Attachment 1: Purpose of Experiment

Row 44, Inc. ("Row 44") is seeking a license in the Experimental Radio Service for a two year period to operate up to twelve aircraft Earth stations ("AESs") in North America. The purpose of this operation is to test and evaluate the terminal antenna for provision of commercial aeronautical mobile satellite service ("AMSS"). This application is complementary with its current request for a permanent AMSS license for remote AES units which will function with an existing hub Earth station.[1] Row 44 understands that its experimental operation must operate on a non-interference basis with respect to primary users in the band, and must accept any interference caused by these licensees. To facilitate processing of this request, Row 44 is submitting the information provided in this attachment in addition to a completed Form 442. This attachment describes the general scope of Row 44's planned operations, the research and experimentation to be performed, the complete technical details of the experimental operations proposed, the program objectives and the performance evaluation of Aeronautical-Mobile Satellite Service ('AMSS') these operations..

1.0 General Overview of Row 44's Planned AMSS System

Row 44 plans to offer a commercial broadband Internet data service to passengers and crew aboard commercial aircraft traveling in North American airspace, consistent with the framework that the Commission has proposed in its AMSS rulemaking proceeding. *See Service Rules and Procedures to Govern the Use of Aeronautical Mobile Satellite Service Earth Stations in Frequency Bands Allocated to the Fixed Satellite Service*, 20 FCC Rcd 2906 (2005) ("*AMSS NPRM*"). The service will include IP data services, IP voice and IPTV. The geostationary FSS satellites to be accessed are Horizon-1 (127˚ W.L.), AMC-2 (101˚ W.L.) and AMC-9 (83˚ W.L.). The AES will operate with an existing hub terminal at North Las Vegas, Nevada (Latitude: 36 °14 '11.0 "N; Longitude: 115 °7 '4.0 "W - 83-NAD) licensed to Hughes Network Systems (FCC Call Sign E940460). Row 44 notes that its transmission will comply with Section 25.209 of the FCC's rules (47 C.F.R. § 25.209) and the uplink RF transmit power density will not exceed -14 dBW/4 kHz, consistent with Section 25.134(a)(1) (47 C.F.R. § 25.134(a)(1). A summary of principal transmission parameters is provided below in Table 1.

Grant of the requested authority will serve the public interest by completely characterizing the performance and non-interference with existing FSS operations and will permit Row 44 to continue its preparations to offer a new mobile broadband service that is needed by the public. As the Commission noted in the *AMSS NPRM*, there is a growing demand from airline passengers and crew for real-time, in-flight broadband data transmission and other communications capability. *See AMSS NPRM*, 20 FCC Rcd at 2908. Several companies have already been licensed to provide similar services using the same Ku-band spectrum for general aviation and commercial airlines,[2] and this emerging marketplace will benefit

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[1] Row 44 AMSS Network System Description, Technical Information, May 8,2008 submitted to the FCC as part of a blanket license application. *See* FCC File No. SES-LIC-20080508-00570, as amended.

[2] *See Boeing Company*, 16 FCC Rcd 22645 (IB/OET 2001); *ARINC Inc.*, 20 FCC Rcd 7553 (IB/OET 2005); *ViaSat, Inc.*, 22 FCC Rcd 19964 (IB/OET 2007).

from additional competition from new entrants. Row 44's provision of AMSS will ultimately allow airline passengers to access a full range of broadband data, voice, and video services, including high-speed Internet access and interactive entertainment, and would also facilitate access by flight crews to important weather updates and security information. Accordingly, Row 44 requests that the FCC grant on an expedited basis its application for a license in the Experimental Radio Service. Row 44 is able to commence testing immediately, and respectfully requests timely Commission action on this application.

2.0 Overview of Row 44's AMSS System and Theory of Operation

Row 44's license application, as amended, which specifies use of a different antenna, provides a detailed description of the intended operation of the Row 44 system for transmission and reception to Earth terminals aboard commercial and private aircraft. These applications are available in FCC File Nos. SES-LIC-20080508-00570, SES-AMD-20080619-00826, SES-AMD-20080819-01074, SES-AMD-20080829-01117, SES-AMD-20090115-00041, and SES-AMD-20090416-00501. The aircraft-mounted Earth terminals in the Ku bands provide two-way broadband communications services to passengers and flight crews, allowing in-flight, real-time access to email, the Internet and virtual private networks. The AMSS Earth stations ("AESs") will operate in conjunction with a Very Small Aperture Terminal ("VSAT") network hub station that is licensed to Hughes Network Systems (HNS).

The Row 44 AMSS system provides two-way, broadband communications between multiple aircraft terminals and the Internet via multiple satellite gateways under the control of a network operation center (NOC). Satellite gateways are procured from HNS based on the existing Hughes HX architecture. A key element of the HNS's satellite system is a VSAT HX 150/200 broadband terminal that provides Internet Protocol connectivity via geostationary satellites, augmented with a mobility feature to offer airborne users broadband IP data service. The airborne platform is comprised of Satellite Antenna Assembly (SAA), an Antenna Control Unit (ACU), a High Power Transceiver (HPT), a Modem Data Unit (MDU), a Cabin Wireless LAN Unit, and a Server Management Unit (SMU). The system supports reception and transmission in the 11.70 GHz - 12.20 GHz / 14.05 GHz - 14.47 GHz band respectively, utilizing independent linear polarized array antennas for communication to and from a geostationary satellite in space. The SAA supports an elevation range from 90˚ to 0˚ of continuous coverage while the azimuth coverage will be continuous over 360˚.

Space segment capacity for experimental operations will consist of transponders on Horizon-1 (127˚ W.L.), AMC-2 (101˚ W.L.) and AMC-9 (83˚ W.L.) The Ground Earth Station (GES) for is licensed to Hughes Network System under the call sign E940460 and is located in North Las Vegas, Nevada (Latitude: 36 °14 '11.0 "N; Longitude: 115 °7 '4.0 "W - 83-NAD). The aircraft used for experimental testing is a HU-16B Albatross test aircraft (US registration N44HQ) outfitted with the Row 44 Broadband System and a Honeywell Aircraft Data Inertial Reference Unit (ADIRU).

Multiple users access the 36 MHz satellite transponder bandwidth using Time Division Multiple Access (TDMA). The 1.6 MHz bandwidth waveform supports adaptive coding and modulation and is the latest generation transmission standard Digital Video Broadcasting (DVB-S2). The modulation from the satellite to the AES is either Quadrature Phase Shift Keying (QPSK) or Octal Phase Shift Keying (PSK) at a maximum transmitted signaling rate of 30 Mega-symbols/second. The modulation from the AES to the satellite is offset QPSK with a transmitted signaling rate of 512 kilo-symbols/second or 256 kilo-symbols/second. The QPSK transmission uses spreading to convert the 256 ksps to 1024 kchip/sec over a 1024 kHz bandwidth while maintaining compliance with the 1.6 MHz bandwidth allocation. For robust operation, transmit encoding utilizes multi-rate 1/2, 2/3 and 4/5 Turbocoding. Received encoding incorporates a BCH code with a low density parity check code at rates ranging from 3/5, 2/3, 3/4, 5/6, 8/9 and 9/10 for octal PSK and 1/2, 3/5, 2/3, 4/5, 5/6, 8/9 and 9/10 for QPSK. These waveforms are implemented in the MDU with the HPT providing the frequency conversion and amplification from the intermediate frequency signal of 950 to 1450 MHz to the transmit frequency. When the antenna gain is included in the AES link budget, the transmitter emits a maximum effective isotropic radiated power (EIRP) of +38.8 dBW.

Row 44's TECOM/QEST antennas are compliant with the off-axis antenna gain envelope established in Section 25.209(a)(1) of the Commission's Rules. Nonetheless, because the antennas are aircraft mounted mobile Earth stations, Row 44 cannot meet the static elevation plane criteria under Section 25.209(a)(2). Moreover, because the antenna is less than 1.2 meters in diameter, it is not subject to routine processing under Section 25.212(c). Accordingly, Row 44 has coordinated this non-conforming use pursuant to Sections 25.209(f) and 25.220 of the Commission's Rules with the satellite operators (SES Americom, Intelsat and Echostar Satellite Services) that will provide space segment capacity for the service or who are operating adjacent satellites to the target satellites. Copies of these agreements are attached as Exhibits 1 and 2.

The basic technical transmission parameters to be used are detailed in the table below:

Table 1 – Row 44 Transmission Parameters

Antenna Manufacturer	TECOM/QEST
Antenna Model Number	HR6400 RF Subsystem (includes antenna 855000-901)
Transmitter frequencies	14.05-14.47 GHz$\pm 1x10^{-5}$%
Modulating waveform	DVB-S2, QPSK,8-PSK
Boresight Gain	28.8 dBi
Antenna Off-axis gain performance	Complies with §25.209
High Power Amplifier	10 Watts
Peak power density at the antenna flange	-14 dBW/4 kHz
Carrier Bandwidth	1.6 MHz (1M60G7D)
Boresite EIRP	38.8 dBW
Off-axis EIRP Co-pol Spectral Density	Complies with §25.222

A radiation hazard study for this antenna is provided as Exhibit 3 hereto.

Antenna Characteristics

Sample antenna radiation plots for the receive band at 11.75 GHz and 12.75 GHz are provided in Figure A-1 and are in conformance with Section 25.132(b) of the Commission's Rules.

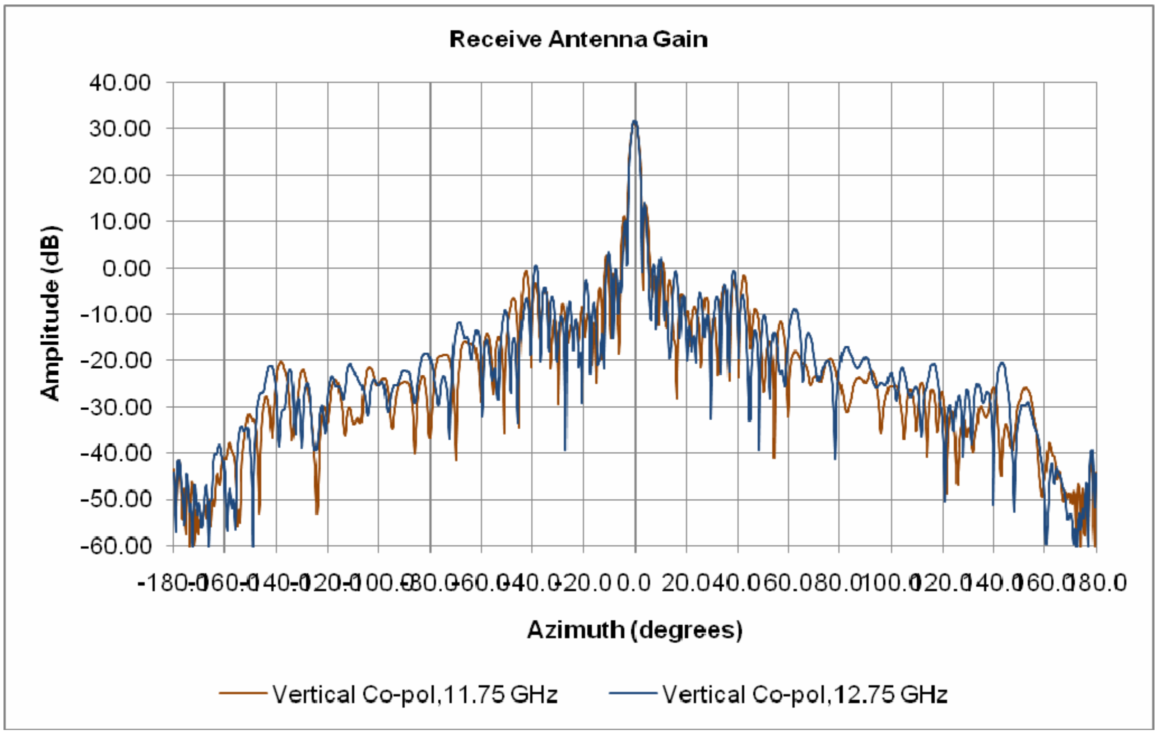

Figure A-1 Receive Antenna Gain for Vertical Polarization at 11.75 and 12.75 GHz

Sample antenna radiation plots for the transmit band are provided in Figures A-2 to A-7 in conformance with Section 25.132(b) of the Commission's Rules. The patterns in Figures A-2 to A-6 are provided in two orientations and show full compliance to 47 CFR § 25.209 (a) (1) and 47 CFR § 25.209(b) for off-axis co-polarization and cross-polarization gain, respectively:

1. Vertical and horizontal polarization referenced to zero degrees relate to antenna gain versus azimuth angle.

2. Vertical and horizontal polarization, referenced to an off-axis elevation performance, show compliance in situations where the aircraft is not on the same longitude as the target satellite (i.e., the angle between the antenna azimuth plane and the direction along the geostationary orbit at the corresponding satellite location

referred to as "skew angle"). The vertical and horizontal polarization off-axis gain depict that the antenna can support up to +/-35 degree effective off-axis angle. The actual skew angle is constantly monitored by the ACU and the aircraft transmitter will be muted in the event that this skew angle is exceeded.

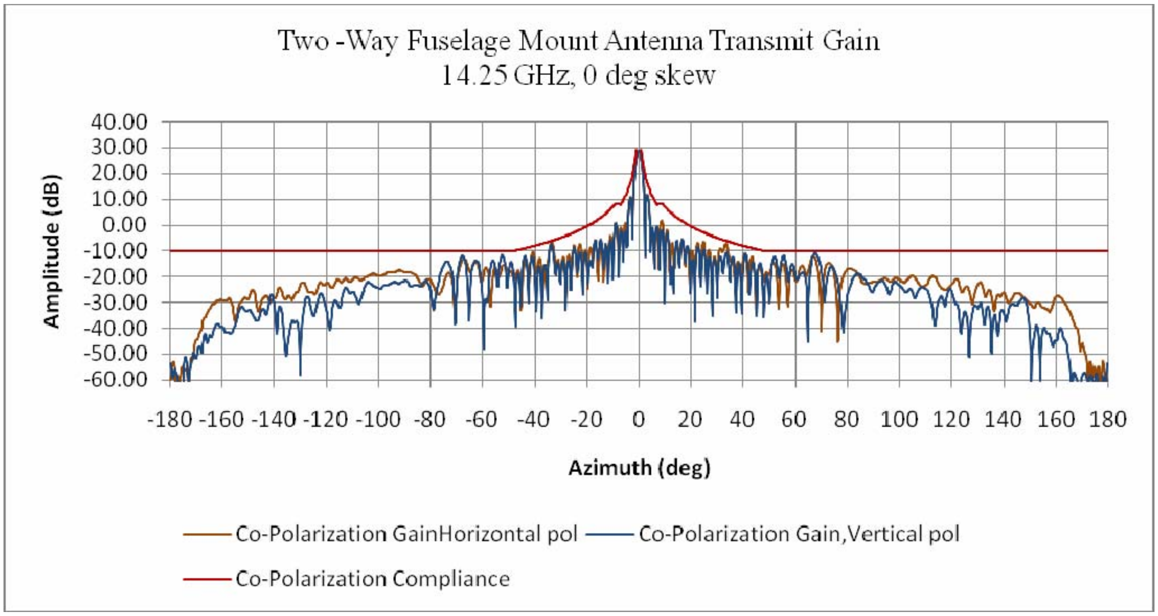

Figure A-2 Transmit Antenna Gain at 14.25 GHz for Vertical and Horizontal Polarization with 0 Degrees Skew (25.209 Co-Pol Compliance)

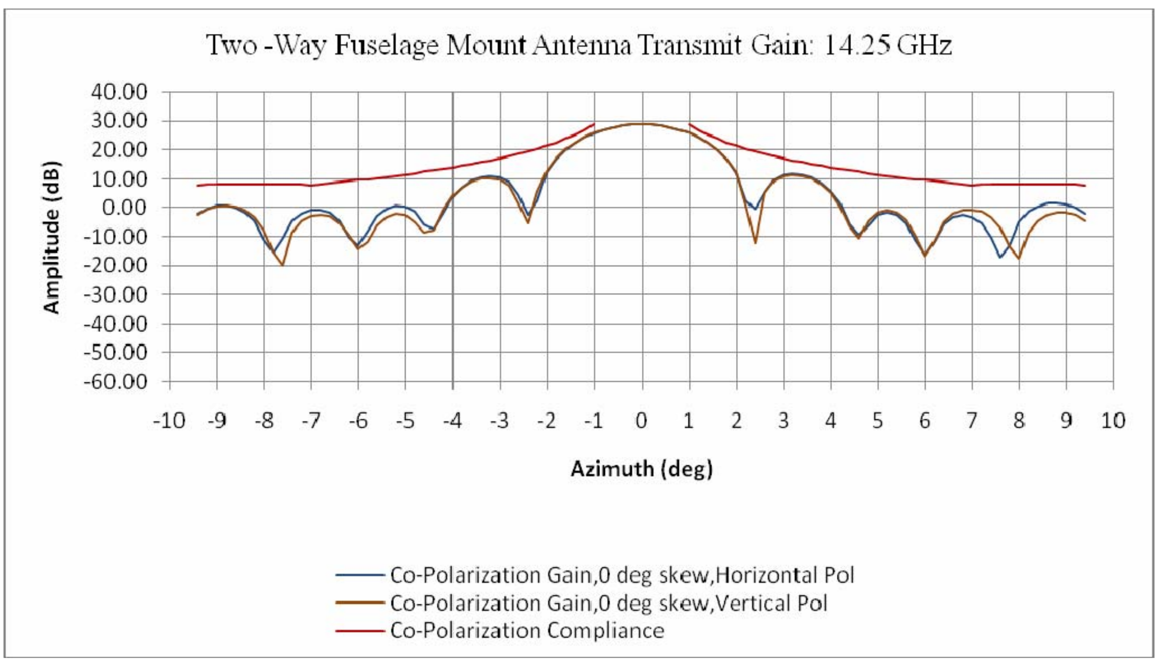

Figure A-3 Transmit Antenna Gain at 14.25 GHz for Vertical and Horizontal Polarization with 0 Degrees Skew and 25.209 Co-Pol Compliance (Expanded Azimuth)

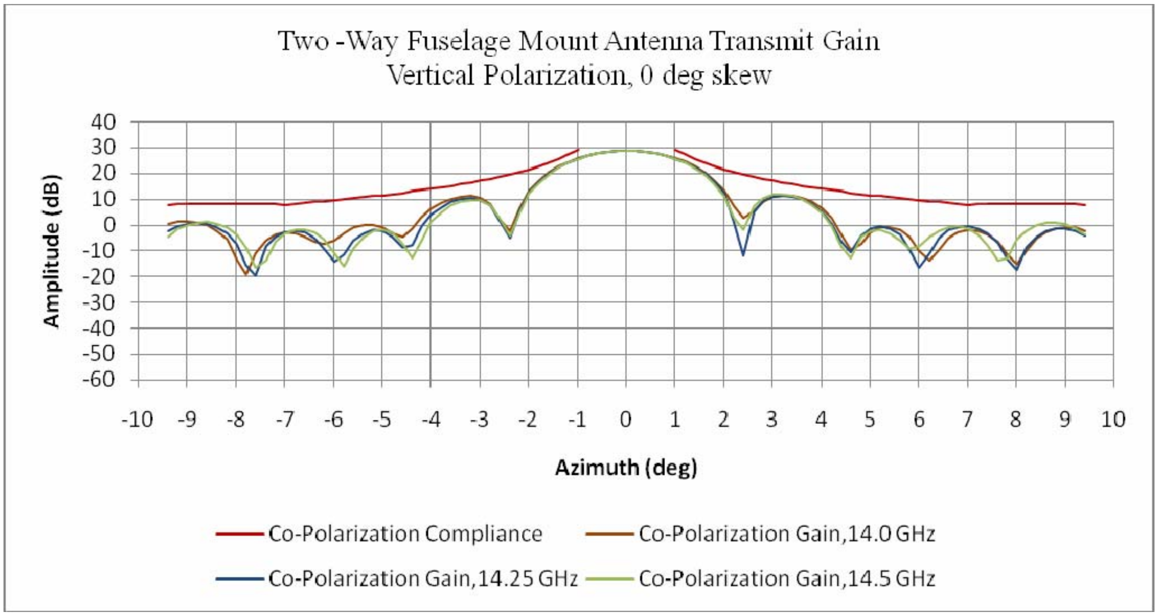

Figure A-4 Transmit Antenna Gain for Vertical Polarization at 14.0, 14.25 and 14.5 GHz with 0 Degrees Skew and 25.209 Co-Pol Compliance (Expanded Azimuth)

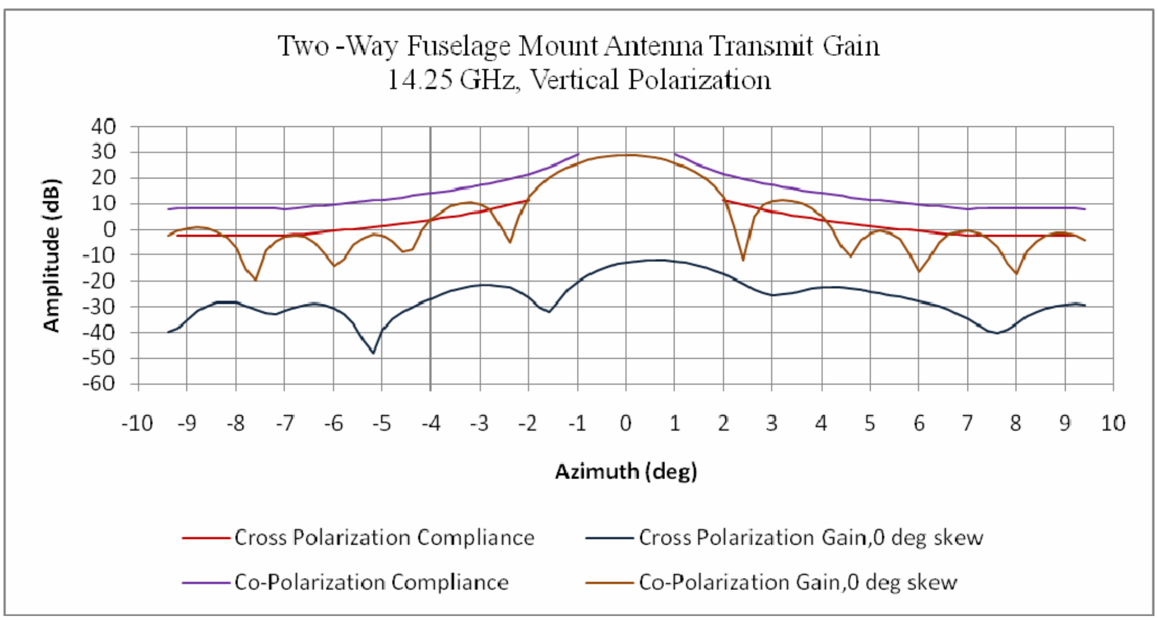

Figure A-5 Transmit Antenna Gain for Vertical Polarization at 14.25 GHz with 0 Degrees Skew and 25.209 Off-Axis Co-Pol and Cross-Pol Compliance (Expanded Azimuth)

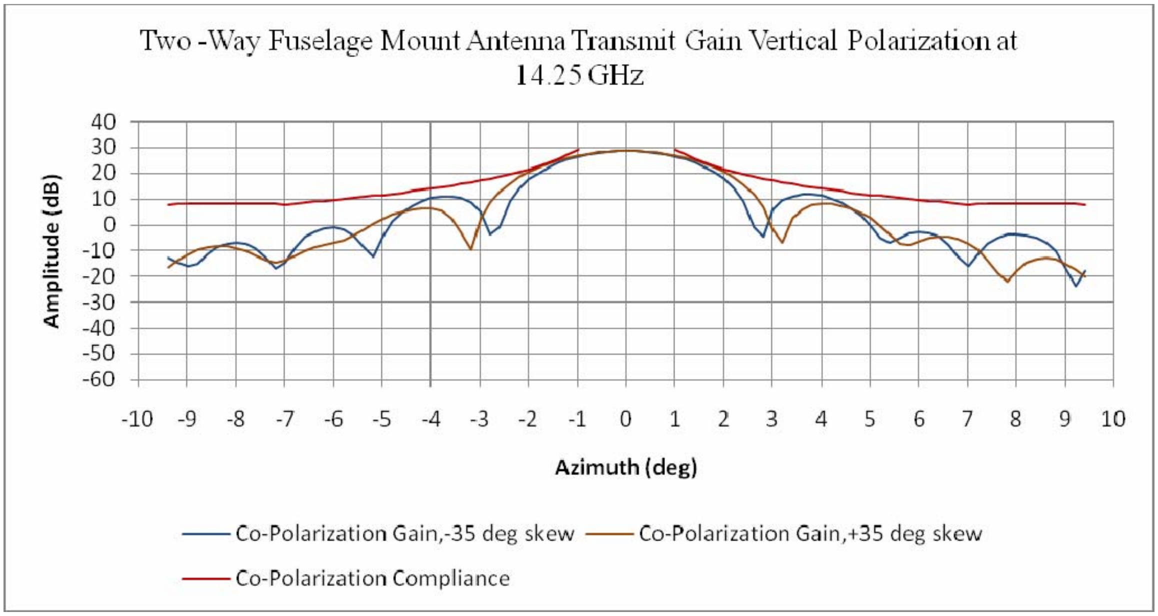

Figure A-6 Transmit Antenna Gain at 14.25 GHz for Vertical Polarization and +/-35 Degrees Skew and 25.209 Co-Pol Compliance (Expanded Azimuth)

Figure A-3 depicts transmit elevation plane patterns for both vertical and horizontal polarization over a +/-90 degree elevation at 14.25 GHz.

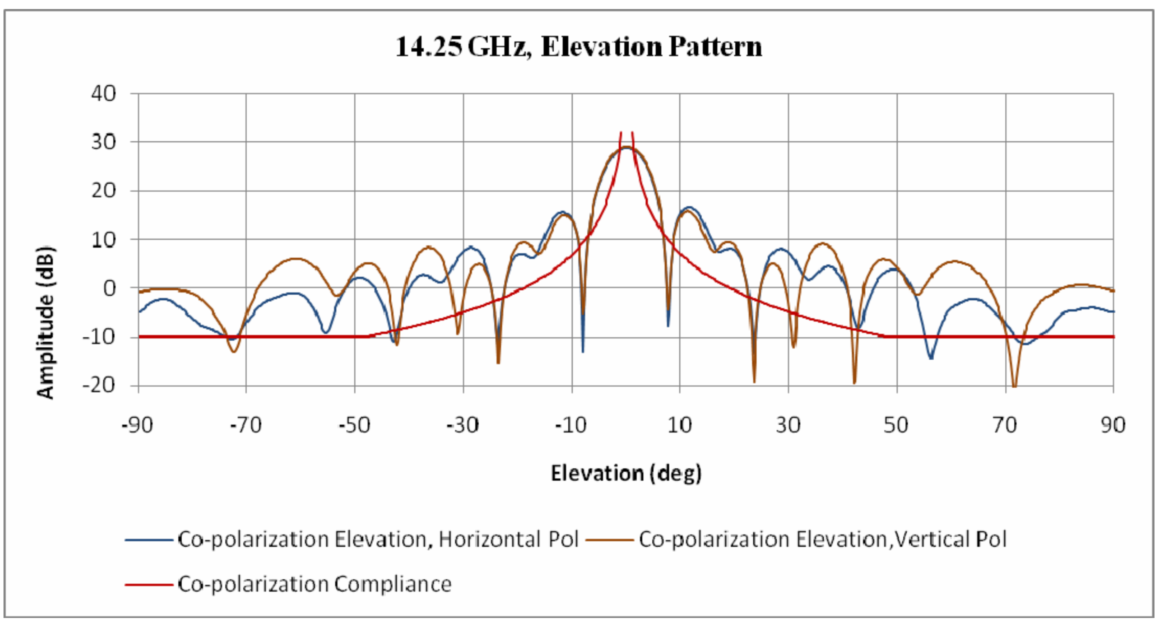

Figure A-7 Transmit Antenna Gain at 14.25 GHz for Vertical and Horizontal Polarization and 25.209 Compliance

In compliance with Section 25.222 of the FCC's Rules and ITU-R M.1643, Annex 1, Part A, Section 2, antenna pointing accuracy is controlled by the ACU to a pointing error of less than 0.2° between the orbital location of the target satellite and the axis of the main lobe of the antenna. All emissions automatically cease within 100 milliseconds if the angle between the orbital location of the target satellite and the axis of the main lobe of the antenna exceeds 0.5°, and transmission is not resumed until the angle is less than 0.2°.

Interference Protection-Terrestrial Sites

Row 44 complies with the out of band emissions requirements in Section 25.202(f) of the FCC's Rules. Row 44 is also cognizant of FCC rules for fixed satellite services and will operate on a non-interfering basis. For purposes of protecting radio astronomy sites, consistent with ITU Recommendation M.1643, Part C, Row 44 will limit aggregate power flux density (pfd) in the band 14.47 GHz to 14.5 GHz as follows:

-221 $dBW/m^2/Hz$ (for protection of Green Bank, Arecibo and Socorro)
-189 $dBW/m^2/Hz$ (for protection of 10 Very Long Baseline Array sites)

Row 44 has executed a coordination agreement with the National Science Foundation that establishes non-interfering operation with radio astronomy observations. *See* Exhibit 4.

Row 44 also acknowledges the utilization of the frequency band from 14.0-14.05 GHz and the possible use of the band from 14.05-14.2 GHz allocated to the National Aeronautics and Space Administration ("NASA") Tracking and Data Relay Satellite System ("TDRSS") for space research. NASA's protection limits specify that the interference threshold limit is -100 dBW in the 14.05-14.4 GHz band, -146 dBW/MHz in the 14.0-14.05 GHz band and -176 dBW/MHz in the 13.4-14.0 GHz band. Row 44 has discussed its planned operation with NASA and by terminating AES transmission in the vicinity of NASA sites located at White Sands, New Mexico and Blossom Point, Maryland, Row 44 will avoid interfering with these earth stations. In the event that Row 44 begins operation in the vicinity of Guam, it will also coordinate this operation with NASA to avoid unacceptable interference. Consistent with the requirements of ITU Recommendation M.1643, Part D, a coordination agreement between Row 44 and NASA has been executed. *See* Exhibit 5.

Finally, Row 44 recognizes that the FCC maintains multiple monitoring stations throughout the US where the received field strength at the monitoring stations must not exceed 10mV/m in the authorized bandwidth.

In summary, Row 44 will mute transmission at a range that would cause interference with any of the above identified terrestrial sites.

Interference Protection-Adjacent Satellites

Adjacent Satellite Interference (ASI) is mitigated by the sidelobe performance of the TECOM/QEST antenna. Satellites at 2° spacing have the greatest potential exposure to interference. It is unlikely that interference occurs for satellites with a spacing that is greater than 2° from the target satellite. Row 44 must ensure that:

- Interference to adjacent satellites and/or adjacent transponders within the same satellite does not occur during aircraft taxi, take-off, in-flight, and landing;
- Mispointing exceeding 0.2° or misorientation exceeding ±35° mutes the transmission.

Maximum EIRP

In compliance with Section 25.134 (g) (1) of the FCC's Rules, Row 44's maximum power spectral density at the antenna flange is -14 dBW/4kHz resulting in a maximum EIRP of 38.8 dBW. The EIRP density in a 4 kHz band for vertical and horizontal polarization at 14.25 GHz with 0 degrees skew is shown in Figure A-8.

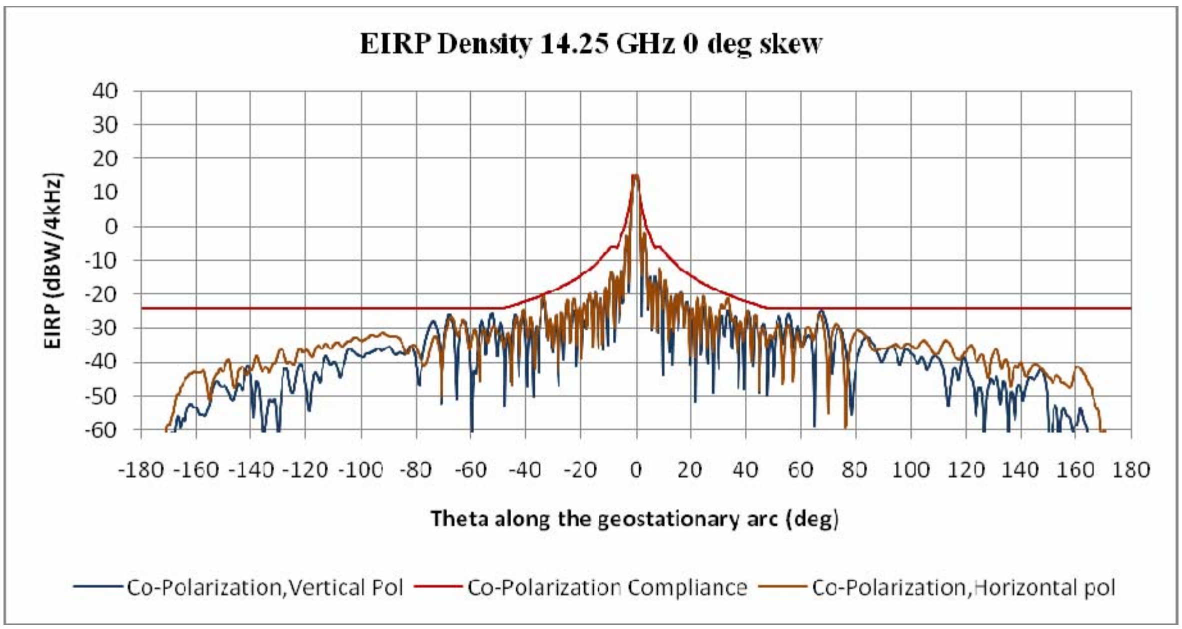

Figure A-8 EIRP Density for Vertical and Horizontal Polarization at 14.25 GHz with 0 Degrees Skew and 25.222 Compliance

3.0 Program Objectives

Row 44's system has several challenges to be met in order to most efficiently attain optimal performance. Although ground and airborne testing has demonstrated the viability of the system's operation, comprehensive performance assessment of the system has not been determined. Thus the following issues need to be evaluated under controlled conditions:

1. Antenna pointing accuracy during aircraft taxi, take-off, in-flight, and landing including the time to mute if the 0.5° accuracy requirement is exceeded

2. Adjacent satellite interference effects for satellites within 2° to 6° spacing of the target satellite in conditions requiring maximum transmitted power

3. Performance assessment at the edge of coverage and during handoff

4. Bit error rate (BER) performance in clear and severe weather situations

5. Doppler performance during rapid aircraft acceleration and high velocity operation

6. Range determination for interference mitigation at terrestrial sites including NASA TDRSS sites, NSF Radio Astronomy site and FCC monitoring sites

4.0 Contribution to the Development of the Radio Art.

Operation of airborne internet service is a new and burgeoning field where airlines anticipate a significant increase in passenger traffic as long as satisfactory experience is attained by users. To ensure that users are offered reliable service at speeds that are commensurate with their normal operation, extensive evaluation of the service must be determined prior to full scale commercial deployment. High speed service aboard a commercial aircraft via satellite is markedly dependent on the radio link performance, aircraft motion and airborne antenna dynamics and characteristics. In addition, this performance must not interfere with existing satellite and ground services making it imperative to identify any situations where interference might occur that require transmitter muting.