ATTN: JOHN S. HICKEY P.O. BOX 4906, BALTIMORE, MD 212200906

United States of America
FEDERAL COMMUNICATIONS COMMISSION
EXPERIMENTAL
RADIO STATION CONSTRUCTION PERMIT
AND LICENSE

EXPERIMENTAL	K O 2 X B Q
(Nature of Service)	(Call Sign)
XD FX	4790-EX-RR-1997
(Class of Station)	(File Number)

NAME LOCKHEED MARTIN CORPORATION

BITHLO, (ORANGE) FL - NL 28-22-35; WL 081-04-55

(Location of Station)

Subject to the provisions of the Communications Act of 1934, subsequent acts, and treaties, and all requlations heretofore or hereafter made by this Commission, and further subject to the conditions and requirements set forth in this license, the licensee hereof is hereby authorized to use and operate the radio transmitting facilities hereinafter described for radio communications in accordance with the program of experimentation described by the licensee in its application for license.

Frequency	Class Stn	Emission Designator	Authorized Power watts

See Attached Page 3

Operation: In accordance with Sec. 5.202(i) of the Commission's Rules.

Special Conditions:

See Attached Page 2

This authorization effective June 1, 1997 and will expire 3:00 A.M. EST June 1, 1999

FEDERAL COMMUNICATIONS COMMISSION

Special Conditions:

(1) All operations subject to coordination with the Eastern Area Frequency Coordinator located at Patrick AFB, Florida, prior to use within the area bounded by 24 degrees N; 31 degrees 30' N; and 70 degrees W. 83 W.

(2) Assignment in frequency bands 960-1400, 2700-2900, or 9000-9200 MHz was coordinated prior to authorization with the FAA Southern Coordinator, Atlanta, GA. Use of frequencies under the authority of this assignment is subject to such further coordination with the FAA Southern Coordinator, Atlanta, GA, as necessary to ensure compatibility with existing uses.

(3) In lieu of frequency tolerance, the occupied bandwidth of the emission shall not extend beyond the band limits set forth above.

(4) The station identification requirements of Section 5.152 of the Commission's Rules are waived.

Frequency	Class Stn	Emission Designator	Authorized Power watts
MHz			
700.00000-960.00000	FX	50M0P0N	1.800M (ERP)
1215.00000-1300.00000	FX	50M0P0N	1.800M (ERP)
1350.00000-1400.00000	FX	50M0P0N	1.800M (ERP)
2300.00000-2500.00000	FX	200MP0N	5.800M (ERP)
2900.00000-3700.00000	FX	200MP0N	5.800M (ERP)
4400.00000-4990.00000	FX	400MP0N	10.200M (ERP)
5250.00000-5925.00000	FX	400MP0N	10.200M (ERP)
8500.00000-9000.00000	FX	400MP0N	12.900M (ERP)
9200.00000-10000.00000	FX	400MP0N	12.900M (ERP)
14500.00000-15350.00000	FX	400MP0N	13.500M (ERP)
15400.00000-18000.00000	FX	400MP0N	13.500M (ERP)
33400.00000-36000.00000	FX	400MP0N	15M (ERP)
GHz			
95.00000-101.00000	FX	400MP0N	15M (ERP)

Federal Communications Commission
Washington, D.C. 20554

November 3, 1998

Mr. John S. Hickey
Lockheed Martin Corporation
P.O. Box 4906
Baltimore, MD 21220-0906

GRANT-IN-PART

Dear Mr. Hickey:

This refers to application, File No. 4790-EX-RR-1997, for Experimental Radio Station KO2XBQ.

The enclosed authorization shall be considered as a grant of the referenced application unless rejected by a written notice within thirty (30) days from the date of this letter, whereupon the enclosed grant will be vacated. Such rejection should include a statement of the reasons, if any, why the applicant believes that the application should be granted in accordance with the terms requested therein.

You are advised that the Commission was unable to make a finding that the public interest would be served by a grant of the application in the manner requested. The frequency band 10,000 - 10,500 MHz is not accepted due to prohibition of pulsed emissions in that band as stated in footnote US58 to the U.S. Table of Frequency Allocations.

Sincerely,

Jim Burtle
Acting Chief
Experimental Licensing Branch

Attachment:
License KO2XBQ

MARTIN MARIETTA CORPORATION

TELECOMMUNICATIONS
POST OFFICE BOX 4906
BALTIMORE, MARYLAND 21220

July 26, 1983

Federal Communications Commission
2025 M Street, N.W.
Washington, DC 20554

Attn: Frequency Liaison Branch
Office of Science and Technology

You will please find enclosed one copy of FCC Form 442, Application for a New Experimental (Developmental) Radio Station Authorization to operate at a remote test site near Bithlo, Florida.

You will find several Exhibits attached which explain in detail all pertinent data required. You will also find enclosed a request for confidentiality, regarding this application, from the program supervisor at our Orlando facility.

If you should require any further information regarding the technical data relating to this application you can contact Mr. Carl F. Schunemann in Orlando, Florida at 305/352-4366.

Any questions regarding how this application was completed, please feel free to call the undersigned at 301/687-7000.

Very truly yours,

Claude E. Wells

Claude E. Wells
Coordinator
Radio Frequencies

CEW:hm

FCC Form 442
January 1977

Federal Communications Commission
Washington, D. C. 20554

Approved by GAO
B-180227(R0376)

APPLICATION FOR NEW OR MODIFIED RADIO STATION AUTHORIZATION UNDER PART 5 OF FCC RULES EXPERIMENTAL RADIO SERVICES (OTHER THAN BROADCAST)

1. Applicant's Name and Post Office address (Give street, city, state, and ZIP Code, see Instruction No. 4)

Martin Marietta Corporation
P.O. Box 4906
Baltimore, Maryland 21220

Attn: John S. Hickey

DO NOT WRITE IN THIS BLOCK

File No.

2.(a) Class of station applied for
Experimental FX

2.(b) Nature of Service
Experimental (Developmental)

3.(a) Application for *(check only one box)*

[X] New Station [ ] Modification of existing authorization

3.(b) For Modification indicate below

File No. Call Sign

4. Application for modification indicate change in (check all that apply)

[ ] Frequency [ ] Emission [ ] Power [ ] Location

[ ] Other particulars *(describe below or in attached Exhibit No. _____)*

5. Particulars of Operation *see instructions below)*

Frequency (State Whether kHz or MHz (A)	POWER (B)	POWER (C)	POWER (D)	EMISSION (E)	MODULATING SIGNAL (F)	NECESSARY BANDWIDTH (kHz) (G)
700-1400	1 KW Peak	1.8 MW Peak	14.3W Mean	PO	100-200	50,000
2000-4000	" "	5.8 MW Peak	" "	PO	Nanosecond	200,000
4000-8000	" "	10.2 MW Peak	" "	PO	at either	400,000
8000-12000	" "	12.9 MW Peak	" "	PO	1000-2000	400,000
12000-18000	" "	13.5 MW Peak	" "	PO	PPS or	400,000
35800-37200	160 W Peak	15.0 MW Peak	2.3 W Mean	PO	60,000 to 70,000	400,000
95000-101000	70 W Peak	16.8 MW Peak	1.0 W Mean	PO	PPS	

(A) List each frequency or frequency band separately. (If more space is required, attach as Exhibit No. _____).
(B) Insert maximum R.F. output power at the transmitter terminals. Specify units.
(C) Insert maximum effective radiated power from the antenna (If pulsed emission specify peak power).
(D) Insert "MEAN" or "PEAK" (See definitions in Part 5).
(E) List each type of emission separately for each frequency. (See Section 2.201 FCC Rules.)
(F) Insert the following information for each type of emission:
for A1, insert maximum speed of keying in bauds
for A2, insert maximum audio modulating frequency and maximum speed of keying in bauds
for A3, insert maximum audio modulating frequency
for F1, insert mark and space frequencies, maximum speed of keying in bauds
for F2, insert maximum audio modulating frequency, frequency deviation of carrier, maximum speed of keying in bauds
for F3, insert maximum audio modulating frequency and frequency deviation of carrier
for P0, insert pulse duration and repetition rate
for other emissions describe in detail in space provided below.
(G) Describe how the necessary bandwidth was determined in space provided below.

Calculation is by Fourier Transform of measured wave shape.

(This form supersedes FCC Forms 440 & 441.)

6(a). Proposed location of transmitter and transmitting antenna (Check only one box)

[x] FIXED/BASE [ ] MOBILE [ ] BASE & MOBILE

(b) If permanently located at a fixed location, give below

State	County	City or Town
Florida	Orange	Bithlo

Number and street (or other indication of location)
Deseret Ranch test facility 6.5 miles south of Beeline Exp. on Tramway Road

(c) If mobile, describe the exact area of operation

Geographical coordinates exact to the nearest second

North Latitude			West Longitude		
°	'	"	°	'	"
28	22	35	81	04	55

Geographical coordinates of the approximate center of proposed area of operation (mobile applications)

North Latitude			West Longitude		
°	'	"	°	'	"

Place an "X" in the appropriate column	YES	NO
7. Is a directional antenna *(other than radar)* used?	x	
If "YES", give the following information:		
(a) Width of beam in degrees at the half-power point. 6.8° at 0.7 GHz to 1.1° at 18 GHz (See Exhibit II)		
(b) Orientation in horizontal plane 146° 56' south east of north		
(c) Orientation in vertical plane 0° elevation (parallel to ground) 52' high at 0.7 GHz to 3.5' at 18 GHz (See Exhibit III).		
8. Is this authorization to be used for fulfilling the requirements of a government contract with an agency of the United States Government?		x
If "Yes", attach FCC Form 440-A, Supplemental Information for Applications in the Experimental Radio Service Involving Government Contract, in triplicate to this application.		
9. Is this authorization to be used for the exclusive purpose of developing radio equipment for export to be employed by stations under the jurisdiction of a foreign government?		x
If "Yes", attach as EXHIBIT No. _____, the following information:		
(a) The contract number and the name of the foreign government concerned.		
(b) The daily hours of operation and the estimated date of the beginning and end of the specific time period for which the authorization is required.		
10. Is this authorization to be used for providing communications essential to a research project. (The radio communication is not the objective of the research project).		x
If "Yes", attach as EXHIBIT No. _____, a narrative statement providing the following information		
(a) A description of the nature of the research project being conducted.		
(b) A showing that the communications facilities requested are necessary for the research project involved.		
(c) A showing that existing communications facilities are inadequate.		

11. If all the answers to Items 8, 9, and 10 are "No", attach as EXHIBIT NO. _____, a narrative statement describing in detail the following:

(a) The complete program of research and experimentation proposed including description of equipment and theory of operation.

(b) The specific objectives sought to be accomplished.

(c) How the program of experimentation has a reasonable promise of contribution to the development, extension, expansion, or utilization of the radio art, or is along lines not already investigated.

12. (a) Give an estimate of the length of time that will be required to complete the program of experimentation proposed in this application

(b) If less than 2 years, give the length of time in months that the authorization requested in this application will be required.

In excess of 2 years. Use of this RCS range on R&D is planned for extended usage through calander year 1985.

13. List below transmitting equipment to be installed (if experimental, so state):

MANUFACTURER	TYPE	NO. OF UNITS
SPC Technologies, Inc. 1500 Wilson Boulevard Arlington, VA 22209-2454	Mark III-B Radar	

14. State provisions that will be made for measurement and periodic checking of the station's technical characteristics (power, frequency, bandwidths) to insure compliance with terms of license.

See Exhibit IV

Place an "X" in the appropriate column	YES	NO
15. Will the antenna extend more than 6 meters above the ground, or if mounted on an existing building will it extend more than 6 meters above the building, or will the proposed antenna be mounted on an existing structure other than a building?	X	
16. Does this application propose a developmental program of experimentation which requires the submission of a petition? (See Instructions 10 and 11)		X
17. Applicant is *(check only one box)* [ ] Individual [ ] Association [ ] Partnership [X] Corporation [ ] Other *(describe below)*		
18. Is applicant a foreign government or a representative of a foreign government?		X
19. Has applicant or any party to this application had any FCC station license or permit revoked or had any application for permit, license or renewal denied by this Commission?		X

If "Yes", give the following (See Instruction9): 0.6 M maximum at 18 GHz to 16 M maximum at 0.7 GHz (See exhibit I).

(a) Overall height above ground to tip of antenna is _____ meters.

(b) Elevation of ground at antenna site above mean sea level is 22.9 meters.

(c) Distance to nearest aircraft landing area is 25 kilometers to Orlando International 15 kilometers to Lake X (private) kilometers.

(d) List any natural formations or existing man-made structures (hills, trees, water tanks, towers, etc.) which, in the opinion of the applicant, would tend to shield the antenna from aircraft and thereby minimize the aeronautical hazard of the antenna.

60 to 70 foot high tree line at boresight end of range will absorb much of the narrow beam radiation used.

(e) Submit as EXHIBIT No. _____, a vertical profile sketch of total structure (including supporting building, if any, giving heights in meters above ground for all significant features. Clearly indicate existing portion, noting particulars of aviation obstruction lighting already available.

If "Yes", attach the petition as EXHIBIT No. _____.

If "Yes", attach as EXHIBIT No. _____, a statement giving call sign of license or permit revoked and relate circumstances.

Place "X" in the appropriate column.	YES	NO
20. Will applicant be owner and operator of station?	X	
If "No", explain applicant's relation to station.		
21. Will applicant have absolute control of station, both as to physical operation and service conducted?	X	
If "No", explain circumstances and give name of person who will have control of station.		
22. Will the transmitter be operated with licensed operator on duty at a remote control point?		X
If "Yes", the following information must be provided. (If there is to be a licensed operator on duty at the transmitter, data required by this item may be omitted.)		
(a) Location of remote control point. (If more than one remote control point is involved, attach as EXHIBIT No. _____, a statement giving location of each remote control point, plan of operation, etc.)		
State / County		
City or Town / Street & No.		
(b) By what means will the transmitter be rendered inaccessible?		
(c) Can transmitter be placed in an inoperative condition from the remote control point?		

(d) Describe below the equipment to be used to enable the operator at the control point to determine when there is a deviation from the terms of the station license or when operation is not in accordance with the Commission's Rules governing the class of station involved.

23. Give name, title, and telephone number (include area code) of person who can best handle inquiries pertaining to this application.

Carl F. Schunemann, Division Radio Frequency Coordinator, 305/352-4366.

24. List below all exhibits in numerical sequence and the item number of form requiring the exhibit identified.

EXHIBITS AND ITEM NO. OF FORM

Exhibit Number	Item No. of Form	Exhibit Number	Item No. of Form	Exhibit Number	Item No. of Form
I	15(a)	V	Confidential		
II	7(a)	VI	15(e)		
III	7(c)	A	Description of Range		
IV	14				

25. CERTIFICATION

ATTENTION: Read this certification carefully before signing this application.

THE APPLICANT CERTIFIES THAT:

(a) Copies of the FCC Rules Parts 2 and 5 are on hand; and

(b) Adequate financial appropriations have been made to carry on the program of experimentation which will be conducted by qualified personnel; and

(c) All operations will be on an experimental basis in accordance with Part 5 and other applicable rules, and will be conducted in such a manner and at such a time as to preclude harmful interference to any authorized station; and

(d) Grant of the authorization requested herein will not be construed as a finding on the part of the Commission

(1) that the frequencies and other technical parameters specified in the authorization are the best suited for the proposed program of experimentation, and

(2) that the applicant will be authorized to operate on any basis other than experimental, and

(3) that the Commission is obligated by the results of the experimental program to make provision in its rules including its table of frequency allocations for applicant's type of operation on a regularly licensed basis.

APPLICANT CERTIFIES FURTHER THAT:

(e) All the statements in the application and attached exhibits are true, complete and correct to the best of the applicant's knowledge; and

(f) The applicant is willing to finance and conduct the experimental program with full knowledge and understanding of the above limitations; and

(g) The applicant waives any claim to the use of any particular frequency or of the ether as against the regulatory power of the USA.

Signed and dated this 27th. day of July, 19 83.

Name of Applicant Martin Marietta Corporation
correspond with name given on page 1

By John S. Hickey
(print) *(signature)*

Title Assistant Director of Telecommunications

WILLFUL FALSE STATEMENTS MADE ON THIS FORM ARE PUNISHABLE BY FINE AND IMPRISONMENT. U. S. CODE, TITLE 18. SECTION 1001.

Check Appropriate Classification

- [ ] Individual Applicant
- [ ] Member of Applicant Partnership
- [X] Officer of Applicant Corporation or Association
- [ ] Authorized Employee

NOTIFICATION TO INDIVIDUALS UNDER PRIVACY ACT OF 1974

Information requested through this form are authorized by the Communications Act of 1934, as amended, and specifically by Section 308 therein. The information will be used by Federal Communications Commission staff to determine eligibility for issuing authorizations in the use of the frequency spectrum and to effect the provisions of regulatory responsibilities rendered the Commission by the Act. Information requested by this form will be available to the public unless otherwise requested pursuant to Section 0.459 of FCC Rules and Regulations.

THE FOREGOING NOTICE IS REQUIRED BY THE PRIVACY ACT OF 1974, P.L. 93-579, DECEMBER 31, 1974, 5 U.S.C. 552a(e)(3).

EXHIBIT A

A Martin Marietta radar cross section (RCS) measurement range is being established in a remote, undeveloped ranch-land and swamp-land area approximately 4 miles south of the East-West Bee-Line expressway linking Orlando, Florida to the Titusville-Cocoa area, approximately mid-way between the east and west limits of the expressway.

The range is being constructed on an interior 3600 acre rectangular portion of the 400,000 acre Deseret Ranch, those 3600 acres having been acquired by Martin Marietta Orlando Aerospace under a 10-year lease with option-to-buy.

Its perimeter is fenced by 15 miles of D.O.D. approved security fence, 8-feet high topped by 3-strand barbed wire. Access is controlled by an entrance guard post approximately 3/4 mile south of the northwest corner of the property. The guardpost is manned by Martin Marietta security guards on a 24-hour, 7-day week basis, with roving security patrols within the fenced area during classified data taking periods.

Roving and gate guards are linked by FCC-licensed land-mobile radio to the Martin Marietta Security command post 25-miles N-NW of the range at the Orlando main plant.

Access to the property is strictly controlled because of the high security level of the measurements to be performed there. Visual access to range operation is denied by the distance and terrain from the target areas to the security fence perimeter, and by Martin Marietta Security control of access to the city of Cocoa's water standpipe just northwest of the property (by agreement with the city's water department).

Public access to the Bee-Line expressway is limited to toll booths in the Orlando and Titusville-Cocoa areas and at its intersection with State Route 520 northeast of the property. The Deseret Ranch and City of Cocoa further limit access to the private roads in the area surrounding the fenced perimeter.

Access to the closed equipment trailer is controlled via an enclosed personnel walkway from the cipher-locked security area in the range office module a few feet north of that trailer and its antenna supports. A resident RCS range manager will control all range operations in accordance with license provisions and applicable Government security directives.

Martin Marietta policy limits any identification of the facility and its activities to simply that it is "a test facility to be used in support of the company's programs."

The heart of the measurement facility is a flat asphalt-paved ground plane, 6000 feet long, extending from the transmitting antenna supports at 28° 22' 17" north-latitude and 81° 04' 40"west-longitude at an azimuth of 146° 56' south-east of north. Antennas are narrowbeam antennas, boresighted essentially horizontal parallel to that paved ground plane, down the ground-plane center line to target positioners at 2500 feet, 3000 feet, and 6000 feet from the antennas. The 2500 foot target location contains a below-ground rotator pit with 30-foot diameter turntable flush with the paved surface. The 3000 foot and 6000 foot target locations have 20-foot high and 53-foot high low-RCS target support pylons, respectively.

The range is a full-scale, far-field RCS ground-plane range, meeting the $\frac{2D^2}{\lambda}$ far-field criterion, and with antenna heights meeting the $\frac{0.8\ R\lambda\ \text{min}}{4\ \text{ht.}}$ to $\frac{1.1\ R\lambda\text{max}}{4\ \text{ht}}$ normal ground-plane range criterion. In the above expressions, λ is the radar wavelength, D is the target maximum dimension, ht is the target height, R is range to target, and λ min and λ max the radar wavelengths corresponding to the frequency limits of each operating band. The paved ground plane tapers in width from 60-feet at the antenna end to 534-feet wide at the 6000 foot end (corresponding to antenna null beamwidth at S-band). The 2500 foot target turntable is offset slightly from range centerline, the 3000-foot and 6000-foot target pylon being located on centerline. The paved ground plane carries FAA-required X-markings to warn pilots that it is not a landing strip.

Exhibit I gives the basic measurement radar system RF characteristics, showing the required antenna heights (up to 52 feet above the ground-plane elevation of 75 feet above mean-sea level).

Frequency bands, antenna sizes, transmitter types, peak powers, and 1-dB beamwidths in feet at the target plane for both azimuth and elevation planes are shown in Table I. Signal-to-noise and RF-loss plus noise figures parameters are also shown.

Exhibit II shows detailed gain, beamwidth and side-lobe parameters plus power ratings of those antennas.

Exhibit VI shows the antenna support assemblies alongside the equipment trailer. Single antenna dishes are used in each frequency band (diplexed for transmit and receive), for true monostatic RCS measurements.

Exhibit III gives the antenna design goals for the antenna mechanisms of Figure 1.

Exhibit IV, VII gives the system specifications, including peak transmitter pulse power in KW, antenna gain in dBi, minimum pulsewidths in nanoseconds, and the instantaneous bandwidths in MHz required.

Two basic PRF ranges will be used, 1 to 2 KHz and 60-70 KHz. Pulse widths will range form 100 nanoseconds to 200 nanoseconds. Step-chirped waveforms, (monotonic increasing in frequency) as shown in the footnotes of Table III will be used for some measurements requiring range resolution down to 6".

Average radiated power levels will be quite low as shown in Appendix I, 95% of the time being between only 0.6 to 0.4 watts, and the remaining 5% of the time between 6 and 14.3 watts.

Appendix I contains the calculations for duty cycle, average power, and effective radiated power corresponding to the parameters of Tables I through III. Note that only 5% of range operating time is expected to use the higher PRF's of 60,000 to 70,000 PPS with their higher average power and higher average effective radiated power. The in-phase addition of direct and ground-plane-reflected rays at the target height will cause power densities at target to be up to 4 times those corresponding to the values of Appendix I.

While the high-gain,narrow-beam antennas give significantly high peak and average effective radiated powers at the target, the low average power and favorable horizontal, fixed-azimuth boresighting of the narrow beams in the remote swamp-land locations minimize interference potential with other services in these bands.

Range operating efficiency and spectrum transmitting-time-conservation are enhanced by the multiple band operation capability of 1, 2, or 4 radar frequencies interleaved, minimizing the on-the-air time required to take the RCS data on a particular target.

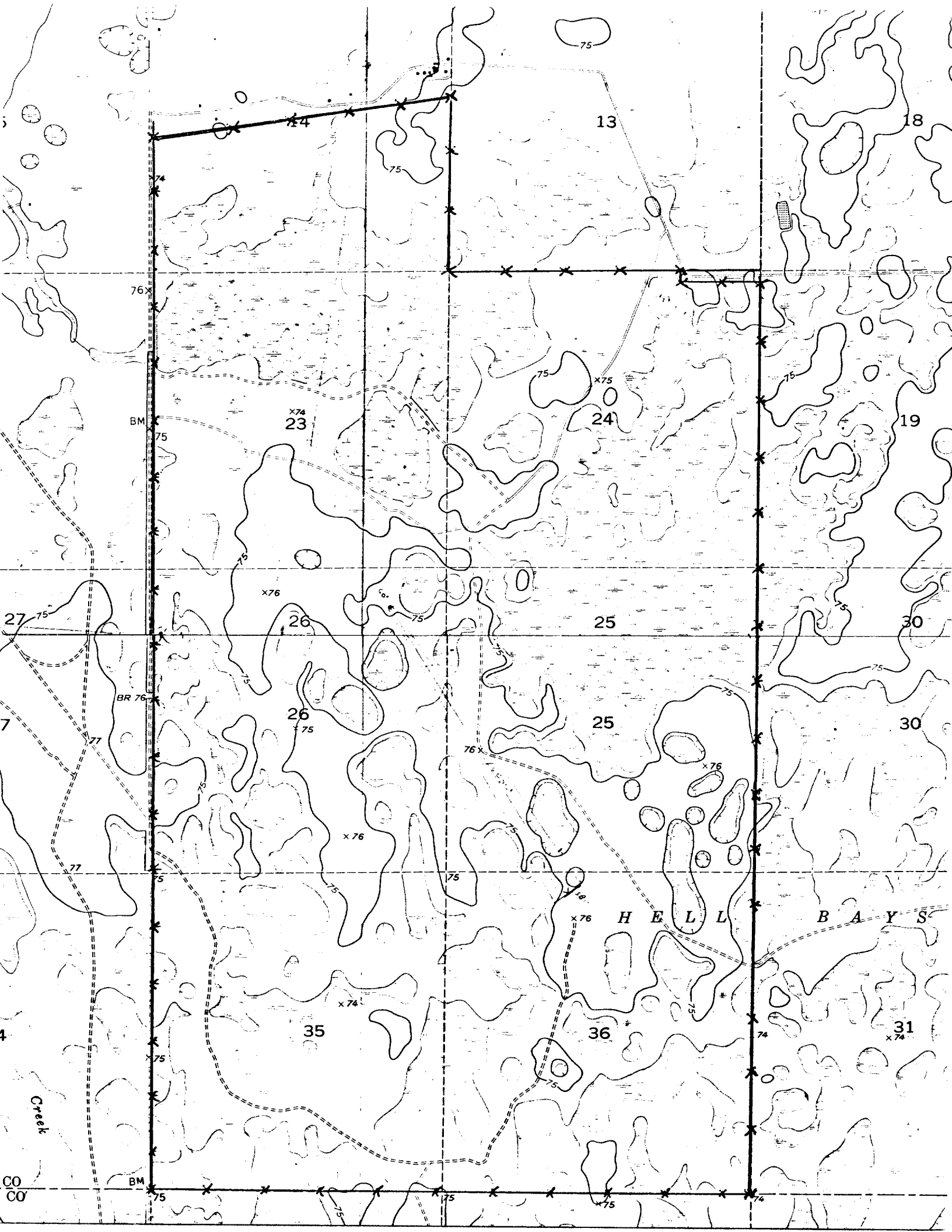
Operation of the multi-frequency radar is computer-controlled, permitting positive lock-out of those frequencies so directed by the processing co-ordination of the RCS range licensing.

The range will be operated by skilled engineers and technicians with years of experience in RCS range operating, supported by operations-monitoring instrumentation traceable to the U.S. Bureau of Standards through the Martin Marietta Orlando Aerospace calibrations laboratory.

Frequency bands from 0.7 through 18.0 GHz are being implemented initially, with growth to include the 35 and 95 GHz bands planned. Frequency auth-orizations for all seven bands are requested at this time to permit quick reaction implementation of the growth bands as required by U.S. Government customers and in-house Martin Marietta IR&D programs.

Figures 1 and 2 from the U.S. Coast and Geodetic Survey and FAA Air Navigation maps show the range perimeter and the range centerline, the arrow head pointing in the boresight direction. Instrumentation trailer and antennas are at the arrow tail and the 6000 foot target pylon at the arrow point.

As is evident in Figures 1 and 2, favorable boresighting is maintained, the narrow beam horizontal radiation pattern directed over remote undeveloped swampland and ranchland away from east-coast Florida and Orlando area installations. A 60 to 70 foot high tree-line at the southeast end of the range centerline will absorb most of the radiated energy before it leaves the range property.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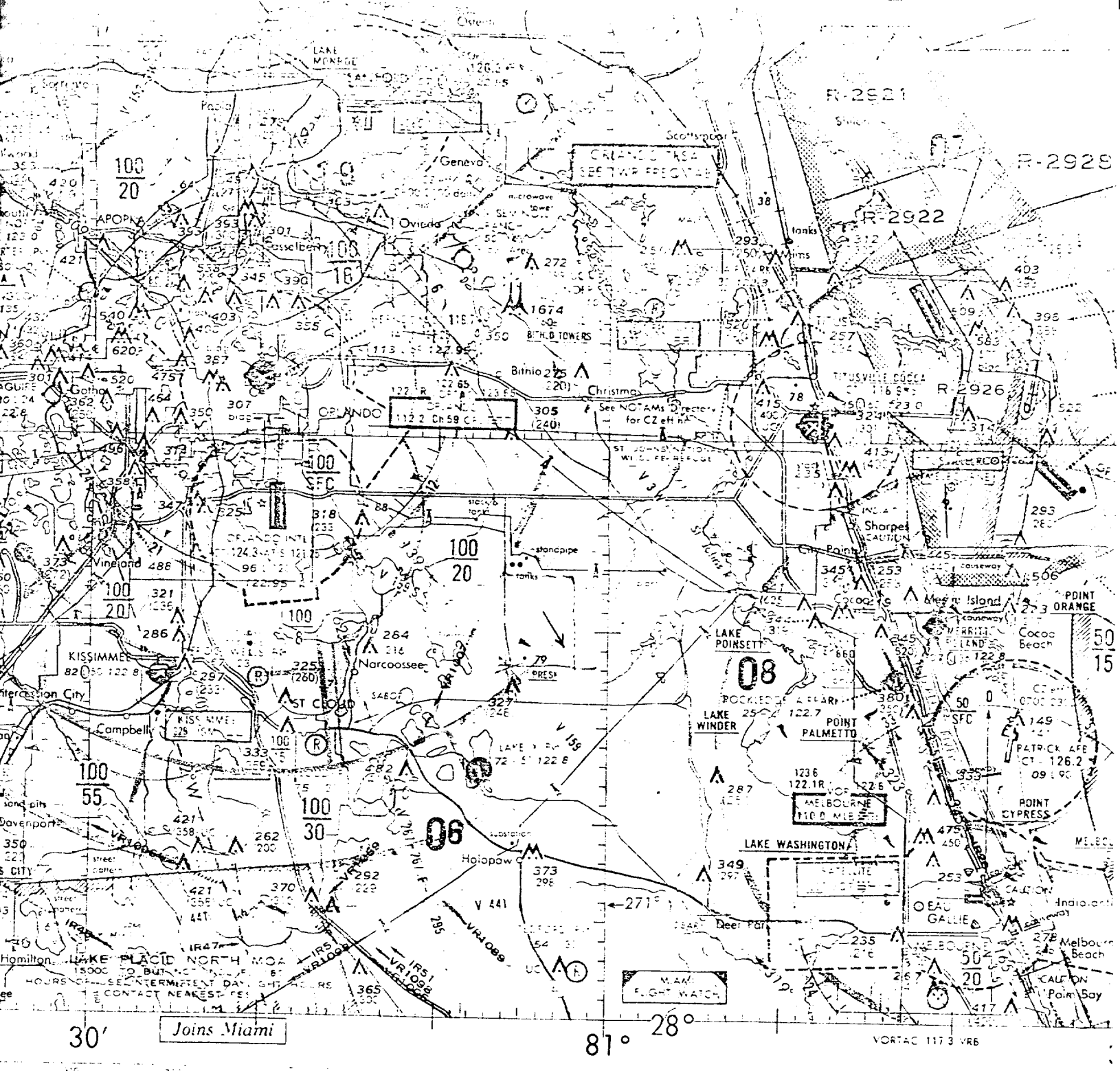

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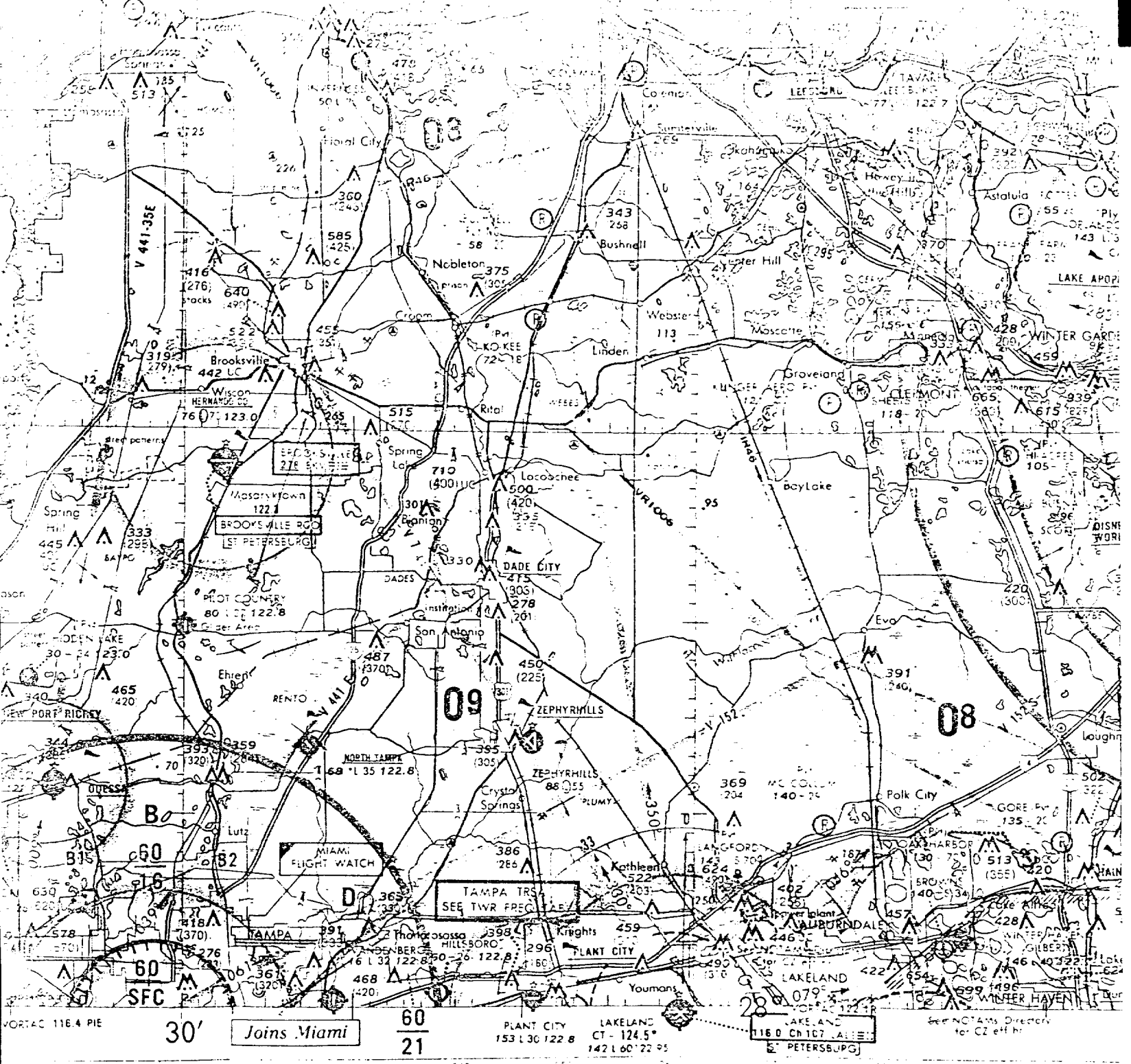

R-3007E	Townsend, Ga	500 AGL to 5000	Mon-Fri, 0800-1700 O T by NOTAM 24 hrs in advance	• FAA • Area Savannah A Brunswick
R-3007C	Townsend, Ga	100 AGL to 13,000	Mon-Fri, 0800-1700 O T by NOTAM 24 hrs in advance	• FAA • Area Savannah A Brunswick
R-3007E	Townsend, Ga	1200 AGL to 13,000	Mon-Fri, 0800-1700 O T by NOTAM 24 hrs in advance	• FAA • Area Savannah A Brunswick
R-3007E	Townsend, Ga	To 13,000	Mon-Fri, 0800-1700 O T by NOTAM 24 hrs in advance	• FAA • Area Savannah A Brunswick
W-132A	Charleston, S C	Unlimited	0700-2200	• FAA • Area Fleet

W-132E	Charleston, S C	To FL 24
W-133	Beaufort, S C	To 4800
W-134	Beaufort, S C	

EXHIBIT I

MARTIN MULTIFREQUENCY RADAR
ANTENNA MECHANISM DESIGN GOALS

Antenna size (ft)	15	6x12	4x8	3x6	2x4	4*	3*
Frequency (GHz)	0.7-1.4	2.0-4.0	4.0-8.0	8.0-12	12-18.0	36-38	95
Wavelength (ft)	1.25-0.77	0.50-0.25	0.25-0.13	0.13-0.083	0.083-0.061	0.027	0.011
Azimuth HPBW (deg)	5.7-3.5	2.4-1.2	1.8-0.9	1.2-0.8	1.2-0.9	0.5	0.2
Height							
STOW (ft)	12.5	4	3.7	2.5	1.8		
Operating							
Minimum (ft)	23	7.5	3.7	2.5	1.8	Fixed	Fixed
Maximum (ft)	52	21	10.3	5.2	3.5	at	at
Rate of travel (ft/min)	10	10	1	1	1	4	4
Readout Accuracy (ft)	± 0.02	± 0.02	± 0.02	± 0.02	± 0.02		
Angle							
Azimuth (deg)	± 10	± 10	± 5	± 5	± 5	± 5	± 5
Elevation (deg)	± 5	± 5	± 5	± 5	± 5	± 5	± 5
Rate of travel (ft/min)	30	30	12	12	12	12	12
Readout accuracy (deg)	± 0.02	± 0.02	± 0.02	± 0.02	± 0.02	± 0.02	± 0.02

$$\text{HPBW} = \begin{cases} 1.2\dfrac{\lambda}{D} & \text{Circular} \\ 1.0\dfrac{\lambda}{D} & \text{Elliptical} \end{cases}$$

$$\text{Operating height} = 0.8\,\frac{R\lambda_{min}}{4h_t} \text{ to } 1.1\,\frac{R\lambda_{max}}{4h_t}$$

*Growth

EXHIBIT II

MARTIN MULTIFREQUENCY RADAR
ANTENNAS

APERTURE (FT)	FREQUENCY (GHz)			MIN GAIN (dBi)[a]			MAX AZ BEAMWIDTH				SIDELOBES[b]					POWER (kW)	
							3 dB		12 dB								
	f_l	f_c	f_h	f_l	f_c	f_h	f_l	f_h	f_l	f_h	REGION 1 (0-5°)	REGION 2	REGION 3	REGION 4	REGION 5 (110-180°)	PEAK	AVE
2x4	12	14.25	18.0	37.8	40.2	41.3	1.6°	1.1°	3.2°	2.2°	20	25 (5-15°)	30 (15-35°)	35 (35-110°)	GMIN	20	0.4
3x6	8	10	12	37.6	40.5	41.1	1.6°	1.1°	3.2°	2.2°	20	25 (5-15°)	30 (15-35°)	35 (35-110°)	GMIN	20	0.4
4x8	4	6	8	34.1	38.5	40.1	2.4°	1.2°	4.8°	2.4°	20	25 (5-15°)	30 (15-35°)	35 (35-110°)	GMIN	20	0.4
6x12	2	3	4	31.6	36.1	37.6	3.2°	1.6°	6.4°	3.2°	20	25 (5-15°)	30 (15-35°)	35 (35-110°)	GMIN	5	0.1
15	0.7	1.05	1.4	26.5	30.0	32.5	6.8°	3.4°	13.6°	6.8°	17	19 (5-10°)	22 (10-15°)	27 (15-110°)	GMIN	5	0.2

[a] Gain $= \eta \frac{4\pi A}{\lambda^2}$ η = 0.4 minimum, 0.5 at f_c.

[b] Sidelobe: Phase reversal >1 dB.
All Regions apply toward azimuthal sidelobes;
Regions 4 and 5 apply toward elevation sidelobes.

Maximum VSWR = 1.5:1.
Cross Polarization Discrimination >30 dB over 1-dB beamwidth.

EXHIBIT III

MARTIN MULTIFREQUENCY RADAR
RADAR SYSTEM RF CHARACTERISTICS

BAND	FREQUENCY COVERAGE (GHz)	ANTENNA SIZE (ft)	ANTENNA VERTICAL TRAVEL (ft)	TRANSMITTER TYPE	PEAK POWER (kW)	RF LOSS + NOISE FIGURE (dB)	S/N ON −60 dBsm AT 6000 ft[1] (dB)	DISTANCE BETWEEN 1-dB (TWO-WAY) POINTS ON FIELD PATTERN AT TARGET	
								AZ (ft)	EL (ft)
L	0.7-1.4	15	23-52	TWT	1 kW	9.5 (coax)	17-21	151	18
S	2-4	6 × 12	7.5-21	TWT	1 kW	10.8 (coax)	16-22	61	18
C	4-8	4 × 8	3.7-10.3	TWT	1 kW	9.1 (WG)	17-23	49	18
X	8-12	3 × 6	2.5-5.2	TWT	1 kW	7.7 (WG)	19-22	41	18
K_u	12-18.0	2 × 4	1.8-3.5	TWT	1 kW	10.9 (WG)	12-15	45	18
K_a[2]	35	4	–	IMPATT	160 W	11 (WG)	9	21	21
W[2]	95	3	–	IMPATT	70 W	15 (WG)	5	10	10

[1] 30 dB of Coherent Integration Gain
[2] Growth

EXHIBIT IV

Item 14 - Martin Marietta Orlando Division Instruments, regularly calibrated by our Metrology Laboratory,traceable to the Bureau of Standards, will be used to assure operating frequencies and radiated signal spectral are maintained within specified limits.

The built-in A scope also provides periodic monitoring of transmit pulse, rise-time and pulsewidth parameters affecting necessary bandwidth.

MARTIN MULTIFREQUENCY RADAR
ANTENNA ASSEMBLY

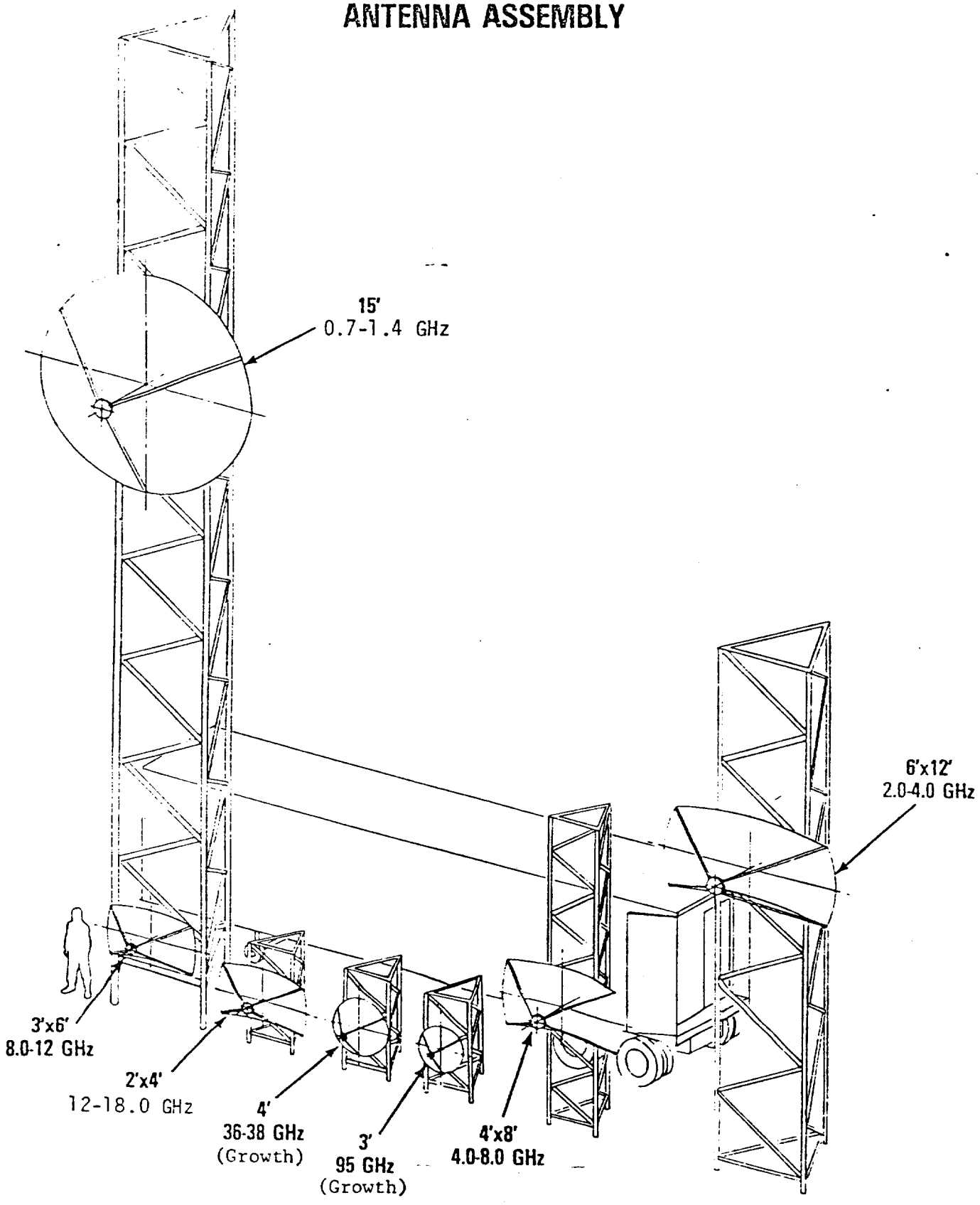

EXHIBIT VI

EXHIBIT VII

MARTIN MULTIFREQUENCY RADAR
SYSTEM SPECIFICATIONS

Spectrum Coverage (GHz)	0.7-1.4	2-4	4-8	8-12	12-18.0	35*	95*		
Antenna Size (ft)	15	6x12	4x8	3x6	2x4	4	3		
Antenna Gain (min, dB)	26.5	31.6	34.1	37.6	37.8				
Peak Power (kW)	1	1	1	1	1				
Step Frequency Range (MHz)	500	2000	4000	4000	4500	2000	–		
Instantaneous Bandwidth (MHz)	50	200	400	400	400	400	–		
Minimum Pulsewidth (ns)	20	5	5	5	5	5	–		
Range Resolution (ft)									
Single Pulse Mode	10	2.5	2.5	2.5	2.5	2.5	–		
Stepped Frequency Mode	1.5	0.5	0.5	0.5	0.5	0.5	–		
LNA Noise Figure (dB)	2	3	4	4	6	–	–		
Two-Way System Losses (dB)	7.5	7.8	5.1	3.6	5	–	–		

Integration Gain

Coherent Integration (8000 Pulses): 39 dB

Step Chirp (128): 42 dB

Maximum PRF: 40 kHz

Frequency Stability: 1×10^{-9} Per Day

Multiple Band Operation: 1, 2, or 4 Radar Frequencies Interleaved

*Growth

7-11-83

APPENDIX I.

DUTY CYCLE CALCULATIONS:

$$\text{DUTY CYCLE} = \frac{\text{PULSE WIDTH IN SECONDS}}{\text{REPETITION RATE PERIOD IN SECONDS}}$$

$$= \text{PULSE WIDTH} \times (\text{PULSES PER SECOND})$$

PULSE WIDTHS = 100 TO 200 NANOSECONDS

$= 10^{-7}$ TO 2×10^{-7} SECONDS.

PULSE REPETITION RATES, (PULSE REPETITION FREQUENCY, PRF

1000 TO 2000 PULSES PER SECOND, (95% OF THE TIME)

60,000 TO 70,000 PULSES PER SECOND, (5% OF THE TIME)

MAXIMUM DUTY CYCLE = MAX. PULSE WIDTH × MAX. PRF

MINIMUM DUTY CYCLE = MIN. PULSE WIDTH × MIN. PRF

DUTY CYCLE USED 95% OF THE TIME:

MAX. DUTY CYCLE $= (2 \times 10^{-7}\ \text{SECONDS}) \times (2000\ \text{PPS})$

$= 4 \times 10^{-4}$

MIN. DUTY CYCLE $= (10^{-7}\ \text{SECONDS}) \times (1000\ \text{PPS})$

$= 10^{-4}$

DUTY CYCLE USED 5% OF THE TIME, LOW RCS TARGETS:

MAX. DUTY CYCLE $= (2 \times 10^{-7}\ \text{SECONDS}) \times (70{,}000\ \text{PPS}) = 1.4 \times 10^{-2}$

MIN. DUTY CYCLE $= (10^{-7}\ \text{SECONDS}) \times (60{,}000\ \text{PPS}) = 0.6 \times 10^{-2}$

APPENDIX I - CONTINUED

AVERAGE POWER CALCULATIONS:

AVERAGE POWER = (PEAK PULSE POWER) × (DUTY CYCLE)

PEAK PULSE POWER = 1 KW
(BANDS L, S, C, X, Ku; 0.7 TO 18.0 GHz)

GROWTH CAPABILITY BANDS; Ka & W, 35 & 95 GHz.

PEAK PULSE POWER, 35 GHz = 160 WATTS

PEAK PULSE POWER, 95 GHz = 70 WATTS

MAX. AVERAGE POWER = (PEAK PULSE POWER) × (MAX DUTY CYCLE)

MIN. AVERAGE POWER = (PEAK PULSE POWER) × (MIN. DUTY CYCLE)

AVERAGE POWER (USING ABOVE RELATIONSHIPS)						
FREQUENCY, GHz	0.7 TO 18	35	95	0.7 TO 18	35	95
MAX. AVG. POWER, WATTS	0.4	0.064	0.028	14.3	2.29	1.0
MIN. AVG. POWER, WATTS.	0.1	0.016	0.007	4.0	0.96	0.42
PERCENT TIME RANGE OPERATIONS	95%			5%		

APPENDIX I - CONTINUED

EFFECTIVE RADIATED POWER, ERP IN KILOWATTS, AVERAGE.
(AVERAGE POWER × NUMERIC ANTENNA GAIN)

ANTENNA PARAMETERS				95% OF TIME		5% OF TIME	
BAND	MAX. FREQ GHz	GAIN, dBi	GAIN NUMERIC	MAX. ERP	MIN. ERP	MAX. ERP	MIN. ERP
L	1.4	32.5	1,800	0.7	0.2	25.7	10.7
S	4.0	37.6	5,800	2.3	0.6	82.3	34.5
C	8.0	40.1	10,200	4.1	1.0	146	61.4
X	12.0	41.1	12,900	5.2	1.3	184	77.3
KU	18.0	41.3	13,500	5.4	1.3	193	81.0
GROWTH:							
KA	35.0	42.0	15,800	1.0	0.25	35.8	15.0
W	95.0	46.0	39,800	1.1	0.28	40.0	16.8

PEAK PULSE EFFECTIVE RADIATED POWER, PEAK ERP IN MEGAWATTS.
(PEAK PULSE POWER × NUMERIC ANTENNA GAIN)

ANTENNA PARAMETERS				
BAND	MAX. FREQ GHz	GAIN, dBi	GAIN NUMERIC	PEAK ERP, MEGAWATTS
L	1.4	32.5	1,800	1.8
S	4.0	37.6	5,800	5.8
C	8.0	40.1	10,200	10.2
X	12.0	41.1	12,900	12.9
KU	18.0	41.3	13,500	13.5
GROWTH:				
KA	35.0	42.0	15,800	2.5
W	95.0	46.0	39,800	2.8