The Johns Hopkins University
Applied Physics Laboratory
Laurel, Maryland 20723-6099

Exhibit No. 1 (Line 2a)

Application Information

This application is for a new station license because the former license (KA2XNE) had expired on April 1, 1993. A copy of the expired license is attached. We would like the same frequencies (if possible). See Exhibit 2 for a listing of the existing transceiver's capability.

I am supplying this information per a telecon with Mr. Carl Huie of your office wherein he stated that the old frequency assignments may still be in the government data base. If so, it would speed up and simplify the process of re-licensing.

11100 Johns Hopkins Rd., Applied Physics Lab., Laurel, Md. 20723-6099

United States of America
FEDERAL COMMUNICATIONS COMMISSION
EXPERIMENTAL
RADIOSTATIONCONSTRUCTIONPERMIT
AND LICENSE

EXPERIMENTAL
(Nature of Service)

K A 2 X N E
(Call Sign)

XC FX
(Class of station)

3422-EX-R-92
(File number)

NAME THE JOHNS HOPKINS UNIVERSITY

Scaggsville (Howard) MD - NL 39 10 00; WL 76 54 00
(Location of station)

Subject to the provisions of the Communications Act of 1934, subsequent acts, and treaties, and all regulations 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.

Frequency MHz	Authorized Power (watts)	Emission Designator
268.3	23 (ERP)	6K00A3E
305.8	23 (ERP)	6K00A3E
345.0	23 (ERP)	6K00A3E

Frequency Tolerance: .005%

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

Special Condition:

(1) This authorization is issued for the express purpose of conducting experimental operations described in the related application and required by U.S. Navy Contract No. N00039-89-C-0001. The use of this radio station in any other manner or for any other purpose will constitute a violation of the privileges herein authorized.

(2) Except as subsequently authorized by the Commission, this radio station shall not be operated after the expiration date of the contract designated in the related application and enumerated above.

This authorization effective April 1, 1991 and will expire 3:00 A.M. EST April 1, 1993

FEDERAL COMMUNICATIONS COMMISSION

Exhibit No. 1 Attachment

The Johns Hopkins University
Applied Physics Laboratory
Laurel, Maryland 20723-6099

Exhibit No. 2 (Line 4a)

Transceiver Description

The UHF transceiver which will be used for this license is a model RT 980/GRC-171 V, manufactured by Collins Radio Corp. in the mid-80's. It's output power is 23 watts across the UHF band of 225 to 400 MHz. This transceiver is amplitude modulated (Voice) with a bandwidth capability of up to 20 Khz. The Collins part no. is 622-1628-002; serial number 13393. This unit is a ground-to-air transceiver, manufactured for the U. S. Air Force. It is synthesized with the capability of tuning down to 25 Khz.

The Johns Hopkins University
Applied Physics Laboratory
Laurel, Maryland 20723-6099

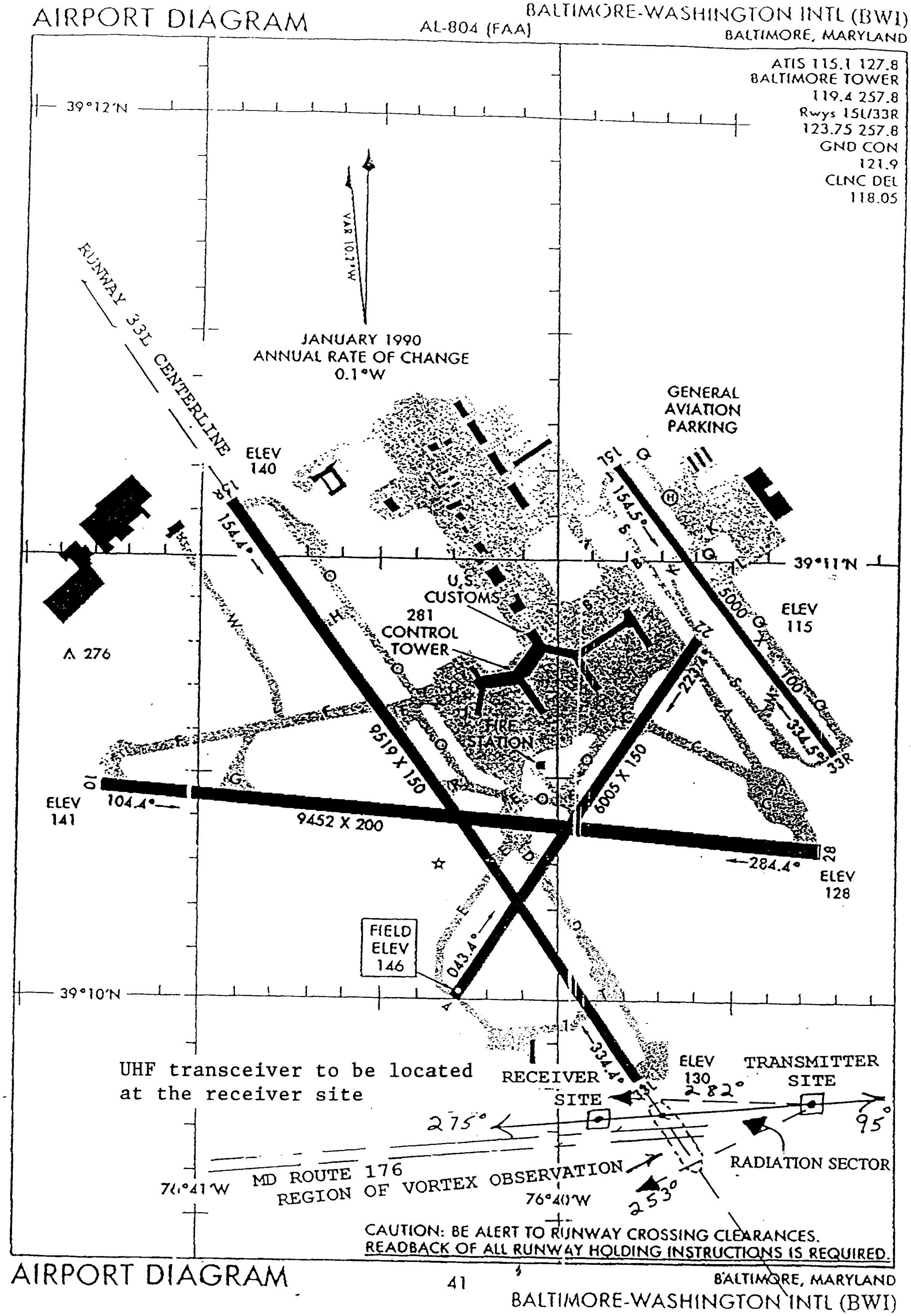
Exhibit No. 3 (Line 5c)

Mobile Testing Description

The Applied Physics Laboratory will continue the next phase of the wake vorticie testing at BWI in late spring of 1997. Direct UHF communications with the NASA C130 will be helpful to direct their crew to turn on and off the wingtip smoke generators as they approach runway 33L and to plan the next testing event. Attached to this exhibit please find a sketch of the airport showing the location of the bistatic radar's receiver location. This radar was given an experimental license (KS2XAH) [file no. S-2709-EX96]. A six-month renewal was effective June 1, 1996. Also included is a copy of the BWI installation permit and a news clipping from Nov. 7, 1996.

I spoke with Mr. Greg Rick at BWI's FAA Aircraft Facilities Sector, (410) 859-7250. He confirmed their glide slope frequency band is 328.6 to 335.4 MHz. He also stated their UHF voice communications frequencies are 228.4, 307.9, 325.8 and 255.4 MHz. He could see no potential interference from our mobile transceiver during the C130 testing.

To date, all of the financial support for the wake vortex project has been in-house IRAD funding. NASA Langley has supplied, and will continue to supply, the C130 aircraft via NASA funding. There is also considerable interest in this project from the FAA, which has given APL permission to test at both BWI and JFK airports.



VORTEX DETECTION EXPERIMENT AT BWI

Exhibit No. 3 Attachment

Form Approved OMB No. 2120-00

U.S. Department of Transportation
Federal Aviation Administration

Notice of Proposed Construction or Alteration

Failure To Provide All Requested Information May Delay Processing Of Your Notice

Aeronautical Study Number

1. Nature of Proposal

A. Type
- [X] New Construction
- [ ] Alteration *

B. Class
- [ ] Permanent
- [X] Temporary (Duration 1.5 months)

C. Work Schedule Dates
Beginning 07/15/96
End 08/30/96

* If Alteration, provide previous FAA Aeronautical Study Number, if available :

3A. Name, address, and telephone number of individual, company corporation, etc. proposing the construction or alteration. (Number, Street, City, State, and Zip Code)

The Johns Hopkins University
Applied Physics Laboratory
Johns Hopkins Road, Laurel, MD 20723-6099
(301) 953-5695
Area Code / Telephone Number

3B. Name, address and telephone number of proponent's representative, if different than 3A. above.

Leo E. McKenzie

(301) 953-5695
Area Code / Telephone Number

2. Complete Description of Structure

Please describe the proposed construction or alteration.

A. For proposals involving transmitting stations, include effective radiated power (ERP) and assigned frequency. If not known, give frequency band and maximum ERP.

B. For proposals involving overhead wire, transmission lines, etc., include the size and the configuration of the wires and their supporting structures.

C. For buildings, include site orientation, dimensions, and construction materials.

D. **Optional**— Describe the type of obstruction marking and lighting system desired. The FAA will consider this in their study. See Figure 2 of attachment.

Containers 8'x8'x10' long. To be mounted on large planking and leveled transmitter to radiate (PTGT) +92dBm at 10.359 GHz.

4. Location Of Structure

A. Coordinates (to hundredths of seconds, if known)

	°	'	"
Latitude Xmit	39	9.0	46.0
Latitude Recv	39	9.0	43.5
Longitude Xmit	76	39	16.0
Longitude Recv	76	39	51.5

B. Nearest City or Town and State: Glen Burnie, MD
(1). Distance to 4B: 3 miles
(2). Direction to 4B: Due East

C. Nearest public or military airport, heliport, flightpark, or seaplane base: BWI
(1). Distance from structure to nearest point of nearest runway: 750'
(2). Direction from structure to airport: See Figure 2

4D. Source for item 4A data.
- [ ] USGS 7.5' Quad Chart
- [ ] Survey
- [X] Other Specify: Airport diagram FAA AL 804

Indicate the reference datum.
- [ ] NAD 27
- [ ] NAD 83
- [ ] Other Specify

4E. Description of site location with respect to highways, street, airports, prominent terrain, features, existing structures, etc. Please attach a U.S. Geological Survey Map (or equivalent) showing the construction site. If available, attach a copy of a documented site survey with the surveyor's certification. Adjacent to MD 176 But inside BWI fence. See figure 2.

5. Height and Elevation (to nearest foot)

A. Elevation of ground above mean sea level. Xmitter / Receiver	Approx. 118 ft. / 122 ft.
B. Height of structure including all appurtenances and lighting above ground or water. (Both)	14 ft.
C. Overall height above mean sea level. Xmitter / Receiver	132 ft. / 136 ft.

Notice is required by Part 77 of the Federal Aviation Regulations (14 C.F.R. Part 77) pursuant to Section 1101 of the Federal Aviation Act of 1958, as amended (49 U.S.C. app. § 1501). Persons who knowingly and willfully violate the Notice requirements of Part 77 are subject to a civil penalty of $1,000 per day until the notice is received, pursuant to Section 901(a) of the Federal Aviation Act of 1958, as amended (49 U.S.C. app § 1471(a)) as well as the fine (criminal penalty) of not more than $500 for the first offense and not more than $2,000 for subsequent offenses, pursuant to Section 902(a) of the Federal Aviation Act of 1958, as amended (49 U.S.C. app § 1472(a)).

I HEREBY CERTIFY that all of the above statements made by me are true, complete, and correct to the best of my knowledge. In addition, I agree to obstruction mark and/or light the structure in accordance with established marking & lighting standards as necessary.

Date	Typed or Printed Name and Title of Person Filing Notice	Signature
May 10, 1996	L. E. McKenzie, Microwave Engineer	Leo E. McKenzie

FOR FAA USE ONLY — FAA will either return this form or issue a separate acknowledgement.

The Proposal:
- [ ] Does not require a notice to FAA.
- [ ] Is not identified as an obstruction under any standard of FAR, Part 77, Subpart C, and would not be a hazard to air navigation.
- [ ] Is identified as an obstruction under the standards of FAR, Part 77, Subpart C, but would not be a hazard to air navigation.
- [ ] Should be obstruction marked, lighted per FAA Advisory Circular 70/7460-1, Chapter(s)
- [ ] Obstruction marking and lighting are not necessary.

Supplemental Notice of Construction, FAA Form 7460-2, is required any time the project is abandoned or:
- [ ] At least 48 hours before the start of construction.
- [ ] Within five days after the construction reaches its greatest height.

This determination expires on ... unless: (a) extended, revised or terminated by the issuing office; (b) the construction is subject to the licensing authority of the Federal Communications Commission (FCC) and an application for a construction permit is made to the FCC on or before the above expiration date. In such cases the determination expires on the date prescribed by the FCC for completion of construction, or on the date the FCC denies the application.

NOTE: Request for extension of the effective period of this determination must be postmarked or delivered to the issuing office at least 15 days prior to the expiration date.

If the structure is subject to the licensing authority of the FCC, a copy of this determination will be sent to that agency.

Remarks:

NAD 83 Coordinates (Use these coordinates for any future correspondence with the FAA) | Latitude ° ' " | Longitude ° ' "

Issued in | Signature | Date

FAA Form 7460-1 Supersedes Previous Edition

Exhibit No. 3 Attachment

NSN: 0052-00-012-0008

mber of stores, and that, aid, would be too high.
incil members believe their f contracting out allows the -keep greater control over es. "We're saying we agree county executive that we ot have county employees selling alcohol over the Ewing said.
ouncil's plan would require itive approval. And Ewing desire to keep the issue m Annapolis was why the acked the second option— a system like Talbot Coun- ead of a franchising option.
franchising, you give up she said, adding that the ould have to live with the ie orked out by state s ad of local officials. se, you're turning it over to "
il member Betty Ann (R-Potomac/Bethesda) said ntracting out: "We've tested works. With franchising, if it work, we wouldn't be able to irselves. We'd have to go he state."
uncan has said he believes ing out doesn't go far o end the county's involve- retail operations. The alco- , for example, still would be the county.
y, the council and the execu- e staked out different ap- anging the way the does business," said eaver, Duncan's spokesman. od news, however, is that interest on both sides in the way we do business, and tep in the right direction."

Researchers Use BWI as Radar Lab

Aim Is to Detect Jetliner Turbulence

By Alex Dominguez
Associated Press

LINTHICUM, Md.—Researchers are hoping to use radar to detect deadly jet turbulence that has been implicated in two fatal crashes and has prompted new regulations that are being blamed for costly airport delays.

The turbulence, known as wake vortices, is caused by air that spills from the tips of airplane wings. The vortices from larger jets essentially are small sideways tornadoes that can be deadly to smaller aircraft.

The turbulence is suspected in the December 1992 crash of a twin-engine jet in Billings, Mont., which killed eight people, and a December 1993 crash of a twin-engine corporate jet in Santa Ana, Calif., which took five lives. Those two accidents prompted the Federal Aviation Administration in August to require private aircraft, commuter planes and small jets to fly and land farther behind jetliners.

Despite the danger presented by vortices, a reliable detection system has not been developed to warn pilots of their presence, especially at airports where small planes often are forced to land behind larger jets.

Researchers from the Johns Hopkins Applied Physics Laboratory are hoping to detect vortices with highly sensitive radar systems that combine sound and radio waves.

The researchers began experimenting in September at Baltimore-Washington International Airport and plan to test the system at John F. Kennedy International Airport in New York.

"The overall interest in the aviation community is to develop a system not only to detect them but [also] to track them and give controllers more information about the nature of the vortices on any given day," said Dennis Kirschner, who leads transportation programs at the Johns Hopkins lab.

The new FAA regulations increase the distance that small planes must stay behind Boeing 757s from four miles to five. The FAA also added more planes to the list of those that must remain five miles behind 757s.

If a detection system can be developed, controllers will be able to shorten the distance between landings and save time.

The airline industry has opposed the new standards, which it says are causing more delays without improving safety.

For every hour of cloudy conditions, there was an average total of 16½ hours of delay for incoming traffic at Los Angeles International Airport because of the new rules, a recent study by the Air Transport Association of America found. The report said those delays are costing airlines about $200,000 a day.

Radar was developed in the 1930s and initially was used to detect solid objects such as ships and planes through radio waves reflected back to the radar installation. Improvements have enabled scientists to use radar to detect many more objects, including moisture in the air, giving meteorologists a powerful tool in short-term weather forecasting.

In the 1980s, scientists discovered that if sound waves were emitted, the sensitivity of radar systems could be increased enough to detect differences in the density of air, said Lex Hughes, supervisor of the Johns Hopkins radar group.

The pressure created by the sound "modulates the atmosphere so the radar can better see the air," Hughes said, giving researchers what they hope is a new tool to detect wake vortices.

John Hansman, a professor of aeronautics and astronautics at the Massachusetts Institute of Technology, which also is involved in the research, likened the effect to creating ripples on a still pond.

"If you had a very flat sheet of water it would be hard to see the flow of the water. If you were to put a ripple in the water, which is what the sound wave is, that would create a pattern which your eye, in this case the radar, could see," Hansman said.

Researchers tested the system in September at BWI and are analyzing the data to see if the vortices were detected, Hughes said.

"We collected a lot of good data, and now we're in the middle of analyzing," he said. "We don't have an answer on how it's going to work yet."

Testing at JFK Airport has been deferred.

Exhibit No. 3 Attachment

The Johns Hopkins University
Applied Physics Laboratory
Laurel, Maryland 20723-6099

Exhibit No. 4 (Line 7)

The transceiver for which this license is being requested works in conjunction with the Navy's AN/SPG-55B fire control radar which has been installed since 1964 on building 40 at the Applied Physics Laboratory, The Johns Hopkins University, here at Scaggsville, MD. This radar is used as a test bed for various projects. It normally tracks dedicated aircraft on a true north vector starting at Westminster, MD, to Stonyfork, New York, via Harrisburg, PA; a distance of 158 nautical miles. This flight profile is coordinated with the FAA and is only available to us from 11 p.m. thru 0630 a.m. whenever commercial traffic is the least.

These dedicated aircraft are usually NASA, Navy or Learjet aircraft under Navy contract. These aircraft are always equipped with UHF voice transceivers which operate between 225 and 400 MHz. Voice communication is required to vector the aircraft during testing periods. It is also essential to communicate with a NASA C130 (which is equipped with "Smokers") to turn on the wingtip smoke generators for visual observation of the wingtip vortex energy (see attachment 3).

All of the projects, for which the UHF voice transmission is required, are to provide communications to dedicated aircraft which are working in conjunction with the AN/SPG-55B radar or the experimental radar at BWI airport. The Applied Physics Laboratory's prime contract number with the Navy is N000-39-95-C-002. This contract is used to support numerous projects within the Laboratory. The Navy sponsoring activity is NAVSEA-00U. The prime contract officer is David N. Sivillo at (703) 602-9828.

The Johns Hopkins University
Applied Physics Laboratory
Laurel, Maryland 20723-6099

Exhibit No. 5 (Line 9)

The Wake Vortex Project is described in Exhibit No. 3. APL has used an experimental bi-static doppler radar to identify the location and magnitude of the vortex energy which eminates from the wingtips of heavy jets as they land. In addition to obtaining data from targets of opportunity (i.e., heavy jets) as they land at runway 33L at BWI Airport, we have also had services of a NASA C130 from the Wallops Island Flight Facility to overfly runway 33L. As they make these flybys at an altitude of 150 to 300 ft., they are instructed via UHF radio when to turn on the smoke generators on either or both wingtips. This permits a visual sighting of the vorticie as it "settles" into the region of the bi-static radar's acquisition sector. The presence of this visual vortex energy is also confirmed from a video camera which is collimated with the radar's receiver antenna. The present method of communication from the radar's receiver is to talk via cellular phone to the control tower and have them relay information to the aircraft. This is seen as cumbersome and it burdens an already very busy control tower employee. A mobile UHF location at BWI (for this license) would improve our communication with the C130.

At APL, we have also been requested to support UHF communications with a cessna aircraft during an experimental infrared (IR) project at the Bldg. 40 Land Base Test Site. This aircraft will be augmented with an infrared source which can be detected while going inbound or outbound from our site. Once again UHF communications with the aircraft are essential for the successful completion of this testing. This testing is an AEGIS radar program sensor integration study. It is funded via the main contract No. N000-39-95-C-002 and the point of contact is Cdr Roy Wood. His telephone number is (703) 602-7090. The purpose of this test series is to measure minimum and maximum IR detection ranges from the IR source in the augmented cessna aircraft.

The Johns Hopkins University

Applied Physics Laboratory
Laurel, Maryland 20723-6099

Exhibit No. 6 (Line 12)

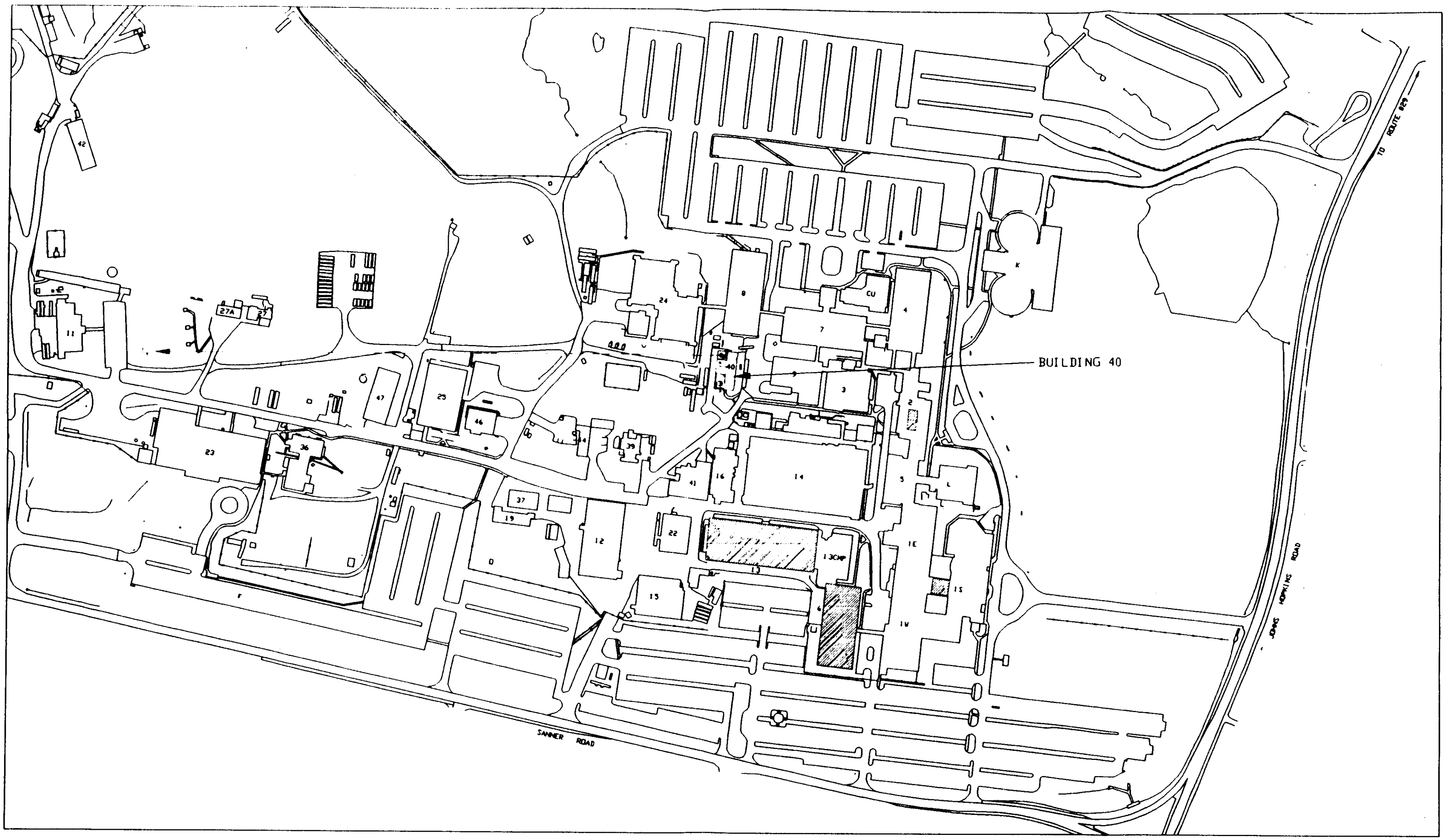
The subject ground-to-air transmitter has been used for voice communications to radar-controlled-aircraft from the APL Building 40 TERRIER Land Based Test Site since the 60's. Its purpose is to provide communications to aircraft which are participating in testing for the US Navy. Because of the geographic location of our site (midway between Baltimore and Washington), the FAA will permit live aircraft testing only from midnight to 0600 whenever the airways are the least crowded.

The low gain omni antenna for this transmitter is located on the roof of Building 40. This rooftop is a controlled area and permission must be obtained before access can be gained. The antenna is mast-mounted 15 feet above the roof level. Due to the hours of operation, limited access to our roof area and relative low power, this transmitter antenna presents no personnel health risk from radio frequency energy. The omni antenna has unity gain, and due to its location and transmission line loss from the basement (125 ft.), has no measurable radiation on the roof of Building 40 or anywhere else within the APL building complex.

The Applied Physics Laboratory has an active Microwave Radiation Subcommittee (of which I am a member). The attached Health and Safety bulletin dated 19 October 1984 reflects a change wherein APL increased the RF radiation factor of safety by 10dB. The attached graph illustrates APL's operating standard for exposure to RF radiation (solid line). It also provides a comparison of the limits of controlled and uncontrolled permissible Radiofrequency radiation exposure limits as listed in CFR 47, paragraph 1.1310. An additional factor of safety is provided in the APL radiation operating standard.

There are currently five (or more) Narda model 8616 radiation meters within APL. These are factory calibrated annually and these instruments are used to measure the power densities from all RF emitters at APL. Figure 1 is a plan view of the APL building complex. This rural, 365-acre complex is located in Howard County, MD. Figure 2 illustrates our location just south of Columbia, MD. Figure 3 is an elevation view of Building 40 showing the elevations of the antennas on the highest roof level. Figure 4 is a plan view of the roof and illustrates the location of the omni antenna.

Based upon our site location, the previous licensing of this station and no change in zoning, there are no other known environmental requirements listed in CFR 47, paragraph 1.1311.



PLAN VIEW OF JHU/APL BUILDING COMPLEX

THE JOHNS HOPKINS UNIVERSITY **APPLIED PHYSICS LABORATORY** JOHNS HOPKINS ROAD LAUREL, MD. 20723-6099	EXHIBIT 6, FIGURE 1	DRAWN BY: DJD DATE: 2/3/97 SCALE: NO SCALE	BUILDING 40 LOCATION

DRAWING NO.: D 22X34

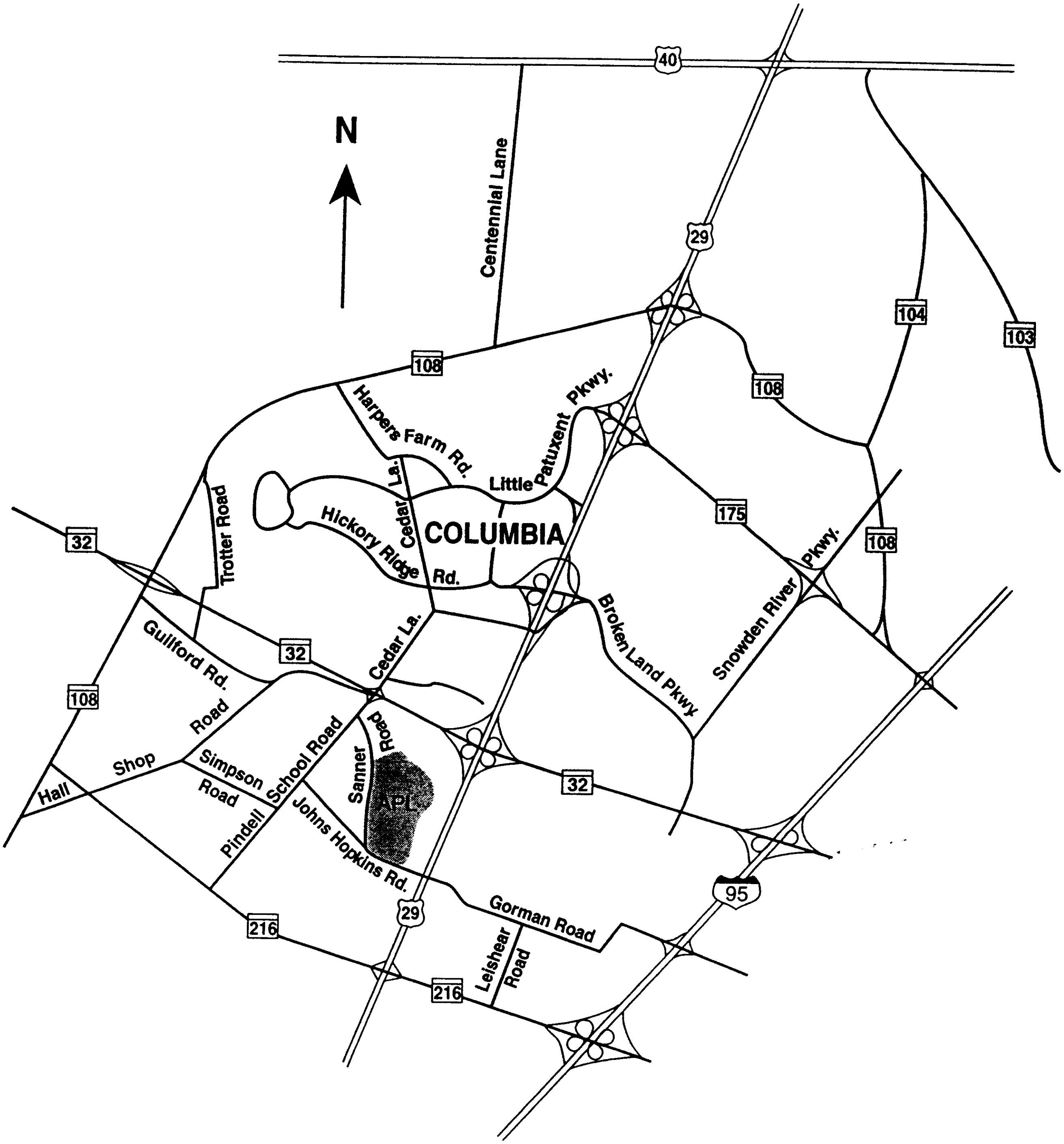
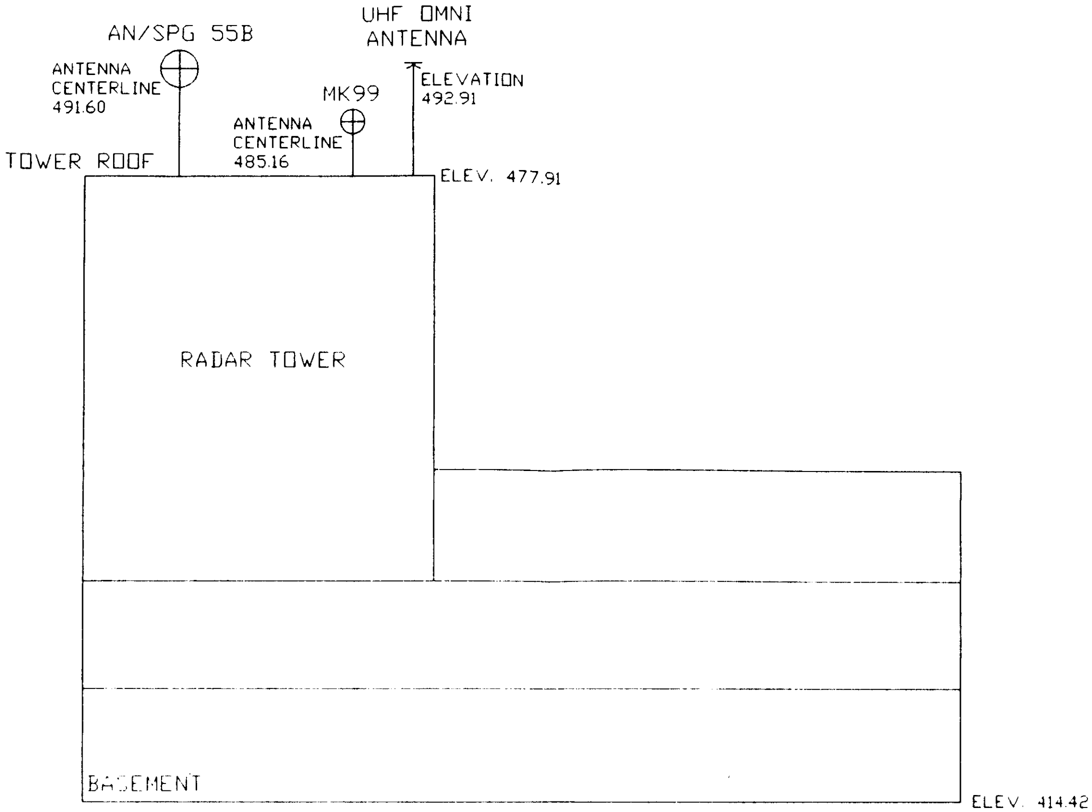


Exhibit 6, Figure 2 - APL Regional Location



BUILDING 40 NORTH ANTENNA ELEVATION

THE JOHNS HOPKINS UNIVERSITY
APPLIED PHYSICS LABORATORY
JOHNS HOPKINS ROAD LAUREL, MD. 20723-6099

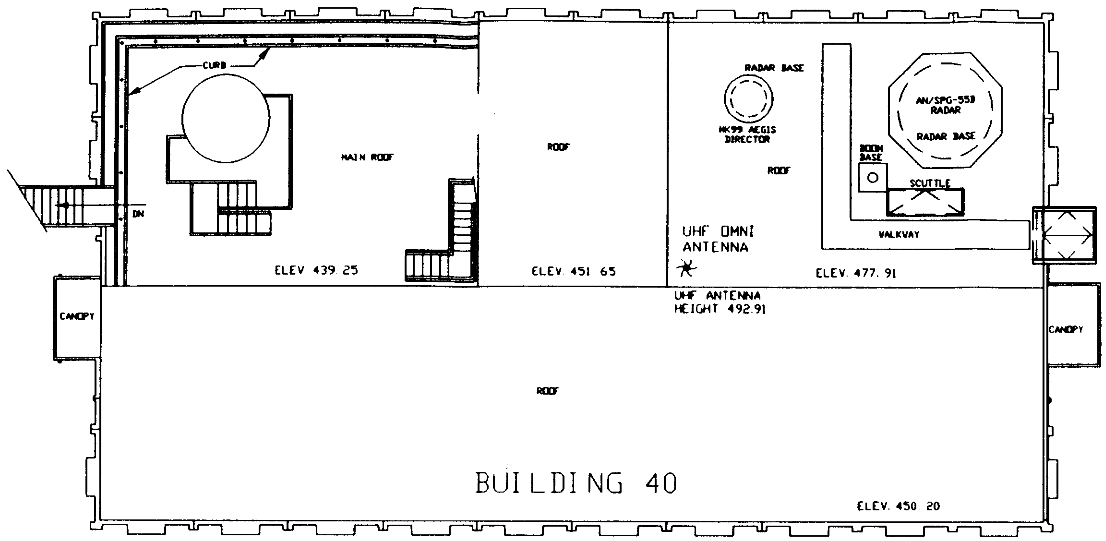
EXHIBIT 6 , FIGURE 3

DRAWN BY: DJD
DATE: 2/10/97
SCALE: NO SCALE

ANTENNA ELEVATIONS
BUILDING 40

DRAWING NO.: 40-R
B 11X17

UHF OMNI ANTENNA LOCATION



THE JOHNS HOPKINS UNIVERSITY APPLIED PHYSICS LABORATORY JOHNS HOPKINS ROAD LAUREL, MD. 20723-6099	EXHIBIT 6 , FIGURE 4	DRAWN BY: DJD DATE: 2/10/97 SCALE: NO SCALE	UHF OMNI ANT. LOCATION BUILDING 40	DRAWING NO: 40-R B 11X17

HEALTH AND SAFETY BULLETIN

No. 51 October 19, 1984

TO: Department, Branch, Group and Section Supervisors

SUBJECT: APL Operating Standard For Exposure To Radio-Frequency Radiation

REFERENCE: A) APL Safety Memo No. 15, dated January 15, 1970
B) Attached Definitions and Discussion

The APL Microwave Radiation Subcommittee recommends that the APL Operating Standard for permissible exposure to radio-frequency electromagnetic fields be revised to reflect evolving scientific understanding of the biological effects of non-ionizing radiation, the difficulties of properly measuring complex fields, and the desirability of a conservative safety factor. There is no evidence that permissible power levels stated in the old standard were unsafe, and this revision is intended only to increase the factor of safety over the old APL standard of 1 mW/cm^2. The referenced Safety Bulletin No. 15 is hereby cancelled, and the new APL Operating Standard is shown on the back of this page.

The Standard calls for averaging over a 0.1 hour period for all modulations. Typically, the maximum equivalent power density is 0.1 mW/cm^2 for frequencies above 30 MHz. Both mean-squared field strength and equivalent power density are specified according to frequency. These several parameters describe similar levels of exposure. Unusually high peak power levels should be noted. The Safety Office shall be consulted whenever the peak equivalent power density, during the pulse, is greater than 100 mW/cm^2 in any area of potential personnel exposure.

For personnel directly involved in the operation of RF equipment, exposures to higher intensity fields are permissible for very brief periods. The average power density during the period of exposure to the higher intensity fields shall not exceed ten times the values given in the Exposure Standard. Such exposures should be no longer than six minutes total in any one hour. Staff members responsible for the operation of various RF equipment must ensure that personnel

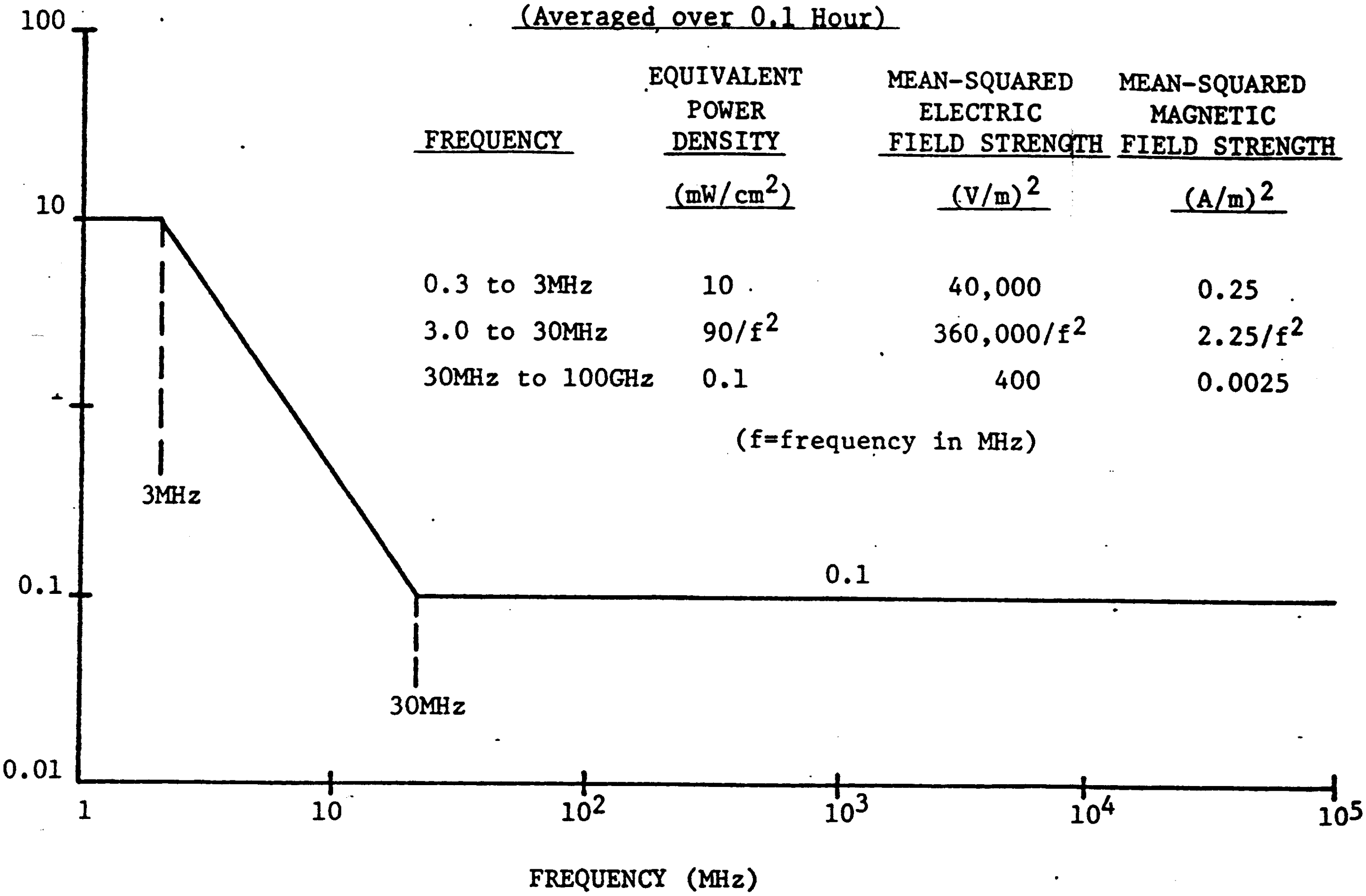
Exhibit 6
Attachment
(4 pages)

exposures be as low as reasonably achievable below the maximum levels. The Safety Office must be notified if field levels are expected to approach the maximum levels so that a survey can be conducted.

RADIO-FREQUENCY EXPOSURE LIMITS
(Averaged over 0.1 Hour)

FREQUENCY	EQUIVALENT POWER DENSITY (mW/cm^2)	MEAN-SQUARED ELECTRIC FIELD STRENGTH (V/m)^2	MEAN-SQUARED MAGNETIC FIELD STRENGTH (A/m)^2
0.3 to 3MHz	10	40,000	0.25
3.0 to 30MHz	$90/f^2$	$360{,}000/f^2$	$2.25/f^2$
30MHz to 100GHz	0.1	400	0.0025

(f=frequency in MHz)



This Standard does not apply to emissions from consumer electronic products such as microwave ovens and handheld transceivers which are controlled by product performance standards administered by the Food and Drug Administration (FDA). It also does not address intentional exposures during the course of medical experimentation such as RF hyperthermia for cancer therapy.

Mark W. Woods, Chairman
Safety Committee

H. L. Hall, Jr.
Safety Officer

Definitions and Discussion

A few definitions are required to allow a consistent interpretation of the Standard. Except for Hermitian magnitude, all quantities that follow have units of mW/cm^2:

equivalent power density. The power density of a hypothetical plane wave in free space having the same electric or magnetic field strength (Hermitian magnitude) as that measured in a complex reflective field or in an antenna near-field. Equivalent power density varies from point to point within a complex field.

Hermitian magnitude. For the vector $\underset{\sim}{A}$, the Hermitian magnitude is $|\underset{\sim}{A}| = \sqrt{\underset{\sim}{A} \cdot \underset{\sim}{A}^*} = \sqrt{A_x A_x^* + A_y A_y^* + A_z A_z^*}$ in which the asterisk denotes the complex conjugate. It implies a time averaging when used with the electric ($\underset{\sim}{E}$) or magnetic ($\underset{\sim}{H}$) field vector. The Hermitian magnitude provides a means of comparing fields with different polarizations.

power density. The time average of the Poynting vector.

Poynting vector. The vector product of the electric and magnetic field vectors of an electromagnetic wave ($\underset{\sim}{S} = \underset{\sim}{E} \times \underset{\sim}{H}$). When summed over a closed surface, the Poynting vector represents the total instantaneous power entering or leaving that surface. At a single point, the Poynting vector is generally accepted to denote the instantaneous power flow per unit area.

(over)

Discussion

Traditionally, radiation hazard standards have specified power density (mW/cm^2). This parameter is a valid indicator of potential hazard only for plane wave exposure. Under more complicated conditions, such as antenna near-fields or regions containing direct and reflected waves, true power density cannot be properly measured, and the parameter itself is not well related to potential hazard.

Mean-squared field strength, the square of the Hermitian magnitude, is an accepted indicator of hazard in a complex field. This is the quantity measured by the isotropic field probes which have become available commercially in recent years. Equivalent power density is derived from the observed level of mean-squared field strength. Although this parameter has little physical meaning, it retains the familiar units of mW/cm^2, and most isotropic field meters are so calibrated. Accordingly, the exposure limits are defined for each of three parameters: mean-squared electric field strength, mean-squared magnetic field strength, and equivalent power density.

The instrumentation used to measure potentially hazardous fields must have an isotropic probe which responds to mean-squared field strength. The only exception is for far-field zones within an RF anechoic chamber or other situations in which a simple unidirectional field exists. In those cases, true power density may be measured or calculated.

When their source is a radar, RF electromagnetic fields will have a very complex time modulation. This is caused by the combination of the transmitter's pulse modulation and the scanning of the radar's antenna. The Standard calls for averaging over a 0.1 hour interval to ensure all such modulations are included.

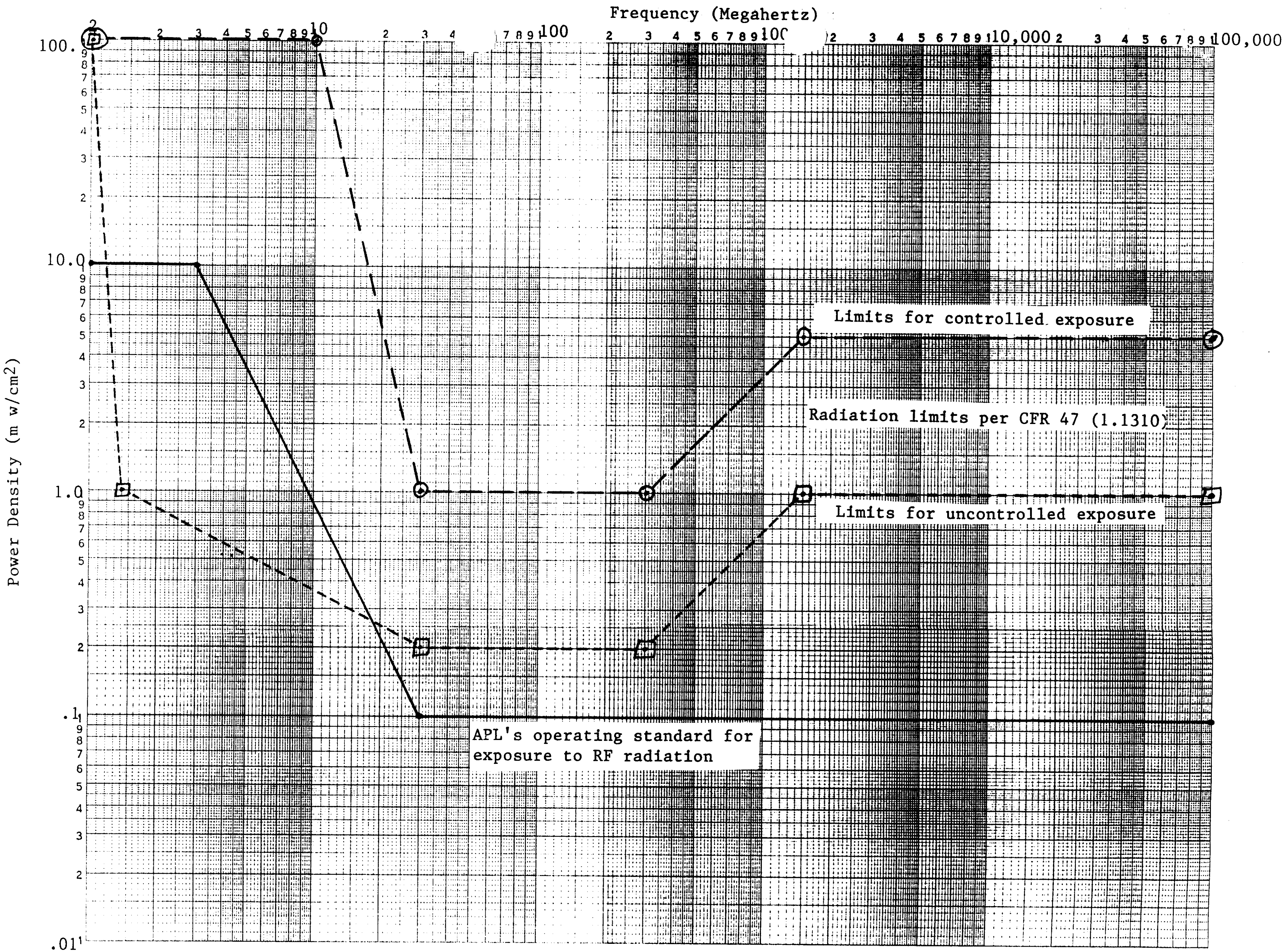


Exhibit 6, Graph 1

Comparison of RF Exposure Limits