SQUIRE, SANDERS & DEMPSEY L.L.P.

1201 Pennsylvania Avenue, N.W.
P.O. Box 407
Washington, D.C. 20044-0407

Office: +1.202.626.6600
Fax: +1.202.626.6780

SQUIRE SANDERS | LEGAL COUNSEL WORLDWIDE

(202) 626-6634

February 27, 2004

VIA ELECTRONIC MAIL AND HAND DELIVERY

Marlene H. Dortch
Secretary
Federal Communications Commission
445 12th Street, S.W.
Washington, D.C. 20054

Re: **Request for Confidential Treatment**
The Boeing Company
Authority for Use of the 1990-2025/2165-2200 MHz and
Associated Frequency Bands for a Mobile-Satellite System
FCC File Nos. SAT-MOD-20030711-00128 & SAT-AMD-20030827-00241

Dear Secretary Dortch:

The Boeing Company ("Boeing") respectfully requests that the documents covered by this correspondence be treated as confidential and be withheld from public inspection pursuant to Sections 0.457 and 0.459 of the Commission's Rules, 47 C.F.R. §§ 0.457, 0.459. In accordance with the requirements of Section 0.459(b), 47 C.R.F. § 0.459(b), Boeing submits the following:

0.459(b)(1): Boeing seeks confidential treatment for the attached letter from Joseph P. Markoski to Thomas S. Tycz, dated February 27, 2004, providing responses to the questions raised by the Commission in its letter dated February 11, 2004 and the four attachments to the letter.

0.459(b)(2): Boeing is providing this information, subject to the grant of confidential treatment, in response to a letter of inquiry from the FCC's Satellite Division regarding the above captioned proceeding.[1] The Division's letter specifically requested access to the materials addressed in this request for confidentiality.

0.459(b)(3): Boeing's letter and attachments contain highly sensitive, confidential, and proprietary commercial and technical information, including trade secrets regarding the

[1] *See Letter from Thomas S. Tycz, Chief, Satellite Division, to JosephMarkoski, Squire, Sanders & Dempsey L.L.P.* (Feb. 11, 2004).

construction of satellite spacecraft. Such information "would customarily be guarded from competitors." *See* 47 C.F.R. § 0.457(d)(2). Furthermore, under the Freedom of Information Act ("FoIA"), "trade secrets and protected commercial or financial information obtained from a person and privileged or confidential" information is protected from disclosure. 5 U.S.C.A. § 552(b)(4).

0.459(b)(4): Boeing's letter and attachments contain trade secrets and confidential information that is commercially sensitive within the satellite manufacturing industry, both with respect to the sale of satellites to commercial and governmental customers. The satellite manufacturing industry is extremely competitive, with the current global supply of satellite manufacturing capacity greatly exceeding the demand for satellite construction services.

0.459(b)(5): Boeing Satellite Systems ("BSS"), a wholly owned subsidiary of Boeing, is the world's largest satellite manufacturer. Boeing maintains a competitive edge vis-à-vis other satellite manufactures by offering customers the benefits of BSS's experience and expert technical design capability. For example, Boeing's 2 GHz MSS satellite is based on the BSS GEO-Mobile spacecraft model, the success of which has been demonstrated by its previous deployment for other geostationary MSS networks. Release of the information contained in Boeing's letter and attachments could compromise BSS's competitive edge in the MSS market segment, resulting in substantial harm to BSS and Boeing.

0.459(b)(6): Boeing does not permit the dissemination of the information contained in Boeing's letter and attachments to non-Boeing personnel without the execution of a confidentiality agreement. Three of the attachments to Boeing's letter were extracted from the Critical Desire Review ("CDR") for Boeing's 2 GHz MSS spacecraft. Boeing requires that any copy of a Boeing CDR, including excerpts from CDRs, must state on every page of every printed copy that the material is "BOEING PROPRIETARY." In addition, all excerpts from a Boeing CDR must be accompanied by a statement that the document contains technical data as defined in the U.S. Government's International Traffic in Arms Regulations ("ITAR"). *See* Section 22 C.F.R. § 120.10. As such, its dissemination to non-U.S. citizens or companies without prior approval may be a violation of federal law.

0.459(b)(7): The information contained in Boeing's letter and attachments are not available to the public and, to the best of Boeing's knowledge, have not been disseminated to non-Boeing personnel without the execution of a confidentiality agreement.

0.459(b)(8): Boeing requests that the Commission permanently withhold the information contained in Boeing's letter and attachments. Release of this information at any time in the future would cause substantial competitive harm to Boeing.

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For the foregoing reasons, Boeing respectfully requests that Boeing's letter and attachments be granted confidential status and be withheld from public inspection. Thank you for your attention to this matter. Please let us know if you have any questions.

Sincerely,

Joseph P. Markoski
Bruce A. Olcott
Counsel for The Boeing Company

cc: Marylou Cahir
Thomas Tycz
Karl Kensinger
Robert Nelson
John Martin
William Bell
Sankar Persaud

Enclosures

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1201 Pennsylvania Avenue, N.W.
P.O. Box 407
Washington, D.C. 20044-0407
Office: +1.202.626.6600
Fax: +1.202.626.6780

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February 27, 2004

VIA ELECTRONIC MAIL
AND HAND DELIVERY

Thomas S. Tycz
Chief, Satellite Division
Federal Communications Commission
445 12th Street, S.W.
Washington, D.C. 20054

Re: **Confidential Treatment Requested**
Application for Authority of The Boeing Company
For Modification of Authority for Use of the 1990-2025/2165-2200
MHz and Associated Frequency Bands for a Mobile-Satellite System
FCC File Nos. SAT-MOD-20030711-00128 & SAT-AMD-20030827-00241

Dear Mr. Tycz:

In your correspondence of February 11, 2004, you raised a number of questions regarding the above referenced applications of The Boeing Company ("Boeing"). In particular, you inquired about Boeing's use of the Inter-Agency Space Debris Coordination Committee ("IADC") formula to support Boeing's proposal to use an end-of-life disposal orbit with a perigee at least 300 kilometers above the geostationary orbit. Your letter also requested additional information about Boeing's request to operate its spacecraft using a 0.1° longitudinal station keeping tolerance.

As discussed in Boeing's accompanying Request for Confidential Treatment, Boeing requests that this letter, along with all materials provided in support of the letter, be given confidential treatment and be withheld from public inspection because they contain trade secrets and confidential commercial information. If the Commission declines to provide confidential treatment to these materials, Boeing requests that they be returned to Boeing without submission in the record of this, or any other, proceeding.

Furthermore, the technical information contained in this letter and attachments is subject to the U.S. Government's International Traffic in Arms Regulations ("ITAR"). *See* Section 22 C.F.R. § 120.10. As such, its dissemination to non-U.S. citizens or companies without prior approval may be a violation of federal law.

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Satellite Deorbit Plan

As you are aware, the IADC formula requires the following deorbit offset (in kilometers) from the geosynchronous altitude:

$$\Delta H > 235 + 1000\, C_r\, A/M \quad (1)$$

where:

C_r is the reflectivity coefficient of the satellite at beginning of life and will vary between 1 and 2 depending upon its surface characteristics
A is the aspect area of the satellite exposed to the sun (m^2)
M is the dry mass of the satellite (kg).

As Boeing explained during its December 19, 2003 meeting with the staff of the International Bureau, rather than use discrete values for *Cr* and *A* in its design work, Boeing carried out a much more precise and complex analysis using its own proprietary torque analysis computer program to evaluate the solar force acting upon the entire spacecraft. The program models the relevant physical characteristics of the spacecraft in a comprehensive manner. Boeing has used this model for many years and the results – most notably, the results for a similar antenna – have been validated by actual in-orbit flight data. The analysis yielded a range of values that are a function of sun elevation angle, with the maximum value being 783×10^{-6} Newtons.[1] The relationship between the solar force and the vehicle's effective C_rA used in the IADC equation above, is:

$$F = C_r AS/c \quad (2)$$

where:

C_r and A are as given above,
S is the mean solar flux at Earth, 1371 W/m^2
c is the speed of light, 2.9979×10^8 m/s.

Based on equation *(2)*, the effective C_rA was 171.216 meters squared. The dry mass of the spacecraft indicated in Boeing's Critical Design Review ("CDR") was 3670.6 kilograms. Boeing, however, assumed a 1% margin in its deorbit analysis, resulting in a calculated dry mass of 3633 kilograms and yielding a more conservative (higher ΔH) result. When these numbers are evaluated in equation *(1)*, the ΔH specified is approximately 283 kilometers, within the 300 kilometer deorbit plan proposed by Boeing in its application.

In order to respond fully to your February 11 inquiry, however, Boeing has made an effort to relate the results of its computer modeling system to discrete equivalent values for the

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[1] The program was used to calculate the expected solar force on the spacecraft during worst-case conditions, *i.e.*, when the spacecraft is on-station, deployed, and sun tracking with its wings. Once decommissioned, it is highly unlikely that the spacecraft will produce greater solar forces. The spacecraft wings will no longer track the sun and the orientation of the spacecraft will not be controlled, permitting the spacecraft to tumble due to its center-of-pressure offset.

reflectivity coefficient of the satellite at beginning of life ("C_r") and the aspect area of the satellite exposed to the sun ("A"). Using these calculations, Boeing provides the following responses to your specific inquiries:

1) The *maximum* cross-sectional area of the spacecraft with the solar panel and 22 meter antenna fully deployed.

As indicated in Attachment 1, the maximum cross-sectional area of the spacecraft with the solar panel and 22 meter antenna fully deployed is 497.5 square meters. This calculation reflects the maximum capture area of the antenna and has not been reduced by any factors.

2) The dimensions of the spacecraft and panel used for calculating the maximum cross-sectional area.

The dimensions of the spacecraft and panel are depicted in Attachment 1. The figure shows the overall spacecraft dimensions and cross-sectional areas of the major modules. The solar arrays represent the largest solid projected area. Each array (North and South) is comprised of seven 1.84 by 3.5 meter panels. The bus platform is 2.9 by 2.3 meters, not counting the reflector cradle and feeder link antenna. The total combined area of the bus platform, reflector cradle and feeder link antenna is 10.5 square meters.

As indicated above, however, Boeing did not rely solely on the dimensions of the spacecraft and panel to obtain the cross-sectional area of the spacecraft for its deorbit calculations. Instead, Boeing used the more accurate approach of developing a computer analytic model to determine the solar force acting on the spacecraft taking into account the characteristics of each relevant physical component.

3) A diagram of the spacecraft with solar panel and 22 meter antenna fully deployed, showing the orientation used for calculating the maximum cross-sectional area.

A diagram of the spacecraft with solar panels and 22 meter antenna fully deployed is included as Attachment 1, with the spacecraft projected along the Z axis, the orientation used for calculating the maximum cross-sectional area listed in response to Question 1 above.

4) The effective area-to-mass ratio of the 22 meter antenna, the method used for calculating the ratio, and the data used in the calculation.

The effective area-to-mass ratio of the 22 meter antenna is presented in Table 1 using two different configurations. The first configuration assumes the antenna is an opaque structure. The second configuration computes the effective area using the actual antenna with its five main structural components. The following five main structural components constitute the majority of the antenna area: Batten Tubes, Longeron Tubes, Diagonal Tubes, Web Tapes and Mesh Wires. The effective area-to-mass ratio of the boom antenna support structure is also given in Table 1.

The effective area of the antenna and boom was calculated by projecting their geometry onto a planar grid. Each grid element occupied by the antenna and boom geometry was summed together to give the total effective area shown in Table 1.

	Effective Area (in^2)	Mass (lb)	Area/Mass (in^2/lb)
Opaque Antenna	681,000[2]	280	2,432.1
Actual Antenna	143,242	280	511.6
Boom	1,802	260	6.9

Table 1. 22 Meter Antenna and Boom Projected Area and Mass

As indicated previously, however, Boeing did not rely solely on this data to calculate the appropriate disposal orbit for its 2 GHz MSS satellite. Instead, Boeing used the more accurate approach of developing a computer analytic model to determine the solar force acting on the spacecraft taking into account the characteristics of each relevant physical component, including the 22 meter mesh antenna.

5) A description of the 22 meter mesh antenna, specifying the dimensions and material composition of each component and the spacing of the lattice wires.

The 22 meter antenna has five main structural components including the Batten Tubes, Longeron Tubes, Diagonal Tubes, Web Tapes, and Mesh Wires. The dimensions and material composition of each of the five main structural components is given in Table 2. The dimensions and material composition of the boom are also given in Table 2. The spacing in the mesh wire weave is ten openings per inch.

Antenna Element	Length (in)	Diameter (in)	Width (in)	Thickness (in)	Material
Batten Tubes	151.07	1.2	-	0.025	Graphite/Epoxy
Longeron Tubes	101.71	1.23	-	0.035	Graphite/Epoxy
Diagonal Tubes	182.12	1.56	-	0.02	Graphite/Epoxy
Web Tapes	-	-	0.56	0.011	Kevlar/Epoxy
Mesh Wires	-	0.0012	-		Molybdenum/Gold (10 OPI)
Boom	486	8 by 8 Square	-	0.06	Graphite/Epoxy

Table 2. 22 Meter Antenna and Boom Description

[2] The effective area of the 22 meter antenna provided in Table 1 (681,000 square inches) differs from the effective area of the 22 meter antenna listed in Attachment 1 (397 square meters or 615,500 square inches). This is because Attachment 1 depicts the entire spacecraft during worst-case conditions, *i.e.*, when the spacecraft is on-station, deployed, and sun tracking with its wings. In this worst-case configuration, the 22 meter antenna will be tilted "downward" toward the Earth, reducing its effective area and its impact on the solar force acting on the spacecraft.

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6) The area-to-mass ratio of the spacecraft, including the 22 meter antenna, and an explanation for use of any cross-sectional area other than the maximum to calculate this ratio.

The *maximum* cross-sectional area of the spacecraft with the solar panel and 22 meter antenna fully deployed is 497.5 square meters. The dry mass of the spacecraft used in the application of the IADC formula was 3633 kilograms. It is inappropriate, however, to divide these two numbers because the antenna cross-section is largely open space with respect to the solar forces. As noted above, the effective C_rA was 171.216 meters squared. Therefore, the area-to-mass ratio (times the reflectivity coefficient) of the spacecraft, including the 22 meter antenna, is .047.

Spacecraft Station Keeping

Your February 11 letter also requested additional information about Boeing's request to operate its spacecraft using a 0.1° longitudinal station keeping tolerance. Specifically, you requested a graphic depiction of the projected ground trace of the satellite showing the maximum longitudinal variation about its proposed nominal location as it crosses the equatorial plane. This graphic depiction is provided herein as Attachment 2. The depiction was developed as a part of Boeing's CDR process and was intended as a conceptual sample that is not entirely representative of the detailed analysis that Boeing has subsequently performed on its station keeping requirements. The attached depiction, however, provides significant insight regarding the nature of Boeing's planned operations. Please let us know if you need additional clarification.

Your letter also requested the following information regarding the satellite's planned orbital characteristics, which is provided below:

Inclination: A sample inclination history for the spacecraft is provided herein as Attachment 3. The sample inclination history should not be assumed to be comprehensive for all possible launch dates. The minimum and maximum inclination of the spacecraft throughout its usable life regardless of launch date will be 1° to 6°.

Eccentricity: The eccentricity of the spacecraft is a function of satellite-specific parameters. During its CDR process, Boeing derived an eccentricity of 0.00056 for its 0.1° longitude control plan and satellite-specific parameters. The eccentricity is held approximately constant over the life of the satellite using the sun-synchronous perigee pointing strategy for eccentricity control.

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Apogee Altitude: Boeing will use an initial value of 42164.2 kilometers for the semi-major axis of its spacecraft orbit, which is typically used to approximate the geosynchronous period. This will yield an apogee radius of 42187.8 kilometers. Boeing observes, however, that the *altitude* of the satellite is not usually considered in orbital control, as it varies with latitude due to the aspheric nature of the earth. The corresponding radii are related to eccentricity through semi-major axis, which also sets the geosynchronous orbital period.

Perigee Altitude: Boeing will use an initial value of 42164.2 kilometers for semi-major axis, which yields a perigee radius of 42140.6 kilometers (as noted above, strictly speaking, these are not *altitudes*).

Right Ascension of the Ascending Node ("RAAN"): A sample history of the RAAN of the orbit is provided herein as Attachment 4. The sample history was developed for Boeing's CDR and is not time-indexed. Boeing will employ a maximum bound of ±60° for the RAAN of the spacecraft orbit.

Argument of Perigee: The argument of perigee for the sun-synchronous perigee pointing strategy that will be employed by Boeing will clock from 0° to 180° (through 90°) in half a year and back to 0° (through 270°) in the remaining half year. Each of these values is relevant to an analysis of Boeing's longitudinal station keeping requirements.

Thank you for your attention to this matter. Please let us know if you have any questions, or if additional meetings or conference calls with Boeing's engineering team would be appropriate to explore further the issues addressed in this letter.

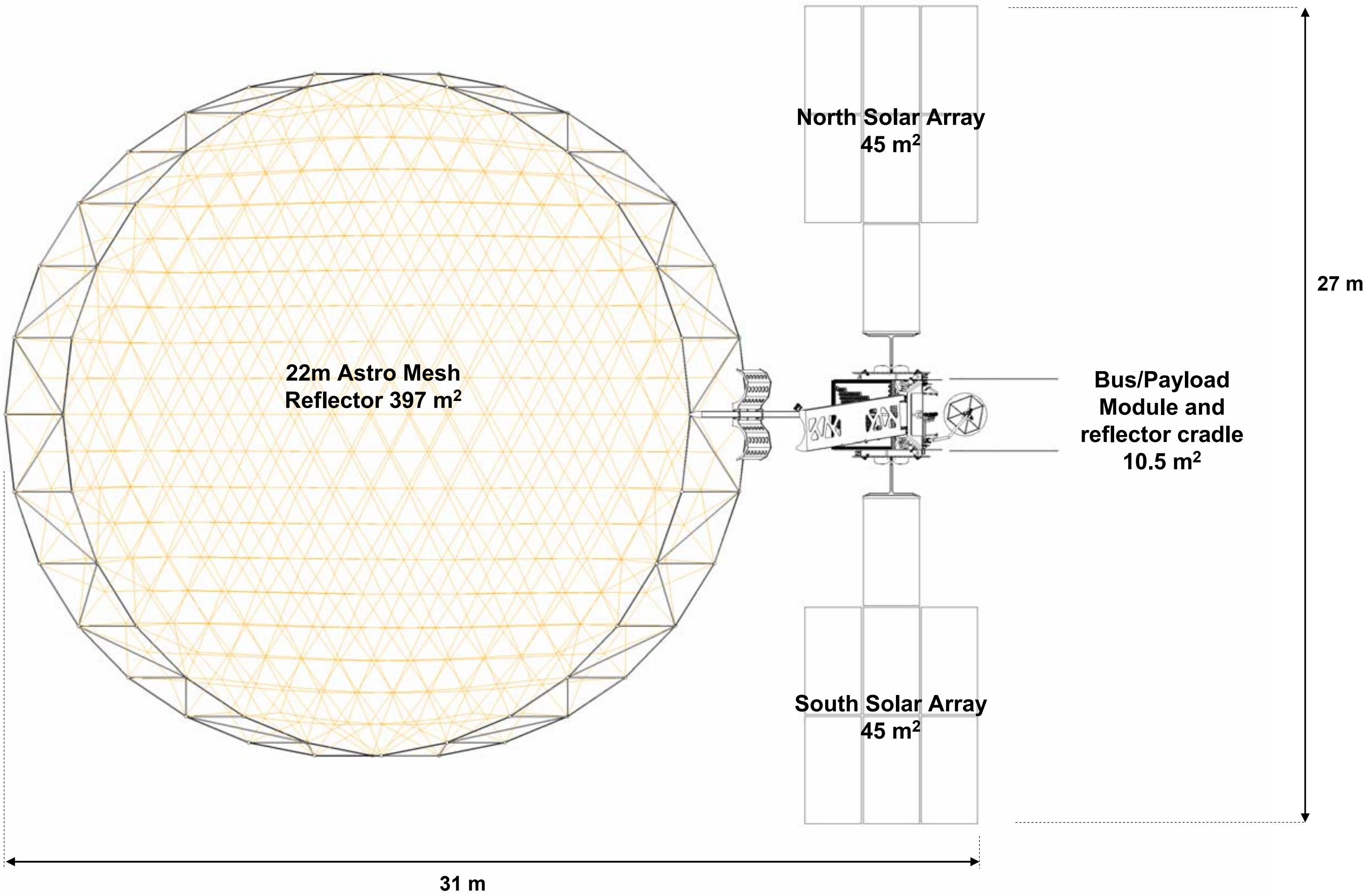
Sincerely,

Joseph P. Markoski
Bruce A. Olcott
Counsel for The Boeing Company

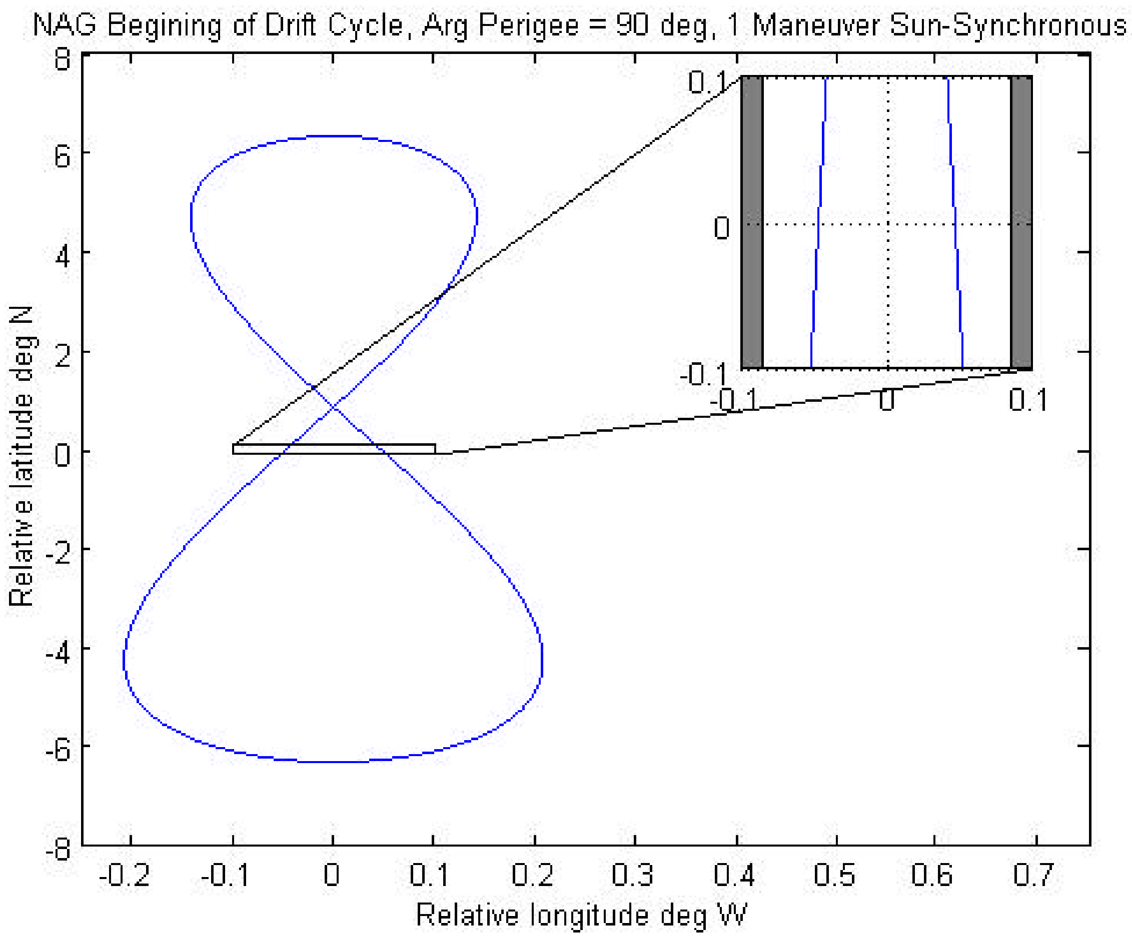
cc: Marylou Cahir
Thomas Tycz
Karl Kensinger
Robert Nelson
John Martin
William Bell
Sankar Persaud

NA Gem

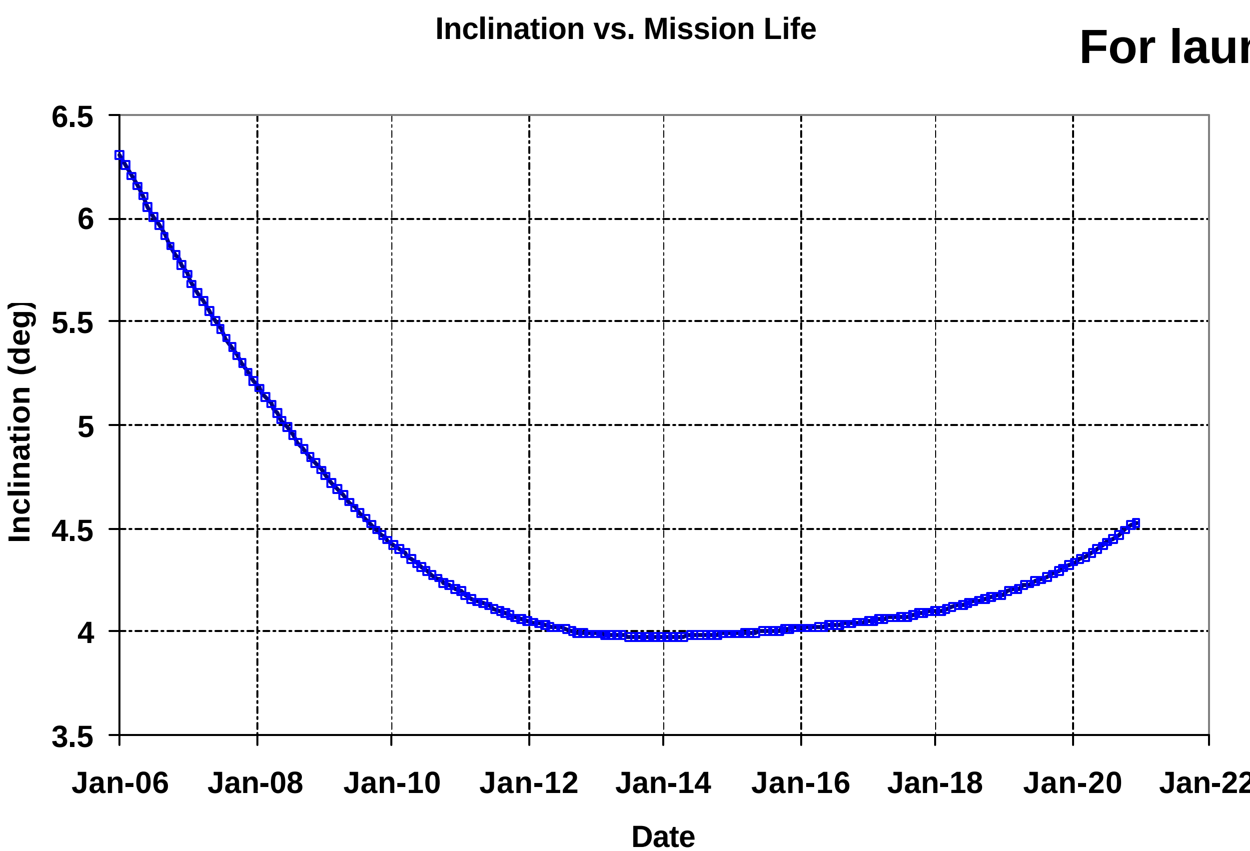
Spacecraft Area (projected along Z axis onto the separation plane)



Analemma plots



On-station Inclination



For launch in January 2006

EOT inclination: 6.30°
BOS inclination: 6.00°
EOL inclination: 4.15°
plot shows inclination through 15 years

- **BOS is assumed to be at L+6 months.**
- **Inclination will be < 6.0° after In Orbit Test and check-outs**

On-station Inclination / RAAN

For launch in January 2006

Sample injection

- **At the end of Transfer Orbit:**
  RAAN = 324.0°
  Inclination = 6.30°
- **BOS Inclination = 6.00°**
- **EOL Inclination = 4.15°**
- **EOL RAAN = 13.5°**

RAAN vs Inclination