Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
EchoStar Satellite Operating Corporation	)	Call Sign: S2653
	)	File No. SAT-MOD-2013_____
Application for Renewal of Authority to Operate EchoStar 12 at 61.35° W.L.	)	

APPLICATION FOR RENEWAL OF AUTHORITY TO OPERATE ECHOSTAR 12 AT 61.35° W.L. AND REQUEST FOR WAIVER

Pursuant to Section 308, 309 and 319 of the Communications Act of 1934, as amended,[1] and Part 25 of the Commission's rules,[2] EchoStar Satellite Operating Corporation (with its affiliates, "EchoStar") files this application[3] to renew its authority to operate the EchoStar 12 satellite at the 61.35° W.L. orbital location on Direct Broadcast Satellite ("DBS") channels 3 through 32 through July 31, 2022.[4] EchoStar 12's current license expires on October 15, 2013.

[1] 47 U.S.C. §§ 308, 309 and 319.

[2] 47 C.F.R. Part 25.

[3] This application qualifies as a minor modification because it proposes no change to orbital location or authorized frequencies and it will not increase the potential for interference.

[4] July 31, 2022 is the current predicted end of life for the EchoStar 12 satellite. This date is based upon the remaining fuel and projected operational parameters for the satellite.

DBS Channels 1 and 2 in the 61.5° W.L. cluster are unassigned. EchoStar's satellites in the cluster hold special temporary authority to operate on channels 1 and 2. *See* Applications to Modify Authority to Operate Direct Broadcast Satellite Service Space Stations EchoStar 3, EchoStar 12, and EchoStar 15 on Channels 3 through 32 and for Special Temporary Authority to Operate Direct Broadcast Satellite Service Space Stations EchoStar 3, EchoStar 12, EchoStar 15, and EchoStar 16 on Channels 1 and 2 at the 61.5° W.L. Orbital Location, *Order and Authorization*, 27 FCC Rcd. 7138, 7141-42 ¶ 11 (June 22, 2012) ("June 2012 Order") (stating

EchoStar 12 was launched before the Commission's current orbital debris rules went into effect. Accordingly, as required for renewal applications for satellites that predate the orbital debris rules, EchoStar is filing an orbital debris mitigation plan with this application.[5] In conjunction with this plan, and to the extent necessary, EchoStar requests a limited waiver of Sections 25.114(d)(14)(ii) and 25.283(c) of the Commission's rules to accommodate certain well-known design features of EchoStar 12's Lockheed Martin A2100 spacecraft bus.[6]

I. A LICENSE RENEWAL IS IN THE PUBLIC INTEREST

In April 2003, the Commission authorized R/L DBS Company, LLC ("Rainbow") to launch and operate EchoStar 12 (then named Rainbow 1) at the 61.5° W.L. orbital location.[7] Rainbow launched the satellite in July 2003 and subsequently notified the Commission that it was operational on October 16, 2003.[8] Rainbow later assigned the satellite and the

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that the granted STAs would become effective upon notification that EchoStar 16 had commenced operations at 61.5° W.L.); Letter from Jaime Londono, Vice President, Advanced Programs & Spectrum Management, EchoStar Technologies LLC, to Fern Jarmulnek, Acting Chief, Satellite Division, International Bureau, FCC (Feb. 19, 2013), *filed in* IBFS File No. SAT-LOA-20110902-00172, Call Sign S2844 ("EchoStar 16 Letter") (stating that EchoStar 16 became operational at 61.5° W.L. on February 14, 2013). An application to renew the STA is currently pending before the Commission. *See* IBFS File No. SAT-STA-20130626-00089 (filed June 26, 2013).

[5] *See* 47 C.F.R. § 25.114(d)(14) (requiring space station applicants to provide a description of the "design and operational strategies that will be used to mitigate orbital debris . . . .").

[6] 47 C.F.R. §§ 25.114(d)(14)(ii), 25.283(c).

[7] *See* R/L DBS Company, LLC, Application for Minor Modification to Direct Broadcast Satellite Authorization, for Issuance of Authority to Launch, and for Authority to Operate Rainbow 1 (USABBS-17), *Order and Authorization*, 18 FCC Rcd. 7694, DA 03-1185 (Apr. 22, 2003).

[8] Letter from Benjamin J. Griffin, Counsel for Rainbow DBS Company LLC, to Marlene Dortch, Secretary, FCC, *filed in* IBFS File No. SAT-MOD-20020408-00062 (Oct. 16, 2003).

accompanying Commission authorizations to EchoStar.[9] On June 9, 2010, the Commission granted EchoStar's minor modification to move to and operate EchoStar 12 at 61.35º W.L.[10]

EchoStar 12 currently serves as an active spare for the 61.5° W.L. cluster, where EchoStar also operates the EchoStar 3 and EchoStar 16 satellites.[11] EchoStar's customer, DISH Network Corporation ("DISH"), provides service to millions of satellite television subscribers from the cluster. In the event that EchoStar 16, which is currently operating on all 32 DBS channels at 61.5° W.L.,[12] experiences any anomalies, EchoStar 12's continued presence mitigates the risk of any potential degradation or loss of service for DISH's customers. A renewal of the EchoStar 12 operating authority through its projected end of life therefore serves the public interest by helping to ensure continued, uninterrupted service for millions of DISH subscribers.

II. A LIMITED WAIVER OF THE ORBITAL DEBRIS MITIGATION RULES IS IN THE PUBLIC INTEREST

The EchoStar 12 satellite is fully compliant with the Commission's orbital debris mitigation rules, with the exception of residual amounts of oxidizer and helium that will remain

[9] *See* Rainbow DBS Company LLC, Assignor, and EchoStar Satellite L.L.C., Assignee, Consolidated Application for Consent to Assignment of Space Station and Earth Station Licenses, and Related Special Temporary Authorization, *Memorandum Opinion and Order*, 20 FCC Rcd. 16868 (2005).

[10] Stamp Grant, IBFS File No. SAT-MOD-20100310-00042, Call Sign S2653 (June 9, 2010).

[11] EchoStar 3 is an in-orbit spare. *See* Stamp Grant, IBFS File No. SAT-STA-20121113-00198, Call Sign S2741 (Jan. 28, 2013). EchoStar 16 is newly launched and carrying all active traffic for the cluster. *See* EchoStar 16 Letter.

[12] EchoStar 16 has regular operating authority for channels 3 through 32 and special temporary authority to operate on channels 1 and 2. *See* June 2012 Order; EchoStar 16 Letter.

within sealed tanks in the spacecraft at the satellite's end of life.[13] EchoStar therefore requests a limited waiver of Sections 25.283(c) and 25.114(d)(14)(ii) of the Commission's rules to accommodate these features of the EchoStar 12 satellite.

Section 25.283(c) requires space station licensees to ensure, at spacecraft end of life, "that all stored energy sources on board the satellite are discharged, by venting excess propellant, discharging batteries, relieving pressure vessels, and other appropriate measures."[14] Similarly, Section 25.114(d)(14)(ii) requires space station applicants to address in their applications "whether 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."[15] The purpose of these rules is to "limit the probability of accidental explosions . . . after completion of mission operations."[16]

Because of the design of EchoStar 12's Lockheed Martin A2100 bus, however, small amounts of oxidizer and helium will remain in their respective tanks and cannot be vented at the spacecraft's end of life. Following orbit-raising maneuvers shortly after launch in 2003 and in accordance with the manufacturer's instructions, the oxidizer tanks were permanently sealed off from the rest of the spacecraft with pyrotechnic valves. Similarly, after a final repressurization of the hydrazine tank preceding maneuvers to raise the satellite to its disposal orbit, the helium tanks will be sealed off via latch valve, pursuant to the spacecraft manufacturer's recommended

[13] *See* Attachment A, Section A.10.2.

[14] 47 C.F.R. § 25.283(c).

[15] 47 C.F.R. § 25.114(d)(14)(ii).

[16] *Id.*

operational procedures. There is no mechanism to vent the residual oxidizer or helium. Nevertheless, the residual oxidizer and helium will be stored under conditions that make a leak extremely unlikely, and an accidental, post-mission explosion even more unlikely still.[17] Therefore, despite their variance from the Commission's rules, these satellite design features and associated procedures work to minimize the risk of accidental explosions, consistent with the purpose of the Commission's orbital debris requirements.[18]

The Commission may waive its rules for "good cause shown," including in cases where compliance would impose an undue hardship and the policy underlying the rule will still be served.[19] These circumstances for a waiver are present here. First, EchoStar 12 cannot be modified at this stage. This satellite was designed and launched before the adoption of the Commission's current orbital debris mitigation rules, and its design makes it impossible to vent the residual oxidizer and helium at the satellite's end of life. At the same time, it is extremely unlikely that the tanks will leak or burst.[20] This means that the chance of accidental explosions has been minimized, consistent with the purpose of Sections 25.283(c) and 25.114(d)(14)(ii) of

[17] *See* Attachment A, Section A.10.2.

[18] *See* 47 C.F.R. § 25.114(d)(14)(ii) (addressing the discharge of energy sources in the context of requiring satellite operators to assess and limit "the probability of accidental explosions during and after completion of mission operations"); *WAIT Radio*, 418 F.2d 1153, 1157 (D.C. Cir. 1969) (noting that a waiver may be granted when it would not undermine the purpose of the rule); *see also Intelsat North America LLC*, 22 FCC Rcd. 11989 ¶ 6 (2007).

[19] *See* 47 C.F.R. § 1.3; *WAIT Radio* 418 F.2d at 1157; *see also* Stamp Grant, IBFS File No. SAT-STA-20080219-00048, Call Sign 2746 (Mar. 12, 2008) (explaining that "waiver is granted because modification of the [Lockheed Martin A2100] spacecraft would present an undue hardship, given the late stage of satellite construction").

[20] *See* Attachment A, Section A.10.2.

the Commission's rules.[21] The Commission is well aware of these features of the A2100 bus and has consistently found that a waiver is warranted to accommodate them.[22] The Commission should grant the same waiver here.

III. CONCLUSION

For the foregoing reasons, EchoStar respectfully requests that the Commission promptly grant this application for a minor modification to extend the expiration date on the EchoStar 12 license to July 31, 2022.

Respectfully submitted,

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/s/

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September 5, 2013

[21] *See supra* note 18.

[22] *See* Stamp Grant, SES Americom, Inc., IBFS File No. SAT-MOD-20121224-00221, Call Sign S2181, at condition 5 (Mar. 22, 2013); Stamp Grant, SES Americom, Inc., IBFS File No. SAT-MOD-20111220-00243, Call Sign S2162, at condition 7 (June 28, 2012); Stamp Grant, Intelsat License LLC, IBFS File No. SAT-RPL-20120216-00018, Call Sign S2854, at condition 4 (May 25, 2012); Stamp Grant, New Skies Satellites B.V., IBFS File No. SAT-MPL-20120215-00017, Call Sign S2463, at condition 7 (May 25, 2012); Stamp Grant, SES Americom, Inc., IBFS File No. SAT-MOD-20110718-00130, Call Sign S2445, at condition 2 (Oct. 13, 2011); Stamp Grant, EchoStar Corp., IBFS File No. SAT-LOA-20071221-00183, at condition 4 (Mar. 12, 2008).

ATTACHMENT A

ORBITAL DEBRIS MITIGATION PLAN

A.1 Orbital Debris Mitigation Plan (§ 25.114(d)(14))

A.10.1 Spacecraft Hardware Design

EchoStar's satellite contractor, Lockheed Martin (Lockheed), has assessed and limited the amount of debris released during normal operations. ECHOSTAR-12, which was launched in July 2003, shares all relevant characteristics with all Lockheed satellites using the same A2100 bus. Lockheed has advised EchoStar that, like all of these satellites, ECHOSTAR-12 was designed to minimize debris generated after separation from the launch vehicle and to cause no debris during normal on-station operations. All pyrotechnic devices on-board the satellite have been designed to retain all physical debris. Lockheed has also informed EchoStar that it has assessed and limited the probability of the space station becoming a source of debris by collisions with small debris or meteoroids smaller than one centimeter in diameter that could cause loss of control and prevent post-mission disposal. The possibility of collisions with small debris and meteoroids was taken into account as part of the satellite design. Lockheed has taken steps to limit the effects of such collisions through the use of shielding, the placement of components, and the use of redundant systems. In addition, all sources of stored energy are located within the body of the spacecraft, thereby providing protection from small orbital debris.

A.10.2 Minimizing Accidental Explosions

On behalf of EchoStar, Lockheed Martin has assessed and limited the probability of accidental explosions during and after completion of mission operations. ECHOSTAR-12 was designed to ensure that debris generation does not result from the conversion of energy sources on board the satellite into energy that fragments the satellite. The propulsion subsystem pressure vessels have been designed to provide high safety margins. Lockheed Martin has limited the probability of accidental explosions during mission operations by means of a failure mode verification analysis. All pressures, including those of the batteries, are monitored by telemetry by EchoStar.

At end-of-life and once the satellite has been placed into its final disposal orbit, the batteries will be left in a permanent state of discharge and all sources of stored energy (with the exception of the oxidizer and helium pressurant) will be removed or vented by leaving all fuel lines open. Because of Lockheed Martin's design of the spacecraft bus, however, the small amount of oxidizer and helium remaining in the respective tanks of the spacecraft at end-of-mission cannot be vented. Following orbit-raising maneuvers shortly after launch in 2003 and in accordance with the manufacturer's instructions, the oxidizer tanks were permanently sealed off from the rest of the spacecraft with pyrotechnic valves, making a leak as well as an accidental, post-mission explosion very unlikely. Similarly, the inert residual gaseous helium will also be securely sealed and stored so that a leak or sudden pressure release is extremely unlikely.

As demonstrated in the attached Memorandum from Lockheed Martin,[23] Lockheed has taken a number of measures to avoid an explosion. Specifically, the [oxidizer] 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) that are extremely unlikely to leak.[24] The residual amount of oxidizer after the completion of orbit-raising maneuvers and the isolation of the oxidizer tanks per manufacturer design was estimated at 20 kg, meaning that there is no capability to vent the remaining volume. Given the small amount of oxidizer that will remain 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 likely 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.[25] Using the amount of residual oxidizer, a (combined) volume of 39968 cubic inches for the oxidizer tanks, and the

[23] *See* Attachment B, Engineering Memorandum from Lockheed Martin Space Systems (Dec. 18, 2007).

[24] *See id.* at 1.

[25] *See id.*

manufacturer's maximum expected temperature of 35° C, calculations using the ideal gas law produce an estimated worst case pressure of 308 pounds per square inch areas ("psia"). Average pressures would be even lower. Using the expected oxidizer mass, a temperature of 20°C, and the referenced tank volume, the corresponding pressure remaining in the pressurant tanks at the end of the operational life of the ECHOSTAR-12 satellite would be approximately 279 psia. Second, Lockheed has designed and constructed the tanks in accordance with stringent technical standards to leak rather than burst in the case of any flaw in the materials. The tanks have accordingly been qualified as leak-before-burst pressure vessels.[26] For all of these reasons, the secure storage of the residual oxidizer in this manner is no less safe than the venting of the oxidizer.

The helium tanks were also built under the stringent 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). The maximum designed operating pressure of the helium tanks is 4500 psia at 30°C, still with a burst factor of 1.5:1 for additional safety margin. The estimated total remaining mass of helium is expected to be 0.4 kg after final spacecraft repressurization. Worst case helium tank pressures with this expected mass, the manufacturer's maximum expected temperatures of 35°C at the disposal orbit, and a (combined) helium tank volume of 8159.1 cubic inches, are predicted to be approximately 285 psia, far below the designed operational maximum pressures. Average pressures are even lower. Using the expected helium mass, a temperature of 20°C, and the (combined) tank volume of 8159.1 cubic inches, the corresponding pressure remaining in the pressurant tanks at the end of the operational life of the ECHOSTAR-12 satellite would be approximately 269 psia. Like the oxidizer tanks, the helium tanks by design are sealed off from the rest of the system upon the final propulsion system repressurization and therefore cannot be fully vented during end of mission maneuvers. There is no manufacturer-recommended mechanism to vent the residual helium from the helium tanks themselves after the final repressurization of the hydrazine tank. However, because of the relatively low pressure at the end of the operational life, the possibility of helium tanks leaking or bursting is extremely unlikely.

[26] *Id*. at 1-2.

A.10.3 Safe Flight Profiles

EchoStar has reviewed the lists of FCC-licensed satellite networks and all networks that have been submitted to the ITU with an orbital location within ±0.5 degrees of 61.35° W.L.

Currently there are five operational U.S. and foreign licensed satellites in the vicinity of 61.35° W.L. including ECHOSTAR-12. These are as follows:

- ECHOSTAR-16 satellite at 61.5° W.L.
- ECHOSTAR-3 satellite at 61.8° W.L.
- AMAZONAS-2 and AMAZONAS-3 satellites at 61.0° W.L.

All of the above satellites are operated with an east-west station-keeping tolerance of ±0.05 degrees. EchoStar will continue to operate the ECHOSTAR-12 satellite at 61.35° W.L. with an east-west stationkeeping tolerance of ±0.05 degrees. Therefore, there is no possibility of station-keeping volume overlap between the operational satellites. EchoStar is not aware of any satellites planned to be launched near the 61.35° W.L. orbit location. If such satellites are deployed in the future, however, EchoStar will coordinate with the respective operators to ensure safe spacecraft operations and avoid any risk of collision.

A.10.4 Post Mission Disposal

At the end of the operational life of the ECHOSTAR-12 satellite, EchoStar will maneuver the satellite to a disposal orbit with a minimum perigee of 300 km above the normal Geostationary satellite (GSO) operational orbit. This proposed disposal orbit altitude exceeds the minimum required by Section 25.283 of the Commission's rules, which is calculated below.

The input data required for the calculation is as follows:

Total Solar Pressure Area "A" = 100 m^2
(includes area of solar array, satellite body and deployed antennas)
"M" = Dry Mass of Satellite = 2150 kg
"C_R" = Solar Pressure Radiation Coefficient = 1.25

Using the formula given in Section 25.283, the Minimum Disposal Orbit Perigee Altitude is calculated as follows:

= 36,021 km + 1000 x C_R x A/m
= 36,021 km + 1000 x 1.25 x 100/2150
= 36,079 km
= 293 km above GSO (35,786 km)

Thus, the calculated disposal orbit is 293 km above the GSO, however EchoStar will allocate enough propellant to deorbit the spacecraft to a minimum perigee altitude of 300 km, which exceeds the required minimum by a margin of 7 km. Maneuvering the satellite to the disposal orbit will require 12 kg of propellant. This quantity of fuel, taking account of all fuel measurement uncertainties, will be reserved to perform the final orbit-raising maneuvers. The fuel reserve was calculated using two methods. The first method applied was the pressure-volume temperature method, which uses tank pressure and temperature information to determine remaining propellant. The second method applied was the bookkeeping method, which evaluates the flow rate at average pressure and total thruster on-time of orbital maneuvers to determine the amount of propellant used. EchoStar has assessed fuel gauging uncertainty and has provided an adequate margin of fuel to address such uncertainty.

ATTACHMENT B

LOCKHEED MEMORANDUM

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.