Exhibit For
SES Americom, LLC
Bristow, Virginia
ViaSat 11.3 Meter Earth Station

Compliance with FCC Report & Order (FCC96-377) for the 13.75 - 14.0 GHz Band
Analysis and Calculations

1. Background

This Exhibit is presented to demonstrate the extent to which the SES Americom, LLC satellite earth station in Bristow, Virginia is in compliance with FCC REPORT & ORDER 96-377. The potential interference from the earth station to US Navy shipboard radiolocation operations (RADAR) and the NASA space research activities in the 13.75 - 14.0 GHz Band is addressed in this exhibit. The parameters for the earth station are:

Table 1. Earth Station Characteristics

• Coordinates (NAD83):	38° 47' 0.6" N, 77° 34' 25.4" W
• Satellite Location for Earth Station:	NSS 7 (20.0° W)
• Frequency Band:	13.75-14.0 GHz for uplink
• Polarizations:	Linear
• Emissions:	500KG7W, 1M00G7W, 36M0G7W, and 77M0G7W
• Modulation:	Digital
• Maximum Aggregate Uplink EIRP:	69.8 dBW for the 500 kHz Carriers 70.99 dBW for the 1 MHz Carriers 78.77 dBW for the 36 MHz Carriers 82.07 dBW for the 77 MHz Carriers
• Transmit Antenna Characteristics	
Antenna Size:	11.3 meters in Diameter
Antenna Type/Model:	ViaSat
Gain:	62.8 dBi
• RF power into Antenna Flange:	500 kHz 7.0 dBW or -14.0 dBW/4 kHz (Maximum)

- RF power into Antenna Flange (Continued)

  1.0 MHz
  8.2 dBW or 0.0 dBW/ MHz
  or -15.8 dBW/4 kHz (Maximum)

  36 MHz
  16.0 dBW or 15.5 dBW/ MHz
  or -23.5 dBW/4 kHz (Maximum

  77 MHz
  19.3 dBW or 18.8 dBW/ MHz
  or -23.5 dBW/4 kHz (Maximum

- Minimum Elevation Angle: Bristow. 16.4° @ 111.7° Az. (NSS 7) at 20.0° W

- Side Lobe Antenna Gain: 32 - 25*log(θ)

Because the above uplink spectrum is shared with the Federal Government, coordination in this band requires resolution data pertaining to potential interference between the earth station and both Navy Department and NASA systems. Potential interference from the earth station could impact with the Navy and/or NASA systems in two areas. These areas are noted in FCC Report and Order 96-377 dated September 1996, and consist of (1) Radiolocation and radio navigation, (2) Data Relay Satellites.

Summary of Coordination Issues:

1) Potential Impact to Government Radiolocation (Shipboard Radar)
2) Potential Impact to NASA Data Relay Satellite Systems (TDRSS)

2. Potential Impact to Government Radiolocation (Shipboard Radar)

Radiolocation operations (RADAR) may occur anywhere in the 13.4 - 14 GHz frequency band aboard ocean going United States Navy ships. The Federal Communication Commission (FCC) order 96-377 allocates the top 250 MHz of this 600 MHz band to the Fixed Satellite Service (FSS) on a co-primary basis with the radiolocation operations and provides for an interference protection level of -167 dBW/m^2/4 kHz.

The closest distance to the shoreline from the Bristow earth station is approximately 97.5 km East toward the Chesapeake Bay. The calculation of the power spectral density at this distance is given by:

		500 kHz	1.0 MHz	36 MHz	77.0 MHz
1.	Clear Sky EIRP:	69.8 dBW	71.0 dBW	78.8 dBW	82.1 dBW
2.	Carrier Bandwidth:	500 kHz	1.0 MHz	36.0 MHz	77.0 MHz
3.	PD at antenna Input: (dBW/4 kHz)	-14.0	-15.8	-23.5	-23.5
4.	Transmit Antenna Gain:	62.8 dBi			
5.	Antenna Gain Horizon:	FCC Reference Pattern			
6.	Antenna Elevation Angles:	43.3°			

The proposed earth station will radiate interference toward the Bay according to its off-axis side-lobe performance. A conservative analysis, using FCC standard reference pattern, results in off-axis antenna gains of 1.3 dBi toward the Chesapeake Bay.

The signal density at the shoreline, through free space is:

500 kHz Carriers
PFD = Antenna Feed Power density (dBW/4 kHz) + Antenna Off-Axis Gain (dBi) – Spread Loss (dBw-m^2).

= -14.0 dBw/4 kHz + 1.3 dBi – 10*log[4Π*(97500m)^2]
= -123.5 dBW/m^2/4 kHz + Additional Path Losses (~64.3 dB)
= -187.8 dBW/m^2/4 kHz

1 MHz Carriers
PFD = Antenna Feed Power density (dBW/4 kHz) + Antenna Off-Axis Gain (dBi) – Spread Loss (dBw-m^2).

= -15.8 dBw/4 kHz + 1.3 dBi – 10*log[4Π*(97500m)^2]
= -125.3 dBW/m^2/4 kHz + Additional Path Losses (~64.3 dB)
= -189.6 dBW/m^2/4 kHz

36 MHz Carriers
PFD = Antenna Feed Power density (dBW/4 kHz) + Antenna Off-Axis Gain (dBi) – Spread Loss (dBw-m^2).

= -23.5 dBw/4 kHz + 1.3 dBi – 10*log[4Π*(97500m)^2]
= -133.0 dBW/m^2/4 kHz + Additional Path Losses (~64.3 dB)
= -197.3 dBW/m^2/4 kHz

77 MHz Carriers
PFD = Antenna Feed Power density (dBW/4 kHz) + Antenna Off-Axis Gain (dBi) – Spread Loss ($dBw\text{-}m^2$).

= -23.5 dBw/4 kHz + 1.3 dBi – 10*log[4Π*$(97500m)^2$]
= -133.0 dBW/m^2/4 kHz + Additional Path Losses (~64.3 dB)
= -197.3 dBW/m^2/4 kHz

Our calculations show additional path loss of approximately 64.3 dB including absorption loss and earth diffraction loss for the actual path profiles from the proposed earth station to the nearest shoreline.

The worst case calculated PFD including additional path losses to the closest shoreline location is –187.8 dBW/m^2/4 kHz. This is 20.8 dB below the –167 dBW/ m^2/4 kHz interference criteria of R&O 96-377. Therefore, there should be no interference to the US Navy RADAR from the Bristow earth station due to the distance and the terrain blockage between the site and the shore.

3. Potential Impact to NASA's Data Relay Satellite System (TDRSS)

The geographic location of the SES Americom earth station in Bristow, Virginia is outside the 390 km radius coordination contour surrounding NASA's White Sands, New Mexico ground station complex. Therefore, the TDRSS space-to-earth link will not be impacted by the SES Americom earth station in Bristow, Virginia.

The TDRSS space-to-space link in the 13.770 to 13.780 GHz band is assumed to be protected if an earth station produces an EIRP less than 71 dBW/6 MHz in this band. The 11.3 meter earth station antenna will have an EIRP less than 71 dBW/6 MHz for the 500 kHz carriers in this band. In addition, the total EIRP for the 1 MHz, 36 MHz, and 77 MHz carriers is 70.99 dBW, 78.99 dBW and 82.07 dBW, respectively. The equivalent EIRP per 6 MHz segment will remain at 69.8 dBW/6 MHz and 70.99 dBW/6 MHz for the 500 kHz and 1 MHz carriers. For the 36 MHz and 77 MHz carriers the calculated dBW/6 MHz are 70.99 dBW/6 MHz for both sets of carriers. Therefore, there should not be interference to the TDRSS space-to-space link for the 500 kHz or 1 MHz, 36 MHz, or 77 MHz carriers.

At the above power levels, transmit operations from 13750 to 14000 MHz will be permitted.

Further, SES Americom also plans to operate the 1.0 MHz, 36 MHz, and 77 MHz carriers, with total EIRPs of 72.8 dBW (1 MHz), 88.3 dBW (36 MHz) and 89.8 dBW (77 MHz). These total EIRPs will equate to an EIRP per 6 MHz level of 72.8 dBW/6 MHz, 80.5 dBW/6 MHz, and 78.7 dBW/6 MHz, respectively. Since these levels are above the 71.0 dBW/6 MHz threshold, and there will be interference to the TDRSS space-to-space link, SES Americom will avoid operations between 13770 - 13780 MHz and limit their operations in this spectrum from 13780 to 14000 MHz.

For these higher power levels, transmit operations will not be permitted between 13770 and 13780 MHz. Operations at these levels for the 1 MHz, 36 MHz, and 77 MHz carriers will be limited to that portion of the spectrum from 13780 to 14000 MHz.

4. Coordination Issue Result Summary and Conclusions

The results of the analysis and calculations performed in this exhibit indicate that compatible operation between the earth station at the Bristow facility and the US Navy and NASA systems space-to-earth link are possible for the 500 kHz, 1 MHz, 36 MHz, and 77 MHz carriers. Operations in NASA systems space-to-space link (13772.0 to 13778.0 MHz) will also be permitted, at the lower EIRP levels noted on Page 1 of this report (Table 1).

When SES Americom utilizes higher EIRP levels noted above for the 1 MHz, 36 MHz, and 77 MHz carriers, the results of the analysis and calculations performed in this exhibit indicate that compatible operation between the earth station at the Bristow facility and the US Navy and NASA systems space-to-earth link are possible. However, operations in NASA systems space-to-space link (13770.0 to 13780.0 MHz) will not be permitted. In this instance, operations in the spectrum will be restricted to frequencies 13780 to 14000 MHz for the 1 MHz, 36 MHz, and 77 MHz carriers.