

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

In the Matter of Application by)
)
XM Radio Inc.) File No. SAT-MOD-_____
) Call Sign S2118
For Modification of the XM-1 License)

APPLICATION OF XM RADIO INC.

XM Radio Inc. (“XM Radio”),¹ a satellite digital audio radio service (“SDARS”) licensee, hereby applies to modify the license for its XM-1 spacecraft, Call Sign S2118, to reassign the satellite from its current orbital position of 85.150° W.L. to 115.25° W.L. and operate it there with a +/-0.1 degree east-west stationkeeping tolerance. XM Radio seeks to relocate XM-1 to the nominal 115° W.L. orbital position in order to facilitate the use of XM-1 to provide back-up capacity for XM Radio’s SDARS operations. XM Radio requests an expanded stationkeeping volume at the new orbital location to permit collocation of XM-1 with XM-4 and XM-2. Apart from the relocation and expanded stationkeeping volume, XM Radio proposes no other changes in the operation of the XM-1 spacecraft.

A completed FCC Form 312 is attached, and XM Radio incorporates by reference the technical information previously provided in support of XM-1.² XM Radio herein provides updated technical information relating to the proposed modification to the XM-1 license. Grant of the requested authority will serve the public interest by facilitating safe and efficient operation of XM-1 in support of XM Radio’s satellite radio network.

¹ XM Radio is a wholly-owned subsidiary of Sirius XM Radio Inc. (“Sirius XM”).

² The most recent technical information submitted relating to XM-1 is found in File Nos. SAT-MOD-20070912-00124; SAT-AMD-20071113-00157; and SAT-AMD-20080129-00031, all grant-stamped on February 14, 2008.

MODIFICATION

XM-1 commenced operations at 85° W.L. on May 31, 2001. XM-1 was replaced as a primary operational satellite at 85° W.L. in April 2005, when XM-3 commenced operations.³ Following a period of temporary operation at 115° W.L., XM-1 returned to the nominal 85° W.L. location in August 2007, along with XM-2, which also functions as an in-orbit spare spacecraft.

XM Radio recently launched a new in-orbit spare satellite, XM-5, to 85.2° W.L.⁴ In connection with the XM-5 launch, XM Radio is reconfiguring its satellite fleet to enhance its ability to provide continuous service to Sirius XM's more than 40 million listeners. Earlier this year, XM Radio requested and received authority to relocate XM-4, one of its primary operational spacecraft, from 115.0° W.L. to 115.25° W.L. +/-0.1 degrees.⁵ The Commission has also authorized XM Radio to drift the XM-2 spare satellite from 85.217° W.L. to 115.25° W.L. in order to collocate it with XM-4.⁶

XM Radio here seeks authority to redeploy XM-1 to 115.25° W.L. as well. At 115.25° W.L., the XM-1 and XM-2 spare spacecraft can be used to restore service promptly in the event of an outage affecting XM Radio's primary spacecraft, without the need to repoint

³ When launched, XM-1 had an expected useful life of fifteen years. However, as the Commission is aware, XM Radio's initial in-orbit satellites, including XM-1, are Boeing 702 class spacecraft manufactured by Boeing Satellite Systems International, Inc. ("Boeing"). In late August 2001, Boeing advised XM Radio of a progressive degradation problem with the solar array output power of the Boeing 702 class satellites, including XM-1. XM Radio accelerated the replacement of XM-1 in response to these issues.

⁴ See File No. SAT-LOA-20090217-00025, Call Sign S2786, grant-stamped Aug. 31, 2009.

⁵ See File No. SAT-MOD-20100722-00165, Call Sign S2616, grant-stamped Oct. 14, 2010 ("XM-4 Modification Grant").

⁶ See File No. SAT-MOD-20101001-00205, Call Sign S2119, grant-stamped Nov. 9, 2010 ("XM-2 Modification Grant").

feeder link ground antennas. XM Radio requests authority to operate XM-1 at 115.25° W.L. with an east-west stationkeeping tolerance of +/- 0.1 degrees. XM Radio proposes to operate XM-1, XM-2 and XM-4 in formation. The larger requested stationkeeping volume for the three satellites will facilitate their safe operation and conserve fuel, prolonging their useful life.

As demonstrated in the attached technical appendix, granting the request to reassign XM-1 and operate it with an increased stationkeeping volume should not adversely affect any other satellite operators. At its proposed orbital location of 115.25° W.L. +/- 0.1 degrees, XM-1's stationkeeping volume will not overlap with those of any other satellites except spacecraft licensed to XM Radio and its affiliates.⁷

Furthermore, the proposed reassignment of XM-1 should not cause harmful interference to any other satellite operators. Except for other satellites licensed to XM Radio and its affiliates, no satellites using either the S-band or X-band frequencies assigned to XM-1 currently operate within two degrees of 115.25° W.L., nor is XM Radio aware of any such operations that are planned. XM Radio does not share S-band spectrum with other satellite systems, and the SDARS downlink frequencies are not subject to two degree spacing rules.

The Commission has generally afforded satellite operators the flexibility to design and modify their networks in response to customer requirements, absent compelling countervailing public interest considerations.⁸ In addition, the Commission has consistently

⁷ XM Radio's affiliate, Satellite CD Radio, has a pending application to launch and operate its FM-6 satellite at 115.2° W.L. See File No. SAT-LOA-20100409-00072. XM Radio will coordinate with its affiliate regarding the placement and operation of FM-6 at or near the 115.2° W.L. orbital location.

⁸ See, e.g. *AMSC Subsidiary Corporation*, 13 FCC Rcd 12316 at ¶ 8 (IB 1998) (the Commission generally leaves space station design decisions to the licensee "because the licensee is in a better position to determine how to tailor its system to meet the particular needs of its customers.") (footnote omitted).

recognized that ensuring continuity of service is an important public interest objective.⁹ The requested modification will allow XM Radio to operate XM-1 in formation with XM-4 and XM-2 in the stationkeeping volume bounded by 115.15° W.L. and 115.35° W.L. and will serve the public interest by permitting XM Radio to optimize use of its satellite assets to help ensure service reliability.

WAIVER REQUESTS

XM Radio requests limited waivers of the Commission’s requirements in connection with the requested XM-1 license modification. 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.¹⁰

Section 25.210(j): Section 25.210(j) of the Commission’s rules specifies that geostationary space stations “must be maintained within 0.05° of their assigned orbital longitude in the east/west direction, unless specifically authorized by the Commission to operate with a

⁹ See, e.g., *DIRECTV Enterprises, LLC, Request for Special Temporary Authority to Conduct Telemetry, Tracking and Control During the Relocation of DIRECTV 1 to the 72.5° W.L. Orbital Location*, Order and Authorization, DA 05-1890 (Sat. Div. rel. July 14, 2005) at ¶ 18 (granting STA to relocate spacecraft to a location where it will replace a satellite with failing solar panels “will enable DIRECTV to maintain continuity of DBS service to its customers”); *DIRECTV Enterprises, LLC, Application for Authorization to Operate DIRECTV 5, a Direct Broadcast Satellite, at the 109.8° W.L. Orbital Location*, Order and Authorization, DA 05-2654 (Sat. Div. rel. Oct. 5, 2005) at ¶ 8 (“DIRECTV’s proposal to provide DBS service from this location will serve the public interest, convenience and necessity in that it will ensure continuity of service to DIRECTV subscribers”).

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

different longitudinal tolerance.” 47 C.F.R. § 25.210(j). The Commission has previously waived this rule based on a finding that allowing an increased stationkeeping volume would “not adversely affect the operations of other spacecraft, and would conserve fuel for future operations.”¹¹ In addition, the Commission has waived the rule to allow multiple space stations to operate in formation within a combined stationkeeping volume.¹²

The facts here fit squarely within this precedent. As discussed above, allowing XM-1 to operate within an increased stationkeeping volume will not harm other operators. The only satellites with which XM-1’s stationkeeping volume will overlap are other spacecraft in the Sirius XM fleet. XM Radio will ensure that the satellites’ flight is closely controlled for safe joint operation. Furthermore, the proposed operations will not materially affect the interference environment.

Finally, allowing XM-1 to be flown in formation with XM-4 and XM-2 in an east-west stationkeeping volume of +/-0.1 degrees will result in fuel savings for all three spacecraft. This will prolong the time during which XM-1 and XM-2 will be available to provide any needed back-up capacity for XM-3 and XM-4. Under these circumstances, grant of any necessary waiver of Section 25.210(j) will serve the public interest.

Section 25.283(c): XM Radio also requests any necessary waiver of the requirements of Section 25.283(c) concerning venting excess propellant and relieving pressure

¹¹ *SES Americom, Inc. Application for Modification of Satcom SN-4 Fixed Satellite Space Station License*, 20 FCC Rcd 11542, 11545 (Sat. Div. 2005).

¹² *See SES Americom, Inc.*, File No. SAT-MOD-20080314-00072, Call Sign S2135, grant-stamped May 19, 2008 at ¶ 1 (“We agree with SES Americom that increasing the station-keeping volume of the AMC-4 spacecraft will not adversely affect the operations of other spacecraft, will conserve fuel for future operations and will facilitate coordinated operation of AMC-4 and AMC-2 in the same station-keeping range.”); *see also* XM-4 Modification Grant at ¶ 1 (authorizing operation of XM-4 with +/-0.1 degree east-west stationkeeping tolerance to facilitate flying spacecraft in formation with XM-1 and XM-2).

vessels at end of life. XM-1 is a Boeing 702 model spacecraft and was launched well before the Commission adopted or even proposed Section 25.283(c). As described in more detail in the attached Technical Appendix, the Boeing 702 has four tanks that retain residual pressure at end of life: two helium tanks sealed following completion of the launch phase, and two tanks containing xenon propellant that cannot be fully vented at end of life. Given the spacecraft design, it is physically impossible for XM Radio to vent these four tanks in order to comply with Section 25.283(c).

Under Commission precedent, grant of a waiver is warranted. In a number of cases involving both Boeing 702 satellites and other models, 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.¹³ In the case of XM-1, which was launched and operational before the Commission proposed venting requirements, there is no question of bringing the satellite into compliance with the rule. The Commission has expressly recognized this, finding a waiver of Section 25.283(c) to be justified for in-orbit spacecraft that cannot satisfy the rule's requirements. Specifically, in a decision involving the SES Americom AMC-2 satellite, which like XM-1 was launched before Section 25.283(c) took effect, the

¹³ See, e.g., *DIRECTV Enterprises LLC*, File No. SAT-LOA-20090807-00086, Call Sign S2797, grant-stamped Dec. 15, 2009, Attachment at ¶ 4 (granting a partial waiver of Section 25.283(c) for DIRECTV 12, a Boeing 702 model spacecraft, on grounds that requiring modification of satellite would present an undue hardship); *PanAmSat Licensee Corp.*, File Nos. SAT-MOD-20070207-00027, SAT-AMD-20070716-00102, Call Sign S2237, grant-stamped Oct. 4, 2007, Attachment at ¶ 7 (granting a partial waiver of Section 25.283(c) for Intelsat 11 on grounds of undue hardship). See also *Hughes Network Systems, LLC*, File Nos. SAT-MOD-20050523-00106 & SAT-AMD-20060306-00025, Call Sign S2663, grant-stamped June 29, 2006 (authorizing launch and operation of SPACEWAY 3, a Boeing 702 model satellite, without a Section 25.283(c) waiver).

Commission waived the rule on its own motion, observing that venting the spacecraft's sealed oxidizer tanks "would require direct retrieval of the satellite, which is not currently possible."¹⁴

The same practical obstacle is present here. Because XM-1 is already in orbit, XM Radio can do nothing to enable full venting of residual pressure in the helium and xenon tanks. Given this reality, waiver is clearly warranted; there is no possible public interest benefit in requiring strict adherence to a rule with which the licensee is incapable of complying.

The record also demonstrates that the inability to vent all residual helium and xenon will not compromise safe disposal of the spacecraft. Information from Boeing indicates that the pressure remaining in the tanks will be well below their tolerances, and both the residual helium and xenon are inert, posing no risk of chemical energy release. Under these circumstances, grant of any necessary waiver of Section 25.283(c) is warranted.

Section 25.114(d)(3): XM Radio requests a limited waiver of Section 25.114(d)(3) of the Commission's rules, which requires submission of predicted antenna gain contours for each transmit and receive antenna beam and specifies that for geostationary orbit satellites, the information must be provided in a .gxt format. As discussed in the Technical Appendix, contour maps for operation of XM-1 at the nominal 115° W.L. orbital location are already on file with the Commission, but were submitted before the Commission began requiring SDARS applicants to submit the data in .gxt format.

¹⁴ *SES Americom, Inc.*, File No. SAT-MOD-20100324-00056, Call Sign S2134, grant-stamped June 21, 2010, Attachment at ¶ 8. *See also* XM-4 Modification Grant at ¶ 2 (waiving Section 25.283(c) for XM-4, a Boeing 702 model spacecraft, because "modification of the spacecraft would present an undue hardship, since XM-4 is an in-orbit space station and venting XM-4's helium and xenon tanks would require direct retrieval of the satellite, which is not currently possible."); XM-2 Modification Grant at ¶ 6 (granting Section 25.283(c) waiver for XM-2 based on same rationale).

The Commission has previously waived the requirements of Section 25.114(d)(3) in similar factual circumstances.¹⁵ In acting on these requests, the Commission recognized that the purpose of the rule is to ensure that adequate information is available to allow evaluation of the potential for harmful interference.¹⁶ Here, in lieu of the .gxt file, XM Radio has provided alternative data that is sufficient to permit the Commission and any interested party to evaluate the antenna's interference potential. Accordingly, XM Radio requests limited waiver of Section 25.114(d)(3).

¹⁵ See, e.g., Application of PanAmSat Licensee Corp., File No. SAT-RPL-20061219-00155, Call Sign S2715, grant stamp dated April 24, 2007 (“*Galaxy 17 Grant*”) at ¶ 5 (waiving Section 25.114(d)(3) to allow submission of gain information for omni antenna in non-.gxt format where manufacturer did not provide .gxt data); *Spectrum Five, LLC*, Order and Authorization, DA 06-2439, 21 FCC Rcd 14023, 14033 at ¶ 17 (IB 2006) (conditionally accepting antenna gain information not filed in .gxt format); XM-2 Modification Grant at ¶ 7.

¹⁶ *Galaxy 17 Grant* at n.5.

CONCLUSION

For the foregoing reasons, XM Radio hereby respectfully requests that the Commission modify the license for XM-1 to reassign the satellite to 115.25° W.L. and to permit operations there with a +/- 0.1 degree east-west stationkeeping tolerance.

Respectfully submitted,

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TECHNICAL APPENDIX

1. INTRODUCTION

XM Radio submits this technical appendix in support of its application for a modification of the license of the XM-1 SDARS spacecraft. XM Radio seeks assignment of the satellite to 115.25° W.L. and authority to operate with a +/- 0.1 degree east-west stationkeeping tolerance. XM Radio incorporates by reference the technical information previously provided regarding operations of XM-1,¹ and provides herein information that is changing as a result of the proposed modification.

2. GAIN CONTOURS

XM-1 was previously licensed for operations at 115° W.L., and contour maps were submitted pursuant to Commission requirements for SDARS applicants at that time.² The proposal to operate XM-1 at 115.25° W.L. rather than at 115° W.L. will produce no visible change in the gain contours from the contour maps already on file.

3. LINK BUDGETS AND INTERFERENCE ANALYSIS

With the exception of satellites operated by XM Radio, no satellites within two degrees of the 115.25° W.L. orbital location operate in either the S-band frequencies XM Radio uses for service links or the X-band frequencies XM Radio uses for feeder links. XM Radio does not

¹ The most recent technical information submitted relating to XM-1 is found in File Nos. SAT-MOD-20070912-00124; SAT-AMD-20071113-00157; and SAT-AMD-20080129-00031, all grant-stamped on February 14, 2008.

² See File No. SAT-MOD-20040212-00017, Appendix B at 3-4, granted in *XM Radio Inc.*, Order and Authorization, 20 FCC Rcd 1620 (Sat. Div. 2005). XM Radio is attaching as Annex 1 hereto copies of the original contour maps for operation of XM-1 (identified as "XM-Roll" in the Annex) at 115° W.L. for the Commission's convenience.

share S-band spectrum with satellite systems other than its affiliate Satellite CD Radio, and the SDARS downlink frequencies are not subject to two degree spacing rules.

At 115.25° W.L., XM-1 will be co-located with XM Radio's primary operational satellite, XM-4, and will serve as an in-orbit spare. In its application to operate XM-4 at 115.25° W.L., XM Radio demonstrated that operating XM-4 as proposed will result in no material change to the interference environment with respect to existing or future adjacent satellites.³ XM Radio incorporates that showing by reference herein. In the unlikely event that any future concerns arise with respect to operations of XM-1 at the proposed offset location, XM Radio will coordinate as necessary with the adjacent operators in order to arrive at a mutually satisfactory solution.

4. UPDATED ORBITAL DEBRIS MITIGATION STATEMENT

Pursuant to Section 25.114(d)(14) of the Commission's rules, XM Radio hereby submits the following supplemented information regarding orbital debris mitigation:

Spacecraft Hardware Design (47 C.F.R. § 25.114(d)(14)(i)). XM Radio has assessed and limited the amount of debris released in a planned manner during normal operations of XM-1. XM-1 will not be a source of debris during operating mode, as XM Radio does not intend to release debris during normal on-station operations, and the spacecraft will be in a stable configuration. XM Radio has requested authority to operate within a +/- 0.1 degree east-west control box.

XM Radio has assessed and limited the probability of XM-1 becoming a source of debris by collisions with small debris or meteoroids (smaller than one centimeter in diameter) that could

³ See File No. SAT-MOD-20100722-00165, Call Sign S2616, Technical Appendix at 1-2, grant-stamped Oct. 14, 2010.

cause loss of control and prevent post-mission disposal. The design of XM-1 locates all critical spacecraft components within the body of the structure, which provides protection from small orbital debris, and XM Radio has ensured that satellite subsystems have redundant components. The command receivers and decoders, telemetry encoders and transmitters, the bus control electronics, and the power subsystem components are fully redundant, physically separated, and located within a shielded area to minimize the possibility of the spacecraft becoming a source of debris due to a collision.

Minimizing Accidental Explosions (47 C.F.R. § 25.114(d)(14)(ii)). XM Radio has assessed and limited the possibility of accidental explosions during and after completion of mission operations. XM-1 has been designed to minimize the potential for accidental explosions through propellant leakage and fuel and oxidizer mixing or other means. Propellant tanks and thrusters are isolated using redundant valves, and electrical power systems are shielded in accordance with standard industry practices. During the mission, batteries and various critical areas of the propulsion subsystem are monitored to avoid conditions that could result in explosion.

After XM-1 reaches its final disposal orbit, its batteries will be discharged, all on-board sources of stored energy will be depleted, all fuel line valves will be left open, and all active units will be turned off. XM-1 is a Boeing 702 model, and as the Commission is aware, four vessels on the spacecraft will retain residual pressure at the satellite's end of life.⁴ Two of the

⁴ See, e.g., Hughes Network Systems, LLC, Amendment to Application for Spaceway 3 Satellite, File No. SAT-AMD-20060306-00025, Call Sign S2663, Narrative at 20-22 (describing characteristics of SPACEWAY 3, a Boeing 702 model spacecraft, and its inability to vent residual helium and xenon at end of spacecraft life), grant-stamped June 29, 2006; DIRECTV Enterprises LLC, Application for Authorization to Launch and Operate DIRECTV 12, File No. SAT-LOA-20090807-00086, Call Sign S2797, Narrative at 19-21 (helium and xenon tanks on

vessels contain helium used to maintain pressure in the propellant tanks during launch. At the end of the launch phase, these tanks were permanently sealed in order to prevent fuel and oxidizer from bleeding back into the lines where they could mix and create the risk of explosion. Boeing has estimated that each helium tank, which has a volume of 0.068 m³, will contain residual helium at end of life with a mass of approximately 158 grams and a volume of 0.068 m³.

The other two vessels contain xenon propellant for the satellite's XIPS drives, which are used for deorbit maneuvers. These tanks are equipped with a regulator, and once the pressure drops below the set point of the regulator, no more gas flows out of the tanks. Boeing estimates that at end of life, each xenon tank, which has a volume of 0.068 m³, will contain residual xenon with a mass of approximately 1100 grams and a volume of 0.068 m³.

Both the residual helium and the residual xenon are inert, posing no risk of chemical energy release. Furthermore, the tanks are well shielded, and the residual pressure in the tanks will be well below their maximum rating. In the narrative portion of this application, XM Radio requests any necessary waiver of Section 25.283(c) in connection with the residual helium and xenon that will remain in these tanks at the end of the satellite's life.

Safe Flight Profiles (47 C.F.R. § 25.114(d)(14)(iii)). XM Radio has assessed and limited the possibility of XM-1 becoming a source of debris by collisions with large debris or other operational space stations. Specifically, XM Radio has assessed the possibility of collision with satellites located at, or reasonably expected to be located at, the requested orbital locations or assigned in the vicinity of those locations.

The underlying application requests reassignment of XM-1 to 115.25° W.L. with a +/- 0.1 degree east-west stationkeeping tolerance to permit operation of XM-1 in formation with

DIRECTV 12, a Boeing 702 model spacecraft, will retain residual pressure at end of life), grant-stamped Dec. 15, 2009.

XM-4 and XM-2. XM Radio is not aware of any other FCC- or non-FCC licensed spacecraft that are operational or planned to be deployed at 115.25° W.L. or to nearby orbital locations such that there would be an overlap with the proposed stationkeeping volume of XM-1.⁵

During relocation, the moving spacecraft is maneuvered such that it is at least 10 km away from any nearby satellites when the drift begins or ends and at least 30 km away from the synchronous radius when the planned drift rate is achieved. Advance notification is given to any other operators through whose stationkeeping volumes the spacecraft will pass. 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.

Post-Mission Disposal (47 C.F.R. § 25.114(d)(14)(iv)). The plans for post-mission disposal of XM-1 from operational orbit are already on file with the Commission.⁶

5. SCHEDULE S

As discussed above, the proposed modification of the XM-1 license involves relocation of the spacecraft to the nominal 115° W.L. orbital location, and XM-1 previously operated at that position. Accordingly, full technical information regarding operation of XM-1 at 115° W.L. is already on file with the Commission.⁷ The proposal here to offset XM-1 by 0.25 degrees from its former orbital location will not result in any material changes to the spacecraft's operating characteristics or to the interference environment. As a result, the

⁵ As noted previously, XM Radio's affiliate, Satellite CD Radio, has a pending application to launch and operate its FM-6 satellite at 115.2° W.L. See File No. SAT-LOA-20100409-00072. XM Radio will coordinate with its affiliate regarding the placement and operation of FM-6 at or near the 115.2° W.L. orbital location.

⁶ See File No. SAT-AMD-20080129-00031, Call Sign S2118, Amendment Narrative at 3-4.

⁷ See File No. SAT-MOD-20040212-00017.

information requested in Schedule S duplicates information that is already on file with the Commission concerning the technical parameters of XM-1's proposed operation. In similar cases involving requests for slight offsets from the nominal orbital position, the Satellite Division has not required the submission of a new Schedule S.⁸ Accordingly, XM Radio is not filing a Schedule S with this application. XM Radio will nevertheless prepare and submit a Schedule S upon request of the Commission staff.

⁸ See, e.g., File No. SAT-MOD-20040405-00076 (PanAmSat request for authority to operate SBS-6 at 74.05° W.L. rather than 74.0° W.L.).

Figure B-1: S-band Transmit EIRP Contours for XM-Roll Collocated at 115°W

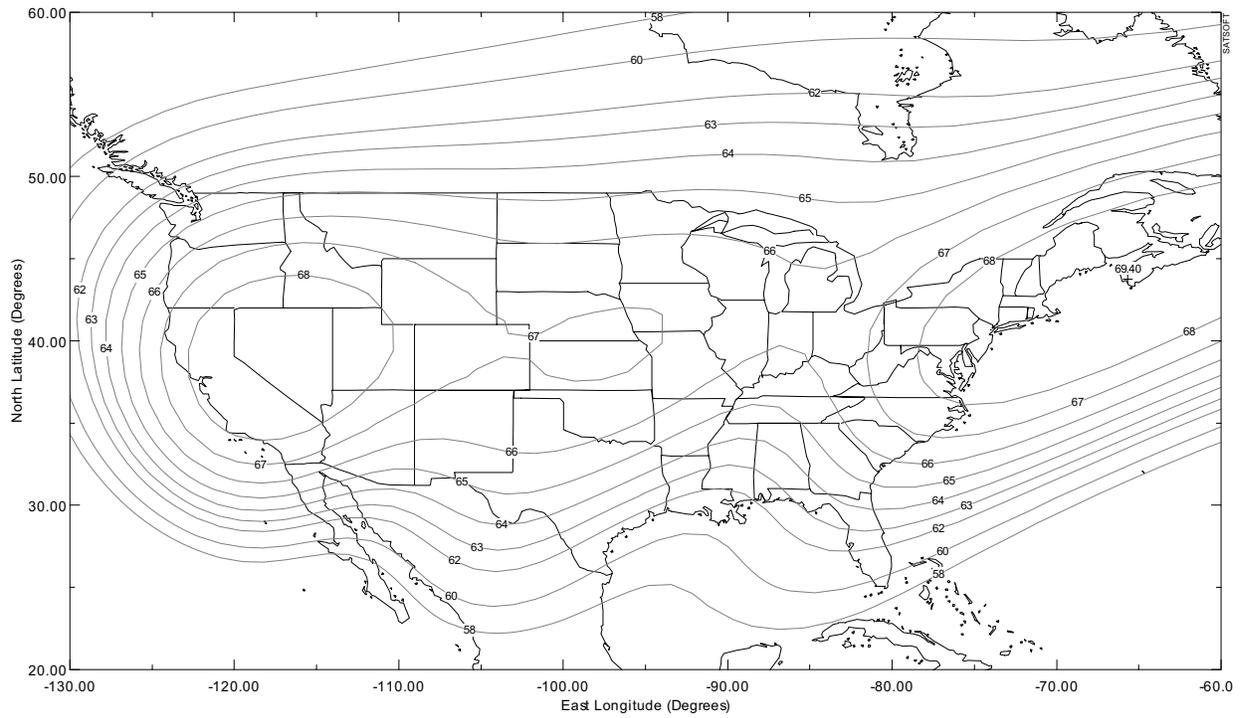


Figure B-2: X-band Receive Gain Contours for XM-Roll Collocated at 115°W

