

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

In the Matter of)	
)	
Satellite CD Radio, Inc.)	File No. SAT-MOD-_____
)	
Application for Modification to Extend License)	Call Sign S2105
Term and to De-Orbit the FM-1, FM-2 and FM-)	
3 Satellites)	

APPLICATION FOR MODIFICATION

Satellite CD Radio, Inc., a wholly-owned subsidiary of Sirius XM Radio Inc. (together “Sirius XM”), hereby applies for a seven-year extension, through February 11, 2017, of the license for its FM-1, FM-2, and FM-3 (plus a ground spare) non-geostationary satellite orbit (“NGSO”) spacecraft (call sign S2105, collectively the “Sirius NGSO Satellites”). Sirius XM also seeks authority to de-orbit these NGSO satellites as they reach the end of their useful life. In support of this application, Attachment A contains an orbital debris mitigation statement pursuant to Section 25.114(d)(14) of the Commission’s rules.¹ The rest of the technical information previously provided for the Sirius NGSO Satellites remains unchanged and is incorporated by reference.² As shown below, grant of this application will serve the public

¹ 47 C.F.R. § 25.114. The Sirius NGSO Satellites were initially licensed in 2001 and launched and began commercial operations in 2002. As such, these satellites were constructed and in orbit well before the October 12, 2004 effective date of the orbital debris mitigation rules. *Mitigation of Orbital Debris*, Second Report and Order, 19 FCC Rcd 11567 (2004); *Mitigation of Orbital Debris*, 69 Fed. Reg. 54581-54589 (Sept. 9, 2004). Consequently, this modification application triggers the initial requirement for Sirius XM to provide orbital debris mitigation information for these satellites. Procedures for compliance with these rules are described in Attachment A.

² *Sirius Satellite Radio Inc. Application for Minor Modification of License to Construct, Launch and Operate a Non-Geostationary Satellite Digital Audio Radio Service System*, Order and Authorization, 16 FCC Rcd 5419 (2001) (“2001 Modification Order”). Sirius XM is not

interest by authorizing Sirius XM to continue operating the Sirius NGSO Satellites for the remainder of their useful lives and then to remove the satellites to a safe disposal orbit.

I. EXTENSION OF THE LICENSE TERM FOR THE SIRIUS NGSO SATELLITES SERVES THE PUBLIC INTEREST

This modification application first seeks Commission authority for Sirius XM to extend the license term for the in-orbit Sirius NGSO Satellites to February 11, 2017. The current license term for these satellites commenced on February 11, 2002 and will expire on February 11, 2010.

Extending the license term for an additional seven years is in the public interest. The FCC initially selected an eight year license term to comply with the statutory limit on broadcast license terms at a time when it was unknown whether satellite radio service would be provided on a broadcast or subscription basis.³ Sirius XM operates on a subscription basis and thus the statutory limit does not apply. In this case, grant of this extension will conform Sirius XM's license to the fifteen year license term that is customary for most other satellites.

Grant of this application to extend the license term will allow Sirius XM to continue providing quality satellite radio service to millions of customers. Indeed, continued operation of the Sirius NGSO Satellites currently is required for customers with legacy Sirius satellite radios to continue to receive satellite radio service.

Moreover, extension of the license term for an additional seven years will allow Sirius XM to maximize the utility of its in-orbit assets. The initial eight year license term provided to

(Continued . . .)

providing Form Schedule S because this modification application does not request any technical changes to the Sirius NGSO Satellites or the existing interference environment. Consequently, submission of a Schedule S with the instant application would be duplicative of the previously provided technical information. For this reason, and to the extent necessary, Sirius XM requests a waiver of any requirement to provide Schedule S. Sirius XM will, however, prepare and file a Schedule S in the event the Commission determines that such a submission is necessary.

³ *Establishment of Rules and Policies for the Satellite Digital Audio Radio Satellite Service in the 2310-2360 MHz Frequency Band*, Report and Order Memorandum Opinion and Order and Further Notice of Proposed Rulemaking, 12 FCC Rcd. 5754, ¶ 111 (1997).

satellite radio service satellites is well shorter than the design life of the Sirius NGSO Satellites. Sirius XM estimates that the FM-1 and FM-2 satellites will have a 13 year useful life and the FM-3 satellite will have a 15 year useful life. These satellites are in good health and are expected to provide service for many years.

Finally, Sirius XM's continued operation of the Sirius NGSO Satellites for the requested extended license term poses no risk of harmful interference.⁴ Throughout the extended license period, Sirius XM will operate these satellites in accordance with the technical parameters on file with and previously approved by the Commission.⁵

II. GRANTING AUTHORITY TO DE-ORBIT THE SIRIUS NGSO SATELLITES AT THEIR END OF USEFUL LIFE SERVES THE PUBLIC INTEREST

This modification application also seeks authority for Sirius XM to remove the Sirius NGSO Satellites from their operating orbits at the end of their useful lives.⁶ The public interest would be served by granting such authority now, well in advance of the expected de-orbit. Sirius XM proposes to follow the orbital disposal plan set forth in Attachment A. Obtaining FCC concurrence with this plan today avoids the possibility of a future urgent request for review shortly before disposal. Moreover, grant poses no risk of interference to other operators. Sirius XM will also coordinate its orbit raising maneuver TT&C operations with spacecraft existing at the time of de-orbit to ensure that no unacceptable interference results from its TT&C operations during disposal operations. Within 30 days of completion of end-of-life maneuvers for each

⁴ To the extent necessary, Sirius XM requests that the waivers granted to the FM-1, FM-2, and -3 satellites, specifically the waiver of Section 25.202(g) permitting use of C-band TT&C, continue to apply during the requested extended license term.

⁵ See *supra* note 2.

⁶ The end-of-life disposal authority provided in Section 25.283(b) of the Commission's rules does not apply to non-geostationary satellites. The FCC requires NGSO satellites to obtain specific de-orbit authority. See *Mitigation of Orbital Debris*, Second Report and Order, 19 FCC Rcd 11567 ¶ 84 (2004).

satellite, Sirius XM will send a letter notifying the FCC of the apogee and perigee of each satellite's disposal orbit.

III. CONCLUSION

For the foregoing reasons, Sirius XM hereby respectfully requests that the Commission extend the license term for FM-1, FM-2, and FM-3 (plus a ground spare) until February 11, 2017 and authorize Sirius XM to de-orbit the satellites at the end of their useful lives.

Respectfully submitted,

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Counsel for Sirius XM Radio Inc.

Dated: November 19, 2009

Attachment A: Orbital Debris Mitigation

Sirius' FM-1, FM-2 and FM-3 satellites (the "Sirius NGSO Satellites") were designed in 1997. Each was constructed and tested in 1998-2000, and launched in the last five months of 2000 into a non-geostationary satellite orbit ("NGSO"). This was well before the Commission recognized concerns about orbital debris and adopted regulations in the 2004 Orbital Debris Mitigation Order.¹ The Sirius NGSO Satellites have performed well over the past nine years and are based on the Space Systems/Loral ("SS/L") 1300 spacecraft platform, whose many satellites have never had an orbital debris/disposal issue during the past decade. As described below, operational measures were undertaken in 2002 to avoid orbital debris concerns and, after discussions with the Commission last year, Sirius XM adopted a plan intended to place the subject satellites into a stable disposal orbit when they reach their end of useful life.

Section 25.114(d)(14)(i): Normal Operations and Collisions with Small Debris,

Meteoroids.² Sirius XM has assessed and limited the amount of debris released in a planned manner during normal operations of the Sirius NGSO Satellites, and has assessed and limited the probability of the Sirius NGSO Satellites becoming a source of debris by collisions with small debris or meteoroids that could cause loss of control and prevent post-mission disposal. Other than in the event of collisions, the satellites release no debris during normal operations. Although the satellites were not designed with such collisions in mind, post facto analysis indicates a low probability of the space stations becoming a source of debris by collisions with small debris or meteoroids smaller than one centimeter in diameter or which could cause loss of control and prevent post-mission disposal. Collisions with the background environment, including meteoroids, were considered as part of satellite design. These effects were considered on a statistical basis to determine collision risk. The analysis of Sirius XM's satellite manufacturer, SS/L, included such environments and review of literature for large size space objects. There is little prior environmental or orbital collision data for the subject satellites' orbits.

¹ *Mitigation of Orbital Debris*, Second Report and Order, 19 FCC Rcd 11567 (2004); *Mitigation of Orbital Debris*, 69 Fed. Reg. 54581-54589 (Sept. 9, 2004).

² 47 C.F.R. §25.114(d)(14)(i).

25.114(d)(14)(ii): Accidental explosions, energy sources on board.³ SS/L and Sirius XM have assessed and limited the probability of accidental explosions during and after completion of operations. The satellites are designed so that debris generation will not result from the conversion of energy sources on board the satellite into energy that fragments the satellite. In particular, SS/L advises that no structural failures of pressurized containers have occurred on any of its many satellites to date. Burst tests were performed on all pressure vessels during qualification testing to demonstrate a margin of safety against burst. Unintentional bipropellant mixing is addressed by use of valves that prevent backward flow in propellant and pressurization lines. The batteries will be discharged after the satellites are put in their disposal orbits and commands sent to fire any unfired pyrotechnics. Upon entering their final disposal orbits, the satellites' fuel tanks will be close to empty and any remaining propellants and pressurants subsequently will be vented using the on-board thrusters.

25.114(d)(14)(iii): Collisions with large debris and operational space stations.⁴ Sirius XM has assessed and limited the probability of the Sirius NGSO Satellites becoming a source of debris by collisions with large debris or other satellites. Specifically, Sirius XM has assessed the possibility of collision with geostationary satellite orbit ("GSO") satellites since there are no known existing or planned satellites utilizing the non-geostationary orbit of the Sirius NGSO Satellites. The assessment focused on the two crossings of the equatorial plane and showed no collision possibility, since the NGSO orbit of the Sirius NGSO Satellites intersects that plane below geostationary satellite orbit altitude. However, Sirius XM reviews these crossings yearly to ensure sufficient inter-satellite clearances. Sirius XM additionally provides updated orbital parameters for the subject satellites to GSO operators with satellites in proximity of the equatorial plane intersections every six months. In the event that similar NGSO satellites are authorized in the future by the United States or another administration, Sirius XM will coordinate physical operation of the Sirius NGSO Satellites with that satellite operator to ensure there is no possibility of collision.

³ 47 C.F.R. §25.114(d)(14)(ii).

⁴ 47 C.F.R. §25.114(d)(14)(iii).

The accuracies with which the orbital parameters have been and are currently maintained are shown below:

Apogee Radius	53,841 km +/- 211 km
Perigee Radius	30,847 km +/- 211 km
Inclination	63.4 +/- 2 degrees
RAAN*	120 +/- 0.5 degrees
Apogee Longitude	96 +/- 0.5 degrees
Argument of Perigee	270 +/- 2 degrees
Eccentricity	0.2684 +/- 0.005

* The three RAANs are kept at a nominal spacing relative to each other of 120 degrees.

Section 25.114(d)(14)(iv): Post –mission disposal plan.⁵ At the end of the operational life of the Sirius NGSO Satellites, Sirius XM intends to maneuver them into disposal orbits that will not intersect the geostationary satellite orbits and will not be co-orbital with currently known or planned satellites. Sirius XM plans to allocate and to reserve sufficient propellant, namely 333 kg, 345kg, and 419kg, for FM-1, FM-2, and FM-3, respectively, for the final orbit disposal maneuvers. At mission operations completion, assumed in the following analysis as December 31, 2015, the plan is to circularize the highly inclined, elliptical orbits of the Sirius NGSO Satellites at 31,000 km (height of orbit above the earth’s center). After orbit circularization, the remaining propellant will be used to reduce each orbit’s inclination since lower inclination has been found to have better stability characteristics. The disposal orbits are 1000 km above the proposed Galileo navigation satellites, 4000 km above the GPS navigation satellites and 11,000 km below the geostationary satellite orbit. As shown later, the orbits show excellent stability for the analysis period of 100 years.

The analysis used by SIRIUS XM to generate the following predictions is based upon a commercial flight dynamics application called OASYS (Orbital Analysis SYStem). The propagator uses a Bulirsch-Stoer Cowell integration algorithm and has been validated against other independent propagators, such as STK and TRACE, over time spans of a hundred years. To further validate OASYS, the disposal orbits were also independently simulated by SS/L and found to produce nearly identical results.

⁵ 47 C.F.R. §25.114(d)(14)(iv).

The forces modeled in the below simulations are:

Earth gravity model (12x12 harmonics)

Solar gravity

Lunar gravity

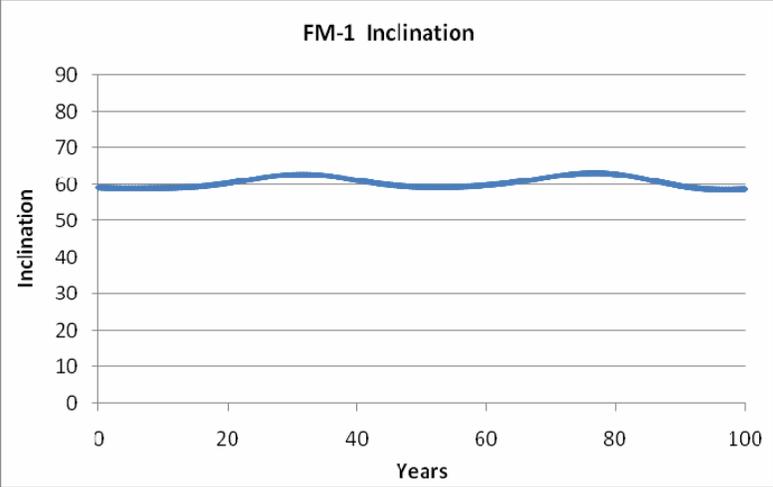
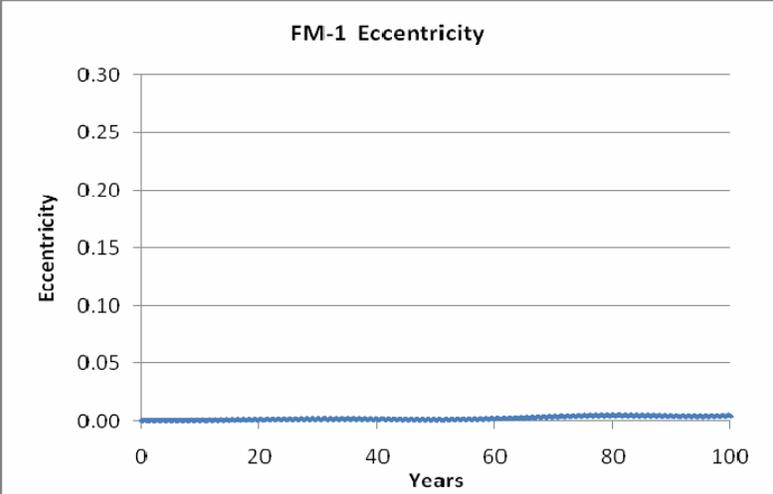
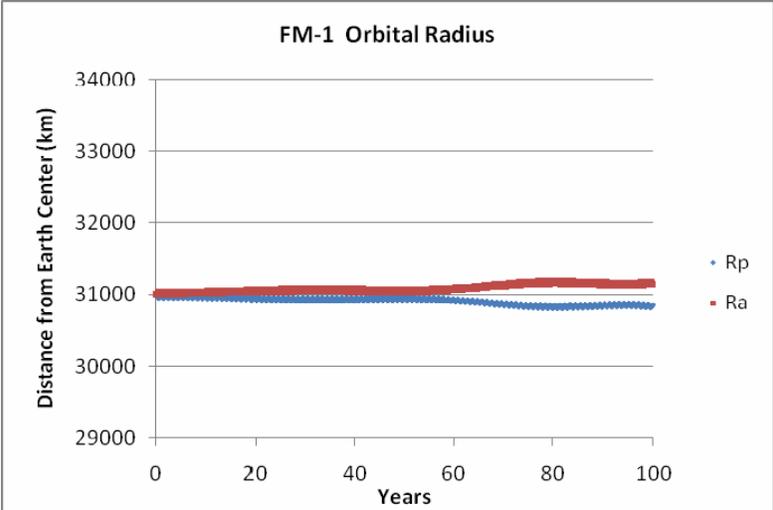
Solar radiation pressure (assumed area-to-mass ratio of ~0.05)

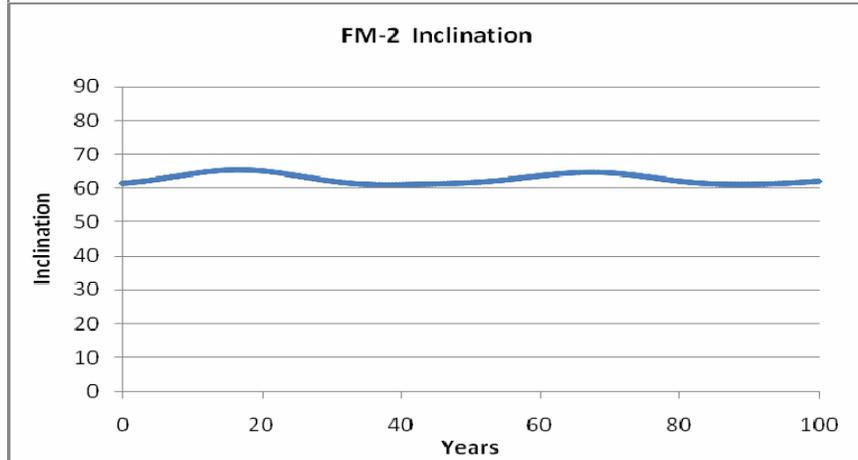
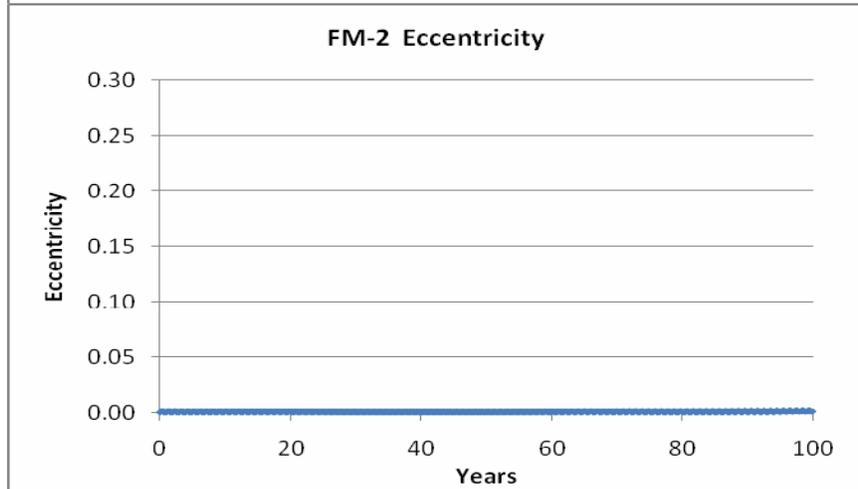
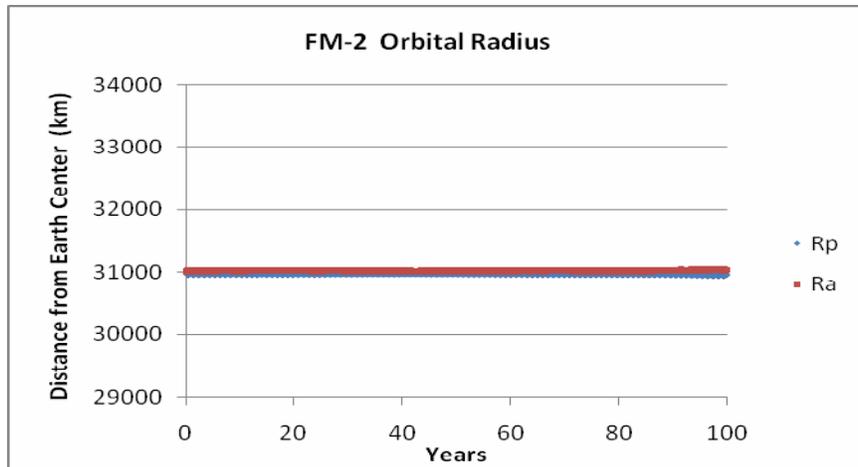
The starting conditions assumed after circularization and inclination reduction from the operational elliptical orbits are illustrated below:

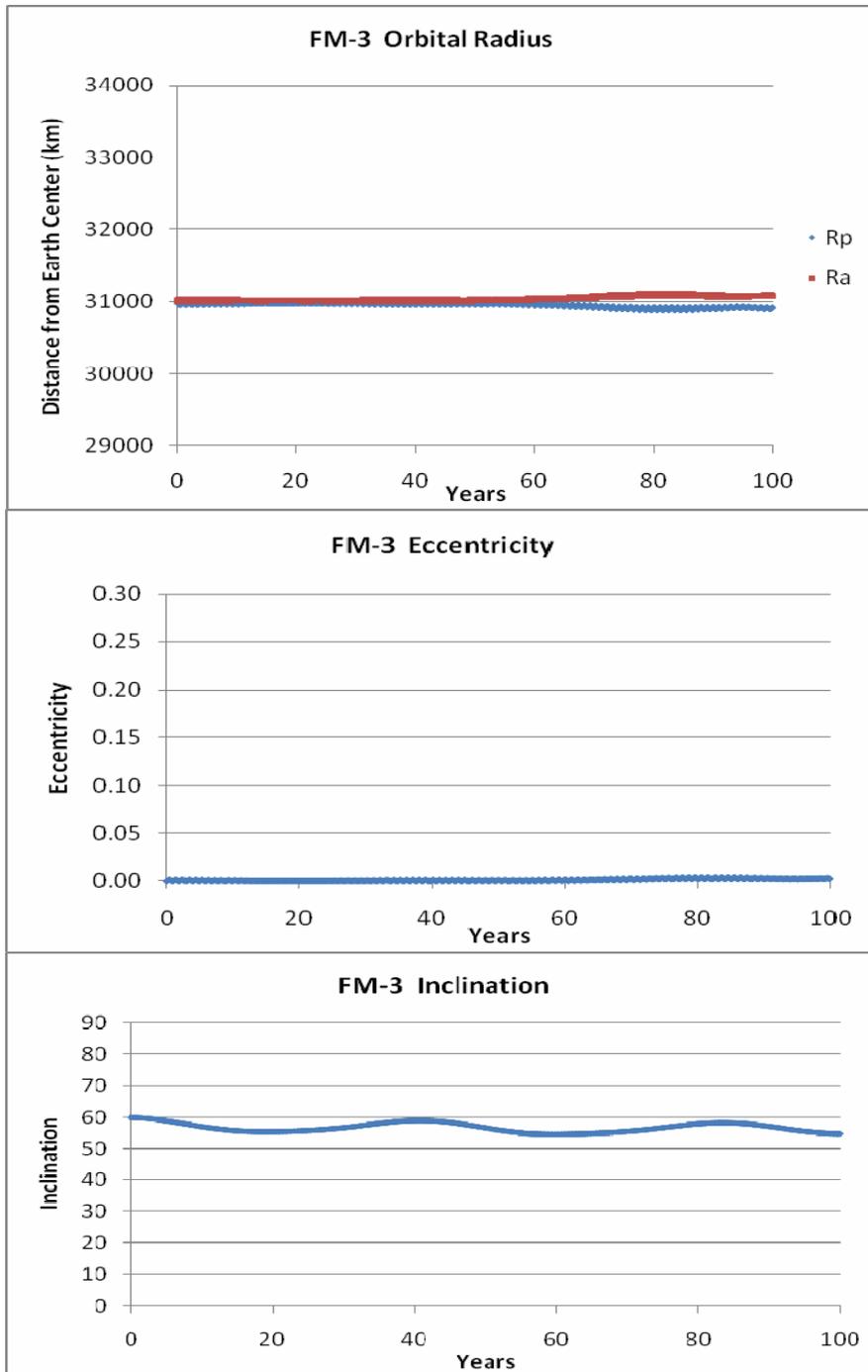
	S1	S2	S3
Semi-major Axis (km)	31,000	31,000	31,000
Eccentricity	0.0001	0.0001	0.0001
Argument of Perigee	270.0	270.0	270.0
RAAN (deg)	236.3	116.3	356.3
Inclination (deg)	59.2	61.6	59.9
Assumed Retirement Date	12/31/2015	12/31/2015	12/31/2015

After disposal, the three satellites have nearly identical orbital parameters except for RAAN.

The following nine figures demonstrate orbit stability for the Sirius NGSO Satellites following disposal orbit operations.







Sirius XM believes the proposed disposal plan for the Sirius NGSO Satellites meets the Commission’s objectives with regard to orbital debris. If the Commission accepts Sirius XM’s orbital disposal plan, any changes necessitated by initiation differences from the above or future failures in needed satellite subsystems (i.e., tracking, telemetry and command; thrusters; attitude control; etc.) will be conveyed to the Commission.

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 pleading, 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 pleading, and that it is complete and accurate to the best of my knowledge and belief.

/s/ Robert Briskman _____

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Dated: November 19, 2009

**Response to FCC Form 312 Question 40:
Officers and Directors of Satellite CD Radio, Inc.**

Satellite CD Radio, Inc. is a wholly-owned subsidiary of Sirius XM Radio Inc. (“Sirius XM”). Liberty Media Corporation, a Delaware corporation, holds a 40% ownership interest in Sirius XM. The address of Liberty Media Corporation is 12300 Liberty Boulevard, Englewood, Colorado 80112. Dr. John C. Malone, a United States citizen, owns shares of Liberty Media Corporation representing approximately 34.4% of the aggregate voting power of the company. Dr. Malone’s business address is 12300 Liberty Boulevard, Englewood, Colorado 80112.

No other entities or individuals own a 10% or greater direct or indirect interest in Sirius XM.

The Officers of Satellite CD Radio, Inc. are:

Mel Karmazin, President
David Frear, Treasurer
Patrick Donnelly, Secretary

The Directors of Satellite CD Radio, Inc. are:

Patrick Donnelly
Lawrence Gilberti

The Executive Officers of Sirius XM Radio Inc. are:

Mel Karmazin, Chief Executive Officer
James E. Meyer, President, Operations and Sales
Scott Greenstein, President and Chief Content Officer
Patrick L. Donnelly, Executive Vice President, General Counsel and Secretary
David J. Frear, Executive Vice President and Chief Financial Officer
Dara Altman, Executive Vice President and Chief Administrative Officer

The Directors of Sirius XM Radio Inc. are:

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The address of all Satellite CD Radio, Inc. and Sirius XM Radio Inc. officers and directors is:

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