be a function of the size of the transmitting earth station. The following Table 5 lists the boresight gain, the off-axis gain and the corresponding C/I that would result in this interference scenario:

Table 5: Ku-band uplink C/I for 2-degree geocentric spacing

Antenna size (m)	On-axis gain (dBi)	Off-axis gain	C/I (dB)
1.2	43.19	20.94	22.25
1.8	46.71	20.94	25.77
2.4	49.21	20.94	28.27
4.5	54.67	20.94	33.73
6	57.17	20.94	36.22

Assuming that the minimum (i.e., threshold) C/N for a digital service is 8 dB, the effect of the C/I (22.25 dB) from the 1.2 meter earth station in Table 1 above would only degrade the C/N by 0.16 dB.

2.2 Ku-band Downlink Interference Assessment

This scenario addresses downlink interference between digital carriers in both the wanted and victim satellite networks. The analysis assumes that the EIRPs of the two satellites are either similar, or the wanted network has an EIRP of 2 dB lower than AMC-3. Similar to the uplink, the downlink C/I will be a function of the difference between the gain of the receiving earth stations at boresight and the gain at the off-axis angle, as well as any difference in EIRP between the two networks.

The topocentric angle for a geocentric separation of 2º is approximately 2.1º. The gain at 2.1º off boresight for an antenna that meets the 29-25 log (θ) reference pattern is 20.4dBi. The boresight gain will be a function of the size of the receiving earth station.

The following Tables list the boresight gain, the off-axis gain and the corresponding C/I that would result in this interference scenario, where the EIRP of the two networks is similar (Table 6) and where the EIRP of the two networks is different by 2 dB (Table 7):

Table 6: Ku-band downlink C/I for 2-degree geocentric spacing
EIRP of the wanted and interfering satellites is the same

Antenna size (m)	On-axis gain (dBi)	Off-axis gain (dBi)	Off-axis discrimination (dB)	C/I (dB)
1.2	41.66	20.94	20.72	20.72
1.8	45.18	20.94	24.24	24.24
2.4	47.68	20.94	26.74	26.74
4.5	53.14	20.94	32.20	32.20
6	55.64	20.94	34.70	34.70

Table 7: Ku-band downlink C/I for 2-degree geocentric spacing
EIRP of the wanted satellite is 2 dB lower than that of the interfering satellite

Antenna size (m)	On-axis gain (dBi)	Off-axis gain (dBi)	Off-axis discrimination (dB)	C/I (dB)
1.2	41.66	20.94	20.72	18.72
1.8	45.18	20.94	24.24	22.24
2.4	47.68	20.94	26.74	24.74
4.5	53.14	20.94	32.20	30.20
6	55.64	20.94	34.70	32.70

Again, assuming that the minimum (i.e., threshold) C/N for a digital service is 8 dB, the effect of the C/I (18.72 dB) into the 1.2 meter earth station in Table 3 above would only degrade the C/N by 0.35 dB.

2.3 Additional examples of Ku-band C/I estimates

Attached Tables 8 to 11 show some examples of single-entry C/I analysis for typical Ku-band carriers on the satellite networks. The adjacent satellite is assumed to be at 65° W.L. The results would be improved for the 70° W.L neighbor, given the increased orbital separation.

Table 8 shows the key uplink parameters of AMC-3 and adjacent satellite carriers. Table 9 shows C/I estimates in AMC-3 and adjacent satellite carrier uplinks. The C/I values in the adjacent carriers are at least 20.0 dB.

Table 10 shows the key downlink parameters of AMC-3 and adjacent satellite carriers. Table 11 shows C/I estimates in AMC-3 and adjacent satellite carrier uplinks. The C/I values in the adjacent carriers are minimally about 20.0 dB.

Table 8: SES and adjacent satellite uplink carrier characteristics – Ku-band (AMC-3 at 67° W.L., Adjacent satellite at 65° W.L., Topocentric separation at the receiver location 2.1°)

SES carriers	36M0G7W	27M0G7W	6M95G1W	5M00G1W	1M60G1W	100KG1W
Bandwidth, MHz	36	27	6.95	5	1.6	0.1
UL flange power dens., dBW/Hz	-55	-55	-50.5	-50.5	-50.5	-50.5
UL ant. Dia, m	6.1	6.1	3.7	3.7	1.8	1.2
UL ant. Gain, dBi	57.3	57.3	53.0	53.0	46.7	43.2
UL EIRP, dBW	77.9	76.6	70.9	69.5	58.3	42.7
UL flange power, dBW	20.6	19.3	17.9	16.5	11.5	-0.5
UL EIRP density, dBW/Hz	2.3	2.3	2.5	2.5	-3.8	-7.3
Sidelobe gain, dBi	20.9	20.9	20.9	20.9	20.9	20.9
Off-ax. EIRP dens, dBW/Hz	-34.1	-34.1	-29.6	-29.6	-29.6	-29.6
G/T, dB/K	5.39	5.39	5.39	5.39	5.39	5.39
C/N (thermal), dB	29.3	29.3	29.5	29.5	23.2	19.7

Adjacent Satellite carriers	25M0G7W	17M5G7W	Dig. TV(20.0)	Dig. TV(3.95)	TDMA	64Kbps	9.6Kbps
Bandwidth, MHz	25	17.5	14.9	3.4	36	0.1	0.0235
UL flange power dens., dBW/Hz	-58.4	-63.9	-56.1	-51.9	-54.4	-50.8	-50.5
UL ant. Dia, m	7	7	7	1.8	4.5	1.2	1.2
UL ant. Gain, dBi	58.5	58.5	58.5	46.7	54.7	43.2	43.2
UL EIRP, dBW	74.1	67.0	74.1	60.1	75.8	42.4	36.4
UL flange power, dBW	15.6	8.5	15.6	13.4	21.2	-0.8	-6.8
UL EIRP density, dBW/Hz	0.1	-5.4	2.4	-5.2	0.3	-7.6	-7.3
Sidelobe gain, dBi	20.9	20.9	20.9	20.9	20.9	20.9	20.9
Off-ax. EIRP dens, dBW/Hz	-37.5	-43.0	-35.2	-31.0	-33.5	-29.9	-29.6
G/T, dB/K	0	0	0	0	0	0	0
C/N (thermal), dB	21.7	16.2	24.0	16.4	21.9	14.0	14.3

Table 9: Ku-band uplink C/I estimates for carriers shown in Table 8

Uplink C/I into SES carriers due to interference from adj. satellite

	SES carriers					
Adj. Sat carriers	36M0G7W	27M0G7W	6M95G1W	5M00G1W	1M60G1W	100KG1W
25M0G7W	39.8	39.8	39.9	39.9	33.7	30.1
17M5G7W	45.3	45.3	45.4	45.4	39.2	35.6
Dig. TV(20.0)	37.5	37.5	37.6	37.6	31.4	27.8
Dig. TV(3.95)	33.3	33.3	33.4	33.4	27.2	23.6
TDMA	35.8	35.8	35.9	35.9	29.7	26.1
64Kbps	32.2	32.2	32.3	32.3	26.1	22.5
9.6Kbps	31.9	31.9	32.0	32.0	25.8	22.2

Uplink C/I into adjacent sat carriers due to interference from SES carriers

	SES carriers					
Adj. Sat carriers	36M0G7W	27M0G7W	6M95G1W	5M00G1W	1M60G1W	100KG1W
25M0G7W	34.2	34.2	29.7	29.7	29.7	29.7
17M5G7W	28.7	28.7	24.2	24.2	24.2	24.2
Dig. TV(20.0)	36.5	36.5	32.0	32.0	32.0	32.0
Dig. TV(3.95)	28.9	28.9	24.4	24.4	24.4	24.4
TDMA	34.3	34.3	29.8	29.8	29.8	29.8
64Kbps	26.4	26.4	21.9	21.9	21.9	21.9
9.6Kbps	26.7	26.7	22.2	22.2	22.2	22.2

Table 10: SES and adjacent satellite downlink carrier characteristics – Ku-band (AMC-3 at 67° W.L., Adjacent satellite at 65° W.L., Topocentric separation at the receiver location 2.1°)

SES carriers	36M0G7W	27M0G7W	6M95G1W	5M00G1W	1M60G1W	100KG1W
Bandwidth, MHz	36	27	6.95	5	1.6	0.1
Carrier EIRP density, dBW/Hz	-26.0	-26.0	-27.7	-27.7	-26.0	-26.0
Satellite EIRP max, dBW	50.34	50.34	50.34	50.34	50.34	50.34
Carrier EIRP, dBW	49.6	48.3	40.7	39.3	36.0	24.0
Rx ES ant. Dia., m	1.2	1.2	1.8	1.8	1.2	1.2
Rx ES ant. Gain, dBi	41.7	41.7	45.2	45.2	41.7	41.7
Sidelobe gain, dBi	20.9	20.9	20.9	20.9	20.9	20.9
Noise Temp, K	110	110	110	110	110	110
C/N (thermal), dB	16.8	16.8	18.7	18.7	16.8	16.8

Adjacent Satellite carriers	36M0G7W	36M0G7W	27M0G7W	Dig. TV(20.0)	Dig. TV(3.95)	TDMA
Bandwidth, MHz	36	36	27	14.9	3.4	36
Carrier EIRP density, dBW/Hz	-27.6	-27.6	-26.0	-27	-27	-28.6
Satellite EIRP max, dBW	50	50	50	50	50	50
Carrier EIRP, dBW	48.0	48.0	48.3	44.7	38.3	47.0
Rx ES ant. Dia., m	1.8	2.4	1.2	1.8	1.8	4.5
Rx ES ant. Gain, dBi	45.2	47.7	41.7	45.2	45.2	53.1
Sidelobe gain, dBi	20.9	20.9	20.9	20.9	20.9	20.9
Noise Temp, K	110	110	110	110	110	110
C/N (thermal), dB	18.8	21.3	16.8	19.4	19.4	25.7

Table 11: Downlink C/I estimates in carriers shown in Table 10

Downlink C/I into SES carriers due to interference from adj. satellite						
	SES carriers					
Adj. Sat carriers	36M0G7W	27M0G7W	6M95G1W	5M00G1W	1M60G1W	100KG1W
36M0G7W (1)	22.3	22.3	24.1	24.1	22.3	22.3
36M0G7W (2)	22.3	22.3	24.1	24.1	22.3	22.3
27M0G7W	20.7	20.7	22.6	22.6	20.7	20.7
Dig. TV(20.0)	21.7	21.7	23.5	23.5	21.7	21.7
Dig. TV(3.95)	21.7	21.7	23.5	23.5	21.7	21.7
TDMA	23.3	23.3	25.1	25.1	23.3	23.3
Downlink C/I into adjacent sat carriers due to interference from SES carriers						
	SES carriers					
Adj. Sat carriers	36M0G7W	27M0G7W	6M95G1W	5M00G1W	1M60G1W	100KG1W
36M0G7W (1)	22.6	22.7	24.3	24.3	22.7	22.7
36M0G7W (2)	25.1	25.2	26.8	26.8	25.2	25.2
27M0G7W	20.7	20.7	22.4	22.4	20.7	20.7
Dig. TV(20.0)	23.2	23.3	24.9	24.9	23.3	23.3
Dig. TV(3.95)	23.2	23.3	24.9	24.9	23.3	23.3
TDMA	29.6	29.6	31.3	31.3	29.6	29.6

Engineering Declaration

DECLARATION OF DEBA ATHER

I, Deba Ather, hereby certify under penalty of perjury that I am the technically qualified person responsible for preparation of the technical information contained in the foregoing exhibit; that I am familiar with the technical requirements of Part 25; and that I either prepared or reviewed the technical information contained in the exhibit and that it is complete and accurate to the best of my knowledge, information and belief.

_*/s/*_______________________

SES Americom, Inc.

Dated: December 20, 2011