

APPLICATION FOR EARTH STATION SPECIAL TEMPORARY AUTHORITY

APPLICANT INFORMATION Enter a description of this application to identify it on the main menu:  
Request for STA for 30 Days to Provide TT&C using E110104 for ASTRA 1D at 73.0 W.L.

**1. Applicant**

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<b>Country:</b>	USA	<b>Zipcode:</b>	20036
<b>Attention:</b>	Ms Petra A Vorwig		



File # SES-STA-20180129-00069  
E-110104  
Call Sign (or other identifier) Grant Date 2-7-18  
Term Dates From 2-9-18 To: 3-11-18  
Approved: [Signature]

Applicant: SES Americom, Inc.  
Call Sign: E110104  
File No.: SES-STA-20180129-00069  
Special Temporary Authority



File # SES-STA-20180129-00069  
E110104  
Call Sign E110104 Grant Date 2-7-18  
(or other identifier)  
Term Dates  
From: 2-9-18 To: 3-11-18  
Approved: Paul E. [Signature]

SES Americom, Inc. is granted special temporary authority for 30 days, beginning February 9, 2018, to operate its fixed earth station located at 38° 47' 0.6" N/077° 34' 25.4" W in Bristow, Virginia to provide telemetry, tracking, and command ("TT&C") services on-station station-keeping operations for ASTRA ID satellite while positioning at 73.0° W orbital location using frequencies: 14013.00 MHz and 14493.00 MHz (Earth-to-space); and 11447.50 MHz and 11454.00 MHz (space-to-Earth) under the following conditions:

1. All operations must be within the coordinated emission and power limits.
2. All operations under this grant of special temporary authority shall be on an unprotected and non-harmful interference basis. SES Americom, Inc., shall not cause harmful interference to, and shall not claim protection from interference caused to it by, any other lawfully operating radio communication system.
3. In the event of any harmful interference as a result of operations under this grant SES Americom, Inc. shall cease operations immediately upon notification of such interference and shall immediately inform the Commission, in writing, of such an event.
4. Grant of this special temporary authority is without prejudice to any determination that the Commission may make regarding pending or future SES Americom, Inc. applications.
5. Any action taken or expense incurred as a result of operations pursuant to this special temporary authority is solely at SES Americom, Inc.'s risk.
6. SES Americom Inc.'s request for a waiver of Section 25.210(j) is GRANTED. Section 25.210(j) requires geostationary space stations to be maintained within  $\pm 0.05$  degrees of their assigned orbital locations unless specifically authorized by the Commission to operate with a different longitudinal tolerance. The operations of ASTRA ID satellite with an east-west station keeping tolerance of  $\pm 0.10$  degrees of its assigned orbital location in the east/west direction is authorized as long as no other space station is located within the station-keeping volume. Should a spacecraft be launched or relocated into the station-keeping volume of ASTRA ID, then Astra ID is required to maintain  $\pm 0.05^\circ$  East/West station-keeping, or coordinate its operations with that of the other spacecraft.
7. This grant is issued pursuant to Section 0.261 of the Commission's rules on delegated authority, 47 C.F.R. § 0.261, and is effective upon release.

<b>2. Contact</b>	
<b>Name:</b> Karis Hastings	<b>Phone Number:</b> 202--599--0975
<b>Company:</b> SatCom Law LLC	<b>Fax Number:</b>
<b>Street:</b> 1317 F St., NW Suite 400	<b>E-Mail:</b> karis@satcomlaw.com
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<b>Attention:</b>	<b>Relationship:</b> Legal Counsel
(If your application is related to an application filed with the Commission, enter either the file number or the IB Submission ID of the related application. Please enter only one.)	
3. Reference File Number or Submission ID	
4a. Is a fee submitted with this application?	
<input checked="" type="radio"/> If Yes, complete and attach FCC Form 159. If No, indicate reason for fee exemption (see 47 C.F.R. Section 1.1114).	
<input type="radio"/> Governmental Entity <input type="radio"/> Noncommercial educational licensee	
<input type="radio"/> Other (please explain):	
4b. Fee Classification CGX - Fixed Satellite Transmit/Receive Earth Station	
5. Type Request	
<input type="radio"/> Use Prior to Grant <input type="radio"/> Change Station Location <input checked="" type="radio"/> Other	
6. Requested Use Prior Date	
7. City Bristow	
8. Latitude (dd mm ss.s h) 38 47 0.6 N	

9. State VA	10. Longitude (dd mm ss.s h) 77 34 25.4 W
11. Please supply any need attachments. Attachment 1: STA Narrative Attachment 2: Attachment 3:	
12. Description. (If the complete description does not appear in this box, please go to the end of the form to view it in its entirety.) SES Americom, Inc. requests special temporary authority for 30 days to operate its E110104 earth station beginning on February 9, 2018, to provide TT&C service for the ASTRA 1D satellite operating at 73.0 W.L.	
13. By checking Yes, the undersigned certifies that neither applicant nor any other party to the application is subject to a denial of Federal benefits that includes FCC benefits pursuant to Section 5301 of the Anti-Drug Act of 1988, 21 U.S.C. Section 862, because of a conviction for possession or distribution of a controlled substance. See 47 CFR 1.2002(b) for the meaning of "party to the application"; for these purposes. <input checked="" type="radio"/> Yes <input type="radio"/> No	
14. Name of Person Signing Petra A. Vorwig	15. Title of Person Signing Senior Legal & Regulatory Counsel
WILLFUL FALSE STATEMENTS MADE ON THIS FORM ARE PUNISHABLE BY FINE AND / OR IMPRISONMENT (U.S. Code, Title 18, Section 1001), AND/OR REVOCATION OF ANY STATION AUTHORIZATION (U.S. Code, Title 47, Section 312(a)(1)), AND/OR FORFEITURE (U.S. Code, Title 47, Section 503).	

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**THE FOREGOING NOTICE IS REQUIRED BY THE PAPERWORK REDUCTION ACT OF 1995, PUBLIC LAW 104-13, OCTOBER 1, 1995, 44 U.S.C. SECTION 3507.**

## REQUEST FOR SPECIAL TEMPORARY AUTHORITY

By this application, SES Americom, Inc. (“SES Americom” or “SES”) respectfully requests earth station special temporary authority (“STA”) for a period of 30 days to permit SES to use its E110104 earth station to communicate with the ASTRA 1D spacecraft in order to provide Tracking, Telemetry and Command (“TT&C”) while the spacecraft is positioned at 73° W.L. (+/- 0.10° east/west station keeping).<sup>1</sup>

SES Americom’s affiliate, SES ASTRA S.A. (“SES ASTRA”), holds an authorization from the Luxembourg Ministry of State, Office of Media and Communications<sup>2</sup> for the ASTRA 1D Ku-band spacecraft. SES ASTRA has requested that SES Americom assist with providing TT&C to support the operation of ASTRA 1D at 73.0° W.L. ASTRA 1D is operating in inclined orbit.

SES is not requesting U.S. market access or any other authorization from the Commission in relation to the non-U.S.-licensed ASTRA 1D spacecraft, and therefore is not providing full technical information about the ASTRA 1D satellite as part of this application.<sup>3</sup>

Details regarding the ASTRA 1D TT&C operations, including the certifications required under

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<sup>1</sup> SES previously received authority to use E110104 to provide TT&C for ASTRA 1D as the satellite drifted from 47.3° W.L. to 72.5° W.L. See SES Americom, Inc., Call Sign E110104, File Nos. SES-STA-20170421-00447, granted May 3, 2017 and SES-STA-20170421-00448, granted June 7, 2017, (collectively, the “ASTRA 1D Grants”). The satellite arrived at 72.5° W.L. in July 2017 and remained there until November 2017, when a Canadian earth station was used to drift the satellite to 73.0° W.L. Subsequent to the relocation of the satellite to 73.0° W.L., the Canadian earth station has been and will remain the primary TT&C facility, and SES proposes to use the E110104 antenna only for receipt of telemetry and as a back-up for transmission of commands if needed.

<sup>2</sup> Ministère d’État, Service des Médias et des Communications of the Grand Duchy of Luxembourg.

<sup>3</sup> See Waiver Requests, *infra*.

Section 25.140 of the Commission's rules, are provided in the attachments to this request. A basic technical description of the satellite's operations, and an orbital debris mitigation statement for ASTRA 1D, are provided in Attachments 2 and 3 for the Commission's information. As discussed below, communications with ASTRA 1D will not adversely affect the operation of any adjacent satellites.

Grant of this request is in the public interest as the requested TT&C authority will facilitate the safe operation of ASTRA 1D at 73.0° W.L.

**No Harmful Interference to Other Spacecraft.** Apart from AMC-3, located at 72.0° W.L., the nearest satellite to 73.0° W.L. with overlapping Ku-band operations is ARSAT 1 operated at 71.8° W.L. by Empresa Argentina de Soluciones Satelitales Sociedad Anónima (ARSAT). SES has coordinated operations with ARSAT 1.

**Waiver Requests.** SES requests limited waivers of the Commission's requirements in connection with the instant request. 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.<sup>4</sup>

Sections 25.137 and 25.114. SES requests a waiver of Section 25.137 and the other Commission rules cross-referenced therein. SES seeks authority in connection with providing TT&C for ASTRA 1D, a foreign-licensed spacecraft. Section 25.137 requires that

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<sup>4</sup> *PanAmSat Licensee Corp.*, 17 FCC Rcd 10483, 10492 (Sat. Div. 2002) (footnotes omitted).



applicants proposing to use U.S.-licensed earth stations to communicate with foreign-licensed spacecraft demonstrate that the Commission's policies for U.S. market access are satisfied. Section 25.137 also incorporates by reference other requirements for Commission-licensed space stations, including the obligation to file detailed technical information as specified in Section 25.114.

Waiving Section 25.137 is consistent with the purpose of the rule, which was intended to address situations in which a non-U.S.-licensed satellite is to be used to serve the United States. Here, the E110104 earth station will be used solely for TT&C, not for commercial operations. Thus, SES is not seeking authority to communicate with ASTRA 1D for purposes of providing U.S. service within the meaning of Section 25.137.

To the extent the Commission disagrees, SES requests a waiver of the market access and other requirements imposed in Section 25.137. Grant of a waiver will not undermine the objectives of these requirements. The market access test described in the rule is intended to ensure that U.S.-licensed systems have "effective competitive opportunities."<sup>5</sup> Because SES Americom is not seeking authority to provide commercial services in the United States, the requested modification does not raise any concerns about competitive equality.<sup>6</sup>

Strict adherence with Section 25.114's requirements for detailed technical information is also unnecessary and would be unduly burdensome. SES Americom is proposing to use the antenna only for the limited purpose of performing TT&C for the satellite located at 73° W.L., and the relevant technical characteristics of those transmissions are provided below.

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<sup>5</sup> 47 C.F.R. § 25.137(a).

<sup>6</sup> In any event, the ASTRA 1D spacecraft at 73.0° W.L. will be operating under the authority of Luxembourg, a WTO member country, and therefore is exempt from the requirement to make a showing of effective competitive opportunities. 47 C.F.R. § 25.137(a)(2).



The transmissions to the spacecraft will be conducted on a non-harmful interference basis. In these circumstances, no valid purpose would be served by requiring a complete description of the ASTRA 1D spacecraft.

SES Americom's request is consistent with Commission precedent. In similar cases in which limited communications by U.S. earth stations with a foreign-licensed satellite were proposed, the Commission has granted operational authority without requiring a market access showing under Section 25.137 or full technical data as required by Section 25.114.<sup>7</sup>

Section 2.106 Footnote NG52. To the extent that reception of telemetry at 11447.5 MHz and 11454 MHz constitutes a domestic (*i.e.*, non-international) service, SES Americom respectfully requests a limited waiver of the international-service-only restriction.<sup>8</sup> Such a waiver is warranted in the circumstances for the limited purpose of TT&C. As the Commission has recognized, TT&C operations generally require uplink and downlink capability from the same earth station. For this reason, the Commission has previously granted waivers of the international service restriction to enable TT&C to be performed in the U.S. using the extended Ku-band frequencies.<sup>9</sup>

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<sup>7</sup> See, e.g., Hawaii Pacific Teleport, L.P., File No. SES-STA-20131030-00914 (Call Sign E030115), granted Nov. 18, 2013 (granting authority for earth station to provide TT&C services to ASTRA 3A operating at 176.85° W.L.); PanAmSat Licensee Corp., File Nos. SES-STA-20090922-01211 (Call Sign E4132) & SES-STA-20090922-01212 (Call Sign E040125), both grant-stamped Oct. 16, 2009 (granting authority for earth stations to communicate with foreign-licensed NSS-12 spacecraft for purposes of providing launch and early operations services).

<sup>8</sup> 47 U.S.C. § 2.106 Footnote NG52.

<sup>9</sup> See, e.g., EchoStar KuX Corporation, 20 FCC Rcd 919 (Int'l Bur. 2004) ("*EchoStar 83W Order*"); EchoStar Satellite LLC, 20 FCC Rcd 930 (Int'l Bur. 2004) ("*EchoStar109W Order*"); EchoStar KuX Corporation, 20 FCC Rcd 942 (2004) ("*EchoStar 121W Order*"). These decisions granted waivers of the international only restriction in Footnote NG104, which has been replaced by Footnote NG52.

Grant of the requested waiver would not undermine the purpose of the restriction, which is to ensure that earth station deployments in the extended Ku-band do not negatively impact the deployment of fixed service (“FS”) in the same band or cause interference to such operations. The telemetry downlink signals from ASTRA 1D in the extended Ku-band are narrow in bandwidth, and will comply with the power flux density limits in the Commission’s rules and, thus, will not interfere with FS station operations. Call sign E110104 is the only U.S. antenna that will be used to provide TT&C to ASTRA 1D at 73.0° W.L. and will not be entitled to interference protection from FS facilities. As a result, there will be no restrictions placed on the deployment of FS in this band.

Section 25.210(j). The ASTRA 1D satellite is authorized by the Luxembourg Government to operate at 73.0° W.L. within a +/- 0.1 degrees 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 degrees 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.”<sup>10</sup>

The facts here fit squarely within this precedent. Allowing ASTRA 1D to be maintained within an increased station keeping volume will not harm other operators. ASTRA 1D’s station keeping volume will not overlap with that of any other satellites. In addition, allowing ASTRA 1D to be flown at 73.0° 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

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<sup>10</sup> See, e.g., *SES Americom, Inc.*, File Nos. SAT-MOD-20080124-00030 & SAT-AMD-20080311-00070, grant-stamped May 19, 2008, Attachment at ¶ 1.

which ASTRA 1D will be available to provide service. Under these circumstances, grant of any necessary waiver of Section 25.210(j) will serve the public interest.

SES hereby certifies that no party to this application is subject to a denial of federal benefits pursuant to Section 5301 of the Anti-Drug Abuse Act of 1988, 21 U.S.C. § 862.

For the foregoing reasons, SES respectfully requests special temporary authority to communicate with ASTRA 1D for a period of up to 30 days in order to provide TT&C to the satellite as described herein. Grant of the requested authority will promote safe operation of the satellite.

## Attachment 1: TT&C Emission Characteristics

### 1. Earth Station Transmission Characteristics

E110104 (Manassas, VA)

Emission Designator: 800KF9D

Max EIRP: 78.8 dBW

Max EIRP Density: 54.8 dBW/4kHz

These EIRP and EIRP density levels are within the maximum EIRP and EIRP density levels authorized in the current E110104 earth station license.

### 2. TT&C Frequencies<sup>1</sup>

Telecommand: 14013 MHz (omni) horizontal polarization

14493 MHz (spot) vertical polarization

Telemetry: 11447.5 MHz (spot) horizontal polarization/ (omni) vertical polarization

11454 MHz (spot, omni) vertical polarization

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<sup>1</sup> In compliance with Section 25.202(g)(1) of the Commission's rules, the proposed TT&C operations will cause no greater interference and require no greater protection from harmful interference than communications traffic in these bands.

Attachment 2: ASTRA 1D at 73.0° W.L.

1. **Orbital Location**

73.0° W.L. +/- 0.1° east-west station keeping and operating in inclined orbit

2. **TT&C Frequencies**

Telecommand: 14013 MHz (omni) horizontal polarization  
14493 MHz (spot) vertical polarization  
Telemetry: 11447.5 MHz (spot) horizontal polarization/ (omni) vertical polarization  
11454 MHz (spot, omni) vertical polarization

3. **Section 25.140 Certifications**

**Section 25.140(a)(2).** SES Americom certifies that the ASTRA 1D TT&C operations in the Ku-band have been coordinated with ARSAT 1, located at 71.8° W.L. for the telecommand operations, and there is no frequency overlap for the telemetry. There is no frequency overlap with Nimiq 5 located at 72.7° W.L.

**Section 25.140(a)(3)(ii).** SES Americom certifies that the downlink EIRP density for its operations in the conventional and extended Ku-bands will not exceed 17 dBW/4kHz for analog transmissions and that the associated uplink operation will not exceed applicable EIRP density envelopes in Section 25.218 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 the orbital location of the proposed space station.

3. **Compliance with PFD limits in 11.45-11.7 GHz**

The allowable PFD levels in the 11.45-11.70 GHz bands (per 4 kHz) are defined in Section 25.208(b)(1) of the Commission's rules for all conditions, including clear sky, and for all methods of modulation as follows:

For angles of arrival between 0 and 5 degrees above the horizontal plane: -150 dBW/m<sup>2</sup> in any 4 kHz band;

For angles of arrival  $\delta$  (in degrees) between 5 and 25 degrees above the horizontal plane:  $-150 + (\delta-5)/2$  dBW/m<sup>2</sup> in any 4 kHz band; and

For angles of arrival between 25 and 90 degrees above the horizontal plane: -140 dBW/m<sup>2</sup> in any 4 kHz band.

In order to demonstrate such compliance, the PFD levels for the telemetry carriers, are calculated below. It can be seen from the results that compliance with the PFD levels has been achieved.

TM Beam						
Elevation angle, deg	5.0	10.0	15.0	20.0	25.0	90.0
Max. EIRP, dBW	18.0	18.0	18.0	18.0	18.0	18.0
Gain roll-off at elevation angle, dBi	-20.0	-20.0	-20.0	-20.0	-20.0	0.0
EIRP at elevation angle, dBW	-2.0	-2.0	-2.0	-2.0	-2.0	18.0
Carrier bandwidth, MHz	0.20	0.20	0.20	0.20	0.20	0.20
EIRP density at elevation angle dBW/4kHz	-18.2	-18.2	-18.2	-18.2	-18.2	1.8
Minimum spreading loss, dB/m <sup>2</sup>	-163.3	-163.2	-163.1	-162.9	-162.8	-162.1
25.208(a) pfd limit (10.95-11.2 and 11.45-11.7 MHz), dBW/m2/4kHz	-150.0	-147.5	-145.0	-142.5	-140.0	-140.0
pfd, dBW/m2/4KHz	-181.5	-181.4	-181.3	-181.1	-181.0	-160.3
Margin, dB, relative to 25.208	31.5	33.9	36.3	38.6	41.0	20.3

4. **TT&C Contour Maps**

SES Americom has previously provided the contour maps for the spot beam telemetry and telecommand operations in gxt format in File No. SES-STA-20170323-00336. The antenna gain contours for the TT&C omni beam operations are not included because the contours at 8 dB below peak fall entirely beyond the edge of the visible Earth.<sup>1</sup>

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<sup>1</sup> See 47 C.F.R. § 25.114(c)(4)(vi)(A).

### **Attachment 3: Orbital Debris Mitigation Statement**

Information regarding the orbital debris mitigation plan for ASTRA 1D is provided below.

#### **Spacecraft Hardware Design**

The ASTRA 1D satellite was built on the proven Boeing 601 bus and was launched in November 1994. No debris is generated during normal on-station operations, and the spacecraft will be in a stable configuration.

The design of SES's spacecraft locates all sources of stored energy within the body of the structure, which provides protection from small orbital debris. SES requires that spacecraft manufacturers assess the probability of micrometeorite damage that can cause any loss of functionality. This probability is then factored into the ultimate spacecraft probability of success. Any significant probability of damage would need to be mitigated in order for the spacecraft design to meet SES's required probability of success of the mission. SES has taken the following steps to limit the effects of such collisions: (1) critical spacecraft components are located inside the protective body of the spacecraft and properly shielded; and (2) where practical, all spacecraft subsystems have redundant components to ensure no single-point failures. The spacecraft will not use any subsystems for end-of-life disposal that are not used for normal operations.

#### **Minimizing Accidental Explosions**

The spacecraft manufacturer generates a Failure Mode Effects and Criticality Analysis for the spacecraft to identify all potential mission failures. This analysis indicates failure modes, possible causes, methods of detection, and compensating features of the spacecraft design.



The design of the ASTRA 1D spacecraft is such that the risk of explosion is minimized both during and after mission operations. In designing and building the spacecraft, the manufacturer took steps to ensure that debris generation will not result from the conversion of energy sources on board the satellite into energy that fragments the satellite. All propulsion subsystem pressure vessels, which have high margins of safety at launch, have even higher margins in orbit, since use of propellants and pressurants during launch decreases the propulsion system pressure. Burst tests are performed on all pressure vessels during qualification testing to demonstrate a margin of safety against burst. Bipropellant mixing is prevented by complete isolation of propellant species from each other. Pressures, including a subset of the batteries, will be monitored by telemetry.

At the end of operational life, after the satellite has reached its final disposal orbit, all on-board sources of stored energy will be depleted or secured, excess propellant remaining in the chemical propulsion tanks will be vented, and the batteries will be discharged.

### **Safe Flight Profiles**

SES has assessed and limited the probability of the space station becoming a source of debris by collisions with large debris or other operational space stations. Specifically, SES has assessed the possibility of collision with satellites located at, or reasonably expected to be located at, the requested orbital location or assigned in the vicinity of that location. Regarding avoidance of collisions with controlled objects, in general, if a geosynchronous satellite is controlled within its specified longitude and latitude station-keeping limits, collision with another controlled object (excluding where the satellite is collocated with another object) is the direct result of that object entering the allocated space.

ASTRA 1D will be positioned at 73.0° W.L. with +/- 0.1 degree station keeping tolerance. In considering current and planned satellites that may have a station-keeping volume that overlaps the ASTRA 1D satellite, SES has reviewed the FCC databases for FCC licensed satellite networks and those that are currently under consideration by the FCC. In addition, networks for which a request for coordination has been published by the ITU within  $\pm 0.15$  degrees of 73.0° W.L. have also been reviewed. Only those networks that either operate, or are planned to operate, and have an overlapping station-keeping volume with the ASTRA 1D satellite, have been taken into account in the analysis. While there are additional ITU filings at 73.0° W.L., SES is not aware of other companies operating or planning to operate within the station keeping box of ASTRA 1D.

Based on these reviews, the only satellites operating near 73.0° W.L. are Nimiq 5, which is operating 0.3 degrees away, Amazonas 4A, which is operating 0.9 degrees away at 73.9°W.L. and AMC-3 operating at 72.0° W.L., which is also controlled and operated by SES. SES is not aware of any pending applications before the Commission requesting authorization to use an orbital location within  $\pm 0.15^\circ$  of 73.0° W.L., and within this sub-arc, SES is not aware of any proposals by any other administration to launch or deploy a satellite to such locations in the near term. Based on the preceding, it is concluded that physical coordination of the ASTRA 1D satellite with another party is not required at the present time.

On-station station-keeping operations will be within the +/- 0.1 degree E-W control box with no inclination control, thereby ensuring adequate collision avoidance distance from other satellites in geosynchronous orbit.

SES uses the Space Data Center (“SDC”) system from the Space Data Association to monitor the risk of close approach of its satellites with other objects. Any close

encounters (separation of less than 10 km) are flagged and investigated in more detail. If required, avoidance maneuvers are performed to eliminate the possibility of collisions. During any relocation, the moving spacecraft is maneuvered such that it is at least 30 km away from the synchronous radius at all times. In most cases, much larger deviation from the synchronous radius is used. In addition, the SDC system is used to ensure no close encounter occurs during the move. When de-orbit of a spacecraft is required, the initial phase is treated as a satellite move, and the same precautions are used to ensure collision avoidance.

### **Post Mission Disposal Plan**

At the end of the satellite's life, SES plans to maneuver ASTRA 1D to a disposal orbit with a minimum perigee of 263.2 km above the normal operational altitude. The proposed disposal orbit altitude complies with the altitude resulting from application of the IADC formula based on the following calculation:

Area of the satellite (average aspect area): 24.0 m<sup>2</sup>

Mass of the spacecraft: 1277 kg

C<sub>R</sub> (solar radiation pressure coefficient): 1.50

Therefore the Minimum Disposal Orbit Perigee Altitude, as calculated under the IADC formula, is:

$$36,021 \text{ km} + (1000 \times C_R \times A/m) = 36049.2 \text{ km, or } 263.2 \text{ km above the GSO arc (35,786 km)}$$

SES intends to reserve 6.9 kg of fuel in order to account for post-mission disposal of ASTRA 1D. SES has assessed fuel-gauging uncertainty and has provided an adequate margin of fuel reserve to address the assessed uncertainty.