

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

In the Matter of)	
)	
SES AMERICOM, INC.)	File No. SAT-MOD-_____
)	Call Sign S2347
Application for Modification of AMC-6)	
Fixed-Satellite Space Station License)	

APPLICATION OF SES AMERICOM, INC.

SES Americom, Inc. (“SES”) respectfully requests a modification of its license for the AMC-6 C- and Ku-band fixed-satellite space station to extend the satellite’s license term to June 30, 2027. The requested extension will serve the public interest by enabling SES to continue to offer services using AMC-6, thus promoting efficient use of satellite and orbital resources. In addition, SES seeks any necessary further authority for deorbit of the satellite at end of life. A completed FCC Form 312 is attached, and SES incorporates by reference the technical information previously provided in support of AMC-6.¹ In addition, SES is providing an updated orbital debris mitigation statement regarding the spacecraft.

MODIFICATION

AMC-6 is a hybrid C/Ku-band satellite that is licensed to operate pursuant to Commission authority at 72° W.L. AMC-6 commenced operations on November 20, 2000,² and

¹ The most recent technical information submitted relating to AMC-6 is found in File No. SAT-MOD-20050819-00163 (the “AMC-6 Modification”).

² See IBFS File No. SAT-LOA-19971222-00230, Letter of Karis A. Hastings to Magalie Roman Salas dated Dec. 5, 2000 (reporting that what was then known as the “GE-6” spacecraft commenced operations at 72° W.L. on November 20, 2000).

accordingly, the satellite's current license term expires on November 20, 2015.³ SES requests an extension of the AMC-6 license term to June 30, 2027. SES has calculated that there is sufficient fuel onboard the AMC-6 spacecraft for the spacecraft to continue providing reliable service during the proposed extended license term and to deorbit the spacecraft to a disposal altitude of at least 150 km above geostationary orbit (see below).⁴ In making these calculations, SES has assumed that standard stationkeeping maneuvers will be performed to maintain AMC-6 within its existing east-west and north-south stationkeeping tolerances.⁵ Furthermore, SES has made allowance in its fuel life calculations for the possibility of two relocations during the requested extension term of the AMC-6 license.⁶

The AMC-6 satellite has experienced solar array circuit failures that have affected the total power available to the spacecraft. Apart from these, the satellite's overall health is good, with all satellite subsystems functioning nominally. There is no single point of failure in the

³ See 47 C.F.R. § 25.121 (for geostationary satellites, the license term is fifteen years and begins on the date of commencement of operations of the satellite at its assigned orbital location in conformance with the license); see also File No. SAT-MOD-20050819-00163, grant-stamped Oct. 26, 2005 (AMC-6 license term date is fifteen years from operating date). The Commission's IBFS database incorrectly lists October 22, 2015, as the end of the current AMC-6 license term. That date appears to be based on the date AMC-6 was launched, not on the date operations commenced.

⁴ SES developed the nominal lifetime prediction by estimating future fuel consumption, including for the planned deorbiting maneuvers, and taking into account fuel usage predictions based on data from previous maneuvers. SES's calculations use lifetime models that incorporate uncertainty in a number of variables including initial tank loading, fuel usage efficiency, and the oxidizer to fuel ratio.

⁵ The calculations do not assume that the spacecraft will be placed into inclined orbit during the requested extension term. If AMC-6 is placed into inclined orbit during this time, the lifetime of the satellite will be extended.

⁶ Depending on the distance and speed of any such relocations, the expected lifetime of the satellite may be longer or shorter than estimated. In any case, SES will de-orbit the spacecraft to at least 150 km above the geostationary arc (as discussed below), regardless of the remaining term of the AMC-6 license.

satellite's design; and there is no problem with the satellite's TT&C links, including the back-up TT&C links. As a result, extending the license term for AMC-6 will serve the public interest by allowing SES to continue to use the spacecraft to provide service to customers, promoting the efficient use of satellite and orbital resources.

SES also seeks any necessary Commission authority to relocate AMC-6 at its end of life to a disposal orbit with a minimum perigee altitude of at least 150 km above the geostationary arc.⁷ Because AMC-6 was launched before March 18, 2002, the spacecraft is not subject to the minimum perigee requirements of Section 25.283(a).⁸ The Commission has previously authorized the use of a 150-km deorbit altitude for spacecraft launched prior to March 18, 2002.⁹ Calculations performed by SES indicate that at the conclusion of the requested extension period, the spacecraft will have sufficient fuel to reach the proposed deorbit altitude, barring a catastrophic failure of satellite components.

WAIVER REQUEST

SES requests any necessary waiver of Sections 25.114(d)(14)(ii) and 25.283(c) of the Commission's requirements in connection with the instant modification application. Grant of the waivers is consistent with Commission policy:

The Commission may waive a rule for good cause shown.
Waiver is appropriate if special circumstances warrant a

⁷ No change has occurred in the disposal orbit plan previously filed as part of the AMC-6 Modification. *See* File No. SAT-MOD-20050819-00163, Technical Appendix at 7 (describing plan to raise the orbit a minimum of 150 km above the normal operational altitude). The Commission granted that modification without expressly addressing disposal matters. *See* File No. SAT-MOD-20050819-00163, grant-stamped Oct. 26, 2005. To avoid uncertainty, SES is seeking here any further authority required for its plan for post-mission disposal of AMC-6.

⁸ *See* 47 C.F.R. § 25.283(d).

⁹ *See, e.g., SES Americom, Inc., Application for Modification of Satcom SN-4 Fixed Satellite Space Station License, DA 05-1812, 20 FCC Rcd 11542 (Sat. Div. 2005) at ¶ 15.*

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

Sections 25.114(d)(14) and 25.283(c) address requirements relating to venting stored energy sources at the spacecraft's end of life.¹¹ AMC-6 is a Lockheed Martin A2100A model spacecraft. As described in more detail in the attached Orbital Debris Mitigation Statement, the oxidizer tanks on the spacecraft were sealed following completion of the launch phase and will therefore retain residual pressure when the spacecraft is retired. Given the spacecraft design, it is physically impossible for SES to vent the oxidizer tanks in order to comply with Section 25.283(c).

Under Commission precedent, grant of a waiver is warranted. In a number of cases involving various spacecraft models with similar limitations, the Commission has waived Section 25.283(c) to permit launch and operation of spacecraft that do not allow for full venting of pressure vessels at end of life, based on a finding that modifying the space station design at a late stage of construction would pose an undue hardship.¹² In the case of AMC-6, which was

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

¹¹ 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).

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

launched and operational before the venting requirements were adopted, 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. For example, in a decision involving the AMC-2 satellite, which like AMC-6 was launched before Section 25.283(c) was adopted, the Commission waived the rule on its own motion, observing that venting the spacecraft's sealed oxidizer tanks "would require direct retrieval of the satellite, which is not currently possible."¹³

The same practical obstacle is present here. Because AMC-6 is already in orbit, SES can do nothing to enable full venting of residual pressure in the oxidizer tanks. Given this reality, a waiver is clearly warranted.

For the foregoing reasons, SES seeks a modification of the AMC-6 license to extend the satellite's license term through June 30, 2027.

Respectfully submitted,

SES AMERICOM, INC.

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¹³ File No. SAT-MOD-20101215-00261, Call Sign S2134, grant-stamped Mar. 8, 2011, Attachment at ¶ 4. *See also XM Radio Inc.*, File No. SAT-MOD-20100722-00165, Call Sign S2616, grant-stamped Oct. 14, 2010, Attachment at ¶ 2 (waiving Section 25.283(c) for XM-4, a Boeing 702 model spacecraft, because "modification of the spacecraft would present an undue hardship, since XM-4 is an in-orbit space station and venting XM-4's helium and xenon tanks would require direct retrieval of the satellite, which is not currently possible").

Attachment A: Updated Orbital Debris Mitigation Statement

SES hereby updates the information previously provided in the AMC-6 Modification regarding the orbital debris mitigation plan for AMC-6.

A.1. Spacecraft Hardware Design (§ 25.114(d)(14)(i)):

SES has assessed and limited the amount of debris released in a planned manner during normal operations of AMC-6 at 72° W.L. No debris is generated during normal on-station operations, and the spacecraft is 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 the AMC-6 satellite locates all sources of stored energy within the body of the structure, which provides protection from small orbital debris. SES requires that spacecraft manufacturers assess the probability of micrometeorite damage that can cause any loss of functionality. This probability is then factored into the ultimate spacecraft probability of success. Any significant probability of damage would need to be mitigated in order for the spacecraft design to meet SES's required probability of success of the mission. SES has taken steps to limit the effects of any collisions through shielding, the placement of components, and the use of redundant systems.

A.2. Minimizing Accidental Explosions (§ 25.114(d)(14)(ii)):

The AMC-6 satellite was designed and manufactured by Lockheed Martin and was launched in 2000.

SES has assessed and limited the probability of accidental explosions during and after completion of mission operations. As part of the Safety Data Package submission for SES spacecraft, an extensive analysis is completed by the spacecraft manufacturer, reviewing each

potential hazard relating to accidental explosions. A matrix is generated indicating the worst-case effect, the hazard cause, and the hazard controls available to minimize the severity and the probability of occurrence. Each subsystem is analyzed for potential hazards, and the Safety Design Package is provided for each phase of the program running from design phase, qualification, manufacturing and operational phase of the spacecraft. Also, the spacecraft manufacturer generates a Failure Mode Effects and Criticality Analysis for the spacecraft to identify all potential mission failures. The risk of accidental explosion is included as part of this analysis. This analysis indicates failure modes, possible causes, methods of detection, and compensating features of the spacecraft design.

The design of the AMC-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, are monitored by telemetry.

At the end of operational life, after the satellite has reached its final disposal orbit, onboard sources of stored energy will be depleted or secured, and the batteries will be discharged. However, at the end of AMC-6's operational life, there will be oxidizer remaining in the tanks that cannot be vented. Following insertion of the spacecraft into orbit, the spacecraft

manufacturer permanently sealed the oxidizer tanks by firing pyrotechnic valves. This is a design feature of the Lockheed A2100 series spacecraft that cannot now be changed or remedied.

Information regarding the residual oxidizer in the tanks is as follows:

Tank	Volume [l]	Pressure [bar]	Temp. [deg C]	Oxidizer mass [kg]
Ox 1	328.2	14.0	36	10.48
Ox 2	328.2	14.0	36	10.48

The oxidizer tanks are well shielded, and the residual pressure in the tanks will be well below their maximum rating.

In the narrative portion of this application, SES requests any necessary waiver of Sections 25.114(d)(14)(ii) and 25.283(c) in connection with the residual oxidizer that will remain in these tanks at the end of the satellite's life.

A.3. Safe Flight Profiles (§ 25.114(d)(14)(iii)):

SES has assessed and limited the probability of the space station becoming a source of debris by collisions with large debris or other operational space stations. Specifically, SES has assessed the possibility of collision with satellites located at, or reasonably expected to be located at, the requested orbital location or assigned in the vicinity of that location.

Regarding avoidance of collisions with controlled objects, in general, if a geosynchronous satellite is controlled within its specified longitude and latitude 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 Americom is not aware of any other FCC- or non-FCC licensed spacecraft that are operational or planned to be deployed at 72° W.L. or to nearby orbital locations such that there would be an overlap with the stationkeeping volume of AMC-6.

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. In the event that collocation with another satellite is required, SES will use the proven Inclination-Eccentricity (IE) technique to ensure adequate separation between 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 Americom 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 deorbit of a spacecraft is required, the initial phase is treated as a satellite move, and the same precautions are used to ensure collision avoidance.

A.4. Post Mission Disposal Plan (§ 25.114(d)(14)(iv)):

Post-mission disposal of the satellite from operational orbit will be accomplished by carrying out maneuvers to raise the satellite 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.

AMC-6 is not subject to the minimum perigee requirement of Section 25.283(a) of the Commission’s Rules because the satellite was launched prior to March 18, 2002. SES plans to maneuver AMC-6 to a disposal orbit with a minimum perigee at least 150 km above its

operational geostationary orbit. SES intends to reserve 16.3 kg of fuel in order to account for post-mission disposal of AMC-6. SES has assessed fuel-gauging uncertainty and has provided an adequate margin of fuel reserve to address the assessed uncertainty.

DECLARATION

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

/s/ Pascal Wauthier

Pascal Wauthier
Senior Vice President, Space Operations
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Dated: August 20, 2015