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

In the Matter of	)	
	)	
SES AMERICOM, INC.	)	File No. SAT-AMD-___________
	)	Call Sign S2445
Amendment to Application for Modification of	)	
AMC-1 Fixed-Satellite Space Station License	)	

AMENDMENT OF SES AMERICOM, INC.

SES Americom, Inc. (doing business as "SES") hereby amends its pending application for modification of its license for the AMC-1 fixed-satellite space station[1] in order to seek reassignment of the satellite to 129.15° W.L., rather than to 47.5° W.L. SES requests authority to perform Telemetry, Tracking and Command ("TT&C") using certain C-band and Ku-band frequencies in order to relocate AMC-1 from 103º W.L. to 129.15° W.L., and authority to operate both the TT&C and Ku-band communications payloads on AMC-1 after it has arrived. Grant of the requested authority will serve the public interest by allowing SES to use AMC-1 to respond to customer demand and initiate Ku-band services from a new orbital location.

A completed FCC Form 312 is attached, and SES incorporates by reference the information previously provided in support of AMC-1.[2] In addition, SES is providing here

[1] *See SES Americom, Inc.*, File No. SAT-MOD-20140730-00089 (the "AMC-1 Modification").

[2] The most recent technical information was submitted with the AMC-1 Modification. *See also* File Nos. SAT-MOD-20110718-00130; SAT-MOD-19930805-00031; & SAT-MOD-19911114-00033.

technical information relating to the amendment in Schedule S and in narrative form pursuant to Section 25.114 of the Commission's Rules.[3]

AMENDMENT

AMC-1 is a hybrid C/Ku-band satellite that is currently licensed by the Commission to operate at 103° W.L., with a license term that expires October 15, 2016.[4] The replacement for AMC-1, the SES-3 satellite, is in position at 103° W.L. and ready to begin operations as soon as Commission authority is granted.[5] In the AMC-1 Modification filed last summer, SES proposed to relocate AMC-1 to 47.5° W.L. in order to provide additional Ku-band coverage of the North Atlantic. However, until the Commission acts on the SES-3 application, which has been pending for more than 25 months, AMC-1 must remain at 103° W.L. As a result of the continued delay in action on SES-3, the commercial opportunity for AMC-1 at 47.5° W.L. is no longer viable. Instead, SES now proposes to redeploy AMC-1 to the nominal 129° W.L. orbital location following the transfer of traffic from AMC-1 to SES-3.

Relocation Authority. Grant of the requested authority to relocate and operate AMC-1 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

---

3 In completing the Schedule S, SES has relied on the most recent Schedule S instructions that take into account the changes to Section 25.114 adopted in the Part 25 reform proceeding. Consistent with those instructions, in cases where the Schedule S software requests information that space station applicants are no longer required to provide, SES has omitted data elements, or where necessary to permit validation of the Schedule S file, has entered a "1" as a placeholder. SES specifies that these "1" data entries are outside the scope of the certifications herein regarding accuracy of the information provided with this amendment.

4 *See SES Americom, Inc.*, File No. SAT-MOD-20110718-00130, grant-stamped Oct. 13, 2011 (the "AMC-1 2011 Modification Grant").

5 *See* File Nos. SAT-RPL-20121228-00227 & SAT-AMD-20131113-00132, Call Sign S2892.

satellites in their fleet to reflect business and customer considerations where no public interest factors are adversely affected."[6] 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 there are no compelling countervailing public interest considerations.[7]

Here, the proposed change will serve the public interest by allowing SES to make efficient use of AMC-1 in order to introduce new Ku-band service at the nominal 129° W.L. orbital location. At that location, AMC-1 will provide capacity for a variety of high-quality video, broadband and data services to the North American market. Among other things, relocation of AMC-1 will enable SES to augment the DBS capacity on Ciel-2 at 128.85° W.L. (operated by SES's Canadian affiliate, Ciel Satellite L.P.) with conventional Ku-band DTH capacity.[8]

Reassignment of AMC-1 to the nominal 129° W.L. orbital location will not adversely affect other operators. SES will operate only the telemetry, tracking and command ("TT&C") frequencies of AMC-1 during the drift and will follow standard industry practices for coordination of such TT&C transmissions. The Technical Appendix demonstrates that the

---

6 *SES Americom, Inc.*, Order and Authorization, 21 FCC Rcd 3430, 3433, ¶ 8 (IB 2006), *citing Amendment of the Commission's Space Station Licensing Rules and Policies,* Second Report and Order, 18 FCC Rcd 12507, 12509, ¶ 7 (2003).

7 *AMSC Subsidiary Corp.*, Order and Authorization, DA 98-493, 13 FCC Rcd 12316, 12318, ¶ 8 (IB 1998) (footnote omitted).

8 *See SES Americom, Inc., Order and Authorization*, 18 FCC Rcd 16589, 16590, ¶ 1 (IB 2003) (authorizing the use of SES Americom's fleet for DTH would "promote fair and increased competition in the provision of satellite service in the United States" and would "provide benefits to the public by maximizing consumer choice.").

AMC-1 network is compliant with Commission rules for operation in a two-degree spacing environment and is compatible with co-frequency satellites adjacent to the nominal 129° W.L. orbital location.

WAIVER REQUESTS

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

> 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.[9]

The AMC-1 Modification sought waivers of Commission rules that SES incorporates by reference herein. Specifically, for the reasons set forth in the AMC-1 Modification, SES seeks a limited waiver of the requirement to provide antenna contour information for the global horn antenna in a GIMS-readable format[10] and any necessary waiver of the requirement in Section 25.202(g) to permit the use of C-band frequencies for TT&C.[11] In addition, the Commission has previously approved the post-mission disposal plan for AMC-1

---

9 *PanAmSat Licensee Corp*., 17 FCC Rcd10483, 10492 (Sat. Div. 2002) (footnotes omitted).

10 *See* AMC-1 Modification, Narrative at 4-5. At the time SES filed the AMC-1 Modification, the applicable requirement for which SES was seeking a waiver was in Section 25.114(d)(3) of the Commission's rules. *See id.* However, the rule changes adopted in the Commission's proceeding on reform of Part 25 subsequently took effect, and now the applicable requirement is in Section 25.114(c)(vi)(A).

11 *See* AMC-1 Modification, Narrative at 5-7.

and granted waivers of Sections 25.114(d)(14) and 25.283(c) in connection with the inability of the AMC-1 spacecraft to vent all stored energy at the end of the spacecraft's life.[12]

CONCLUSION

For the foregoing reasons, SES amends the pending AMC-1 Modification to seek reassignment of the spacecraft to 129.15° W.L., as described in the attached materials.

Respectfully submitted,

SES AMERICOM, INC.

By: <u>*/s/ Gerald E. Oberst*</u>

Gerald E. Oberst
Nancy J. Eskenazi
SES Americom, Inc.
1129 20th Street, N.W., Suite 1000
Washington, D.C. 20036

<u>Of Counsel</u>
Karis A. Hastings
SatCom Law LLC
1317 F Street, N.W., Suite 400
Washington, D.C. 20004
Tel: (202) 599-0975

Dated: February 19, 2015

[12] *See* AMC-1 2011 Modification Grant, Attachment to Grant at 1, ¶ 2.

TECHNICAL APPENDIX

AMC-1 AT 129.15° W.L.

1.0 Overall Description (§25.114(d)(1))

This technical appendix is submitted in support of the amendment of SES Americom, Inc. ("SES") to its pending application for modification of the AMC-1 license[1] in order to seek reassignment of AMC-1 to 129.15° W.L. from its current orbital position of 103.0º W.L. SES hereby incorporates by reference the technical information it has already provided with respect to AMC-1,[2] and provides here technical information relating to operation of AMC-1 at 129.15° W.L. as proposed in this amendment.

AMC-1 is equipped with twenty-four 36 MHz C-band transponders and twenty-four 36 MHz Ku-band transponders. At 129.15° W.L., the spacecraft's Ku-band transponders will provide coverage of the contiguous United States, Alaska, Hawaii, Mexico, and parts of Canada and the Caribbean. The C-band transponders will not be used at 129.15° W.L, recognizing that Galaxy 12 is licensed in C-band at the nominal 129° W.L. orbital location. The TT&C frequencies of AMC-1 are in C-band with a beacon in Ku-band.

2.0 Schedule S (§25.114(c))

The Schedule S database is included with this filing. As noted in the narrative section of this amendment, in preparing the Schedule S, SES relied on the most recent instructions that take into account the changes to Section 25.114 adopted in the Part 25 reform proceeding, which eliminated or modified various requirements for information that must be provided in the Schedule.

---

[1] *See SES Americom, Inc.*, File No. SAT-MOD-20140730-00089 (the "AMC-1 Modification"). The AMC-1 Modification proposed relocation of the spacecraft to 47.5 º W.L., but the business opportunity at that orbital location is no longer viable.

[2] The most recent technical information was submitted with the AMC-1 Modification. *See also* File Nos. SAT-MOD-20110718-00130; SAT-MOD-19930805-00031; & SAT-MOD-19911114-00033.

1. *Telemetry and Telecommand (TT&C) frequencies and beams.* The TT&C link budgets are included in the Schedule S. In order to maximize compatibility with nearby spacecraft, SES plans to use the following configuration of the TT&C carriers. The command horn (“"GLBRH") will be used for receiving C-band telecommand carriers. The communications antennas (“CTV” and “KTH”) will be used for transmitting telemetry carriers. Table 1 below shows the planned TT&C carrier center frequencies and bandwidths, and also describes, in a note, the other possible TT&C configurations that could be implemented as necessary to facilitate coordination with nearby spacecraft.

Table 1: TT&C Carrier Frequencies

	Frequency, MHz	Nominal polarization
Command carriers (bandwidth: 800KHz, 1.2 MHz capture range)		
C-band	6423.5	H
Beacons/Telemetry (bandwidth: 300 KHz)		
C-band pair	3700.5	V
	4199.5	V
Ku-band	12198	H

Note: Both C-band telemetry carriers can also be transmitted through the communications antenna (in this case, the 4199.5 MHz carrier is horizontally polarized) or an omni antenna (in this case, both carriers are horizontally polarized). The C-band telecommand carrier can also be received through the communications antenna (in this case, the 6423.5 MHz is vertically polarized) or an omni antenna (in this case, the 6423.5 MHz carrier is horizontally polarized).

2. *PFD limits in C-band.* The C-band PFD values are provided in Section S8 of Schedule S, and Section 3.0 below (Table 2) demonstrates that these values comply with §25.208.

3. *Carrier parameters and link budgets.* The carrier parameters and link budgets as displayed in Sections S11 and S13 have been updated based on the planned operations of AMC-1 at 129.15° W.L. C-band link budgets are not provided, except for TT&C, as the C-band communications payload is not planned to be used at the 129.15° W.L. location.

4. *Beam diagrams.* The attached beam diagrams in Section S8 have been updated to reflect the projected coverage areas at 129.15° W.L.

3.0 PFD limits (§25.114(d)(8) and §25.208)

Table 2 demonstrates that the PFD values for the C-band TT&C carriers from AMC-1 at 129.15° W.L. comply with §25.208.

Table 2: Maximum PFD values and margins relative to permissible limits of §25.208

Beam: CTV				
Elevation angle (°)	Max. EIRP density (dBW/4 kHz)	Max. PFD (dBW/m^2-4 kHz)	Permissible PFD (dBW/m^2-4 kHz)	Margin (dB)
5	-4.1	-167.3	-152.0	15.3
10	-4.0	-167.2	-149.5	17.7
15	-3.9	-167.0	-147.0	20.0
20	-3.8	-166.8	-144.5	22.3
25	-3.8	-166.7	-142.0	24.7

Beam: CTH				
Elevation angle (°)	Max. EIRP density (dBW/4 kHz)	Max. PFD (dBW/m^2-4 kHz)	Permissible PFD (dBW/m^2-4 kHz)	Margin (dB)
5	-5.2	-168.5	-152.0	16.5
10	-5.2	-168.4	-149.5	18.9
15	-5.2	-168.3	-147.0	21.3
20	-5.2	-168.2	-144.5	23.7
25	-5.0	-167.9	-142.0	25.9

Beam: GBLTV				
Elevation angle (°)	Max. EIRP density (dBW/4 kHz)	Max. PFD (dBW/m^2-4 kHz)	Permissible PFD (dBW/m^2-4 kHz)	Margin (dB)
5	-12.75	-176.0	-152.0	24.0
10	-12.75	-175.9	-149.5	26.4
15	-12.75	-175.8	-147.0	28.8
20	-12.75	-175.7	-144.5	31.2
25	-12.75	-175.6	-142.0	33.6

No PFD limits for the 11700 – 12200 MHz band are specified in §25.208 or in No. 21.16 of the ITU Radio Regulations with respect to the operation of geostationary satellites.

4.0 Satellite Antenna Gain Contours (§25.114(c)(4))

Annex A shows the typical antenna gain contours for the AMC-1 space station beams at 129.15° W.L. The peak EIRP and G/T values of the beams are shown in Table 3. As the C-band communications transponders will not be used at this location, information is provided only on the C-band antennas potentially used for TT&C. The EIRP of the telemetry carrier is provided.

Table 3: Maximum EIRP and G/T

Beam ID	Band	Pol	Link Direction	GXT filename	Max. EIRP (dBW)	Max. G/T (dB/K)
KRV	Ku	V	Receive	AMC-1 (129.15W) GIMS.mdb		7.2
KRH	Ku	H	Receive	AMC-1 (129.15W) GIMS.mdb		6.6
CRV	C	V	Receive	AMC-1 (129.15W) GIMS.mdb		5.5
KTV	Ku	V	Transmit	AMC-1 (129.15W) GIMS.mdb	50.4	
KTH	Ku	H	Transmit	AMC-1 (129.15W) GIMS.mdb	49.8	
CTV	C	V	Transmit	AMC-1 (129.15W) GIMS.mdb	15	
CTH	C	H	Transmit	AMC-1 (129.15W) GIMS.mdb	15	
GBLTV	C	V	Transmit		6	
GBLRH	C	H	Receive			-12.6

The gain characteristics for the global horn antenna ("GBLRH") and ("GBLTV") are not provided in a GIMS-readable format because the data is not available in that format from the spacecraft manufacturer. Instead, gain vs. off-set angle information is provided as Figure A-8 in Annex A. In the narrative section of this amendment, SES requests a waiver to permit this substitution and demonstrates that grant of the requested waiver is consistent with Commission precedent.

5.0 Link Budgets (§25.140(a))

Annex B shows typical link budgets, including emission designators. C-band link budgets, except for TT&C, are not provided as the C-band communications payload is not planned to be operated.

6.0 Maximum Theoretical Operation Levels

AMC-1 will be operated consistent with coordination agreements with adjacent satellites. In any case, in the 11.7-12.2 GHz band, the downlink EIRP density of the AMC-1 digital carriers will not exceed -19 dBW/Hz; and in the 14-14.5 GHz band, the input power density of the uplink digital carriers of earth stations operating with AMC-1 will not exceed -45 dBW/Hz.

7.0 Two Degree Spacing Analysis (§25.114(d)(7) and §25.140(a))

Annex C provides analyses demonstrating the compatibility of AMC-1 at 129.15° W.L. with neighboring spacecraft.

8.0 Mitigation of Orbital Debris (§25.114(d)(14))

The information required under §25.114(d)(14) of the Commission's Rules is already on file with the Commission and is incorporated by reference herein.[3] The only change to that information is that SES proposes to move AMC-1 to the 129.15° W.L orbital location. At 129.15° W.L., AMC-1 will be in inclined orbit.[4]

SES Americom is not aware of any other FCC- or non-FCC licensed spacecraft that are operational or planned to be deployed at 129.15° W.L. or to nearby orbital locations such that there would be an overlap with the requested stationkeeping volume of AMC-1. Ciel 2 operates at 128.85° W.L. and Galaxy-12 operates at 129.0° W.L., both with an east/west stationkeeping tolerance of ±0.05 degrees.

---

[3] *See* File No. SAT-MOD-20110718-00130, Technical Appendix, Section 3.

[4] AMC-1 will begin inclined orbit operation once it arrives at 129.15°W.L. The initial inclination will be 0.13 degrees, and the rate of change in inclination per year will be 0.8 degrees. The expected end-of-life of the satellite accounting for inclined orbit operation and the maneuvers specified under §25.283 of the Commission's rules is June 2023 assuming that inclined orbit operation begins in June 2015. SES has not taken into account the effects of inclined orbit operations for purposes of the estimated lifetime of the satellite in the Schedule S, item S.1.f.

ANNEX A

Space Station Antenna Beam Diagrams

Figure A-1
Receive Beam: KRV
Ku-band, V-pol, Peak Gain: 34.1 dBi, Peak G/T = 7.2 dB/K

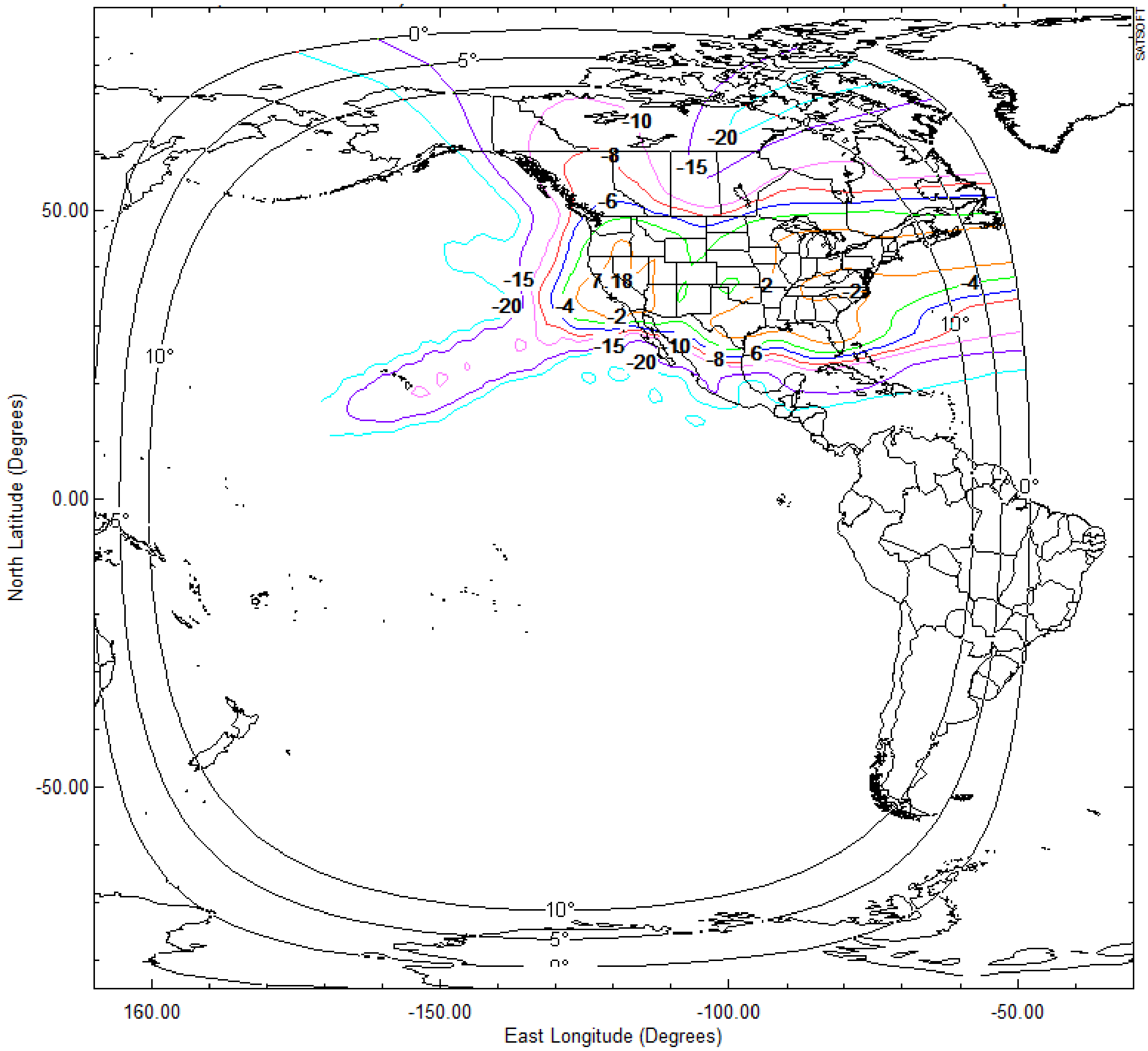

Figure A-2
Receive Beam: KRH
Ku-band, H-pol, Peak Gain: 34.2 dBi, Peak G/T = 6.6 dB/K

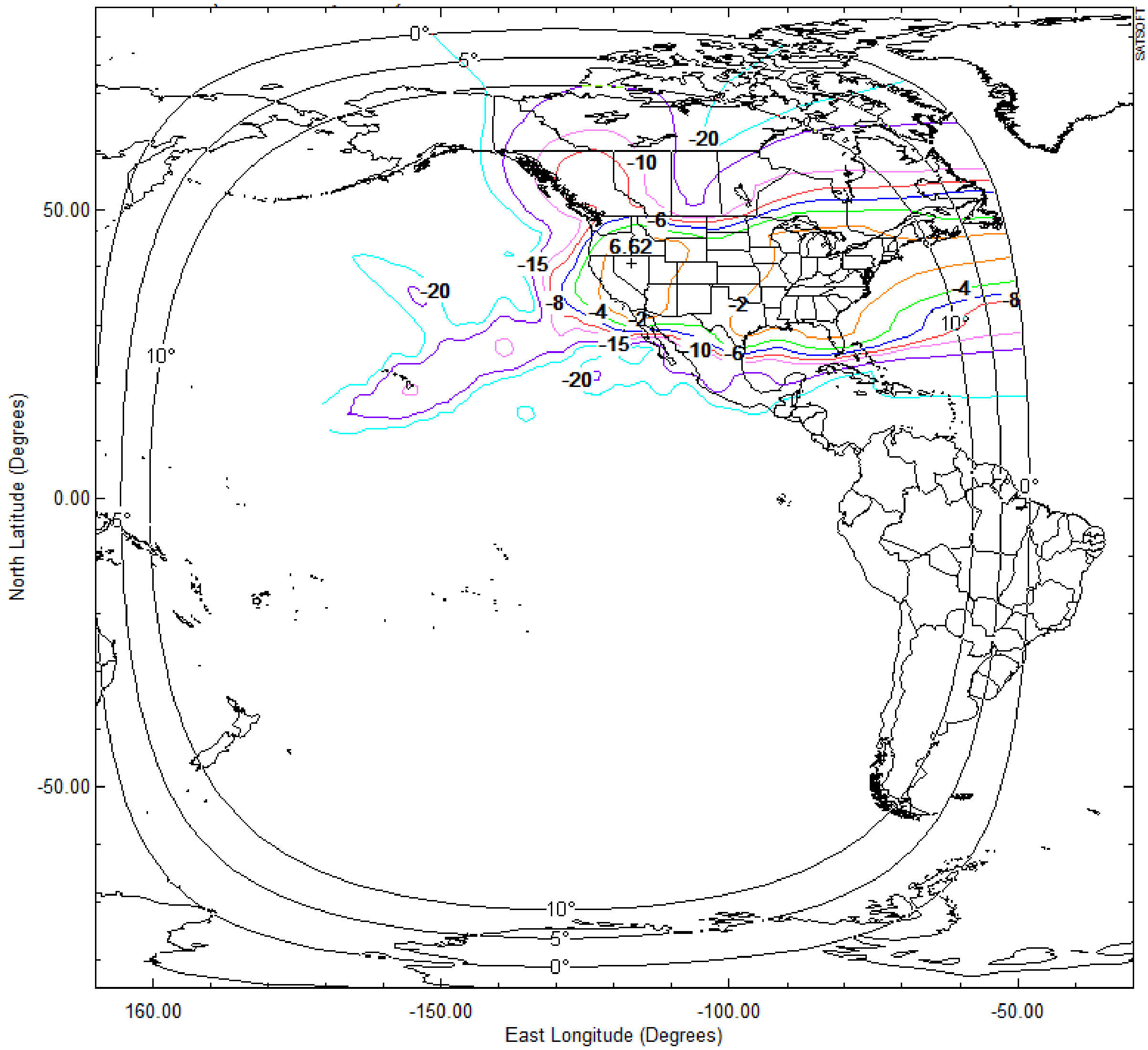

Figure A-3
Transmit Beam: KTV
Ku-band, V-pol, Peak Gain: 33.9 dBi, Peak EIRP = 50.4 dBW

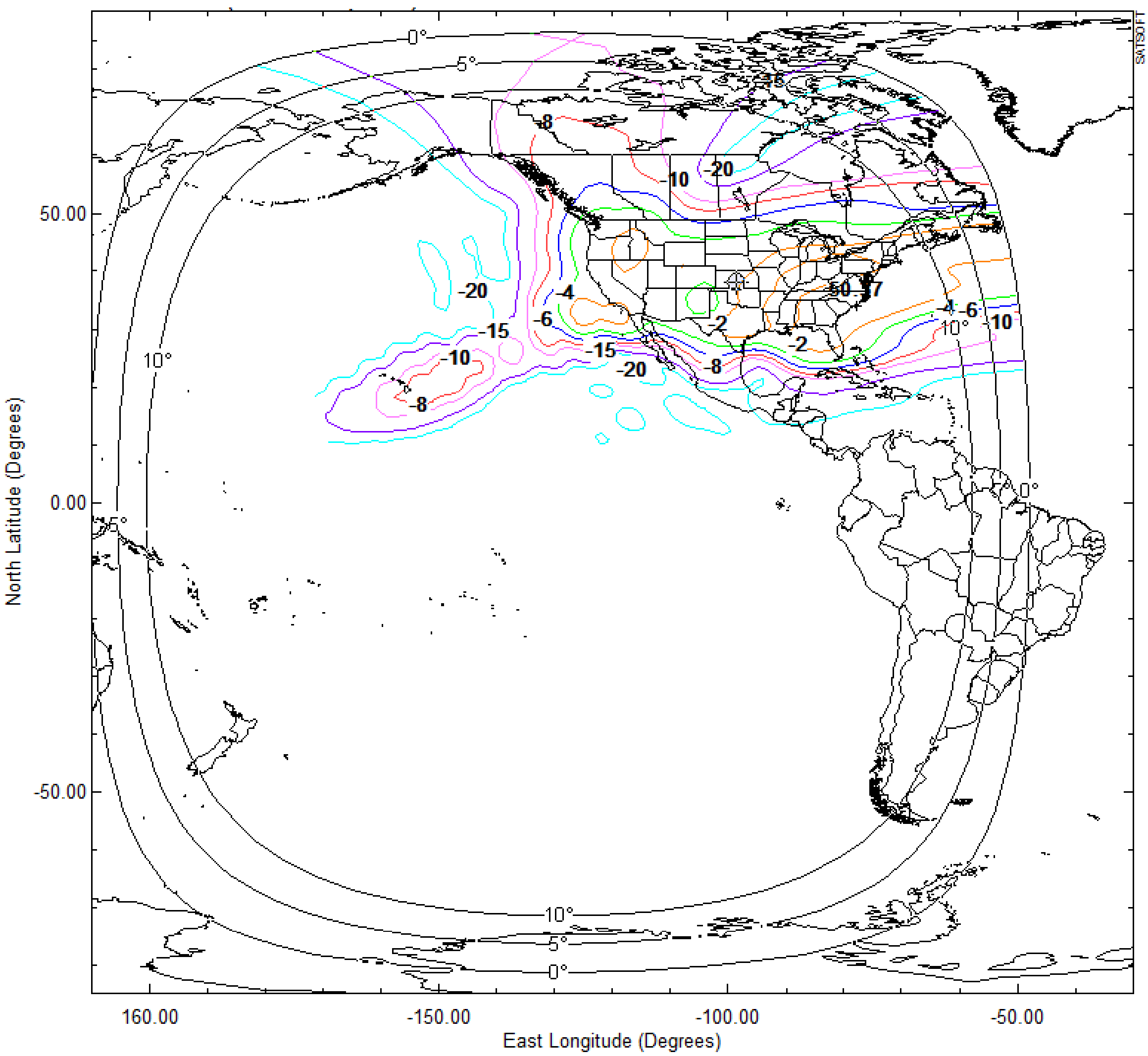

Figure A-4
Transmit Beam: KTH
Ku-band, H-pol, Peak Gain: 33.1 dBi, Peak EIRP = 49.8 dBW

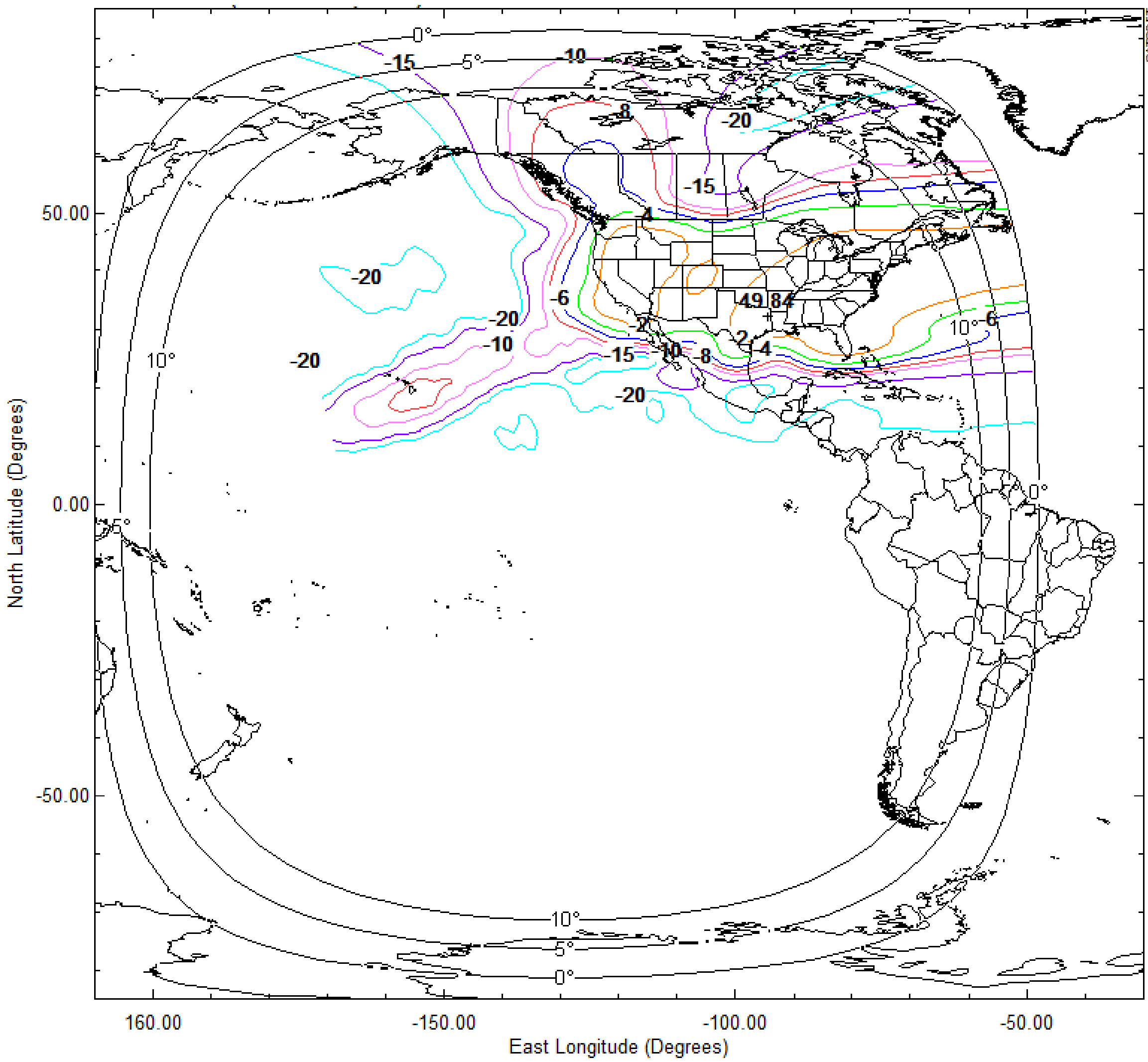

Figure A-5
Receive Beam: CRV
C-band, V-pol, Peak Gain: 33.3 dBi, Peak G/T = 5.5 dB/K

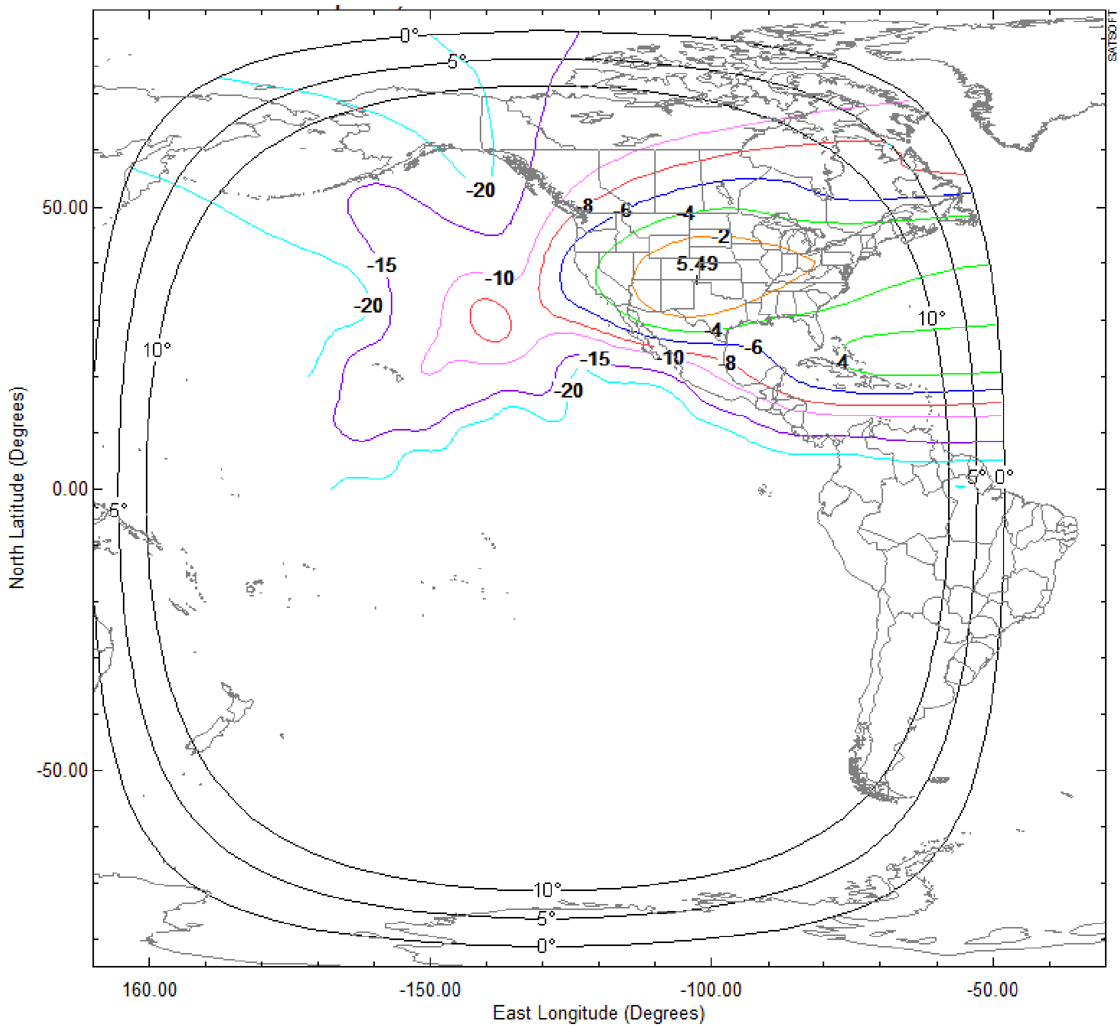

Figure A-6
Transmit Beam: CTV
C-band, V-pol, Peak Gain: 30.4 dBi, Peak EIRP = 41.3 dBW*
(*For Telemetry the Peak EIRP is 15 dBW)

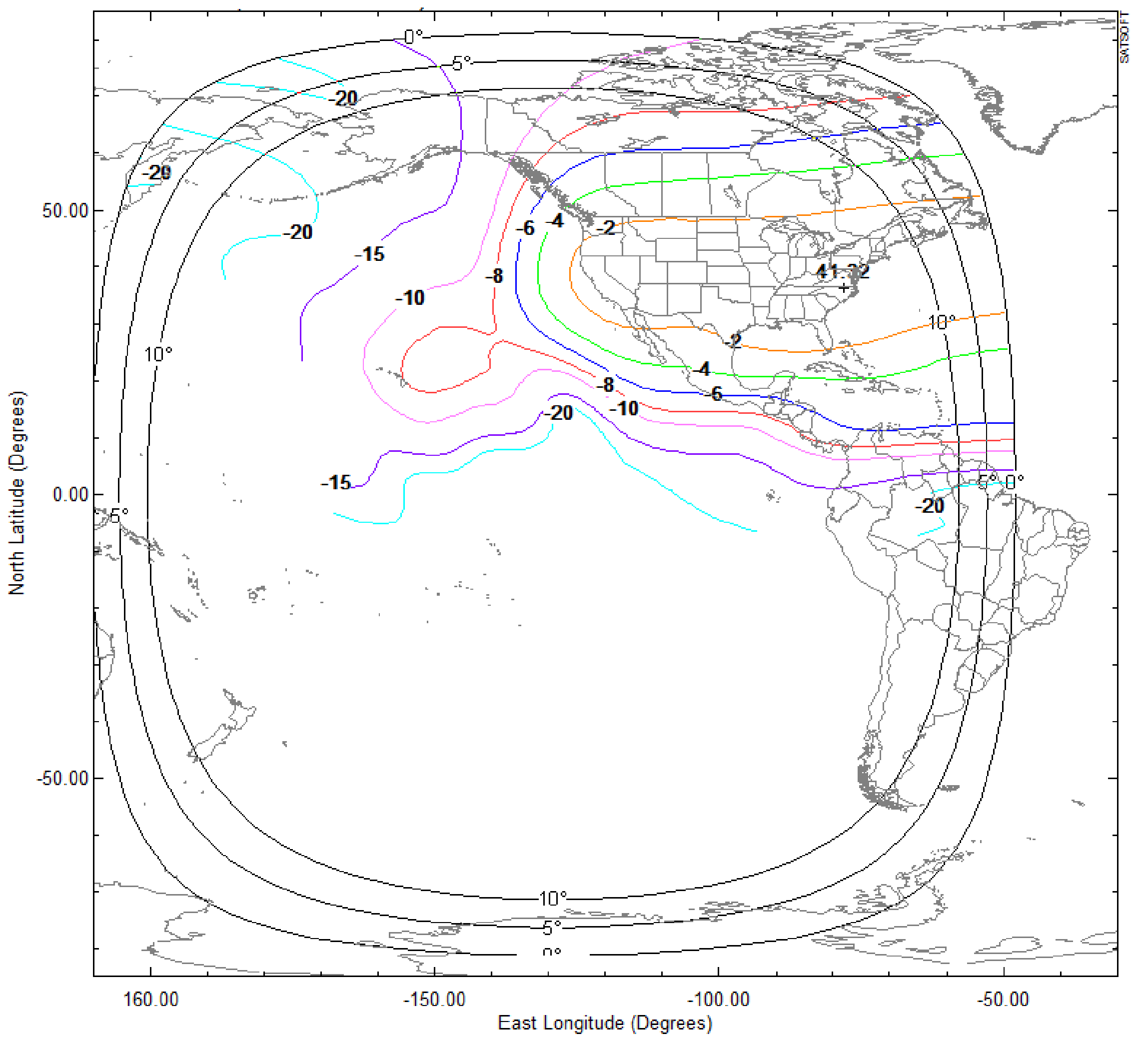

Figure A-7
Transmit Beam: CTH
C-band, H-pol, Peak Gain: 30.4 dBi, Peak EIRP = 40.8 dBW*
(*For Telemetry the Peak EIRP is 15 dBW)

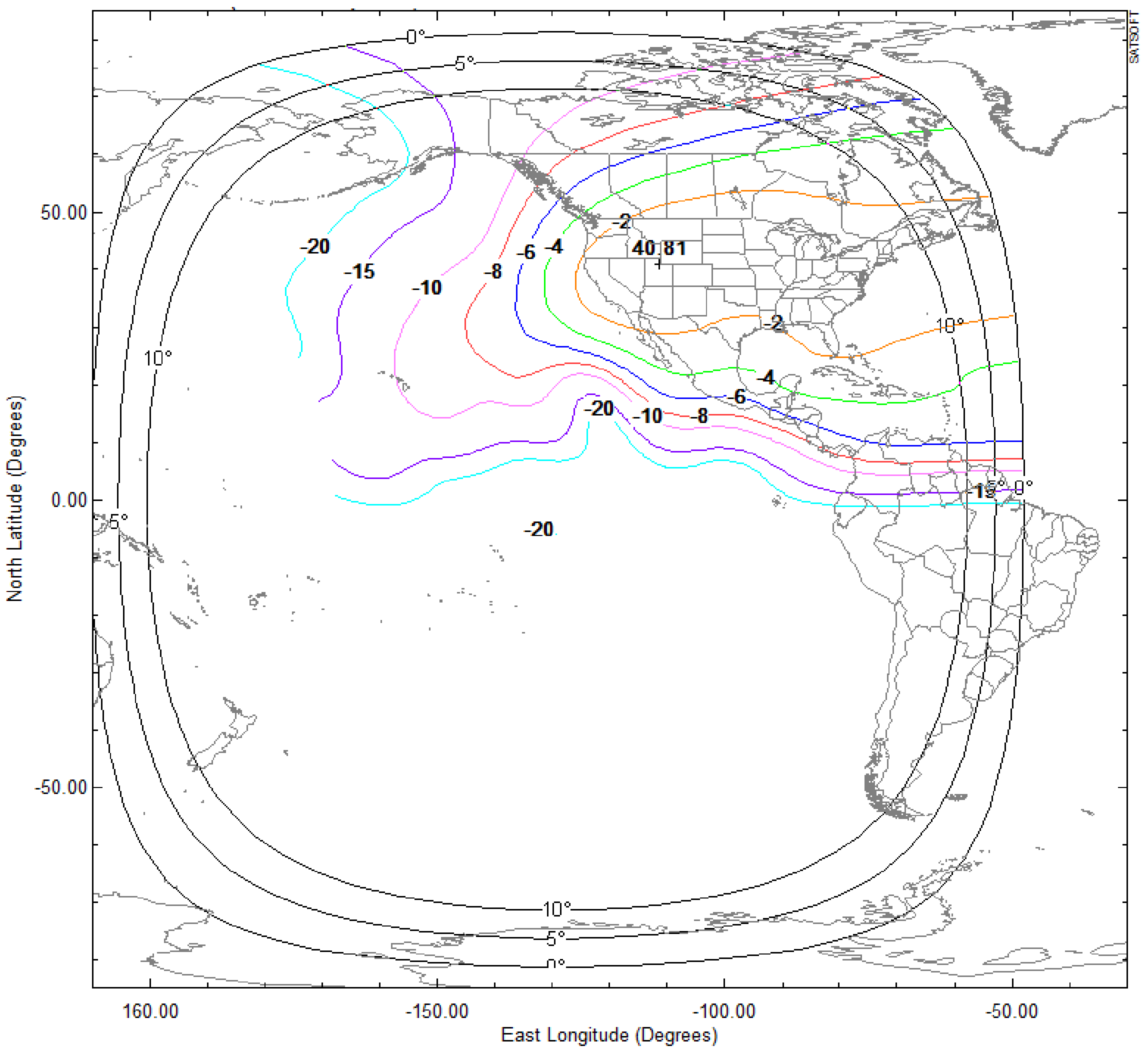

Figure A-8
Global Horn Characteristics

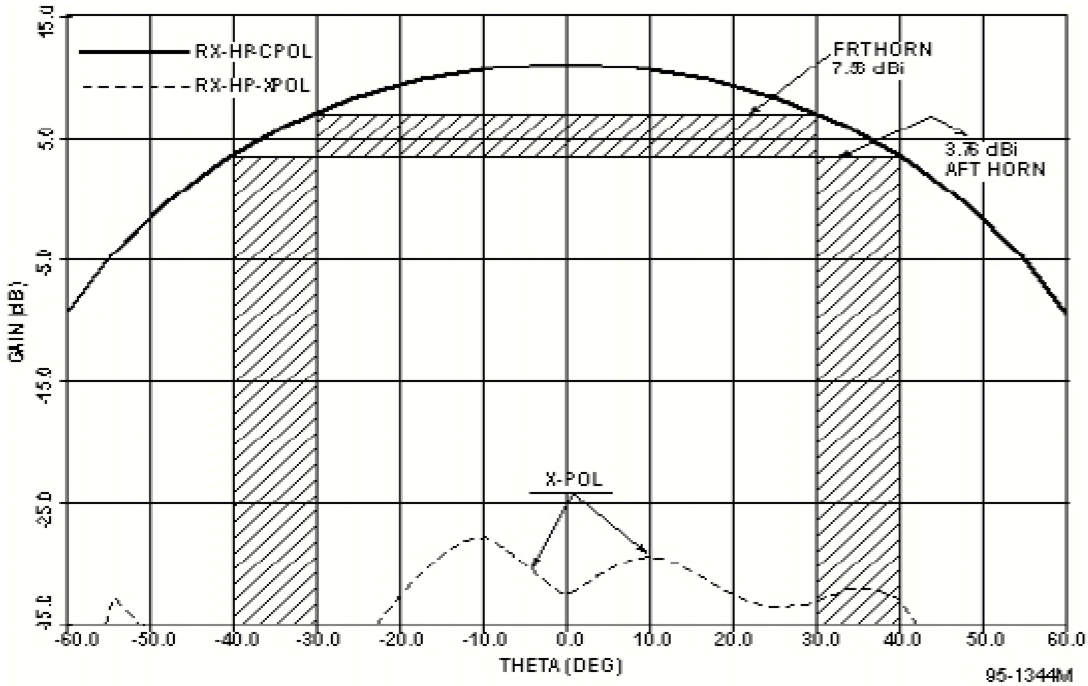

Figure 2.3-4. Measured Performance of Command Horn

ANNEX B

Link Budgets

Table B-1
Ku-Band Link Budgets

Link Parameters	Units	1M20G7W	36M0G7W	100KG7W	36M0G7W	4M50G7W	36M0G7W
Uplink Frequency	GHz	14.260	14.260	14.260	14.260	14.260	14.260
Downlink Frequency	GHz	11.960	11.960	11.960	11.960	11.960	11.960
Carrier modulation		QPSK	QPSK	QPSK	QPSK	8PSK	8PSK
Code rate		0.50	0.50	0.75	0.75	0.67	0.67
Carrier bandwidth	MHz	1.2	36.0	0.1	36.0	4.5	36.0
Uplink:							
Nominal E/S e.i.r.p. per carrier	dBW	41.9	72.9	35.7	72.4	54.9	72.4
Earth Station Diameter	m	0.45	6.10	0.76	7.60	1.80	7.00
Earth Station Gain	dBi	34.7	57.3	39.3	59.3	46.7	58.5
Uplink Input Power per Carrier	dBW	7.2	15.6	-3.6	13.1	8.2	13.9
Free Space Loss	dB	207.2	207.2	207.2	207.2	207.2	207.2
G/T Satellite	dB/K	3.0	3.0	3.0	3.0	3.0	3.0
C/N Thermal Uplink	dB	5.5	21.7	10.6	21.2	12.7	21.2
C/I XPOL, ACI, IM, ASI	dB	7.2	23.4	12.3	22.9	14.4	22.9
C/(N+I) uplink	dB	3.2	19.5	8.4	19.0	10.5	19.0
Downlink:							
Satellite e.i.r.p. per carrier	dBW	25.0	48.6	13.7	48.2	33.7	48.2
Free Space Loss	dB	205.7	205.7	205.7	205.7	205.7	205.7
Earth Station Diameter	m	6.1	0.45	7.60	0.76	3.70	1.80
Earth Station Gain	dBi	55.8	33.2	57.7	37.7	51.5	45.2
Earth Station G/T	dB/K	34.1	11.4	36.0	16.0	29.7	23.5
C/N Thermal Downlink	dB	21.2	7.3	23.1	11.5	19.8	19.0
C/I XPOL, ACI, IM, ASI	dB	22.1	8.3	24.0	12.4	20.7	19.9
C/(N+I) downlink	dB	18.6	4.8	20.5	8.9	17.2	16.4
Adjacent Satellite Interference:							
Uplink Inp. Pwr. Dens. @ 2 degrees	dBW/Hz	-50	-50	-50	-50	-50	-50
Downlink e.i.r.p. Dens @ 2 degrees	dBW/Hz	-26	-26	-26	-26	-26	-26
C/I up (single satellite)	dB	10.2	26.4	15.3	25.9	17.4	25.9
C/I dn (single satellite)	dB	25.1	11.3	27.0	15.4	23.7	22.9
Aggregate C/I up	dB	7.2	23.4	12.3	22.9	14.4	22.9
Aggregate C/I down	dB	22.1	8.3	24.0	12.4	20.7	19.9
Overall:							
C/(N+I) overall	dB	3.1	4.6	8.1	8.5	9.7	14.5
C/(N+I) required	dB	2.9	2.9	6.0	6.0	7.8	7.8
System Margin	dB	0.2	1.7	2.1	2.5	1.9	6.7

Table B-2
TT&C Link Budgets

Link Parameters	Units	TT&C			
		800KF9D	**300KF9D**	**300KF9D**	**300KF9D**
Uplink Frequency	GHz	6423.5			
Downlink Frequency	GHz		3700.5	4199.5	12198.0
Carrier Allocated Bandwidth	kHz	800.0	300.0	300.0	300.0
Energy Dispersal	MHz	n/a	n/a	n/a	n/a
Uplink:					
Nominal E/S e.i.r.p. per carrier	dBW	71.0			
Earth Station Diameter	m	7.3			
Earth Station Gain	dBi	52.0			
Input power density	dBW/4 kHz	-4			
Free Space Loss	dB	199.7			
G/T Satellite towards E/S	dB/K	-12.6			
C/N Thermal Uplink	dB	28.2			
C/I XPOL, ACI, IM, ASI	dB	35.0			
C/(N+I) uplink	dB	27.4			
Downlink:					
Satellite e.i.r.p. per carrier	dBW		15.0	6.0	12.4
Maximum e.i.r.p. density	dBW/4kHz		-3.8	-12.8	-6.4
Free Space Loss	dB		194.9	196.0	205.3
Earth Station Diameter	m		7.3	7.3	9.0
Earth Station Gain	dBi		47.2	48.3	59.3
Noise Temperature	K		100.0	100.0	120.0
Earth Station G/T	dB/K		27.2	28.3	38.5
C/N Thermal Downlink	dB		21.1	12.1	19.5
C/I XPOL, ACI, IM, ASI	dB		20.4	12.5	19.0
C/(N+I) downlink	dB		17.7	9.3	16.3
Adjacent Satellite Interference:					
Uplink Inp. Pwr. Dens. @ 2 degrees	dBW/Hz	-47	-47	-47	-50
Downlink e.i.r.p. Dens @ 2 degrees	dBW/Hz		-37	-37	-26
C/I up (single satellite)	dB	38.0			
C/I dn (single satellite)	dB		23.4	15.5	22.0
Aggregate C/I up	dB	35.0			
Aggregate C/I down	dB		20.4	12.5	19.0
Overall:					
C/(N+I) overall	dB	27.4	17.7	9.3	16.3
C/(N+I) required	dB	10.0	9.0	9.0	9.0
System Margin	dB	17.4	8.7	0.3	7.3

ANNEX C

Interference Analysis

Interference Analysis

The AMC-1 Modification included an interference analysis that relied on a generic approach, *i.e.*, assuming that the two adjacent systems are identical and spaced at two degrees. *See* AMC-1 Modification, Technical Appendix, Annex C, at 21-28. The proposal in this amendment to relocate AMC-1 to 129.15° W.L. rather than the 47.5° W.L. location specified in the AMC-1 Modification does not alter this generic analysis, and SES incorporates it by reference herein. SES provides below an analysis addressing the specific case of interference between AMC-1 and adjacent systems.

For the C-band, to ensure that the AMC-1 C-band TT&C operations do not cause harmful interference into the adjacent satellite networks, coordination of the TT&C channels will be completed with Intelsat, 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-1 at 129.15° W.L.

For the Ku-band, the only operational Ku-band satellite adjacent to the 129.15° W.L. position is SPTVJSAT/Intelsat's Horizons 1 at 127° W.L. with more than 2° geocentric separation. Given that there is currently no Ku-band satellite at 131° W.L., a hypothetical satellite assumed to be transmitting at the same maximum uplink power density and downlink EIRP density levels as those being sought for the AMC-1 is used to estimate interference levels at that orbital location.

Specific C/I Analysis:

C-band TT&C Interference Assessment

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 following analysis describes the specific factors that allow the AMC-1 C-band TT&C operations proposed herein to operate in a two-degree spacing environment without causing or experiencing harmful adjacent satellite interference. Given the complexity of the TT&C systems and the fact that AMC-1 will be in close proximity to Galaxy 12, SES will coordinate with Intelsat to define the best final operating configuration.

C-band Uplink Interference Assessment – Galaxy 12 at 129.0° W.L.

SES has carefully planned its TT&C operations for AMC-1 to facilitate coordination with Galaxy 12. In order to maximize compatibility, SES plans to operate its command carrier and upper telemetry carrier using polarizations opposite to those of Galaxy 12 to take advantage of cross polarization isolation. For this analysis, SES relied on information from the Galaxy 12 FCC application. Where specific information was not available in the FCC application, SES made certain assumptions (such as using a 10 m earth station antenna, the largest specified in the Galaxy 12 application for other links). The 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.

Table 1. Uplink Command C/I for AMC-1 at 129.15° W.L. and Galaxy-12 at 129.0° W.L.

	Earth station size (m)	Earth station On-axis gain (dBi)	Input power density (dBW/4 kHz)	Earth station Off-axis gain (dBi)	Receive beam cross polarization isolation (dB)	C/I (dB)
AMC-1	7.3	52.0	-4.0	51.8	30.0	27.6
Galaxy-12	10	54.7	-4.0	54.4	30.0	32.9

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 will be addressed through coordination of the proposed AMC-1 C-band TT&C operations with Intelsat, taking into account SES's proposed use of polarization diversity to improve isolation towards the neighboring satellite.

C-band Uplink Interference Assessment – Galaxy 13 at 127.0° W.L.

Many of the factors described above will also facilitate compatibility with Galaxy 13, together with improved earth station gain isolation due to the increased orbital separation. For this analysis, SES relied on information from the Galaxy 13 FCC application. Where specific information was not available in the FCC application, SES made certain assumptions (such as using a 6.1 m earth station antenna, the largest specified in the Galaxy 13 application for other links). 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 2. Uplink Command C/I for AMC-1 at 129.15° W.L. and Galaxy-13 at 127.0° W.L.

	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-1	7.3	52	-4	20.2	0.0	31.8
Galaxy-13	6.1	50.4	-4	20.2	0.0	30.2

C-band Downlink Interference Assessment – Galaxy 12 at 129.0° W.L.

Here again, SES has carefully planned its TT&C operations for AMC-1 to facilitate coordination with Galaxy 12. In order to maximize compatibility, SES has chosen to operate its telemetry carriers with polarizations opposite to those of Galaxy 12 carriers to take advantage of cross polarization isolation.

For this analysis, SES relied on information from the Galaxy 12 FCC application. Where specific information was not available in the FCC application, SES made certain assumptions (such as using a 10 m earth station antenna, the largest specified in the Galaxy 12 application for other links). SES notes that these C/I values correspond to U.S. based antennas and assume TT&C earth station locations in the Continental U.S. However, SES is planning to use an additional TT&C earth station located in Argentina, and the C/I value obtained here would be higher for the Argentine site.

Table 3. Downlink Telemetry C/I for AMC-1 at 129.15° W.L. and Galaxy 12 at 129.0° W.L.

	Earth station size (m)	Earth station On-axis gain (dBi)	EIRP density (dBW/4 kHz)	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)	Cross polarization isolation (dB)	C/I (dB)
AMC-1	7.3	48.3	-12.75	0	0	48.2	30.0	17.3
Galaxy-12	10	51.0	2.04	-2	-2	50.9	30.0	42.9

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 will be addressed through coordination of the proposed AMC-1 C-band TT&C operations with Intelsat, taking into account SES's proposed use of polarization diversity to improve isolation towards the neighboring satellite.

C-band Downlink Interference Assessment – Galaxy 13 at 127.0° W.L.

The larger orbital separation to Galaxy 13 leads to an increased earth station gain isolation. For this analysis, SES relied on information from the Galaxy 13 FCC application. Where specific information was not available in the FCC application, SES made certain assumptions (such as using a 6.1 m earth station antenna, the largest specified in the Galaxy 13 application for other links). 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 for AMC-1 at 129.15° W.L. and Galaxy-13 at 127.0° W.L.

	Earth station size (m)	Earth station On-axis gain (dBi)	EIRP density (dBW/4 kHz)	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-1	7.3	48.3	-12.75	0.0	0.0	20.2	26.9
Galaxy-13	6.1	46.7	-11.56	0.0	0.0	20.2	27.7

Two Degree Spacing Analysis for Ku-band

For this portion of the analysis, the carrier-to-interference ratio between two adjacent systems is estimated for a set of competing emissions. The analysis methodology consists of defining the emission characteristics for each network and computing the interference levels resulting from co-channel operation. C/I levels are calculated for each combination of overlapping emissions (*i.e.*, the same frequency band and link direction). Results are presented in tables providing the interference levels for combinations of emissions pairs.

The worst-case geometry for the earth and space stations is assumed. That is, the space stations are positioned closer to each other by their respective stationkeeping tolerances and the earth station is mispointed toward the interfering space station by an assumed pointing error.

The following equations can be used to express the uplink and downlink C/I:

$$C/I_{UP} = (PD_{ES,W} - PD_{ES,I}) + (G_{ES,W}(\theta_W) - G_{ES,I}(\theta_I)) + \Delta G/T$$

$$C/I_{DN} = (ED_{SS,W} - ED_{SS,I}) + (G_{ES,W}(\theta_W) - G_{ES,W}(\theta_I)) + \Delta GC$$

Here the uplink C/I is estimated using the emission power densities and gains of the earth stations, and an assumption defining the locations of the wanted and interfering earth stations relative to the wanted space station beam boresight. The downlink C/I is estimated using the wanted and interfering space station emission EIRP densities, the gain of the wanted earth station, and an assumption defining the location of the wanted earth station relative to the wanted and interfering space station beam boresights.

The off-axis performance of the earth station antenna is modeled using Part 25 Section 25.209. According to Section 29.209(c)(1), receiving earth stations are afforded protection to the extent that they meet the 25.209(a) and (b) masks at 1.5 degrees off-axis. Therefore, all receiving earth stations are assumed to meet this mask in the interference analysis contained herein. Note that this antenna pattern does not define gain values for angles less than 1.5 degrees. In order to account for earth station pointing errors, a parabolic main beam model is used for gain values at small off-axis angles ($G_{MAX} - 0.0025 * (D/\lambda * \varphi)$ ^ 2).

Earth station topocentric off-axis angles are approximated by adding 10% to the geocentric angular separation, taking into account the satellite stationkeeping tolerance and earth station pointing error.

System characteristics used in the analysis are shown in the following tables. Three space stations are considered: AMC-1 and two adjacent stations: SPTVJSAT/Intelsat's Horizons 1 at 127° W.L., and a hypothetical satellite at 131° W.L. assumed to be transmitting at the same maximum uplink power density and downlink EIRP density levels as those for AMC-1.

Table C-3 provides the space station name and orbital information, and assumed earth station parameters of the networks.

Table C-3: Station Parameters

Parameter	System 1	System 2	System 3
Space station name	Horizons 1	AMC-1	Hypothetical Satellite
Nominal orbit location (+E, -W)	-127.00	-129.15	-131.00
Stationkeeping tolerance (∘)	0.05	0.05	0.05
Earth station pointing error (∘)	0.15	0.15	0.15
Earth station antenna efficiency (fraction)	0.65	0.65	0.65

This analysis considers the digital emissions signals of both networks. Analog TV/FM signals are coordinated on a case-by-case basis with nearby spacecraft, and are therefore not addressed in this analysis. Digital signals are more robust and operate typically down to much lower C/N ratios than analog signals, and therefore are more tolerant of interference.

Tables C-4a and C-4b show the emission characteristics considered here for Horizons 1 and a hypothetical satellite at 131° W.L. (The emissions characteristics for Horizons 1 have been derived from its Schedule S file). All off-axis EIRP densities and off-axis gain values shown in Tables C-4a and C-4b were calculated with respect to the off-axis angle towards the adjacent satellite.

Table C-4a: Horizons 1 Typical Emissions

UPLINK -- Horizons 1 Carriers								
Emission	Occupied Bandwidth (MHz)	Uplink SFD	Uplink EIRP	Uplink Eirp density	Transm. Ant. (m)	Earth Station Gain	Sidelobe Charact.	Off-axis Eirp density
36M0G7W	36.0	-89.0	74.0	-1.6	6.1	57.3	29	-38.7
6M00G7W	5.565	-82.0	68.9	1.4	6.1	57.3	29	-35.7
1M45G7W	1.229	-82.0	62.3	1.4	6.1	57.3	29	-35.7
200KG7W	0.154	-82.0	53.3	1.4	6.1	57.3	29	-35.7
100KG7W	0.077	-82.0	50.3	1.4	6.1	57.3	29	-35.7
400KG7W	0.307	-82.0	56.3	1.4	3	51.1	30	-28.5

DOWNLINK -- Horizons 1 Carriers							
Emission	Satellite EIRP	Bandw. (MHz)	Downlink EIRP density	Receive Ant. (m)	Earth Station Gain	Sidelobe Charact.	Off-axis Gain
36M0G7W	51.8	36.0	-23.8	1.8	45.2	29	20.2
6M00G7W	51.8	5.565	-26.8	3.7	51.4	29	20.2
1M45G7W	51.8	1.229	-26.8	1.8	45.2	29	20.2
200KG7W	51.8	0.154	-26.8	2.4	47.7	29	20.2
100KG7W	51.8	0.077	-26.8	2.4	47.7	29	20.2
400KG7W	51.8	0.307	-26.8	6.1	55.8	29	20.2

Table C-4b: Hypothetical satellite at 131° W.L. Typical Emissions

UPLINK -- Hypothetical satellite Carriers									
Emission	Bandwidth (MHz)	EIRP (dBW)	Power (dBW)	Power density (dBW/Hz)	ES diameter (m)	Earth Station Gain (dBi)	EIRP density (dBW/Hz)	Sidelobe Characteristic	Off-axis Eirp density (dBW/Hz)
1M20G7W	1.2	41.9	7.2	-53.6	0.45	34.7	-18.9	29.0	-31.7
36M0G7W	36.0	72.9	15.6	-60.0	6.1	57.3	-2.7	29.0	-38.1
100KG7W	0.1	35.7	-3.5	-53.5	0.8	39.2	-14.3	29.0	-31.6
36M0G7W	36.0	72.4	13.2	-62.4	7.6	59.2	-3.2	29.0	-40.5
4M50G7W	4.5	54.9	8.2	-58.3	1.80	46.7	-11.6	29.0	-36.5
36M0G7W	36.0	72.4	13.9	-61.7	7.0	58.5	-3.2	29.0	-39.8

DOWNLINK -- Hypothetical satellite Carriers							
Emission	Satellite EIRP	Bandwidth (MHz)	Downlink EIRP density	Receive Antenna (m)	Earth Station Gain	Sidelobe Characteristic	Off-axis Gain
1M20G7W	25.0	1.2	-35.8	6.1	55.8	29	21.9
36M0G7W	48.6	36.0	-27.0	0.45	33.1	29	21.9
100KG7W	13.7	0.1	-36.3	7.60	57.7	29	21.9
36M0G7W	48.2	36.0	-27.4	0.76	37.7	29	21.9
4M50G7W	33.7	4.5	-32.8	3.70	51.4	29	21.9
36M0G7W	48.2	36.0	-27.4	1.80	45.2	29	21.9

Table C-5 shows the AMC-1 emission characteristics considered here (derived from the Schedule S file). Similar to Tables C-4a and C-4b, all off-axis EIRP densities and off-axis gain values shown in Table C-5 were calculated with respect to the off-axis angle towards the adjacent satellite.

Table C-5: AMC-1 Typical Emissions

UPLINK -- AMC-1 Carriers						
Emission	1M20G7W	36M0G7W	100KG7W	36M0G7W	4M50G7W	36M0G7W
Bandwidth (MHz)	1.2	36.0	0.1	36.0	4.5	36.0
EIRP (dBW)	41.9	72.9	35.7	72.4	54.9	72.4
Power (dBW)	7.2	15.6	-3.5	13.2	8.2	13.9
Power density (dBW/Hz)	-53.6	-60.0	-53.5	-62.4	-58.3	-61.7
ES diameter (m)	0.45	6.1	0.8	7.6	1.80	7.0
Earth Station Gain (dBi)	34.7	57.3	39.2	59.2	46.7	58.5
EIRP density (dBW/Hz)	-18.9	-2.7	-14.3	-3.2	-11.6	-3.2
Sidelobe Characteristic	29.0	29.0	29.0	29.0	29.0	29.0
Off-axis Eirp density (dBW/Hz)	-31.7	-38.1	-31.6	-40.5	-36.5	-39.8

DOWNLINK -- AMC-1 Carriers						
Emission	1M20G7W	36M0G7W	100KG7W	36M0G7W	4M50G7W	36M0G7W
Bandwidth	1.2	36.0	0.1	36.0	4.5	36.0
Receive Earth Station (m)	6.1	0.45	7.60	0.76	3.70	1.80
Satellite EIRP	25.0	48.6	13.7	48.2	33.7	48.2
Downlink EIRP density	-35.8	-27.0	-36.3	-27.4	-32.8	-27.4
RX Earth Station Gain	55.8	33.1	57.7	37.7	51.4	45.2
Sidelobe Characteristic	29.0	29.0	29.0	29.0	29.0	29.0
Off-axis Gain	21.9	21.9	21.9	21.9	21.9	21.9

Applying the methodology present above to the emission characteristics shown in Tables C-4 and C-5 results in the C/I levels shown in Appendix 1 to this Annex. A separate table is provided for each frequency band/link direction pair that shows the C/I level for each emission pair.

The worst-case C/I levels extracted from the tables in Appendix 1 for each band and link direction are summarized in Table C-6. This table also shows the resulting impact to the wanted links assuming a threshold C/N of 8 dB.

Table C-6: Worst-Case C/I and Impact to Wanted Links[5]

Worst-case interference AMC-1 into Horizons 1					
Link	**Worst-case C/I (dB)**	**C/N (dB)**	**I/N (dB)**	**ΔT/T (%)**	**Inc. in Noise (dB)**
Ku-band uplink	31.8	8.0	-23.8	0.4	0.02
Ku-band downlink	25.6	8.0	-17.6	1.7	0.07

Worst-case interference Horizons 1 into AMC-1					
Link	**Worst-case C/I (dB)**	**C/N (dB)**	**I/N (dB)**	**ΔT/T (%)**	**Inc. in Noise (dB)**
Ku-band uplink	14.2	8.0	-6.2	23.7	0.9
Ku-band downlink	13.9	8.0	-5.9	25.5	1.0

Worst-case interference AMC-1 into Hypothetical satellite					
Link	**Worst-case C/I (dB)**	**C/N (dB)**	**I/N (dB)**	**ΔT/T (%)**	**Inc. in Noise (dB)**
Ku-band uplink	17.3	8.0	-9.3	11.6	0.5
Ku-band downlink	15.8	8.0	-7.8	16.6	0.7

Worst-case interference Hypothetical satellite into AMC-1					
Link	**Worst-case C/I (dB)**	**C/N (dB)**	**I/N (dB)**	**ΔT/T (%)**	**Inc. in Noise (dB)**
Ku-band uplink	17.3	8.0	-9.3	11.6	0.5
Ku-band downlink	15.8	8.0	-7.8	16.6	0.7

As can be seen from these results, the interference from AMC-1 to Horizons 1 is well below the 6% coordination threshold. The SES worst case C/I occurs for the Ku-downlink to and from the 131W orbital location, where a ΔT/T coordination trigger is exceeded. Although the normal

[5] Aeronautical operations (which are represented by the first two carriers in Table B-1) are not included in this summary, as they are a special case governed by Section 25.227 of the Commission's rules, including Section 25.227(a)(8) which specifies the extent to which these operations are entitled to protection.

criteria of 6% is exceeded by a small amount, the victim system's link degradation is around 0.5 dB for the uplink and 0.7 dB for the downlink, which is significantly less than the likely link margin. It should be recognized that this trigger is just referenced as one potential rule of thumb, and that the FCC's rules specify power levels above which coordination is required. AMC-1's operations are just above that coordination threshold of 10 dBW/4kHz, and are below the operating levels of most satellites serving the domestic arc.

APPENDIX 1

C/I CALCULATIONS

Table A1-1: AMC-1 into Horizons 1 Ku-Band Uplink C/I

Uplink C/I analysis	AMC-1 into Horizons 1	
Frequency	Ku-band	
AMC-1 Orbital Position	129.15	W
Horizons 1 Orbital Position	127.0	W
Geocentric Separation	2.1	degrees
Topocentric Separation	2.3	degrees

UPLINK -- AMC-1 Carriers						
Emission	1M20G7W	36M0G7W	100KG7W	36M0G7W	4M50G7W	36M0G7W
Bandwidth (MHz)	1.2	36.0	0.1	36.0	4.5	36.0
Uplink EIRP	41.9	72.9	35.7	72.4	54.9	72.4
Uplink Power	7.2	15.6	-3.5	13.2	8.2	13.9
Uplink Power density	-53.6	-60.0	-53.5	-62.4	-58.3	-61.7
Uplink Earth Station (m)	0.45	6.1	0.8	7.6	1.80	7.0
Earth Station Gain	34.7	57.3	39.2	59.2	46.7	58.5
Upl. EIRP density	-18.9	-2.7	-14.3	-3.2	-11.6	-3.2
Sidelobe Characteristic	29.0	29.0	29.0	29.0	29.0	29.0
Off-axis Eirp density	-33.4	-39.8	-33.4	-42.2	-38.2	-41.5

UPLINK -- Horizons 1 Carriers									UPLINK C/I - AMC-1 into Horizons 1					
Emission	Occupied Bandwidth (MHz)	Uplink SFD	Uplink EIRP	Uplink Eirp density	Transm. Ant. (m)	Earth Station Gain	Sidelobe Charact.	Off-axis Eirp density	C/I	C/I	C/I	C/I	C/I	C/I
36M0G7W	36.0	-89.0	74.0	-1.6	6.1	57.3	29	-38.7	31.8	38.2	31.8	40.7	36.6	39.9
6M00G7W	5.565	-82.0	68.9	1.4	6.1	57.3	29	-35.7	34.8	41.2	34.8	43.7	39.6	42.9
1M45G7W	1.229	-82.0	62.3	1.4	6.1	57.3	29	-35.7	34.8	41.2	34.8	43.7	39.6	42.9
200KG7W	0.154	-82.0	53.3	1.4	6.1	57.3	29	-35.7	34.8	41.2	34.8	43.7	39.6	42.9
100KG7W	0.077	-82.0	50.3	1.4	6.1	57.3	29	-35.7	34.8	41.2	34.8	43.7	39.6	42.9
400KG7W	0.307	-82.0	56.3	1.4	3	51.2	30	-28.5	34.8	41.2	34.8	43.7	39.6	42.9

Table A1-2: AMC-1 into Horizons 1 Ku-Band Downlink C/I

Downlink C/I analysis	AMC-1 into Horizons 1	
Frequency	Ku-band	
AMC-1 Orbital Position	129.2	W
Horizons 1 Orbital Position	127.0	W
Geocentric Separation	2.1	degrees
Topocentric Separation	2.3	degrees

DOWNLINK -- AMC-1 Carriers						
Emission	1M20G7W	36M0G7W	100KG7W	36M0G7W	4M50G7W	36M0G7W
Bandwidth	1.2	36.0	0.1	36.0	4.5	36.0
Receive Earth Station (m)	6.1	0.45	7.60	0.76	3.70	1.80
Satellite EIRP	25.0	48.6	13.7	48.2	33.7	48.2
Downlink EIRP density	-35.8	-27.0	-36.3	-27.4	-32.8	-27.4
RX Earth Station Gain	55.8	33.1	57.7	37.7	51.4	45.2
Sidelobe Characteristic	29.0	29.0	29.0	29.0	29.0	29.0
Off-axis Gain	20.2	20.2	20.2	20.2	20.2	20.2

DOWNLINK -- Horizons 1 Carriers								DOWNLINK C/I - AMC-1 into Horizons 1					
Emission	Satellite EIRP	Bandw. (MHz)	Downlink EIRP density	Receive Ant. (m)	Earth Station Gain	Sidelobe Charact.	Off-axis Gain	C/I	C/I	C/I	C/I	C/I	C/I
36M0G7W	51.8	36.0	-23.8	1.8	45.2	29	20.2	37.0	28.2	37.6	28.6	34.1	28.6
6M00G7W	51.8	5.565	-26.8	3.7	51.4	29	20.2	40.3	31.5	40.8	31.9	37.3	31.9
1M45G7W	51.8	1.229	-26.8	1.8	45.2	29	20.2	34.0	25.2	34.6	25.6	31.1	25.6
200KG7W	51.8	0.154	-26.8	2.4	47.7	29	20.2	36.5	27.7	37.1	28.1	33.6	28.1
100KG7W	51.8	0.077	-26.8	2.4	47.7	29	20.2	36.5	27.7	37.1	28.1	33.6	28.1
400KG7W	51.8	0.307	-26.8	6.1	55.8	29	20.2	44.6	35.8	45.2	36.2	41.7	36.2

Table A1-3: Horizons 1 into AMC-1 Ku-Band Uplink C/I

Uplink C/I analysis	Horizons 1 into AMC-1	
Frequency	Ku-band	
AMC-1 Orbital Position	129.15	W
Horizons 1 Orbital Position	127.0	W
Geocentric Separation	2.1	degrees
Topocentric Separation	2.3	degrees

UPLINK -- AMC-1 Carriers						
Emission	1M20G7W	36M0G7W	100KG7W	36M0G7W	4M50G7W	36M0G7W
Bandwidth (MHz)	1.2	36.0	0.1	36.0	4.5	36.0
Uplink EIRP	41.9	72.9	35.7	72.4	54.9	72.4
Uplink Power	7.2	15.6	-3.5	13.2	8.2	13.9
Uplink Power density	-53.6	-60.0	-53.5	-62.4	-58.3	-61.7
Uplink Earth Station (m)	0.45	6.1	0.8	7.6	1.80	7.0
Earth Station Gain	34.7	57.3	39.2	59.2	46.7	58.5
Upl. EIRP density	-18.9	-2.7	-14.3	-3.2	-11.6	-3.2
Sidelobe Characteristic	29.0	29.0	29.0	29.0	29.0	29.0
Off-axis Eirp density	-33.4	-39.8	-33.4	-42.2	-38.2	-41.5

UPLINK -- Horizons 1 Carriers									UPLINK C/I - Horizons 1 into AMC-1					
Emission	Occupied Bandwidth (MHz)	Uplink SFD	Uplink EIRP	Uplink Eirp density	Transm. Ant. (m)	Earth Station Gain	Sidelobe Charact.	Off-axis Eirp density	C/I	C/I	C/I	C/I	C/I	C/I
36M0G7W	36.0	-89.0	74.0	-1.6	6.1	57.3	29	-38.7	19.8	36.0	24.4	35.5	27.1	35.5
6M00G7W	5.565	-82.0	68.9	1.4	6.1	57.3	29	-35.7	16.8	33.0	21.4	32.5	24.1	32.5
1M45G7W	1.229	-82.0	62.3	1.4	6.1	57.3	29	-35.7	16.8	33.0	21.4	32.5	24.1	32.5
200KG7W	0.154	-82.0	53.3	1.4	6.1	57.3	29	-35.7	16.8	33.0	21.4	32.5	24.1	32.5
100KG7W	0.077	-82.0	50.3	1.4	6.1	57.3	29	-35.7	16.8	33.0	21.4	32.5	24.1	32.5
400KG7W	0.307	-82.0	56.3	1.4	3	51.2	30	-28.5	9.7	25.9	14.2	25.4	16.9	25.4

Table A1-4: Horizons 1 into AMC-1 Ku-Band Downlink C/I

Downlink C/I analysis	Horizons 1 into AMC-1	
Frequency	Ku-band	
AMC-1 Orbital Position	129.2	W
Horizons 1 Orbital Position	127.0	W
Geocentric Separation	2.1	degrees
Topocentric Separation	2.3	degrees

DOWNLINK -- AMC-1 Carriers						
Emission	1M20G7W	36M0G7W	100KG7W	36M0G7W	4M50G7W	36M0G7W
Bandwidth	1.2	36.0	0.1	36.0	4.5	36.0
Receive Earth Station (m)	6.1	0.45	7.60	0.76	3.70	1.80
Satellite EIRP	25.0	48.6	13.7	48.2	33.7	48.2
Downlink EIRP density	-35.8	-27.0	-36.3	-27.4	-32.8	-27.4
RX Earth Station Gain	55.8	33.1	57.7	37.7	51.4	45.2
Sidelobe Characteristic	29.0	29.0	29.0	29.0	29.0	29.0
Off-axis Gain	20.2	20.2	20.2	20.2	20.2	20.2

DOWNLINK -- Horizons 1 Carriers								DOWNLINK C/I - Horizons 1 into AMC-1					
Emission	Satellite EIRP	Bandw. (MHz)	Downlink EIRP density	Receive Ant. (m)	Earth Station Gain	Sidelobe Charact.	Off-axis Gain	C/I	C/I	C/I	C/I	C/I	C/I
36M0G7W	51.8	36.0	-23.8	1.8	45.2	29	20.2	23.6	9.8	25.0	13.9	22.2	21.4
6M00G7W	51.8	5.565	-26.8	3.7	51.4	29	20.2	26.6	12.8	28.0	16.9	25.2	24.4
1M45G7W	51.8	1.229	-26.8	1.8	45.2	29	20.2	26.6	12.8	28.0	16.9	25.2	24.4
200KG7W	51.8	0.154	-26.8	2.4	47.7	29	20.2	26.6	12.8	28.0	16.9	25.2	24.4
100KG7W	51.8	0.077	-26.8	2.4	47.7	29	20.2	26.6	12.8	28.0	16.9	25.2	24.4
400KG7W	51.8	0.307	-26.8	6.1	55.8	29	20.2	26.6	12.8	28.0	16.9	25.2	24.4

Table A1-5: AMC-1 into Hypothetical satellite at 131° W.L. Ku-Band Uplink C/I

Uplink C/I analysis	AMC-1 into Hypothetical satellite	
Frequency	Ku-band	
AMC-1 Orbital Position	129.15	W
Hypothetical sat Orbital Position	131.0	W
Geocentric Separation	1.7	degrees
Topocentric Separation	1.9	degrees

UPLINK -- AMC-1 Carriers						
Emission	1M20G7W	36M0G7W	100KG7W	36M0G7W	4M50G7W	36M0G7W
Bandwidth (MHz)	1.2	36.0	0.1	36.0	4.5	36.0
EIRP (dBW)	41.9	72.9	35.7	72.4	54.9	72.4
Power (dBW)	7.2	15.6	-3.5	13.2	8.2	13.9
Power density (dBW/Hz)	-53.6	-60.0	-53.5	-62.4	-58.3	-61.7
ES diameter (m)	0.45	6.1	0.8	7.6	1.80	7.0
Earth Station Gain (dBi)	34.7	57.3	39.2	59.2	46.7	58.5
EIRP density (dBW/Hz)	-18.9	-2.7	-14.3	-3.2	-11.6	-3.2
Sidelobe Characteristic	29.0	29.0	29.0	29.0	29.0	29.0
Off-axis Eirp density (dBW/Hz)	-31.7	-38.1	-31.6	-40.5	-36.5	-39.8

UPLINK -- Hypothetical satellite Carriers										UPLINK C/I - AMC-1 into Hypothetical satellite					
Emission	Bandwidth (MHz)	EIRP (dBW)	Power (dBW)	Power density (dBW/Hz)	ES diameter (m)	Earth Station Gain (dBi)	EIRP density (dBW/Hz)	Sidelobe Characteristic	Off-axis Eirp density (dBW/Hz)	C/I (dB)	C/I (dB)	C/I (dB)	C/I (dB)	C/I (dB)	C/I (dB)
1M20G7W	1.2	41.9	7.2	-53.6	0.45	34.7	-18.9	29.0	-31.7	12.8	19.2	12.7	21.6	17.6	20.9
36M0G7W	36.0	72.9	15.6	-60.0	6.1	57.3	-2.7	29.0	-38.1	29.0	35.4	29.0	37.8	33.8	37.1
100KG7W	0.1	35.7	-3.5	-53.5	0.8	39.2	-14.3	29.0	-31.6	17.4	23.8	17.3	26.2	22.2	25.5
36M0G7W	36.0	72.4	13.2	-62.4	7.6	59.2	-3.2	29.0	-40.5	28.5	34.9	28.5	37.3	33.3	36.6
4M50G7W	4.5	54.9	8.2	-58.3	1.80	46.7	-11.6	29.0	-36.5	20.0	26.5	20.0	28.9	24.8	28.2
36M0G7W	36.0	72.4	13.9	-61.7	7.0	58.5	-3.2	29.0	-39.8	28.5	34.9	28.5	37.3	33.3	36.6

Table A1-6: AMC-1 into Hypothetical satellite at 131° W.L. Ku-Band Downlink C/I

Downlink C/I analysis	AMC-1 into Hypothetical satellite	
Frequency	Ku-band	
AMC-1 Orbital Position	129.2	W
Hypothetical sat Orbital Position	131.0	W
Geocentric Separation	1.7	degrees
Topocentric Separation	1.9	degrees

DOWNLINK -- AMC-1 Carriers						
Emission	1M20G7W	36M0G7W	100KG7W	36M0G7W	4M50G7W	36M0G7W
Bandwidth	1.2	36.0	0.1	36.0	4.5	36.0
Receive Earth Station (m)	6.1	0.45	7.60	0.76	3.70	1.80
Satellite EIRP	25.0	48.6	13.7	48.2	33.7	48.2
Downlink EIRP density	-35.8	-27.0	-36.3	-27.4	-32.8	-27.4
RX Earth Station Gain	55.8	33.1	57.7	37.7	51.4	45.2
Sidelobe Characteristic	29.0	29.0	29.0	29.0	29.0	29.0
Off-axis Gain	21.9	21.9	21.9	21.9	21.9	21.9

DOWNLINK -- Hypothetical satellite Carriers								DOWNLINK C/I - AMC-1 into Hypothetical satellite					
Emission	Satellite EIRP	Bandwidth (MHz)	Downlink EIRP density	Receive Antenna (m)	Earth Station Gain	Sidelobe Characteristic	Off-axis Gain	C/I	C/I	C/I	C/I	C/I	C/I
1M20G7W	25.0	1.2	-35.8	6.1	55.8	29	21.9	33.9	25.1	34.4	25.5	30.9	25.5
36M0G7W	48.6	36.0	-27.0	0.45	33.1	29	21.9	20.1	11.3	20.6	11.7	17.1	11.7
100KG7W	13.7	0.1	-36.3	7.60	57.7	29	21.9	35.3	26.5	35.8	26.9	32.3	26.9
36M0G7W	48.2	36.0	-27.4	0.76	37.7	29	21.9	24.2	15.4	24.7	15.8	21.3	15.8
4M50G7W	33.7	4.5	-32.8	3.70	51.4	29	21.9	32.5	23.7	33.0	24.1	29.6	24.1
36M0G7W	48.2	36.0	-27.4	1.80	45.2	29	21.9	31.7	22.9	32.2	23.3	28.8	23.3

Table A1-7: Hypothetical satellite at 131° W.L. into AMC-1 Ku-Band Uplink C/I

Uplink C/I analysis	Hypothetical satellite into AMC-1	
Frequency	Ku-band	
AMC-1 Orbital Position	129.15	W
Hypothetical sat Orbital Position	131.0	W
Geocentric Separation	1.7	degrees
Topocentric Separation	1.9	degrees

UPLINK -- AMC-1 Carriers						
Emission	1M20G7W	36M0G7W	100KG7W	36M0G7W	4M50G7W	36M0G7W
Bandwidth (MHz)	1.2	36.0	0.1	36.0	4.5	36.0
EIRP (dBW)	41.9	72.9	35.7	72.4	54.9	72.4
Power (dBW)	7.2	15.6	-3.5	13.2	8.2	13.9
Power density (dBW/Hz)	-53.6	-60.0	-53.5	-62.4	-58.3	-61.7
ES diameter (m)	0.45	6.1	0.8	7.6	1.80	7.0
Earth Station Gain (dBi)	34.7	57.3	39.2	59.2	46.7	58.5
EIRP density (dBW/Hz)	-18.9	-2.7	-14.3	-3.2	-11.6	-3.2
Sidelobe Characteristic	29.0	29.0	29.0	29.0	29.0	29.0
Off-axis Eirp density (dBW/Hz)	-31.7	-38.1	-31.6	-40.5	-36.5	-39.8

UPLINK -- Hypothetical satellite Carriers										UPLINK C/I - Hypothetical satellite into AMC-1					
Emission	Bandwidth (MHz)	EIRP (dBW)	Power (dBW)	Power density (dBW/Hz)	ES diameter (m)	Earth Station Gain (dBi)	EIRP density (dBW/Hz)	Sidelobe Characteristic	Off-axis Eirp density (dBW/Hz)	C/I	C/I	C/I	C/I	C/I	C/I
1M20G7W	1.2	41.9	7.2	-53.6	0.45	34.7	-18.9	29.0	-31.7	12.8	29.0	17.4	28.5	20.0	28.5
36M0G7W	36.0	72.9	15.6	-60.0	6.1	57.3	-2.7	29.0	-38.1	19.2	35.4	23.8	34.9	26.5	34.9
100KG7W	0.1	35.7	-3.5	-53.5	0.8	39.2	-14.3	29.0	-31.6	12.7	29.0	17.3	28.5	20.0	28.5
36M0G7W	36.0	72.4	13.2	-62.4	7.6	59.2	-3.2	29.0	-40.5	21.6	37.8	26.2	37.3	28.9	37.3
4M50G7W	4.5	54.9	8.2	-58.3	1.80	46.7	-11.6	29.0	-36.5	17.6	33.8	22.2	33.3	24.8	33.3
36M0G7W	36.0	72.4	13.9	-61.7	7.0	58.5	-3.2	29.0	-39.8	20.9	37.1	25.5	36.6	28.2	36.6

Table A1-8: Hypothetical satellite at 131° W.L. into AMC-1 Ku-Band Downlink C/I

Downlink C/I analysis	Hypothetical satellite into AMC-1	
Frequency	Ku-band	
AMC-1 Orbital Position	129.2	W
Hypothetical sat Orbital Position	131.0	W
Geocentric Separation	1.7	degrees
Topocentric Separation	1.9	degrees

DOWNLINK -- AMC-1 Carriers						
Emission	1M20G7W	36M0G7W	100KG7W	36M0G7W	4M50G7W	36M0G7W
Bandwidth	1.2	36.0	0.1	36.0	4.5	36.0
Receive Earth Station (m)	6.1	0.45	7.60	0.76	3.70	1.80
Satellite EIRP	25.0	48.6	13.7	48.2	33.7	48.2
Downlink EIRP density	-35.8	-27.0	-36.3	-27.4	-32.8	-27.4
RX Earth Station Gain	55.8	33.1	57.7	37.7	51.4	45.2
Sidelobe Characteristic	29.0	29.0	29.0	29.0	29.0	29.0
Off-axis Gain	21.9	21.9	21.9	21.9	21.9	21.9

DOWNLINK -- Hypothetical satellite Carriers								DOWNLINK C/I - Hypothetical satellite into AMC-1					
Emission	Satellite EIRP	Bandw. (MHz)	Downlink EIRP density	Receive Ant. (m)	Earth Station Gain	Sidelobe Charact.	Off-axis Gain	C/I	C/I	C/I	C/I	C/I	C/I
1M20G7W	25.0	1.2	-35.8	6.1	55.8	29	21.9	33.9	20.1	35.3	24.2	32.5	31.7
36M0G7W	48.6	36.0	-27.0	0.45	33.1	29	21.9	25.1	11.3	26.5	15.4	23.7	22.9
100KG7W	13.7	0.1	-36.3	7.60	57.7	29	21.9	34.4	20.6	35.8	24.7	33.0	32.2
36M0G7W	48.2	36.0	-27.4	0.76	37.7	29	21.9	25.5	11.7	26.9	15.8	24.1	23.3
4M50G7W	33.7	4.5	-32.8	3.70	51.4	29	21.9	30.9	17.1	32.3	21.3	29.6	28.8
36M0G7W	48.2	36.0	-27.4	1.80	45.2	29	21.9	25.5	11.7	26.9	15.8	24.1	23.3

DECLARATION

I, Pascale Dumit, 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/*______________________

Pascale Dumit
Manager, Spectrum Management and Development
SES Americom, Inc.

Dated: February 19, 2015