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

In the Matter of	)	
	)	
New Skies Satellites B.V.	)	File No. SAT-PPL-_____
	)	
Request for U.S. Market Access for NSS-6	)	

PETITION

New Skies Satellites B.V. ("SES") hereby respectfully requests that the Commission authorize the Netherlands-licensed NSS-6 Ku-band spacecraft to serve the U.S. market from 169.5° W.L.[1] Specifically, SES requests that the Commission add NSS-6 to the Permitted Space Station List ("Permitted List") for fixed-satellite service ("FSS") and telemetry, tracking and control ("TT&C") in the 13.75-14.5 GHz band for Earth-to-space operations and the 10.95-11.2 GHz and 11.45-11.7 GHz bands for space-to-Earth operations. SES also requests authority to serve the U.S. using the 12.5-12.75 GHz band for space-to-Earth operations.[2] Grant of the requested authority is consistent with Commission precedent and will serve the public interest by allowing SES to meet demand for new Ku-band services to the U.S. market from 169.5° W.L.

A completed FCC Form 312 is attached, along with technical materials on Schedule S and in narrative form pursuant to Section 25.114 of the Commission's rules. SES seeks action on this petition to permit use of the in-orbit NSS-6 spacecraft to initiate service to U.S. customers beginning on September 1, 2019.

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[1] At this orbital location, the NSS-6 satellite network will operate pursuant to the following filings of the Netherlands Administration: NSS-G5-1 and NSS-BSS 169.5W.

[2] NSS-6 also includes a payload capable of operating in the 29.5-30.0 GHz band, but SES is not seeking U.S. market access in those frequencies.

I. BACKGROUND

NSS-6 is a Ku-band spacecraft that was launched in December 2002 and operates under an authorization issued by the Radiocommunications Agency Netherlands (Agentschap Telecom) at the 95° E.L. orbital location, where it currently provides service to Asia. SES recently launched the SES-12 satellite to the nominal 95° E.L. orbital location. As soon as traffic transfer is completed, SES intends to relocate NSS-6 to 169.5° W.L. to respond to customer demand in Alaska, Hawaii, the Northwestern United States, the Pacific Ocean and East Asia.

II. AUTHORIZING NSS-6 TO PROVIDE FSS IN THE U.S. IS CONSISTENT WITH FCC POLICIES AND THE PUBLIC INTEREST

SES is a leading provider of satellite communications services in the United States and around the world. Granting U.S. market access for NSS-6 will enable SES to introduce Ku-band service at the 169.5° W.L. orbital location for the benefit of U.S. satellite service customers. Furthermore, grant of market access for NSS-6 is consistent with the Commission's *DISCO II* policies.[3]

In the *DISCO II* proceeding, the Commission adopted standards for determining whether to permit foreign-licensed satellites to serve the U.S. market, which are codified in Section 25.137 of the Commission's Rules.[4] The Commission's policies are intended to ensure that entry by a foreign-licensed satellite will not distort competition in the U.S.[5] The Commission also considers whether there are spectrum availability issues or concerns relating to

[3] *Amendment of the Commission's Policies to Allow Non-U.S. Licensed Space Stations providing Domestic and International Service in the United States*, Report & Order, 12 FCC Rcd 24094 (1997) ("*DISCO II*").

[4] 47 C.F.R. § 25.137.

[5] *DISCO II* at ¶ 7.

national security, law enforcement, foreign policy or trade that would present an obstacle to U.S. market access.[6] SES's request to add NSS-6 to the Permitted List in the Ku-band fully complies with the Commission's requirements.

In *DISCO II*, the Commission adopted a presumption that, with respect to services covered by the WTO agreement, entry into the U.S. market by entities licensed by WTO member countries will promote competition in the U.S. market.[7] FSS operations except for direct-to-home services are covered by the WTO agreement.[8]

SES seeks authority to use NSS-6 to provide FSS to U.S. customers. The Netherlands, the licensing administration for NSS-6, is a WTO member country. Accordingly, the SES proposal to provide WTO-covered services is subject to the presumption in favor of entry described above.

Allowing SES to use NSS-6 to offer FSS to, from, and within the U.S. will promote competition and is otherwise consistent with the *DISCO II* framework. Therefore, the Commission should add NSS-6 to the Permitted List for services in the 10.95-11.2 GHz, 11.45-11.7 GHz, and 13.75-14.5 GHz frequencies.

Furthermore, the Commission applies the same framework that governs requests for addition to the Permitted List to petitions seeking U.S. market access for bands not eligible for inclusion on the Permitted List.[9] Accordingly, the Commission should also authorize NSS-6 to offer FSS capacity in the United States using spectrum in the 12.5-12.75 GHz band subject to earth station-specific licensing.

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[6] *See id.* at ¶ 178.

[7] *Id.* at ¶ 39.

[8] *Id.* at ¶¶ 25 & 30.

[9] *See DISCO II* at ¶ 192.

III. RULE WAIVERS ARE WARRANTED FOR NSS-6

SES seeks limited waivers of the Commission's rules in connection with the petition for NSS-6 U.S. market access. Grant of these waivers is consistent with Commission policy:

> The Commission may waive a rule for good cause shown. Waiver is appropriate 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. Generally, the Commission may grant a waiver of its rules in a particular case if the relief requested would not undermine the policy objective of the rule in question and would otherwise serve the public interest.[10]

NSS-6 substantially complies with the Commission's rules, but certain waivers are necessary in light of the frequencies used and the technical characteristics of the spacecraft. The Commission has granted similar waivers in other cases. As shown below, NSS-6 will allow SES to initiate new Ku-band services at the 169.5° W.L. orbital location, and grant of the waivers will therefore serve the public interest.

Section 2.106: SES seeks a waiver of the U.S. Table of Frequency Allocations to permit NSS-6 to use the 12.5-12.75 GHz frequency band for FSS downlinks on an unprotected, non-interference basis in International Telecommunication Union ("ITU") Region 2, including in the United States.[11] Waivers of the Table of Allocations are generally granted "when there is little potential for interference into any service authorized under the Table of Frequency allocations

[10] *PanAmSat Licensee Corp*., 17 FCC Rcd 10483, 10492 (Sat. Div. 2002) (footnotes omitted).

[11] Separately, SES has recommended that the Commission evaluate expanded FSS protected access to the 12.2-12.7 GHz band in its open proceeding on revision of the rules for Direct Broadcast Satellite service. *See* Comments of SES Americom, Inc., filed in *Amendment of the Commission's Policies and Rules for Processing Applications in the Direct Broadcast Satellite Service*, IB Docket No. 06-160 (Mar. 25, 2019). If the Commission adopts such changes to its rules, SES will seek a modification of its authority to request protected status for NSS-6 operations in the 12.5-12.7 GHz frequencies.

and when the nonconforming operator accepts any interference from authorized services."[12] A waiver for NSS-6 is in the public interest because SES's use of these frequencies in ITU Region 2 will not cause harmful interference to any terrestrial fixed service ("FS") stations or broadcasting-satellite service ("BSS") operations, and SES will accept interference from FS and BSS operations.

Terrestrial FS networks operating within the United States will not be subject to harmful interference because NSS-6's transmissions in the 12.5-12.75 GHz frequency band in ITU Region 2 will comply with the power flux density ("pfd") limits for this band specified in Article 21.16. The technical materials being submitted in support of this application demonstrate that the pfd levels for the NSS-11 transmit beams do not exceed those in Article 21.16.

Similarly, there is no potential for harmful interference from NSS-6 into U.S. BSS networks. The Commission has authorized a number of satellites to use the 12.2-12.7 GHz frequencies for FSS downlinks within the U.S. and ITU Region 2. For example, in an order regarding EUTELSAT 172B at 172° E.L., the Commission noted that waiving the Table of Allocations to allow FSS downlinks in the 12.2-12.7 GHz frequencies "was justified because FSS operations in these bands are consistent with No. 5.492 of the ITU Radio Regulations and there are no U.S. BSS satellites transmitting from orbital locations within 50° of the 172° E.L. orbital location."[13]

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[12] *The Boeing Company*, 16 FCC Rcd 22645 (IB & OET 2001) at 22651 & n.48 (citing cases).

[13] *ES 172 LLC*, Call Sign S3021, File No. SAT-RPL-20170927-00136, grant-stamped Apr. 25 2018, Attachment to Grant at 2, ¶ 3. No. 5.492 states that "Assignments to stations of the broadcasting-satellite service which are in conformity with the appropriate regional Plan or included in the Regions 1 and 3 List in Appendix 30 may also be used for transmissions in the fixed-satellite service (space-to-Earth), provided that such transmissions do not cause more interference, or require more protection from interference, than the broadcasting-satellite service transmissions operating in conformity with the Plan or the List, as appropriate." 47 C.F.R. § 2.106, No. 5.492.

The same rationale justifies grant of a waiver for NSS-6, as there are no U.S. BSS satellites transmitting from orbital locations within 50° of the 169.5° W.L. orbital location. Instead, the nearest operational BSS satellite to NSS-6 that serves any portion of ITU Region 2 in the 12.2-12.7 GHz band is Ciel-2, operated by an SES affiliate and located more than 40 degrees away from NSS-6 at the nominal 129° W.L. orbital location. Accordingly, no operational BSS satellite providing service to ITU Region 2 would be subjected to harmful interference from the NSS-6 transmissions.

NSS-6 operations in ITU Region 2 will also be compatible with any future non-geostationary orbit ("NGSO") FSS operations, which have an allocation in the 12.2-12.7 GHz band in ITU Region 2.[14] The Commission has required NGSO systems authorized to serve the United States to comply with ITU limits on the equivalent power flux density ("EPFD") of NGSO operations,[15] and those limits are designed to facilitate co-frequency sharing between NGSO systems and geostationary orbit systems.

Finally, NSS-6 transmissions in the 12.7-12.75 GHz frequency band to earth stations in ITU Region 2 will not cause harmful interference to, nor claim protection from, any FSS Earth-to-space links operating in that band in ITU Region 2. SES will ensure that its receiving earth stations are sufficiently separated from any transmitting FSS earth station operating in the 12.7-12.75 GHz frequency band in ITU Region 2. If sufficient distance separation cannot be achieved, SES will not claim protection from interference that may be due to the transmitting FSS earth station. The NSS-6 downlink transmissions in the 12.7-12.75 GHz frequency band

[14] 47 C.F.R. § 2.106, No. 5.487A.

[15] *See, e.g., WorldVu Satellites Limited LLC,* Order and Declaratory Ruling, 32 FCC Rcd 5366 (2017) at ¶ 24(d).

will not cause interference to receiving space stations. SES is not aware of any nearby geostationary space station in ITU Region 2 receiving in the 12.7-12.75 GHz frequency band.

Section 25.210(j). The NSS-6 satellite is authorized by Radiocommunications Agency Netherlands to operate at 169.5° W.L. within a +/- 0.10° east/west station keeping box. To the extent necessary, SES respectfully requests a waiver of Section 25.210(j) of the Commission's rules, which requires geostationary space stations to be operated within a +/- 0.05° east/west station keeping box. The Commission has previously waived this rule based on a finding that allowing an increased station keeping volume would "not adversely affect the operations of other spacecraft and would conserve fuel for future operations."[16]

The facts here fit squarely within this precedent. Allowing NSS-6 to be maintained within an increased station keeping volume will not harm other operators. NSS-6's station keeping volume will not overlap with that of any other satellites. There are no satellites operating at the nominal 169.5° W.L. orbital location and therefore no risk of overlapping stationkeeping tolerances. In addition, allowing NSS-6 to be flown at 169.5° W.L. in an expanded east-west station keeping volume of +/-0.1 degrees will result in fuel savings for the spacecraft. This will prolong the time during which NSS-6 will be available to provide service. Under these circumstances, grant of any necessary waiver of Section 25.210(j) will serve the public interest.

[16] *See, e.g., SES Americom, Inc.*, File Nos. SAT-MOD-20080124-00030 & SAT-AMD-20080311-00070, grant-stamped May 19, 2008, Attachment at ¶ 1.

Sections 25.114(d)(14)(ii) and 25.283(c): These rules address requirements relating to venting stored energy sources at the spacecraft's end of life.[17] NSS-6 is a Lockheed Martin A2100 series spacecraft. As previously described, the oxidizer tanks on the spacecraft were sealed following completion of the launch phase and will therefore retain residual pressure when the spacecraft is retired.[18] Given the spacecraft design, it is physically impossible for SES to vent the oxidizer tanks.

Under Commission precedent, grant of a waiver is warranted. In a number of cases involving various spacecraft models with similar limitations, the Commission has waived Section 25.283(c) to permit launch and operation of spacecraft that do not allow for full venting of pressure vessels at end of life, based on a finding that modifying the space station design at a late stage of construction would pose an undue hardship.[19] SES would have faced the same hardship if it had been required to alter the design of NSS-6 to conform to Section 25.283(c) prior to launch of the spacecraft.

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[17] Section 25.283(c) contains the substantive venting requirement, and Section 25.114(d)(14)(ii) requires applicants to submit information that addresses "whether stored energy will be removed at the spacecraft's end of life." 47 C.F.R. § 25.114(d)(14)(ii).

[18] *See Panasonic Avionics Corp.*, Call Sign E100089, File No. SES-MFS-20150609-00349, Technical Appendix, Annex A-6, Part D; Letters from Carlos M. Nalda, Counsel to Panasonic Avionics Corp., to Marlene H. Dortch, Secretary, Federal Communications Commission, File No. SES-MFS-20150609-00349 *et al.*, dated Jan. 7, 2016 and Feb. 10, 2016.

[19] *See, e.g.*, *EchoStar Satellite Operating Corp.*, File No. SAT-LOA-20071221-00183, Call Sign S2746, grant-stamped Mar. 12, 2008, Attachment at ¶ 4 (granting a partial waiver of Section 25.283(c) for AMC-14, a Lockheed Martin A2100 model spacecraft, on grounds that requiring modification of satellite would present an undue hardship); *DIRECTV Enterprises LLC*, File No. SAT-LOA-20090807-00086, Call Sign S2797, grant-stamped Dec. 15, 2009, Attachment at ¶ 4 (same for DIRECTV 12, a Boeing 702 model spacecraft); *PanAmSat Licensee Corp.*, File Nos. SAT-MOD-20070207-00027, SAT-AMD-20070716-00102, Call Sign S2237, grant-stamped Oct. 4, 2007, Attachment at ¶ 7 (same for Intelsat 11, an Orbital Sciences Star model spacecraft).

With NSS-6 already in orbit and operational, there is no question of bringing the satellite into compliance with the rule. The Commission has expressly recognized this, finding a waiver of Section 25.283(c) to be justified for in-orbit spacecraft that cannot satisfy the rule's requirements. For example, in a decision involving the AMC-2 satellite, the Commission waived the rule on its own motion, observing that venting the spacecraft's sealed oxidizer tanks "would require direct retrieval of the satellite, which is not currently possible."[20]

The same practical obstacle is present here. Because NSS-6 is already in orbit, SES can do nothing to enable full venting of residual pressure in the oxidizer tanks. Given this reality, a waiver is clearly warranted.

[20] File No. SAT-MOD-20101215-00261, Call Sign S2134, grant-stamped Mar. 8, 2011, Attachment at ¶ 4. *See also XM Radio Inc.*, File No. SAT-MOD-20100722-00165, Call Sign S2616, grant-stamped Oct. 14, 2010, Attachment at ¶ 2 (waiving Section 25.283(c) for XM-4, a Boeing 702 model spacecraft, because "modification of the spacecraft would present an undue hardship, since XM-4 is an in-orbit space station and venting XM-4's helium and xenon tanks would require direct retrieval of the satellite, which is not currently possible").

IV. CONCLUSION

For the foregoing reasons, SES respectfully requests that the Commission add NSS-6 to the Permitted List for FSS operations and TT&C in the Ku-band and grant U.S. market access for FSS operations in the 12.5-12.75 GHz band.

Respectfully submitted,

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TECHNICAL APPENDIX

NSS-6 AT 169.5° W.L.

1.0 Overall Description: §25.114(d)(1)

This technical appendix is submitted in support of an application of New Skies Satellites B.V. ("SES") seeking authority to serve the U.S. market with the in-orbit NSS-6 fixed-satellite service ("FSS") spacecraft once the satellite is relocated to 169.5° W.L. NSS-6 is equipped with fifty Ku-band transponders (36 MHz or 54 MHz) with uplinks in the 13.75-14.5 GHz frequencies and downlinks in the 10.95-11.2 GHz, 11.45-11.70 GHz and 12.5-12.75 GHz frequencies using both horizontal and vertical polarizations.[1] These transponders will provide coverage of Alaska, Hawaii, the Northwestern United States, the Pacific Ocean and East Asia. The Ku-band Telemetry, Tracking and Command ("TT&C") operations, the interconnectivity of the NSS-6 uplink and downlink transponders, and the satellite's detailed frequency plan are described below.

2.0 Schedule S: §25.114(c)

The Schedule S online information is submitted as part of this filing.[2] Pursuant to Section 25.114(c)(4)(vi)(A), the gxt diagrams for the Omni telecommand receive beam ("ROH") and telemetry transmit beam ("TOV") and the horn antennas ("RHV") and ("THH") are not included because for each of these beams the contour at 8 dB below peak falls entirely beyond the edge of the visible Earth.

[1] The NSS-6 spacecraft also has Ka-band uplink spot beams in the 29.5-30.0 GHz band, but because these operations will occur outside of the United States, SES is not seeking authority to operate in this band segment as part of this application.

[2] The online Schedule S online does not allow the decimal place to be entered into the field for Orbital Longitude Information. As a result, the response to this field appears as 169.0° W.L. in Schedule S instead of the actual 169.5° W.L. center of the station-keeping box.

3.0 TT&C frequencies and beams

The TT&C subsystem consists of redundant receivers and transmitters which are able to operate through either an omnidirectional antenna system or through a horn antenna. Table 1 below shows the satellite's TT&C frequencies, polarizations and associated antennas, and possible configurations.

Table 1: TT&C Carrier Frequencies

	Center Frequency, MHz	On Station Polarization	On Station Antenna	Transfer Orbit/Contingency Polarization	Transfer Orbit/Contingency Antenna
Command carriers (bandwidth: 800 kHz)					
TC1	14496	V	Horn	H	Omni
TC2	14499	V	Horn	H	Omni
Telemetry (bandwidth: 200 kHz)/Beacon					
TM1	11198	H	Horn	V	Omni
TM2	11199.5	H	Horn	V	Omni

4.0 PFD limits: §25.208

Section 25.208(b) specifies power flux density ("pfd") limits in the 10.95-11.2 GHz and 11.45-11.7 GHz frequencies. The Commission's rules do not specify a pfd limit in the 12.5-12.75 GHz band, but Article 21.16 of the ITU Radio Regulations includes pfd limits for this band. The tables provided in Schedule S and in Annex A demonstrate that the pfd values for the NSS-6 Ku-band payload will comply with §25.208(b) for the 10.95-11.2 GHz and 11.45-11.7 GHz bands and with the ITU Radio Regulations for the 12.5-12.75 GHz band.

5.0 Adjacent Satellite Compatibility: §25.114(d)(7) and §25.140(a)

SES certifies that the NSS-6 downlink EIRP density in the 10.95-11.2 GHz and 11.45-11.70 GHz bands will not exceed 14 dBW/4kHz[3] for digital transmissions and that associated uplink operations in the 13.75-14.5 GHz band will not exceed applicable EIRP density envelopes in §25.218, §25.222(a)(1), §25.226(a)(1), or §25.227(a)(1) unless the non-routine uplink and/or downlink operation is coordinated with operators of authorized co-frequency space stations at assigned locations within six degrees of 169.5° W.L. and except as provided in §25.140(d). Because no authorized co-frequency GSO FSS space station is located within six degrees of 169.5° W.L.,[4] SES intends to operate NSS-6 with a maximum downlink EIRP density of 18 dBW/4kHz, and associated maximum uplink EIRP density of $20-25\log_{10}\theta$ dBW/4kHz. Attached as Annex B is an interference analysis demonstrating the compatibility of NSS-6 with adjacent spacecraft operating in the 12.5-12.75 GHz frequency band. As there is no previously authorized space station using this band within two degrees of 169.5° W.L., the analysis

[3] There is a discrepancy between the 13 dBW/4kHz downlink EIRP density limit for operations in the conventional and extended Ku-bands that is discussed in the Commission's 2015 Second Report and Order in the Part 25 proceeding and the 14 dBW/4kHz limit specified in Section 25.140(a)(3)(ii). *See Comprehensive Review of Licensing and Operating Rules for Satellite Services*, Second Report and Order, 30 FCC Rcd 14713 (2015) at ¶¶ 112, 115. If the Commission determines that the lower limit identified in the Part 25 Order should apply, SES will adjust its operations accordingly.

[4] A Tracking and Data Relay Satellite System ("TDRSS") space station located at 171° W.L. operates in the 13.75-14.1 GHz frequencies used by NSS-6 but in the opposite direction of transmission. Analyses of such reverse band situations by the ITU and the Commission have concluded that an orbital separation of 0.2 degrees is required for adjacent satellites operating in opposite direction of transmission. *See Sharing between broadcasting-satellite service (BSS) networks using the Region 2 17.3-17.8 GHz BSS allocation and feeder links of BSS networks using the worldwide 17.3-17.8 GHz fixed-satellite service (FSS) (Earth-to-space) allocation*, Recommendation ITU-R BO.1835 (2008); 47 C.F.R. §25.264(g). The orbital distance of 1.5 degrees between NSS-6 and the TDRSS spacecraft will provide more than enough separation to prevent any risk of space path interference between the two satellites. SES recognizes that earth stations seeking to communicate with NSS-6 in the 13.75-14 GHz band segment will be required to comply with applicable requirements to protect TDRSS operations.

considers a hypothetical co-frequency space station located at 167.5° W.L. with the same receiving and transmitting characteristics as NSS-6. The results of the interference analysis demonstrate that NSS-6 can successfully operate in a two-degree spacing environment.

6.0 Mitigation of Orbital Debris: §25.114(d)(14)

The information for NSS-6 specified under Section 25.114(d)(14) of the Commission's rules is already on file with the Commission,[5] and SES incorporates that information by reference herein. SES hereby submits the following supplemental information regarding orbital debris mitigation:

6.1 Spacecraft Hardware Design: § 25.114(d)(14)(i)

SES has assessed and limited the amount of debris released in a planned manner during normal operations of NSS-6 at 169.5° W.L. No debris is generated during normal on-station operations, and the spacecraft will be in a stable configuration. The satellite will maintain an E-W station-keeping tolerance within +/- 0.1 degrees.

6.2 Safe Flight Profiles: § 25.114(d)(14)(iii)

SES seeks authority for operation of NSS-6 at the 169.5° W.L. orbital location and on-station operations require station-keeping within the +/- 0.1 degree N-S and +/- 0.1 degree E-W control box, thereby ensuring adequate collision avoidance distance from other satellites in geosynchronous orbit. SES is not aware of any other FCC- or non-FCC licensed spacecraft that are operational or planned to be deployed at 169.5° W.L. or to nearby orbital locations such that there would be an overlap with the requested station-keeping volume of NSS-6. Based on the preceding, it is concluded that physical coordination of the NSS-6 satellite with another party is

[5] *See Panasonic Avionics Corp.*, Call Sign E100089, File No. SES-MFS-20150609-00349, Technical Appendix, Annex A-6, Part D; Letters from Carlos M. Nalda, Counsel to Panasonic Avionics Corp., to Marlene H. Dortch, Secretary, Federal Communications Commission, File No. SES-MFS-20150609-00349 *et al.*, dated Jan. 7, 2016 and Feb. 10, 2016.

not required at the present time. SES will seek the necessary waivers to operate the satellite with a relaxed E-W station-keeping volume.

Annex A: PFD tables by beam

The tables below show compliance with the pfd limits in §25.208(b) for beams operating in the 10.95-11.2 GHz and 11.45-11.7 GHz band, and with relevant provisions of the ITU Radio Regulations in the 12.5-12.75 GHz band.

TAHl						
Max EIRP density	-18.0	-18.0	-18.0	-18.0	-18.0	-18.0
Elevation angle, deg	5.0	10.0	15.0	20.0	25.0	90.0
Gain roll-off at elevation angle, dBi	-12.0	-11.4	-8.3	-4.7	-1.9	0.0
EIRPd at elevation angle, dBW/Hz	-30.0	-29.4	-26.3	-22.7	-19.9	-18.0
Minimum spreading loss, dB/m2	-163.3	-163.2	-163.1	-162.9	-162.8	-162.1
pfd, dBW/m2/Hz	-193.3	-192.5	-189.4	-185.6	-182.7	-180.1
pfd, dBW/m2/4kHz	-157.3	-156.5	-153.4	-149.6	-146.7	-144.0
Corresponding PFD Limit dBW/m2/4kHz	-150.0	-147.5	-145.0	-142.5	-140.0	-140.0
Margin to Limit	7.3	9.0	8.4	7.1	6.7	4.0

TAHh						
Max EIRP density	-18.0	-18.0	-18.0	-18.0	-18.0	-18.0
Elevation angle, deg	5.0	10.0	15.0	20.0	25.0	90.0
Gain roll-off at elevation angle, dBi	-12.0	-11.4	-8.3	-4.7	-1.9	0.0
EIRPd at elevation angle, dBW/Hz	-30.0	-29.4	-26.3	-22.7	-19.9	-18.0
Minimum spreading loss, dB/m2	-163.3	-163.2	-163.1	-162.9	-162.8	-162.1
pfd, dBW/m2/Hz	-193.3	-192.5	-189.4	-185.6	-182.7	-180.1
pfd, dBW/m2/4kHz	-157.3	-156.5	-153.4	-149.6	-146.7	-144.0
Corresponding PFD Limit dBW/m2/4kHz	-148.0	-145.5	-143.0	-140.5	-138.0	-138.0
Margin to Limit	9.3	11.0	10.4	9.1	8.7	6.0

TAV						
Max EIRP density	-18.0	-18.0	-18.0	-18.0	-18.0	-18.0
Elevation angle, deg	5.0	10.0	15.0	20.0	25.0	90.0
Gain roll-off at elevation angle, dBi	-12.0	-11.4	-8.3	-4.7	-1.9	0.0
EIRPd at elevation angle, dBW/Hz	-30.0	-29.4	-26.3	-22.7	-19.9	-18.0
Minimum spreading loss, dB/m2	-163.3	-163.2	-163.1	-162.9	-162.8	-162.1
pfd, dBW/m2/Hz	-193.3	-192.5	-189.4	-185.6	-182.7	-180.1
pfd, dBW/m2/4kHz	-157.3	-156.5	-153.4	-149.6	-146.7	-144.0
Corresponding PFD Limit dBW/m2/4kHz	-148.0	-145.5	-143.0	-140.5	-138.0	-138.0
Margin to Limit	9.3	11.0	10.4	9.1	8.7	6.0

TCHl						
Max EIRP density	-18.4	-18.4	-18.4	-18.4	-18.4	-18.4
Elevation angle, deg	5.0	10.0	15.0	20.0	25.0	90.0
Gain roll-off at elevation angle, dBi	-4.4	-3.7	-3.0	-2.5	-1.8	0.0
EIRPd at elevation angle, dBW/Hz	-22.7	-22.0	-21.3	-20.8	-20.1	-18.4
Minimum spreading loss, dB/m2	-163.3	-163.2	-163.1	-162.9	-162.8	-162.1
pfd, dBW/m2/Hz	-186.0	-185.2	-184.4	-183.8	-182.9	-180.4
pfd, dBW/m2/4kHz	-150.0	-149.2	-148.4	-147.8	-146.9	-144.4
Corresponding PFD Limit dBW/m2/4kHz	-150.0	-147.5	-145.0	-142.5	-140.0	-140.0
Margin to Limit	0.0	1.7	3.4	5.3	6.9	4.4

TCHHm						
Max EIRP density	-18.4	-18.4	-18.4	-18.4	-18.4	-18.4
Elevation angle, deg	5.0	10.0	15.0	20.0	25.0	90.0
Gain roll-off at elevation angle, dBi	-4.4	-3.7	-3.0	-2.5	-1.8	0.0
EIRPd at elevation angle, dBW/Hz	-22.7	-22.0	-21.3	-20.8	-20.1	-18.4
Minimum spreading loss, dB/m2	-163.3	-163.2	-163.1	-162.9	-162.8	-162.1
pfd, dBW/m2/Hz	-186.0	-185.2	-184.4	-183.8	-182.9	-180.4
pfd, dBW/m2/4kHz	-150.0	-149.2	-148.4	-147.8	-146.9	-144.4
Corresponding PFD Limit dBW/m2/4kHz	-150.0	-147.5	-145.0	-142.5	-140.0	-140.0
Margin to Limit	0.0	1.7	3.4	5.3	6.9	4.4

TCV						
Max EIRP density	-18.4	-18.4	-18.4	-18.4	-18.4	-18.4
Elevation angle, deg	5.0	10.0	15.0	20.0	25.0	90.0
Gain roll-off at elevation angle, dBi	-4.4	-3.7	-3.0	-2.5	-1.8	0.0
EIRPd at elevation angle, dBW/Hz	-22.8	-22.1	-21.3	-20.9	-20.1	-18.4
Minimum spreading loss, dB/m2	-163.3	-163.2	-163.1	-162.9	-162.8	-162.1
pfd, dBW/m2/Hz	-186.0	-185.2	-184.4	-183.8	-183.0	-180.4
pfd, dBW/m2/4kHz	-150.0	-149.2	-148.4	-147.8	-146.9	-144.4
Corresponding PFD Limit dBW/m2/4kHz	-150.0	-147.5	-145.0	-142.5	-140.0	-140.0
Margin to Limit	0.0	1.7	3.4	5.3	6.9	4.4

TIHl						
Max EIRP density	-18.0	-18.0	-18.0	-18.0	-18.0	-18.0
Elevation angle, deg	5.0	10.0	15.0	20.0	25.0	90.0
Gain roll-off at elevation angle, dBi	-22.0	-21.7	-20.9	-19.3	-17.7	0.0
EIRPd at elevation angle, dBW/Hz	-40.0	-39.7	-38.9	-37.3	-35.7	-18.0
Minimum spreading loss, dB/m2	-163.3	-163.2	-163.1	-162.9	-162.8	-162.1
pfd, dBW/m2/Hz	-203.3	-202.8	-202.0	-200.3	-198.5	-180.1
pfd, dBW/m2/4kHz	-167.3	-166.8	-166.0	-164.3	-162.5	-144.0
Corresponding PFD Limit dBW/m2/4kHz	-150.0	-147.5	-145.0	-142.5	-140.0	-140.0
Margin to Limit	17.3	19.3	21.0	21.8	22.5	4.0

TIHh						
Max EIRP density	-18.0	-18.0	-18.0	-18.0	-18.0	-18.0
Elevation angle, deg	5.0	10.0	15.0	20.0	25.0	90.0
Gain roll-off at elevation angle, dBi	-22.0	-21.7	-20.9	-19.3	-17.7	0.0
EIRPd at elevation angle, dBW/Hz	-40.0	-39.7	-38.9	-37.3	-35.7	-18.0
Minimum spreading loss, dB/m2	-163.3	-163.2	-163.1	-162.9	-162.8	-162.1
pfd, dBW/m2/Hz	-203.3	-202.8	-202.0	-200.3	-198.5	-180.1
pfd, dBW/m2/4kHz	-167.3	-166.8	-166.0	-164.3	-162.5	-144.0
Corresponding PFD Limit dBW/m2/4kHz	-148.0	-145.5	-143.0	-140.5	-138.0	-138.0
Margin to Limit	19.3	21.3	23.0	23.8	24.5	6.0

TIV						
Max EIRP density	-18.0	-18.0	-18.0	-18.0	-18.0	-18.0
Elevation angle, deg	5.0	10.0	15.0	20.0	25.0	90.0
Gain roll-off at elevation angle, dBi	-22.0	-21.7	-20.9	-19.3	-17.7	0.0
EIRPd at elevation angle, dBW/Hz	-40.0	-39.7	-38.9	-37.3	-35.7	-18.0
Minimum spreading loss, dB/m2	-163.3	-163.2	-163.1	-162.9	-162.8	-162.1
pfd, dBW/m2/Hz	-203.3	-202.8	-202.0	-200.3	-198.5	-180.1
pfd, dBW/m2/4kHz	-167.3	-166.8	-166.0	-164.3	-162.5	-144.0
Corresponding PFD Limit dBW/m2/4kHz	-148.0	-145.5	-143.0	-140.5	-138.0	-138.0
Margin to Limit	19.3	21.3	23.0	23.8	24.5	6.0

TMH						
Max EIRP density	-22.5	-22.5	-22.5	-22.5	-22.5	-22.5
Elevation angle, deg	5.0	10.0	15.0	20.0	25.0	90.0
Gain roll-off at elevation angle, dBi	-0.2	-0.2	-0.4	-0.7	-0.8	0.0
EIRPd at elevation angle, dBW/Hz	-22.7	-22.7	-22.9	-23.2	-23.3	-22.5
Minimum spreading loss, dB/m2	-163.3	-163.2	-163.1	-162.9	-162.8	-162.1
pfd, dBW/m2/Hz	-186.0	-185.9	-186.0	-186.2	-186.1	-184.6
pfd, dBW/m2/4kHz	-150.0	-149.8	-149.9	-150.1	-150.1	-148.6
Corresponding PFD Limit dBW/m2/4kHz	-150.0	-147.5	-145.0	-142.5	-140.0	-140.0
Margin to Limit	0.0	2.3	4.9	7.6	10.1	8.6

TMVl						
Max EIRP density	-22.5	-22.5	-22.5	-22.5	-22.5	-22.5
Elevation angle, deg	5.0	10.0	15.0	20.0	25.0	90.0
Gain roll-off at elevation angle, dBi	-0.2	-0.2	-0.4	-0.7	-0.8	0.0
EIRPd at elevation angle, dBW/Hz	-22.7	-22.7	-22.9	-23.2	-23.3	-22.5
Minimum spreading loss, dB/m2	-163.3	-163.2	-163.1	-162.9	-162.8	-162.1
pfd, dBW/m2/Hz	-186.0	-185.9	-186.0	-186.2	-186.1	-184.6
pfd, dBW/m2/4kHz	-150.0	-149.8	-149.9	-150.1	-150.1	-148.6

Corresponding PFD Limit dBW/m2/4kHz	-150.0	-147.5	-145.0	-142.5	-140.0	-140.0
Margin to Limit	0.0	2.3	4.9	7.6	10.1	8.6

TMVm						
Max EIRP density	-22.5	-22.5	-22.5	-22.5	-22.5	-22.5
Elevation angle, deg	5.0	10.0	15.0	20.0	25.0	90.0
Gain roll-off at elevation angle, dBi	-0.2	-0.2	-0.4	-0.7	-0.8	0.0
EIRPd at elevation angle, dBW/Hz	-22.7	-22.7	-22.9	-23.2	-23.3	-22.5
Minimum spreading loss, dB/m2	-163.3	-163.2	-163.1	-162.9	-162.8	-162.1
pfd, dBW/m2/Hz	-186.0	-185.9	-186.0	-186.2	-186.1	-184.6
pfd, dBW/m2/4kHz	-150.0	-149.8	-149.9	-150.1	-150.1	-148.6
Corresponding PFD Limit dBW/m2/4kHz	-150.0	-147.5	-145.0	-142.5	-140.0	-140.0
Margin to Limit	0.0	2.3	4.9	7.6	10.1	8.6

TNH						
Max EIRP density	-18.9	-18.9	-18.9	-18.9	-18.9	-18.9
Elevation angle, deg	5.0	10.0	15.0	20.0	25.0	90.0
Gain roll-off at elevation angle, dBi	-2.1	-1.6	-1.1	-0.4	-0.9	0.0
EIRPd at elevation angle, dBW/Hz	-21.0	-20.5	-20.0	-19.3	-19.8	-18.9
Minimum spreading loss, dB/m2	-163.3	-163.2	-163.1	-162.9	-162.8	-162.1
pfd, dBW/m2/Hz	-184.3	-183.6	-183.0	-182.3	-182.6	-181.0
pfd, dBW/m2/4kHz	-148.3	-147.6	-147.0	-146.2	-146.6	-145.0
Corresponding PFD Limit dBW/m2/4kHz	-148.0	-145.5	-143.0	-140.5	-138.0	-138.0
Margin to Limit	0.3	2.1	4.0	5.7	8.6	7.0

TNVm						
Max EIRP density	-20.8	-20.8	-20.8	-20.8	-20.8	-20.8
Elevation angle, deg	5.0	10.0	15.0	20.0	25.0	90.0
Gain roll-off at elevation angle, dBi	-2.1	-1.6	-1.1	-0.4	-0.9	0.0
EIRPd at elevation angle, dBW/Hz	-22.9	-22.3	-21.8	-21.2	-21.6	-20.8

Minimum spreading loss, dB/m2	-163.3	-163.2	-163.1	-162.9	-162.8	-162.1
pfd, dBW/m2/Hz	-186.1	-185.5	-184.9	-184.1	-184.5	-182.8
pfd, dBW/m2/4kHz	-150.1	-149.4	-148.8	-148.1	-148.5	-146.8
Corresponding PFD Limit dBW/m2/4kHz	-150.0	-147.5	-145.0	-142.5	-140.0	-140.0
Margin to Limit	0.1	1.9	3.8	5.6	8.5	6.8

TNVh						
Max EIRP density	-19.0	-19.0	-19.0	-19.0	-19.0	-19.0
Elevation angle, deg	5.0	10.0	15.0	20.0	25.0	90.0
Gain roll-off at elevation angle, dBi	-2.1	-1.6	-1.1	-0.4	-0.9	0.0
EIRPd at elevation angle, dBW/Hz	-21.1	-20.5	-20.0	-19.4	-19.8	-19.0
Minimum spreading loss, dB/m2	-163.3	-163.2	-163.1	-162.9	-162.8	-162.1
pfd, dBW/m2/Hz	-184.3	-183.7	-183.1	-182.3	-182.7	-181.0
pfd, dBW/m2/4kHz	-148.3	-147.6	-147.0	-146.3	-146.7	-145.0
Corresponding PFD Limit dBW/m2/4kHz	-148.0	-145.5	-143.0	-140.5	-138.0	-138.0
Margin to Limit	0.3	2.1	4.0	5.8	8.7	7.0

TSH						
Max EIRP density	-18.0	-18.0	-18.0	-18.0	-18.0	-18.0
Elevation angle, deg	5.0	10.0	15.0	20.0	25.0	90.0
Gain roll-off at elevation angle, dBi	-20.1	-19.8	-19.3	-18.4	-17.4	0.0
EIRPd at elevation angle, dBW/Hz	-38.1	-37.8	-37.3	-36.4	-35.4	-18.0
Minimum spreading loss, dB/m2	-163.3	-163.2	-163.1	-162.9	-162.8	-162.1
pfd, dBW/m2/Hz	-201.4	-201.0	-200.3	-199.3	-198.2	-180.1
pfd, dBW/m2/4kHz	-165.4	-165.0	-164.3	-163.3	-162.2	-144.0
Corresponding PFD Limit dBW/m2/4kHz	-150.0	-147.5	-145.0	-142.5	-140.0	-140.0
Margin to Limit	15.4	17.5	19.3	20.8	22.2	4.0

TSVl						
Max EIRP density	-18.0	-18.0	-18.0	-18.0	-18.0	-18.0
Elevation angle, deg	5.0	10.0	15.0	20.0	25.0	90.0
Gain roll-off at elevation angle, dBi	-20.1	-19.8	-19.3	-18.4	-17.4	0.0

EIRPd at elevation angle, dBW/Hz	-38.1	-37.8	-37.3	-36.4	-35.4	-18.0
Minimum spreading loss, dB/m2	-163.3	-163.2	-163.1	-162.9	-162.8	-162.1
pfd, dBW/m2/Hz	-201.4	-201.0	-200.3	-199.3	-198.2	-180.1
pfd, dBW/m2/4kHz	-165.4	-165.0	-164.3	-163.3	-162.2	-144.0
Corresponding PFD Limit dBW/m2/4kHz	-150.0	-147.5	-145.0	-142.5	-140.0	-140.0
Margin to Limit	15.4	17.5	19.3	20.8	22.2	4.0

TSVm						
Max EIRP density	-18.0	-18.0	-18.0	-18.0	-18.0	-18.0
Elevation angle, deg	5.0	10.0	15.0	20.0	25.0	90.0
Gain roll-off at elevation angle, dBi	-20.1	-19.8	-19.3	-18.4	-17.4	0.0
EIRPd at elevation angle, dBW/Hz	-38.1	-37.8	-37.3	-36.4	-35.4	-18.0
Minimum spreading loss, dB/m2	-163.3	-163.2	-163.1	-162.9	-162.8	-162.1
pfd, dBW/m2/Hz	-201.4	-201.0	-200.3	-199.3	-198.2	-180.1
pfd, dBW/m2/4kHz	-165.4	-165.0	-164.3	-163.3	-162.2	-144.0
Corresponding PFD Limit dBW/m2/4kHz	-150.0	-147.5	-145.0	-142.5	-140.0	-140.0
Margin to Limit	15.4	17.5	19.3	20.8	22.2	4.0

Annex B: Compatibility with Adjacent Satellites

UPLINK		
Ku-band	14000 MHz	
topocentric sep.	2.2 deg	
k	-228.6 dBK	

SES	off-axis	on-axis
RNH	-26.6	7.5
RAV	-26.6	7.5
RIV	-26.6	7.5

ADJ.	off-axis	on-axis
Beam A	-26.6	7.5
Beam B	-26.6	7.5
Beam C	-26.6	7.5

SES carriers	RNH	RAV	RIV
Bandwidth, MHz	36	36	36
UL flange power dens., dBW/Hz	-47	-47	-47
UL ant. Dia, m	4.5	4.5	4.5
UL ant. Gain, dBi	54.5	54.5	54.5
UL EIRP, dBW	83.1	83.1	83.1
UL flange power, dBW	28.6	28.6	28.6
UL EIRP density, dBW/Hz	7.5	7.5	7.5
Sidelobe gain, dBi	20.4	20.4	20.4
Off-ax. EIRP dens, dBW/Hz	-26.6	-26.6	-26.6
G/T, dB/K	8.5	8	10.7
C/N (thermal), dB	37.6	37.1	39.8

Adjacent Satellite at 167.5°W	Beam A	Beam B	Beam C
Bandwidth, MHz	36	36	36
UL flange power dens., dBW/Hz	-47	-47	-47
UL ant. Dia, m	4.5	4.5	4.5
UL ant. Gain, dBi	54.5	54.5	54.5
UL EIRP, dBW	83.1	83.1	83.1
UL flange power, dBW	28.6	28.6	28.6
UL EIRP density, dBW/Hz	7.5	7.5	7.5
Sidelobe gain, dBi	20.4	20.4	20.4
Off-ax. EIRP dens, dBW/Hz	-26.6	-26.6	-26.6
G/T, dB/K	8.5	8	10.7
C/N (thermal), dB	37.6	37.1	39.8

Uplink Summary	RNH	RAV	RIV
SES C/N	37.6	37.1	39.8
C/I into SES	34.1	34.1	34.1
C/N+I	32.5	32.3	33.1

Uplink Summary Adj	Beam A	Beam B	Beam C
Adj C/N	37.6	37.1	39.8
C/I from SES	34.1	34.1	34.1
C/N+I	32.5	32.3	33.1

Uplink C/I into SES carriers due to interference from adj. satellite

	SES carriers		
Adj. Sat carriers	RNH	RAV	RIV
Beam A	34.1	34.1	34.1
Beam B	34.1	34.1	34.1
Beam C	34.1	34.1	34.1

Uplink C/I into adjacent sat carriers due to interference from SES carriers

	SES carriers		
Adj. Sat carriers	RNH	RAV	RIV
Beam A	34.1	34.1	34.1
Beam B	34.1	34.1	34.1
Beam C	34.1	34.1	34.1

DOWNLINK		
Ku-band	12700 MHz	
topocentric sep.	2.2 deg	
k	-228.6 dBK	

	SES	
	off-axis	on-axis
TNH	1.4	17.9
TAV	2.4	24.2
TIV	2.4	21.7

NSS-6 at 169.5°W	TNH	TAV	TIV
Bandwidth, MHz	36	36	36
Carrier EIRP density, dBW/Hz	-19.0	-18.0	-18.0
Rx ES ant. Dia., m	0.65	1.2	0.9
Rx ES ant. Gain, dBi	36.9	42.2	39.7
Sidelobe gain, dBi	20.4	20.4	20.4
Noise Temp, K	148	148	148
C/N (thermal), dB	17.8	24.1	21.6

	ADJ.	
	off-axis	on-axis
Beam A	1.4	17.9
Beam B	2.4	24.2
Beam C	2.4	21.7

Adjacent Satellite at 167.5°W	Beam A	Beam B	Beam C
Bandwidth, MHz	36	36	36
Carrier EIRP density, dBW/Hz	-19.0	-18.0	-18.0
Rx ES ant. Dia., m	0.65	1.2	0.9
Rx ES ant. Gain, dBi	36.9	42.2	39.7
Sidelobe gain, dBi	20.4	20.4	20.4
Noise Temp, K	148	148	148
C/N (thermal), dB	17.8	24.1	21.6

Downlink Summary	TNH	TAV	TIV
SES C/N	17.8	24.1	21.6
C/I into SES	16.4	21.7	19.3
C/N+I	14.0	19.8	17.3

Downlink C/I into SES carriers due to interference from adj. satellite			
	SES carriers		
Adj. Sat carriers	TNH	TAV	TIV
Beam A	16.4	22.7	20.3
Beam B	15.4	21.7	19.3
Beam C	15.4	21.7	19.3

Downlink Summary Adj	Beam A	Beam B	Beam C
Adj C/N	17.8	24.1	21.6
C/I from SES	16.4	21.7	19.3
C/N+I	14.0	19.8	17.3

Uplink C/I into adjacent sat carriers due to interference from SES carriers			
	SES carriers		
Adj. Sat carriers	TNH	TAV	TIV
Beam A	16.4	15.4	15.4
Beam B	22.7	21.7	21.7
Beam C	20.3	19.3	19.3

Summary

NSS-6 at 169.5W	TNH	TAV	TIV
C/N, Uplink	37.6	37.1	39.8
C/I, Uplink	34.1	34.1	34.1
C/N+I, Uplink	32.5	32.3	33.1
C/N, Downlink	17.8	24.1	21.6
C/I, Downlink	16.4	21.7	19.3
C/N+I Downlink	14.0	19.8	17.3
C/N+I Total	14.0	19.5	17.1

Adj Satellite at 167.5W	Beam A	Beam B	Beam C
C/N, Uplink	37.6	37.1	39.8
C/I, Uplink	34.1	34.1	34.1
C/N+I, Uplink	32.5	32.3	33.1
C/N, Downlink	17.8	24.1	21.6
C/I, Downlink	16.4	21.7	19.3
C/N+I Downlinl	14.0	19.8	17.3
C/N+I Total	14.0	19.5	17.1

Resulting values for C/N+I are well within the minimum C/N+I expected for this type of traffic (aeronautical forward carrier).

DECLARATION

I, Frederic Portier, hereby certify under penalty of perjury that I am the technically qualified person responsible for the technical information contained in the foregoing exhibit; that I am familiar with the technical requirements of Part 25; and that I either prepared or reviewed the technical information contained in the exhibit and that it is complete and accurate to the best of my knowledge, information and belief.

_/s/____ Frederic Portier_____

Frederic Portier
Senior Manager, Spectrum Management &
Development Americas
SES

Dated: April 3, 2019