ECHOSTAR SATELLITE L.L.C.

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Federal Communications Commission
Office of the Secretary

Marlene H. Dortch
Secretary
Federal Communications Commission
445 12th Street S.W.
Washington, D.C. 20554

Re: **EchoStar Satellite Operating L.L.C.**
File Nos. SAT-LOA-20051221-00247, SAT-AMD-20060120-00007, SAT-MOD-20060329-00031

Dear Ms. Dortch,

EchoStar Satellite Operating L.L.C.[1] ("EchoStar") updates its orbital debris mitigation plan for the EchoStar 10 satellite, previously submitted on December 21, 2005. That satellite uses the Lockheed Martin A2100 bus, and EchoStar discovered that this update was appropriate recently when filing its application to operate the AMC-14 satellite, which uses the same bus. The characteristics of the EchoStar 10 and AMC-14 satellites are shared by a large number of Lockheed Martin A2100 satellites in operation today. We want to ensure that the Commission has a full and comprehensive record with respect to our EchoStar 10 satellite. That satellite has been a critical addition to our satellite fleet, allowing us to expand greatly the number of local broadcast markets served by DISH Network.

In the EchoStar 10 satellite orbital debris mitigation plan, EchoStar stated that "[a]t end of life and once the satellite has been placed into its final disposal orbit, all on-board sources of stored energy will be depleted, the batteries will be discharged and all fuel line valves will be left open." *See* File No. SAT-LOA-20051221-00247, app. A, at 10. This statement remains true with respect to all fuel tanks relied upon to operate the satellite once it arrives at its destination. Two oxidizer tanks on the satellite – used only to propel the spacecraft into geostationary orbit – however, will retain a small amount of oxidizer and helium pressurant (approximately 18.8 kg pressurized with helium to approximately 250 psi) at the satellite's end-of-life. Because of the design of the Lockheed Martin A2100 bus, this residual oxidizer and pressurant in the two tanks cannot be vented at end-of-life.

Instead, as affirmed in the attached Declaration from Lockheed Martin ("Lockheed Memorandum") (Attachment A), the residual oxidizer and pressurant were securely sealed using pyrotechnic valves upon completion of the satellite's transfer to geostationary orbit, and have been stored under conditions that would make even a leak extremely unlikely, and an accidental, post-mission explosion more unlikely still. EchoStar has been informed by the Lockheed Martin that

[1] Effective January 1, 2008, EchoStar was converted from a Colorado corporation into a Colorado limited liability company. Under Colorado law, "[t]he resulting entity is the same entity as the converting entity." *See* Colo. Rev. Stat. 7-90-202(4).

this is a feature common to all Lockheed A2100 spacecraft buses, on which the EchoStar 10 satellite was built.

As demonstrated in the Lockheed Memorandum, Lockheed has taken a number of measures to avoid an explosion. First, it has built hardy tanks that are extremely unlikely to leak. The tanks are all-titanium vessels that have been inspected, tested and qualified to the stringent requirements of the MIL-STD-1522A (Standard General Requirements for Safe Design and Operation of Pressurized Missile and Space Systems) and the EWR-127-1 (Eastern and Western Range Safety Requirements). *See* Lockheed Memorandum at 1. Given the small amount of oxidizer that remains in the oxidizer tanks, the tanks would have to be heated above 165° F (or 76° C) in order for their designed pressure tolerances to be exceeded. Such temperatures are highly unlikely to be experienced, and Lockheed's worst-case analysis shows that temperatures will be less than 95° F (or 35° C) at end-of-life, resulting in a maximum pressure well below the pressure tolerance of the tanks. *See id.* at 1. Second, Lockheed has designed and constructed the tanks in accordance with stringent technical standards to leak rather than burst in the case of a flaw in the materials. The tanks have accordingly been qualified as leak-before-burst pressure vessels. *Id.* at 1-2. For these reasons, post-mission storage of the oxidizer in this manner is no less secure than post-mission venting.

In these circumstances, EchoStar believes that the Lockheed-designed and built tanks comply with sections 25.283(c) and 25.114(d)(14)(ii) of the Commission's orbital debris mitigation rules. Section 25.283(c) mentions an illustrative list of "appropriate measures" for discharging energy sources. The measures taken by Lockheed to discharge the energy (including the ultra-secure storage of a small residual amount) qualifies as such an appropriate measure. This understanding of the rule is confirmed by Section 25.114(d)(14)(ii), which requires applicants to address "whether [not that] stored energy will be removed at the spacecraft's end of life, by depleting residual fuel and leaving all fuel line valves open, venting any pressurized system, leaving all batteries in a permanent discharge state, and removing any remaining source of stored energy, *or through other equivalent procedures specifically disclosed in the application.*" In other words, Section 25.114(d)(14)(ii) contemplates "other equivalent procedures" than the ones listed for limiting the probability of accidental explosions and does not restrict these procedures to removal or depletion of energy. Finally, the Lockheed design is consistent with the purpose of the rules, which, as is evident from Section 25.114(d)(14)(ii), is to "limit the probability of accidental explosion . . . after the completion of mission operations,"[2] and with FCC precedent.[3]

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[2] Section 25.114(d)(14)(ii) of the Commission's rules requires space station applicants to "assess[] and limit[] the probability of accidental explosions" at the end-of-mission by, among other things, "address[ing] whether stored energy will be removed at the spacecraft's end of life . . . ." 47 C.F.R. § 25.114(d)(14)(ii).

[3] For example, Hughes Communications, Inc. was granted an authorization for the Spaceway-3 satellite without a waiver of the orbital debris mitigation rules, even though four tanks on the Boeing 702 spacecraft would continue to have residual helium and xenon gas in them at the end-of-life. *See Hughes Communications, Inc.*, Stamp Grant, File Nos. SAT-MOD-20050523-00106, SAT-AMD-20060306-00025 (granted Jun. 24, 2006) ("*HNS*"). As Hughes noted in its amended application, "the standard practice of retaining four tanks with a low residual pressure is both a responsible approach and results in a far lower risk of accidental explosion over time than would any attempt to completely depressurize the tanks during or after the spacecraft's mission." Amendment at Att. A, p.20, File No. SAT-AMD-20060306-00025. The Commission reached a similar conclusion when it evaluated a request by PanAmSat for a waiver of the orbital debris mitigation rules with respect to the sealing of oxidizer tanks on its Horizons 2 and Intelsat 11 spacecraft. *See PanAmSat H-2 Licensee Corp*, Stamp Grant, File No. SAT-AMD-

While we are confident that the EchoStar 10 satellite is compliant with the Commission's rules, we provide this more granular information to supplement the record in connection with the above-captioned file. We also wish to notify you that the two most recent satellites we have contracted for – EchoStar 11 and EchoStar 14 – do not present similar challenges.

Please contact the undersigned if you have any questions.

Respectfully submitted,

/s/ Linda Kinney
Linda Kinney
Vice President, Law and Regulation

Enclosure (by email)

cc: Robert Nelson
Karl Kensinger

20070731-00108 (granted Nov. 30, 2007) ("*PanAmSat H-2*"); *PanAmSat Licensee Corp.*, Stamp Grant, File No. SAT-AMD-20070716-00102 (granted Oct. 4, 2007) ("*Intelsat 11*"). While the Commission granted the request for waiver in those cases, it stopped short of saying that the rule could never be complied with by alternative measures such as the ones taken here, if an appropriate showing is made. It found only that "the information submitted in [PanAmSat's] application is not sufficient to support a finding that the intent of the rule would be satisfied by the described procedure for sealing the oxidizer tanks." *PanAmSat H-2* at condition 5; *Intelsat 11* at condition 7. In contrast, the detailed information provided in this case supports a finding that the EchoStar 10 spacecraft design is consistent with the Commission's orbital debris policies.

ATTACHMENT A

Lockheed Martin Space Systems

LOCKHEED MARTIN

Engineering Memorandum

Program: A2100	**Date:** 18 December 2007
Title: EOL A2100 Oxidizer System Pressures	**EM No.:** PSS07-A2100-0040
Key Words: End of Life, Oxidizer, Pressures	
Prepared For: B. Noakes LMCSS Chief Engineer	**Prepared by:** J. Henderson LM Propulsion Fellow 12-18-07

1.0 Summary

Currently, the A2100 propulsion system has no way to vent off the oxidizer tanks following transfer orbit. The pressure and residual oxidizer is sealed via pyrotechnic valves in the two oxidizer tanks. We consider it very unlikely that these tanks could catastrophically lose pressure either during the mission or after the spacecraft has been placed in a disposal orbit.

2.0 Background

The oxidizer tanks are all titanium pressure vessels that have been inspected, tested and qualified to the requirements of the MIL-STD-1522A (Standard General Requirements for Safe Design and Operation of Pressurized Missile and Space Systems) and the EWR-127-1 (Eastern and Western Range Safety Requirements) as hazardous leak before burst pressure vessels. These documents place stringent requirements on the design, manufacturing, test and operation of the pressure vessels so that it is extremely unlikely that these tanks will leak external and even more unlikely that they would rupture with explosive force. The leak before burst requirement was demonstrated on the qualification tank.

Specifically, the tanks are designed to a Maximum Expected Operating Pressure of 300 psia, and are proof tested during manufacturing and after system integration to 375 psia. The tanks are designed such that their rupture pressure is not less than 450 psig – the qualification test unit for this tank design actually ruptured at 664 psig. At the end of transfer orbit, the tanks have between 255 – 265 psia inside them. The maximum expected amount of remaining oxidizer is less than 3% of the tank volume. To get the tanks to a pressure above the design rupture pressure, the tank temperature would have to increase to above 165 F (76 C). Analysis of the spacecraft at end of life indicates a worst case temperature less than 95 F(35 C), with a corresponding maximum pressure in the tanks less than 295 psia. Therefore, there is no risk of rupture of the tanks after retirement of the spacecraft. The other failure mode for the tank is leakage. The tanks are designed such that they will leak before they burst – the tank materials have been inspected to such an extent that flaws, if they are present in the material, will not propagate catastrophically – they will growth through the wall and the tank will leak, relieving the

pressure, rather than grow in a manner that the stored energy in the tank will be released in an instant. Because of this design, the tanks will not fail in such a manner that debris is generated.

3.0 Conclusion

It is extremely unlikely that the oxidizer system in an A2100 will catastrophically lose pressure after the system has been isolated following transfer orbit.