NARRATIVE DESCRIPTION AND PUBLIC INTEREST STATEMENT

Ground and Flight Testing of the eXConnect Ku-Band AMSS System

Panasonic Avionics Corporation ("PAC"), pursuant to Section 5.61 of the Commission's rules, 47 C.F.R. § 5.61, seeks experimental special temporary authority ("STA") for ground and flight testing of up to ten (10) aircraft earth stations ("AESs") of two AES types (up to 20 total) to further test and demonstrate the functionality of its eXConnect Ku-band Aeronautical Mobile-Satellite Service ("AMSS") system. This STA request is an expansion of existing experimental authority granted in Call Sign WD9XQT (File No. 0200-EX-ST-2009), which enables ground testing of eXConnect AESs through December 1, 2009. PAC seeks to maintain such ground test authority but add flight test authority commencing no later than October 1, 2009.

I. INTRODUCTION

As the Commission is aware, PAC, a leading provider of in-flight entertainment ("IFE") systems, is developing the eXConnect Ku-band AMSS system to provide satellite-based broadband connectivity to commercial aircraft. eXConnect will provide broadband Internet access, real-time video content, voice and other services aboard commercial aircraft. Passengers may use these services for entertainment and to enhance productivity. These services will also be available to the crew and will enable a range of airline operational and administrative applications, allowing airlines to operate more effectively and efficiently.

The eXConnect system will use Ku-band Fixed-Satellite Service ("FSS") satellites under an existing domestic and international secondary allocation to Mobile-Satellite Service ("MSS") in the 14.0-14.5 GHz band. Adjacent FSS satellites will be protected from harmful interference by limiting the off-axis EIRP spectral density along the GSO arc to no more than the levels permitted for routinely licensed Ku-band VSAT terminals. eXConnect will also protect radio astronomy and space service operating in the Ku-band by limiting emissions in the vicinity of these stations and, when necessary, automatically inhibiting emissions. The technical aspects of the eXConnect system are discussed in detail in the attached Technical Appendix.[1]

There is ample precedent for granting PAC an experimental license to perform this testing based on prior authority for Ku-band AMSS experimental operations granted to Boeing (Call Sign WC2XVE), ARINC (Call Sign WC2XPE), Hughes Network Systems (Call Sign WE2XEW) and, of course, PAC itself (Call Sign WD9XQT).

II. BACKGROUND

On December 2, 2008, the Commission granted PAC a six-month STA (Call Sign WD9XQT) to conduct ground testing of up to five (5) Ku-band transmit/receive terminals for testing and demonstration purposes. PAC's STA application listed one (1) Aura LE aircraft earth station ("AES") manufactured by EMS Technologies. PAC further explained that, although these terminals were being evaluated for use in the AMSS context, its application requested temporary authority for ground testing only. The proposed experimental operations were to be conducted at and around specified test facilities for a very limited duration (*e.g.*, several hours per test session) and scheduled intermittently during the six (6) month authorization of the STA. The experimental STA was renewed on June 1, 2009 to permit further ground testing of the antenna.

On February 5, 2009, PAC filed a Section 5.77 notice (47 C.F.R. § 5.77) in connection with Call Sign WD9XQT to inform the Commission that it intended to test two terminals not specifically listed in its original STA application: AESs manufactured by TECOM Industries and Mitsubishi Electric Corporation ("MELCO"). PAC does not intend

[1] *See* Exhibit 1.

to conduct ground or flight testing of the TECOM antenna under the requested experimental STA.

PAC provided detailed technical information on the Aura LE antenna in its original experimental STA filing, which is hereby incorporated by reference.[2] Additional technical data regarding the antenna, as well as information on the MELCO antenna, is provided in the Technical Appendix attached hereto.

III. DESCRIPTION OF PROPOSED EXPERIMENTAL OPERATIONS

PAC seeks to conduct ground and flight testing throughout the continental United States ("CONUS"), subject to protection of U.S. Government radio astronomy and space research operations. PAC recognizes and accepts that any experimental STA authority will be conditioned upon coordination with and/or protection of these co-frequency operations.[3] The general objectives of the testing to be carried out under this experimental STA include: (i) integrating and testing the Aura LE and MELCO terminals and eXConnect network; (ii) demonstrating two-way data service from an in-flight aeronautical mobile platform; (iii) validating the predicted performance of the system; (iv) demonstrating that the system meets the established interference requirements for Ku-band AMSS systems; and (v) conducting limited market studies of the system to verify commercial and technical viability in trial roll-out periods.

A. Ground Testing

PAC seeks to retain experimental authority to conduct ground testing of the Aura LE and MELCO antennas in three modes: (i) fully stationary; (ii) mounted on a three-axis motion

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[2] *See* ELS File No. 0544-EX-ST-2008.

[3] *See* 47 C.F.R. § 5.111(a)(2); *see also* 47 C.F.R. § 25.222 (analogous rules governing Ku-band earth stations onboard vessels).

platform that simulates aircraft yaw, pitch and roll; and (iii) on a ground vehicle rooftop for in-motion testing.

Extensive receive-only tests also will be conducted to verify antenna performance and subsystem integration prior to any transmit operation. Two-way tests requiring transmit operation will then be performed to evaluate, optimize and demonstrate return link performance as well as the passenger experience with fixed, ground-based terminals.

With respect to vehicle-mounted tests, limited operations will occur subject to limitations set forth in coordination agreements and FCC rules provisions designed to protect radio astronomy sites and the Tracking and Data Relay Satellite System (TDRSS) sites for space research at White Sands, New Mexico and the US Naval Research Lab at Blossom Point, Maryland.[4] Additional coordination with NSF to avoid experimental operations during period of RAS observations, as well as with NASA, will further ensure that there is no potential for interference from PAC's planned experimentations.

B. Flight Testing

PAC also seeks authorization to conduct flight testing under the requested STA. Testing will involve deploying the Aura LE AES on a single test aircraft (provisionally a Boeing Business Jet 737 aircraft) and a MELCO antenna on an existing commercial airline installation. Initial testing will involve single beam coverage. Subsequent testing will support iDirect automatic beam switching.

PAC will conduct flight testing only in areas that are outside exclusion zones for radio astronomy sites (during observations) and NASA TDRSS sites, and in accordance with applicable coordination agreements and FCC rules. In addition, PAC may conduct flight

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[4] In conjunction with its STA application, PAC has contacted NASA and the National Science Foundation to initiate coordination discussions for both on-ground and in-flight operations. PAC will accept technical limitations imposed on other Ku-band land-mobile and AMSS operations necessary to protect RAS and TDRSS operations.

tests in international airspace (e.g., over the Pacific Ocean off the coast of California near PAC's headquarters).

The following performance objectives will be examined in connection with flight testing:

- hand-off performance;
- geographic mapping and automated shut-off;
- reliability of data link;
- two-way data link performance and coverage;
- receive-only video link performance and coverage;
- antenna performance;
- Doppler correction; and
- network management and operation.

This testing will be very limited in duration (several days of testing over the six-month STA period). In all cases, the aircraft will operate in selected test conditions in a dedicated manner under close control of PAC's network control personnel.

IV. LIMITED MARKET STUDIES

PAC also seeks authorization to conduct limited market studies pursuant to Sections 5.3(j) and 5.93 of the Commission's Rules, 47 C.F.R. §§ 5.3(j), 5.93. PAC is in advanced discussions with potential participants in limited trials of its AMSS terminals, some of which are seeking market-test and operational data regarding terminal capabilities. PAC intends to use the limited market studies to demonstrate the potential uses and performance of its terminals, and to collect engineering and operational data regarding these uses.

A. Limited Market Study Authority

PAC proposes a limited market study designed to evaluate the commercial viability and usage characteristics of its land mobile terminals in various applications, including government vehicles, passenger vehicles and trains. Through the study, PAC seeks to obtain information regarding the frequency and duration of use in in-flight and on-ground modes, data rates achieved to and from aircraft and aggregate data rates achieved in the network.

PAC also seeks to validate the network's performance by collecting data relating to quality of service, including bit error rates, latency and possible degradation of service at the edge of service contours.

The Commission has previously permitted limited market studies in the context of experimental AMSS operations. *See* ARINC Experimental Authorization, Call Sign WC2XPE. Furthermore, consistent with Section 5.93(b) of the Commission's Rules, PAC will inform its trial partners and the users involved with testing that the land mobile service is being provided only on a test basis under an experimental authorization, is being offered only on a strictly temporary basis, and that PAC has not yet received Commission approval for the offering of a long-term commercial service. PAC intends to obtain long-term authority subject to license requirements and AMSS licensing and service rules adopted by the Commission.

B. Request for Limited Waiver of 47 C.F.R. §5.93(a)

PAC seeks a limited waiver of 47 C.F.R. §5.93(a) in connection with its request for limited market study authority. Section 5.93(a) provides that an experimental licensee shall own the transmitting and/or receiving equipment used in the study. This restriction was adopted to help ensure that experimental licensees did not deploy full commercial operations in the U.S. market under experimental authority that would otherwise require a commercial license.[5] In addition to the equipment ownership limitation, specific size and scope limitations on limited market studies also serve to protect the same interest.[6]

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[5] *See Amendment of Part 5 of the Commission's Rules to Revise the Experimental Radio Service Regulations*, ET Docket No. 96-256, Report and Order, FCC 98-283 (rel. Oct. 27, 1998) at 7-8.

[6] *Id.*

Certain of PAC's potential trial partners are foreign airlines that are primarily subject to the licensing authority of their registering nations,[7] which do not impose the equipment ownership limitations for trial operations set forth in 47 C.F.R. §5.93(a). The only time when foreign aircraft would be directly affected by this restriction is when such aircraft are temporarily located within U.S. territory (within U.S. airspace or on the ground). Moreover, one foreign airline partner already owns MELCO antenna equipment purchased several years ago in the context of implementing the previously authorized Connexion by Boeing service. Given the limited and intermittent presence of foreign airline partners in U.S. jurisdiction during the proposed limited market study period, and given that one foreign airline partner already owns AES equipment to be used with the trial operations, PAC respectfully requests that the equipment ownership restriction set forth in 47 C.F.R. §5.93(a) be waived for limited market studies with foreign airline partners.[8]

The Commission has the authority to waive its rules for good cause.[9] *WAIT Radio* establishes that the Commission may grant a waiver if special circumstances warrant a deviation from the general rule and the deviation would serve the public interest.[10] In this case, the circumstances are significantly different than those sought to be addressed by 47 C.F.R. §5.93(a).

PAC does not seek to market its equipment or services in the United States or to U.S. airline customers on a commercial basis, or to otherwise circumvent FCC commercial license

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[7] Based on Article 30 of the Chicago Convention and Articles 18.1, 18.8 and 18.11 of the ITU Radio Regulations, foreign-registered aircraft are considered the responsibility of the state of the aircraft's registry although they musty comply with the regulations of other nations overflown by the aircraft.

[8] PAC does not seek a waiver of this rule with respect to potential U.S. airline partners.

[9] 47 C.F.R. § 1.3.

[10] *WAIT Radio, Inc. v. Federal Communications Comm'n*, 418 F.2d 1153, 1157-59 (D.C. Cir. 1969).

requirements. PAC recognizes the equipment ownership restriction applies to limited market studies on U.S. airlines and does not seek a waiver of the provision for operations with U.S. airlines. Instead, PAC seeks a limited waiver for equipment installed on *foreign airlines only* that would not otherwise be subject to the ownership restriction anywhere else in the world. Imposing the restrictions of Section 5.93(a) when foreign aircraft are temporarily present within U.S. territory would unduly limit the proposed limited market studies on flights to and from the United States, thereby undermining the operational testing and market information to be derived from such studies.

It is also plainly contrary to the public interest to impose the restrictions of Section 5.93(a) on PAC where a foreign airline trial partner previously purchased the MELCO antenna equipment from a former AMSS network operator. PAC did not sell the equipment in the first instance, is not seeking to provide full commercial service using the equipment at this time and cannot be expected to buy the equipment from its present airline owner to perform experimental testing and limited market studies only to sell the same equipment back if such trials lead to full commercial implementation. Moreover, a foreign airline's ownership and past use of the equipment does not diminish the need for testing and limited market studies with the eXConnect system. Rather, testing equipment designed for a prior AMSS network is essential to ensure technical and commercial compatibility of such equipment with the eXConnect system.

For all of these reasons, granting a limited waiver of Section 5.93(a) for limited market studies with foreign airline partners only would serve the public interest in the unique circumstances of this case, and would not otherwise undermine the purposes of the rule.

V. SATELLITES AND HUB EARTH STATIONS

PAC will utilize commercial FSS satellite capacity to conduct its experimental operations. Specifically, capacity will be leased on the Horizons 1, Galaxy 16, Telstar 11N, Telstar 14 and/or GE-23 satellites and coordinated with adjacent satellite operators within +/-6 degrees of each satellite. PAC will not commence operations with these satellite points of communications until the operations hae been coordinated and PAC will file the relevant satellite operator coordination affidavits in the record of this proceeding. Communication with these satellites is essential to the experimentations to confirm that the eXConnect terminals can effectively communicate with existing satellites of various operators in diverse geographic regions to ensure efficient and interference-free operations once the PAC commences full commercial operations.[11]

The hub earth stations for the proposed experimental operations are located at Atlanta, Georgia (serving Galaxy 16), Holmdel, New Jersey (serving Telstar 11N and 14), Steele Valley, California (serving Horizons 1) and Brewster, Washington (serving GE-23). These earth stations are licensed as FSS earth stations and are connected to eXConnect network control facilities. Network control of eXConnect operations will be provided pursuant to PAC's direction and control from a Network Operations Center in Miramar, Florida.

VI. PROTECTION OF OTHER USERS IN THE 14.0–14.5 GHZ BAND

Protection of Fixed-Satellite Service. The FCC has not yet established service rules applicable to AMSS terminal operations, but interference considerations are analogous to those that currently apply to mobile ESVs set forth in 47 C.F.R. § 25.222. PAC's terminals will operate in such a manner that the off-axis EIRP levels are no greater than the levels produced by routinely licensed VSAT earth stations. This is consistent with past FCC licensing conditions in the AMSS context. To the extent that any adjacent satellite operator

[11] Operation only with other experimental stations would plainly not be adequate for PAC's experimentations since Ku-band AMSS terminals must communicate using Ku-band FSS satellites. *See* 47 C.F.R. § 5.125.

experiences unacceptable interference from PAC's experimental operations, PAC will cease terminal transmissions immediately.[12]

Protection of Potential NGSO FSS Systems. Panasonic acknowledges that non-geostationary orbit ("NGSO") systems are also permitted to operate in the Ku-band. However, no such systems are currently authorized or plan to operate within the period contemplated for the proposed experimental operations.

Protection of Terrestrial Radio Services. PAC has examined current spectrum use in the 14.0-14.5 GHz band and has determined that there are no active FCC-licensed terrestrial services in this band in North America with which its proposed operations could conflict.

Protection of the Radio Astronomy Service. For purposes of protecting radio astronomy sites, consistent with Recommendation ITU-R M.1643, Part C, PAC will limit aggregate power flux density (pfd) in the band of 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 all other Radio Astronomy sites)

For purposes of this experimental STA application, PAC terminals will not operate within line-of-sight vicinity of Radio Astronomy sites and during observation periods.

Protection of Space Research Service. PAC recognizes 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 conducted at White Sands, New Mexico and Blossom Point, Maryland. For purposes of this experimental STA application, PAC will avoid AES operation within line-of-sight vicinity of these earth stations.

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[12] *See* 47 C.F.R. § 5.111(a)(2).

VII. SUPERVISION AND CONTROL

For purposes of these experiments, the PAC terminals will be operated under PAC's full supervision and control. The point of contact for the planned experimental operations is:

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Systems Engineering
eXConnect
Office: +1 (949) 672-2589
Cell: +1 (760) 685-3273
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Panasonic Avionics Corporation
26200 Enterprise Way
Lake Forest, CA 92630
paul.sarraffe@panasonic.aero

This contact will have access to all network functions, and will have the ability and authority to cease all transmissions from the terminals wherever they are located.

VIII. CONCLUSION

Grant of this experimental license and associated waiver request will allow Panasonic to further develop and demonstrate the eXConnect AMSS system and confirm the operational characteristics of the system. The eXConnect system combines available Ku-band satellite capacity and proven waveforms with high-performance antennas to provide cost-effective, broadband AMSS service to passengers and crew onboard commercial aircraft. eXConnect has been designed to protect other uses in the Ku-band from interference and will make use of an existing secondary allocation to AMSS in the Ku-band. There is ample precedence for granting this experimental authority and it is clearly in the public interest to do so.

EXHIBIT 1

Exhibit 1
Technical Description of the eXConnect System

Panasonic Avionics Corporation ("PAC") seeks experimental special temporary authority ("STA") for ground and flight testing of up to ten (10) aircraft earth stations ("AESs") of two AES types (up to 20 total) to further test and demonstrate the functionality of its eXConnect Ku-band Aeronautical Mobile-Satellite Service ("AMSS") system. This Technical Description expands on the prior information provided in connection with grant of experimental STA Call Sign WD9XQT (File No. 0544-EX-ST-2008), which is hereby incorporated by reference.

1. The eXConnect System

A system block diagram for the eXConnect Ku-band AMSS system is shown in Figure 1. The system consists of up to five previously authorized Aura LE and five MELCO terminals, leased satellite capacity on a commercial Ku-band FSS satellite and a gateway earth station facility. PAC seeks experimental authority to test and demonstrate the eXConnect terminals only, but provides a full eXConnect system description to convey the operating and control parameters of the system.

The Aura LE terminal is a dual-panel, mechanically steered antenna, which has been specifically designed for the aeronautical environment (*see* Section 3.1). The terminal's broadband controller ("BC") will contain a DVB-S2 receiver, an iDirect Deterministic Time Division Multiple Access waveform (D-TDMA) modulator and control and routing capabilities (*see* Section 3.2). The BC will interface with the aircraft cabin distribution system and in-flight entertainment system.

The MELCO reflector antenna is a mechanically-steered Cassegrain antenna with an elliptical profile to be compatible with installation on an aircraft. The MELCO reflector antenna has been installed on over 100 passenger aircraft and has a proven history performance and reliability. This antenna has been previously licensed by the FCC for AMSS service in the United States and by other countries around the world.

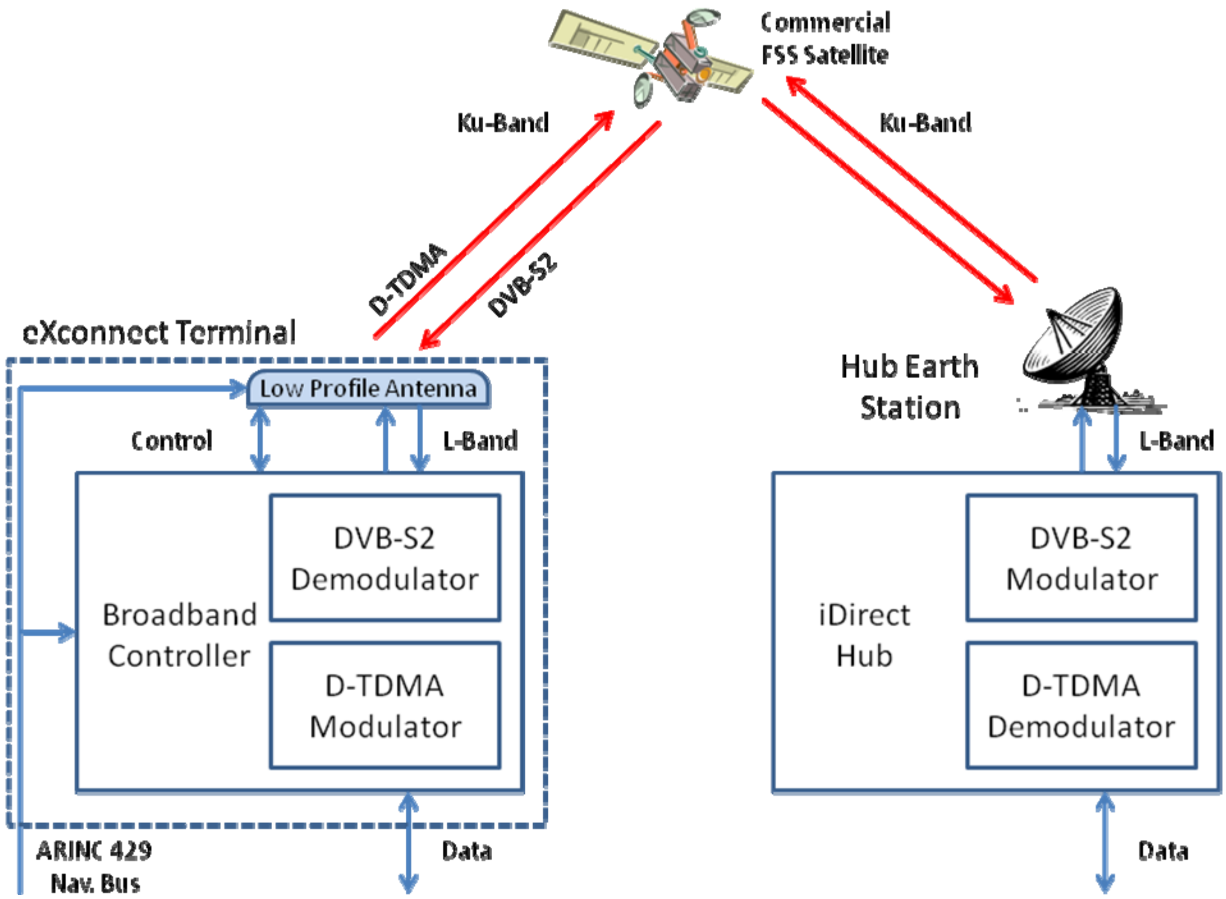

Figure 1 eXConnect System Block Diagram

Commercial FSS satellite capacity will be leased on the Horizons 1, Galaxy 16, Telstar 11N, Telstar 14 and/or GE-23 satellites, many of which have provided service for similar mobile Ku-band applications. PAC is in the process of obtaining affidavits from the operators of these satellites demonstrating that the proposed flight test operations have been coordinated with other satellite operators within +/- 6 degrees from the serving satellites. PAC will submit such affidavits in the record of this proceeding once finalized.

The forward (hub-to-terminal) link will consist of a single DVB-S2 carrier which may occupy up to a full transponder may operate at up to 2.04 Mbps (*see* Section 2.1). The return (terminal-to-hub) link will consist of one or more iDirect D-TDMA in-routes (see Section 2.2), which may be shared by multiple terminals on a TDMA basis. The return link will operate at up to 384 kbps under this experimental.

The hub earth stations for the proposed experimental operations are located at Atlanta, Georgia (serving Galaxy 16), Holmdel, New Jersey (serving Telstar 11N and 14), Steele Valley, California (serving Horizons 1) and Brewster, Washington (serving GE-23). These earth stations are licensed as an FSS gateways and will include an iDirect hub which consists of a DVB-S2 forward link modulator and an iDirect D-TDMA demodulator (*see* Section 2.3). Network control of experimental eXConnect operations will be provided pursuant to PAC's direction and control from a Network Operations Center in Miramar, Florida.

Operation of the system will be controlled so as to prevent interference to other users of the Ku-band. Principally, this will be accomplished by controlling the off-axis EIRP spectral density emissions of the terminal along the GSO arc to protect adjacent FSS satellites, and by frequency avoidance and/or exclusion zones with respect to radio astronomy and space research sites. In this connection, subject to further coordination of limited flight test operations with NASA and the National Science Foundation ("NSF"), PAC will accept the restrictions in its existing experimental STA and those set forth in Section 25.222 of the Commission's rules for analogous Ku-band operations of earth stations onboard vessels ("ESVs").[1]

Prior to obtaining new coordination agreements with the NSF and NASA, the eXConnect terminal will not be operated within line of sight or other distance specified in the Commission's rules of any radio astronomy station (during observations) or space research earth station. The broadband controller within the terminal will inhibit transmissions when within line of sight of these facilities based on navigation data received from the aircraft navigation bus. Once coordination agreements are in place with the NSF and NASA, the terminal will be operated in accordance with those agreements.

Off-axis EIRP spectral density will be controlled through the directivity of the antenna, limitations on the transmit power spectral density, control of pointing error and control of skew angle relative to the serving satellite orbital location. The capability of the terminal to limit off-axis EIRP spectral density is discussed further in Section 3.

2. Network Description

The eXConnect system will be implemented using iDirect network technology. iDirect provides satellite network technology that has been used for a wide range of Ku-band FSS networks, including mobile applications such as ESVs. The use of proven network technology with proven control and monitoring protocols minimizes the risk of interference. The following sections discuss the forward link, return link and hub used for eXConnect experimental operations.

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[1] PAC references Section 25.222 governing Ku-band ESV licensing as a general guide to provisions that may be useful in ensuring that Ku-band AMSS systems operate without causing harmful interference to co-frequency operations. However, PAC is not applying under nor is AMSS operating authority available under Section 25.222 of the Commission's rules.

eXConnect will leverage existing satellite capacity on Ku-Band FSS satellites and proven waveforms - DVB-S2 and iDirect's D-TDMA - to provide these services at minimum cost and risk. Using existing waveforms will minimize development cost. DVB-S2 is a highly efficient waveform that is used widely in the FSS industry and will be used for the forward link. iDirect's D-TDMA waveform, which will be used for the return link, is well-established waveform for FSS applications and has also been widely used for mobile applications. In particular, iDirect's D-TDMA waveform is already used for ESV applications and supports spread spectrum for small mobile terminals so it is ideal for a Ku-band AMSS applications.

2.1. Forward Link

The forward link will consist of a single DVB-S2 carrier which may occupy up to a full transponder and operate in saturation. Data may be multiplexed on this carrier for multiple terminals. DVB-S2 is a widely adopted standard for digital data and video broadcasting over satellite. The DVB-S2 standard supports Adaptive Coding and Modulation (ACM) with QPSK, 8PSK, and 16APSK modulations and Low Density Parity Check Coding rates between 0.25 and 0.9. The forward link is not being licensed under this experimental application but will operate at up to 2.04 Mbps.

2.2. Return Link

The return link will use iDirect's proprietary D-TDMA. D-TDMA supports multi-frequency (MF) TDMA sharing of return link carriers, although the eXConnect terminal will be assigned to only one in-route carrier with fixed data rate, modulation and coding parameters. Frequency and time slot parameters are managed by the iDirect hub. Terminal transmit EIRP is also power controlled so that the minimum power is used to close the satellite link. D-TDMA supports BPSK, QPSK and 8PSK modulations, turbo code rates between 0.431 and 0.793, and spread spectrum factors between 1 and 16. The return link will operate at up to 1024 kbps under this experimental authority using occupied bandwidths between 160 kHz and 5.12 MHz (emissions designators 160KG7D to 5M12G7D).

2.3. Hub Earth Station

The hub earth station consists of licensed gateways located at Atlanta, Georgia (serving Galaxy 16), Holmdel, New Jersey (serving Telstar 11N and 14), Steele Valley, California (serving Horizons 1) and Brewster, Washington (serving GE-23), an iDirect hub at each location, and the interface to the Internet and other content sources. The iDirect hub will consist of a DVB-S2 modulator and an iDirect D-TDMA demodulator. Operation of the hub earth station and the network will be controlled by a Network Operations Center (NOC) in Miramar, Florida subject to PAC's direction and control. The NOC will maintain the ability to inhibit transmissions from any terminal in the network, including the hub and eXConnect terminal, at any time.

3. Terminal Description

3.1. Antennas

PAC seeks to test and demonstrate the Aura LE antenna, developed by EMS Technologies, under this experimental STA.[2] The Aura LE antenna is a mechanically steered, flat-plate AES with two transmit/receive apertures. At most elevation angles, both apertures are coherently combined to form a beam. At low elevation angles, only a single aperture is used. This allows the antenna to maintain high performance over a large range of elevation angles between 5 degrees and 90 degrees in flight (10 degrees on the ground) while maintaining a low profile for aerodynamic integration with an aircraft. The Aura LE was previously examined by the Commission and authorized in experimental STA Call Sign WD9XQT (File No. 0544-EX-ST-2008). The basic characteristics of the antenna are summarized in Table 1.

In addition, the MELCO reflector antenna was developed by Mitsubishi Electronics Company for the Connexion by Boeing AMSS system.[3] It is a mechanically-steered Cassegrain antenna with an elliptical profile designed to be compatible with installation and operation onboard an aircraft. The MELCO antenna was previously examined by the Commission and authorized in experimental Call Sign WC2XVE (File No. 0002-EX-PL-2004) and commercial blanket license Call Sign E000723 (File No. SES-MOD-20030512-00639). The basic characteristics of the MELCO antenna are also summarized in Table 1.

Table 1. Aura LE and MELCO Antenna Characteristics

Characteristic	EMS Aura LE	MELCO Reflector
Frequency	Tx: 14.0 GHz to 14.5 GHz Rx: 10.7 GHz to 12.75 GHz	Tx: 14.0 GHz to 14.4 GHz Rx: 11.2 GHz to 12.8 GHz
Aperture Size	2 Apertures of 35" X 6" each	25.6” X 7.7”
EIRP	42.5 dBW @ 5 deg Elevation 48.0 dBW @ 90 deg Elevation	47.2 dBW
G/T	11 dB/K @ 5 deg Elevation 14 dB/K @ 90 deg Elevation	8.0 dB/K @ 11.2 to 11.7GHz 9.3 dB/K @ 11.9 to 12.8GHz
Tracking Rate	40 deg/sec in Azimuth 25 deg/sec in Elevation	40 deg/sec in Azimuth 25 deg/sec in Elevation
Az Pointing Accuracy	0.2 deg 1-sigma	0.25 deg 1-sigma
Antenna Patterns	*See* Appendix A	*See* Appendix B

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[2] A Radiation Hazard analysis for the Aura LE is included as Exhibit 1a.

[3] A Radiation Hazard analysis for the MELCO Reflector is included as Exhibit 1b.

Both the MELCO and Aura LE antennas are designed to maintain pointing towards the intended satellite through the full range of maneuvers carried out by commercial aircraft. The antennas are pointed based on aircraft position and attitude information obtained from the ARINC 429 data bus, which is standard on commercial aircraft. This information is augmented with higher rated data from an inertial sensor package that is integrated with the antenna and compensates for INS errors that result from latency and bending of the airframe between the aircraft INS unit and the antenna. The pointing accuracy of the MELCO reflector is 0.25 deg 1-sigma and the pointing accuracy of the EMS Aura LE antenna will be less than 0.2 deg 1-sigma. Pointing error will be continuously monitored and if it ever exceeds 0.5 degrees, then transmissions will be automatically inhibited within 100 ms.[4]

3.2. Broadband Controller

The Broadband Controller ("BC") contains the modem and control functionality of the terminal. The modem will include a DVB-S2 demodulator and iDirect D-TDMA modulator. With respect to control functionality, the BC includes the ability to inhibit transmissions as a function of location and skew angle, control transmit power and select the serving satellite as a function of location.

The ability to inhibit transmission by location is essential to protecting Radio Astronomy and Space Research. Prior to obtaining further coordination with the NSF and NASA, the terminal will inhibit transmissions when within line of sight at altitude of any Radio Astronomy site (during observations) and Space Research site based on maps that will be preloaded onto the BC. The ability to inhibit transmission as a function of skew angle and control transmit power is essential for controlling the off-axis EIRP spectral density projected along the GSO arc (*see* Section 3.3 for more details). Skew angle control will be enforced regardless of whether the skew angle results from the location of the aircraft with respect to the satellite or the attitude of the aircraft. Finally, the BC will select the serving satellite based on preloaded maps.

3.3. Off Axis-EIRP Control

Control of off-axis EIRP spectral density is essential to protect adjacent satellites operating in the Ku-band. The eXConnect system will control the off-axis EIRP spectral density generated by a single terminal so that it is no greater than is accepted for Ku-band terminals under Part 25. Terminals do not operate on a co-frequency basis so management of aggregate emissions is not required.

The Commission's off axis EIRP spectral density limits are defined by Section 25.222 for analogous ESV operations (*see also* Section 25.218(f)(1), where N = 1 for TDMA) and the

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[4] *See* 47 C.F.R. § 25.222(a)(7) (rule governing Ku-band ESVs).

terminal may be mispointed by up to 0.2 degrees. The effective off-axis EIRP spectral density generated by a conforming terminal will be:

15–25log10 (Θ + 0.2)	dBW/4 kHz	For	1.5° ≤ Θ ≤ 7°
−6	dBW/4 kHz	For	7° < Θ ≤ 9.2°
18–25log10(Θ + 0.2)	dBW/4 kHz	For	9.2° < Θ ≤ 48°
−24	dBW/4 kHz	For	48° < Θ ≤ 85°
−14	dBW/4 kHz	For	85° < Θ ≤ 180°

The eXConnect system will limit off-axis EIRP spectral density to no more than this level by:

- Limiting transmit power spectral density by controlling the transmit power of the terminal and by selecting appropriate in-route carrier bandwidths.
- Controlling the off-axis gain of the antenna along the GSO by inhibiting transmissions when the skew angle exceeds a specified threshold.
- Controlling pointing error and inhibiting transmissions when the pointing error exceeds a threshold of 0.5 deg.

The specific transmit power, bandwidth and skew angle thresholds will be selected based on the desired terminal transmission rates, coverage area, and satellite performance. Higher transmit power and narrower bandwidth will result in a more restrictive skew angle threshold.

An example of off-axis EIRP control is shown in Figures 2 and 3 for the MELCO and Aura LE antennas, respectively. These off-axis EIRPs are based on the specific link parameters shown in the link budget in Section 4. They represent edge of beam cases where the terminal is operating with a 3.76 MHz carrier bandwidth and a skew angle threshold of 30 degrees. The terminal off-axis EIRP spectral density, shown in the solid red line, remains well below the 25.218(f)(1) off-axis EIRP spectral density limit, shown in the solid blue line. Even with the mispointing of the terminal at the point where it automatically inhibits transmissions – 0.5 deg pointing offset – the off-axis EIRP spectral density of the terminal, shown in the dashed red line, remains below the off-axis EIRP spectral density of a conforming FSS terminal which is mispointed by 0.2 degrees.

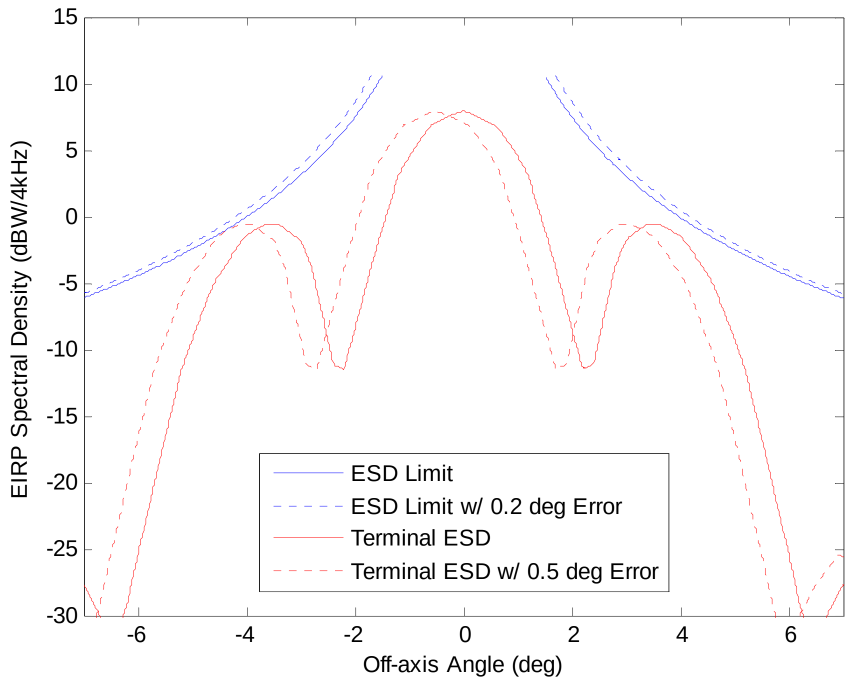

Figure 2 Maximum Off-Axis EIRP Spectral Density for the MELCO Antenna

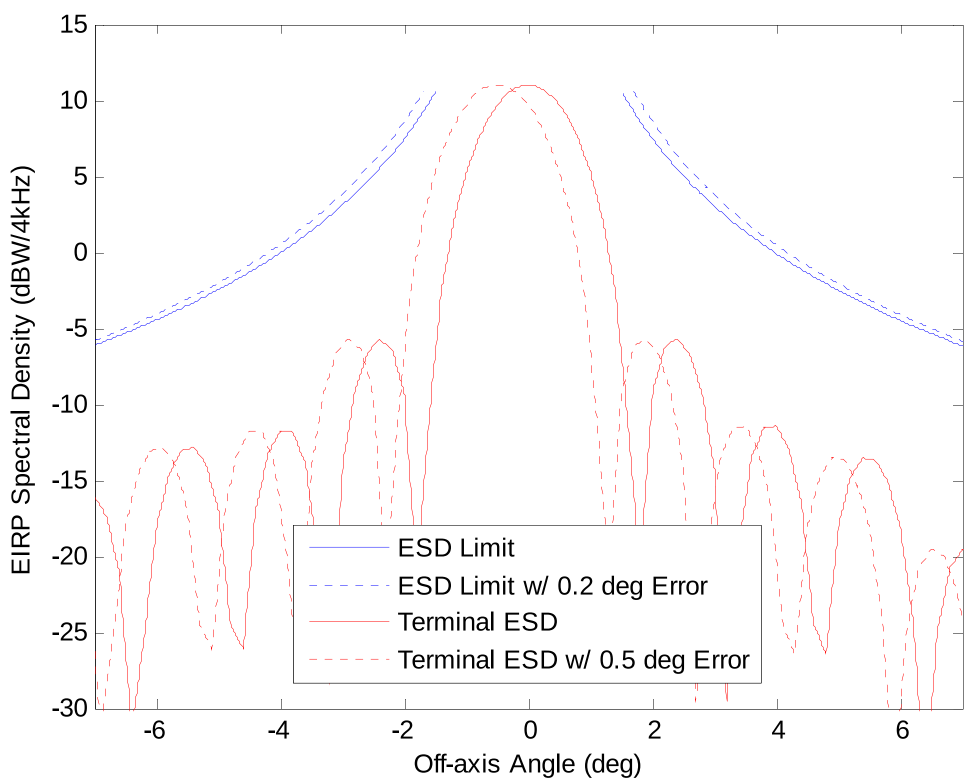

Figure 3. Maximum Off-Axis EIRP Spectral Density of the Aura LE

It should be emphasized that the examples in Figures 2 and 3 are extreme cases: worst-case power (edge of coverage), worst-case skew, and worst-case pointing error. Reaching the limits in this way will only occur rarely and briefly.

At the present time, the eXConnect system exceeds the off-axis EIRP spectral density values set forth in the Commission's rules in directions away from the geostationary arc. The separate off-axis EIRP spectral density mask in Section 25.218(f)(1) was intended to protect Ku-band NGSO FSS systems. However, no systems of this type are presently planned or are operating. PAC will enter into a coordination arrangement with any future Ku-band NGSO FSS system to protect such system from interference from eXConnect AES transmissions.

4. Link Budgets

Edge of coverage link budgets for the eXConnect forward and return links are shown in Table 2 for both antenna types. The eXConnect network in this example is operating with a 2.048 Mbps forward link and a 192 kbps return link for the MELCO reflector and a 384 kbps return link for the Aura LE. The transmit EIRP for each return link has been backed off to produce a 0.5 dB target Eb/No margin. As shown by the table, the terminals are able to close the link with positive link margin.

Table 2. Aura LE and MELCO Link Budgets

Forward Link Budget

	MELCO Reflector	EMS Aura LE	
eXconnect Terminal			
Antenna	MELCO Reflector	EMS Aura LE	
G/T	9.3	11	dB/K
Hub Earth Station			
EIRP max	73.1	73.1	dBW
Signal			
Waveform	DVB-S2	DVB-S2	
Modulation and Coding	QPSK/0.25	QPSK/0.25	
Data Rate	2.048E+06	2.048E+06	bps
Spectral Efficiency	0.348	0.348	bps/Hz
Noise Bandwidth	5.89E+06	5.89E+06	Hz
Eb/No Threshold	2.8	2.8	dB
Uplink			
Frequency	14.25	14.25	dBW
Back off	18.1	18.1	dB
EIRP Spectral Density	23.3	23.3	dBW/4kHz
Slant Range	39000	39000	km
Space Loss, Ls	207.3	207.3	dB
ASI Degradation	0.5	0.5	dB
Transponder G/T @ Hub	2.0	2.0	dB/K
C/No	79.0	79.0	dBHz
Satellite			
Flux Density	-107.8	-107.8	dBW/m2
SFD @ Hub	-102.5	-102.5	dBW/m2
OBO	5.3	5.3	dB
Downlink			
Frequency	11.95	11.95	GHz
Transponder Sat. EIRP @ Beam Peak	50.0	50.0	dBW
Transponder Sat. EIRP @ Beam Edge	46.0	46.0	dBW
DL PSD Limit	13.0	13.0	dBW/4kHz
DL PSD @ Beam Peak	13.0	13.0	dBW/4kHz
Carrier EIRP @ Beam Peak	44.7	44.7	dBW
Carrier EIRP @ Beam Edge	40.7	40.7	dBW
Slant Range	39000	39000	km
Space Loss, Ls	205.8	205.8	dB
ASI Degradation @ 30 deg skew	4.9	1.5	dB
C/No	67.9	73.0	dBHz
End to End			
End to End C/No	67.5	72.0	dBHz
Implementation Loss	0.5	0.5	dB
End to End Eb/No	3.9	8.4	dB
Link Margin	1.1	5.6	dB

Return Link Budget

	MELCO Reflector	EMS Aura LE	
eXconnect Terminal			
Antenna	MELCO Reflector	EMS Aura LE	
EIRP	42.5	42.5	dBW
Hub Earth Station			
G/T	28.1	28.1	dB/K
Signal			
Waveform	iDirect D-TDMA	iDirect D-TDMA	
Modulation and Coding	BPSK/SF4/0.43	BPSK/SF4/0.43	bps
Data Rate	3.84E+05	3.84E+05	
Spectral Efficiency	0.102	0.102	bps/Hz
Noise Bandwidth	3.76E+06	3.76E+06	Hz
Eb/No Threshold	4.6	4.6	dB
Uplink			
Frequency	14.25	14.25	dBW
Back off	0	0	dB
EIRP Spectral Density	12.8	12.8	dBW/4kHz
Slant Range	39000	39000	km
Space Loss, Ls	207.3	207.3	dB
ASI Degradation	0.5	0.5	dB
Transponder G/T @ Beam Edge	0.0	0.0	dB/K
C/No	63.3	63.3	dBHz
Satellite			
Flux Density	-120.3	-120.3	dBW/m2
SFD @ Beam Edge	-100.5	-100.5	dBW/m2
OBO	19.8	19.8	dB
Downlink			
Frequency	11.95	11.95	GHz
Transponder Sat. EIRP @ Beam Peak	50.0	50.0	dBW
Transponder Sat. EIRP @ Hub	48.0	48.0	dBW
DL PSD Limit	10.0	10.0	dBW/4kHz
DL PSD @ Beam Peak	0.4	0.4	dBW/4kHz
Carrier EIRP @ Beam Peak	30.2	30.2	dBW
Carrier EIRP @ Hub	28.2	28.2	dBW
Slant Range	39000	39000	km
Space Loss, Ls	205.8	205.8	dB
ASI Degradation	0.5	0.5	dB
C/No	78.6	78.6	dBHz
End to End			
End to End C/No	63.1	63.1	dBHz
Implementation Loss	0.5	0.5	dB
End to End Eb/No	6.8	6.8	dB
Link Margin	2.2	2.2	dB

Appendix A - Aura LE Gain Patterns

This appendix includes predicted transmit gain patterns for the Aura LE antenna. Because the antenna pattern for the Aura LE changes with elevation angle, patterns are included for the minimum and maximum elevation angles of the antenna: 5 deg and 90 deg. Azimuth patterns are plotted against the 25.209(a)(2) antenna pattern mask. Elevation patterns are plotted against the 25.209(a)(4) antenna pattern mask. The patterns are plotted 14.25 GHz.

A.1 Aura LE Antenna Patterns for 5 deg Elevation

A.1.1 Transmit Antenna Patterns for 5 deg Elevation

A.1.1.1 Transmit Azimuth Antenna Patterns for 5 deg Elevation

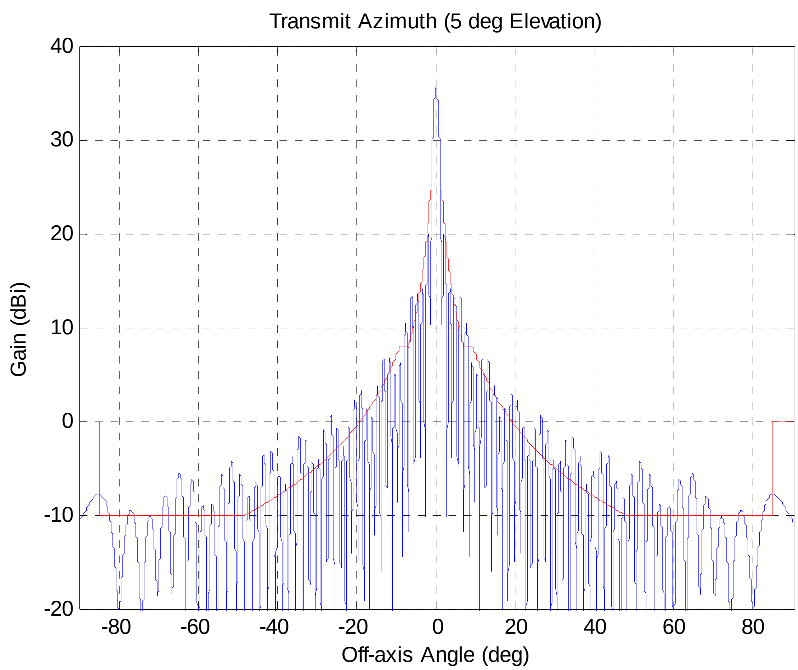

Figure A.1 Transmit Azimuth Pattern (5 deg Elevation)

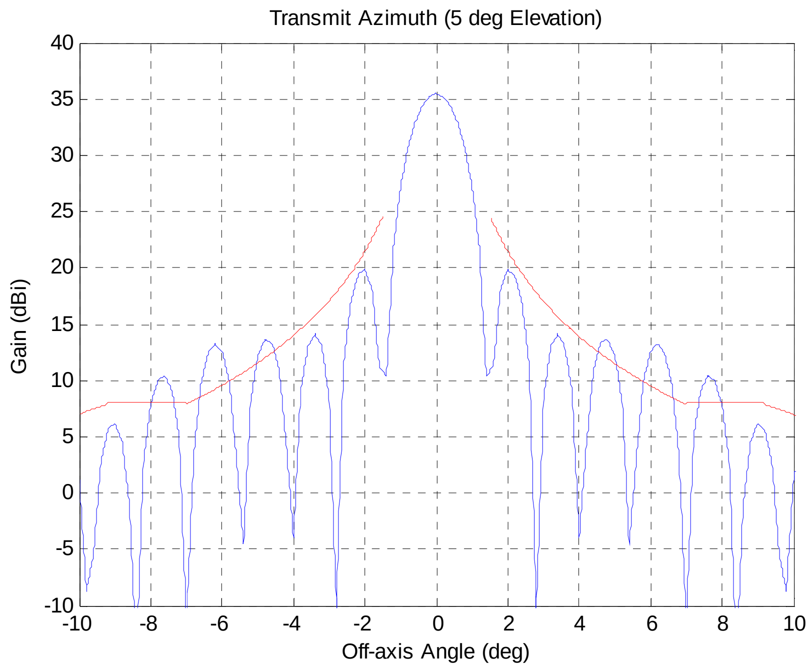

Figure A.2 Transmit Azimuth Pattern (5 deg Elevation) - Detail

A.1.1.2 Transmit Elevation Antenna Patterns for 5 deg Elevation

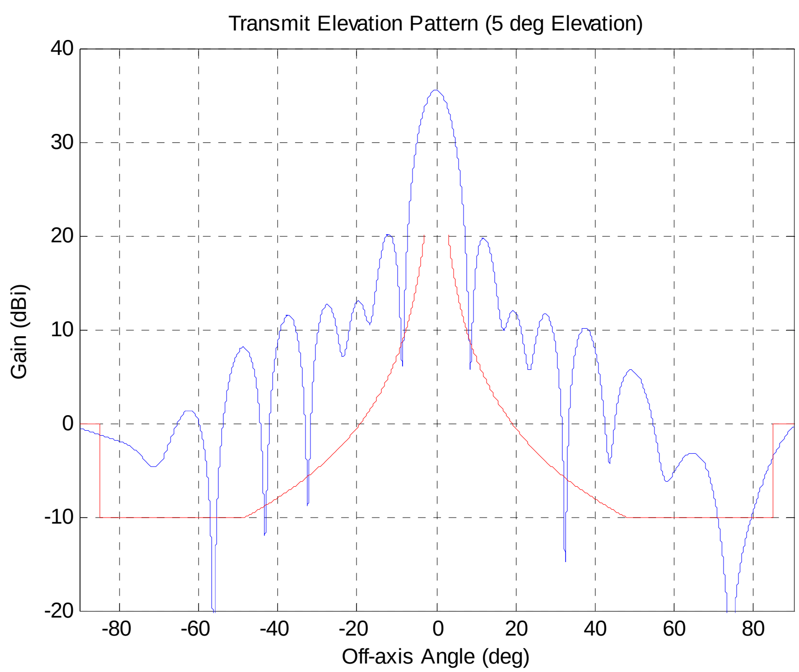

Figure A.3 Transmit Elevation Pattern (5 deg Elevation)

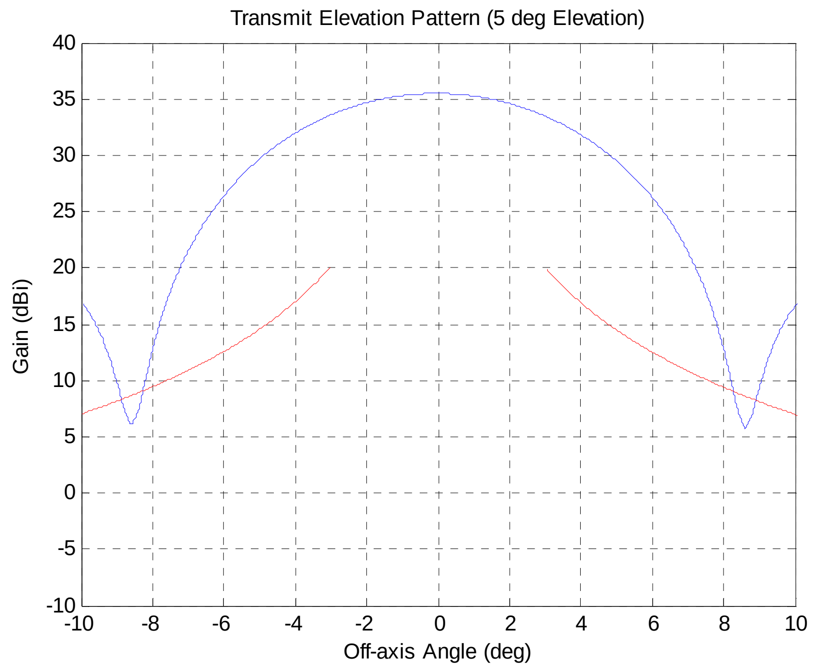

Figure A.4 Transmit Elevation Pattern (5 deg Elevation) - Detail

A.2 EMS Aura LE Antenna Patterns for 90 deg Elevation

A.2.1 Transmit Antenna Patterns for 90 deg Elevation

A.2.1.1 Transmit Azimuth Antenna Patterns for 90 deg Elevation

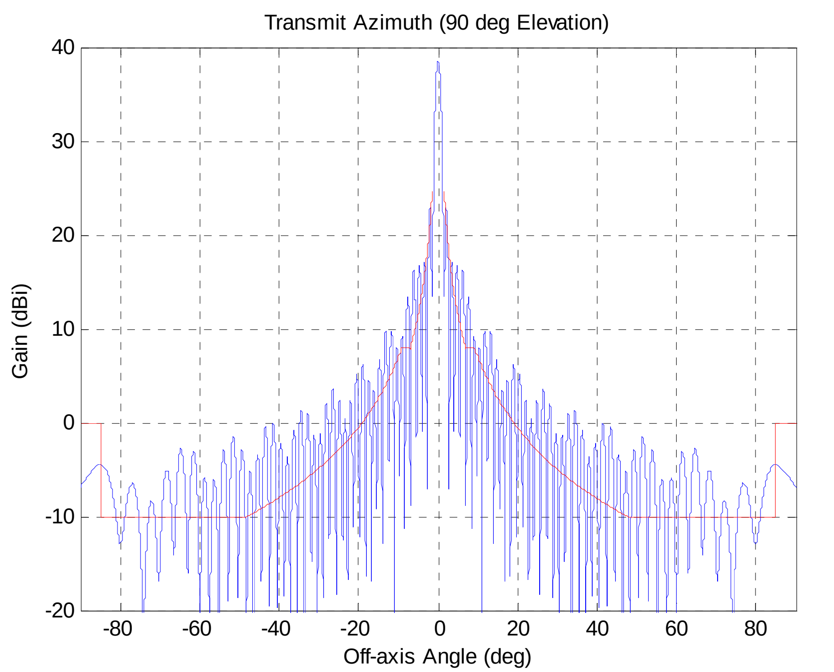

Figure A.9 Transmit Azimuth Pattern (90 deg Elevation)

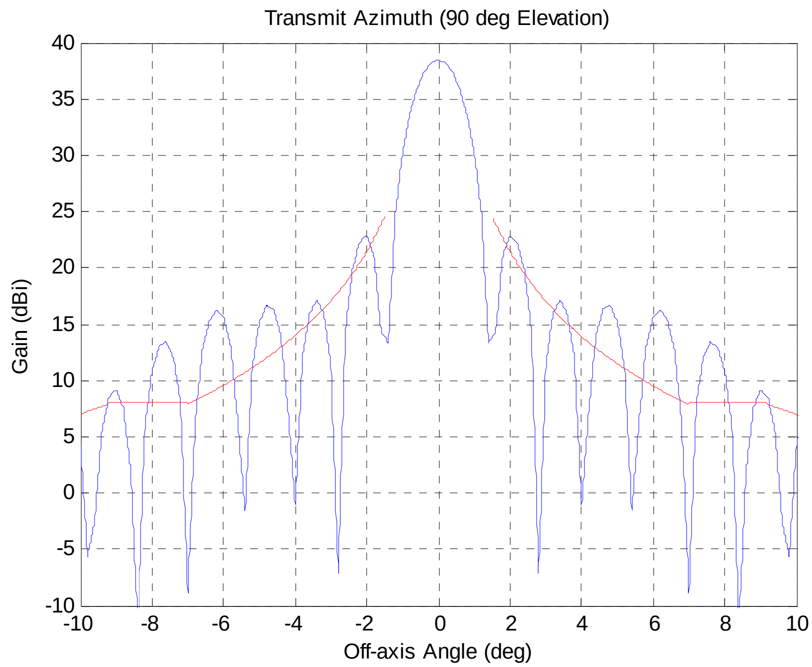

Figure A.10 Transmit Azimuth Pattern (90 deg Elevation) – Detail

A.2.1.2 Transmit Elevation Antenna Patterns for 90 deg Elevation

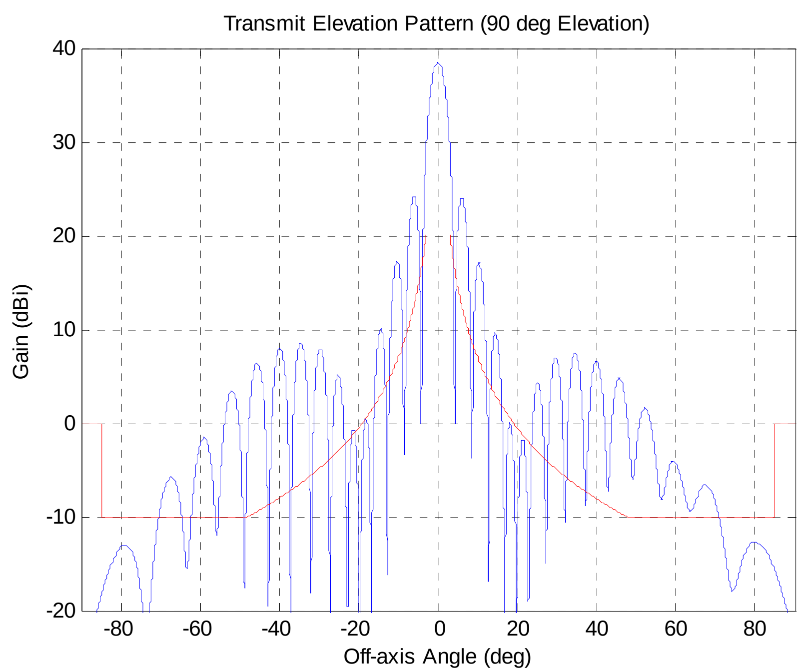

Figure A.11 Transmit Elevation Pattern (90 deg Elevation)

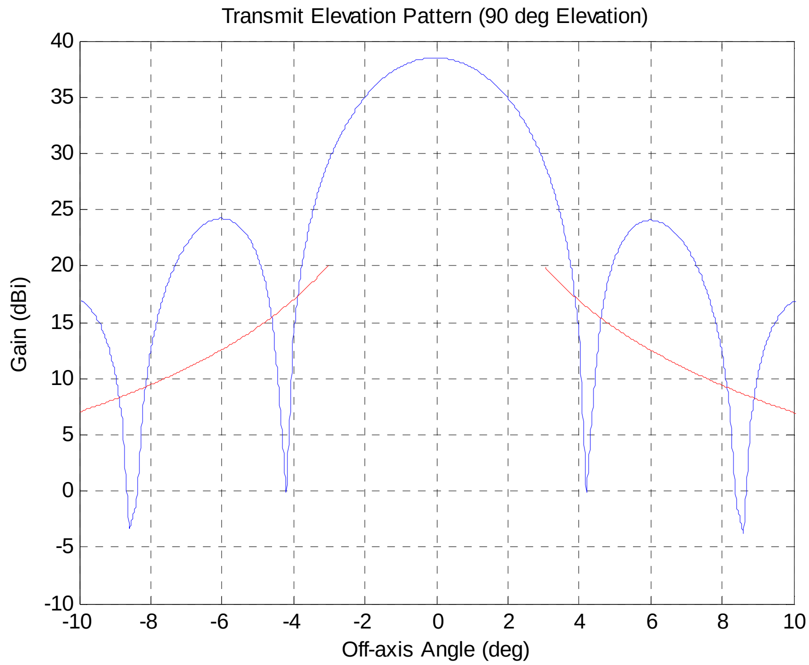

Figure A.12 Transmit Elevation Pattern (90 deg Elevation)

Appendix B - MELCO Reflector Gain Patterns

This appendix includes measured transmit gain patterns for the MELCO Reflector antenna. The MELCO Reflector antenna patterns are elevation independent. Azimuth patterns are plotted against the 25.209(a)(2) antenna pattern mask. Elevation patterns are plotted against the 25.209(a)(4) antenna pattern mask. The patterns were measured at 14.00 GHz.

B.1 MELCO Reflector Antenna Patterns

B.1.1 Transmit Antenna Patterns

B.1.1.1 Transmit Azimuth Antenna Patterns

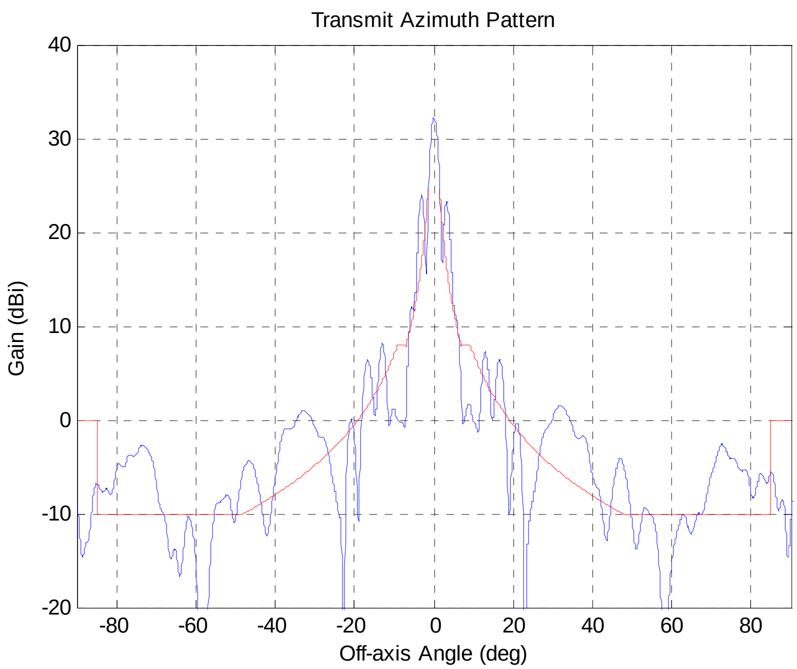

Figure B.1 Transmit Azimuth Pattern

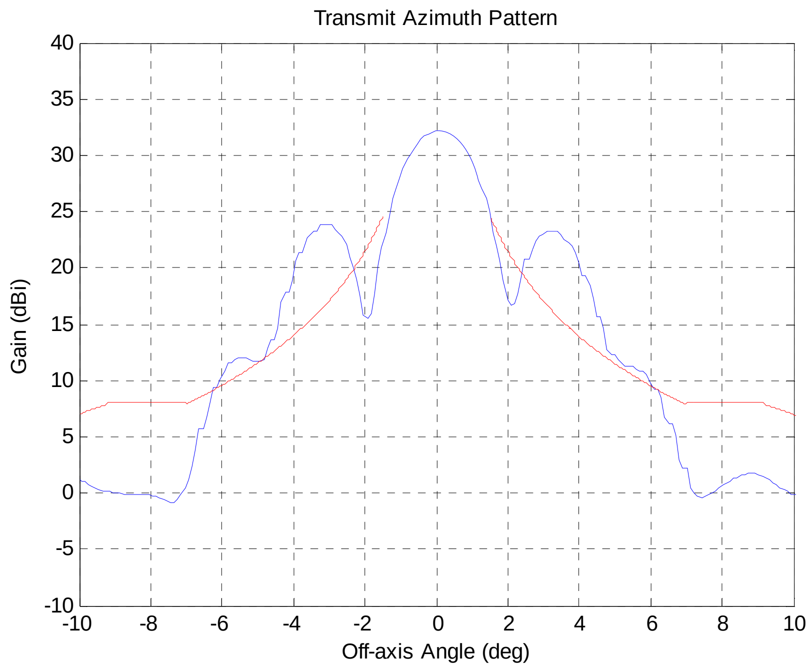

Figure B.2 Transmit Azimuth Pattern - Detail

B.1.1.2 Transmit Elevation Antenna Patterns

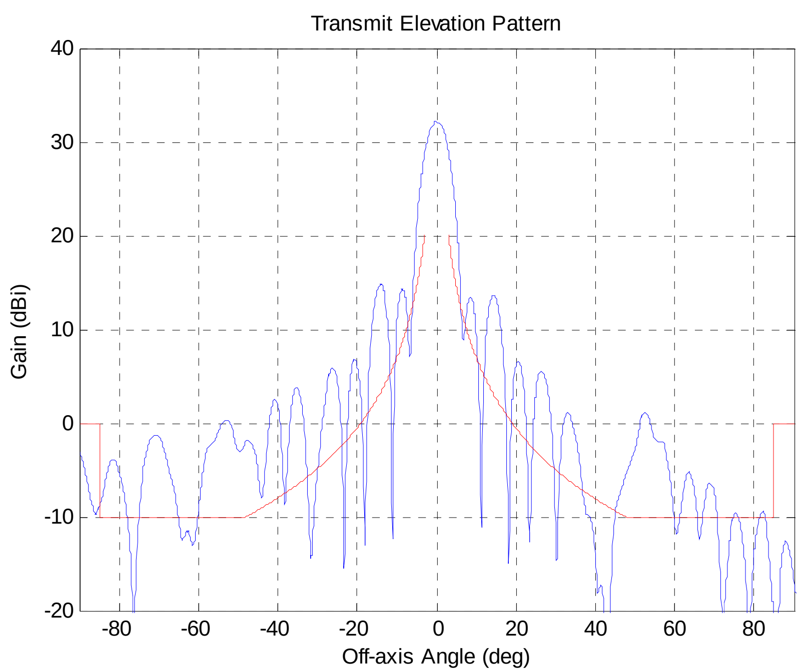

Figure B.3 Transmit Elevation Pattern

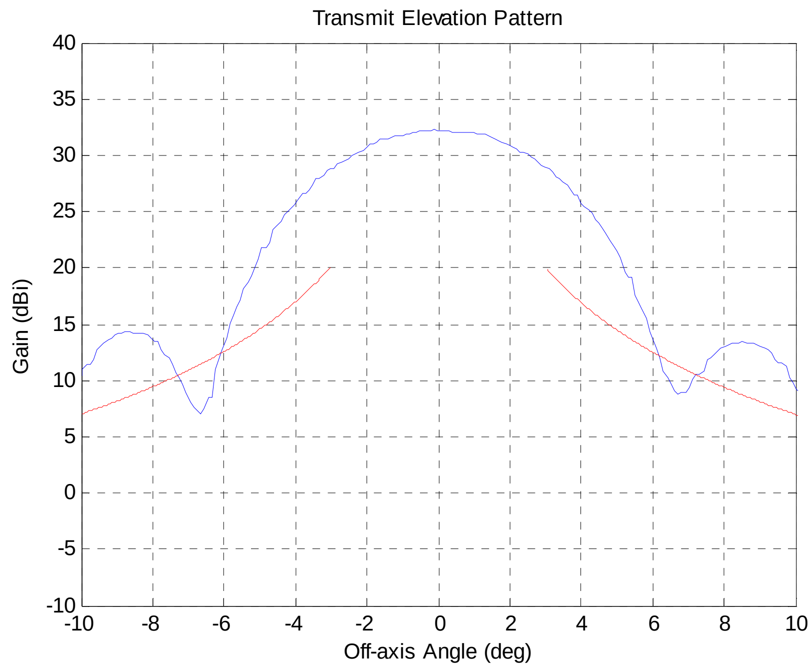

Figure B.4 Transmit Elevation Pattern - Detail

EXHIBIT 1a

Radiation Hazard Analysis for AURA LE

This report analyzes the non-ionizing radiation levels for the AURA LE antenna. This report is developed in accordance with the prediction methods contained in OET Bulletin No. 65, Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields, Edition 97-01.

Bulletin No. 65 specifies that there are two separate tiers of exposure limits that are dependant on the situation in which the exposure takes place and/or the status of the individuals who are subject to the exposure -- the General Population/ Uncontrolled Environment and the Controlled Environment, where the general population does not have access.

The maximum level of non-ionizing radiation to which individuals may be exposed is limited to a power density level of 5 milliwatts per square centimeter (5 mW/cm^2) averaged over any 6 minute period in a controlled environment, and the maximum level of non-ionizing radiation to which the general public is exposed is limited to a power density level of 1 milliwatt per square centimeter (1 mW/cm^2) averaged over any 30 minute period in a uncontrolled environment.

In the normal range of transmit powers for satellite antennas, the power densities at or around the antenna surface are expected to exceed safe levels. This area will not be accessible to the general public. Operators and technicians will receive training specifying this area as a high exposure area. Procedures will be established to ensure that all transmitters are turned off before this area may be accessed by operators, maintenance or other authorized personnel.

Near Field Exposure

The AURA LE antenna potentially exceeds MPE limits in the near field within the rectangular volume directly in front of the panels (7.0 mW/cm^2). For this calculation, it was assumed that all 10 watts from each SSPA module are uniformly distributed across the surface area of the panel. There are two SSPA modules, one for each antenna panel. This is a reasonable assumption for a flat panel waveguide fed phased array with minimal sidelobe tapering.

The extent of the near field region is defined by the following

$$R_{nf} = D^2 / (4\lambda)$$

8.9 meters

Where D is the width of the panel (0.86 meters)

The maximum power density in the Near Field can be determined by the following equation:

$$S_{nf} = P_{SSPA} / A$$
$$7 \text{ mW/ cm}^2$$

Where A is the surface area of the panel and P is the power available from the SSPA.

In normal operation, this antenna is mounted on a rooftop with the main beam pointed toward the sky at a minimum elevation angle of 10 degrees when operated on the ground such that human exposure in the near field is not possible. Furthermore, normal TDMA operation uses a duty cycle of 10% or less, reducing maximum near field exposure by an order of magnitude to 0.7 mW/cm^2. Additionally, in normal operation, any blockage in the near field (human or otherwise) will cause the transmitter to be disabled within seconds as the system does not transmit unless it can receive the downlink carrier from the satellite. Therefore, prolonged exposure in the near field is not possible in normal operation.

Far Field Exposure (in main beam)

$$R_{ff} = 0.60 D^2 / \lambda$$
$$22 \text{ m}$$

$$S_{ff} = P_{EIRP} / (4 \pi R_{ff}^2)$$
$$1.0 \text{ mW/ cm}^2$$

At a distance of 22 meters, the power density of the Aura LE is 1.0 mW/cm^2, which is within the limits of General Population/Uncontrolled Exposure (MPE) even in the direction of the main beam of the antenna.

As noted previously, the antenna will be mounted on a building or vehicle rooftop with the main beam pointed to the sky at a minimum elevation angle of 10 degrees. In this case, maximum far field exposure to humans would be due to a sidelobe which is at least 15 dB below the main beam. At a distance of 22 meters, the exposure to humans would be less than 0.032 mW/cm^2.

Transition Region Exposure (in main beam)

At a distance of 13 m from the antenna, maximum exposure in the main beam is 5 mW/cm^2. This assumes that PFD decreases linearly from 7 mW/cm^2 to 1.0 mW/cm^2 in this region between the near field and far field (8.9 m to 22 m from the antenna).

Exposure to personnel located below antenna height

The antenna will be mounted at a height above personnel. In this case, the worst case exposure is due to the first elevation sidelobe at a level of -15 dB. For the AURA LE antenna, the far field distance in the elevation plane is approximately 0.8 meters. The 5 mW/cm^2 threshold is reached at a distance of 1.8 meters and the 1 mW/cm^2 threshold is reached at a distance of 4.0 m. Observing the safe radius distance noted above during transmit operations will ensure that the threshold will not be exceeded.

Table 1: Parameters Used for Determining PFD (Aura LE)

Antenna Width	34	in	0.8636	m
Antenna Height	6.5	in	0.1651	m
Antenna Surface Area			0.14258	m^2
Frequency			14250	MHz
Wavelength			0.021	m
Transmit Power			10	W
Antenna Gain			38	dBi
Antenna Gain			6309.573	
EIRP			48	dBW
Far Field Boundary (Azimuth)			22.0	m
Power Density at far field boundary (Azimuth)			1.0	mW/cm^2
Near Field Distance (Azimuth)			8.9	m
Near Field Power Density (Azimuth)			7.0	mW/cm^2
Elevation sidelobe level			-15.0	dB
Far Field Boundary (Elevation)			0.8	m
Power Density at far field boundary (Elevation)			26.3	mW/cm^2
Safe Far Field Distance (Elevation)			1.8	m
Power Density			4.9	mW/cm^2
Safe Far Field Distance (Elevation)			4.0	m
Power Density			1.0	mW/cm^2

Conclusions

The radiation hazard can be divided into two cases: above the mounting plane of the antenna and below it. Different measures will be taken in each region to ensure that the exposure limits will not be exceeded.

The worse-case radiation hazards exist exists above the mounting plane of the antenna along the main beam axis. The antenna will be mounted on a building or vehicle rooftop so access to this region can be controlled and restricted to trained personnel so this case applies to personnel commissioning and testing the antenna. Transmit operations will only be conducted with a clear field of view towards the serving satellite so that the beam does not impose on any uncontrolled areas. By maintaining a safety radius of 22 meters in the boresight direction during transmit operations in this region, it can be guaranteed that the General Population/Uncontrolled Exposure limits will not be exceeded under any test conditions.

Below the mounting plane of the antenna radiation exposure can only occur through sidelobes, which are substantially attenuated.   In this case, the safety radius where the General Population/Uncontrolled Exposure limits are satisfied is 4.0 meters in the worst case direction. The antenna will be mounted in such a way that the general population cannot approach to within the safety radius when below the plane of the antenna so that the General Population/Uncontrolled Exposure limits will not be exceeded under any test conditions.

EXHIBIT 1b

Radiation Hazard Analysis for the MELCO Reflector

This report analyzes the non-ionizing radiation levels for the MELCO reflector antenna. This report is developed in accordance with the prediction methods contained in OET Bulletin No. 65, Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields, Edition 97-01.

Bulletin No. 65 specifies that there are two separate tiers of exposure limits that are dependant on the situation in which the exposure takes place and/or the status of the individuals who are subject to the exposure -- the General Population/ Uncontrolled Environment and the Controlled Environment, where the general population does not have access.

The maximum level of non-ionizing radiation to which individuals may be exposed is limited to a power density level of 5 milliwatts per square centimeter (5 mW/cm^2) averaged over any 6 minute period in a controlled environment, and the maximum level of non-ionizing radiation to which the general public is exposed is limited to a power density level of 1 milliwatt per square centimeter (1 mW/cm^2) averaged over any 30 minute period in a uncontrolled environment.

In the normal range of transmit powers for satellite antennas, the power densities at or around the antenna surface are expected to exceed safe levels. This area will not be accessible to the general public. Operators and technicians will receive training specifying this area as a high exposure area. Procedures will be established to ensure that all transmitters are turned off before this area may be accessed by operators, maintenance or other authorized personnel.

Near Field Exposure

The MELCO reflector antenna potentially exceeds MPE limits in the near field within the rectangular volume directly in front of the reflector (18.0 mW/cm^2). The output power of the antenna is computed as the maximum EIRP minus the transmit gain, 46.7 dBW – 33.1 dBi = 13.6 dBW or 23 watts. For this calculation, it was assumed that all 23 watts output power of the antenna is uniformly distributed across the surface area of the reflector.

The extent of the near field region is defined by the following

$$R_{nf} = D^2/(4\lambda)$$

5.8 meters

Where D is the width of the panel (0.65 meters)

The maximum power density in the Near Field can be determined by the following equation:

$$S_{nf} = P_{SSPA} / A$$
18 mW/ cm^2

Where A is the surface area of the panel and P is the power available from the SSPA. The surface area of the antenna is approximated as the width of the antenna times its height, which is a reasonable approximation given its shape.

In normal operation, this antenna is mounted on a rooftop with the main beam pointed toward the sky at a minimum elevation angle of 10 degrees when operated on the ground such that human exposure in the near field is not possible. Furthermore, normal TDMA operation uses a duty cycle of 10% or less, reducing maximum near field exposure by an order of magnitude to 1.8 mW/cm^2. Additionally, in normal operation, any blockage in the near field (human or otherwise) will cause the transmitter to be disabled within seconds as the system does not transmit unless it can receive the downlink carrier from the satellite. Therefore, prolonged exposure in the near field is not possible in normal operation.

Far Field Exposure (in main beam)

$$R_{ff} = 0.60 D^2 / \lambda$$
13 m

$$S_{ff} = P_{EIRP} / (4 \pi R_{ff}^2)$$
2.2 mW/ cm^2

At a distance of 13 meters, the power density of the MELCO reflector is 2.2 mW/cm^2, which exceeds the General Population/Uncontrolled Exposure (MPE) but is less than the controlled environment limit. The power density falls to the General Population / Uncontrolled Exposure (MPE) limit of 1 mW/cm^2 at 19.5 meters.

As noted previously, the antenna will be mounted on a building or vehicle rooftop with the main beam pointed to the sky at a minimum elevation angle of 10 degrees. In this case, maximum far field exposure to humans would be due to a sidelobe which is at least 16 dB below the main beam. At a distance of 13 meters, the exposure to humans would be less than 0.055 mW/cm^2.

Transition Region Exposure (in main beam)

At a distance of 11.7 m from the antenna, maximum exposure in the main beam is 5 mW/cm^2. This assumes that PFD decreases linearly from 18 mW/cm^2 to 2.2 mW/cm^2 in this region between the near field and far field (5.8 m to 13 m from the antenna).

Exposure to personnel located below antenna height

The antenna will be mounted at a height above personnel. In this case, the worst case exposure is due to the first elevation sidelobe at a level of -16 dB. For the MELCO reflector antenna, the far field distance in the elevation plane is approximately 1.1 meters.

The 5 mW/cm^2 threshold is reached at a distance of 1.4 meters and the 1 mW/cm^2 threshold is reached at a distance of 3.0 m. Observing the safe radius distance noted above during transmit operations will ensure that the threshold will not be exceeded.

Table 1: Parameters Used for Determining PFD (MELCO reflector)

Antenna Width	25.6	in	0.65	m
Antenna Height	7.7	in	0.196	m
Antenna Surface Area			0.14258	m^2
Frequency			14250	MHz
Wavelength			0.021	m
Transmit Power			23	W
Antenna Gain			33.1	dBi
Antenna Gain			2042	
EIRP			46.7	dBW
Far Field Boundary (Azimuth)			13.0	m
Power Density at far field boundary (Azimuth)			2.2	mW/cm^2
Safe Far Field Distance (Azimuth)			19.5	m
Power Density			1.0	mW/cm^2
Near Field Distance (Azimuth)			5.0	m
Near Field Power Density (Azimuth)			16.1	mW/cm^2
Elevation sidelobe level			-16.0	dB
Far Field Boundary (Elevation)			1.1	m
Power Density at far field boundary (Elevation)			7.8	mW/cm^2
Safe Far Field Distance (Elevation)			1.4	m
Power Density			4.8	mW/cm^2
Safe Far Field Distance (Elevation)			3.0	m
Power Density			1.0	mW/cm^2

Conclusions

The radiation hazard can be divided into two cases: above the mounting plane of the antenna and below it. Different measures will be taken in each region to ensure that the exposure limits will not be exceeded.

The worse-case radiation hazards exist exists above the mounting plane of the antenna along the main beam axis. The antenna will be mounted on a building or vehicle rooftop so access to this region can be controlled and restricted to trained personnel so this case applies to personnel commissioning and testing the antenna. Transmit operations will only be conducted with a clear field of view towards the serving satellite so that the beam does not impose on any uncontrolled areas. By maintaining a safety radius of 19.5 meters in the boresight direction during transmit operations in this region, it can be guaranteed that the General Population/Uncontrolled Exposure limits will not be exceeded under any test conditions.

Below the mounting plane of the antenna radiation exposure can only occur through sidelobes, which are substantially attenuated.   In this case, the safety radius where the General Population/Uncontrolled Exposure limits are satisfied is 3.0 meters in the worst case direction. The antenna will be mounted in such a way that the general population cannot approach to within the safety radius when below the plane of the antenna so that the General Population/Uncontrolled Exposure limits will not be exceeded under any test conditions.