The Boeing Company
Application for Special Temporary Authority

1 INTRODUCTION

The Boeing Company ("Boeing") seeks continued temporary authority to operate on an experimental basis earth station antennas in the maritime mobile context to government users. This testing will continue to allow Boeing to validate potential new maritime communications services. Boeing intends to conduct its experimentations on a non-harmful interference basis.

Significantly, Boeing has been granted experimental special temporary authority ("STA") to operate the antenna that is the subject of this application (*See* The Boeing Company, Experimental Special Temporary Authorization, File No. 0424-EX-ST-2006, Call Sign WD2XFK (granted June 19, 2006; exp. Dec. 20, 2006)). By this filing, Boeing seeks to renew its temporary authority to operate up to ten (10) Melco RN211709 antennas. The experimental antennas will continue to operate using the same network control facilities and satellites as Boeing's licensed Aeronautical Mobile-Satellite Service ("AMSS") system, and will benefit from the considerable experience Boeing has gained from operating this network.

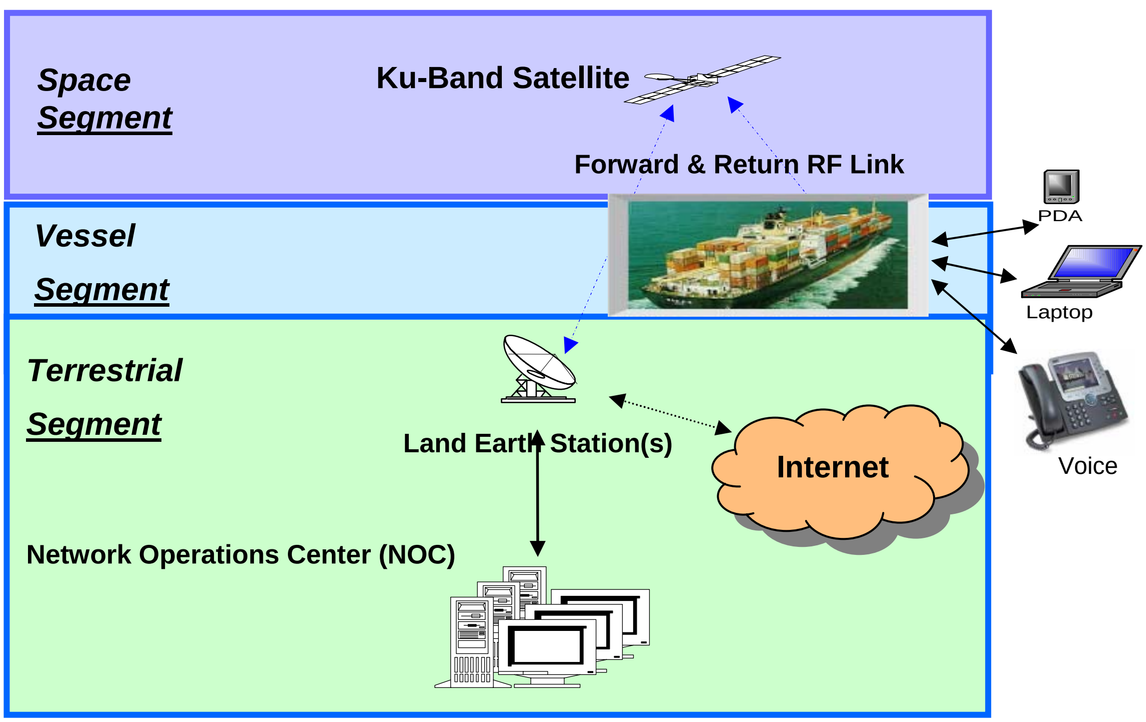

Figure 1 System Architecture

As demonstrated herein, granting Boeing's STA for the Melco antennas would not increase the potential for interference into other service from Boeing's experimental operations, and would facilitate the provision of broadband services to maritime customers. As a result, grant of this authority would serve the public interest, convenience and necessity.

Because the technical information and public interest considerations supporting this extension request is the same as that supporting the original grant, Boeing hereby incorporates the previously filed information by reference. Boeing also expressly accepts all of the conditions included in its prior STA.

2 MELCO ANTENNA SYSTEM

The Melco antenna system will use a mechanically steered symmetric parabolic reflector antenna, as shown in Figure 2. The antenna is installed near the top of a vessel, inside a radome, and is designed to track the desired satellite over a large geographic range and through the most extreme movement expected of a vessel.

Figure 2. Illustration of a typical Melco 1.0 m antenna

The Melco 1.0 m antenna characteristics are summarized in Table 1. The E- and H-plane patterns for this antenna, based on the predicted values are as shown in Figure 3.

Antenna parameters	**Specifications**
Aperture Dimensions	100 cm circular
Antenna Beam-width (3 dB)	1.4º
Transmit Band	14.0 GHz to 14.5 GHz
Receive Band	11.2 GHz to 12.75 GHz
Transmit Gain	41.5 dBi
Receive Gain	39.9 dBi
Maximum EIRP	48.2 dBW
Peak ERP	40.7 kW
Maximum G/T	17.3 dB/K
Antenna Polarization	Tx: Single Variable Linear Rx: Dual Orthogonal Linear

Table 1. Melco 1.0 m Antenna Characteristics

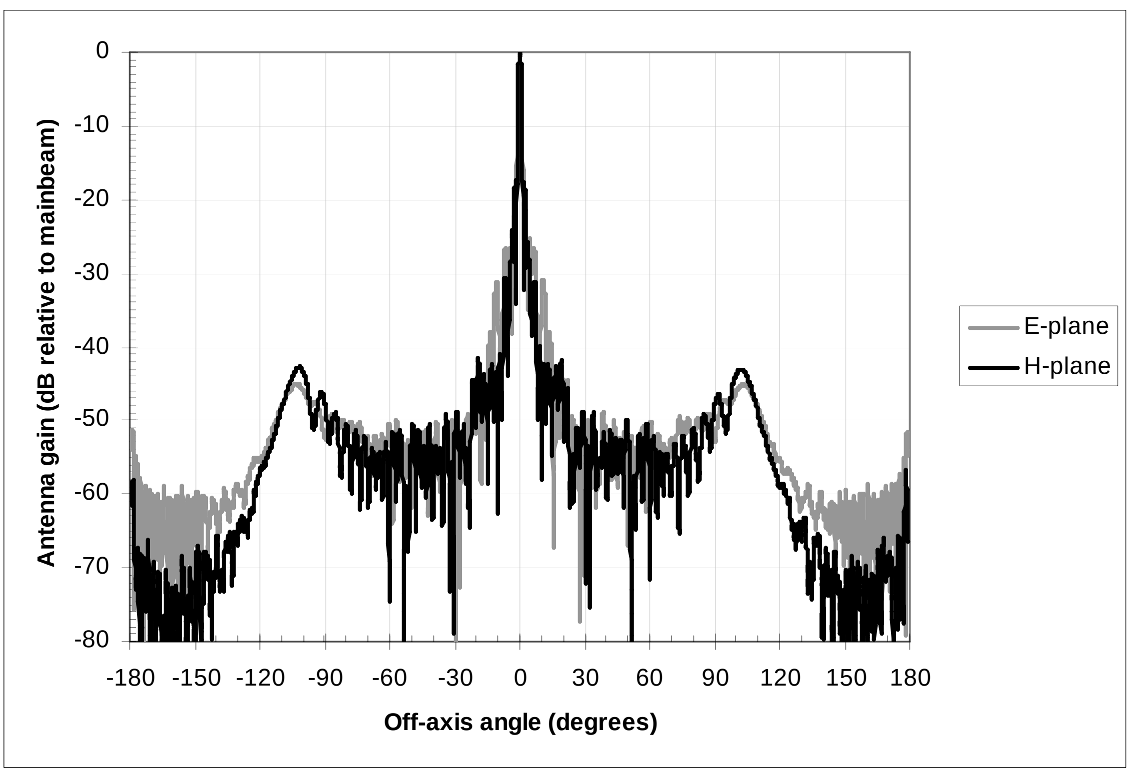

Figure 3. Melco Antenna radiation patterns (measured)

Antenna Pointing Control

Accurate pointing of transmit and receive beams is achieved by using angular rate sensors, and closed loop conical scan tracking of the RF signal from the satellite by the receive beam. The common receive and transmit reflector aperture provides accurate pointing of the transmit beam.

Spatial acquisition of the satellite RF link is accomplished by means of open loop pointing using ship provided heading data, rate sensor data for pitch and roll motion, and target satellite position data. Following initial acquisition, accurate pointing is achieved by rate sensors mounted on the aperture for rapid compensation of pitch, roll, and yaw motion and flexing of the ship. Correction for errors in spatial acquisition and any bias or drift of the rate sensors is accomplished by continuous conical scanning of the receive beam about the estimated pointing vector to the satellite. Correlation of scan angles with Received Signal Strength Indicator ("RSSI") signals computed by the modem enable high rate correction of the estimated antenna to satellite pointing vector. The RSSI signal is a measure of received satellite signal strength based on output of the receiver filter, and provides robustness against adjacent satellite interference in the receiver bandwidth.

Control of receive and transmit polarization is performed by computing polarization commands based on ship's heading, calculated pitch and roll, satellite location and selected polarization.

Power Level Monitoring

As described below, Boeing effectively monitors and controls the on-axis and off-axis equivalent isotropic radiated power ("e.i.r.p.") from the Melco antennas.

On-Axis e.i.r.p. The on-axis e.i.r.p. of the terminal is ascertained from direct measurement of the RF power delivered to the antenna. The Power Amplifier ("PA") contains a calibrated coupler and a calibrated power detector to measure the power delivered to the output port of the PA. Together with knowledge of the antenna gain and losses downstream of the PA (including the radome loss), the e.i.r.p. of transmitting antennas be calculated.

Aggregate Off-Axis e.i.r.p. The system uses a Code Division Multiple Access ("CDMA") transmission scheme, which will permit multiple co-frequency transmissions from different antennas to be simultaneously received at the same satellite. In order to maintain compatibility with adjacent FSS satellites, the aggregate off-axis e.i.r.p. produced by the all terminals operating on a single frequency will be controlled so as to meet the off-axis e.i.r.p. limits described in herein.

The aggregate off-axis e.i.r.p. generated by Melco antenna operations will be computed based on the number of antennas in a satellite coverage area, the antenna patterns of the antennas, and the aggregate on-axis e.i.r.p. of the antennas. The portion of the off-axis e.i.r.p. allocated to Melco antenna operations will vary dynamically based on a bandwidth-on-demand approach (*i.e.*, the aggregate off-axis e.i.r.p. of all transmitting terminals will be continually compared to the applicable off-axis e.i.r.p. limits and, based on how closely the aggregate value approaches the limits, the NOC will issue commands to allow additional antennas into the network, change antenna data rates/power levels or remove antennas from the network). In all cases, the aggregate off-axis e.i.r.p. limits set forth in herein will be satisfied.

Figure 4 shows the e.i.r.p. spectral density of a single Melco antenna with respect to the e.i.r.p. spectral limits of 25.222.

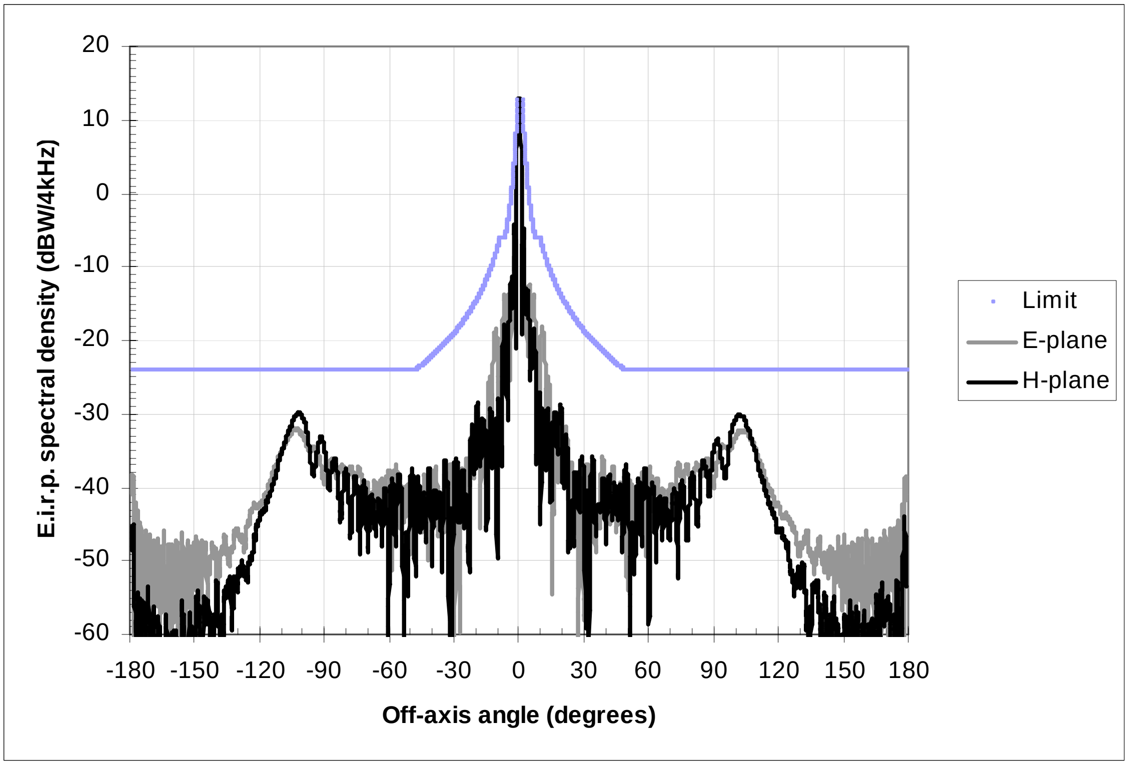

Figure 4. Melco 1.0 m antenna e.i.r.p. spectral density

Waveform Definition

Melco antenna operations will use identical waveforms to the Boeing AMSS system. Both the forward and return link waveforms use Direct Sequence Spread Spectrum ("DSSS") modulation to reduce the waveform e.i.r.p spectral density. Signals will be spread to 90% of the fraction of the transponder that is used. The waveform characteristics of the Melco antenna for both the forward and return links are nearly identical and are shown in Table 2.

Typical 3 dB Bandwidth	up to 32.4 MHz
Typical ITU Emission Designation	6M75G7W , 32M4G7W[1]
Modulation	DSSS / Offset-QPSK
Multiplex Carrier Access Scheme	Forward link: Single carrier with packet multiplexing Return link: Code Division Multiple Access (CDMA)
Filtering	Square Root Raised Cosine (SRRC), $\alpha = 0.35$

Table 2. Waveform Characteristics

Link Power Spectral Density

On the return link, the maximum uplink e.i.r.p., spectral density from an individual melco antenna will be between 7.6 dBW/4kHz and 14.4 dBW/4 kHz for return link signal bandwidths between 32.4 MHz and 6.75 MHz. The aggregate uplink e.i.r.p. density for all Melco antennas sharing a transponder will not exceed approximately 19 dBW/4kHz when operating under the U.S. off-axis e.i.r.p. limits and no more than 31 dBW/4kHz when operating under the off-axis e.i.r.p. limits set forth in Resolution 902.

The downlink e.i.r.p. spectral density from the satellite on the forward link is dependant on the exact satellite e.i.r.p. and spreading bandwidth used for that satellite. For a typical transponder, the down link e.i.r.p. spectral density will not exceed 12 dBW/4 kHz for a typical 32.4 MHz spread signal with an e.i.r.p. of 51 dBW.

3 PROTECTION OF OTHER AUTHORIZED SERVICES

Fixed-Satellite Service ("FSS")

The Boeing system will protect FSS satellite receivers in the 14.0-14.5 GHz band by controlling the aggregate off-axis e.i.r.p spectral density in the direction of the geostationary arc emitted by Melco antennas as discussed above. When using satellites that have been coordinated for 2-degree spacing and/or to which the Commission's 2-degree spacing rules apply, Boeing will meet the off-axis e.i.r.p. limits given by §25.222 (a) (1)-(4):

(1) The maximum co-polarized component along the GSO arc of θ degrees from the antenna main beam will not exceed the limits, as given below:

$15 - 25\log(\theta)$ dBW/4kHz	for $1.25° \leq \theta \leq 7.0°$
-6 dBW/4kHz	for $7.0° < \theta \leq 9.2°$

[1] These emission designations are based on the spreading bandwidths of 6.75 MHz and 32.4 MHz. Fractions of a transponder may be used for forward, or return-link, signals in order to more efficiently utilize space segment resources.

$18 - 25\log(\theta)$ dBW/4kHz	for $9.2° < \theta \leq 48°$
-24 dBW/4kHz	for $48° < \theta \leq 180°$

(2) In all other directions, the off-axis EIRP spectral density for co-polarized signals emitted from the ESV shall not exceed the following values:

$18 - 25\log(\theta)$ dBW/4kHz	for $1.25° \leq \theta \leq 48°$
-24 dBW/4kHz	for $48° < \theta \leq 180°$

(3) For $\theta > 7°$, the values given in paragraphs (a)(1) of this Section may be exceeded by no more than 10% of the sidelobes, provided no individual sidelobe exceeds the criteria given by more than 3 dB.

(4) In all directions, the off-axis EIRP spectral density for cross-polarized signals emitted from the ESV shall not exceed the following values:

$5 - 25\log(\theta)$ dBW/4kHz	for $1.8° \leq \theta \leq 7°$
-16 dBW/4kHz	for $7° < \theta \leq 9.2°$

Where θ is the angle in degrees from the axis of the main lobe.

When using satellites that have been coordinated for larger orbital spacings and/or where the Commission's 2-degree spacing rules do not apply, Boeing will meet the off-axis e.i.r.p. limits coordinated for the serving (target) satellite up to the limits set forth in ITU-R Resolution 902:

14.0-14.5 GHz

Angle off-axis	*Maximum e.i.r.p. in any 40 kHz band*
$2° \leq \varphi \leq 7°$	$33 - 25 \log \varphi$ dB(W/40 kHz)
$7° < \varphi \leq 9.2°$	12 dB(W/40 kHz)
$9.2° < \varphi \leq 48°$	$36 - 25 \log \varphi$ dB(W/40 kHz)
$48° < \varphi \leq 180°$	–6 dB(W/40 kHz)

Again, the Melco antennas will operate within the coordinated values of off-axis e.i.r.p. density for the satellite being used, which may be lower than the values given above.

Fixed Service ("FS")

The Melco antenna operations will comply with the requirements of Resolution 902 in order to protect co-frequency FS systems. Before operating on a primary basis within 125 km of the potentially concerned administrations identified in Resolution 902, Annex 1, Boeing will obtain prior agreement for these operations from the concerned administration. However, Boeing expects that in most cases it will be possible to avoid using FS frequencies near concerned administrations.

Previous studies in ITU-R WP 4-9S have shown that the significant factor in determining the minimum distance is the maximum e.i.r.p. towards the horizon, which would be received by the FS system. In Resolution 902 (WRC-03), this is expressed as both a maximum e.i.r.p. level and a maximum e.i.r.p. density towards the horizon. These values of e.i.r.p. towards the horizon are based on the antenna's maximum transmit power at the flange and the gain of the antenna in the direction of the horizon.[2] Melco antenna emissions will meet both of these criteria and so they will have an interference effect on the terrestrial services which is no greater than that which would be caused with an antenna size of 1.2 m.

Radio Astronomy Service ("RAS")

Boeing will coordinate with radio astronomy observatories within line of sight of navigable waters through the National Telecommunications and Information Administration ("NTIA") Interdepartment Radio Advisory Committee ("IRAC") to address potential interference to the RAS observations, as required per §25.222(e).

Space Research Service ("SRS")

Boeing will coordinate with the operators of space research facilities in line-of-sight of navigable waters to address interference to these receivers as required per §25.222(d).

[2] Preliminary Draft Revision of Recommendation ITU-R SF.1649, Guidance for determination of interference from earth stations on vessels (ESVs) to stations in the fixed service when the ESV is within the minimum distance, ITU-R Document 4-9S/71-E, Annex 4 of Annex 3, 18 May 2005.