Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
	)	
Amendment of Parts 2 and 25 of the	)	
Commission's Rules to Allocate Spectrum and	)	IB Docket No. 07-101
Adopt Service Rules and Procedures to Govern	)	
the Use of Vehicle-Mounted Earth Stations in	)	
Certain Frequency Bands Allocated to the Fixed-	)	
Satellite Service	)	

ORDER ON RECONSIDERATION

Adopted: January 4, 2013 **Released: January 8, 2013**

By the Commission:

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Heading Paragraph #

I. INTRODUCTION

1. In this Order on Reconsideration for Vehicle-Mounted Earth Stations (*VMES Reconsideration Order*), we revise our VMES rules[1] in order to promote the deployment of broadband service and provide operational flexibility consistent with other services. Our actions in this Order address petitions for reconsideration filed by The Boeing Company (Boeing) and ViaSat, Inc. (ViaSat)[2] requesting changes to the VMES rules. The changes we adopt in this Order should promote greater flexibility for VMES operators, which in turn should enable the VMES industry to create more

[1] The VMES rules are set forth in section 25.226 of the Commission's rules. *See* 47 C.F.R. § 25.226.

[2] *See* Petition for Reconsideration of The Boeing Company, filed Dec. 4, 2009 (Boeing Petition); Petition for Clarification or Reconsideration of ViaSat, Inc., filed Dec. 4, 2009 (ViaSat Petition). Appendix A contains the complete list of parties that filed in this proceeding.

spectrally-efficient broadband solutions in the Ku-band.[3] At the same time, the changes will continue to protect Fixed-Satellite Service (FSS) operators from harmful interference and protect the general public from harmful exposure to radiofrequency radiation.

II. BACKGROUND

2. VMES service is among the emerging mobile broadband applications in spectrum allocated to the FSS. The other burgeoning mobile applications in the FSS spectrum band include Earth Stations on Vessels (ESV) and Earth Stations Aboard Aircraft (ESAA),[4] furnishing broadband services to customers on boats and airplanes, respectively.[5] VMES are earth stations that operate from a motorized vehicle traveling primarily on land within the United States that receive from and transmit to a geo-stationary satellite orbit (GSO) FSS satellite.[6] VMES operators offer broadband services, including voice, data, and Internet services, to commercial, government, military and public safety customers, including border patrol, local police and search and rescue operations.

3. *VMES Order.* In 2009, the Commission adopted the *VMES Order*, which amended Parts 2 and 25 of the Commission's rules by establishing domestic allocations as well as service and licensing rules for VMES licensees to operate in the conventional and extended Ku-band frequencies.[7] The Commission added non-Federal footnotes NG187 and NG186 to the U.S. Table of Frequency Allocations in Part 2 of the Commission's rules.[8] NG187 defines VMES as a mobile application of the FSS with primary status in the conventional Ku-band. NG186 authorizes VMES licensees to operate in the extended Ku-band, but requires VMES operators to accept interference from stations of the Fixed Service (FS).[9] In addition, the Commission adopted service and licensing rules for VMES based on the rules adopted in the *ESV Order*,[10] noting that authorizing VMES operations in the FSS Ku-band presented many technical issues that are similar to authorizing ESV operations in that band.[11]

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[3] The Ku-band uplink and downlink are allocated to the FSS on a primary basis. The 14.0-14.5 GHz band is known as the conventional Ku-band uplink. The 11.7-12.2 GHz band is known as the conventional Ku-band downlink. VMES also may operate in a portion of the extended Ku-band (10.95-11.2 GHz and 11.45-11.7 GHz).

[4] *Revisions to Parts 2 and 25 of the Commission's Rules to Govern the Use of Earth Stations Aboard Aircraft Communicating with Fixed-Satellite Service Geostationary-Orbit Space Stations Operating in the 10.95-11.2 GHz, 11.45-11.7 GHz, 11.7-12.2 GHz and 14.0-14.5 GHz Frequency Bands*, IB Docket No. 12-376, Report and Order, FCC 12-161 (rel. Dec. 28, 2012) (*ESAA Order*).

[5] *See generally Procedures to Govern the Use of Satellite Earth Stations on Board Vessels in the 5925-6425 MHz/3700-4200 MHz Bands and 14.0-14.5 GHz/11.7-12.2 GHz Bands*, IB Docket No. 02-10, Report and Order, FCC 04-286, 20 FCC Rcd 674 (2005) (*ESV Order); see also ESAA Order.* ESV terminals operate in the FSS C- and Ku-bands and ESAA terminals operate in the Ku-band.

[6] *See* 47 C.F.R. § 25.201.

[7] *See generally Amendment of Parts 2 and 25 of the Commission's Rules to Allocate Spectrum and Adopt Service Rules and Procedures to Govern the Use of Vehicle-Mounted Earth Stations in Certain Frequency Bands Allocated to the Fixed-Satellite Service*, IB Docket No. 07-101, Report and Order, FCC 09-64, 24 FCC Rcd 10414 (2009) (*VMES Order*).

[8] *See* 47 C.F.R. § 2.106.

[9] *See VMES Order*, 24 FCC Rcd at 10423, 10424, ¶¶ 26-27, 29-31.

[10] *See generally ESV Order*; *see also* 47 C.F.R. §§ 25.221, 25.222 (ESV rules for operating in the C- and Ku-bands, respectively).

[11] *VMES Order*, 24 FCC Rcd at 10418-19, ¶ 12, 10420, ¶ 20. A few VMES requirements, primarily involving the off-axis EIRP-density limits, are based on the rules adopted in the *Part 25 Eighth Report and Order*, in which the Commission streamlined its non-routine earth station processing rules to enable more applications to receive routine (continued….)

4. As part of the VMES service and licensing rules, the Commission adopted technical measures to protect other radio services in the Ku-band, including the FSS, FS (in the extended Ku-band), space research service (SRS) and radio astronomy service (RAS), from harmful interference. For example, to protect FSS satellites operating near the target satellite of a VMES earth station, the Commission adopted: (1) off-axis EIRP-density limits,[12] which cap the amount of power-density emitted from the VMES antenna, and (2) antenna pointing error requirements.[13] In addition, the Commission required VMES operators to coordinate their operations with SRS and RAS facilities, which provide an important service to the United States. Further, the Commission established rules for licensing VMES systems, including licensing of VMES hub stations and/or blanket licensing for VMES earth stations.[14] Finally, the Commission determined that, pursuant to the radiofrequency radiation rules, VMES applicants must submit to the Commission a routine environmental evaluation for human exposure to radiofrequency radiation demonstrating whether operation of VMES terminals will result in power-densities that would exceed the Commission's radiofrequency radiation exposure criteria.[15] In conjunction with that finding, the Commission also required VMES operators to automatically cease transmitting within 100 milliseconds upon loss of a downlink signal.[16] These last two requirements addressed the potential radiofrequency radiation exposure that may result from installing and operating an earth station on a vehicle.

5. *Petitions for Reconsideration.* On December 4, 2009, Boeing filed a Petition for Reconsideration of the *VMES Order* requesting that the Commission modify the rules for variable power-density VMES systems.[17] On the same day, ViaSat filed a Petition for Reconsideration, echoing Boeing's request as well as asking us to modify and/or clarify the VMES rules pertaining to the antenna pointing error and human exposure to radiofrequency radiation.[18] On April 29, 2010, Maritime Telecommunications Network, Inc. (MTN) filed a consolidated response to the Petitions filed by Boeing and ViaSat (collectively referred to as Petitioners).[19] On May 12, 2010, Boeing and ViaSat filed replies to MTN's consolidated response.[20]

6. Boeing, ViaSat and MTN do not have VMES licenses, but each of these companies operates in the satellite industry. Boeing has a variety of interests in the satellite manufacturing and services industry.[21] For example, Boeing provides aeronautical broadband communications to the U.S.

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processing. *See VMES Order*, 24 FCC Rcd at 10419, ¶ 13, 10441-10445, ¶¶ 87-95 (citing *2000 Biennial Regulatory Review – Streamlining and Other Revisions of Part 25 of the Commission's Rules Governing the Licensing of, and Spectrum Usage by, Satellite Network Earth Stations and Space Stations*, IB Docket No. 00-248, Eighth Report and Order, FCC 08-246, 23 FCC Rcd 15099 (2008) (*Part 25 Eighth Report and Order*).

[12] *VMES Order,* 24 FCC Rcd at 10439-10445, ¶¶ 83-95. The phrase "off-axis EIRP-density" is used synonymously with "off-axis power-density."

[13] *Id.* at 10455-10457, ¶¶ 131-135.

[14] *Id.* at 10464, ¶ 162.

[15] *Id.* at 10471, ¶ 185.

[16] *See* 47 C.F.R. § 25.226(a)(9); *see also VMES Order*, 24 FCC Rcd at 10472, ¶ 189.

[17] Boeing Petition at 10-15.

[18] *See generally* ViaSat Petition.

[19] Consolidated Response of Maritime Telecommunications Network, Inc., filed Apr. 29, 2010 (MTN Response).

[20] Reply of the Boeing Company, filed May 12, 2010 (Boeing Reply); Reply of ViaSat, filed May 12, 2010 (ViaSat Reply).

[21] *See* Comments of the Boeing Company at 1, filed Aug. 17, 2007 (*Boeing Comments to the VMES NPRM*).

Government. ViaSat has developed antenna and modulation technology that makes high-speed data communications available on vehicles. In addition, ViaSat's ArcLight technology, which uses variable power-density control, enables the deployment of a wide range of mobile applications by allowing for efficient use of bandwidth and lower power-density requirements through use of spread spectrum technology and advanced signal encoding technologies.[22] MTN provides satellite-based broadband services, including wireless voice and data services,[23] Internet café and Wi-Fi services, and news and entertainment services to the commercial shipping, cruise line, offshore energy, megayacht and aviation markets.[24] Its subsidiary, MTN Government Services, provides integrated communications services to government agencies, nongovernment agencies (disaster relief and recovery efforts) and the military.[25]

III. DISCUSSION

7. In this *VMES Reconsideration Order*, we grant in part and deny in part the Petitioners' requests.[26] As discussed above, the changes we adopt in this Order relate to measures that protect the FSS operators from harmful interference and protect the general public from harmful exposure to radiofrequency radiation. Thus, the measures that the Commission previously adopted to protect the other incumbent services, such as the FS and RAS, are not affected by this Order.

8. In this Order, we address the three issues raised by the Petitioners with respect to the VMES rules. First, we ease the technical requirements for a certain type of VMES system – a variable power-density VMES system – including modifying the off-axis effective isotropically radiated power (EIRP)-density provisions in section 25.226(a)(3) to enable these systems to operate their terminals more efficiently and effectively. Second, we decline ViaSat's request to clarify the antenna pointing error requirements in section 25.226(a) of the Commission's rules. Third, we adopt ViaSat's proposal, in part, to relax the cessation of emission requirement in section 25.226(a)(9), a rule that is designed to lower the risk of human exposure to radiofrequency radiation. The revisions we adopt today should promote operational flexibility and spectral efficiency in the Ku-band. At the same time, these revisions should continue to ensure that VMES operators protect FSS operators from harmful interference and protect the general public from harmful exposure to radiofrequency radiation. We note that, with the exception of the change to the radiofrequency radiation exposure rule in section 25.226(a)(9), the Commission

[22] ViaSat Repy at 6. *See also* Comments of ViaSat, Inc. at 2-3, filed Aug. 17, 2007 (*ViaSat Comments to the VMES NPRM*). ViaSat has used its ArcLight technology extensively in the aeronautical and maritime markets since 2003. ViaSat Reply at 6.

[23] For example, on cruise ships, this wireless service is known as Cellular@Sea. *See* http://cellularatsea.com/. Wireless Maritime Services, which provides the Cellular@Sea service, is a joint venture between MTN and AT&T. *Id*.

[24] *Comments of Maritime Telecommunications Network, Inc.* at 2, filed Aug. 17, 2007 (*MTN Comments to the VMES NPRM*). *See also* http://www.mtnsat.com/mtn-solutions/solutions.

[25] *See* http://www.mtnsat.com/about-mtn/company-history. MTN has worked with the Commission for several years to develop a regulatory framework for ESVs. *MTN Comments to the VMES NPRM* at 2.

[26] Boeing also argues that, in the *VMES Order*, the Commission arbitrarily and capriciously failed to address Boeing's argument that granting primary status for VMES without concurrently granting primary status for Aircraft-Mounted Earth Stations (AMES) would cause harmful interference to other important services. *See* Boeing Petition at 2-10. We recently addressed the issues involving AMES in the ESAA proceeding and, therefore, do not address the merits of Boeing's arguments here as they are moot. *See generally ESAA Order*.

addressed similar issues in the *ESV Second Reconsideration Order*.[27] The changes we adopt today are consistent with the changes made in that Order.

A. Off-Axis EIRP-Density Limits and Aggregate Power-Density Systems

9. *Background.* In the *VMES Order*, the Commission adopted a number of measures to protect incumbent FSS providers operating adjacent to the target satellite from harmful interference. One measure, the off-axis EIRP-density limits, caps the amount of off-axis EIRP-density emitted from VMES terminals (off-axis EIRP-density limits).[28] The off-axis EIRP-density is the power-density[29] emitted from the VMES antenna in directions other than towards the target satellite. The off-axis EIRP-density limits for VMES are based on the limits adopted in the *ESV Order* for ESVs. VMES operators may operate at power-density levels that exceed the off-axis EIRP-density limits if they comply with certification and cessation of emission requirements, but they do not have ALSAT[30] authority because the certification requirements depend upon the coordination agreements negotiated by the target satellite operator with the adjacent satellites.[31]

10. The off-axis EIRP-density limits apply differently depending on whether the VMES operators have a single channel per carrier (SCPC) system or an aggregate power-density system. An SCPC system operates with each VMES terminal transmitting in a single frequency channel whereas in an aggregate power-density system, multiple terminals transmit simultaneously in the same frequency channel by using a spread spectrum technique such as code division multiple access (CDMA). With an SCPC system, the off-axis power-density from the individual terminal must be within the off-axis EIRP-density limits, whereas, for aggregate power-density systems, the power-density from all of the simultaneously operating co-frequency terminals must meet those limits in the aggregate.

11. The off-axis EIRP-density limits adopted in the *ESV Order* were based on the power-density emitted from an individual SCPC terminal, and did not account for power-density emitted from "aggregate power-density" systems – systems with multiple co-frequency terminals. Therefore, the Commission, in the *Part 25 Streamlining Sixth Report and Order*, incorporated a 10*log(N) term into the off-axis EIRP-density limits to account for the power-density from each of the multiple terminals in an

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[27] *See generally Procedures to Govern the Use of Satellite Earth Stations on Board Vessels in the 5925-6425 MHz/3700-4200 MHz Bands and 14.0-14.5 GHz/11.7-12.2 GHz Bands*, IB Docket No. 02-10, Second Order on Reconsideration, FCC 12-79, 27 FCC Rcd 8555 (2012) (*ESV Second Reconsideration Order*).

[28] *See VMES Order*, 24 FCC Rcd at 10439-10445, ¶¶ 83-95.

[29] The "power-density" is the power measured in a specific bandwidth. In this case, the specific bandwidth is 4 kilohertz.

[30] ALSAT means "all U.S.-licensed satellites." When a FSS earth station receives ALSAT authority, it may access any U.S.-licensed space station in the conventional C- and Ku-bands without further Commission approval. However, the term "ALSAT" does not encompass all of the FSS space stations that a routinely-licensed FSS earth station may access without further Commission approval. These earth stations also have the authority to communicate with non-U.S. licensed FSS space stations on the Permitted Space Station List without further Commission approval. *See Amendment of the Commission's Regulatory Policies to Allow Non-U.S. Licensed Space Stations to Provide Domestic and International Satellite Service in the United States*, IB Docket No. 96-111, First Order on Reconsideration, 15 FCC Rcd 7207 (1999). Further, we note that the Permitted List encompasses both U.S.-licensed and non-U.S.-licensed FSS space stations in the conventional C- and Ku-bands: ALSAT is the first entry on the Permitted List, followed by individual non-U.S. licensed FSS space stations granted market access in the conventional C-and/or Ku-bands. *See id.* at 7210-11, ¶ 6, 7214-16, ¶¶ 16-20 (1999). The current Permitted List is available at http://www.fcc.gov/ib/sd/se/permitted.html.

[31] *VMES Order*, 24 FCC Rcd at 10445-10447, ¶¶ 96-101. *See also ESV Reconsideration Order*, 24 FCC Rcd at 10372-76, ¶¶ 8-16.

aggregate power-density ESV systems.[32] Specifically, the power-density of each individual co-frequency transmitter is reduced by a factor of 10*log(N), with "N" being the maximum number of co-frequency ESV transmitters expected to operate simultaneously in the same satellite receiving beam.[33]

12. As a result, the ESV rules provided a regulatory framework for SCPC systems and aggregate power-density systems in order to protect the FSS operations from harmful interference. However, the ESV rules only provided this framework for *fixed power* aggregate systems, in which each terminal emits the same level of power-density. Prior to the release of the *VMES Order* the ESV rules did not have a framework for a *dynamic* or *variable power-density* aggregate system (variable power-density system), which has the ability to operate co-frequency terminals at different power-density levels.

13. In the *VMES Order*, the Commission adopted rules for variable power-density VMES systems.[34] Variable power-density VMES systems are aggregate systems that have the ability to operate co-frequency terminals at different power-density levels.[35] In doing so, the Commission sought to create a regulatory framework for variable power-density VMES systems that ensured that the FSS would be protected from harmful interference. For example, the Commission required the variable power-density systems to maintain power-density 1 dB below the off-axis EIRP-density limits, which means that the maximum power-density permitted would be equivalent to 80 percent of the power-density emitted by other VMES systems.[36] The Commission reasoned that, in a variable power-density system, the network control and monitoring center (NCMC) dynamically allocates a different EIRP-density to individual transmitters based on the amount of data that needs to be transmitted from a particular transmitter[37] and, thus, operating variable power-density VMES systems involved greater operational complexity than fixed power-density systems.[38] The Commission also required the VMES operator to file a report one year following the license issuance demonstrating that the system had complied with the power-density requirements.[39] This regulatory framework is set forth in section 25.226(a)(3) of the VMES rules. The *VMES Order* also declined to provide variable power-density VMES systems with ALSAT authority.

14. *Boeing Petition.* In its petition, Boeing asks the Commission to revise the rules for variable power-density VMES systems in order to promote the Commission's "goal of expanding mobile broadband services to underserved customers."[40] In particular, Boeing requests that the Commission allow variable power-density VMES systems to operate on an ALSAT basis without the 10*log(N) term[41] in the off-axis EIRP-density limits or the 1 dB reduction in power-density required for variable

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[32] *See 2000 Biennial Regulatory Review – Streamlining and Other Revisions of Part 25 of the Commission's Rules Governing the Licensing of, and Spectrum Usage by, Satellite Network Earth Stations and Space Stations*, FCC 05-62, 20 FCC Rcd 5593 (2005) (*Part 25 Streamlining Sixth Report and Order*). *See also ESV Order*, 20 FCC Rcd at 698, 716 nn. 154, 256.

[33] *VMES Order*, 24 FCC Rcd at 10447-10448, ¶¶ 106-107.

[34] *See* 47 C.F.R. § 25.226(a)(3).

[35] *VMES Order*, 24 FCC Rcd at 10447, 10450, ¶¶ 102, 115-117.

[36] For variable power systems, the power-density from all of the simultaneously operating co-frequency terminals must meet those limits in the aggregate.

[37] *VMES Order*, 24 FCC Rcd at 10448, ¶ 110.

[38] *Id.* at 10450, ¶¶ 115-116.

[39] *Id.* at 10451, ¶ 117, n.238.

[40] *See* Boeing Petition at i-ii.

[41] In the *Part 25 Streamlining Sixth Report and Order,* the Commission incorporated a 10*log(N) term into the off-axis EIRP-density limits to account for the power-density from each of the multiple terminals in an aggregate power-(continued….)

power-density VMES operators and without requiring adjacent satellite coordination.[42] Boeing claims that these restrictions do not provide greater interference protection to FSS operations and only serve to limit the potential spectral efficiency of a VMES network.[43] In the alternative, Boeing proposes that the Commission revise section 25.226(a)(3)(i) of its rules by defining N as equal to 1 for variable power-density systems so that the rule states that "the effective aggregate EIRP-density from all terminals shall be at least 1 dB below the off-axis EIRP-density limits defined in [paragraph] (a)(1)(i)(A)-(C), *assuming N equals one*."[44] Boeing contends that this alternative proposal would provide clarity to current and future VMES providers, though it would not provide the same level of spectral efficiency as Boeing's primary proposal.[45]

15. *ViaSat Petition.* ViaSat argues, like Boeing, that variable power-density VMES systems should be allowed to operate without the 1 dB reduction in power-density.[46] ViaSat claims that the 1 dB limitation contravenes Congress' intent in the American Recovery and Reinvestment Act of 2009 (Recovery Act) to encourage the creation of innovative technical solutions such as variable power-density systems for the purpose of expanding the availability of broadband services. According to ViaSat, the Commission should allow an applicant for a variable power-density system to demonstrate its ability to meet the same EIRP-density as other earth stations instead of automatically imposing the 1 dB restriction.[47] ViaSat also argues that, at a minimum, the 1 dB requirement should not apply to static variable power-density systems because the Commission only expressed interference concerns resulting from the complexity of dynamic variable power systems.[48]

16. ViaSat also argues that the Commission's rationale for the 1 dB restriction – that the variable power-density systems are complex – does not justify this restriction for variable power-density VMES systems. ViaSat explains that CDMA networks that use a sophisticated network management system (NMS) ensure that the variable power-density system can meet the off-axis EIRP-density limits by allowing a terminal to increase or decrease power-density only after the NMS determines that such action would not exceed the power-density limits and instructs the terminal accordingly.[49] Thus, ViaSat claims that the variable power-density system does not need to apply complicated techniques to overcome the time lag of the control signal, as the Commission describes in the *VMES Order*.[50] Nonetheless, ViaSat argues, if one or several terminals increased power-density even by a large amount,

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density ESV systems. *See 2000 Biennial Regulatory Review – Streamlining and Other Revisions of Part 25 of the Commission's Rules Governing the Licensing of, and Spectrum Usage by, Satellite Network Earth Stations and Space Stations*, Sixth Report and Order and Third Further Notice of Proposed Rulemaking, 20 FCC Rcd 5593 (2005) (*Part 25 Streamlining Sixth Report and Order*). *See also ESV Order*, 20 FCC Rcd at 698, 716 nn.154, 256. Specifically, the power-density of each individual co-frequency transmitter is reduced by a factor of 10*log(N), with "N" being the maximum number of co-frequency ESV transmitters expected to operate simultaneously in the same satellite receiving beam. *VMES Order*, 24 FCC Rcd at 10447-10448, ¶¶ 106-107.

[42] Boeing Petition at 12.

[43] *Id.*

[44] *Id.* at 13-14 (emphasis added).

[45] *Id.* at 14.

[46] ViaSat Petition at 6-10.

[47] *Id.* at 7-8.

[48] *Id.* at 6.

[49] *Id.* at 8.

[50] *Id.*

it would not have a significant impact on the aggregate power-density level of the system.[51] ViaSat further contends that dynamic variable power-density control technology actually mitigates the risk of interference because it enables the system to flexibly allocate resources to increase efficiency while decreasing the potential for harmful interference.[52]

17. Further, ViaSat proposes that the Commission clarify that, for a variable power-density CDMA system, the term "N" is equal to 1 in section 25.226(a)(3).[53] ViaSat also proposes that the Commission provide VMES variable power-density systems with ALSAT authority, claiming, among other things, that the Commission lacked any reason for denying such authority for these systems.[54]

18. MTN agrees with Boeing and ViaSat that the Commission should clarify that, for variable power-density systems, the value of N equals 1 in section 25.226(a)(3).[55] However, MTN does not support Boeing's and ViaSat's proposal to remove the 1 dB power-density restriction because only time will determine whether ViaSat is right about the risk of harmful interference from variable power-density systems.[56] MTN further argues that section 25.226(a)(3)(ii) allows variable power-density systems to exceed the off-axis EIRP-density levels in section 25.226(a)(3)(i).[57] ViaSat counters that section 25.226(a)(3)(ii) is a burdensome option because VMES operators must coordinate with all adjacent satellite operators, operate without ALSAT authority, and must adhere to "default" antenna pointing limits.[58]

19. *Discussion.* We grant in part and deny in part the Petitioners' requests. Specifically, we grant the Petitioners' requests to give variable power-density VMES systems ALSAT authority and define N equal to 1 in the off-axis EIRP-density limits that apply to these systems in section 25.226(a)(3)(i).[59] ALSAT authority gives variable power-density VMES systems operating in the conventional Ku-band the ability to access any U.S.-licensed space station as well as non-U.S. licensed space stations on the Permitted Space Station List. Providing variable power-density systems with ALSAT authority allows these systems to more effectively compete with non-variable power-density VMES operators.

20. We agree with Boeing and ViaSat that we should clarify that "N" is equal to 1 in the 10*log(N) term when calculating the off-axis EIRP-density limits for variable power-density systems.[60] As the parties point out, the VMES rules explicitly define N for VMES systems using time division multiple access and frequency division multiple access techniques as well as systems using multiple, co-

[51] *Id.* at 9.

[52] *Id.* at 9-10.

[53] *Id.* at 12.

[54] *Id.* at 13-14.

[55] MTN Response at 5-6.

[56] *Id.* at 6.

[57] *Id.* at 3.

[58] ViaSat Reply at 7 n.24.

[59] *See* 47 C.F.R. § 25.226(a)(3)(i) (requiring variable power-density VMES systems to operate within the off-axis EIRP-density limits in Section 25.226(a)(1)(i), minus 1 dB).

[60] *See* Boeing Petition at 14; Boeing Reply at 7; MTN Response at 5-6; ViaSat Petition at 11-13; ViaSat Reply at 2. Mathematically, the value of "log(1)" is zero. Thus, by defining N equal to 1, the 10*log(N) term becomes equal to zero and the term is effectively removed from the off-axis EIRP-density rule for variable power-density VMES systems.

frequency terminals that have the same EIRP,[61] but do not explicitly define N for variable power-density systems.[62] We agree with Boeing that making this change should provide clarity to current and future providers of wireless mobile broadband services.[63] Accordingly, we define N equal to 1 in Section 25.226(a)(3)(i) of the Commission's rules.[64]

21. However, we deny the Petitioners' requests to eliminate the 1 dB power-density restriction, a requirement that applies to variable power-density VMES operators to protect the FSS from harmful interference. As discussed above, a reduction in power-density by 1 dB means that the maximum power-density permitted would be equivalent to 80 percent of the power-density emitted by non-variable power-density VMES systems. Although operating 1 dB below the off-axis EIRP-density limits will result in a reduction of capacity, we disagree with the Petitioners that the 1 dB power-density reduction is unnecessary for a variable power-density system. As we discussed in the *VMES Order*, a dynamic or variable power-density system is complex – the system's NCMC must manage a large number of factors and, as a result of communicating with the VMES terminals through FSS satellites, there are inherent time delays in relaying commands and monitoring the co-frequency earth station terminals.[65] This complexity, combined with the fact that these are mobile applications operating in a FSS frequency band, necessitates adoption of more cautionary measures, such as the 1 dB restriction.[66]

22. Moreover, we are not persuaded by ViaSat's claim that variable power-density VMES systems do not include complexities that would justify the 1 dB reduction in power-density. ViaSat seems to envision a VMES system based entirely on calculations performed at a NCMC with no verification that the variable power-density VMES terminals have responded properly to the commands sent from the NCMC. We note that ITU-R Recommendation M.1643 (ITU[67] Rec. 1634) states, as part of "essential requirements related to the protection of FSS networks," that the mobile terminal should be subject to the *monitoring* and control by a NCMC or equivalent facility.[68] Although ITU Rec. 1634 specifically addresses airborne terminals operating with Ku-band FSS, we believe that similar requirements should apply to variable power-density VMES systems because these systems consist of remote terminals using varying levels of power-density. To properly monitor these remote terminals

[61] *See* 47 C.F.R. § 25.226(a)(1)(i).

[62] *See* Boeing Petition at 13-14; ViaSat Petition at 11.

[63] *See* Boeing Petition at 14.

[64] *See* Appendix B.

[65] *See VMES Order*, 24 FCC Rcd at 10450, ¶ 115.

[66] In addition, we do not see a meaningful distinction between a system that ViaSat describes as a static variable power-density system and a dynamic variable power-density system. ViaSat defines a static variable power system as a system in which each terminal may operate at a different power-density level and, in which the aggregate power-density is known from the outset and only changes occasionally. *See* ViaSat Petition at 3. Both of these systems must change power-density under control of the network management system and, therefore, we believe that they both should be characterized as dynamic (variable) power-density systems.

[67] ITU stands for International Telecommunication Union. The ITU is a United Nations agency that "allocate[s] global radio spectrum and satellite orbits, develop[s] the technical standards that ensure networks and technologies seamlessly interconnect, and strive[s] to improve access to [information and communication technologies] to underserved communities worldwide." *See* http://www.itu.int/en/about/Pages/default.aspx (last visited January 4, 2013).

[68] *See* ITU-R Rec. M.1634 "Technical and operational requirements for aircraft earth stations of aeronautical mobile-satellite service including those using fixed-satellite service network transponders in the band 14-14.5 GHz (Earth-to-space)" Annex 1, Part A "Essential requirements related to the protection of FSS networks," ¶ 4 (emphasis added).

requires either receiving the radiated signals from the terminals, as relayed through the target GSO satellite, or receiving telemetry signals from the terminals, again via the target satellites. Either method results in a time delay between the NCMC issuing a command and verifying that the command was properly executed by the VMES terminal. ViaSat also assumes that each of the co-frequency VMES terminals transmits only a small fraction of the maximum EIRP-density when ViaSat states that "if one terminal or several terminals increased power-density even by a large amount, it would not have a significant impact on the aggregate power-density level of the system." This may be the case for ViaSat's VMES system. However, this may not be the situation for all VMES systems. For example, some VMES systems may operate with a small number of terminals on a single frequency channel where an erroneous increase in the dynamic EIRP-density could cause the aggregate EIRP-density limits to be exceeded. Accordingly, we continue to find that the 1 dB power-density restriction is justified for variable power-density VMES systems.[69]

23. We agree with ViaSat, however, that we should promote, to the greatest extent possible, innovation and flexible and efficient use of spectrum, consistent with the Recovery Act and the National Broadband Plan.[70] As Boeing and ViaSat illustrate, certain variable power-density VMES systems may be capable of operating without the 1 dB power-density restriction while preventing harmful interference to the adjacent FSS satellites. Those VMES operators that believe that they can prevent such interference should file a request to waive the 1 dB requirement pursuant to section 1.3 of the Commission's rules and provide, with their waiver request, data that would demonstrate that these systems would not cause harmful interference without the 1 dB restriction. Specifically, we require the waiver requests to be accompanied by a report (System Report) that demonstrates that the system has operated without providing interference to adjacent satellites while complying with the 1 dB restriction.[71] In order to help ensure that the System Report includes sufficient technical information for us to assess whether a waiver is warranted, a variable power-density VMES operator should file a waiver request *after* its system has operated at or above 50 percent of its capacity without causing harmful interference.[72] The International Bureau, on delegated authority, will place the waiver request and System Report on public notice for comment. Through this process, parties that satisfy the waiver requirements are able to manage their systems more effectively and use spectrum more efficiently while

[69] As a related matter, we disagree with ViaSat's argument that exceeding the power levels, as set forth in section 25.226(a)(3)(ii), is a burdensome option because VMES operators must coordinate with all adjacent satellite operators, operate without ALSAT authority, and must adhere to "default" antenna pointing limits. The target satellite operator is the entity responsible for the coordination with adjacent satellite operators not the VMES operator, so that coordination is not burdensome for VMES operators. In addition, section 25.226(a)(3)(ii) places no specific restrictions on the antenna pointing limits.

[70] *See* Federal Communications Commission, *Connecting America: The National Broadband Plan* (2010), *available at* http://www.broadband.gov.

[71] At a minimum, the System Report should, through the use of operational statistics, actual measurements or a combination thereof, contain an assessment of the aggregate power-density at the geostationary satellite orbit (GSO) from all simultaneously active co-frequency transmitters. The System Report also should include information on the average and maximum number of simultaneous co-frequency transmitters, an analysis of the EIRP-spectral density at the GSO, and a discussion of the factors taken into account at the network control center required to manage the aggregate power-density of the system.

[72] We note that the 1 dB reduction in EIRP spectral-density is equivalent to a capacity reduction of about 20% over operations at the maximum permitted EIRP spectral-density. If the system is designed to operate at the maximum EIRP spectral-density, then notifying the Commission when it has reached 50% of peak capacity allows for a further 30% growth during the year following notification without exceeding the minus 1 dB limit. Further, we note that to show that the system will not cause harmful interference while operating at full power, the report should demonstrate a correspondence between the current capacity and the current aggregate EIRP spectral-density at the GSO.

ensuring that adjacent FSS satellites are protected from harmful interference. Finally, we note that applicants seeking a waiver of the 1 dB requirement will retain ALSAT authority.

24. Further, we adopt rules requiring variable power-density VMES systems to cease emissions under two scenarios. First, if the power-density from an individual transmitter exceeds the applicable[73] power-density limit, then that transmitter must cease emissions automatically within 100 milliseconds of detecting this violation. Under this scenario, the individual transmitter must be self-monitoring and capable of shutting itself off. Second, if the power-density of one or more transmitters causes the aggregate off-axis EIRP-densities to exceed the applicable power-density limit, then the transmitter or transmitters must cease or reduce emissions within 100 milliseconds of receiving the appropriate command from the system's NCMC. In its license application, the VMES applicant should describe how the system will respond if the power-density in excess of the applicable off-axis EIRP-density limits is detected. We adopt these cessation of emission requirements to ensure that variable power-density VMES systems protect the FSS from harmful interference, particularly in light of today's decision to grant the Petitioner's requests for variable power-density VMES systems to obtain ALSAT authority.[74]

25. In addition, we no longer require VMES licensees to file a report detailing the effective aggregate EIRP-density levels resulting from their operations following one year after license issuance and we remove paragraph (a)(3)(iii) from section 25.226 accordingly. We believe that the 1 dB reduction in power-density is a sufficient safeguard for preventing harmful interference by variable power-density VMES systems, obviating the need for such a report. We also find that the System Report described above, along with the waiver request, helps us to determine whether these VMES operators are capable of providing service without the 1 dB safeguard measure and without causing harmful interference.

B. Antenna Pointing Error Requirements

26. *Background.* In the *VMES Order*, the Commission adopted a 0.2 degree antenna pointing error requirement for VMES operators in order to protect adjacent satellites from harmful interference when VMES terminals operate at power-density levels near the off-axis EIRP-density limits.[75] The Commission required each VMES operator to maintain an antenna pointing error within 0.2 degrees between the intended target satellite and the axis of the VMES antenna's main lobe (0.2 degree antenna pointing error rule).[76] The Commission also required the VMES operators to cease emissions automatically within 100 milliseconds if the antenna pointing error exceeded 0.5 degrees (0.5 degree shutdown rule).[77]

27. In addition, the Commission recognized that VMES operators with terminals emitting low power-density might be capable of having a pointing error that is greater than 0.2 degrees without causing harmful interference to the FSS satellites adjacent to the target satellite.[78] Thus, the Commission allowed VMES operators with low power-density systems to declare a maximum antenna pointing error

[73] By "applicable" we mean that, for variable power-density VMES systems that do not request, or request, but do not obtain a waiver of the 1 dB requirement, the applicable power-density limits would be the off-axis EIRP-density limits minus 1 dB in section 25.226(a)(3)(i). For variable power VMES systems that obtain approval from the Commission or the International Bureau, on delegated authority, to waive the 1 dB requirement, the applicable limits would be the off-axis EIRP-density limits in section 25.226(a)(1)(i).

[74] *See supra*, ¶ 19; *see also*, Boeing Petition at 12; ViaSat Petition at 13-14.

[75] *VMES Order*, 24 FCC Rcd at 10456, ¶ 133.

[76] *Id*. *See* 47 C.F.R. § 25.226(a)(1)(ii)(A).

[77] *Id.* at 10456, ¶ 134.

[78] *Id.* at 10457, ¶ 135.

(self-declared antenna pointing error rule) when filing an application for a VMES license with the Commission.[79] However, these VMES operators could only declare an antenna pointing error to the extent that it would enable their systems to remain within the off-axis EIRP-density limits.[80] The Commission also required those VMES systems to shut down within 100 milliseconds if the antenna exceeds the declared pointing error (self-declared shutdown rule).[81]

28. *ViaSat Petition.* ViaSat requests that we clarify certain aspects of the antenna pointing error rules in order to provide the certainty needed to ensure further development of VMES services and technologies.[82] First, ViaSat argues that the 0.2 degree pointing error should be construed as a "peak" level and not a "maximum" limit. As a result, ViaSat proposes that the Commission add the term "peak" to the 0.2 degree antenna pointing error rule and define peak to be "the value three standard deviations above the mean value in a normal distribution."[83] According to ViaSat, in the *ESV Order* the Commission expressed its intent to adopt an antenna pointing error requirement consistent with ITU Resolution 902's (Res. 902) technical parameters, "which requires operators to maintain a pointing accuracy within 0.2 degrees peak."[84] ViaSat also claims that whereas the 0.2 degree antenna pointing error should be understood as being a peak level, the 0.5 degree pointing error in the 0.5 degree shutdown rule should be understood to be a maximum limit on antenna pointing away from the target satellite.[85] ViaSat further contends that the Commission did not appear to intentionally change the relationship between the peak level and shutdown level, but that the language in the self-declared antenna pointing error rule, which requires applicants to "declare a maximum antenna pointing error that may be greater than 0.2 [degrees]," implies that the 0.2 degree pointing error is a maximum limit instead of a peak level.[86]

29. Second, ViaSat argues that, for the reasons discussed above, the VMES applicants declaring their own antenna pointing error should be required to provide both a *peak* antenna pointing error that the VMES operator will normally maintain and a *maximum* antenna pointing error, which ViaSat refers to as the "critical upper limit" that the VMES operator will never exceed.[87] As a result, ViaSat requests that the Commission replace the word "maximum" with the word "peak" in the self-declared antenna pointing error rule so that applicants declare a peak antenna pointing error that may be greater than 0.2 degrees.[88] In addition, ViaSat requests that the Commission modify the self-declared shutdown rule[89] so that the applicants: (1) declare a maximum antenna pointing error in excess of 0.5 degrees (as long as they comply with the applicable off-axis EIRP-density limits), and (2) shut down

[79] 47 C.F.R. § 25.226(a)(1)(ii)(B).

[80] *VMES Order*, 24 FCC Rcd at 10457, ¶ 135.

[81] *Id.*

[82] ViaSat Petition at 17.

[83] *Id.*, Exh. A. at 18. As ViaSat explains, this represents a degree of mispointing greater than or equal to approximately 99.7 percent of all values in that distribution.

[84] *See id*.

[85] *Id.* at 19.

[86] *Id.*, Exh. A.

[87] *Id.* at 20.

[88] *Id.*, Exh. A (setting forth proposed revisions to section 25.226(a)(1)(ii)(B)).

[89] *See* 47 C.F.R. § 25.226(a)(1)(iii)(B).

when the VMES antenna exceeds that maximum antenna pointing error.[90]

30. Third, ViaSat requests that the Commission revise the introductory paragraph of the antenna pointing error rule to clarify that the antenna pointing error includes non-deliberate and deliberate forms of mispointing.[91] ViaSat argues that the VMES antenna pointing requirements are based in part on the *ESV Reconsideration Order*, and that the Commission in that Order only highlights non-deliberate causes of antenna mispointing.[92] ViaSat claims that VMES terminals may use closed-loop tracking systems that deliberately mispoint the antenna in order to determine whether the signal strength from the target satellite can be enhanced.[93] ViaSat therefore concludes that making this clarification would provide the Commission, the satellite industry and the public with more comprehensive information to use when evaluating VMES applications.[94]

31. Finally, ViaSat requests that the Commission clarify that VMES operators may simultaneously deviate from the 0.2 degree antenna pointing error requirement *and* the off-axis EIRP-density limits provided that the technical parameters of the VMES system have been coordinated with satellites adjacent to the target satellite.[95] According to ViaSat, section 25.226(a)(2) of the VMES rules allows VMES operators to exceed the off-axis EIRP-density limits, but that the self-declared antenna pointing error rule and the self-declared shutdown rule require VMES operators to stay within the off-axis EIRP-density limits if the VMES operators declare their own pointing error.[96] ViaSat argues that making this clarification would be consistent with the intent of the *VMES Order* and the *ESV Reconsideration Order*, which is to maximize operator flexibility to the extent that such flexibility does not cause harmful interference to adjacent satellite operators.[97]

32. Boeing supports ViaSat's request to clarify the antenna pointing error requirements but without explanation.[98] MTN does not oppose ViaSat's proposals, but is not convinced that the changes proposed by ViaSat are needed in order to make the VMES rules fully comprehensible.[99] MTN also expresses concern that adoption of ViaSat's proposals, without careful implementation, could lead to confusion, an outcome that MTN does not support.[100] Boeing also agrees with MTN that the Commission should carefully implement the proposals to avoid causing confusion.[101]

33. *Discussion.* We decline ViaSat's proposal to add the term "peak" into the antenna pointing error rules or to declare that the term "peak" shall be defined as the value three standard deviations (or sigma) from the mean. In the *ESV Second Reconsideration Order*, we similarly declined to incorporate

[90] ViaSat Petition at 20.

[91] *Id.* at 21-22. *See also* 47 C.F.R. § 25.226(a)(1)(i).

[92] ViaSat Petition at 21.

[93] *Id*.

[94] *Id.* at 22.

[95] *Id.* at 22-24; ViaSat Reply at 8-9.

[96] ViaSat Petition at 23 (specifically referring to sections 25.226(a)(1)(ii)(B), 25.226(a)(1)(iii)(B), the self-declared antenna pointing error rule and self-declared shutdown rule, respectively).

[97] *Id.* at 24.

[98] Boeing Reply at 8.

[99] MTN Response at 7.

[100] *Id.* at 7-8.

[101] Boeing Reply at 8-9.

the term "peak" into the ESV antenna pointing error rules. In the *ESV Second Reconsideration Order*, we noted that there are other meanings for the term "peak" and that the ITU did not define the term "peak."[102] By not incorporating the term "peak" into the 0.2 degree antenna pointing error rule and by specifying the shutoff angle in the VMES rules, we provide VMES manufacturers with greater operational flexibility, thereby promoting competition while continuing to ensure that FSS systems would receive no harmful interference.[103] To the extent that ViaSat is correct that some clarification of the 0.2 degree antenna pointing error rule is warranted, however, we provide such clarification here. A VMES license applicant should show that it will comply with the 0.2 degree antenna pointing error rule by demonstrating that the 0.2 degree antenna pointing error in the applicant's proposed network will be three standard deviations from the mean or less.

34. Second, we decline to require VMES applicants declaring their own antenna pointing error to provide a "peak" antenna pointing error that is maintained during operation and a "maximum" antenna pointing error for ceasing emissions.[104] The Commission intended for the self-declared antenna pointing error rule and related shutdown rule to reference the same antenna pointing error. Specifically, the Commission sought to ensure that VMES applicants: (1) identified the maximum pointing angle that could be achieved without causing harmful interference, and (2) were capable of ceasing emissions if that antenna pointing error were exceeded.[105] The Commission expected that, in self-declaring the antenna pointing error and having them shutdown upon exceeding that self-declared angle, the system operator could take into account any difference between a three standard deviation tracking error (or other target the operator chose to use in implementing the antenna tracking system) and the angle at which the off-axis EIRP-density limits would be exceeded. As a result, the VMES operators could determine the design of the system as long as they demonstrate that such design will not cause harmful interference to the FSS satellites adjacent to the target satellite. Accordingly, by declaring one antenna pointing error for operation and cessation of emissions, these VMES operators have the flexibility to innovate and develop new approaches to provide services and to protect incumbents, thereby advancing market-driven deployment of broadband services while continuing to ensure that VMES operators protect FSS providers from harmful interference.

35. Third, although we agree with ViaSat that the antenna pointing error rules apply to both deliberate and non-deliberate antenna mispointing, we decline to add the terms "deliberate and non-deliberate mispointing" to those rules because we believe that this change is unnecessary. There is nothing in the *ESV Reconsideration Order* to indicate that the list of mispointing examples, which happen to be examples of non-deliberate mispointing, was all-inclusive. As MTN correctly states, the antenna pointing error requirements are understood to apply to both deliberate and non-deliberate

[102] *See ESV Second Reconsideration Order*, 27 FCC Rcd at 8566-8567, ¶ 33.

[103] This is also consistent with our conclusion in the *ESV Second Reconsideration Order*. *See Id.*

[104] We note that ViaSat appears to want the self-declared antenna pointing error rules to have different antenna pointing errors for operation and shutdown, just like the 0.2-degree antenna pointing error rule and the 0.5 degree shutdown rule.

[105] In other words, the Commission recognized that VMES systems emitting low power could operate at an antenna pointing error greater than 0.2 degrees without exceeding the off-axis EIRP-density limits, and, therefore, without causing harmful interference to the adjacent FSS satellites. By allowing these systems to declare their own maximum pointing error, operate up to that maximum angle, and shut down at that same angle, these systems have more flexibility in their operations than if they abided by the 0.2 degree/0.5 degree antenna pointing and shutdown requirements. *See VMES Order*, 24 FCC Rcd at 10457, ¶ 35. *See also ESV Reconsideration Order*, 24 FCC Rcd at 10379, ¶ 24 (agreeing with ARINC that certain ESV systems may be capable of exceeding the 0.2 degree antenna pointing error requirement without violating the off-axis EIRP-density limits).

mispointing.[106]

36. Finally, we decline ViaSat's request to revise the self-declared antenna pointing error rule and self-declared shutdown rule to clarify that VMES providers operating at higher power-density levels pursuant to section 25.226(a)(2) could also deviate from the 0.2 degree antenna pointing error rule and 0.5 degree shutdown rule. Although we agree with ViaSat that VMES operators may deviate from the antenna pointing error requirements when operating at higher power-density levels, including such a statement in the self-declared maximum antenna pointing error rules would not be appropriate, particularly when we look at the language in paragraph (a) of section 25.226. Section 25.226(a) states, in part, that "VMES licensees must comply with the requirements in *either* paragraph (a)(1), (a)(2) or (a)(3) of this section."[107] Thus, the antenna pointing error requirements in paragraph (a)(1) do not apply to VMES systems operating pursuant to paragraph (a)(2) of section 25.226. In other words, if the VMES systems operate pursuant to the off-axis EIRP-density limits under paragraph (a)(1), then those systems must remain within those limits when following the 0.2 degree antenna pointing error rule or the self-declared antenna pointing error rule. If the VMES systems operate at higher off-axis EIRP-density levels, as provided under paragraph (a)(2), then, those VMES systems operate pursuant to the parameters agreed to in the coordination agreements with their target satellites and, as mentioned above, the antenna pointing error requirements in paragraph (a)(1) do not apply to them. Accordingly, we decline to modify the antenna pointing error rules as requested by ViaSat.

C. Requirements for Human Exposure to Radiofrequency (RF) Radiation

37. *Background.* The U.S. Congress enacted the National Environmental Policy Act of 1969 (NEPA) requiring Federal Government agencies to evaluate the effect of their major federal actions on the quality of the environment, including the human environment.[108] As a result, the Commission adopted, among other requirements, limits on the level of human exposure to radiofrequency radiation (RF radiation exposure limits) in sections 1.1310 and 2.1093 of its rules.[109] The RF radiation exposure limits are divided into two categories: the "occupational/controlled" exposure category and "general population/uncontrolled" exposure category.[110] Under section 1.1307(b)(1), the RF radiation exposure limits are "generally applicable to all facilities, operations and transmitters regulated by the Commission."[111] However, section 1.1307(b) requires only certain facilities, operations and transmitters to submit a routine environmental evaluation for radiation exposure in order to determine compliance with the RF radiation exposure limits prescribed by sections 1.1310 and 2.1093 and to prepare an

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[106] *See* MTN Response at 4 n.9.

[107] 47 C.F.R. § 25.226(a) (emphasis added).

[108] National Environmental Policy Act of 1969, 42 U.S.C. § 4321, *et. seq.* In 1996, the Commission amended its rules to adopt new guidelines and techniques for evaluating the environmental effects of radiofrequency (RF) radiation from transmitters. *See Guidelines for Evaluating the Environmental Effects of Radiofrequency Radiation*, ET Docket No. 93-62, Report and Order, 11 FCC Rcd 15123 (1996) (*RF Guidelines Order*).

[109] 47 C.F.R. §§ 1.1310, 2.1093(d)(1), (2) (Section 2.1093 applies to portable devices.).

[110] The occupational/controlled category includes persons exposed due to their employment who are made fully aware of the potential for exposure and have the ability to control their exposure. This category also includes "transient" exposure resulting from passing through a location where exposure levels could exceed the RF exposure limits in the general population/uncontrolled category, as long as the exposed persons are made aware of the radiation and can control their exposure to such radiation by leaving the area or otherwise. *See RF Guidelines Order*, 11 FCC Rcd at 15139, ¶ 43. The general population/uncontrolled category includes the general public as well as persons exposed in their employment that are not made fully aware of or have no control over their exposure. *See id.* at 15139, ¶ 44.

[111] 47 C.F.R. § 1.1307(b)(1).

Environmental Assessment (EA) if the limits are exceeded.[112]

38. Under section 1.1307(b)(1) of our rules, all satellite communications services regulated under Part 25 of the Commission's rules are subject to these requirements and applicants must submit a routine environmental evaluation for human exposure to RF radiation in order to determine whether the proposed facility would cause human exposure to RF levels in excess of the limits in section 1.1310.[113] Section 25.226(b)(8), in turn, specifies, among other things, that VMES applicants must submit a RF hazard analysis determining whether operation of VMES terminals or classes of terminals will result in power-densities that would exceed the Commission's RF exposure limits in section 1.1310.[114] Section 25.226(b)(8) also requires an applicant with VMES terminals that will exceed the RF radiation exposure limits in section 1.1310 to provide, with its environmental assessment, a plan for mitigation of RF exposure that would meet those guidelines.[115] In addition, in the *VMES Order*, the Commission required VMES licensees to use qualified installers to install VMES terminals onto the vehicles and to attach a warning label to VMES terminals exhibiting RF radiation exposure levels exceeding 1 mW/cm^2 in accessible areas.[116] Further, the Commission adopted section 25.226(a)(9), which requires VMES terminals to automatically cease transmitting within 100 milliseconds upon loss of the satellite downlink signal.[117] In adopting this rule, the Commission agreed with commenters that the VMES operators should be required to comply with a general interference protection rule similar to the cessation of emission rule for VSATs.[118] Section 25.226(a)(9) promotes NEPA's goals by requiring VMES operators to cease transmitting when there is a blockage (the blockage may be human, man-made, such as buildings, or natural, such as trees) in order to ensure that, if the blockage happens to be a person, the amount of radiation exposure to that person is mitigated.

39. *ViaSat Petition.* ViaSat argues that VMES operators should not be subject to section 25.226(a)(9) of the Commission's rules, which requires VMES terminals to cease operating within 100 milliseconds of losing a downlink signal from the target satellite.[119] ViaSat contends that the Commission fails to explain why the shutdown requirement only applies to VMES terminals and not to VSAT and ESV terminals.[120] ViaSat also claims that the shutdown requirement does not consider the momentary downlink signal interruptions that are inherent in mobile operations. ViaSat further argues that most of the interruptions will result from natural terrain or man-made structures, and that it would be a very rare event for a human being to be in the VMES terminal's transmit or receive path.[121] Moreover,

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[112] *See* 47 C.F.R. § 1.1307(b)(1). Table 1 of section 1.1307(b)(1) and section 1.1307(b)(2) specify the transmitters, facilities and operations that are subject to a routine environmental evaluation. *See* 47 C.F.R. § 1.1307(b)(1) Table 1; § 1.1307(b)(2).

[113] 47 C.F.R. § 1.1307(b)(1), Table 1. The RF radiation exposure limit for the general population/uncontrolled category in the 14.0-14.5 GHz band is 1.0 mW/cm^2 and the RF radiation exposure limit for an individual in an occupational/controlled environment is 5.0 mW/cm^2. 47 C.F.R. § 1.1310.

[114] *See* 47 C.F.R. § 25.226(b)(8); *VMES Order*, 24 FCC Rcd at 10471, ¶ 185.

[115] 47 C.F.R. § 25.226(b)(8). *See also VMES Order*, 24 FCC Rcd at 10471, ¶ 185.

[116] *Id.* at 10471, ¶ 186.

[117] 47 C.F.R. § 25.226(a)(9).

[118] *VMES Order*, 24 FCC Rcd at 10472, ¶ 189. *See also* 47 C.F.R. § 25.134(h) (prohibiting VSAT operators from using remote earth stations in their networks that are not designed to stop transmissions when synchronization with the target satellite fails).

[119] ViaSat Petition at 14-15.

[120] *Id*.

[121] *Id.* at 15-16.

ViaSat argues that many VMES terminals include features that limit human exposure to RF radiation, such as radomes, which prevent parts of the human body from being inserted between the reflector and the feed horn.[122] Nonetheless, ViaSat contends that an individual could be exposed to radiation from a VMES terminal for several seconds, on several occasions, without exceeding the Commission's RF radiation exposure limit.[123] MTN supports ViaSat's proposed rule modification.[124]

40. *Discussion*. Based on our review of the record, we modify section 25.226(a)(9) to allow VMES operators to accommodate instances where the brief loss of downlink signal is caused by man-made objects, such as overpasses, or natural objects, such as trees. Therefore, we adopt, in part, ViaSat's proposal to require the VMES terminals to cease transmissions when loss of synchronization with the satellite signal occurs instead of when loss of the satellite downlink signal occurs. Specifically, as explained further below, we require a VMES system to automatically cease transmissions: (1) when loss of synchronization occurs, or (2) within 5 seconds of the loss of the satellite downlink signal, whichever timeframe is shorter. This change should provide the VMES operators with greater flexibility while continuing to ensure that the general public is protected from exposure to RF radiation in excess of the limit determined safe under our rules.[125] In addition, this revision should ensure that if a VMES terminal loses contact with its target satellite, and, therefore, with the NCMC, it will cease transmissions to avoid operating in an uncontrolled manner.

41. We agree with ViaSat that basing the cessation of emission requirement upon loss of synchronization would give VMES operators greater flexibility in managing their systems. Loss of synchronization occurs when the internal timing in the VMES receiver is no longer in step with the signal coming from the satellite. If the loss of the satellite downlink signal is sufficiently brief, the receiver will still remain synchronized with the satellite and, once the downlink signal is restored, data may be immediately transmitted. If the transmitter is forced to shut off when the satellite downlink signal is lost, the receiver will have to go through a resynchronization process following reacquisition of the satellite signal. Resynchronization could take anywhere from milliseconds to seconds depending on the system design, causing a loss of communication capacity in the VMES system until the vehicle has passed the man-made or natural objects. However, once synchronization with the satellite signal has been lost, communication with the satellite cannot take place, so shutting off the transmitter should cause no additional loss of communication capability. In addition, the longer time delay in shutting down the transmitter should reduce the number of instances that the VMES system would need to cease transmissions.

42. However, depending on the specific receiver's design and implementation, loss of synchronization may not occur for several hundred milliseconds after the loss of the satellite downlink signal, resulting in a potentially significant delay in ceasing transmissions. To ensure against human exposure to RF radiation in excess of the limits in these situations, we require VMES terminals to cease transmissions upon loss of synchronization or within 5 seconds of the loss of satellite downlink signal, whichever timeframe is shorter. In Exhibit B of its Petition, ViaSat demonstrates that a delay of 5 seconds in shutting down the transmitter following loss of satellite downlink signal would not result in human exposure to RF radiation in excess of the RF limit for exposure to the general public specified in the Table in section 1.1310, and we agree with this assessment.[126] In particular, in Exhibit B, ViaSat

[122] *Id.* at 15.

[123] ViaSat Petition at 16, Exh. B. ViaSat illustrates this point in Exhibit B of its Petition.

[124] *See* MTN Response at 8.

[125] *See RF Guidelines Order*, 11 FCC Rcd at 15184, ¶ 168.

[126] ViaSat Petition Exh. B.

calculates the peak power-density of four different types of VMES terminals and compares their estimated power-densities with the allowable general population power-density RF radiation limit from OET Bulletin No. 65.[127] The peak power-density from all four terminals does not exceed the level of the general population power-density limit of 1 milliwatt per square centimeter, even in the near field area only a few meters from the antenna. Therefore, the radiation exposure from a VMES terminal for up to 5 seconds is well within the allowable RF limits for the general population.

43. Consistent with our decision above, we decline to adopt ViaSat's proposed language for section 25.226(a)(9).[128] Instead, we revise section 25.226(a)(9) as follows: "Each VMES terminal shall automatically cease transmitting upon the loss of synchronization or within 5 seconds upon loss of reception of the satellite downlink signal, whichever is the shorter timeframe." We emphasize that VMES system operators must still comply with the RF limits in section 1.1310 in order to ensure public safety, as set forth in section 25.226(b)(8)[129] and comply with the professional installation and labeling requirements that the Commission adopted in the VMES Order.[130] Accordingly, revising section 25.226(a)(9) in the manner described above should provide VMES operators with greater flexibility in running their mobile systems while still fully protecting the public from harmful exposure to RF radiation and should not have a potentially significant effect on the quality of the human environment that requires the preparation of an environmental assessment under section 1.1307(b) of the Commission's rules.

IV. PROCEDURAL MATTERS

A. Final Regulatory Flexibility Certification

44. The Regulatory Flexibility Act of 1980, as amended (RFA),[131] requires that a regulatory flexibility analysis be prepared for notice-and-comment rule making proceedings, unless the agency certifies that "the rule will not, if promulgated, have a significant economic impact on a substantial number of small entities."[132] The RFA generally defines the term "small entity" as having the same meaning as the terms "small business," "small organization," and "small governmental jurisdiction."[133] In addition, the term "small business" has the same meaning as the term "small business concern" under the Small Business Act.[134] A "small business concern" is one which: (1) is independently owned and

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[127] *See* OET Bulletin No. 65, *Evaluating Compliance With FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields wherein the General Population/Uncontrolled Limit is given as 1 mW/cm^2 for 30 minutes* at 67. According to OET Bulletin No. 65, the general population RF limit is an exposure to a power-density level averaged over a period of 30 minutes.

[128] ViaSat suggests that section 25.226(a)(9) be modified to read: "VMES operators licensed pursuant to this section are prohibited from using remote earth stations in their networks that are not designed to stop transmissions from their remote earth stations when synchronization with the target satellite fails." *See* ViaSat Petition Exh. A at 2.

[129] *See* 47 C.F.R. § 25.226(b)(8) (citing 47 C.F.R. § 1.1310).

[130] *VMES Order*, 24 FCC Rcd at 10471, ¶ 186.

[131] The RFA, *see* 5 U.S.C. §§ 601-612, has been amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA), Pub. L. No. 104-121, Title II, 110 Stat. 857 (1996).

[132] 5 U.S.C. § 605(b).

[133] 5 U.S.C. § 601(6).

[134] 5 U.S.C. § 601(3) (incorporating by reference the definition of "small-business concern" in the Small Business Act, 15 U.S.C. § 632). Pursuant to 5 U.S.C. § 601(3), the statutory definition of a small business applies "unless an agency, after consultation with the Office of Advocacy of the Small Business Administration and after opportunity for public comment, establishes one or more definitions of such term which are appropriate to the activities of the agency and publishes such definition(s) in the Federal Register."

operated; (2) is not dominant in its field of operation; and (3) satisfies any additional criteria established by the U.S. Small Business Administration (SBA).[135]

45. In light of the rules adopted in the *VMES Order,* we find that there are only two categories of licensees that would be affected by the new rules. These categories of licensees are Satellite Telecommunications and Fixed-Satellite Transmit/Receive Earth Stations. The SBA has determined that the small business size standard for Satellite Telecommunications is a business that has $15 million or less in average annual receipts.[136] Commission records reveal that there are 20 space station licensees and operators in the Ku-band. We do not request or collect annual revenue information concerning such licensees and operators, and thus are unable to estimate the number of geostationary space station licensees and operators that would constitute a small business under the SBA definition cited above, or apply any rules providing special consideration for geostationary space station licensees and operators that are small businesses. Currently there are approximately 2,879 operational fixed-satellite transmit/received earth stations authorized for use in the Ku-band. The Commission does not request or collect annual revenue information, and thus is unable to estimate the number of earth stations that would constitute a small business under the SBA definition. Of the two classifications of licensees, we estimate that only 10 entities will provide VMES service. For the reasons described below, we certify that the policies and rules adopted in this *VMES Reconsideration Order* will not have a significant economic impact on a substantial number of small entities.

46. In the *VMES Order*, the Commission adopted domestic U.S. allocation, service and licensing rules that allow VMES systems to operate in the conventional and extended Ku-band frequencies while adhering to the Commission's two-degree satellite spacing interference avoidance requirements of the Ku-band FSS. The "conventional" Ku-band refers to frequencies in the 11.7-12.2 GHz (downlink) and 14.0-14.5 GHz (uplink) bands and the covered "extended Ku-band" includes the 10.95-11.2 GHz and 11.45-11.7 GHz (downlink) bands. The VMES rules enable the VMES to operate as a primary application of the FSS in the conventional bands. In the extended band frequencies, VMES may be authorized to communicate with geostationary satellite orbit FSS space stations but must accept interference from stations of the Fixed Service (FS) operating in accordance with the Commission's rules. The VMES rules promote spectrum sharing with certain secondary incumbent services in the uplink bands, including government space research service and radio astronomy service.

47. The Commission does not expect small entities to incur significant costs associated with the changes adopted in this *VMES Reconsideration Order*. The changes will benefit both large and small entities by allowing greater operational flexibility in providing VMES service. We believe these requirements are nominal and do not impose a significant economic impact on small entities. Therefore, we certify that the requirements adopted in this *VMES Reconsideration Order* will not have a significant economic impact on a substantial number of small entities.

B. Final Paperwork Reduction Act and Congressional Review Act

48. This document does not contain new or modified information collection requirements subject to the Paperwork Reduction Act of 1995 (PRA), Public Law 104-13. In addition, it does not contain any new or modified information collection burden for small business concerns with fewer than 25 employees, pursuant to the Small Business Paperwork Relief Act of 2002, Public Law 107-198, *see* 44 U.S.C. 3506(c)(4). The Commission will send a copy of this Order on Reconsideration to Congress and the Government Accountability Office pursuant to the Congressional Review Act, *see* 5 U.S.C. 801(a)(1)(A).

[135] 15 U.S.C. § 632.

[136] 13 C.F.R. § 121.201, NAICS codes 517410 and 517910.

V. ORDERING CLAUSES

49. IT IS ORDERED that, pursuant to sections 4(i), 7, 302, 303(c), 303(e), 303(f) and 303(r) of the Communications Act of 1934, as amended, 47 U.S.C. sections 154(i), 157, 302, 303(c), 303(e), 303(f) and 303(r), this Order on Reconsideration IS ADOPTED. Part 25 of the Commission's Rules IS AMENDED, as specified in Appendix B, effective 30 days after publication in the Federal Register.

50. IT IS FURTHER ORDERED that the Petition for Reconsideration filed by The Boeing Company IS GRANTED in part to the extent described above and IS DENIED in all other respects.

51. IT IS FURTHER ORDERED that the Petition for Reconsideration filed by ViaSat, Inc. IS GRANTED in part to the extent described above and IS DENIED in all other respects.

52. IT IS FURTHER ORDERED that the Final Regulatory Flexibility Certification, as required by section 604 of the Regulatory Flexibility Act, IS ADOPTED.

53. IT IS FURTHER ORDERED that the Commission's Consumer and Governmental Affairs Bureau, Reference Information Center, SHALL SEND a copy of this Order on Reconsideration including the Final Regulatory Flexibility Certification, to the Chief Counsel for Advocacy of the Small Business Administration.

FEDERAL COMMUNICATIONS COMMISSION

Marlene H. Dortch
Secretary

APPENDIX A

List of Parties

Petitions
The Boeing Company (Boeing)
ViaSat, Inc. (ViaSat)

Replies
Boeing
Maritime Telecommunications Network, Inc.
ViaSat

Ex Parte Filings
Boeing

APPENDIX B

Final Rules

For the reasons discussed above, the Federal Communications Commission amends 47 C.F.R. part 25 as follows:

PART 25 – SATELLITE COMMUNICATIONS

1. The authority citation for Part 25 continues to read as follows:

Authority: 47 U.S.C. 701-744. Interprets or applies Sections 4, 301, 302,303, 307, 309 and 332 of the Communications Act, as amended, 47 U.S.C. Sections 154, 301, 302, 303, 307, 309, 332, unless otherwise noted.

§ 25.226 [Amended]

2. Amend Section 25.226 as follows:

a. Revise the first sentence of paragraph (a)(1)(ii) and paragraph (a)(1)(iii);

b. Revise paragraph (a)(3)(i);

c. Remove paragraph (a)(3)(iii);

d. Revise paragraph (a)(9);

e. Revise paragraph (b)(3)(i);

f. Remove paragraph (b)(3)(iii);

g. Revise the last sentence of paragraph (b)(8).

§ 25.226 Blanket Licensing provisions for domestic, U.S. Vehicle-Mounted Earth Stations (VMESs) receiving in the 10.95-11.2 GHz (space-to-Earth), 11.45-11.7 GHz (space-to-Earth), and 11.7-12.2 GHz (space-to-Earth) frequency bands and transmitting in the 14.0-14.5 GHz (Earth-to-space) frequency band, operating with Geostationary Satellites in the Fixed-Satellite Service

(a) * * *

(i) * * *

(ii) Except for VMES systems operating under paragraph (a)(3), each VMES transmitter must meet one of the following antenna pointing error requirements:

* * * * *

(iii) Except for VMES systems operating under paragraph (a)(3), each VMES transmitter must meet of one the following cessation of emission requirements:

* * * * *

(3) * * *

(i) The effective aggregate EIRP-density from all terminals shall be at least 1 dB below the off-

axis EIRP-density limits defined in paragraph (a)(1)(i), with the value of N=1. In this context the term "effective" means that the resultant co-polarized and cross-polarized EIRP-density experienced by any GSO or non-GSO satellite shall not exceed that produced by a single transmitter operating 1 dB below the limits defined in paragraph (a)(1)(i). The individual VMES transmitter shall automatically cease emissions within 100 milliseconds if the VMES transmitter exceeds the off-axis EIRP-density limits minus 1 dB specified above. If one or more VMES transmitters causes the aggregate off-axis EIRP-densities to exceed the off-axis EIRP-density limits minus 1 dB specified above, then the transmitter or transmitters shall cease or reduce emissions within 100 milliseconds of receiving a command from the system's network control and monitoring center. A VMES system operating under this subsection shall provide a detailed demonstration as described in paragraph (b)(3)(i) of this section.

(ii) * * *

(iii) [Removed]

(9) Each VMES terminal shall automatically cease transmitting upon the loss of synchronization or within 5 seconds upon loss of reception of the satellite downlink signal, whichever is the shorter timeframe.

* * * * *

(b) * * *

* * * * *

(3) * * *

(i) The applicant shall make a detailed showing of the measures it intends to employ to maintain the effective aggregate EIRP-density from all simultaneously transmitting co-frequency terminals operating with the same satellite transponder at least 1 dB below the off-axis EIRP-density limits defined in paragraphs (a)(1)(i)(A)-(C) of this section. In this context the term "effective" means that the resultant co-polarized and cross-polarized EIRP-density experienced by any GSO or non-GSO satellite shall not exceed that produced by a single VMES transmitter operating at 1 dB below the limits defined in paragraphs (a)(1)(i)(A)-(C) of this section. The applicant also must demonstrate that an individual transmitter and the entire VMES system is capable of automatically ceasing emissions within 100 milliseconds if the aggregate off-axis EIRP-densities exceed the off-axis EIRP-density limits minus 1 dB, as set forth in paragraph (a)(3)(i) of this section. The International Bureau will place this showing on public notice along with the application.

(ii) * * *

(iii) [Removed]

(8) All VMES applicants shall submit a radio frequency hazard analysis determining via calculation, simulation, or field measurement whether VMES terminals, or classes of terminals, will produce power-densities that will exceed the Commission's radio frequency exposure criteria. VMES applicants with VMES terminals that will exceed the guidelines in §1.1310 of this chapter for radio frequency radiation exposure shall provide, with their environmental

assessment, a plan for mitigation of radiation exposure to the extent required to meet those guidelines. All VMES licensees shall ensure installation of VMES terminals on vehicles by qualified installers who have an understanding of the antenna's radiation environment and the measures best suited to maximize protection of the general public and persons operating the vehicle and equipment. A VMES terminal exhibiting radiation exposure levels exceeding 1.0 mW/cm^2 in accessible areas, such as at the exterior surface of the radome, shall have a label attached to the surface of the terminal warning about the radiation hazard and shall include thereon a diagram showing the regions around the terminal where the radiation levels could exceed 1.0 mW/cm^2. All VMES applicants shall demonstrate that their VMES terminals are capable of automatically ceasing transmissions upon the loss of synchronization or within 5 seconds upon loss of reception of the satellite downlink signal, whichever is the shorter timeframe.

(9) Except for VMES systems operating pursuant to paragraphs (a)(2) and (a)(3)(ii) of this section, VMES systems authorized pursuant to this section shall be eligible for a license that lists ALSAT as an authorized point of communication.

* * * * *