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

In the Matter of	)	
	)	
NEW SKIES SATELLITES B.V.	)	File No. SAT-PPL-___________
	)	
Request for U.S. Market Access for SES-6	)	

<u>PETITION</u>

New Skies Satellites B.V. ("New Skies," doing business as "SES") hereby respectfully requests that the Commission authorize the Netherlands-licensed SES-6 spacecraft to serve the U.S. market from the 40.5º W.L. (319.5º E.L.) orbital location. At that location, SES-6 will replace the NSS-806 spacecraft and expand service from the 40.5° W.L. orbital location using additional frequency bands. Specifically, SES requests that the Commission: (i) add SES-6 to the Commission's Permitted Space Station List ("Permitted List") for Fixed Satellite Service ("FSS") operations in the conventional C- and Ku-bands; (ii) permit use of the SES-6 extended C- and Ku-band capacity, and Appendix 30B bands, for FSS and limited telemetry, tracking and control ("TT&C") operations, consistent with the Commission's rules and subject to earth station-specific licensing; and (iii) authorize use of SES-6 for direct-to-home ("DTH") service within the United States and between the U.S. and the other markets identified herein. Grant of the requested authority is consistent with Commission precedent and will serve the public interest by allowing SES to continue to provide service from 40.5° W.L. and to respond to customer demand for DTH capacity.

A completed FCC Form 312 is attached, along with technical materials on Schedule S and in narrative form pursuant to Section 25.114 of the Commission's rules. Launch of SES-6 is currently scheduled to occur late in the first quarter of 2013, and SES seeks action on this petition consistent with that schedule.

I. BACKGROUND

SES currently operates the NSS-806 C/Ku-band hybrid spacecraft at 40.5° W.L. pursuant to a license issued by The Netherlands. In 2001, the Commission added NSS-806 to the Permitted List to authorize U.S.-licensed earth stations to communicate with the satellite using the standard C- and Ku-bands.[1] SES uses NSS-806 to provide a wide range of FSS services, including transmission of voice, video and narrowband to wideband digital services, to customers throughout the Americas, Europe, and the northern part of Africa.

SES-6 is a C/Ku-band hybrid spacecraft that will provide follow-on service at 40.5° W.L. As in the case of NSS-806, SES-6 will operate on a non-common carrier basis. SES-6 is capable of operating on many of the same conventional and extended C- and Ku-band frequencies available on NSS-806, as well as in the extended Ku-band and the Appendix 30B C- and Ku-band spectrum. The following table compares the frequency bands on the existing NSS-806 satellite with those on SES-6.

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[1] *New Skies Satellites, N.V.*, Order, 16 FCC Rcd 7482 (Sat. Div.2001) ("*NSS-806 Order*"). *See also New Skies Satellites, N.V.*, File No. SAT-MPL-20110923-00187, Call Sign S2591 (the "NSS-806 Modification").

Frequency Band	NSS-806	SES-6
Extended C-band	3465-3700 MHz downlink; 5850-5925 MHz and 6490-6650 MHz uplink	3625-3700 MHz downlink; 5850-5925 MHz uplink
Conventional C-band	3700-4200 MHz downlink; 5925-6425 MHz uplink	3700-4200 MHz downlink; 5925-6425 MHz uplink
Appendix 30B C-band	Not on NSS-806	4500-4800 MHz downlink; 6725-7025 MHz uplink
Extended Ku-band	Not on NSS-806	10.95-11.2 GHz and 11.45-11.7 GHz downlink; 13.75-14.0 GHz uplink
Appendix 30B Ku-band	Not on NSS-806	11.2-11.45 GHz downlink[2]
Conventional Ku-band	11.7-11.95 GHz downlink; 14.0-14.25 GHz uplink	11.7-12.2 GHz downlink; 14.0-14.5 GHz uplink

II. AUTHORIZING SES-6 TO SERVE THE U.S. IS CONSISTENT WITH COMMISSION POLICIES AND THE PUBLIC INTEREST

SES is a leading provider of satellite communications services in the United States and around the world. The application to launch and operate the proposed SES-6 satellite reflects SES's continuing commitment to serving the existing and future needs of its customers. Granting U.S. market access for SES-6 will enable SES to provide service continuity at the 40.5° W.L. orbital location and to introduce new capacity to the benefit of U.S. satellite service customers. Furthermore, grant of market access for SES-6 is consistent with the Commission's *DISCO II* policies.[3]

A. SES is Entitled to a Replacement Expectancy at 40.5° W.L.

The Commission has expressly recognized a replacement expectancy for geostationary ("GSO") satellite operators:

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2 As shown in the technical materials, the Appendix 30B Ku-band frequencies are on the East Atlantic beam that does not have coverage of United States territory.

3 *See Amendment of the Commission's Policies to Allow Non-U.S. Licensed Space Stations providing Domestic and International Service in the United States*, Report & Order, 12 FCC Rcd 24094 (1997) ("*DISCO II*").

> Given the huge costs of building and operating GSO space stations, we have found that there should be some assurance that operators will be able to continue to serve their customers. Therefore, the Commission has stated that, when an orbit location remains available for a U.S. satellite with the technical characteristics of the proposed replacement satellite, it will generally authorize the replacement satellite at the same location.[4]

Furthermore, the Commission has made clear that foreign-licensed satellite operators are entitled to a replacement expectancy as well:

> We afford non-U.S.-licensed satellites the same replacement expectancy as we do U.S.-licensed satellites. That is, we will permit the proposed replacement satellite to access the U.S. market provided that the location remains available to a satellite authorized by the Administration that authorized the existing satellite, and the technical characteristics of the proposed replacement satellite allow it to be assigned to the location.[5]

The proposal to deploy SES-6 to provide follow-on capacity at 40.5° W.L. conforms to these policies. Like NSS-806, SES-6 is licensed by The Netherlands, and is authorized to operate at the same orbital location on many of the same (and more) frequencies. The Commission's replacement expectancy policies are designed to promote service continuity, and granting U.S. market access for SES-6 is consistent with that objective.

B. SES-6 Qualifies for U.S. Market Access under *DISCO II*

In the *DISCO II* proceeding, the Commission adopted policies for determining whether to permit foreign-licensed satellites to serve the U.S. market, and these standards are

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[4] *Amendment of the Commission's Space Station Licensing Rules and Policies*, First Report and Order and Further Notice of Proposed Rulemaking, 18 FCC Rcd 10760 at ¶ 250 (2003) (footnotes omitted).

[5] *Id*. at ¶ 324.

codified in Section 25.137 of the Commission's Rules.[6] The Commission's policies are intended to ensure that entry by a foreign-licensed satellite will not distort competition in the U.S.[7] The Commission also considers whether there are spectrum availability issues or concerns relating to national security, law enforcement, foreign policy or trade that would present an obstacle to U.S. market access.[8] The SES request to add SES-6 to the Permitted List in the conventional C- and Ku-bands, authorize use of the satellite's other payloads consistent with the Commission's rules, and permit use of the spacecraft for DTH services fully complies with the Commission's market access requirements.

1. FSS Operations

In *DISCO II*, the Commission adopted a presumption that with respect to services covered by the WTO agreement, entry into the U.S. market by entities licensed by WTO member countries will promote competition in the U.S. market.[9] FSS operations except for DTH are covered by the WTO agreement.[10] SES seeks authority to use SES-6 to provide FSS services to U.S. customers. Because SES-6 is licensed by The Netherlands, a WTO-member country, the SES proposal to provide WTO-covered services is subject to the presumption in favor of entry described above.

Grant of market access for SES-6 to provide FSS is supported by Commission precedent. As noted above, the Commission has authorized use of the Netherlands-licensed

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6 47 C.F.R. § 25.137.

7 *DISCO II* at ¶ 7.

8 *See id.*at¶ 178.

9 *Id.* at ¶ 39.

10 *Id.* at ¶¶ 25 & 30.

NSS-806 space station for FSS service to U.S. customers from 40.5° W.L.[11] Numerous other satellites licensed by The Netherlands to New Skies are similarly on the Commission's Permitted List.[12] The Commission's decision to authorize each of these satellites to serve the U.S. reflects a determination that the competition policies underlying the *DISCO II* framework are satisfied and that no other barriers to grant of U.S. market access exist.

The same conclusion is warranted with respect to SES-6. Allowing SES to use SES-6 to offer FSS to, from, and within the U.S. will promote competition and is otherwise consistent with the *DISCO II* framework. Therefore, the Commission should add SES-6 to the Permitted List for services in the conventional C- and Ku-band.

Furthermore, the Commission applies the same framework that governs Permitted List petitions to requests for U.S. market access for bands other than the conventional C- and Ku-bands.[13] Accordingly, the Commission should also authorize SES-6 to serve the United States using spectrum in the extended C- and Ku-bands, and Appendix 30B bands, subject to earth station-specific licensing. SES recognizes that under the Commission's rules, some of these bands are limited to international service[14] and some are subject to case-by-case electromagnetic compatibility analysis with co-primary U.S. government systems.[15] SES will conform to these requirements with respect to operations of SES-6.

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11 *See NSS-806 Order*.

12 *See* Permitted List, available at: http://transition.fcc.gov/ib/sd/se/permitted.html (listing NSS-5, NSS-7, and NSS-703 space stations in addition to NSS-806).

13 *See DISCO II* at¶ 192.

14 *See* 47 C.F.R. § 2.106, Footnotes US245, NG104, and NG185; 47 C.F.R.§ 2.108; &47 C.F.R. § 25.202(a)(1) Note 2.

15 *See* 47 C.F.R. § 2.106, Footnote US245; 47 C.F.R. § 2.108.

2. DTH Operations

In *DISCO II*, the Commission adopted the "ECO-Sat" test for services such as DTH that are excluded from the U.S. commitments in the WTO Telecom Agreement.[16] That test requires a determination that U.S.-licensed satellites have "effective competitive opportunities" in the relevant foreign markets to provide analogous services.[17] Under the Commission's rules, the relevant foreign markets for this test are (i) the country in which the non-U.S.-licensed satellite is licensed; and (ii) the countries in which communications with U.S. earth stations will originate or terminate.[18] To assess compliance with the ECO-Sat test, the Commission looks at whether there are *de jure* or *de facto* barriers to entry for U.S. satellite operators seeking to provide comparable services in the relevant foreign jurisdiction.[19]

In this instance, SES is seeking authority to use capacity on SES-6 to provide DTH services: (1) within the U.S., (2) between the U.S. and the Netherlands, (3) between the U.S. and other European Union member states, (4) between the U.S. and Mexico, and (5) between the U.S. and Brazil, the Netherlands Antilles, Guatemala, Honduras, Nicaragua, and the overseas territories of the United Kingdom located in the Caribbean (Bermuda, the British Virgin Islands, and the Cayman Islands). As demonstrated below, all of these countries satisfy the ECO-Sat test. SES acknowledges that the DTH authority it is seeking would be subject to any band-specific restrictions in the Commission's rules, unless specifically waived. Thus, for

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16 *DISCO II* at ¶ 98.

17 *Id.* at ¶ 99.

18 *See* 47 C.F.R. § 25.137(a).

19 *DISCO II* at ¶ 75.

example, use of the extended Ku-band downlink frequencies for DTH would be limited to international service, unless specifically waived.

The Netherlands. The Netherlands, which is the licensing administration for SES-6, passes the ECO-Sat test. There are no *de jure* or *de facto* barriers in the Netherlands to U.S. satellite operators wishing to provide capacity for DTH service.[20] The Netherlands' policy conforms to the European Union ("EU") directive specifying that "Member States shall ensure that any regulatory prohibition or restriction on the offer of space segment capacity to any authorised satellite earth station network operator are abolished."[21] Accordingly, authorizing SES-6 to offer DTH service within the U.S. and between the U.S. and the Netherlands is consistent with *DISCO II*.

Other EU Member States. Similarly, there are no *de jure* or *de facto* barriers in other EU member states to U.S. satellite operators wishing to provide capacity for DTH service. In addition to the Netherlands, the Commission has previously determined that the ECO-Sat test

[20] In support of its request to provide Direct Broadcast Satellite ("DBS") service to the U.S. using Netherlands-licensed satellites, Spectrum Five demonstrated that the "only Dutch regulation applicable to the provision of satellite services (including DBS) requires that a license be obtained from the Radiocommunications Agency Netherlands for the use of frequencies for a satellite earth station," and there are "no restrictions regarding the nationality of the applicant for a license." Petition for Declaratory Ruling of Spectrum Five LLC, File Nos.SAT-LOI-20050312-00062/00063, Narrative at 16. Given this undisputed showing, the International Bureau found no evidence "that suggests the existence of market entry barriers to the Netherlands." *Spectrum Five LLC*, Order and Authorization, DA 06-2439, 21 FCC Rcd 14023 (IB 2006) at ¶ 12; *applications for review denied*, FCC 08-64, 23 FCC Rcd 3252 (2008).

More recently, the Commission authorized the Netherlands-licensed SES-4 satellite to provide DTH service to, from, and within the U.S. *See New Skies Satellites, B.V.*, File No. SAT-PPL-20110620-00112, grant-stamped Mar. 15, 2012 ("*SES-4 Grant*").

[21] Commission Directive 2002/77/EC, 16 September 2002 on competition in the markets for electronic communications networks and services, OJ L249, Article 7(1) at 21.

is satisfied with respect to EU member the United Kingdom and its offshore territory Gibraltar[22] and has applied an analysis similar to the ECO-Sat test with respect to EU member Luxembourg.[23] Further individual analyses are not necessary, however, because pursuant to the EU directive described above, all EU member states are prohibited from imposing any regulations or restrictions on satellite capacity, including capacity for DTH services. In light of this directive, the Commission recently granted requests for DTH authority for all the EU member states for other SES spacecraft.[24] Accordingly, the ECO-Sat test is satisfied for every EU member state.[25]

Mexico. Mexico passes the ECO-Sat test. The U.S. and Mexico have entered into a bilateral agreement pursuant to which Mexico has agreed to permit U.S.-licensed satellites to provide FSS including DTH service to, from, and within Mexico provided that licensing and

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22 *See SES Americom, Inc.*, Call Sign S2676, Consent to Assignment, File No. SAT-ASG-20080609-00120 (grant-stamped Aug. 6, 2008) ("*AMC-21 Grant*"), Attachment at 3.

23 Specifically, the Commission considered competitive issues in connection with provision of DTH services by SES Americom using its U.S.-licensed satellites given the ultimate ownership of SES Americom by a Luxembourg entity. *See SES Americom, Inc.*, 18 FCC Rcd 16589 at ¶¶ 16-17 (IB 2003). In that context, the Commission considered whether "a foreign operator could provide services in the United States that a U.S.-owned operator could not provide because it could not obtain authorization to operate in the home market of the foreign operator." *Id*. at ¶ 16. The Commission concluded that "such concerns . . . have not been presented in this case," and that "no competitive concerns [were] presented by SES Global's indirect ownership in the Applicants as providers of DTH service in the United States." *Id*. at ¶ 17.

24 *SES-4 Grant*, Attachment at 1; *New Skies Satellites, B.V.*, File No. SAT-MPL-2012-0215-00017, grant-stamped May 25, 2012 ("*NSS-7 DTH Grant*"); *New Skies Satellites B.V.*, File No. SAT-MPL-20110923-00187, grant-stamped Jun. 28, 2012 ("*NSS-806 DTH Grant*").

25 The twenty-seven current member states of the EU are: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and the United Kingdom. *See* http://europa.eu/about-eu/member-countries/index_en.htm.

coordination conditions are met.[26] Accordingly, allowing SES-6 to provide DTH capacity in Mexico is consistent with *DISCO II*.[27]

Brazil, Netherlands Antilles, Guatemala, Honduras, Nicaragua and U.K. Territories in the Caribbean. The Satellite Division has previously found that the ECO-Sat test is satisfied for DTH with respect to Brazil[28] and with respect to the Netherlands Antilles, Guatemala, Honduras, Nicaragua, Bermuda, British Virgin Islands, and Cayman Islands route markets.[29]

In sum, U.S.-licensed operators have effective competitive opportunities to provide DTH transmission capacity in the Netherlands and other EU member states, Mexico, Brazil, the Netherlands Antilles, Guatemala, Honduras, Nicaragua, and the relevant Caribbean islands. Thus, the ECO-Sat test is satisfied for both the home and route markets for DTH service

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[26] *See* Protocol Concerning the Transmission and Reception of Signals from Satellites for the Provision of Direct-to-Home Satellite Television Services in the United States of America and the United Mexican States, November 8, 1996.

[27] *See DISCO II*, 12 FCC Rcd at 24157 (there is no need for an inquiry into effective competitive opportunities where a bilateral agreement is in place with respect to the relevant service). *See also EchoStar Satellite LLC*, 21 FCC Rcd 4077, 4080 (Sat. Div. 2006) at ¶ 8 & n.20 (in light of U.S.-Mexico bilateral agreement, "no further market access analysis is required" under *DISCO II* in order to authorize U.S.-licensed earth stations to communicate with satellite operating under Mexican authority for DTH services); *SES-4 Grant*, Attachment at 1.

[28] *See Hispamar Satelites, S.A.*, Call Sign S2622, File No. SAT-MOD-20040628-00124 (grant-stamped Aug. 26, 2004) ("Amazonas-1 Modification") (modifying the Permitted Space Station List entry for the Brazilian-licensed Amazonas-1 satellite to permit the provision of DTH service to, from, or within the U.S.); *Hispamar Satelites, S.A.*, Call Sign S2793, File Nos. SAT-PPL-20100506-00093 & SAT-APL-20101209-00257 (grant-stamped Dec. 21, 2010; grant reissued Jan. 7, 2011) (same with respect to Amazonas-2). *See also SES-4 Grant*, Attachment at 1.

[29] *See AMC-21 Grant*, Attachment at 3; *SES-4 Grant*, Attachment at 1; *NSS-7 DTH Grant*; *NSS-806 DTH Grant*.

by SES-6. Accordingly, SES respectfully requests that the Commission authorize the use of SES-6 for DTH services to, from, and within the U.S. and on the route markets addressed herein.

III. WAIVERS OF TECHNICAL RULES ARE WARRANTED FOR SES-6

SES seeks limited waivers of the Commission's rules in connection with the petition for SES-6 U.S. market access authority. Grant of these 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.[30]

SES-6 substantially complies with the Commission's rules, including the rules implementing two-degree spacing, but waivers are necessary to accommodate certain technical characteristics of the spacecraft. The Commission has granted similar waivers in other cases, including with respect to the NSS-806 satellite that SES-6 will be replacing at 40.5° W.L.[31] As shown below, SES-6 will allow SES to continue and expand its services at that orbital location, and grant of the requested waivers will therefore serve the public interest.

Section 25.202(g): Section 25.202(g) requires that TT&C operations be conducted at the edges of the allocated bands.[32] The Commission has explained that:

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

31 *See NSS-806 Order* at ¶¶ 13-16 & 22-23 (granting waivers of various Commission rules for U.S. earth stations communicating with NSS-806).

32 47 C.F.R. § 25.202(g).

> 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.[33]

As shown in the Technical Appendix, the majority of the TT&C frequencies for SES-6 are located on the band edges.[34] However, the frequency for beacon 1 is 3947.5 MHz, which is in the middle of the conventional C-band.[35]

SES requests a waiver to permit use of this single mid-band frequency in support of the SES-6 TT&C operations. Grant of a waiver will not undermine the objectives of the rule. SES-6 will be replacing NSS-806 at 40.5° W.L., which has both telemetry and beacon frequencies located in the middle of the C-band.[36] Maintaining one beacon in the middle of the band will simplify pointing and tracking for earth station operators that currently use NSS-806 and that will be transitioning to SES-6. Furthermore, the current use of center-band TT&C frequencies on NSS-806 is consistent with the coordination agreements that have been reached. Accordingly, permitting use of this individual frequency for SES-6 beacon operations will serve the public interest and will not adversely affect adjacent spacecraft.

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

34 *See* Attachment A, Section 7.

35 *Id.* The frequency for beacon 2 is 4500.1 MHz. *See id*. The 4500-4800 MHz band is subject to Section 2.108 of the Commission's rules and to footnote US245 to the Table of Allocations in Section 2.106. These provisions specify that use of the band is limited to international inter-continental service. 47 C.F.R. §§ 2.108 & 2.106 US245. To the extent that the Commission considers the beacon operation to be domestic rather than international, SES respectfully requests a waiver of these provisions. The beacon will be used only for antenna pointing and tracking purposes by earth stations that otherwise have been authorized to communicate in this band in compliance with the international-only restriction. Allowing this limited class of earth stations to receive a domestic beacon signal will therefore not undermine the purpose of the restriction.

36 *See* NSS-806 Modification, Technical Appendix at Section 6.

The Commission has previously granted NSS-806 a waiver of Section 25.202(g) for both mid-band telemetry and mid-band beacon frequencies.[37] In this instance, SES is seeking a more limited waiver for just a single mid-band beacon frequency to support existing customers transitioning from NSS-806. Telemetry frequencies have been moved to the edge of the service bands. Thus, a waiver of Section 25.202(g) is warranted for SES-6 and is consistent with Commission precedent.

<u>Sections 25.210(a)(1) and (3)</u>: Sections 25.210(a)(1) and (3) specify C-band polarization and polarization switching requirements.[38] SES-6, like NSS-806, uses circular polarization for its C-band communications payload.[39] Furthermore, a conventional C-band tracking beacon on SES-6 uses linear polarization, but the polarization planes are rotated 45 degrees relative to the equatorial plane. Finally, the SES-6 C-band polarization cannot be switched on ground command.

To a significant extent, these characteristics can be traced to the historic international origins and specific design of satellites such as NSS-806 that were originally part of the INTELSAT system. SES inherited this technical design with the transfer of the NSS-806 satellite from INTELSAT together with the associated customer traffic. Today, a very large installed base of customers accesses the NSS-806 satellite using circular polarization in the C-band. Using circular polarization on SES-6 will allow SES to maintain continuity of service to these customers and to minimize disruptions during the transition to SES-6.

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[37] *NSS-806 Order* at ¶ 22.

[38] 47 C.F.R. §§ 25.210(a)(1) and (3).

[39] *See* Attachment A, Section 3 and Schedule S, item S7.h.

The beacon with linear polarization at a 45 degree skew angle is designed to facilitate reception of the signal by a wide variety of terminals to allow them to lock on to the satellite. The SES-6 tracking beacon will be no more interfering than the circularly polarized telemetry beacon on NSS-806 at the same frequency, and will be operated consistent with the coordination agreements that have been reached.

Grant of waivers to accommodate these SES-6 satellite characteristics will not undermine the purposes of Sections 25.210(a)(1) and (3), which are to minimize interference potential between adjacent satellites and ensure full frequency reuse. Noting that NSS-806 has existing C-band circular polarized operations, the continued use of circular polarization for the SES-6 C-band communications payload at this orbital location will not affect adjacent satellites. Similarly, the impact on the interference environment of the 45 degree skewed SES-6 beacon is comparable to that of the existing NSS-806 circularly-polarized beacon on the same frequency, and the beacon will be operated consistent with the coordination agreements that have been reached. SES-6 achieves full reuse of the C-band frequencies through the use of dual circular polarization (right- and left-hand).[40] Under these circumstances, granting a waiver of Sections 25.210(a)(1) and (3) for SES-6 is consistent with Commission precedent.[41]

Section 25.210(i): Section 25.210(i) sets a minimum cross-polarization isolation performance in the primary coverage area of a satellite.[42] Certain beams of the SES-6 satellite do not meet this minimum. Specifically, among the communications beams, the minimum cross-

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[40] *See* Attachment A, Section 2.

[41] *See, e.g., NSS-806 Order* at ¶¶ 14 & 22; *see also USAsia Telecom, LLC,*15 FCC Rcd 16582 (Sat. Div. 2000) at ¶¶ 12-13 (authorizing communications with the JCSAT-3 satellite, which has C-band linear polarization rotated by 22 degrees relative to the equatorial plane).

[42] 47 C.F.R. § 25.210(i).

polarization isolation is 25.4 dB.[43] However, for the omnidirectional TT&C beams that are used during transfer orbit and on-station emergency situations, the minimum cross-polarization is 16 dB.[44]

The Commission has previously waived the requirements of Section 25.210(i) in a number of similar cases. For example, in granting a waiver for the NSS-7 spacecraft, the Commission agreed that the cross-polarization performance does not have a material impact on neighboring satellite systems.[45] Instead, the primary effect of any increased interference is on the satellite operator itself,[46] which can manage the interference internally. A similar finding is warranted here with respect to SES-6.

<u>Section 25.211(a)</u>: Section 25.211(a) specifies the center frequencies for C-band transponders used for analog video transmissions.[47] The C-band frequency plan for SES-6 does not conform to the specifications in this rule. However, SES has no plans to use the SES-6 spacecraft for C-band analog video transmissions. In the event that SES seeks in the future to commence providing analog video in the C-band, SES recognizes that such transmissions would have to be coordinated with adjacent satellites.

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43 *See* Schedule S, item S7.g.

44 *Id.*

45 *See New Skies Satellites N.V.*, 17 FCC Rcd 10369 (IB 2002) ("*NSS-7 Order*") at ¶ 19. The NSS-7 cross-polarization isolation characteristics were in the 25-30 dB range, with typical ratios better than 27 db. *Id*. *See also SES-4 Grant*, Attachment at 2 (waiving Section 25.210(i) for SES-4 based on a finding that shortfalls in the cross-polarization isolation performance "will not produce a significant increase in interference, except to the space station itself, and will not adversely affect any other operator.").

46 *See id.*

47 47 C.F.R. § 25.211(a).

Section 25.114(d)(3): SES requests any necessary waiver of Section 25.114(d)(3) of the Commission's rules, which prescribes the level of detail required for the space station antenna gain contours.[48] For certain SES-6 TT&C beams, some of the contours specified in the rule do not intersect with the earth's surface.[49] As a result, these contours would not supply any information relevant to the Commission or interested third parties and therefore have not been provided.[50]

Sections 25.114(d)(14)(ii) and 25.283(c): These rules address requirements relating to venting stored energy sources at the spacecraft's end of life.[51] SES-6 is an EADS Astrium Eurostar E3000 model spacecraft. As described in more detail in the attached Technical Appendix, the helium tank on the spacecraft will be sealed following completion of the launch phase and will therefore retain residual pressure at end of life. Given the spacecraft design, it will be impossible for SES to vent the helium tank in order to comply with Section 25.283(c).

Section 25.283(c) does not appear to apply, however, to foreign-licensed spacecraft such as SES-6. By its terms, the rule governs only "space station licensee[s]," *i.e.*, operators of spacecraft licensed by the Commission, rather than spacecraft licensed by other Administrations that are seeking U.S. market access.

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48 47 C.F.R. § 25.114(d)(3).

49 *See* Attachment A, Annex B, Figures 26-35.

50 The Commission has granted similar waivers in the past, finding that maps identifying only those contours that intersect with the earth's surface satisfy the requirements of Section 25.114(d)(3). *See, e.g., NSS-7 DTH Grant,* Attachment to Grant at 3, ¶ 6.

51 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).

When it adopted its orbital debris mitigation policies, the Commission ruled that a request for market access by a foreign-licensed satellite operator must include information describing the applicant's orbital debris mitigation plans[52] or evidence that the foreign licensing jurisdiction exercises "direct and effective regulatory oversight"[53] of the operator's debris mitigation measures. However, the Commission expressly disclaimed any intent to engage in a "'unilateral' or 'extraterritorial' imposition of Commission rules" on non-U.S.-licensed spacecraft.[54] Consistent with that commitment, SES respectfully requests that the Commission confirm that the venting requirements of Section 25.283(c) do not extend to foreign-licensed satellites.

Nevertheless, out of an abundance of caution, SES requests a waiver of Section 25.283(c), to the extent one is necessary. 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.[55] For example, the Commission granted a waiver of Section 25.283(c) to Hispamar for

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52 *Mitigation of Orbital Debris,* Second Report and Order, FCC 04-130, 19 FCC Rcd 11567 (2004) ("*Second Orbital Debris Order*") at ¶¶ 93-94.

53 *Id.* at ¶ 95.

54 *Id.*at ¶ 96 (footnote omitted).

55 *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,

its Amazonas-2 satellite, which like SES-6 is a Eurostar E3000 model spacecraft.[56] The waiver was based on the Commission's determination that "undue hardship would result from requiring modification of the space station at this time."[57]

The same rationale applies here. Construction of SES-6 began more than two years ago and is well under way. Requiring a change in the spacecraft design at this late stage would impose a significant hardship on SES. As a result, if Section 25.283(c) applies here, a waiver is clearly warranted.

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grant-stamped Oct. 4, 2007, Attachment at ¶ 7 (same for Intelsat 11, an Orbital Sciences Star model spacecraft).

[56] *See Hispamar Satélites, S.A,* File Nos. SAT-PPL-20100506-00093 & SAT-APL-20101209-00257, Call Sign S2793, grant-stamped Dec. 21, 2010, Attachment at ¶ 1 (granting waiver of Section 25.283(c) in connection with residual helium that will be present on Amazonas-2 at its end of life).

[57] *Id. See also Telesat Canada,* File Nos. SAT-PPL-20110630-00123 & SAT-APL-20111117-00222, Call Sign S2703, grant-stamped Apr. 11, 2012, Attachment at ¶ 3 (granting partial waiver of Section 25.283(c) for Anik F3, another EADS Astrium E3000 series satellite unable to vent residual helium at end of life).

IV. CONCLUSION

For the foregoing reasons, SES respectfully requests that the Commission:

(a) add SES-6 to the Permitted List for FSS operations in the conventional C- and Ku-bands,

(b) permit use of the SES-6 extended C- and Ku-band capacity and Appendix 30B bands, consistent with Commission rules and subject to earth station-specific licensing, and

(c) authorize use of SES-6 for DTH service within the United States and between the U.S. and the other markets identified herein

Respectfully submitted,

NEW SKIES SATELLITES B.V.

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Attachment A

Technical Information to Supplement Schedule S

1 SCOPE

New Skies Satellites B.V. (doing business as "SES") hereby requests U.S. market access for the SES-6 spacecraft to be located at 40.5° W.L. This Attachment contains information required by §25.114(d) and other sections of the FCC Part 25 rules that cannot be entered into the Schedule S submission.

2 GENERAL DESCRIPTION

SES-6 is a hybrid C- and Ku-band satellite that will operate at the 40.5° W.L. orbital location, where it will replace and augment the services currently being provided by the NSS-806 spacecraft. SES-6 is capable of using the following frequency bands:

- 3625-4200 MHz (conventional and extended C-band)
- 4500-4800 MHz (Appendix 30B C-band)
- 5850-6425 MHz (conventional and extended C-band)
- 6725-7025 MHz (Appendix 30B C-band)
- 10.95-11.2 GHz and 11.45-11.7 GHz (extended Ku-band)
- 11.2-11.45 GHz (Appendix 30B Ku-band)
- 11.7-12.2 GHz (conventional Ku-band)
- 13.75-14.0 GHz (extended Ku-band)
- 14.0-14.5 GHz (conventional Ku-band)

The satellite has a single C-band beam (in both circular polarizations), which covers North, Central and South America, plus the Caribbean and Western Europe. The Ku-band payload has four beams covering the Americas plus a West Atlantic ("ATW") beam and an East Atlantic ("ATE") beam. The countries served by each of the four Americas beams are given below:

- North America ("NA"): U.S., Canada, Mexico, Central America and the Caribbean;

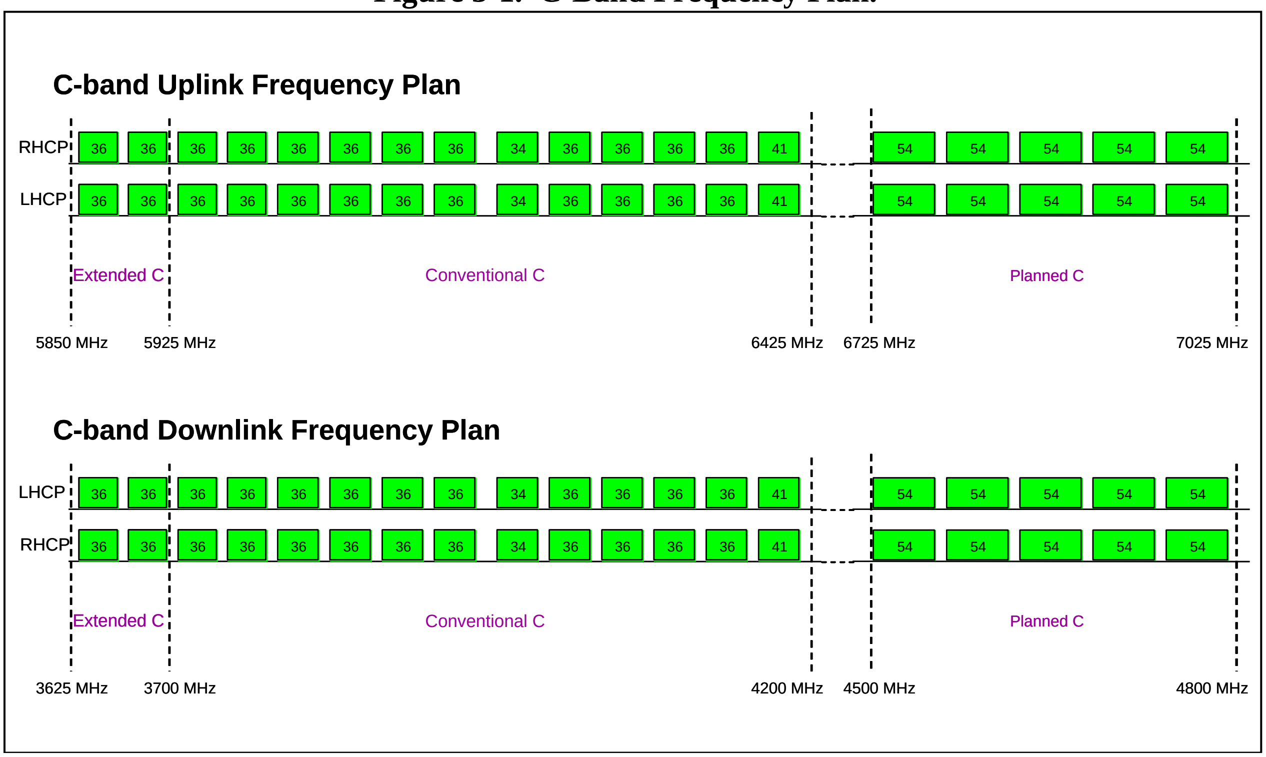
- Brazil (“BR”): Brazil, Guyana, French Guiana and Suriname;
- Andes (“AN”): Venezuela, Colombia, Ecuador, Peru, Bolivia and Central America;
- Southern Cone (“SC”): Argentina, Chile, Paraguay, Uruguay and the southern parts of Brazil and Peru.

All frequency bands are re-used at least twice, which satisfies the requirements of §25.210(d) of the Rules. The 11.2-11.45 GHz (Appendix 30B Ku-band beam) is on the East Atlantic beam only, which does not have coverage of United States territory.

3 FREQUENCY PLAN

Figure 3-1 shows the frequency plan of the satellite’s C-band payload. All C-band transponders use circular polarization.

Figure 3-1. C-Band Frequency Plan.



Figures 3-2 and 3-3 show the Ku-band uplink and downlink frequency plans, respectively. All Ku-band transponders use linear polarization.

Figure 3-2. Ku-Band Uplink Frequency Plan.

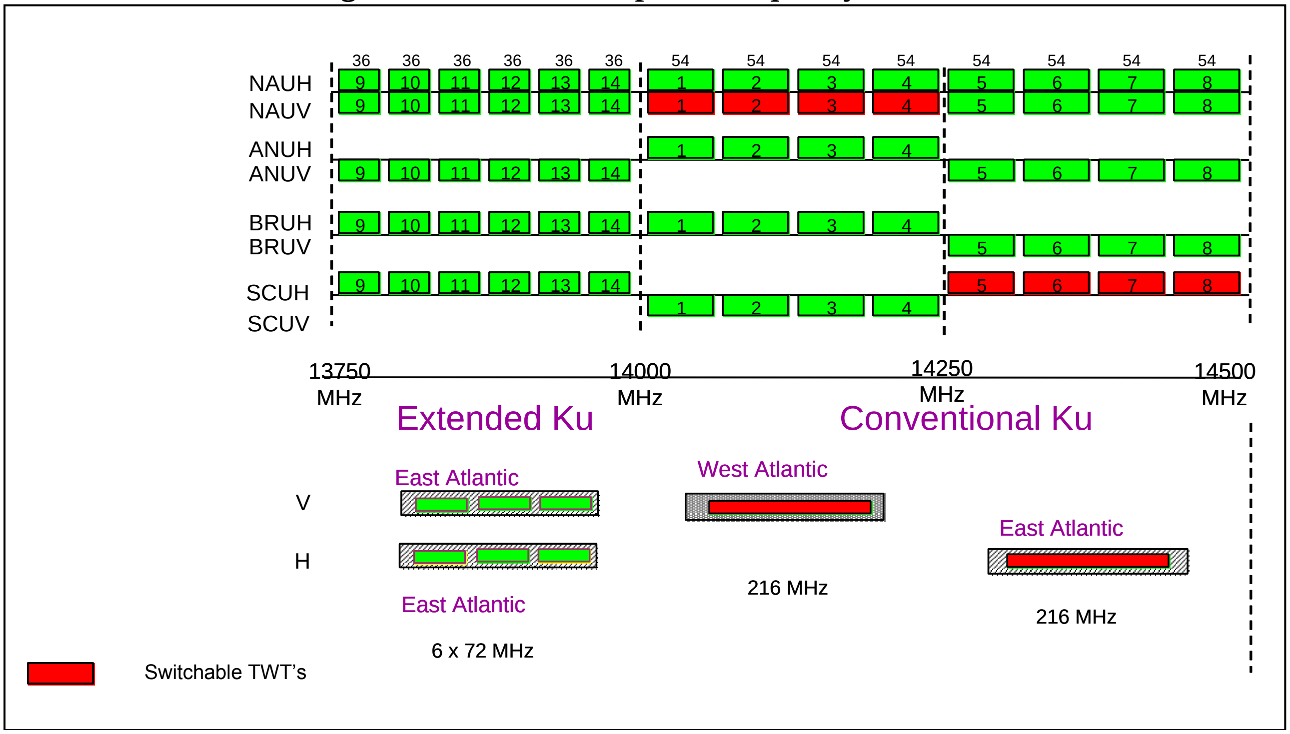
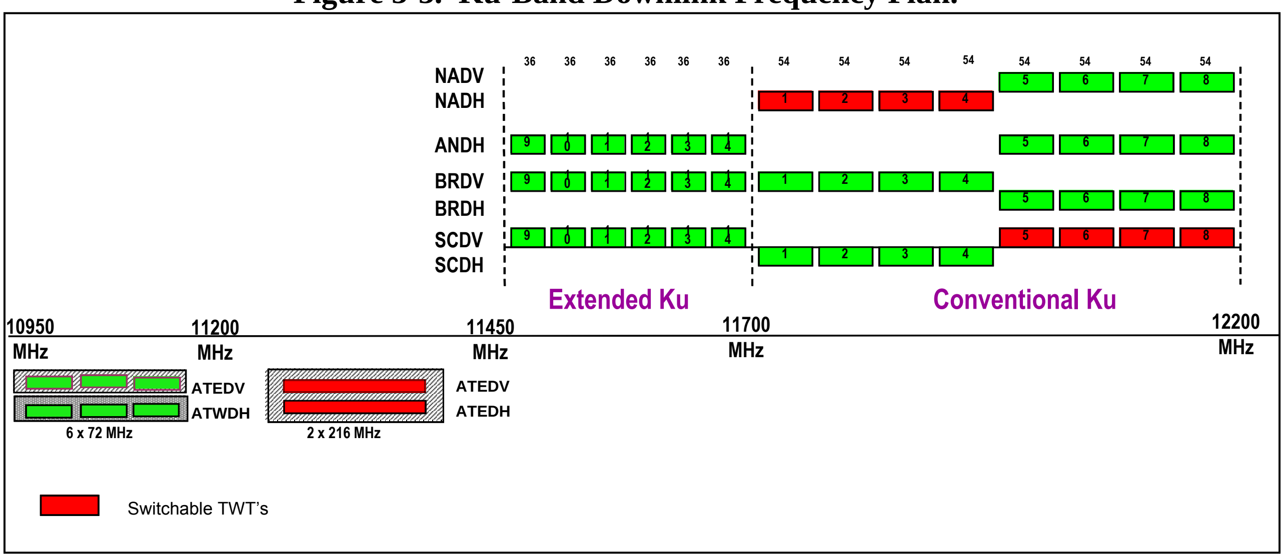


Figure 3-3. Ku-Band Downlink Frequency Plan.



The Ku-band beam connectivity is quite complex. The beam inter-connectivity options are shown in Tables 3-1 and 3-2. Note that when certain Atlantic beam channels are in use, certain channels of the Americas beams cannot be used due to switchable (common) TWT's.

Table 3-1. Connectivity of the North and South American beams.

UPLINK									DOWNLINK								XPDR	
BEAM								Center Freq. (MHz)	BEAM							Center Freq. (MHz)	ID	BW (MHz)
NAUV	NAUH	ANUV	ANUH	BRUV	BRUH	SCUV	SCUH		NADV	NADH	ANDH	BRDV	BRDH	SCDV	SCDH			
X			X		X	X		14040		X						11750	1	54
X			X		X	X		14100		X						11810	2	54
X			X		X	X		14160		X						11870	3	54
X			X		X	X		14220		X						11930	4	54
	X	X		X			X	14280	X							11990	5	54
	X	X		X			X	14340	X							12050	6	54
	X	X		X			X	14400	X							12110	7	54
	X	X		X			X	14460	X							12170	8	54
X	X		X		X	X		14040				X				11750	9	54
X	X		X		X	X		14100				X				11810	10	54
X	X		X		X	X		14160				X				11870	11	54
X	X		X		X	X		14220				X				11930	12	54
X	X	X		X			X	14280			X		X			11990	13	54
X	X	X		X			X	14340			X		X			12050	14	54
X	X	X		X			X	14400			X		X			12110	15	54
X	X	X		X			X	14460			X		X			12170	16	54
X	X		X		X	X		14040							X	11750	17	54
X	X		X		X	X		14100							X	11810	18	54
X	X		X		X	X		14160							X	11870	19	54
X	X		X		X	X		14220							X	11930	20	54
X	X	X		X			X	14280						X		11990	21	54
X	X	X		X			X	14340						X		12050	22	54
X	X	X		X			X	14400						X		12110	23	54
X	X	X		X			X	14460						X		12170	24	54
X		X			X		X	13770			X					11480	25	36
X		X			X		X	13810			X					11520	26	36
X		X			X		X	13850			X					11560	27	36
X		X			X		X	13890			X					11600	28	36
X		X			X		X	13930			X					11640	29	36
X		X			X		X	13970			X					11680	30	36
	X	X			X		X	13770				X		X		11480	31	36
	X	X			X		X	13810				X		X		11520	32	36
	X	X			X		X	13850				X		X		11560	33	36
	X	X			X		X	13890				X		X		11600	34	36
	X	X			X		X	13930				X		X		11640	35	36
	X	X			X		X	13970				X		X		11680	36	36

Table 3-2. Connectivity of the Atlantic beams.

Uplink				Downlink				BW (MHz)
Beam			Center Frequency (MHz)	Beam			Center Frequency (MHz)	
ATEUV	ATEUH	ATWUV		ATEDV	ATEDH	ATWDH		
X			13795			X	10995	72
X			13875			X	11075	72
X			13955			X	11155	72
	X		14375	X			11325	216
	X		13795	X			10995	72
	X		13875	X			11075	72
	X		13955	X			11155	72
		X	14125		X		11325	216

4 MAXIMUM THEORETICAL OPERATION LEVELS

SES-6 will be operated consistently with coordination agreements with adjacent satellites. In any case, in the Ku band frequencies, the downlink EIRP density of the SES-6 digital carriers will not exceed -20 dBW/Hz; and the input power density of the uplink digital carriers of earth stations operating with SES-6 will not exceed -47 dBW/Hz. In the C band frequencies, the downlink EIRP density of the SES-6 digital carriers will not exceed -30 dBW/Hz; and the input power density of the uplink digital carriers of earth stations operating with SES-6 will not exceed -38.7 dBW/Hz.

5 PREDICTED SPACE STATION ANTENNA GAIN CONTOURS

The SES-6 satellite's antenna gain contours for all receive and transmit beams, as required by §25.114(d)(3), are provided in GXT format. Because the Schedule S software would not accept the uploading of all the GXT files into the Schedule S form, all GXT files are being provided to the Commission as a separate data package. The antenna gain contour diagrams are also shown in Annex B.

6 SERVICES TO BE PROVIDED

The SES-6 satellite will provide a variety of FSS and DTH services including a range of narrow- and wide-band digital services. Representative link budgets, which include details of the transmission characteristics, performance objectives and earth station characteristics, are provided in the associated Schedule S submission.

7 ARRANGEMENT FOR TT&C

The information provided in this section complements that provided in the associated Schedule S submission.

The TT&C sub-system provides for communications during pre-launch, transfer orbit and on-station operations, as well as during spacecraft emergencies. During transfer orbit and on-station emergencies the TT&C signals will be received and transmitted by the satellite using dual wide-angle antennas on the satellite that create a near omni-directional gain pattern around the satellite. During normal on-station operations, all TT&C transmissions, including the C-band beacons, use global beams. The TT&C earth station locations have not yet been finalized, but it is currently expected that the TT&C earth stations will be located in Manassas, VA, Betzdorf, Luxembourg, and /or Gerrards Cross, United Kingdom. Tables 7-1 and 7-2 show the salient details of the TT&C for on-station and emergency operations, respectively.

Table 7-1. TT&C on-station frequencies, polarizations and beams

Carrier Type	Frequency (MHz)	Polarization Type	Beam
Command 1	14000	V	Global horn
Command 2	14499	H	Global horn
Telemetry 1	11701	H or V	Global horn
Telemetry 2	11700.5	H or V	Global horn
Telemetry 3	12199.5	H	Global horn
Beacon 1	3947.5	Linear (45°)	Global horn
Beacon 2	4500.1	Linear (135°)	Global horn

Table 7-2. TT&C transfer and emergency frequencies, polarizations and beams

Carrier Type	Frequency (MHz)	Polarization Type	Beam
Command 1	14000	L or R	Dual Omni's
Command 2	14499	L or R	Dual Omni's
Telemetry 1	11701	L or R	Dual Omni's
Telemetry 2	11700.5	L or R	Dual Omni's
Telemetry 3	12199.5	L or R	Dual Omni's

8 SATELLITE TRANSPONDER FREQUENCY RESPONSES

The transponder frequency responses specified over the various channel bandwidths are shown in Tables 8-1 through 8-8. In addition, the frequency tolerances of §25.202(e) and the out-of-band emission limits of §25.202(f)(1), (2) and (3) will be met.

Table 8-1. C-Band Transponder Frequency Response

Channel Bandwidth	Frequency Offset (MHz)	dB p-p
34 MHz	±9.5	0.6
	±11.5	0.9
	±15	1.35
	±17	2.55

Table 8-2. C-Band Transponder Frequency Response

Channel Bandwidth	Frequency Offset (MHz)	dB p-p
36 MHz	±10	0.6
	±12	0.9
	±16	1.4
	±18	2.85

Table 8-3. C-Band Transponder Frequency Response

Channel Bandwidth	Frequency Offset (MHz)	dB p-p
41 MHz	±11	0.6
	±14	0.9
	±18	1.4
	±20	2.55

Table 8-4. C-Band Transponder Frequency Response

Channel Bandwidth	Frequency Offset (MHz)	dB p-p
54 MHz	±15	0.6
	±18.9	0.9
	±21.6	1.1
	±24.3	1.45
	±27	2.5

Table 8-5. Ku-Band Transponder Frequency Response

Channel Bandwidth	Frequency Offset (MHz)	dB p-p
36 MHz	±8	0.65
	±10	1.0
	±12	1.1
	±16	2.65
	±18	5.65

Table 8-6. Ku-Band Transponder Frequency Response

Channel Bandwidth	Frequency Offset (MHz)	dB p-p
54 MHz	±12	0.65
	±15	1.0
	±18	1.05
	±24	2.25
	±27	4.65

Table 8-7. Ku-Band Transponder Frequency Response

Channel Bandwidth	Frequency Offset (MHz)	dB p-p
72 MHz	±20	0.7
	±24	1.05
	±32	2.1
	±36	4.55

Table 8-8. Ku-Band Transponder Frequency Response

Channel Bandwidth	Frequency Offset (MHz)	dB p-p
216 MHz	±60	0.7
	±72	1.0
	±96	1.85
	±108	4.35

9 INTERFERENCE AND PFD ANALYSES

The interference and PFD analyses are contained in Annex A of this Attachment.

10 ORBITAL DEBRIS MITIGATION PLAN

10.1 Spacecraft Hardware Design

SES has assessed and limited the amount of debris released in a planned manner during normal operations of SES-6. During the satellite ascent, after separation from the launcher, no debris will be generated. As with all recent SES satellite launches, all deployments will be conducted using pyrotechnic devices designed to retain all physical debris. No debris is generated during normal on-station operations, and the spacecraft will be in a stable configuration.

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 design of SES's recent spacecraft 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 the following steps to limit the effects of such collisions: (1) critical spacecraft components are located inside the protective body of the spacecraft and properly shielded; and (2) all spacecraft subsystems have redundant components to ensure no single-point failures. The spacecraft will not use any subsystems for end-of-life disposal that are not used for normal operations.

10.2 Minimizing Accidental Explosions

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 SES-6 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, will be monitored by telemetry.

At the end of operational life, after the satellite has reached its final disposal orbit, all on-board sources of stored energy will be depleted or secured, excess propellant remaining in the chemical propulsion tanks will be vented, and the batteries will be discharged. However, at the end of SES-6's operational life, there will be helium remaining in the tank that cannot be vented. This is a design feature of the fuel system on the Astrium Eurostar E3000 series spacecraft. The helium tank will be isolated from the fuel system after transfer orbit. The helium tank is well shielded, and the residual pressure in the tank will be well below its maximum rating.

The predicted level of residual helium that will remain in the tank at end of life is as follows:

Tank	Volume [l]	Pressure [bar]	Temp. [deg C]	Helium mass [kg]
Helium Tank	182.79	41	10	1.25

10.3 Safe Flight Profiles

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 station-keeping 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.

SES-6 will be positioned at 40.5° W.L., where it will replace the NSS-806 spacecraft. In considering current and planned satellites that may have a station-keeping volume that overlaps the SES-6 satellite, SES has reviewed the FCC databases for FCC licensed satellite networks and those that are currently under consideration by the FCC. In addition, networks for which a request for coordination has been published by the ITU within ±0.15 degrees of 40.5° W.L. have also been reviewed. Only those networks that either operate, or are planned to operate, and have an overlapping station-keeping volume with the SES-6 satellite, have been taken into account in the analysis.

Based on these reviews, the only satellite operating nominally at 40.5° W.L. is NSS 806, which is also controlled and operated by SES. There are no pending applications before the Commission requesting authorization to use an orbital location within ±0.15° of 40.5° W.L., and within this sub-arc, there are no ITU networks other than those at 40.5° W.L., all of which were submitted on behalf of SES.

Based on the preceding, it is concluded that physical coordination of the SES-6 satellite with another party is not required at the present time.

On-station operations require station-keeping 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-6 will be temporarily collocated with NSS 806 as traffic is transferred to SES-6. After traffic transfer is complete, the NSS 806 satellite will be relocated to another orbital location such that there will be no station-keeping volume overlap with SES-6. During the period of collocation, SES will use the proven inclination-eccentricity technique to ensure adequate separation between the satellites. This strategy is presently in use by SES at several orbital locations to ensure proper operation and safety of multiple satellites within one orbital box.

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.

10.4 Post Mission Disposal Plan

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 SES-6 to a disposal orbit with a minimum perigee of 259.8 km above the normal GSO operational orbit. This proposed disposal orbit altitude results from application of the IADC formula based on the following calculation:

Total Solar Pressure Area “A” = 59.1 m^2

“M” = Dry Mass of Satellite = 2767 kg

“C_R” = Solar Pressure Radiation Coefficient = 1.16

Therefore the Minimum Disposal Orbit Perigee Altitude:

= 36,021 km + 1000 x C_R x A/m

= 36,021 km + 1000 x 1.16 x 59.1/2767

= 36,045.8 km

= 259.8 km above GSO (35,786 km)

SES intends to reserve 15 kg of propellant in order to account for post-mission disposal of SES-6. SES has assessed fuel-gauging uncertainty and has provided an adequate margin of fuel reserve to address the assessed uncertainty.

11 SPACECRAFT CHARACTERISTICS

The spacecraft’s physical characteristics are embedded in the associated Schedule S form.

The SES-6 satellite was designed for a 15 year lifetime. The probability of the entire satellite successfully operating throughout this period is 0.72; the probabilities of successful operation of the payload and bus are 0.85 and 0.84, respectively. These numbers are based on predicted failure rates of all critical components in the satellite bus and payload.

CERTIFICATION OF PERSON RESPONSIBLE FOR PREPARING ENGINEERING INFORMATION

I hereby certify that I am the technically qualified person responsible for preparation of the engineering information contained in this application, that I am familiar with Part 25 of the Commission's rules, that I have either prepared or reviewed the engineering information submitted in this application and that it is complete and accurate to the best of my knowledge and belief.

/s/

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ANNEX A

INTERFERENCE AND PFD ANALYSES

1.0 Interference Analyses

This section demonstrates that the SES-6 satellite is two degree compatible in the C-band (both unplanned FSS bands and the planned FSS Appendix 30B bands), extended Ku-band (both unplanned FSS bands and the planned FSS Appendix 30B downlink band) and the conventional Ku-band.

Currently there are no operational C-or Ku-band satellites within two degrees of the 40.5° W.L. location, nor are there any pending applications before the Commission requesting to use the bands used by the SES-6 satellite at a location two degrees or less from 40.5° W.L. In order to demonstrate two-degree compatibility, the transmission parameters of the SES-6 satellite have been assumed as both the wanted and interfering transmissions.

The following interference calculation assumptions are applicable to all subsequent sub-sections:

1) The interference calculations assume a 1 dB advantage for topocentric-to-geocentric conversion, all wanted and interfering carriers are co-polarized and all earth station antennas conform to a sidelobe pattern of 29-25 log(θ). The C/I calculations were performed on a per Hz basis.

2) The results of the C/I interference calculations for the various frequency bands are shown in the subsequent sub-sections. The results are provided in a format similar to that of the output of the Sharp Adjacent Satellite Interference Analysis program.

1.1 C-Band (Unplanned FSS Bands)

Table 1 provides a summary of the C-band transmission parameters derived from the SES-6 link budgets embedded in the Schedule S form, which were used in the interference analysis.

Table 2 shows the results of the interference calculations in terms of the overall C/I margins. It can be seen that the majority of the C/I margins are positive, although there are a few negative margins. The worst case negative C/I margin is 0.7 dB which is considered acceptable.

Table 1. SES-6 Typical C-band Transmission Parameters

Carrier ID	Emission Designator	Bandwidth (MHz)	Tx E/S Gain (dBi)	Uplink EIRP (dBW)	Downlink EIRP (dBW)	Rx E/S Gain (dBi)	C/I Criterion (dB)
1	48K6G7W	0.0486	47.4	50.5	13.9	38.1	17.9
2	1M34G7W	1.34	47.4	61.5	24.9	43.6	17.9
3	6M33G7W	6.33	47.4	68.0	31.4	43.6	18.0
4	27M0G7W	27	53.5	70.7	40.4	40.6	16.1
5	36M0G7W	36	50.1	83.9	40.4	41.9	17.9
6	36M0G7W	36	50.1	74.7	40.4	43.6	18.7

Table 2. Summary of the overall link C/I margins (dB)

		Interfering Carriers					
	Carrier ID	1	2	3	4	5	6
Wanted Carriers	1	-0.7	2.7	2.9	0.7	0.8	1.8
	2	0.3	3.7	4.0	2.6	0.8	3.4
	3	0.0	3.4	3.6	2.3	0.4	3.1
	4	0.4	3.8	4.0	3.8	0.0	4.2
	5	1.1	4.5	4.7	2.3	2.9	3.4
	6	-0.1	3.3	3.6	3.0	-0.1	3.5

1.2 C-Band (Appendix 30B Bands)

Table 3 provides a summary of the Appendix 30B C-band transmission parameters derived from the SES-6 link budgets embedded in the Schedule S form, which were used in the interference analysis.

Table 4 shows the results of the interference calculations in terms of the overall C/I margins. The majority of the C/I margins are positive, although there are a few negative margins. The worst case negative C/I margin is 0.5 dB, which is considered acceptable.

Table 3. SES-6 Typical Appendix 30B C-band Transmission Parameters

Carrier ID	Emission Designator	Bandwidth (MHz)	Tx E/S Gain (dBi)	Uplink EIRP (dBW)	Downlink EIRP (dBW)	Rx E/S Gain (dBi)	C/I Criterion (dB)
1	48K6G7W	0.0486	48.4	50.5	13.9	39.5	17.9
2	1M34G7W	1.34	48.4	59.9	23.3	45.0	17.9
3	6M33G7W	6.33	48.4	65.6	29.0	47.6	18.0
4	27M0G7W	27	54.4	71.0	34.4	45.0	16.1
5	36M0G7W	36	51.0	84.9	40.4	43.3	17.9
6	54M0G7W	54	51.0	85.0	40.4	45.0	18.7

Table 4. Summary of the overall link C/I margins (dB)

		Interfering Carriers					
	Carrier ID	1	2	3	4	5	6
Wanted Carriers	1	0.6	5.7	6.7	8.0	1.8	3.5
	2	0.0	5.0	6.0	8.1	-0.2	1.5
	3	0.5	5.5	6.5	9.2	-0.5	1.2
	4	-0.2	4.9	5.9	8.0	-0.4	1.3
	5	2.5	7.6	8.6	9.6	4.3	6.0
	6	1.6	6.6	7.6	8.8	3.1	4.9

1.3 Conventional Ku-Band

Table 5 provides a summary of the conventional Ku-band transmission parameters derived from the SES-6 link budgets embedded in the Schedule S form, which were used in the interference analysis.

Table 6 shows the results of the interference calculations in terms of C/I margins. All C/I margins are positive.

Note that certain carriers listed in Table 5 uplink in the conventional Ku-band, but downlink in the Appendix 30B Ku-band. The downlink transmissions of these carriers have not been taken into account because they cannot contribute interference into transmissions of carriers that downlink in the conventional Ku-band.

Table 5. SES-6 Typical Conventional Ku-band Transmission Parameters

Carrier ID	Emission Designator	Bandwidth (MHz)	Tx E/S Gain (dBi)	Uplink EIRP (dBW)	Downlink EIRP (dBW)	Rx E/S Gain (dBi)	C/I Criterion (dB)
1	48K6G7W	0.0486	43.2	40.2	21.6	41.7	17.9
2	1M34G7W	1.34	46.7	58.0	32.4	47.7	17.9
3	6M33G7W	6.33	49.2	67.1	39.5	45.2	18.0
4	27M0G7W	27	53.0	71.1	43.5	47.7	16.1
5	36M0G7W	36	57.3	81.8	49.5	41.7	17.9
6	54M0G7W	54	57.3	84.6	49.5	47.7	18.7
7	32M4G7W	32.4	37.1	52.4			1.4
8	32M4G7W	32.4	37.3	52.4			1.4
9	1M34G7W	1.34	57.4	65.0			17.9
10	6M33G7W	6.33	54.8	68.6			18.0
11	36M0G7W	36	54.8	73.3			17.9
12	72M0G7W	72	54.8	76.3			18.7
13	72M0G7W	72	57.4	84.8			18.7

Table 6. Summary of the overall link C/I margins (dB).

		Interfering Carriers												
	Carrier ID	1	2	3	4	5	6	7	8	9	10	11	12	13
Wanted Carriers	1	1.0	2.9	2.8	6.9	2.0	2.5	14.8	15.0	8.7	9.2	12.0	12.0	6.2
	2	3.8	5.8	5.8	9.6	4.8	5.4	18.2	18.4	12.1	12.6	15.4	15.4	9.6
	3	2.7	5.5	5.3	8.4	3.6	4.8	20.5	20.6	14.3	14.8	17.7	17.7	11.8
	4	4.3	6.7	6.6	10.0	5.2	6.1	20.1	20.2	13.9	14.4	17.3	17.3	11.4
	5	2.4	5.9	5.6	8.0	3.2	4.9	27.7	27.9	21.6	22.1	24.9	24.9	19.1
	6	5.7	9.1	8.8	11.4	6.6	8.1	28.0	28.1	21.8	22.3	25.2	25.2	19.3
	7	5.3	5.5	5.6	11.7	6.6	5.5	15.3	15.4	9.1	9.6	12.5	12.5	6.6
	8	5.3	5.5	5.6	11.7	6.6	5.5	15.3	15.4	9.1	9.6	12.5	12.5	6.6
	9	15.3	15.4	15.5	21.6	16.5	15.5	25.2	25.4	19.1	19.6	22.4	22.4	16.6
	10	12.0	12.2	12.3	18.4	13.2	12.2	22.0	22.1	15.8	16.3	19.2	19.2	13.3
	11	9.3	9.4	9.5	15.6	10.5	9.5	19.2	19.4	13.1	13.6	16.4	16.4	10.6
	12	8.5	8.6	8.7	14.8	9.7	8.6	18.4	18.6	12.3	12.8	15.6	15.6	9.8
	13	17.0	17.1	17.2	23.3	18.2	17.1	26.9	27.1	20.8	21.3	24.1	24.1	18.3

1.4 Extended Ku-Band (Unplanned FSS Bands)

Table 7 provides a summary of the extended Ku-band transmission parameters derived from the SES-6 link budgets embedded in the Schedule S form, which were used in the interference analysis.

Table 8 shows the results of the interference calculations in terms of the overall C/I margins. There are no negative C/I margins.

Table 7. SES-6 Typical Extended Ku-band Transmission Parameters

Carrier ID	Emission Designator	Bandwidth (MHz)	Tx E/S Gain (dBi)	Uplink EIRP (dBW)	Downlink EIRP (dBW)	Rx E/S Gain (dBi)	C/I Criterion (dB)
1	48K6G7W	0.0486	54.5	51.1	23.5	41.4	17.9
2	1M34G7W	1.34	54.5	59.7	33.1	47.5	17.9
3	6M33G7W	6.33	54.5	67.1	40.5	45.9	18.0
4	27M0G7W	27	54.5	72.0	48.3	41.4	16.1
5	36M0G7W	36	57.1	76.8	49.5	43.4	17.9
6	1M34G7W	1.34	54.5	67.3	36.1	41.0	17.9
7	6M33G7W	6.33	54.5	67.6	35.0	50.8	18.0
8	36M0G7W	36	54.5	72.1	41.5	50.8	17.9
9	72M0G7W	72	54.5	78.8	47.5	49.0	18.7
10	32M4G7W	32.4	57.1	75.5	42.4	35.0	5.3
11	32M4G7W	32.4	57.1	74.1	42.7	35.0	5.3

Table 8. Summary of the overall link C/I margins (dB)

		Interfering Carriers										
	Carrier ID	1	2	3	4	5	6	7	8	9	10	11
Wanted Carriers	1	2.9	7.7	7.1	5.6	5.7	4.4	12.1	13.4	10.3	12.0	11.9
	2	3.3	8.3	7.7	6.5	6.5	4.1	11.4	13.2	10.0	11.9	12.1
	3	2.6	7.5	6.9	5.6	5.6	3.6	11.0	12.7	9.5	11.3	11.4
	4	1.8	6.7	6.0	4.7	4.7	2.9	10.5	12.0	8.9	10.6	10.6
	5	2.0	6.9	6.2	4.9	4.9	3.3	11.0	12.4	9.3	11.0	10.9
	6	0.9	5.7	5.0	3.6	3.6	2.5	10.4	11.5	8.5	10.1	9.9
	7	2.2	7.1	6.4	5.1	5.1	3.3	10.8	12.4	9.2	11.0	11.1
	8	0.9	5.9	5.3	4.1	4.0	1.8	9.2	10.9	7.7	9.6	9.8
	9	1.7	6.6	5.9	4.6	4.6	2.9	10.4	11.9	8.8	10.5	10.6
	10	0.0	4.8	4.2	2.7	2.7	1.7	9.6	10.7	7.7	9.3	9.0
	11	0.2	5.0	4.4	2.9	2.9	1.9	9.8	10.9	7.9	9.5	9.3

1.5 Extended Ku-Band (Appendix 30B Downlink Band)

As previously noted, the Appendix 30B Ku-band frequencies are on the East Atlantic beam only, which has no coverage of United States territory. Table 9 provides a summary of the transmission parameters of the carriers that downlink in the Appendix 30B Ku-band. These parameters were derived from the SES-6 link budgets embedded in the Schedule S form and were used in the interference analysis. Note that for the carriers that downlink in the Appendix 30B band, the associated uplinks use the conventional Ku-band.

Table 10 shows the results of the interference calculations in terms of C/I margins. All C/I margins are positive.

Note that certain carriers listed in Table 9 uplink and downlink in the conventional Ku-band. The downlink transmissions of these carriers have not been taken into account because they cannot contribute interference into transmissions of carriers that downlink in the Appendix 30B band.

Table 9. SES-6 Typical Appendix 30B Ku-band Downlink (plus uplink conventional Ku-band) Transmission Parameters

Carrier ID	Emission Designator	Bandwidth (MHz)	Tx E/S Gain (dBi)	Uplink EIRP (dBW)	Downlink EIRP (dBW)	Rx E/S Gain (dBi)	C/I Criterion (dB)
1	48K6G7W	0.0486	43.2	40.2			17.9
2	1M34G7W	1.34	46.7	58.0			17.9
3	6M33G7W	6.33	49.2	67.1			18.0
4	27M0G7W	27	53.0	71.1			16.1
5	36M0G7W	36	57.3	81.8			17.9
6	54M0G7W	54	57.3	84.6			18.7
7	32M4G7W	32.4	37.1	52.4	27.7	55.3	1.4
8	32M4G7W	32.4	37.3	52.6	27.9	55.3	1.4
9	1M34G7W	1.34	57.4	65.0	24.5	52.7	17.9
10	6M33G7W	6.33	54.8	68.6	31.2	52.7	18.0
11	36M0G7W	36	54.8	73.3	37.9	52.7	17.9
12	72M0G7W	72	54.8	76.3	40.9	55.3	18.7
13	72M0G7W	72	57.4	84.8	48.7	51.0	18.7

Table 10. Summary of the overall link C/I margins (dB)

		Interfering Carriers												
	Carrier ID	1	2	3	4	5	6	7	8	9	10	11	12	13
Wanted Carriers	1	4.9	5.0	5.1	11.2	6.1	5.1	14.8	14.8	8.7	9.2	12.0	12.0	6.2
	2	8.3	8.4	8.5	14.6	9.5	8.5	18.2	18.2	12.1	12.6	15.4	15.4	9.6
	3	10.5	10.7	10.8	16.9	11.7	10.7	20.5	20.4	14.3	14.8	17.7	17.7	11.8
	4	10.1	10.3	10.4	16.5	11.3	10.3	20.1	20.0	13.9	14.4	17.3	17.3	11.4
	5	17.8	17.9	18.0	24.1	19.0	18.0	27.7	27.7	21.6	22.1	24.9	24.9	19.1
	6	18.0	18.1	18.3	24.3	19.2	18.2	28.0	27.9	21.8	22.3	25.2	25.2	19.3
	7	5.3	5.5	5.6	11.7	6.6	5.5	15.2	15.2	9.0	9.4	12.2	12.2	6.2
	8	5.5	5.7	5.8	11.9	6.8	5.7	15.4	15.4	9.2	9.6	12.4	12.4	6.4
	9	15.3	15.4	15.5	21.6	16.5	15.5	22.1	22.0	13.1	13.3	14.5	14.5	7.0
	10	12.0	12.2	12.3	18.4	13.2	12.2	20.2	20.1	11.9	12.2	13.7	13.7	6.3
	11	9.3	9.4	9.5	15.6	10.5	9.5	18.0	17.9	10.2	10.5	12.3	12.3	5.1
	12	8.5	8.6	8.7	14.8	9.7	8.6	17.7	17.6	10.5	10.9	12.9	12.9	6.0
	13	17.0	17.1	17.2	23.3	18.2	17.1	25.0	23.9	16.6	16.9	18.3	18.3	11.0

2.0 PFD Analyses

2.1 C-Band (Unplanned FSS and Appendix 30B Bands)

SES will operate the SES-6 satellite such that all C-band downlink transmissions will comply with the PFD limits of §25.208(a), as well as those of Article 21 of the ITU's Radio Regulations. The Commission's Part 25 rules do not contain PFD limits for the Appendix 30B 4500-4800 MHz band; however it is noted that Article 21 of the ITU Radio Regulations does include PFD limits that are applicable to GSO satellites using the 4500-4800 MHz band. These ITU limits are identical to those of §25.208(a).

Table 11 shows the PFD levels that will occur at various angles of arrival for the two C-band beams (one in each polarization) when transmitting with an assumed peak downlink EIRP density of -30.0 dBW/Hz for both the unplanned FSS and Appendix 30B bands. The table demonstrates compliance with §25.208(a) and the ITU's Article 21 PFD limits in all cases.

Table 11.Maximum PFD Levels of Beams CDR and CDL

Angle of Arrival	Applicable PFD Limit for Angle of Arrival (dBW/m²/4 kHz)	Spreading Loss (dBW/m²)	Gain Contour (dB)	Worst Case PFD Level at Angle of Arrival (dBW/m²/4 kHz)	PFD Margin (dB)
0°	-152.0	-163.4	-2.4	-159.8	7.8
5°	-152.0	-163.3	-2.3	-159.6	7.6
10°	-149.5	-163.2	-2.1	-159.2	9.7
15°	-147.0	-163.0	-1.8	-158.8	11.8
20°	-144.5	-162.9	-1.4	-158.3	13.8
25°	-142.0	-162.8	-1.0	-157.8	15.8
50.2° (Peak)	-142.0	-162.4	0.0	-156.4	14.4

2.2 Extended Ku-Band (Unplanned FSS and Appendix 30B Bands)

SES will operate the SES-6 satellite such that all extended Ku-band downlink transmissions will comply with the PFD limits of §25.208(b), as well as those of Article 21 of the ITU's Radio Regulations. The Commission's Part 25 rules do not contain PFD limits for the Appendix 30B 11200-11450 MHz band; however it is noted that Article 21 of the ITU Radio Regulations does include PFD limits that are applicable to GSO satellites using the 11200-11450 MHz band. These ITU limits are identical to those of §25.208(b). As noted previously, the 11200-11450 MHz band is not on a beam that has coverage of the United States.

Tables 12 through 16 show the PFD levels that will occur at various angles of arrival for the extended Ku-band beams when transmitting with the following peak downlink EIRP densities:[1]

1) Beam ANDH: Peak downlink EIRP density = -20.0 dBW/Hz

2) Beam BRDV: Peak downlink EIRP density = -20.0 dBW/Hz

3) Beam SCDV: Peak downlink EIRP density = -20.0 dBW/Hz

[1] See Section 4 of this Technical Appendix for the maximum theoretical operation levels for SES-6.

4) Beam ATWDH: Peak downlink EIRP density = -21.8 dBW/Hz

5) Beams ATEDH and ATEDV: Peak downlink EIRP density = -21.7 dBW/Hz

Tables 12 through 16 demonstrate compliance with §25.208(b) and the ITU's Article 21 PFD limits in all cases.

Table 12. Maximum PFD Levels of Beam ANDH

Angle of Arrival	Applicable PFD Limit for Angle of Arrival (dBW/m²/4 kHz)	Spreading Loss (dBW/m²)	Gain Contour (dB)	Worst Case PFD Level at Angle of Arrival (dBW/m²/4 kHz)	PFD Margin (dB)
0°	-150.0	-163.4	-10.3	-157.7	7.7
5°	-150.0	-163.3	-10.0	-157.3	7.3
10°	-147.5	-163.2	-9.6	-156.7	9.2
15°	-145.0	-163.0	-7.5	-154.5	9.5
20°	-142.5	-162.9	-5.6	-152.5	10
25°	-140.0	-162.8	-3.8	-150.6	10.6
63.8° (Peak)	-140.0	-162.2	0.0	-146.2	6.2

Table 13. Maximum PFD Levels of Beam BRDV

Angle of Arrival	Applicable PFD Limit for Angle of Arrival (dBW/m²/4 kHz)	Spreading Loss (dBW/m²)	Gain Contour (dB)	Worst Case PFD Level at Angle of Arrival (dBW/m²/4 kHz)	PFD Margin (dB)
0°	-150.0	-163.4	-19.0	-166.4	16.4
5°	-150.0	-163.3	-18.8	-166.1	16.1
10°	-147.5	-163.2	-18.2	-165.3	17.8
15°	-145.0	-163.0	-17.2	-164.2	19.2
20°	-142.5	-162.9	-16.2	-163.1	20.6
25°	-140.0	-162.8	-13.2	-160.0	20.0
47.2° (Peak)	-140.0	-162.4	0.0	-146.4	6.4

Table 14. Maximum PFD Levels of Beam SCDV

Angle of Arrival	Applicable PFD Limit for Angle of Arrival (dBW/m^2/4 kHz)	Spreading Loss (dBW/m^2)	Gain Contour (dB)	Worst Case PFD Level at Angle of Arrival (dBW/m^2/4 kHz)	PFD Margin (dB)
0°	-150.0	-163.4	-4.5	-151.9	1.9
5°	-150.0	-163.3	-4.0	-151.3	1.3
10°	-147.5	-163.2	-2.9	-150.0	2.5
15°	-145.0	-163.0	-1.6	-148.6	3.6
20°	-142.5	-162.9	-0.4	-147.3	4.8
25°	-140.0	-162.8	0.0	-146.8	6.8
65.2° (Peak)	-140.0	-162.2	0.0	-146.2	6.2

Table 15. Maximum PFD Levels of Beam ATWDH

Angle of Arrival	Applicable PFD Limit for Angle of Arrival (dBW/m^2/4 kHz)	Spreading Loss (dBW/m^2)	Gain Contour (dB)	Worst Case PFD Level at Angle of Arrival (dBW/m^2/4 kHz)	PFD Margin (dB)
0°	-150.0	-163.4	-0.9	-150.1	0.1
5°	-150.0	-163.3	-0.9	-150.0	0.0
10°	-147.5	-163.2	-0.8	-149.7	2.2
15°	-145.0	-163.0	-0.8	-149.6	4.6
20°	-142.5	-162.9	-0.8	-149.5	7.0
25°	-140.0	-162.8	-0.8	-149.4	9.4
49.8° (Peak)	-140.0	-162.4	0.0	-148.2	8.2

Table 16. Maximum PFD Levels of Beams ATEDH and ATEDV

Angle of Arrival	Applicable PFD Limit for Angle of Arrival (dBW/m^2/4 kHz)	Spreading Loss (dBW/m^2)	Gain Contour (dB)	Worst Case PFD Level at Angle of Arrival (dBW/m^2/4 kHz)	PFD Margin (dB)
0°	-150.0	-163.4	-1.1	-150.2	0.2
5°	-150.0	-163.3	-1.0	-150.0	0.0
10°	-147.5	-163.2	-0.9	-149.7	2.2
15°	-145.0	-163.0	-0.7	-149.4	4.4
20°	-142.5	-162.9	-0.7	-149.3	6.8
25°	-140.0	-162.8	-0.7	-149.2	9.2
47.6° (Peak)	-140.0	-162.4	0.0	-148.1	8.1

ANNEX B

ANTENNA GAIN CONTOUR DIAGRAMS

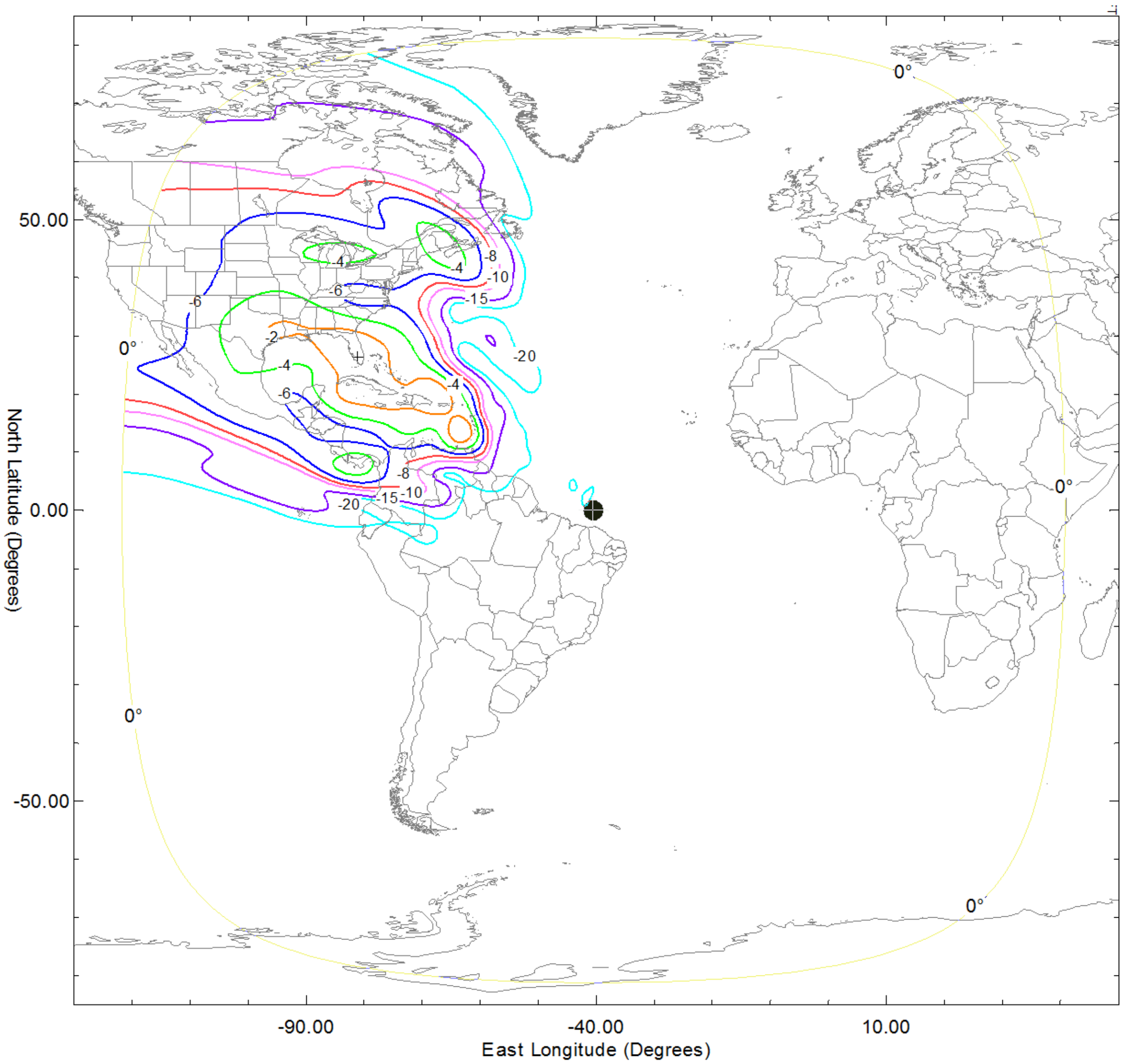

Figure 1.
Uplink Beam NAUH
Peak Gain = 35.4 dBi
Horizontal Polarization

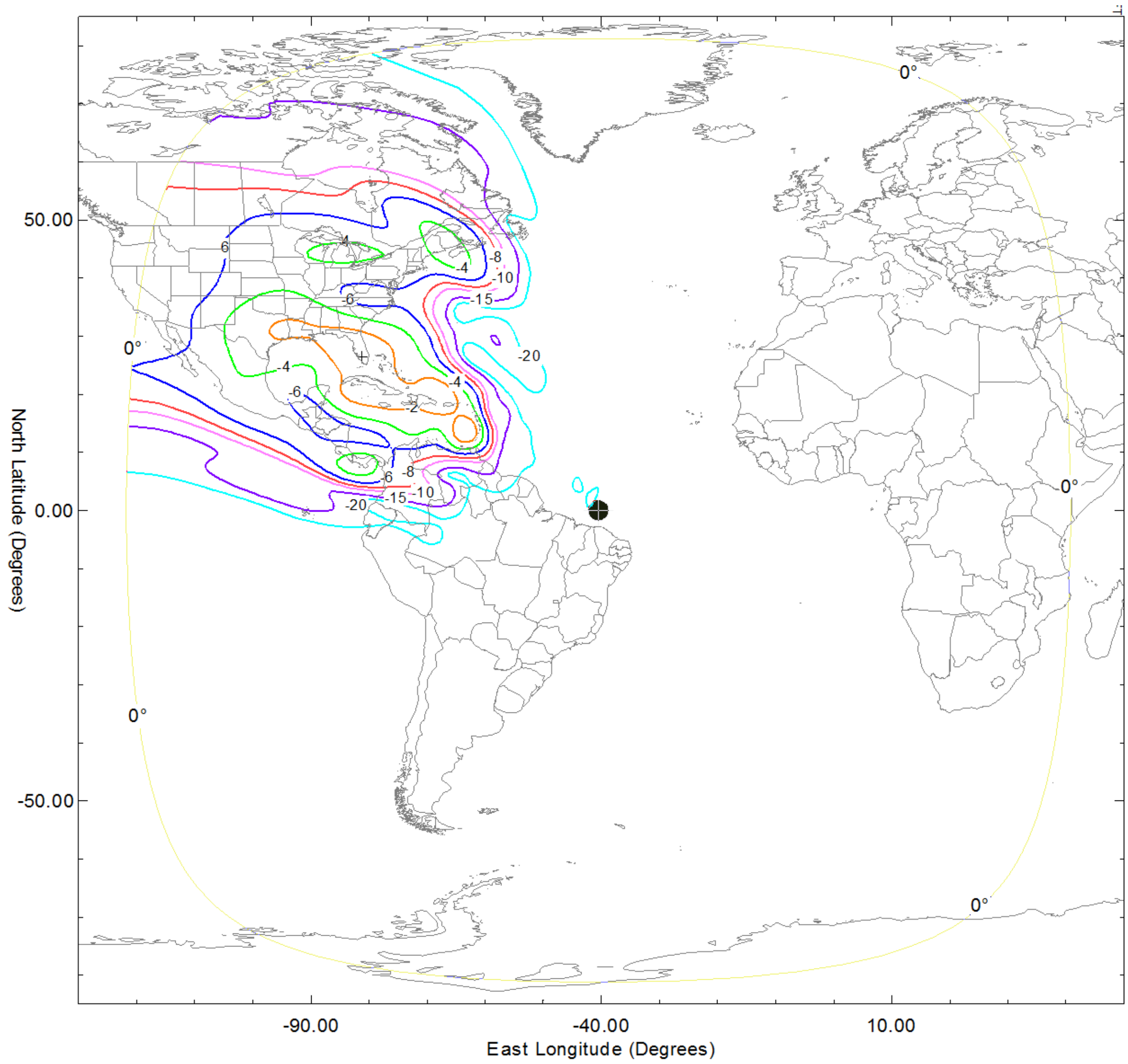

Figure 2.
Uplink Beam NAUV
Peak Gain = 35.4 dBi
Vertical Polarization

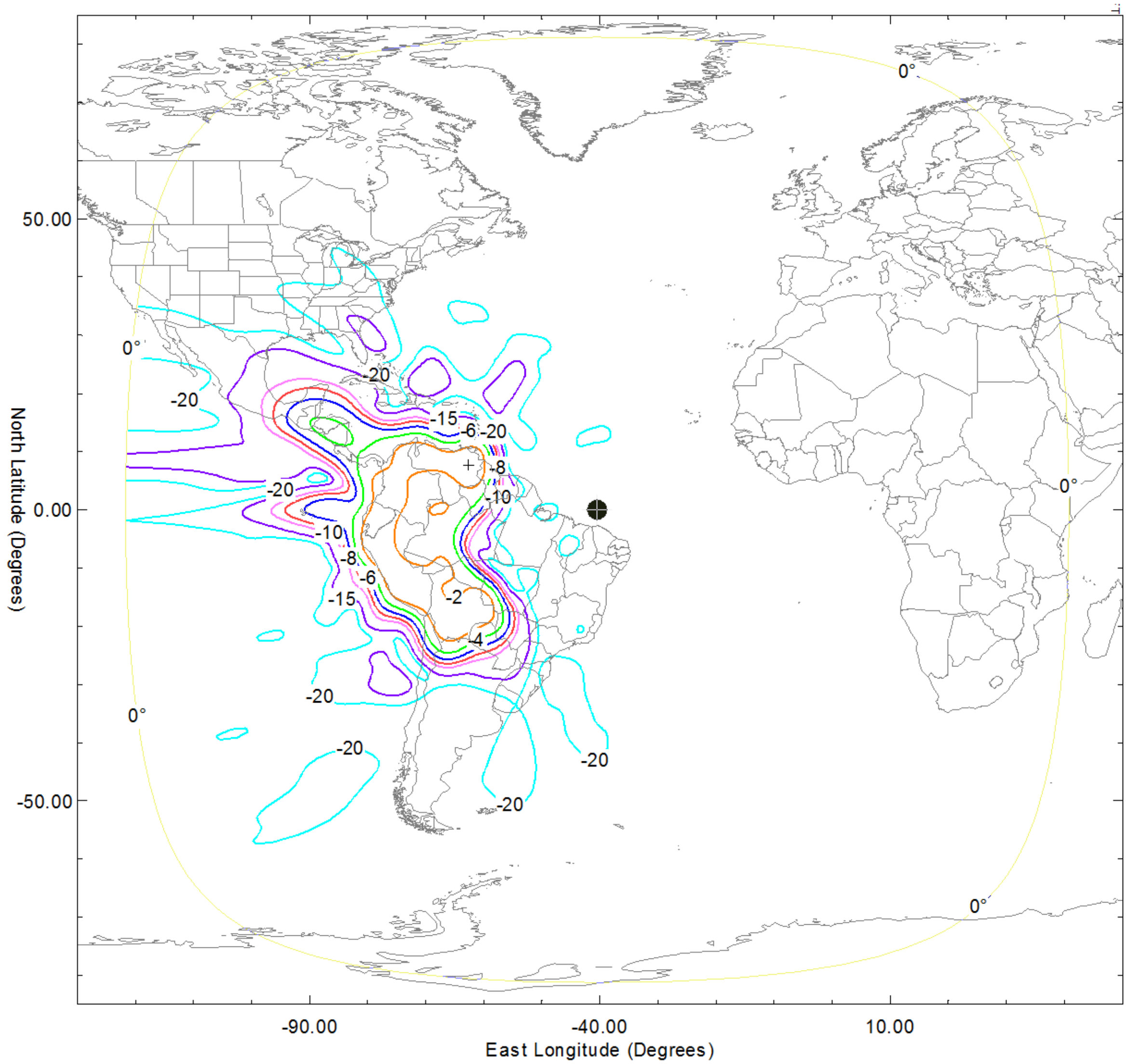

Figure 3.
Uplink Beam ANUH
Peak Gain = 34.7 dBi
Horizontal Polarization

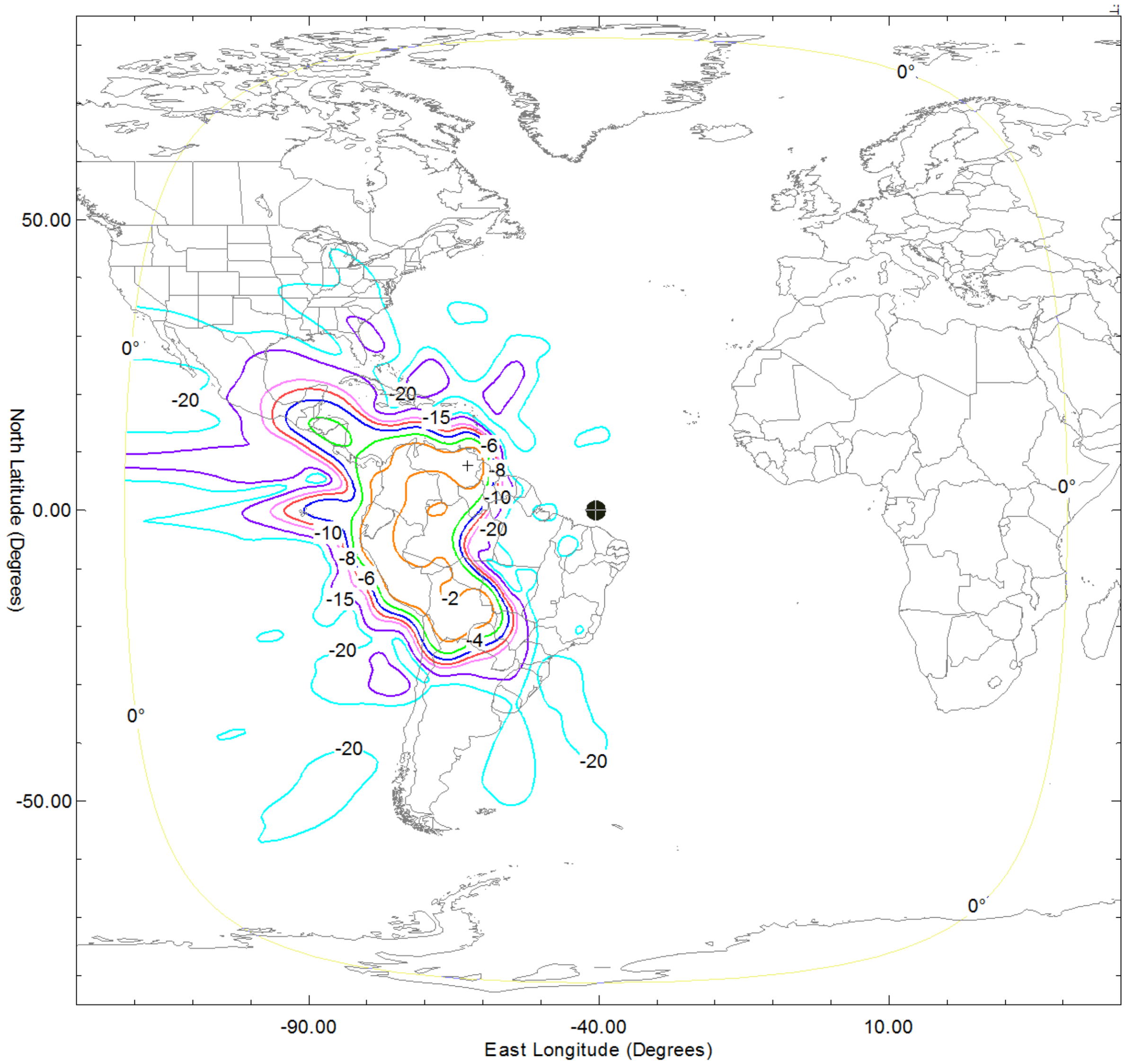

Figure 4.
Uplink Beam ANUV
Peak Gain = 34.7 dBi
Vertical Polarization

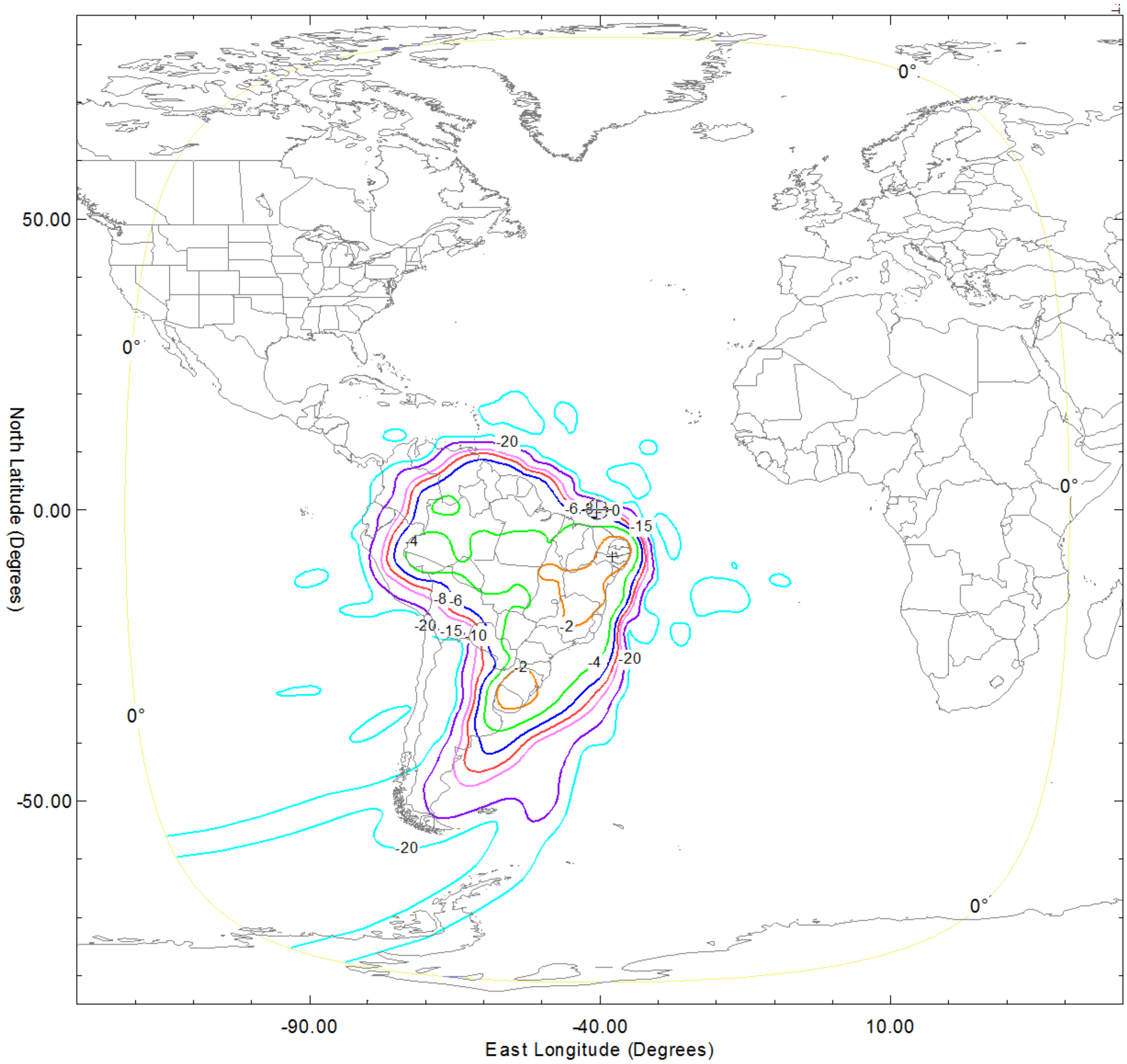

Figure 5.
Uplink Beam BRUH
Peak Gain = 33.9 dBi
Horizontal Polarization

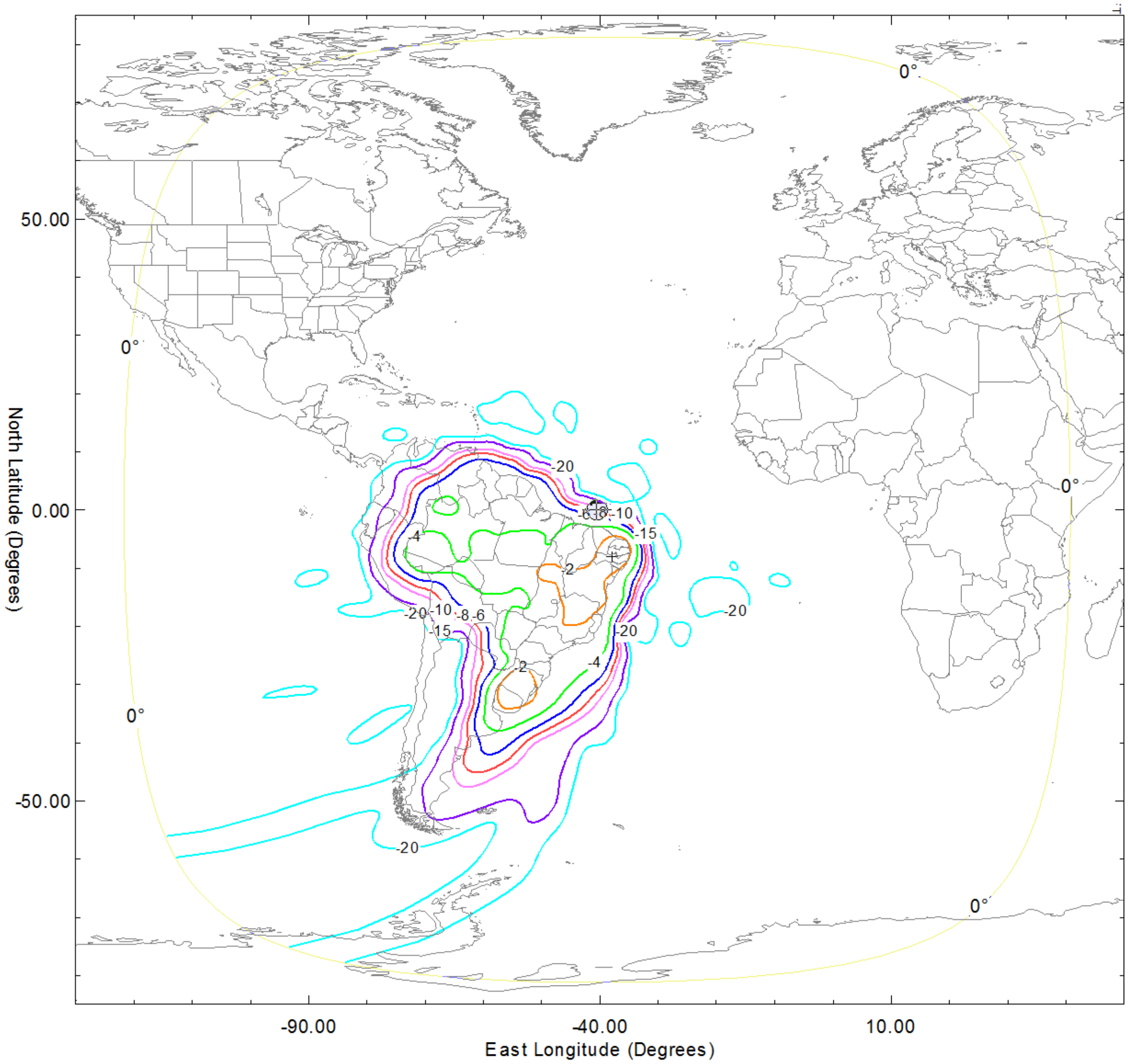

Figure 6.
Uplink Beam BRUV
Peak Gain = 33.9 dBi
Vertical Polarization

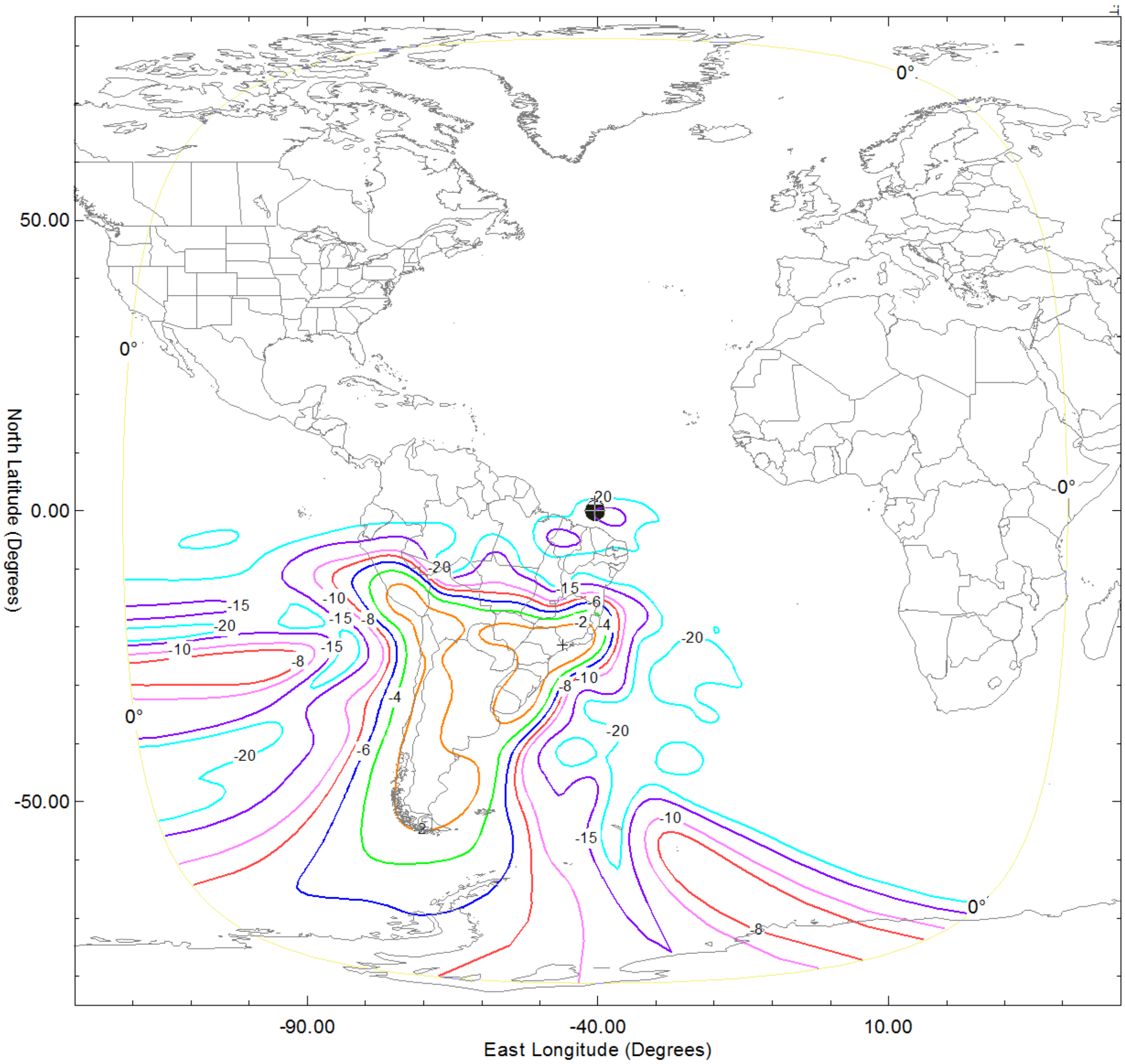

Figure 7.
Uplink Beam SCUH
Peak Gain = 33.6 dBi
Horizontal Polarization

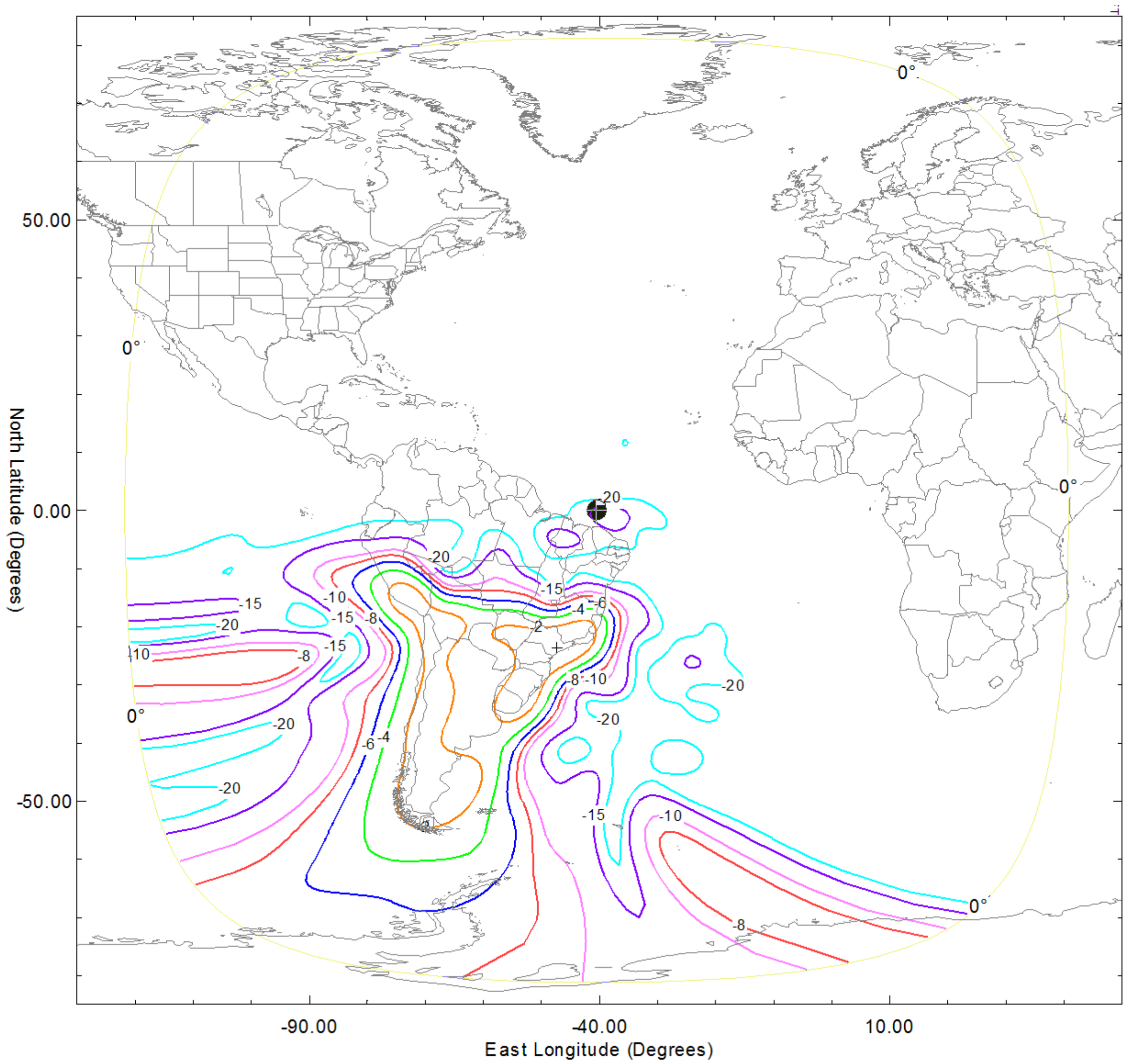

Figure 8.
Uplink Beam SCUV
Peak Gain = 33.6 dBi
Vertical Polarization

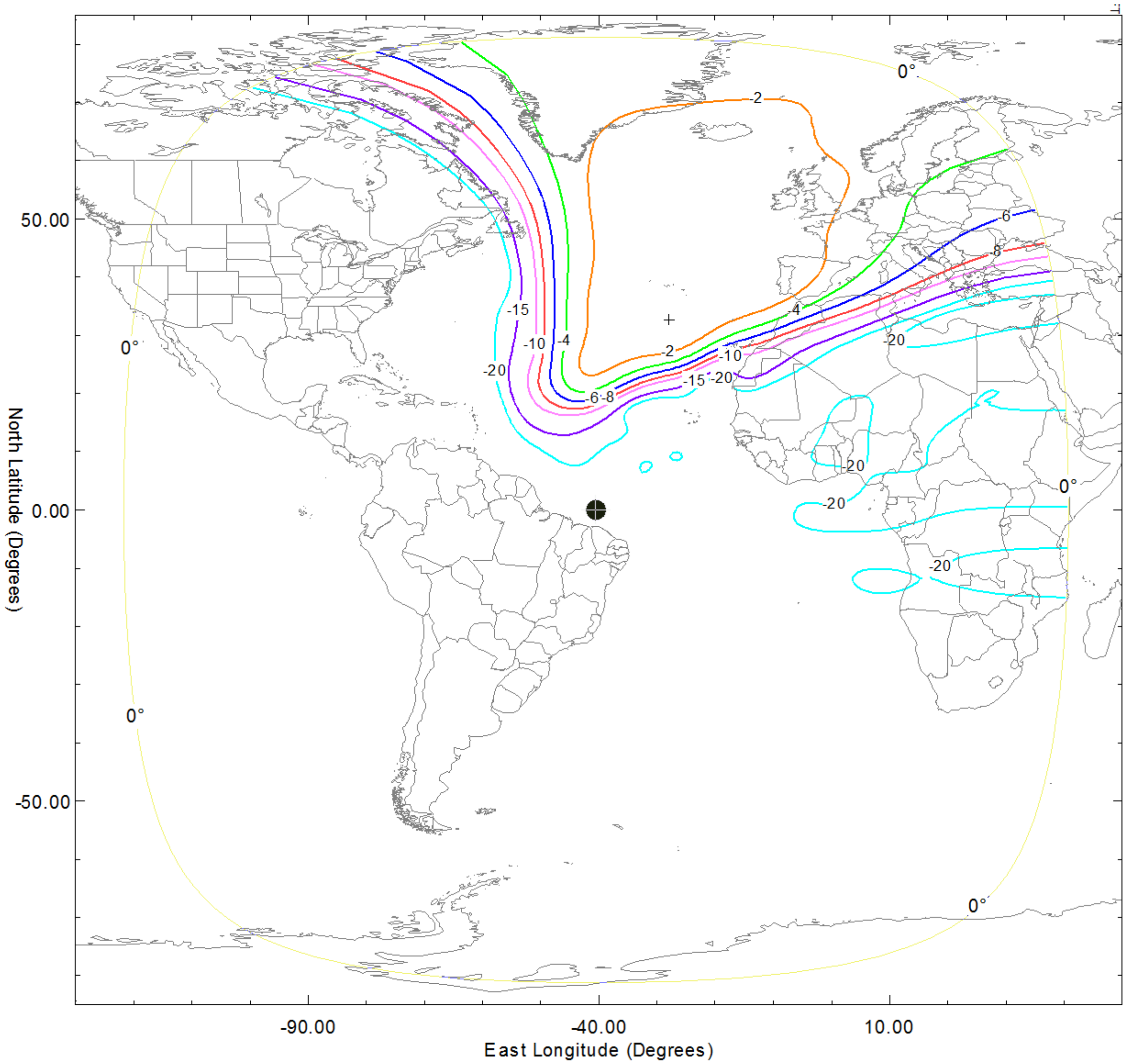

Figure 9.
Uplink Beam ATEUH
Peak Gain = 32.6 dBi
Horizontal Polarization

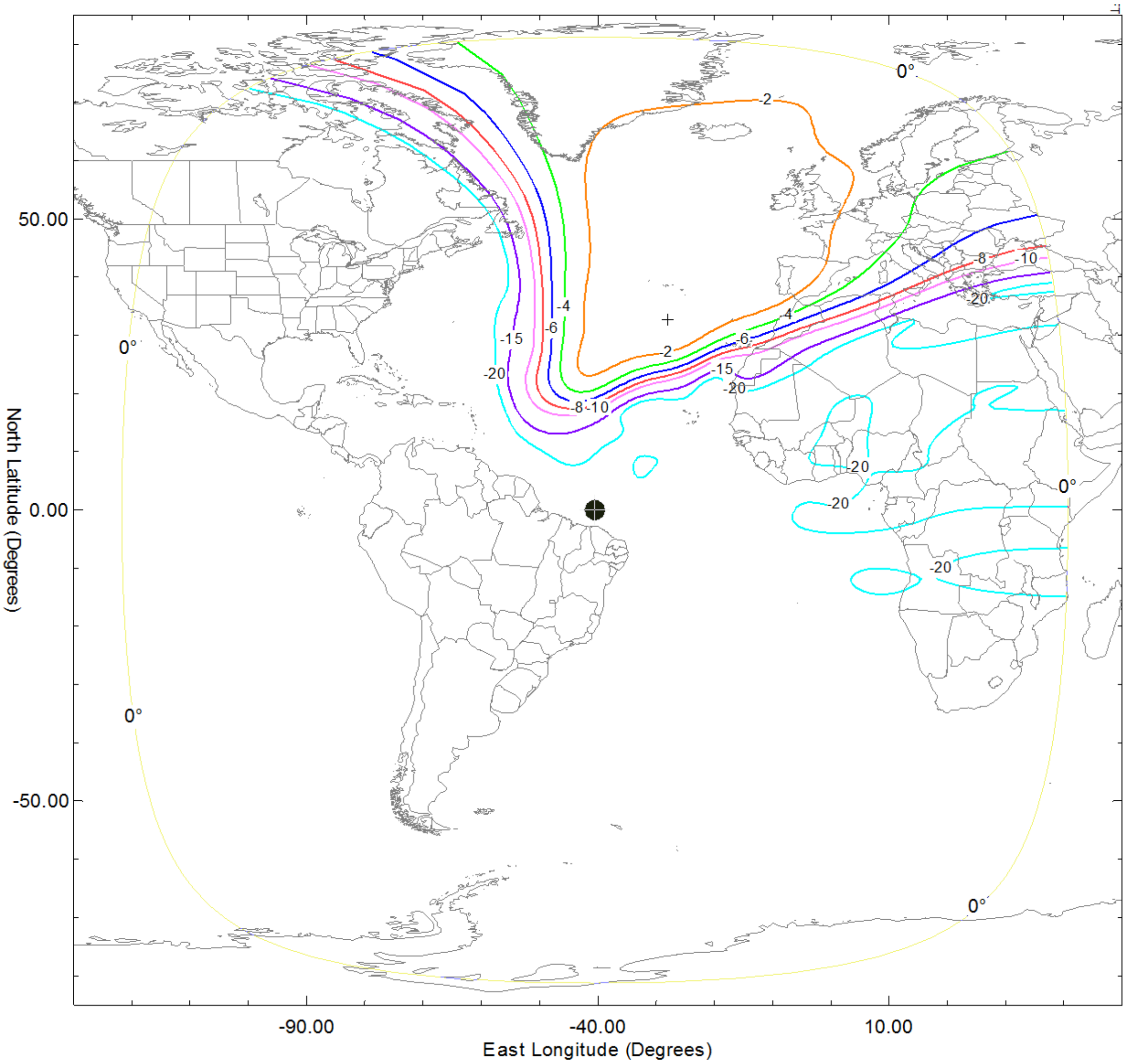

Figure 10.
Uplink Beam ATEUV
Peak Gain = 32.6 dBi
Vertical Polarization

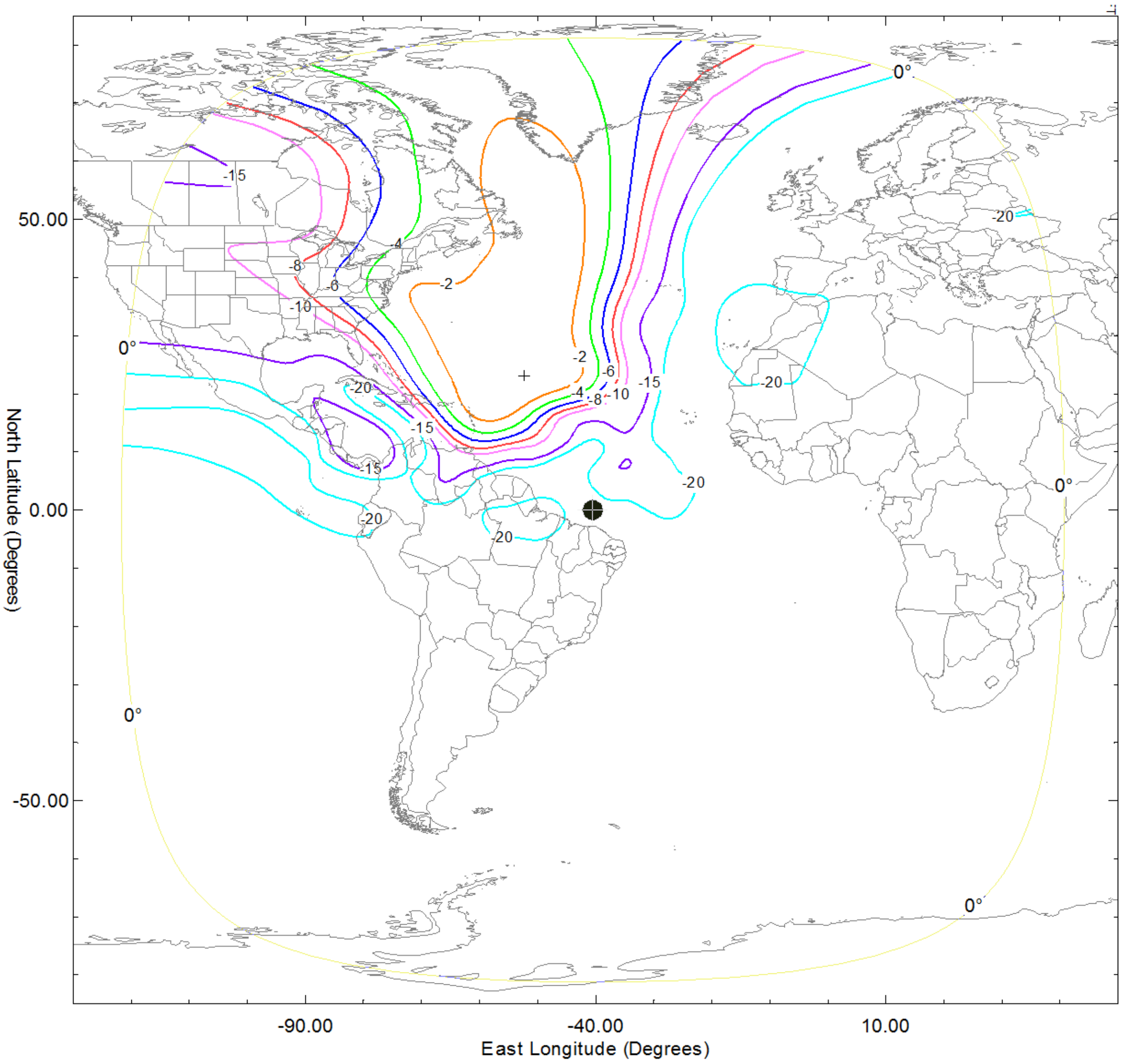

Figure 11.
Uplink Beam ATWUV
Peak Gain = 32.4 dBi
Vertical Polarization

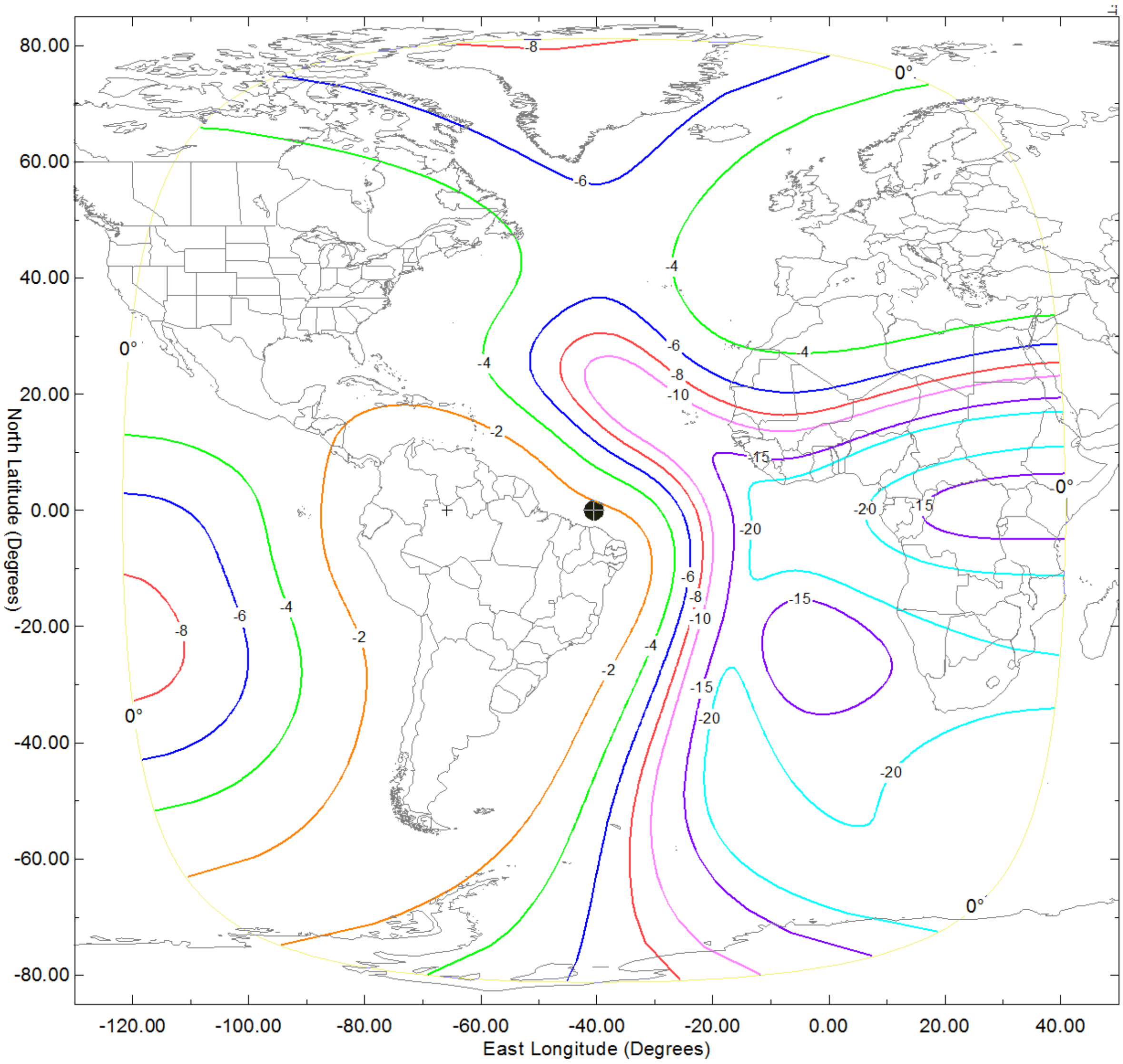

Figure 12.
Uplink Beam CUR
Peak Gain = 24.5 dBi
Right-Hand Circular Polarization

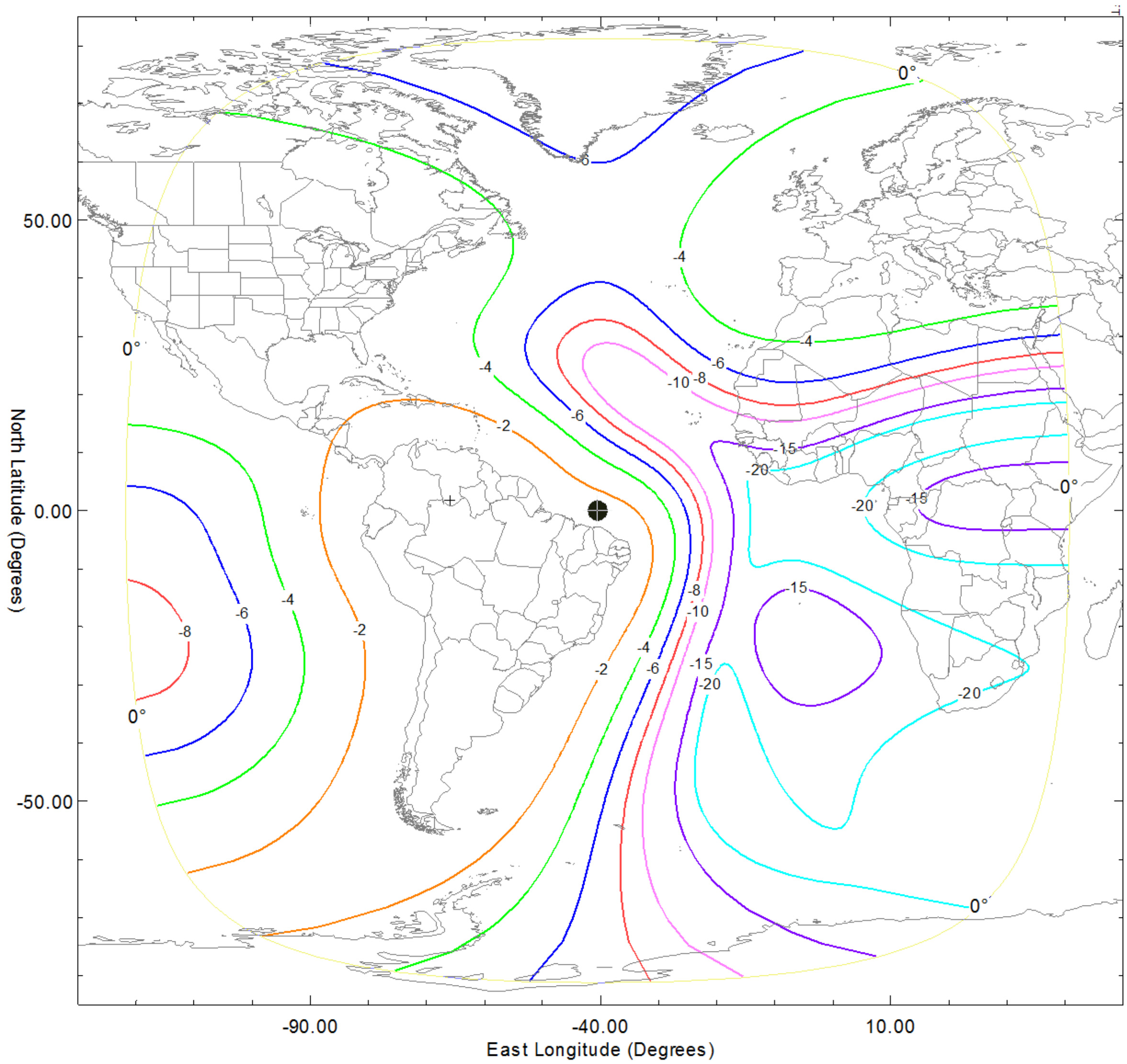

Figure 13.
Uplink Beam CUL
Peak Gain = 24.5 dBi
Left-Hand Circular Polarization

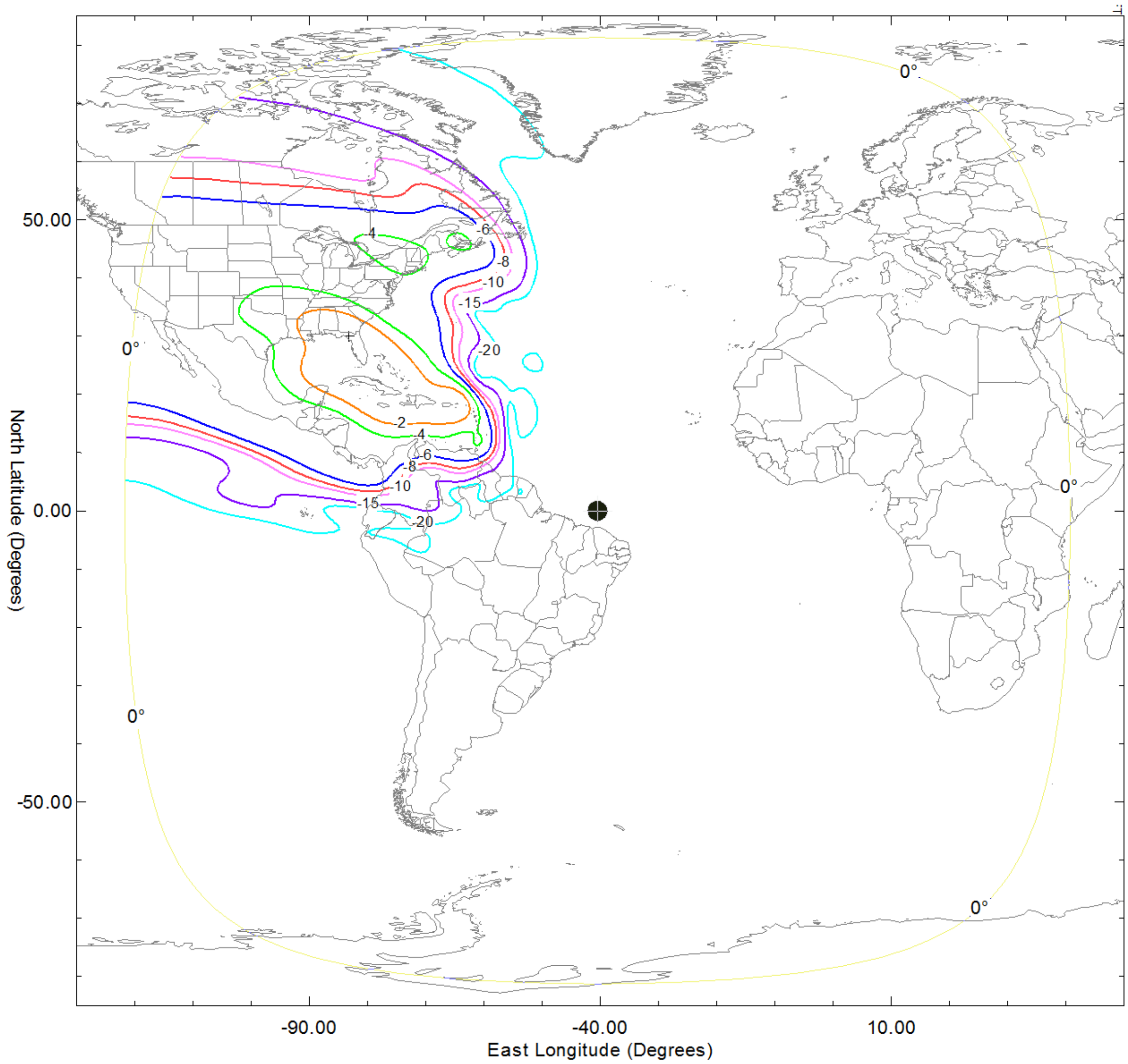

Figure 14.
Downlink Beam NADH
Peak Gain = 34.7 dBi
Horizontal Polarization

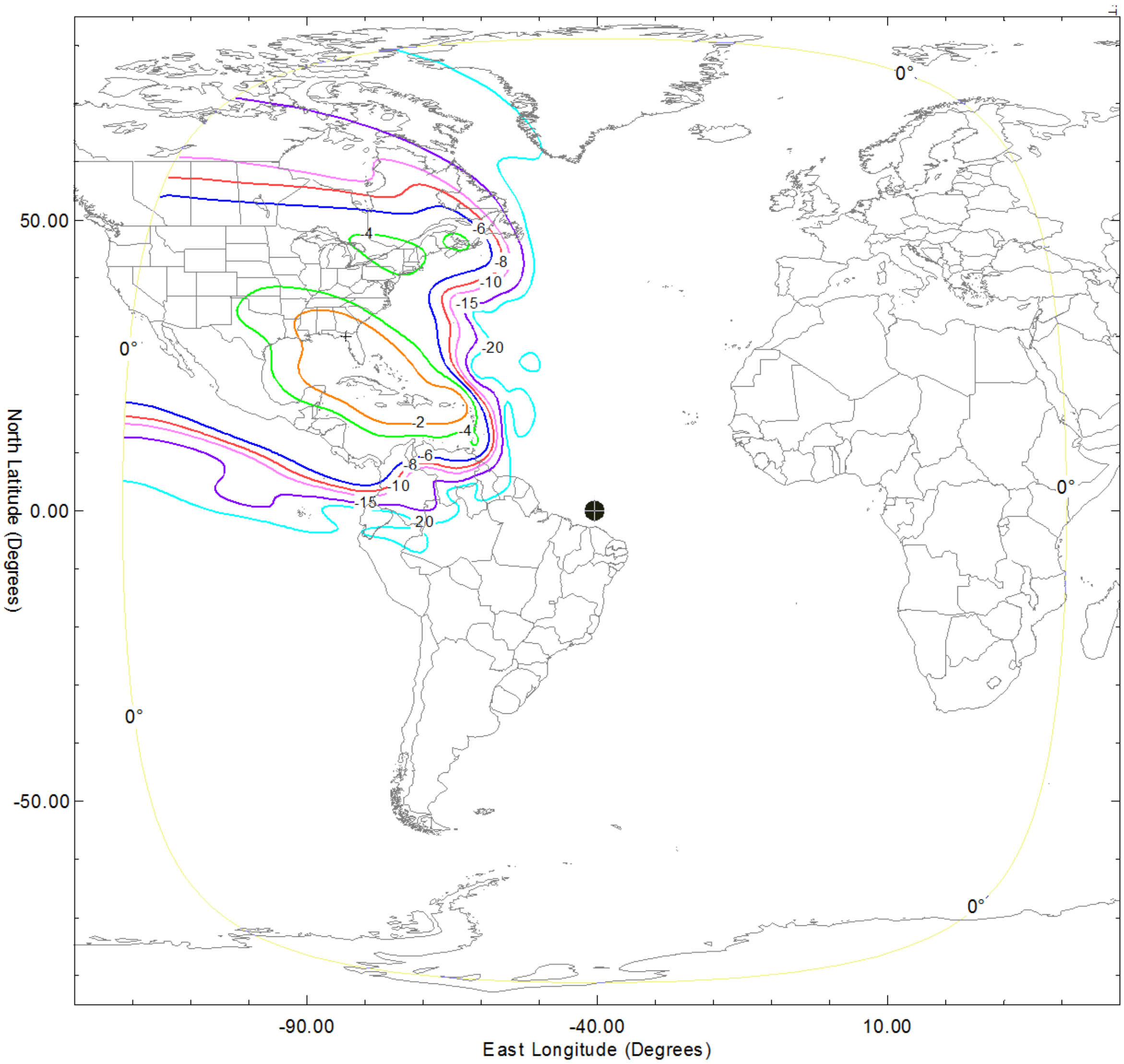

Figure 15.
Downlink Beam NADV
Peak Gain = 34.7 dBi
Vertical Polarization

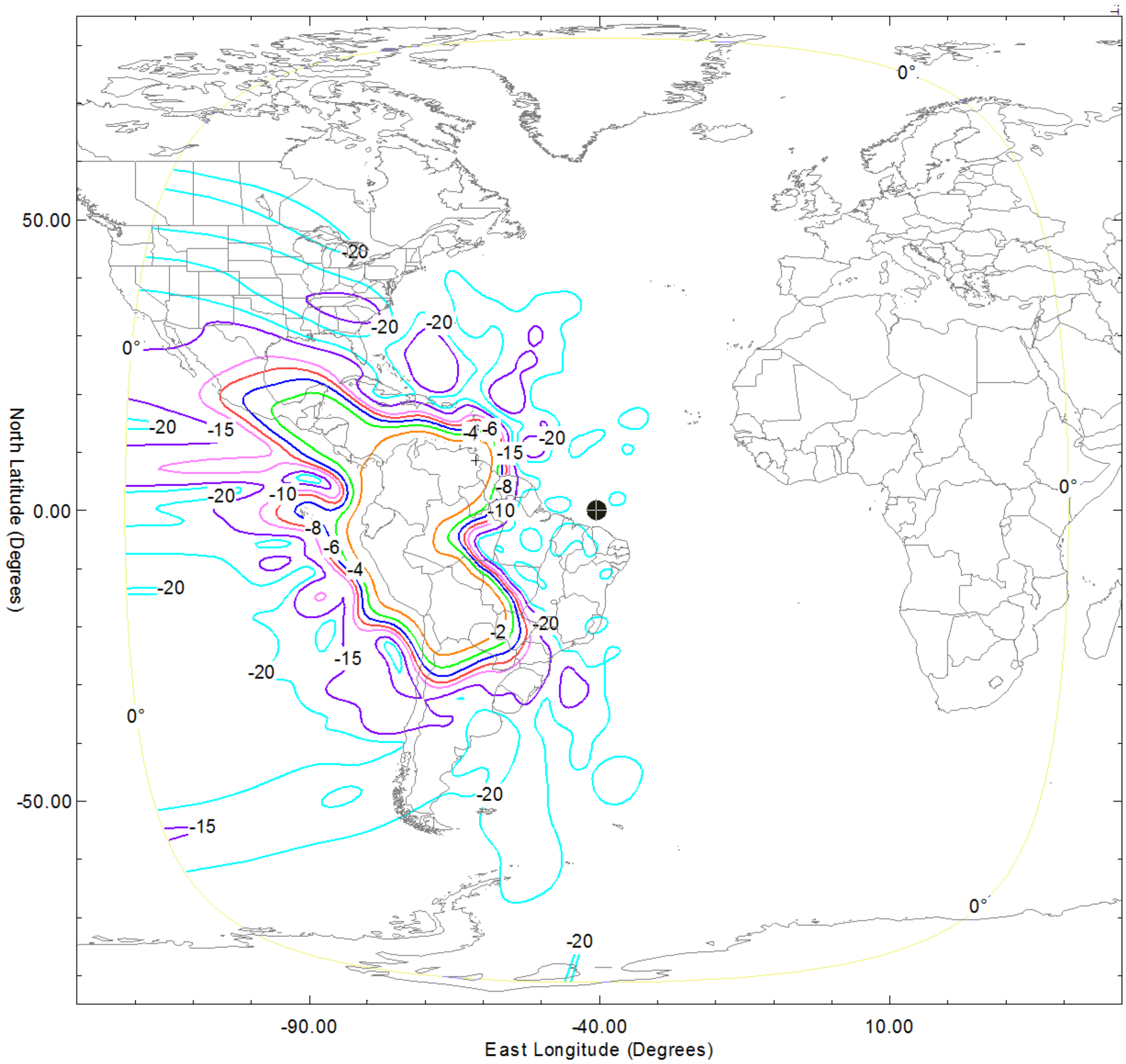

Figure 16.
Downlink Beam ANDH
Peak Gain = 33 dBi
Horizontal Polarization

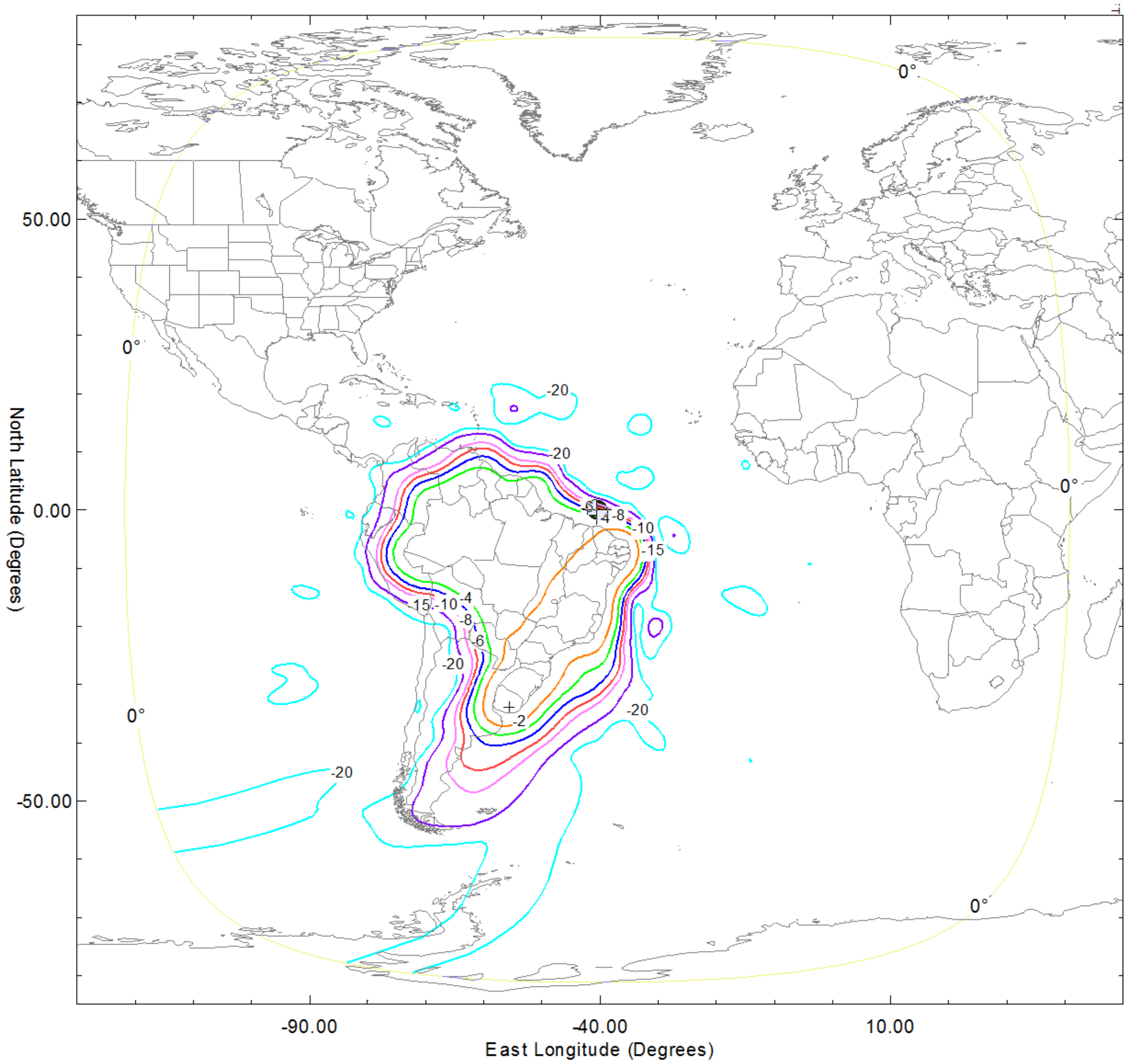

Figure 17.
Downlink Beam BRDH
Peak Gain = 32.8 dBi
Horizontal Polarization

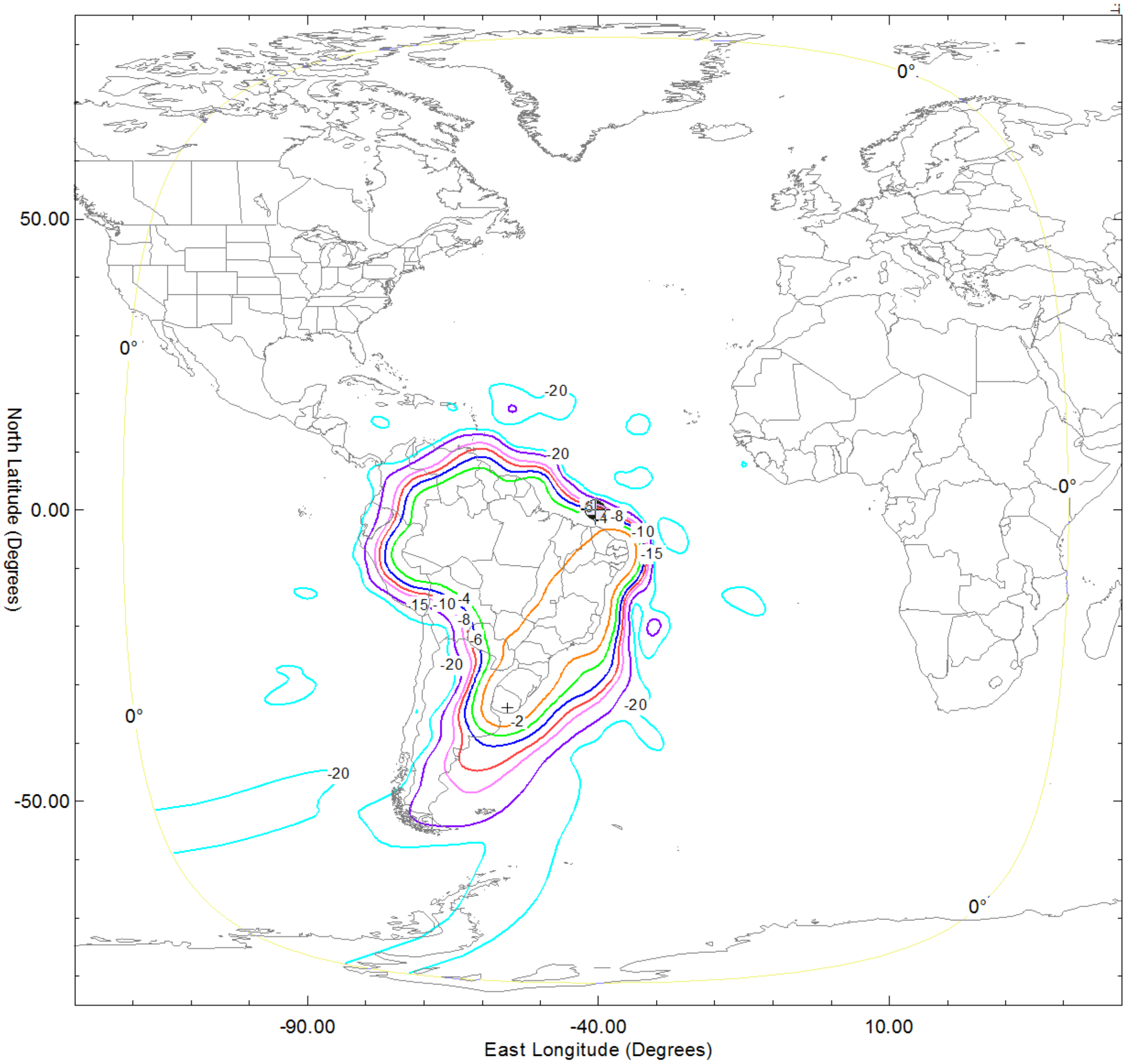

Figure 18.
Downlink Beam BRDV
Peak Gain = 32.8 dBi
Vertical Polarization

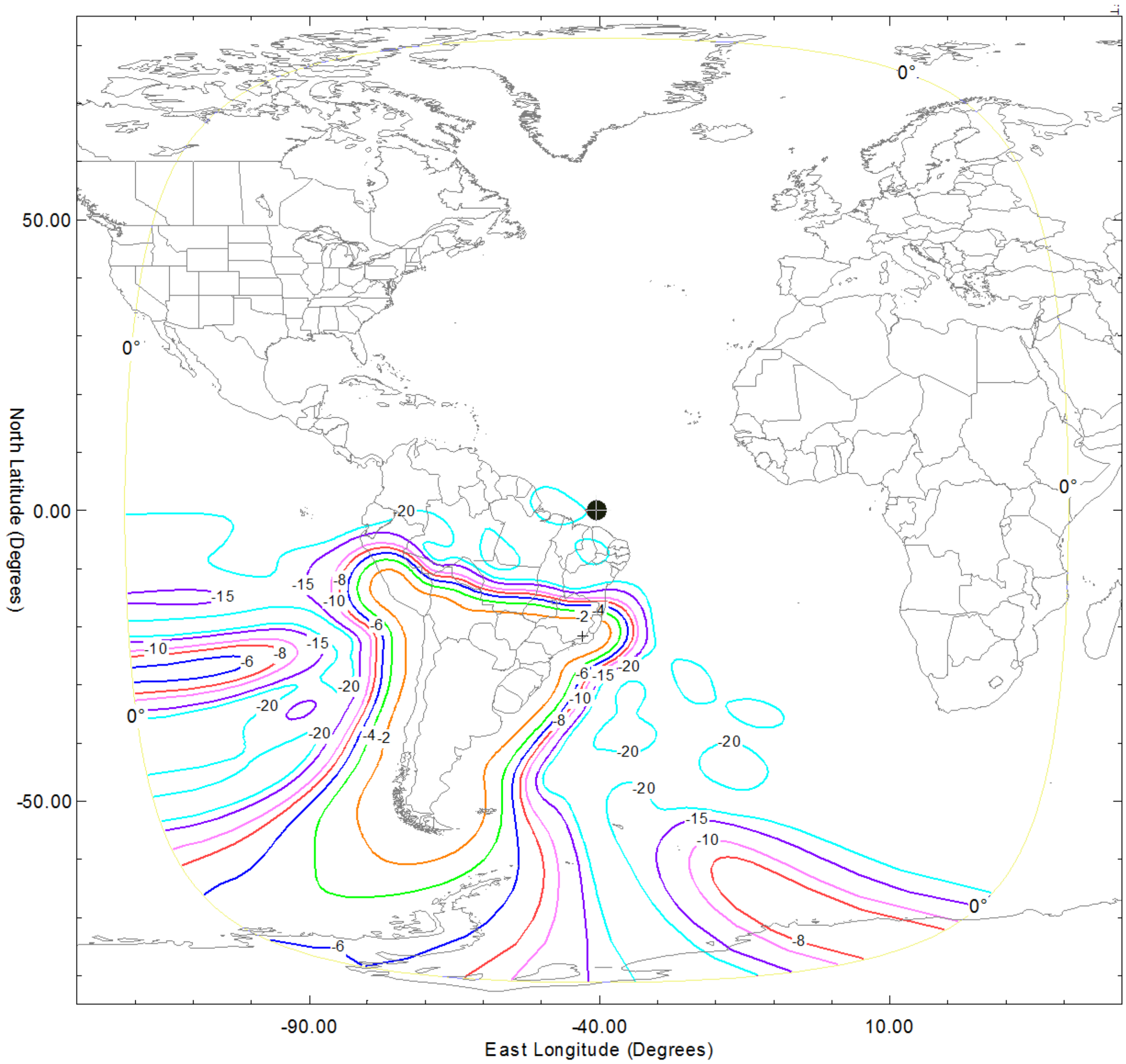

Figure 19.
Downlink Beam SCDH
Peak Gain = 32.6 dBi
Horizontal Polarization

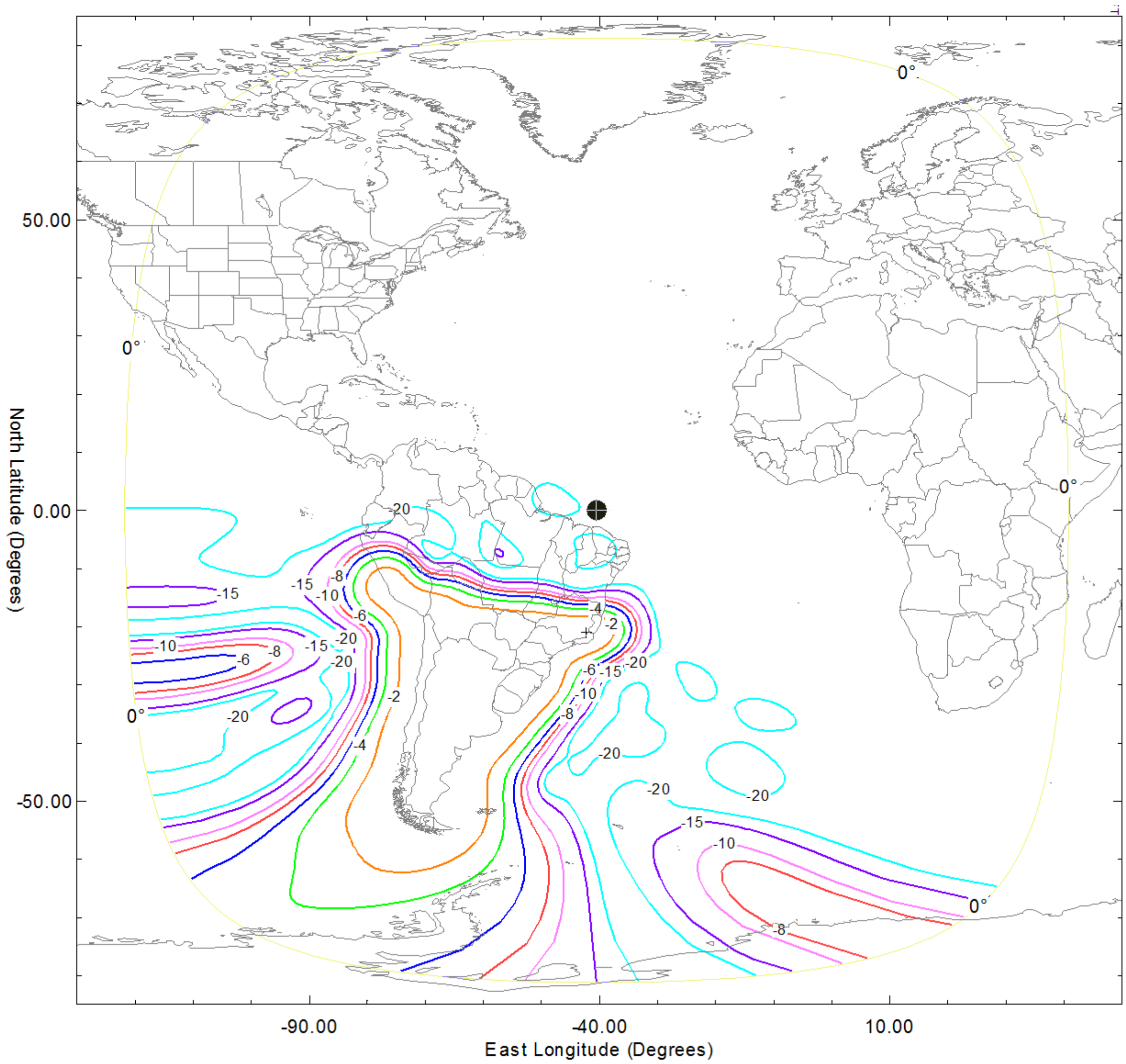

Figure 20.
Downlink Beam SCDV
Peak Gain = 32.6 dBi
Vertical Polarization

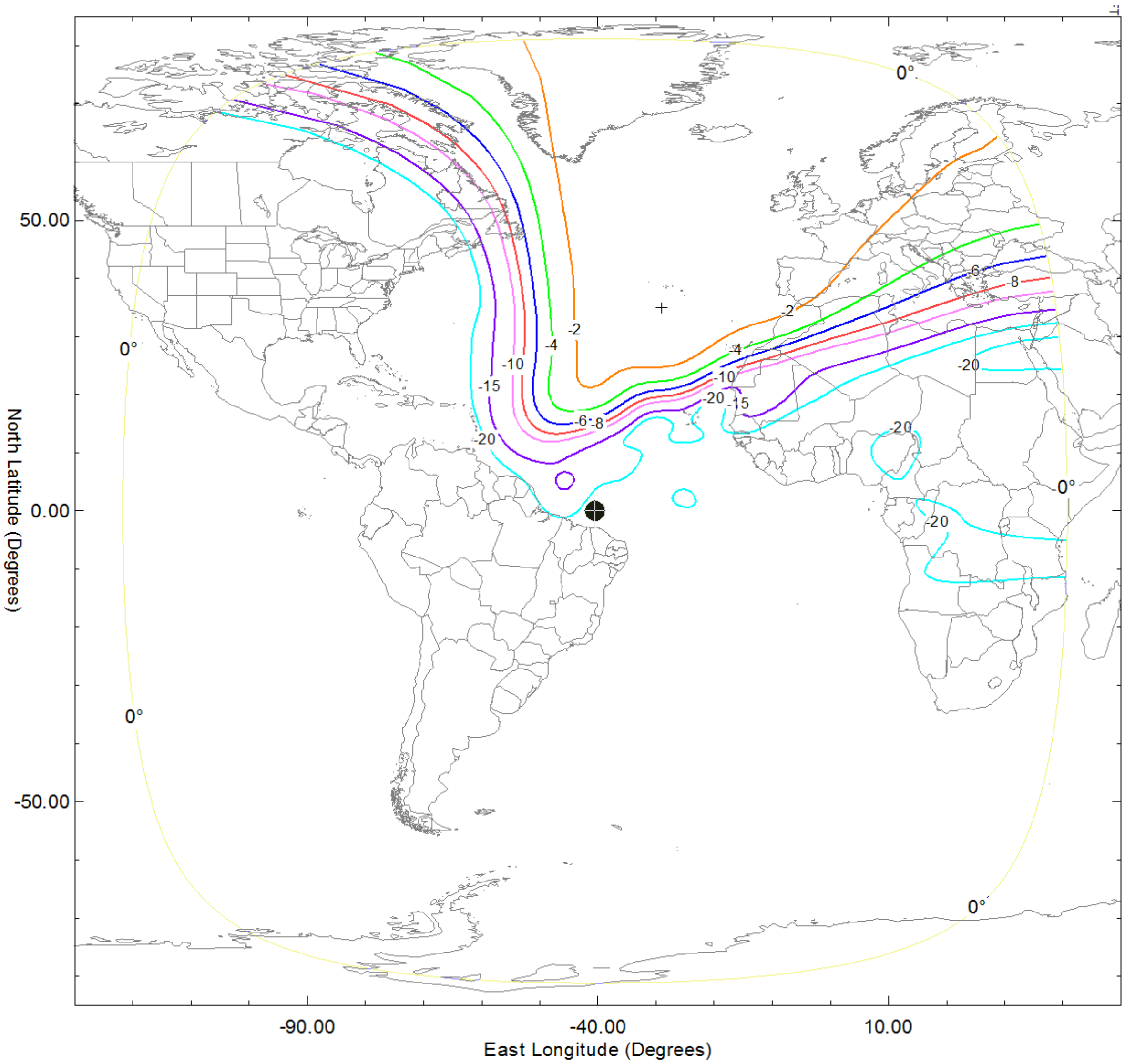

Figure 21.
Downlink Beam ATEDH
Peak Gain = 31.3 dBi
Horizontal Polarization

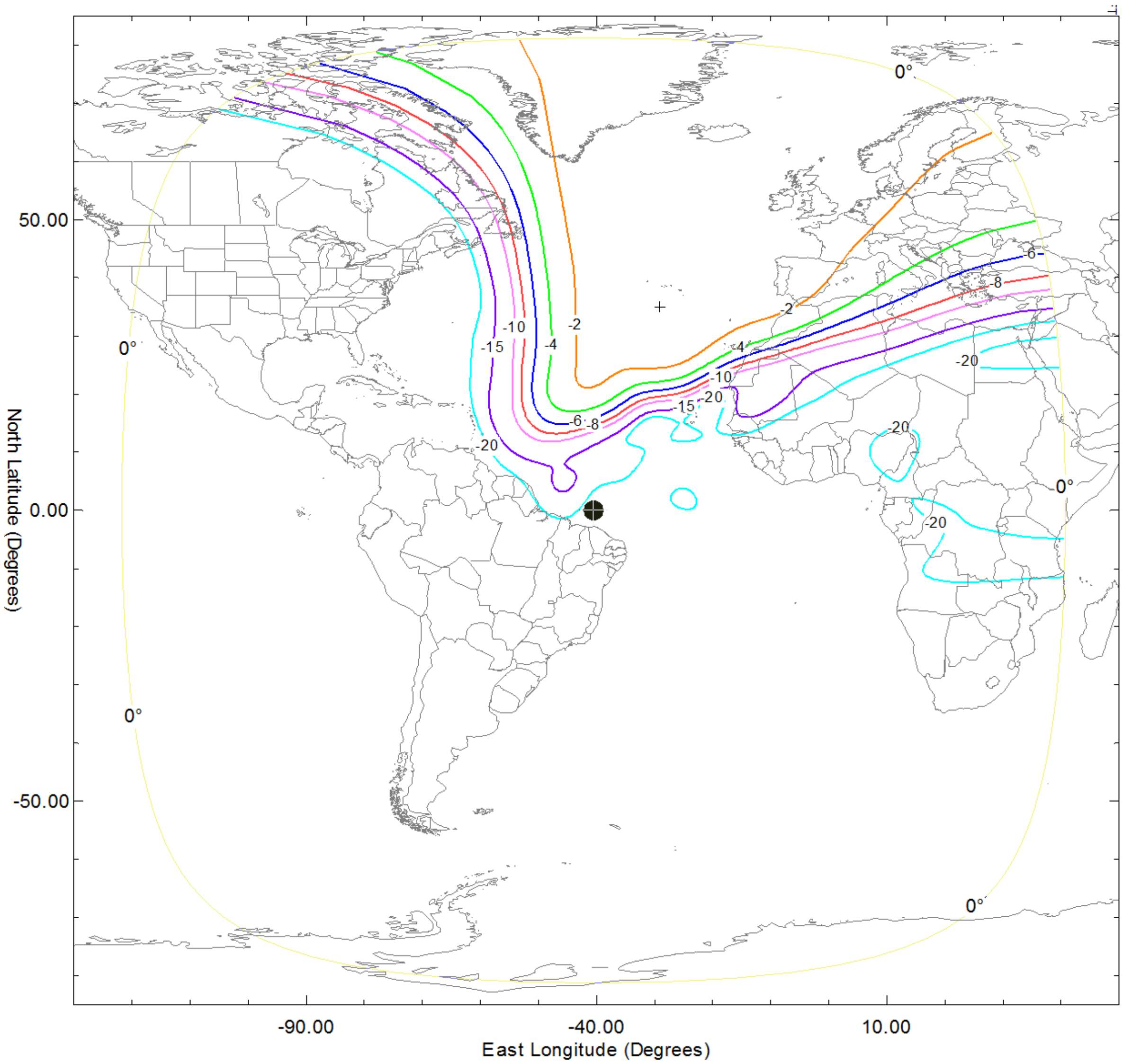

Figure 22.
Downlink Beam ATEDV
Peak Gain = 31.3 dBi
Vertical Polarization

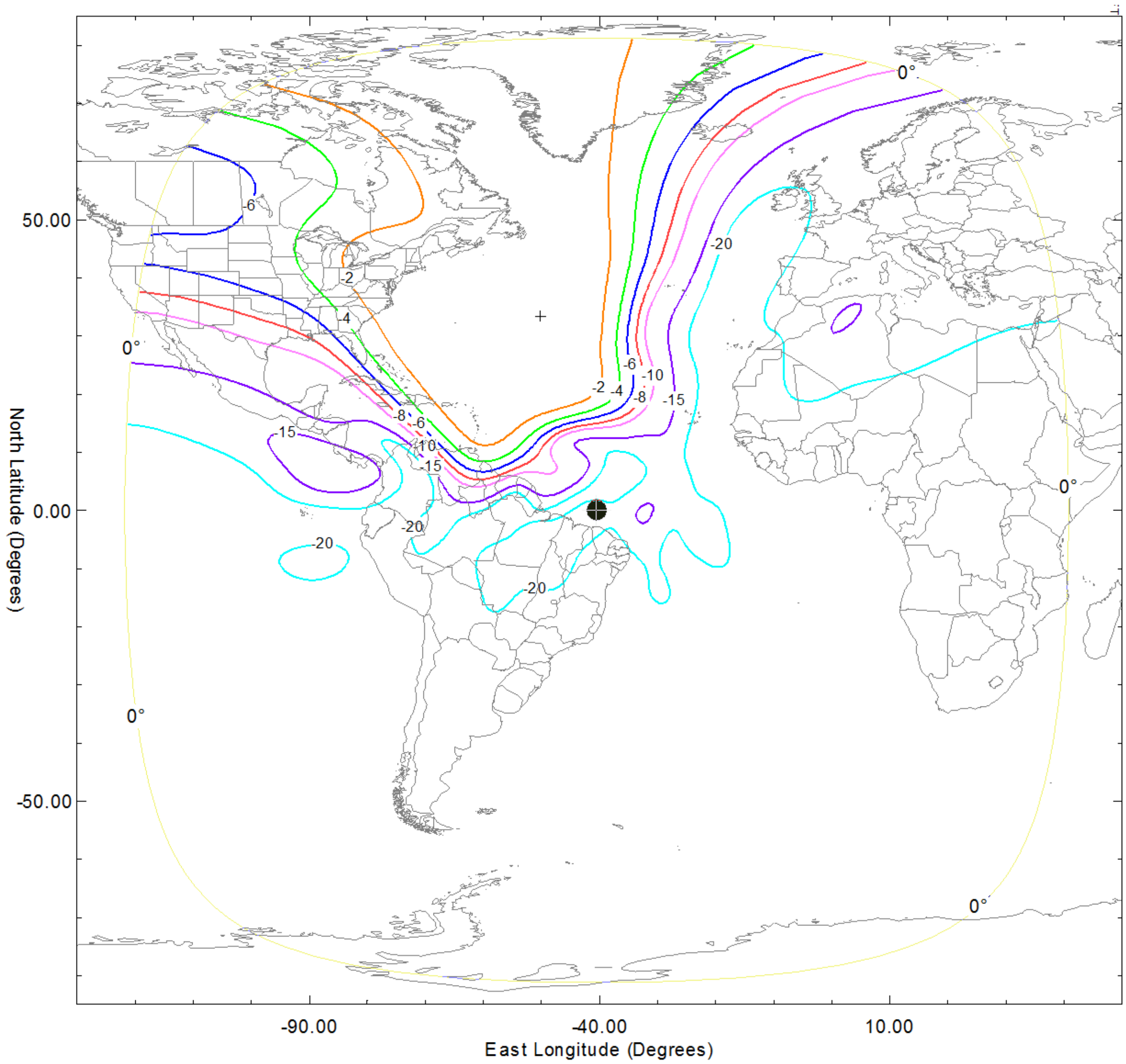

Figure 23.
Downlink Beam ATWDH
Peak Gain = 30.2 dBi
Horizontal Polarization

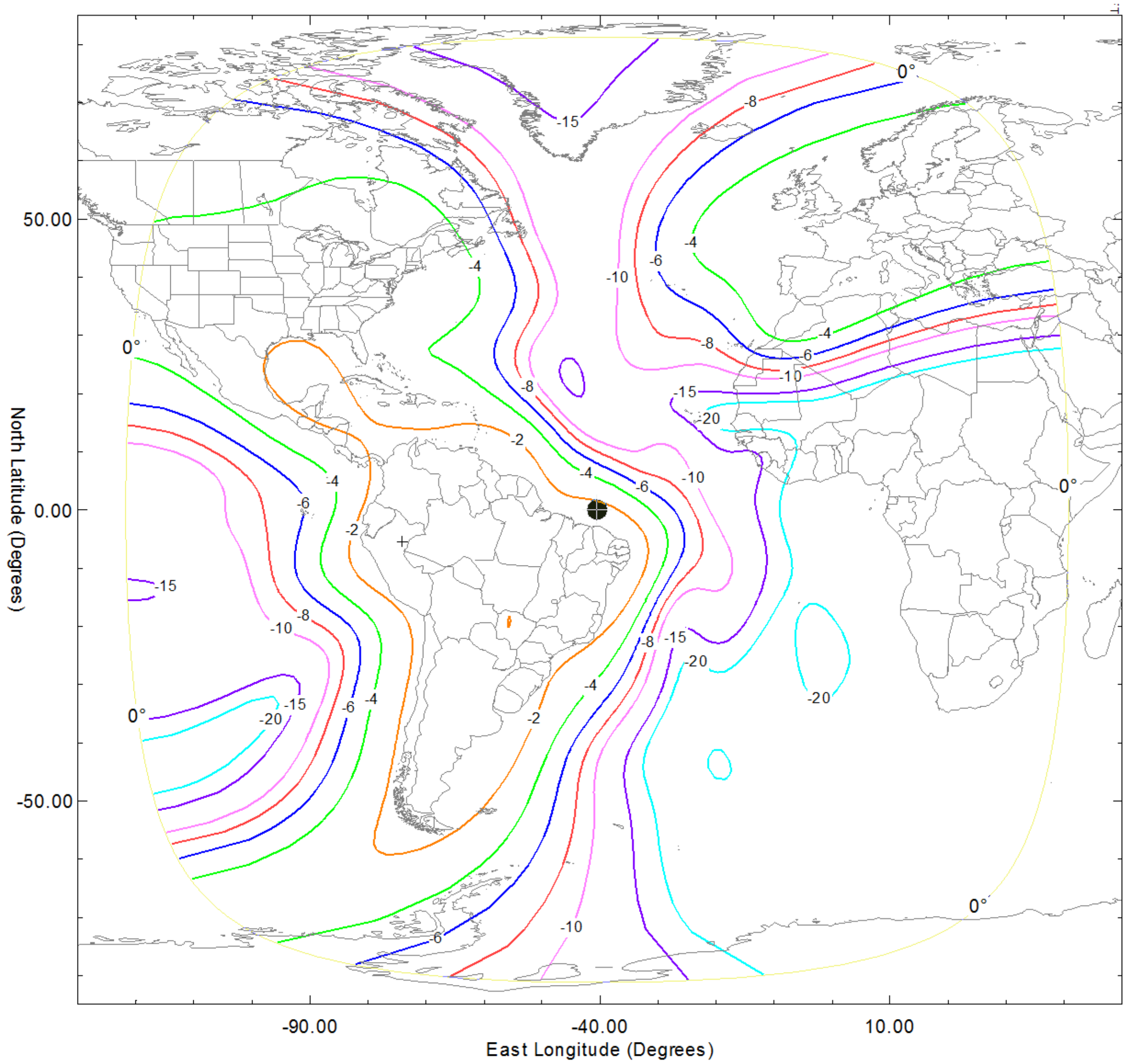

Figure 24.
Downlink Beam CDR
Peak Gain = 26.5 dBi
Right-Hand Circular Polarization

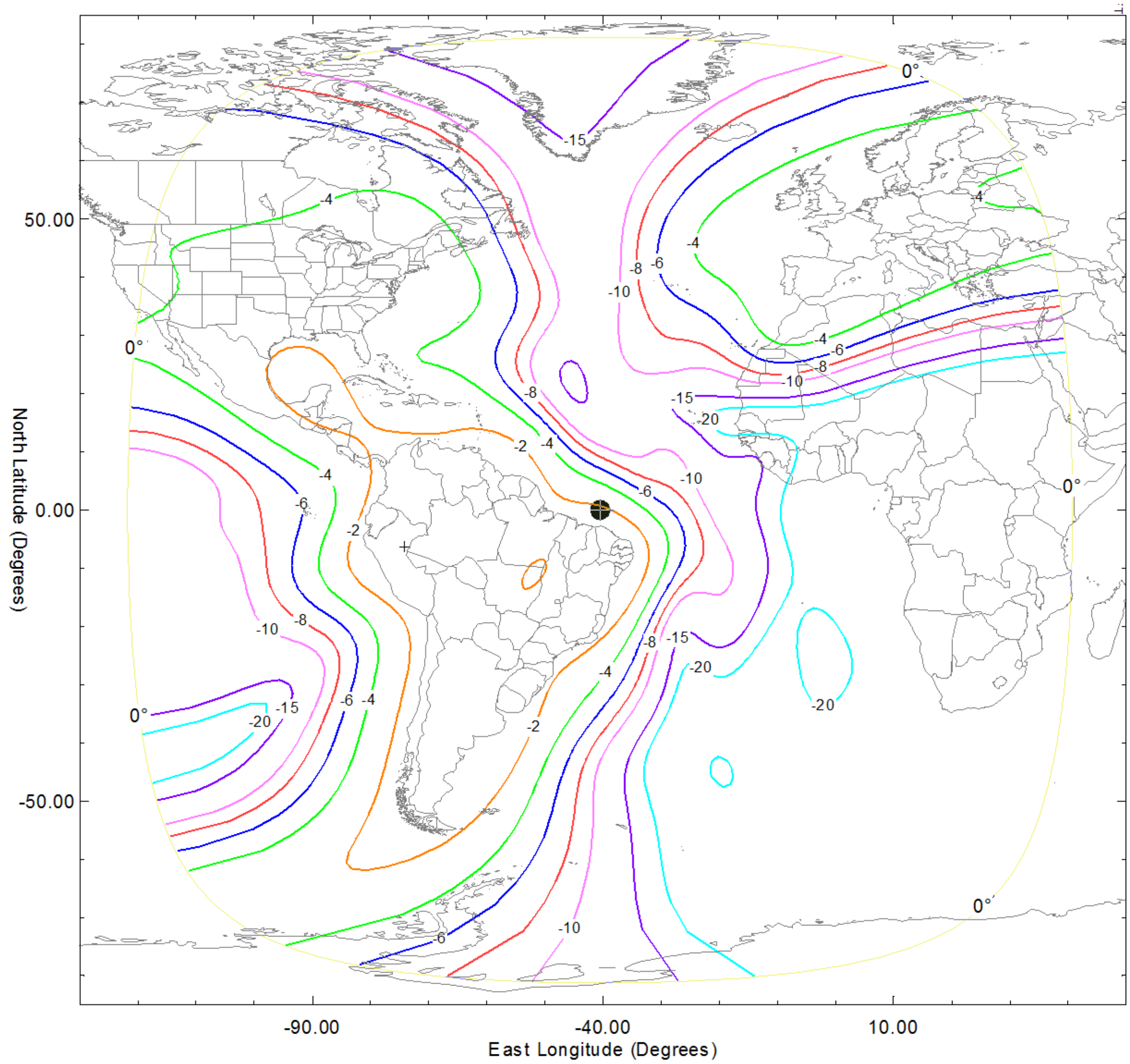

Figure 25.
Downlink Beam CDL
Peak Gain = 26.5 dBi
Left-Hand Circular Polarization

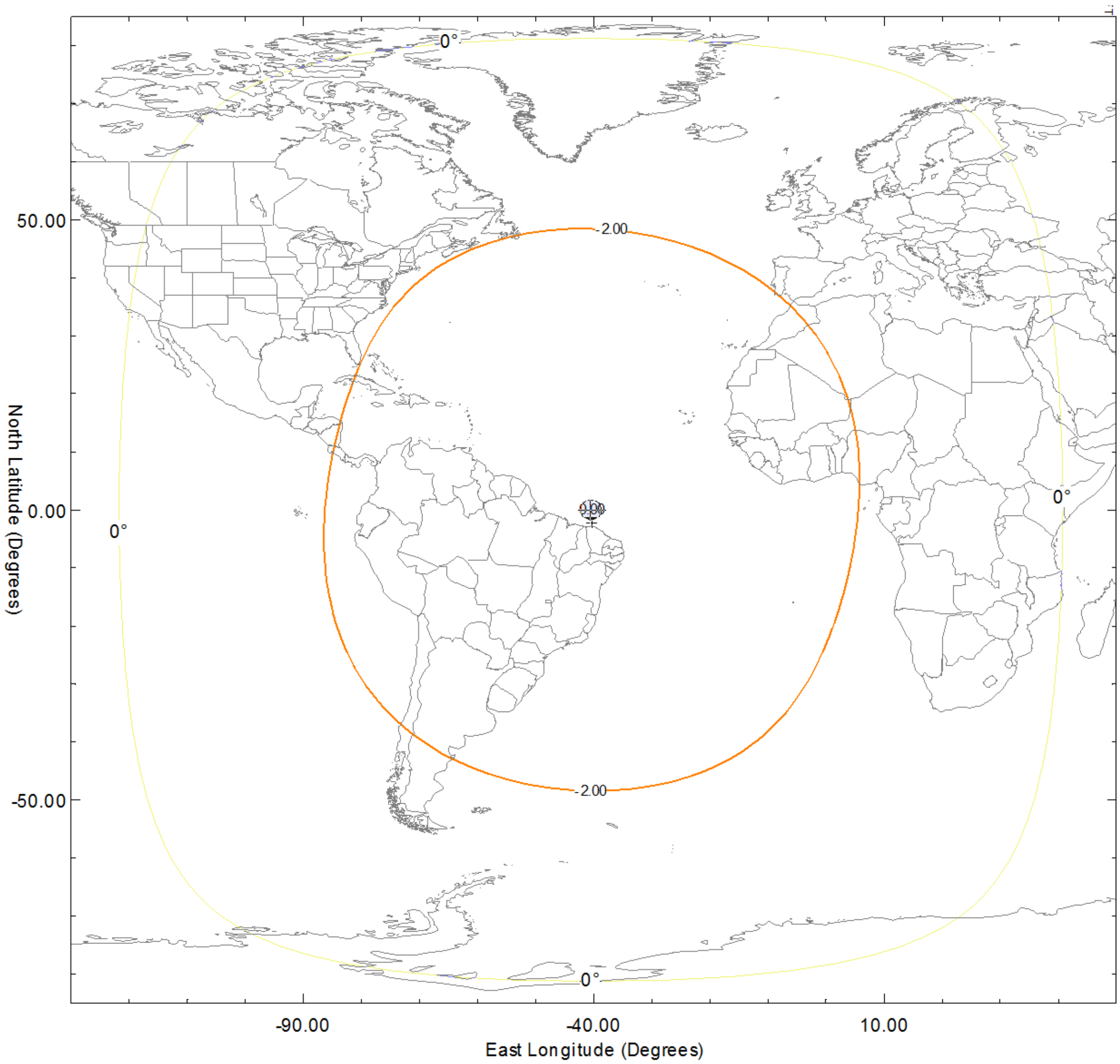

Figure 26.
Uplink Beam TCUH
Peak Gain = 20.2 dBi
Horizontal Polarization

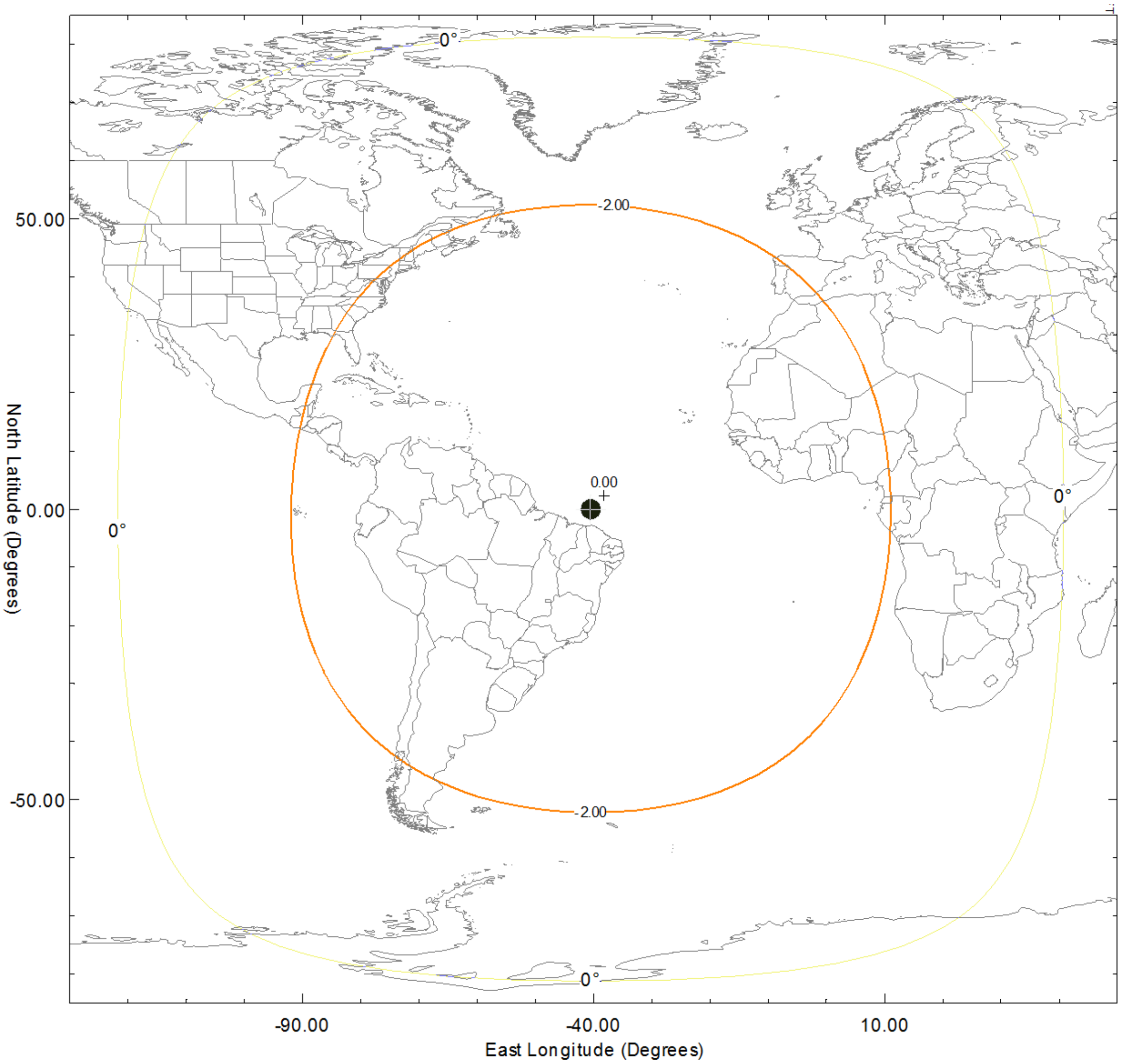

Figure 27.
Uplink Beam TCUV
Peak Gain = 20.2 dBi
Vertical Polarization

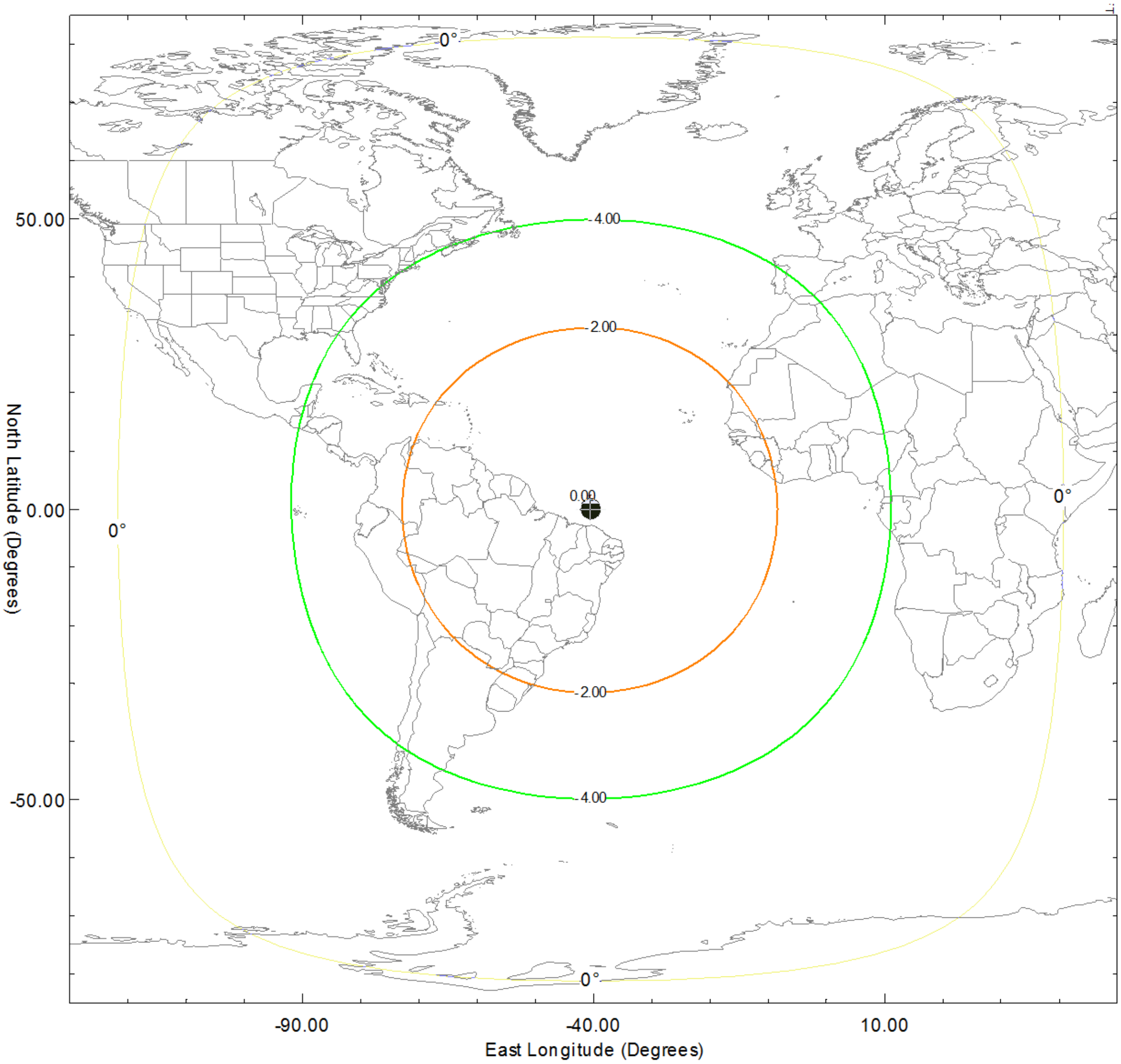

Figure 28.
Downlink Beam TMDH
Peak Gain = 23.3 dBi
Horizontal Polarization

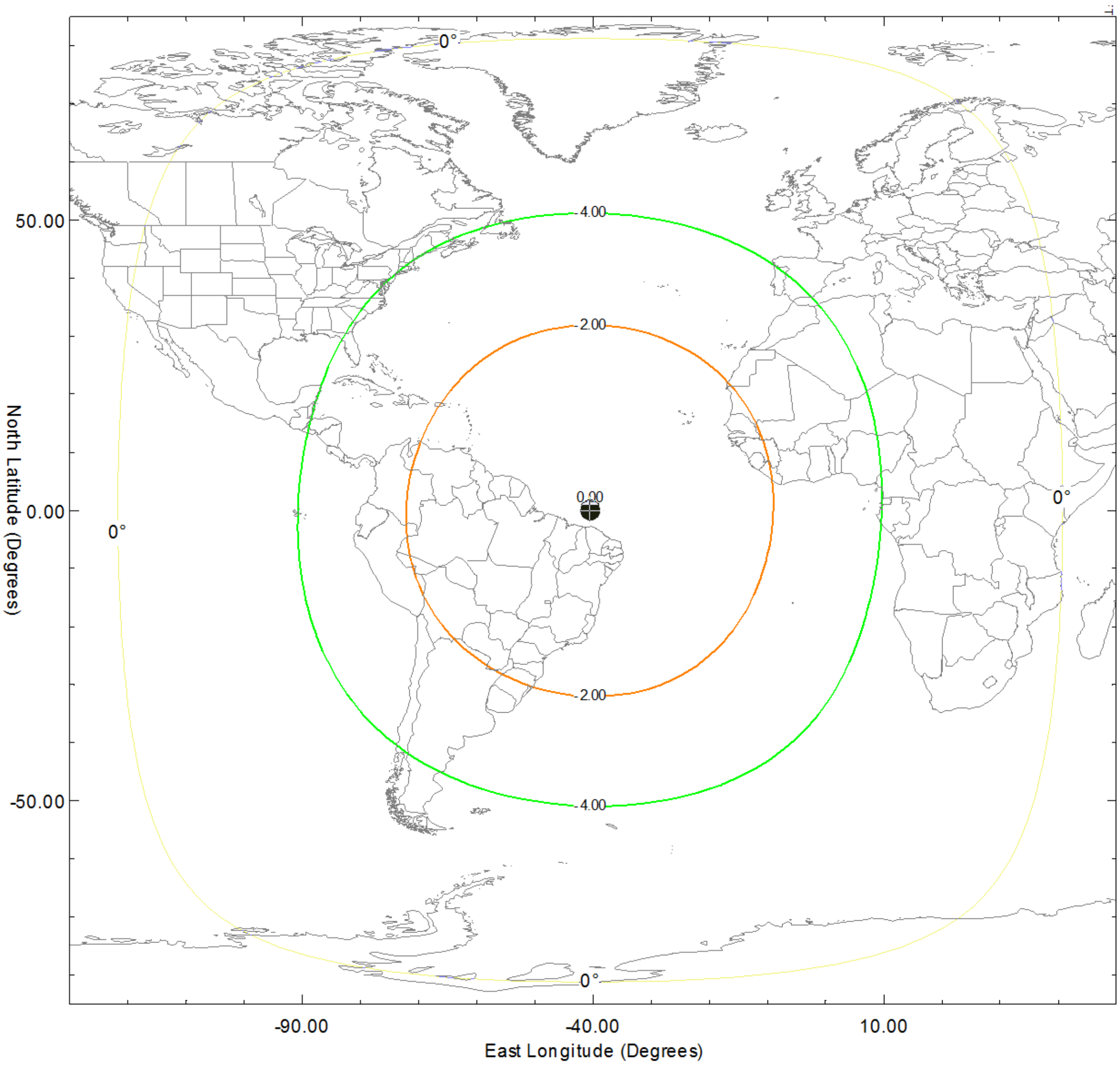

Figure 29.
Downlink Beam TMDV
Peak Gain = 23.3 dBi
Vertical Polarization

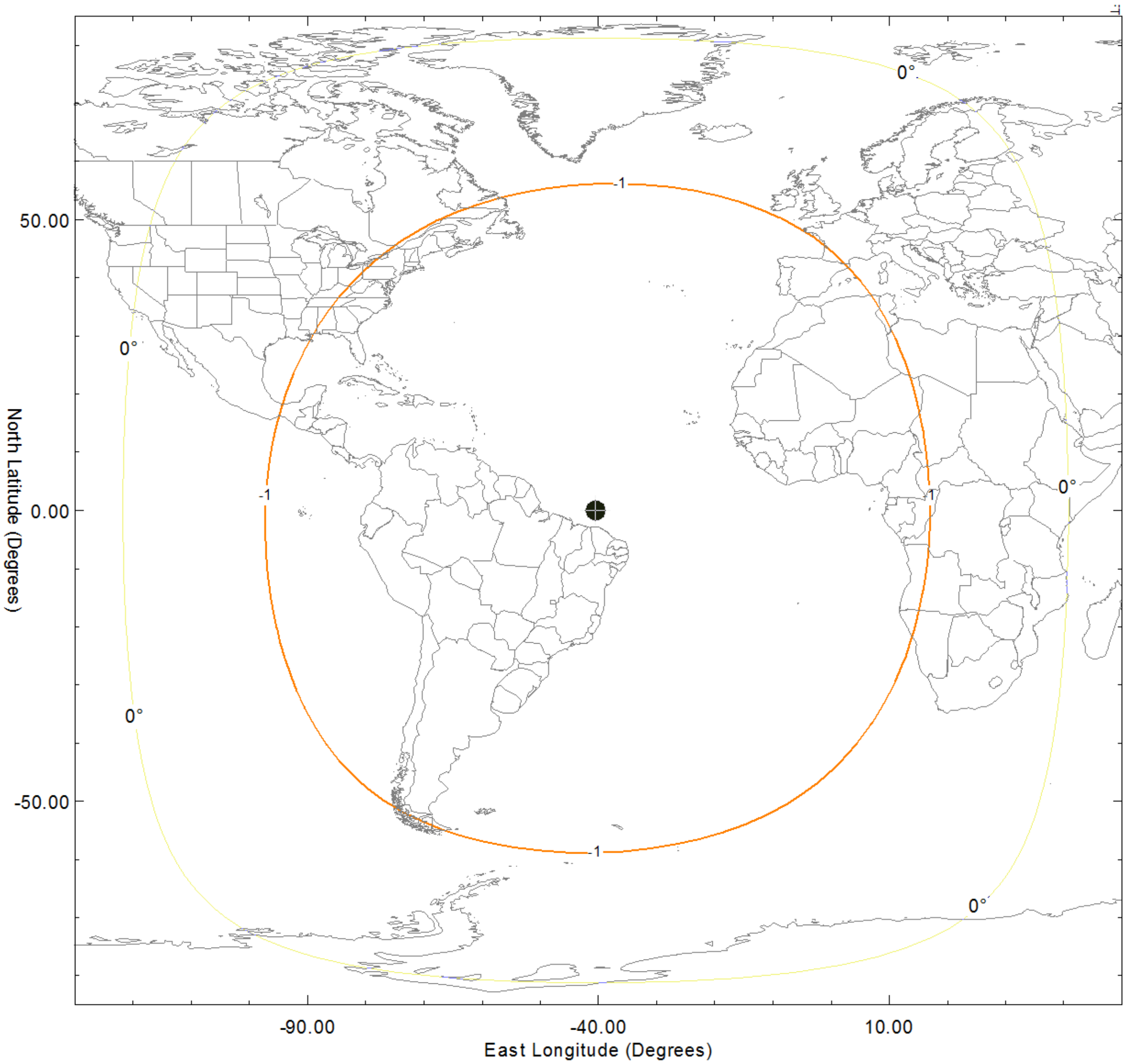

Figure 30.
Downlink Beam BCN1
Peak Gain = 16.7 dBi
Linear Polarization (45°)

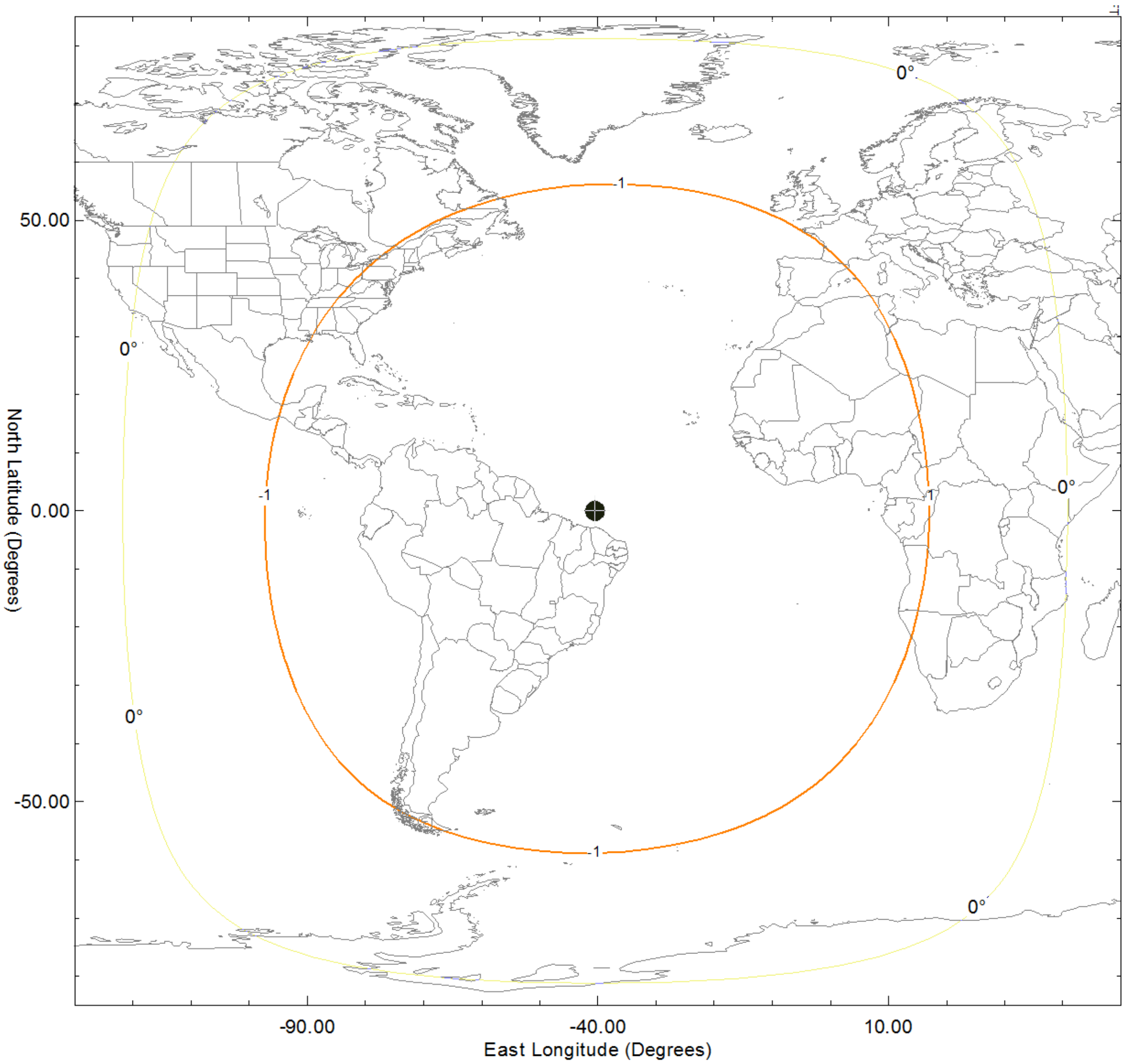

Figure 31.
Downlink Beam BCN2
Peak Gain = 16.7 dBi
Linear Polarization (-45°)

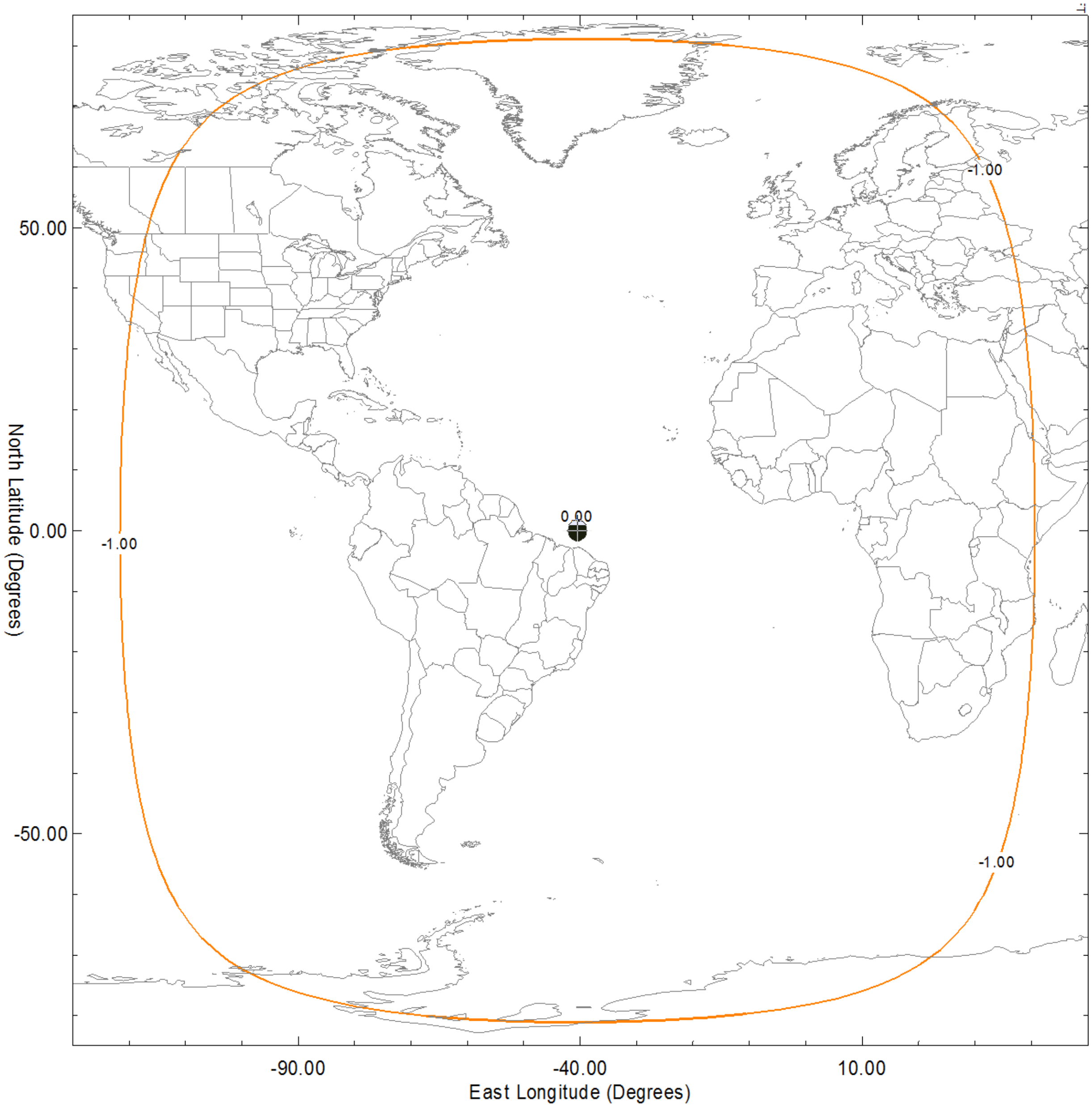

Figure 32.
Downlink Beam OMNUR
Peak Gain = 8.8 dBi
Right-Hand Circular Polarization

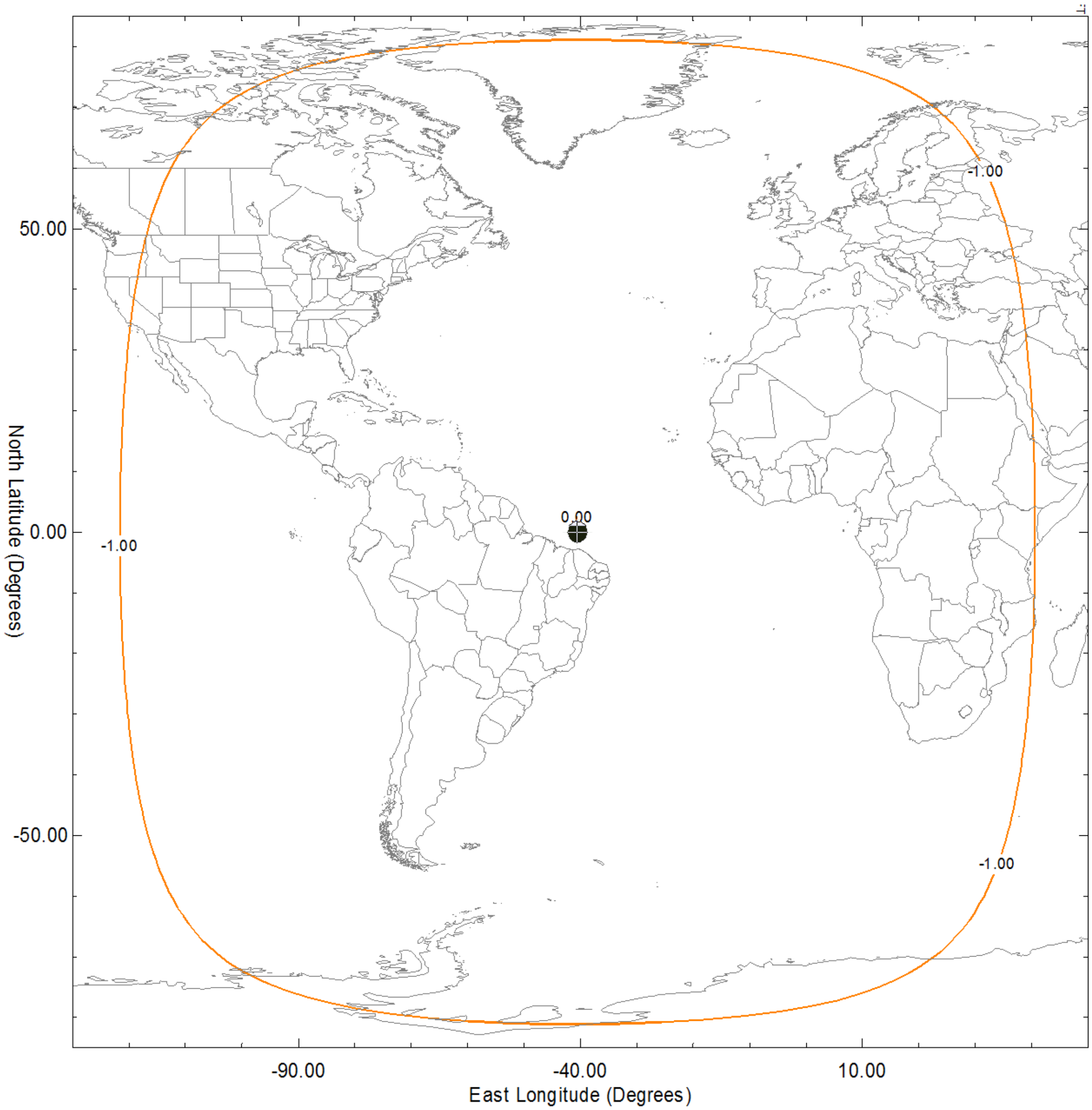

Figure 33.
Downlink Beam OMNUL
Peak Gain = 8.8 dBi
Left-Hand Circular Polarization

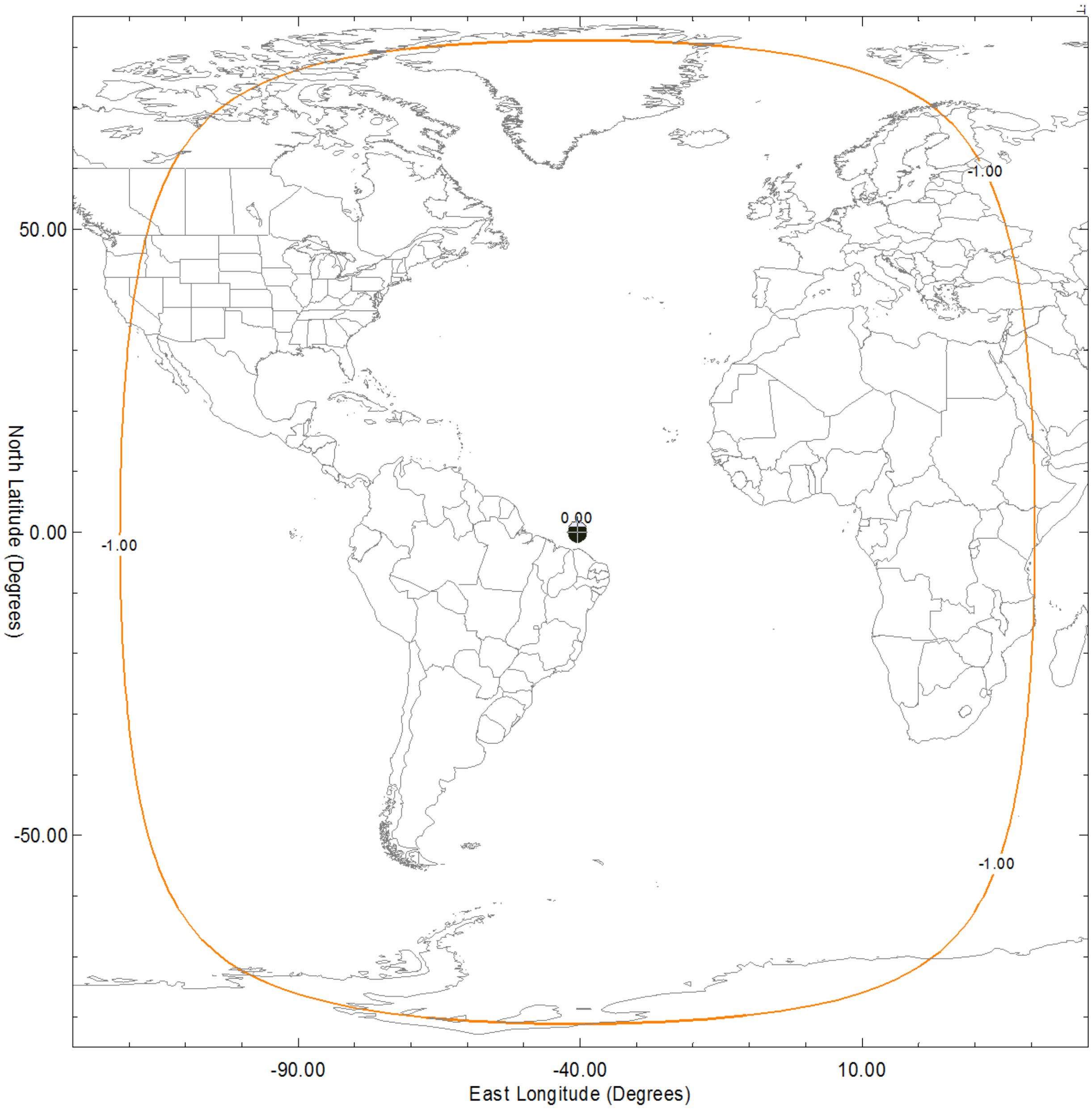

Figure 34.
Downlink Beam OMNDR
Peak Gain = 8.8 dBi
Right-Hand Circular Polarization

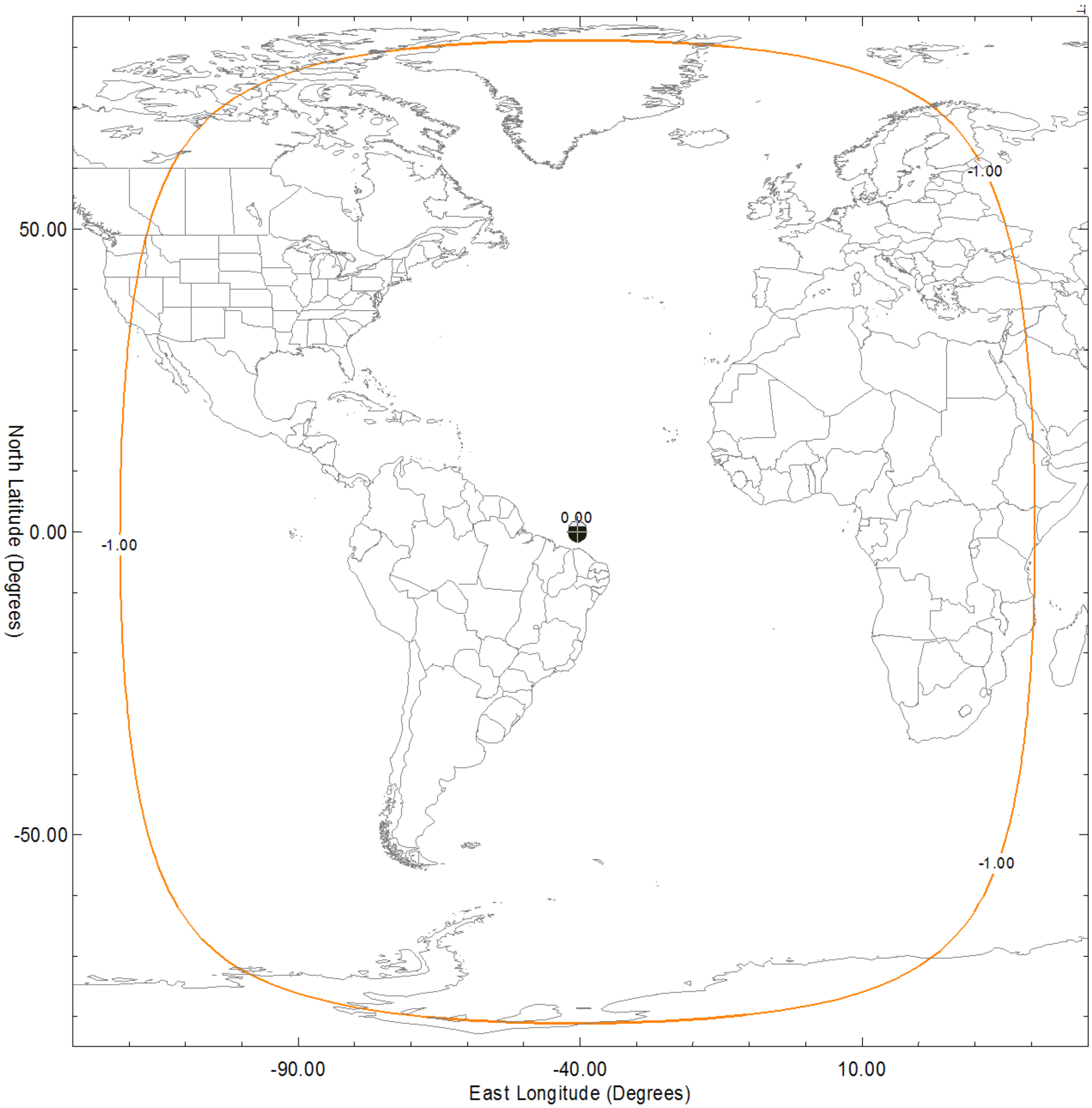

Figure 35.
Downlink Beam OMNDL
Peak Gain = 8.8 dBi
Left-Hand Circular Polarization
