a. VMES Mask in GSO Plane

85. *Background.* Section 25.222 of the Commission's rules establishes the off-axis E.I.R.P.-density requirements for ESVs transmitting in the Ku-band.[166] The *NPRM* invited comment on an off-axis E.I.R.P.-density envelope, or mask, for VMES that would be based on the off-axis E.I.R.P.-density mask for Ku-band ESVs.[167] In the GSO plane, the Commission proposed the following mask:

> The off-axis EIRP spectral density for co-polarized signals, emitted from the VMES in the plane of the geostationary satellite orbit as it appears at the particular earth station location (*i.e.*, the plane determined by the focal point of the antenna and the line tangent to the arc of the geostationary satellite orbit at the position of the target satellite), shall not exceed the following values:
>
> $15 - 25\log(\theta) - 10*\log(N)$ dBW/4kHz for $1.25° \leq \theta \leq 7.0°$
> $-6 - 10*\log(N)$ dBW/4kHz for $7.0° < \theta \leq 9.2°$
> $18 - 25\log(\theta) - 10*\log(N)$ dBW/4kHz for $9.2° < \theta \leq 48°$
> $-24 - 10*\log(N)$ dBW/4kHz for $48° < \theta \leq 180°$
>
> where (θ) is the angle in degrees from the axis of the main lobe. For a VMES network using frequency division multiple access (FDMA) or time division multiple access (TDMA) technique, N is equal to one. For a VMES network using code division multiple access (CDMA) technique, N is the maximum number of co-frequency simultaneously transmitting earth stations in the same satellite receiving beam.[168]

86. SIA, ARINC, Raysat, NSMA, Boeing, MTN, ViaSat, Americom, and Hughes favor adopting an off-axis E.I.R.P.-density mask for VMES based on the mask for ESVs.[169] SIA also asks us to revise the proposed VMES mask to incorporate the changes to the VSAT envelope proposed in the *Sixth Report and Order and Third Further Notice*.[170] For example, SIA notes that the *Sixth Report and Order and Third Further Notice* adopted but stayed the effectiveness of a 10 dB escalation in antenna gain between 85 and 180 degrees, which SIA recommends applying also to VMES.[171] Americom, Hughes, ViaSat, Boeing, Raysat, and NSMA agree.[172]

---

[166] 47 C.F.R. § 25.222(a)(1)(i), formerly 47 C.F.R. § 25.222(a)(1)-(4).

[167] *NPRM*, 22 FCC Rcd at 9696-97, Appendix B, proposed § 25.xxx(a)(1)-(4). The terms "envelope" and "mask" refer to the equations that limit the E.I.R.P. spectral density over a range of angles, "θ". These equations are an upper limit to the E.I.R.P. spectral density that the VMES antenna may transmit in any direction and, therefore, form an envelope around the VMES antenna constraining the maximum E.I.R.P. spectral density radiated.

[168] *NPRM*, 22 FCC Rcd at 9696-97, Appendix B, proposed § 25.xxx(a)(1).

[169] SIA Comments at 13; ARINC Comments at iii, 1; Raysat Comments at 8; NSMA Comments at 5; Boeing Comments at 21; MTN Comments at 4; ViaSat Comments at 16; Americom Comments at 1 (supports SIA Comments); Hughes Reply at 1 (endorses SIA Comments).

[170] *Sixth Report and Order and Third Further Notice*, 20 FCC Rcd 5593.

[171] SIA Comments at 13-14. *See also Sixth Report and Order and Third Further Notice*, 20 FCC Rcd at 5656, Appendix C, Part IV (proposing off-axis power-density envelopes for Ku-band digital earth stations, including 10 dB escalation).

[172] Americom Comments at 1 (supporting SIA Comments); Hughes Reply at 1 (endorsing SIA Comments); ViaSat Reply at 18 (agreeing with SIA); Boeing Comments at 21 (stating that escalation, if adopted, should be equally applicable to all FSS earth stations on mobile platforms); Raysat Comments at 8-9 (stating that, if adopted, should

(continued....)

87. *Discussion.* Recent changes to Part 25 inform our decision today. In the *Eighth Report and Order*, the Commission put into effect the new 1.5 degree E.I.R.P.-density envelope starting angle and the 10 dB escalation between 85 and 180 degrees ("back lobe escalation") it had adopted in the *Sixth Report and Order and Third Further Notice* but stayed until resolution of the issues in the notice portion of that proceeding.[173] In the *ESV Order on Reconsideration*, we likewise modify section 25.222 of the rules to incorporate the starting angle and the back lobe escalation.[174]

88. We concur that it makes sense to adopt the ESV E.I.R.P.-density mask for VMES and to incorporate changes adopted for VSATs and ESVs into the VMES mask. As NSMA observes, the ESV mask is equivalent to the envelope for a routinely licensed VSAT antenna compliant with section 25.209 antenna performance standards and operating at maximum permissible input power.[175] Applying that mask to VMES will ensure that the operations of VMES antennas do not cause unacceptable interference to adjacent satellite systems under the Commission's two-degree Ku-band satellite spacing policy.

89. Thus, we adopt section 25.226(a)(1)(A) as the VMES mask, including the 10 dB escalation between 85 and 180 degrees. Additionally, we adopt 1.5 degrees as the starting angle for the VMES off-axis E.I.R.P.-density mask along the GSO. We discuss below the off-axis E.I.R.P.-density mask starting angle and envelope in directions away from the GSO plane.

90. Additionally, we note that, in the Part 25 *Eighth Report and Order* adopted a new definition for the reference angle, theta (θ), associated with the off-axis E.I.R.P.-density mask.[176] In the *ESV Order on Reconsideration* we also adopt the new definition for the reference angle.[177] This change in definition shifts the reference axis of the E.I.R.P.-density mask from "the main axis of the antenna" to "the line from the focal point of the antenna to the target satellite."[178] We adopt this new definition of the reference axis for VMES, to be consistent with the off-axis E.I.R.P.-density rules for Ku-band ESV and VSAT transmitters. Therefore, we adopt the following mask for the GSO plane:

> The off-axis EIRP spectral-density emitted from the VMES, in the plane of the geostationary satellite orbit (GSO) as it appears at the particular earth station location, shall not exceed the following values:

(...continued from previous page)
include in VMES mask); NSMA Comments at 6 (stating that, for regulatory parity, it may be appropriate to extend Part 25 streamlining rule changes to VMES).

[173] *Eighth Report and Order*, 23 FCC Rcd at 15110, ¶ 20, 15156-57, Appendix B, § 25.218, Off-Axis EIRP Envelopes for FSS Earth Station Operations; 47 C.F.R. § 25.218(e)(1), (f)(1).

[174] *ESV Order on Reconsideration*, Appendix B, § 25.222(a)(1)(i)(A).

[175] NSMA Comments at 5; *see* 47 C.F.R. § 25.209. The E.I.R.P.-density envelope for Ku-band ESV transmitters is consistent with the off-axis E.I.R.P.-density limits for routinely-licensed Ku-band VSAT transmitters for co-polarized signals transmitted toward the GSO. *See ESV Report and Order*, 20 FCC Rcd at 716, ¶ 99. The off-axis E.I.R.P.-density limits for Ku-band ESV transmitters are set out in 47 C.F.R. § 25.222(a)(1)(i)(A)-(D), formerly 47 C.F.R. § 25.222(a)(1)-(4).

[176] *Eighth Report and Order*, 23 FCC Rcd at 15112-13, ¶ 24 n.90.

[177] *ESV Order on Reconsideration*, ¶ 22. *See also* 47 C.F.R. § 25.222(a)(1)(i). We found that this revision would make the ESV rules more logically consistent with protecting adjacent FSS satellites from interference. *ESV Order on Reconsideration*, ¶ 22.

[178] *Eighth Report and Order*, 23 FCC Rcd at 15113, ¶ 24 n.90; *ESV Order on Reconsideration*, ¶ 22. *See also* 47 C.F.R. §§ 25.218(e)(1), (f)(1), 25.222(a)(1)(i).

15 - 10log(N) - 25logθ	dBW/4 kHz	for	$1.5° \leq \theta \leq 7°$
-6 -10log(N)	dBW/4 kHz	for	$7° < \theta \leq 9.2°$
18 -10log(N) - 25logθ	dBW/4 kHz	for	$9.2° < \theta \leq 48°$
-24 -10log(N)	dBW/4 kHz	for	$48° < \theta \leq 85°$
-14 -10log(N)	dBW/4 kHz	for	$85° < \theta \leq 180°$

where theta (θ) is the angle in degrees from the line connecting the focal point of the antenna to the orbital location of the target satellite, the plane of the GSO is determined by the focal point of the antenna and the line tangent to the arc of the GSO at the orbital location of the target satellite. For VMES networks using frequency division multiple access (FDMA) or time division multiple access (TDMA) techniques, N is equal to one. For VMES networks using multiple co-frequency transmitters that have the same EIRP, N is the maximum expected number of co-frequency simultaneously transmitting VMES earth stations in the same satellite receiving beam. For the purpose of this subsection, the peak EIRP of an individual sidelobe shall not exceed the envelope defined above for θ between 1.5° and 7.0°. For θ greater than 7.0°, the envelope shall be exceeded by no more than 10% of the sidelobes, provided no individual sidelobe exceeds the envelope given above by more than 3 dB.[179]

The VMES mask we adopt here mirrors the mask the Commission adopted for conventional Ku-band digital earth station operations and for Ku-band ESV.[180]

b. VMES Mask in Directions Other Than GSO Plane

91. *Background.* The E.I.R.P.-density mask in directions other than the GSO plane is designed to protect non-geostationary orbit ("NGSO") FSS systems, which, although not yet implemented in the Ku-band, are a permitted use.[181] In the *NPRM*, the Commission proposed the following mask in directions other than the GSO plane:

> In all other directions, the off-axis EIRP spectral density for co-polarized signals emitted from the VMES shall not exceed the following values:
>
> | | | | |
> |---|---|---|---|
> | 18 – 25log(θ) – 10*log(N) | dBW/4kHz | for | $1.25° \leq \theta \leq 48.0°$ |
> | –24 – 10*log(N) | dBW/4kHz | for | $48.0° < \theta \leq 180°$ |
>
> where θ and N are defined as set forth in paragraph (a)(1) of this section.[182]

The Commission asked whether it should adopt variations of the E.I.R.P.-density mask rule in directions other than the GSO plane: first, it asked whether the VMES rule should start the off-axis E.I.R.P.-density envelope at 3.0 degrees from the antenna main lobe, as adopted but stayed for VSATs in the *Sixth Report*

[179] Appendix B, *infra*, at § 25.226(a)(1)(i)(A). *See also* Appendix B, § 25.226(a)(1)(i)(C)-(D).

[180] *Eighth Report and Order*, 23 FCC Rcd at 15156-57, Appendix B, § 25.218(f); *ESV Order on Reconsideration*, Appendix B, § 25.222(a).

[181] *See Amendment of Parts 2 and 25 of the Commission's Rules to Permit Operation of NGSO FSS Systems Co-Frequency with GSO and Terrestrial Systems in the Ku-Band Frequency Range*, ET Docket No. 98-206, First Report and Order and Further Notice of Proposed Rule Making, FCC 00-418, 16 FCC Rcd 4096 (2000).

[182] *NPRM*, 22 FCC Rcd at 9697, Appendix B, proposed § 25.xxx(a)(2).

and Order and Third Further Notice, rather than at the 1.25 degree start angle then in the ESV rules;[183] and, second, it sought comment on relaxing the off-axis E.I.R.P.-density envelope.[184]

92. Boeing and SIA support starting the mask at 3.0 degrees off-axis.[185] ViaSat asserts that existing low-profile antennas may require a larger starting angle than 3.0 degrees and proposes 7.0 degrees.[186] ViaSat asserts that increasing the allowable off-axis E.I.R.P.-density outside the GSO plane would promote the use of small and low-profile antennas.[187] ViaSat observes that reducing the size of the antenna in height axis necessarily will increase the beam width in the elevation (or vertical) plane.[188] Raysat states that low-profile antennas – as opposed to larger, circular parabolic antennas – transmit at higher off-axis E.I.R.P.-density levels in directions other than the GSO plane.[189] Raysat, like ViaSat, urges greater (but unspecified) off-axis E.I.R.P.-density limits in directions other than the GSO plane to promote deployment of low-profile VMES terminals.[190] Raysat and ViaSat state that co-primary Ku-band NGSO systems may never be deployed.[191] SIA urges against relaxing E.I.R.P.-density requirements in directions other than the GSO plane, beyond the 3.0 degree off-axis start angle, stating that such relaxations preemptively could impact future co-primary FSS NGSO systems.[192] General Dynamics contends that the only significant reason for increasing permitted E.I.R.P.-density values to and from VMES terminals would be to permit a significant reduction in the size of the VMES antennas, recommends against permitting E.I.R.P.-density levels in any direction that are higher than the level for routinely-authorized FSS Ku-band transmissions, and urges non-routine processing rather than general rule changes that would impose obligations on all existing and future GSO and NGSO FSS Ku-band operations.[193]

93. *Discussion.* In the *Sixth Report and Order and Third Further Notice*, the Commission adopted but stayed the effectiveness of an antenna gain starting angle for Ku-band VSATs of 3.0 degrees in directions other than the GSO.[194] In the *Eighth Report and Order* and the *ESV Order on Reconsideration*, the Commission implemented 3.0 degrees as the starting angle in directions other than

[183] *NPRM*, 22 FCC Rcd at 9679-80, ¶ 69. *See also* 47 C.F.R. § 25.222(a)(2) (2007) (ESV 1.25° start angle in directions other than GSO); *Sixth Report and Order and Third Further Notice*, 20 FCC Rcd at 5610, ¶¶ 37-38 (revising start of antenna gain pattern envelope to 3.0 degrees off-axis outside GSO orbital plane for earth stations operating in conventional Ku-band to facilitate development of more advanced elliptical antennas without creating additional interference issues).

[184] *NPRM*, 22 FCC Rcd at 9679-80, ¶ 69.

[185] Boeing Comments at ii, 23; SIA Comments at 20.

[186] ViaSat Reply at 19.

[187] ViaSat Reply at 18-19.

[188] ViaSat Reply at 18.

[189] Raysat Comments at 15.

[190] Raysat Comments at 15.

[191] Raysat Reply at 8; ViaSat Comments at 20.

[192] SIA Comments at 20-21.

[193] General Dynamics Comments 43-44.

[194] *Sixth Report and Order and Third Further Notice*, 22 FCC Rcd at 5614, ¶ 49.

the GSO plane for, respectively, Ku-band VSATs and ESVs.[195] We adopt, for VMES, a 3.0 degree off-axis starting angle – measured from the line of the focal point of the antenna to the target satellite – in directions other than the GSO plane.[196] We find this consistent with the Commission's approach toward VSATs and ESVs.

94. We agree with SIA that we do not have a sufficient record in this proceeding to adopt other relaxations of the starting angle in directions other than the GSO plane.[197] A chief objective in this proceeding is to ensure that VMES can operate in the Ku-band FSS frequencies without causing interference to other co-primary FSS operations. VMES will be a viable mobile application of the FSS only if it can operate without causing unacceptable interference to FSS satellite systems also operating on a primary basis. Although we do not adopt general rules further relaxing the starting angle in directions other than the GSO plane, it may be possible for individual applicants to demonstrate that their systems merit a waiver of the technical rules.[198]

95. In the *Eighth Report and Order*, the Commission also adopted a 10 dB back lobe escalation in directions other than the GSO plane.[199] The *ESV Order on Reconsideration* adopts a similar 10 dB back lobe escalation.[200] SIA and Raysat support adjusting the VMES mask to take into account the changes the Commission adopted but stayed in the *Sixth Report and Order and Third Further Notice* – and that the Commission subsequently implemented in the *Eighth Report and Order* – which include the 10 dB escalation between 85 and 180 degrees.[201] We adopt the 10 dB back lobe escalation in directions other than the GSO plane. Therefore, we adopt the following mask in directions other than the GSO plane:

> In all directions other than along the GSO, the off-axis EIRP spectral-density for co-polarized signals emitted from the VMES shall not exceed the following values:
>
> | | | | |
> |---|---|---|---|
> | $18 - 10\log(N) - 25\log\theta$ | dBW/4 kHz | for | $3.0° \leq \theta \leq 48°$ |
> | $-24 - 10\log(N)$ | dBW/4 kHz | for | $48° < \theta \leq 85°$ |
> | $-14 - 10\log(N)$ | dBW/4kHz | for | $85° < \theta \leq 180°$ |
>
> where θ and N are defined in (a)(1)(A)(i). This off-axis EIRP spectral-density applies in any plane that includes the line connecting the focal point of the antenna to the orbital location of the target satellite with the exception of the plane of the GSO as defined in

[195] *Eighth Report and Order*, 23 FCC Rcd at 15110, ¶ 20; *ESV Order on Reconsideration*, Appendix B, § 25.222(a)(1)(i)(B).

[196] Therefore, we do not adopt ViaSat's proposal for a 7° starting angle. We find that the 3° start angle adopted for VMES, like that adopted for VSATs, appropriately balances a goal of facilitating more advanced elliptical antennas with the objective of preventing additional harmful interference.

[197] *See* SIA Reply at 9 (stating that the showings and claims made in support of unspecified relaxations of the limits that preemptively could impact co-primary FSS applications are not compelling).

[198] *See, e.g.*, SIA Reply at 9 (stating that it may be possible for VMES applicants to make specific showings regarding increased allowances that could lead to authorization of antennas of the type loosely described by ViaSat and Raysat on a non-interfering basis with regard to future users of the co-primary NGSO allocations in the Ku-band FSS frequencies). *See also* General Dynamics Comments at 43-44 (urging non-routine processing).

[199] *Eighth Report and Order*, 23 FCC Rcd at 15156, 15157, Appendix B, § 25.218(e)(2), (f)(2).

[200] *ESV Order on Reconsideration*, Appendix B, § 25.222(a)(1)(i)(B).

[201] SIA Comments at 20-21; Raysat Comments at 8.

paragraph (a)(1)(A)(i) of this section. For the purpose of this subsection, the envelope shall be exceeded by no more than 10% of the sidelobes provided no individual sidelobe exceeds the gain envelope given above by more than 6 dB. The region of the main reflector spillover energy is to be interpreted as a single lobe and shall not exceed the envelope by more than 6 dB.[202]

c. Operations in Excess of E.I.R.P-Density Mask

96. *Background.* In the *ESV Order on Reconsideration*, we adopt new rule provisions for ESVs that operate at off-axis E.I.R.P-densities in excess of the limits in the Commission's rules. Of particular relevance to domestic U.S. VMES operations, we allow ESV licensees to operate domestically at higher off-axis power-density levels where ESV operators are able to coordinate higher off-axis power-density levels with adjacent satellite operators.[203] We conclude that allowing U.S.-licensed ESVs to transmit at higher off-axis E.I.R.P.-density levels based on compliance with coordination agreements between the target satellite and adjacent satellite operators will foster greater operational flexibility without causing harmful interference to adjacent satellites.[204]

97. *Discussion.* As discussed above, we are modeling VMES off-axis power-density requirements on the ESV off-axis E.I.R.P.-density rules, including certain changes to the rules adopted in the *ESV Order on Reconsideration*. Therefore, we will allow U.S.-licensed VMES operators to transmit at off-axis power-density levels that exceed the off-axis E.I.R.P.-density limits as long as they comply with the certification and cessation of emission requirements set out in section 25.226(a)(2) and (b)(2) of the VMES rules. We note that, although the Commission did not seek specific comment in the *NPRM* on operating at off-axis power-densities in excess of the E.I.R.P.-density mask, it did seek comment on following the ESV technical rules generally.[205] The rules we discuss in this section are comparable to the rules for ESVs we adopt in the *ESV Order on Reconsideration*.[206]

98. We find that adoption of these rules will serve the public interest by providing greater operational flexibility while ensuring that adjacent satellite operators are protected from harmful interference. Target satellite operators already may have coordinated higher off-axis power-density levels for other, non-VMES, earth stations. Thus, allowing VMES to operate at the agreed upon off-axis power-density levels should not cause harmful interference to adjacent satellites. If the target satellite operator is unable to complete a coordination agreement with future adjacent satellite operators located within six degrees of the target satellite operator, we require the VMES operator to operate at off-axis power-density levels in accordance with the off-axis E.I.R.P.-density limits set out in the VMES rules.[207] Applicants seeking to operate at higher off-axis power-density levels may not access satellites pursuant to ALSAT

---

[202] Appendix B, § 25.226(a)(1)(i)(b). *See also* Appendix B, § 25.226(a)(1)(i)(C)-(D).

[203] *ESV Order on Reconsideration*, ¶¶ 8-16. The *ESV Order on Reconsideration* also permits higher off-axis power-density levels in areas where 2° spacing is not common, such as in Asia and Europe. *ESV Order on Reconsideration*, ¶¶ 8-16.

[204] *ESV Order on Reconsideration*, ¶ 11. *See also Fifth Report and Order*, 20 FCC Rcd at 5092, ¶ 65 (in streamlining Part 25 rules, the Commission stated that "...[if an] earth station operator can successfully coordinate its operations with an [off-axis E.I.R.P.]-density greater than [a Commission-imposed limit], then we see no reason to preclude the earth station from operating at that [off-axis] power-density level with the particular target satellite that has been coordinated.").

[205] *See, e.g., NPRM*, 22 FCC Rcd at 9670-71, ¶¶ 47-48.

[206] *See* 47 C.F.R. § 25.222(a)(2), (b)(2).

[207] *See* 47 C.F.R. § 25.226(a).

authority – authority to use "all U.S.-licensed space stations" – and therefore, must specifically list in their applications all of the satellites that they plan to access at higher off-axis power-density levels.[208] We observe that our decision to allow VMES operators greater flexibility to transmit at higher off-axis power-density levels does not alter the obligation of VMES operators to comply with section 25.204(j), to protect SRS operators.

99. We require VMES applicants seeking to operate at higher E.I.R.P.-density levels to file the following certifications: (1) a statement from the target satellite operator acknowledging that the proposed VMES operation has the potential to create interference to adjacent satellite networks that may be unacceptable; (2) a statement from the target satellite operator that the VMES operations will not violate existing coordination agreements with adjacent satellites within six degrees longitude of the target satellite; and (3) a statement from the target satellite operator that it will include the off-axis power-density levels of the VMES applicant in all future coordination agreements.[209] These certifications, obtained from the target satellite operator, will be based upon coordination agreements that exist between the target satellite operator and potentially affected operators of satellites within six degrees longitude of the target satellite. The certification requirement ensures that the higher off-axis power-density levels will not cause harmful interference to adjacent satellite operations but precludes the need for the VMES applicant to file entire coordination agreements with the Commission. This comports with the Ku-band ESV rules.[210]

100. We envision that the VMES applicant, in its effort to operate at higher off-axis power-density levels and obtain certifications from the target satellite operator, will provide the target satellite operator with information about the VMES operator's proposed operations. This information will allow the target satellite operator to determine if the VMES operator's proposed higher off-axis power-density levels fall within the parameters of the coordination agreements that exist between the target satellite operator and satellites operating within six degrees longitude of the target satellite. This information may take a number of forms, but must be sufficient for the target satellite operator to determine the off-axis power-density values of the relevant VMES transmitters. If the VMES operator's proposed power-density levels exceed the parameters of the coordination agreements, then we expect that the target satellite operator either will negotiate with the operators of neighboring satellites to modify the coordination agreements to include the VMES operational parameters or inform the VMES operator that it cannot operate pursuant to the proposed parameters given to the target satellite operator.

101. Because the VMES applicant may not have access to the details of the target satellite operator's coordination agreements, we will require the VMES applicant, once authorized to operate, to remain within the power-density values that it gives to the target satellite operator. We also require the VMES licensee to cease transmission within 100 milliseconds if it exceeds the off-axis power-density values it has given to the target satellite operator.[211] If the VMES licensee were to exceed the power-

[208] For more on ALSAT, *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 Reconsideration Order, FCC 99-325, 15 FCC Rcd 7207 (1999) ("*DISCO II First Reconsideration Order*"). *See also infra* Section III.C.5.

[209] *See infra* Appendix B, Final Rules, § 25.226(b)(2)(i)-(iii).

[210] *See* 47 C.F.R. § 25.222(b)(2).

[211] Because VMES terminals operating within the VMES off-axis E.I.R.P.-density limits and antenna pointing rules must cease emissions within 100 milliseconds, we require VMES terminals that operate at power levels that exceed the off-axis E.I.R.P.-density limits also to cease emissions within 100 milliseconds. *See infra* Appendix B, §§ 25.226(a)(2)(iii), (b)(2)(iv).

density values given to the target satellite operator, there is the potential that the VMES licensee would be in violation of the target satellite operator's coordination agreements and possibly could cause harmful interference to neighboring satellites. Thus, if a VMES transmitter exceeds the off-axis power-density values given to the target satellite operator – whether due to an excessive antenna pointing error or some other factor – the VMES transmitter must cease transmitting until it again is in compliance with the relevant coordination agreement. This comports with the Ku-band ESV rules.[212]

d. Aggregate Power-Density Limits and the 10*log(N) Rule

102. As discussed below, we adopt a new aggregate power-density rule for VMES systems that use co-frequency dynamic-power transmissions. In doing so, we require VMES applicants that seek to use aggregate dynamic power-densities to demonstrate that their operations will meet the VMES E.I.R.P.-density mask minus one dB. There currently are no aggregate power-density rules for co-frequency dynamic-power ESV transmissions similar to what we adopt today for VMES.

103. *Background.* The Ku-band ESV rules permit several ESV terminals to transmit simultaneously on the same frequency in a single satellite receive beam, so long as the ESV operator uses the 10*log(N) rule to reduce each of the individual earth station emissions by a fixed amount, such that the aggregate emission from all co-frequency transmitters does not exceed the E.I.R.P.-density limits established for a single ESV terminal.[213]

104. The rules the Commission adopted in the *ESV Report and Order*, including the off-axis E.I.R.P.-density limits, were based on single channel per carrier ("SCPC") ESV systems that had operated pursuant to STA for several years.[214] In an SCPC system, each ESV transmitter could be expected to emit the maximum level of E.I.R.P. spectral density. As a result, the rules limiting the E.I.R.P. spectral density towards adjacent satellites are applied to each of the ESV transmitters within the ESV system and each of the transmitters operates on a different channel or frequency.

105. In addition to using SCPC, VSATs and ESVs may make use of a number of other multiple access techniques. Included in these techniques are those, such as Code Division Multiple Access ("CDMA"), which permit several transmitters to transmit simultaneously on the same channel. When multiple transmitters simultaneously use the same channel to transmit to the same satellite it is the sum of the E.I.R.P. spectral density from all of the transmitters that forms the potential interference source to adjacent satellites. To keep within the two-degree spacing guidelines, the sum or "aggregate" E.I.R.P. spectral density should be no greater than that produced by a single SCPC transmitter operating at the maximum permitted E.I.R.P. spectral density.

106. In the *Sixth Report and Order and Third Further Notice*, the Commission modified the Ku-band E.I.R.P.-density envelope it had adopted in the *ESV Report and Order* to accommodate co-frequency CDMA ESV systems by adding the 10*log(N) term to section 25.222.[215] As a result, section 25.222 of the rules provides that, for an ESV network using frequency division multiple access ("FDMA") or time division multiple access technique, "N" is equal to one, and, for an ESV network

[212] *See* 47 C.F.R. § 25.222(a)(2).

[213] 47 C.F.R. § 25.222(a)(1)(i)(A).

[214] *See NPRM*, 22 FCC Rcd at 9674, ¶ 57.

[215] *See NPRM*, 22 FCC Rcd at 9674-75, ¶ 57; *Sixth Report and Order and Third Further Notice*, 20 FCC Rcd at ¶ 63 n.177 (incorporating 10*log(N) into § 25.222).

using CDMA technique, "N" is the maximum number of co-frequency simultaneously transmitting earth stations in the same satellite receiving beam.[216]

107. Thus, the 10*log(N) rule for Ku-band ESVs requires CDMA systems to reduce the E.I.R.P.-density of co-frequency earth stations simultaneously transmitting to the same satellite, in order to ensure that the overall system meets, in the aggregate, the E.I.R.P-density limits established for a single ESV terminal.[217] If each of the CDMA transmitters has the same E.I.R.P.-density, each transmitter will radiate the maximum E.I.R.P.-density reduced by a factor of 10*log(N), in dB, where, as noted, "N" represents the peak number of co-frequency CDMA earth stations simultaneously transmitting in the same satellite receiving beam.[218]

108. In the proceeding leading up to the *NPRM*, ViaSat and Qualcomm urged the Commission to change the 10*log(N) term, as applied to VMES.[219] They stated that 10*log(N) presupposes a VMES network will employ homogeneous transmitters, prevents variable data rates (and thus variable power-density systems) from being accommodated unless the system operates with a significant loss of capacity, and favors other techniques such as FDMA.[220]

109. In the *NPRM*, the Commission sought comment on proposals to revise the Ku-band ESV power-density limits, as applied to VMES, to accommodate VMES networks employing aggregate system power control.[221] As explained above, certain multiple access techniques permit multiple transmitters, within the same system, to operate simultaneously on the same channel and, in this situation, it is the aggregate E.I.R.P. spectral power density from all of the co-frequency transmitters that forms the potential interference source to adjacent satellites. The 10*log(N) rule applies when all of the co-frequency transmitters operate at the same E.I.R.P. spectral power density. The maximum data rate a transmitter is capable of transmitting depends on the maximum E.I.R.P. it can transmit. By using the same E.I.R.P. spectral power density, each transmitter within the system has the same maximum data rate.

110. An alternative system implementation would be to have a central control and monitoring station allow each transmitter to use a different data rate depending on the instantaneous requirements at each transmitter. In a VMES system where different terminals required varying data rates, the overall data flow from all of the co-frequency terminals could be optimized by dynamically allocating to each terminal a different E.I.R.P. spectral density depending on the amount of data that needed to be transmitted from that terminal. However, to avoid interference to adjacent satellites, the central control and monitoring station would need to maintain control of all of the co-frequency transmitters to ensure that the sum of the dynamically changing E.I.R.P. spectral density did not exceed the E.I.R.P. spectral density from a single VSAT terminal operating at the maximum E.I.R.P. spectral density limit.

111. Because the time a control signal takes to go from an earth station through a GSO satellite to another earth terminal is a significant portion of a second, the central control and monitoring station would, at times, have to rely on complicated techniques to ensure that the two-degree spacing

[216] 47 C.F.R. § 25.222(a)(1).

[217] *See* 47 C.F.R. §§ 25.222(a)(1)(i)(A) (applicable to Ku-band ESV CDMA systems). *See also* 47 C.F.R. §§ 25.134(g), 25.218 (applicable to VSAT-like CDMA systems).

[218] *See* 47 C.F.R. § 25.222(a)(1).

[219] *NPRM*, 22 FCC Rcd at 9675, ¶ 57; Comments of ViaSat, RM-11336, at 7 (filed Aug. 21, 2006) ("ViaSat RM-11336 Comments"); Qualcomm RM-11336 Comments at 4.

[220] *NPRM*, 22 FCC Rcd at 9675, ¶ 57; ViaSat RM-11336 Comments at 7; Qualcomm RM-11336 Comments at 4.

[221] *NPRM*, 22 FCC Rcd at 9674-75, ¶¶ 56-57.

criteria were met for these dynamic, variable power-density systems. The Commission asked commenters to suggest specific changes to the rules that would allow the efficient use of variable power-density spread spectrum systems while still ensuring that the systems meet the E.I.R.P.-density mask in the aggregate.[222]

112. SIA states that it would be desirable to accommodate variable-power spread spectrum VMES systems provided the aggregate off-axis E.I.R.P.-density of all such terminals does not exceed the off-axis E.I.R.P.-density of a compliant terminal in a system where "N" equals one.[223] SIA supports a rule requiring VMES applicants to demonstrate that particular measures, including but not limited to 10*log(N), could satisfy the off-axis E.I.R.P.-density limits required to ensure protection of adjacent satellite networks.[224]

113. Raysat, Boeing, and ViaSat argue that 10*log(N) is unnecessarily restrictive, potentially limits VMES technologies for spread spectrum systems, and simplistically assumes that a VMES network will be made up of homogeneous co-frequency transmitters.[225] Raysat suggests it may be desirable to accommodate systems with multiple, co-frequency VMES terminals having differing E.I.R.P.-density levels that comply, in the aggregate, with the mask for compliant SCPC terminals.[226] Boeing supports using the section 25.222(a) power limits as aggregate limits.[227] ViaSat states the rules should allow VMES licensees to determine whether a network control center manages off-axis E.I.R.P. on a network-wide or individual terminal basis, and proposes a formula to replace 10*log(N) for individual variable-power VMES terminals.[228]

114. General Dynamics urges that any change to 10*log(N) ensure that the aggregate power in a CDMA network not exceed the power of an individual FDMA transmitter operating in the maximum off-axis E.I.R.P.-density envelope.[229] General Dynamics states that two satellite access techniques allow earth station antennas simultaneous access to, and use of, the same frequencies. These are, according to General Dynamics: (1) CDMA systems, where each transmission occupies the same spectrum simultaneously but is separated from other co-frequency transmissions through the use of a distinct spreading code; and (2) uplink-cancellation systems that use a sample of the uplink signal to "cancel" the uplink effects of an earth station transmission as seen in the single downlink from overlapping earth stations.[230] For CDMA systems, General Dynamics states that "N" properly should be the maximum

[222] *NPRM*, 22 FCC Rcd at 9675, ¶ 57.

[223] SIA Comments at 16-17.

[224] SIA Comments at 16-17.

[225] Raysat Comments at 11-12; Boeing Comments at 22-23; ViaSat Comments at 16-19.

[226] *See, e.g.*, Raysat Comments at 12 (notes that the VMES applicant would have the burden of demonstrating that its system would comply with an aggregate off-axis E.I.R.P.-density envelope);

[227] Boeing Comments at ii, 22-23.

[228] ViaSat Comments at 16, 19. ViaSat observes that 10*log(N) presents operational and efficiency considerations for licensees when, for example, terminals at differing locations require varying power levels to close the link with the satellite. ViaSat Comments at 18-19, 18 n. 24 and Attachment 1, Figures 4-5. ViaSat asks the Commission to revise 10*log(N) to define the aggregate off-axis E.I.R.P.-density of a non-homogeneous network of "N" technically different VMES terminals, each operating at different parameters, as the sum of the individual VMES off-axis E.I.R.P.-densities. The aggregate off-axis E.I.R.P.-density of the network as calculated by ViaSat's formula would not be permitted to exceed the proposed off-axis E.I.R.P.-density mask. ViaSat Comments at 19.

[229] General Dynamics Comments at 37.

[230] General Dynamics Comments at 36.

number of earth stations having the capability to transmit simultaneously, but suggests that "N" might be lower than the total number of licensed earth stations if a VMES system were to limit the possible number of simultaneously-transmitting stations to some smaller number, "M."[231] General Dynamics asserts, however, that without a rigorous test and validation methodology there could be no assurance that more than "M" simultaneous transmissions might not occur and thus cause the licensee to exceed the off-axis E.I.R.P.-density mask.[232]

115. *Discussion.* There are considerable differences in complexity between a VMES system using fixed-power transmitters (as regulated under the 10*log(N) rule) and a dynamic E.I.R.P.-density VMES system.[233] As ViaSat observes, an aggregate dynamic-power system requires the applicable network control and monitoring center to manipulate a relatively large set of factors, with the inherent time delays in relaying commands and monitoring the various VMES terminals through a GSO satellite.[234] Additionally, while the E.I.R.P.-density limit for SCPC and fixed-rate aggregate VMES systems is oriented around the main-beam direction of the VMES antenna, dynamic CDMA VMES systems would need to be subject to an aggregate E.I.R.P. envelope limit. Thus, the rules could not specify, as they do now, the power limit from any particular VMES antenna.[235]

116. Moreover, the current rules for VSAT and ESV earth stations do not include specific provisions for variable power-density systems. VMES is a new service that does not yet have as extensive a track record as VSAT and ESV earth stations in meeting the two-degree spacing interference avoidance requirements of the Ku-band FSS. Therefore, we conclude that a one-dB reduction below the VMES mask is a prerequisite condition for VMES systems employing dynamic power-density systems. We find that this margin is an effective mechanism for controlling aggregate off-axis E.I.R.P.-density and for ensuring that such operations – despite their complexities – will not exceed the power-density envelopes established for VSAT, ESV and VMES networks.

117. Therefore, we require a VMES applicant that seeks to use an aggregate dynamic power-density system to make a showing of the measures it proposes to apply to demonstrate that its system will be able to operate at one dB below the E.I.R.P.-density mask adopted for single terminals or fixed-power aggregate system transmitters regulated under the 10*log(N) rule.[236] The International Bureau will place

---

[231] General Dynamics Comments at 37. General Dynamics states that, in the case of the uplink-cancellation technique, "N" would be 2. *Id.*

[232] General Dynamics Comments at 38. General Dynamics concedes that confirmation testing of such a network scheme might be difficult. *Id.* at 38.

[233] The time lags inherent in a dynamic system require the control center to use predictive algorithms to estimate the power-density on the GSO orbit and manipulate the data rates and other factors to ensure that all co-frequency operations remain at or below the power-density envelope for a single VSAT terminal. This will result in dynamic systems that are far more complex than those electing to use simple fixed-characteristic transmitters.

[234] ViaSat Comments at 17-18 (listing factors including satellite performance contours, range to the satellite, rain and atmospheric attenuation, antenna pointing, transmitted data rates, chip rate of the spreading code, and number of simultaneous transmitters).

[235] That is, although the SCPC E.I.R.P.-density envelope is topocentric in nature, a CDMA E.I.R.P.-density envelope would need to be geocentric because it would represent the aggregate E.I.R.P.-density, at the satellite, from a number of different CDMA transmitters scattered over the surface of the Earth. The E.I.R.P.-density at the adjacent satellites, not the actual radiated E.I.R.P.-density from any specific antenna, would be the relevant limit.

[236] The Commission has conditioned certain FSS Ku-band mobile licenses by requiring the licensee to reduce its off-axis E.I.R.P.-density by at least one dB below the applicable regulatory envelope. *See, e.g., ARINC Incorporated, Application for Blanket Authority for Operation of Up to One Thousand Technically Identical Ku-band Transmit/Receive Airborne Mobile Stations Aboard Aircraft Operating in the United States and Adjacent Waters,*

(continued....)

this showing on Public Notice along with the application in order to obtain industry comment. Dynamic power-density system applicants and licensees are precluded from seeking ALSAT authority,[237] and must file a report one year following license issuance demonstrating that the system has met the power-density requirements.[238] We conclude that these measures are prudent steps to protect other FSS systems from possible harmful interference.

118. We recognize that a minus one-dB requirement for dynamic power-density systems will impact the capacity and robustness of the relevant VMES networks, by limiting the flexibility of such dynamic-power systems to operate up to the mask for single carrier and fixed- power systems. Therefore, we will allow a VMES applicant employing a dynamic-power system and its target satellite licensee to coordinate higher power levels with adjacent satellite operators and to file a certification that the target satellite operator and adjacent satellite operators up to six degrees away from the target satellite have completed a coordination agreement to this effect.[239] If the VMES applicant and target satellite licensee cannot reach a coordination agreement, then the VMES licensee employing dynamic power must operate at an E.I.R.P.-density envelope that is one dB below the envelope adopted for single carrier and fixed-power systems. A VMES applicant that coordinates higher power levels (and in effect operates without regard to the minus one-dB margin) and files a certification to take advantage of this exception to the minus one-dB requirement also must specify the particular satellites with which its system will operate.[240]

119. Finally, we agree that, given the E.I.R.P.-density mask, and the antenna limitation and emission cessation requirements discussed below, a one-dB reduction of the E.I.R.P.-density mask for

(...continued from previous page)
Order and Authorization, 20 FCC Rcd 7553, 7573, ¶ 58(k) (Int'l Bur. & OET 2005) (conditioning authorization to limit probability of exceeding -1 dB margin for aggregate off-axis E.I.R.P.-density to within 0.001%); The Boeing Company, Radio Station Authorization, E000723, File No. SES-MFS-20050701-00853 (granted Dec. 20, 2005), at Special Provision 5411 (conditioning authorization to require aggregate off-axis E.I.R.P. spectral density for co-polarized signals, emitted from all simultaneously transmitting aircraft earth station antennas in the GSO plane, not to exceed 1 dB margin below specified E.I.R.P.-density envelope); *ViaSat, Inc., Application for Blanket Authority for Operation of 1,000 Technically Identical Ku-band Aircraft Earth Stations in the United States and Over Territorial Waters*, Order and Authorization, 22 FCC Rcd 19964, 19974, ¶ 28(l) (Int'l Bur. & OET 2007) (conditioning authorization to reduce aggregate off-axis radiation from AES terminals to levels 1 dB below the routine-processing envelope, in event another co-frequency FSS satellite comments operation within 6 degrees of the ViaSat system target satellite, pending demonstration of coordination with operator of new satellite); *Raysat LMSS Order*, 23 FCC Rcd at 2000, ¶ 51 (conditioning authorization to reduce aggregate off-axis radiation from METs to levels 1 dB below routine processing envelope, in event another co-frequency FSS satellite commences operation within 6 degrees longitude of Raysat system target satellite, pending demonstration of coordination with operator of new satellite).

[237] *See infra* Section III.C.5.

[238] *See infra* Appendix B, section 25.226(b)(3)(iii). The report should evaluate, through the use of operational statistics or actual measurements or a combination thereof, the aggregate power-density at the GSO from all simultaneously active co-frequency transmitters. The aggregate power-density at the GSO should be compared with the power-density at the GSO that would result from a single VSAT operating at 1 dB below the maximum permitted power-density. The report should include information on the average and maximum number of simultaneous co-frequency transmitters, an analysis of the E.I.R.P.-spectral density at the GSO, and a discussion of the factors taken into account at the network control center to manage the aggregate power-density of the system.

[239] *See infra* Appendix B, section 25.226(b)(3)(ii).

[240] *See infra* Section III.C.5.

VMES is not necessary as a general rule for all VMES systems.[241] As commenters note, a general one-dB reduction in the off-axis E.I.R.P.-density mask for VMES is not necessary where VMES operations are equivalent, from an interference perspective, to the operations of VSATs and ESVs.[242] However, notwithstanding the absence of a general rule, particular circumstances, in addition to aggregate variable-power systems, may require us to condition a future license to manage uplink operations through a one-dB or other margin.[243] We anticipate that this would not be the case for most applications under the VMES rules.

e. Contention Protocols

120. As discussed below, we adopt a new rule provision that permits VMES applicants to use contention protocols similar to those used by VSAT networks. We require VMES applicants seeking to use contention protocols to certify that the protocols are "reasonable."

121. *Background.* Section 25.134 of the rules establishes specific limits for individual VSAT earth station antenna input power densities.[244] The power-density limits are designed to limit the interference power received at space stations adjacent to the target satellite. Contention protocol use may result in aggregate power densities in the adjacent satellite receivers that exceed the limits produced by a single VSAT transmitter operating with a power density specified in section 25.134.[245]

122. In the *NPRM*, the Commission described contention protocols as multiple access techniques that permit users to transmit on a random or near-random basis with transmissions from one or more users that occasionally overlap, causing "collision."[246] The Commission stated that the probability of collisions is determined by the length of user transmission, number of transmissions per unit of time, and number of users transmitting on the same frequency.[247] It noted that, when collisions occur, the

[241] In the *NPRM* the Commission asked whether it should consider a 1-dB or other reduction below the ESV or VSAT mask to accommodate concerns about potential VMES antenna mispointing under rough off-road conditions. *NPRM*, 22 FCC Rcd at 9672, ¶ 50 (noting that the authorizations for certain Ku-band AMSS systems limit the aggregate E.I.R.P.-density to 1 dB less than the E.I.R.P.-density envelope defined for routinely-authorized VSATs).

[242] *See, e.g.*, Raysat Comments at 9, Reply at 7; Boeing Comments at ii, 22, Reply at 5. In lieu of a lower mask, Raysat suggests that we require a VMES operator to demonstrate that it meets the E.I.R.P.-density mask for VSAT-like earth stations under all potential operating conditions. Raysat Comments at 9. Raysat contends, for example, that rapid antenna acceleration due to vehicle movement in off-road conditions would be a rare occurrence and could be addressed through requirements on the speed and accuracy of pointing angle calculation and correction, operation at lower transmit power, spread spectrum modulation, and/or cessation of transmission. Raysat Comments at 9. *See also* SIA Comments at 15 (stating that it would be reasonable to use an envelope lower than the VSAT or ESV envelope, but arguing against defining any specific reduction; rather, urging us to require applicant to demonstrate that its system's proposed density and pointing accuracy would provide equivalent protection to the mask set out in the *NPRM*'s Appendix B, proposed § 25.xxx(a)); Americom Comments at 1 (supporting SIA Comments); Hughes Reply at 1 (endorsing SIA Comments).

[243] *See, e.g.*, Raysat Comments at 9 (stating that "The one circumstance cited by the Commission that might warrant consideration of a lower mask (*i.e.*, rapid antenna acceleration due to vehicle movement or 'jarring' in off-road conditions), [citation omitted] would be rare and can be addressed via other means (*e.g.*, speed and accuracy of pointing angle calculation and correction, operation at lower transmit power, spread spectrum modulation schemes, cessation of transmission, etc.).").

[244] 47 C.F.R. § 25.134.

[245] *Eighth Report and Order*, 23 FCC Rcd at 15132-33, ¶ 77.

[246] *NPRM*, 22 FCC Rcd at 9676, ¶ 59.

[247] *NPRM*, 22 FCC Rcd at 9676, ¶ 59.

E.I.R.P.-density at the GSO may exceed the E.I.R.P.-density that would be created by a single user.[248] It stated that the *Sixth Report and Order and Third Further Notice* had proposed adopting a contention table that would specify the percentage of time that collisions would be allowed to result in higher levels of E.I.R.P.-density.[249] The Commission proposed, rather than seeking additional comment on the use of contention protocols, to await the results of the Part 25 streamlining proceeding before considering the use of contention tables for VMES operations.[250]

123. In the streamlining proceeding, in the *Eighth Report and Order*, the Commission subsequently found that use of contention protocols tends to decrease the likelihood of harmful interference in almost all cases.[251] It concluded that there was no current need to develop detailed regulations to govern the use of contention protocols in VSAT networks where demand statistics normally allow for significant percentages of time during which no transmissions occur.[252] The Commission relied in part on a SIA study that found that a contention protocol system operating at reasonable loading factors produces less outage for neighboring satellites than a static system transmitting at the maximum power density.[253] The Commission adopted an exception to section 25.134 that permits a VSAT system to exceed the maximum VSAT digital earth station input power density in the aggregate when multiple earth stations simultaneously transmit, for purposes of "reasonable use" of a contention protocol.[254] It stated that VSAT applicants proposing to use contention protocols must certify that their contention protocol usage will be reasonable.[255]

124. SIA, Raysat, Americom, and Hughes filed comments supporting our proposal to await the results of the Part 25 streamlining.[256] Thus, no party filed substantive comments in this proceeding on the contention protocol issue.

125. *Discussion.* We find that the reasoning underlying our rules governing contention protocol usage in VSAT networks also is applicable to VMES networks, Therefore, we include language in section 25.226(a)(4) and (b)(5) of the rules to require an applicant seeking to operate a Ku-band VMES

[248] *NPRM*, 22 FCC Rcd at 9676, ¶ 59.

[249] *NPRM*, 22 FCC Rcd at 9676, ¶ 59, *citing to Sixth Report and Order and Third Further Notice*, 20 FCC Rcd at 5635-36, ¶ 119.

[250] *NPRM*, 22 FCC Rcd at 9676, ¶ 60.

[251] *Eighth Report and Order*, 23 FCC Rcd at 15133, ¶ 79. This results because, for any contention system with randomly-timed requests for access, there will be a portion of the time when there is no demand for access and thus no transmission to the satellite for part of the time. This reduces the outages caused to neighboring satellites by the system with the contention protocol. The reduction mostly offsets outages that may be caused by multiple simultaneous transmissions occurring when multiple earth stations simultaneously seek access. *Id.* at ¶ 79. In the *Eighth Report and Order*, the Commission referenced a SIA study showing a decrease in unavailability in five of six case studies, ranging from 1.3% to 5.1%, with the sixth case study showing a *de minimis* increase in unavailability. *Id.* at ¶ 79, citing to SIA Comments in IB Docket No. 00-248, App. 1 at 19.

[252] *Eighth Report and Order*, 23 FCC Rcd at 15134, ¶ 80.

[253] *Eighth Report and Order*, 23 FCC Rcd at 15134, ¶ 80. *See supra* note 251. By "static" system, the *Eighth Report and Order* referred to VSAT systems operating continuously at the applicable power limit set out in the rules. *Id.* at 15134, ¶ 79 n.241.

[254] *Eighth Report and Order*, 23 FCC Rcd at 15134, ¶ 81.

[255] *Eighth Report and Order*, 23 FCC Rcd at 15135, ¶ 83; 47 C.F.R. § 25.134(g)(4).

[256] SIA Comments at 17; Raysat Comments at 12; Americom Comments at 1 (supports SIA Comments); Hughes Reply at 1 (endorses SIA Comments).

system and planning to use a contention protocol to certify that its contention protocol usage will be reasonable.[257]

3. Antenna Pointing Accuracy and Cessation Requirements

126. As discussed below, we adopt a 0.2 degree antenna pointing accuracy requirement for VMES applications. As an alternative, we will permit applicants to declare, justify and abide by a maximum antenna pointing error that may be larger than 0.2 degrees but will be achieved without exceeding the off-axis E.I.R.P.-density limits, mirroring the alternative rule we adopt today for ESV.

127. *Background.* In the *NPRM*, the Commission sought comment on whether to adopt the Ku-band ESV rules for antenna pointing accuracy and cessation or to modify the ESV rules as proposed by Americom, ViaSat and Qualcomm in response to the Petition, which had preceded the *NPRM*.[258] At the time that Americom, ViaSat and Qualcomm made their proposals, section 25.222(a)(6) required each Ku-band ESV antenna to have a pointing error of less than 0.2 degrees between the orbital location of the target satellite and the axis of the main lobe of the ESV antenna.[259] Section 25.222(a)(7) required the ESV operator to automatically cease all emissions from the ESV within 100 milliseconds if the angle between the orbital location of the target satellite and the axis of the main lobe of the ESV antenna exceeded 0.5 degrees and not to resume transmission until the angle decreased to less than 0.2 degrees.[260]

128. The *NPRM* also sought comment on a proposal by Americom to adopt, for VMES, an exception to section 25.222(a)(6) that would be based on two conditions. The first condition Americom proposed would require the VMES applicant to demonstrate that its proposed system complied with the off-axis E.I.R.P.-density limits set out in section 25.222(a), notwithstanding its failure to comply with specified antenna pointing accuracy requirements. The second proposed condition would require the applicant to obtain and submit affidavits from potentially affected satellite operators agreeing to the applicant's proposed operations.[261] The *NPRM* sought comment on whether adoption of Americom's proposal would provide sufficient protection to adjacent FSS systems.[262]

129. In addition, in response to the Petition, ViaSat proposed that systems using spread spectrum modulation techniques in which individual antennas operate at extremely low E.I.R.P.-densities – and in which there is central control of aggregate power density – not be subject to pointing accuracy rules.[263] For antennas that cannot control interference through spread spectrum and/or power control technology, ViaSat and Qualcomm supported pointing accuracy limits that are a function of antenna beam width rather than of a specified fixed angular limit applied equally to all sizes of antennas.[264] The *NPRM* asked whether adopting a "fraction of the antenna beam width" approach seemed reasonable, how the Commission should determine the fraction that would apply, whether this approach should be limited to

[257] 47 C.F.R. § 25.226(a)(4) and (b)(5).

[258] *NPRM*, 22 FCC Rcd at 9673-74, ¶¶ 52-55. *See also* 47 C.F.R. § 25.222(a)(1)(ii)-(iii), formerly § 25.222(a)(6)-(7) (Ku-band ESV antenna pointing accuracy and cessation provisions); Comments of SES Americom, Inc. and Americom Government Services, RM-11336, at 5-6 (filed Aug. 21, 2006) ("Americom RM-11336 Comments"); ViaSat RM-11336 Comments at 5-6.

[259] 47 C.F.R. § 25.222(a)(6). This provision is revised and renumbered as 47 C.F.R. § 25.222(a)(1)(ii)(A).

[260] 47 C.F. R. § 25.222(a)(7). This provision is revised and renumbered as 47 C.F.R. § 25.222(a)(1)(iii)(A).

[261] *NPRM*, 22 FCC Rcd at 9673, ¶ 52; Americom RM-11336 Comments at 5-6.

[262] *NPRM*, 22 FCC Rcd at 9673, ¶ 52.

[263] *NPRM*, 22 FCC Rcd at 9673, ¶ 53; ViaSat RM-11336 Comments at 5-6.

[264] *NPRM*, 22 FCC Rcd at 9673, ¶ 53; ViaSat RM-11336 Comments at 6; Qualcomm RM-11336 Comments at 4.

peak E.I.R.P.-densities from a single terminal or to the aggregate emissions from multiple, co-frequency terminals, and, if so, with which value.[265]

130. With respect to Americom's proposal, Raysat, SIA, ViaSat, Boeing, NSMA, Americom, Hughes, and MTN favor granting applicants some flexibility on antenna pointing accuracy if the pointing error is taken into account in satisfying the mask or if there has been coordination with adjacent satellites to allow higher power levels.[266] General Dynamics, APTS/PBS, and ARINC, however, seek to apply a pointing accuracy requirement more strictly.[267] Only ViaSat itself spoke in favor of its own proposal to replace a pointing accuracy limit based on fixed angles with a limit that is a function of antenna beam width.[268] General Dynamics and MTN oppose making pointing accuracy a function of antenna beam width.[269]

131. *Discussion.* We adopt an antenna pointing accuracy requirement for VMES applications that is based on the modifications we make today to the ESV antenna pointing accuracy rule. In the *ESV Order on Reconsideration*, we modify and reorder section 25.222(a)(6) as section 25.222(a)(1)(ii).[270] Although declining to remove the antenna pointing requirement, we agree that the 0.2 degree antenna pointing limit is excessive for ESV systems that transmit below the off-axis E.I.R.P.-density limits contained in section 25.222(a).[271] We determine that such systems may allow any single ESV antenna to

[265] *NPRM*, 22 FCC Rcd at 9674, ¶ 54.

[266] *See, e.g.*, Raysat Comments at 10-11, Reply at 6-7 (stating Raysat's Stealthray has nominal pointing accuracy of 0.35°, but takes pointing error into account such that at +/-0.5° off-axis E.I.R.P. is below mask); SIA Comments at 6, 14-16, Reply at 2-3 (stating rules should treat as fully conforming those terminals with lower E.I.R.P. and lower pointing accuracy if combination provides equivalent protection, and allow higher power levels if coordination with adjacent satellites); ViaSat Comments at 8, 10, Reply at 14 (stating no pointing accuracy requirement should apply to antennas that operate at power density level sufficiently below mask, while pointing accuracy limit may be appropriate for VMES antenna that operates at power density levels close to mask, provided that mask varies in accordance with beam width and input power level of antenna); Boeing Comments at ii, 2, 21, 23-25, Reply at 4-5 (stating rules should permit operator to demonstrate equivalent protection from combination of power level and pointing accuracy or no pointing accuracy); NSMA Comments at 6 (stating separate pointing accuracy requirement may not be necessary for terminals taking into account mispointing to control off-axis E.I.R.P.-density); Intellicom Comments at 2 (stating rule should rely on off-axis E.I.R.P.); Americom Comments at 4 (stating rule should provide opportunity to demonstrate no harmful interference); Hughes Reply at 1 (supporting SIA Comments); MTN Comments at 5, Reply at 3-4 (stating it is unacceptable risk to eliminate requirements, but that MTN does not oppose consideration of licensing for VMES operators willing to operate with reduced power and less efficiency).

[267] General Dynamics Comments at 3-4, 30 (supports treating non-conforming terminals as non-routine, requiring coordination to license); APTS/PBS Comments at 3 (urges demonstration, through prototype testing, that each antenna meets 0.2°accuracy requirement); ARINC Reply at 2-3 (supports General Dynamics' contention that VMES should be strictly required to meet ESV requirements in order to minimize interference issues potentially caused by operation of VMES in Ku-band).

[268] ViaSat Comments at 12 and Attachment 3, Reply at 14 (supporting proposal for antennas that operate at power density levels close to off-axis E.I.R.P. limit).

[269] General Dynamics Comments at 31, 33 (stating Commission should not reduce ESV antenna pointing accuracy requirements for VMES, but could consider in different class of terminals with different signal structure); MTN Comments at 6 (stating it is unnecessary to adopt change because of readily available antennas that comply with existing antenna pointing requirements).

[270] *ESV Order on Reconsideration*, ¶¶ 21-22.

[271] *ESV Order on Reconsideration*, ¶ 23.

have a pointing error that is more than 0.2 degrees away from the target satellite without exceeding the off-axis E.I.R.P.-density limits that protect adjacent satellites from harmful interference.[272]

132. Thus, the rules adopted in the *ESV Order on Reconsideration* require ESV operators that seek relaxed pointing restrictions to declare, justify, and abide by a maximum antenna pointing error that may be larger than 0.2 degrees and will be achieved without exceeding the off-axis E.I.R.P.-density limits.[273] These low power-density ESV transmitters also must cease transmissions within 100 milliseconds after exceeding the declared antenna pointing error maximum.[274]

133. Similarly, we adopt the 0.2 degree antenna pointing requirement for VMES. In this regard, we decline to adopt ViaSat's proposal to eliminate antenna pointing accuracy requirements for systems using spread spectrum modulation techniques in which individual antennas operate at extremely low E.I.R.P.-densities and in which there is central control of aggregate power-density. We also decline to replace the angular pointing accuracy requirement with a rule based on beam width.[275] VMES, like ESV, is a service with mobile capabilities operating in the Ku-band FSS frequencies. In the *ESV Order on Reconsideration*, we observe that ESV antennas are subject to motion and vibrations that may cause rapid movement and antenna mispointing.[276] We retain the antenna pointing error requirement for ESVs to ensure that satellites adjacent to the target satellite are not subject to harmful interference.[277] The record in this VMES proceeding demonstrates that VMES is subject to greater accelerations, directional changes, and vibrations than ESVs.[278] Thus, we find that the 0.2 degree antenna pointing requirement is necessary for VMES operations that transmit at off-axis power-density levels close to the E.I.R.P.-density mask, in order to protect adjacent FSS satellite systems from harmful interference.

134. The VMES applicant must provide a certification from the equipment manufacturer stating that the antenna tracking system will maintain a pointing error of less than or equal to 0.2 degrees between the orbital location of the target satellite and the axis of the main lobe of the VMES antenna and that the antenna tracking system is capable of ceasing emissions within 100 milliseconds if the angle

---

[272] *ESV Order on Reconsideration*, ¶ 24.

[273] *ESV Order on Reconsideration*, ¶¶ 23, 25. *See also* 47 C.F.R. § 25.222(a)(1)(ii)(B).

[274] *ESV Order on Reconsideration*, ¶ 26. *See also* 47 C.F.R. § 25.222(a)(1)(iii)(B).

[275] As noted, no commenter except ViaSat spoke in favor of this approach. Adopting a "fraction of the antenna beam width" alternative instead of a fixed value to specify pointing accuracy would lower the required pointing accuracy for small antennas. As an antenna becomes smaller, the beam becomes wider. Thus, a pointing accuracy rule based on beam width would permit greater pointing inaccuracies as the width of the beam increased with smaller-sized antennas. *See NPRM*, 22 FCC Rcd at 9674, ¶ 54.

[276] *ESV Order on Reconsideration*, ¶ 21.

[277] *ESV Order on Reconsideration*, ¶ 21.

[278] *See, e.g., NPRM*, 22 FCC Rcd at 9659, ¶ 19, 9670-72, ¶¶ 46-50; APTS/PBS Comments at 2-3 (stating that, unlike sea and air vessels, land vehicles move quickly on rough terrain, take sharp turns, hit obstructions); Americom Comments at 5 (contending that it may be difficult for VMES to meet ESV antenna pointing and cessation requirements due to terrain variations encountered by vehicles, particularly during off-road operations); ARINC Comments at 4-5 (asserting that it is improper to equate VMES platforms with stable ESV platforms unaffected by terrain variations); General Dynamics Comments at 6 (stating that VMES terminal hardware costs are significantly higher than costs of current VSAT and ESV systems because VMES operations require highly sophisticated antenna tracking and pointing systems), 24 (stating that accurate antenna pointing is more difficult for VMES than ESV because shipboard environment is less rigorous and determination of absolute spatial reference with VMES target satellite is more complex).

between the orbital location of the target satellite and the axis of the main lobe of the antenna exceeds 0.5 degrees.[279]

135. Although we do not eliminate the pointing accuracy requirement for low power-density systems as requested by ViaSat, we will permit flexibility for implementing low power-density VMES systems that choose not to meet the 0.2 degree pointing error requirement. We require VMES applicants with such systems to declare, justify and abide by a maximum antenna pointing error that shall be achieved without exceeding the off-axis E.I.R.P. mask.[280] In this regard, we apply the new ESV rules, and the rationale for adopting them, to VMES. The applicant shall demonstrate technically how the overall system will operate within the mask, taking into account the declared pointing error and low power-density emissions.[281] The applicant shall demonstrate how it will correct the E.I.R.P.-density at adjacent satellites in the event that emissions inadvertently exceed the permissible level.[282] The licensee is required to initiate corrective action and shut down within 100 milliseconds if its antenna exceeds the declared pointing error.[283] An applicant electing not to meet the 0.2 degree pointing error requirement also must specify the particular satellites with which its system will operate.[284]

4. Data Collection, Retention and Availability

136. As discussed below, we adopt requirements for the collection, retention, and availability of data to assist in identifying and resolving sources of interference. We model these requirements on similar requirements for Ku-band ESVs, but change the recordation time interval for VMES systems to five minutes.

a. Applying ESV Rules to VMES

137. *Background.* In the *ESV Report and Order*, the Commission adopted a requirement that ESV operators maintain data logs on the operation of each ESV terminal, including terminals operating in the Ku-band, retain that data for a year, and share the data with a relevant list of entities.[285] In the *NPRM*, the Commission sought comment on applying the data collection, retention and availability requirements set out in the Ku-band ESV rules to VMES.[286]

---

[279] 47 C.F.R. §§ 25.226(a)(1)(iii)(A), 25.226(b)(1)(iii). *See also* 47 C.F.R. § 25.226(a)(9) (like 47 C.F.R. § 25.134(h) for VSATs, § 25.226(a)(9) requires VMES terminals to automatically cease transmitting upon loss of reception of satellite downlink signal).

[280] 47 C.F.R. § 25.226(a)(1)(ii)(B).

[281] 47 C.F.R. § 25.226(b)(1)(iv). The precise value of the declared antenna pointing error will depend on the off-axis E.I.R.P.-density pattern, the characteristics of the VMES transmitters, the number of co-frequency operating transmitters, and the statistical accuracy of the antenna tracking system. *See ESV Order on Reconsideration*, ¶ 25 n.66.

[282] 47 C.F.R. § 25.226(b)(1)(iv)(B).

[283] 47 C.F.R. § 25.226(a)(1)(iii)(B).

[284] *See infra* Section III.C.5.

[285] *ESV Report and Order*, 20 FCC Rcd at 695-96, ¶ 48. *See also* 47 C.F.R. § 25.222(a)(4), formerly § 25.222(c)(1)-(3).

[286] *NPRM*, 22 FCC Rcd at 9677, ¶ 64.

138. APTS/PBS, SIA, Boeing, ViaSat, ARINC, and Hughes support applying the ESV requirements to VMES.[287] Intellicom suggests applying the requirements to VMES and then perhaps removing them in the future if few interference events occur.[288]

139. General Dynamics asks the Commission to decline to apply such requirements because, it states, the most likely operators in the near term will be military and other Federal users.[289] MTN urges us to excuse both VMES and ESV from the requirements.[290] Raysat asserts that such requirements are of limited benefit to Ku-band adjacent satellite interference resolution, raise national security concerns, and would be unnecessarily burdensome.[291] Americom states it may be inappropriate to adopt requirements because of national security concerns.[292]

140. *Discussion.* Based on our analysis of the record, we conclude that it is appropriate to adopt a modified version of the ESV data logging requirement for VMES. This requirement will ensure that VMES operators, like ESV operators, have the capability to track certain data that will be available in the event we are presented with an interference concern. We discuss each aspect of the requirement below.

b. Collection

141. *Background.* The ESV rules require Ku-band ESV network operators to collect data on the satellites each vessel uses, the operating frequencies and bandwidths used, the time of day, and the vessel location in longitude and latitude.[293] ESV licensees record data at time intervals of no greater than every twenty minutes while the ESV is transmitting.[294] In the *NPRM*, the Commission proposed adopting the relevant ESV requirements for VMES.[295]

142. Boeing, Hughes and ViaSat commented on collection intervals for VMES. They suggest shorter collection intervals of five to six minutes.[296] They suggest this shorter timeframe because VMES terminals are more likely than ESVs to change direction abruptly and experience higher speeds that result in more frequent antenna pointing changes.[297] Raysat, which urges us not to adopt data requirements for

---

[287] *See, e.g.*, APTS/PBS Comments at 3-4; SIA Comments at 18-19, Boeing Comments at iii, 27; ViaSat Comments at 22, Reply at 19; ARINC Reply at 3; Hughes Reply at 4-6.

[288] Intellicom Comments at 2.

[289] General Dynamics Comments at 39-41.

[290] MTN Comments at 7, Reply at 5.

[291] Raysat Comments at 13.

[292] Americom Comments at 4.

[293] 47 C.F.R. § 25.222(a)(4), formerly § 25.222 (c)(1).

[294] 47 C.F.R. § 25.222(a)(4), formerly § 25.222(c)(1).

[295] *NPRM*, 22 FCC Rcd at 9698, Appendix B, proposed section 25.xxx(a)(10)(i) ("for each VMES transmitter a record of the vehicle location (*i.e.*, latitude/longitude), transmit frequency, channel bandwidth, and satellite used shall be time annotated" and "Records will be recorded at time intervals no greater than every 20 minutes while the VMES is transmitting.").

[296] Boeing Reply at ii, 8 (no longer than 5 minutes); Hughes Reply at 6 (6 minutes); ViaSat Reply at 19 (5 minutes).

[297] Boeing Comments at 29 (20-minute interval adequate for ESVs on slow moving ships where movements are highly predictable, but likely inadequate for vehicles, which can travel at greater speeds and with much less predictability due to curves and grade changes in roads), Reply at 9 (collection of data in 5-minute intervals would achieve interference protection goals and not overly burden VMES operators); Hughes Reply at 6 (if VMES travels

(continued....)

VMES operations, suggests that the proposed twenty-minute logging interval may not be meaningful and that decreasing the interval could create a data retention and processing burden with little associated benefit.[298]

143. *Discussion.* Based on our analysis of the record, we agree with Boeing, Hughes and ViaSat that we should reduce the collection interval from twenty minutes to take into account the more frequent directional changes and relevant speeds that are likely to result in more frequent VMES antenna pointing changes. We revise and adopt proposed section 25.xxx(a)(10)(i) – now denominated section 25.226(a)(6) – to require collection of the relevant data in no greater than five-minute intervals while the VMES terminal is transmitting.[299]

c. Retention

144. *Background.* The ESV rules require Ku-band ESV operators to retain the collected data for not less than one year.[300] In the *NPRM*, the Commission proposed adopting the same retention requirement for VMES.[301]

145. APTS/PBS and ViaSat support a one-year interval.[302] Boeing proposes 90 days; Hughes recommends 30 days but states that it could accept 90 days.[303] SIA states that if the purpose of the rules is to enable operators of other networks and systems that are experiencing unexpected interference to obtain location information on mobile transmitters, then retention of less than one year may be sufficient.[304] SIA further suggests that the Commission should study the matter, taking into account ESV experience and objectives.[305] Raysat agrees with Boeing that some level of data retention may be useful for the internal purposes of VMES network operators, but recommends that we allow VMES licensees to develop data retention policies that best meet their particular needs and network architecture.[306]

146. *Discussion.* We apply the ESV one-year retention rule to VMES licensees.[307] We note that, in the proceeding leading up to the *ESV Report and Order*, the Commission considered but rejected a

---

(...continued from previous page)
while transmitting at top speed of 110 km/hour, point taken every 6 minutes would be adequate to determine whether VMES was in ellipse at time of interference event); ViaSat Reply at 5 (even assuming worst case vehicle speed of 80 mph, 5-minute logging interval would update location once every 6.6 miles).

[298] Raysat Comments at 13-14.

[299] *See infra* Appendix B, section 25.226(a)(6).

[300] 47 C.F.R. § 25.222(a)(4), formerly § 25.222(c)(1).

[301] *NPRM*, 22 FCC Rcd at 9698, Appendix B, proposed § 25.xxx(a)(10)(i).

[302] APTS/PBS Comments at 3; ViaSat Reply at 20 (at least one year).

[303] Boeing Comments at 30 (asserting that 90 days should be adequate to address interference concerns because network operators generally raise them at time of interference event rather than weeks or months later); Hughes Reply at 4-5 (asserting that retention for 30 days is sufficient because interference events would be reported to the VMES operator within a few days of the occurrence and resolution should be effected shortly thereafter, but that 90 days is acceptable compromise that would allow sufficient time for analysis of data to respond to interference claims in even the most complex situations).

[304] SIA Comments at 18.

[305] SIA Comments at 18. SIA itself did not provide such historical analysis.

[306] Raysat Reply at 8.

[307] *See infra* Appendix B, section 25.226(a)(6).

shorter, 90-day retention period, opting instead for one-year retention to provide additional time for investigating incidences and patterns of interference.[308] We have not modified the one-year retention rule in the *ESV Order on Reconsideration*, which revises and reorders the ESV rules. We find that a one-year retention rule for VMES likewise will assist with investigations of interference incidents and incident patterns.

d. Availability

147. *Background.* The ESV rules state that an ESV operator will make the collected and retained data available upon request to a coordinator, FS operator, FSS system operator, NTIA, or the Commission within twenty-four hours of the request.[309] In the *NPRM*, the Commission proposed to adopt the ESV requirement for VMES.[310]

148. Hughes and SIA suggest withholding the data from non-government entities.[311] Boeing argues against real-time availability via the Internet, but supports provision of the data to the Commission and NTIA upon request.[312] ViaSat opposes a publicly-accessible data base.[313] ViaSat supports our proposal to require response within twenty-four hours, and APTS/PBS argues for a one-hour response interval.[314] SIA suggests that a twenty-four hour response time for all data may be unrealistic.[315]

149. *Discussion.* In adopting ESV rules, the Commission required licensees to provide data to relevant entities within twenty-four hours of request.[316] In the proceeding leading up the *ESV Report and Order*, the Commission considered but rejected a longer response time.[317] In the *ESV Order on Reconsideration*, in revising and reordering the Ku-band ESV rules, we retain the requirement that ESV licensees provide data upon request to a coordinator, FS operator, FSS operator, NTIA or the Commission within twenty-four hours of the request.[318] Based on the Commission's ESV approach and on the record

[308] *See* 47 C.F.R. § 25.222(a)(4); *ESV Report and Order*, 20 FCC Rcd at 695-96, ¶ 48 (C-band), 721, ¶ 112 (Ku-band).

[309] 47 C.F.R. § 25.222(a)(4), formerly § 25.222(c)(1).

[310] *NPRM*, 22 FCC Rcd at 9698, Appendix B, proposed § 25.xxx(a)(10)(i).

[311] Hughes Reply at 4 (supports withholding from non-government); SIA Comments at 19 (states there is no need to supply data to non-government; could supply to Commission or NTIA if verification needed). *See also* Americom Comments at 1 (supports SIA Comments).

[312] Boeing Comments at 28-29, Reply at 10-11 (opposes availability to any party other than applicable regulatory bodies).

[313] ViaSat Comments at 23 (asserts that in other mobile services network operators have demonstrated that parties are able to cooperate and often voluntarily provide necessary information to resolve interference incidents and that public database of tracked locations may raise privacy and security concerns without adding benefit to process that works today).

[314] ViaSat Reply at 20; APTS/PBS Comments at 3-4. *But see* Hughes Reply at 5 (stating that one-hour response time is untenable).

[315] SIA Comments at 19. *See also* Hughes Reply at 1 (endorses SIA Comments); Americom Comments at 1 (supports SIA Comments).

[316] *See* 47 C.F.R. § 25.222(a)(4), formerly 47 C.F.R. § 25.222(c)(1).

[317] In the *ESV Report and Order*, the Commission considered but rejected a 72-hour response time, opting instead for a 24-hour response to help to ensure quicker resolution of interference problems. *See, e.g., ESV Report and Order*, 20 FCC Rcd at 696, ¶ 49 (C-band), 721, ¶ 113 (Ku-band).

[318] *See* 47 C.F.R. § 25.222(a)(4).

here, we require VMES licensees to make data available to coordinators, system operators, NTIA, and the Commission within twenty-four hours of request. We find that this rule, as applied to VMES, will assist with any applicable investigation of interference complaints.

e. National Security Exception/Waiver

150. *Background.* The ESV data retention rule does not provide an exception for national security. In the *NPRM*, the Commission did not propose such an exemption for VMES. As discussed below, various commenters propose that the Commission adopt a national security exception or waive the rule for national security reasons.

151. Raysat and General Dynamics argue against adopting a VMES data logging requirement because of national security concerns.[319] Americom, Hughes, SIA and ViaSat suggest that we establish a national security exception or waive the rule for national security reasons.[320] Boeing states that national security concerns are serious but that we should address the issue with a requirement limiting who can see the data.[321] SIA observes that a general non-application of the requirement to provide data upon request could hinder the ability of a secondary MSS operator to rapidly refute a claim of interference that otherwise could require the MSS operator to shut down preemptively.[322] SIA proposes supplying sensitive customer data only to the Commission or NTIA, if needed for verification, after the VMES operator makes prompt analysis of the data in response to the interference claim.[323] SIA states that, should the Commission grant a waiver, the target satellite licensee and VMES operator would not be absolved from the obligation to cooperate with the operator of the victim satellite to identify the source of the interference and correct it.[324] APTS/PBS argues that the government should use the 7 GHz band if it can not comply with data logging.[325]

152. *Discussion.* The Commission did not adopt a national security exception or waiver of the data collection, retention or availability requirements when it released the ESV rules in 2005. Nor do we add one as we revise and reorder the ESV rules in the *ESV Order on Reconsideration* adopted today. Similarly, based on the record here, we think there continues to be good reason for these requirements for VMES. In asking us to adopt no requirements because VMES initially may be used for U.S. military training and other Federal uses, Raysat and General Dynamics are asking us to speculate on the uses to which VMES may be applied and to limit the scope of the ESV rules, as applied to VMES, based on that assumption.

---

[319] Raysat Comments at 14 (asserts there should not be data logging requirement in part because VMES primarily will be used for military and other government operations); General Dynamics Comments at 39-41, 41 n. 35 (states separate classified system would be required because information should not be forwarded to agencies without security clearance).

[320] Americom Comments at 4 (urges granting exemption or waiver); Hughes Reply at 4 (urges availability of waivers); SIA Comments at 18 (suggests waiving recordation rule if public interest showing is made); ViaSat Comments at 22-23 (urges exception for certain government and law enforcement applications where disclosure could have security considerations).

[321] Boeing Comments at 28-29.

[322] SIA Comments at 19.

[323] SIA Comments at 19.

[324] SIA Comments at 19 n.37.

[325] APTS/PBS Comments at 4.

153. We follow the procedures the Commission adopted in the ESV rules. We do not adopt an explicit national security exception for VMES licensees. We find that a better approach would be to consider an applicable request to waive the availability component of the rule for national security reasons.

154. We observe that section 1.3 of the Commission's rules authorizes the Commission to waive its rules for "good cause shown."[326] Waiver is appropriate only if special circumstances warrant a deviation from the general rule and such deviation would better serve the public interest than would strict adherence to the general rule.[327] Generally, the Commission may grant a waiver of its rules in a particular case only if the relief requested would not undermine the policy objective of the rule in question and otherwise would serve the public interest.[328] If a VMES applicant or licensee seeks a waiver of the rules on data availability, we will review the waiver request pursuant to this standard.

5. Point of Contact

155. As discussed below, we adopt an operating rule requiring VMES licensees to maintain a point of contact in the United States with authority and ability to cease all emissions from their VMES terminals.

156. *Background.* The ESV rules require an ESV operator to maintain a point of contact in the United States with authority and ability to cease all emissions from its ESV terminals, either directly or through the facilities of a U.S. hub (or hub located in another country with which the United States has a bilateral agreement that enable such cessation of emissions).[329] In the *NPRM*, the Commission proposed that, whether or not an applicant requests a VMES license that includes a hub, the VMES rules would require the licensee to maintain in the United States both a network control and monitoring center and a twenty-four-hours-per day, seven-days-per-week point of contact.[330] Thus, the Commission proposed, in the *NPRM*'s Appendix B, proposed section 25.xxx(a)(8), that "There shall be a point of contact in the United States, with phone number and address included with the application, available 24 hours a day, 7 days a week, with authority and ability to cease all emissions from the VMES."[331] The Commission also proposed, in Appendix B, proposed section 25.xxx(a)(10)(ii), that "VMES operators shall control all VMESs by a hub earth station located in the United States."[332]

157. SIA, General Dynamics, ViaSat, Boeing, Americom and Hughes support a U.S. point of contact with authority to cease operations twenty-four hours of the day and seven days of the week.[333]

---

[326] 47 C.F.R. § 1.3. *See also WAIT Radio v. FCC*, 418 F.2d 1153 (D.C. Cir. 1969) ("*WAIT Radio*"); *Northeast Cellular Telephone Co.*, 897 F.2d 1164 (D.C. Cir. 1990) ("*Northeast Cellular*").

[327] *Northeast Cellular*, 897 F.2d at 1166.

[328] *WAIT Radio*, 418 F.2d at 1157.

[329] 47 C.F.R. § 25.222(a)(3), formerly § 25.222(a)(8). *See also* 47 C.F.R. § 25.222(a)(6), formerly § 25.222(c)(3) (ESVs operators shall control all ESVs by a hub earth station located in the United States except that an ESV on U.S.-registered vessels may operate under control of a hub location outside the United States provided that the ESV operator maintains a point of contact within the United States with the capability and authority to cause an ESV on a U.S.-registered vessel to cease transmitting if necessary).

[330] *NPRM*, 22 FCC Rcd at 9683, ¶ 78.

[331] *See* 22 FCC Rcd at 9698, Appendix B, proposed § 25.xxx(a)(8).

[332] *See* 22 FCC Rcd at 9698, Appendix B, proposed § 25.xxx(a)(10)(ii).

[333] SIA Comments at 19, 26, Reply at 10; General Dynamics Comments at 60-61 (supports both U.S. network control and monitoring center and U.S. 24/7 point of control as prerequisite to U.S. operations to ensure rapid

(continued....)

SIA questions the need for also requiring a U.S. hub, stating that so long as there is "absolute control" from a U.S. network operation center and U.S. point of contact, a U.S. hub is not essential.[334] Boeing and ViaSat assert that so long as there is a U.S. point of contact with authority to cease operations or a network control monitoring center in the United States, a U.S. hub is not necessary.[335]

158. *Discussion.* We agree that it is not necessary to require a U.S. hub at this time. We adopt proposed section 25.xxx(a)(8) – reordered here as section 25.226(a)(5) – requiring each VMES licensee to provide a 24/7 point of contact that shall have the authority and ability to cease all VMES operations, as necessary.[336] We are adopting technical and licensing rules for the domestic, U.S. use of VMES. In the future, if we should authorize VMES to operate internationally, we will consider appropriate modifications of the rules to take into account international operations.

159. We observe that Part 25 licensees have responsibility for proper operation and maintenance of earth stations, and that authority to operate transmitting earth stations by remote control is contingent on compliance with certain conditions.[337] Thus, VMES systems that operate by remote control are subject to section 25.271 of the rules and must complete items E61 through E66 in Schedule B of FCC Form 312. We recognize that most VMES terminals will operate by remote control although we do not explicitly use the term "remote control" in the VMES rules.

6. Licensing Issues

a. Blanket Licensing

160. *Background.* The ESV rules provide for blanket licensing of ESV systems.[338] In the *NPRM*, the Commission proposed to provide applicants with the option of seeking a VMES system

(...continued from previous page)
resolution of any potential interference issues); ViaSat Reply at 23 (supports U.S. network control and monitoring center); Boeing Comments at iii, 30-31 (supports 24/7 U.S. point of contact with authority to cease operations); Americom Comments at 1 (supports SIA Comments); Hughes Reply at 1 (endorses SIA Comments). *See also* Intellicom Comments at 2 (silent on 24/7 and whether hub must be in United States, but urges hub with positive control and no transmit unless demodulated unique carrier originating from hub specifies time and frequency of transmissions); APTS/PBS Comments at 3-4 (silent on 24/7 and whether hub must be in United States, but would require hub master monitoring station held responsible for terminals' operations).

[334] SIA Comments at 26. SIA also states, however, that it has no difficulty with the suggestion that a hub master station, or network control center for stations operated remotely, be held responsible for operations of VMES terminals. SIA Reply at 10.

[335] Boeing Comments at iii, 30-31 (stating that Boeing does not support requirement for U.S. hub, but supports 24/7 U.S. point of contact with authority to cease operations); ViaSat Reply at 23 (states no need for U.S. hub so long as network control monitoring center control point in United States for both individual and multiple VMES antennas).

[336] *See infra* Appendix B, § 25.226(a)(5). We require each VMES terminal to be capable to receive 'enable transmission' and 'disable transmission' commands from the network control center/point of contact and to cease transmission immediately upon receipt of any 'parameter change' demand, until it receives an 'enable transmission' command from the network control center/point of contact. We expect a VMES licensee's network control center/point of contact to monitor operations of the network's VMES terminals to determine if any terminal is malfunctioning. We also expect the VMES terminal to self-monitor and automatically cease transmission upon detecting an operational fault that could cause harmful interference to other FSS networks.

[337] *See* 47 C.F.R. § 25.271 (requiring a trained operator to be present at the transmitting earth station or, under applicable conditions, at the designated remote control point for the earth station, at all times that the earth station is transmitting).

[338] 47 C.F.R. § 25.222 (Blanket Licensing Provisions for Earth Stations on Vessels in Ku-bands). *See also ESV Report and Order*, 20 FCC Rcd at 722, ¶ 115 (adopting blanket licensing approach is both consistent with approach
(continued....)

license consisting of a hub located in the United States and/or a blanket earth station license.[339] The Commission considered blanket licensing for VMES terminals because the number and mobility of VMES locations may make it impractical to license VMES terminals on a unit-by-unit basis.[340]

161. SIA, Boeing, Raysat, NSMA, ViaSat, General Dynamics, MTN, Americom and Hughes support blanket licensing.[341] Boeing states that blanket licensing is necessary because deployment of large numbers of technically identical terminals would make individual licensing of antennas burdensome and inefficient.[342] Raysat and NSMA support blanket licensing for technically identical VMES terminals, stating that a requirement for individual licensing would be cumbersome and a burden on applicants and the Commission.[343] MTN supports blanket licensing because of the large number and ubiquity of system terminals.[344] ViaSat supports our proposal to allow both blanket licensing and individual licensing of VMES terminals, stating that blanket licensing is the most efficient way to license networks of widely-deployed terminals.[345]

162. *Discussion.* We adopt our proposal to provide for blanket licensing of VMES.[346] Under a blanket licensing approach, we will require applicants to file a narrative describing the overall system operations as well as specific information on the antennas, power density, and emission characteristics of each class of earth station comprising the network. We will issue a VMES system license (consisting of a U.S. hub and/or blanket earth station license) to applicants that demonstrate they are capable of controlling all aspects of the VMES network. As noted above, we require a point of contact with the authority and ability to control the emissions of individual VMES terminals.

b. Individual Licensing

163. *Background.* In the *NPRM*, the Commission also proposed to provide for the licensing of individual earth stations, using the same technical criteria that are applied to the antennas in a blanket-licensed VMES network.[347] This proposal varies from the Commission's approach in the ESV

(...continued from previous page)
for Ku-band VSATs and takes into account unique operational characteristics of ESVs, including deployment of large numbers of technically identical earth stations operating over wide geographic area).

[339] *NPRM*, 22 FCC Rcd at 9683, ¶ 78.

[340] *NPRM*, 22 FCC Rcd at 9683, ¶ 79.

[341] SIA Comments at 25; Boeing Comments at iii, 32; Raysat Comments at 16; NSMA Comments at 8; ViaSat Comments at 21; General Dynamics Comments at 60; MTN Comments at 8; Americom Comments at 1 (supports SIA Comments); Hughes Reply at 1 (endorses SIA Comments).

[342] Boeing at 32-33.

[343] Raysat Comments at 16; NSMA Comments at 8.

[344] MTN Comments at 8.

[345] ViaSat Comments at 21.

[346] *See infra* Appendix B, § 25.226 (Blanket Licensing Provisions for Domestic, U.S. Vehicle-Mounted Earth Stations in Ku-band).

[347] *NPRM*, 22 FCC Rcd at 9683, ¶ 80.

proceeding, where the Commission declined to include specific provisions for individual, as opposed to blanket, earth station licensing.[348]

164. General Dynamics and ViaSat support individual licensing. General Dynamics states that, as VMES will be interoperable with other Ku-band FSS operations, there probably will be applications for single terminals.[349] ViaSat states that it should not matter whether an operator seeks a license to operate a single terminal or to deploy numerous identical terminals over the United States, so long as the operation and management of the terminals comply with the rules.[350] ViaSat adds that we should evaluate applications for single VMES terminals to determine whether the antenna will be operated within a network of separately licensed terminals and will meet off-axis E.I.R.P-density network limits on an aggregate basis.[351] SIA, Raysat, NSMA, Boeing, Americom and Hughes comment that an individual licensing requirement would be cumbersome.[352]

165. *Discussion.* We will permit VMES applicants to seek licensing of an individual VMES earth station where the applicant does not propose to operate multiple technically identical terminals over a wide geographic area. In response to ViaSat's comments, we will require each licensee to meet the applicable off-axis E.I.R.P.-density requirements. We do not encourage the separate licensing of single terminals that will be operated in a VMES "network." Rather, we would anticipate that any network of technically identical antennas – or classes of technically identical antennas – would be licensed under blanket authority.

c. ALSAT Authority

166. *Background.* In the *NPRM*, the Commission sought comment on whether to authorize Ku-band VMES operators to operate with any U.S.-licensed satellite and those non-U.S. satellites on the Permitted Space Station List using the parameters consistent with earth stations, specifically the proposed off-axis E.I.R.P.-density requirements.[353] This ALSAT authority permits an earth station operator providing FSS services in the Ku-band to access any U.S. satellite and any foreign satellite on the Permitted Space Station List without additional Commission action, provided that its communications are in accordance with the same technical parameters and conditions established in the earth stations' licenses.[354] Because ALSAT authority is not available to FSS earth station applicants whose operations must be coordinated with adjacent satellite operators, the *NPRM* proposed to deny ALSAT authority to

[348] *See ESV Report and Order*, 20 FCC Rcd at 722, ¶117 n.304 (because there was no comment on need for individual earth station licensing and the Commission viewed demand for individual as opposed to network ESV earth station use as limited, the Commission declined to adopt individual licensing provisions for ESV).

[349] General Dynamics Comments at 61.

[350] ViaSat Comments at 21.

[351] ViaSat Comments at 21.

[352] SIA Comments at 25 (individual licensing would be cumbersome; it would be helpful if VMES could be included as a class of antennas on network licenses); Raysat Comments at 16 (individual licensing cumbersome and should not be required); NSMA Comments at 8 (individual licensing burdensome and no benefit from requiring individual licensing); Boeing Comments at 32 (individual antenna licensing burdensome); Americom at 1 (supports SIA Comments); Hughes Reply at 1 (endorses SIA Comments).

[353] *NPRM*, 22 FCC Rcd at 9683, ¶ 81.

[354] *See DISCO II First Reconsideration Order*, 15 FCC Rcd at 7210-11, ¶ 6, 7215-16, ¶ 19.