

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

In the matter of)
)
Amendment of ~~Parts~~ 2 and 25 of the Commission's)
Rules to Permit Operation of NGSO FSS System) ET Docket No. 98-206
Co-Frequency with GSO and Terrestrial Systems in)
the Ku-Band Frequency Range)

THIRD MEMORANDUM OPINION AND ORDER

Adopted: February 3, 2003

Released February 6, 2003

By the Commission:

I. INTRODUCTION

1. With this order, we address petitions for reconsideration of the Commission's decision to permit non-geostationary satellite orbit fixed-satellite service in certain segments of the Ku-band frequencies.¹ Our action in this order is limited to addressing sharing issues between geostationary satellite orbit service providers and non-geostationary satellite orbit service providers. For the reasons discussed below, we amend our rules for demonstrating that limits on equivalent power flux-density are met, and we make editorial changes to two other rules. We otherwise deny the petitions for reconsideration on the limited issues addressed in this order.

II. BACKGROUND

2. On November 29, 2000, the Commission adopted the *First Report and Order* in this proceeding.² In the *First Report and Order*, the Commission adopted technical sharing criteria to allow non-geostationary satellite orbit ("NGSO) fixed-satellite service ("FSS") and geostationary satellite orbit ("GSO") FSS to operate on a co-primary basis in certain Ku-band frequencies, consistent with decisions taken at the 2000 World Radiocommunication Conference ("WRC-2000"). The adopted technical criteria consist of uplink and downlink limits on equivalent power flux-density ("EPFD").³ The Commission also adopted rules to assess NGSO FSS licensees' compliance with those EPFD limits.

¹ The Ku-band typically refers to frequencies between 10 and 14 GHz. The specific bands subject to this proceeding are the 10.7-12.7 GHz, 12.75-13.25 GHz and 13.75-14.5 GHz bands.

² *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*, First Report and Order and Further Notice of Proposed Rulemaking, FCC 00-418, 16 FCC Red. 4096 (2000) ("*First Report and Order*").

³ Power flux-density ("PFD") is a measure of the amount of energy emitted by a transmitter that is present over a unit area at the Earth's surface or at the satellite, and is a critical factor in determining whether satellite systems can successfully share spectrum with other services or satellite systems. See *First Report and Order*, 16 FCC Red. at 4106. The Commission adopted revised terminology used by international working groups, referring to "EPFD_{down}" for power limits applicable to NGSO FSS space stations within an NGSO FSS system and EPFD, for power limits applicable to NGSO FSS Earth stations within an NGSO FSS system or GSO BSS and FSS systems. *Id.*

3. The rules the Commission adopted **are** based on an international consensus on GSOMGSO sharing developed through study groups of the International Telecommunication Union (“ITU”). The ITU concluded that a combination of single-entry EPFD_{down} limits and aggregate EPFD_{down} limits for NGSO FSS operations adequately protected GSO **FSS** operations, thereby defining the level of acceptable interference from an NGSO **FSS** system into a GSO **FSS** system! The Commission determined that it would require U.S.-licensed NGSO FSS systems to comply with each type of limit.

4. Specifically, the Commission adopted EPFD_{down} limits that must be met by each NGSO **FSS** system for emissions from all satellites in its system. There **are** three elements of these limits: (1) “validation” EPFD_{down} limits, including more stringent validation EPFD_{down} limits for specific sizes of antennas located at high latitudes; (2) “operational” EPFD_{down} limits, which protect against synchronization loss in GSO FSS Earth stations between 3 and 18 meters in diameter; and (3) “additional operational” EPFD_{down} limits for 3 meter and 10 meter GSO **FSS** Earth stations? Each of these three elements of limits must be met by each individual NGSO **FSS** system; collectively, they comprise the “single-entry EPFD_{down} limits.”⁶ In addition to the single-entry EPFD_{down} limits, the Commission adopted aggregate validation EPFD_{down} limits, which limit the cumulative level of interference from all co-frequency NGSO **FSS** systems into GSO FSS networks?

5. In the *First Report and Order*, the Commission adopted a number of rules for demonstrating that NGSO FSS systems comply with these EPFD limits? For the validation EPFD_{down} limits, the Commission required that each NGSO FSS applicant demonstrate, prior to licensing, that it meets the limits by means of a software simulation developed in accordance with an ITU software specification? The Commission will verify the applicants’ demonstrations, and then submit the information to the ITU Radiocommunication Bureau (“ITU-BR”) if the Commission is satisfied that each applicant meets the limit.

6. To ensure compliance with the operational and additional operational EPFD_{down} limits, the Commission required each NGSO FSS licensee to demonstrate that it meets these limits, after it is licensed, but prior to placing its licensed system into service.” The licensee is to **make** the required demonstration through a computer simulation using the licensee’s satellite and Earth station resource allocation strategy, its spacecraft antenna switching algorithm, and its measured spacecraft antenna patterns.” If this technical demonstration exceeds the Commission’s operational or additional operational EPFD_{down} limits at any test point, the licensee is prohibited from initiating service to the public until it rectifies the deficiency by reducing satellite transmission power or making other adjustments.

⁴ *Firs: Report and Order*, 16 FCC Red. at 4128.

⁵ *Id.* “Validation limits.” and other defined terms used herein were first defined by the Commission in the *First Report and Order*, where it adopted domestically various terms developed by ITU study groups. See *Firs: Report and Order*, 16 FCC Red. at 4130.

⁶ *Firs: Report and Order*, 16 FCC Red. at 4128.

⁷ *First Report and Order*, 16 FCC Red. at 4140.

⁸ *First Report and Order*, 16 FCC Red. at 4132-4141.

⁹ *First Report and Order*, 16 FCC Red. at 4134.

¹⁰ *First Report and Order*, 16 FCC Red. at 4136.

¹¹ *First Report and Order*, 16 FCC Red. at 4137.

7. After an applicant has made all the required demonstrations and has become operational, its operations must continuously remain below the Commission's $EPFD_{down}$ limits. The Commission found no need to develop additional procedures or remedies for those cases where NGSO FSS systems exceed those limits in operation, because existing administrative sanctions would apply." The Commission did find, however, that it was important for GSO FSS operators to have the necessary information to locate satellites in an NGSO FSS constellation at any given time, in order to identify a satellite causing harmful interference. The Commission therefore required that NGSO FSS licensees publish their satellites' orbital elements every three days in the North American Aerospace Defense Command 2-line element format, on a website maintained by the NGSO FSS licensee."

8. Finally, the Commission adopted an aggregate validation $EPFD_{down}$ limit, in addition to the three components of the single-entry $EPFD_{down}$ limits. Recognizing the practical difficulties of checking compliance with the aggregate limits, the Commission did not adopt rules requiring a demonstration of NGSO FSS compliance in the *First Report and Order*. Instead, it required NGSO FSS licensees to simply certify that they will meet the aggregate limits, and noted that it may require a demonstration when it addresses the issue in the proceeding in which it is addressing NGSO FSS to NGSO FSS sharing.¹⁴

9. Four parties filed petitions for reconsideration of the *First Report and Order* on issues regarding NGSO and GSO sharing in the Ku-band frequencies: SkyBridge, *DIRECTV*, PanAmSat, and a collection of Hughes entities." The majority of the issues raised in these petitions for reconsideration concern the rules for demonstrating compliance with $EPFD$ limits.¹⁶

III. DISCUSSION

A. Single-entry Validation $EPFD_{down}$ limits

10. As is explained more fully below, the Commission's rules require that each NGSO FSS applicant demonstrate, prior to licensing, that it meets the validation $EPFD_{down}$ limits, by using a software simulation developed in accordance with an ITU software specification. The Commission required that applicants provide the results of the computer program in a cumulative probability distribution function of

¹² *First Report and Order*, 16 FCC Rcd. at 4138. See 47 C.F.R. § 25.160 (2001) (administrative sanctions).

¹³ *First Report and Order*, 16 FCC Rcd. at 4138.

¹⁴ *First Report and Order*, 16 FCC Rcd. at 4140. See also, *Establishment of Policies and Service Rules for the Non-Geostationary Satellite Orbit, Fixed Satellite Service in the Ku-Band*, Notice of Proposed Rulemaking, FCC 01-134, 16 FCC Rcd. 9680 (2001); *Establishment of Policies and Service Rules for the Non-Geostationary Satellite Orbit, Fixed Satellite Service in the Ku-Band*, Report and Order and Further Notice of Proposed Rulemaking, FCC 02-123, 17 FCC Rcd. 7841 (2002).

¹⁵ SkyBridge L.L.C. Petition for Reconsideration ("SkyBridge Petition"); Petition for Reconsideration of DIRECTV, Inc. ("DIRECTV Petition"); PanAmSat Corporation Petition for Reconsideration ("PanAmSat Petition"); and Hughes Communications, Inc., Hughes Communications Galaxy, Inc., and Hughes Network Systems, a division of Hughes Electronics Corporation Joint Petition for Partial Reconsideration ("Hughes Petition") (all filed March 19, 2001).

¹⁶ The SkyBridge Petition and the *DIRECTV* Petition raise a number of additional issues affecting the direct broadcast satellite service and the multichannel video distribution and data service. These issues have been addressed in a separate memorandum opinion and order. 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*, Memorandum Opinion and Order and Second Report and Order, FCC 02-116, 17 FCC Rcd. 9614 (2002).

EPFD_{down}, containing the worst three test points in the United States for domestic service and the worst three test points on each continent outside the United States for international service.” For the validation EPFD, limits, the Commission’s rules require a comparable result, executing the same computer program containing an EPFD_{up} for every longitudinal location on the geostationary satellite orbit at every two-degree spacing that is visible to the United States, for domestic service, and every three-degree longitudinal location in the geostationary satellite orbit for service outside of the United States.¹⁸

11. SkyBridge petitioned for reconsideration of those aspects of the Commission’s validation EPFD limits that it says are inconsistent with agreements reached at the WRC-2000.¹⁹ SkyBridge contends that the worst three test points requirement for the EPFD_{down} demonstration, and the longitudinal location requirements for the EPFD, demonstration, are difficult to interpret and reopen delicate debates resolved before WRC-2000.²⁰ In its opposition to SkyBridge’s petition and its reply comments, PanAmSat concurs that there is no clear definition for the “worst three test points,” but PanAmSat argues that as a consequence GSO FSS operators should be permitted to specify multiple test points to be used to evaluate compliance with the validation limits?’

12. Based upon the petitions filed and subsequent *ex parte* presentations, there is some confusion about both the purpose of the validation EPFD limits and the method used to demonstrate compliance with them. We find, on reconsideration, that some of the requirements in our rules are inconsistent with the purpose of the validation limits as developed by the ITU after adoption of our rules, and therefore we amend the rules herein to correct the methods used to demonstrate compliance with the validation EPFD limits.

13. As stated in the *First Report and Order*, the purpose of the validation EPFD limits is to provide a fixed outer limit on the amount of power that NGSO FSS systems can be designed to emit.²² The ITU Joint Task Group 4-9-11 (“JTG”) developed a software requirement for a computer simulation to demonstrate that an NGSO FSS system can meet the EPFD limits. In order for the computer simulation to work on all types of NGSO FSS constellations (including, for example, both low Earth orbit and highly elliptical orbit systems) and in order to take into account the fact that operational parameters of NGSO FSS systems change frequently, the software used for the simulation employs worst case scenario parameters, not actual operating parameters. The ITU JTG software specification thereby simulates an “outer envelope” of acceptable interference by any NGSO FSS system.

14. For an EPFD_{down} demonstration, the software will compute power fluxdensity masks representing the power from each satellite in an NGSO FSS constellation at worst-case power levels and beam configurations. EPFD statistics will then be computed by simulating the movement of the satellites in the constellation and adding the power fluxdensity radiated by the NGSO satellites at the input of a GSO FSS receiver at each time step. The software will then compute the worst case power level from the

¹⁷ 47 C.F.R. § 25.146(a)(1)(v) (2001).

¹⁸ 47 C.F.R. § 25.146(a)(2)(v) (2001).

¹⁹ SkyBridge Petition at 28.

²⁰ SkyBridge Petition at 30.

²¹ PanAmSat Corporation Opposition to Petition for Reconsideration at p.7 (filed April 24, 2001) (“PanAmSat Opposition”); Consolidated Reply of PanAmSat Corporation at p. 2 (filed May 9, 2001) (“PanAmSat Reply”).

²² *First Report and Order*, 16FCC Rcd. at 4130.

NGSO FSS system as a whole into any GSO location anywhere in the world. The resulting worst-case power level can then be compared with, and must be lower than, the validation EPFD limits specified in the Commission's rules.

15. For an EPFD, demonstration, the software will compute power fluxdensity masks representing the power from Earth stations in an NGSO FSS system at worst-case power levels and beam configurations. EPFD statistics will then be computed by adding the power flux-density radiated by the Earth stations at the input of a GSO satellite receiver for each time step. The software will then compute the worst case power level from the NGSO FSS system as a whole into any GSO FSS satellite location. The resulting worst-case power level will be compared with, and must be lower than, the validation EPFD, limits specified in the Commission's rules.

16. Although these outer envelope calculations generate a result that is a hypothetical worst case test point at which the NGSO FSS system power level is at its highest, the software is not designed to measure power fluxdensity at specific points on Earth or in space. We find, on reconsideration, that these portions of our rules require point-specific measurements that conflict with the global envelope simulation that the ITU software specification is designed to measure. The Commission determined in the First *Report and Order* that the validation test used in the United States should be the same as that used by the ITU-BR.²³ We therefore amend our rules to delete the requirement that the EPFD_{down} demonstration contain the worst three test points. We likewise amend our rules to delete the requirement that the EPFD, demonstration contain an EPFD, measurement for every longitudinal location on the geostationary satellite orbit at every two-degree spacing that is visible to the United States for domestic service, and every three-degree longitudinal location in the geostationary satellite orbit for service outside the United States. The amendments we make to our rules in this Order will still guarantee protection of current GSO FSS operations and will bring our demonstration rules into harmony with software designed for use by the ITU-BR.

17. The Commission determined in the *First Report and Order* that it would first verify the validation demonstration made by NGSO FSS applicants, and then, when it was satisfied that the applicant could comply with the validation EPFD limits, the Commission would submit the required information to the ITU-BR, which will make its own determination of compliance with the validation EPFD limits. The Commission's validation EPFD rules provide us with confidence that the validation information we send to the ITU-BR will be accurate. That confidence will also allow the Commission to license NGSO FSS applicants. We do not adopt the suggestion that we should delay licensing until after the ITU completes and publishes its compliance determination.²⁴ The Commission frequently authorizes new satellite systems prior to completion of ITU review, although such authorizations are conditioned upon the licensee completing ITU advance publication, coordination and notification procedures. There is nothing peculiar to this satellite service that would necessitate departure from this normal licensing procedure.

18. Having amended our rules to bring their validation methodology into harmony with the methods specified for the ITU software, we concur with the suggestion that our rules should encourage use of the software package eventually approved by the ITU.²⁵ We agree that if ITU-approved software is available, it should be used, thereby reducing the potential inconsistencies of using different software. If an applicant uses the ITU-approved software to make its validation EPFD demonstration, it will not be required to provide the source code and the compiled executable program. If the ITU-BR software is not

²³ *First Report and Order*, 16FCC Red. at 4134.

²⁴ PanAmSat Petition at p. 6.

²⁵ See SkyBridge Petition at pp. 29-30.

yet available and an applicant **seeks** to demonstrate compliance with validation EPFD limits with its **own** software, we will require the source code and the compiled executable program, with which **the** Commission will verify this information. Providing the source code and the compiled executable program will allow the Commission to ensure that the validation EPFD demonstrated complies with **our** rules and with the **ITU-BR** software. Regardless of the software used, it must establish that the applicant meets the validation **EPFD_{down}** and EPFD, limits.

B. Operational and Additional Operational EPFD_{down} limits

19. The single entry validation EPFD limits adopted by the Commission establish a **fixed** outer limit on the amount of power that an NGSO **FSS** system can emit toward any point anywhere on the Earth. Interference levels computed by the EPFD validation software will overestimate the actual interference that can be expected into any actual GSO **FSS** Earth station, due to the worst-case inputs that must be provided by the operator and the conservative assumptions employed by the software. For this reason, tightening these limits imposes significant burdens on proposed NGSO **FSS** operations without any demonstration by GSO **FSS** operators of an actual need for the vast majority of their links. Negotiations within the ITU JTG and at the WRC-2000 between NGSO and GSO parties generally recognized that co-frequency use by the two services would need more restrictive limits on power transmitted into actual, operating GSO **FSS** Earth stations, because GSO **FSS** operators are clearly relying on lower interference levels for some of their links. To meet that need, WRC-2000 set two further types of single-entry power limits, “operational” and, for certain Earth station antenna sizes, “additional operational” EPFD limits. As indicated by their names, these limits apply to emissions from actual, operating NGSO **FSS** space stations into operational GSO **FSS** Earth stations.

20. While the validation limits can never be exceeded anywhere on Earth at any time and place a hard constraint on NGSO **FSS** system design and operation, the operational-type limits may be exceeded by definition, so long **as** they are not exceeded into any operational GSO **FSS** Earth station? NGSO **FSS** proponents must accept the risk that they may occasionally need to constrain their operations to meet the operational limits, and GSO **FSS** operators must accept an operational rather than a validation limit for these tighter bounds. The distinction between the two types of EPFD limits requires different kinds of proof that NGSO **FSS** operations will meet the respective limits.

21. The Commission adopted operational and additional operational EPFD limits in the *First Report and Order*. The limits will be enforced by the Commission, because the **ITU's** enforcement role is limited to requiring that national administrations commit that their NGSO **FSS** operators will be able to meet the limits. The Commission determined, in the *First Report and Order*, that its existing procedures and remedies apply to any situations when NGSO **FSS** systems exceed the operational and additional operational EPFD limits after the system is placed into service. NGSO **FSS** systems that exceed EPFD limits in Commission rules are in violation of the rules, as well **as** in violation of the system's Commission authorization, and thereby subject to appropriate Commission actions?

22. To reduce the likelihood that the Commission will have to resort to sanctions or other remedial measures, the Commission decided to require a demonstration of compliance **with** operational and additional operational limits before NGSO **FSS** systems begin commercial service. The Commission expected that such a demonstration would assure the Commission that **NGSO FSS systems** will be built in accordance with the rules, thereby enabling the Commission to commit to the **ITU-BR** that the systems

²⁶ SkyBridge asserts that studies showed an extremely small probability that an NGSO **FSS** system meeting the validation limits would violate **the** operational limits into an actual operating GSO **FSS Earth** station. SkyBridge Petition at p. 33.

²⁷ See, e.g., 47 C.F.R. § 25.160 (2001).

will be able to meet the operational and additional operational EPFD limits. The required demonstration will also provide incumbent satellite operators assurance that they will not receive unacceptable interference. SkyBridge questions whether we should retain this pre-operational compliance demonstration requirement, and if so, questions the methods of proof required in our rules.²⁸ PanAmSat and DIRECTV question the timing of the demonstration, asserting that it should be made earlier than is required in the rules.²⁹ Petitioners also question whether the existing remedies for violation of these limits by operating NGSO FSS systems are sufficient.³⁰

1. Test Points, Source Code and Test Results

23. We have considered the assertion in SkyBridge's petition for reconsideration that there is no definite database of GSO Earth stations in operation, including their pointing direction, with which to **make** a demonstration simulation. We have also considered the request, in DIRECTV's petition for reconsideration, that this compliance demonstration include at least 30 GSO Earth station test points defined by direct broadcast service operators.³¹ Considering both petitions on this issue, we amend our rules to delete the requirement that the demonstration include the worst three test points in the United States and on each continent. In place of that requirement, we amend our rules to allow each U.S.-licensed Ku-Band GSO FSS operator and each U.S.-licensed Ku-Band broadcast satellite service operator to submit up to 10 test points for operational limit compliance, and up to 10 test points for additional operational limit compliance. The test points submitted will provide a database of GSO Earth Stations that NGSO FSS systems need. We find this number of test points sufficient to test the two EPFD limits, and therefore do not adopt DIRECTV's suggestion that we allow 30 or more submitted test points. If it chooses to submit test points, a GSO operator must submit the latitude, longitude, altitude, azimuth, elevation, antenna size, and efficiency for each submitted test point by January 1 of each year until all licensed NGSO FSS systems are placed into service. Each NGSO FSS licensee will be required to demonstrate its compliance with operational and additional operational limits one time, before its system is placed into service, at each of the current submitted test points at that time.

24. We do not amend the rule requirement that NGSO FSS licensees provide to the Commission their computer programs for this demonstration, including the source code and the executable file. As the Commission explained in the First Report and Order, we expect that the result of the compliance demonstration at each submitted test point will be made available to the public.³² The result should be a power fluxdensity measurement at each submitted test point that is or is not within the limits in the Commission's rules. NGSO FSS systems will not be permitted to place their system into service if they fail at a submitted test point. If a licensee does not comply with the operational or additional operational limits, it will be required to reduce its power or apply other mitigation techniques until it can pass the demonstration.

²⁸ SkyBridge Petition at p. 34.

²⁹ PanAmSat Petition at p. 3; DIRECTV Petition at p. 23.

³⁰ PanAmSat Petition at p. 7.

³¹ DIRECTV Petition at p. 27.

³² *First Report and Order*, 16FCC Rcd. at 4137. While only the results are made public, the Commission requires that the source code be filed so that the Commission can verify the results.

2. Timing of Demonstrations

25. SkyBridge argues that a critical difference between the validation EPFD limits and the operational EPFD limits is that validation limits **are** hard limits that apply at all points and at all times. According to SkyBridge, operational and additional operational limits apply only when there is interference into an operating GSO FSS Earth station. SkyBridge asserts that because the operational limits can be exceeded (except into an operational GSO Earth station), **as** operational power levels from an NGSO FSS system change over the life of an NGSO FSS system with changes in traffic patterns, and because there is **no** definite database of GSO Earth stations in operation, it is impossible to demonstrate compliance with these limits via computer simulations prior to commencement of operation without changing the scope of the **limits**.³³ SkyBridge suggests that the Commission establish a requirement that an operating licensee demonstrate compliance with the additional operational limits in response to any credible complaint of a violation of those limits into an identified operational GSO Earth station.³⁴ The technical showing SkyBridge proposes would employ computer simulation based on relevant ITU Radiocommunication Sector (“ITU-R”) Recommendations, but would input the actual system parameters being used at the time, and the actual location and pointing direction of the affected GSO Earth station at a limited number of test points (random or selected).”

26. Although we also emphasize the distinction between validation limits and operational limits, we do not agree with SkyBridge’s conclusion that the distinction means that operational and additional operational limits cannot be demonstrated before an NGSO **FSS** system is Operational. We therefore do not adopt SkyBridge’s suggestion that we amend our rules to remove the requirement for a pre-operational compliance demonstration. We find no reason why the technical showing suggested **by** SkyBridge cannot be undertaken prior to the initiation of **service** to the public, **as** our rules require.³⁶ Indeed, the rules adopted by the Commission are fairly flexible with regard to how an NGSO FSS system makes its demonstration. We concur with SkyBridge that the demonstration should employ more realistic operating parameters, but we do not accept that this requires no less than a fully operational NGSO FSS system already placed into service. The fact that NGSO FSS system parameters will change in operation **does** not mean that a demonstration cannot be made with *anticipated* operational parameters – including expected maximum traffic loading distributions and geographic specific scheduling – **as well as** actual measured space station antenna patterns of constructed satellites **as** they exist at the time of the demonstration.” The purpose of the demonstration that an NGSO FSS system can meet operational and additional operational EPFD limits before it is placed into service is to give the Commission and incumbent operators some assurance that the NGSO FSS system will be built to operate in accordance with the Commission’s EPFD limits.

27. Any NGSO FSS systems whose system operations will exceed operational or additional operational EPFD limits except into operational GSO Earth stations, must necessarily design some type of avoidance method to power down to meet the limits whenever its space-to-Earth emissions near an operating GSO Earth station. If an NGSO **FSS** system can accomplish this task, it must demonstrate it to the Commission. If it cannot do so, **the** alternative is that its system must remain within operational and additional operational EPFD limits at all times. We therefore retain **our** requirement that an NGSO FSS

³³ SkyBridge Petition at p. 35.

³⁴ SkyBridge Petition at p. 39.

³⁵ SkyBridge Petition at p. 40.

³⁶ 47 C.F.R. § 25.146(b) (2001).

³⁷ See 47 C.F.R. 5 25.146(b)(1) (2001).

system submit a comprehensive technical showing demonstrating, before its system is placed into service, that its system is not expected to operate in excess of the Commission's operational and additional operational EPFD_{down} limits into operational GSO ~~Earth~~ stations.

28. Given the pass/fail nature of this demonstration, we cannot see how it will become the procedural morass that SkyBridge imagines, or the last-minute emergency that PanAmSat and **DIRECTV** imagine when they ask us to require the demonstration far earlier than 90 days prior to the initiation of service to the public. Because an NGSO FSS system cannot initiate service to the public until it can pass the demonstration, licensees have an incentive to make the demonstration as soon as possible, and we encourage licensees to do so.³⁸ Whenever the results of a demonstration ~~are~~ made public, all interested parties will be allowed to comment on the results. Since the demonstration will be a pass or fail determination, however, there is little to debate. If an **NGSO FSS** operator demonstrates that its system meets the operational and additional operational limits at the submitted test points, the Commission and incumbent operators will have the assurance we seek in this requirement. These demonstrations will not be a forum to debate the NGSO FSS system's operational design. If for any reason a GSO FSS operator remains unconvinced that it can co-exist with an NGSO FSS system even ~~after~~ a demonstration that EPFD limits are met at as many as 20 test points submitted by the GSO FSS operator, its ultimate recourse is to monitor the NGSO FSS system's compliance in operation and to provide information concerning any alleged non-compliant operations of the NGSO FSS system of concern. Existing rules apply to all earth and space station licensees, and define the actions the Commission would follow if a licensee is found to be non-compliant with our rules.³⁹

C. Other Issues

1. Aggregate **EPFD_{down}** limits

29. Several petitions for reconsideration raise the issue of compliance with aggregate **EPFD** limits. Shortly after these petitions were filed, the Commission released a *Further Notice of Proposed Rulemaking* seeking comment on a methodology for proof that NGSO **FSS** licensees will meet the aggregate EPFD limits.⁴⁰ The Commission will consider comments on the aggregate EPFD limits issue in that proceeding.

2. GSO FSS Earth station ~~Off-axis~~EIRP density limits

30. SkyBridge argues that the WRC-2000 limits established a clear bound on GSO emissions upon which NGSO operators can rely and use in designing their systems and indicated that no combination of existing rules comprehensively limits the off-axis equivalent isotropically radiated power ("EIRP") of GSO Earth stations in all cases.⁴¹ To the contrary, PanAmSat states that that the current Part

³⁸ **DIRECTV** suggests the demonstration might be made when the **NGSO FSS** system's first satellite, or a small fraction of its operational constellation, is launched. **DIRECTV** Petition at p. 25.

³⁹ See 47 C.F.R. § 25.160 (2001). We also note that since the *First Report and Order* was adopted, the **ITU-R** has developed Recommendation ITU-R S. 1527 to assist GSO FSS operators in identifying the source of interference in excess of the operational EPFD limits, and Recommendation **ITU-R S. 1558** to measure **EPFD** levels to verify compliance with the operational EPFD limits. Our rule requiring publicly available ephemeris data is supported by Recommendation ITU-R S. 1527. See 47 C.F.R. § 25.271(e).

⁴⁰ See *Establishment of Policies and Service Rules for the Non-Geostationary Satellite Orbit, Fired Satellite Service in the Ku-Band*, Further Notice of Proposed Rulemaking, 17 FCC Rcd. 7841 (2002).

⁴¹ SkyBridge Petition at p. 44.

25 rules **are** more restrictive for GSO FSS Earth stations than **the** limits adopted at WRC-2000.⁴² Commission rules currently require GSO FSS systems to meet antenna gain characteristics.” Routine licensing provisions of our rules also limit the antenna input power density of **carriers**.⁴⁴ These rules effectively result in off-axis **EIRP** limits for GSO networks that meet the standards specified in international agreements. When operators create any variance from these rules, they must either seek coordination with affected parties, or provide a demonstration that the variance will not cause any unacceptable interference to other parties, and they **are** required to accept interference from other lawfully operating radiocommunication facilities. We therefore find that our current rules are more restrictive, and thus do not accept SkyBridge’s suggestion that we adopt WRC-2000 limits. Instead, we retain our current part 25 rules limiting the off-axis EIRP of GSO FSS Earth stations.

3. NGSO FSS Space Station Antenna sidelobe patterns

31. PanAmSat suggests that the rules should make clear that the NGSO FSS space station antenna patterns must have 99% “confidence bound” on sidelobe levels over the life of the **satellite**.⁴⁵ SkyBridge responds that in the context of the validation tool, however, such specificity is not **required**.⁴⁶ SkyBridge asserts that any change that affects these envelopes requires re-validation with updated PFD masks, and any system that does not report any changes that would affect the **PFD masks** would be in violation of the limits. There is no comparable requirement for space station antenna sidelobe patterns for GSO FSS space station antennas.

32. To address the antenna sidelobe accuracy concerns raised by PanAmSat, SkyBridge recommends as an alternative that the Commission impose an explicit condition on each NGSO **FSS** license that any change in satellite performance that affects the **PFD mask** be expeditiously reported to the Commission so that new validation tests can be conducted with the new parameters.⁴⁷ In addition, SkyBridge suggests that each licensee should be required to include in its annual report to the Commission a certification that its system continues to operate within the bounds of the PFD and **EIRP** masks and other input parameters used in the domestic demonstration of compliance with Validation Limits. We adopt this alternative proposal, and amend the rules to require that in its annual report to the Commission, each NGSO FSS licensee certify that its system continues to operate within the bounds of the PFD and **EIRP** masks and other input parameters used in the domestic demonstration of compliance.

4. Operational Limits in Alaska for the protection of GSO BSS

33. SkyBridge states that WRC-2000 adopted a special Operational Limit to protect BSS **Earth** stations of 240 cm diameter located in Region 2 west of 140°W, north of 60°N, pointing at GSO BSS

⁴² PanAmSat Corporation Opposition to Petition for Reconsideration at p. 7. See *First Report and Order*, 16 FCC Rcd. at 4185.

⁴³ See 47 C.F.R. § 25.209 (2001).

⁴⁴ See 47 C.F.R. § 25.212 (2001). But see 47 C.F.R. § 25.134 (2001), which is one instance of FCC requirements for licensing non-routine **Earth** stations. The Commission defers similar requirements for **Earth** stations in the Ku-Band frequencies, but may revisit the issue as NGSO FSS systems in the Ku-Band are licensed.

⁴⁵ PanAmSat Petition at p. 5. We take this to imply an up-front assurance on the patterns for the manufactured antenna.

⁴⁶ SkyBridge L.L.C. Opposition to Petitions for Reconsideration at p. 5 (filed April 24, 2002) (“SkyBridge Opposition”).

⁴⁷ SkyBridge Opposition at p. 6.

satellites at certain orbital locations with elevation greater than 5°. ⁴⁸ Our rules replaced the WRC-2000 text “Region 2 west of 140°W, north of 60°N” with “Alaska.” ⁴⁹ These latitude-dependent validation limits provide greater protection to broadcast satellite service Earth stations in Alaska. ⁵⁰ BSS Earth stations currently in use in portions of the state of Alaska south of 60°N would be affected were we to adopt the WRC-2000 text. In addition, the Commission adopted a transition period for the implementation of these latitude-dependent validation limits? We therefore find that our existing rule protects existing BSS Earth stations in Alaska without unduly constraining **NGSO** FSS systems. We do not adopt the WRC-2000 text.

5. Protection of Very Large Earth Station Antennas

34. The *First Report and Order* adopted coordination procedures to protect GSO **FSS** networks using sensitive receiving Earth stations with very large antennas. ⁵² The Commission did not propose $EPFD_{down}$ limits in this situation because the required limits could preclude **NGSO** FSS operations altogether? These coordination procedures are required for GSO FSS Earth stations with a maximum isotropic gain greater than or equal to 64 dBi (Earth station antennas greater than about 18 meters in diameter), with a G/T of 44 dB/K or higher, and an emission bandwidth of 250 megahertz or higher.” Pending the development of an ITU simulation software package that permits the calculation of $EPFD_{down}$ limits, the United States has asked the Director of the ITU-BR to identify coordination between specific GSO Earth stations and **NGSO** FSS systems, based on bandwidth overlap and the GSO satellite network having Earth stations that meet the specific criteria that the Commission has adopted in Rule Section 25.146. ⁵⁵ Once the ITU simulation software is available, coordination procedures will be required only when the $EPFD_{down}$ radiated by an **NGSO** FSS system exceed the limits in Section 25.146. Until that time, coordination procedures will be triggered by the GSO Earth station criteria, as specified in Section 25.146, and as identified by the Director of the ITU-BR.

6. Omitted information on EPFD Tables

35. SkyBridge comments that several of the EPFD tables left out text stating that “[f]or each reference antenna diameter, the limit consists of the complete curve on a plot which is linear in decibels for the EPFD levels and logarithmic for the time percentages, with straight lines joining the data points.” ⁵⁶ As this text constitutes an important part of the definition of certain of the limits, SkyBridge proposes that

⁴⁸ SkyBridge Petition at p. 27

⁴⁹ See 47 C.F.R. § 25.208, Footnote 2 of Table 1L and Footnote 2 of Table 1M (2001).

⁵⁰ *First Report and Order*, 16 FCC Rcd. at 4165.

⁵¹ *First Report and Order*, 16 FCC Rcd. at 4166.

⁵² *First Report and Order*, 16 FCC Rcd. at 4142.

⁵³ Generally, the larger the GSO FSS Earth Station antenna, the more stringent the required **NGSO** FSS $EPFD_{down}$ mask. See *First Report and Order*, 16 FCC Rcd. at 4141.

⁵⁴ 47 C.F.R. §25.146(f). See also *First Report and Order*, 16 FCC Rcd. at 4142.

⁵⁵ Letter from Richard C. Beaird, Senior Deputy U.S. Coordinator, Department of State, to Robert W. Jones, Director, ITU-BR (June 25, 2002).

⁵⁶ SkyBridge Petition at p. 27.

it be inserted in the appropriate tables, consistent with the WRC-2000 agreements. We find that this text was inadvertently omitted and therefore amend the rules to insert it.

IV. CONCLUSION

36. For the reasons stated in this order, we amend portions of our rules for demonstrating that non-geostationary satellite orbit fixed satellite service system providers demonstrate that they meet the limits on equivalent power flux-density in the rules. We otherwise deny the petitions for reconsideration of the Commission's *First Report and Order* concerning issues of sharing between geostationary satellite orbit and non-geostationary satellite orbit service providers.

V. ORDERING CLAUSES

37. Accordingly, IT IS ORDERED that pursuant to the authority contained in Sections 4(i), 7(a), 301, 303(c), 303(f), 303(g), 303(r), 308, and 309(j) of the Communications Act of 1934, as amended, 47 U.S.C. §§ 154(i), 157(a), 301, 303(c), 303(f), 303(g), 303(r), 308, 309(j), this *Third Memorandum Opinion and Order* IS ADOPTED.

38. IT IS FURTHER ORDERED that, Part 25 of the Commission's Rules IS AMENDED as specified in the Appendix, effective 30 days after publication in the Federal Register, except as specified. This action is taken pursuant to Sections 4(i), 303(c), 303(f), 303(g), 303(r), and 309(j) of the Communications Act of 1934, as amended, 47 U.S.C. §§ 154(i), 303(c), 303(f), 303(g), 303(r) and 309(j).

39. IT IS FURTHER ORDERED that pursuant to Sections 4(i), 302, 303(e), 303(f), 303(g), 303(r) and 405 of the Communications Act of 1934, as amended, 47 U.S.C. §§ 154(i), 302, 303(e), 303(f), (303(g), 303(r) and 405, the SkyBridge L.L.C. Petition for Reconsideration, the Petition for Reconsideration of DIRECTV, Inc., the PanAmSat Corporation Petition for Reconsideration, and the Hughes Communications, Inc., Hughes Communications Galaxy, Inc., and Hughes Network Systems, Joint Petition for Partial Reconsideration are GRANTED to the extent indicated in this *Third Memorandum Opinion and Order*, and are otherwise DENIED.

40. IT IS FURTHER ORDERED that the Consumer and Governmental Affairs Bureau, Reference Information Center, SHALL SEND a copy of this *Third Memorandum Opinion and Order*, including the Final Regulatory Flexibility Certification, to the Chief Counsel for Advocacy of the Small Business Administration.

FEDERAL COMMUNICATIONS COMMISSION

Marlene H. Dortch
Secretary

APPENDIX A: FINAL RULES

The FCC amends 47 C.F.R. Part 25 as follows:

PART 25 – SATELLITE COMMUNICATIONS

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

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

2. Section 25.146 is amended to read as follows:

25.146(a)(1)(iii): If a computer program that has been approved by the ITU for determining compliance with the single-entry EPFD_{down} validation limits is not yet available, the applicant shall provide a computer program for the single-entry EPFD_{down} validation computation, including both the source code and the executable file. This computer program shall be developed in accordance with the specification stipulated in Recommendation ITU-R S.1503 (2000). If the applicant uses the ITU approved software, the applicant shall indicate the program name and the version used.

25.146(a)(1)(v): Provide the result, the cumulative probability distribution function of EPFD, of the execution of the computer program described in paragraph (a)(1)(iii) of this section by using only the input parameters contained in paragraphs (a)(1)(i) and (a)(1)(iv) of this section.

25.146(a)(2)(iii): If a computer program that has been approved by the ITU for determining compliance with the single-entry EPFD validation limits is not yet available, the applicant shall provide a computer program for the single-entry EPFD validation computation, including both the source code and the executable file. This computer program shall be developed in accordance with the specification stipulated in Recommendation ITU-R S.1503 (2000). If the applicant uses the ITU approved software, the applicant shall indicate the program name and the version used.

25.146(a)(2)(v): Provide the result of the execution of the computer program described in paragraph (a)(2)(iii) of this section by using only the input parameters contained in paragraphs (a)(2)(i) and (a)(2)(iv) of this section.

25.146(b)(1)(v): Provide the result, the cumulative probability distribution function of EPFD, of the execution of the verification computer program described in paragraph (b)(1)(iii) of this section by using only the input parameters contained in paragraphs (b)(1)(i) and (b)(1)(iv) of this section for each of the submitted test points provided by the Commission. These test points are based on information from U.S.-licensed geostationary satellite orbit fixed-satellite service and broadcast satellite service operators in the bands 10.7 GHz to 14.5 GHz. Each U.S.-licensed geostationary satellite orbit fixed satellite service and broadcast satellite service operator in the bands 10.7 GHz to 14.5 GHz may submit up to 10 test points for this section containing the latitude, longitude, altitude, azimuth, elevation angle, antenna size, efficiency

to be used by non-geostationary satellite orbit fixed-satellite service licensees in the bands 10.7 GHz to 14.5 GHz during the upcoming year.

25.146(b)(2): Operational equivalent power flux-density, space-to-Earth direction, (operational EPFD_{down}) limits. Using the information contained in (b)(1) of this section plus the measured space station antenna patterns, provide the result of the execution of the computer simulation for the anticipated in-line operational EPFD_{down} levels for each of the submitted test points provided by the Commission. Submitted test points are based on inputs from U.S.-licensed geostationary satellite orbit fixed-satellite service and broadcast satellite service operators in the bands 10.7 GHz to 14.5 GHz. Each U.S.-licensed geostationary satellite orbit fixed-satellite service and broadcast satellite service operator in the bands 10.7 GHz to 14.5 GHz may submit up to 10 test points for this section containing the latitude, longitude, altitude, azimuth, elevation angle, antenna size, efficiency to be used by non-geostationary satellite orbit fixed-satellite service licensees in the bands 10.7 GHz to 14.5 GHz during the upcoming year.

25.146(c): The NGSO FSS system licensee shall, on June 30 of each year, file a report with the International Bureau and the Commission's Columbia Operations Center in Columbia, Maryland, certifying that the system continues to operate within the bounds of the masks and other input parameters specified under 25.146(a) and 25.146(b) as well as certifying the status of the additional operational EPFD_{down} levels into the 3 m and 10 m geostationary satellite orbit fixed-satellite service receiving Earth station antennas, the operational EPFD_{down} levels into the 3 m, 4.5 m, 6.2 m and 10 m geostationary satellite orbit fixed-satellite service receiving Earth station antennas and the operational EPFD_{down} levels into the 180 cm geostationary satellite orbit broadcast satellite service receiving Earth station antennas in Hawaii and 240 cm geostationary satellite orbit broadcast satellite service receiving Earth station antennas in Alaska.

25.146(f) Coordination will be required between NGSO FSS systems and GSO FSS earth stations in the frequency band 10.7-12.75 GHz when all of the following threshold conditions are met:

- (1) Bandwidth overlap; and
- (2) the satellite network using the GSO has specific receive earth stations which meet all of the following conditions: earth station antenna maximum isotropic gain greater than or equal to 64 dBi; G/T of 44 dB/K or higher; and emission bandwidth of 250 MHz; and the EPFD_{down} radiated by the satellite system using the NGSO into the GSO specific receive earth station, either within the U.S. for domestic service or any points outside the U.S. for international service, as calculated using the ITU software for examining compliance with EPFD limits set forth in Article 22 of the ITU Radio Regulations exceeds -174.5 dB(W/(m²/40kHz)) for any percentage of time for NGSO systems with all satellites only operating at or below 2500 km altitude, or -202 dB(W/(m²/40kHz)) for any percentage of time for NGSO systems with any satellites operating above 2500 km altitude.
- (3) If there is no ITU software for examining compliance with EPFD limits set forth in Article 22 of the ITU Radio Regulations, then the EPFD_{down} coordination trigger is suspended and the requirement for coordination will be based on bandwidth overlap and the satellite network using the GSO has specific receive earth stations which meet all of the following conditions: earth station antenna maximum isotropic gain greater than or equal to 64 dBi; G/T of 44 dB/K or higher; and emission bandwidth of 250 MHz.

4. Section 25.208 is amended so that Footnote 5 of Table 1L and Footnote 5 of Table 1M read as follows:

For each reference antenna diameter, the limit consists of the complete curve on a plot which is linear **in** decibels for the EPFD levels and logarithmic for the time percentages, with straight lines joining the data points.

APPENDIX B: FINAL REGULATORY FLEXIBILITY CERTIFICATION

The Regulatory Flexibility Act of 1980, as amended (RFA),¹ requires that a regulatory flexibility analysis be prepared for notice and comment rulemaking proceedings, unless the agency certifies that “the rule will not, if promulgated, have a significant economic impact on a substantial number of small entities.”² The RFA generally defines “small entity” as having the same meaning as the terms “small business,” “small organization,” and “small governmental jurisdiction.”³ In addition, the term “small business” has the same meaning as the term “small business concern” under the Small Business Act.⁴ A small business concern is one which: (a) is independently owned and operated; (b) is not dominant in its field of operation; and (c) satisfies any additional criteria established by the Small Business Administration (SBA).⁵

The objective of this *Third Memorandum Opinion and Order* and of this proceeding is to assign the NGSO FSS spectrum to satellite systems operators who can implement their proposals in a manner that serves the public interest. The final rules in the *Third Memorandum Opinion and Order* will reduce regulatory burdens and, with minimal disruption to existing FCC permittees and licensees, result in the continued development of NGSO FSS and other satellite services to the public.

Neither the Commission nor the U.S. Small Business Administration has developed a small business size standard specifically for NGSO FSS licensees. The appropriate size standard is therefore the SBA standard for Satellite Telecommunications, which provides that such entities are small if they have \$12.5 million or less in annual revenues?

The rules adopted in this *Third Memorandum Opinion and Order* apply only to entities providing GSO FSS or NGSO FSS. Small businesses will not have the financial ability to become GSO FSS or NGSO FSS system operators because of the high implementation costs, including construction of satellite space stations and rocket launch, associated with satellite systems and services! There is no question that the entities affected by this *Third Memorandum Opinion and Order* are well above the standard for

¹ See 5 U.S.C. § 603. The RFA, 5 U.S.C. § 601- 612, has been amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA), Pub. L. No. 104-121, Title II, 110 Stat. 857 (1996).

² 5 U.S.C. § 605(b).

⁴ Id. at § 601(6).

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

⁶ Small Business Act, 15 U.S.C. § 632. An Initial Regulatory Flexibility Analysis (“IRFA”) was incorporated in the Notice of Proposed Rule Making in this proceeding. ET Docket No. 98-206, 14 FCC Rcd. 1131, 1194 (1998). The Commission sought written public comment on the proposals in that Notice, including comment on the IRFA. While the Notice, the IRFA and the Commission’s First Report and Order in this proceeding affected a wider number of entities, the rules in this *Third Memorandum Opinion and Order* are restricted to issues affecting satellite telecommunications providers for which the regulatory flexibility certification procedure is appropriate.

⁷ 13 C.F.R. § 121.201, North American Industry Classification System (“NAICS”) code 517410, formerly code 513340.

⁸ See, e.g., *Final Analysis Communication Services, Inc.*, 13 FCC Rcd. 6618, 6644 (1998) (non-geostationary satellite applicant estimated that “cost of construction, launch and first-year operating costs for two satellites was approximately \$6.22 million”). This reference illustrates the high cost of just one aspect of the operation of these companies, but is not meant to illustrate the classification of these companies by SBA size standard, which is discussed infra.

determining small entities. Since the spectrum and orbital resources available for assignment **are** not open to new entrants, no more than the seven applicants whose applications **are** pending will be authorized by the Commission to provide these services. None of the seven applicants is a small business because each has revenues in excess of \$12.5 million annually or has parent companies or investors that have revenues in excess of \$12.5 million annually? Therefore, we certify that the rules adopted in this *Third Memorandum Opinion and Order* will not have a significant economic impact on a substantial number of small entities.

The Commission will send a copy of this *Third Memorandum Opinion and Order*, including this Final Regulatory Flexibility Certification, in a report to Congress pursuant to the Congressional Review Act.” In addition, the *Third Memorandum Opinion and Order* and this final certification will be sent to **the** Chief Counsel for Advocacy of the Small Business Administration, and will be published in the Federal Register.”

⁹ 13 C.F.R. § 121.201, North American Industry Classification System (“NAICS”) code 517410, formerly code 513340.

¹⁰ See 5 U.S.C. § 801(a)(1)(A).

¹¹ See 5 U.S.C. § 605(b).