DCN 368

174

DEPARTMENT OF THE NAVY
OFFICE OF NAVAL RESEARCH
800 NORTH QUINCY STREET
ARLINGTON, VA 22217-5660

IN REPLY REFER TO
11010
Ser 91/160
17 Aug 94

From: Chief of Naval Research
To: Chief of Naval Operations (N44)

Subj: 1995 BASE REALIGNMENT AND CLOSURE (BRAC) DATA CALL NUMBER TWELVE

Ref: (a) CNO ltr 11000 Ser N441/4U594484 of 07 Apr 94
(b) CNO ltr 11000 Ser N441/4U594572 of 17 May 94

Encl: (1) NRL Data Call Number Twelve with Certifications

1. Enclosure (1) provides information and certification required by reference (a) and amended by reference (b).

2. The ONR point of contact is Mr. Frederick C. Esposito who may be reached on (703) 696-4613.

MARC PELAEZ
Rear Admiral, USN

INCLUDES:

- REVISED PAGES DATED 8 AUG 1994 (RUBBER STAMPED) IN LOWER RIGHT CORNER, ~~OF BOTTOM OF PAGE~~
- REVISED PAGES DATED 19 AUG 1994 (RUBBER STAMPED) IN LOWER RIGHT CORNER.
- REVISED PAGES DATED 16 SEP 1994 (RUBBER STAMPED) IN LOWER RIGHT CORNER
- REVISED PAGES DATED 20 SEP 1994 (RUBBER STAMPED) IN LOWER RIGHT CORNER
- REVISED PAGES DATED 27 SEP 1994 (RUBBER STAMPED) IN LOWER RIGHT CORNER

BRAC-95 CERTIFICATION

Reference: SECNAV NOTE 11000 dtd 8 Dec 93

In accordance with policy set forth by the Secretary of the Navy, personnel of the Department of the Navy, uniformed and civilian, who provide information for use in the BRAC-95 process are required to provide a signed certification that states "I certify that the information contained herein is accurate and complete to the best of my knowledge and belief."

The signing of this certification constitutes a representation that the certifying official has reviewed the information and either (1) personally vouches for its accuracy and completeness or (2) has possession of, and is relying upon, a certification executed by a competent subordinate.

Each individual in your activity generating information for the BRAC-95 process must certify that information. Enclosure (1) is provided for individual certifications and may be duplicated as necessary. You are directed to maintain those certifications at your activity for audit purposes. For purposes of this certification sheet, the commander of the activity will begin the certification process and each reporting senior in the Chain of Command reviewing the information will also sign this certification sheet. This sheet must remain attached to this package and be forwarded up the Chain of Command. Copies must be retained by each level in the Chain of Command for audit purposes.

I certify the information contained herein is accurate and complete to the best of my knowledge and belief.

ACTIVITY COMMANDER

L.M. CASSIDY
NAME (Please type of print)

L.M. Cassidy
Signature

COMMANDING OFFICER
Title

5/13/94
Date

NRL
Activity

I certify that the information contained herein is accurate and complete to the best of my knowledge and belief.

NEXT ECHELON LEVEL (if applicable)

NAME (Please type or print

Signature

Title

Date

Activity

I certify that the information contained herein is accurate and complete to the best of my knowledge and belief.

NEXT ECHELON LEVEL (if applicable)

NAME (Please type of print

Signature

Title

Date

Activity

In certify that the information herein is accurate and complete to the best of my knowledge and belief.

MAJOR CLAIMANT LEVEL

MARC PELAEZ

NAME (Please type or print

Signature

CHIEF OF NAVAL RESEARCH

Title

12 Aug 1994

Date

OFFICE OF NAVAL RESEARCH

Activity

I certify that the information contained herein is accurate and complete to the best of my knowledge belief.

DEPUTY CHIEF OF NAVAL OPERATIONS (LOGISTICS)
DEPUTY CHIEF OF STAFF (INSTALLATIONS & LOGISTICS)

W. A. EARNER

NAME (Please type of print

Signature

Title

8/24/94

Date

DEPARTMENT OF THE NAVY
OFFICE OF NAVAL RESEARCH
800 NORTH QUINCY STREET
ARLINGTON, VA 22217-5660

174

IN REPLY REFER TO
11010
Ser 91/272
25 Aug 94

From: Chief of Naval Research
To: Chief of Naval Operations (N44)

Subj: 1995 BASE REALIGNMENT AND CLOSURE (BRAC) DATA CALL NUMBER TWELVE CLARIFICATION ANSWERS

Ref: (a) ONR ltr 11010 Ser 91/160 of 17 Aug 1994
(b) Uncertified NRL BRAC Data Call Twelve of 27 July 1994
(c) BSAT Memo 3 June 1994

Encl: (1) Naval Research Laboratory Data Call Twelve Clarification letter 1001-188 of 8 Aug 1994 with Certifications
(2) BSAT Facsimile of 4 Aug 1994

1. Enclosure (1) forwards responses to questions in enclosure (2) about references (a) and (b), with required certifications. Enclosure (2) was facsimiled by the BSAT direct to NRL, by-passing both N44 and ONR. Enclosure (1) does not comply with format in reference (c) because the original response to the Data Call, references (a) and (b), did not have numbered pages. The BSAT questions and the NRL responses are annotated by section and paragraph providing the ability to accurately insert the additional information in the correct location in reference(a).

2. The ONR point of contact is Mr. Frederick C. Esposito who may be reached on 703-696-4613.

MARC PELAEZ
Rear Admiral, USN

18 AUG 1994

8 AUG 1994

BRAC-95 CERTIFICATION

BRAC - 12
Amend # 2

Reference: SECNAV NOTE 11000 dtd 8 Dec 93

In accordance with policy set forth by the Secretary of the Navy, personnel of the Department of the Navy, uniformed and civilian, who provide information for use in the BRAC-95 process are required to provide a signed certification that states "I certify that the information contained herein is accurate and complete to the best of my knowledge and belief."

The signing of this certification constitutes a representation that the certifying official has reviewed the information and either (1) personally vouches for its accuracy and completeness or (2) has possession of, and is relying upon, a certification executed by a competent subordinate.

Each individual in your activity generating information for the BRAC-95 process must certify that information. Enclosure (1) is provided for individual certifications and may be duplicated as necessary. You are directed to maintain those certifications at your activity for audit purposes. For purposes of this certification sheet, the commander of the activity will begin the certification process and each reporting senior in the Chain of Command reviewing the information will also sign this certification sheet. This sheet must remain attached to this package and be forwarded up the Chain of Command. Copies must be retained by each level in the Chain of Command for audit purposes.

I certify the information contained herein is accurate and complete to the best of my knowledge and belief.

ACTIVITY COMMANDER

Captain Richard M. Cassidy, USN
NAME (Please type of print)

R.M. Cassidy
Signature

Commanding Officer
Title

8/8/94
Date

Naval Research Lab
Washington, DC 20375-5320
Activity

8 AUG 1994

8 AUG 1994

I certify that the information contained herein is accurate and complete to the best of my knowledge and belief.

NEXT ECHELON LEVEL (if applicable)

NAME (Please type or print

Signature

Title

Date

Activity

I certify that the information contained herein is accurate and complete to the best of my knowledge and belief.

NEXT ECHELON LEVEL (if applicable)

NAME (Please type of print

Signature

Title

Date

Activity

In certify that the information herein is accurate and complete to the best of my knowledge and belief.

MAJOR CLAIMANT LEVEL

MARC PELAEZ

NAME (Please type or print

Signature

CHIEF OF NAVAL RESEARCH

Title

8/25/94

Date

OFFICE OF NAVAL RESEARCH

Activity

I certify that the information contained herein is accurate and complete to the best of my knowledge belief.

DEPUTY CHIEF OF NAVAL OPERATIONS (LOGISTICS)
DEPUTY CHIEF OF STAFF (INSTALLATIONS & LOGISTICS)

W. A. EARNER

NAME (Please type of print

Signature

Title

8/30/94

Date

AUG 1994

DEPARTMENT OF THE NAVY
NAVAL RESEARCH LABORATORY
WASHINGTON, D.C. 20375-5320

IN REPLY REFER TO:
1001-188
8 Aug 94

From: Commanding Officer, Naval Research Laboratory
To: Base Structure Analysis Team (Attn: CDR T. S. Evans)

Via: Chief of Naval Research
Chief of Naval Operations (N44)

Subj: 1995 BASE REALIGNMENT AND CLOSURE (BRAC) AMENDMENT TWO TO DATA CALL TWELVE - NAVAL RESEARCH LABORATORY

Ref: (a) BSAT Fax memo of 4 Aug 94

Encl: (1) Revised Avionics CSF Table 3.4.1
(2) Revised Space Satellites CSF Section 3.0
(3) Revised Space Satellites CSF Section 3.4.1
(4) Revised Airborne C4I CSF Response
(5) Revised Ground-Based C4I CSF Response
(6) Revised Electronic Devices CSF Section 3.0
(7) Revised Electronic Devices CSF Section 3.4.1
(8) Revised Environmental Sciences CSF Section 3.0
(9) Revised Environmental Sciences CSF Section 3.4.1
(10) Revised Environmental Quality CSF Section 3.0
(11) Revised Environmental Quality CSF Section 3.4.1
(12) Revised Advanced Materials CSF Section 3.0
(13) Revised Advanced Materials CSF Section 3.4.1

1. BRAC-95 Data Call #12 requested that the Naval Research Laboratory indicate its capability to perform certain common support functions. NRL responded with capability statements in the areas of Avionics, Space Systems, C4I, Electronic Devices, Environmental Sciences, Environmental Quality, and Advanced Materials. In preparing this revised submission, statements have been made in each section about the relationships and interconnectivity of each CSF with other functions in support of the overall NRL mission. There is, however, some danger in losing "the forest for the trees" as one reviews the individual BRAC Data Call 12 submissions. NRL was established at the recommendation of Thomas Edison, who argued that "the Government should maintain a great research laboratory, jointly under military and naval and civilian control. In this could be developed the continually increasing possibilities of great guns, the minutia of new explosives, all the technique of military and naval progression." Edison believed that the mobilization of science and invention in this research laboratory was the key to developing good weapons. He stated: "When the time came, if it ever did, we could take

advantage of the knowledge gained through the research work and quickly manufacture in large quantities the very latest and most effective instruments of warfare." The essential idea proposed by Edison and embodied by NRL was to bring together, in one location, individuals from a wide variety of disciplines, each contributing specialized knowledge. The ensemble knowledge base at NRL provides each employee access to skills and facilities which greatly increase their capacities. As a result of the co-location of expertise, NRL can rapidly organize team efforts for specific tasks and bring together a greater range of skills and knowledge than any single individual or any more narrowly focused organization. This capability has served the nation well over the past 70 years. It must be remembered, however, that the essential ingredient of the Naval Research Laboratory is the co-location of a multitude of science and technology disciplines. This will inevitably lead to the Naval Research Laboratory having organic capabilities which provide expertise in areas that are also possessed by more narrowly-focused organizations. The concept of the Naval Research Laboratory requires this. If one begins to strip out various subsets of the disciplines represented at NRL, one destroys the concept upon which the Laboratory was founded. It is the synergy amongst the various co-located disciplines at NRL that is the true contribution of NRL. This synergy must be preserved if the Laboratory is to have any meaning or any place in naval and defense R&D.

2. The following additional detailed information is submitted in response to reference (a).

3. **QUESTION 2.2**

Actual Workyears peak in FY91 is listed as 4909, but in the table in Questions 2.1 it is listed as 4090. Which is correct?

ANSWER - 4909 is correct.

4. **AVIONICS**

Your response addresses the "Avionics" CSF. This needs to be further broken out to "Fixed Wing Avionics" and "Rotary Wing Avionics." All questions in Section III must be answered for each common support function you perform.

RESPONSE: The preponderance of the effort in this CSF is in support of fixed wing applications. Some of the products of this effort will be applicable to rotary wing as well as fixed wing aircraft. Effort directly attributable to rotary wing avionics is insignificant compared to the total.

5. **AVIONICS QUESTION 3.0**

In addition to describing the major capabilities at your activity contributing to the common support function for which you are responding, the question asks you to describe any relationship and interconnectivity with other functions (common or otherwise) in support of the overall activity. Your response addressed this to some extent in a general manner; however, the question is to be answered for each CSF. Please provide response by each CSF.

RESPONSE: See Response 3 above. There is no practical way to separate out the relatively small amount of effort devoted to rotary wing aircraft avionics.

6. **AVIONICS QUESTIONS 3.1-3.5**

Answer each question for each CSF in which you are performing work.

RESPONSE: See previous response.

7. **AVIONICS QUESTION 3.4.1**

The question asks you to "describe major facilities and equipment to support **each CSF**." The question further asks **"If the facilities and equipment are shared with other functions, identify those functions and the percentage of total time used by each of these functions."** (Note: The response to SPACE does a good job of allocating percentage usage to CSF).

RESPONSE: See enclosure (1). The remaining percentage of utilization of items marked with a single asterisk is devoted to shipboard electronic warfare system development. The remaining percentage of utilization for facilities denoted by two asterisks supports the electronic devices CSF.

8. Following **AVIONICS** question 3.5, there are 21 pages of "3.4.1 MAJOR EQUIPMENT AND FACILITIES." They are additional information on the following: Organometallic VPE, Optical Characterization Facility, Electronic Properties Facility, Epicenter Facility, Microwave Technology Facility, Magnetic Resonance Facility, Optical Properties Facility, Crystal Growth Facility, Far Infrared Spectroscopy Facility, and Reliability Facility. These do not correlate to the facilities listed in response to question 3.4.1 for Avionics. Are they part of the Avionics response? If so, they need to be listed in the response to 3.4.1.

RESPONSE: The above-listed facilities belong in Part D, Electronic Devices.

9. **AVIONICS QUESTIONS 3.5.2, 3.5.3**

Please provide a response to these questions, for each CSF in which you are performing work. Citing Data Call #4 is not acceptable.

RESPONSES:

a. **3.5.2:** NRL has 11.2 acres available for unrestricted expansion located at its Chesapeake Bay Detachment. Parking would have to be included as part of any expansion project. Utilities, while available, are aged and would be required to be upgraded to accommodate any expansion.

The building space (class 2 property) currently available for growth opportunities at the NRL DC site, either constrained or unconstrained, represents a total of multiple small areas located throughout the Laboratory which cannot be effectively utilized by any other functions other than the primary occupant of the facility. It is important to note, however, that NRL facilities can be re-configured, e.g., demolished and rebuilt, altered, fitted with capital equipment, etc. to accommodate new or expanded mission assignments. However, accurate quantification of the maximum amount of space available for expansion is not practical without the benefit of revised mission/program planning guidance. For planning purposes, a rough order of magnitude estimate of the minimum class 2 space available for expansion is 10 percent. This would involve minimal reconfiguration.

b. **3.5.3:** Utility service capacities are depicted in the following table:

	On Base Capacity	Off Base Long Term Contract	Normal Steady State Load	Peak Demand
Electrical Supply (KWH)	N/A	54,000 KWH	13,098 KWH	17,280 KWH
Natural Gas (CFH)[1]	N/A	2,961 CFH	141 CFH	1,868 CFH
Sewage (GPD)	N/A	Unlimited	847,583 GPD	1,017,100 GPD
Potable Water (GPD	N/A	9,740,978 GPD	1,118,911 GPD	1,342,693 GPD
Steam (PSI & lb/Hr)[2]	190,000 lb/Hr	N/A	116,000 lb/Hr	125,000 lb/Hr

1 The availability of natural gas is controlled by the Washington Gas Light Company. It cannot be relied on as a primary fuel.

2 Production plant owned by PWC, Washington.

10. **SPACE QUESTION 3.1.5:** This question asks for "nearby organizations which facilitate accomplishing or performing your mission." Please list and describe the importance of any such organizations for each CSF (up to five per CSF).

ANSWER: There are no nearby outside organizations whose location facilitates accomplishing the Space CSF effort.

11. **SPACE**

Enclosure (2) is a revised Section 3.0 for the Space Satellites CSF. Enclosure (3) is a revised Section 3.4.1 for the Space Satellites CSF.

12. **C4I:**

All questions in Section III must be answered for each common support function you perform. You list Airborne and Fixed Ground. Please provide separate responses for each CSF.

RESPONSE: See enclosures (4) and (5).

13. **ELECTRONIC DEVICES**

See revised section 3.0 for the Electronic Devices CSF in enclosure (6).

14. **ELECTRONIC DEVICES QUESTION 3.1.5**

This question asks for "nearby organizations which facilitate accomplishing or performing your mission." Please list and describe the importance of any such organizations for each CSF (up to five per CSF).

ANSWER: There are no nearby outside organizations whose location facilitates the Electronic Devices CSF effort.

15. **ELECTRONIC DEVICES QUESTION 3.4.1**

The question asks you to "describe major facilities and equipment to support **each CSF**." The question further asks **"If the facilities and equipment are shared with other functions, identify those functions and the percentage of total time used by each of these functions"** (Note: The response to SPACE does a good job of allocating percentage usage to CSF).

RESPONSE: See enclosure (7).

8 AUG 1994

16. **ENVIRONMENTAL SCIENCES QUESTION 3.0**

This question asks you to describe any relationship and interconnectivity with other functions (common or otherwise) in support of the overall activity. Your response addressed this to some extent in a general manner; however, the question is to be answered for each CSF. Your response identifies interconnectivity with "WEAPONS", "C4I", "SPACE", "TRAINING", AND "ENVIRONMENTAL QUALITY". Weapons, C4I, and Space need to be further broken down into applicable CSFs (i.e., Cruise Missiles, Bombs,..., Satellites,..., Airborne C4I, ...) per the listing in the Data Call, further amplified in MM-0193-F4, BSAT/JT dtd 2 June 1994. Please provide response by each CSF.

RESPONSE: See enclosure (8).

17. **ENVIRONMENTAL SCIENCES QUESTION 3.4.1**

The question asks you to "describe major facilities and equipment to support **each CSF**." The question further asks **"If the facilities and equipment are shared with other functions, identify those functions and the percentage of total time used by each of these functions**." (Note: The response to SPACE does a good job of allocating percentage usage to CSF).

RESPONSE: See enclosure (9).

18. **ENVIRONMENTAL SCIENCES QUESTIONS 3.5.2, 3.5.3**

Please provide a response to these questions, for each CSF in which you are performing work. Citing Data Call #4 is not acceptable.

RESPONSES

a. **3.5.2** NRL has 11.2 acres available for unrestricted expansion located at its Chesapeake Bay Detachment. Parking would have to be included as part of any expansion project. Utilities, while available, are aged and would be required to be upgraded to accommodate any expansion.

The building space (class 2 property) currently available for growth opportunities at the NRL DC site, either constrained or unconstrained, represents a total of multiple small areas located throughout the Laboratory which cannot be effectively utilized by any other functions other than the primary occupant of the facility. It is important to note, however, that NRL facilities can be re-configured, e.g., demolished and rebuilt, altered, fitted with capital equipment, etc. to accommodate new or expanded mission assignments. However, accurate quantification of the maximum amount of space available for

expansion is not practical without the benefit of revised mission/program planning guidance. For planning purposes, a rough order of magnitude estimate of the minimum class 2 space available for expansion is 10 percent. This would involve minimal reconfiguration.

b. **3.5.3**: Utility service capacities are depicted in the following table:

	On Base Capacity	Off Base Long Term Contract	Normal Steady State Load	Peak Demand
Electrical Supply (KWH)	N/A	54,000 KWH	13,098 KWH	17,280 KWH
Natural Gas (CFH)[1]	N/A	2,961 CFH	141 CFH	1,868 CFH
Sewage (GPD)	N/A	Unlimited	847,583 GPD	1,017,100 GPD
Potable Water (GPD	N/A	9,740,978 GPD	1,118,911 GPD	1,342,693 GPD
Steam (PSI & lb/Hr)[2]	190,000 lb/Hr	N/A	116,000 lb/Hr	125,000 lb/Hr

1 The availability of natural gas is controlled by the Washington Gas Light Company. It cannot be relied on as a primary fuel.

2 Production plant owned by PWC, Washington.

19. **ENVIRONMENTAL QUALITY QUESTION 3.0**

In addition to describing the major capabilities at your activity contributing to the common support function for which you are responding, the question asks you to describe any relationship and interconnectivity with other functions (common or otherwise) in support of the overall activity. Your response addressed this to some extent in a general manner; however, the question is to be answered for each CSF. Please provide response by each CSF.

RESPONSE: See enclosure (10).

20. **ENVIRONMENTAL QUALITY QUESTION 3.2.1**

Total Personnel labeled "Electronic Devices". Is this a typo?

ANSWER: Yes; it should read "Environmental Quality".

21. **ENVIRONMENTAL QUALITY QUESTION 3.4.1**

The question asks you to "describe major facilities and equipment to support **each CSF**." The question further asks **"If the facilities and equipment are shared with other functions, identify those functions and the percentage of total time used by each of these functions**." (Note: The response to SPACE does a good job of allocating percentage usage to CSF).

RESPONSE: See enclosure (11).

22. **ENVIRONMENTAL QUALITY QUESTIONS 3.5.2, 3.5.3**

Please provide a response to these questions, for each CSF in which you are performing work. Citing Data Call #4 is not acceptable.

RESPONSES:

a. **3.5.2**: NRL has 11.2 acres available for unrestricted expansion located at its Chesapeake Bay Detachment. Parking would have to be included as part of any expansion project. Utilities, while available, are aged and would be required to be upgraded to accommodate any expansion.

The building space (class 2 property) currently available for growth opportunities at the NRL DC site, either constrained or unconstrained, represents a total of multiple small areas located throughout the Laboratory which cannot be effectively utilized by any other functions other than the primary occupant of the facility. It is important to note, however, that NRL facilities can be re-configured, e.g., demolished and rebuilt, altered, fitted with capital equipment, etc. to accommodate new or expanded mission assignments. However, accurate quantification of the maximum amount of space available for expansion is not practical without the benefit of revised mission/program planning guidance. For planning purposes, a rough order of magnitude estimate of the minimum class 2 space available for expansion is 10 percent. This would involve minimal reconfiguration.

b. **3.5.3**: Utility service capacities are depicted in the following table:

	On Base Capacity	Off Base Long Term Contract	Normal Steady State Load	Peak Demand
Electrical Supply (KWH)	N/A	54,000 KWH	13,098 KWH	17,280 KWH
Natural Gas (CFH)[1]	N/A	2,961 CFH	141 CFH	1,868 CFH
Sewage (GPD)	N/A	Unlimited	847,583 GPD	1,017,100 GPD
Potable Water (GPD	N/A	9,740,978 GPD	1,118,911 GPD	1,342,693 GPD
Steam (PSI & lb/Hr)[2]	190,000 lb/Hr	N/A	116,000 lb/Hr	125,000 lb/Hr

1 The availability of natural gas is controlled by the Washington Gas Light Company. It cannot be relied on as a primary fuel.

2 Production plant owned by PWC, Washington.

23. **ADVANCED MATERIALS**

Enclosure (12) is a revised Section 3.0 to the Advanced Materials CSF.

24. **ADVANCED MATERIALS QUESTION 3.4.1**

The question asks you to "describe major facilities and equipment to support **each CSF**." The question further asks **If the facilities and equipment are shared with other functions, identify those functions and the percentage of total time used by each of these functions**." (Note: The response to SPACE does a good job of allocating percentage usage to CSF).

RESPONSE: See enclosure (13).

25. **ADVANCED MATERIALS QUESTIONS 3.5.2, 3.5.3**

Please provide a response to these questions, for each CSF in which you are performing work. Citing Data Call #4 is not acceptable.

RESPONSE

a. **3.5.2**: NRL has 11.2 acres available for unrestricted expansion located at its Chesapeake Bay Detachment. Parking would have to be included as part of any expansion project. Utilities, while available, are aged and would be required to be upgraded to accommodate any expansion.

The building space (class 2 property) currently available for growth opportunities at the NRL DC site, either constrained or unconstrained, represents a total of multiple small areas located throughout the Laboratory which cannot be effectively utilized by any other functions other than the primary occupant of the facility. It is important to note, however, that NRL facilities can be re-configured, e.g., demolished and rebuilt, altered, fitted with capital equipment, etc. to accommodate new or expanded mission assignments. However, accurate quantification of the maximum amount of space available for expansion is not practical without the benefit of revised mission/program planning guidance. For planning purposes, a rough order of magnitude estimate of the minimum class 2 space available for expansion is 10 percent. This would involve minimal reconfiguration.

b. **3.5.3**: Utility service capacities are depicted in the following table:

	On Base Capacity	Off Base Long Term Contract	Normal Steady State Load	Peak Demand
Electrical Supply (KWH)	N/A	54,000 KWH	13,098 KWH	17,280 KWH
Natural Gas (CFH)[1]	N/A	2,961 CFH	141 CFH	1,868 CFH
Sewage (GPD)	N/A	Unlimited	847,583 GPD	1,017,100 GPD
Potable Water (GPD	N/A	9,740,978 GPD	1,118,911 GPD	1,342,693 GPD
Steam (PSI & lb/Hr)[2]	190,000 lb/Hr	N/A	116,000 lb/Hr	125,000 lb/Hr

1 The availability of natural gas is controlled by the Washington Gas Light Company. It cannot be relied on as a primary fuel.

2 Production plant owned by PWC, Washington.

R.M. Cassidy

AUG 1994

BRAC-95 CERTIFICATION

I certify that the information contained herein is accurate and complete to the best of my knowledge and belief.

Captain Richard M. Cassidy, USN
NAME (Please type or print)

R. M. Cassidy
Signature

Commanding Officer
Title

8/8/94
Date

Naval Research Laboratory
Division

4555 Overlook Avenue, SW
Department

Washington, DC 20375-5320
Activity

Enclosure (1)

8 AUG 1994

Encl (2)

8 AUG 1994

Department of the Navy
Base Structure Analysis Team

BSAT

Facsimile Transmission
Cover Sheet

Date: 4 AUG 94

From: CDR T. SCOTT EVANS
Office: (703) 681-0476
Fax: (703) 756-2174

To: **Name:** MR. BOB DOAK
Org: ARD
Office: (202)767-2371
Fax: (202)404-7728

Message Per our telecon, please find attached a list of clarification questions to data call 12 . Request response by FAX *as soon as possible* and follow with official certified copy through the Chain of Command. We are scheduled to share data with the Joint Cross-Service Group on Monday, 8 Aug.

Thanks in advance,

Scott Scott

Number of Pages (including cover page) : 4

8 AUG 1994

Encl (2)

NAVAL RESEARCH LABORATORY

QUESTION 2.2

Actual Workyears peak in FY91 is listed as 4909 but in the table in Questions 2.1 it is listed as 4090. Which is correct?

A. AVIONICS:

Your response addresses the 'Avionics" CSF. This needs to be further broken out to "Fixed Wing Avionics" and "Rotary WIng Avionics " **All questions in Section III** must be answered for each common support function you perform.

QUESTION 3.0 In addition to describing the major capabilities at your activity contributing to the common support function for which you are responding, the question asks you to describe any relationship and interconnectivity with other functions (common or otherwise) in support of the overall activity. Your response addressed this to some extent in a general manner; however, the question is to be answered for each CSF. Please provide response by each CSF.

QUESTIONS 3.1-3.5 Anwer each question for each CSF in which you are performing work.

QUESTION 3.4.1 The question asks you to "describe major facilities and equipment to support each CSF." The question further asks **"If the facilities and equipment are shared with other functions, identify those functions and the percentage of total time used by each of these functions"** (Note: The response to SPACE does a good job of allocating percentage usage to CSF).

Following question 3.5 there are 21 pages of "3.4.1 MAJOR EQUIPMENT AND FACILITIES". They are additional information on the following: Organometallic VPE, Optical Characterization Facility, Electronic Properties Facility, Epicenter Facility, Microwave Technology Facility, Magnetic Resonance Facility, Optical Properties Facility, Crystal Growth Facility, Far Infrared Spectroscopy Facility, and Reliability Facility. These do not correlate to the facilities listed in response to question 3.4.1for Avionics. Are they part of the Avionics response? If so, they need to be listed in the response to 3.4.1.

QUESTION 3.5.2, 3.5.3 Please provide a response to these questions, for each CSF in which you are performing work. Citing Data Call # 4 is not acceptable.

B. SPACE:

QUESTION 3.1.5 This question asks for "nearby organizations which facilitate accomplishing or performing your mission". Please list and describe the importance of any such organizations for each CSF, (up to five per CSF).

C. C4I: **All questions in Section III** must be answered for each common support function you perform. You list Airborne and Fixed Ground. Please provide seperate responses for each CSF.

QUESTION 3.1.5 This question asks for "nearby organizations which facilitate accomplishing or performing your mission". Please list and describe the importance of any such organizations for each CSF, (up to five per CSF).

QUESTIONS 3.2-3.3 Anwer each question for each CSF in which you are performing work.

QUESTION 3.4.1 The question asks you to "describe major facilities and equipment to support each CSF." The question further asks **"If the facilities and equipment are shared with other functions, identify those functions and the percentage of total time used by each of these functions"** (Note: The response to SPACE does a good job of allocating percentage usage to CSF).

QUESTION 3.5.2, 3.5.3 Please provide a response to these questions, for each CSF in which you are performing work. Citing Data Call # 4 is not acceptable.

D. ELECTRONIC DEVICES:

QUESTION 3.1.5 This question asks for "nearby organizations which facilitate accomplishing or performing your mission". Please list and describe the importance of any such organizations for each CSF, (up to five per CSF).

QUESTION 3.4.1 The question asks you to "describe major facilities and equipment to support each CSF." The question further asks **"If the facilities and equipment are shared with other functions, identify those functions and the percentage of total time used by each of these functions"** (Note: The response to SPACE does a good job of allocating percentage usage to CSF).

E. ENVIRONMENTAL SCIENCE:

QUESTION 3.0 This question asks you to describe any relationship and interconnectivity with other functions (common or otherwise) in support of the overall activity. Your response addressed this to some extent in a general manner; however, the question is to be answered for each CSF. Your response identifies interconnectivity with "WEAPONS", "C4I", "SPACE", "TRAINING", and "ENVIRONMENTAL QUALITY". Weapons, C4I, and Space need to be further broken down into applicable CSFs (ie. Cruise Missiles, Bombs . . , Satellites, . . , Airborne C4I, ...) per the listing in the Data Call, further amplified in MM-0193-F4, BSAT/JT dtd 2 June 1994. Please provide response by each CSF.

QUESTION 3.4.1 The question asks you to "describe major facilities and equipment to support each CSF." The question further asks **"If the facilities and equipment are shared with other functions, identify those functions and the percentage of total time used by each of these functions"** (Note: The response to SPACE does a good job of allocating percentage usage to CSF).

QUESTION 3.5.2, 3.5.3 Please provide a response to these questions, for each CSF in which you are performing work. Citing Data Call # 4 is not acceptable.

8 AUG 1994

F. ENVIRONMENTAL QUALITY:

QUESTION 3.0 In addition to describing the major capabilities at your activity contributing to the common support function for which you are responding, the question asks you to describe any relationship and interconnectivity with other functions (common or otherwise) in support of the overall activity. Your response addressed this to some extent in a general manner; however, the question is to be answered for each CSF. Please provide response by each CSF.

QUESTION 3.2.1 Total Personnel labeled "Elctronic Devices". Is this a typo?

QUESTION 3.4.1 The question asks you to "describe major facilities and equipment to support each CSF." The question further asks **"If the facilities and equipment are shared with other functions, identify those functions and the percentage of total time used by each of these functions"** (Note: The response to SPACE does a good job of allocating percentage usage to CSF).

QUESTION 3.5.2, 3.5.3 Please provide a response to these questions, for each CSF in which you are performing work. Citing Data Call # 4 is not acceptable.

G. ADVANCED MATERIALS:

QUESTION 3.4.1 The question asks you to "describe major facilities and equipment to support each CSF." The question further asks **"If the facilities and equipment are shared with other functions, identify those functions and the percentage of total time used by each of these functions"** (Note: The response to SPACE does a good job of allocating percentage usage to CSF).

QUESTION 3.5.2, 3.5.3 Please provide a response to these questions, for each CSF in which you are performing work. Citing Data Call # 4 is not acceptable.

8 AUG 1994

DEPARTMENT OF THE NAVY
OFFICE OF NAVAL RESEARCH
800 NORTH QUINCY STREET
ARLINGTON, VA 22217-5660

IN REPLY REFER TO
11010
Ser 91/279

1 September 1994

From: Chief of Naval Research
To: Chief of Naval Operations (N44)

Subj: 1995 BASE REALIGNMENT AND CLOSURE (BRAC) DATA CALL NUMBER TWELVE CERTIFICATION ANSWERS

Ref: (a) Uncertified advance copy NRL BRAC Data Call Twelve Certification Answers-Revised of 19 Aug 94
(b) ONR ltr 11010 Ser 91/272 of 25 Aug 94
(c) Uncertified advance copy of NRL BRAC Data Call Twelve Certification Answers of 8 Aug 94
(d) BSAT memo of 3 Jun 94

Encl: (1) Naval Research Laboratory Data Call Twelve Certification Revision with Certifications
(2) BSAT Facsimile of 15 Aug 94

1. Reference (a) forwarded to BSAT an uncertified copy of enclosure (1) in response to enclosure (2). Enclosure (1) forwards the required certified copy of reference (a).

2. Enclosure (2) was facsimiled by the BSAT directly to NRL, bypassing both N44 and ONR, and as a result, BSAT reviewed reference (c) before completion of the ONR certification. Reference (b) corrected most of the administrative errors cited in enclosure (2) about reference (c) not complying with the format in reference (d). Reference (a) and enclosure (1) correct the remaining errors cited and provided additional information requested by enclosure (2).

3. The ONR point of contact is Mr. Frederick C. Esposito who may be reached on 703-696-4613.

MARC PELAEZ
Rear Admiral, USN

19 AUG 1994

DATA CALL

I certify that the information contained herein is accurate and complete to the best of my knowledge and belief.

NEXT ECHELON LEVEL (if applicable)

NAME (Please type or print

Signature

Title

Date

Activity

I certify that the information contained herein is accurate and complete to the best of my knowledge and belief.

NEXT ECHELON LEVEL (if applicable)

NAME (Please type of print

Signature

Title

Date

Activity

In certify that the information herein is accurate and complete to the best of my knowledge and belief.

MAJOR CLAIMANT LEVEL

MARC PELAEZ

NAME (Please type or print

Signature

CHIEF OF NAVAL RESEARCH

Title

9/1/94

Date

OFFICE OF NAVAL RESEARCH

Activity

I certify that the information contained herein is accurate and complete to the best of my knowledge belief.

DEPUTY CHIEF OF NAVAL OPERATIONS (LOGISTICS)
DEPUTY CHIEF OF STAFF (INSTALLATIONS & LOGISTICS)

J. B. GREENE, JR.

NAME (Please type of print

Signature

ACTING

Title

14 SEP 1994

Date

19 AUG 1994

BRAC-95 CERTIFICATION

Reference: SECNAV NOTE 11000 dtd 8 Dec 93

In accordance with policy set forth by the Secretary of the Navy, personnel of the Department of the Navy, uniformed and civilian, who provide information for use in the BRAC-95 process are required to provide a signed certification that states "I certify that the information contained herein is accurate and complete to the best of my knowledge and belief."

The signing of this certification constitutes a representation that the certifying official has reviewed the information and either (1) personally vouches for its accuracy and completeness or (2) has possession of, and is relying upon, a certification executed by a competent subordinate.

Each individual in your activity generating information for the BRAC-95 process must certify that information. Enclosure (1) is provided for individual certifications and may be duplicated as necessary. You are directed to maintain those certifications at your activity for audit purposes. For purposes of this certification sheet, the commander of the activity will begin the certification process and each reporting senior in the Chain of Command reviewing the information will also sign this certification sheet. This sheet must remain attached to this package and be forwarded up the Chain of Command. Copies must be retained by each level in the Chain of Command for audit purposes.

I certify the information contained herein is accurate and complete to the best of my knowledge and belief.

ACTIVITY COMMANDER

R. E. Leonard
NAME (Please type of print)

Signature

Acting, CO
Title

8/19/94
Date

NRL
Activity

19 AUG 1994

DEPARTMENT OF THE NAVY
NAVAL RESEARCH LABORATORY
WASHINGTON, D.C. 20375-5320

IN REPLY REFER TO
1001-195
19 Aug 94

From: Commanding Officer, Naval Research Laboratory
To: Base Structure Analysis Team (Attn: CDR T. S. Evans)

Via: Chief of Naval Research
Chief of Naval Operations (N44)

Subj: 1995 BASE REALIGNMENT AND CLOSURE (BRAC) AMENDMENT THREE TO DATA CALL TWELVE - NAVAL RESEARCH LABORATORY

Ref: (a) BSAT fax memo of 15 Aug 94
(b) CNO ltr Ser N44C1/4U594615 of 3 Jun 94
(c) BSAT fax memo of 4 Aug 94

Encl: (1) Subject submission

1. Enclosure (1) is submitted in response to reference (a). In some instances we were unable to comply with guidance on pagination, since the pagination of the original submission was mistakenly and irrevocably changed during the preparation of amendments one and two. In accordance with references (a), (b) and (c), Sections A (Avionics), B (Space), and C (C4I) have each been divided into separate CSFs, which required the complete replacement of virtually all pages containing text or data of previous submissions of these sections.

2. All photos originally included in the Avionics section, except that of the Seeker Simulation Lab, should now be attached to Part A1, Fixed-Wing Avionics. The Seeker Simulation Lab photograph should be moved to Part A2, Rotary-Wing Avionics.

3. In response to question 3.5.2 of reference (a):

a. The response in the Electronic Devices CSF has been modified to be consistent with other submissions.

b. No vacant acreage is available at the NRL Washington site. NRL has for several years been implementing a long-range plan to repair and refurbish a number of the higher-quality older buildings at the DC site. This effort will not be completed for another six to eight years. At that point, demolition of lower-quality structures could make areas of the Laboratory available for new construction. Until that time, however, new populations of personnel (up to 10 percent of current population) could only be accommodated through minor reconfiguration of existing facilities.

R. E. LEONARD
Acting

19 AUG 1994

BASE REALIGNMENT AND CLOSURE
DATA CALL 12
Naval Research Laboratory
Amendment 3
Contents

Section II: Revised 8 Aug 94 (1 page)

Section III:
A. Air Vehicles
A1 Fixed Wing Avionics, revised 17 Aug 94 (pages A1R-A12aR)
A2 Rotary-Wing Avionics, new section 17 Aug 94 (pages A12bR-A12hR, plus 3 photos)

B. Space
B1 Satellites, revised 17 Aug 94 (pages B1R-B10R)
B2 Ground Control Systems, revised 17 Aug 94 pages B11R-B17R

C. C4I
C1 Airborne C4I, revised 17 Aug 94 (pages C1R-C7R)
C2 Groundbased C4I, revised 8 Aug 94 (pages C8R-C13R)

D. Electronic Devices, revised 8 Aug 94 (pages D1-D54)

E. Environmental Science, revised 17 Aug 94 (pages E1-E18R)

F. Environmental Quality, revised 8 Aug 94 (pages F1-F13aR)

G. Advanced Materials, revised 8 Aug 94 (pages G1R-G6)

Department of the Navy
Base Structure Analysis Team

BSAT

Facsimile Transmission
Cover Sheet

Date: 15 AUGUST 1994

From: CDR SCOTT EVANS / Major Mike Cone
Office: (703) 681-0476
Fax: (703) 756-2174

To: Name: BOB DOAK
Org: NRL
Office: ARL
Fax: 202-404-7728

Message The attached clarifications to Data Call 12, Laboratory Joint Cross-Service responses are required. Response must be certified through the Chain-of-Command and be configured in accordance with Navy BRAC policy and procedures. An advance copy of your response should be FAXed to the above NLT COB 17 August 1994.

Thanx Scott

OPTIONAL FORM 99 (7-90)
FAX TRANSMITTAL
# of pages ▶ 2
To Fred Esposito
From Skip Lacher
Dept./Agency
Phone #
Fax #
Fax #
NSN 7540-01-317-7368 5099-101 GENERAL SERVICES ADMINISTRATION

Number of Pages (includ

19 AUG 1994

NAVAL RESEARCH LABORATORY, WASHINGTON, DC

(Advance Copy dated 8 August 94 plus FAX of 9 August 94 w/ enclosures 4&5)

GENERAL

Your 8 August letter provided responses in the form of attached change pages as well as comments revising previous input statements. Changes must be done in accordance with Navy BRAC policy and procedures. This requires complete replacement of pages with the replacement page number marked with an "R" after it plus the revision date on each change page for all changes made to the data call response. Please submit change pages for all changes/corrections to facilitate our configuratiuon control. Certified copy must follow correct procedure.

Question 3.0

Air Vehicle, Rotary, Avionics must be broken out. Your response that there is no practical way to separate out the relatively small amount of effort is not acceptable. This needs to be done to the best of your ability, and your response footnoted to annotate the method for estimating it, if necessary, to meet certification requirements. Section III needs to be filled out in its ~~entirety for this CSF~~.

Under CSF Space Systems,Ground Control Systems you list"Launch Vehicle Propulsion Technology Development'. Are you performing work that falls in the Space Systems, Launch Vehicle CSF. If so, this CSF must be reported and all questions in Section III answered, even if the work is at a very low level.

QUESTION 3.4.1

The percentage shared was not indicated for the Major Equipment and Facilities supporting the Environmental Science CSF.

QUESTION 3.5.2

For the Electronic Devices CSF your response was "None". For CSFs Ground Based C4I; Airborne C4I; Avionics; Environmental Sciences; Environmental Quality; and Advanced Materials your response stated "For planning purposes, a rough order of magnitude estimate of the minimum class 2 space available for expansion is 10 percent" and "11.2 Acres available for unrestricted expansion located at its Chesapeake Bay Detachment". Why is your response to Electronic devices different than all the rest? If it wasn't meant to be, just correct your answer. If it was meant to be, please explain. Class 2 space is facilities. From your input we assume that there are no acres available at the Washington D.C site. If that is not the case, please revise your response accordingly.

DEPARTMENT OF THE NAVY
OFFICE OF NAVAL RESEARCH
800 NORTH QUINCY STREET
ARLINGTON, VA 22217-5660

174

IN REPLY REFER TO

11010
Ser 91/302
20 September 1994

FIRST ENDORSEMENT on NRL ltr 1001.1/048 of 16 September 1994

From: Chief of Naval Research
To: Chief of Naval Operations (N44)

Subj: 1995 BASE REALIGNMENT AND CLOSURE (BRAC) AMENDMENT FOUR TO DATA CALL TWELVE - NAVAL RESEARCH LABORATORY

1. The subject amendment is forwarded for further action.

2. The ONR point of contact is Mr. Frederick C. Esposito, who may be reached on 703-696-4613.

MARC PELAEZ
Rear Admiral, USN

16 SEP 1994

DEPARTMENT OF THE NAVY
NAVAL RESEARCH LABORATORY
WASHINGTON, D.C. 20375-5320

IN REPLY REFER TO:

1001.1/048
16 Sept 1994

From: Commanding Officer, Naval Research Laboratory
To: Base Structure Analysis Team (Attn: John J. Trick)

Via: Chief of Naval Research
Chief of Naval Operations (N44)

Subj: 1995 BASE REALIGNMENT AND CLOSURE (BRAC) AMENDMENT FOUR TO DATA CALL TWELVE - NAVAL RESEARCH LABORATORY

Ref: (a) BSAT fax memo of 12 Sep 1994
(b) OPNAV ltr Ser N441/4U594484 of 7 Apr 1994

Encl: (1) Subject submission

1. Enclosure (1) is submitted in response to reference (a).

2. An attempt has been made to respond to the guidance provided in reference (a) regarding peer-reviewed journals. However, it should be noted that conventional practice for listing references in scientific journals is to provide journal name, volume, page number(s), and year. The month of the issue is not normally included in a list of journal articles. As a result, this information is not available in the NRL publications data base. The only way this information can be obtained is by manually checking every article. Time did not permit completion of this effort in all cases.

3. The publication lists for all Common Support Functions except C4I Systems and Ground Control Systems have been resubmitted in their entirety to ensure proper pagination and sequential numbering of articles, where this was possible. Significant changes and deletions have been denoted by an "R", for revised. The following changes were considered too minor to warrant individual notation as a revision:

a. Correction of typographical errors.
b. Deletion of duplicative entries.
c. Addition of missing data for entries previously submitted.
d. Changes to sequential numbers caused by deletions.

However, page numbers with such corrections were marked with an "R".

16 SEP 1994

Subj: 1995 BASE REALIGNMENT AND CLOSURE (BRAC) AMENDMENT FOUR TO DATA CALL TWELVE - NAVAL RESEARCH LABORATORY

4. The guidance provided in reference (b) for Section 3.2.1 and 3.2.2 were that personnel were to be included if they were "**engaged in** science and technology, engineering development and in-service engineering activities ..." (emphasis added). At NRL, this was interpreted to include only scientific, engineering, technical, and support personnel directly charging to R&D programs. It did not include clerical or administrative personnel, or anyone on overhead or General and Administrative funding. Unfortunately, not all NRL components followed this guidance completely in our original submission, which led to the inconsistencies noted in reference (a). These inconsistencies have been corrected in enclosure (1).

R. M. Cassidy
RICHARD M. CASSIDY

16 SEP 1994

BRAC-95 CERTIFICATION

Reference: SECNAV NOTE 11000 dtd 8 Dec 93

In accordance with policy set forth by the Secretary of the Navy, personnel of the Department of the Navy, uniformed and civilian, who provide information for use in the BRAC-95 process are required to provide a signed certification that states "I certify that the information contained herein is accurate and complete to the best of my knowledge and belief."

The signing of this certification constitutes a representation that the certifying official has reviewed the information and either (1) personally vouches for its accuracy and completeness or (2) has possession of, and is relying upon, a certification executed by a competent subordinate.

Each individual in your activity generating information for the BRAC-95 process must certify that information. Enclosure (1) is provided for individual certifications and may be duplicated as necessary. You are directed to maintain those certifications at your activity for audit purposes. For purposes of this certification sheet, the commander of the activity will begin the certification process and each reporting senior in the Chain of Command reviewing the information will also sign this certification sheet. This sheet must remain attached to this package and be forwarded up the Chain of Command. Copies must be retained by each level in the Chain of Command for audit purposes.

I certify the information contained herein is accurate and complete to the best of my knowledge and belief.

ACTIVITY COMMANDER

Richard M. Cassidy
NAME (Please type of print)

RM Cassidy
Signature

Commanding Officer
Title

9-16-94
Date

Naval Research Laboratory
Activity

10 SEP 1994

DATA CALL

I certify that the information contained herein is accurate and complete to the best of my knowledge and belief.

NEXT ECHELON LEVEL (if applicable)

NAME (Please type or print

Signature

Title

Date

Activity

I certify that the information contained herein is accurate and complete to the best of my knowledge and belief.

NEXT ECHELON LEVEL (if applicable)

NAME (Please type of print

Signature

Title

Date

Activity

In certify that the information herein is accurate and complete to the best of my knowledge and belief.

MAJOR CLAIMANT LEVEL

MARC PELAEZ

NAME (Please type or print

Signature

CHIEF OF NAVAL RESEARCH

Title

9/20/94

Date

OFFICE OF NAVAL RESEARCH

Activity

I certify that the information contained herein is accurate and complete to the best of my knowledge belief.

DEPUTY CHIEF OF NAVAL OPERATIONS (LOGISTICS)
DEPUTY CHIEF OF STAFF (INSTALLATIONS & LOGISTICS)

W. A. EARNER

NAME (Please type of print

Signature

Title

9/21/94

Date

16 SEP 1994

BASE REALIGNMENT AND CLOSURE
DATA CALL 12

Naval Research Laboratory
Amendment 4
Contents

A. Air Vehicles
- A1 Fixed Wing Avionics, revised 16 Sep 94: pages A-4R through A-6R
- A2 Rotary Wing Avionics, revised 16 Sep 94: page A-12dR

B. Space
- B1 Satellites, revised 15 Sep 94: pages B-5R and B-6R

C. C4I
- C1 Airborne C4I, revised 15 Sep 94: page C4R
- C2 Ground-based C4I, revised 15 Sep 94: page C9R

D. Electronic Devices, revised 14 Sep 94: pages D-3R, D-4R, and D-B-1R through D-B-77R

E. Environmental Sciences, revised 14 Sep 94: pages E-5R and E-A1R through E-A27R

F. Environmental Quality, revised 14/15 Sep 94: pages F-2R, F-3R and F-6R through F-10R

G. Advanced Materials, revised 14 Sep 94: pages G-3R, G-4R, and G-3-1R through G-3-88R

16 SEP 1994

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DEPARTMENT OF THE NAVY
OFFICE OF NAVAL RESEARCH
800 NORTH QUINCY STREET
ARLINGTON, VA 22217-5660

IN REPLY REFER TO

11010
Ser 91/311
21 September 1994

FIRST ENDORSEMENT on NRL ltr 1001.1/050 of 20 September 1994

From: Chief of Naval Research
To: Chief of Naval Operations (N44)

Subj: 1995 BASE REALIGNMENT AND CLOSURE (BRAC) AMENDMENT FOUR SUPPLEMENT TO DATA CALL TWELVE - NAVAL RESEARCH LABORATORY

1. The subject amendment supplement is forwarded for further action.

2. The ONR point of contact is Mr. Frederick C. Esposito, who may be reached on 703-696-4613.

MARC PELAEZ
Rear Admiral, USN

20 SEP 1994

DEPARTMENT OF THE NAVY
NAVAL RESEARCH LABORATORY
WASHINGTON, D.C. 20375-5320

IN REPLY REFER TO:
1001.1/050
20 Sept 1994

From: Commanding Officer, Naval Research Laboratory
To: Base Structure Analysis Team (Attn: John J. Trick)

Via: Chief of Naval Research
Chief of Naval Operations (N44)

Subj: 1995 BASE REALIGNMENT AND CLOSURE (BRAC) AMENDMENT FIVE TO DATA CALL TWELVE - NAVAL RESEARCH LABORATORY

Ref: (a) NRL ltr Ser 1001.1/048 of 16 Sept 1994

Encl: (1) Subject submission

1. Reference (a) submitted amendment 4 to BRAC data call 12. As was stated in paragraph 2 of reference (a), the tight deadline did not permit completion of the requested revisions to all publication lists.

2. Enclosure (1) is a revised version of the NRL publications list for the Electronic Devices Common Support Function. These pages should be inserted into Section D of the NRL submission to BRAC data call 12. Given the magnitude of the changes included in enclosure (1), the pages have been completely renumbered.

R.E. Lennard
R.E. Lennard
Acting

20 SEP 1994

BRAC-95 CERTIFICATION

Reference: SECNAV NOTE 11000 dtd 8 Dec 93

In accordance with policy set forth by the Secretary of the Navy, personnel of the Department of the Navy, uniformed and civilian, who provide information for use in the BRAC-95 process are required to provide a signed certification that states "I certify that the information contained herein is accurate and complete to the best of my knowledge and belief."

The signing of this certification constitutes a representation that the certifying official has reviewed the information and either (1) personally vouches for its accuracy and completeness or (2) has possession of, and is relying upon, a certification executed by a competent subordinate.

Each individual in your activity generating information for the BRAC-95 process must certify that information. Enclosure (1) is provided for individual certifications and may be duplicated as necessary. You are directed to maintain those certifications at your activity for audit purposes. For purposes of this certification sheet, the commander of the activity will begin the certification process and each reporting senior in the Chain of Command reviewing the information will also sign this certification sheet. This sheet must remain attached to this package and be forwarded up the Chain of Command. Copies must be retained by each level in the Chain of Command for audit purposes.

I certify the information contained herein is accurate and complete to the best of my knowledge and belief.

ACTIVITY COMMANDER

R E Leonard
NAME (Please type of print)

Signature

Acting Commanding Officer
Title

20 SEP 1994
Date

Naval Research Laboratory
Activity

20 SEP 1994

DATA CALL

I certify that the information contained herein is accurate and complete to the best of my knowledge and belief.

NEXT ECHELON LEVEL (if applicable)

NAME (Please type or print

Signature

Title

Date

Activity

I certify that the information contained herein is accurate and complete to the best of my knowledge and belief.

NEXT ECHELON LEVEL (if applicable)

NAME (Please type of print

Signature

Title

Date

Activity

In certify that the information herein is accurate and complete to the best of my knowledge and belief.

MAJOR CLAIMANT LEVEL

MARC PELAEZ

NAME (Please type or print

Signature

CHIEF OF NAVAL RESEARCH

Title

21 Sep 94

Date

OFFICE OF NAVAL RESEARCH

Activity

I certify that the information contained herein is accurate and complete to the best of my knowledge belief.

DEPUTY CHIEF OF NAVAL OPERATIONS (LOGISTICS)
DEPUTY CHIEF OF STAFF (INSTALLATIONS & LOGISTICS)

W. A. EARNER

NAME (Please type of print

Signature

Title

9/21/94

Date

20 SEP 1994

DEPARTMENT OF THE NAVY
NAVAL RESEARCH LABORATORY
WASHINGTON, D.C. 20375-5320

IN REPLY REFER TO:
1001.1/055
28 Sept 94

From: Commanding Officer, Naval Research Laboratory
To: Base Structure Analysis Team (Attn: John J. Trick)

Via: Chief of Naval Research
Chief of Naval Operations (N44)

Subj: 1995 BASE REALIGNMENT AND CLOSURE (BRAC) AMENDMENT SIX TO DATA CALL TWELVE - NAVAL RESEARCH LABORATORY

Ref: (a) NRL ltr Ser 1001.1/048 of 16 Sept 1994
(b) BSAT fax memo of 12 Sept 1994

Encl: (1) Subject submission

1. Reference (a) submitted amendment 4 to BRAC data call 12. As was stated in paragraph 2 of reference (a), the tight deadline did not permit completion of the requested revisions to all publication lists.

2. Enclosure (1) is a revised version of the NRL publications list for one NRL division that was included in the Materials Science Common Support Function. The enclosed material replaces pages G-3-70 through G-3-88 of the material submitted by reference (a). Since virtually every entry has had information added or revised in accordance with the guidance provided by reference (b), revised items have not been specially denoted with the letter "R".

R. M. Cassidy
RICHARD M. CASSIDY

27 SEP 1994

BRAC-95 CERTIFICATION

Reference: SECNAV NOTE 11000 dtd 8 Dec 93

In accordance with policy set forth by the Secretary of the Navy, personnel of the Department of the Navy, uniformed and civilian, who provide information for use in the BRAC-95 process are required to provide a signed certification that states "I certify that the information contained herein is accurate and complete to the best of my knowledge and belief."

The signing of this certification constitutes a representation that the certifying official has reviewed the information and either (1) personally vouches for its accuracy and completeness or (2) has possession of, and is relying upon, a certification executed by a competent subordinate.

Each individual in your activity generating information for the BRAC-95 process must certify that information. Enclosure (1) is provided for individual certifications and may be duplicated as necessary. You are directed to maintain those certifications at your activity for audit purposes. For purposes of this certification sheet, the commander of the activity will begin the certification process and each reporting senior in the Chain of Command reviewing the information will also sign this certification sheet. This sheet must remain attached to this package and be forwarded up the Chain of Command. Copies must be retained by each level in the Chain of Command for audit purposes.

I certify the information contained herein is accurate and complete to the best of my knowledge and belief.

ACTIVITY COMMANDER

NAME (Please type of print) RICHARD M. CASSIDY

Title Captain, U.S. Navy
Commanding Officer

Activity Naval Research Laboratory
Washington, DC 20375-5000

R.M. Cassidy
Signature

27 SEP [redacted]
Date

27 SEP 1994

DATA CALL

~~175~~ 174

I certify that the information contained herein is accurate and complete to the best of my knowledge and belief.

NEXT ECHELON LEVEL (if applicable)

NAME (Please type or print

Signature

Title

Date

Activity

I certify that the information contained herein is accurate and complete to the best of my knowledge and belief.

NEXT ECHELON LEVEL (if applicable)

NAME (Please type of print

Signature

Title

Date

Activity

In certify that the information herein is accurate and complete to the best of my knowledge and belief.

MAJOR CLAIMANT LEVEL

MARC PELAEZ

NAME (Please type or print

Signature

CHIEF OF NAVAL RESEARCH

Title

30 Sept 1994

Date

OFFICE OF NAVAL RESEARCH

Activity

I certify that the information contained herein is accurate and complete to the best of my knowledge belief.

DEPUTY CHIEF OF NAVAL OPERATIONS (LOGISTICS)
DEPUTY CHIEF OF STAFF (INSTALLATIONS & LOGISTICS)

J. B. GREENE, JR.

NAME (Please type of print

Signature

ACTING

Title

13 OCT 1994

Date

27 SEP 1994

NAVAL RESEARCH LABORATORY

response to

Base Realignment and Closure 1995 Data Call 12

12 May 1994

SECTION I: TASKING

This section contained tasking instructions only, and is not included in the response.

SECTION II: CAPACITY OF DOD COMPONENTS

R

SECTION II: CAPACITY OF DOD COMPONENTS

2.1 Workload. Use the following table to describe historic and projected workload at each activity in terms of funding and workyears. Assume previous BRAC closures and realignments are implemented on schedule. Projected funding will be derived from FY95 President's Budget Submission (Then year dollars). Past fiscal year data shall begin with FY86 or at the inception of the activity as it existed on 1 Oct 93. (BRAC Criteria I & IV)

Information Required	Fiscal Years											
	86	87	88	89	90	91	92	93	94	95	96	97
Total Funds Programmed ($M)	543	483	604	556	646	746	651	707	840	842	867	893
Total Actual Funds ($M)	552	596	642	646	727	769	722	811				
Programmed Workyears	3,916	4,080	4,296	4,259	4,308	5,010	4,717	4,471	4,593	4,459	4,415	4,397
Actual Workyears	4,031	4,094	4,242	4,249	4,256	4,909	4,821	4,609				

R

NOTE: Increase due to inclusion of on-site contractors beginning in FY91. On-site contractor data not collected prior to FY91.

2.2 Excess "Lab" Capacity: 358 Workyears

Mandated Formula: Actual Workyears peak in FY91 minus Projected FY97 Workyears
(4909 - 4397= 512)

Formula Adjustment:
Calculated 512
Less Transfer of:
Public Works to PWC, DC (133)
Acctg to DFAS, OH (21)

Adjusted Excess Capacity: 358

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SECTION II: CAPACITY OF DOD COMPONENTS

2.1 Workload. Use the following table to describe historic and projected workload at each activity in terms of funding and workyears. Assume previous BRAC closures and realignments are implemented on schedule. Projected funding will be derived from FY95 President's Budget Submission (Then year dollars). Past fiscal year data shall begin with FY86 or at the inception of the activity as it existed on 1 Oct 93. (BRAC Criteria I & IV)

Information Required	Fiscal Years											
	86	87	88	89	90	91	92	93	94	95	96	97
Total Funds Programmed ($M)	543	483	604	556	646	746	651	707	840	842	867	893
Total Actual Funds ($M)	552	596	642	646	727	769	722	811				
Programmed Workyears	3,916	4,080	4,296	4,259	4,308	5,010	4,717	4,471	4,593	4,459	4,415	4,397
Actual Workyears	4,031	4,094	4,242	4,249	4,256	4909 ~~4,090~~	4,821	4,609				

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NOTE: Increase due to inclusion of on-site contractors beginning in FY91. On-site contractor data not collected prior to FY91.

2.2 Excess "Lab" Capacity: 358 Workyears

Mandated Formula: Actual Workyears peak in FY91 minus Projected FY97 Workyears
(4909 - 4397= 512)

Formula Adjustment:

Calculated	512
Less Transfer of:	
Public Works to PWC, DC	(133)
Acctg to DFAS, OH	(21)
Adjusted Excess Capacity:	358

SECTION III: CAPABILITY OF NRL TO PERFORM COMMON SUPPORT FUNCTIONS

A. Air Vehicles (Avionics)
B. Space
C. C4I
D. Electronic Devices
E. Environmental Sciences
F. Environmental Quality
G. Advanced Materials

R

A. AIR VEHICLES
A1. FIXED-WING AVIONICS R

3.0 Mission. The fixed-wing avionics work at NRL includes efforts in EW systems, EO/IR systems, and Cooperative Aircraft Identification (CAI). This research is conducted in three NRL divisions: the Tactical EW Division, the Optical Sciences Division, and the Radar Division. The research in these three warfare areas span a broad spectrum of research into the science, technologies, and system concepts that will enable the Navy to best meet its military requirements. The avionic activities at NRL draw upon the full spectrum of S&T areas within NRL, the Navy, the Department of Defense, and our international allies to develop new systems and to devise technologies that meet emerging needs of the Navy, and that better enable it to fulfill its designated role in DoD. R

The EW research includes a wide range of effort addressing EW needs for both Naval ships and aircraft and for their missions in the area of electronic support measures and countermeasures, as well as in critical supporting technologies for electronic warfare. Although principally focused on EW research for ships, as part of the full spectrum Corporate Laboratory for the Navy, the NRL EW program includes a significant fraction that focuses on the needs unique to carrier aviation, and on other aircraft platforms that support the overall Navy mission. The NRL EW program is executed by a group of nearly 300 scientists, engineers, and technical support personnel who each specialize in one or more of the science and technology areas that are critical to EW for the Navy. In general, each of these personnel performs research that supports both ship and aircraft needs within their individual areas of expertise as the needs arise. The EW program is supported by an extensive set of modern research tools and facilities which are highly specialized to EW technology research needs, and are used to support both the larger ships related portion of the research program as well as the smaller part devoted to avionics for EW. In general, these specialized facilities are Navy specific in design and focus on the S&T needs for EW in support of the unique needs of the Navy.

The research in optical science includes a wide range of effort which include the application of EO/IR sensors to ships, aircraft, and undersea surveillance; application of optical devices to signal processing, delay lines, fiber–optic gyros, strain sensors, fiber–optic hydrophones, fiber–optic magnetic sensors, imaging systems, and basic research in optical materials, optical propagation studies, IR signature studies, and laser research. Specifically, the fixed-wing avionics program includes work in: R

- IR focal plane design
- IR missile seeker evaluation
- Surveillance and reconnaissance camera development
- Modelling, detection and tracking algorithm development
- Missile threat warning receiver (both IR and UV) design and development
- In–house radiation hardened fiber fabrication
- Ultra high bandwidth fiber delay lines for EW decoys
- File networking for avionic data communications
- Smart structure development using embedded fiber sensors

The work in this area is complemented by work in other NRL divisions such as Materials, Chemistry, Electronics, etc. The NRL optical sciences program is supported by a group of nearly 140 scientists, engineers, and technical support personnel who each specialize in one or more of the science and technology areas which comprise the optical sciences effort. Of this complement less than 12% of the personnel support the fixed-wing avionics portion of the work. The optical sciences program is supported by a number of modern research tools and facilities, a portion of which are used in the avionics program. In general, these specialized facilities are Navy-specific in design and focus on unique Navy applications. R

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NRL has been the acknowledged technical leader among the four Services in the field of Cooperative Aircraft Identification (CAI), formerly called Identification Friend or Foe (IFF). Its work in this area affects all four Services as well as the NATO allies. In terms of work years and funding, it is a small part of the total effort in the Radar division, but its importance is far greater than the dollar amount of funding indicates.

3.1 Location

3.1.1 Geographic/Climatological Features. The Chesapeake Bay Detachment (CBD) of the NRL provides a geographically unique facility (East Coast location) that is particularly well suited for research needs in support of Naval warfare areas. The site, on a cliff overlooking the Bay, provides a nine mile overwater path to the NRL site on Tilghman Island. The approximately 100 foot cliff height closely represents the height of ship sensors above the ocean, and the path to Tilghman Island approaches the surface horizon for these sensors. This geometry is exactly that seen in attacks on US ships by enemy missiles, and in attacks on enemy ships by low flying US aircraft and sea skimming missiles. Such a geometry must be achieved if successful experiments are to be conducted in support of the NRL warfare systems research program.

3.1.2 Licenses & Permits. Ordnance handling, transportation, and storage at CBD.

3.1.3 Environmental Constraints. None known other than those associated with the handling of explosives at the CBD site.

3.1.4 Special Support Infrastructure. None

3.1.5. Proximity to Mission–Related organizations. The two principal organizations on which the fixed-wing avionics research is most dependent upon are the Naval Air Warfare Center (NAWC) facilities at Patuxent River (PAX), MD and at the Naval Surface Warfare Center facilities at Wallops Island, VA. These facilities support the NRL EW effort by providing test ranges and radars at Wallops Island and a large aircraft test anechoic chamber at Patuxent River which is unique to the Navy. R

Common Support Functions	Name	Type of Organization	Distance	Workyears Performed by Your Activity	Workyears Funded by Your Activity
FIXED-WING AVIONICS	PAX	TEST CENTER	60 MI	7.0	0.5
FIXED-WING AVIONICS	WALLOPS	TEST RANGE	150 MI	1.0	0.5

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3.2 Personnel

3.2.1 Total Personnel. Only government and on–site system engineering technical assistance (SETA) personnel support the avionics CSF. There are no military or FFRDC personnel supporting the program. The count below gives the number of persons, not the number of work years.

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Types of Personnel	Number of Personnel			
	Government		On-Site FFRDC	On-Site SETA
	Civilian	Military		
Technical	57	0	0	33
Management (Supv)	10	0	0	0
Other	0	0	0	0

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3.2.2 Education. The number of government personnel actively engaged in S&T, engineering development and in-service engineering activities by highest degree and type of position is provided in the following table (note that one Certified Professional Engineer is included in the Bachelor category).

Type of Degree/ Diploma	Number of Government Personnel by Type of Position		
	Technical	Management (Supv)	Other
High School or Less	6	0	0
Associates	1	0	0
Bachelor	22	4	0
Masters	15	0	0
Doctorate (include Med/Vet/etc.)	13	6	0

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3.2.3 Experience. The experience level of government personnel is provided in the following table.

Type of Position	Years of Government and/or Military Service				
	Less than 3 years	3-10 years	11-15 years	16-20 years	More than 20 years
Technical	4	22	10	1	20
Management (Supv)	0	0	2	1	7
Total	4	22	12	2	27

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3.2.4 Accomplishments During FY91-93.

3.2.4.1 The number and listing of patent awards in the fixed-wing avionics area for FY91-93 are: R

CSF	Disclosures	Awarded	Patent Titles (List)
FIXED-WING AVIONICS	6	2	List Follows
Total	6	2	

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Note that this list does not include those classified patents which have been assigned but not published or awarded due to classification.

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FIXED-WING AVIONICS PATENTS AWARDED: R

1. Interferometer With Two Phase Conjugate Mirrors, #5,120,133
2. Room Temperature Flashpumped 2.09 Micron Solid State Laser, #5,088,103

FIXED-WING AVIONICS PATENT DISCLOSURES: R

1. Apparatus for Two Dimensional Images, #73,939
2. Combined Range Delay, #75,638
3. CW Mode–Locked 2 Micron Tm:YAG Laser, #73,829
4. Intracavity Pumped Tm:Ho 2.01 Micron Coupled Cavity Laser, #74,075
5. Subpicosecond Pulse Operation of a 2 Micron Tm:YAG Laser using Additive Pulse Modelocking, #74,203
6. Reduced Signal Friend Identification, #74,336

3.2.4.2 The number of papers published in peer reviewed journals in the years FY91–93 is provided in the table below. It should be noted that many of the NRL fixed-wing avionics research results are classified and cannot be published in the usual peer reviewed journals. Only the Journal of Defense Research (recently defunct) sponsored by DoD was available as a classified peer reviewed journal. Also many avionics research results are published in the form of classified DoD documents. R

CSF	Number Published	Paper Titles (List)
FIXED-WING AVIONICS	11	List Follows

FIXED-WING AVIONICS PUBLICATIONS: R

1. "Ship Wake Exploitation for Cruise Missile Guidance", Journal of Defense Research, Nov. 1991, Vol. 21, No. 1, pp.1–34.
2. "Over–the–Horizon Radar ECM", Journal of Defense Research, Sep. 1992, Vol. 21, No. 4, pp.921–986.
3. "Tactical Proforma Exploitation", Journal of Defense Research, June 1992, Vol. 21, No. 3, pp.715–739.
4. "Transmission Line Amplifier", IEEE Transactions on Electron Devices, Sept. 1992, Vol. 39, No. 9, pp.2165–2171.
5. "Diode Pumped Amplifier/Laser using Leaky–Wave Fiber Coupling: An Evaluation", IEEE J. Quantum Mechanics, Apr. 1992, Vol. 28, No. 4.
6. "Image Speckle Contrast Reduction from Integrative Synthetic Aperture Imaging", Applied Optics, Jan. 1992, Vol. 31, No. 1.
7. "Effects on Nonredundance on a Synthetic Aperture Imaging System", Journal of the Optical Society of America, April 1993, Vol. 10, No.4. R
8. "Short Wavelength Imaging Laser Radar using a Digicon Detector",* SPIE Optical Engineering, Nov. 1992, Vol. 31, No. 11.
9. "Infrared Focal Plane Array Technology", Proceedings IEEE, Jan 1991, Vol. 79, No. 1.
10. "Even Length Median Filters in Optimal Signal Processing", Elect. Letters, June 1992, Vol. 28, No. 13.

R

FIXED-WING AVIONICS PATENTS AWARDED: R

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1. Apparatus for Two Dimensional Images, #73,939
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3. CW Mode–Locked 2 Micron Tm:YAG Laser, #73,829
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5. Subpicosecond Pulse Operation of a 2 Micron Tm:YAG Laser using Additive Pulse Modelocking, #74,203
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3.2.4.2 The number of papers published in peer reviewed journals in the years FY91–93 is provided in the table below. It should be noted that many of the NRL fixed-wing avionics research results are classified and cannot be published in the usual peer reviewed journals. Only the Journal of Defense Research (recently defunct) sponsored by DoD was available as a classified peer reviewed journal. Also many avionics research results are published in the form of classified DoD documents. R

CSF	Number Published	Paper Titles (List)
FIXED-WING AVIONICS	25	List Follows

R

FIXED-WING AVIONICS PUBLICATIONS: R

1. "A Toolset for Navigation in Virtual Environments", * Proceedings of the ACM Symposium on User Interface Software & Technology, Nov. 1993, pp. 157–165.
2. "Hands–off Interactions with Menus in Virtual Spaces", * Proceedings of the 7th Annual Workshop on Space Operations Applications & Research, Feb. 1994.
3. "Ship Wake Exploitation for Cruise Missile Guidance", Journal of Defense Research, Nov. 1991, Vol. 21, No. 1, pp.1–34.
4. "Over–the–Horizon Radar ECM", Journal of Defense Research, Sep. 1992, Vol. 21, No. 4, pp.921–986.
5. "Tactical Proforma Exploitation", Journal of Defense Research, June 1992, Vol. 21, No. 3, pp.715–739.
6. "Transmission Line Amplifier", IEEE Transactions on Electron Devices, Sept. 1992, Vol. 39, No. 9, pp.2165–2171.
7. "Diode Pumped Amplifier/Laser using Leaky–Wave Fiber Coupling: An Evaluation", IEEE J. Quantum Mechanics, Apr. 1992, Vol. 28, No. 4.
8. "Image Speckle Contrast Reduction from Integrative Synthetic Aperture Imaging", Applied Optics, Jan. 1992, Vol. 31, No. 1.
9. "Effects on Nonredundance on a Synthetic Aperture Imaging System", Journal of the Optical Society of America, 1993.
10. "Laser Ranging Countermeasure Program Acceptance Test",* Proceedings of IRIS IRCM, 1992. R
11. "Short Wavelength Imaging Laser Radar using a Digicon Detector",* SPIE Optical Engineering, Nov. 1992, Vol. 31, No. 11.
12. "Infrared Focal Plane Array Technology", Proceedings IEEE, Jan 1991, Vol. 79, No. 1.
13. "Even Length Median Filters in Optimal Signal Processing", Elect. Letters, June 1992, Vol. 28, No. 13.

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11. "Intracavity–pumped 2.09 Micron Ho:YAG Laser", Optics Letters, May 1992, Vol. 17, No. 10. R

3.3 Workload

3.3.1 FY93 Workload

3.3.1.1 Work Year and Lifecycle. The number of actual workyears executed for the fixed-wing avionics CSF in FY93 is provided by the table below for each of the following: government civilian; military; on–site FFRDCs; and on–site SETAs. R

"LAB"	Fiscal Year 1993 Actual			
	Civilian	Military	FFRDC	SETA
Science & Technology	37.21	0	0	16.05
Engineering Development	27.90	0	0	15.7
In–Service Engineering	0	0	0	0

R

14. "Intracavity–pumped 2.09 Micron Ho:YAG Laser", Optics Letters, May 1992, Vol. 17, No. 10.
15. "Adaptive Nonuniformity Correction for Staring IRFPA Camera",* Proceedings IRIS Detectors, Aug. 1993.
16. "Composite Infrared Color Images and Related Processing", * Proceedings IRIS Targets, Jan. 1993.
17. "Effects of System Stability and Detector 1/f Noise on Staring IRFPA Performance",* Proceedings IRIS Sensors, Mar. 1993.
18. "Adaptive Retina–like Preprocessing for Imaging Detector Arrays",* Proceedings IEEE Conf. on Neural Networks, Mar. 1993.
19. "Performance of Real–time Adaptive Nonuniformity Correction Techniques for Arrays",* Proceedings IRIS Sensors, Mar. 1993.
20. "Effects of Low Power IR Laser Countermeasures on Several IR Focal Plane Arrays",* Proceeding IRIS IRCM, Apr. 1993.
21. "Protection of Civil and Military Aircraft from Heat Seeking Missiles",* Proceedings ADPA Symposium on Transport Aircraft Survivability, Oct. 1993. R
22. "Automatic Classification of Threat Missiles",* Proceeding IRIS IRCM, Apr. 1993.
23. "Measurement and Analysis of Optical Scatter in FLIR's",* Proceedings IRIS IRCM, Apr. 1993.
24. "Multispectral IRFPA Needs",* Proceedings IRIS Detector, Aug. 1993.
25. "Theory and Design of Local Interpolators",* CVGIP Graphical Methods and Image Processing, 1993, Vol. 55, No. 6.

*Peer–Reviewed Conference Proceedings

3.3 Workload

3.3.1 FY93 Workload

3.3.1.1 Work Year and Lifecycle. The number of actual workyears executed for the fixed-wing avionics CSF in FY93 is provided by the table below for each of the following: government civilian; military; on–site FFRDCs; and on–site SETAs. R

"LAB"	Fiscal Year 1993 Actual			
	Civilian	Military	FFRDC	SETA
Science & Technology	37.21	0	0	16.05
Engineering Development	27.90	0	0	15.7
In–Service Engineering	0	0	0	0

R

3.3.1.2 Engineering Development By ACAT. For the fixed-wing avionics CSF programs conducted under engineering development, the following table provides a summary of the efforts and identifies the specific engineering development programs that are supported. R

Engineering Development	Name or Number	Workyears(FY93 Actual)	FY93 Funds Received($ K) (Obligation Authority)	Narrative
ACAT IC	None			
ACAT ID	Combat ID/ Cooperative Aircraft ID	3.6	600	New CAI system to correct the deficiencies in the current Mark XII IFF
ACAT II	None			
ACAT III/IV	3	19.4	3914	Navy EA–6B EW AN/ALE–50 Decoy SLQ–20 Upgrade
Other	6	20.60	6791	Airborne RF Decoys RF Labs/INEWS E2C Emitter ATEWES STORYFINDER Gusty Beast (Classified Program)

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3.3.1.3 In–Service Engineering. None R

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3.3.1.2 Engineering Development By ACAT. For the fixed-wing avionics CSF programs conducted under engineering development, the following table provides a summary of the efforts and identifies the specific engineering development programs that are supported. R

Engineering Development	Name or Number	Workyears(FY93 Actual)	FY93 Funds Received($ K) (Obligation Authority)	Narrative
ACAT IC	None			
ACAT ID	CAI	3.6	600	New CAI system to correct the deficiencies in the current Mark XII IFF
ACAT II	None			
ACAT III/IV	3	19.4	3914	Navy EA–6B EW AN/ALE–50 Decoy SLQ–20 Upgrade
Other	6	20.60	6791	Airborne RF Decoys RF Labs/INEWS E2C Emitter ATEWES STORYFINDER Gusty Beast (Classified Program)

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3.3.1.3 In–Service Engineering. None R

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3.3.2 Projected Funding

3.3.2.1 Direct Funding. The NRL fixed-wing avionics program receives no direct funding, consequently all entries in the table below are zero. R

CSF	FY94($K)	FY95($K)	FY96($K)	FY97($K)
FIXED-WING AVIONICS	0	0	0	0

3.3.2.2 Other Obligation Authority. Reimbursable and direct–cite funding (other obligation authority expected) from FY94 to FY97 is provided below:

CSF	FY94($K)	FY95($K)	FY96($K)	FY97($K)
Reimbursable	17,328	18,833	19,850	20,550
Direct–Cite	6,441	7,150	7,870	8,100

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3.4 Facilities and Equipment

3.4.1 Major Equipment and Facilities. The major facilities and equipment necessary to support the fixed-wing avionics CSF are listed in the following table, and are described more fully in the text that follows the table. Where the facilities are shared with other functions, the percentage of total time used by the avionics function is shown in parentheses following each table entry. The remaining percentages are used to support Navy specific activities. R

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Common Support Function	Major Facility or Equipment Description	Unique To DOD	Federal Gov't	U. S.	Replacement Cost ($K)
AVIONICS FIXED-WING	Ships Radar ECM Simulator(30%)*	X	X	X	3,500
AVIONICS FIXED-WING	RCS Measurement Facility(50%)*	X	X	X	15,000
AVIONICS FIXED-WING	Compact Antenna Range(60%)*				2,600
AVIONICS FIXED-WING	Isolation Meas. Chamber(70%) *	X			3,000
AVIONICS FIXED-WING	Millimeter Wave Chamber(50%)*				2,000
AVIONICS FIXED-WING	RF Techniques Chamber(80%)*				1,500
AVIONICS FIXED-WING	High Precision Optical Tracker (50%)***				1,200
AVIONICS FIXED-WING	Focal Plane Array Evaluation Facility(50%)**	X			2,000
AVIONICS FIXED-WING	Missile Warning System Facility(50%)***	X			2,000
AVIONICS FIXED-WING	Digital Signal Proc. Facility(75%)**	X			650

* The remaining percentage of utilization for these facilities supports Shipboard EW Systems.

** The remaining percentage of utilization for these facilities supports the Electronic Devices Function.

*** The remaining percentage of utilization for these facilities supports the Rotary-Wing Avionics CSF. R

More detailed information on each of the special facilities identified above is provided in the following descriptions and photographs.

SEARCH RADAR ECM SIMULATOR(SRES)

SRES is an electronic laboratory designed to test ECM equipment by simulating the engagement between an airborne threat search radar and a group of surface ships and aircraft that use ECM as part of their defense. The method of simulation is real–time generation of the RF signals that would be present in the threat radar receiver from the radar echoes and the ECM. These signals are processed by the radar receivers and displayed on radar displays for man–in–the–loop determination of the ECM effects. An effective ECM would prevent the radar operator from determining the preferred target's location.

The combination of specific equipment, software and capabilities associated with and developed for the SRES laboratory are unique to this facility.

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RADAR CROSS-SECTION MEASUREMENTS LABORATORY (CHESAPEAKE BAY DETACHMENT)

This facility is a land based installation designed to accurately characterize and quantify the over the water radar cross–section (RCS) signature of ships, aircraft and electronic warfare passive and active systems used to defend these platforms. The system is capable of collecting precision data in 2 to 18 Ghz, and 35 Ghz bands. Additionally, the system can characterize and quantify the Effective Radiated Power (ERP) and sensitivity of active electronic warfare systems over the same frequency range. This facility includes conventional single frequency radars as well as broad–band frequency agile units. Both coherent and noncoherent radars can be used. A 95 Ghz radar is being installed.

This is a one of a kind facility. It is the only facility which routinely conducts the necessary measurements critical to the design and development of R&D decoy and onboard ECM systems.

COMPACT ANTENNA RANGE FACILITY

The primary purpose of the Compact Antenna Range Facility is to provide a unique state–of–the–art anechoic chamber to measure the phase and amplitude of antenna systems over a frequency range of 2 to 100 Ghz in a controlled environment in support of NRL research in EW. The facility also provides the capability for radar cross–section measurements from 2 to 40 Ghz, and small device metrology from 0.45 to 50 Ghz.

The facility has been specially EMI/RFI hardened using massive hydraulically actuated doors. A special hydraulic elevator was installed to move equipment in and out of the chamber. The chamber also has a state–of–the–art microwave lining designed to provide a 4 foot diameter by 6 foot length quiet zone area with greater than 50 dB below incident reflectivity reduction. The chamber also has an automatic fire suppression system designed to prevent damage to electrical systems under test. The facility and equipment are controlled in temperature and humidity to prevent large fluctuations in the microwave absorber and parabolic reflector characteristics.

ISOLATION MEASUREMENT CHAMBER FACILITY

The Isolation Measurement Chamber Facility provides a capability for measuring antenna to antenna radiation coupling characteristics from 2 to 40 Ghz in support of EW research. Configuration and size of the facility and special handling equipment allow for unique accommodation of portions of airframes having antennas mounted in the same position as those of operational aircraft. This feature accounts for the DoD uniqueness.The facility is also capable for making accurate measurements of the RCS of small objects. The facility has been specially EMI/RFI hardened using massive hydraulically actuated doors. In addition, the facility was provided with special handling fixtures to allow removal of a 12 ft. by 15 ft. panel to accommodate the installation of parts of ship structures, aircraft fuselages, wings, etc. for testing. The chamber has a state–of–the–art microwave absorber lining designed to provide a large quiet zone area of 12 ft. by 18 ft. by 10 ft. with a greater than 100dB below incident reflectivity reduction. The chamber has an automatic sensing fire suppression system designed to prevent damage to electrical systems under test. The facility/equipment are controlled in temperature and humidity to prevent large fluctuations in the microwave absorber characteristics.

MILLIMETER WAVE ANECHOIC CHAMBER FACILITY

The primary function of the state–of–the–art Millimeter Anechoic Chamber Facility is to measure and characterize antenna gain, beamwidth, axial roll, beam squint, phase center, VSWR and cross–polarization levels at low power continuously over the frequency range from 8 to 100 Ghz. The facility also provides a means to measure the radio frequency transmission and insertion loss of radomes intended for use in shipboard, aircraft, satellite and missile seekers. The facility consists of a fixed anechoic chamber with a carefully calibrated quiet zone area, while an extremely small portion of the control hardware is moveable, most of the hardware is permanently installed.

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The facility has been specially EMI/RFI hardened using massive hydraulically actuated doors. A special hydraulic elevator was installed to move equipment in and out of the anechoic chamber. The chamber has a state–of–the–art microwave absorber lining designed to provide a 3 ft. diameter quiet zone area with greater than 50 dB incident reflectivity reduction. The chamber has an automatic sensing fire suppression system designed to prevent damage to electrical systems under test.

RF TECHNIQUES CHAMBER FACILITY

The primary purpose of the RF Techniques Chamber Facility is to provide a low cost anechoic chamber capability to conduct ECM research on RF homing missiles, airborne intercept radars, antiradiation missiles, small tracking radars and in general to aid in the development of airborne EW systems over the frequency range of 2 to 4 Ghz. The facility has been specially EMI/RFI hardened using massive hydraulically actuated doors. In addition, one side wall of the chamber can be moved electrically to increase the length of the chamber. The chamber has a state–of–the–art microwave absorber lining designed to provide a 4 ft. by 4 ft. spherical quiet zone area with greater than 50 dB below incident reflectivity reduction. The chamber has an automatic sensing fire suppression system designed to prevent damage to electrical systems under test. This facility and equipment are controlled in temperature and humidity to prevent large fluctuations in microwave absorber characteristics.

HIGH PRECISION OPTICAL TRACKER

This facility measures optical and IR signatures of targets in motion and the propagation of light through the atmosphere. It consists of two 40 ft. long by 7 ft. wide electronic trailers. One has a 32" diameter optical tracker mounted on the back. Built originally to do absolute transmittance measurements between ships, the tracker now has the capability of tracking noncooperative targets for signature studies. With a 6 microradian tracking accuracy capability, tracking choices are trackball, video image tracking by contrast or correlation, or computer drive. Newtonian optics direct gathered radiation to either IR imaging sensors or to an IR scanning spectrometer. The second trailer provides the calibration capability of the facility. A 36" mirror with four blackbody sources with associated computer programs and control provide a known value of radiation arriving at the tracker telescope aperture. To complete the calibration suite is equipment to measure and record meteorological parameters such as air temperature, dew point and visibility.

FOCAL PLANE ARRAY EVALUATION FACILITY

In this facility, the optical and electrical evaluation of developmental IR focal plane arrays is conducted to determine the development status, to provide guidelines for future development contracts, and to evaluate the potential for fulfilling Navy sensor requirements. The automated evaluation facility consists of optical sources and electronics required to evaluate monolithic or hybrid IR focal plane arrays that use charge coupled device (CCD), charge injected device (CID), direct readout (DRO), or charge imaging matrix (CIM) technologies. Since developmental arrays are often received in chip form, there are a variety of dewars and mounts to accept different chip carriers. Optical sources are used to illuminate the detectors with short pulse or continuous radiation in both uniform and single detector modes. Calibrated laser sources are used to study array performance under optical overload conditions. The data are acquired and reduced by using computer techniques because each array may consist of tens of thousands of detectors, and many samples of each detector are required for statistical significance. The spectral response of the arrays is determined by using optical filters or spectrometers.

The combination of the high data rate acquisition with real time imaging capability makes this facility unique within the Defense Department.

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MISSILE WARNING SYSTEM FACILITY

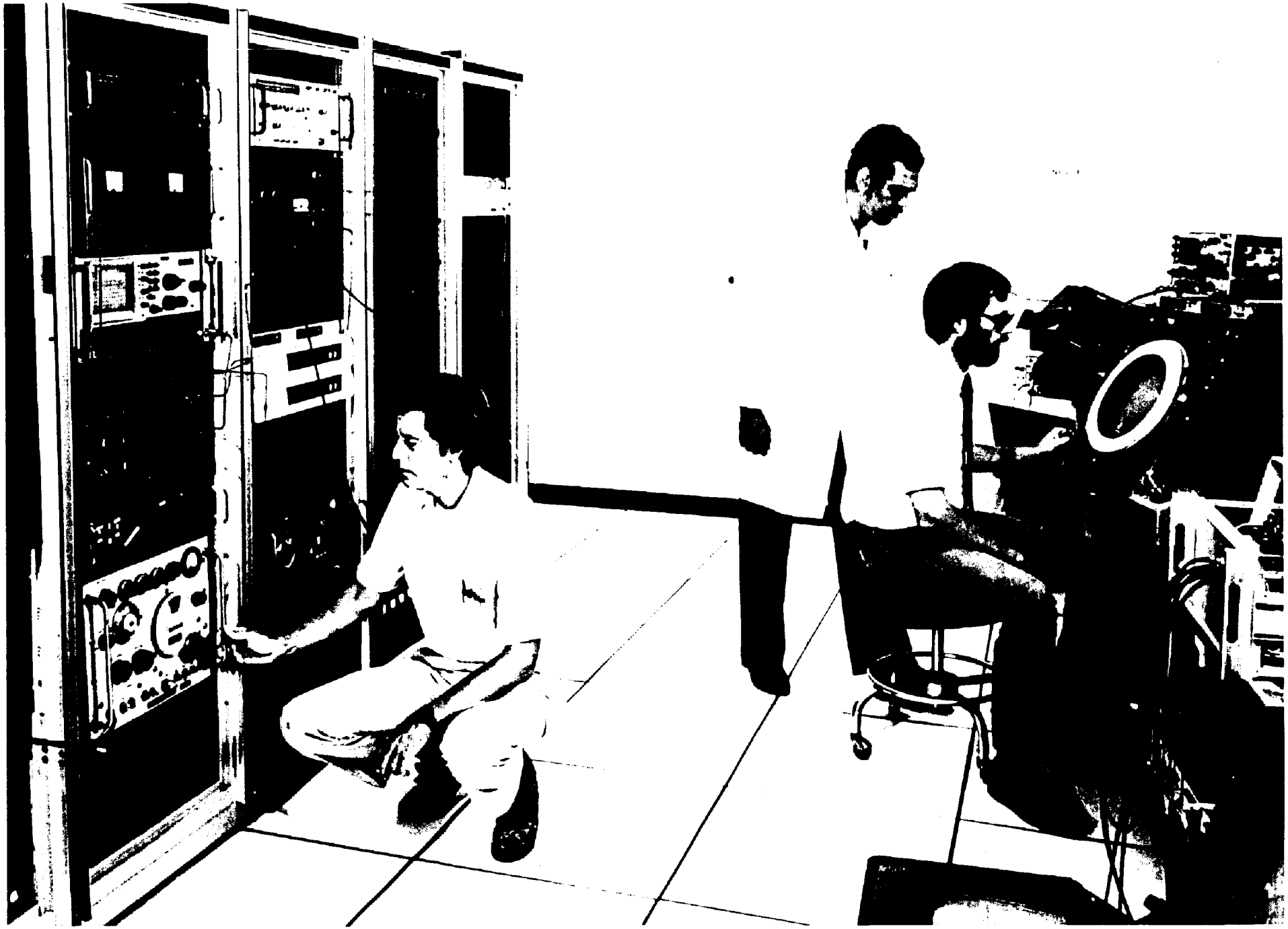
This facility is used for the development and demonstration of sensors and algorithms for missile warning systems and data collection in support of sensor and algorithm development. A missile warning sensor for aircraft requires a system capable of detecting the threat missile at sufficient range to implement effective countermeasures while requiring nonthreat missiles and background or clutter features which mimic the characteristics of threat missiles. The development of such systems requires a body of data characterizing both the targets and the competing background and clutter and a set of algorithms capable of sorting the features of all sources to provide a high probability of threat missile detection with a low false alarm rate under stressing clutter or battlefield conditions.

The capability of this facility for developing and demonstrating sensors and algorithms in spectral regions from the ultraviolet through the infrared spectral is unique within the Defense Department.

DIGITAL SIGNAL PROCESSING FACILITY

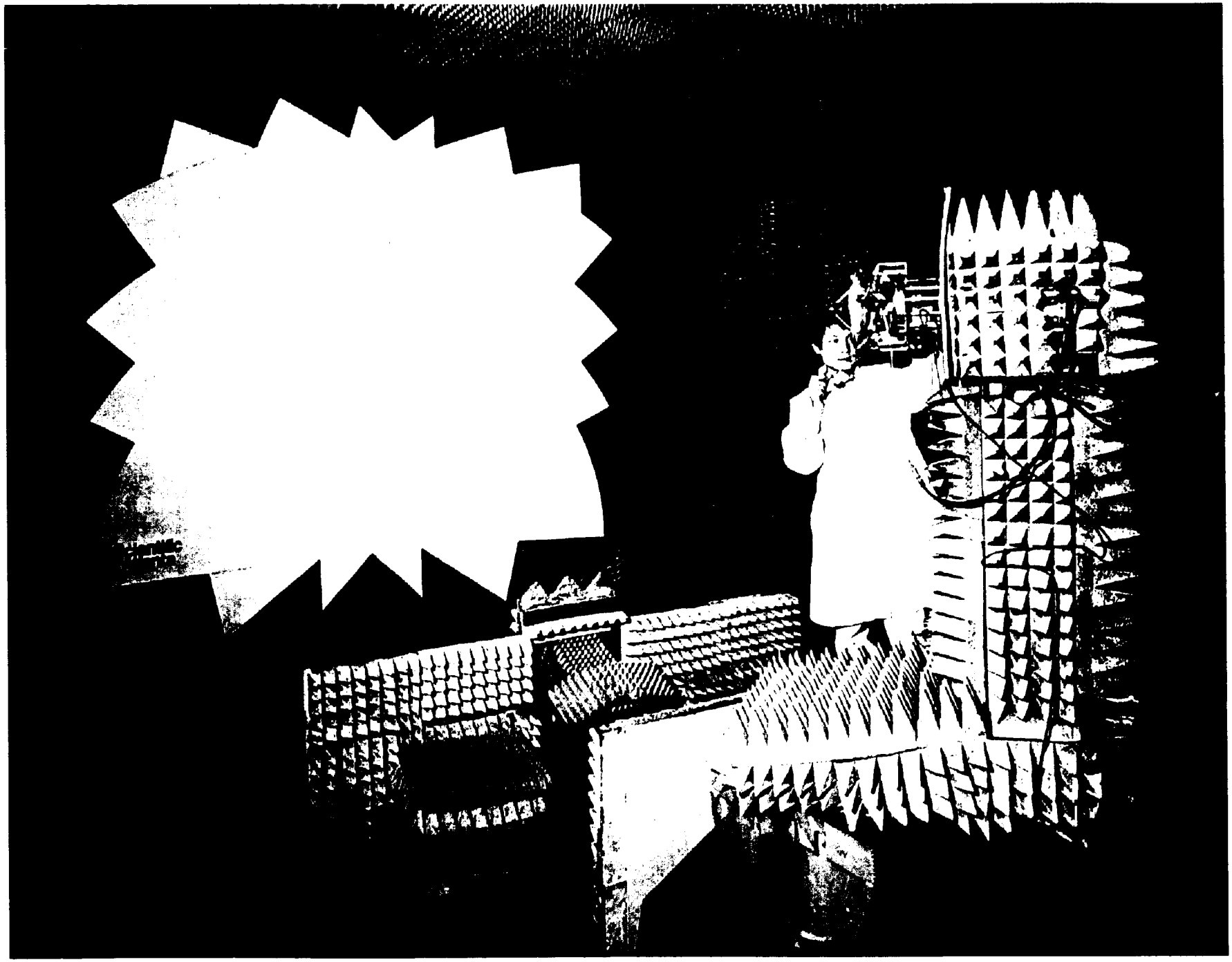
The signal processing facility provides a repository of visible, IR and Multispectral imagery and combines this database with processing tools needed for developing target detection algorithms. The existing database is updated and augmented with imagery from new sensors as it becomes available. The facility allows users to easily compile the necessary metrics for evaluating the images and to manipulate the images for extrapolation to other target/background scenarios. Current target detection algorithms are compared and emerging signal processing methods are tested and refined. Background modeling and sensor tradeoff studies are carried out against appropriate types of backgrounds and target data. The facility also designs and develops custom communications terminals, low–level protocols, and real–time data acquisition and processing systems that operate at speeds of gigabits/sec. This facility operates proof–of–concept adaptations of commercial high speed communications equipment for tactical use, and has demonstrated the importance of selecting international standards based products.

This facility has available a class of spatial, multispectral, and change detection algorithms, unique within the Defense Department, which are applied to actual electro-optic and infrared data from ground and airborne sensors for target discrimination.

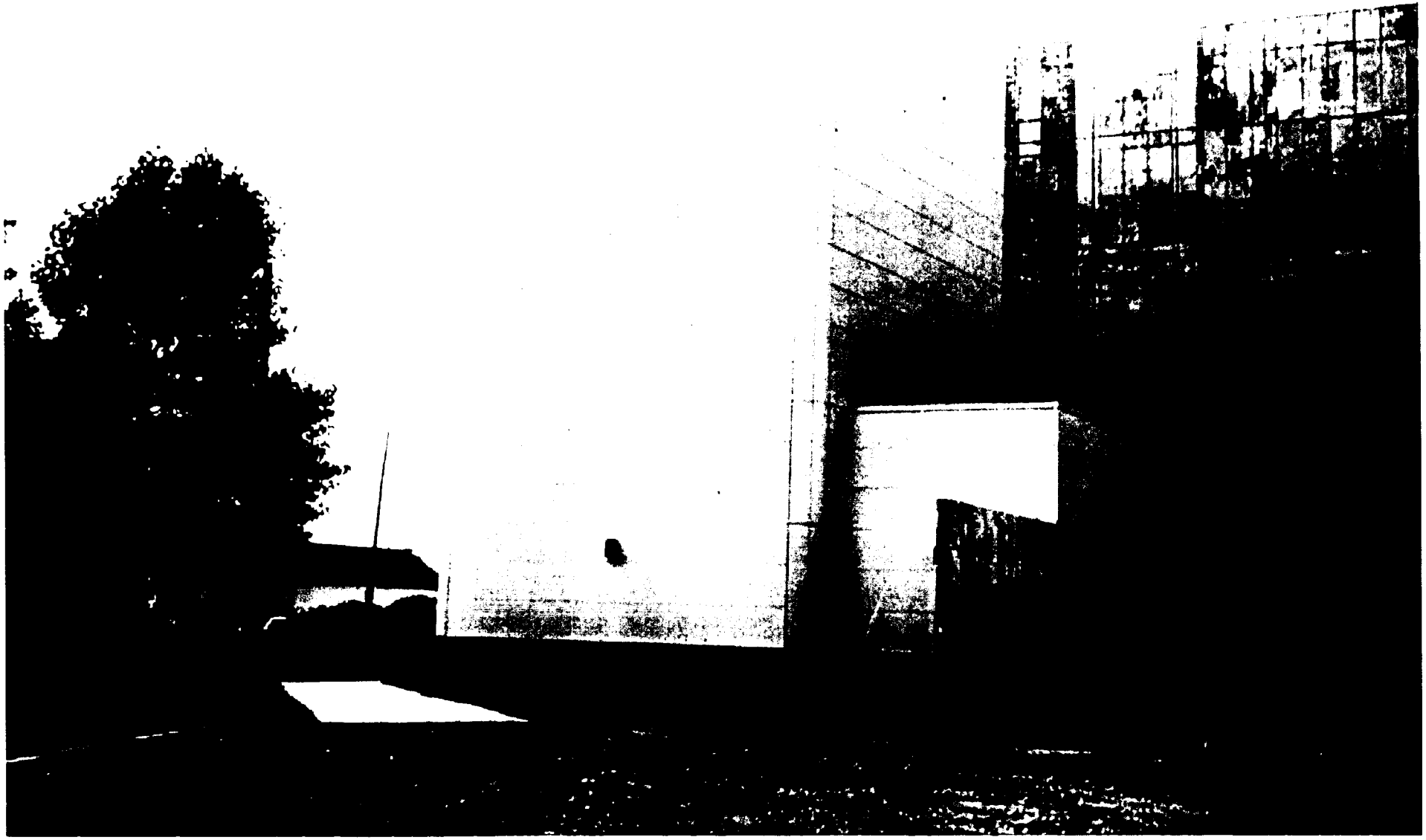


SEARCH RADAR ECM SIMULATOR

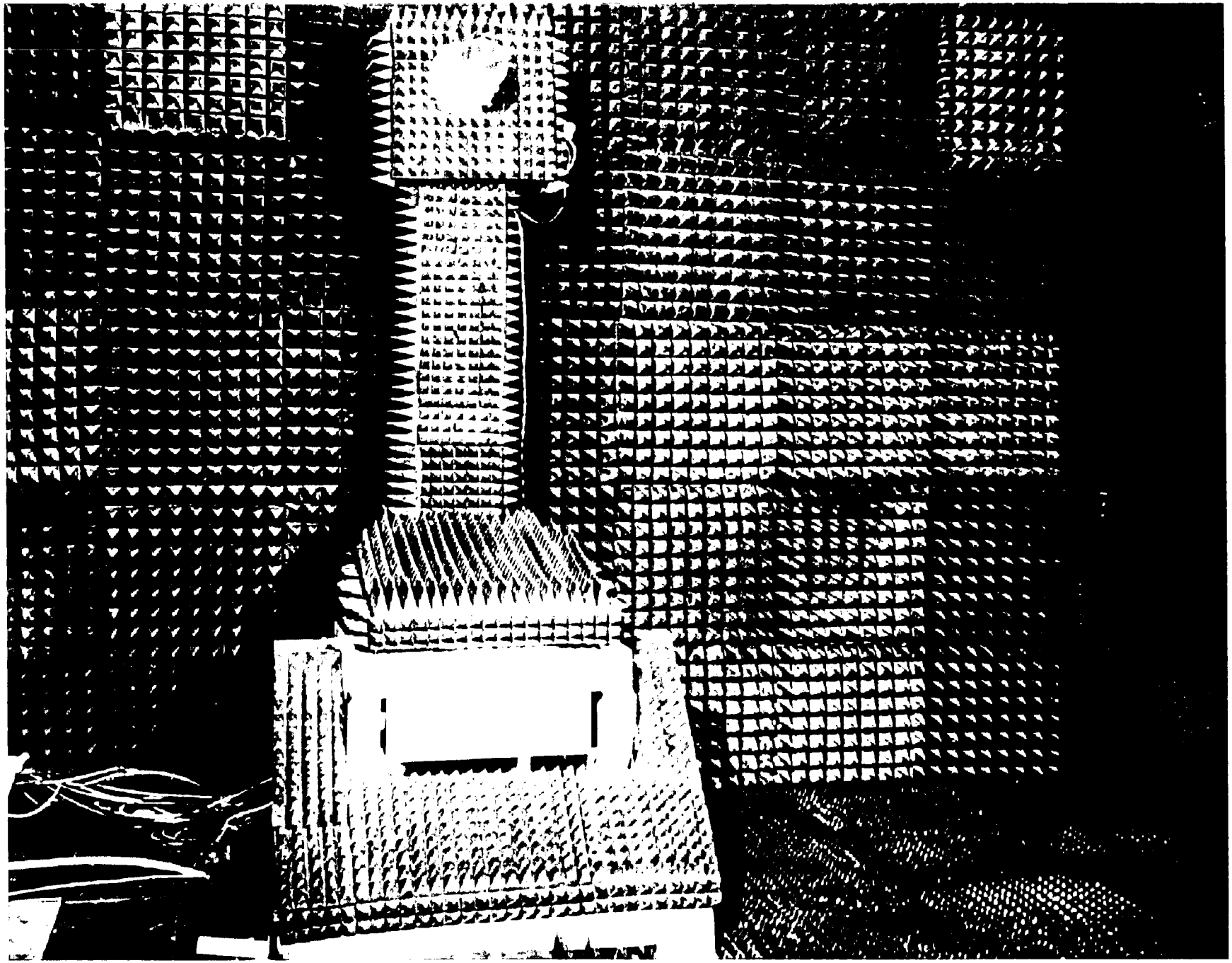
RADAR CROSS SECTION MEASUREMENT LABORATORY



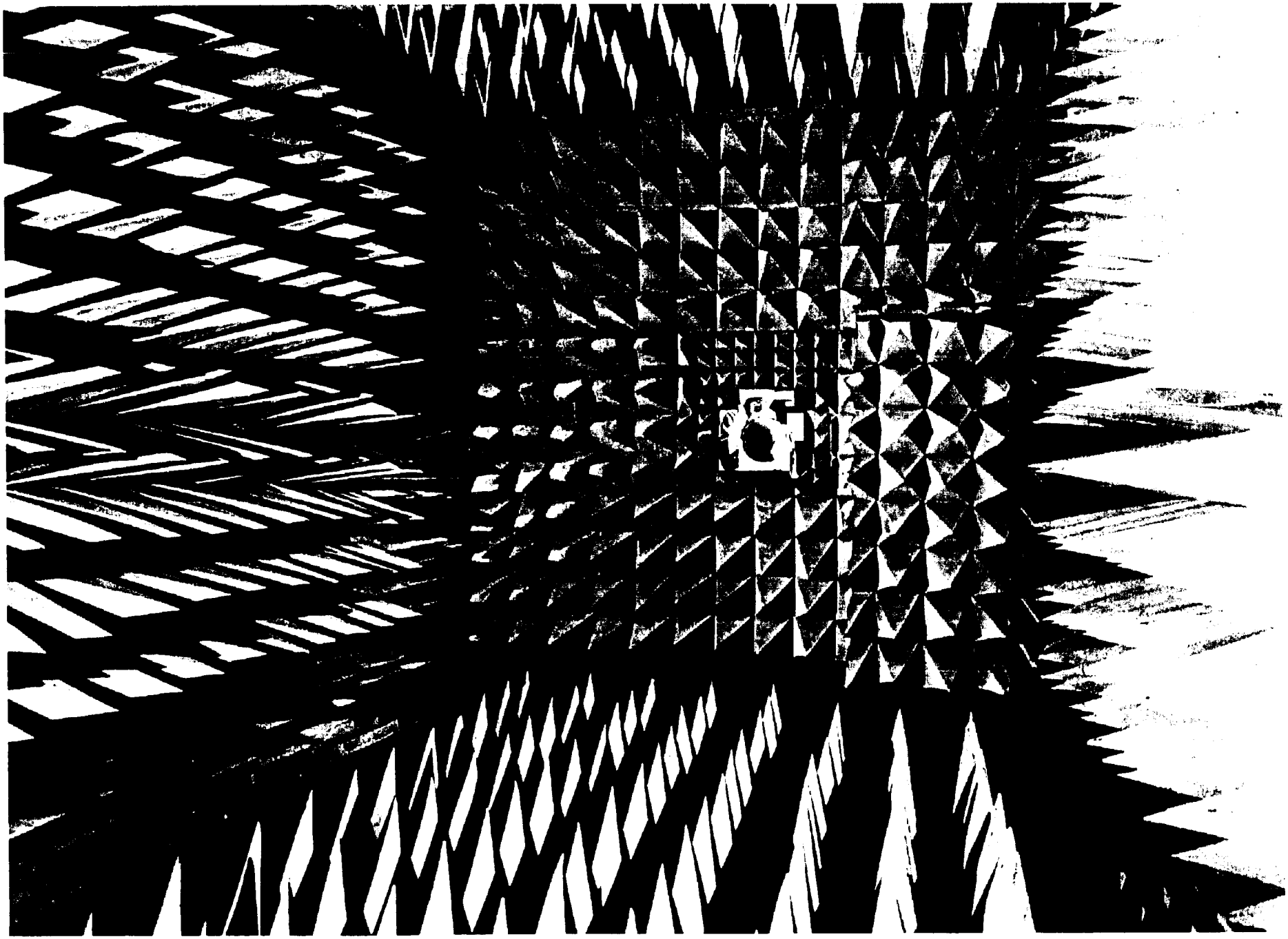
COMPACT ANTENNA RANGE FACILITY



ISOLATION MEASUREMENT CHAMBER

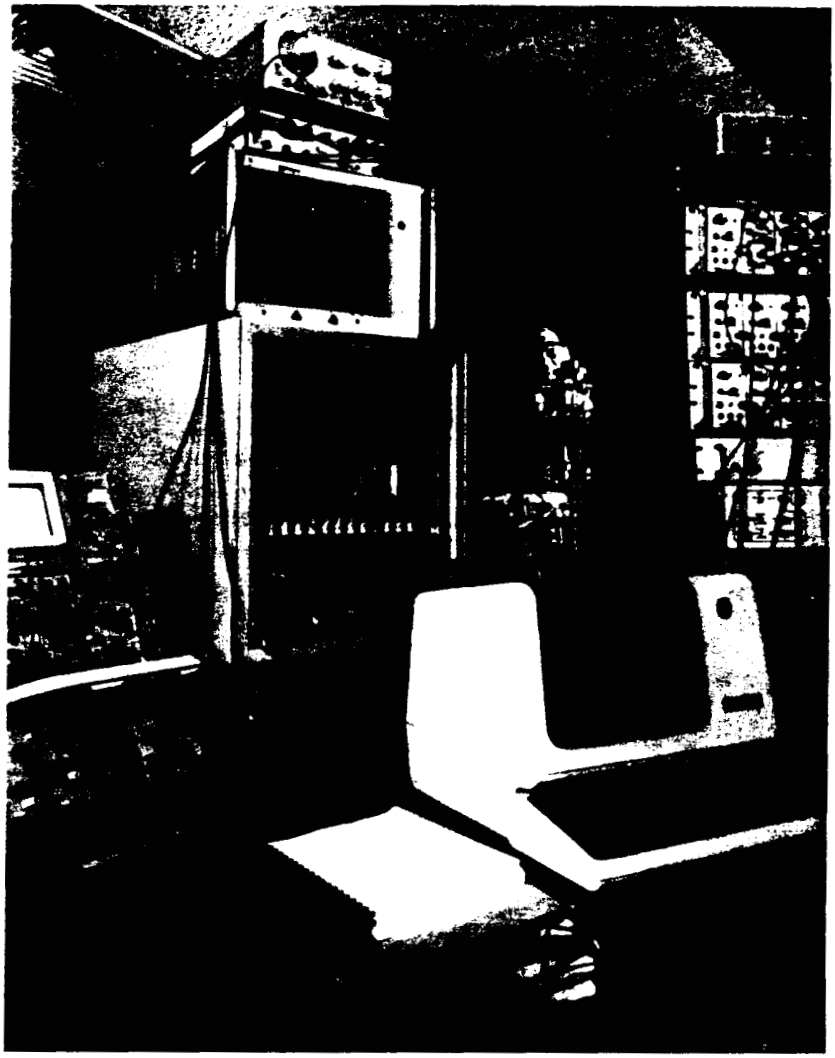


MILLIMETER WAVE ANECHOIC CHAMBER

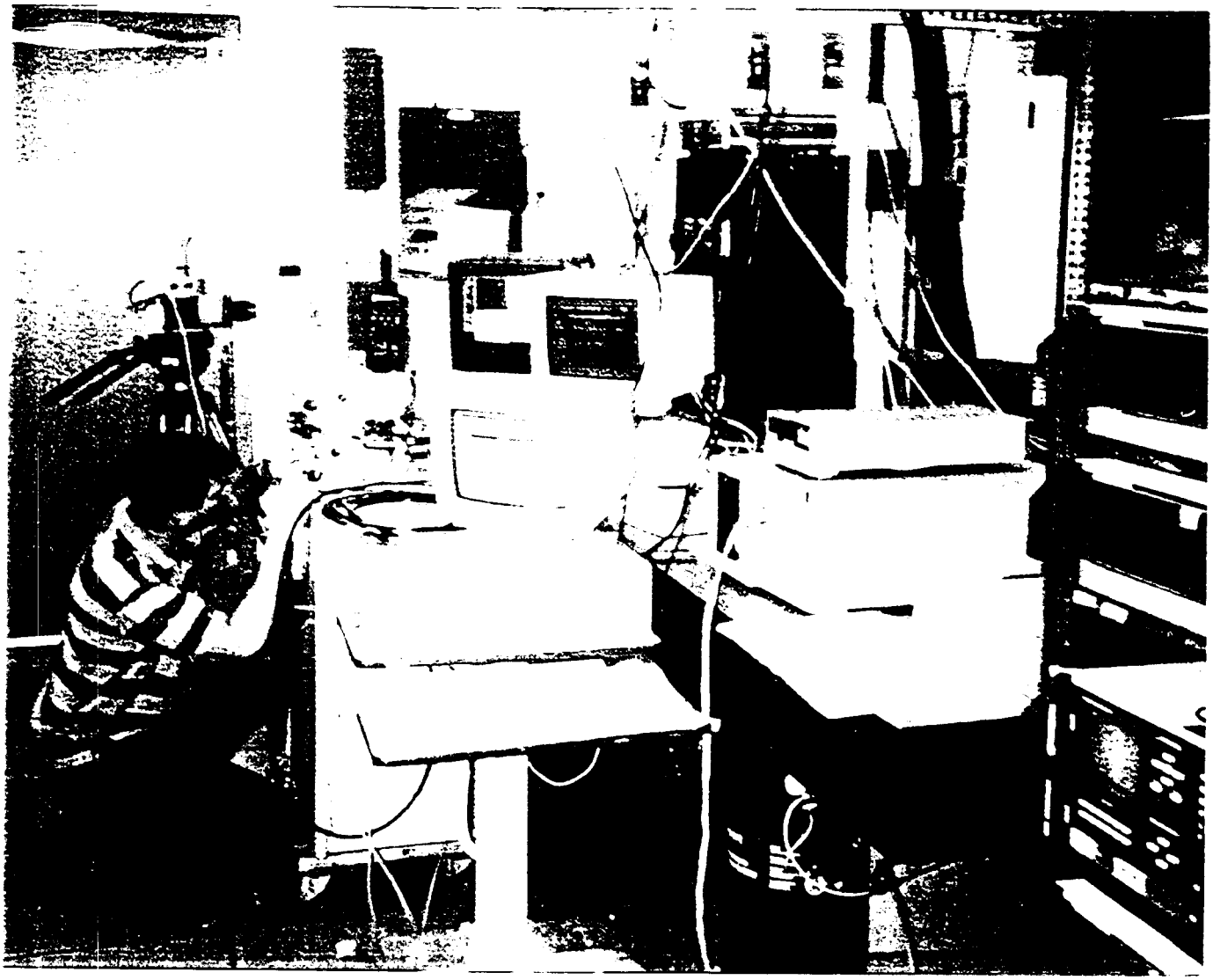


RF TECHNIQUES CHAMBER

REAR PANEL OPENING AND DOUBLE DOORS



FOCAL PLANE ARRAY EVALUATION FACILITY



MISSILE TARGETING SYSTEM FACILITY

DIGITAL SIGNAL PROCESSING FACILITY

R

3.5 Expansion Potential

3.5.1 Laboratory Facilities. Facilities records as of the fourth–quarter FY93 are used in providing the following data (in ksq. ft.) for the fixed-wing avionics CSF. R

			Space Capacity (KSF)		
Common Support Function	Facility or Equipment Description	Type of Space*	Current	Used	Excess
FIXED-WING AVIONICS	Office	Administrative	.719	.719	0
	Office	Technical	15	15	0
	Laboratory	Technical	40.13	40.13	0
	Storage	Storage	1.844	1.844	0

R

* Administrative, Technical, Storage, Utility

Space is centrally managed at NRL. When space becomes excess in a Division the excess space is returned to the NRL space coordinator for reallocation. Hence, in general, the NRL performing Divisions do not have excess space and thus the above tables show no excess space for the avionics CSF.

3.5.1.1 In general, the facilities/labs that support the fixed-wing avionics CSF are readily capable of accepting a modest increase of work as long as the type of work that would be gained is of the same type that is currently being performed. In this case, it is assumed that the physical size of the space, and the equipment and instrumentation available, is of the proper variety for the work. Although much greater increases in the capacity might be obtained, it is expected that this would entail major modifications to existing facilities or the construction of expanded facilities. Significant changes in the nature of the work might also entail a similar degree of modification. R

3.5.1.2 Based on current available space, and using the consideration of similarity of work discussed above, it is believed that the NRL fixed-wing avionics CSF could be increased by as much as 43 workyears per year before major modifications to facilities would be required. This increased workyear effort would have to be largely accommodated by new hires. R

3.5.1.3 For 3.5.1.1 and 3.5.1.2 (above) describe the impact of military construction programs or other alteration projects programmed in the FY95 PBS. (BRAC Criteria II). None

3.5.2 Land Use. NRL has 11.2 acres available for unrestricted expansion located at its Chesapeake Bay Detachment. Parking would have to be included as part of any expansion project. Utilities, while available, are aged and would be required to be upgraded to accommodate any expansion. R

The building space (class 2 property) currently available for growth opportunities at the NRL DC site, either constrained or unconstrained, represents a total of multiple small areas located throughout the Laboratory which cannot be effectively utilized by any other functions other than the primary occupant of the facility. It is important to note, however, that NRL facilities can be re-configured, e.g., demolished and rebuilt, altered, fitted with capital equipment, etc. to accommodate new or expanded mission assignments. However, accurate quantification of the R

R

maximum amount of space available for expansion is not practical without the benefit of revised mission/program planning guidance. For planning purposes, a rough order of magnitude estimate of the minimum class 2 space available for expansion is 10 percent. This would involve minimal reconfiguration.

3.5.3 Utilities. Utility service capacities are depicted in the following table: R

	On Base Capacity	Off Base Long Term Contract	Normal Steady State Load	Peak Demand
Electrical Supply (KWH)	N/A	54,000 KWH	13,098 KWH	17,280 KWH
Natural Gas (CFH)[1]	N/A	2,961 CFH	141 CFH	1,868 CFH
Sewage (GPD)	N/A	Unlimited	847,583 GPD	1,017,100 GPD
Potable Water (GPD)	N/A	9,740,978 GPD	1,118,911 GPD	1,342,693 GPD
Steam (PSI & lb/Hr)[2]	190,000 lb/Hr	N/A	116,000 lb/Hr	125,000 lbr/Hr

1 The availability of natural gas is controlled by the Washington Gas Light Company. It cannot be relied on as a primary fuel.
2 Production plant owned by PWC, Washington.

BRAC-95
DATA Call #12

Technical Center Site	NRL-DC/SSC/MRY
Facility/Equipment Nomenclature or Title	Organometallic VPE

3.4.1 MAJOR EQUIPMENT AND FACILITIES

Surface and Interface Sciences Branch

1. Primary Purpose: The equipment is used to fabricate thin epitaxial layers of semiconductors used in fundamental and applied studies of new materials and device concepts.

2. Portability: The equipment is not portable.

3. Replacement value of facility/equipment: $2.4 M

4. Gross weight and cube: 6000 lbs, 1500 cubic feet.

5. Special utility support: Back up diesel generator, toxic gas scrubbers, integrated safety system, DI water, hydrogen , nitrogen, and air lines, water chiller, acid neutralization tank, and one pass HVAC system.

6. Special budget requirements: Operating budget for facility (solvents, gases, safety consumables, etc..), hydride and organometallic sources for research.

7. Environmental control requirements: Integrated safety system for handling highly toxic gases and hydrogen, real-time toxic gas scrubbers, hoods and fans for exhaust, stainless steel ductwork throughout, one pass HVAC.

8. Relocation: Extremely difficult, would require special site preparation, dismantling of building walls to move equipment, manufacturer support for moving equipment, purchasing of similar equipment that could not be moved because it is delicate and/or to sensitive. No other facilities government wide that could be utilized. Commercial capabilities are extremely limited and not amenable to facility/section mission.

9. Indicate how and when equipment was transported or constructed: One piece of equipment was transported to site after removal of wall in 2/92. Other equipment constructed on-site from existing and purchased parts during 1992 and 1993.

10. Functional support areas: Electronic Devices 11.4 and Materials 11.5

11. Historical utilization for last 5 FY. Used every work day since facility and equipment came on line, mid 1992 for the first piece of equipment.

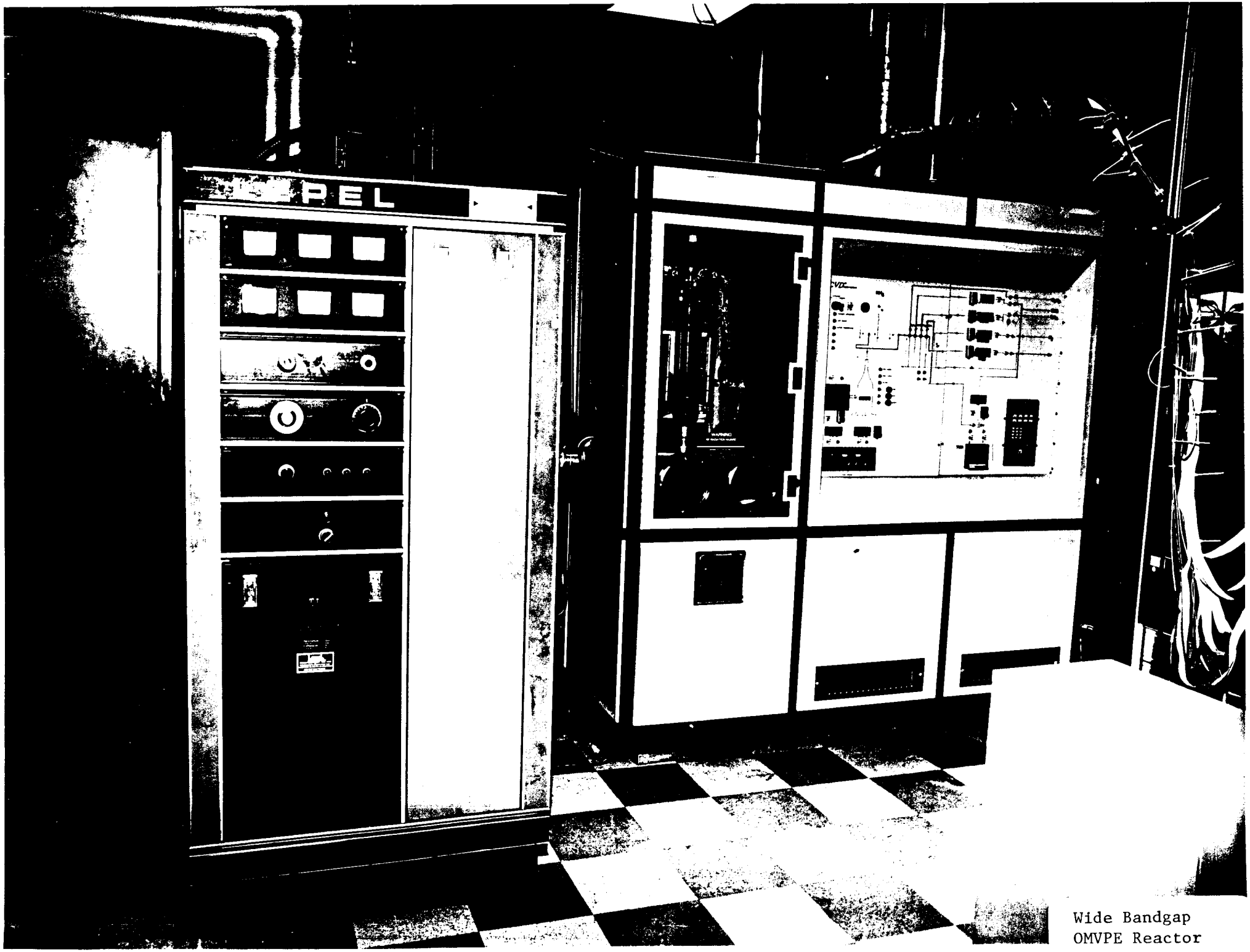
12. Projected utilization: Same as historical, every work day.

13. Number of personnel: Five.

14. Number to maintain: 5

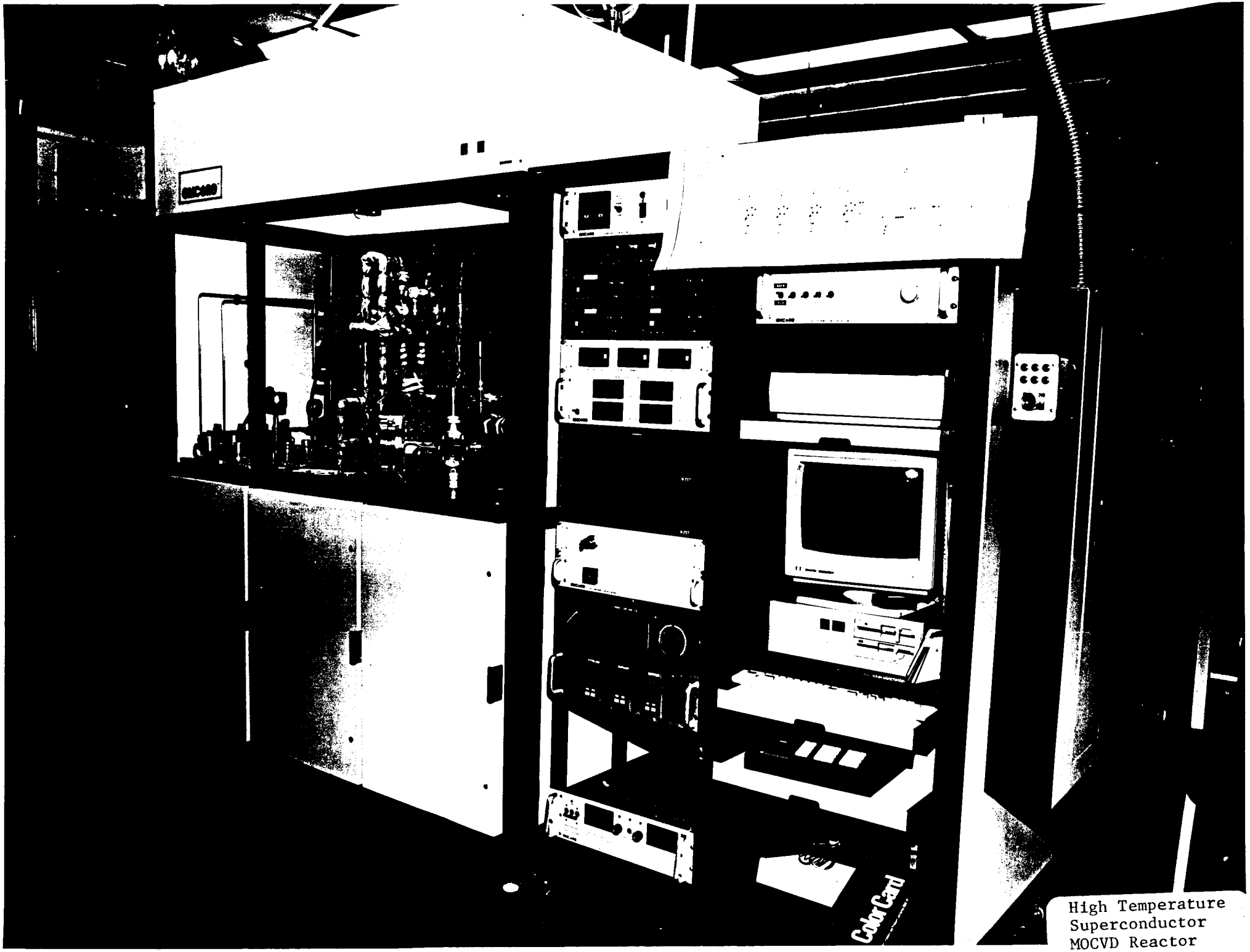
15. Facility Photos Attached.

16. This facility is not shared with any other function. Others may have this capability but this particular facility is unique because of special safety capabilities needed to use the equipment. Therefore, it is unique to DoD.



Wide Bandgap
OMVPE Reactor

EMCORE 3300
OMVPE Reactor



High Temperature
Superconductor
MOCVD Reactor

BRAC-95
DATA CALL #12

Technical Center Site	NRL/ESTD
Facility/Equipment Nomenclature or Title	Optical Characterization Facility

3.4.1 MAJOR EQUIPMENT AND FACILITIES

Surface and Interface Sciences Branch

1. The Optical Characterization Facility utilizes visible and infrared spectroscopy to provide information on materials properties and processing. Instrumentation includes Ar ion and Ti sapphire lasers, and Fourier Transform Infrared Spectroscopy. The latter is coupled with a processing chamber and ultra high vacuum chamber to provide information on film deposition, etching, and other chemical processing.

2. Equipment is movable.

3. Replacement Value: $670K

4. Gross Weight: 1500 lbs. Gross Cubage: 6000 cu. ft.

5. Facility requires gaseous nitrogen, liquid helium, and cooling water.

6. None.

7. None.

8. This facility could be replicated or relocated. Delicate optical components require special care for transportation. Other facilities concerned with materials characterization and processing require timely feedback from this facility.

9. Equipment for this facility was acquired over the time period 1984 to 1994.

10. The Optical Characterization Facility supports areas 11.4 Electronics Devices and 11.5 Materials and Processes.

11. Average utilization from FY89 to FY93 was 5 WY per year.

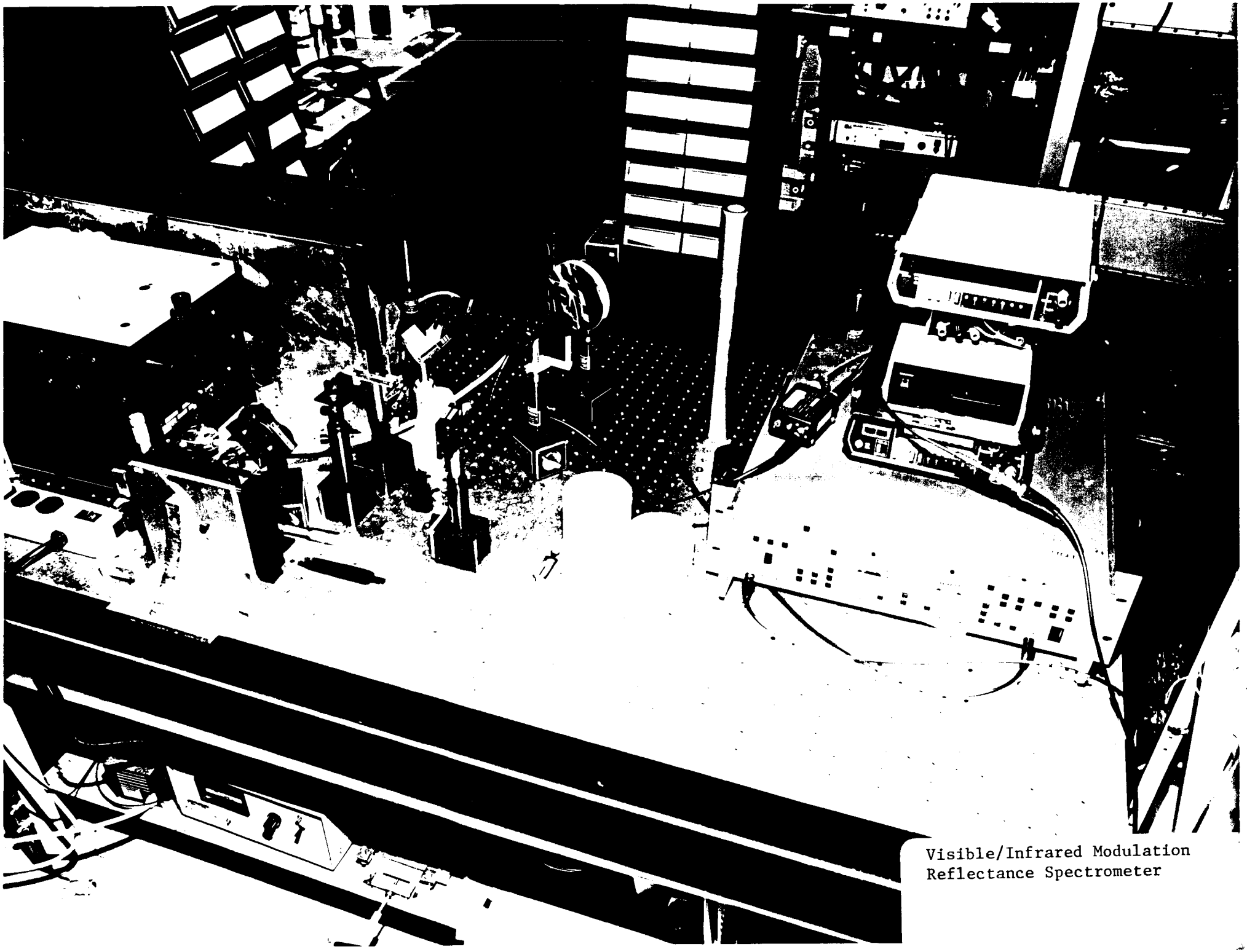
12. Utilization is expected to be 5 WY per year for FY94 - FY97.

13. 3 people are required to operate the equipment.

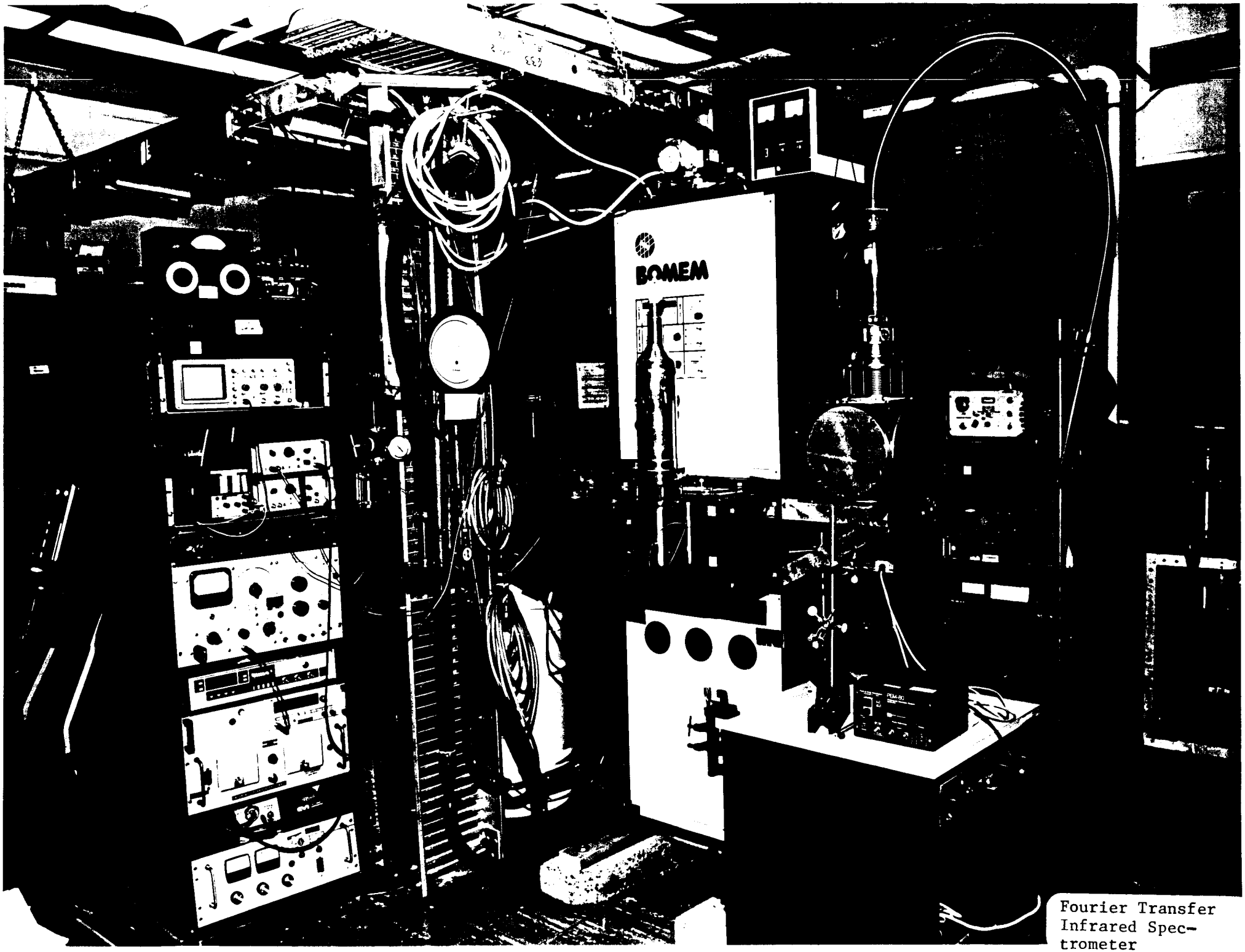
14. No dedicated maintenance personnel are required.

15. Facility Photo Attached.

16. This facility is not shared with any other function.



Visible/Infrared Modulation
Reflectance Spectrometer



Fourier Transfer Infrared Spectrometer

BRAC-95
DATA CALL #12

Technical Center Site	NRL/ESTD
Facility/Equipment Nomenclature or Title	Electronic Properties Facility

3.4.1 MAJOR EQUIPMENT AND FACILITIES

Electronic Materials Branch

1. The Electronic Properties Facility provides detailed measurements of: a.) electron and hole transport in semiconductor materials and structures using variable-temperature resistivity and Hall effect measurements; b.) bulk and interface trap densities and energies using DLTS; and c.) surface structure, morphology , and electronic density of surface states of semiconductors, metals, insulators, and heterostructures using ambient STM/AFM and low-temperature STM. These measurements are crucial to the evaluation of materials grown and processed in other facilities. In addition, the ambient STM/AFM is crucial for the exploratory research in new approaches to nanometer-scale and atomic-scale lithography, processing, and device fabrication.

2. Equipment is movable.

3. Replacement value: $725K

4. Gross Weight: 6500 lbs. Gross Cubage: 7600 cu. ft.

5. Facility requires good vibration isolation,including fully-floating isolation table, gaseous and liquid nitrogen, 2000 W power, high pressure nitrogen gas line, gaseous and liquid helium, 208 Volt 40 Amp electrical service. Plans exist to add gaseous hydrogen, chlorine, and fluorine (including vent and detection systems) to the low-temperature system for advanced surface chemistry studies.

6. None.

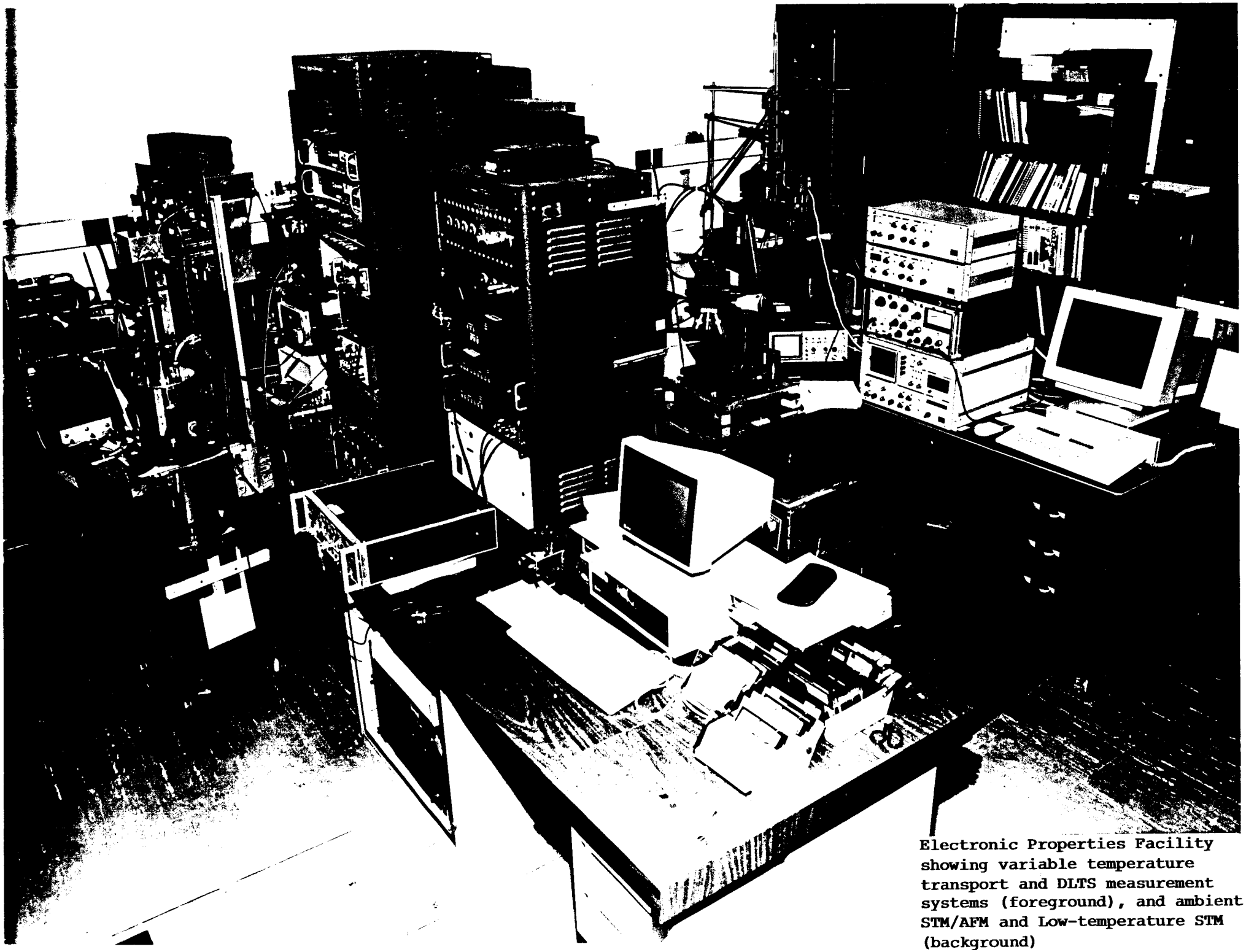
7. Temperature and humidity stability required to maintain acceptable operating environment for electronics. Vibration-free environment required for STM/AFM.

8. This equipment is unique. Few STM/AFMs have a 130 μm scan field (essential for nanolithography) and virtually no other STMs have low-temperature capability combined with an 8 μm scan field. A move away from NRL would severely impact on Navy electronics R&D because the diagnostic equipment in the electronics properties laboratory is essential for assessment of materials quality and for basic research on electronic materials. In addition, the ambient STM/AFM is essential to the nanometer and atomic scale lithographic research removal of this equipment would bring this research to a complete halt.

9. Equipment was acquired from 1985 - present.

10. The Electronic Properties Facility supports areas 11.4 Electronic Devices and 11.5 Materials and Processes.

11. Average utilization from FY89 to FY93 was 6 WY per year.
12. Utilization is expected to be 6 WY per year for FY94 - FY97.
13. 6 people are required to operate the equipment.
14. No dedicated maintenance personnel are required.
15. Facility Photo Attached.
16. This facility is not shared with any other function.



Electronic Properties Facility showing variable temperature transport and DLTS measurement systems (foreground), and ambient STM/AFM and Low-temperature STM (background)

BRAC-95
DATA CALL #12

Technical Center Site	NRL/ESTD
Facility/Equipment Nomenclature or Title	Microwave Technology Facility

3.4.1 MAJOR EQUIPMENT AND FACILITIES

Microwave Technology Branch

1. **Purpose of facility/equipment.**

Code 6850 operates and maintains an extensive state-of-the-art facility for design, fabrication in a research environment, measurement, and modelling of microwave devices and circuits incorporating novel materials and/or topologies to address the needs of next generation electronic warfare, radar, and communication systems.

Design is performed with a networked cluster of four workstations including three state-of-the-art RISC machines (two Hewlett Packard 735s and one Hewlett Packard 710) running microwave CAD software which performs linear and non-linear analysis, electromagnetic simulation, and mask layout.

Research fabrication facilities include all capabilities required for thin film deposition and patterning including mask aligners, deposition systems for metals and dielectrics (thermal and electron beam evaporators as well as sputtering systems), and wet and dry etching processes. Photolithography is performed in a 400 square foot clean room facility. Some special lithography and processes are performed by the Nanoelectronics Processing Facility as needed. Code 6850 is also equipped with facilities for mounting, assembling and packaging microwave circuits and subsystems which are capable of being qualified for space applications

Test and measurement is performed using Code 6850's extensive array of microwave and general purpose test equipment. Major facilities are two laboratories centered around two vector network analyzers. There are facilities for spectrum analysis, noise figure characterization and scalar network analysis. Two closed-cycle refrigeration systems have been specially configured to facilitate the measurement of microwave cryoelectronics, including superconductors and quantum transport devices, over a temperature range from 10K to 400K. On wafer microwave characterization of novel microwave devices and circuits is also part of this facility. In addition, there is extensive general purpose microwave instrumentation to address custom and special purpose test and measurement needs.

Modelling is also performed using the computational tools discussed in the design section as well as custom codes. Special attention is presently focused on novel devices including narrow-band-gap InAs channel HEMTs for very high frequency performance and wide-band-gap GaN FETs for high-temperature operation.

2. **Portability/movability.**

All of these facilities are, in principle, movable. However, movement of any of the thin film deposition systems is difficult due to their size and weight and the requirement that these systems must remain under high-vacuum conditions during movement. The clean room facility could be dismantled and moved but it would probably be cheaper to build a new one than try to move and reassemble the existing facility whose integrity may be permanently compromised by such handling. Much of the equipment needs extensive utility connections beyond simple electrical hook-up.

3. **Replacement value.**

The cost to replace the three Hewlett Packard workstations is approximately $75,000. The microwave design software represents a total investment of another $75,000. The thin film deposition and dry processing facilities represent a replacement cost estimated at $400,000. The clean room itself would cost $400,000 to duplicate. The remaining processing and lithography equipment would require another $100,000 to duplicate. Equipment such as wafer scribers, thermo-compression and ultrasonic bonders, soldering and welding stations used in the assembly, mounting and packaging of microwave circuits would exceed $75,000. Each of the Hewlett Packard 8510C network analyzers and supporting accessories cost $160,000 (total: $320,000). Other microwave (sources, scalar analyzer, spectrum analysis, noise figure measurement, etc.) and general purpose test and measurement electronics in support of this effort represent an investment of over $250,000. Each of the closed cycle cryogenic refrigeration systems along with their control electronics represents an investment of approximately $30,000 (total: $60,000). On-wafer probing facilities would cost approximately $75,000 to reproduce. Total cost to duplicate existing equipment would be approximately $2,000,000. Not included in this estimate is the cost of providing standard laboratory equipment such as benches, cabinets, special utilities, etc.

4. **Gross weight and cubic volume.**

Excluding offices for personnel and support facilities, this facility would require 4,000 square feet of floor space, 48,000 cubic feet of space, and the total weight is roughly estimated at 7,500 lbs.

5. **Special utilities.**

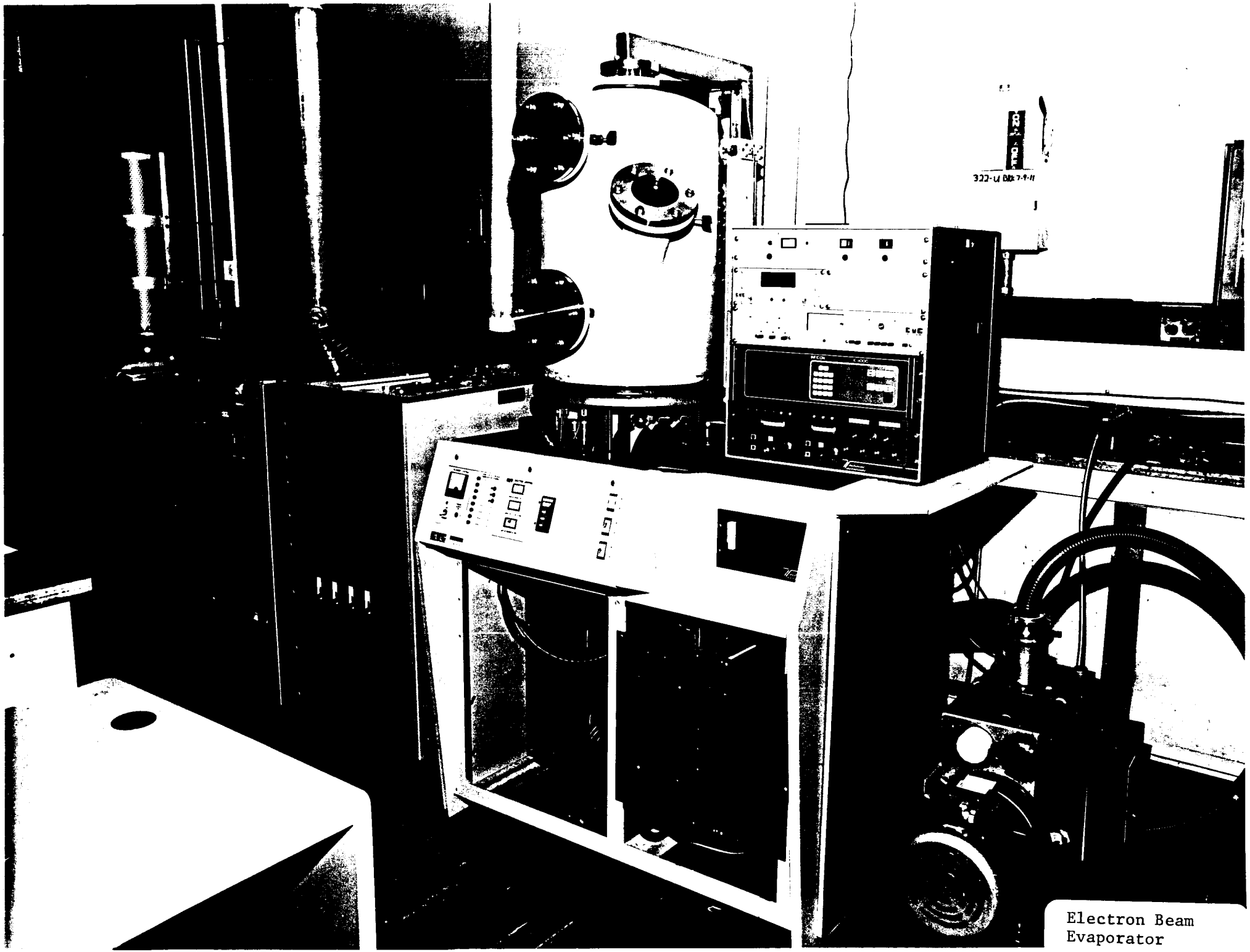
In addition to standard single phase 110V and three phase 220V electrical utilities, the following are required: ethernet LAN; LocalTalk LAN; filtered, dry compressed air; vacuum; dry nitrogen gas (standard compressed tank is insufficient), ultra-pure de-ionized water, filtered water, 400 square foot clean room, fume hoods (one of which must be in the clean room), toxic gas storage, acid storage, solvent storage.

6. **Special budget requirements.**

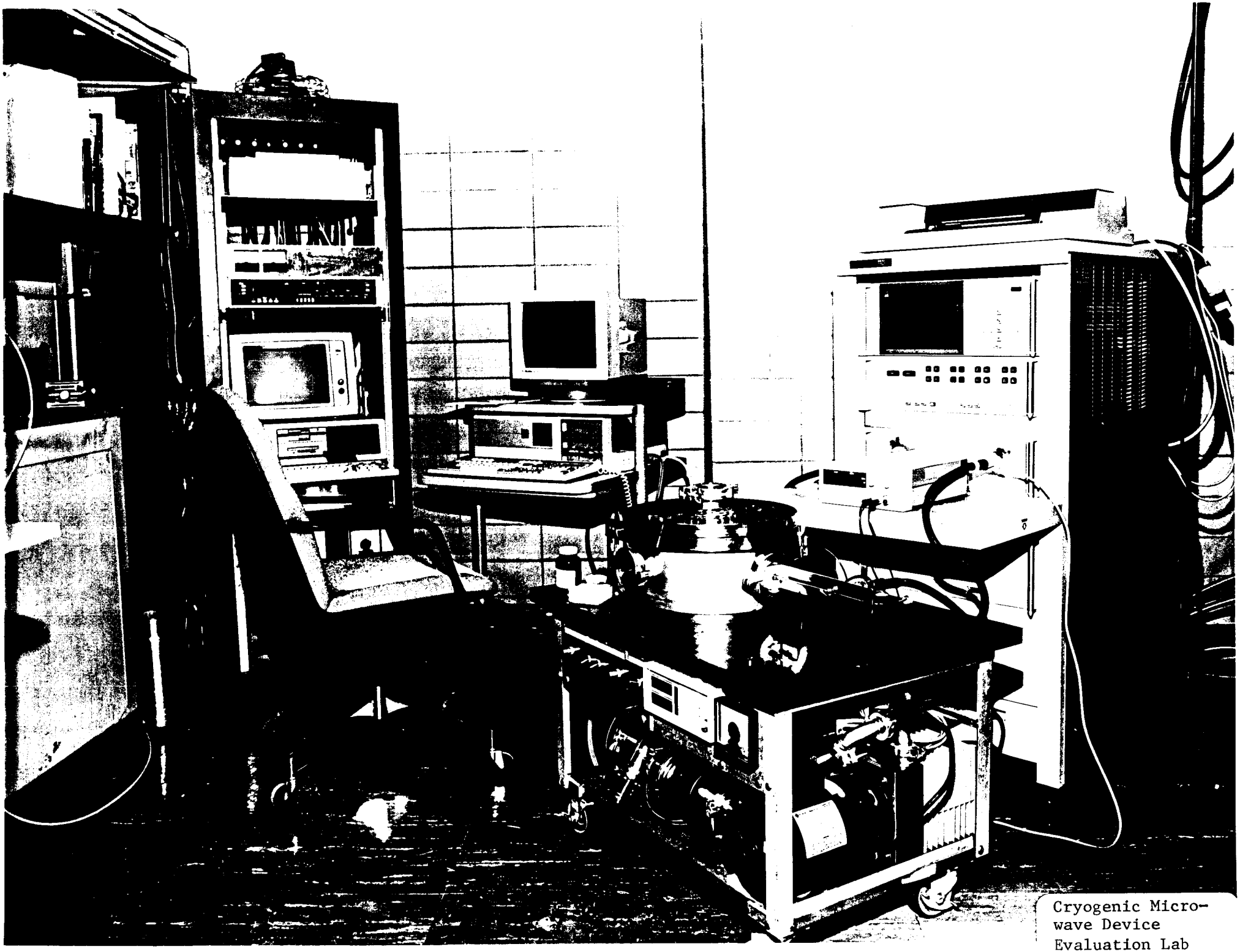
A 400 square foot HEPA filtered clean room is required. Laboratories must be equipped with lab benches, storage cabinets, etc.

7. **Environmental control requirements.**

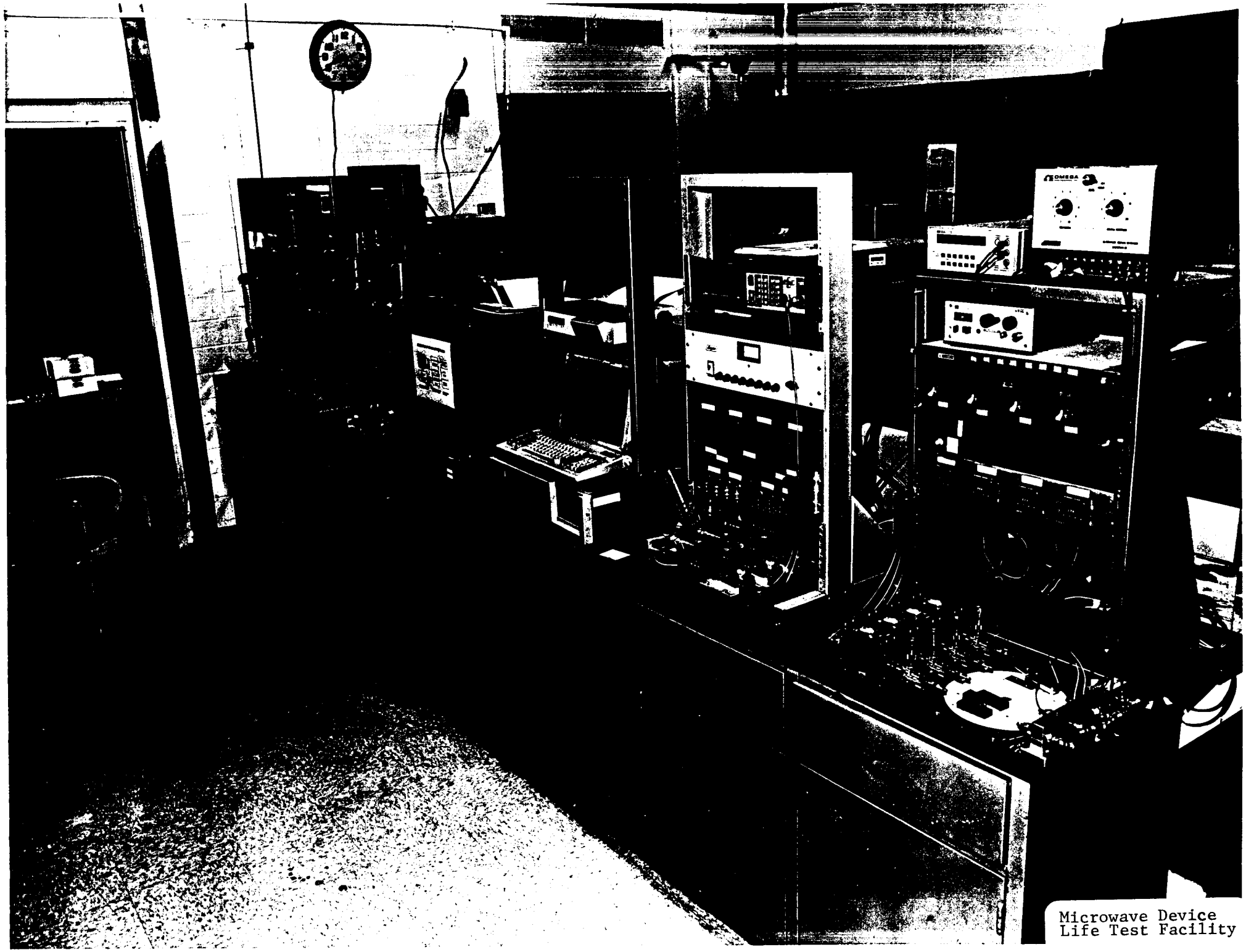
A clean room facility is required for proper photolithographic processes which requires that all air entering the room be extensively filtered. Photolithographic and chemical processes require highly stable temperature and humidity control. Standard temperature



Electron Beam
Evaporator



Cryogenic Micro-
wave Device
Evaluation Lab



Microwave Device
Life Test Facility

BRAC-95
DATA CALL #12

Technical Center Site	NRL/ESTD
Facility/Equipment Nomenclature or Title	EPICENTER Facility

3.4.1 MAJOR EQUIPMENT AND FACILITIES

The EPICENTER: A facility for the molecular beam epitaxial growth and characterization of compound semiconductor materials and structures

(This facility is a shared initiative of the Electronics Science and Technology, Materials Science and Technology and Chemistry Division.)

Electronic Materials Branch

1. The facility is dedicated to the growth and physical characterization of both III-V and II-VI semiconductors and selected metal films. In addition to two growth chambers, the facility allows in vacuo transfer from either growth chamber to two analysis chambers; one for scanning tunneling microscopy and the other for angle-resolved electron spectroscopy. While both growth chambers are of commercial design (Riber Model 32P), the analysis chambers are of custom design and commercial manufacture. The focus of effort in III-V film and superlattice growth is on the GaSb, AlSb, and InAs semiconductor family. The focus of effort in II-VI film and superlattice growth is on the diluted magnetic semiconductors MnxZn1-xSe and FexZn1-xSe.

2. The facility is moveable (Class 2). However, moving is complicated by the requirement that the various components be maintained under high vacuum conditions during movement. Since a variety of potentially toxic substances have been used inside the chambers, special safety precautions may be mandatory for shipment.

3. The replacement value is $3M. (Exclusive of site preparation.)

4. Gross weight: 15,000 lbs. Gross cubage: 2,000 cubic feet.

5. Utility support: Filtered water delivery and drain system. Liquid nitrogen supply and exhaust system. (Either through bulk storage container or on-site liquifaction with peak demand capability of at least 10 gallon/hour. Insulated delivery lines from source to facility.) At least 120 kw of 3 phase, 225 volt electrical power for bake-out shrouds and growth chamber electronic systems. Vacuum exhaust system. Dry nitrogen purge gas. Ultra-pure deionized water for substrate processing. Fume hood with HEPA filters to minimize surface contamination during substrate processing. Pressurized (70 psi) nitrogen or clean, dry air to operate pneumatic valves.

6. Special budget requirements: The facility must be installed on a stable, low vibration floor in order to operate the scanning tunneling microscope which is vibration-sensitive.

Non-ferrous construction is mandatory adjacent to the magnetic-field sensitive electron spectrometer.

7. Environmental requirements: Temperature stability and sufficiently low relative humidity in order to provide an acceptable operating environment for electronic systems.

8. There is no facility within the U.S. government that is comparable to the Epicenter. In the private sector, a number of universities have facilities of equivalent size. However, each is configured differently from the Epicenter. The configuration of the Epicenter is unique in its combination of surface science techniques with semiconductor film growth capabilities. This emphasis has developed in recognition of the increased importance of interface/surface properties for the successful production of superior quality semiconductor heterostructures for optical and electronic devices of interest to the Navy. This facility could be relocated at another site but the down-time probably would be one year. If the facility were lost, device-oriented programs at NRL would have to find alternate sources of well-characterized semiconductor heterostructures. These device programs are quite diverse, ranging from infrared detectors to digital electronic applications.

9. Facility Construction: The major components of the facility were transported to the site by air/truck freight. However, a number of customized components, such as optical spectroscopy systems, were constructed on site.

10. Functional support areas: 11.4, Electronic devices and 11.5, Materials and processing.

11. Historical utilization average: The unit of measure is scientist work-year (WY). Since this is a new facility, the five year (FY89-93) average of 1.8WY is somewhat misleading: FY89, 0.5WY; FY90, 1.5WY; FY91, 2WY; FY92, 2WY; FY93, 3WY.

11A. Alternate measure of historical utilization average: The unit of measure is the individual semiconductor film, heterostructure or superlattice produced in the III-V and II-VI growth chambers. Since both growth chambers became fully operational (FY91), the facility has produced about 50 samples per month. Since routine maintenance consumes 2 months per year, 500 samples are produced per annum.

12. Projected utilization data out to FY1997 - Work Years (WY)

FY1994: 4WY
FY1995: 6WY
FY1996: 7WY
FY1997: 7WY

13. Personnel to operate equipment in FY1994: 4 scientists (4WY).

14. Personnel to maintain the equipment in FY1994: All equipment is maintained by scientist-users.

15. Facility Photo Attached.

16. This facility is not shared with any other function. The equipment in this facility is unique since there is none other available in DoD or in the Federal government.

and humidity constraints appropriate for computers and electronic equipment must be met in the remainder of the facility. Facilities must be provided for the safe use and storage of toxic gases used in dry processing as well as for acids and solvents.

8. **Impact of facility loss.**

This facility is at the forefront of most of the promising new areas of microwave research including: the DARPA Ferrite Consortium, the SPAWAR High Temperature Superconductor Space Experiment, ONR funded efforts in; InAs and GaN devices, quantum transport devices, novel circuit topologies for narrow-band and other filter topologies, and a CRADA with Superconducting Core Technologies on ferroelectric/superconductor devices and circuits. Relocation of these facilities to another location would result in suspension of the activities performed in these facilities for a considerable length of time. Although certain equipment such as the network analyzers might be down for only a month or two assuming that the physical plant was fully ready to accept them, vacuum systems, cryogenic systems, and, in particular, the clean room photolithographic facility would take more than a year to become operational. It is estimated that to get the facility fully functional would require two years assuming that the present personnel were assigned the task and even longer if new personnel were assigned the task. In the meantime, progress on all of these programs which are critical to next generation electronic warfare, radar, and communication systems will be greatly slowed.

9. **Facility construction.**

The facility/equipment has been assembled over the past several years. All equipment in the facility was shipped via normal ground transportation. Assembly of the clean room facility requires a contractor specialized in that area.

10. **Areas of functional support:**

Electronic devices and electronic materials.

11. **Historical use average.**

Use is defined as the number of full-time-equivalent (FTE)/work years (WY) for personnel engaged in sponsor supported research using the facility. The level of utilization has increased steadily over the past five years from approximately 3.5 WY to 6 WY as the facility and its capabilities have been expanded.

12. **Projected use to FY 1997.**

The level of utilization is expected to increase through 1997 as the trend in sponsor interest moves more toward subsystem demonstration and delivery of functional, and in some cases, space qualified, hardware such as that delivered to the HTSSE I and HTSSE II programs. In addition it is expected that measurement and characterization of novel microwave devices, such as InAs channel HEMTs and low-temperature quantum-transport devices will significantly increase the demands placed on this facility.

13. **Personnel used to operate the equipment.**

The equipment is operated by the researchers and technicians of Code 6850 and involves approximately 6 work-years.

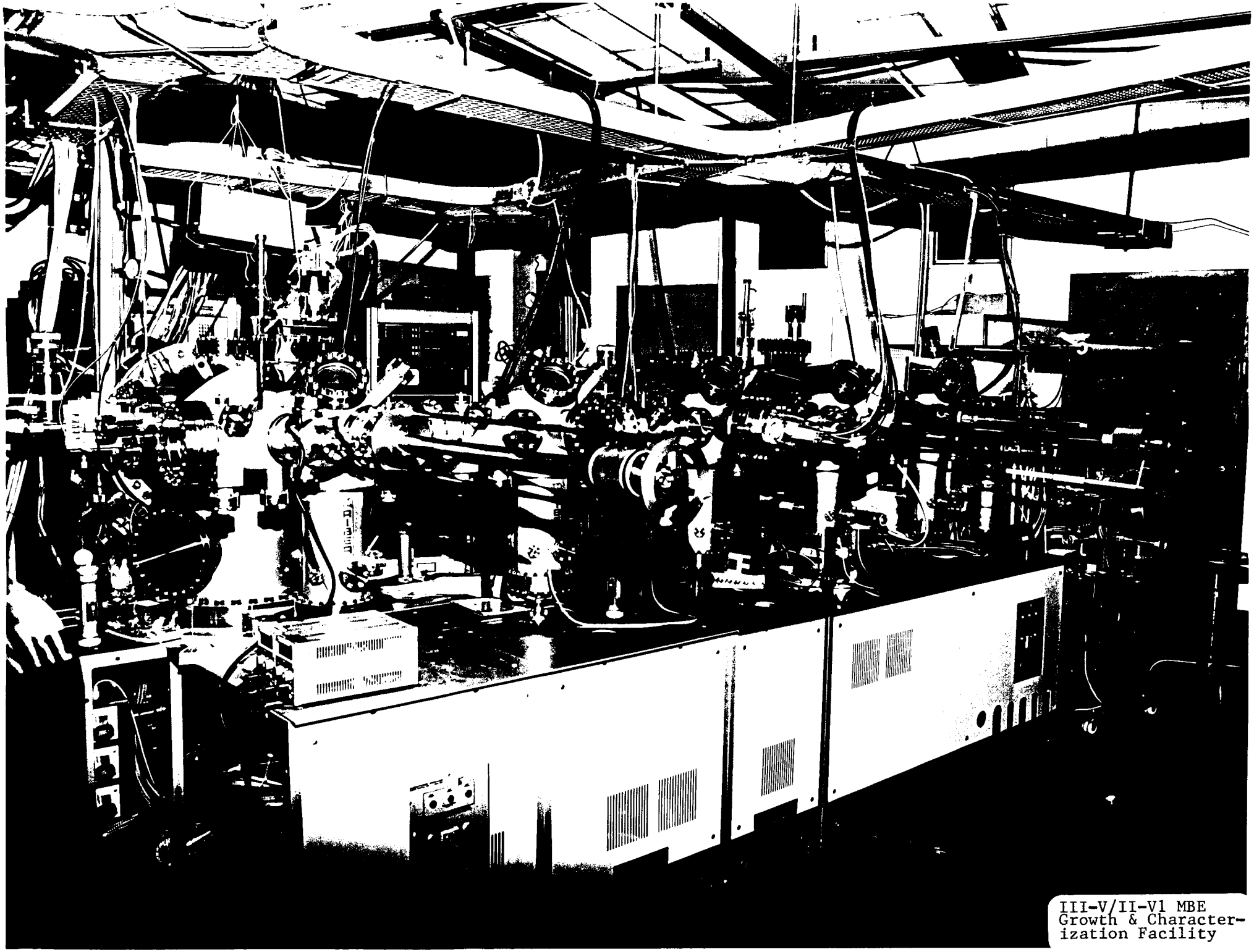
14. **Personnel used to maintain the equipment.**

With the exception of the Hewlett Packard vector network analyzers which are maintained by a service contract and building utilities maintained by NRL, the researchers and technicians of Code 6850 maintain the facility.

15. **Photos.**

Facility photographs attached.

16. This facility is not shared with any other function.



III-V/II-VI MBE
Growth & Characterization Facility

BRAC-95
DATA CALL #12

Technical Center Site	NRL/ESTD
Facility/Equipment Nomenclature or Title	Magnetic Resonance Facility

3.4.1 MAJOR EQUIPMENT AND FACILITIES

Electronic Materials Branch

1. The Magnetic Resonance Facility consists of 3 permanent magnet electron paramagnetic resonance (EPR) spectrometers and one superconducting magnet magnetic resonance spectrometer along with optical tables, lasers, optical monochrometers and detectors,variable temperature apparatus, and ancillary signal processing/control electronics. The spectrometers are used for conventional EPR, optically detected magnetic resonance (ODMR) and electron-nuclear double resonance (ENDOR). These diagnostic techniques are used to determine the effects of point defects on the electronic properties of semiconductors and are used integrally to provide analysis of materials quality for materials development and electronic device development.

2. The facility is moveable.

3. Replacement Value: $704K

4. Gross Weight: 8500 lb. Cubic Feet: 9320.

5. Equipment requires chilled cooling water for magnets; enhanced pressure city water; 208 Volt, 60 Amp electrical service; liquid helium; liquid nitrogen; and high purity nitrogen gas from liquid boil off.

6. Magnets require some load-spreading but is currently accommodated on flooring rated at 100 lbs/sq. ft.

7. Vacuum pump exhaust lines, temperature control and humidity control are required to maintain alignment of optical equipment and for stability of electronics.

8. The facility could be replicated or relocated. However, much of the facility is unique within the DoD. Loss of the facility would have a significant impact on the Navy because the facility has been tailored to support bulk and epitaxial materials growth programs and electronic device research and development programs for Navy electronics systems. Part of the side of the building will need to be removed to remove large optical tables.

9. Some of the equipment was developed in-house using NRL machine shop but most was delivered to NRL by overland freight and installed by NRL personnel and by manufacturer technical personnel. Major purchases were made in 1979, 1985, 1987 and 1988.

10. The Magnetic Resonance Facility supports area 11.4, Electronic Devices and 11.5, Materials and Processes.

11. The average useage from FY89 - FY93 was 5 work years per year.

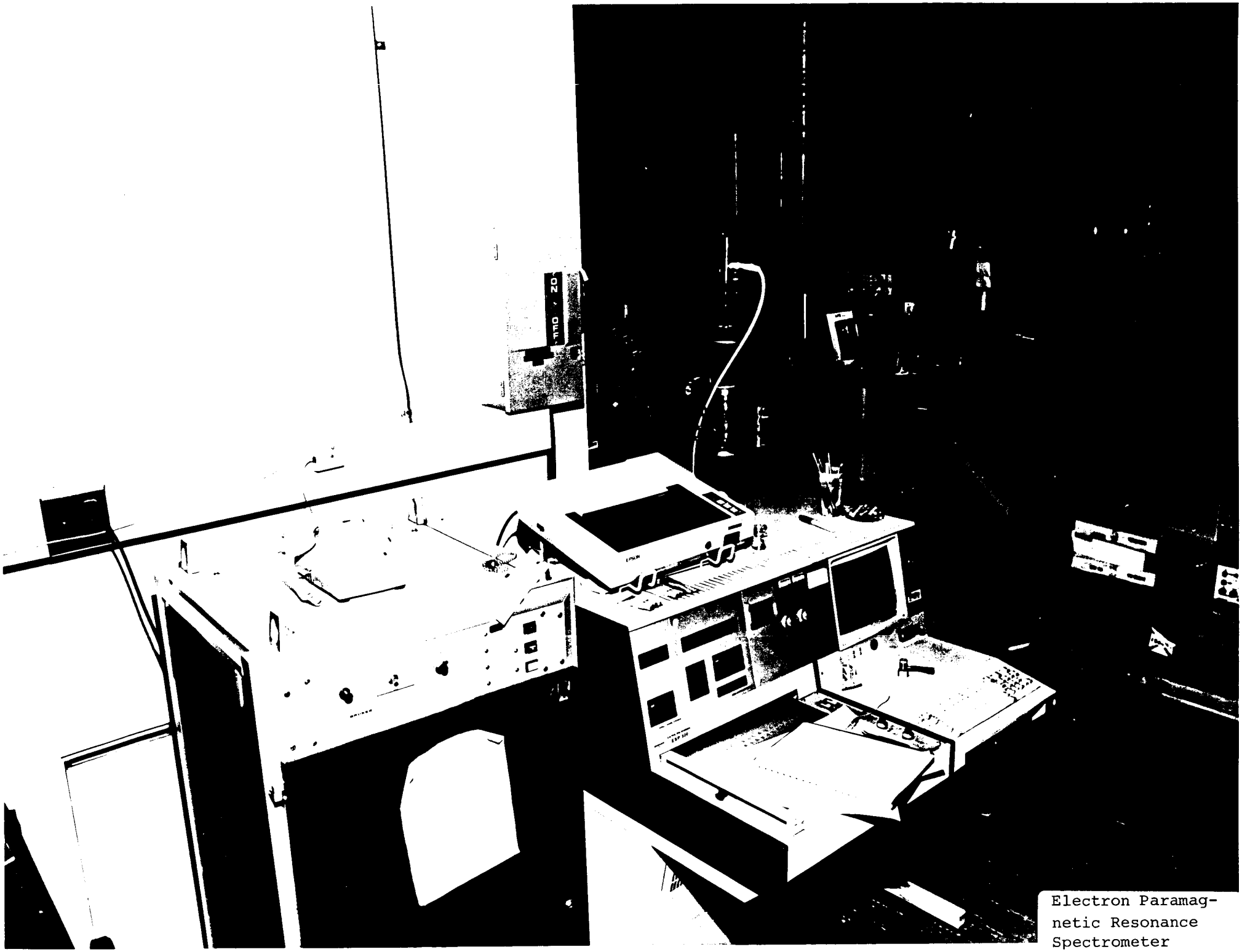
12. Expected usage (WY): FY94: 5; FY95: 5; FY96: 5; FY97: 5.

13. Number of people required to operate equipment: 4

14. Number of people required for maintenance: 0 (No dedicated technician. Service and repair performed by users as required.)

15. Facility Photo Attached.

16. This facility is not shared with any other function.



Electron Paramagnetic Resonance Spectrometer

BRAC-95
DATA CALL #12

Technical Center Site	NRL/ESTD
Facility/Equipment Nomenclature or Title	Optical Properties Facility

3.4.1 MAJOR EQUIPMENT AND FACILITIES

Electronic Materials Branch

1. The Optical Properties Laboratory performs interband-impurity, intra-impurity and vibrational spectroscopic measurements on materials used in current and emerging electronic technologies. The materials studied include thin films, superlattices and nanostructures produced by molecular beam epitaxy and organo-metalic vapor deposition, and bulk crystals. These materials are grown as part of electronic device research and development to provide diagnostics and to develop an understanding of basic physical properties of device materials. Specific spectroscopic techniques include pulsed and continuous wave photoluminescence, photoluminescence excitation, optical absorption and reflection, Raman scattering, and modulation spectroscopies. These measurements are performed in the spectral range from the mid infrared to the ultraviolet, at magnetic fields as high as 13 Tesla, and at temperatures between 1.5K and 400K.

2. Equipment is moveable.

3. Replacement Value: $843K

4. Gross weight: 13800 lbs. Gross Cubage: 8500 cu. ft.

5. Facility requires a high-pressure filtered water delivery system, high pressure nitrogen gas line, hydrogen and fluorine gas delivery (including vent and detection systems), 208 Volt 40 Amp electrical service.

6. None.

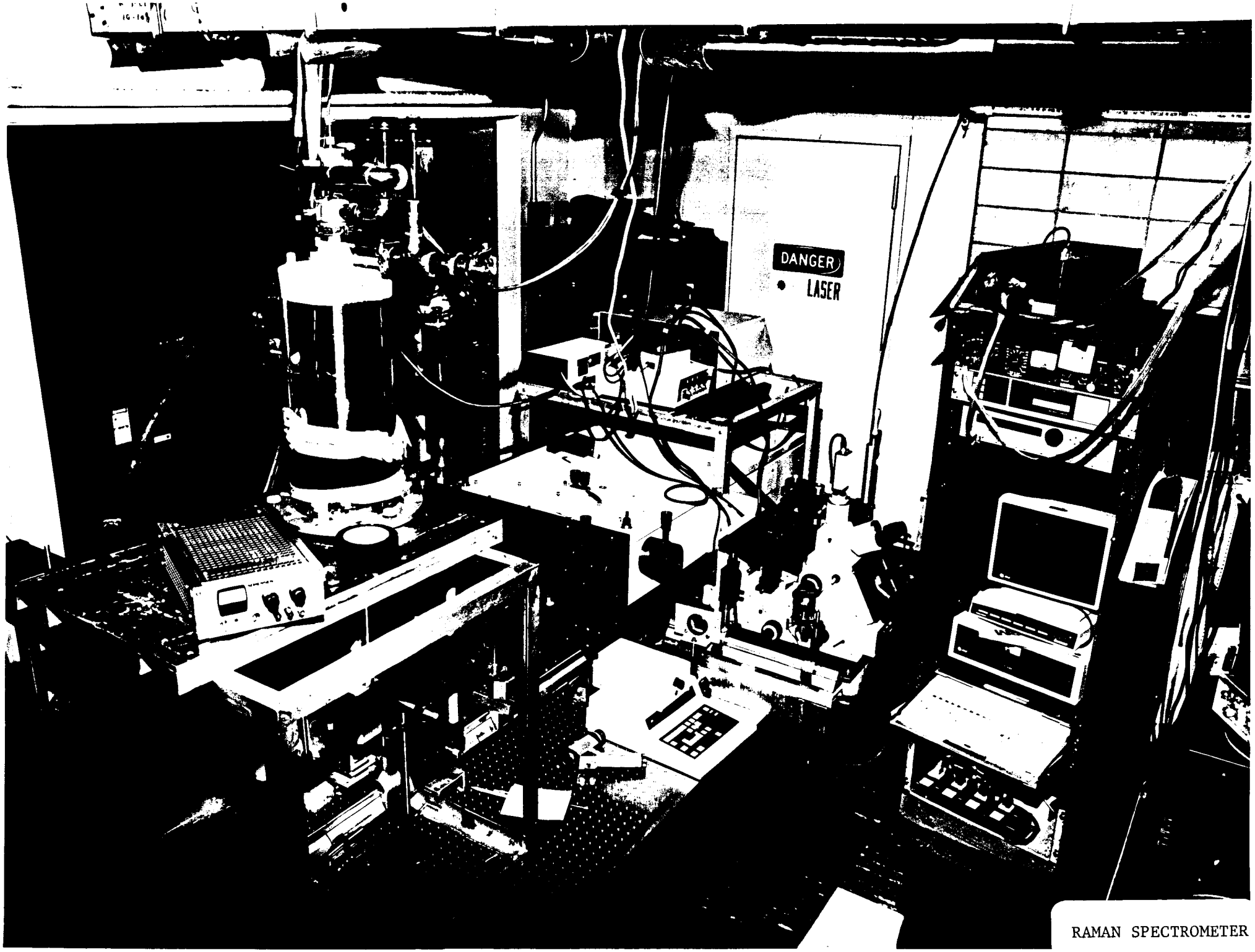
7. Temperature and humidity stability are required to maintain alignment of spectroscopic systems and to maintain an acceptable operating environment for electronics equipment.

8. The facility could be replicated or relocated. If this facility were lost to the Department of the Navy, the electronics materials and device development programs would be severely impacted. It is extremely important that all materials growth, diagnostics equipment and device fabrication facilities be colocated in order to provide timely feedback during growth and process development.

9. Equipment was shipped to NRL by overland freight and was installed by NRL personnel and by vendor technical personnel. The facility has been evolving at its present site since 1979. Various parts of the facility have been added over the years as modernization and capability expansion was required.

10. The Optical Properties Laboratory supports areas 11.4 Electronic Devices and 11.5 Materials and Processes.

11. Average utilization from FY89 to FY93 was 4 Work Years (WY) per year
12. Utilization is expected to be 4 WY per year for FY94 - FY97.
13. 4 people are required to operate the equipment.
14. No dedicated maintenance personnel are required.
15. Facility Photo Attached.
16. This facility is not shared with any other function.



RAMAN SPECTROMETER

BRAC-95
DATA CALL #12

Technical Center Site	NRL/ESTD
Facility/Equipment Nomenclature or Title	Crystal Growth Facility

3.4.1 MAJOR EQUIPMENT AND FACILITIES

Electronic Materials Branch

1. The crystal growth facility grows crystals of semiconductor materials and crystalline layered structures of superconductor materials used in studies of new materials and new device concepts. Electronic device research often requires new materials or materials with electronic properties that are not commercially available. The mission of the crystal growth facility is to engage in the research necessary to study those electronic materials and devices. This research is multi-disciplinary and often involves solid state physicists and device engineers in addition to the crystal growth researchers of the facility.

2. The equipment is moveable as defined by paragraph 6, page 12 of this data call. For all practical purposes, however, much of the equipment in the crystal growth facility is fixed. In addition to being attached to plumbing for water cooling and attached to fume hoods for safety enclosure operation, the crystal growth furnaces are not capable of being moved without breaking fragile heating elements. Moving the furnaces might require replacement of the entire furnace because the heating elements become very brittle after they have been used.

3. Replacement value of the facility/equipment: $2250K

4. Gross weight : 22000 lbs. Cube: 35000 cu. ft.

5. The facility requires fume hoods for the processing of hazardous materials, water cooling for the crystal growth furnaces, a nitrogen gas supply for the MOCVD reactor, hydrogen and oxygen gas supply for the glass shop, compressed air supply for valve operation in the MOCVD reactor, 208V and 240V electrical supply for the high temperature furnaces and 480V power supply for the RF generator used to heat the high pressure Czochralski furnace.

6. Special budget requirements for the facility/equipment: None.

7. Environmental control requirements for the facility/equipment: None

8. Relocating the facility would likely involve replacement of many of the resistance heated crystal growth furnaces because of expected breakage of brittle heating elements. Replication of the facility would not be entirely possible because certain items such as the high pressure Czochralski crystal growth furnace (sized for research purposes) is no longer manufactured. Replacement of the high pressure furnace would mean that a production sized unit would be substituted for the research sized unit. Future research using the production sized unit would be much more expensive because of the larger quantities of new materials which would be required for the larger furnace.

Possible alternative crystal growth facilities at either government or commercial sites do not exist with the depth of capability that is present at NRL. Certain aspects of the capabilities could be obtained at various other facilities, but no other laboratory has the range of crystal growth/processing facilities that is located at NRL. Loss of the crystal growth facility would limit the ability of device engineers to obtain new materials or materials with desired properties for new device experimentation. The performance of electronic devices is often limited by the crystalline and chemical perfection of the materials from which the device is fabricated. Continued improvements in the quality of electronic materials is key to better device performance and new applications for the electronic materials. Enhanced electronic materials and enhanced electronics are responsible for providing force multipliers for the US.

9. The equipment of the crystal growth facility was assembled over the period from 1975 through the present. Moving the equipment when it was new did not present a problem. The heating elements become very brittle after they have been heated to high temperatures.

10. The crystal growth facility supports area 11.4 Electronic Devices and 11.5 Materials and Processes

11. Historical utilization average for the past five years (1989-1993): The facility has been used on a continual basis (4 work-years/year) over the past five years.

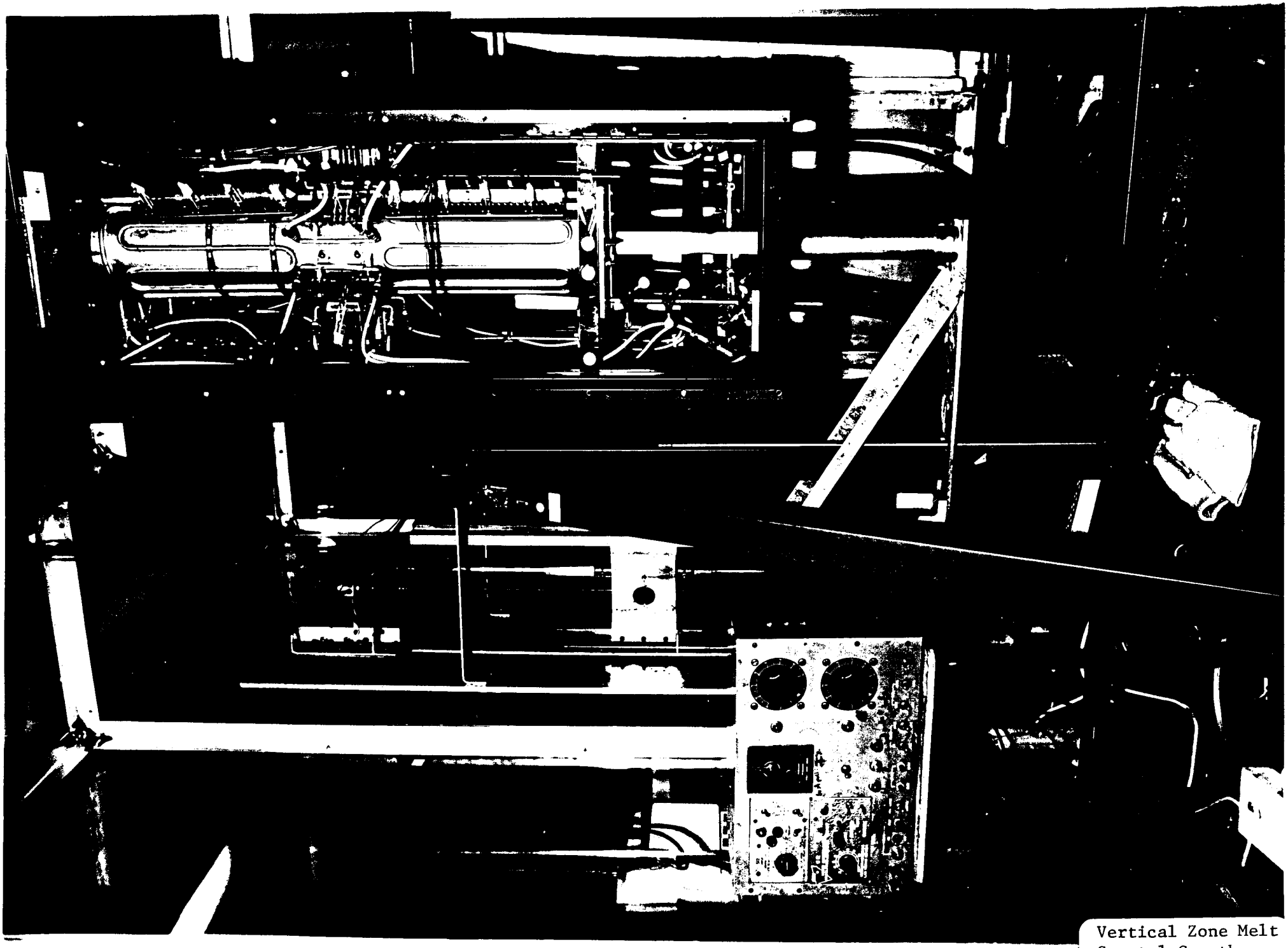
12. Projected utilization data out to 1997: The facility is expected to be used on a continual basis (4 work-years/year) through 1997.

13. Approximate number of personnel used to operate the facility equipment: 4

14. Approximate number of people to maintain the facility: 1

15. Facility Photo Attached.

16. This facility is not shared with any other function.



Vertical Zone Melt
Crystal Growth
Apparatus

BRAC-95
DATA CALL #12

Technical Center Site	NRL/ESTD
Facility/Equipment Nomenclature or Title	Far Infrared Spectroscopy Facility

3.4.1 MAJOR EQUIPMENT AND FACILITIES

Electronic Materials Branch

1.The far infrared laboratory is used for transient and steady state infrared spectroscopy covering the wavelength range from two microns up to two mm. Experiments are performed on electronic and optical materials used in near-term and far-term Navy electronics systems. This includes semiconductors, superconductors and glasses. Experiments are performed under applied magnetic fields up to 13 Tesla using a number of specialized far infrared lasers and interferometers.

2. The far infrared spectroscopy facility is moveable.

3. Replacement value: $685K

4. Gross Weight: 13000 lbs. Cubic Feet: 2400

5. Vacuum exhaust system, filtered water delivery and drain systems, chemical fume hood, dry nitrogen purge gas line from liquid boil-off system.

6. None

7. Environmental requirements: Temperature and humidity stability required to maintain alignment of optical systems and to maintain acceptable operating environment for electronics.

8. No government or commercial facility exists that has flexible capabilities afforded by this infrared facility. The facility could be replicated elsewhere but if the equipment were relocated, a part of the building would have to be removed to move large optical tables. Loss of this facility to the Navy would have a serious negative impact on the Navy's ability to develop advanced materials for electronics systems.

9. Delivered to NRL by overland freight, installed by NRL personnel and by factory representatives. Parts of spectrometer built by laboratory personnel. Part of building removed to install parts of the system. (1975 - present)

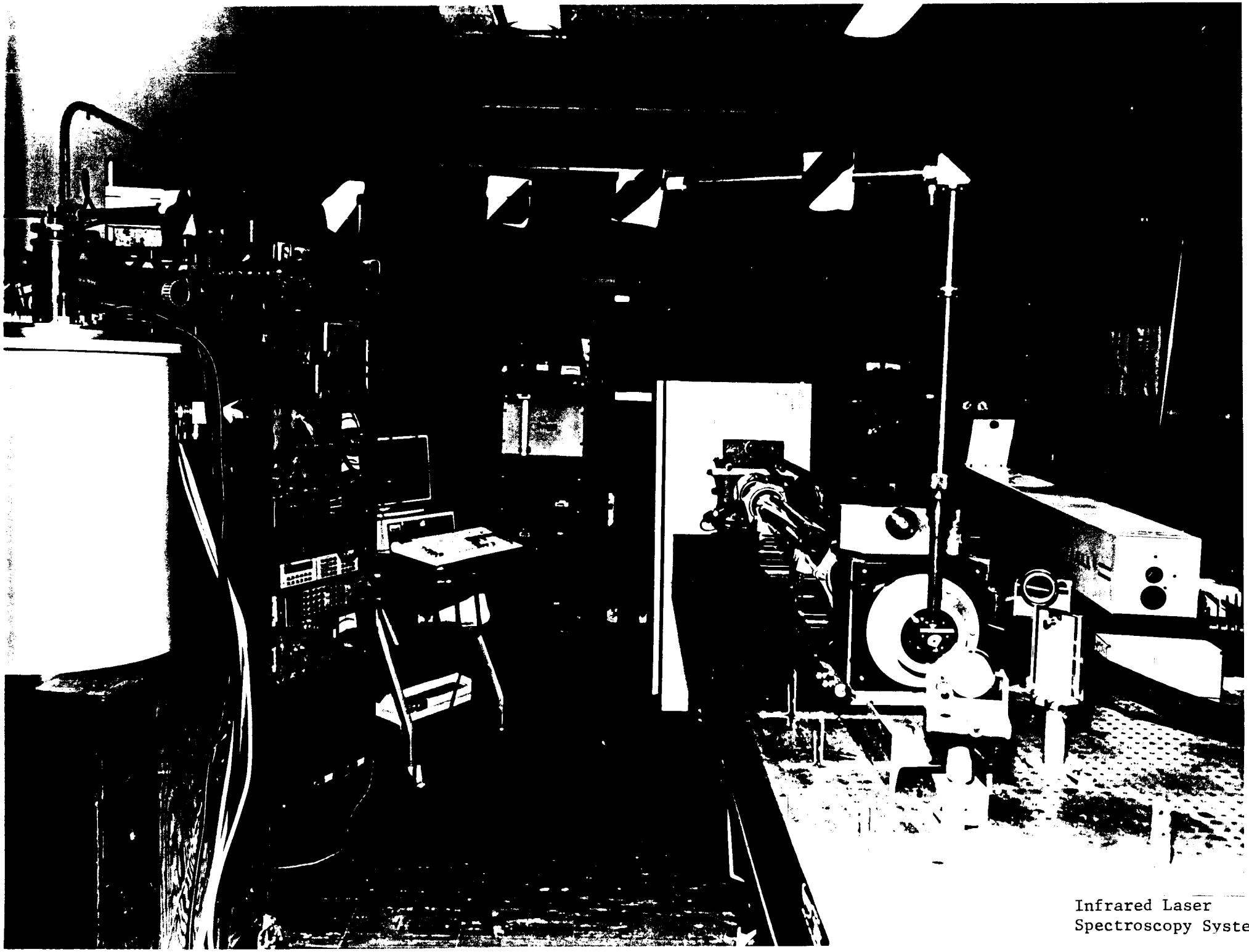
10. The far infrared spectroscopy facility supports areas 11.4 Electronic Devices and 11.5 Materials and Processes.

11. Average useage over the past 5 fiscal years is 5 work years per year.

12. Projected utilization FY94 - FY95: 5 work years per year

13. Number of personnel used to operate the facility: 5

14. Number of personnel needed to maintain the equipment: 0 (no dedicated technician required.)
15. Facility Photo Attached.
16. This facility is not shared with any other function.



Infrared Laser
Spectroscopy System

BRAC-95
DATA CALL #12

Technical Center Site	NRL/ESTD
Facility/Equipment Nomenclature or Title	Reliability Facility

3.4.1 MAJOR EQUIPMENT AND FACILITIES

Microwave Technology Branch

1. Purpose of Facility/Equipment.
   Code 6855 operates and maintains a Reliability and Failure Analysis Facility for the study of semiconductor devices. Operational life times are determined by a number of acceleration and stressing methods. After failure is induced, the physical failure mechanisms are determined by such methods as electrical characterization, optical microscopy, scanning electron microscopy, infrared microscopy, energy dispersive X-ray analysis, and various other X-ray techniques. Failure mechanisms are modeled by the Monte Carlo method and the results are correlated with the experimental results to gain a better understanding of the failure mechanisms and to improve the reliability of the devices.

2. The equipment is installed in laboratories and is not portable.

3. Replacement value.
   The cost to replace the reliability and failure analysis equipment is approximately $1,800,000.

4. Gross weight and cubic volume.
   The gross weight of the reliability and failure analysis equipment is approximately 11,000 pounds. The total laboratory space required is about 4,500 cubic feet.

5. Special Utilities.
   None required.

6. Special budget requirements.
   None required.

7. Environmental control requirements.
   Standard temperature and humidity constraints appropriate for electronic equipment must be met.

8. Impact of facility loss.
   Certain types of equipment, such as the RF reliability accelerated life testing stations were built at NRL and could only be rebuilt at another location at a large expense. This combination of equipment and the staff trained to use it is unique in the military laboratories and its loss would leave the Navy without the ability to assess the

reliability of electronic components and to conduct research in the area of reliability and failure physics.

9. Facility construction.
Most of the present equipment has been purchased or built over a period of time starting in 1985.

10. Areas of functional support:
Electronic devices.

11. Historical use average.
Over the period of 1989-1993 the facilities have required utilization of approximately 6 work-years per year.

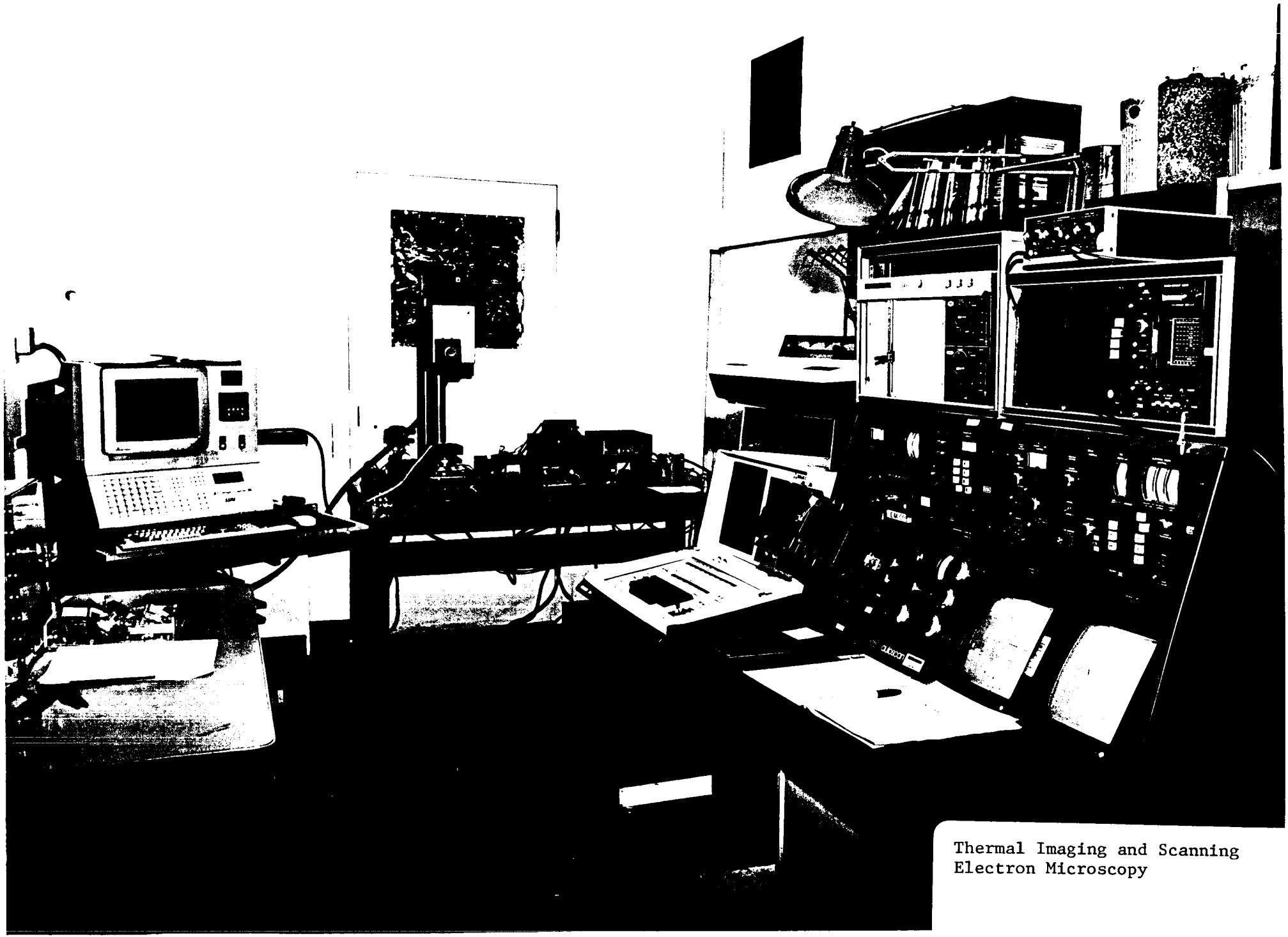
12. Projected use to FY 1997.
Out to FY1997 the projected use is expected to be 6 work-years per year.

13. Personnel used to operate the equipment.
Six professionals are required to operate the equipment.

14. Personnel used to maintain the equipment.
Four professionals are required to maintain the equipment.

15. Facility photo attached.

16. This facility is not shared with any other function. This facility is unique to DoD and the Federal Government, because it allows RF life testing at microwave frequencies. No other government owned equipment does this.



Thermal Imaging and Scanning
Electron Microscopy

X-Ray Diagnostic
Facility

R

A.2: AIR VEHICLES: ROTARY-WING AVIONICS (note: this is a new section; 17 Aug 94)

3. 0 Mission. The rotary-wing avionics work at NRL involves R&D in EO/IR systems. This research is conducted in the Optical Sciences Division. The research in this warfare area spans a broad spectrum of research into the science, technology, and system concepts that will enable the Navy to best meet its military requirements. The rotary-wing avionics activities at NRL draw upon the spectrum of S&T areas within NRL, the Navy, the Department of Defense, and our international allies to develop new systems and to devise technologies that meet emerging needs of the Navy, and that better enable it to fulfill its designated role in DoD.

The research in optical sciences includes a wide range of efforts which include the application of EO/IR sensors, application of optical devices to signal processing, and IR signature studies, Specifically the rotary-wing avionics program includes work in:

- IR missile seeker evaluation
- Modeling, detection and tracking algorithm development
- Missile threat warning receiver (both IR and UV) design and development

The work in this area is complemented by work in other NRL divisions such as Materials, Chemistry, Electronic Technology, etc. The NRL optical sciences program is supported by a group of nearly 140 scientists, engineers, and technical support personnel who each specialize in one or more of the science and technology areas which comprise the optical sciences effort. Of this complement, less than 8% of the personnel support the rotary-wing avionics portion of the work. The optical sciences program is supported by a number of modern research tools and facilities, a portion of which are used in the rotary-wing avionics program. In general, these specialized facilities are Navy specific in design and focus on unique Navy applications.

3.1 Location

3.1.1 Geographic/Climatological Features. No special geographic/climatological features are relevant to this CSF.

3.1.2 Licenses & Permits. None.

3.1.3 Environmental Constraints. None.

3.1.4 Special Support Infrastructure. None

3.1.5 Proximity to Mission-Related Organizations. None

3.2 Personnel

3.2.1 Total Personnel. Only Government and on-site system engineering technical assistance (SETA) personnel support the rotary-wing avionics CSF. There are no military or FFRDC personnel supporting the program. The count below gives the number of persons, not the number of work years.

R

Types of personnel	Number of Personnel			
	Government		On-Site FFRDC	On-Site SETA
	Civilian	Military		
Technical	8			4
Management (Supv)	2			
Other				

3.2.2 Education. The number of government personnel actively engaged in S&T, engineering development and in-service engineering activities by highest degree and type of position is provided in the following table.

Type of Degree/ Diploma	Number of Government Personnel by Type of Position		
	Technical	Management (Supv)	Other
High School or Less			
Associates			
Bachelor	1		
Masters	1		
Doctorate (include Med/Vet/etc.)	6	2	

3.2.3 Experience. The experience level of government personnel is provided in the following table.

Type of Position	Years of Government and/or Military Service				
	Less than 3 years	3-10 years	11-15 years	16-20 years	More than 20 years
Technical		3	1	1	3
Management (Supv)			1		1
Total		3	2	1	4

3.2.4 Accomplishments During FY91-93.

3.2.4.1 The number and listing of patent awards in the rotary-wing avionics area for FY91-93 are:

CSF	Disclosures	Awarded	Patent Titles (List)
ROTARY-WING AVIONICS	0	1	List Follows
Total	0	1	

16 SEP 1994

R

Types of personnel	Number of Personnel			
	Government		On-Site FFRDC	On-Site SETA
	Civilian	Military		
Technical	8			4
Management (Supv)	2			
Other				

3.2.2 Education. The number of government personnel actively engaged in S&T, engineering development and in-service engineering activities by highest degree and type of position is provided in the following table.

Type of Degree/ Diploma	Number of Government Personnel by Type of Position		
	Technical	Management (Supv)	Other
High School or Less			
Associates			
Bachelor	1		
Masters	1		
Doctorate (include Med/Vet/etc.)	6	2	

3.2.3 Experience. The experience level of government personnel is provided in the following table.

Type of Position	Years of Government and/or Military Service				
	Less than 3 years	3-10 years	11-15 years	16-20 years	More than 20 years
Technical		3	1	1	3
Management (Supv)			1		1
Total		3	2	1	4

3.2.4 Accomplishments During FY91-93.

3.2.4.1 The number and listing of patent awards in the rotary-wing avionics area for FY91-93 are:

CSF	Disclosures	Awarded	Patent Titles (List)
ROTARY-WING AVIONICS	0	1	List Follows
Total	0	1	

R

ROTARY-WING AVIONICS PATENTS AWARDED:
1. "Noninvasive Pressure Measuring Device and Method", 5,115,668

ROTARY-WING AVIONICS PATENT DISCLOSURES: None

3.2.4.2 The number of papers published in peer reviewed journals in FY91-93 is provided in the table below.

CSF	Number Published	Paper Titles (List)
ROTARY-WING AVIONICS	None	

R

R

3.3 Workload

3.3.1 FY93 Workload

3.3.1.1 Work Year and Lifecycle The number of actual workyears executed for the rotary-wing avionics CSF in FY93 is provided by the table below for each of the following: government civilian; military; on-site FFRDCs; and on-site SETAs.

"LAB"	Fiscal Year 1993 Actual			
	Civilian	Military	FFRDC	SETA
Science & Technology	0.15			1
Engineering Development	0.62			1
In-Service Engineering	8.16			0.7

R

ROTARY-WING AVIONICS PATENTS AWARDED:
1. "Noninvasive Pressure Measuring Device and Method", 5,115,668

ROTARY-WING AVIONICS PATENT DISCLOSURES: None

3.2.4.2 The number of papers published in peer reviewed journals in FY91-93 is provided in the table below.

CSF	Number Published	Paper Titles (List)
ROTARY-WING AVIONICS	2	List Follows
TOTAL	2	

AVIONICS PUBLICATIONS:
1. "Design and Performance of a Loral Laser Warning Receiver",* Proc. IRIS IRCM, 347, **1**, 1992.
2. "Laboratory and Field Evaluation of a Loral Laser Warning Receiver",* Proc. IRIS IRCM, Apr 1993.

* Peer-Reviewed Conference Proceedings

3.3 Workload

3.3.1 FY93 Workload

3.3.1.1 Work Year and Lifecycle The number of actual workyears executed for the rotary-wing avionics CSF in FY93 is provided by the table below for each of the following: government civilian; military; on-site FFRDCs; and on-site SETAs.

"LAB"	Fiscal Year 1993 Actual			
	Civilian	Military	FFRDC	SETA
Science & Technology	0.15			1
Engineering Development	0.62			1
In-Service Engineering	8.16			0.7

R

3.3.1.2 Engineering Development By ACAT. For each rotary-wing avionics CSF programs conducted under engineering development, the following table provides a summary of the efforts and identifies the specific engineering development programs that are supported.

Engineering Development	Name or Number	Workyears (FY93 Actual)	FY93 Funds Received (Obligation Authority)	Narrative
ACAT IC	None			
ACAT ID	None			
ACAT II	None			
ACAT III/IV	None			
Other	1	1.62	1,067	Tactical Aircraft CM

3.3.1.3 In-Service Engineering. The following table provides for each in-service engineering program in the rotary-wing avionics CSF the FY93 workyears, funding, and weapon system supported.

Common Support Functions	In-Service Engineering Efforts (List)	FY93 Actual		Weapon System(s) Supported
		Funds Received (Obligation Authority)	Workyears	
ROTARY-WING AVIONICS	Helicopter IRCM	628.3	0.81	AN/AAR-47
	Laser RF/D CM	3685.4	4.22	AN/AAR-47
	IR Lamp Tester	131.7	0.47	AN/AAR-47
	IR Source	650	3.36	AN/AAR-47

3.3.2 Projected Funding

3.3.2.1 Direct Funding. The NRL rotary-wing avionics program receives no direct funding, consequently all entries in the table below are zero.

CSF	FY94	FY95	FY96	FY97
ROTARY-WING AVIONICS	0	0	0	0

3.3.2.2 Other Obligation Authority. Reimbursable and direct-cite funding (other obligation authority expected) from FY94 to FY97 is provided below.

CSF	FY94	FY95	FY96	FY97
Reimbursable	2,803	3,200	3,300	3,400
Direct-Cite	2,195	2,300	2,500	2,700

R

3.4 Facilities and Equipment

3.4.1 Major Equipment and Facilities. The major facilities necessary to support the rotary-wing avionics CSF are listed in the following table, and are described more fully in the text that follows the table. Where the facilities are shared with other functions, the percentage of total time used by the rotary-wing avionics function is shown in parentheses following each table entry. The remaining percentages are used to support Navy specific activities.

		Unique to			
Common Support Function	**Major Facility or Equipment Description**	**DoD**	**Federal Gov't**	**U. S.**	**Replacement Cost ($K)**
ROTARY-WING AVIONICS	High Precision Optical Tracker* (50%)				1,200
	Seeker Simulation Laboratory (100%)	X	X	X	3,000
	Missile Warning System Facility* (50%)	X			2,000

*The remaining percentage of these facilities support the fixed-wing avionics CSF.

HIGH PRECISION OPTICAL TRACKER

This facility measures optical and infrared (IR) signatures of targets in motion and the propagation of light through the atmosphere. It consists of two 40-ft long, 7-ft wide electronics trailers. One has a 32" diameter optical tracker mounted at the back. Built originally to do absolute transmittance measurements between ships, the tracker now has the capability of tracking noncooperative targets for signature studies. With a 6-μrad tracking accuracy capability, tracking choices are trackball, video image tracking by contrast or correlation, or computer drive. Newtonian optics direct gathered radiation to either IR imaging sensors or to an IR scanning spectrometer. The second trailer provides the calibration capability to the facility. A 36" mirror with four blackbody sources with associated computer programs and control provide a known value of radiation arriving at the tracker telescope aperture. To complete the calibration suite is equipment to measure and record meteorological parameters such as air temperature, dew point and visibility.

SEEKER SIMULATION LABORATORY

The function of this laboratory is to assess optical countermeasure vulnerability of infrared seekers and trackers, to determine the effectiveness of the operation of infrared jammers, and to develop advanced jamming techniques. This laboratory consists of two computer-controlled rate tables where systems are mounted; four lasers acousto-optically modulated to simulate target and jammer; two computer-controlled arbitrary waveform generators; four computer-controlled function generators; a 32-channel Ampex tape recorder; and an extensive variety of electronicprocessing equipment including spectrum analyzer, vector phase lock analyzers, etc. All electronics systems are interfaced to a desktop computer that controls the experiment and data acquisition. The combination of the diagnostic electronics and the four lasers integrated into a single operating system is a unique capability unavailable anywhere else in the US.

R

MISSILE WARNING SYSTEM FACILITY
This facility is used for the development and demonstration of sensors and algorithms for missile warning systems and for data collection in support of sensor and algorithm development. A missile warning sensor for aircraft requires a system capable of detecting the threat missile at sufficient range to implement effective countermeasures while rejecting non-threat missiles and background or clutter features which mimic the characteristics of threat missiles. The development of such systems requires a body of data characterizing both the targets and the competing background and clutter and a set of algorithms capable of sorting the features of all sources to provide a high probability of threat missile detection with a low false alarm rate under stressing clutter or battlefield conditions. A facility for supporting such development must be capable of acquiring the necessary data and processing it rapidly to assess the effectiveness of algorithms. The capability of this facility for developing and demonstrating sensors and algorithms in spectral regions from the ultraviolet through the infrared spectral is unique within the Defense Department.

3.5 Expansion Potential

3.5.1 Laboratory Facilities. Facilities records as of the fourth-quarter FY93 are used in providing the following data (in ksq ft) for the rotary-wing avionics CSF.

Common Support Function	Facility or Equipment Description	Type of Space*	Space Capacity (KSF)		
			Current	Used	Excess
AVIONICS	Office	Administrative	0.360	0.360	0
	Laboratory	Technical	6.90	6.90	0
	Storage	Storage	.072	.072	0

* Administrative, Technical, Storage, Utility

Space is centrally managed at NRL. When space becomes excess in a Division the excess space is returned to the NRL space coordinator for reallocation. Hence, in general, the NRL performing Divisions do not have excess space and thus the above tables show no excess space for the rotary-wing avionics CSF.

3.5.1.1 In general, the facilities/labs that support the rotary-wing CSF are readily capable of accepting a modest increase of work as long as the type of work that would be gained is of the same type that is currently being performed. In this case, it is assumed that the physical size of the space, and the equipment and instrumentation available is of the proper variety for the work. Although much greater increases in the capacity may be obtained, it is expected that this would entail major modifications to existing facilities or the construction of expanded facilities. Significant changes in the nature of the work might also entail a similar degree of modification.

3.5.1.2 Based on currently available space, and using the consideration of similar work discussed above, it is believed that the NRL rotary-wing avionics CSF could be increased by as much as 5 workyears per year before major modifications to facilities would be required. This increased workyear effort would have to be accommodated largely by new hires.

3.5.1.3 For 3.5.1.1 and 3.5.1.2 (above) describe the impact of military construction programs or other alteration projects programmed in the FY95 PBS. (BRAC Criteria II). None.

16 SEP 1994

R

MISSILE WARNING SYSTEM FACILITY
This facility is used for the development and demonstration of sensors and algorithms for missile warning systems and for data collection in support of sensor and algorithm development. A missile warning sensor for aircraft requires a system capable of detecting the threat missile at sufficient range to implement effective countermeasures while rejecting non-threat missiles and background or clutter features which mimic the characteristics of threat missiles. The development of such systems requires a body of data characterizing both the targets and the competing background and clutter and a set of algorithms capable of sorting the features of all sources to provide a high probability of threat missile detection with a low false alarm rate under stressing clutter or battlefield conditions. A facility for supporting such development must be capable of acquiring the necessary data and processing it rapidly to assess the effectiveness of algorithms. The capability of this facility for developing and demonstrating sensors and algorithms in spectral regions from the ultraviolet through the infrared spectral is unique within the Defense Department.

3.5 Expansion Potential

3.5.1 Laboratory Facilities. Facilities records as of the fourth-quarter FY93 are used in providing the following data (in ksq ft) for the rotary-wing avionics CSF.

			Space Capacity (KSF)		
Common Support Function	Facility or Equipment Description	Type of Space*	Current	Used	Excess
AVIONICS	Office	Administrative	0.360	0.360	0
	Laboratory	Technical	6.90	6.90	0
	Storage	Storage	.072	.072	0

* Administrative, Technical, Storage, Utility

Space is centrally managed at NRL. When space becomes excess in a Division the excess space is returned to the NRL space coordinator for reallocation. Hence, in general, the NRL performing Divisions do not have excess space and thus the above tables show no excess space for the rotary-wing avionics CSF.

3.5.1.1 In general, the facilities/labs that support the rotary-wing CSF are readily capable of accepting a modest increase of work as long as the type of work that would be gained is of the same type that is currently being performed. In this case, it is assumed that the physical size of the space, and the equipment and instrumentation available is of the proper variety for the work. Although much greater increases in the capacity may be obtained, it is expected that this would entail major modifications to existing facilities or the construction of expanded facilities. Significant changes in the nature of the work might also entail a similar degree of modification.

3.5.1.2 Based on currently available space, and using the consideration of similar work discussed above, it is believed that the NRL rotary-wing avionics CSF could be increased by as much as 5 workyears per year before major modifications to facilities would be required. This increased workyear effort would have to be accommodated largely by new hires.

3.5.1.3 For 3.5.1.1 and 3.5.1.2 (above) describe the impact of military construction programs or other alteration projects programmed in the FY95 PBS. (BRAC Criteria II). None.

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3.5.2 Land Use. NRL has 11.2 acres available for unrestricted expansion located at its Chesapeake Bay Detachment. Parking would have to be included as part of any expansion project. Utilities, while available, are aged and would be required to be upgraded to accommodate any expansion.

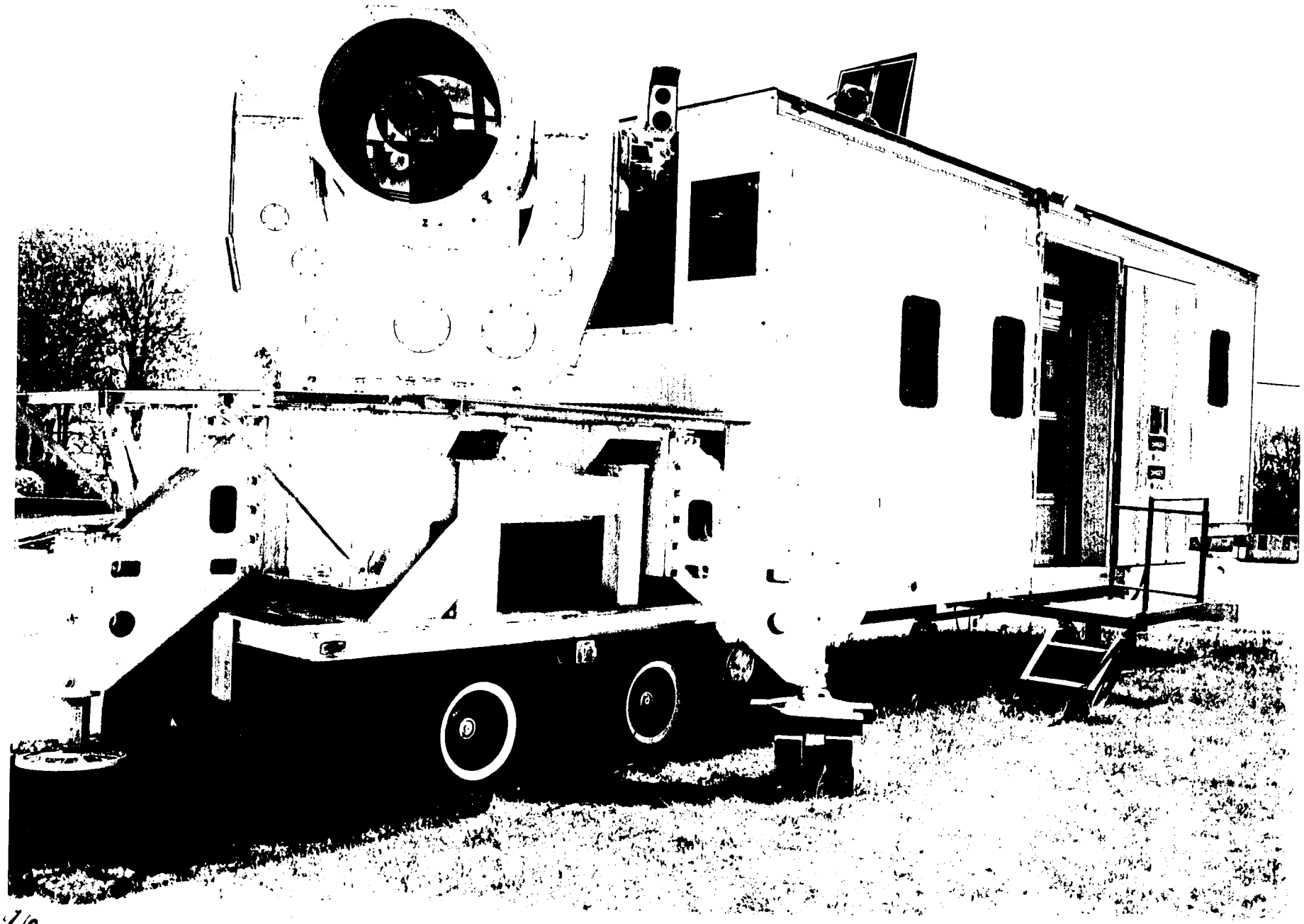
The building space, (class 2 property) currently available for growth opportunities at the NRL DC site, either constrained or unconstrained, represents a total of multiple small areas located throughout the Laboratory which cannot be effectively utilized by any other functions other than the primary occupant of the facility. It is important to note, however, that NRL facilities can be re-configured, e.g. demolished and rebuilt, altered, and fitted with capital equipment, etc. to accommodate new or expanded mission assignments. However, accurate quantification of the maximum amount of space available for expansion is not practical without the benefit of revised mission/program planning guidance. For planning purposes, a rough order of magnitude estimate of the minimum class 2 space available for expansion is 10 percent. This would involve minimal reconfiguration.

3.5.3 Utilities. Utility service capacities are depicted in the following table:

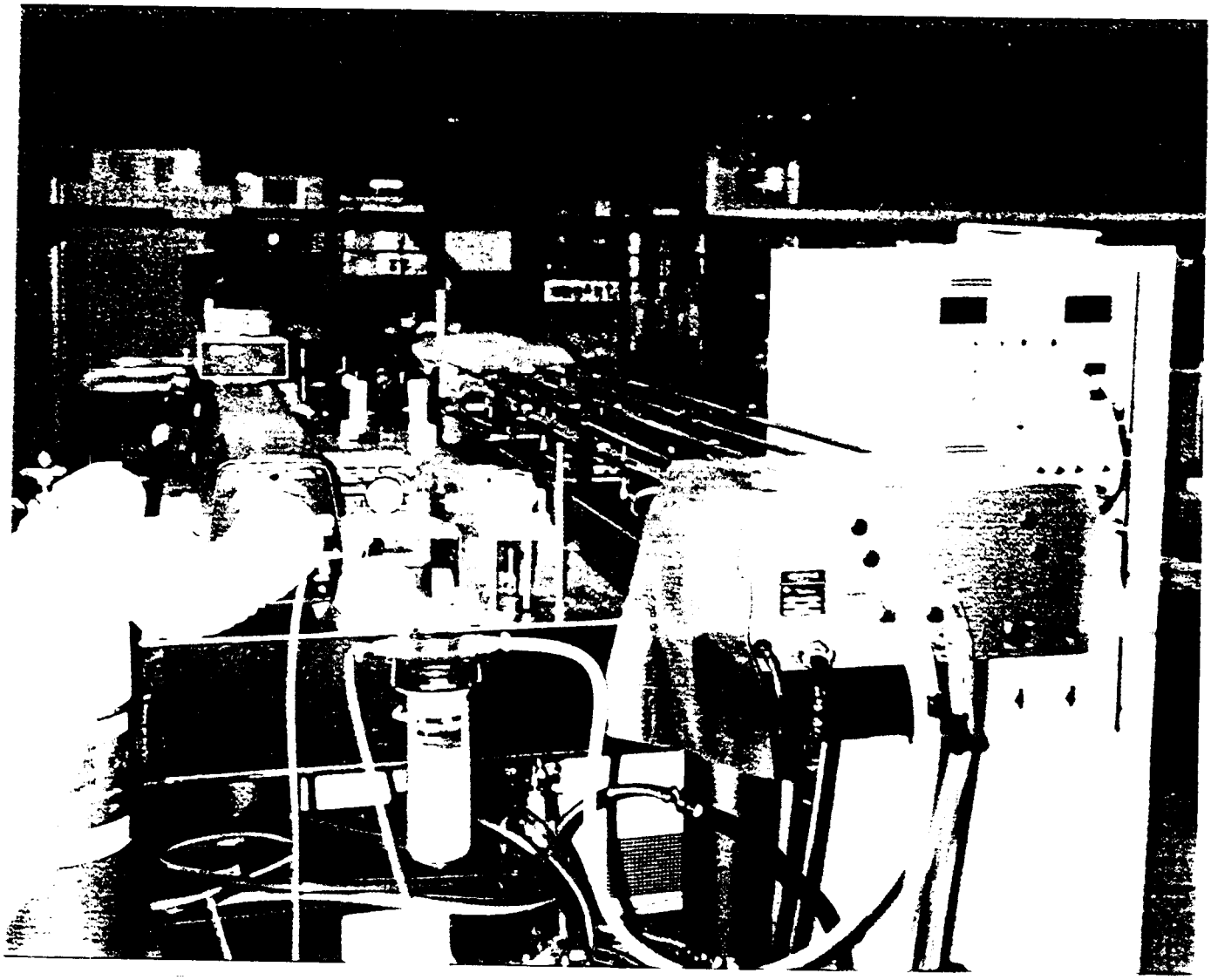
	On Base Capacity	Off Base Long Term Contract	Normal Steady State Load	Peak Demand
Electrical Supply (KWH)	N/A	54,000 KWH	13,098 KWH	17,280 KWH
Natural Gas (CFH)[1]	N/A	2,961 CFH	141 CFH	1,868 CFH
Sewage (GPD)	N/A	Unlimited	847,583 GPD	1,017,100 GPD
Potable Water (GPD)	N/A	9,740,978 GPD	1,118,911 GPD	1,342,693 GPD
Steam (PSI & lb/Hr)[2]	190,000 lb/Hr	N/A	116,000 lb/Hr	125,000 lb/Hr

1 The availability of natural gas is controlled by the Washington Gas Light Company. It can be relied on as a primary fuel.

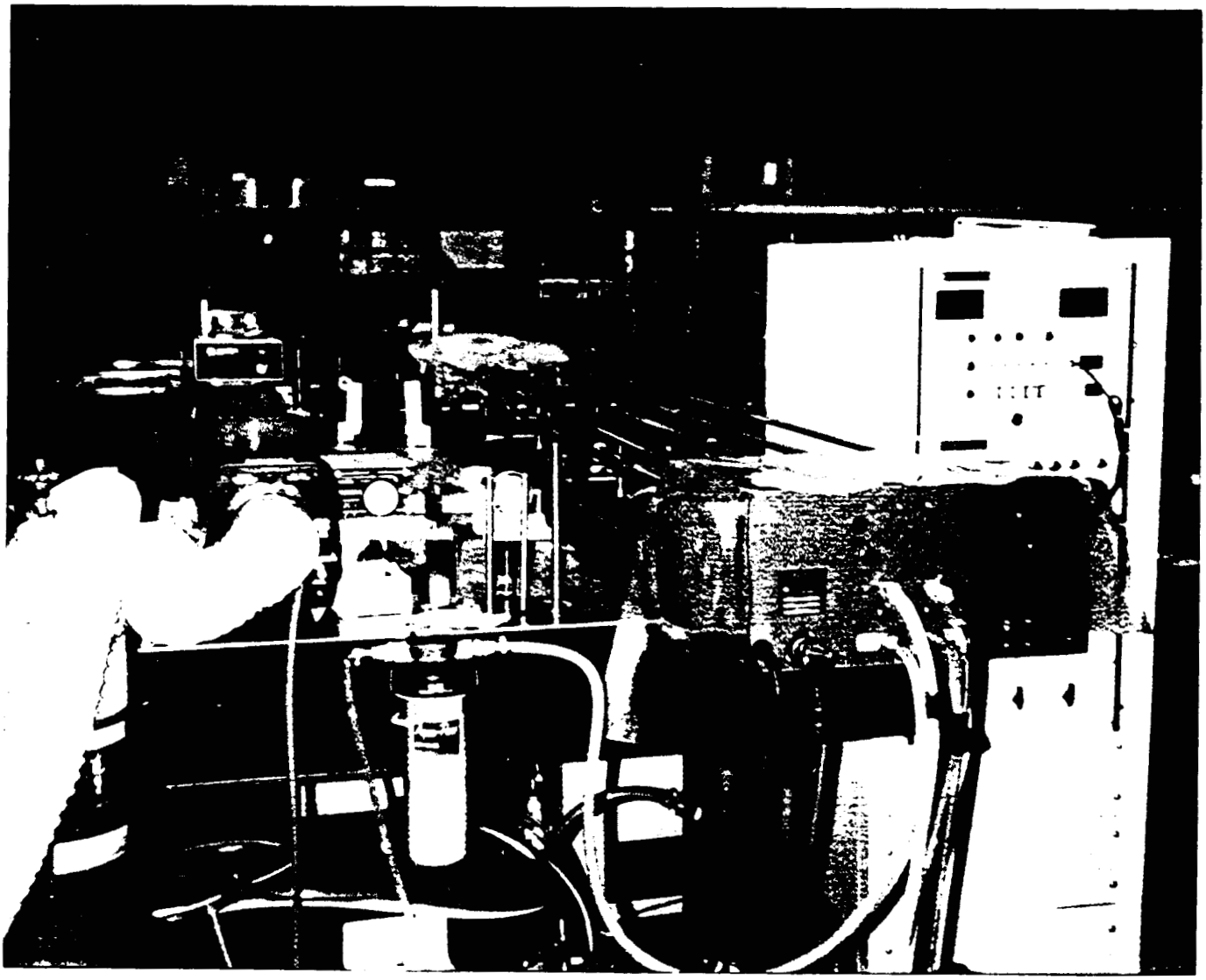
2 Production plant owned by the PWC, Washington.BRAC-95 CERTIFICATION



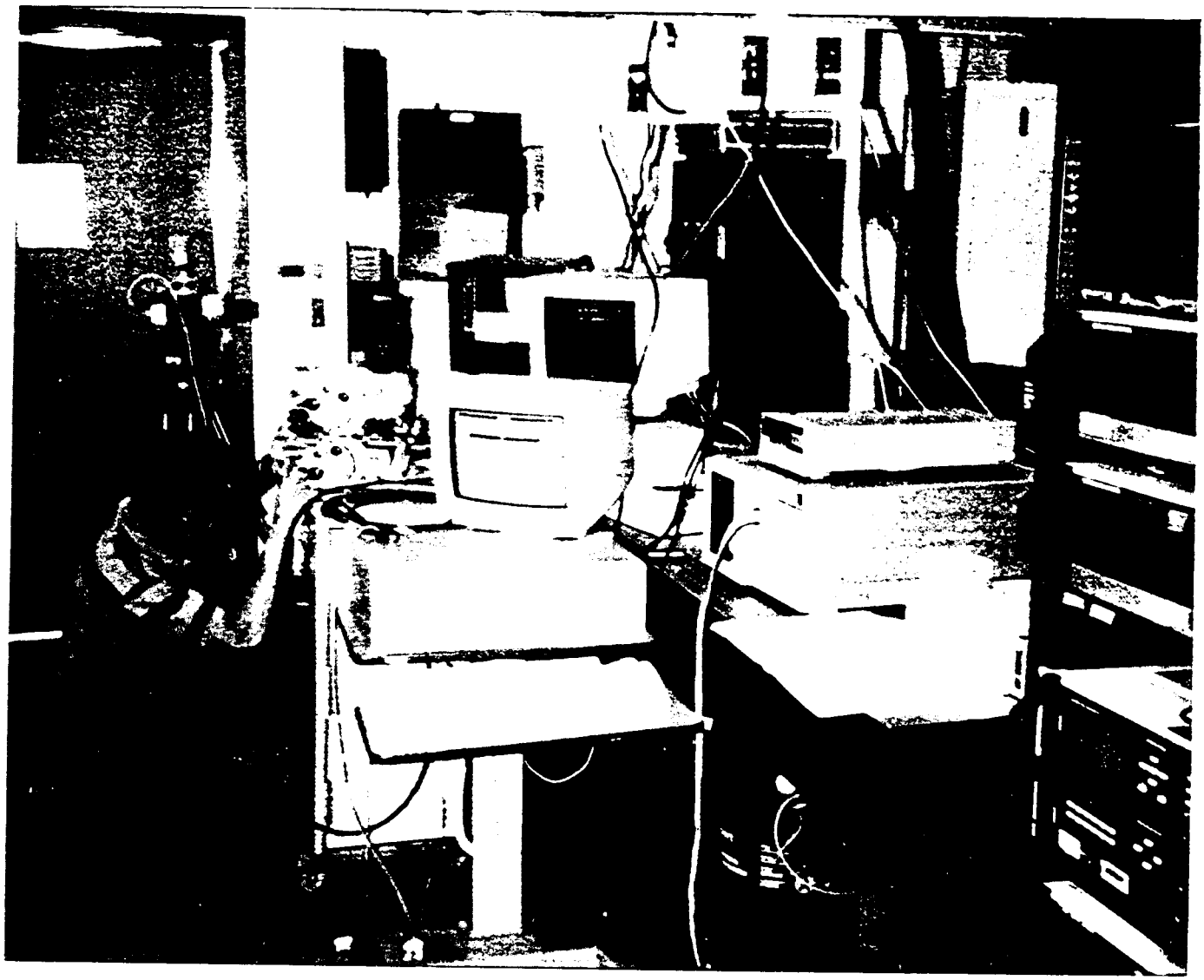
HIGH-PRECISION OPTICAL TRACKER



SEEKER SIMULATION



SEEKER SIMULATION LABORATORY



MISSILE WARNING SYSTEM FACILITY

19 AUG 1994

REPLACED IN ITS ENTIRETY BY AIRVEHICLES/FIXED WING AVIONICS SECTION of 19 AUG 94 AND AIRVEHICLE/ROTARY WING AVIONICS SECTION of 19 AUG 94. PICTURES MOVED TO NEW SECTIONS

A: AIR VEHICLES: AVIONICS

3.0 Mission. The avionics work at NRL includes efforts in EW systems, EO/IR systems, and Cooperative Aircraft Identification (CAI). This research is conducted in three NRL divisions: the Tactical EW Division, the Optical Sciences Division, and the Radar Division. The research in these three warfare areas span a broad spectrum of research into the science, technologies, and system concepts that will enable the Navy to best meet its military requirements. The avionic activities at NRL draw upon the full spectrum of S&T areas within NRL, the Navy, the Department of Defense, and our international allies to develop new systems and to devise technologies that meet emerging needs of the Navy, and that better enable it to fulfill its designated role in DoD.

The EW research includes a wide range of effort addressing EW needs for both Naval ships and aircraft and for their missions in the area of electronic support measures and countermeasures, as well as in critical supporting technologies for electronic warfare. Although principally focused on EW research for ships, as part of the full spectrum Corporate Laboratory for the Navy, the NRL EW program includes a significant fraction that focuses on the needs unique to carrier aviation, and on other aircraft platforms that support the overall Navy mission. The NRL EW program is executed by a group of nearly 300 scientists, engineers, and technical support personnel who each specialize in one or more of the science and technology areas that are critical to EW for the Navy. In general, each of these personnel performs research that supports both ship and aircraft needs within their individual areas of expertise as the needs arise. The EW program is supported by an extensive set of modern research tools and facilities which are highly specialized to EW technology research needs, and are used to support both the larger ships related portion of the research program as well as the smaller part devoted to avionics for EW. In general, these specialized facilities are Navy specific in design and focus on the S&T needs for EW in support of the unique needs of the Navy.

The research in optical science includes a wide range of effort which include the application of EO/IR sensors to ships, aircraft, and undersea surveillance; application of optical devices to signal processing, delay lines, fiber–optic gyros, strain sensors, fiber–optic hydrophones, fiber–optic magnetic sensors, imaging systems, and basic research in optical materials, optical propagation studies, IR signature studies, and laser research. Specifically the avionics program includes work in;

- IR focal plane design
- IR missile seeker evaluation
- Surveillance and reconnaissance camera development
- Modelling, detection and tracking algorithm development
- Missile threat warning receiver (both IR and UV) design and development
- In–house radiation hardened fiber fabrication
- Ultra high bandwidth fiber delay lines for EW decoys
- File networking for avionic data communications
- Smart structure development using embedded fiber sensors

The work in this area is complemented by work in other NRL divisions such as Materials, Chemistry, Electronics, etc. The NRL optical sciences program is supported by a group of nearly 140 scientists, engineers, and technical support personnel who each specialize in one or more of the science and technology areas which comprise the optical sciences effort. Of this complement less than 20% of the personnel support the avionics portion of the work. The optical sciences program is supported by a number of modern research tools and facilities, a portion of which are used in the avionics program. In general, these specialized facilities are Navy specific in design and focus on unique Navy applications.

NRL has been the acknowledged technical leader among the four Services in the field of Cooperative Aircraft Identification (CAI), formerly called Identification Friend or Foe (IFF). Its work in this area affects all four Services as well as the NATO allies. In terms of work years and funding, it is a small part of the total effort in the Radar division, but its importance is far greater than the dollar amount of funding indicates.

3.1 Location

3.1.1 Geographic/Climatological Features. The Chesapeake Bay Detachment (CBD) of the NRL provides a geographically unique facility (East Coast location) that is particularly well suited for research needs in support of Naval warfare areas. The site, on a cliff overlooking the Bay, provides a nine mile overwater path to the NRL site on Tilghman Island. The approximately 100 foot cliff height closely represents the height of ship sensors above the ocean, and the path to Tilghman Island approaches the surface horizon for these sensors. This geometry is exactly that seen in attacks on US ships by enemy missiles, and in attacks on enemy ships by low flying US aircraft and sea skimming missiles. Such a geometry must be achieved if successful experiments are to be conducted in support of the NRL warfare systems research program.

3.1.2 Licenses & Permits. Ordnance handling, transportation, and storage at CBD.

3.1.3 Environmental Constraints. None known other than those associated with the handling of explosives at the CBD site.

3.1.4 Special Support Infrastructure. None

3.1.5. Proximity to Mission–Related organizations. The two principal organizations on which the avionics research is most dependent upon are the Naval Air Warfare Center (NAWC) facilities at Patuxent River (PAX), MD and at the Naval Surface Warfare Center facilities at Wallops Island, VA. These facilities support the NRL EW effort by providing test ranges and radars at Wallops Island and a large aircraft test anechoic chamber at Patuxent River which is unique to the Navy.

Common Support Functions	Name	Type of Organization	Distance	Workyears Performed by Your Activity	Workyears Funded by Your Activity
AVIONICS	PAX	TEST CENTER	60 MI	7.0	0.5
AVIONICS	WALLOPS	TEST RANGE	150 MI	1.0	0.5

3.2 Personnel

3.2.1 Total Personnel. Only government and on–site system engineering technical assistance (SETA) personnel support the avionics CSF. There are no military or FFRDC personnel supporting the program. The count below gives the number of persons, not the number of work years.

Types of Personnel	Number of Personnel			
	Government		On-Site FFRDC	On-Site SETA
	Civilian	Military		
Technical	65	0	0	37
Management (Supv)	12	0	0	0
Other	0	0	0	0

3.2.2 Education. The number of government personnel actively engaged in S&T, engineering development and in-service engineering activities by highest degree and type of position is provided in the following table (note that one Certified Professional Engineer is included in the Bachelor category).

Type of Degree/ Diploma	Number of Government Personnel by Type of Position		
	Technical	Management (Supv)	Other
High School or Less	6	0	0
Associates	1	0	0
Bachelor	23	4	0
Masters	16	0	0
Doctorate (include Med/Vet/etc.)	19	8	0

3.2.3 Experience. The experience level of government personnel is provided in the following table.

Type of Position	Years of Government and/or Military Service				
	Less than 3 years	3-10 years	11-15 years	16-20 years	More than 20 years
Technical	4	25	11	2	23
Management (Supv)	0	0	3	1	8
Total	4	25	14	3	31

3.2.4 Accomplishments During FY91-93.

3.2.4.1 The number and listing of patent awards in the avionics area for FY91-93 are:

CSF	Disclosures	Awarded	Patent Titles (List)
AVIONICS	6	3	List Follows
Total	6	3	

Note that this list does not include those classified patents which have been assigned but not published or awarded due to classification.

AVIONICS PATENTS AWARDED:
1. Noninvasive Pressure Measuring Device and Method, #5,115,668
2. Interferometer With Two Phase Conjugate Mirrors, #5,120,133
3. Room Temperature Flashpumped 2.09 Micron Solid State Laser, #5,088,103

AVIONICS PATENT DISCLOSURES:
1. Apparatus for Two Dimensional Images, #73,939
2. Combined Range Delay, #75,638
3. CW Mode–Locked 2 Micron Tm:YAG Laser, #73,829
4. Intracavity Pumped Tm:Ho 2.01 Micron Coupled Cavity Laser, #74,075
5. Subpicosecond Pulse Operation of a 2 Micron Tm:YAG Laser using Additive Pulse Modelocking, #74,203
6. Reduced Signal Friend Identification, #74,336

3.2.4.2 The number of papers published in peer reviewed journals in the years FY91–93 is provided in the table below. It should be noted that many of the NRL avionics research results are classified and cannot be published in the usual peer reviewed journals. Only the Journal of Defense Research (recently defunct) sponsored by DoD was available as a classified peer reviewed journal. Also many avionics research results are published in the form of classified DoD documents.

CSF	Number Published	Paper Titles (List)
AVIONICS	27	List Follows

AVIONICS PUBLICATIONS:
1. "A Toolset for Navigation in Virtual Environments", * Proceedings of the ACM Symposium on User Interface Software & Technology, Nov. 1993, pp. 157–165.
2. "Hands–off Interactions with Menus in Virtual Spaces", * Proceedings of the 7th Annual Workshop on Space Operations Applications & Research, Feb. 1994.
3. "Ship Wake Exploitation for Cruise Missile Guidance", Journal of Defense Research, Nov. 1991, Vol. 21, No. 1, pp.1–34.
4. "Over–the–Horizon Radar ECM", Journal of Defense Research, Sep. 1992, Vol. 21, No. 4, pp.921–986.
5. "Tactical Proforma Exploitation", Journal of Defense Research, June 1992, Vol. 21, No. 3, pp.715–739.
6. "Transmission Line Amplifier", IEEE Transactions on Electron Devices, Sept. 1992, Vol. 39, No. 9, pp.2165–2171.
7. "Diode Pumped Amplifier/Laser using Leaky–Wave Fiber Coupling: An Evaluation", IEEE J. Quantum Mechanics, Apr. 1992, Vol. 28, No. 4.
8. "Image Speckle Contrast Reduction from Integrative Synthetic Aperture Imaging", Applied Optics, Jan. 1992, Vol. 31, No. 1.
9. "Effects on Nonredundance on a Synthetic Aperture Imaging System", Journal of the Optical Society of America, 1993.
10. "Design and Performance of a Loral Laser Warning Receiver", * Proceedings of IRIS IRCM 1992.
11. "Laser Ranging Countermeasure Program Acceptance Test",* Proceedings of IRIS IRCM , 1992.
12. "Short Wavelength Imaging Laser Radar using a Digicon Detector",* SPIE Optical Engineering, Nov. 1992, Vol. 31, No. 11.
13. "Infrared Focal Plane Array Technology", Proceedings IEEE, Jan 1991, Vol. 79, No. 1.
14. "Even Length Median Filters in Optimal Signal Processing", Elect. Letters, June 1992, Vol. 28, No. 13.
15. "Intracavity–pumped 2.09 Micron Ho:YAG Laser", Optics Letters, May 1992, Vol. 17,

No. 10.

16. "Adaptive Nonuniformity Correction for Staring IRFPA Camera",* Proceedings IRIS Detectors, Aug. 1993.
17. "Composite Infrared Color Images and Related Processing", * Proceedings IRIS Targets, Jan. 1993.
18. "Effects of System Stability and Detector 1/f Noise on Staring IRFPA Performance",* Proceedings IRIS Sensors, Mar. 1993.
19. "Adaptive Retina–like Preprocessing for Imaging Detector Arrays",* Proceedings IEEE Conf. on Neural Networks, Mar. 1993.
20. "Performance of Real–time Adaptive Nonuniformity Correction Techniques for Arrays",* Proceedings IRIS Sensors, Mar. 1993.
21. "Effects of Low Power IR Laser Countermeasures on Several IR Focal Plane Arrays",* Proceeding IRIS IRCM, Apr. 1993.
22. "Laboratory and Field Evaluation of a Loral Laser Warning Receiver",*, Proceeding IRIS IRCM, Apr. 1993.
23. "Protection of Civil and Military Aircraft from Heat Seeking Missiles",* Proceedings ADPA Symposium on Transport Aircraft Survivability, Oct. 1993.
24. "Automatic Classification of Threat Missiles",* Proceeding IRIS IRCM, Apr. 1993.
25. "Measurement and Analysis of Optical Scatter in FLIR's",* Proceedings IRIS IRCM, Apr. 1993.
26. "Multispectral IRFPA Needs",* Proceedings IRIS Detector, Aug. 1993.
27. "Theory and Design of Local Interpolators",* CVGIP Graphical Methods and Image Processing, 1993, Vol. 55, No. 6.

*Peer–Reviewed Conference Proceedings

3.3 Workload

3.3.1 FY93 Workload

3.3.1.1 Work Year and Lifecycle. The number of actual workyears executed for the avionics CSF in FY93 is provided by the table below for each of the following: government civilian; military; on–site FFRDCs; and on–site SETAs.

"LAB"	Fiscal Year 1993 Actual			
	Civilian	Military	FFRDC	SETA
Science & Technology	37.36	0	0	17.05
Engineering Development	28.52	0	0	16.7
In–Service Engineering	8.16	0	0	0.7

3.3.1.2 Engineering Development By ACAT. For the avionics CSF programs conducted under engineering development, the following table provides a summary of the efforts and identifies the specific engineering development programs that are supported.

Engineering Development	Name or Number	Workyears(FY93 Actual)	FY93 Funds Received($K) (Obligation Authority)	Narrative
ACAT IC	None			
ACAT ID	CAI	3.6	600	New CAI system to correct the deficiencies in the current Mark XII IFF
ACAT II	None			
ACAT III/IV	3	19.4	3914	Navy EA–6B EW AN/ALE–50 Decoy SLQ–20 Upgrade
Other	7	22.22	7858	Airborne RF Decoys RF Labs/INEWS E2C Emitter ATEWES STORYFINDER Tactical Aircraft CM Gusty Beast (Classified Program)

3.3.1.3 In–Service Engineering. The following table provides for each in–service engineering program in the avionics CSF the FY93 workyears, funding, and weapon system supported.

Common Support Functions	In–Service Engineering Efforts (List)	FY93 Actual		Weapon System(s) Supported
		Funds Received ($K) (Obligation Authority)	Workyears	
AVIONICS	Helicopter IRCM Laser RF/D CM IR Lamp Tester IR Source	628.3 3685.4 131.7 650	0.81 4.22 0.47 3.36	AN/AAR–47 AN/AAR–47 AN/AAR–47 AN/AAR–47

3.3.2 Projected Funding

3.3.2.1 Direct Funding. The NRL avionics program receives no direct funding, consequently all entries in the table below are zero.

CSF	FY94($K)	FY95($K)	FY96($K)	FY97($K)
AVIONICS	0	0	0	0

3.3.2.2 Other Obligation Authority. Reimbursable and direct–cite funding (other obligation authority expected) from FY94 to FY97 is provided below:

CSF	FY94($K)	FY95($K)	FY96($K)	FY97($K)
Reimbursable	20,131	22,033	23,150	23,950
Direct–Cite	8,636	9,450	10,370	10,800

3.4 Facilities and Equipment

3.4.1 Major Equipment and Facilities. The major facilities and equipment necessary to support the avionics CSF are listed in the following table, and are described more fully in the text that follows the table. Where the facilities are shared with other functions, the percentage of total time used by the avionics function is shown in parentheses following each table entry. The remaining percentages are used to support Navy specific activities.

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Common Support Function	Major Facility or Equipment Description	Unique To DOD	Federal Gov't	U. S.	Replacement Cost ($K)
AVIONICS Fixed Wing	Ships Radar ECM Simulator(30%)*	X	X	X	3,500
AVIONICS Fixed Wing	RCS Measurement Facility(50%)*	X	X	X	15,000
AVIONICS Fixed Wing	Compact Antenna Range(60%)*				2,600
AVIONICS Fixed Wing	Isolation Meas. Chamber(70%)*	X			3,000
AVIONICS Fixed Wing	Millimeter Wave Chamber(50%)*				2,000
AVIONICS Fixed Wing	RF Techniques Chamber(80%)*				1,500
AVIONICS Fixed Wing	High Precision Optical Tracker (100%)				1,200
AVIONICS Fixed Wing	Focal Plane Array Evaluation Facility(50%)**	X			2,000
AVIONICS Fixed Wing	Seeker Simulation Laboratory(100%)	X	X	X	3,000
AVIONICS Fixed Wing	Missile Warning System Facility(100%)	X			2,000
AVIONICS Fixed Wing	Digital Signal Proc. Facility(75%)**	X			650

* The remaining percentage of utilization for these facilities support Shipboard EW Systems.
** The remaining percentage of utilization for these facilities support the Electronic Devices Function.

More detailed information on each of the special facilities identified above is provided in the following descriptions and photographs.

SEARCH RADAR ECM SIMULATOR(SRES)

SRES is an electronic laboratory designed to test ECM equipment by simulating the engagement between an airborne threat search radar and a group of surface ships and aircraft that use ECM as part of their defense. The method of simulation is real–time generation of the RF signals that would be present in the threat radar receiver from the radar echoes and the ECM. These signals are processed by the radar receivers and displayed on radar displays for man–in–the–loop determination of the ECM effects. An effective ECM would prevent the radar operator from determining the preferred target's location.

The combination of specific equipment, software and capabilities associated with and developed for the SRES laboratory are unique to this facility.

Revision Table 3.4.1
7CE/ONR91 8/17/94

		Unique To			
Common Support Function	Major Facility or Equipment Description	DOD	Federal Gov't	U. S.	Replacement Cost ($K)
AVIONICS	Ships Radar ECM Simulator(30%)	X	X	X	3,500
	RCS Measurement Facility(50%)	X	X	X	15,000
	Compact Antenna Range(60%)				2,600
	Isolation Meas. Chamber(70%)	X			3,000
	Millimeter Wave Chamber(50%)				2,000
	RF Techniques Chamber(80%)				1,500
	High Precision Optical Tracker (100%)				1,200
	Focal Plane Array Evaluation Facility(50%)	X			2,000
	Seeker Simulation Laboratory(100%)	X	X	X	3,000
	Missile Warning System Facility(100%)	X			2,000
	Digital Signal Proc. Facility(75%)	X			650

More detailed information on each of the special facilities identified above is provided in the following descriptions and photographs.

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The combination of specific equipment, software and capabilities associated with and developed for the SRES laboratory are unique to this facility.

RADAR CROSS-SECTION MEASUREMENTS LABORATORY (CHESAPEAKE BAY DETACHMENT)

This facility is a land based installation designed to accurately characterize and quantify the over the water radar cross–section (RCS) signature of ships, aircraft and electronic warfare passive and active systems used to defend these platforms. The system is capable of collecting precision data in 2 to 18 Ghz, and 35 Ghz bands. Additionally, the system can characterize and quantify the Effective Radiated Power (ERP) and sensitivity of active electronic warfare systems over the same frequency range. This facility includes conventional single frequency radars as well as broad–band frequency agile units. Both coherent and noncoherent radars can be used. A 95 Ghz radar is being installed.

This is a one of a kind facility. It is the only facility which routinely conducts the necessary measurements critical to the design and development of R&D decoy and onboard ECM systems.

COMPACT ANTENNA RANGE FACILITY

The primary purpose of the Compact Antenna Range Facility is to provide a unique state–of–the–art anechoic chamber to measure the phase and amplitude of antenna systems over a frequency range of 2 to 100 Ghz in a controlled environment in support of NRL research in EW. The facility also provides the capability for radar cross–section measurements from 2 to 40 Ghz, and small device metrology from 0.45 to 50 Ghz.

The facility has been specially EMI/RFI hardened using massive hydraulically actuated doors. A special hydraulic elevator was installed to move equipment in and out of the chamber. The chamber also has a state–of–the–art microwave lining designed to provide a 4 foot diameter by 6 foot length quiet zone area with greater than 50 dB below incident reflectivity reduction. The chamber also has an automatic fire suppression system designed to prevent damage to electrical systems under test. The facility and equipment are controlled in temperature and humidity to prevent large fluctuations in the microwave absorber and parabolic reflector characteristics.

ISOLATION MEASUREMENT CHAMBER FACILITY

The Isolation Measurement Chamber Facility provides a capability for measuring antenna to antenna radiation coupling characteristics from 2 to 40 Ghz in support of EW research. Configuration and size of the facility and special handling equipment allow for unique accommodation of portions of airframes having antennas mounted in the same position as those of operational aircraft. This feature accounts for the DoD uniqueness.The facility is also capable for making accurate measurements of the RCS of small objects. The facility has been specially EMI/RFI hardened using massive hydraulically actuated doors. In addition, the facility was provided with special handling fixtures to allow removal of a 12 ft. by 15 ft. panel to accommodate the installation of parts of ship structures, aircraft fuselages, wings, etc. for testing. The chamber has a state–of–the–art microwave absorber lining designed to provide a large quiet zone area of 12 ft. by 18 ft. by 10 ft. with a greater than 100dB below incident reflectivity reduction. The chamber has an automatic sensing fire suppression system designed to prevent damage to electrical systems under test. The facility/equipment are controlled in temperature and humidity to prevent large fluctuations in the microwave absorber characteristics.

MILLIMETER WAVE ANECHOIC CHAMBER FACILITY

The primary function of the state–of–the–art Millimeter Anechoic Chamber Facility is to measure and characterize antenna gain, beamwidth, axial roll, beam squint, phase center, VSWR and cross–polarization levels at low power continuously over the frequency range from 8 to 100 Ghz. The facility also provides a means to measure the radio frequency transmission and insertion loss of radomes intended for use in shipboard, aircraft, satellite and missile seekers. The facility consists of a fixed anechoic chamber with a carefully calibrated quiet zone area, while an extremely small portion of the control hardware is moveable, most of the hardware is permanently installed.

The facility has been specially EMI/RFI hardened using massive hydraulically actuated doors. A special hydraulic elevator was installed to move equipment in and out of the anechoic chamber. The chamber has a state–of–the–art microwave absorber lining designed to provide a 3 ft. diameter quiet zone area with greater than 50 dB incident reflectivity reduction. The chamber has an automatic sensing fire suppression system designed to prevent damage to electrical systems under test.

RF TECHNIQUES CHAMBER FACILITY

The primary purpose of the RF Techniques Chamber Facility is to provide a low cost anechoic chamber capability to conduct ECM research on RF homing missiles, airborne intercept radars, antiradiation missiles, small tracking radars and in general to aid in the development of airborne EW systems over the frequency range of 2 to 4 Ghz. The facility has been specially EMI/RFI hardened using massive hydraulically actuated doors. In addition, one side wall of the chamber can be moved electrically to increase the length of the chamber. The chamber has a state–of–the–art microwave absorber lining designed to provide a 4 ft. by 4 ft. spherical quiet zone area with greater than 50 dB below incident reflectivity reduction. The chamber has an automatic sensing fire suppression system designed to prevent damage to electrical systems under test. This facility and equipment are controlled in temperature and humidity to prevent large fluctuations in microwave absorber characteristics.

HIGH PRECISION OPTICAL TRACKER

This facility measures optical and IR signatures of targets in motion and the propagation of light through the atmosphere. It consists of two 40 ft. long by 7 ft. wide electronic trailers. One has a 32" diameter optical tracker mounted on the back. Built originally to do absolute transmittance measurements between ships, the tracker now has the capability of tracking noncooperative targets for signature studies. With a 6 microradian tracking accuracy capability, tracking choices are trackball, video image tracking by contrast or correlation, or computer drive. Newtonian optics direct gathered radiation to either IR imaging sensors or to an IR scanning spectrometer. The second trailer provides the calibration capability of the facility. A 36" mirror with four blackbody sources with associated computer programs and control provide a known value of radiation arriving at the tracker telescope aperture. To complete the calibration suite is equipment to measure and record meteorological parameters such as air temperature, dew point and visibility.

FOCAL PLANE ARRAY EVALUATION FACILITY

In this facility, the optical and electrical evaluation of developmental IR focal plane arrays is conducted to determine the development status, to provide guidelines for future development contracts, and to evaluate the potential for fulfilling Navy sensor requirements. The automated evaluation facility consists of optical sources and electronics required to evaluate monolithic or hybrid IR focal plane arrays that use charge coupled device (CCD), charge injected device (CID), direct readout (DRO), or charge imaging matrix (CIM) technologies. Since developmental arrays are often received in chip form, there are a variety of dewars and mounts to accept different chip carriers. Optical sources are used to illuminate the detectors with short pulse or continuous radiation in both uniform and single detector modes. Calibrated laser sources are used to study array performance under optical overload conditions. The data are acquired and reduced by using computer techniques because each array may consist of tens of thousands of detectors, and many samples of each detector are required for statistical significance. The spectral response of the arrays is determined by using optical filters or spectrometers.

The combination of the high data rate acquisition with real time imaging capability makes this facility unique within the Defense Department.

SEEKER SIMULATION LABORATORY

The function of this laboratory is to assess optical countermeasures vulnerability of IR seekers and trackers, to determine the effectiveness of the operation of IR jammers, and to develop advanced jamming techniques. This laboratory consists of two computer controlled rate tables where systems are mounted: four laser acousto–optically modulated to simulate target and jammer; two computer controlled arbitrary waveform generators; four computer controlled function generators; a 32–channel Ampex tape recorder; and an extensive variety of electronic processing equipment including a spectrum analyzer, vector phase lock analyzers, etc. All electronic systems are interfaced to a desktop computer that controls the experiment and data analysis.

The combination of the diagnostic electronics and the four lasers integrated into a single operating system is a unique capability unavailable anywhere else in the US.

MISSILE WARNING SYSTEM FACILITY

This facility is used for the development and demonstration of sensors and algorithms for missile warning systems and data collection in support of sensor and algorithm development. A missile warning sensor for aircraft requires a system capable of detecting the threat missile at sufficient range to implement effective countermeasures while requiring nonthreat missiles and background or clutter features which mimic the characteristics of threat missiles. The development of such systems requires a body of data characterizing both the targets and the competing background and clutter and a set of algorithms capable of sorting the features of all sources to provide a high probability of threat missile detection with a low false alarm rate under stressing clutter or battlefield conditions.

The capability of this facility for developing and demonstrating sensors and algorithms in spectral regions from the ultraviolet through the infrared spectral is unique within the Defense Department.

DIGITAL SIGNAL PROCESSING FACILITY

The signal processing facility provides a repository of visible, IR and Multispectral imagery and combines this database with processing tools needed for developing target detection algorithms. The existing database is updated and augmented with imagery from new sensors as it becomes available. The facility allows users to easily compile the necessary metrics for evaluating the images and to manipulate the images for extrapolation to other target/background scenarios. Current target detection algorithms are compared and emerging signal processing methods are tested and refined. Background modeling and sensor tradeoff studies are carried out against appropriate types of backgrounds and target data. The facility also designs and develops custom communications terminals, low–level protocols, and real–time data acquisition and processing systems that operate at speeds of gigabits/sec. This facility operates proof–of–concept adaptations of commercial high speed communications equipment for tactical use, and has demonstrated the importance of selecting international standards based products.

This facility has available a class of spatial, multispectral, and change detection algorithms, unique within the Defense Department, which are applied to actual electro-optic and infrared data from ground and airborne sensors for target discrimination.

3.5 Expansion Potential

3.5.1 Laboratory Facilities. Facilities records as of the fourth–quarter FY93 are used in providing the following data (in ksq. ft.) for the avionics CSF.

			Space Capacity (KSF)		
Common Support Function	**Facility or Equipment Description**	**Type of Space***	**Current**	**Used**	**Excess**
AVIONICS	Office	Administrative	1.079	1.079	0
	Office	Technical	15	15	0
	Laboratory	Technical	47.03	47.03	0
	Storage	Storage	1.916	1.916	0

* Administrative, Technical, Storage, Utility

Space is centrally managed at NRL. When space becomes excess in a Division the excess space is returned to the NRL space coordinator for reallocation. Hence, in general, the NRL performing Divisions do not have excess space and thus the above tables show no excess space for the avionics CSF.

3.5.1.1 In general, the facilities/labs that support the avionics CSF are readily capable of accepting a modest increase of work as long as the type of work that would be gained is of the same type that is currently being performed. In this case, it is assumed that the physical size of the space, and the equipment and instrumentation available, is of the proper variety for the work. Although much greater increases in the capacity might be obtained, it is expected that this would entail major modifications to existing facilities or the construction of expanded facilities. Significant changes in the nature of the work might also entail a similar degree of modification.

3.5.1.2 Based on current available space, and using the consideration of similarity of work discussed above, it is believed that the NRL avionics CSF could be increased by as much as 48 workyears per year before major modifications to facilities would be required. This increased workyear effort would have to be largely accommodated by new hires.

3.5.1.3 For 3.5.1.1 and 3.5.1.2 (above) describe the impact of military construction programs or other alteration projects programmed in the FY95 PBS. (BRAC Criteria II). None

3.5.2 Land Use. Provide number of buildable acres for additional laboratory/ administrative support construction at your installation. (BRAC Criteria II) Not separately reportable - see response to BRAC Data Call 4.

3.5.3 Utilities. Provide an estimate of your installation's capability to expand or procure additional utility services (electric, gas, water). Estimates should be provided in appropriate units — e.g. KWH of electricity. (BRAC Criteria II) Not separately reportable - see response to BRAC Data Call 4.

9. **AVIONICS QUESTIONS 3.5.2, 3.5.3**

Please provide a response to these questions, for each CSF in which you are performing work. Citing Data Call #4 is not acceptable.

RESPONSES:

a. **3.5.2:** NRL has 11.2 acres available for unrestricted expansion located at its Chesapeake Bay Detachment. Parking would have to be included as part of any expansion project. Utilities, while available, are aged and would be required to be upgraded to accommodate any expansion.

The building space (class 2 property) currently available for growth opportunities at the NRL DC site, either constrained or unconstrained, represents a total of multiple small areas located throughout the Laboratory which cannot be effectively utilized by any other functions other than the primary occupant of the facility. It is important to note, however, that NRL facilities can be re-configured, e.g., demolished and rebuilt, altered, fitted with capital equipment, etc. to accommodate new or expanded mission assignments. However, accurate quantification of the maximum amount of space available for expansion is not practical without the benefit of revised mission/program planning guidance. For planning purposes, a rough order of magnitude estimate of the minimum class 2 space available for expansion is 10 percent. This would involve minimal reconfiguration.

b. **3.5.3:** Utility service capacities are depicted in the following table:

	On Base Capacity	Off Base Long Term Contract	Normal Steady State Load	Peak Demand
Electrical Supply (KWH)	N/A	54,000 KWH	13,098 KWH	17,280 KWH
Natural Gas (CFH)[1]	N/A	2,961 CFH	141 CFH	1,868 CFH
Sewage (GPD)	N/A	Unlimited	847,583 GPD	1,017,100 GPD
Potable Water (GPD	N/A	9,740,978 GPD	1,118,911 GPD	1,342,693 GPD
Steam (PSI & lb/Hr)[2]	190,000 lb/Hr	N/A	116,000 lb/Hr	125,000 lb/Hr

1 The availability of natural gas is controlled by the Washington Gas Light Company. It cannot be relied on as a primary fuel.

2 Production plant owned by PWC, Washington.

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B. SPACE

B1. Satellites

3.0 Mission: Major capabilities contributing to the common support function. R

- o Navy's Lead Laboratory For Space
- o Systems And Missions Analyses
- o Technology Assessment/Advancement
- o Systems Engineering
- o Spacecraft Electronic Systems Development
- o Spacecraft Integration, Test, And Launch Operations
- o Mission Operations
- o Payload Data Management Systems Design
- o Spacecraft On-Board Processor Design
- o Spacecraft Software Technology Development
- o Spacecraft Electrical Power System Design
- o Spacecraft Telemetry And Command Systems Design
- o Spacecraft Networking Systems Design
- o Space Systems Architecture Development
- o Space Systems Astrodynamics Analysis
- o Space Surveillance Systems Design
- o Orbitology Technology Development
- o Parallel Processing For Space Surveillance Applications Technology Development
- o On-Orbit Performance Analysis
- o Space Based Laser Communications Technology Development
- o Laser Ranging Technology Development

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- o Space Based High Temperature Superconductivity Technology Development
- o Launch Vehicle Propulsion Technology Development
- o Transfer Stage Technology Development And Systems Design
- o Time And Frequency Technology Development
- o Space Based Navigation Systems Technology Development
- o Spacecraft Structures And Mass Properties Analysis And Design
- o Spacecraft Environmental Testing
- o Spacecraft Mechanism And Space Borne Robotics Systems Design
- o Spacecraft Attitude And Orbit Control Systems Analysis And Design
- o Spacecraft Reaction Control Systems Design
- o Spacecraft Propulsion Systems Design
- o Spacecraft Thermal Control Systems Design
- o Spacecraft Launch Vehicle Integration
- o Space Expert Systems Design
- o Large Space Structures Control Analysis And Design
- o Advanced Data Modem Design
- o Advanced Spacecraft Materials Technology Development

Describe any relationship and interconnectivity with other function (common or otherwise) in support of the overall activity mission.

The Naval Center for Space Technology (NCST), in performing the mission detailed herein, relies very heavily on the basic research and exploratory development work conducted in the other research divisions of NRL, in that the systems developed by the NCST to solve DOD problems and requirements integrate these technologies into operational systems. Conversely, these research divisions of NRL rely on the NCST to provide a "product line" for these technologies to be demonstrated or integrated into the military service or transitioned to commercial or industrial applications. Having the vertical integration of 6.1 research with the systems design, systems engineering, and systems integration capability for Satellites collocated at the laboratory allows for the very rapid infusion of Laboratory technology into operational satellites.

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Specific Pervasive Functions that are intimately linked to satellites are Electronic Devices, Environmental Sciences, and Advanced Materials. Large cooperative efforts exist in all of these areas. For example, the High Temperature Superconductivity Space Experiment is a classic example that is held as a model for managing technology development and bringing laboratory research into operational use in record time. This will result in the first use of high temperature superconducting devices in space. Another example in the utilization of Advanced Composite Materials in spacecraft applications. The use of these materials developed in the laboratory in experimental space craft fabricated, integrated, and most importantly, qualified here at NRL could not be accomplished effectively without having the pervasive functions and the common support co-located in one facility. R

In addition, there is a significant, pervasive and inseverable coupling of technology development, analysis and engineering between the Product Functions of Satellites and C4I Systems. The primary technology effort of NRL in Satellites is devoted to surveillance and sensor systems. The application of these systems in defense is to provide combat data to the war fighter. The systems must be treated as complete "sensor- to-shooter" architectures, including the requirements determination, performance analysis, engineering design, acquisition, and operations. Inherent in this treatment is the sensor portion and the C4I portion; the space portion and the ground portion; the tactical terminal and the satellite command and control portion. All engineering, trade studies, performance analysis, and indeed the operation of the system must be optimized across the entire system. The successful function of the system requires this. Separation the functions of C4I and Satellites Technology development would seriously jeopardize the development of future systems such as those which NRL has been so highly successful at developing and deploying in the past.

3.1 Location

3.1.1 Geographic/Climatological Features: There are no special geographic or climatological features in or around this activity relevant to the Satellites CSF.

3.1.2 Licenses & Permits: The Satellites CSF requires no special licenses or permits for the performance of its function.

3.1.3 Environmental Constraints: There are no environmental constraints to the Satellites CSF at this activity.

3.1.4 Special Support Infrastructure: No special support infrastructure is required for the Satellites CSF at this activity.

3.1.5 Proximity to Mission-Related organizations: There are no nearby outside organizations whose location facilitates accomplishing the satellites CSF effort. R

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3.2 Personnel

3.2.1 Total Personnel: The total number of government (military and civilian), on-site federally funded research and development center (FFRDC) and on-site system engineering technical assistance (SETA) personnel engaged in science and technology (S&T), engineering development and in-service engineering activities as of the end of FY93 is described on the chart below:

CSF-SATELLITES

Types of Personnel	Number of Personnel			
	Government		On-Site FFRDC	On-Site SETA
	Civilian	Military		
Technical	176	0	0	142
Management (SUPV)	51	0	0	14
Other	0	0	0	0

3.2.2 Education: the number of government personnel actively engaged in S&T, engineering and in-service engineering activities by highest degree and type of position is as follows:

CSF-SATELLITES

Type of Degree/Diploma	Number of Government Personnel by Type of Position			
	Technical	Management (supv)	Other	
High School or less	35	3		
Associates	8	0		
Bachelor	95	27		
Masters	24	17		
Doctorate	14	4		
(incl med/vet,etc)	0	0		

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3.2.3 **Experience**: The experience level of government personnel is provided below.

CSF-SATELLITES

Type of Position	Years of Government and/or Military Service				
	Less than 3 Years	3-10 Years	11-15 Years	16-20 Years	More than 20 Years
Technical	24	73	15	14	50
Management (supv)	2	9	8	4	28
Total	26	82	23	18	78

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3.2.4.1 The following patents were awarded or disclosed.

CSF	Disclosures	Awarded	Patent Titles
Satellites	1	1	Multi-GHZ Frequency Divider Efficient Dynamic Phasefront Modulation System for Free-space Optical Communications

3.2.4.2 The following papers were published in peer reviewed journals.

CSF	Number Published	Paper Titles (List)
Satellites	13	

Reilly, M.H., Upgrades for efficient three-dimensional ionospheric ray tracing: Investigation of HF near vertical incidence sky wave effects, Radio Sci. 26, No. 4, 971-980, July/August 1991

Reilly, M.H., F.J. Rhoads, and J.M. Goodman, Updated climatological model predictions of ionospheric and HF propagation parameters, Radio Sci. 26, No. 4, 1017-1024, July/August 1991

"Operating modes of a charge-transfer-plate liquid crystal phase modulator", Appl. Opt., 31 3892 (1992), G.A. Melnik, G.C. Gilbreath, T.N. Tsakiris, R.P. Jurgilewicz, D.M. O'Mara, T.N. Horsky, and C. Warde.

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3.2.3 **Experience**: The experience level of government personnel is provided below.

CSF-SATELLITES

Type of Position	Years of Government and/or Military Service				
	Less than 3 Years	3-10 Years	11-15 Years	16-20 Years	More than 20 Years
Technical	24	73	15	14	50
Management (supv)	2	9	8	4	28
Total	26	82	23	18	78

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3.2.4.1 The following patents were awarded or disclosed.

CSF	Disclosures	Awarded	Patent Titles
Satellites	1	1	Multi-GHZ Frequency Divider Efficient Dynamic Phasefront Modulation System for Free-space Optical Communications

3.2.4.2 The following papers were published in peer reviewed journals.

CSF	Number Published	Paper Titles (List)
Satellites	15	

Reilly, M.H., Upgrades for efficient three-dimensional ionospheric ray tracing: Investigation of HF near vertical incidence sky wave effects, Radio Sci. 26, No. 4, 971-980, 1991

Reilly, M.H., F.J. Rhoads, and J.M. Goodman, Updated climatological model predictions of ionospheric and HF propagation parameters, Radio Sci. 26, No. 4, 1017-1024, 1991

"Operating modes of a charge-transfer-plate liquid crystal phase modulator", Appl. Opt., 31 3892 (1992), G.A. Melnik, G.C. Gilbreath, T.N. Tsakiris, R.R. Jurgilewicz, D.M. O'Mara, T.N. Horsky, and C. Warde.

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"Passive stabilization of photorefractive two beam coupling with laser diodes using acromatic grating techniques", Opt. Comm., 93, 156 (1992), W.S. Rabinovich, G.C. Gilbreath, A.E. Clement, and B.J. Feldman.

"Comparison of photorefractive beam fanning using monochromatic and achromatic two-wave mixing in SBN", Opt. Comm., 94, 609 (1992), C.L.Adler, W.S. Rabinovich, A.E. Clement, G.C. Gilbreath, and B.J. Feldman.
3.2.4.2

Selected Article: "Thin-phase Screen Estimates of TID Effects on Midlatitude Transionosperic Radio Paths," Radio Science, Vol. 28, No. 6, pp 979-986, November - December 1993

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"Determination of the Effective Trap Density of Ta:$KNbO_3$ and $BaTiO_3$ at 823NM Using the Shallow Trap Model," A.E. Clement, G.C. Gilbreath, NRL Code 8123; and S.N. Peterson

"Frozen orbit morphology in Orlov's plane," (AAS 93-695), Astrodynamics, Aug. 1993, Vol. 85, Advances in the Astronautical Sciences (Univelt, San Diego, CA, 1994) R

"Geolocation Accuracy of HERCULES on STS 53," (AAS 93-604), with M.T. Soyka, H.M. Pickard, S.N. Lam, K.H. Little, R.R. Dasenbrock and T.W. Murphy, Astrodynamics, Aug. 1993, Vol. 85, Advances in the Astronautical Sciences (Univelt, San Diego, CA, 1994) R

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"Kinematic and Dynamic Properties of an Elbow Manipulator Mounted on a Satellite," Lindberg, Robert E., Richard W. Longman, and Michael F. Zedd., The Journal of the Astronautical Sciences, 38(4), October-December, 1990, 397-421.

"Paint by number: Uncovering phase flows of an integrable dynamical system," Coffey, S., Healy, L. and Deprit, E.,Computers in Physics, Sept-Oct, 1991.

"Ground-based Ladar Measurements of Satellite Vibrations," Schultz, K. I. and Fisher, Journal of Applied Optics, Laser and Photonics, Vol. 31, No. 36, Dec 1992. R

"Frozen Orbits for Satellites Close to an Earth-like Planet," Coffey, S., Deprit, A. and Deprit, E., Celestial Mechanics, May 1994. R

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"Passive stabilization of photorefractive two beam coupling with laser diodes using acromatic grating techniques", Opt. Comm., 93, 156 (1992), W.S. Rabinovich, G.C. Gilbreath, A.E. Clement, and B.J. Feldman.

"Comparison of photorefractive beam fanning using monochromatic and achromatic two-wave mixing in SBN", Opt. Comm., 94, 609 (1992), C.L.Adler, W.S. Rabinovich, A.E. Clement, G.C. Gilbreath, and B.J. Feldman.
3.2.4.2

Selected Article: "Thin-phase Screen Estimates of TID Effects on Midlatitude Transionosperic Radio Paths," Radio Science, Vol. 28, No. 6, pp 979-986, November - December 1993

"Along Track Formation keeping for Satellites with Low Eccentricity", Jay W. Middour; AAS 91-510, AAS/AIAA Astrodynamics Conference, Durango, CO, August 19-22, 1991.

"Determination of the Effective Trap Density of Ta:KNb0_3 and BaTi0_3 at 823NM Using the Shallow Trap Model," A.E. Clement, G.C. Gilbreath, NRL Code 8123; and S.N. Peterson

"Frozen orbit morphology in Orlov's plane," (AAS 93-695), to appear Astrodynamics 1993, Vol. 85, Advances in the Astronautical Sciences (Univelt, San Diego, CA, 1994)

"Geolocation Accuracy of HERCULES on STS 53," (AAS 93-604), with M.T. Soyka, H.M. Pickard, S.N. Lam, K.H. Little, R.R. Dasenbrock and T.W. Murphy, to appear Astrodynamics 1993, Vol. 85, Advances in the Astronautical Sciences (Univelt, San Diego, CA, 1994)

"Painting the Phase Space Portrait of an Integrable Dynamical System, "Coffey, S., Deprit, A., Deprit, E., Healy, L.,Science, 247, 833--836, Feb. 1990.

"Kinematic and Dynamic Properties of an Elbow Manipulator Mounted on a Satellite," Lindberg, Robert E., Richard W. Longman, and Michael F. Zedd., The Journal of the Astronautical Sciences, 38(4), October-December, 1990, 397-421.

"Paint by number: Uncovering phase flows of an integrable dynamical system," Coffey, S., Healy, L. and Deprit, E.,Computers in Physics, Sept-Oct, 1991.

"Ground-based Ladar Measurements of Satellite Vibrations," Schultz, K. I. and Fisher, Journal of Applied Optics, Laser and Photonics, Vol. 31, No. 36, Dec 1992. R

"Frozen Orbits for Satellites Close to an Earth-like Planet," Coffey, S., Deprit, A. and Deprit, E., Celestial Mechanics, May 1994. R

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3.3 Workload

3.3.1 FY93 Workload

3.3.1.1 Work Year Lifecycle: Identified below are the number of actual workyears executed for the Satellites CSF in FY93 for each of the following: government civilian; military; on-site FFRDCs; and on-site SETA'S

SATELLITES	Fiscal Year 1993 Actual			
	Civilian	Military	FFRDC	SETA
Science & Technology	21.7	0	0	8.7
Engineering Development	213.3	0	0	158.6
In-Service Engineering	0	0	0	0

3.3.1.2 Engineering Development by ACAT: No CSF's to report in this area.

3.3.1.3 In-Service Engineering: No CSF's to report in this area.

3.3.2 Projected Funding

3.3.2.1 Direct Funding: The are no direct appropriations to the satellites CSF.

3.3.2.2 Other Obligation Authority: For The Satellites CF we have identified funding from FY94-FY97.

	$K	$K	$K	$K
CSF	FY94	FY95	FY96	FY97
Satellites	111092.6	114174.4	121270.2	126307.3

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3.4 Facilities and Equipment

3.4.1 Major Equipment and Facilities: The major facilities and equipment necessary to support the Satellites CSF are listed in the table below. None of the facilities are shared with other CSF's. Many of these facilities are SCIF's and therefore no photographs can be supplied.

	% Util.	CSF or Pervasive	% Util.	Major Facility or Equipment Description	Unique to DOD	Unique to Fed. Gov't	Unique to U.S.	Repacement Cost ($K)
Satellite	50	Ground Control	50	SCI Data Storage and Media Management Vault				500
Satellite	50	Ground Control	50	SCI Management Information System				200
Satellite	50	Ground Control	50	SCI Data Processing Center				800
Satellite	40	Electronic Devices Adv Materials	30 30	Laser Physics Lab				1300 1300
Satellite	50	Ground Control	50	NCST Management Information System				1000
Satellite	80	Electronic Devices Adv Materials	10 10	SCI Payload Test Facility/Processor Development Laboratory	X			10000
Satellite	50	Ground Control	50	Space Systems Development Department Computation Facility				1000
Satellite	100			Spacecraft Battery Laboratory		X		200
Satellite	50	Ground Control	50	Precision Oscillator Test Facility			X	4800
Satellite	80	Electronic Devices Adv Materials	10 10	Precision RF Anechoic Chamber	X			3000
Satellite	100			Secure Payload Development Facility				1000
Satellite	100			Reshape Facility			X	250
Satellite	100			Secure Spacecraft Assembly/Test Facility(SCI)				1000
Satellite	80	Electronic Devices Adv Materials	10 10	Spacecraft Acoustic Reverberation Chamber	X			5000
Satellite	80	Electronic Devices Adv Materials	10 10	Spacecraft Vibration Test Facility				1500
Satellite	80	Electronic Devices Adv Materials	10 10	Class-100 Clean Room				400
Satellite	100			Spacecraft Propulsion System Welding Facility	X			500
Satellite	80	Electronic Devices Adv Materials	10 10	Thermal High Vacuum Chambers				2500
Satellite	100			RF Compact Range				2000
Satellite	90	Adv Materials	10	Spacecraft Static Test Loads Facility	X			500
Satellite	80	Electronic Devices Adv Materials	10 10	Spacecraft Assembly and Test Facility				2000
Satellite	100			Spacecraft Spin Balance Facility				500
Satellite	100			Spacecraft Optical Alignment Facility				200
Satellite	100			Spacecraft Thermal Blanket Facility				100
Satellite	90	Ground Control	10	RF Anechoic Chamber	X			3000
Satellite	100			Microelectronics Clean Room				200
Satellite	100			EMI/EMC Screen Room				200
Satellite	100			RF Anechoic Chamber SCIF				30
Satellite	100			Spacecraft Storage SCIF				70

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Satellite	100			Spacecraft Design SCIF				1200
Satellite	100			Payload Exploitation SCIF				430
Satellite	100			Mission Development SCIF				100
Satellite	100			Advanced Systems SCIF				80
Satellite	100			Space Applications SCIF				235
Satellite	100			Fuels Testing Laboratory				100
				Total				47195

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3.5 Expansion Potential:

3.5.1 Laboratory Facilities: The facilities required to perform the Satellites CSF at this activity are listed below. For those facilities located at the NRL main base, NRL's MIS data were used. For facilities located at NRL's field sites, local data were used.

Common Support Function	Major Facility or Equipment Description	Type Of Space	Current	(KSF) Used	Excess
Satellite	SCI Data Storage and Media Management Vault	Technical	2.0	2.0	0
Satellite	SCI Management Information System	Technical	0.3	0.3	0
Satellite	SCI Data Processing Center	Technical	1.0	1.0	0
Satellite	Laser Physics Lab	Technical	0.5	0.5	0
Satellite	NCST Management Information System	Technical	1.4	1.4	0
Satellite	SCI Payload Test Facility/Processor Development Laboratory	Technical	2.4	2.4	0
Satellite	Space Systems Development Department Computation Facility	Technical	0.9	0.9	0
Satellite	Spacecraft Battery Laboratory	Technical	2.4	2.4	0
Satellite	Precision Oscillator Test Facility	Technical	5.8	5.8	0
Satellite	Precision RF Anechoic Chamber	Technical	2.3	2.3	0
Satellite	Secure Payload Development Facility	Technical	1.9	1.9	0
Satellite	Reshape Facility	Technical	0.9	0.9	0
Satellite	Secure Spacecraft Assembly/Test Facility(SCI)	Technical	12.0	12.0	0
Satellite	Spacecraft Acoustic Reverberation Chamber	Technical	1.4	1.4	0
Satellite	Spacecraft Vibration Test Facility	Technical	2.6	2.6	0
Satellite	Class-100 Clean Room	Technical	1.6	1.6	0
Satellite	Spacecraft Propulsion System Welding Facility	Technical	1.0	1.0	0
Satellite	Thermal High Vacuum Chambers	Technical	6.1	6.1	0
Satellite	RF Compact Range	Technical	0.5	0.5	0
Satellite	Spacecraft Static Test Loads Facility	Technical	2.6	2.6	0
Satellite	Spacecraft Assembly and Test Facility	Technical	4.9	4.9	0
Satellite	Spacecraft Spin Balance Facility	Technical	1.0	1.0	0
Satellite	Spacecraft Optical Alignment Facility	Technical	1.0	1.0	0
Satellite	Spacecraft Thermal Blanket Facility	Technical	1.0	1.0	0
Satellite	RF Anechoic Chamber	Technical	7.7	7.7	0
Satellite	Microelectronics Clean Room	Technical	0.5	0.5	0
Satellite	EMI/EMC Screen Room	Technical	1.0	1.0	0
Satellite	RF Anechoic Chamber SCIF	Technical	0.2	0.2	0
Satellite	Spacecraft Storage SCIF	Storage	0.3	0.3	0

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Satellite	Spacecraft Design SCIF	Technical	6.0	6.0	0
Satellite	Payload Exploitation SCIF	Technical	2.1	2.1	0
Satellite	Mission Development SCIF	Technical	0.5	0.5	0
Satellite	Advanced Systems SCIF	Technical	0.4	0.4	0
Satellite	Space Applications SCIF	Technical	1.2	1.2	0
Satellite	Fuels Testing Laboratory	Technical	1.6	1.6	0
Satellite	General Laboratories	Technical	10.8	10.8	0
Satellite	General Design Space	Technical	62.7	62.7	0
Satellite	General Office Space	Administrative	22.5	22.5	0
Satellite	Storage	Storage	31.4	31.4	0
Satellite	Utility	Utility	1.5	1.5	0
	Total		207.9	207.9	0

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3.5.1.1 This activity has the capacity to absorb about 85% more work years in the Satellites CSF with minor facility modification. Even though the table above indicates that there is no excess capacity in our facilities square footage, this additional work load is achievable through the use of multiple shifts and overtime, which is the standard mode of operation for assembly, testing and qualification of spacecraft. In other words, the amount of facility space would not increase, but the percentage of time that the facility was utilized would increase. This additional workload would be distributed among the on-base test facilities and the off-base operational field sites. The peak loading of head count during the day at any one facility would be minimal.

3.5.1.2 This activity has the capability to absorb an additional 320 work years in the Satellites CSF.

3.5.1.3 There would be no impact of 3.5.1.1 and 3.5.1.2 (above) to military construction programs or other alteration projects programmed in the FY95 PBS at this activity for the Satellites CSF.

3.5.2 Land Use: For the Satellites CSF, approximately 50 acres are available for additional Satellites CSF construction at the NRL field sites.

3.5.3 Utilities: There is no restriction or limit to expand the utility services for the Satellites CSF at the NRL field sites.

SECTION III: CAPABILITY OF ACTIVITIES PERFORM COMMON SUPPORT FUNCTIONS (CFSs)

3.0 Mission: Major capabilities contributing to the common support function.

This Section Replaced in its entirety with "SATELLITES" SECTION dated 8-19-94

Satellites

- o Navy's Lead Laboratory For Space
- o Systems And Missions Analyses
- o Technology Assessment/Advancement
- o Systems Engineering
- o Spacecraft Electronic Systems Development
- o Spacecraft Integration, Test, And Launch Operations
- o Mission Operations
- o Payload Data Management Systems Design
- o Spacecraft On-Board Processor Design
- o Spacecraft Software Technology Development
- o Spacecraft Electrical Power System Design
- o Spacecraft Telemetry And Command Systems Design
- o Spacecraft Networking Systems Design
- o Space Systems Architecture Development
- o Space Systems Astrodynamics Analysis
- o Space Surveillance Systems Design
- o Orbitology Technology Development
- o Parallel Processing For Space Surveillance Applications Technology Development
- o On-Orbit Performance Analysis
- o Space Based Laser Communications Technology Development
- o Laser Ranging Technology Development

Revision
FCE/ONR91 8/17/94

- o Space Based High Temperature Superconductivity Technology Development
- o Launch Vehicle Propulsion Technology Development
- o Transfer Stage Technology Development And Systems Design
- o Time And Frequency Technology Development
- o Space Based Navigation Systems Technology Development
- o Spacecraft Structures And Mass Properties Analysis And Design
- o Spacecraft Environmental Testing
- o Spacecraft Mechanism And Space Borne Robotics Systems Design
- o Spacecraft Attitude And Orbit Control Systems Analysis And Design
- o Spacecraft Reaction Control Systems Design
- o Spacecraft Propulsion Systems Design
- o Spacecraft Thermal Control Systems Design
- o Spacecraft Launch Vehicle Integration
- o Space Expert Systems Design
- o Large Space Structures Control Analysis And Design
- o Advanced Data Modem Design
- o Advanced Spacecraft Materials Technology Development

Describe any relationship and interconnectivity with other function (common or otherwise) in support of the overall activity mission.

The Naval Center for Space Technology (NCST), in performing the mission detailed herein, relies very heavily on the basic research and exploratory development work conducted in the other research divisions of NRL, in that the systems developed by the NCST to solve DOD problems and requirements integrate these technologies into operational systems. Conversely, these research divisions of NRL rely on the NCST to provide a "product line" for these technologies to be demonstrated or integrated into the military service or transitioned to commercial or industrial applications. Having the vertical integration of 6.1 research with the systems design, systems

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engineering, and systems integration capability for Satellites collocated at the laboratory allows for the very rapid infusion of Laboratory technology into operational satellites.

Specific Pervasive Functions that are intimately linked to satellites are Electronic Devices, Environmental Sciences, and Advanced Materials. Large cooperative efforts exist in all of these areas. For example, the High Temperature Superconductivity Space Experiment is a classic example that is held as a model for managing technology development and bringing laboratory research into operational use in record time. This will result in the first use of high temperature superconducting devices in space. Another example in the utilization of Advanced Composite Materials in spacecraft applications. The use of these materials developed in the laboratory in experimental space craft fabricated, integrated, and most importantly, qualified here at NRL could not be accomplished effectively without having the pervasive functions and the common support co-located in one facility.

In addition, there is a significant, pervasive and inseverable coupling of technology development, analysis and engineering between the Product Functions of Satellites and C4I Systems. The primary technology effort of NRL in Satellites is devoted to surveillance and sensor systems. The application of these systems in defense is to provide combat data to the war fighter. The systems must be treated as complete "sensor- to-shooter" architectures, including the requirements determination, performance analysis, engineering design, acquisition, and operations. Inherent in this treatment is the sensor portion and the C4I portion; the space portion and the ground portion; the tactical terminal and the satellite command and control portion. All engineering, trade studies, performance analysis, and indeed the operation of the system must be optimized across the entire system. The successful function of the system requires this. Separation the functions of C4I and Satellites Technology development would seriously jeopardize the development of future systems such as those which NRL has been so highly successful at developing and deploying in the past.

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3.4 Facilities and Equipment

3.4.1 Major Equipment and Facilities: The major facilities and equipment necessary to support the Satellites CSF are listed in the table below. None of the facilities are shared with other CSF's. Many of these facilities are SCIF's and therefore no photographs can be supplied.

	% Util.	CSF or Pervasive	% Util.	Major Facility or Equipment Description	Unique to DOD	Unique to Fed. Gov't	Unique to U.S.	Repacement Cost ($K)
Satellite	50	Ground Control	50	SCI Data Storage and Media Management Vault				500
Satellite	50	Ground Control	50	SCI Management Information System				200
Satellite	50	Ground Control	50	SCI Data Processing Center				800
Satellite	40	Electronic Devices	30	Laser Physics Lab				1300
		Adv Materials	30					1300
Satellite	50	Ground Control	50	NCST Management Information System				1000
Satellite	80	Electronic Devices	10	SCI Payload Test Facility/Processor Development Laboratory	X			10000
		Adv Materials	10					
Satellite	50	Ground Control	50	Space Systems Development Department Computation Facility				1000
Satellite	100			Spacecraft Battery Laboratory		X		200
Satellite	50	Ground Control	50	Precision Oscillator Test Facility			X	4800
Satellite	80	Electronic Devices	10	Precision RF Anechoic Chamber	X			3000
		Adv Materials	10					
Satellite	100			Secure Payload Development Facility				1000
Satellite	100			Reshape Facility			X	250
Satellite	100			Secure Spacecraft Assembly/Test Facility(SCI)				1000
Satellite	80	Electronic Devices	10	Spacecraft Acoustic Reverberation Chamber	X			5000
		Adv Materials	10					
Satellite	80	Electronic Devices	10	Spacecraft Vibration Test Facility				1500
		Adv Materials	10					
Satellite	80	Electronic Devices	10	Class-100 Clean Room				400
		Adv Materials	10					
Satellite	100			Spacecraft Propulsion System Welding Facility	X			500
Satellite	80	Electronic Devices	10	Thermal High Vacuum Chambers				2500
		Adv Materials	10					
Satellite	100			RF Compact Range				2000
Satellite	90	Adv Materials	10	Spacecraft Static Test Loads Facility	X			500
Satellite	80	Electronic Devices	10	Spacecraft Assembly and Test Facility				2000
		Adv Materials	10					
Satellite	100			Spacecraft Spin Balance Facility				500
Satellite	100			Spacecraft Optical Alignment Facility				200
Satellite	100			Spacecraft Thermal Blanket Facility				100
Satellite	90	Ground Control	10	RF Anechoic Chamber	X			3000
Satellite	100			Microelectronics Clean Room				200
Satellite	100			EMI/EMC Screen Room				200
Satellite	100			RF Anechoic Chamber SCIF				30
Satellite	100			Spacecraft Storage SCIF				70

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Satellite	100			Spacecraft Design SCIF				1200
Satellite	100			Payload Exploitation SCIF				430
Satellite	100			Mission Development SCIF				100
Satellite	100			Advanced Systems SCIF				80
Satellite	100			Space Applications SCIF				235
Satellite	100			Fuels Testing Laboratory				100
				Total				47195

3.5 Expansion Potential:

3.5.1 Laboratory Facilities: The facilities required to perform the Satellites CSF at this activity are listed below. For those facilities located at the NRL main base, NRL's MIS data were used. For facilities located at NRL's field sites, local data were used.

Common Support Function	Major Facility or Equipment Description	Type Of Space	Current	(KSF) Used	Excess
Satellite	SCI Data Storage and Media Management Vault	Technical	2.0	2.0	0
Satellite	SCI Management Information System	Technical	0.3	0.3	0
Satellite	SCI Data Processing Center	Technical	1.0	1.0	0
Satellite	Laser Physics Lab	Technical	0.5	0.5	0
Satellite	NCST Management Information System	Technical	1.4	1.4	0
Satellite	SCI Payload Test Facility/Processor Development Laboratory	Technical	2.4	2.4	0
Satellite	Space Systems Development Department Computation Facility	Technical	0.9	0.9	0
Satellite	Spacecraft Battery Laboratory	Technical	2.4	2.4	0
Satellite	Precision Oscillator Test Facility	Technical	5.8	5.8	0
Satellite	Precision RF Anechoic Chamber	Technical	2.3	2.3	0
Satellite	Secure Payload Development Facility	Technical	1.9	1.9	0
Satellite	Reshape Facility	Technical	0.9	0.9	0
Satellite	Secure Spacecraft Assembly/Test Facility(SCI)	Technical	12.0	12.0	0
Satellite	Spacecraft Acoustic Reverberation Chamber	Technical	1.4	1.4	0
Satellite	Spacecraft Vibration Test Facility	Technical	2.6	2.6	0
Satellite	Class-100 Clean Room	Technical	1.6	1.6	0
Satellite	Spacecraft Propulsion System Welding Facility	Technical	1.0	1.0	0
Satellite	Thermal High Vacuum Chambers	Technical	6.1	6.1	0
Satellite	RF Compact Range	Technical	0.5	0.5	0
Satellite	Spacecraft Static Test Loads Facility	Technical	2.6	2.6	0
Satellite	Spacecraft Assembly and Test Facility	Technical	4.9	4.9	0
Satellite	Spacecraft Spin Balance Facility	Technical	1.0	1.0	0
Satellite	Spacecraft Optical Alignment Facility	Technical	1.0	1.0	0
Satellite	Spacecraft Thermal Blanket Facility	Technical	1.0	1.0	0
Satellite	RF Anechoic Chamber	Technical	7.7	7.7	0
Satellite	Microelectronics Clean Room	Technical	0.5	0.5	0
Satellite	EMI/EMC Screen Room	Technical	1.0	1.0	0
Satellite	RF Anechoic Chamber SCIF	Technical	0.2	0.2	0
Satellite	Spacecraft Storage SCIF	Storage	0.3	0.3	0

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Satellite	Spacecraft Design SCIF	Technical	6.0	6.0	0
Satellite	Payload Exploitation SCIF	Technical	2.1	2.1	0
Satellite	Mission Development SCIF	Technical	0.5	0.5	0
Satellite	Advanced Systems SCIF	Technical	0.4	0.4	0
Satellite	Space Applications SCIF	Technical	1.2	1.2	0
Satellite	Fuels Testing Laboratory	Technical	1.6	1.6	0
Satellite	General Laboratories	Technical	10.8	10.8	0
Satellite	General Design Space	Technical	62.7	62.7	0
Satellite	General Office Space	Administrative	22.5	22.5	0
Satellite	Storage	Storage	31.4	31.4	0
Satellite	Utility	Utility	1.5	1.5	0
	Total		207.9	207.9	0

3.5.1.1 This activity has the capacity to absorb about 85% more work years in the Satellites CSF with minor facility modification. Even though the table above indicates that there is no excess capacity in our facilities square footage, this additional work load is achievable through the use of multiple shifts and overtime, which is the standard mode of operation for assembly, testing and qualification of spacecraft. In other words, the amount of facility space would not increase, but the percentage of time that the facility was utilized would increase. This additional workload would be distributed among the on-base test facilities and the off-base operational field sites. The peak loading of head count during the day at any one facility would be minimal.

3.5.1.2 This activity has the capability to absorb an additional 320 work years in the Satellites CSF.

3.5.1.3 There would be no impact of 3.5.1.1 and 3.5.1.2 (above) to military construction programs or other alteration projects programmed in the FY95 RBS at this activity for the Satellites CSF.

3.5.2 Land Use: For the Satellites CSF, approximately 50 acres are available for additional Satellites CSF construction at the NRL field sites.

3.5.3 Utilities: There is no restriction or limit to expand the utility services for the Satellites CSF at the NRL field sites.

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SECTION III: CAPABILITY OF ACTIVITIES PERFORM COMMON SUPPORT FUNCTIONS (CFSs)

3.0 Mission: Major capabilities contributing to the common support function.

Satellites

- o Navy's Lead Laboratory For Space
- o Systems And Missions Analyses
- o Technology Assessment/Advancement
- o Systems Engineering
- o Spacecraft Electronic Systems Development
- o Spacecraft Integration, Test, And Launch Operations
- o Mission Operations
- o Payload Data Management Systems Design
- o Spacecraft On-Board Processor Design
- o Spacecraft Software Technology Development
- o Spacecraft Electrical Power System Design
- o Spacecraft Telemetry And Command Systems Design
- o Spacecraft Networking Systems Design
- o Space Systems Architecture Development
- o Space Systems Astrodynamics Analysis
- o Space Surveillance Systems Design
- o Orbitology Technology Development
- o Parallel Processing For Space Surveillance Applications Technology Development
- o On-Orbit Performance Analysis
- o Space Based Laser Communications Technology Development
- o Laser Ranging Technology Development

This Section Replaced in its entirety with "SATELLITES" Section dated 8-8-94

- o Space Based High Temperature Superconductivity Technology Development
- o Launch Vehicle Propulsion Technology Development
- o Transfer Stage Technology Development And Systems Design
- o Time And Frequency Technology Development
- o Space Based Navigation Systems Technology Development
- o Spacecraft Structures And Mass Properties Analysis And Design
- o Spacecraft Environmental Testing
- o Spacecraft Mechanism And Space Borne Robotics Systems Design
- o Spacecraft Attitude And Orbit Control Systems Analysis And Design
- o Spacecraft Reaction Control Systems Design
- o Spacecraft Propulsion Systems Design
- o Spacecraft Thermal Control Systems Design
- o Spacecraft Launch Vehicle Integration
- o Space Expert Systems Design
- o Large Space Structures Control Analysis And Design
- o Advanced Data Modem Design
- o Advanced Spacecraft Materials Technology Development

Describe any relationship and interconnectivity with other function (common or otherwise) in support of the overall activity mission.

The Naval Center for Space Technology (NCST), in performing the mission detailed herein, relies very heavily on the basic research and exploratory development work conducted in the other research divisions of NRL, in that the systems developed by the NCST to solve DOD problems and requirements integrate these technologies into operational systems. Conversely, these research divisions of NRL rely on the NCST to provide a "product line" for these technologies to be demonstrated or integrated into the military service or transitioned to commercial or industrial applications. Having the vertical integration of 6.1 research with the systems design, systems

engineering, and systems integration capability for Satellites collocated at the laboratory allows for the very rapid infusion of Laboratory technology into operational satellites.

Specific Pervasive Functions that are intimately linked to satellites are Electronic Devices, Environmental Sciences, and Advanced Materials. Large cooperative efforts exist in all of these areas. For example, the High Temperature Superconductivity Space Experiment is a classic example that is held as a model for managing technology development and bringing laboratory research into operational use in record time. This will result in the first use of high temperature superconducting devices in space.

In addition, there is a significant, pervasive and inseverable coupling of technology development, analysis and engineering between the Product Functions of Satellites and C4I Systems. The primary technology effort of NRL in Satellites is devoted to surveillance and sensor systems. The application of these systems in defense is to provide combat data to the war fighter. The systems must be treated as complete "sensor- to-shooter" architectures, including the requirements determination, performance analysis, engineering design, acquisition, and operations. Inherent in this treatment is the sensor portion and the C4I portion; the space portion and the ground portion; the tactical terminal portion and the satellite command and control portion. All engineering, trade studies, performance analysis, and indeed the operation of the system must be optimized across the entire system. The successful function of the system requires this. Separation the functions of C4I and Satellites Technology development would seriously jeopardize the development of future systems such as those which NRL has been so highly successful at developing and deploying in the past.

3.1 Location

3.1.1 Geographic/Climatological Features: There are no special geographic or climatological features in or around this activity relevant to the Satellites CSF.

3.1.2 Licenses & Permits: The Satellites CSF requires no special licenses or permits for the performance of its function.

3.1.3 Environmental Constraints: There are no environmental constraints to the Satellites CSF at this activity.

3.1.4 Special Support Infrastructure: No special support infrastructure is required for the Satellites CSF at this activity.

3.1.5 Proximity to Mission-Related organizations: The Satellites CSF does not require proximity to any particular mission-related organizations.

3.2 Personnel

3.2.1 Total Personnel: The total number of government (military and civilian), on-site federally funded research and development center (FFRDC) and on-site system engineering technical assistance (SETA) personnel engaged in science and technology (S&T), engineering

development and in-service engineering activities as of the end of FY93 is described on the chart below:

CSF-SPACE SYSTEMS

Types of Personnel	Number of Personnel			
	Government		On-Site FFRDC	On-Site SETA
	Civilian	Military		
Technical	176	0	0	142
Management (SUPV)	51	0	0	14
Other	0	0	0	0

3.2.2 Education: the number of government personnel actively engaged in S&T, engineering and in-service engineering activities by highest degree and type of position is as follows:

CSF-SPACE SYSTEMS

Type of Degree/Diploma	Number of Government Personnel by Type of Position			
	Technical	Management (supv)	Other	
High School or less	35	3		
Associates	8	0		
Bachelor	95	27		
Masters	24	17		
Doctorate	14	4		
(incl med/vet,etc)	0	0		

3.2.3 Experience: The experience level of government personnel is provided below.

CSF-SATELLITES

Type of Position	Years of Government and/or Military Service				
	Less than 3 Years	3-10 Years	11-15 Years	16-20 Years	More than 20 Years
Technical	24	73	15	14	50
Management (supv)	2	9	8	4	28
Total	26	82	23	18	78

3.2.4.1 The following patents were awarded or disclosed.

CSF	Disclosures	Awarded	Patent Titles
Satellites	1	1	Multi-GHZ Frequency Divider Efficient Dynamic Phasefront Modulation System for Free-space Optical Communications

3.2.4.2 The following papers were published in peer reviewed journals.

CSF	NUMBER PUBLISHED	PAPER TITLES (LIST)
Satel-lites	15	Upgrades for efficient three-dimensional ionospheric ray tracing: Investigation of HF near vertical incidence sky wave effects Updated climatological model predictions of ionospheric and HF propagation parameters Operating modes of a charge-transfer-plate liquid crystal phase modulator Passive stabilization of photorefractive two beam coupling with laser diodes using achromatic grating techniques Comparison of photorefractive beam fanning using monochromatic and achromatic two-wave mixing in SBN Thin-phase Screen Estimates of TID Effects on Midlatitude Transionospheric Radio Paths Along Track Formation keeping for Satellites With Low Eccentricity Determination of the Effective Trap Density of TaKNb03 and BaTi03 at 823NM Using the Shallow Trap Model Frozen orbit morphology in Orlov's plane Geolocation Accuracy of HERCULES on STS 53 Painting the Phase Space Portrait of an Integral Dynamical System Kinematic and Dynamic Properties of an Elbow Manipulator Mounted on a Satellite Paint by Number: Uncovering phase flows of an integrable dynamical system Ground-based Ladar Measurements of Satellite Vibrations Frozen Orbits for Satellites Close to an Earth-like Planet

3.3 Workload

3.3.1 FY93 Workload

3.3.1.1 Work Year Lifecycle: Identified below are the number of actual workyears executed for the Satellites CSF in FY93 for each of the following: government civilian; military; on-site FFRDCs; and on-site SETA'S

SATELLITES	Fiscal Year 1993 Actual			
	Civilian	Military	FFRDC	SETA
Science & Technology	21.7	0	0	8.7
Engineering Development	213.3	0	0	158.6
In-Service Engineering	0	0	0	0

3.3.1.2 Engineering Development by ACAT: No CSF's to report in this area.

3.3.1.3 In-Service Engineering: No CSF's to report in this area.

3.3.2 Projected Funding

3.3.2.1 Direct Funding: The are no direct appropriations to the satellites CSF.

3.3.2.2 Other Obligation Authority: For The Satellites CSF, the following funding has been identified for FY94-FY97:

	$K	$K	$K	$K
CF	FY94	FY95	FY96	FY97
Satellites	111093	114174	121270	126307

3.4 Facilities and Equipment

3.4.1 Major Equipment and Facilities: The major facilities and equipment necessary to support the Satellites CSF are listed in the table below. None of the facilities are shared with other CSF's. Many of these facilities are SCIF's and therefore no photographs can be supplied.

Common Support Function	% Util.	Shared Support Function	% Util.	Major Facility or Equipment Description	Unique to DOD	Unique to Fed. Gov't	Unique to U.S.	Repacement Cost ($K)
Satellite	50	Ground Control	50	SCI Data Storage and Media Management Vault				500
Satellite	50	Ground Control	50	SCI Management Information System				200
Satellite	50	Ground Control	50	SCI Data Processing Center				800
Satellite	100			Laser Physics Lab				1300
Satellite	50	Ground Control	50	NCST Management Information System				1000
Satellite	100			SCI Payload Test Facility/Processor Development Laboratory	X			10000
Satellite	50	Ground Control	50	Space Systems Development Department Computation Facility				1000
Satellite	100			Spacecraft Battery Laboratory		X		200
Satellite	50	Ground Control	50	Precision Oscillator Test Facility			X	4800
Satellite	100			Precision RF Anechoic Chamber	X			3000
Satellite	100			Secure Payload Development Facility				1000
Satellite	100			Reshape Facility			X	250
Satellite	100			Secure Spacecraft Assembly/Test Facility(SCI)				1000
Satellite	100			Spacecraft Acoustic Reverberation Chamber	X			5000
Satellite	100			Spacecraft Vibration Test Facility				1500
Satellite	100			Class-100 Clean Room				400
Satellite	100			Spacecraft Propulsion System Welding Facility	X			500
Satellite	100			Thermal High Vacuum Chambers				2500
Satellite	100			RF Compact Range				2000
Satellite	100			Spacecraft Static Test Loads Facility	X			500
Satellite	100			Spacecraft Assembly and Test Facility				2000
Satellite	100			Spacecraft Spin Balance Facility				500
Satellite	100			Spacecraft Optical Alignment Facility				200
Satellite	100			Spacecraft Thermal Blanket Facility				100
Satellite	90	Ground Control	10	RF Anechoic Chamber	X			3000
Satellite	100			Microelectronics Clean Room				200
Satellite	100			EMI/EMC Screen Room				200
Satellite	100			RF Anechoic Chamber SCIF				30
Satellite	100			Spacecraft Storage SCIF				70
Satellite	100			Spacecraft Design SCIF				1200
Satellite	100			Payload Exploitation SCIF				430
Satellite	100			Mission Development SCIF				100
Satellite	100			Advanced Systems SCIF				80
Satellite	100			Space Applications SCIF				235
Satellite	100			Fuels Testing Laboratory				100
				Total				45895

3.5 Expansion Potential:

3.5.1 Laboratory Facilities: The facilities required to perform the Satellites CSF at this activity are listed below. For those facilities located at the NRL main base, NRL's MIS data were used. For facilities located at NRL's field sites, local data were used.

Common Support Function	Major Facility or Equipment Description	Type Of Space	Current	(KSF) Used	Excess
Satellite	SCI Data Storage and Media Management Vault	Technical	2.0	2.0	0
Satellite	SCI Management Information System	Technical	0.3	0.3	0
Satellite	SCI Data Processing Center	Technical	1.0	1.0	0
Satellite	Laser Physics Lab	Technical	0.5	0.5	0
Satellite	NCST Management Information System	Technical	1.4	1.4	0
Satellite	SCI Payload Test Facility/Processor Development Laboratory	Technical	2.4	2.4	0
Satellite	Space Systems Development Department Computation Facility	Technical	0.9	0.9	0
Satellite	Spacecraft Battery Laboratory	Technical	2.4	2.4	0
Satellite	Precision Oscillator Test Facility	Technical	5.8	5.8	0
Satellite	Precision RF Anechoic Chamber	Technical	2.3	2.3	0
Satellite	Secure Payload Development Facility	Technical	1.9	1.9	0
Satellite	Reshape Facility	Technical	0.9	0.9	0
Satellite	Secure Spacecraft Assembly/Test Facility(SCI)	Technical	12.0	12.0	0
Satellite	Spacecraft Acoustic Reverberation Chamber	Technical	1.4	1.4	0
Satellite	Spacecraft Vibration Test Facility	Technical	2.6	2.6	0
Satellite	Class-100 Clean Room	Technical	1.6	1.6	0
Satellite	Spacecraft Propulsion System Welding Facility	Technical	1.0	1.0	0
Satellite	Thermal High Vacuum Chambers	Technical	6.1	6.1	0
Satellite	RF Compact Range	Technical	0.5	0.5	0
Satellite	Spacecraft Static Test Loads Facility	Technical	2.6	2.6	0
Satellite	Spacecraft Assembly and Test Facility	Technical	4.9	4.9	0
Satellite	Spacecraft Spin Balance Facility	Technical	1.0	1.0	0
Satellite	Spacecraft Optical Alignment Facility	Technical	1.0	1.0	0
Satellite	Spacecraft Thermal Blanket Facility	Technical	1.0	1.0	0
Satellite	RF Anechoic Chamber	Technical	7.7	7.7	0
Satellite	Microelectronics Clean Room	Technical	0.5	0.5	0
Satellite	EMI/EMC Screen Room	Technical	1.0	1.0	0
Satellite	RF Anechoic Chamber SCIF	Technical	0.2	0.2	0
Satellite	Spacecraft Storage SCIF	Storage	0.3	0.3	0
Satellite	Spacecraft Design SCIF	Technical	6.0	6.0	0
Satellite	Payload Exploitation SCIF	Technical	2.1	2.1	0
Satellite	Mission Development SCIF	Technical	0.5	0.5	0
Satellite	Advanced Systems SCIF	Technical	0.4	0.4	0
Satellite	Space Applications SCIF	Technical	1.2	1.2	0
Satellite	Fuels Testing Laboratory	Technical	1.6	1.6	0
Satellite	General Laboratories	Technical	10.8	10.8	0
Satellite	General Design Space	Technical	62.7	62.7	0

Satellite	General Office Space	Administrative	22.5	22.5	0
Satellite	Storage	Storage	31.4	31.4	0
Satellite	Utility	Utility	1.5	1.5	0
	Total		207.9	207.9	0

3.5.1.1 This activity has the capacity to absorb about 85% more work years in the Satellites CSF with minor facility modification. Even though the table above indicates that there is no excess capacity in our facilities square footage, this additional work load is achievable through the use of multiple shifts and overtime, which is the standard mode of operation for assembly, testing and qualification of spacecraft. In other words, the amount of facility space would not increase, but the percentage of time that the facility was utilized would increase. This additional workload would be distributed among the on-base test facilities and the off-base operational field sites. The peak loading of head count during the day at any one facility would be minimal.

3.5.1.2 This activity has the capability to absorb an additional 320 work years in the Satellites CSF.

3.5.1.3 There would be no impact of 3.5.1.1 and 3.5.1.2 (above) to military construction programs or other alteration projects programmed in the FY95 PBS at this activity for the Satellites CSF.

3.5.2 Land Use: For the Satellites CSF, approximately 50 acres are available for additional Satellites CSF construction at the NRL field sites.

3.5.3 Utilities: There is no restriction or limit to expand the utility services for the Satellites CSF at the NRL field sites.

B2. Ground Control Systems:

3.0 Mission: Major capabilities contributing to the common support function.

- o Navy's Lead Laboratory For Space
- o Systems And Missions Analyses
- o Technology Assessment/Advancement
- o Systems Engineering
- o Ground Station Development
- o Mission Operations
- o Space Systems Architecture Development
- o Mobile Spacecraft Command, Control, And Communications System Design
- o Space Surveillance Systems Design
- o Parallel Processing For Space Surveillance Applications Technology Development
- o Laser Ranging Technology Development
- o Time And Frequency Technology Development
- o Space Based Navigation Systems Technology Development
- o Surveillance of Space Technology Development
- o Ground Support Equipment Design
- o Space Expert Systems Design
- o Advanced Tactical Terminal Design
- o Advanced Data Modem Design

Describe any relationship and interconnectivity with other function (common or otherwise) in support of the overall activity mission.

The Naval Center for Space Technology (NCST), in performing the mission detailed herein, relies very heavily on the basic research and exploratory development in the majority of the other research divisions of NRL, in that the systems developed by the NCST to solve DOD problems and requirements integrates these technologies into operational systems. Conversely, these research divisions of NRL rely on the NCST to provide a "product line" for these technologies to be demonstrated or integrated into the military service or transitioned to commercial or industrial applications. Having the vertical integration of 6.1 research with the systems design, systems engineering, and systems integration capability for Ground Control Systems collocated at the laboratory allows for the very rapid infusion of laboratory technology into operational Ground Control Systems.

Specific Pervasive Functions that are intimately linked to Ground Control Systems are Electronic Devices, Environmental Sciences, and Advanced Materials. Large cooperative efforts exist in all of these areas. For example, the High Temperature Superconductivity Space Experiment is a classic example that is held as a model for managing technology development and bringing laboratory research into operational use in record time. This will result in the first use of high temperature superconducting devices in space. R

In addition, there is a significant, pervasive and inseverable coupling of technology development, analysis and engineering between the Product Functions of Ground Control Systems and C4I Systems. The primary technology effort of NRL in Ground Control Systems is devoted to surveillance and sensor systems. The application of these systems in the defense role is to provide combat data to the war fighter. The systems must be treated as complete "sensor- to-shooter" architectures, including the requirements determination, performance analysis, engineering design, acquisition, and operations. Inherent in this treatment is the sensor portion and the C4I portion; the space portion and the ground portion; the tactical terminal and the satellite command and control portion. All engineering, trade studies, performance analysis, and indeed the operation of the system must be optimized across the entire system. The successful function of the system requires this. Separation the functions of C4I and Ground Control Systems Technology development would seriously jeopardize the development of future systems such as those which NRL has been so highly successful at developing and deploying in the past.

3.1 Location

3.1.1 Geographic/Climatological Features: There are no special geographic or climatological features in or around this activity relevant to the Ground Control Systems CSF.

3.1.2 Licenses & Permits: The Ground Control Systems CSF requires no special licenses or permits for the performance of its function.

3.1.3 Environmental Constraints: There are no environmental constraints to the Ground Control Systems CSF at this activity.

3.1.4 Special Support Infrastructure: No special support infrastructure is required for the Ground Control Systems CSF at this activity.

3.1.5 Proximity to Mission-Related organizations: There are no nearby outside organizations whose location facilities accomplishing the Ground Control Systems CSF effort. R

3.2 Personnel

3.2.1 Total Personnel: The total number of government (military and civilian), on-site federally funded research and development center (FFRDC) and on-site system engineering technical assistance (SETA) personnel engaged in science and technology (S&T), engineering development and in-service engineering activities as of the end of FY93 is described on the chart below:

CSF-GROUND STATION

Types of Personnel	Number of Personnel			
	Government		On-Site FFRDC	On-Site SETA
	Civilian	Military		
Technical	45	0	0	24
Management (SUPV)	11	0	0	3
Other	0	0	0	0

R

3.2.2 Education: the number of government personnel actively engaged in S&T, engineering and in-service engineering activities by highest degree and type of position is as follows:

CSF-GROUND CONTROL SYSTEMS

Type of Degree/Diploma	Number of Government Personnel by Type of Position			
	Technical	Management (supv)	Other	
High School or less	9	1		
Associates	3	2		
Bachelor	23	4		
Masters	9	4		
Doctorate	1	0		
(incl med/vet,etc)	0	0		

R

3.2.3 **Experience**: The experience level of government personnel is provided below.

CSF-GROUND CONTROL SYSTEMS

Type of Position	Years of Government and/or Military Service				
	Less than 3 Years	3-10 Years	11-15 Years	16-20 Years	More than 20 Years
Technical	5	27	1	2	10
Management (supv)	0	0	2	2	7
Total	5	27	3	4	17

R

3.2.4.1 No patents were awarded in the Ground Control Systems CSF.

3.2.4.2 No papers were published in the Ground Control Systems CSF.

3.3 Workload

3.3.1 FY93 Workload

3.3.1.1 **Work Year Lifecycle:** Identified below are the number of actual workyears executed for each application CSF in FY93 for each of the following: government civilian; military; on-site FFRDCs; and on-site SETA'S

GROUND	Fiscal Year 1993 Actual			
	Civilian	Military	FFRDC	SETA
Science & Technology	0	0	0	0
Engineering Development	62.0	0	0	2.2
In-Service Engineering	0	0	0	0

R

3.3.1.2 **Engineering Development by ACAT:** No CSF's to report in this area.

3.3.1.3 **In-Service Engineering:** No CSF's to report in this area.

3.3.2 Projected Funding

3.3.2.1 **Direct Funding:** The are no direct appropriations to the Ground Control Systems CSF.

3.3.2.2 Other Obligation Authority: For this CSF, the following funding has been identified for FY94-FY97:

CSF	$K FY94	$K FY95	$K FY96	$K FY97
Ground Control Systems	40986.9	42134.6	43356.4	44450.8

R

3.4 Facilities and Equipment

3.4.1 Major Equipment and Facilities: The major facilities and equipment necessary to support the Ground Control Systems CSF is listed in the table below. None of the facilities are shared with other CSF's. Many of these facilities are SCIF's and therefore no photographs can be supplied.

Common Support Function	% Util.	Shared Support Function	% Util.	Major Facility or Equipment Description	Unique to DOD	Unique to Fed. Gov't	Unique to U.S.	Repacement Cost ($K)
Ground Control	50	Satellite	50	SCI Data Storage and Media Management Vault				500
Ground Control	50	Satellite	50	SCI Management Information System				200
Ground Control	50	Satellite	50	SCI Data Processing Center				800
Ground Control	50	Satellite	50	NCST Management Information System				1000
Ground Control	50	Satellite	50	Space Systems Development Department Computation Facility				1000
Ground Control	100			SCI Spacecraft Data Processing Development Facility				300
Ground Control	50	Satellite	50	Precision Oscillator Test Facility			X	4800
Ground Control	100			Ground Station Assembly and Test Facility				100
Ground Control	90	Satellite	10	RF Anechoic Chamber	X			3000
Ground Control	100			Ground Station Assembly SCIF				280
Ground Control	100			Systems Management SCIF				45
Ground Control	100			Ground Station Configuration Management SCIF				125
Ground Control	100			SCIF Conference Room				150
Ground Control	100			Security Storage SCIF				55
Ground Control	100			MRC Precision Spacecraft Calibration Facility			X	40000
Ground Control	100			Pomonkey Deep Space Tracking Facility			X	25890
Ground Control	100			Spacecraft Command and Control Facility VAFB				3000
Ground Control	100			Blossom Point Spacecraft Tracking Facility				27000
				Total				108245

R

19 AUG 1994

3.5 Expansion Potential:

3.5.1 Laboratory Facilities: The facilities required to perform the Ground Control Systems CSF at this activity are listed below. For those facilities located at the NRL main base, NRL's MIS data was used. For facilities located at NRL's field sites, local data was used.

Common Support Function	Major Facility or Equipment Description	Type Of Space	(KSF) Current	Used	Excess
Ground Control	SCI Data Storage and Media Management Vault	Technical	2.0	2.0	0
Ground Control	SCI Management Information System	Technical	0.3	0.3	0
Ground Control	SCI Data Processing Center	Technical	1.0	1.0	0
Ground Control	NCST Management Information System	Technical	1.4	1.4	0
Ground Control	Space Systems Development Department Computation Facility	Technical	0.9	0.9	0
Ground Control	SCI Spacecraft Data Processing Development Facility	Technical	6.8	6.8	0
Ground Control	Precision Oscillator Test Facility	Technical	5.8	5.8	0
Ground Control	Ground Station Assembly and Test Facility	Technical	3.4	3.4	0
Ground Control	RF Anechoic Chamber	Technical	7.7	7.7	0
Ground Control	Ground Station Assembly SCIF	Technical	1.4	1.4	0
Ground Control	Systems Management SCIF	Administration	0.2	0.2	0
Ground Control	Ground Station Configuration Management SCIF	Technical	0.6	0.6	0
Ground Control	SCIF Conference Room	Administration	0.7	0.7	0
Ground Control	Security Storage SCIF	Storage	0.3	0.3	0
Ground Control	MRC Precision Spacecraft Calibration Facility	Technical	10.0	10.0	0
Ground Control	Pomonkey Deep Space Tracking Facility	Technical	16.5	16.5	0
Ground Control	Spacecraft Command and Control Facility VAFB	Technical	9.4	9.4	0
Ground Control	Blossom Point Spacecraft Tracking Facility	Technical	61.1	61.1	0
Ground Control	General Laboratories	Technical	10.8	10.8	0
Ground Control	General Design Space	Technical	62.7	62.7	0
Ground Control	General Office Space	Administrative	22.5	22.5	0
Ground Control	Storage	Storage	31.4	31.4	0
Ground Control	Utility	Utility	1.5	1.5	0
	Total		258.5	258.5	0

R

3.5.1.1 This activity has the capacity to absorb about 85% more work years in the Ground Control Systems CSF with minor. Even though the table above indicates that there is no excess capacity in our facilities square footage, this additional work load is achievable through the use of multiple shifts and overtime which is the standard mode of operation for assembly, testing and qualification of spacecraft. In other words, the amount of space of the facilities does not increase, but the percentage of time that the facility is utilized increases. This additional workload would be distributed among the on-base test facilities and the off-base operational field sites. The peak loading of head count during the day at any one facility would be minimal. R

3.5.1.2 This activity has the capability to absorb an additional 80 work years in the Ground Control Systems CSF.

19 AUG 1994

3.5.1.3 There would be no impact of 3.5.1.1 and 3.5.1.2 (above) to military construction programs or other alteration projects programmed in the FY95 PBS at this activity for the Ground Control Systems CSF.

3.5.2 Land Use: For the Ground Control Systems CSF, approximately 50 acres are available foe additional Ground Control Systems CSF construction at the NRL field sites. R

3.5.3 Utilities: There is no restriction or limit to expand the utility services for the Ground Control Systems CSF at the NRL field sites.

SECTION III: CAPABILITY OF ACTIVITIES PERFORM COMMON SUPPORT FUNCTIONS (CFSs)

3.0 Mission: Major capabilities contributing to the common support function.

Ground Control Systems:

- o Navy's Lead Laboratory For Space
- o Systems And Missions Analyses
- o Technology Assessment/Advancement
- o Systems Engineering
- o Ground Station Development
- o Mission Operations
- o Space Systems Architecture Development
- o Mobile Spacecraft Command, Control, And Communications System Design
- o Space Surveillance Systems Design
- o Parallel Processing For Space Surveillance Applications Technology Development
- o Laser Ranging Technology Development
- o Launch Vehicle Propulsion Technology Development
- o Time And Frequency Technology Development
- o Space Based Navigation Systems Technology Development
- o Surveillance of Space Technology Development
- o Ground Support Equipment Design
- o Space Expert Systems Design
- o Advanced Tactical Terminal Design
- o Advanced Data Modem Design

Describe any relationship and interconnectivity with other function (common or otherwise) in support of the overall activity mission.

The Naval Center for Space Technology (NCST), in performing the mission detailed herein, relies very heavily on the basic research and exploratory development work conducted in the other research divisions of NRL, in that the systems developed by the NCST to solve DOD problems and requirements integrate these technologies into operational systems. Conversely, these research divisions of NRL rely on the NCST to provide a "product line" for these technologies to be demonstrated or integrated into the military service or transitioned to commercial or industrial applications. Having the vertical integration of 6.1 research with the systems design, systems engineering, and systems integration capability for Ground Control Systems collocated at the Laboratory allows for the very rapid infusion of laboratory technology into operational Ground Control Systems.

Specific Pervasive Functions that are intimately linked to Ground Control Systems are Electronic Devices, Environmental Sciences, and Advanced Materials. Large cooperative efforts exist in all of these areas. For example, the High Temperature Superconductivity Space Experiment is a classic example that is held as a model for managing technology development and bringing laboratory research into operational use in record time. This will result in the first use of high temperature superconducting devices in space.

In addition, there is a significant, pervasive and inseverable coupling of technology development, analysis and engineering between the Product Functions of Ground Control Systems and C4I Systems. The primary technology effort of NRL in Ground Control Systems is devoted to surveillance and sensor systems. The application of these systems in defense is to provide combat data to the war fighter. The systems must be treated as complete "sensor- to-shooter" architectures, including the requirements determination, performance analysis, engineering design, acquisition, and operations. Inherent in this treatment is the sensor portion and the C4I portion; the space portion and the ground portion; the tactical terminal portion and the satellite command and control portion. All engineering, trade studies, performance analysis, and indeed the operation of the system must be optimized across the entire system. The successful function of the system requires this. Separation the functions of C4I and Ground Control Systems Technology development would seriously jeopardize the development of future systems such as those which NRL has been so highly successful at developing and deploying in the past.

3.1 Location

3.1.1 Geographic/Climatological Features: There are no special geographic or climatological features in or around this activity relevant to the Ground Control Systems CSF.

3.1.2 Licenses & Permits: The Ground Control Systems CSF requires no special licenses or permits for the performance of its function.

3.1.3 Environmental Constraints: There are no environmental constraints to the Ground Control Systems CSF at this activity.

3.1.4 Special Support Infrastructure: No special support infrastructure is required for the Ground Control Systems CSF at this activity.

3.1.5 Proximity to Mission-Related organizations: The Ground Control Systems CSF does not require proximity to any particular mission-related organizations.

3.2 Personnel

3.2.1 Total Personnel: The total number of government (military and civilian), on-site federally funded research and development center (FFRDC) and on-site system engineering technical assistance (SETA) personnel engaged in science and technology (S&T), engineering development and in-service engineering activities as of the end of FY93 is described on the chart below:

CSF-GROUND STATION

Types of Personnel	Number of Personnel			
	Government		On-Site FFRDC	On-Site SETA
	Civilian	Military		
Technical	45	0	0	24
Management (SUPV)	11	0	0	3
Other	0	0	0	0

3.2.2 Education: the number of government personnel actively engaged in S&T, engineering and in-service engineering activities by highest degree and type of position is as follows:

CSF-GROUND CONTROL SYSTEMS

Type of Degree/Diploma	Number of Government Personnel by Type of Position			
	Technical	Management (supv)	Other	
High School or less	9	1		
Associates	3	2		
Bachelor	23	4		
Masters	9	4		
Doctorate	1	0		
(incl med/vet,etc)	0	0		

3.2.3 **Experience**: The experience level of government personnel is provided below.

CSF-GROUND CONTROL SYSTEMS

Type of Position	Years of Government and/or Military Service				
	Less than 3 Years	3-10 Years	11-15 Years	16-20 Years	More than 20 Years
Technical	5	27	1	2	10
Management (supv)	0	0	2	2	7
Total	5	27	3	4	17

3.2.4.1 No patents were awarded in the Ground Control Systems CSF.

3.2.4.2 No papers were published in the Ground Control Systems CSF.

3.3 Workload

3.3.1 FY93 Workload

3.3.1.1 Work Year Lifecycle: Identified below are the number of actual workyears executed for each application CSF in FY93 for each of the following: government civilian; military; on-site FFRDCs; and on-site SETA'S

GROUND	Fiscal Year 1993 Actual (new) (old)			
	Civilian	Military	FFRDC	SETA
Science & Technology	0	0	0	0
Engineering Development	62.0	0	0	2.2
In-Service Engineering	0	0	0	0

3.3.1.2 Engineering Development by ACAT: No CSF's to report in this area.

3.3.1.3 In-Service Engineering: No CSF's to report in this area.

3.3.2 Projected Funding

3.3.2.1 Direct Funding: The are no direct appropriations to the Ground Control Systems CSF.

3.3.2.2 Other Obligation Authority: For this CSF, the following funding has been identified for FY94-FY97:

CSF	$K FY94	$K FY95	$K FY96	$K FY97
Ground Control Systems	40987	42135	43356	44451

3.4 Facilities and Equipment

3.4.1 Major Equipment and Facilities: The major facilities and equipment necessary to support the Ground Control Systems CSF are listed in the table below. None of the facilities are shared with other CSF's. Many of these facilities are SCIF's and therefore no photographs can be supplied.

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Ground Control	50	Satellite	50	SCI Data Processing Center				800
Ground Control	50	Satellite	50	NCST Management Information System				1000
Ground Control	50	Satellite	50	Space Systems Development Department Computation Facility				1000
Ground Control	100			SCI Spacecraft Data Processing Development Facility				300
Ground Control	50	Satellite	50	Precision Oscillator Test Facility			X	4800
Ground Control	100			Ground Station Assembly and Test Facility				100
Ground Control	90	Satellite	10	RF Anechoic Chamber	X			3000
Ground Control	100			Ground Station Assembly SCIF				280
Ground Control	100			Systems Management SCIF				45
Ground Control	100			Ground Station Configuration Management SCIF				125
Ground Control	100			SCIF Conference Room				150
Ground Control	100			Security Storage SCIF				55
Ground Control	100			MRC Precision Spacecraft Calibration Facility			X	40000
Ground Control	100			Pomonkey Deep Space Tracking Facility			X	25890
Ground Control	100			Spacecraft Command and Control Facility VAFB				3000
Ground Control	100			Blossom Point Spacecraft Tracking Facility				27000
				Total				108245

3.5 Expansion Potential:

3.5.1 Laboratory Facilities: The facilities required to perform the Ground Control Systems CSF at this activity are listed below. For those facilities located at the NRL main base, NRL's MIS data were used. For facilities located at NRL's field sites, local data were used.

Common Support Function	Major Facility or Equipment Description	Type Of Space	(KSF) Current	Used	Excess
Ground Control	SCI Data Storage and Media Management Vault	Technical	2.0	2.0	0
Ground Control	SCI Management Information System	Technical	0.3	0.3	0
Ground Control	SCI Data Processing Center	Technical	1.0	1.0	0
Ground Control	NCST Management Information System	Technical	1.4	1.4	0
Ground Control	Space Systems Development Department Computation Facility	Technical	0.9	0.9	0
Ground Control	SCI Spacecraft Data Processing Development Facility	Technical	6.8	6.8	0
Ground Control	Precision Oscillator Test Facility	Technical	5.8	5.8	0
Ground Control	Ground Station Assembly and Test Facility	Technical	3.4	3.4	0
Ground Control	RF Anechoic Chamber	Technical	7.7	7.7	0
Ground Control	Ground Station Assembly SCIF	Technical	1.4	1.4	0
Ground Control	Systems Management SCIF	Administration	0.2	0.2	0
Ground Control	Ground Station Configuration Management SCIF	Technical	0.6	0.6	0
Ground Control	SCIF Conference Room	Administration	0.7	0.7	0
Ground Control	Security Storage SCIF	Storage	0.3	0.3	0
Ground Control	MRC Precision Spacecraft Calibration Facility	Technical	10.0	10.0	0
Ground Control	Pomonkey Deep Space Tracking Facility	Technical	16.5	16.5	0
Ground Control	Spacecraft Command and Control Facility VAFB	Technical	9.4	9.4	0
Ground Control	Blossom Point Spacecraft Tracking Facility	Technical	61.1	61.1	0
Ground Control	General Laboratories	Technical	10.8	10.8	0
Ground Control	General Design Space	Technical	62.7	62.7	0
Ground Control	General Office Space	Administrative	22.5	22.5	0
Ground Control	Storage	Storage	31.4	31.4	0
Ground Control	Utility	Utility	1.5	1.5	0
	Total		258.5	258.5	0

3.5.1.1 This activity has the capacity to absorb about 85% more work years in the Ground Control Systems CSF with minor facility modifications. Even though the table above indicates that there is no excess capacity in our facilities square footage, this additional work load is achievable through the use of multiple shifts and overtime, which is the standard mode of operation for assembly, testing and qualification of spacecraft. In other words, the amount of facility space would not increase, but the percentage of time that the facility was utilized would increase. This additional workload would be distributed among the on-base test facilities and the off-base operational field sites. The peak loading of head count during the day at any one facility would be minimal.

3.5.1.2 This activity has the capability to absorb an additional 80 work years in the Ground Contro Systems CSF.

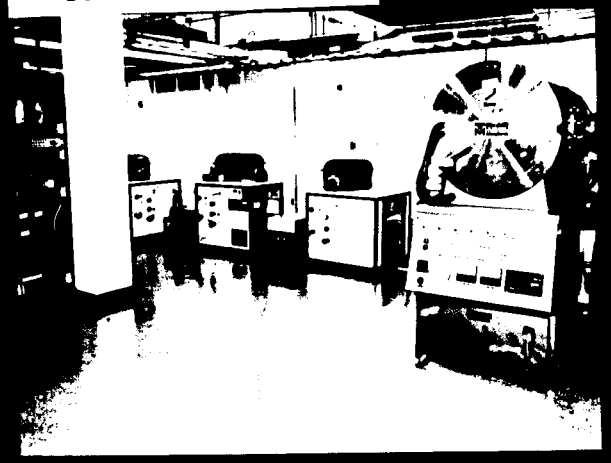
3.5.1.3 There would be no impact of 3.5.1.1 and 3.5.1.2 (above) to military construction programs or other alteration projects programmed in the FY95 PBS at this activity for the Ground Control Systems CSF.

3.5.2 Land Use: For the Ground Control Systems CSF, approximately 50 acres are available foe additional Ground Control Systems CSF construction at the NRL field sites.

3.5.3 Utilities: There is no restriction or limit to expand the utility services for the Ground Control Systems CSF at the NRL field sites.

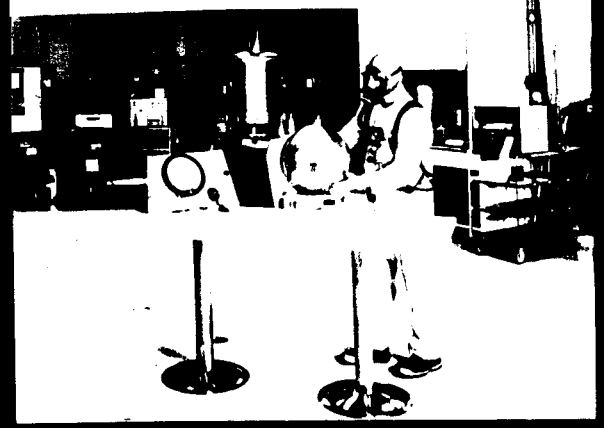
NCST FACILITIES

Precision Oscillator Test Facility



Clock Test Facility

Fuels Testing Laboratory

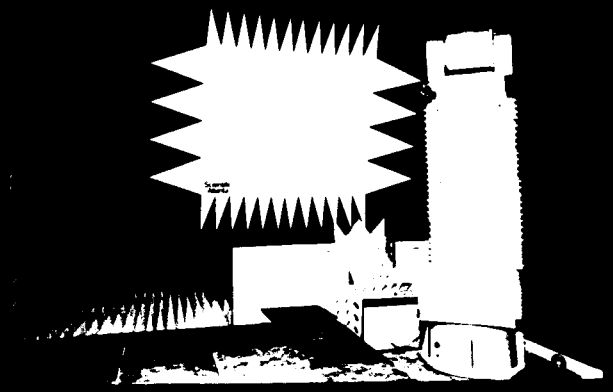


Fuels Test Facility

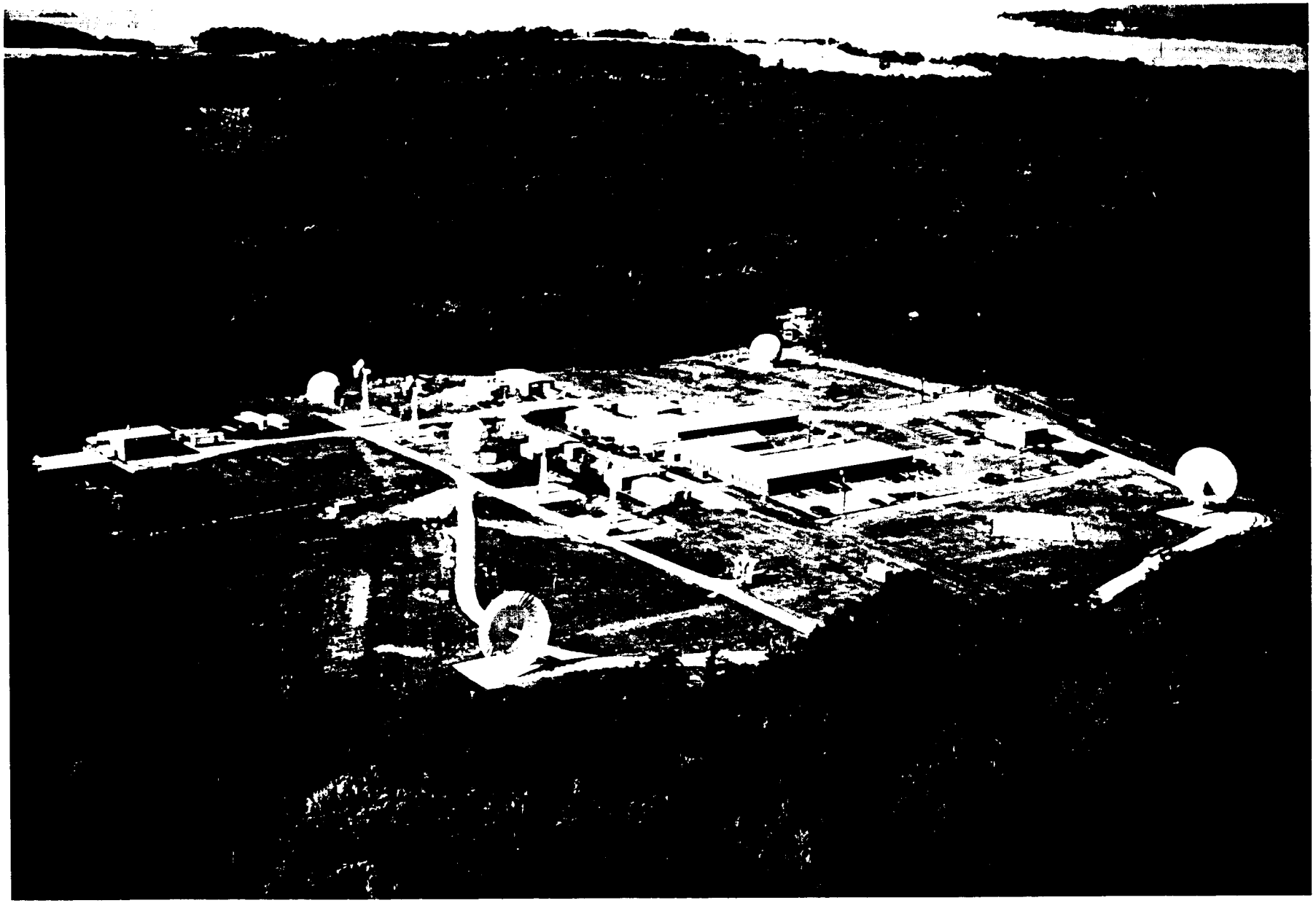
Precision RF Anechoic Chamber

RF Anechoic Chambers

RF Compact Range



Compact Range



Blossom Point Spacecraft
Tracking Facility

MRC Precision Spacecraft
Calibration Facility

NCST FIELD SITES

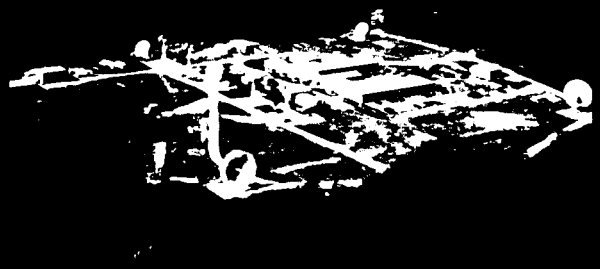
MRC Precision Spacecraft Calibration Facility

Midway Research Center, Va.

Spacecraft Command and Control Facility VAFB

Building 660, VAFB

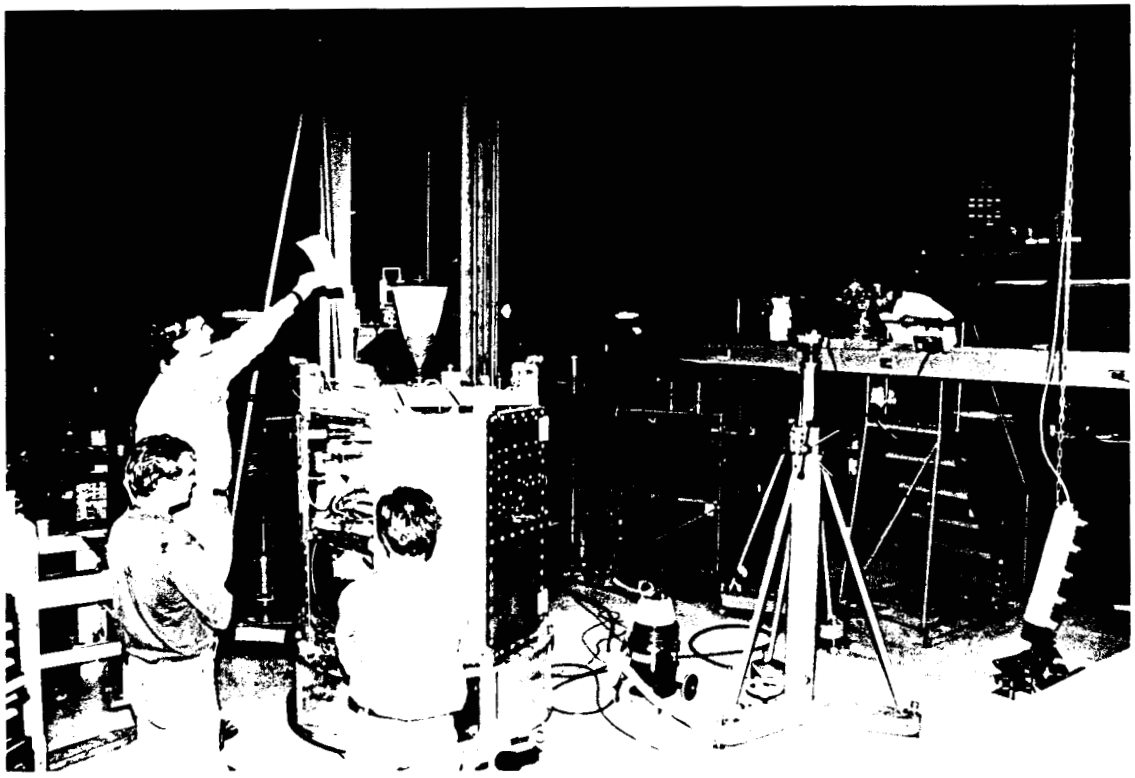
Blossom Point Spacecraft Tracking Facility



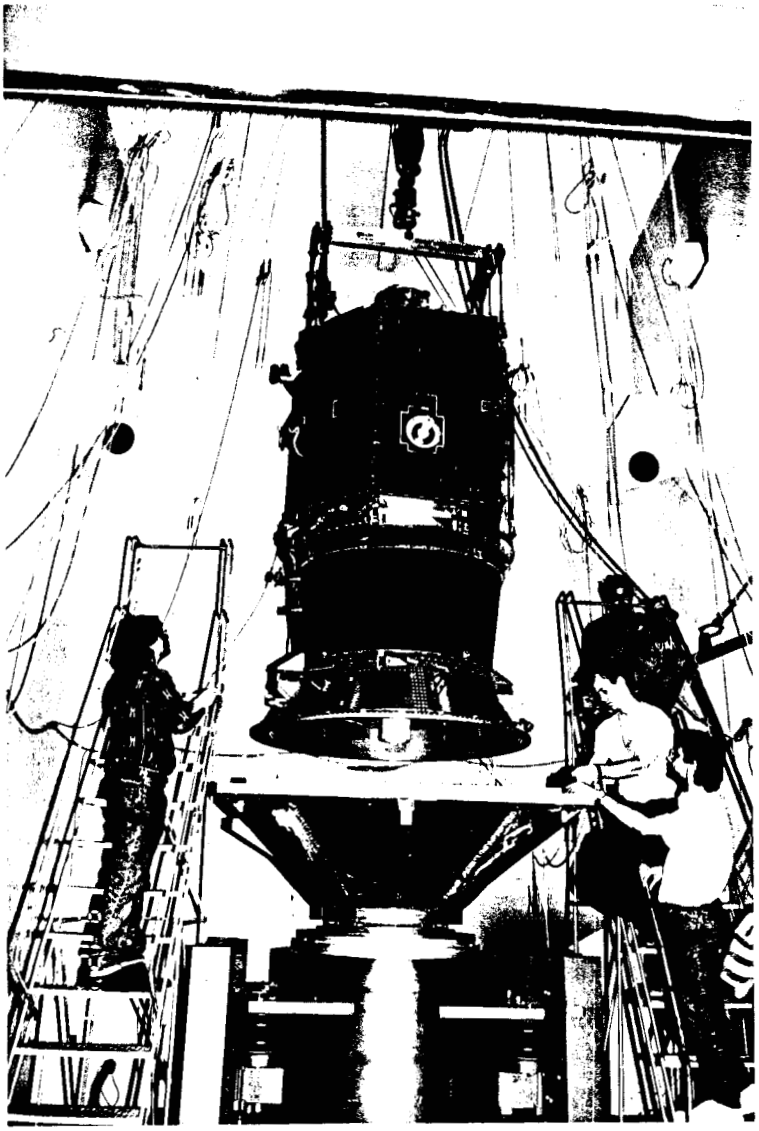
Blossom Point, Md.

Pomonkey Deep Space Tracking Facility

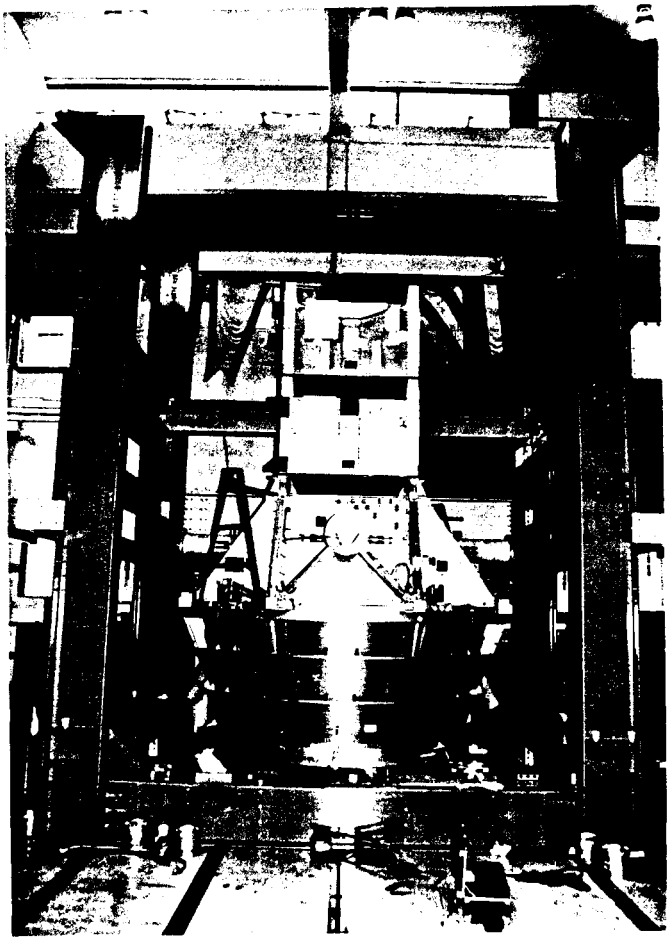
Pomonkey, Md.

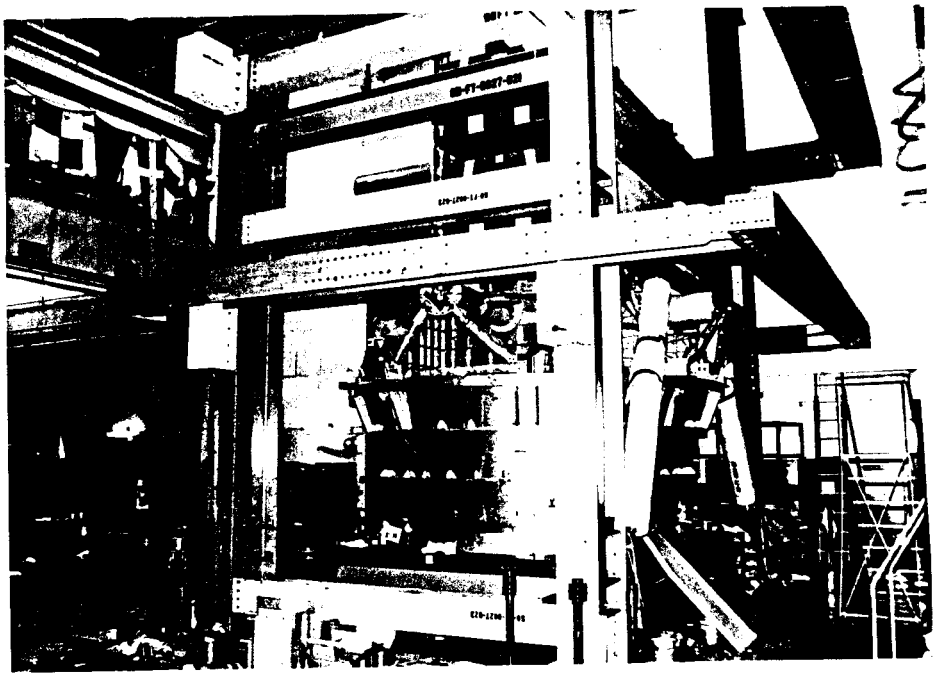


Spacecraft Optical
Alignment Facility

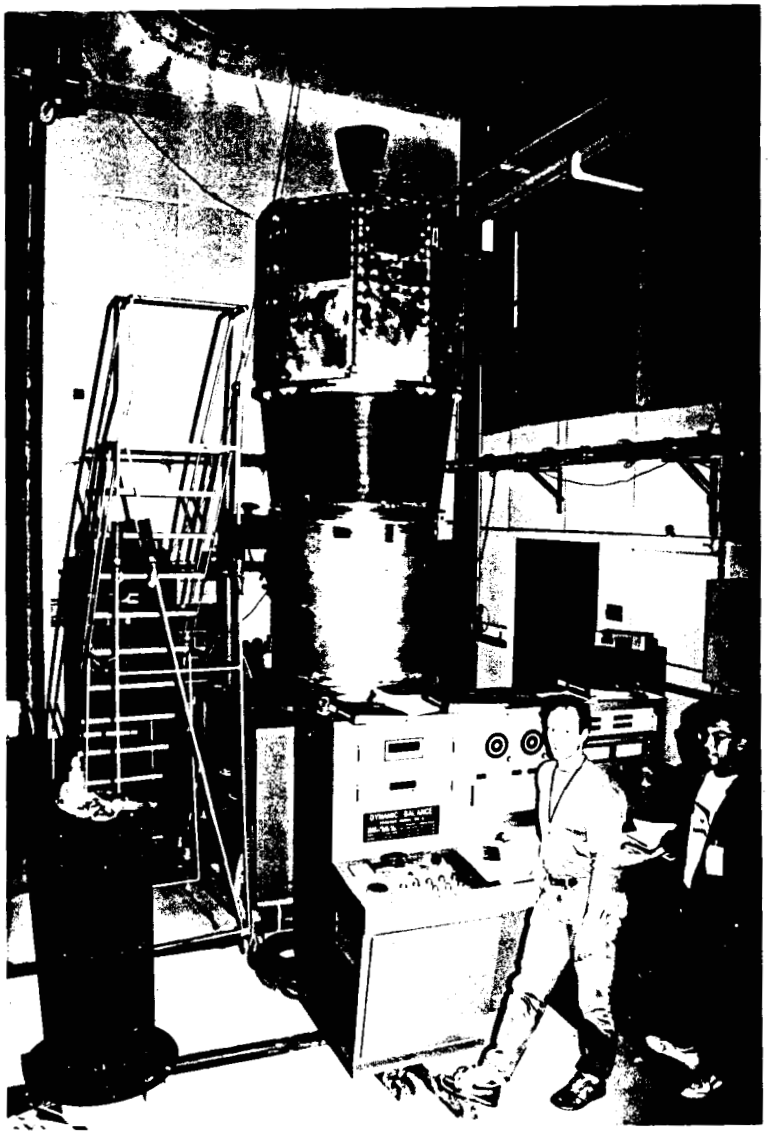


Spacecraft Acoustic
Reverberation Chamber



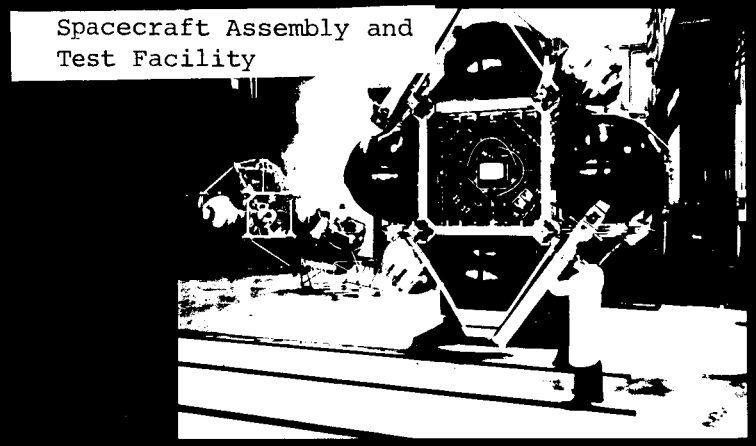


Spacecraft Static
Test Loads Facility



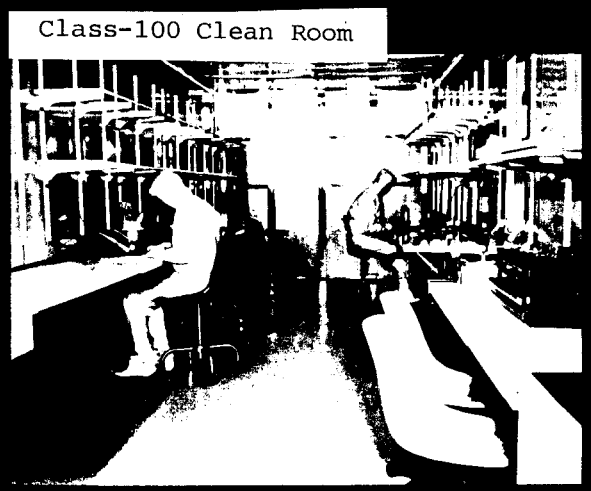
Spacecraft Spin
Balance Facility

NCST FACILITIES



Spacecraft Fabrication & Assembly

CAD/CAM



Clean Rooms

Pomonkey Deep Space
Tracking Facility

NCST FACILITIES

Reshape Facility

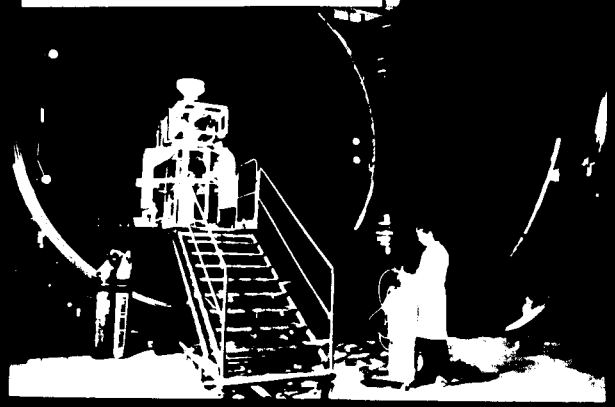
RESHAPE

Reverberation Chamber

Spacecraft Vibration Test Facility

Shock & Vibration Test

Thermal High Vacuum Chamber



Thermal Vacuum Chambers

R

C. C4I

R

C1. Airborne C4I

3.0 Mission

In this CSF there is significant coupling of technology development, analysis and engineering between the Product Functions of Space Systems and C4I Systems. The primary technology effort of NRL in Space Systems is devoted to surveillance and sensor systems. The application of these systems to defense provides combat data to the war fighter. The systems must be considered as complete "sensor-to-shooter" architectures, including the requirement determination, performance analysis, engineering design, acquisition, and operations. Due to the close coupling and strong interaction of Space Systems and the C4I functions described here it would seriously jeopardize several efforts to consider them in isolation.

- **Improved Data Modem**
  - -Short Range Data Communication for :
    - Close Air Support
    - Suppression of Enemy Air Defense
    - Forward Air Controller
    - Battlefield Air Interdiction
    - Situation Awareness
    - Command and Control
  - Multi-Service program
  - Aircraft Platforms: F-16, A-10, AH-64, OH-58, UH-60, JSTARS
  - Interservice interoperability
  - Foreign Military Sales : Korea, Taiwan, Greece, Turkey, Denmark, Netherlands; Belgium, and Norway
  - Quick Reaction Program, Hardware delivered in 9 months
  - Government owned Drawings and Software
  - Transitioned to production with two Small business companies
  - Over 1000 units first year in production
- **Multi-mission Advanced Tactical Terminal**
  - Satcom and LOS Tactical Terminal
  - Real Time Situation Awareness
  - Multi -Service program
  - Aircraft Platforms: IDAS on MH-53, Combat Talon II, UH-60
  - Quick reaction capability for prototyping of C4I Systems
  - In-house engineering with limited contractual involvement
  - Transitioned to Production

3.1 Location: Naval Research Laboratory, Washington DC

3.1.1 **Geographic/Climatological Features:** No special features required

3.1.2 **Licenses & permits:** None

3.1.3 **Environmental constraints:** None

3.1.4 **Special Support Infrastructure:** Several SCIFs specially equipped for communications investigations are used in these efforts.

3.1.5. **Proximity to Mission-Related organizations:**
Frequent interaction is required both with the sponsors of this work and the various other laboratories and facilities involved in conducting these efforts. The close proximity of these facilities facilitates effective interaction and greatly reduces travel.

3.0 Mission

Common Support Function: Airborne C4I
In this CSF there is significant coupling of technology development, analysis and engineering between the Product Functions of Space Systems and C4I Systems. The primary technology effort of NRL in Space Systems is devoted to surveillance and sensor systems. The application of these systems to defense provides combat data to the war fighter. The systems must be considered as complete "sensor-to-shooter" architectures, including the requirement determination, performance analysis, engineering design, acquisition, and operations. Due to the close coupling and strong interaction of Space Systems and the C4I functions described here it would seriously jeopardize several efforts to consider them in isolation.

- **Improved Data Modem**
  - -Short Range Data Communication for :
    - Close Air Support
    - Suppression of Enemy Air Defense
    - Forward Air Controller
    - Battlefield Air Interdiction
    - Situation Awareness
    - Command and Control
  - Multi-Service program
  - Aircraft Platforms: F-16, A-10, AH-64, OH-58, UH-60, JSTARS
  - Interservice interoperability
  - Foreign Military Sales : Korea, Taiwan, Greece, Turkey, Denmark, Netherlands; Belgium, and Norway
  - Quick Reaction Program, Hardware delivered in 9 months
  - Government owned Drawings and Software
  - Transitioned to production with two Small business companies
  - Over 1000 units first year in production
- **Multi-mission Advanced Tactical Terminal**
  - Satcom and LOS Tactical Terminal
  - Real Time Situation Awareness
  - Multi -Service program
  - Aircraft Platforms: IDAS on MH-53, Combat Talon II, UH-60
  - Quick reaction capability for prototyping of C4I Systems
  - In-house engineering with limited contractual involvement
  - Transitioned to Production

3.1 Location: Naval Research Laboratory, Washington DC

3.1.1 **Geographic/Climatological Features:** No special features required

3.1.2 **Licenses & permits:** None

3.1.3 **Environmental constraints:** None

3.1.4 **Special Support Infrastructure:** Several SCIFs specially equipped for communications investigations are used in these efforts.

3.1.5. **Proximity to Mission-Related organizations:**
Frequent interaction is required both with the sponsors of this work and the various other laboratories and facilities involved in conducting these efforts. The close proximity of these facilities facilitates effective interaction and greatly reduces travel.

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C. C4I

3.0 Mission.

Common Support Function: Airborne C4I
In this CSF there is significant coupling of technology development, analysis and engineering between the Product Functions of Space Systems and C4I Systems. The primary technology effort of NRL in Space Systems is devoted to surveillance and sensor systems. The application of these systems to defense provides combat data to the war fighter. The systems must be considered as complete "sensor-to-shooter" architectures, including the requirement determination, performance analysis, engineering design, acquisition, and operations. Due to the close coupling and strong interaction of Space Systems and the C4I functions described here it would seriously jeopardize both efforts to consider them in isolation.

- **Improved Data Modem**
  - Short Range Data Communication for :
    - Close Air Support
    - Suppression of Enemy Air Defense
    - Forward Air Controller
    - Battlefield Air Interdiction
    - Situation Awareness
    - Command and Control
  - Multi-Service program
  - Aircraft Platforms: F-16, A-10, AH-64, OH-58, UH-60, JSTARS
  - Interservice interoperability
  - Foreign Military Sales : Korea, Taiwan, Greece, Turkey, Denmark, Netherlands; Belgium, and Norway
  - Quick Reaction Program, Hardware delivered in 9 months
  - Government owned Drawings and Software
  - Transitioned to production with two small business companies
  - Over 1000 units first year in production
- **Multi-mission Advanced Tactical Terminal**
  - Satcom and LOS Tactical Terminal
  - Real Time Situation Awareness
  - Multi -Service program
  - Aircraft Platforms: IDAS on MH-53, Combat Talon II, UH-60
  - Quick reaction capability for prototyping of C4I Systems
  - In-house engineering with limited contractual involvement
  - Transitioned to Production

Common Support Function: Fixed groundbased C4I
The groundbased C4I efforts described are conducted in close coordination with Navy-specific research in networking and communications. The efforts reported here are aimed at shipboard problems even though they were conducted using land-based sites.

- Communications
  - ROTHR communications investigation
  - Digital data retransmission
  - Radio frequency interference research

3.1 Location

3.1.1 Geographic/Climatological Features. No special features required

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Common Support Functions	Name	Type of Organization	Distance (Miles)	Workyears Performed by Your Activity	Workyears Funded by Your Activity
Airborne C4I	ARINC	NFP Commercial	45		1
Airborne C4I	SPAWAR	MATT Sponsor	1	10	
Airborne C4I	NESSEC	Test Facility	10		1
Airborne C4I	NAWC	Test Facility	90		1
Airborne C4I	NSA	Support & Evaluation	30		1

R

3.2 Personnel:

3.2.1 **Total Personnel:**

Types of personnel	Number of Personnel			
	Government		On-Site FFRDC	On-Site SETA
	Civilian	Military		
Technical	9			15
Management (Supv)	2			
Other				

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Common Support Functions	Name	Type of Organization	Distance (Miles)	Workyears Performed by Your Activity	Workyears Funded by Your Activity
Airborne C4I	ARINC	NFP Commercial	45		1
Airborne C4I	SPAWAR	MATT Sponsor	1	10	
Airborne C4I	NESSEC	Test Facility	10		1
Airborne C4I	NAWC	Test Facility	90		1
Airborne C4I	NSA	Support & Evaluation	30		1

3.2 Personnel:

3.2.1 **Total Personnel:**

Types of personnel	Number of Personnel			
	Government		On-Site FFRDC	On-Site SETA
	Civilian	Military		
Technical	9			15
Management (Supv)	2			
Other				

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3.1.2 Licenses & permits. None

3.1.3 Environmental constraints. None

3.1.4 Special Support Infrastructure. Several SCIFs specially equipped for communications investigations are used in these efforts.

3.1.5. Proximity to Mission-Related organizations. Frequent interaction is required both with the sponsors of this work and the various other laboratories and facilities involved in conducting these efforts. The close proximity of these facilities facilitates effective interaction and greatly reduces travel.

Common Support Functions	Name	Type of Organization	Distance (Miles)	Workyears Performed by Your Activity	Workyears Funded by Your Activity
Airborne C4I	ARINC	NFP Commercial	45		1
Airborne C4I	SPAWAR	MATT Sponsor	1	10	
Airborne & Groundbased C4I	NESSEC	Test Facility	10		1
Airborne C4I	NAWC	Test Facility	130		1
Airborne & Groundbased C4I	NSA	Support & Evaluation	30		1

3.2 Personnel

3.2.1 Total Personnel.

Types of personnel	**Number of Personnel**			
	Government		On-Site FFRDC	On-Site SETA
	Civilian	**Military**		
Technical	10			15
Management (Supv)	2			
Other				

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3.2.2 **Education:**

Type of Degree/ Diploma	Number of Government Personnel by Type of Position		
	Technical	Management (Supv)	Other
High School or Less			
Associates		1	
Bachelor	8	1	
Masters	1		
Doctorate (include Med/Vet/etc.)			

R

3.2.3 **Experience:**

Type of Position	Years of Government and/or Military Service				
	Less than 3 years	3-10 years	11-15 years	16-20 years	More than 20 years
Technical	1	5	2	0	1
Management (Supv)	0			0	2
Total	1	5	2	0	3

R

3.2.4 **Accomplishments During FY91-93:** For government personnel answer the following questions.

3.2.4.1 How many patents were awarded and patent disclosures (only count disclosures with issued disclosure numbers) were made? (BRAC Criteria I)

CSF	Disclosures	Awarded	Patent Titles (List)
Airborne C4I	0	0	
Total	0	0	

3.2.4.2 How many papers were published in peer reviewed journals? (BRAC Criteria I)

CSF	Number Published	Paper Titles (List)
Airborne C4I	0	
TOTAL	0	

3.2.2 **Education:**

Type of Degree/ Diploma	Number of Government Personnel by Type of Position		
	Technical	Management (Supv)	Other
High School or Less			
Associates		1	
Bachelor	8	1	
Masters	1		
Doctorate (include Med/Vet/etc.)			

3.2.3 **Experience:**

Type of Position	Years of Government and/or Military Service				
	Less than 3 years	3-10 years	11-15 years	16-20 years	More than 20 years
Technical	1	5	2	0	1
Management (Supv)	0			0	2
Total	1	5	2	0	3

3.2.4 **Accomplishments During FY91-93:** For government personnel answer the following questions.

3.2.4.1 How many patents were awarded and patent disclosures (only count disclosures with issued disclosure numbers) were made? (BRAC Criteria I)

CSF	Disclosures	Awarded	Patent Titles (List)
Airborne C4I	0	0	
Total	0	0	

3.2.4.2 How many papers were published in peer reviewed journals? (BRAC Criteria I)

CSF	Number Published	Paper Titles (List)
Airborne C4I	0	
TOTAL	0	

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3.2.2 Education.

Type of Degree/ Diploma	Number of Government Personnel by Type of Position		
	Technical	Management (Supv)	Other
High School or Less			
Associates		1	
Bachelor	8	1	
Masters	2		
Doctorate (include Med/Vet/etc.)			

3.2.3 Experience.

Type of Position	Years of Government and/or Military Service				
	Less than 3 years	3-10 years	11-15 years	16-20 years	More than 20 years
Technical	2	5	2	0	1
Management (Supv)	0			0	2
Total	2	5	2	0	3

3.2.4 Accomplishments During FY91-93. For government personnel answer the following questions.

3.2.4.1 How many patents were awarded and patent disclosures (only count disclosures with issued disclosure numbers) were made? (BRAC Criteria I)

CSF	Disclosures	Awarded	Patent Titles (List)
Airborne C4I	0	0	
Groundbased C4I	0	0	
Total	0	0	

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3.3 Workload

3.3.1 FY93 Workload

3.3.1.1 Work Year and Lifecycle:

"LAB"	Fiscal Year 1993 Actual			
	Civilian	Military	FFRDC	SETA
Science & Technology	3			2
Engineering Development	7			11
In-Service Engineering	3			2

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3.3.1.2 Engineering Development By ACAT:

Engineering Development	Name or Number	Workyears (FY93 Actual)	FY93 Funds Received (Obligation Authority)	Narrative
ACAT III/IV	C3 Advanced Technology	18	$15.562M	Improved Data Modem (IDM), Multi-mission Advanced Tactical Terminal (MATT) (Military, non-Navy Program)

R

3.3.1.3 In-Service Engineering:

Common Support Functions	In-Service Engineering Efforts (List)	FY93 Actual		Weapon System(s) Supported
		Funds Received (Obligation Authority)	Workyears	
Airborne C4I	Depot Support Software Maintenance Logistics Support Reliability Demonstration Product Improvements	$1.3M	5	F-16, A-10, AH-64, UH-60, OH-58, JSTARS

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3.3 Workload

3.3.1 FY93 Workload

3.3.1.1 Work Year and Lifecycle:

"LAB"	Fiscal Year 1993 Actual			
	Civilian	Military	FFRDC	SETA
Science & Technology	3			2
Engineering Development	7			11
In-Service Engineering	3			2

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3.3.1.2 Engineering Development By ACAT:

Engineering Development	Name or Number	Workyears (FY93 Actual)	FY93 Funds Received (Obligation Authority)	Narrative
ACAT III/IV	2	18	$15.562M	Improved Data Modem (IDM), Multi-mission Advanced Tactical Terminal (MATT)

3.3.1.3 In-Service Engineering:

Common Support Functions	In-Service Engineering Efforts (List)	FY93 Actual		Weapon System(s) Supported
		Funds Received (Obligation Authority)	Workyears	
Airborne C4I	Depot Support Software Maintenance Logistics Support Reliability Demonstration Product Improvements	$1.3M	5	F-16, A-10, AH-64, UH-60, OH-58, JSTARS

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3.3 Workload

3.3.1 FY93 Workload

3.3.1.1 Work Year and Lifecycle:

"LAB"	Fiscal Year 1993 Actual			
	Civilian	Military	FFRDC	SETA
Science & Technology	3			2
Engineering Development	7			11
In-Service Engineering	3			2

3.3.1.2 Engineering Development By ACAT:

Engineering Development	Name or Number	Workyears (FY93 Actual)	FY93 Funds Received (Obligation Authority)	Narrative
ACAT III/IV	2	18	$15.562M	Improved Data Modem (IDM), Multi-mission Advanced Tactical Terminal (MATT)

3.3.1.3 In-Service Engineering:

Common Support Functions	In-Service Engineering Efforts (List)	FY93 Actual		Weapon System(s) Supported
		Funds Received (Obligation Authority)	Workyears	
Airborne C4I	Depot Support Software Maintenance Logistics Support Reliability Demonstration Product Improvements	$1.3M	5	F-16, A-10, AH-64, UH-60, OH-58, JSTARS

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3.2.4.2 How many papers were published in peer reviewed journals? (BRAC Criteria I).

CSF	Number Published	Paper Titles (List)
Airborne C4I	0	
Groundbased C4I	1	- "NVIS Antenna Investigation" IEE Conference
TOTAL	1	

3.3 Workload

3.3.1 FY93 Workload.

3.3.1.1 Work Year and Lifecycle.

"LAB"	Fiscal Year 1993 Actual			
	Civilian	Military	FFRDC	SETA
Science & Technology	4			2
Engineering Development	7			11
In-Service Engineering	3			2

3.3.1.2 Engineering Development By ACAT:

Engineering Development	Name or Number	Workyears (FY93 Actual)	FY93 Funds Received (Obligation Authority)	Narrative
ACAT III/IV	2	18	$15.562M	Improved Data Modem (IDM), Multi-mission Advanced Tactical Terminal (MATT)

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3.3.2 Projected Funding

3.3.2.1 **Direct Funding:** For each applicable CSF, identify direct mission funding by appropriation from FY94 to FY97. Use FY95 PBS for FY95-FY97. (BRAC Criteria I)

CSF	FY94	FY95	FY96	FY97
Airborne C4I	0	0	0	0

3.3.2.2 **Other Obligation Authority:**

CSF	FY94	FY95	FY96	FY97
Airborne C4I	$9.9M	$6.2M	$3.35M	$2.75M

R

3.4 Facilities and Equipment

3.4.1 Major Equipment and Facilities:

Common Support Function	Major Facility or Equipment Description	Unique To			Replacement Cost ($K)
		DOD	Federal Gov't	U. S.	
Airborne C4I	Tactical Terminal Lab	X			$500K
Airborne C4I	Comsec Lab	X			$250K

The facilities above and those listed in table 3.5.1 have been used in conjunction with efforts in the Information Technology and Remote Sensing Divisions at NRL and also with DISA, Army and Air Force in many other efforts. During FY93 approximately 25% of the effort within these facilities was devoted to supporting these other functions and demonstrations associated with external efforts.

3.3.2 Projected Funding

3.3.2.1 **Direct Funding:** For each applicable CSF, identify direct mission funding by appropriation from FY94 to FY97. Use FY95 PBS for FY95-FY97. (BRAC Criteria I)

CSF	FY94	FY95	FY96	FY97
Airborne C4I	0	0	0	0

3.3.2.2 **Other Obligation Authority:**

CSF	FY94	FY95	FY96	FY97
Airborne C4I	$9.9M	$6.2M	$3.35M	$2.75M

3.4 Facilities and Equipment

3.4.1 **Major Equipment and Facilities:**

Common Support Function	Major Facility or Equipment Description	Unique To			Replacement Cost ($K)
		DOD	Federal Gov't	U. S.	
Airborne C4I	Tactical Terminal Lab	X			$500K
Airborne C4I	Comsec Lab	X			$250K

The facilities above and those listed in table 3.5.1 have been used in conjunction with efforts in the Information Technology and Remote Sensing Divisions at NRL and also with DISA, Army and Air Force in many other efforts. During FY93 approximately 25% of the effort within these facilities was devoted to supporting these other functions and demonstrations associated with external efforts.

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3.3.1.3 In-Service Engineering.

Common Support Functions	In-Service Engineering Efforts (List)	FY93 Actual		Weapon System(s) Supported
		Funds Received (Obligation Authority)	Workyears	
Airborne C4I	Depot Support Software Maintenance Logistics Support Reliability Demonstration Product Improvements	$1.3M	5	F-16, A-10, AH-64, UH-60, OH-58, JSTARS

3.3.2 **Projected Funding**

3.3.2.1 Direct Funding. For each applicable CSF, identify direct mission funding by appropriation from FY94 to FY97. Use FY95 PBS for FY95-FY97. (BRAC Criteria I)

CSF	FY94	FY95	FY96	FY97
Airborne C4I	0	0	0	0
Groundbased C4I	0	0	0	0

3.3.2.2 **Other Obligation Authority**:

CSF	FY94	FY95	FY96	FY97
Airborne C4I	$9.9M	$6.2M	$3.35M	$2.75M
Groundbased C4I	$0.15M	$0.15M	$0.05M	$0.05M

3.4 Facilities and Equipment

3.4.1 Major Equipment and Facilities.

Common Support Function	Major Facility or Equipment Description	Unique To			Replacement Cost ($K)
		DOD	Federal Gov't	U. S.	
Airborne C4I	Tactical Terminal Lab	X			$500K
Airborne C4I	Comsec Lab	X			$250K

R

3.5 Expansion Potential

3.5.1 **Laboratory Facilities:** Use facilities records as of fourth-quarter FY93 in answering the following (in sq ft) for each CSF: (BRAC Criteria II)

Common Support Function	Facility or Equipment Description	Type of Space*	Space Capacity (KSF)		
			Current	Used	Excess
Airborne C4I	Office	Administrative	0.6	0.6	0
Airborne C4I	Tactical Lab	Technical	1.5	1.5	0
Airborne C4I	EMI Lab	Technical	0.3	0.3	0
Airborne C4I	Configuration	Administrative	0.3	0.3	0
Airborne C4I	Quality Assurance	Administrative	0.2	0.2	0
Airborne C4I	Library	Storage	0.3	0.3	0
Airborne C4I	Comsec Lab	Technical	2.5	2.5	0

R

* Administrative, Technical, Storage, Utility

3.5.1.1 Capacity to absorb new work: This in-house effort is expected to decrease between now and FY 1997. An additional similar effort could be absorbed with minor facility modification to accommodate uniqueness of additional work.

3.5.1.2 If there is capacity to absorb additional workyears, how many additional workyears can be supported? (BRAC Criteria III)

In excess of 16 work years capacity could be available by FY 1997.

3.5.1.3 For 3.5.1.1 and 3.5.1.2 (above) describe the impact of military construction programs or other alteration projects programmed in the FY95 PBS. (BRAC Criteria II)

Planning activities to more fully utilize available space in Building A-59 through alterations and minor MILCON will enhance facility capacity to absorb additional work.

3.5.2 **Land Use:** Provide number of buildable acres for additional laboratory/administrative support construction at your installation. (BRAC Criteria II)

NRL has 11.2 acres available for unrestricted expansion located at its Chesapeake Bay Detachment. Parking would have to be included as part of any expansion project. Utilities, while available, are aged and would be required to be upgraded to accommodate any expansion. R

The building space (class 2 property) currently available for growth opportunities at the NRL DC site, either constrained or unconstrained, represents a total of multiple small areas located throughout the Laboratory which cannot be effectively utilized by any other functions other than the primary occupant of the facility. It is important to note that NRL facilities can be re-configured, e.g., demolished and rebuilt, altered, fitted with capital equipment, etc. to accommodate new or expanded mission assignments. However, accurate quantification of the maximum amount of space available for expansion is not R

3.5 Expansion Potential

3.5.1 **Laboratory Facilities:** Use facilities records as of fourth-quarter FY93 in answering the following (in sq ft) for each CSF: (BRAC Criteria II)

Common Support Function	Facility or Equipment Description	Type of Space*	Space Capacity (KSF)		
			Current	Used	Excess
Airborne C4I	Office	Administrative	0.6	0.6	0
Airborne C4I	Tactical Lab	Technical	1.5	1.5	0
Airborne C4I	EMI Lab	Technical	0.3	0.3	0
Airborne C4I	Configuration	Administrative	0.3	0.3	0
Airborne C4I	Quality Assurance	Administrative	0.2	0.2	0
Airborne C4I	Library	Storage	0.3	0.3	0
Airborne C4I	Comsec Lab	Technical	2.5	2.5	0

* Administrative, Technical, Storage, Utility

3.5.1.1 Capacity to absorb new work: This in-house effort is expected to decrease between now and FY 1997. An additional similar effort could be absorbed with minor facility modification to accommodate uniqueness of additional work.

3.5.1.2 If there is capacity to absorb additional workyears, how many additional workyears can be supported? (BRAC Criteria III)

In excess of 16 work years capacity could be available by FY 1997.

3.5.1.3 For 3.5.1.1 and 3.5.1.2 (above) describe the impact of military construction programs or other alteration projects programmed in the FY95 PBS. (BRAC Criteria II)

Planning activities to more fully utilize available space in Building A-59 through alterations and minor MILCON will enhance facility capacity to absorb additional work.

3.5.2 **Land Use:** Provide number of buildable acres for additional laboratory/administrative support construction at your installation. (BRAC Criteria II)
NRL has 11.2 acres available for unrestricted expansion located at its Chesapeake Bay Detachment. Parking would have to be included as part of any expansion project. Utilities, while available, are aged and would be required to be upgraded to accommodate any expansion.

The building space (class 2 property) currently available for growth opportunities at the NRL DC site, either constrained or unconstrained, represents a total of multiple small areas located throughout the Laboratory which cannot be effectively utilized by any other functions other than the primary occupant of the facility. It is important to note that NRL facilities can be re-configured, e.g., demolished and rebuilt, altered, fitted with capital equipment, etc. to accommodate new or expanded mission assignments. However, accurate quantification of the maximum amount of space available for expansion is not

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3.5 Expansion Potential

3.5.1 Laboratory Facilities. Use facilities records as of fourth-quarter FY93 in answering the following (in sq ft) for each CSF: (BRAC Criteria II)

Common Support Function	Facility or Equipment Description	Type of Space*	Space Capacity (KSF)		
			Current	Used	Excess
Airborne C4I	Office	Administrative	0.6	0.6	0
Airborne C4I	Tactical Lab	Technical	1.5	1.5	0
Airborne C4I	EMI Lab	Technical	0.3	0.3	0
Airborne C4I	Configuration	Administrative	0.3	0.3	0
Airborne C4I	Quality Assurance	Administrative	0.2	0.2	0
Airborne C4I	Library	Storage	0.3	0.3	0
Airborne C4I	Comsec Lab	Technical	2.5	2.5	0
Groundbased C4I	Secure Labs	Technical	0.3	0.3	0

* Administrative, Technical, Storage, Utility

3.5.1.1 Both IDM and MATT in-house efforts are planned to decrease between now and FY 1997. An additional similar effort could be absorbed with minor facility modification to accommodate uniqueness of additional work.

3.5.1.2 If there is capacity to absorb additional workyears, how many additional workyears can be supported? (BRAC Criteria III)

In excess of 16 work years capacity could be available by FY 1997.

3.5.1.3 For 3.5.1.1 and 3.5.1.2 (above) describe the impact of military construction programs or other alteration projects programmed in the FY95 PBS. (BRAC Criteria II)

Planning activities to more fully utilize available space in Building A-59 through alterations and minor MILCON will enhance facility capacity to absorb additional work.

3.5.2 Land Use. Provide number of buildable acres for additional laboratory/administrative support construction at your installation. (BRAC Criteria II)

N/A; See response to BRAC Data Call 4

3.5.3 Utilities:. Provide an estimate of your installation's capability to expand or procure additional utility services (electric, gas, water). Estimates should be provided in appropriate units -- e.g. KWH of electricity. (BRAC Criteria II)

N/A; See response to BRAC Data Call 4.

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practical without the benefit of revised mission/program planning guidance. For planning purposes, a rough order of magnitude estimate of the minimum class 2 space available for expansion is 10%. This would involve minimal reconfiguration.

3.5.3 **Utilities:** Provide an estimate of your installation's capability to expand or procure additional utility services (electric, gas, water). Estimates should be provided in appropriate units -- e.g., KWH of electricity. (BRAC Criteria II) R

	On Base Capacity	Off Base Long Term Contract	Normal Steady State Load	Peak Demand
Electrical Supply (KWH)	N/A	54,000 KWH	13,098 KWH	17,280 KWH
Natural Gas (CFH) [1]	N/A	2,961 CFH	141 CFH	1,868 CFH
Sewage (GPD)	N/A	Unlimited	847,583 GPD	1,017,100 GPD
Potable Water (GPD)	N/A	9,740,978 GPD	1,118,911 GPD	1,342,693 GPD
Steam (PSI & lb/Hr) [2]	190,000 lb/Hr	N/A	116,000 lb/Hr	125,000 lb/Hr

[1] The availability of natural gas is controlled by the Washington Gas Light Company. It cannot be relied on as a primary fuel.
[2] Production plant owned by PWC, Washington

practical without the benefit of revised mission/program planning guidance. For planning purposes, a rough order of magnitude estimate of the minimum class 2 space available for expansion is 10%. This would involve minimal reconfiguration.

3.5.3 **Utilities:** Provide an estimate of your installation's capability to expand or procure additional utility services (electric, gas, water). Estimates should be provided in appropriate units -- e.g., KWH of electricity. (BRAC Criteria II)

	On Base Capacity	Off Base Long Term Contract	Normal Steady State Load	Peak Demand
Electrical Supply (KWH)	N/A	54,000 KWH	13,098 KWH	17,280 KWH
Natural Gas (CFH) [1]	N/A	2,961 CFH	141 CFH	1,868 CFH
Sewage (GPD)	N/A	Unlimited	847,583 GPD	1,017,100 GPD
Potable Water (GPD)	N/A	9,740,978 GPD	1,118,911 GPD	1,342,693 GPD
Steam (PSI & lb/Hr) [2]	190,000 lb/Hr	N/A	116,000 lb/Hr	125,000 lb/Hr

[1] The availability of natural gas is controlled by the Washington Gas Light Company. It cannot be relied on as a primary fuel.
[2] Production plant owned by PWC, Washington

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C2. Groundbased C4I
3.0 Mission

The groundbased C4I efforts described are conducted in close coordination with Navy-specific research in networking and communications. The efforts reported here are aimed at shipboard problems even though they were conducted using land-based sites. R

- **Communications**

  - ROTHR communications investigation
  - Digital data retransmission
  - Radio frequency interference research

3.1 Location: Naval Research Laboratory, Washington DC

3.1.1 **Geographic/Climatological Features:** No special features required

3.1.2 **Licenses & permits:** None

3.1.3 **Environmental constraints:** None

3.1.4 **Special Support Infrastructure:** Several SCIFs specially equipped for communications investigations are used in these efforts.

3.1.5. **Proximity to Mission-Related organizations:**
Frequent interaction is required both with the sponsors of this work and the various other laboratories and facilities involved in conducting these efforts. The close proximity of these facilities facilitates effective interaction and greatly reduces travel.

Common Support Functions	Name	Type of Organization	Distance (Miles)	Workyears Performed by Your Activity	Workyears Funded by Your Activity
Groundbased C4I	NESSEC	Test Facility	10		
Groundbased C4I	NSA	Support & Evaluation	30		

R

3.2 Personnel:

3.2.1 **Total Personnel:**

Types of personnel	**Number of Personnel**			
	Government		On-Site FFRDC	On-Site SETA
	Civilian	Military		
Technical	1			
Management (Supv)	0			
Other	0			

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3.0 Mission

Common Support Function: Fixed groundbased C4I
The groundbased C4I efforts described are conducted in close coordination with Navy-specific research in networking and communications. The efforts reported here are aimed at shipboard problems even though they were conducted using land-based sites.

- **Communications**

  - ROTHR communications investigation
  - Digital data retransmission
  - Radio frequency interference research

3.1 Location: Naval Research Laboratory, Washington DC

3.1.1 **Geographic/Climatological Features:** No special features required

3.1.2 **Licenses & permits:** None

3.1.3 **Environmental constraints:** None

3.1.4 **Special Support Infrastructure:** Several SCIFs specially equipped for communications investigations are used in these efforts.

3.1.5. **Proximity to Mission-Related organizations:**
Frequent interaction is required both with the sponsors of this work and the various other laboratories and facilities involved in conducting these efforts. The close proximity of these facilities facilitates effective interaction and greatly reduces travel.

Common Support Functions	Name	Type of Organization	Distance (Miles)	Workyears Performed by Your Activity	Workyears Funded by Your Activity
Groundbased C4I	NESSEC	Test Facility	10		
Groundbased C4I	NSA	Support & Evaluation	30		

3.2 Personnel:

3.2.1 **Total Personnel:**

Types of personnel	Number of Personnel			
	Government		On-Site FFRDC	On-Site SETA
	Civilian	Military		
Technical	1			
Management (Supv)	0			
Other	0			

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3.2.2 **Education:**

Type of Degree/ Diploma	Number of Government Personnel by Type of Position		
	Technical	Management (Supv)	Other
High School or Less			
Associates			
Bachelor			
Masters	1		
Doctorate (include Med/Vet/etc.)			

R

3.2.3 **Experience:**

Type of Position	Years of Government and/or Military Service				
	Less than 3 years	3-10 years	11-15 years	16-20 years	More than 20 years
Technical	1				
Management (Supv)					
Total	1				

R

3.2.4 **Accomplishments During FY91-93:** For government personnel answer the following questions.

3.2.4.1 How many patents were awarded and patent disclosures (only count disclosures with issued disclosure numbers) were made? (BRAC Criteria I)

CSF	Disclosures	Awarded	Patent Titles (List)
Groundbased C4I	0	0	
Total	0	0	

3.2.4.2 How many papers were published in peer reviewed journals? (BRAC Criteria I)

CSF	Number Published	Paper Titles (List)
Groundbased C4I	1	"Near-Vertical Incidence Skywave Antenna Investigation, IEEE Fifth International Conference on HF Radio Systems and Techniques, July 1991"
TOTAL	1	

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3.2.2 **Education:**

Type of Degree/Diploma	Number of Government Personnel by Type of Position		
	Technical	Management (Supv)	Other
High School or Less			
Associates			
Bachelor			
Masters	1		
Doctorate (include Med/Vet/etc.)			

R

3.2.3 **Experience:**

Type of Position	Years of Government and/or Military Service				
	Less than 3 years	3-10 years	11-15 years	16-20 years	More than 20 years
Technical	1				
Management (Supv)					
Total	1				

R

3.2.4 **Accomplishments During FY91-93:** For government personnel answer the following questions.

3.2.4.1 How many patents were awarded and patent disclosures (only count disclosures with issued disclosure numbers) were made? (BRAC Criteria I)

CSF	Disclosures	Awarded	Patent Titles (List)
Groundbased C4I	0	0	
Total	0	0	

3.2.4.2 How many papers were published in peer reviewed journals? (BRAC Criteria I)

CSF	Number Published	Paper Titles (List)
Groundbased C4I	1	"NVIS Antenna Investigation" IEEE Conference
TOTAL	1	

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3.2.2 **Education:**

Type of Degree/ Diploma	Number of Government Personnel by Type of Position		
	Technical	Management (Supv)	Other
High School or Less			
Associates			
Bachelor			
Masters	1		
Doctorate (include Med/Vet/etc.)			

3.2.3 **Experience:**

Type of Position	Years of Government and/or Military Service				
	Less than 3 years	3-10 years	11-15 years	16-20 years	More than 20 years
Technical	1				
Management (Supv)					
Total	1				

3.2.4 **Accomplishments During FY91-93:** For government personnel answer the following questions.

3.2.4.1 How many patents were awarded and patent disclosures (only count disclosures with issued disclosure numbers) were made? (BRAC Criteria I)

CSF	Disclosures	Awarded	Patent Titles (List)
Groundbased C4I	0	0	
Total	0	0	

3.2.4.2 How many papers were published in peer reviewed journals? (BRAC Criteria I)

CSF	Number Published	Paper Titles (List)
Groundbased C4I	1	"NVIS Antenna Investigation" IEEE Conference
TOTAL	1	

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3.3 Workload

3.3.1 FY93 Workload

3.3.1.1 Work Year and Lifecycle:

"LAB"	Fiscal Year 1993 Actual			
	Civilian	Military	FFRDC	SETA
Science & Technology	1			
Engineering Development				
In-Service Engineering				

R

3.3.1.2 Engineering Development By ACAT:

Engineering Development	Name or Number	Workyears (FY93 Actual)	FY93 Funds Received (Obligation Authority)	Narrative
		None		

R

3.3.1.3 In-Service Engineering:

Common Support Functions	In-Service Engineering Efforts (List)	FY93 Actual		Weapon System(s) Supported
		Funds Received (Obligation Authority)	Workyears	
Groundbased C4I		None		

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3.3 Workload

3.3.1 FY93 Workload

3.3.1.1 Work Year and Lifecycle:

"LAB"	Fiscal Year 1993 Actual			
	Civilian	Military	FFRDC	SETA
Science & Technology	1			
Engineering Development				
In-Service Engineering				

3.3.1.2 Engineering Development By ACAT:

Engineering Development	Name or Number	Workyears (FY93 Actual)	FY93 Funds Received (Obligation Authority)	Narrative
		None		

3.3.1.3 In-Service Engineering:

Common Support Functions	In-Service Engineering Efforts (List)	FY93 Actual		Weapon System(s) Supported
		Funds Received (Obligation Authority)	Workyears	
Groundbased C4I		None		

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3.3.2 Projected Funding

3.3.2.1 **Direct Funding:** For each applicable CSF, identify direct mission funding by appropriation from FY94 to FY97. Use FY95 PBS for FY95-FY97. (BRAC Criteria I)

CSF	FY94	FY95	FY96	FY97
Groundbased C4I	0	0	0	0

3.3.2.2 **Other Obligation Authority:**

CSF	FY94	FY95	FY96	FY97
Groundbased C4I	$0.15M	$0.15M	$0.05M	$0.05M

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3.4 Facilities and Equipment

3.4.1 Major Equipment and Facilities:

Common Support Function	Major Facility or Equipment Description	Unique To			Replacement Cost ($K)
		DOD	Federal Gov't	U. S.	
Groundbased C4I	None				

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3.3.2 Projected Funding

3.3.2.1 **Direct Funding:** For each applicable CSF, identify direct mission funding by appropriation from FY94 to FY97. Use FY95 PBS for FY95-FY97. (BRAC Criteria I)

CSF	FY94	FY95	FY96	FY97
Groundbased C4I	0	0	0	0

3.3.2.2 **Other Obligation Authority:**

CSF	FY94	FY95	FY96	FY97
Groundbased C4I	$0.15M	$0.15M	$0.05M	$0.05M

3.4 Facilities and Equipment

3.4.1 **Major Equipment and Facilities:**

Common Support Function	Major Facility or Equipment Description	Unique To			Replacement Cost ($K)
		DOD	Federal Gov't	U. S.	
Groundbased C4I	None				

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3.5 Expansion Potential

3.5.1 **Laboratory Facilities:** Use facilities records as of fourth-quarter FY93 in answering the following (in sq ft) for each CSF: (BRAC Criteria II)

Common Support Function	Facility or Equipment Description	Type of Space*	Space Capacity (KSF)			R
			Current	Used	Excess	
Groundbased C4I	Secure Labs	Technical	0.3	0.3	0	

* Administrative, Technical, Storage, Utility

3.5.1.1 Capacity to absorb additional workyears: An additional similar effort could be absorbed with minor facility modification to accommodate uniqueness of additional work. R

3.5.1.2 If there is capacity to absorb additional workyears, how many additional workyears can be supported? (BRAC Criteria III)

A small number (less than 5) of work years capacity could be available by FY 1997. R

3.5.1.3 For 3.5.1.1 and 3.5.1.2 (above) describe the impact of military construction programs or other alteration projects programmed in the FY95 PBS. (BRAC Criteria II)

No impact

3.5.2 **Land Use:** Provide number of buildable acres for additional laboratory/administrative support construction at your installation. (BRAC Criteria II)

NRL has 11.2 acres available for unrestricted expansion located at its Chesapeake Bay Detachment. Parking would have to be included as part of any expansion project. R
Utilities, while available, are aged and would be required to be upgraded to accommodate any expansion. The building space (class 2 property) currently available for growth opportunities at the NRL DC site, either constrained or unconstrained, represents a total of multiple small areas located throughout the Laboratory which cannot be effectively utilized by any other functions other than the primary occupant of the facility. It is important to note that NRL facilities can be re-configured, e.g., demolished and rebuilt, altered, fitted with capital equipment, etc. to accommodate new or expanded mission assignments. However, accurate quantification of the maximum amount of space available for expansion is not practical without the benefit of revised mission/program planning guidance. For planning purposes, a rough order of magnitude estimate of the minimum class 2 space available for expansion is 10%. This would involve minimal reconfiguration.

3.5.3 **Utilities:** Provide an estimate of your installation's capability to expand or procure additional utility services (electric, gas, water). Estimates should be provided in appropriate units - e.g., KWH of electricity. (BRAC Criteria II) R

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3.5 Expansion Potential

3.5.1 **Laboratory Facilities:** Use facilities records as of fourth-quarter FY93 in answering the following (in sq ft) for each CSF: (BRAC Criteria II)

Common Support Function	Facility or Equipment Description	Type of Space*	Space Capacity (KSF)		
			Current	Used	Excess
Groundbased C4I	Secure Labs	Technical	0.3	0.3	0

* Administrative, Technical, Storage, Utility

3.5.1.1 Capacity to absorb additional workyears: An additional similar effort could be absorbed with minor facility modification to accommodate uniqueness of additional work.

3.5.1.2 If there is capacity to absorb additional workyears, how many additional workyears can be supported? (BRAC Criteria III)

A small number (less than 5) of work years capacity could be available by FY 1997.

3.5.1.3 For 3.5.1.1 and 3.5.1.2 (above) describe the impact of military construction programs or other alteration projects programmed in the FY95 PBS. (BRAC Criteria II)

No impact

3.5.2 **Land Use:** Provide number of buildable acres for additional laboratory/administrative support construction at your installation. (BRAC Criteria II)

NRL has 11.2 acres available for unrestricted expansion located at its Chesapeake Bay Detachment. Parking would have to be included as part of any expansion project. Utilities, while available, are aged and would be required to be upgraded to accommodate any expansion. The building space (class 2 property) currently available for growth opportunities at the NRL DC site, either constrained or unconstrained, represents a total of multiple small areas located throughout the Laboratory which cannot be effectively utilized by any other functions other than the primary occupant of the facility. It is important to note that NRL facilities can be re-configured, e.g., demolished and rebuilt, altered, fitted with capital equipment, etc. to accommodate new or expanded mission assignments. However, accurate quantification of the maximum amount of space available for expansion is not practical without the benefit of revised mission/program planning guidance. For planning purposes, a rough order of magnitude estimate of the minimum class 2 space available for expansion is 10%. This would involve minimal reconfiguration.

3.5.3 **Utilities:** Provide an estimate of your installation's capability to expand or procure additional utility services (electric, gas, water). Estimates should be provided in appropriate units - e.g., KWH of electricity. (BRAC Criteria II)

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	On Base Capacity	Off Base Long Term Contract	Normal Steady State Load	Peak Demand
Electrical Supply (KWH)	N/A	54,000 KWH	13,098 KWH	17,280 KWH
Natural Gas (CFH)[1]	N/A	2,961 CFH	141 CFH	1,868 CFH
Sewage (GPD)	N/A	Unlimited	847,583 GPD	1,017,100 GPD
Potable Water (GPD)	N/A	9,740,978 GPD	1,118,911 GPD	1,342,693 GPD
Steam (PSI & lb/Hr)[2]	190,000 lb/Hr	N/A	116,000 lb/Hr	125,000 lb/Hr

[1] The availability of natural gas is controlled by the Washington Gas Light Company. It cannot be relied on as a primary fuel.
[2] Production plant owned by PWC, Washington

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	On Base Capacity	Off Base Long Term Contract	Normal Steady State Load	Peak Demand
Electrical Supply (KWH)	N/A	54,000 KWH	13,098 KWH	17,280 KWH
Natural Gas (CFH) [1]	N/A	2,961 CFH	141 CFH	1,868 CFH
Sewage (GPD)	N/A	Unlimited	847,583 GPD	1,017,100 GPD
Potable Water (GPD)	N/A	9,740,978 GPD	1,118,911 GPD	1,342,693 GPD
Steam (PSI & lb/Hr) [2]	190,000 lb/Hr	N/A	116,000 lb/Hr	125,000 lb/Hr

[1] The availability of natural gas is controlled by the Washington Gas Light Company. It cannot be relied on as a primary fuel.
[2] Production plant owned by PWC, Washington

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D. ELECTRONIC DEVICES

3.0 Mission. Describe the major capabilities at your activity contributing to the common support function in bulletized format. Describe any relationship and interconnectivity with other functions (common or otherwise) in support of the overall activity mission.

The Electronic Devices Common Support Function mission is to:

- Participate in the advancement of knowledge, understanding, and technology of Electronic Devices by in-house R&D in: materials, processes, structures, devices, and circuits

- Transform private sector advances into military electronics technologies

- Address unique or predominantly military needs both by in-house performance and by industrial interactions

- Develop new state-of-the-art devices and circuits with emphasis on performance, affordability, and robustness

- Advise Navy on electronic and electro-optics S&T needs, capabilities, and opportunities. Provide S&T advocacy as appropriate

- Perform Technology Transfer to the Private Sector

The major resources present at the NRL-Washington site to conduct electronic devices R&D include:

- A highly educated science and engineering work force;

- State of the art flexible R&D facilities and equipment;

- An efficient Laboratory central support service for administration, maintanance, and minor construction.

The major capabilites at the NRL-Washington site include:

- The planning and execution of a broadly based, balanced, long term, multidiscplinary R&D program

- A proven track record of accomplishment in the creation and transfer of electronics and electro-optics technologies into Naval warfighting systems and into US industrial competitiveness.

- The ability to create, characterize, fabricate and evaluate advanced and novel electronic and electro-optic materials, devices, and circuits and to transition them to the Fleet or to the commercial marketplace.

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3.0 Mission (cont'd). Relationship and Interconnectivity with other NRL R&D Functions

The electronic devices common support function at NRL is part of a multidisciplinary co-located laboratory work environment that is crucial to achieve scientific and technological advances in electronics and to respond to the needs of the Navy for advanced system and operational capabilities paced by electronic and electro-optic requirements. Advances in optical sciences, materials science, bioengineered materials, chemistry, condensed matter physics, and radiation and plasma physics serve to form an intellectual synergy for advancing the state of the art in electronic devices. In a complementary manner, capabilities in electronic devices R&D associated with electronic and electromagnetic characterization of materials and the methods and capabilities of nano/microfabrication serve to enhance the R&D capabilies of other S&T activities at the Laboratory.

The electronic devices capability at NRL also supports directly the mission of the Laboratory in electronic warfare, radar, space systems, and information technology. The co-location of S&E's who are creating new electronic device capability and who are highly knowledgeable about existing and emerging electronic/electro-optic devices with systems engineers who are in need of knowing what is new and what is possible results in a highly efficient transfer of capability from the laboratory bench into systems. It is also imperative that those that create research results are readily available on a continual basis to transistion the results successfully to those that can benefit by its application.

The Electronic Devices capability at NRL also provides Tri-Service Reliance support to the other services in a variety of areas such as device/IC reliability, development of specific processes for RF and microelectronic devices, advanced filters for wideband shared aperture systems, hermetic plastic packages for next generation radar systems, the ferromagnetic consortium, electronic material growth and characterization to name a few. NRL in conjunction with the other services and ARPA is both a performer and coplayer in a number of major DoD initiatives including, for example, MIMIC, DLP, Vacuum Electronics Initiative, HDMP, RASSP and MHDL. NRL works closely with the other services to specify and manage DoD specific technology development at the 6.1, 6.2 and 6.3 levels. NRL makes its excellent design, test and evaluation capabilities available throughout the government. In more than one instance NRL has provided the inspiration and technology base for major initiatives. R

3.1 Location

3.1.1 Geographic/Climatological Features. Describe any geographic/climatological features in and around your activity that are relevant to each CSF. Indicate and justify those that are required versus those that just serve to enhance accomplishing the mission of the activity. For example, clear air at high altitude that increases quality of atmospheric, ground-based laser experiments in support of the weapons CSF. (BRAC Criteria I)

There are several geographic features on the NRL-Washington site that are relevant to the satisfactory performance of Electronic Devices R&D. Seismic isolation is easily achieved at this site for advanced electron beam equipments because of the close proximity of bedrock to the surface. The distributed nature of the Laboratory's research buildings on the Washington site also facilitates electromagnetic and rfi isolation. There are no special or unique climatological features.

3.1.2 Licenses & permits. Describe and list the licenses or permits (e.g., environmental, safety, etc.) that your activity currently holds and justify why they are required to allow tests, experiments, or other special capabilities at your location for each CSF. For example, permit to store and use high explosives. (BRAC Criteria I)

NRL holds a site license for the acquisition, receipt, possession, use for research purposes, storage, and disposal of radioactive materials. The license is Permit No.-8-001733. Some types of radioactive material are required to perform certain electronic materials and device radiation tests. These tests are required to ensure surviablity of electronic components in ambient radiation and nuclear burst environments.

3.1.3 Environmental constraints. Describe and list the environmental or land use constraints present at your activity which limit or restrict your current scope for each CSF, i.e., would not allow increased "volume" or "spectrum" for the CSF. Example -- Volume: frequency of a type of experiment. Example -- Spectrum: Current permit to detonate high explosives will not allow detonation or storage of increased quantity of explosives without legal waiver (state law) or relocation of surrounding (non-govt) buildings. (BRAC Criteria II)

There are no environmental or land use constraints present at the NRL-Washngton site which limit or restrict the current or perceived future scope of Electronic Devices R&D.

3.1.4 Special Support Infrastructure. List and describe the importance of any mission related special support infrastructure (e.g. utilities) present at your location for your activity. (BRAC Criteria I)

None.

3.1.5. Proximity to Mission-Related organizations. List and describe the importance and impact of not having nearby organizations which facilitate accomplishing or performing your mission -- e.g. operational units, FFRDCs, universities/colleges, other government organizations, and commercial activities. Restrict your response to the top five. Complete the following: (BRAC Criteria I)

Common Support Functions	Name	Type of Organization	Distance	Workyears Performed by Your Activity	Workyears Funded by Your Activity
Electronic Devices					
	Brookhaven National Laboratories Synchrotron Source	DOE and University Consortium	250	3	3

3.2 Personnel

3.2.1 Total Personnel. What is the total number of government (military and civilian), on-site federally funded research and development center (FFRDC), and on-site system engineering technical assistance (SETA) personnel engaged in science and technology (S&T), engineering development and in-service engineering activities as of end FY93? For individuals that predominantly work in CSFs, involved in more than one CSF, account for those individuals in the CSF that represents the preponderance of their effort. (BRAC Criteria I)

Types of personnel	Number of Personnel			
	Government		On-Site FFRDC	On-Site SETA
Electronic Devices	Civilian	Military		
Technical	192.7			84
Management (Supv)	20			
Other	32			

3.2.2 Education. What is the number of government personnel actively engaged in S&T, engineering development and in-service engineering activities by highest degree and type of position? Provide the data in the following table: (BRAC Criteria I)

There are no environmental or land use constraints present at the NRL-Washngton site which limit or restrict the current or perceived future scope of Electronic Devices R&D.

3.1.4 Special Support Infrastructure. List and describe the importance of any mission related special support infrastructure (e.g. utilities) present at your location for your activity. (BRAC Criteria I)

None.

3.1.5. Proximity to Mission-Related organizations. List and describe the importance and impact of not having nearby organizations which facilitate accomplishing or performing your mission -- e.g. operational units, FFRDCs, universities/colleges, other government organizations, and commercial activities. Restrict your response to the top five. Complete the following: (BRAC Criteria I)

Common Support Functions	Name	Type of Organization	Distance	Workyears Performed by Your Activity	Workyears Funded by Your Activity
Electronic Devices					
	Brookhaven National Laboratories Synchrotron Source	DOE and University Consortium	250	3	3

3.2 Personnel

3.2.1 Total Personnel. What is the total number of government (military and civilian), on-site federally funded research and development center (FFRDC), and on-site system engineering technical assistance (SETA) personnel engaged in science and technology (S&T), engineering development and in-service engineering activities as of end FY93? For individuals that predominantly work in CSFs, involved in more than one CSF, account for those individuals in the CSF that represents the preponderance of their effort. (BRAC Criteria I)

Types of personnel	Number of Personnel			
	Government		On-Site FFRDC	On-Site SETA
Electronic Devices	Civilian	Military		
Technical	195.7			84
Management (Supv)	20			
Other	1			

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3.2.2 Education. What is the number of government personnel actively engaged in S&T, engineering development and in-service engineering activities by highest degree and type of position? Provide the data in the following table: (BRAC Criteria I)

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Electronic Devices

Type of Degree/ Diploma	Number of Government Personnel by Type of Position		
	Technical	Management (Supv)	Other
High School or Less	24.7		1
Associates	7		3
Bachelor	8		
Masters	26	3	
Doctorate (include Med/Vet/etc.)	130	17	

R

3.2.3 Experience. What is the experience level of government personnel? Fill in the number of government personnel in the appropriate boxes of the following table. (BRAC Criteria I)

Electronic Devices

Type of Position	Years of Government and/or Military Service				
	Less than 3 years	3-10 years	11-15 years	16-20 years	More than 20 years
Technical	19	69	30.7	16	61
Management (Supv)	0	2	1	1	16
Total	19	71	31.7	17	77

R

NOTE: Table does not include personnel in the "Other" category.

3.2.4.1 Patents - See Tab A.

3.2.4.2 Published Papers - See Tab B.

3.3 Workload

3.3.1 FY93 Workload.

3.3.1.1 Work Year and Lifecycle. Identify the number of actual workyears executed for each applicable CSF in FY93 for each of the following: government civilian; military; on-site FFRDCs; and on-site SETAs. (BRAC Criteria I)

"LAB"	Fiscal Year 1993 Actual			
	Civilian	Military	FFRDC	SETA
Science & Technology	181	0	0	42.2
Engineering Development				
In-Service Engineering				

Science and Technology = 6.1,6.2,6.3A

R

Electronic Devices

Type of Degree/ Diploma	Number of Government Personnel by Type of Position		
	Technical	Management (Supv)	Other
High School or Less	24.7		29
Associates	4		3
Bachelor	8		
Masters	26	3	
Doctorate (include Med/Vet/etc.)	130	17	

3.2.3 Experience. What is the experience level of government personnel? Fill in the number of government personnel in the appropriate boxes of the following table. (BRAC Criteria I)

Electronic Devices

Type of Position	Years of Government and/or Military Service				
	Less than 3 years	3-10 years	11-15 years	16-20 years	More than 20 years
Technical	19	69	30.7	16	58
Management (Supv)	0	2	1	1	16
Total	19	71	31.7	17	74

NOTE: Table does not include personnel in the "Other" category.

3.2.4.1 Patents - See Tab A.

3.2.4.2 Published Papers - See Tab B.

3.3 Workload

3.3.1 FY93 Workload.

3.3.1.1 Work Year and Lifecycle. Identify the number of actual workyears executed for each applicable CSF in FY93 for each of the following: government civilian; military; on-site FFRDCs; and on-site SETAs. (BRAC Criteria I)

"LAB"	Fiscal Year 1993 Actual			
	Civilian	Military	FFRDC	SETA
Science & Technology	181	0	0	42.2
Engineering Development				
In-Service Engineering				

Science and Technology = 6.1,6.2,6.3A

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3.3.1.2 Engineering Development By ACAT. For each Common Support Function (e.g. airborne C4I) at each activity engaged in engineering development, provide:

- For each ACAT IC, ID, and II program (as defined in DODI 5000.2):
  - The name of the program
  - A brief program description

  - For each ACAT III and IV programs:
  - The number of such programs
  - A list of program names

- For each program not an ACAT I, II, III, IV:
  - The number of such programs
  - A list of program names

- For the purpose of this question, any program between Milestone I and IV and containing demonstration and validation (Dem/Val 6.4)/Engineering and Manufacturing Development (EMD 6.5) funds in the FY95 PBS is considered to be engaged in engineering development (BRAC Criteria I).

Engineering Development	Name or Number	Workyears (FY93 Actual)	FY93 Funds Received (Obligation Authority)	Narrative
ACAT IC	(Name)	NONE		(Description)
ACAT ID	(Name)	NONE		(Description)
ACAT II	(Name)	NONE		(Description)
ACAT III/IV	(Number)	NONE		(List)
Other	(Number)	NONE		(List)

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3.3.1.3 In-Service Engineering. For each Common Support Function at each activity engaged in in-service engineering, list the in-service engineering efforts, the FY93 funds (from all sources) obligated for these efforts, the FY93 workyears for these efforts, and the weapon system(s) supported by these efforts. In-service engineering consists of all engineering support of fielded and/or out of production systems and includes efforts to improve cost, throughput, and schedule to support customer requirements as well as mods and upgrades for reliability, maintainability, and performance enhancements. (BRAC Criteria I)

Common Support Functions	In-Service Engineering Efforts (List)	FY93 Actual		Weapon System(s) Supported
ED		Funds Received (Obligation Authority)	Workyears	
	NONE			

3.3.2 Projected Funding.

3.3.2.1 Direct Funding. For each applicable CSF, identify direct mission funding by appropriation from FY94 to FY97. Use FY95 PBS for FY95-FY97. (BRAC Criteria I)

Does not apply to DBOF Laboratories.

CSF	FY94	FY95	FY96	FY97
ED	-	-	-	-

3.3.2.2 Other Obligation Authority. For each applicable CSF, identify reimbursable and direct-cite funding (other obligation authority expected) from FY94 to FY97. Funding allocation must be traceable to FY95 PBS. (BRAC Criteria I) ($K)

CSF	FY94	FY95	FY96	FY97
ED	86,305.3	91,296.2	94,594.0	96,368.943

3.4 Facilities and Equipment

3.4.1 Major Equipment and Facilities. Describe major facilities and equipment necessary to support each Common Support Function (include SCIFs). If the facilities and equipment are shared with other functions, identify those functions and the percentage of total time used by each of the functions. Provide labeled photographs that picture the breadth and scope of the equipment and facilities described. If it is unique to DOD, to the Federal Government, or to the US, describe why it is unique. Insert the replacement cost. For this exercise, Replacement cost = (Initial cost + capital investment) multiplied by the inflation factor for the original year of construction. (BRAC Criteria II)

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Common Support Function	Major Facility or Equipment Description*	Unique To			Replacement Cost ($K)
		DOD	Federal Gov't	U. S.	
ELECTRONIC DEVICES					
	Nanochannel Glass Technology Facility	X			1,415
	Laser Probe Facility				2,000
	Pulsed Chemical Laser Facility			X	4,000
	Argon-Pumped Ti:Sapphire Laser				750
	Ultrashort Pulse Generation Facility				1,000
	Fiber Optic Sensor Facility			X	2,100
	Optical Devices & Thin Film Fabrication Facilites				1,585
	Fiber Optic Optical-Microwave Laboratory		X		1,500
	Relativistic Klystron Laboratory			X	3,000
	Gyrotron Laboratory			X	2,000
	Long Pulse Accelerator Laboratory				500
	Nanoelectronics Processing Facility	X			19,870
	High Resolution Transmission Electron Microscope				700
	Si MBE & Surface Analysis System	X			1,200
	Vacuum Electronics Design Processing Facility	X			3,200
	III-V MBE Facilities				820
	Surface & Interface Science Facility				1,200
	Organometallic VPE	X			2,400
	Optical Characterization Facility				670
	Electronic Properties Facility				725
	Epicenter Facility	X	X		3,000
	Magnetic Resonance Facility				704

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	Optical Properties Facility				843
	Crystal Growth Facility				2,250
	Far Infrared Spectroscopy Facility				685
	Reliability Facility	X	X		1,800
	Microwave Technology Facility				2,000
	Computers/Software/Networks/Test Equipment				1,500

3.5 Expansion Potential

3.5.1 **Laboratory Facilities:** Use facilities records as of **fourth-quarter FY93** in answering the following (**in sq ft**) for each CSF: (BRAC Criteria II)

Common Support Function	Facility or Equipment Description	Type of Space*	Space Capacity (KSF)		
			Current	Used	Excess
	Lasers	Technical	14,183	12,765	1,418
	Fiber Optics	Technical	8,892	8,002	890
	Optical Microwave Systems	Technical	4,969	4,472	497
	Sensors	Technical	6,560	5,904	656
	Relativistic Klystron Laboratory	Technical	4,200	3,800	400
	Gyrotron Laboratory	Technical	6,000	5,400	600
	Long Pulse Accelerator Laboratory	Technical	1,500	1,300	200
	Nanoelectronics Processing Facility	Technical	4,000	4,000	0
	High Resolution Transmission Electron Microscope	Technical	528	528	0
	Si MBE & Surface Analysis System	Technical	792	792	0
	Vacuum Electronics Design Processing Facility	Technical	1,771	1,771	0

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	III-V MBE Facilities	Technical	506	506	0
	Surface & Interface Science Facility	Technical	1,265	1,265	0
	Organometallic VPE	Technical	1,697	1,697	0
	Optical Characterization Facility	Technical	1,265	1,265	0
	Electronic Properties Facility	Technical	1,012	1,012	0
	Epicenter Facility	Technical	1,012	1,012	0
	Magnetic Resonance Facility	Technical	759	759	0
	Optical Properties Facility	Technical	1,265	1,265	0
	Crystal Growth Facility	Technical	3,289	3,289	0
	Far Infrared Spectroscopy Facility	Technical	1,265	1,265	0
	Reliability Facility	Technical	1,392	1,392	0
	Microwave Technology Facility	Technical	3,542	3,542	0
	Computers/Software/Networks/Test Equipment	Technical	2,500	2,500	0
	General Laboratory	Technical	26,556	16,202	1,353
	Office	Administrative	36, 807	34,977	1,830
	Utility	Utility	300	300	0
	Storage	Storage	8,348	7,999	1,699

*** Type of Space = Administrative, Technical, Storage, Utility**

3.5.1.1 Describe the capacity of your activity to absorb additional similar workyears categorized in the same common support function with minor facility modification. If major modification is required, describe to what extent the facilities would have to be modified. (Use FY97 workyears as your requirement) (BRAC Criteria III)

A modest increase in work force size (about 10%) can be accomodated without major facility modification. Administrative and office space is available.

3.5.1.2 If there is capacity to absorb additional workyears, how many additional workyears can be supported? (BRAC Criteria III)

R

NRL is industrially funded. The 27.87 workyears in Electronic Devices can be supported if additional funding is supplied.

3.5.1.3 For 3.5.1.1 and 3.5.1.2 (above) describe the impact of military construction programs or other alteration projects programmed in the FY95 PBS. (BRAC Criteria II)

There is no military construction or other alteration projects programmed in the FY95 PBS that impact the electronic devices common support function at NRL-Washington.

3.5.2 **Land Use:** Provide number of buildable acres for additional laboratory/administrative support construction at your installation. (BRAC Criteria II)

NRL has 11.2 acres available for unrestricted expansion located at its Chesapeake Bay Detachment. Parking would have to be included as part of any expansion project. Utilities, while available, are aged and would be required to be upgraded to accommodate any expansion. R

The building space (class 2 property) currently available for growth opportunities at the NRL DC site, either constrained or unconstrained, represents a total of multiple small areas located throughout the Laboratory which cannot be effectively utilized by any other functions other than the primary occupant of the facility. It is important to note however, that NRL facilities can be re-configured, e.g., demolished and rebuilt, altered, fitted with capital equipment, etc. to accommodate new or expanded mission assignments. However, accurate quantification of the maximum amount of space available for expansion is not practical without the benefit of revised mission/program planning guidance. For planning purposes, a rough order of magnitude estimate of the minimum class 2 space available for expansion is 10 percent. This would involve minimal reconfiguration. R

3.5.3 **Utilities:** Provide an estimate of your installation's capability to expand or procure additional utility services (electric, gas, water). Estimates should be provided in appropriate units -- e.g. KWH of electricity. (BRAC Criteria II)

Utility service capacities are depicted in the following table: R

	On Base Capacity	Off Base Long Term Contract	Normal Steady State Load	Peak Demand
Electrical Supply (KWH)	N/A	54,000 KWH	13,098 KWH	17,280 KWH
Natural Gas (CFH)[1]	N/A	2,961 CFH	141 CFH	1,868 CFH
Sewage (GPD)	N/A	Unlimited	847,583 GPD	1,017,100 GPD
Potable Water (GPD)	N/A	9,740,978 GPD	1,118,911 GPD	1,342,693 GPD
Steam (PSI & lb/Hr)[2]	190,000 lb/Hr	N/A	116,000 lb/Hr	125,000 lbr/Hr

1 The availability of natural gas is controlled by the Washington Gas Light Company. It cannot be relied on as a primary fuel.

2 Production plant owned by PWC, Washington.

This section replaced in its entirety by Pages D-1 thru D-10R dated 19 AUG 94

3.0 Mission:

Describe the major capabilities at your activity contributing to the common support function in bulletized format. Describe any relationship and interconnectivity with other functions (common or otherwise) in support of the overall activity mission.

The Electronic Devices Common Support Function mission is to:

- Participate in the advancement of knowledge, understanding, and technology of Electronic Devices by in-house R&D in: materials, processes, structures, devices, and circuits

- Transform private sector advances into military electronics technologies

- Address unique or predominantly military needs both by in-house performance and by industrial interactions

- Develop new state-of-the-art devices and circuits with emphasis on performance, affordability, and robustness

- Advise Navy on Electronic and Electro-Optics S&T needs, capabilities, and opportunities. Provide S&T advocacy as appropriate

- Perform Technology Transfer to the Private Sector

The major resources present at the NRL-Washington site to conduct electronic devices R&D include:

- A highly educated science and engineering work force;

- State of the art flexible R&D facilities and equipment;

- An efficient Laboratory central support service for administration, maintanance, and minor construction.

The major capabilites at the NRL-Washington site include:

- The planning and execution of a broadly based, balanced, long term, multidiscplinary R&D program

- A proven track record of accomplishment in the creation and transfer of electronics and electro-optics technologies into DoD warfighting systems and into US industrial competetiveness.

- The ability to create, characterize, fabricate and evaluate advanced and novel electronic and electro-optic materials, devices, and circuits and to transistion them to the Fleet, the other Services, or to the commercial marketplace.

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Relationship and Interconnectivity with other NRL R&D Functions

The electronic devices common support function at NRL is part of a multidisciplinary co-located laboratory work environment that is crucial to achieve scientific and technological advances in electronics and to respond to the needs of the Navy for advanced system and operational capabilities paced by electronic and electro-optic requirements. Advances in optical sciences, materials science, bioengineered materials, chemistry, condensed matter physics, and radiation and plasma physics serve to form an intellectual synergy for advancing the state of the art in electronic devices. In a complementary manner, capabilities in electronic devices R&D associated with electronic and electromagnetic characterization of materials and the methods and capabilities of nano/microfabrication serve to enhance the R&D capabilies of other S&T activities at the Laboratory.

The electronic devices capability at NRL also supports directly the mission of the Laboratory in electronic warfare, radar, space systems, and information technology. The co-location of S&E's who are creating new electronic device capability and who are highly knowledgeable about existing and emerging electronic/electro-optic devices with systems engineers who are in need of knowing what is new and what is possible results in a highly efficient transfer of capability from the laboratory bench into systems. It is also imperative that those that create research results are readily available on a continual basis to transistion the results successfully to those that can benefit by its application.

Relationship and Interconnectivity with Other Service R&D Functions

The Electronic Devices capability at NRL also provides Tri-Service Reliance support to the other services in a variety of areas such as device/IC reliability, development of specific processes for RF and microelectronic devices, advanced filters for wideband shared aperture systems, hermetic plastic packages for next generation radar systems, the ferromagnetic consortium, electronic material growth and characterization to name a few. NRL in conjunction with the other services and ARPA is both a performer and a co-player in a number of major DoD initiatives including, for example, MIMIC, DLP, Vacuum Electronics Initiative, HDMP, RASSP and MHDL. NRL works closely with the other services to specify and manage DoD specific technology development at the 6.1, 6.2 and 6.3 levels. NRL makes its excellent design, test and evaluation capabilities available throughout the government. In more than one instance NRL has provided the inspiration and technology base for major initiatives.

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D. ELECTRONIC DEVICES

3.0 Mission. Describe the major capabilities at your activity contributing to the common support function in bulletized format. Describe any relationship and interconnectivity with other functions (common or otherwise) in support of the overall activity mission.

The Electronic Devices Common Support Function mission is to:

- Participate in the advancement of knowledge, understanding, and technology of Electronic Devices by in-house R&D in: materials, processes, structures, devices, and circuits

- Transform private sector advances into military electronics technologies

- Address unique or predominantly military needs both by in-house performance and by industrial interactions

- Develop new state-of-the-art devices and circuits with emphasis on performance, affordability, and robustness

- Advise Navy on electronic and electro-optics S&T needs, capabilities, and opportunities. Provide S&T advocacy as appropriate

- Perform Technology Transfer to the Private Sector

The major resources present at the NRL-Washington site to conduct electronic devices R&D include:

- A highly educated science and engineering work force;

- State of the art flexible R&D facilities and equipment;

- An efficient Laboratory central support service for administration, maintanance, and minor construction.

The major capabilites at the NRL-Washington site include:

- The planning and execution of a broadly based, balanced, long term, multidiscplinary R&D program

- A proven track record of accomplishment in the creation and transfer of electronics and electro-optics technologies into Naval warfighting systems and into US industrial competitiveness.

- The ability to create, characterize, fabricate and evaluate advanced and novel electronic and electro-optic materials, devices, and circuits and to transition them to the Fleet or to the commercial marketplace.

3.0 Mission (cont'd). Relationship and Interconnectivity with other NRL R&D Functions

The electronic devices common support function at NRL is part of a multidisciplinary co-located laboratory work environment that is crucial to achieve scientific and technological advances in electronics and to respond to the needs of the Navy for advanced system and operational capabilities paced by electronic and electro-optic requirements. Advances in optical sciences, materials science, bioengineered materials, chemistry, condensed matter physics, and radiation and plasma physics serve to form an intellectual synergy for advancing the state of the art in electronic devices. In a complementary manner, capabilities in electronic devices R&D associated with electronic and electromagnetic characterization of materials and the methods and capabilities of nano/microfabrication serve to enhance the R&D capabilies of other S&T activities at the Laboratory.

The electronic devices capability at NRL also supports directly the mission of the Laboratory in electronic warfare, radar, space systems, and information technology. The co-location of S&E's who are creating new electronic device capability and who are highly knowledgeable about existing and emerging electronic/electro-optic devices with systems engineers who are in need of knowing what is new and what is possible results in a highly efficient transfer of capability from the laboratory bench into systems. It is also imperative that those that create research results are readily available on a continual basis to transistion the results successfully to those that can benefit by its application.

3.1 Location

3.1.1 Geographic/Climatological Features. Describe any geographic/climatological features in and around your activity that are relevant to each CSF. Indicate and justify those that are required versus those that just serve to enhance accomplishing the mission of the activity. For example, clear air at high altitude that increases quality of atmospheric, ground-based laser experiments in support of the weapons CSF. (BRAC Criteria I)

There are several geographic features on the NRL-Washington site that are relevant to the satisfactory performance of Electronic Devices R&D. Seismic isolation is easily achieved at this site for advanced electron beam equipments because of the close proximity of bedrock to the surface. The distributed nature of the Laboratory's research buildings on the Washington site also facilitates electromagnetic and rfi isolation. There are no special or unique climatological features.

3.1.2 Licenses & permits. Describe and list the licenses or permits (e.g., environmental, safety, etc.) that your activity currently holds and justify why they are required to allow tests, experiments, or other special capabilities at your location for each CSF. For example, permit to store and use high explosives. (BRAC Criteria I)

NRL holds a site license for the acquisition, receipt, possession, use for research purposes, storage, and disposal of radioactive materials. The license is Permit No.-8-001733. Some types of radioactive material are required to perform certain electronic materials and device radiation tests. These tests are required to ensure surviablity of electronic components in ambient radiation and nuclear burst environments.

3.1.3 Environmental constraints. Describe and list the environmental or land use constraints present at your activity which limit or restrict your current scope for each CSF, i.e., would not allow increased "volume" or "spectrum" for the CSF. Example -- Volume: frequency of a type of experiment. Example -- Spectrum: Current permit to detonate high explosives will not allow detonation or storage of increased quantity of explosives without legal waiver (state law) or relocation of surrounding (non-govt) buildings. (BRAC Criteria II)

There are no environmental or land use constraints present at the NRL-Washngton site which limit or restrict the current or perceived future scope of Electronic Devices R&D.

3.1.4 Special Support Infrastructure. List and describe the importance of any mission related special support infrastructure (e.g. utilities) present at your location for your activity. (BRAC Criteria I)

None.

3.1.5. Proximity to Mission-Related organizations. List and describe the importance and impact of not having nearby organizations which facilitate accomplishing or performing your mission -- e.g. operational units, FFRDCs, universities/colleges, other government organizations, and commercial activities. Restrict your response to the top five. Complete the following: (BRAC Criteria I)

Common Support Functions	Name	Type of Organization	Distance	Workyears Performed by Your Activity	Workyears Funded by Your Activity
Electronic Devices					
	Brookhaven National Laboratories Synchrotron Source	DOE and University Consortium	250	3	3

3.2 Personnel

3.2.1 Total Personnel. What is the total number of government (military and civilian), on-site federally funded research and development center (FFRDC), and on-site system engineering technical assistance (SETA) personnel engaged in science and technology (S&T), engineering development and in-service engineering activities as of end FY93? For individuals that predominantly work in CSFs, involved in more than one CSF, account for those individuals in the CSF that represents the preponderance of their effort. (BRAC Criteria I)

Types of personnel	Number of Personnel			
	Government		On-Site FFRDC	On-Site SETA
Electronic Devices	Civilian	Military		
Technical	192.7			84
Management (Supv)	20			
Other	32			

3.2.2 Education. What is the number of government personnel actively engaged in S&T, engineering development and in-service engineering activities by highest degree and type of position? Provide the data in the following table: (BRAC Criteria I)

Electronic Devices

Type of Degree/ Diploma	Number of Government Personnel by Type of Position		
	Technical	Management (Supv)	Other
High School or Less	24.7		29
Associates	4		3
Bachelor	8		
Masters	26	3	
Doctorate (include Med/Vet/etc.)	130	17	

3.2.3 Experience. What is the experience level of government personnel? Fill in the number of government personnel in the appropriate boxes of the following table. (BRAC Criteria I)

Electronic Devices

Type of Position	Years of Government and/or Military Service				
	Less than 3 years	3-10 years	11-15 years	16-20 years	More than 20 years
Technical	19	69	30.7	16	58
Management (Supv)	0	2	1	1	16
Total	19	71	31.7	17	74

NOTE: Table does not include personnel in the "Other" category.

3.2.4.1 Patents - See Tab A.

3.2.4.2 Published Papers - See Tab B.

3.3 Workload

3.3.1 FY93 Workload.

3.3.1.1 Work Year and Lifecycle. Identify the number of actual workyears executed for each applicable CSF in FY93 for each of the following: government civilian; military; on-site FFRDCs; and on-site SETAs. (BRAC Criteria I)

"LAB"	Fiscal Year 1993 Actual			
	Civilian	Military	FFRDC	SETA
Science & Technology	181	0	0	42.2
Engineering Development				
In-Service Engineering				

Science and Technology = 6.1,6.2,6.3A

3.3.1.2 Engineering Development By ACAT. For each Common Support Function (e.g. airborne C4I) at each activity engaged in engineering development, provide:

- For each ACAT IC, ID, and II program (as defined in DODI 5000.2):
  - The name of the program
  - A brief program description

  - For each ACAT III and IV programs:
  - The number of such programs
  - A list of program names

- For each program not an ACAT I, II, III, IV:
  - The number of such programs
  - A list of program names

- For the purpose of this question, any program between Milestone I and IV and containing demonstration and validation (Dem/Val 6.4)/Engineering and Manufacturing Development (EMD 6.5) funds in the FY95 PBS is considered to be engaged in engineering development (BRAC Criteria I).

Engineering Development	Name or Number	Workyears (FY93 Actual)	FY93 Funds Received (Obligation Authority)	Narrative
ACAT IC	(Name)	NONE		(Description)
ACAT ID	(Name)	NONE		(Description)
ACAT II	(Name)	NONE		(Description)
ACAT III/IV	(Number)	NONE		(List)
Other	(Number)	NONE		(List)

3.3.1.3 In-Service Engineering. For each Common Support Function at each activity engaged in in-service engineering, list the in-service engineering efforts, the FY93 funds (from all sources) obligated for these efforts, the FY93 workyears for these efforts, and the weapon system(s) supported by these efforts. In-service engineering consists of all engineering support of fielded and/or out of production systems and includes efforts to improve cost, throughput, and schedule to support customer requirements as well as mods and upgrades for reliability, maintainability, and performance enhancements. (BRAC Criteria I)

Common Support Functions	In-Service Engineering Efforts (List)	FY93 Actual		Weapon System(s) Supported
ED		Funds Received (Obligation Authority)	Workyears	
	NONE			

3.3.2 Projected Funding.

3.3.2.1 Direct Funding. For each applicable CSF, identify direct mission funding by appropriation from FY94 to FY97. Use FY95 PBS for FY95-FY97. (BRAC Criteria I)

Does not apply to DBOF Laboratories.

CSF	FY94	FY95	FY96	FY97
ED	-	-	-	-

3.3.2.2 Other Obligation Authority. For each applicable CSF, identify reimbursable and direct-cite funding (other obligation authority expected) from FY94 to FY97. Funding allocation must be traceable to FY95 PBS. (BRAC Criteria I) ($K)

CSF	FY94	FY95	FY96	FY97
ED	86,305.3	91,296.2	94,594.0	96,368.943

3.4 Facilities and Equipment

3.4.1 Major Equipment and Facilities. Describe major facilities and equipment necessary to support each Common Support Function (include SCIFs). If the facilities and equipment are shared with other functions, identify those functions and the percentage of total time used by each of the functions. Provide labeled photographs that picture the breadth and scope of the equipment and facilities described. If it is unique to DOD, to the Federal Government, or to the US, describe why it is unique. Insert the replacement cost. For this exercise, Replacement cost = (Initial cost + capital investment) multiplied by the inflation factor for the original year of construction. (BRAC Criteria II)

Common Support Function	Major Facility or Equipment Description*	Unique To			Replacement Cost ($K)
		DOD	Federal Gov't	U. S.	
ELECTRONIC DEVICES					
	Nanochannel Glass Technology Facility	X			1,415
	Laser Probe Facility				2,000
	Pulsed Chemical Laser Facility			X	4,000
	Argon-Pumped Ti:Sapphire Laser				750
	Ultrashort Pulse Generation Facility				1,000
	Fiber Optic Sensor Facility			X	2,100
	Optical Devices & Thin Film Fabrication Facilites				1,585
	Fiber Optic Optical-Microwave Laboratory		X		1,500
	Relativistic Klystron Laboratory			X	3,000
	Gyrotron Laboratory			X	2,000
	Long Pulse Accelerator Laboratory				500
	Nanoelectronics Processing Facility	X			19,870
	High Resolution Transmission Electron Microscope				700
	Si MBE & Surface Analysis System	X			1,200
	Vacuum Electronics Design Processing Facility	X			3,200
	III-V MBE Facilities				820
	Surface & Interface Science Facility				1,200
	Organometallic VPE	X			2,400
	Optical Characterization Facility				670
	Electronic Properties Facility				725
	Epicenter Facility	X	X		3,000
	Magnetic Resonance Facility				704

	Optical Properties Facility				843
	Crystal Growth Facility				2,250
	Far Infrared Spectroscopy Facility				685
	Reliability Facility	X	X		1,800
	Microwave Technology Facility				2,000
	Computers/Software/Networks/Test Equipment				1,500

3.5 Expansion Potential

3.5.1 **Laboratory Facilities:** Use facilities records as of **fourth-quarter FY93** in answering the following **(in sq ft)** for each CSF: (BRAC Criteria II)

Common Support Function	Facility or Equipment Description	Type of Space*	Space Capacity (KSF)		
			Current	Used	Excess
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	Relativistic Klystron Laboratory	Technical	4,200	3,800	400
	Gyrotron Laboratory	Technical	6,000	5,400	600
	Long Pulse Accelerator Laboratory	Technical	1,500	1,300	200
	Nanoelectronics Processing Facility	Technical	4,000	4,000	0
	High Resolution Transmission Electron Microscope	Technical	528	528	0
	Si MBE & Surface Analysis System	Technical	792	792	0
	Vacuum Electronics Design Processing Facility	Technical	1,771	1,771	0

	III-V MBE Facilities	Technical	506	506	0
	Surface & Interface Science Facility	Technical	1,265	1,265	0
	Organometallic VPE	Technical	1,697	1,697	0
	Optical Characterization Facility	Technical	1,265	1,265	0
	Electronic Properties Facility	Technical	1,012	1,012	0
	Epicenter Facility	Technical	1,012	1,012	0
	Magnetic Resonance Facility	Technical	759	759	0
	Optical Properties Facility	Technical	1,265	1,265	0
	Crystal Growth Facility	Technical	3,289	3,289	0
	Far Infrared Spectroscopy Facility	Technical	1,265	1,265	0
	Reliability Facility	Technical	1,392	1,392	0
	Microwave Technology Facility	Technical	3,542	3,542	0
	Computers/Software/Networks/Test Equipment	Technical	2,500	2,500	0
	General Laboratory	Technical	26,556	16,202	1,353
	Office	Administrative	36, 807	34,977	1,830
	Utility	Utility	300	300	0
	Storage	Storage	8,348	7,999	1,699

*** Type of Space = Administrative, Technical, Storage, Utility**

3.5.1.1 Describe the capacity of your activity to absorb additional similar workyears categorized in the same common support function with minor facility modification. If major modification is required, describe to what extent the facilities would have to be modified. (Use FY97 workyears as your requirement) (BRAC Criteria III)

A modest increase in work force size (about 10%) can be accomodated without major facility modification. Administrative and office space is available.

3.5.1.2 If there is capacity to absorb additional workyears, how many additional workyears can be supported? (BRAC Criteria III)

NRL is industrially funded. The 27.87 workyears in Electronic Devices can be supported if additional funding is supplied.

3.5.1.3 For 3.5.1.1 and 3.5.1.2 (above) describe the impact of military construction programs or other alteration projects programmed in the FY95 PBS. (BRAC Criteria II)

There is no military construction or other alteration projects programmed in the FY95 PBS that impact the electronic devices common support function at NRL-Washington.

3.5.2 **Land Use:** Provide number of buildable acres for additional laboratory/administrative support construction at your installation. (BRAC Criteria II)

None

3.5.3 **Utilities:** Provide an estimate of your installation's capability to expand or procure additional utility services (electric, gas, water). Estimates should be provided in appropriate units -- e.g. KWH of electricity. (BRAC Criteria II)

None

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DATA CALL #12

Technical Center Site	NRL/OPTICAL SCIENCES DIVISION
Facility/Equipment Nomenclature or Title	Nanochannel Glass Technology Facility

3.4.1 MAJOR EQUIPMENT AND FACILITIES

This Facility is used to fabricate, test and conduct preliminary application studies of Nanochannel Plate structure. Nanochannel glasses and plates contain parallel hollow channels as small as 10nm in diameter and packing densities approaching 10^{12} channels/cm^2. Individual channels can be positioned with high accuracy to form simple geometric arrays or highly complex architectures. Exact replicas of the channel glass can be made from a variety of materials and a high temperature form of the glass can be fabricated which is stable to greater than 950°C. The glass has a variety of applications. Present emphasis has been on high spatial resolution lithographic mask development. The facility consists of three parts: A fabrication laboratory, an applications laboratory and a characterization laboratory. Primary use is 70% Electron Devices. The other 30% is used by Pervasive Advanced Materials, Environmental Quality, universities, and private industry. R

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Technical Center Site	NRL/OPTICAL SCIENCES DIVISION
Facility/Equipment Nomenclature or Title	Nanochannel Glass Technology Facility

3.4.1 MAJOR EQUIPMENT AND FACILITIES

This Facility is used to fabricate, test and conduct preliminary application studies of Nanochannel Plate structure. Nanochannel glasses and plates contain parallel hollow channels as small as 10nm in diameter and packing densities approaching 10^{12} channels/cm^2. Individual channels can be positioned with high accuracy to form simple geometric arrays or highly complex architectures. Exact replicas of the channel glass can be made from a variety of materials and a high temperature form of the glass can be fabricated which is stable to greater than 950°C. The glass has a variety of applications. Present emphasis has been on high spatial resolution lithographic mask development. The facility consists of three parts: A fabrication laboratory, an applications laboratory and a characterization laboratory. Primary use is 70% Electron Devices. The other 30% is used by Pervasive Advanced Materials, Environmental Quality, universities, and private industry.

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ENCLOSURE (7)

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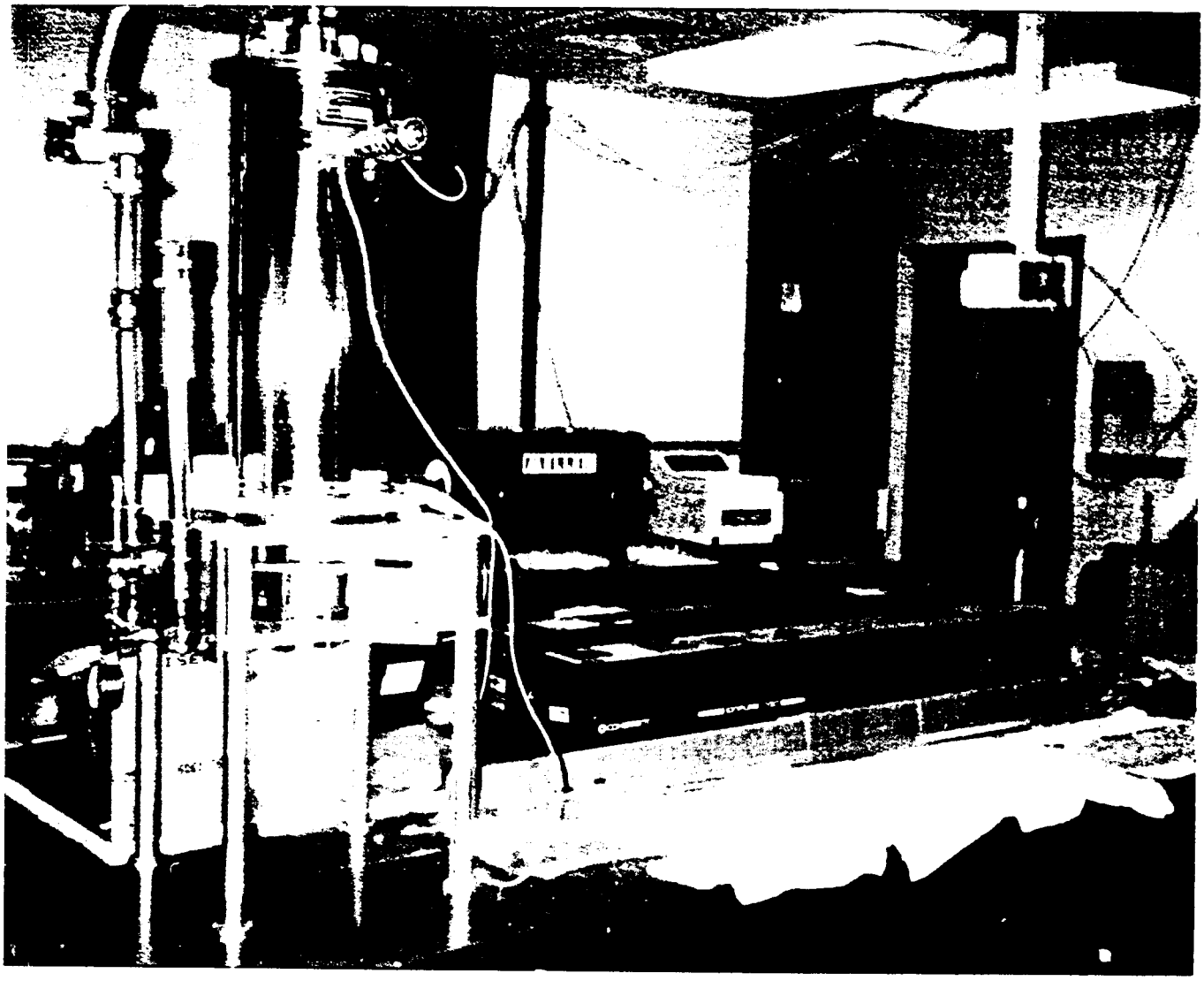
DATA CALL #12

Technical Center Site	NRL/OPTICAL SCIENCES DIVISION
Facility/Equipment Nomenclature or Title	Nanochannel Glass Technology Facility

3.4.1 MAJOR EQUIPMENT AND FACILITIES

This Facility is used to fabricate, test and conduct preliminary application studies of Nanochannel Plate structure. Nanochannel glasses and plates contain parallel hollow channels as small as 10nm in diameter and packing densities approaching 10^{12} channels/cm^2. Individual channels can be positioned with high accuracy to form simple geometric arrays or highly complex architectures. Exact replicas of the channel glass can be made from a variety of materials and a high temperature form of the glass can be fabricated which is stable to greater than 950°C. The glass has a variety of applications. Present emphasis has been on high spatial resolution lithographic mask development. The facility consists of three parts: A fabrication laboratory, an applications laboratory and a characterization laboratory.

This is the only facility in the world where such nanocomposite structures have been fabricated. The facility has the potential to address a broad range of applications relevant to the Navy and the nation, such as nanoscale lithography, including x-ray optics, nanoelectronics, optical switches, pattern development on diamond substrates and DNA mapping.



NANOCHANNEL GLASS TECHNOLOGY FACILITY

Associated Draw Tower is not pictured

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BRAC-95
DATA CALL #12

Technical Center Site	NRL/OPTICAL SCIENCES DIVISION
Facility/Equipment Nomenclature or Title	Laser Probe Facility

3.4.1 MAJOR EQUIPMENT AND FACILITIES

This Optical Physics Branch Facility is used to characterize the properties of advanced electro-optical materials using a wide range of laser spectroscopic probes. The facility consists presently of seven laser laboratories located throughout buildings 216 and A-50 that are dedicated to a wide range of material parameter measurements and optical characterization spanning wavelengths from the UV to the IR. Material properties investigated include optical transmission, elastic and inelastic scattering, ground and excited state absorption, nonlinear and electro-optical constants, free carrier and photo transport, magneto-optical, band structure, lattice structure, photonic band behavior, quantum confinement and reduced dimensionality, cavity QED behavior, inter-and intra-molecular energy transfer rates, electroluminescence and low temperature excitonic behavior. Laser spectroscopies utilized include spontaneous and coherent Raman, degenerate and non-degenerate four wave mixing, photothermal, second and third harmonic generation, two -photon absorption, z-scan, subpicosecond resolution transient absorption, laser induced fluorescence and subpicosecond excite-probe. 70% of this facility is used by Electron Devices. The other 30% is used by Pervasive Advanced Materials, Environmental Quality, universities, and private industrial groups. R

19 AUG 1994

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BRAC-95
DATA CALL #12

Technical Center Site	NRL/OPTICAL SCIENCES DIVISION
Facility/Equipment Nomenclature or Title	Laser Probe Facility

3.4.1 MAJOR EQUIPMENT AND FACILITIES

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Revision
JCE/ONR91
8/17/94

8 AUG 1994

BRAC-95
DATA CALL #12

Technical Center Site	NRL/OPTICAL SCIENCES DIVISION
Facility/Equipment Nomenclature or Title	Laser Probe Facility

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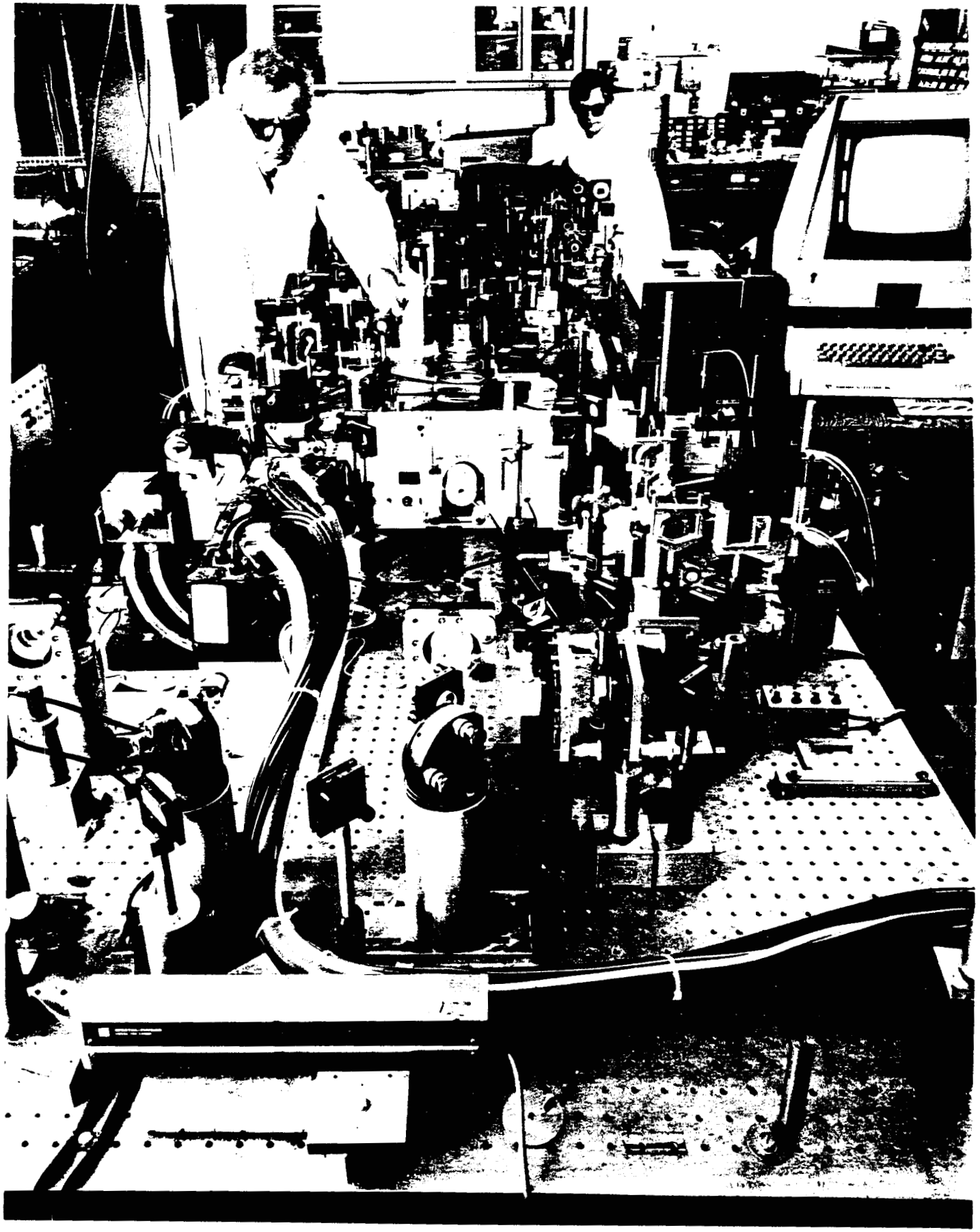

LASER PROBE FACILITY

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BRAC-95

DATA CALL #12

Technical Center Site	NRL/OPTICAL SCIENCES DIVISION
Facility/Equipment Nomenclature or Title	Pulsed Chemical Laser Facility

3.4.1 MAJOR EQUIPMENT AND FACILITIES

This Facility provides high-energy laser pulses in the 3 to 4um spectral range suitable for investigation of pulsed chemical laser kinetics, optical resonator design, nonlinear optics in the infrared, and laser beam materials interaction. The system consists of two flashlamp-pumped laser cavities, each capable of producing 50 J of energy of hydrogen fluoride laser transitions in the 2.8 to 3.5u spectral region, as well as 30 J of deuterium fluoride lasing in the 3.8 to 4.5u spectral region. Grating control enables operation on over 30 spectral lines separately. Pulse lengths typically are 1 to 2 us. The laser runs on a mix of hydrogen or deuterium and diatomic fluorine buffered by helium. Oxygen is incorporated in the system to eliminate spontaneous chain reactions. 70% of the facility is used for Electron Device research, while the other 30%is used by Advanced Materials and Environmental Quality. R

19 AUG 1994

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BRAC-95

DATA CALL #12

Technical Center Site	NRL/OPTICAL SCIENCES DIVISION
Facility/Equipment Nomenclature or Title	Pulsed Chemical Laser Facility

3.4.1 MAJOR EQUIPMENT AND FACILITIES

This Facility provides high-energy laser pulses in the 3 to 4um spectral range suitable for investigation of pulsed chemical laser kinetics, optical resonator design, nonlinear optics in the infrared, and laser beam materials interaction. The system consists of two flashlamp-pumped laser cavities, each capable of producing 50 J of energy of hydrogen fluoride laser transitions in the 2.8 to 3.5u spectral region, as well as 30 J of deuterium fluoride lasing in the 3.8 to 4.5u spectral region. Grating control enables operation on over 30 spectral lines separately. Pulse lengths typically are 1 to 2 us. The laser runs on a mix of hydrogen or deuterium and diatomic fluorine buffered by helium. Oxygen is incorporated in the system to eliminate spontaneous chain reactions. 70% of the facility is used for Electron Device research, while the other 30%is used by Advanced Materials and Environmental Quality.

Revision
7C9/0NR91
8/17/94

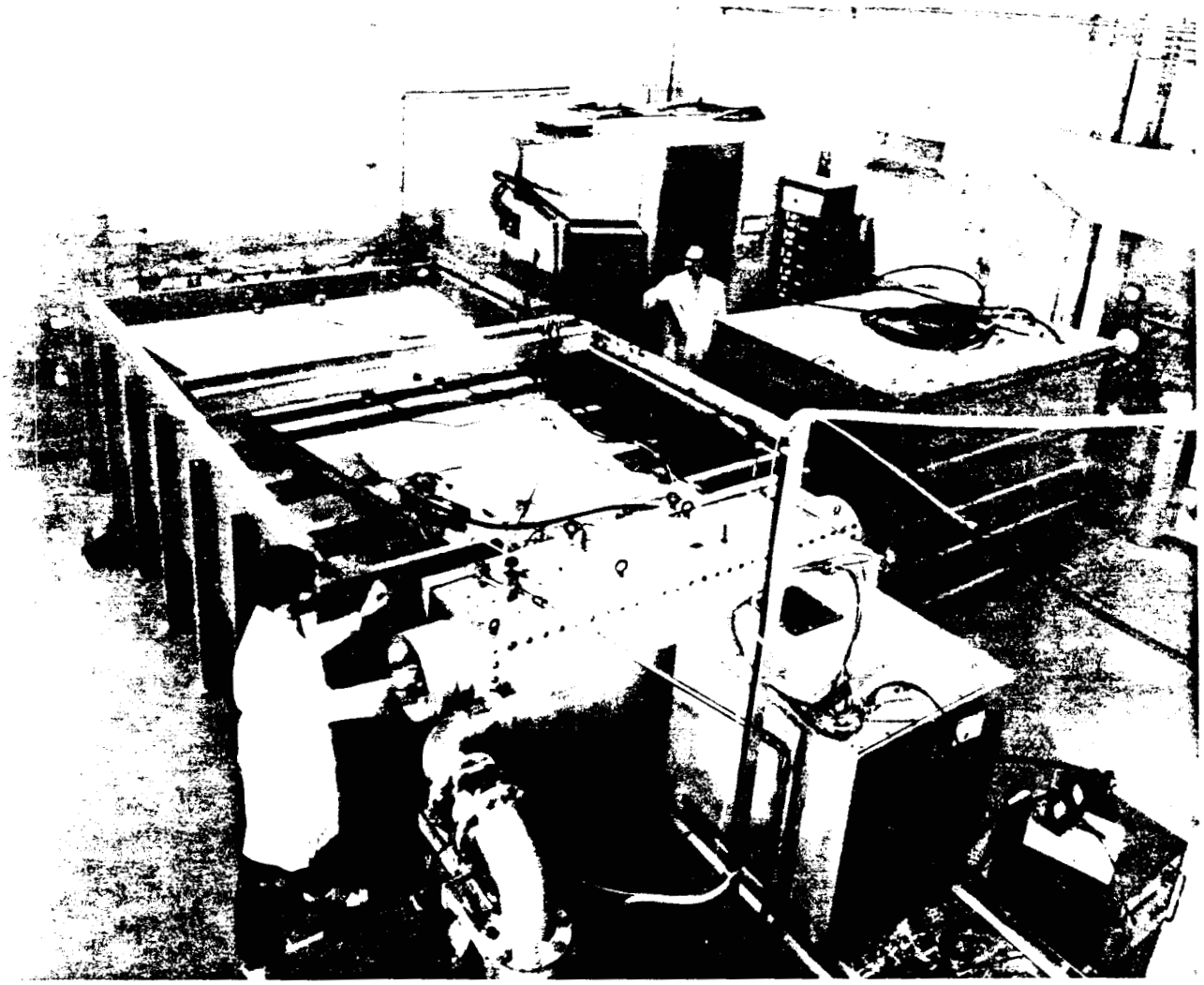
8 AUG 1994

BRAC-95
DATA CALL #12

Technical Center Site	NRL/OPTICAL SCIENCES DIVISION
Facility/Equipment Nomenclature or Title	Pulsed Chemical Laser Facility

3.4.1 MAJOR EQUIPMENT AND FACILITIES

This Facility provides high-energy laser pulses in the 3 to 4um spectral range suitable for investigation of pulsed chemical laser kinetics, optical resonator design, nonlinear optics in the infrared, and laser beam materials interaction. The system consists of two flashlamp-pumped laser cavities, each capable of producing 50 J of energy of hydrogen fluoride laser transitions in the 2.8 to 3.5u spectral region, as well as 30 J of deuterium fluoride lasing in the 3.8 to 4.5u spectral region. Grating control enables operation on over 30 spectral lines separately. Pulse lengths typically are 1 to 2 us. The laser runs on a mix of hydrogen or deuterium and diatomic fluorine buffered by helium. Oxygen is incorporated in the system to eliminate spontaneous chain reactions. The tandem pulse chemical laser device is a unique system in which each source produces 50 J per pulse with uniform beam quality. This system has the versatility to conduct master oscillator power amplified research, i.e., a HF/DF main media. It is the only facility of this kind in the country, and perhaps the free world.



PULSED CHEMICAL LASER FACILITY

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BRAC-95
DATA CALL #12

Technical Center Site	NRL/OPTICAL SCIENCES DIVISION
Facility/Equipment Nomenclature or Title	Argon-Pumped Titanium: Sapphire Laser

3.4.1 MAJOR EQUIPMENT AND FACILITIES

Provides continuous-wave coherent radiation at powers up to 7 watts, with wavelength continuously tunable between 670 nm and 1100 nm. This source is ideally suited for pumping developmental solid state lasers, and for emulating a wide range of diode laser pump sources. This solid state laser source is based on Ti^{3+} ions in single crystal sapphire. It is longitudinally pumped by a commercial argon ion gas laser. The crystal is actively cooled, and the power attainable in the tuning band depends primarily on the power of the argon ion pump laser. The current NRL design has utilized the highest figure of merit Ti:Sapphire crystals to achieve extremely high efficiencies and low lasing thresholds. When pumped with a 23 watt argon ion laser the NRL Ti:sapphire delivers up to 7 watts of unable radiation to the experimental test bed. 70% of the use is by Electron Devices. The other 30% is used by Advanced Materials, Environmental Quality, and the Army. R

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BRAC-95
DATA CALL #12

Technical Center Site	NRL/OPTICAL SCIENCES DIVISION
Facility/Equipment Nomenclature or Title	Argon-Pumped Titanium: Sapphire Laser

3.4.1 MAJOR EQUIPMENT AND FACILITIES

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Revision
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8/17/94

BRAC-95
DATA CALL #12

Technical Center Site	NRL/OPTICAL SCIENCES DIVISION
Facility/Equipment Nomenclature or Title	Argon-Pumped Titanium: Sapphire Laser

3.4.1 MAJOR EQUIPMENT AND FACILITIES

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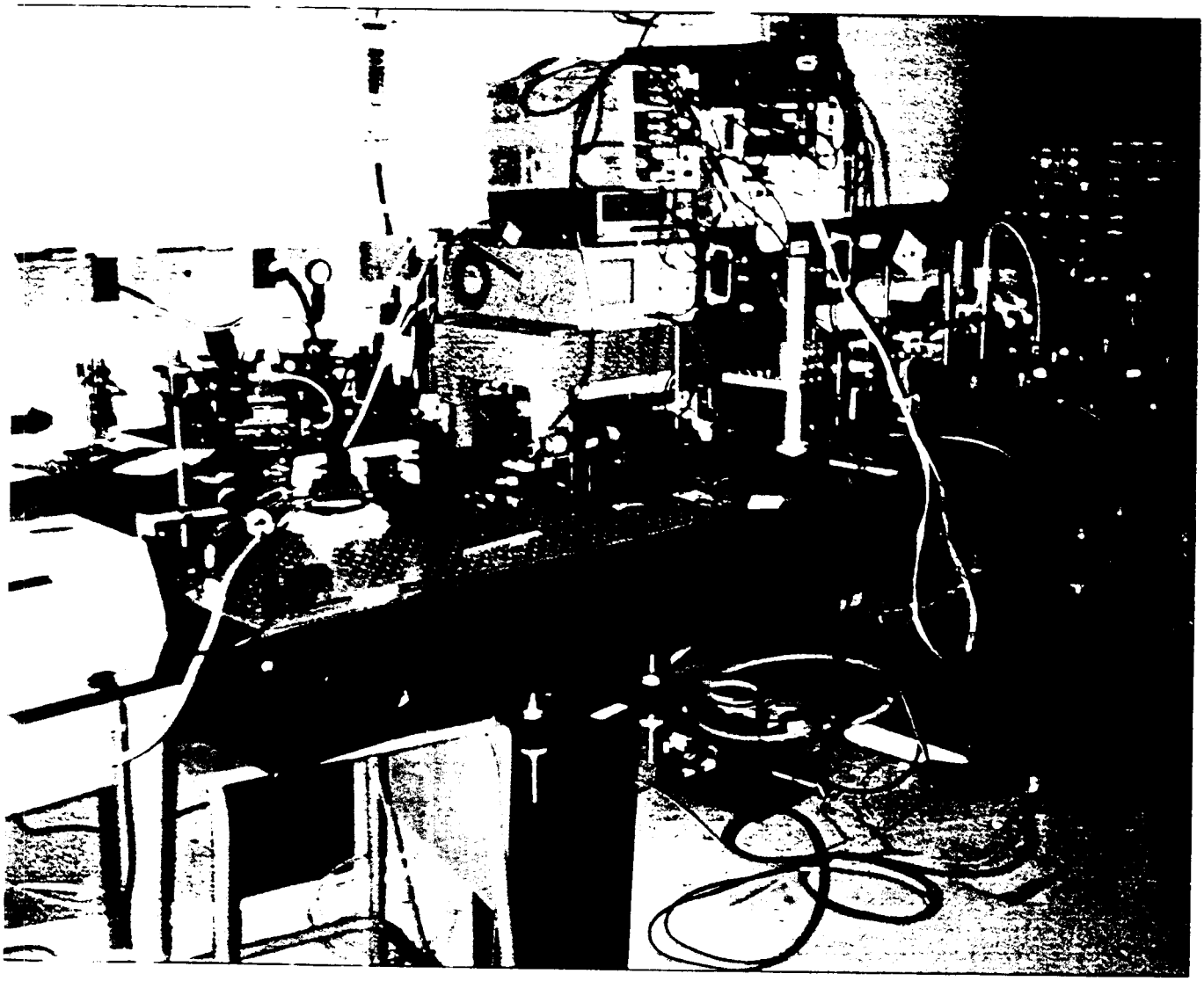

ARGON-PUMPED TITANIUM: SAPPHIRE LASER

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Technical Center Site	NRL/OPTICAL SCIENCES DIVISION
Facility/Equipment Nomenclature or Title	Ultrashort Pulse Generation Facility

3.4.1 MAJOR EQUIPMENT AND FACILITIES

This Facility is used for the production of ultrashort light pulses for the study of material properties, carrier dynamics, nonlinear propagation and ultra-high speed communications. The Facility includes a number of laser systems providing optical pulses in a number of wavelength ranges. The available wavelengths are: 532 nm, 610-630 nm, 781 nm to 1.064 um, and the pulsewidths range from 1 ps down to 50 fs depending on the system. Frequency doubling and mixing crystals are also available to provide other wavelengths. NRL is the primary Navy user, but NASA has evaluated high frequency detectors at the facility. Commercial users have included AT&T, Amoco, Comsat, and Allied Signal. Academic users include University of Nebraska, University of Wisconsin, and the University of Minnesota. All of these make up 25% of the facilities use, primarily in a collaborative mode. R

R

Technical Center Site	NRL/OPTICAL SCIENCES DIVISION
Facility/Equipment Nomenclature or Title	Ultrashort Pulse Generation Facility

3.4.1 MAJOR EQUIPMENT AND FACILITIES

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Revision
JCG/ONR91
8/17/94

Technical Center Site	NRL/OPTICAL SCIENCES DIVISION
Facility/Equipment Nomenclature or Title	Ultrashort Pulse Generation Facility

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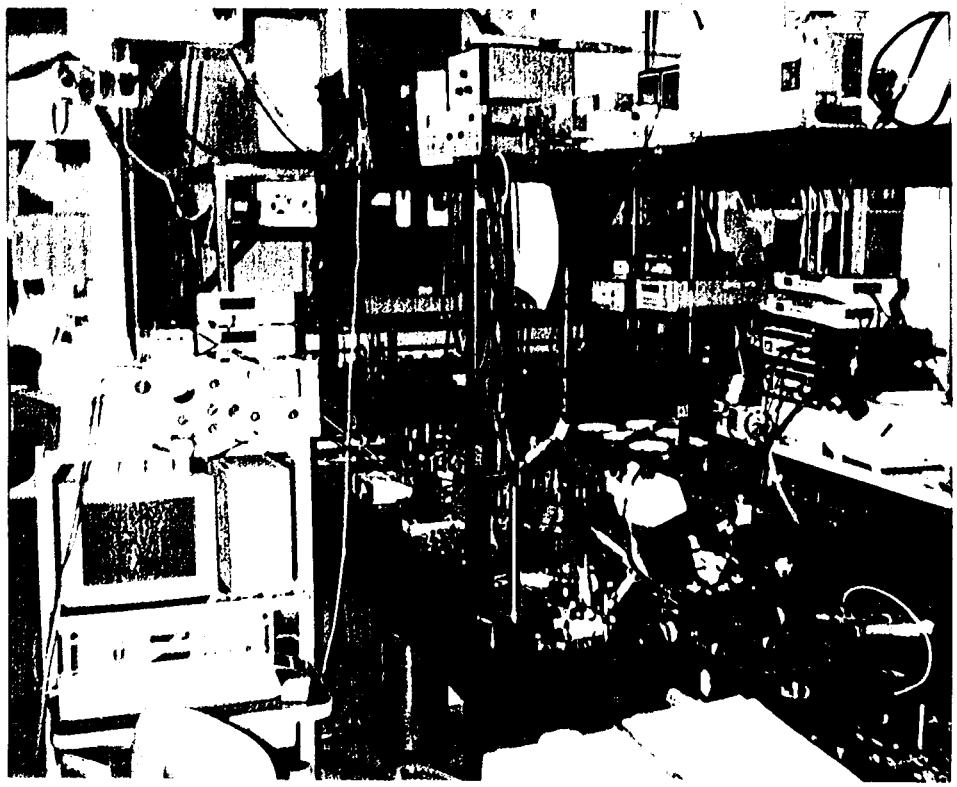

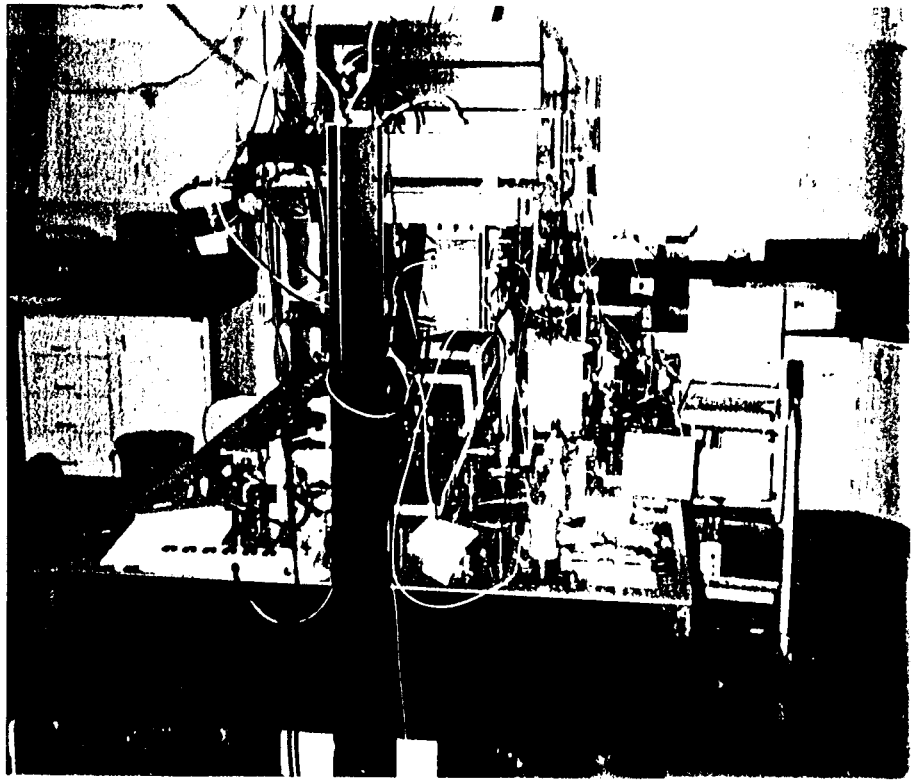

ULTRASHORT PULSE GENERATION FACILITY

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Technical Center Site	NRL/OPTICAL SCIENCES DIVISION
Facility/Equipment Nomenclature or Title	Fiber Optic Sensor Facility

3.4.1 MAJOR EQUIPMENT AND FACILITIES

This Facility is used for the construction and evaluation of fiber optic sensors for a variety of measurands. These measurands include acoustic magnetic and electric field, as well as strain and rate of rotation. The sensor construction facility includes two Accuwinder coil winding machines, seven optical fiber fusion splicers, annealing facilities for magnetic materials, and computer controlled data reduction and analysis stations, one optimized for acoustic sensors and the other optimized for magnetic sensors. There is an environmental chamber which operates from -50 C to 100 C for life testing of prototype sensors. The acoustic sensor evaluation facility also includes a prototype hydrophone designs. The maximum pressure attainable in the chamber is 5000 psi. The evaluation facility for rate of rotation sensors includes a Contraves rate table (1000 deg/sec to Earth rate) and a suite of measurement equipment. The evaluation facility for magnetic sensors includes mumetal magnetic shields for low noise measurements, a superconducting magnetic shield for extremely low noise measurements, and an automated systems for dynamic magnetization and Barkhausen noise measurements. The facility has optical test equipment to evaluate optical sources as well as an OTDR and a SMARTS system to evaluate fiber optic circuitry. The facility is also NUWC, Metrology, the Bureau of Reclamation, and the Department of Transportation are some of the other government users of the facility. Approximately 15% of the facility is used for these groups. R

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Technical Center Site	NRL/OPTICAL SCIENCES DIVISION
Facility/Equipment Nomenclature or Title	Fiber Optic Sensor Facility

3.4.1 MAJOR EQUIPMENT AND FACILITIES

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Revision
7CE/0 NR91
8/17/94

8 AUG 1994

Technical Center Site	NRL/OPTICAL SCIENCES DIVISION
Facility/Equipment Nomenclature or Title	Fiber Optic Sensor Facility

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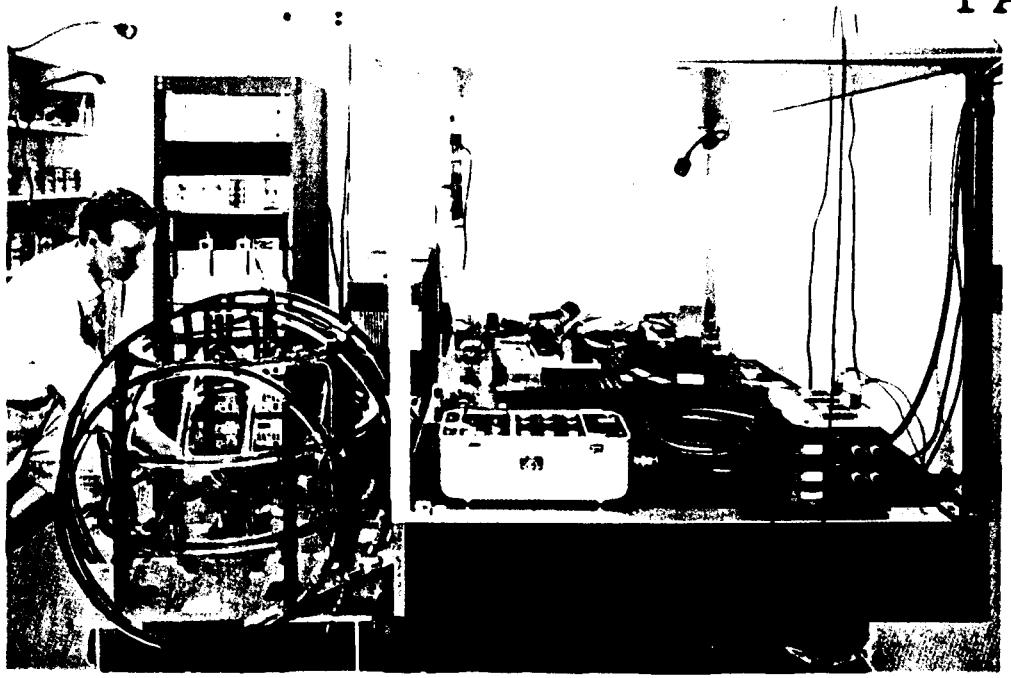
FIBER

OPTIC

SENSOR

FACILITY



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Technical Center Site	NRL/OPTICAL SCIENCES DIVISION
Facility/Equipment Nomenclature or Title	Optical Device and Thin Film Fabrication Facilities

3.4.1 MAJOR EQUIPMENT AND FACILITIES

The thin film fabrication facilities are capable of a variety of thin film deposition techniques for metal and oxide films. These include thermal and electron beam evaporation and RF and magnetron sputtering. Film thicknesses can be controlled from 100's to 10,000 Angstroms. Deposition is done in a class 10,000 clean room. A variety of furnaces are available for thermal diffusion processes, which are primarily used for the fabrication of Ti-diffused or proton exchanged LiNb03. The optical device fabrication facility consists of a Class 1000 clean room primarily designed for the photolithographic processing of LiNbO3/LiTaO3 integrated optical devices. Facilities are available for sample cleaning with ultrapure water, photoresist spinning, pre- and post-bakes, exposure, and development. Critical operations are preformed in Class 100 workstations. Low power plasma etching is available for resist cleaning and hardening. This facility is connected to the one above by a pass-thru. A separate optical polishing capability is available which can end-polish both optical fibers and integrated optical substrates. Besides the Radar and Electronic Warfare Division, the facility is also used by the Naval Postgraduate School for a A/D converter they are developing. The facility has also been used by GTE, AEL, and Harmonic Lightwave for modulator development. That usage makes up approximately 15% of the facility's time and resources. R

Technical Center Site	NRL/OPTICAL SCIENCES DIVISION
Facility/Equipment Nomenclature or Title	Optical Device and Thin Film Fabrication Facilities

3.4.1 MAJOR EQUIPMENT AND FACILITIES

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Revision
JCE/ONR91
8/19/94

8 AUG 1994

Technical Center Site	NRL/OPTICAL SCIENCES DIVISION
Facility/Equipment Nomenclature or Title	Optical Device and Thin Film Fabrication Facilities

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OPTICAL DEVICE AND THIN FILM FABRICATION FACILITIES

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Technical Center Site	NRL/OPTICAL SCIENCES DIVISION
Facility/Equipment Nomenclature or Title	Fiber Optic Optical-Microwave Laboratory

3.4.1 MAJOR EQUIPMENT AND FACILITIES

This Facility is used to apply advantages of fiber optics to transmission of microwave signals out to 100 GHz. Fiber optics can be used to transmit microwave signals on an optical carrier with a loss due only to the fiber itself, on the order of 0.2 dB/km. The applications for these optical microwave links include remote antenna operation, optical control of phased array radars, optical-microwave generation out to 40 GHz and beyond with linewidths on the order of sub-mHz, stable local oscillator sources, electric field monitoring, and FIR filters. This facility is also used by the Radar and Electronic Warfare Divisions to evaluate optical-microwave delay lines, optical-microwave phase shifters, and sub-systems employing fiber optics. Detector manufacturers such as Epitaxx, Ortel, Lasertron, and Honeywell have used the facility for evaluating detector and receiver performance as well as measuring the nonlinear response of detectors. Finally, several universities such as Lehigh and the University of California at Santa Barbara have evaluated high frequency optical components and sub-systems at the facility; these components and sub-systems were developed under Navy, Air Force, and ARPA contracts. These other users comprise approximately 25% of the facility use. R

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Technical Center Site	NRL/OPTICAL SCIENCES DIVISION
Facility/Equipment Nomenclature or Title	Fiber Optic Optical-Microwave Laboratory

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Revision
ACE/O NR91
8/17/94

3 AUG 1994

BRAC-95
DATA CALL #12

Technical Center Site	NRL/OPTICAL SCIENCES DIVISION
Facility/Equipment Nomenclature or Title	Fiber Optic Optical-Microwave Laboratory

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FIBER OPTIC OPTICAL-MICROWAVE

LABORATORY

R

BRAC-95
DATA CALL #12

Technical Center Site	NRL/PLASMA PHYSICS DIVISION
Facility/Equipment Nomenclature or Title	Relativistic Klystron Laboratory

3.4.1 MAJOR EQUIPMENT AND FACILITIES

None of the facilities listed under 3.4.1 for the Plasma Physics Division are shared with other CSF's.

Laser Plasma Branch

The Laboratory has an intense relativistic electron beam (IREB) source that powers the Relativistic Klystron Amplifier (RKA). The electrical parameters of this source are: peak voltage 1.2 MV, current 40kA, 160 nanoseconds duration. A high power >10 GW RKA is connected to this generator. A second IREB generator is in the construction stage. This generator is of a triaxial shape and can generate a 60 cm diameter low impedance IREB. A future RKA will operate at a frequency of 10 GHz with a power level of 30 GW; currently the frequency range is in the 1-3.5 GHz range. This facility is unique because the PI is the inventor of the RKA device and because it is the only facility that has produced > 1 kJ/pulse at 1.3 GHz.

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BRAC-95
DATA CALL #12

Technical Center Site	NRL/PLASMA PHYSICS DIVISION
Facility/Equipment Nomenclature or Title	Relativistic Klystron Laboratory

3.4.1 MAJOR EQUIPMENT AND FACILITIES

None of the facilities listed under 3.4.1 for the Plasma Physics Division are shared with other CSF's.

Laser Plasma Branch

The Laboratory has an intense relativistic electron beam (IREB) source that powers the Relativistic Klystron Amplifier (RKA). The electrical parameters of this source are: peak voltage 1.2 MV, current 40kA, 160 nanoseconds duration. A high power >10 GW RKA is connected to this generator. A second IREB generator is in the construction stage. This generator is of a triaxial shape and can generate a 60 cm diameter low impedance IREB. A future RKA will operate at a frequency of 10 GHz with a power level of 30 GW; currently the frequency range is in the 1-3.5 GHz range. This facility is unique because the PI is the inventor of the RKA device and because it is the only facility that has produced > 1 kJ/pulse at 1.3 GHz.

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8 AUG 1994

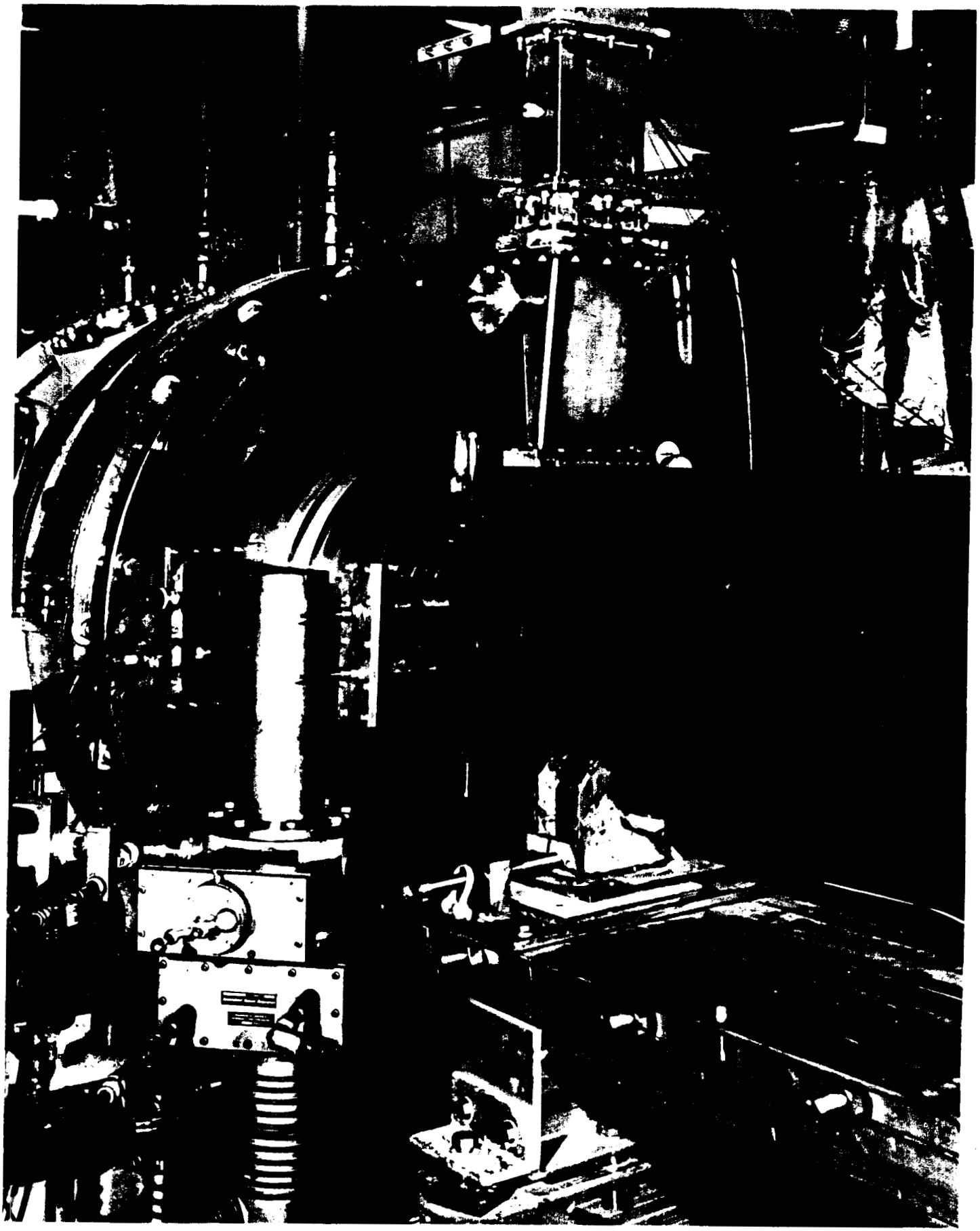
BRAC-95
DATA CALL #12

Technical Center Site	NRL/PLASMA PHYSICS DIVISION
Facility/Equipment Nomenclature or Title	Relativistic Klystron Laboratory

3.4.1 MAJOR EQUIPMENT AND FACILITIES

Laser Plasma Branch

The Laboratory has an intense relativistic electron beam (IREB) source that powers the Relativistic Klystron Amplifier (RKA). The electrical parameters of this source are: peak voltage 1.2 MV, current 40kA, 160 nanoseconds duration. A high power >10 GW RKA is connected to this generator. A second IREB generator is in the construction stage. This generator is of a triaxial shape and can generate a 60 cm diameter low impedance IREB. A future RKA will operate at a frequency of 10 GHz with a power level of 30 GW; currently the frequency range is in the 1-3.5 GHz range. This facility is unique because the PI is the inventor of the RKA device and because it is the only facility that has produced > 1 kJ/pulse at 1.3 GHz.



RELATIVISTIC KLYSTRON LABORATORY

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BRAC-95
DATA CALL #12

Technical Center Site	NRL/PLASMA PHYSICS DIVISION
Facility/Equipment Nomenclature or Title	Gyrotron Laboratory

3.4.1 MAJOR EQUIPMENT AND FACILITIES

Beam Physics Branch

The Laboratory has a 600kW, 80-130 GHz, 13 microsecond rep-rated experimental quasioptical gyrotron (QOG), as well as 100 kW, 1 microsecond, 1000 Hz rep-rate 35 and 94 GHz waveguide cavity gyrotrons. A tunable (60-120GHz), multi-kW CW QOG is under development for use in research on ceramic materials processing. This facility is unique in that it has the only operational QOG in the U.S.

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Technical Center Site	NRL/PLASMA PHYSICS DIVISION
Facility/Equipment Nomenclature or Title	Gyrotron Laboratory

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Revision
ZC2/ONRY
8/17/94

8 AUG 1994

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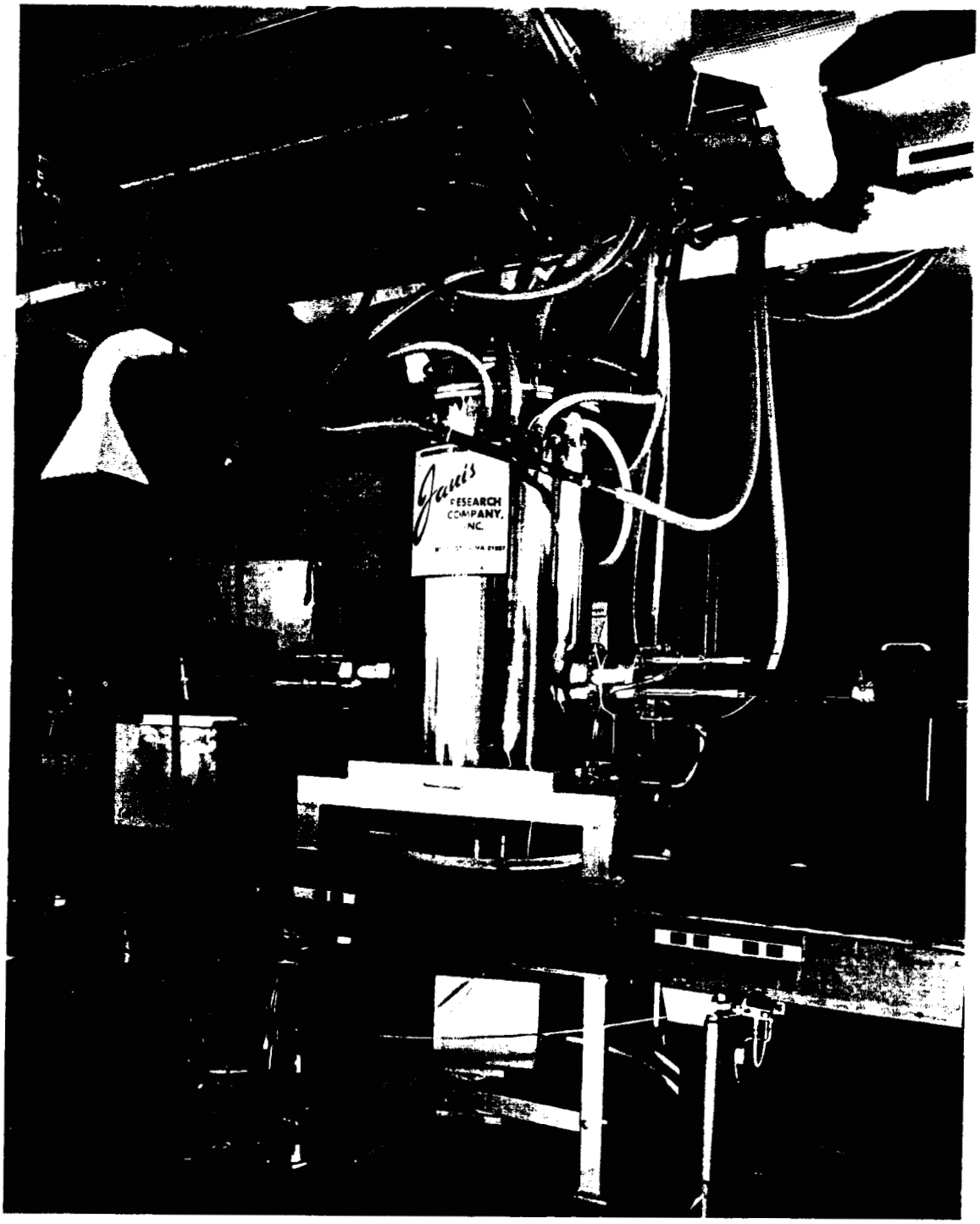
Technical Center Site	NRL/PLASMA PHYSICS DIVISION
Facility/Equipment Nomenclature or Title	Gyrotron Laboratory

3.4.1 MAJOR EQUIPMENT AND FACILITIES

Beam Physics Branch

The Laboratory has a 600kW, 80-130 GHz, 13 microsecond rep-rated experimental quasioptical gyrotron (QOG), as well as 100 kW, 1 microsecond, 1000 Hz rep-rate 35 and 94 GHz waveguide cavity gyrotrons. A tunable (60-120GHz), multi-kW CW QOG is under development for use in research on ceramic materials processing. This facility is unique in that it has the only operational QOG in the U.S.



Photograph of currently operational 85-130 GHz NRL quasi optical gyrotron

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Technical Center Site	NRL/PLASMA PHYSICS DIVISION
Facility/Equipment Nomenclature or Title	Long Pulse Accelerator Laboratory

3.4.1 MAJOR EQUIPMENT AND FACILITIES

Long Pulse Accelerator Laboratory

The accelerator is a Marx generator with variable shunt and crowbar, with voltage adjustable from 250 kV - 1 MV, and up to 10 microseconds for 250 kV- 500 kV. The voltage flatness is +1% ripple, 2% droop for a 1 microsecond pulse into a 1000 ohm load. The present research concentrates on long pulse ($\geq$ 1 microsecond) microwave generation.

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Technical Center Site	NRL/PLASMA PHYSICS DIVISION
Facility/Equipment Nomenclature or Title	Long Pulse Accelerator Laboratory

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Revision
7CE/8NR9
8/17/94

8 AUG 1994

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Technical Center Site	NRL/PLASMA PHYSICS DIVISION
Facility/Equipment Nomenclature or Title	Long Pulse Accelerator Laboratory

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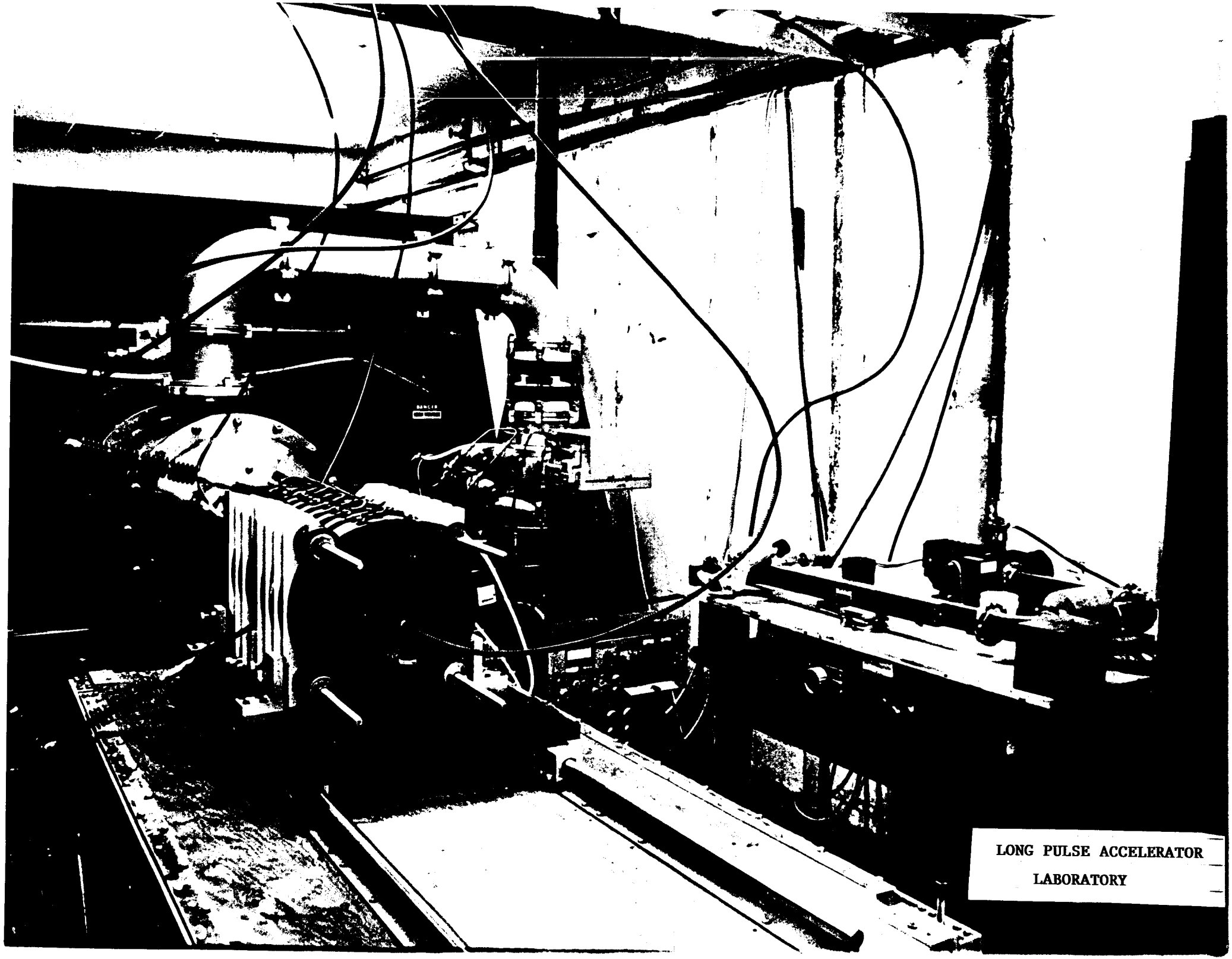

LONG PULSE ACCELERATOR LABORATORY

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BRAC-95
DATA CALL #12

Technical Center Site	NRL/ESTD
Facility/Equipment Nomenclature or Title	Nanoelectronics Processing Facility

3.4.1 MAJOR EQUIPMENT AND FACILITIES

Nanoelectronics Processing Facility

1. The Nanoelectronics Processing Facility (NPF) is dedicated to developing and providing state-of-the-art nanofabrication/microfabrication processing for a wide range of electronic, optoelectronic, optical, chemical and biomolecular materials. The NPF contains 4200 sq ft of class 1000 clean area housing a complete spectrum of microelectronics processing including ultra-high resolution lithography (e-beam and deep UV), plasma etching, deposition furnaces for polysilicon, silicon oxide and silicon nitride, annealing, ultra-clean metalization, inspection and packaging. Laminar flow bech areas provide class 100 areas for wet processing and cleaning. No government facility has such a wide breadth of these facilities. In particular, the combination of processing capabilities and the ability to process the wide range of materials and sized samples (5mm to 5") is unique within DoD and the Federal governemnt. The replacement cost is about 25M$. Support of the Electronic Materials CSF is the primary mission of the NPF and represents 60% of its total activity. R

2. The NPF is housed in Building A-69 at NRL. It is fixed and not moveable or portable.

3.

Building	1.67M$	(8370 sq. ft. x $200)
Cleanroom	1.2M$	(4000 sq. ft. x $300)
Equipment	17M$	

4. The facility has a floor area of 8370 sq. ft. of which 4000 sq. ft. is a class 1000 clean area.

5. Dry Nitrogen, Temperature & Humidity Control, Compressed Air - 90 P.S.I.

6. Clean Room Facility
Shielded Testing/Characterization Labs
Stable Foundations

7. Clean Room Facility requires tight environmental control.

Temperature ±°1 C. ±•1°C in e-beam areas (800 sq. ft.)
Humidity Control 45 ± 5%
Class 1000 Clean Areas
Air Scrubbing

8. Scientists and Engineers at NRL require access to the NPF on a day to day basis. Many collaborative projects involve S & Es working in the NPF. The Facility has many state-of-the-art capabilities (ultra high resolution lithography, anisotropic plasma etching, high temperature deposition, ultra clean metalization) which are unavailable at commercial institutions. No government facility has such

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DATA CALL #12

Technical Center Site	NRL/ESTD
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7 CS/ONR91
8/17/94

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BRAC-95
DATA CALL #12

Technical Center Site	NRL/ESTD
Facility/Equipment Nomenclature or Title	Nanoelectronics Processing Facility

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9. Individual items have been purchased under CPP. Transportation arrangements are made on a case by case basis.

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The NPF moved into Building A-69 in February 1979. A-69 was modified under contract N00173-78-C-0456.

10. 11.4 Electronic Devices
11.5 Materials and Processes

11. The NPF has a staff of 17 personnel. It is used every working day (and on weekends) throughout the year.

12. The NPF will be used every working day (and on 10 weekends/year) through FY97 and beyond.

13. 17

14. 17

15. Facility Photo Attached

16. The Nanoelectronics Processing Facility (NPF) has unique lithographic capabilities and is therefore unique to DoD.Support of the Electronic Materials CSF is the primary mission of the NPF and represents 60% of its total activity. A further 30% is in support of other multidisciplinary Navy specific activities and 10% for crossdisciplinary activities in academic institutions participating in DoD programs.

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8/17/94

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15. Facility Photo Attached

16. This facility is not shared with any other function. It has unique lithographic capabilities and is therefore unique to DoD.

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BRAC-95
DATA CALL #12

Technical Center Site	NRL/ESTD
Facility/Equipment Nomenclature or Title	High Resolution Transmission Electron Microscope

3.4.1 MAJOR EQUIPMENT AND FACILITIES

Solid State Devices Branch

1. The High Resolution Transmission Electron Microscope (HRTEM) is dedicated to providing atomic-scale analysis for a wide range of electronic, optoelectronic, nanostructural, biomolecular, metallurgical and ceramic materials. The 7100 lb. HRTEM is housed in a 480 sq. ft. facility specially modified to reduce vibration. Presently, this facility provides the only direct means of measuring atomic scale materials parameters, such as interface widths, for electronic materials and electron device structures at NRL and is unique within DOD. R

2. The equipment is fixed.

3. The facility replacement cost is $700K

4. The gross weight of the equipment is 7100 lbs. 2700 cu. ft. are needed to house the facility.

5. Electrical power at the level of 240 volts and 100 amperes is needed for the instrument. In addition to electric power, water and a water chiller are needed to cool the instrument. A proper photographic dark room, with a sink designed for developing large cut film negatives is also necessary. Acoustical foam must be attached to walls to prevent noise in room from contributing to sample vibration.

6. It is essential that the electron microscope be sited on a ground or first floor so as to minimize vibration. The floor must be sufficiently stable that the floor vibration does not exceed these levels over the associated frequency range: 0.5 mm (2-3 Hz), 1 m m(3-5 Hz), 2 mm (5-9 Hz), and 3 mm (10 Hz and over). Stray AC magnetic fields must be less than 3 mG measured peak to peak (1 mG RMS). Horizontal DC magnetic fields must be less than 10 mG. This electron microscope has a resolution of 1.8 Angstoms, so that the sample cannot be allowed to move even a small fraction of this distance during the 2 seconds required to record the image. The noise environment of an ordinary room would cause the sample to move while the image is being recorded and in so doing make atomic scale imaging impossible.

7. The water temperature must lie between 15^0 - 20^0C with a fluctuation of less than 0.1^0C/hr. The room temperature must lie between 150 - 20^0C with a fluctuation of less

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BRAC-95
DATA CALL #12

Technical Center Site	NRL/ESTD
Facility/Equipment Nomenclature or Title	High Resolution Transmission Electron Microscope

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8/17/94

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BRAC-95
DATA CALL #12

Technical Center Site	NRL/ESTD
Facility/Equipment Nomenclature or Title	High Resolution Transmission Electron Microscope

3.4.1 MAJOR EQUIPMENT AND FACILITIES

Solid State Devices Branch

1. The purpose of the equipment is to quantify and characterize defects, second phase precipitates, and interfaces in solid state materials on an atomic scale. The materials investigated are used in research programs on the structure of materials and in research programs on electronic and optoelectronic devices at NRL and other DOD laboratories.

2. The equipment is fixed.

3. The facility replacement cost is $700K

4. The gross weight of the equipment is 7100 lbs. 2700 cu. ft. are needed to house the facility.

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7. The water temperature must lie between 15^0 - 20^0C with a fluctuation of less than 0.1^0C/hr. The room temperature must lie between 150 - 20^0C with a fluctuation of less than 1^0C/hr. The air flow in the room must establish a positive pressure to prevent dust from entering the room. The drop ceiling of a room must be removed to prevent trapping of dust. Because the electron gun of the microscope operates at a 300,000 volts, dust

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8. This facility could not be relocated to another site. Even finding a site with the proper degree of mechanical stability, temperature control, and low magnetic field environment would be extremely difficult. The microscope would need to be completely disassembled in order to remove it from its present site. Due to its extremely delicate sample manipulation system, the microscope could not be moved without the danger of harming the mechanisms that prevent the sample from drifting less than a fraction of an Angstrom per second. Disassembly would also degrade the high vacuum system of the electron microscope and promote sample contamination. We know of no high-resolution electron microscope that has been successfully relocated.

Presently, this facility provides the only direct means of measuring atomic scale materials parameters, such as interface widths, for electronic materials and electron device structures at NRL. If this facility were lost, NRL would loose access to this important class of electronic materials parameters and thereby hinder the development of state of the art electronic materials that NRL provides for the Navy. Given the Navy's need for state of the art electronics for the next generation of weapons systems, the termination of this facility would have a deleterious effect on the Navy's capabilities.

9. The equipment was transported by ship and by truck. It arrived here in March 1991.

10. This facility supports the Generic Technology Base: Electronic Devices (11.4) and Materials and Processes (11.5).

11. Since it first arrived at NRL, the microscope has been used on a daily basis.

12. It is anticipated that the microscope will continue to be used on a daily basis through FY1997.

13. There are currently four government researchers and a government technician who use the equipment in their research program.

14. One government scientist and one government technician maintain the facility (in addition to Hitachi Service Engineers under the service contract).

15. Facility Photo Attached.

16. Support of the electronic materials effort at NRL represents 70% of HRTEM use. A further 20% is in support of the Defense Nuclear Agency programs with the remaining 10% in support of other multidisciplinary activities at NRL. R

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8/17/94

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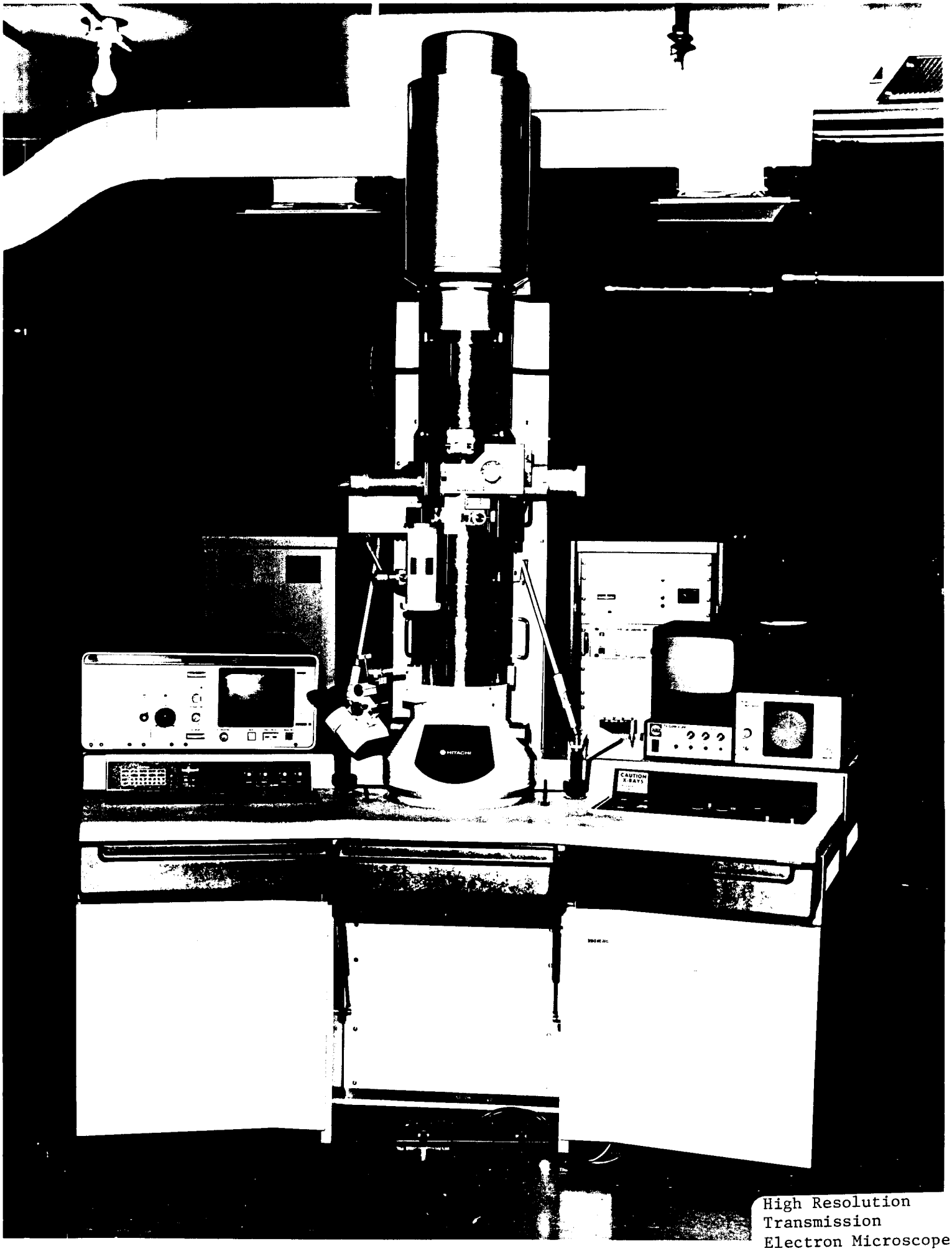

High Resolution
Transmission
Electron Microscope

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BRAC-95
DATA CALL #12

Technical Center Site	NRL/ESTD
Facility/Equipment Nomenclature or Title	Si MBE & Surface Analysis System

3.4.1 MAJOR EQUIPMENT AND FACILITIES

Solid State Devices Branch

1. The Si molecular beam epitaxy (MBE) growth system and surface analysis laboratory is a combined system, designed so that each component can be used independently, or so that a sample can be fabricated in the growth system and be investigated in the surface analysis system without exposure to atmosphere. The Si MBE growth system is used to grow epitaxial films, composed of Si, Ge, or $Si_{1-x}Ge_x$, which are doped n- or p-type or undoped, on Si substrates. These films are investigated in basic research programs on the structure of materials and are used in research programs on electronic and optoelectronic devices at NRL and other DOD laboratories. The Surface Analysis System, which is connected to the Si MBE Growth System, is employed in the fundamental study of the chemistry and physics of heterostructure interfaces. The replacement cost of the facility is $1.2M. The approximate gross weight of the equipment is 6000 lbs and the volume is 600 ft^3. R

2. The equipment is fixed

3. The replacement cost of the facility is $1.2M.

4. The approximate gross weight of the equipment is 6000 lbs and the volume is 600 ft^3.

5. Portions of the system must be water cooled. The Si MBE Growth system and surface analysis laboratory are connected to a closed cycle chilled water system which pumps a cooled mixture of water and ethylene-glychol through the system.

6. None

7. Humidity, particulate, and temperature control are important for the effective use of this equipment, primarily in the handling of the samples which are put into the equipment.

8. This is an ultra-high vacuum system. The base pressure is 10^{-11} mbar. In order to move the system it would have to be dismantled. Accumulated moisture and other impurities would have a deleterious effect on the quality of the vacuum. It would be very difficult to replicate this system. The initial building block is the VG-V80 Si MBE growth system and ESCA lab. Over the years incremental improvements have been added to enhance the performance of the system. This facility is a unique facility in DOD. As such it has been used in research programs of interest to the Navy, DNA, and

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Technical Center Site	NRL/ESTD
Facility/Equipment Nomenclature or Title	Si MBE & Surface Analysis System

3.4.1 MAJOR EQUIPMENT AND FACILITIES

Solid State Devices Branch

1. The Si molecular beam epitaxy (MBE) growth system and surface analysis laboratory is a combined system, designed so that each component can be used independently, or so that a sample can be fabricated in the growth system and be investigated in the surface analysis system without exposure to atmosphere. The Si MBE growth system is used to grow epitaxial films, composed of Si, Ge, or $Si_{1-x}Ge_x$, which are doped n- or p-type or undoped, on Si substrates. These films are investigated in basic research programs on the structure of materials and are used in research programs on electronic and optoelectronic devices at NRL and other DOD laboratories. The Surface Analysis System, which is connected to the Si MBE Growth System, is employed in the fundamental study of the chemistry and physics of heterostructure interfaces. The replacement cost of the facility is $1.2M. The approximate gross weight of the equipment is 6000 lbs and the volume is 600 ft^3.

2. The equipment is fixed

3. The replacement cost of the facility is $1.2M.

4. The approximate gross weight of the equipment is 6000 lbs and the volume is 600 ft^3.

5. Portions of the system must be water cooled. The Si MBE Growth system and surface analysis laboratory are connected to a closed cycle chilled water system which pumps a cooled mixture of water and ethylene-glychol through the system.

6. None

7. Humidity, particulate, and temperature control are important for the effective use of this equipment, primarily in the handling of the samples which are put into the equipment.

8. This is an ultra-high vacuum system. The base pressure is 10^{-11} mbar. In order to move the system it would have to be dismantled. Accumulated moisture and other impurities would have a deleterious effect on the quality of the vacuum. It would be very difficult to replicate this system. The initial building block is the VG-V80 Si MBE growth system and ESCA lab. Over the years incremental improvements have been added to enhance the performance of the system. This facility is a unique facility in DOD. As such it has been used in research programs of interest to the Navy, DNA, and

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Technical Center Site	NRL/ESTD
Facility/Equipment Nomenclature or Title	Si MBE & Surface Analysis System

3.4.1 MAJOR EQUIPMENT AND FACILITIES

Solid State Devices Branch

1. Primary purpose of the facility. The Si MBE growth system is used to grow epitaxial films, composed of Si, Ge, or $Si_{1-x}Ge_x$, which are doped n- or p-type or undoped, on Si substrates. These films are investigated in basic research programs on the structure of materials and are used in research programs on electronic and optoelectronic devices at NRL and other DOD laboratories. The Surface Analysis System, which is connected to the Si MBE Growth System, is employed in the fundamental study of the chemistry and physics of heterostructure interfaces.

2. The equipment is fixed

3. The replacement cost of the facility is $1.2M.

4. The approximate gross weight of the equipment is 6000 lbs and the volume is 600 ft^3.

5. Portions of the system must be water cooled. The Si MBE Growth system and surface analysis laboratory are connected to a closed cycle chilled water system which pumps a cooled mixture of water and ethylene-glychol through the system.

6. None

7. Humidity, particulate, and temperature control are important for the effective use of this equipment, primarily in the handling of the samples which are put into the equipment.

8. This is an ultra-high vacuum system. The base pressure is 10^{-11} mbar. In order to move the system it would have to be dismantled. Accumulated moisture and other impurities would have a deleterious effect on the quality of the vacuum. It would be very difficult to replicate this system. The initial building block is the VG-V80 Si MBE growth system and ESCA lab. Over the years incremental improvements have been added to enhance the performance of the system. This facility is a unique facility in DOD. As such it has been used in research programs of interest to the Navy, DNA, and the Air Force. At this point in time there are no commercial facilities which can perform the functions of this equipment.

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the Air Force. At this point in time there are no commercial facilities which can perform the functions of this equipment.

9. The equipment was transported to the site by air and truck in pieces. It was constructed on site by technicians from the company and NRL scientists. The major portion of the system was delivered in 1986.

10. This facility supports the Generic Technology Base; 11.4 Electronic Devices.

11. The equipment has been used on a daily basis for the past five fiscal years.

12. It is anticipated that the facility will be used on a daily basis out through FY1997.

13. There are three government research scientists, a government technician, and a on-site contractor research engineer who use the equipment as the primary part of their research program.

14. The primary responsibility for the daily maintenance of the equipment is the government technician. However, the three scientists and the research engineer all take an active role in repairs, non-routine maintenance, and system upgrades.

15. Facility Photo Attached.

16. This facility is unique in DOD and is only approximately matched in several corporate laboratories, such as IBM and AT&T. Support of the Electronic Materials CSF is the primary mission and represents 55% of its total activity. A further 30% is spent in support of the electronic devices programs, both at NRL and in Air Force Laboratories. 15% is spent in support of academic institutions participating in DOD programs. R

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the Air Force. At this point in time there are no commercial facilities which can perform the functions of this equipment.

9. The equipment was transported to the site by air and truck in pieces. It was constructed on site by technicians from the company and NRL scientists. The major portion of the system was delivered in 1986.

10. This facility supports the Generic Technology Base; 11.4 Electronic Devices.

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12. It is anticipated that the facility will be used on a daily basis out through FY1997.

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15. Facility Photo Attached.

16. This facility is unique in DOD and is only approximately matched in several corporate laboratories, such as IBM and AT&T. Support of the Electronic Materials CSF is the primary mission and represents 55% of its total activity. A further 30% is spent in support of the electronic devices programs, both at NRL and in Air Force Laboratories. 15% is spent in support of academic institutions participating in DOD programs.

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9. The equipment was transported to the site by air and truck in pieces. It was constructed on site by technicians from the company and NRL scientists. The major portion of the system was delivered in 1986.

10. This facility supports the Generic Technology Base; 11.4 Electronic Devices.

11. The equipment has been used on a daily basis for the past five fiscal years.

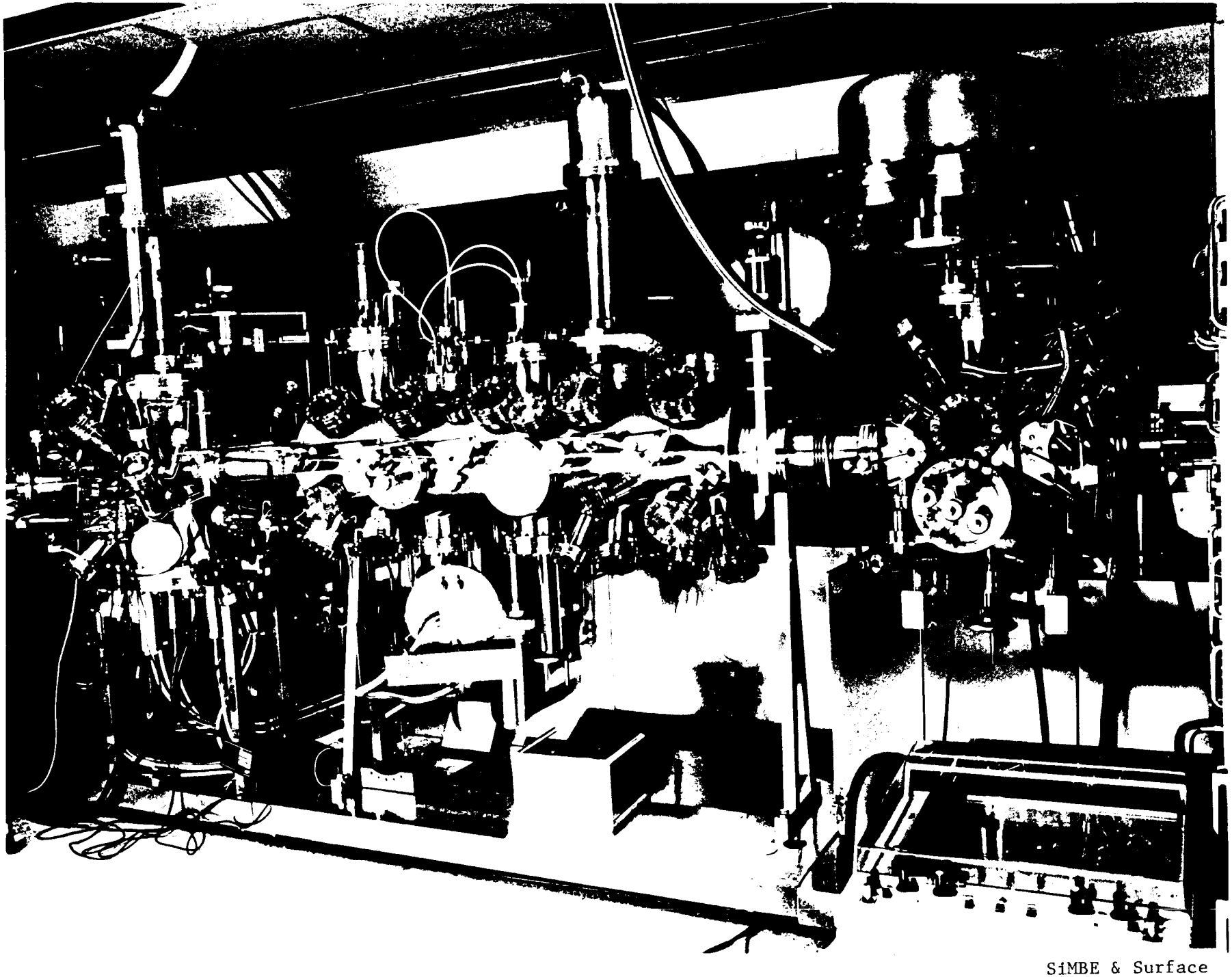
12. It is anticipated that the facility will be used on a daily basis out through FY1997.

13. There are three government research scientists, a government technician, and a on-site contractor research engineer who use the equipment as the primary part of their research program.

14. The primary responsibility for the daily maintenance of the equipment is the government technician. However, the three scientists and the research engineer all take an active role in repairs, non-routine maintenance, and system upgrades.

15. Facility Photo Attached.

16. This facility is not shared with any other function. This facility is unique to DoD since no one else has silicon MBE capability.



SiMBE & Surface
Analysis System

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BRAC-95
DATA CALL #12

Technical Center Site	NRL/ESTD
Facility/Equipment Nomenclature or Title	Vacuum Electronics Engineering Facility

3.4.1 MAJOR EQUIPMENT AND FACILITIES

Vacuum Electronics Branch

1. VACUUM ELECTRONICS ENGINEERING FACILITY...Provides electrical and mechanical design, fabrication, assembly, modification, and repair, as well as processing, services for vacuum electronic devices and maintains support equipment primarily for the tri-Service vacuum electronics research and development program conducted at NRL as the lead laboratory. The facility supports other functions on a not-to-interfere basis. R

DESCRIPTION: The Vacuum Electronics Engineering Facility (VEEF) staff collaborates with Principal Investigators and initiates the experimental device production process based on theoretical design data. VEEF engineers then create assembly and detail parts drawing packages and coordinate a broad spectrum of shop activities to produce unique components. In-house preparation of these specialized components includes heat treatment, surface preparation, micro-cleaning, vacuum firing, and extensive quality assessment. Leak-tight joining of high-purity alloys and refractory metals and ceramics is accomplished using brazing, welding, diffusion bonding, and other specialized processes. Specialized fixtures and jigs are fabricated where required. Completed experimental assemblies are evacuated, baked out, and delivered to the investigator's lab, ready for experimentation. The VEEF is frequently called upon to provide expertise and equipment to perform repair, overhaul, or major modification to an existing experimental or commercially-produced microwave or millimeter-wave vacuum electronic device. VEEF staff also produce drawings and parts as described above, for a "cold" test of experimental circuits, couplers, calorimeters, etc. These tasks frequently include data acquisition and analyses. R

EQUIPMENT: The facility maintains and operates the following pieces of equipment for the fabrication, modification, and repair of vacuum electronic devices.

- Hydrogen Furnace...A permanently installed hydrogen-atmosphere furnace with a working zone volume measuring 10 x 10 x 36 inches, capable of temperatures of up to 1,200 degrees C is used to fire, braze, and clean metals and ceramics during assembly or in preparation for assembly. The building structure, plumbing, and HVAC systems have been extensively modified to accommodate the furnace. R

- High Vacuum Furnace...A high-vacuum furnace utilizing a cryogenically-pumped bell jar 18 inches in diameter, 36 inches high is used for vacuum firing and brazing of experimental UHV tube components and assemblies. R

- Induction Heating System...An industrial RF induction heating system is used for brazing or firing small parts in either hydrogen atmosphere at atmospheric pressure R

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Technical Center Site	NRL/ESTD
Facility/Equipment Nomenclature or Title	Vacuum Electronics Engineering Facility

3.4.1 MAJOR EQUIPMENT AND FACILITIES

Vacuum Electronics Branch

1. VACUUM ELECTRONICS ENGINEERING FACILITY...Provides electrical and mechanical design, fabrication, assembly, modification, and repair, as well as processing, services for vacuum electronic devices and maintains support equipment primarily for the tri-Service vacuum electronics research and development program conducted at NRL as the lead laboratory. The facility supports other functions on a not-to-interfere basis.

DESCRIPTION: The Vacuum Electronics Engineering Facility (VEEF) staff collaborates with Principal Investigators and initiates the experimental device production process based on theoretical design data. VEEF engineers then create assembly and detail parts drawing packages and coordinate a broad spectrum of shop activities to produce unique components. In-house preparation of these specialized components includes heat treatment, surface preparation, micro-cleaning, vacuum firing, and extensive quality assessment. Leak-tight joining of high-purity alloys and refractory metals and ceramics is accomplished using brazing, welding, diffusion bonding, and other specialized processes. Specialized fixtures and jigs are fabricated where required. Completed experimental assemblies are evacuated, baked out, and delivered to the investigator's lab, ready for experimentation. The VEEF is frequently called upon to provide expertise and equipment to perform repair, overhaul, or major modification to an existing experimental or commercially-produced microwave or millimeter-wave vacuum electronic device. VEEF staff also produce drawings and parts as described above, for a "cold" test of experimental circuits, couplers, calorimeters, etc. These tasks frequently include data acquisition and analyses.

EQUIPMENT: The facility maintains and operates the following pieces of equipment for the fabrication, modification, and repair of vacuum electronic devices.

- Hydrogen Furnace...A permanently installed hydrogen-atmosphere furnace with a working zone volume measuring 10 x 10 x 36 inches, capable of temperatures of up to 1,200 degrees C is used to fire, braze, and clean metals and ceramics during assembly or in preparation for assembly. The building structure, plumbing, and HVAC systems have been extensively modified to accommodate the furnace.

- High Vacuum Furnace...A high-vacuum furnace utilizing a cryogenically-pumped bell jar 18 inches in diameter, 36 inches high is used for vacuum firing and brazing of experimental UHV tube components and assemblies.

- Induction Heating System...An industrial RF induction heating system is used for brazing or firing small parts in either hydrogen atmosphere at atmospheric pressure

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Technical Center Site	NRL/ESTD
Facility/Equipment Nomenclature or Title	Vacuum Electronics Design Processing Facility

3.4.1 MAJOR EQUIPMENT AND FACILITIES

Vacuum Electronics Branch

1. VACUUM ELECTRONICS DESIGN PROCESSING FACILITY: Provides mechanical design, construction, repair, and processing services of vacuum electronic devices.

DESCRIPTION: The vacuum electronic processing facility has a core staff of engineers with degrees in physics, electronics, electricity, mechanics, and materials. The staff obtains theoretical design data from the principal investigator of a project in the form of computer printouts, sketches, or discussion notes; makes all assembly and detail parts drawings; has parts made per print then cleans, processes, and assembles the parts. For vacuum tubes, the staff bakes out and evacuates the tube as required, or to the limits dictated by the tube. Repairs and/or modifications to existing devices follow the same format.

EQUIPMENT: The facility maintains and operates the following pieces of equipment for the fabrication, modification, and repair of vacuum electronic devices.

- a hydrogen furnace for firing, brazing, or cleaning metals or ceramics up to 1200 degrees C; the hot zone is about 10 X 10 X 36 inches;

- a high-vacuum system for vacuum brazing or firing metals or ceramics up to 1000 degree C; the Bell Jar is 18 inches in diameter by 36 inches in height;

- an RF induction heating system for brazing or firing small parts in hydrogen or in a vacuum;

- an air oven with inside dimensions of 10 X 10 X 10 inches volume for firing metals or ceramics up to 1000 degrees C;

- a bakeout system for processing electron tubes to 15 feet in length at temperatures up to 500 degrees C;

- two helium leak detectors capable of measuring vacuum leaks as small as 10 E -10 cc/s;

- two gas analyzers capable of detecting masses up to 100 units at partial pressures down to 10 E -13 Tor;

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or in vacuum (partial or high). This system is also used to heat subassemblies locally for precise control of complex components.

- High Vacuum Laboratory /Processing Facility...A high-vacuum bake-out system with capacity to process vacuum electronic devices measuring up to 15 feet in length at temperatures up to 500 degrees C is equipped with gas analyzers for monitoring exhaust gas constituents and helium mass spectrometer leak detectors for locating leak sources. R

- Precision Assembly Facility...A clean-room environment (particle count <200K) is available for the final processing of unassembled parts and for their assembly into vacuum enclosures. This facility is equipped with spot welders (continuously variable between 2 and 100 watts and between 2 and 250 watts), a heliarc welder, two assembly stereo microscopes with variable magnification (X9 to X40), a three-axis high-resolution (1 micron) measurement microscope, and an array of nitrogen-purged humidity-controlled storage chambers for unfinished parts and assemblies. R

2. The facility/equipment is not portable.

3. The replacement value of the facility/equipment is approximately $3.2M.

4. The gross weight of the hydrogen furnace (which is the largest piece of equipment that the facility maintains) is 6000 lbs. with dimensions of approximately 13 feet in length, by 10 feet in height, by 5 feet wide.

5. The hydrogen furnace requires hydrogen at 100 lbs. per hour, nitrogen for purging, and water for cooling.

6. RF shielding is required in the area for hydrogen and RF brazing and heating processes.

7. Clean room environmental conditions (particle count <200K) are required for the processing of piece parts and assemblies.
8. Facility/equipment could be replicated or relocated at another site. The impact to the Department of the Navy, if this facility were lost, would exceed $3.2M.

9. Facility/equipment was transported by truck and was constructed over a period of 5 years.

10. Supports the design, fabrication, and processing of category 11.4 Electron Devices.

11. The historical utilization average for the past five years has been 4.2 **(unique, one-of-a-kind experimental)** vacuum devices per year.

12. Projected utilization data to FY 1997:

	1994	1995	1996	1997
Number of devices	4.0	5.0	5.0	6.0

13. The number of personnel used to operate the facility/equipment is 7.

14. The facility/equipment is maintained under contract.

15. Photo of Hydrogen Furnace is attached.

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or in vacuum (partial or high). This system is also used to heat subassemblies locally for precise control of complex components.

- High Vacuum Laboratory /Processing Facility...A high-vacuum bake-out system with capacity to process vacuum electronic devices measuring up to 15 feet in length at temperatures up to 500 degrees C is equipped with gas analyzers for monitoring exhaust gas constituents and helium mass spectrometer leak detectors for locating leak sources.

- Precision Assembly Facility...A clean-room environment (particle count <200K) is available for the final processing of unassembled parts and for their assembly into vacuum enclosures. This facility is equipped with spot welders (continuously variable between 2 and 100 watts and between 2 and 250 watts), a heliarc welder, two assembly stereo microscopes with variable magnification (X9 to X40), a three-axis high-resolution (1 micron) measurement microscope, and an array of nitrogen-purged humidity-controlled storage chambers for unfinished parts and assemblies.

2. The facility/equipment is not portable.

3. The replacement value of the facility/equipment is approximately $3.2M.

4. The gross weight of the hydrogen furnace (which is the largest piece of equipment that the facility maintains) is 6000 lbs. with dimensions of approximately 13 feet in length, by 10 feet in height, by 5 feet wide.

5. The hydrogen furnace requires hydrogen at 100 lbs. per hour, nitrogen for purging, and water for cooling.

6. RF shielding is required in the area for hydrogen and RF brazing and heating processes.

7. Clean room environmental conditions (particle count <200K) are required for the processing of piece parts and assemblies.

8. Facility/equipment could be replicated or relocated at another site. The impact to the Department of the Navy, if this facility were lost, would exceed $3.2M.

9. Facility/equipment was transported by truck and was constructed over a period of 5 years.

10. Supports the design, fabrication, and processing of category 11.4 Electron Devices.

11. The historical utilization average for the past five years has been 4.2 (**unique, one-of-a-kind experimental**) vacuum devices per year.

12. Projected utilization data to FY 1997:

	1994	1995	1996	1997
Number of devices	4.0	5.0	5.0	6.0

13. The number of personnel used to operate the facility/equipment is 7.

14. The facility/equipment is maintained under contract.

15. Photo of Hydrogen Furnace is attached.

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- two spot welders continuously variable between 2 and 100 watts; or 2 and 250 watts;
- two assembly microscopes with variable magnification
- one three axis high power digital measure microscope;
- one heliarc welder for welding stainless steel;
- three Auto CAD work stations for generation of mechanical designs;
- five vacuum pumps for evacuating vacuum devices;
- three nitrogen/humidity controlled chamber for storage of clean parts/assemblies.

2. The facility/equipment is not portable.

3. The replacement value of the facility/equipment is approximately $3.2 M.

4. The gross weight of the hydrogen furnace (which is the largest piece of equipment that the facility maintains) is 6000 Lbs with dimensions of approximately 13 feet in length, by 10 feet in height , by 5 feet wide.

5. The hydrogen furnace requires hydrogen at 100 Lbs per hour, nitrogen for purging, and water for cooling.

6. RF shielding is required in the area for hydrogen and RF brazing and heating processes

7. Clean room environmental conditions (particle count <200k) are required for the processing of piece parts and assemblies.

8. Facility/equipment could be replicated or relocated at a another site. The impact to the Department of the Navy if this facility were lost, would exceed $3.2 M.

9. Facility /equipment was transported by truck and was constructed over a period of 5 years.

10. Supports the design , fabrication, and processing of category 11.4 Electron Devices.

11. The historical utilization average for the past five years has been 4.2 **(unique, one-of-a-kind experimental)** vacuum devices per year.

12. Projected utilization data to FY 1997:

	1994	1995	1996	1997
No. Devices	4.0	5.0	5.0	6.0

13. The number of personnel used to operate the facility/equipment is 7.

14. The facility/equipment is maintained under contract.

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16. This facility is unique in DoD.; it's ability to handle unique, one-of-a-kind vacuum electronic and UHV devices may be unique in the Federal Government. The VEEF's specialized fabrication and surface treatment capabilities have attracted clientele from among other NRL tenants and from scientists at national labs throughout the country who are involved with high to ultra-high vacuum devices; their requests on handled on a time-available basis, generally not exceeding 10% of VEEF project time. R

R

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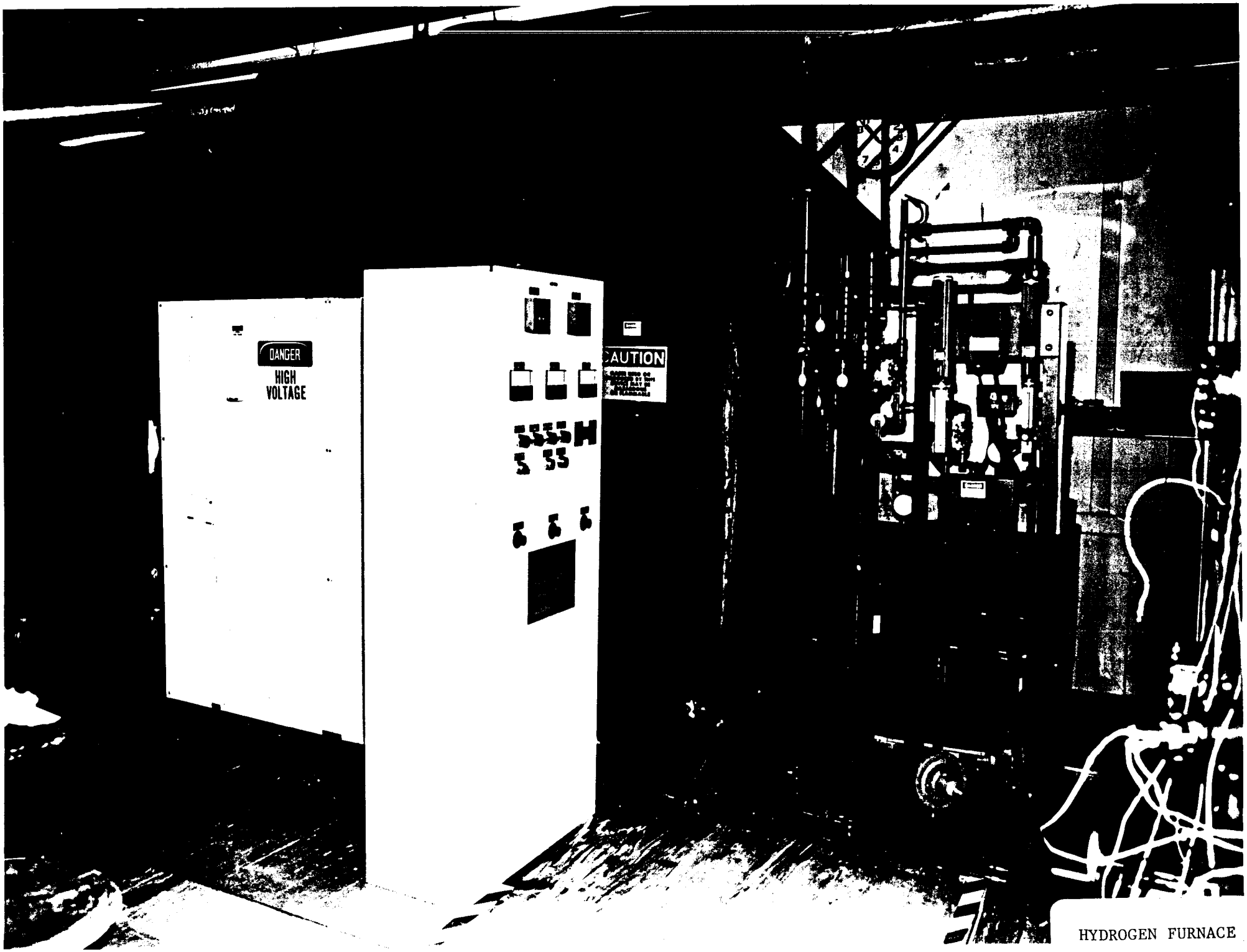
15. Photo of Hydrogen Furnace Attached.

16. This facility is not shared with any other function. This facility is unique because no other facility such as this is available in DoD.



HYDROGEN FURNACE

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BRAC-95
DATA CALL #12

Technical Center Site	NRL/ESTD
Facility/Equipment Nomenclature or Title	III-V MBE Facilities

3.4.1 MAJOR EQUIPMENT AND FACILITIES

Microwave Technology Branch

1. Purpose of Facility/Equipment.
Operates and maintains two Molecular Beam Epitaxy (MBE) systems for the growth of III-V compound semiconductors.

VG (Fisons) V80H:
The first system is a VG (Fisons) V80H system whose purpose is to provide high-quality, uniform, and reproducible Al/In/Ga/As material system with Si or Be doping on wafers up to 3-inches in diameter. This machine has produced material with state-of-the-art optical quality. These materials are used to support research at NRL in: 1) novel electronic and optoelectronic devices; 2) atomic-scale investigation of the effect of growth conditions on the electrical and optical properties of materials and devices; and 3) investigation of new growth techniques for microstructures and three-dimensional structures.

Varian (EPI) 360:
The second system is a Varian (EPI) 360 system whose purpose is to act as an experimental system for the growth of new and/or materials incompatible with high-quality growth of other materials on substrates up to 1-inch in diameter. It is currently used for research in the Al/In/Ga/As/Sb material system with Si, Be and GaTe doping capability.

The purpose of these systems are to support 6800 and NRL research and development programs with: 1) state-of-the-art III-V epitaxial material and 2) the capability to do basic and applied work that advances the state-of-the-art in III-V epitaxial material suitable for electronic, optoelectronic and optical applications. R

The primary user of the facility and its product, external to 6800 is the Optical Science Division, Code 5600. The growth capabilities were not duplicated in the Optical Science Division even thought they have extensive needs for the material. The need has been historically addressed through strongly interactive programs. Currently programs dealing with: 1) optical correlators, 2) fast optical detectors, 3) UV optical detectors and nanostructures are carried out in conjunction with Code 5600. In addition this facility supports a number of other Divisions with material and research. A table of utilization is shown below. R

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BRAC-95
DATA CALL #12

Technical Center Site	NRL/ESTD
Facility/Equipment Nomenclature or Title	III-V MBE Facilities

3.4.1 MAJOR EQUIPMENT AND FACILITIES

Microwave Technology Branch

1. Purpose of Facility/Equipment.
Operates and maintains two Molecular Beam Epitaxy (MBE) systems for the growth of III-V compound semiconductors.

VG (Fisons) V80H:
The first system is a VG (Fisons) V80H system whose purpose is to provide high-quality, uniform, and reproducible Al/In/Ga/As material system with Si or Be doping on wafers up to 3-inches in diameter. This machine has produced material with state-of-the-art optical quality. These materials are used to support research at NRL in: 1) novel electronic and optoelectronic devices; 2) atomic-scale investigation of the effect of growth conditions on the electrical and optical properties of materials and devices; and 3) investigation of new growth techniques for microstructures and three-dimensional structures.

Varian (EPI) 360:
The second system is a Varian (EPI) 360 system whose purpose is to act as an experimental system for the growth of new and/or materials incompatible with high-quality growth of other materials on substrates up to 1-inch in diameter. It is currently used for research in the Al/In/Ga/As/Sb material system with Si, Be and GaTe doping capability.

The purpose of these systems are to support 6800 and NRL research and development programs with: 1) state-of-the-art III-V epitaxial material and 2) the capability to do basic and applied work that advances the state-of-the-art in III-V epitaxial material suitable for electronic, optoelectronic and optical applications.

The primary user of the facility and its product, external to 6800 is the Optical Science Division, Code 5600. The growth capabilities were not duplicated in the Optical Science Division even thought they have extensive needs for the material. The need has been historically addressed through strongly interactive programs. Currently programs dealing with: 1) optical correlators, 2) fast optical detectors, 3) UV optical detectors and nanostructures are carried out in conjunction with Code 5600. In addition this facility supports a number of other Divisions with material and research. A table of utilization is shown below.

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Technical Center Site	NRL/ESTD
Facility/Equipment Nomenclature or Title	III-V MBE Facilities

3.4.1 MAJOR EQUIPMENT AND FACILITIES

Microwave Technology Branch

1. Purpose of Facility/Equipment.
   Operates and maintains two Molecular Beam Epitaxy (MBE) systems for the growth of III-V compound semiconductors.

   VG (Fisons) V80H:
   The first system is a VG (Fisons) V80H system whose purpose is to provide high-quality, uniform, and reproducible Al/In/Ga/As material system with Si or Be doping on wafers up to 3-inches in diameter. This machine has produced material with state-of-the-art optical quality. These materials are used to support research at NRL in: 1) novel electronic and optoelectronic devices; 2) atomic-scale investigation of the effect of growth conditions on the electrical and optical properties of materials and devices; and 3) investigation of new growth techniques for microstructures and three-dimensional structures.

   Varian (EPI) 360:
   The second system is a Varian (EPI) 360 system whose purpose is to act as an experimental system for the growth of new and/or materials incompatible with high-quality growth of other materials on substrates up to 1-inch in diameter. It is currently used for research in the Al/In/Ga/As/Sb material system with Si, Be and GaTe doping capability.

2. Both of these MBE systems are movable (Class 2). However, movement of the systems is extremely difficult due to their size and weight and the requirement that these systems must remain under high-vacuum conditions during movement. These MBE systems are used for the growth of potentially toxic materials (As and Sb compounds), so special safety precautions may be required for their shipment.

3. Replacement value.
   The cost to replace the basic VG (Fisons) V80H system is approximately $750,000. The cost to duplicate the optical substrate temperature measurement system is approximately $15,000. Approximately $5,000 would be required to replace the LN_2 control system, and the water filtration and cooling system. Approximately $50,000 would be needed for replacement spare effusion cells, temperature controllers, and spare parts. Thus, the total replacement cost for our VG (Fisons) V80H MBE system with necessary spares and enhancements would be about $820,000.

User %	6800	5600	Other/NRL	University
of Time	60%	25%	10%	5%

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2. Both of these MBE systems are movable (Class 2). However, movement of the systems is extremely difficult due to their size and weight and the requirement that these systems must remain under high-vacuum conditions during movement. These MBE systems are used for the growth of potentially toxic materials (As and Sb compounds), so special safety precautions may be required for their shipment.

3. Replacement value.
The cost to replace the basic VG (Fisons) V80H system is approximately $750,000. The cost to duplicate the optical substrate temperature measurement system is approximately $15,000. Approximately $5,000 would be required to replace the LN_2 control system, and the water filtration and cooling system. Approximately $50,000 would be needed for replacement spare effusion cells, temperature controllers, and spare parts. Thus, the total replacement cost for our VG (Fisons) V80H MBE system with necessary spares and enhancements would be about $820,000.

The cost of a basic system similar to the Varian (EPI) 360 system is approximately $500,000. The Varian system also includes an Auger electron spectroscopy system, two residual gas analyzers and a data acquisition system which would cost approximately $50,000 to duplicate. Spare effusion cells, spare parts, the LN_2 control system, and the water filtration and cooling system would cost an additional $75,000 to duplicate. Thus, the total replacement cost for our Varian (EPI) 360 system with necessary spares and enhancements would be about $625,000.

4. Gross weight and cubic volume.
The gross weight of the VG (Fisons) V80H system is 4500 pounds. The basic system requires about 1800 cubic feet of space.

The gross weight of the Varian (EPI) 360 is 5000 pounds. The basic system requires about 1500 cubic feet of space.

5. Special Utilities.
The VG (Fisons) V80H system requires 220 V, 3-phase, 60 ampere, electrical service in addition to standard 110 V electricity for instrumentation. In addition, filtered chilled water must be provided to the system continuously to cool the effusion cells. During operation of the system, LN_2 must be provided to the system continuously. Ultra pure de-ionized water must be available in the MBE facility for cleaning substrates prior to growth. The cleaning must be done under fume hoods with HEPA filters to minimize contamination of the cleaned surface. 100 psi dry, filtered compressed air is also required for operation of pneumatic valves and shutter actuactors.

The Varian (EPI) 360 system requires 208 V, single phase electrical service in addition to standard 110V electricity for instrumentation. In addition, filtered chilled water and LN_2 must be provided to the system continuously during operation (typically 10 hours/day). Ultra pure de-ionized water must be available in the MBE facility for cleaning substrates

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User %	6800	5600	Other/NRL	University
of Time	60%	25%	10%	5%

2. Both of these MBE systems are movable (Class 2). However, movement of the systems is extremely difficult due to their size and weight and the requirement that these systems must remain under high-vacuum conditions during movement. These MBE systems are used for the growth of potentially toxic materials (As and Sb compounds), so special safety precautions may be required for their shipment.

3. Replacement value.
The cost to replace the basic VG (Fisons) V80H system is approximately $750,000. The cost to duplicate the optical substrate temperature measurement system is approximately $15,000. Approximately $5,000 would be required to replace the LN_2 control system, and the water filtration and cooling system. Approximately $50,000 would be needed for replacement spare effusion cells, temperature controllers, and spare parts. Thus, the total replacement cost for our VG (Fisons) V80H MBE system with necessary spares and enhancements would be about $820,000.

The cost of a basic system similar to the Varian (EPI) 360 system is approximately $500,000. The Varian system also includes an Auger electron spectroscopy system, two residual gas analyzers and a data acquisition system which would cost approximately $50,000 to duplicate. Spare effusion cells, spare parts, the LN_2 control system, and the water filtration and cooling system would cost an additional $75,000 to duplicate. Thus, the total replacement cost for our Varian (EPI) 360 system with necessary spares and enhancements would be about $625,000.

4. Gross weight and cubic volume.
The gross weight of the VG (Fisons) V80H system is 4500 pounds. The basic system requires about 1800 cubic feet of space.

The gross weight of the Varian (EPI) 360 is 5000 pounds. The basic system requires about 1500 cubic feet of space.

5. Special Utilities.
The VG (Fisons) V80H system requires 220 V, 3-phase, 60 ampere, electrical service in addition to standard 110 V electricity for instrumentation. In addition, filtered chilled water must be provided to the system continuously to cool the effusion cells. During operation of the system, LN_2 must be provided to the system continuously. Ultra pure de-ionized water must be available in the MBE facility for cleaning substrates prior to growth. The cleaning must be done under fume hoods with HEPA filters to minimize contamination of the cleaned surface. 100 psi dry, filtered compressed air is also required for operation of pneumatic valves and shutter actuactors.

The Varian (EPI) 360 system requires 208 V, single phase electrical service in addition to standard 110V electricity for instrumentation. In addition, filtered chilled water and LN_2 must be provided to the system continuously during operation (typically 10 hours/day). Ultra pure de-ionized water must be available in the MBE facility for cleaning substrates

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prior to growth. The cleaning must be done under fume hoods with HEPA filters to minimize contamination of the cleaned surface. 100 psi dry, filtered compressed air is also required for operation of pneumatic valves and shutter actuactors.

6. Special budget requirements.
The site for the MBE facility must be clean, have reliable electrical, water, and LN_2 utilities, and have HEPA filtered fume hoods and clean benches available for substrate preparation and system maintenance.

7. Environmental control requirements.
A proper HEPA filtered fume hood must be available in the facility for substrate preparation. Standard temperature and humidity constraints appropriate for electronic equipment must be met.

8. Impact of facility loss.
The VG (Fisons) V80H system and the Varian (EPI) 360 systems would both be extremely difficult to replicate or relocate due to their high cost of replacement, the difficulty in safely moving such large and heavy stainless-steel systems (e.g. the VG system was damaged in transit from the factory), and the extreme difficulty in duplicating the knowledge of the operating characteristics of the systems without extensive retraining and recalibration of the systems. If the systems were to be moved, at least 2 man-years would be required to make them fully operational and as reproducible as they are in their current configuration. There is a broad and ongoing synergy between the MBE scientists and engineers in Codes 6850, 6870, and 6810. This synergy has led to our groups being much more productive than we would be without the collaboration created by interactions between our groups and systems. The Division and the Navy would be very well served by keeping our existing MBE facilities in place in the Division. The loss of these facilities would be a great blow to the capabilities and productivity of the researchers in the Division and to a variety of electronic and optoelectronic device programs of importance to the Navy. The type of research and development done on these systems cannot reasonably be duplicated by other facilities or through the use of outside agencies. The research and development in the Division on semiconductor devices and semiconductor physics requires stringent correlation between the properties of the grown material and the measured characteristics. It is this type of synergism between basic research and development which makes NRL of unique importance to the DOD. Due to the fact that every MBE system is slightly different, unless there is a long history of understanding the characteristics of the machine, it is difficult or impossible to truly understand and correlate the material and electrical/optical properties measured. This historical data can only be obtained through in-house facilities.

9. Facility construction.
The VG (Fisons) V80H system was shipped via air freight from the factory in England and assembled and tested by VG personnel. The Varian (EPI) system was similarly transported and assembled.

10. Areas of functional support: Category 11.4 Electronic Devices.

11. Historical use average.
The VG (Fisons) V80H system has been used to grow 1166 samples since it was installed in January 1987. From October 1988 - October 1993, the system was used to grow 864 samples or averaged 14.4 samples per month. A "sample" in this case is one or more semiconductor layers deposited by MBE on an individual GaAs substrate. The

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prior to growth. The cleaning must be done under fume hoods with HEPA filters to minimize contamination of the cleaned surface. 100 psi dry, filtered compressed air is also required for operation of pneumatic valves and shutter actuactors.

6. Special budget requirements.
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7. Environmental control requirements.
A proper HEPA filtered fume hood must be available in the facility for substrate preparation. Standard temperature and humidity constraints appropriate for electronic equipment must be met.

8. Impact of facility loss.
The VG (Fisons) V80H system and the Varian (EPI) 360 systems would both be extremely difficult to replicate or relocate due to their high cost of replacement, the difficulty in safely moving such large and heavy stainless-steel systems (e.g. the VG system was damaged in transit from the factory), and the extreme difficulty in duplicating the knowledge of the operating characteristics of the systems without extensive retraining and recalibration of the systems. If the systems were to be moved, at least 2 man-years would be required to make them fully operational and as reproducible as they are in their current configuration. There is a broad and ongoing synergy between the MBE scientists and engineers in Codes 6850, 6870, and 6810. This synergy has led to our groups being much more productive than we would be without the collaboration created by interactions between our groups and systems. The Division and the Navy would be very well served by keeping our existing MBE facilities in place in the Division. The loss of these facilities would be a great blow to the capabilities and productivity of the researchers in the Division and to a variety of electronic and optoelectronic device programs of importance to the Navy. The type of research and development done on these systems cannot reasonably be duplicated by other facilities or through the use of outside agencies. The research and development in the Division on semiconductor devices and semiconductor physics requires stringent correlation between the properties of the grown material and the measured characteristics. It is this type of synergism between basic research and development which makes NRL of unique importance to the DOD. Due to the fact that every MBE system is slightly different, unless there is a long history of understanding the characteristics of the machine, it is difficult or impossible to truly understand and correlate the material and electrical/optical properties measured. This historical data can only be obtained through in-house facilities.

9. Facility construction.
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10. Areas of functional support: Category 11.4 Electronic Devices.

11. Historical use average.
The VG (Fisons) V80H system has been used to grow 1166 samples since it was installed in January 1987. From October 1988 - October 1993, the system was used to grow 864 samples or averaged 14.4 samples per month. A "sample" in this case is one or more semiconductor layers deposited by MBE on an individual GaAs substrate. The

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deposition time for each sample varies between 1 and 10+ hours, depending on the complexity of the structure.

The Varian (EPI) 360 system has been used to grow nearly 1900 samples since it was installed at NRL. From October 1988 - October 1993, the system was used to grow 783 samples or averaged 13.0 samples per month.

12. Projected use to FY 1997.
We expect these system to continue to increase in productivity due to improvements in the reliability and reproducibility of the systems and due to increased understanding of them on our part. Averaging close to 20 samples per month should be possible with these machines.

13. Personnel used to operate the equipment.
Both the VG (Fisons) V80H system and the Varian (EPI) 360 systems currently have one principal operator each. Another engineer (Bijan Tadayon) does occasional work on both machines. Thus a reasonable estimate is that each machine is currently requiring 1.25 man-years for their operation.

14. Personnel used to maintain the equipment.
Each of the 6856 MBE systems is currently maintained by their primary operator.

15. Facility Photo Attached.

16. This facility is not shared with any other function.

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deposition time for each sample varies between 1 and 10+ hours, depending on the complexity of the structure.

The Varian (EPI) 360 system has been used to grow nearly 1900 samples since it was installed at NRL. From October 1988 - October 1993, the system was used to grow 783 samples or averaged 13.0 samples per month.

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14. Personnel used to maintain the equipment.
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15. Facility Photo Attached.

16. This facility is not shared with any other function.

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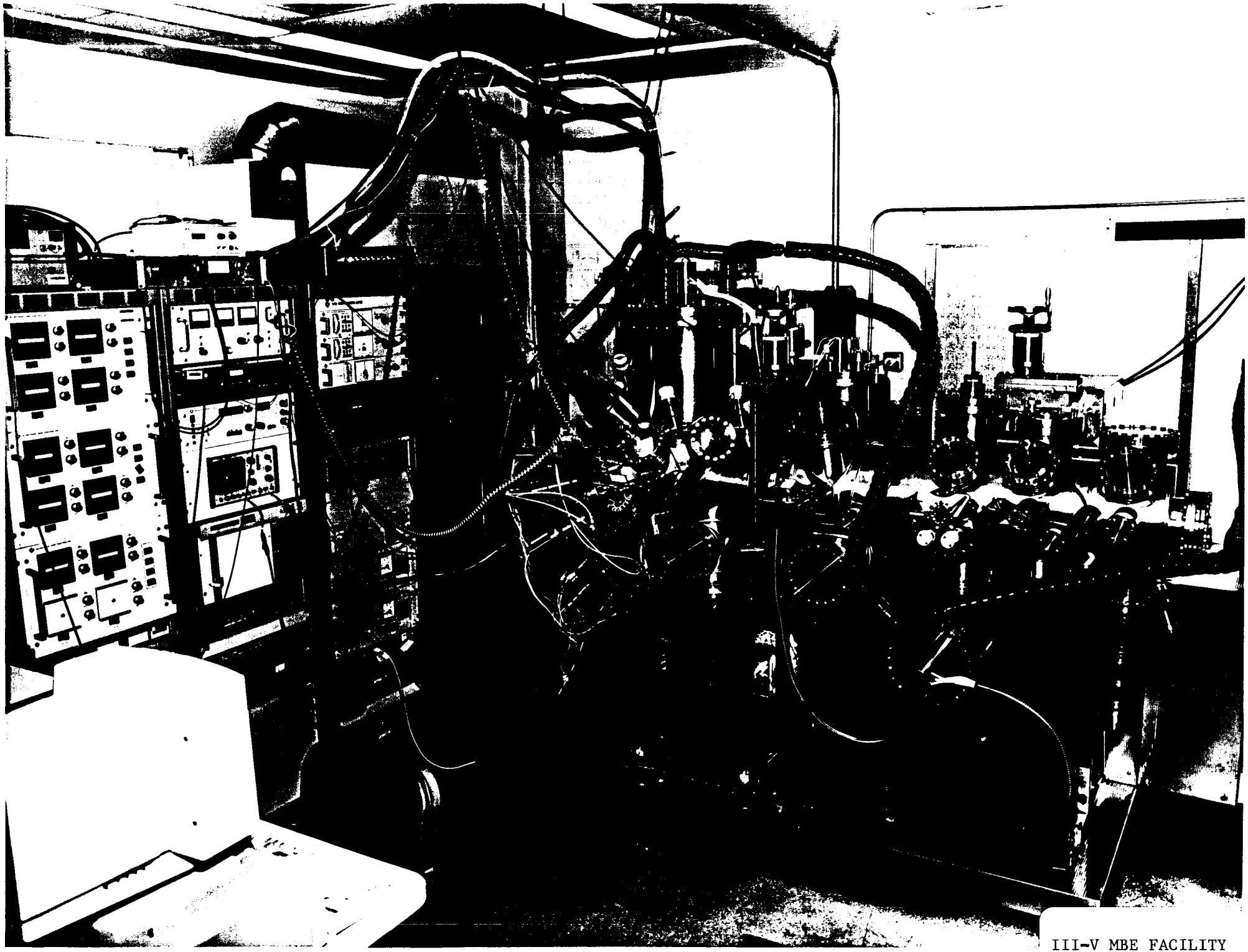

III-V MBE FACILITY

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DATA CALL #12

Technical Center Site	NRL/ESTD
Facility/Equipment Nomenclature or Title	Surface and Interface Science Facility

3.4.1 MAJOR EQUIPMENT AND FACILITIES

Surface and Interface Sciences Branch

1. The Surface and Interface Science Laboratory performs measurements in ultra-high vacuum on the structural, chemical, and electronic properties of specially cleaned or prepared surfaces and interfaces. Among the techniques utilized are low energy electron diffraction, Auger and energy loss spectroscopy, and photoemission spectroscopy. Materials investigated include samples grown in other facilities, as well as films deposited in-situ.

2. Equipment is movable.

3. Replacement Value: $1.2M

4. Gross Weight: Approx. 8000 lbs. Gross Cubage: 5000 cu. ft.

5. Facility requires filtered cooling water and 208 Volt 40 Amp electrical service.

6. None.

7. None.

8. The facility could be replicated or relocated. Relocation would require extreme care to avoid damage to delicate instrumentation. This facility supports programs of materials growth and device fabrication.

9. Equipment acquired during period 1980 to 1994.

10. The Surface and Interface Science Laboratory supports areas 11.4 Electronics Devices and 11.5 Materials and Processes.

11. Average recent utilization was 6WY.

12. Utilization is expected to be 5WY per year for FY94 - FY97.

13. 5 people are required to operate the equipment.

14. No dedicated maintenance personnel are required.

15. Facility Photo Attached.

16. This facility is not shared with any other function.

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DATA CALL #12

Technical Center Site	NRL/ESTD
Facility/Equipment Nomenclature or Title	Surface and Interface Science Facility

3.4.1 MAJOR EQUIPMENT AND FACILITIES

Surface and Interface Sciences Branch

1. The Surface and Interface Science Laboratory performs measurements in ultra-high vacuum on the structural, chemical, and electronic properties of specially cleaned or prepared surfaces and interfaces. Among the techniques utilized are low energy electron diffraction, Auger and energy loss spectroscopy, and photoemission spectroscopy. Materials investigated include samples grown in other facilities, as well as films deposited in-situ.

2. Equipment is movable.

3. Replacement Value: $1.2M

4. Gross Weight: Approx. 8000 lbs. Gross Cubage: 5000 cu. ft.

5. Facility requires filtered cooling water and 208 Volt 40 Amp electrical service.

6. None.

7. None.

8. The facility could be replicated or relocated. Relocation would require extreme care to avoid damage to delicate instrumentation. This facility supports programs of materials growth and device fabrication.

9. Equipment acquired during period 1980 to 1994.

10. The Surface and Interface Science Laboratory supports areas 11.4 Electronics Devices and 11.5 Materials and Processes.

11. Average recent utilization was 6WY.

12. Utilization is expected to be 5WY per year for FY94 - FY97.

13. 5 people are required to operate the equipment.

14. No dedicated maintenance personnel are required.

15. Facility Photo Attached.

16. This facility is not shared with any other function.

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BRAC-95
DATA CALL #12

Technical Center Site	NRL/ESTD
Facility/Equipment Nomenclature or Title	Surface and Interface Science Facility

3.4.1 MAJOR EQUIPMENT AND FACILITIES

Surface and Interface Sciences Branch

1. The Surface and Interface Science Laboratory performs measurements in ultra-high vacuum on the structural, chemical, and electronic properties of specially cleaned or prepared surfaces and interfaces. Among the techniques utilized are low energy electron diffraction, Auger and energy loss spectroscopy, and photoemission spectroscopy. Materials investigated include samples grown in other facilities, as well as films deposited in-situ.

2. Equipment is movable.

3. Replacement Value: $1.2M

4. Gross Weight: Approx. 8000 lbs. Gross Cubage: 5000 cu. ft.

5. Facility requires filtered cooling water and 208 Volt 40 Amp electrical service.

6. None.

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9. Equipment acquired during period 1980 to 1994.

10. The Surface and Interface Science Laboratory supports areas 11.4 Electronics Devices and 11.5 Materials and Processes.

11. Average recent utilization was 6WY.

12. Utilization is expected to be 5WY per year for FY94 - FY97.

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14. No dedicated maintenance personnel are required.

15. Facility Photo Attached.

16. This facility is not shared with any other function.

current configuration. There is a broad and ongoing synergy between the MBE scientists and engineers in Codes 6850, 6870, and 6810. This synergy has led to our groups being much more productive than we would be without the collaboration created by interactions between our groups and systems. The Division and the Navy would be very well served by keeping our existing MBE facilities in place in the Division. The loss of these facilities would be a great blow to the capabilities and productivity of the researchers in the Division and to a variety of electronic and optoelectronic device programs of importance to the Navy. The type of research and development done on these systems cannot reasonably be duplicated by other facilities or through the use of outside agencies. The research and development in the Division on semiconductor devices and semiconductor physics requires stringent correlation between the properties of the grown material and the measured characteristics. It is this type of synergism between basic research and development which makes NRL of unique importance to the DOD. Due to the fact that every MBE system is slightly different, unless there is a long history of understanding the characteristics of the machine, it is difficult or impossible to truly understand and correlate the material and electrical/optical properties measured. This historical data can only be obtained through in-house facilities.

9. Facility construction.
The VG (Fisons) V80H system was shipped via air freight from the factory in England and assembled and tested by VG personnel. The Varian (EPI) system was similarly transported and assembled.

10. Areas of functional support: Category 11.4 Electronic Devices.

11. Historical use average.
The VG (Fisons) V80H system has been used to grow 1166 samples since it was installed in January 1987. From October 1988 - October 1993, the system was used to grow 864 samples or averaged 14.4 samples per month. A "sample" in this case is one or more semiconductor layers deposited by MBE on an individual GaAs substrate. The deposition time for each sample varies between 1 and 10+ hours, depending on the complexity of the structure.

The Varian (EPI) 360 system has been used to grow nearly 1900 samples since it was installed at NRL. From October 1988 - October 1993, the system was used to grow 783 samples or averaged 13.0 samples per month.

12. Projected use to FY 1997.
We expect these system to continue to increase in productivity due to improvements in the reliability and reproducibility of the systems and due to increased understanding of them on our part. Averaging close to 20 samples per month should be possible with these machines.

13. Personnel used to operate the equipment.
Both the VG (Fisons) V80H system and the Varian (EPI) 360 systems currently have one principal operator each. Another engineer (Bijan Tadayon) does occasional work on both machines. Thus a reasonable estimate is that each machine is currently requiring 1.25 man-years for their operation.

14. Personnel used to maintain the equipment.
Each of the 6856 MBE systems is currently maintained by their primary operator.

15. Facility Photo Attached.

16. This facility is not shared with any other function.

The cost of a basic system similar to the Varian (EPI) 360 system is approximately $500,000. The Varian system also includes an Auger electron spectroscopy system, two residual gas analyzers and a data acquisition system which would cost approximately $50,000 to duplicate. Spare effusion cells, spare parts, the LN_2 control system, and the water filtration and cooling system would cost an additional $75,000 to duplicate. Thus, the total replacement cost for our Varian (EPI) 360 system with necessary spares and enhancements would be about $625,000.

4. Gross weight and cubic volume.
The gross weight of the VG (Fisons) V80H system is 4500 pounds. The basic system requires about 1800 cubic feet of space.

The gross weight of the Varian (EPI) 360 is 5000 pounds. The basic system requires about 1500 cubic feet of space.

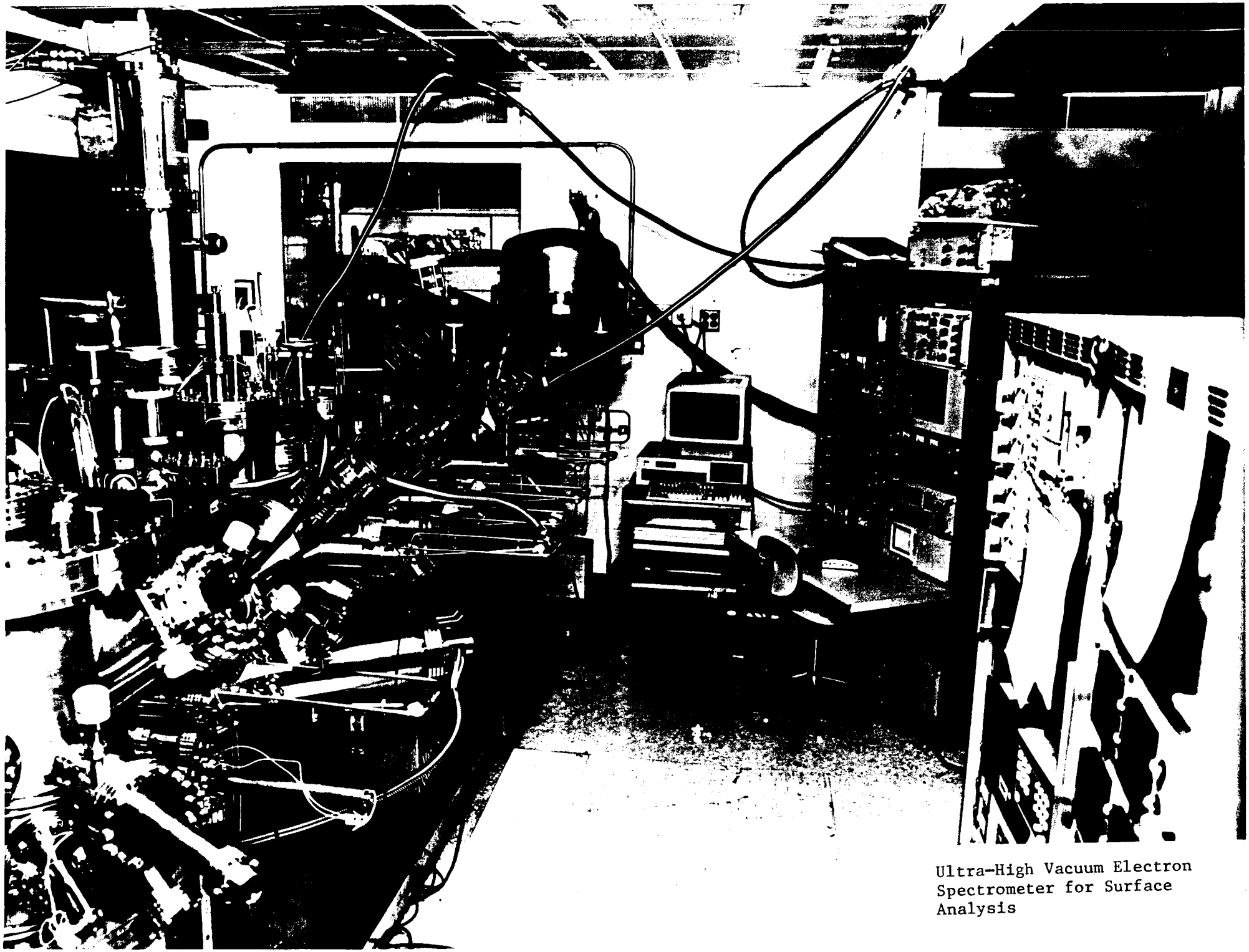
5. Special Utilities.
The VG (Fisons) V80H system requires 220 V, 3-phase, 60 ampere, electrical service in addition to standard 110 V electricity for instrumentation. In addition, filtered chilled water must be provided to the system continuously to cool the effusion cells. During operation of the system, LN_2 must be provided to the system continuously. Ultra pure de-ionized water must be available in the MBE facility for cleaning substrates prior to growth. The cleaning must be done under fume hoods with HEPA filters to minimize contamination of the cleaned surface. 100 psi dry, filtered compressed air is also required for operation of pneumatic valves and shutter actuactors.

The Varian (EPI) 360 system requires 208 V, single phase electrical service in addition to standard 110V electricity for instrumentation. In addition, filtered chilled water and LN_2 must be provided to the system continuously during operation (typically 10 hours/day). Ultra pure de-ionized water must be available in the MBE facility for cleaning substrates prior to growth. The cleaning must be done under fume hoods with HEPA filters to minimize contamination of the cleaned surface. 100 psi dry, filtered compressed air is also required for operation of pneumatic valves and shutter actuactors.

6. Special budget requirements.
The site for the MBE facility must be clean, have reliable electrical, water, and LN_2 utilities, and have HEPA filtered fume hoods and clean benches available for substrate preparation and system maintenance.

7. Environmental control requirements.
A proper HEPA filtered fume hood must be available in the facility for substrate preparation. Standard temperature and humidity constraints appropriate for electronic equipment must be met.

8. Impact of facility loss.
The VG (Fisons) V80H system and the Varian (EPI) 360 systems would both be extremely difficult to replicate or relocate due to their high cost of replacement, the difficulty in safely moving such large and heavy stainless-steel systems (e.g. the VG system was damaged in transit from the factory), and the extreme difficulty in duplicating the knowledge of the operating characteristics of the systems without extensive retraining and recalibration of the systems. If the systems were to be moved, at least 2 man-years would be required to make them fully operational and as reproducible as they are in their



Ultra-High Vacuum Electron Spectrometer for Surface Analysis

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BRAC-95
DATA CALL #12

Technical Center Site	NRL/ESTD
Facility/Equipment Nomenclature or Title	Organometallic VPE

3.4.1 MAJOR EQUIPMENT AND FACILITIES

Surface and Interface Sciences Branch

1. Primary Purpose: The equipment is used to fabricate thin epitaxial layers of semiconductors used in fundamental and applied studies of new materials and device concepts.

2. Portability: The equipment is not portable.

3. Replacement value of facility/equipment: $2.4 M

4. Gross weight and cube: 6000 lbs, 1500 cubic feet.

5. Special utility support: Back up diesel generator, toxic gas scrubbers, integrated safety system, DI water, hydrogen , nitrogen, and air lines, water chiller, acid neutralization tank, and one pass HVAC system.

6. Special budget requirements: Operating budget for facility (solvents, gases, safety consumables, etc..), hydride and organometallic sources for research.

7. Environmental control requirements: Integrated safety system for handling highly toxic gases and hydrogen, real-time toxic gas scrubbers, hoods and fans for exhaust, stainless steel ductwork throughout, one pass HVAC.

8. Relocation: Extremely difficult, would require special site preparation, dismantling of building walls to move equipment, manufacturer support for moving equipment, purchasing of similar equipment that could not be moved because it is delicate and/or to sensitive. No other facilities government wide that could be utilized. Commercial capabilities extremely limit and not amenable to facility/section mission.

9. Indicate how and when equipment was transported or constructed: One piece of equipment was transported to site after removal of wall in 2/92. Other equipment constructed on-site from existing and purchased parts during 1992 and 1993.

10. Functional support areas: Electronic Devices 11.4 and Materials 11.5

11. Historical utilization average for last 5 FY. Used every work day since facility and equipment came on line, mid 1992 for the first piece of equipment.

12. Projected utilization: Same as historical, every work day.

13. Number of personnel: 5

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DATA CALL #12

Technical Center Site	NRL/ESTD
Facility/Equipment Nomenclature or Title	Organometallic VPE

3.4.1 MAJOR EQUIPMENT AND FACILITIES

Surface and Interface Sciences Branch

1. Primary Purpose: The equipment is used to fabricate thin epitaxial layers of semiconductors used in fundamental and applied studies of new materials and device concepts.

2. Portability: The equipment is not portable.

3. Replacement value of facility/equipment: $2.4 M

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8. Relocation: Extremely difficult, would require special site preparation, dismantling of building walls to move equipment, manufacturer support for moving equipment, purchasing of similar equipment that could not be moved because it is delicate and/or to sensitive. No other facilities government wide that could be utilized. Commercial capabilities extremely limit and not amenable to facility/section mission.

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10. Functional support areas: Electronic Devices 11.4 and Materials 11.5

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12. Projected utilization: Same as historical, every work day.

13. Number of personnel: 5

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14. Number to maintain: 5

15. Facility Photos Attached.

16. This facility is not shared with any other function. Others may have this capability but this particular facility is unique because of special safety capabilities needed to use the equipment. Therefore, it is unique to DoD.

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14. Number to maintain: 5

15. Facility Photos Attached.

16. This facility is not shared with any other function. Others may have this capability but this particular facility is unique because of special safety capabilities needed to use the equipment. Therefore, it is unique to DoD.

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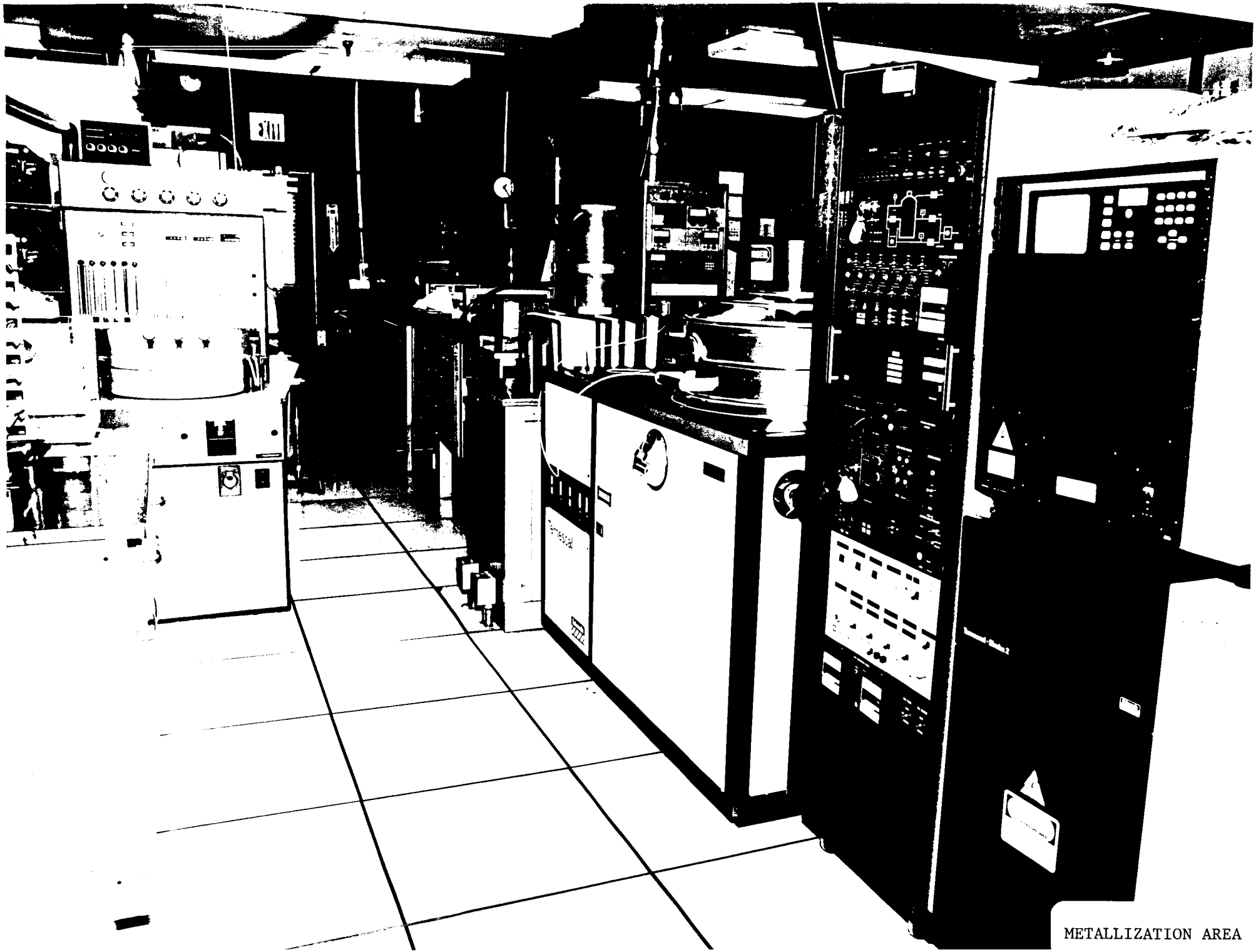

METALLIZATION AREA

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BRAC-95
DATA CALL #12

Technical Center Site	NRL/ESTD
Facility/Equipment Nomenclature or Title	Optical Characterization Facility

3.4.1 MAJOR EQUIPMENT AND FACILITIES

Surface and Interface Sciences Branch

1. The Optical Characterization Facility utilizes visible and infrared spectroscopy to provide information on materials properties and processing. Instrumentation includes Ar ion and Ti sapphire lasers, and Fourier Transform Infrared Spectroscopy. The latter is coupled with a processing chamber and ultra high vacuum chamber to provide information on film deposition, etching, and other chemical processing.

2. Equipment is movable.

3. Replacement Value: $670K

4. Gross Weight: 1500 lbs. Gross Cubage: 6000 cu. ft.

5. Facility requires gaseous nitrogen, liquid helium, and cooling water.

6. None.

7. None.

8. This facility could be replicated or relocated. Delicate optical components require special care for transportation. Other facilities concerned with materials characterization and processing require timely feedback from this facility.

9. Equipment for this facility was acquired over the time period 1984 to 1994.

10. The Optical Characterization Facility supports areas 11.4 Electronics Devices and 11.5 Materials and Processes.

11. Average utilization from FY89 to FY93 was 5 WY per year.

12. Utilization is expected to be 5 WY per year for FY94 - FY97.

13. 3 people are required to operate the equipment.

14. No dedicated maintenance personnel are required.

15. Facility Photo Attached.

16. This facility is not shared with any other function.

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BRAC-95
DATA CALL #12

Technical Center Site	NRL/ESTD
Facility/Equipment Nomenclature or Title	Optical Characterization Facility

3.4.1 MAJOR EQUIPMENT AND FACILITIES

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5. Facility requires gaseous nitrogen, liquid helium, and cooling water.

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12. Utilization is expected to be 5 WY per year for FY94 - FY97.

13. 3 people are required to operate the equipment.

14. No dedicated maintenance personnel are required.

15. Facility Photo Attached.

16. This facility is not shared with any other function.

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8/19/94

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BRAC-95
DATA CALL #12

Technical Center Site	NRL/ESTD
Facility/Equipment Nomenclature or Title	Electronic Properties Facility

3.4.1 MAJOR EQUIPMENT AND FACILITIES

Electronic Materials Branch

1. The Electronic Properties Facility provides detailed measurements of: a.) electron and hole transport in semiconductor materials and structures using variable-temperature resistivity and Hall effect measurements; b.) bulk and interface trap densities and energies using DLTS; and c.) surface structure, morphology , and electronic density of surface states of semiconductors, metals, insulators, and heterostructures using ambient STM/AFM and low-temperature STM. These measurements are crucial to the evaluation of materials grown and processed in other facilities. In addition, the ambient STM/AFM is crucial for the exploratory research in new approaches to nanometer-scale and atomic-scale lithography, processing, and device fabrication.

2. Equipment is movable.

3. Replacement value: $725K

4. Gross Weight: 6500 lbs. Gross Cubage: 7600 cu. ft.

5. Facility requires good vibration isolation,including fully-floating isolation table, gaseous and liquid nitrogen, 2000 W power, high pressure nitrogen gas line, gaseous and liquid helium, 208 Volt 40 Amp electrical service. Plans exist to add gaseous hydrogen, chlorine, and fluorine (including vent and detection systems) to the low-temperature system for advanced surface chemistry studies.

6. None.

7. Temperature and humidity stability required to maintain acceptable operating environment for electronics. Vibration-free environment required for STM/AFM.

8. This equipment is unique. Few STM/AFMs have a 130 μm scan field (essential for nanolithography) and virtually no other STMs have low-temperature capability combined with an 8 μm scan field. A move away from NRL would severely impact on Navy electronics R&D because the diagnostic equipment in the electronics properties laboratory is essential for assessment of materials quality and for basic research on electronic materials. In addition, the ambient STM/AFM is essential to the nanometer and atomic scale lithographic research removal of this equipment would bring this research to a complete halt.

9. Equipment was acquired from 1985 - present.

10. The Electronic Properties Facility supports areas 11.4 Electronic Devices and 11.5 Materials and Processes.

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DATA CALL #12

Technical Center Site	NRL/ESTD
Facility/Equipment Nomenclature or Title	Electronic Properties Facility

3.4.1 MAJOR EQUIPMENT AND FACILITIES

Electronic Materials Branch

1. The Electronic Properties Facility provides detailed measurements of: a.) electron and hole transport in semiconductor materials and structures using variable-temperature resistivity and Hall effect measurements; b.) bulk and interface trap densities and energies using DLTS; and c.) surface structure, morphology , and electronic density of surface states of semiconductors, metals, insulators, and heterostructures using ambient STM/AFM and low-temperature STM. These measurements are crucial to the evaluation of materials grown and processed in other facilities. In addition, the ambient STM/AFM is crucial for the exploratory research in new approaches to nanometer-scale and atomic-scale lithography, processing, and device fabrication.

2. Equipment is movable.

3. Replacement value: $725K

4. Gross Weight: 6500 lbs. Gross Cubage: 7600 cu. ft.

5. Facility requires good vibration isolation,including fully-floating isolation table, gaseous and liquid nitrogen, 2000 W power, high pressure nitrogen gas line, gaseous and liquid helium, 208 Volt 40 Amp electrical service. Plans exist to add gaseous hydrogen, chlorine, and fluorine (including vent and detection systems) to the low-temperature system for advanced surface chemistry studies.

6. None.

7. Temperature and humidity stability required to maintain acceptable operating environment for electronics. Vibration-free environment required for STM/AFM.

8. This equipment is unique. Few STM/AFMs have a 130 µm scan field (essential for nanolithography) and virtually no other STMs have low-temperature capability combined with an 8 µm scan field. A move away from NRL would severely impact on Navy electronics R&D because the diagnostic equipment in the electronics properties laboratory is essential for assessment of materials quality and for basic research on electronic materials. In addition, the ambient STM/AFM is essential to the nanometer and atomic scale lithographic research, removal of this equipment would bring this research to a complete halt.

9. Equipment was acquired from 1985 - present.

10. The Electronic Properties Facility supports areas 11.4 Electronic Devices and 11.5 Materials and Processes.

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11. Average utilization from FY89 to FY93 was 6 WY per year.

12. Utilization is expected to be 6 WY per year for FY94 - FY97.

13. 6 people are required to operate the equipment.

14. No dedicated maintenance personnel are required.

15. Facility Photo Attached.

16. This facility is not shared with any other function. The facility is used to characterize semiconductors by other NRL divisions (Condensed Matter and Radiation Sciences Division (10%) and Optical Sciences Division (5%)) in support of electronic and electro-optic device programs. R

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11. Average utilization from FY89 to FY93 was 6 WY per year.

12. Utilization is expected to be 6 WY per year for FY94 - FY97.

13. 6 people are required to operate the equipment.

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15. Facility Photo Attached.

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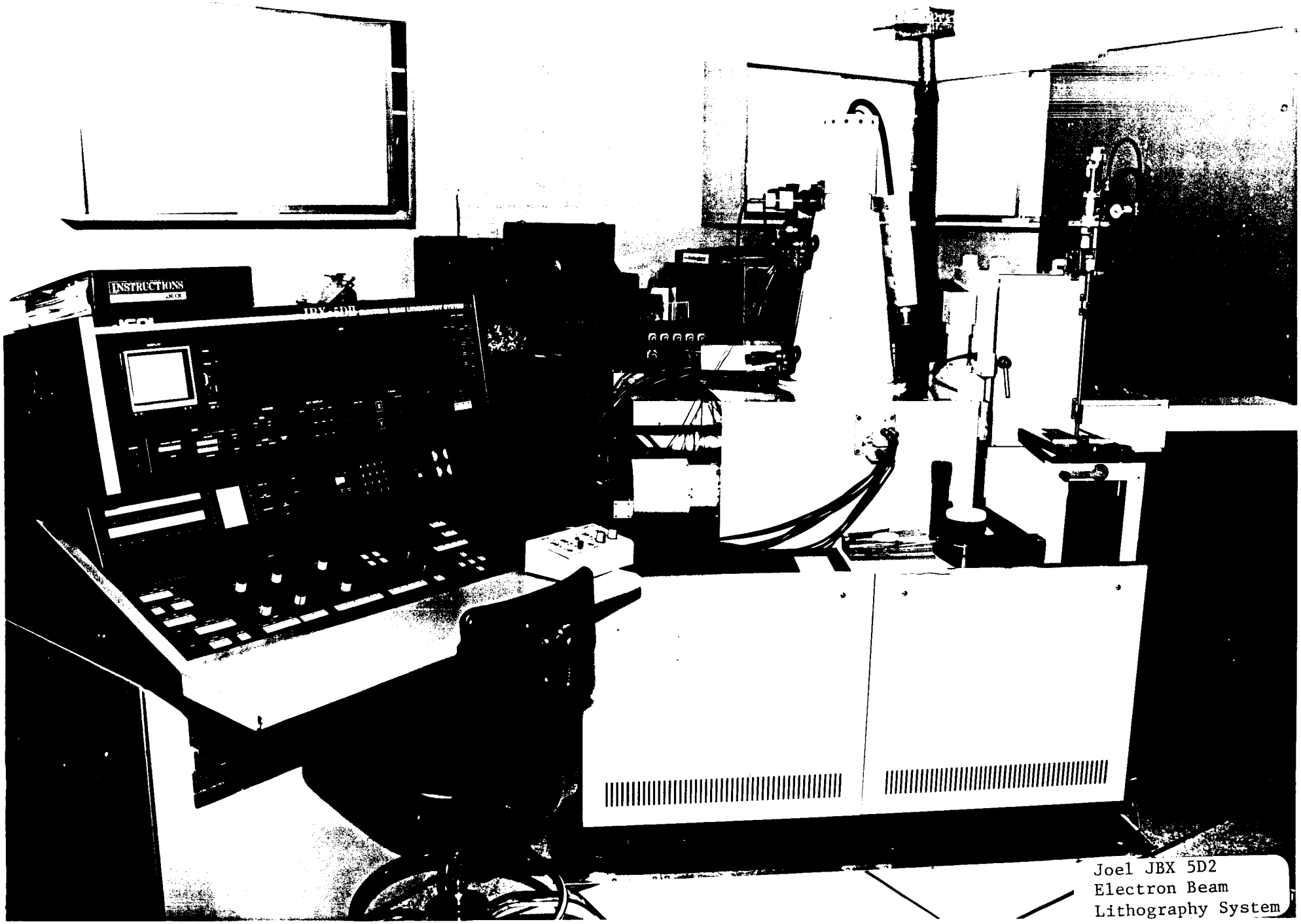

Joel JBX 5D2
Electron Beam
Lithography System

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DATA CALL #12

Technical Center Site	NRL/ESTD
Facility/Equipment Nomenclature or Title	EPICENTER Facility

3.4.1 MAJOR EQUIPMENT AND FACILITIES

The EPICENTER: A facility for the molecular beam epitaxial growth and characterization of compound semiconductor materials and structures

(This facility is a shared initiative of the Electronics Science and Technology, Materials Science and Technology and Chemistry Division.)

Electronic Materials Branch

1. The facility is dedicated to the growth and physical characterization of both III-V and II-VI semiconductors and selected metal films. In addition to two growth chambers, the facility allows in vacuo transfer from either growth chamber to two analysis chambers; one for scanning tunneling microscopy and the other for angle-resolved electron spectroscopy. While both growth chambers are of commercial design (Riber Model 32P), the analysis chambers are of custom design and commercial manufacture. The focus of effort in III-V film and superlattice growth is on the GaSb, AlSb, and InAs semiconductor family. The focus of effort in II-VI film and superlattice growth is on the diluted magnetic semiconductors MnxZn1-xSe and FexZn1-xSe.

2. The facility is moveable (Class 2). However, moving is complicated by the requirement that the various components be maintained under high vacuum conditions during movement. Since a variety of potentially toxic substances have been used inside the chambers, special safety precautions may be mandatory for shipment.

3. The replacement value is $3M. (Exclusive of site preparation.)

4. Gross weight: 15,000 lbs. Gross cubage: 2,000 cubic feet.

5. Utility support: Filtered water delivery and drain system. Liquid nitrogen supply and exhaust system. (Either through bulk storage container or on-site liquifaction with peak demand capability of at least 10 gallon/hour. Insulated delivery lines from source to facility.) At least 120 kw of 3 phase, 225 volt electrical power for bake-out shrouds and growth chamber electronic systems. Vacuum exhaust system. Dry nitrogen purge gas. Ultra-pure deionized water for substrate processing. Fume hood with HEPA filters to minimize surface contamination during substrate processing. Pressurized (70 psi) nitrogen or clean, dry air to operate pneumatic valves.

6. Special budget requirements: The facility must be installed on a stable, low vibration floor in order to operate the scanning tunneling microscope which is vibration-sensitive.

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Technical Center Site	NRL/ESTD
Facility/Equipment Nomenclature or Title	EPICENTER Facility

3.4.1 MAJOR EQUIPMENT AND FACILITIES

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2. The facility is moveable (Class 2). However, moving is complicated by the requirement that the various components be maintained under high vacuum conditions during movement. Since a variety of potentially toxic substances have been used inside the chambers, special safety precautions may be mandatory for shipment.

3. The replacement value is $3M. (Exclusive of site preparation.)

4. Gross weight: 15,000 lbs. Gross cubage: 2,000 cubic feet.

5. Utility support: Filtered water delivery and drain system. Liquid nitrogen supply and exhaust system. (Either through bulk storage container or on-site liquifaction with peak demand capability of at least 10 gallon/hour. Insulated delivery lines from source to facility.) At least 120 kw of 3 phase, 225 volt electrical power for bake-out shrouds and growth chamber electronic systems. Vacuum exhaust system. Dry nitrogen purge gas. Ultra-pure deionized water for substrate processing. Fume hood with HEPA filters to minimize surface contamination during substrate processing. Pressurized (70 psi) nitrogen or clean, dry air to operate pneumatic valves.

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Non-ferrous construction is mandatory adjacent to the magnetic-field sensitive electron spectrometer.

7. Environmental requirements: Temperature stability and sufficiently low relative humidity in order to provide an acceptable operating environment for electronic systems.

8. There is no facility within the U.S. government that is comparable to the Epicenter. In the private sector, a number of universities have facilities of equivalent size. However, each is configured differently from the Epicenter. The configuration of the Epicenter is unique in its combination of surface science techniques with semiconductor film growth capabilities. This emphasis has developed in recognition of the increased importance of interface/surface properties for the successful production of superior quality semiconductor heterostructures for optical and electronic devices of interest to the Navy. This facility could be relocated at another site but the down-time probably would be one year. If the facility were lost, device-oriented programs at NRL would have to find alternate sources of well-characterized semiconductor heterostructures. These device programs are quite diverse, ranging from infrared detectors to digital electronic applications.

9. Facility Construction: The major components of the facility were transported to the site by air/truck freight. However, a number of customized components, such as optical spectroscopy systems, were constructed on site.

10. Functional support areas: 11.4, Electronic devices and 11.5, Materials and processing.

11. Historical utilization average: The unit of measure is scientist work-year (WY). Since this is a new facility, the five year (FY89-93) average of 1.8WY is somewhat misleading: FY89, 0.5WY; FY90, 1.5WY; FY91, 2WY; FY92, 2WY; FY93, 3WY.

11A. Alternate measure of historical utilization average: The unit of measure is the individual semiconductor film, heterostructure or superlattice produced in the III-V and II-VI growth chambers. Since both growth chambers became fully operational (FY91), the facility has produced about 50 samples per month. Since routine maintenance consumes 2 months per year, 500 samples are produced per annum.

12. Projected utilization data out to FY1997 - Work Years (WY)

FY1994: 4WY
FY1995: 6WY
FY1996: 7WY
FY1997: 7WY

13. Personnel to operate equipment in FY1994: 4 scientists (4WY).

14. Personnel to maintain the equipment in FY1994: All equipment is maintained by scientist-users.

15. Facility Photo Attached.

16. This facility is not shared with any other function. The equipment in this facility is unique since there is none other available in DoD or in the Federal government. The facility shared by three NRL divisions (ESTD 60%, MSD 30% and Chemistry Division 10%) in support of tech. base programs. The facility is used to supply state-of-the-art superlattice structures to Air Force and Army electronic device development projects as part of JDL Reliance coordinated programs (5%). R

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Non-ferrous construction is mandatory adjacent to the magnetic-field sensitive electron spectrometer.

7. Environmental requirements: Temperature stability and sufficiently low relative humidity in order to provide an acceptable operating environment for electronic systems.

8. There is no facility within the U.S. government that is comparable to the Epicenter. In the private sector, a number of universities have facilities of equivalent size. However, each is configured differently from the Epicenter. The configuration of the Epicenter is unique in its combination of surface science techniques with semiconductor film growth capabilities. This emphasis has developed in recognition of the increased importance of interface/surface properties for the successful production of superior quality semiconductor heterostructures for optical and electronic devices of interest to the Navy. This facility could be relocated at another site but the down-time probably would be one year. If the facility were lost, device-oriented programs at NRL would have to find alternate sources of well-characterized semiconductor heterostructures. These device programs are quite diverse, ranging from infrared detectors to digital electronic applications.

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10. Functional support areas: 11.4, Electronic devices and 11.5, Materials and processing.

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DATA CALL #12

Technical Center Site	NRL/ESTD
Facility/Equipment Nomenclature or Title	Microwave Technology Facility

3.4.1 MAJOR EQUIPMENT AND FACILITIES

Microwave Technology Branch

1. **Purpose of facility/equipment.**

Code 6850 operates and maintains an extensive state-of-the-art facility for design, fabrication in a research environment, measurement, and modelling of microwave devices and circuits incorporating novel materials and/or topologies to address the needs of next generation electronic warfare, radar, and communication systems.

Design is performed with a networked cluster of four workstations including three state-of-the-art RISC machines (two Hewlett Packard 735s and one Hewlett Packard 710) running microwave CAD software which performs linear and non-linear analysis, electromagnetic simulation, and mask layout.

Research fabrication facilities include all capabilities required for thin film deposition and patterning including mask aligners, deposition systems for metals and dielectrics (thermal and electron beam evaporators as well as sputtering systems), and wet and dry etching processes. Photolithography is performed in a 400 square foot clean room facility. Some special lithography and processes are performed by the Nanoelectronics Processing Facility as needed. Code 6850 is also equipped with facilities for mounting, assembling and packaging microwave circuits and subsystems which are capable of being qualified for space applications

Test and measurement is performed using Code 6850's extensive array of microwave and general purpose test equipment. Major facilities are two laboratories centered around two vector network analyzers. There are facilities for spectrum analysis, noise figure characterization and scalar network analysis. Two closed-cycle refrigeration systems have been specially configured to facilitate the measurement of microwave cryoelectronics, including superconductors and quantum transport devices, over a temperature range from 10K to 400K. On wafer microwave characterization of novel microwave devices and circuits is also part of this facility. In addition, there is extensive general purpose microwave instrumentation to address custom and special purpose test and measurement needs.

Modelling is also performed using the computational tools discussed in the design section as well as custom codes. Special attention is presently focused on novel devices including narrow-band-gap InAs channel HEMTs for very high frequency performance and wide-band-gap GaN FETs for high-temperature operation.

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Technical Center Site	NRL/ESTD
Facility/Equipment Nomenclature or Title	Microwave Technology Facility

3.4.1 MAJOR EQUIPMENT AND FACILITIES

Microwave Technology Branch

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2. **Portability/movability.**

All of these facilities are, in principle, movable. However, movement of any of the thin film deposition systems is difficult due to their size and weight and the requirement that these systems must remain under high-vacuum conditions during movement. The clean room facility could be dismantled and moved but it would probably be cheaper to build a new one than try to move and reassemble the existing facility whose integrity may be permanently compromised by such handling. Much of the equipment needs extensive utility connections beyond simple electrical hook-up.

3. **Replacement value.**

The cost to replace the three Hewlett Packard workstations is approximately $75,000. The microwave design software represents a total investment of another $75,000. The thin film deposition and dry processing facilities represent a replacement cost estimated at $400,000. The clean room itself would cost $400,000 to duplicate. The remaining processing and lithography equipment would require another $100,000 to duplicate. Equipment such as wafer scribers, thermo-compression and ultrasonic bonders, soldering and welding stations used in the assembly, mounting and packaging of microwave circuits would exceed $75,000. Each of the Hewlett Packard 8510C network analyzers and supporting accessories cost $160,000 (total: $320,000). Other microwave (sources, scalar analyzer, spectrum analysis, noise figure measurement, etc.) and general purpose test and measurement electronics in support of this effort represent an investment of over $250,000. Each of the closed cycle cryogenic refrigeration systems along with their control electronics represents an investment of approximately $30,000 (total: $60,000). On-wafer probing facilities would cost approximately $75,000 to reproduce. Total cost to duplicate existing equipment would be approximately $2,000,000. Not included in this estimate is the cost of providing standard laboratory equipment such as benches, cabinets, special utilities, etc.

4. **Gross weight and cubic volume.**

Excluding offices for personnel and support facilities, this facility would require 4,000 square feet of floor space, 48,000 cubic feet of space, and the total weight is roughly estimated at 7,500 lbs.

5. **Special utilities.**

In addition to standard single phase 110V and three phase 220V electrical utilities, the following are required: ethernet LAN; LocalTalk LAN; filtered, dry compressed air; vacuum; dry nitrogen gas (standard compressed tank is insufficient), ultra-pure de-ionized water, filtered water, 400 square foot clean room, fume hoods (one of which must be in the clean room), toxic gas storage, acid storage, solvent storage.

6. **Special budget requirements.**

A 400 square foot HEPA filtered clean room is required. Laboratories must be equipped with lab benches, storage cabinets, etc.

7. **Environmental control requirements.**

A clean room facility is required for proper photolithographic processes which requires that all air entering the room be extensively filtered. Photolithographic and chemical processes require highly stable temperature and humidity control. Standard temperature

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and humidity constraints appropriate for computers and electronic equipment must be met in the remainder of the facility. Facilities must be provided for the safe use and storage of toxic gases used in dry processing as well as for acids and solvents.

8. **Impact of facility loss.**

This facility is at the forefront of most of the promising new areas of microwave research including: the DARPA Ferrite Consortium, the SPAWAR High Temperature Superconductor Space Experiment, ONR funded efforts in; InAs and GaN devices, quantum transport devices, novel circuit topologies for narrow-band and other filter topologies, and a CRADA with Superconducting Core Technologies on ferroelectric/superconductor devices and circuits. Relocation of these facilities to another location would result in suspension of the activities performed in these facilities for a considerable length of time. Although certain equipment such as the network analyzers might be down for only a month or two assuming that the physical plant was fully ready to accept them, vacuum systems, cryogenic systems, and, in particular, the clean room photolithographic facility would take more than a year to become operational. It is estimated that to get the facility fully functional would require two years assuming that the present personnel were assigned the task and even longer if new personnel were assigned the task. In the meantime, progress on all of these programs which are critical to next generation electronic warfare, radar, and communication systems will be greatly slowed.

9. **Facility construction.**

The facility/equipment has been assembled over the past several years. All equipment in the facility was shipped via normal ground transportation. Assembly of the clean room facility requires a contractor specialized in that area.

10. **Areas of functional support:**

Electronic devices and electronic materials.

11. **Historical use average.**

Use is defined as the number of full-time-equivalent (FTE)/work years (WY) for personnel engaged in sponsor supported research using the facility. The level of utilization has increased steadily over the past five years from approximately 3.5 WY to 6 WY as the facility and its capabilities have been expanded.

12. **Projected use to FY 1997.**

The level of utilization is expected to increase through 1997 as the trend in sponsor interest moves more toward subsystem demonstration and delivery of functional, and in some cases, space qualified, hardware such as that delivered to the HTSSE I and HTSSE II programs. In addition it is expected that measurement and characterization of novel microwave devices, such as InAs channel HEMTs and low-temperature quantum-transport devices will significantly increase the demands placed on this facility.

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13. **Personnel used to operate the equipment.**

The equipment is operated by the researchers and technicians of Code 6850 and involves approximately 6 work-years.

14. **Personnel used to maintain the equipment.**

With the exception of the Hewlett Packard vector network analyzers which are maintained by a service contract and building utilities maintained by NRL, the researchers and technicians of Code 6850 maintain the facility.

15. **Photos.**

Facility photographs attached.

16. **Facilities Sharing.**

These capabilities of these facilities are shared with a number of other activities and are essential to many interdisciplinary research programs including:

Space Sciences Division, Code 7662, Diamond UV Detector program funded by NASA (5%).

Optical Sciences Division, Code 5642, Multi-quantum well optical correlator program funded by ONR (5%).

Optical Sciences Division, Code 5672, High-speed heterojunction bipolar transistor optical detector project funded by ONR (5%). R

Louisiana State University, High-speed complementary heterojunction bipolar transistors funded by a Louisiana State Grant and ONR (5%).

George Mason University, Ion Implantation into SiC and GaN funded by NSF (5%).

Electronics Science and Technology Division, Code 6810, SiG heterojunction bipolar transistors for high frequency high power applications (5%).

Naval Center for Space Technology, Code 8120, High Temperature Superconducting Space Experiment funded by SPAWAR (25%)

Naval Air Warfare Center (China Lake), High Temperature Superconductor Antennas Advanced Technology Initiative funded by ONR (10%)

Superconducting Core Technologies (Golden, CO), CRADA for development of tunable microwave devices using ferroelectrics and high temperature superconductors funded by Superconducting Core Technologies (5%)

George Washington University administered Ferrite Consortium, development of ferrite based nonreciprocal microwave components funded by ARPA (15%).

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13. **Personnel used to operate the equipment.**

The equipment is operated by the researchers and technicians of Code 6850 and involv approximately 6 work-years.

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DATA CALL #12

Technical Center Site	NRL/ESTD
Facility/Equipment Nomenclature or Title	Crystal Growth Facility

3.4.1 MAJOR EQUIPMENT AND FACILITIES

Electronic Materials Branch

1. The crystal growth facility grows crystals of semiconductor materials and crystalline layered structures of superconductor materials used in studies of new materials and new device concepts. Electronic device research often requires new materials or materials with electronic properties that are not commercially available. The mission of the crystal growth facility is to engage in the research necessary to study those electronic materials and devices. This research is multi-disciplinary and often involves solid state physicists and device engineers in addition to the crystal growth researchers of the facility.

2. The equipment is moveable as defined by paragraph 6, page 12 of this data call. For all practical purposes, however, much of the equipment in the crystal growth facility is fixed. In addition to being attached to plumbing for water cooling and attached to fume hoods for safety enclosure operation, the crystal growth furnaces are not capable of being moved without breaking fragile heating elements. Moving the furnaces might require replacement of the entire furnace because the heating elements become very brittle after they have been used.

3. Replacement value of the facility/equipment: $2250K

4. Gross weight : 22000 lbs. Cube: 35000 cu. ft.

5. The facility requires fume hoods for the processing of hazardous materials, water cooling for the crystal growth furnaces, a nitrogen gas supply for the MOCVD reactor, hydrogen and oxygen gas supply for the glass shop, compressed air supply for valve operation in the MOCVD reactor, 208V and 240V electrical supply for the high temperature furnaces and 480V power supply for the RF generator used to heat the high pressure Czochralski furnace.

6. Special budget requirements for the facility/equipment: None.

7. Environmental control requirements for the facility/equipment: None

8. Relocating the facility would likely involve replacement of many of the resistance heated crystal growth furnaces because of expected breakage of brittle heating elements. Replication of the facility would not be entirely possible because certain items such as the high pressure Czochralski crystal growth furnace (sized for research purposes) is no longer manufactured. Replacement of the high pressure furnace would mean that a production sized unit would be substituted for the research sized unit. Future research using the production sized unit would be much more expensive because of the larger quantities of new materials which would be required for the larger furnace.

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Technical Center Site	NRL/ESTD
Facility/Equipment Nomenclature or Title	Crystal Growth Facility

3.4.1 MAJOR EQUIPMENT AND FACILITIES

Electronic Materials Branch

1. The crystal growth facility grows crystals of semiconductor materials and crystalline layered structures of superconductor materials used in studies of new materials and new device concepts. Electronic device research often requires new materials or materials with electronic properties that are not commercially available. The mission of the crystal growth facility is to engage in the research necessary to study those electronic materials and devices. This research is multi-disciplinary and often involves solid state physicists and device engineers in addition to the crystal growth researchers of the facility.

2. The equipment is moveable as defined by paragraph 6, page 12 of this data call. For all practical purposes, however, much of the equipment in the crystal growth facility is fixed. In addition to being attached to plumbing for water cooling and attached to fume hoods for safety enclosure operation, the crystal growth furnaces are not capable of being moved without breaking fragile heating elements. Moving the furnaces might require replacement of the entire furnace because the heating elements become very brittle after they have been used.

3. Replacement value of the facility/equipment: $2250K

4. Gross weight : 22000 lbs. Cube: 35000 cu. ft.

5. The facility requires fume hoods for the processing of hazardous materials, water cooling for the crystal growth furnaces, a nitrogen gas supply for the MOCVD reactor, hydrogen and oxygen gas supply for the glass shop, compressed air supply for valve operation in the MOCVD reactor, 208V and 240V electrical supply for the high temperature furnaces and 480V power supply for the RF generator used to heat the high pressure Czochralski furnace.

6. Special budget requirements for the facility/equipment: None.

7. Environmental control requirements for the facility/equipment: None

8. Relocating the facility would likely involve replacement of many of the resistance heated crystal growth furnaces because of expected breakage of brittle heating elements. Replication of the facility would not be entirely possible because certain items such as the high pressure Czochralski crystal growth furnace (sized for research purposes) is no longer manufactured. Replacement of the high pressure furnace would mean that a production sized unit would be substituted for the research sized unit. Future research using the production sized unit would be much more expensive because of the larger quantities of new materials which would be required for the larger furnace.

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Possible alternative crystal growth facilities at either government or commercial sites do not exist with the depth of capability that is present at NRL. Certain aspects of the capabilities could be obtained at various other facilities, but no other laboratory has the range of crystal growth/processing facilities that is located at NRL. Loss of the crystal growth facility would limit the ability of device engineers to obtain new materials or materials with desired properties for new device experimentation. The performance of electronic devices is often limited by the crystalline and chemical perfection of the materials from which the device is fabricated. Continued improvements in the quality of electronic materials is key to better device performance and new applications for the electronic materials. Enhanced electronic materials and enhanced electronics are responsible for providing force multipliers for the US.

9. The equipment of the crystal growth facility was assembled over the period from 1975 through the present. Moving the equipment when it was new did not present a problem. The heating elements become very brittle after they have been heated to high temperatures.

10. The crystal growth facility supports area 11.4 Electronic Devices and 11.5 Materials and Processes

11. Historical utilization average for the past five years (1989-1993): The facility has been used on a continual basis (4 work-years/year) over the past five years.

12. Projected utilization data out to 1997: The facility is expected to be used on a continual basis (4 work-years/year) through 1997.

13. Approximate number of personnel used to operate the facility equipment: 4

14. Approximate number of people to maintain the facility: 1

15. Facility Photo Attached.

16. This facility is not shared with any other function. The facility is used to grow bulk semiconductor crystals in support of Navy Focal Plane Array programs (20%) and to grow high temperature superconductor films for Navy SPAWAR high temperature supercondor space experiment programs (15%). A new effort in FY94 sponsored by a non-DoD agency to utilize VZM GaAs for gamma ray detectors will require 20% of facility time. R

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Possible alternative crystal growth facilities at either government or commercial sites do not exist with the depth of capability that is present at NRL. Certain aspects of the capabilities could be obtained at various other facilities, but no other laboratory has the range of crystal growth/processing facilities that is located at NRL. Loss of the crystal growth facility would limit the ability of device engineers to obtain new materials or materials with desired properties for new device experimentation. The performance of electronic devices is often limited by the crystalline and chemical perfection of the materials from which the device is fabricated. Continued improvements in the quality of electronic materials is key to better device performance and new applications for the electronic materials. Enhanced electronic materials and enhanced electronics are responsible for providing force multipliers for the US.

9. The equipment of the crystal growth facility was assembled over the period from 1975 through the present. Moving the equipment when it was new did not present a problem. The heating elements become very brittle after they have been heated to high temperatures.

10. The crystal growth facility supports area 11.4 Electronic Devices and 11.5 Materials and Processes

11. Historical utilization average for the past five years (1989-1993): The facility has been used on a continual basis (4 work-years/year) over the past five years.

12. Projected utilization data out to 1997: The facility is expected to be used on a continual basis (4 work-years/year) through 1997.

13. Approximate number of personnel used to operate the facility equipment: 4

14. Approximate number of people to maintain the facility: 1

15. Facility Photo Attached.

16. This facility is not shared with any other function. The facility is used to grow bulk semiconductor crystals in support of Navy Focal Plane Array programs (20%) and to grow high temperature superconductor films for Navy SPAWAR high temperature supercondor space experiment programs (15%). A new effort in FY94 sponsored by a non-DoD agency to utilize VZM GaAs for gamma ray detectors will require 20% of facility time.

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Technical Center Site	NRL/ESTD
Facility/Equipment Nomenclature or Title	Optical Properties Facility

3.4.1 MAJOR EQUIPMENT AND FACILITIES

Electronic Materials Branch

1. The Optical Properties Laboratory performs interband-impurity, intra-impurity and vibrational spectroscopic measurements on materials used in current and emerging electronic technologies. The materials studied include thin films, superlattices and nanostructures produced by molecular beam epitaxy and organo-metalic vapor deposition, and bulk crystals. These materials are grown as part of electronic device research and development to provide diagnostics and to develop an understanding of basic physical properties of device materials. Specific spectroscopic techniques include pulsed and continuous wave photoluminescence, photoluminescence excitation, optical absorption and reflection, Raman scattering, and modulation spectroscopies. These measurements are performed in the spectral range from the mid infrared to the ultraviolet, at magnetic fields as high as 13 Tesla, and at temperatures between 1.5K and 400K.

2. Equipment is moveable.

3. Replacement Value: $843K

4. Gross weight: 13800 lbs. Gross Cubage: 8500 cu. ft.

5. Facility requires a high-pressure filtered water delivery system, high pressure nitrogen gas line, hydrogen and fluorine gas delivery (including vent and detection systems), 208 Volt 40 Amp electrical service.

6. None.

7. Temperature and humidity stability are required to maintain alignment of spectroscopic systems and to maintain an acceptable operating environment for electronics equipment.

8. The facility could be replicated or relocated. If this facility were lost to the Department of the Navy, the electronics materials and device development programs would be severely impacted. It is extremely important that all materials growth, diagnostics equipment and device fabrication facilities be colocated in order to provide timely feedback during growth and process development.

9. Equipment was shipped to NRL by overland freight and was installed by NRL personnel and by vendor technical personnel. The facility has been evolving at its present site since 1979. Various parts of the facility have been added over the years as modernization and capability expansion was required.

10. The Optical Properties Laboratory supports areas 11.4 Electronic Devices and 11.5 Materials and Processes.

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Technical Center Site	NRL/ESTD
Facility/Equipment Nomenclature or Title	Optical Properties Facility

3.4.1 MAJOR EQUIPMENT AND FACILITIES

Electronic Materials Branch

1. The Optical Properties Laboratory performs interband-impurity, intra-impurity and vibrational spectroscopic measurements on materials used in current and emerging electronic technologies. The materials studied include thin films, superlattices and nanostructures produced by molecular beam epitaxy and organo-metalic vapor deposition, and bulk crystals. These materials are grown as part of electronic device research and development to provide diagnostics and to develop an understanding of basic physical properties of device materials. Specific spectroscopic techniques include pulsed and continuous wave photoluminescence, photoluminescence excitation, optical absorption and reflection, Raman scattering, and modulation spectroscopies. These measurements are performed in the spectral range from the mid infrared to the ultraviolet, at magnetic fields as high as 13 Tesla, and at temperatures between 1.5K and 400K.

2. Equipment is moveable.

3. Replacement Value: $843K

4. Gross weight: 13800 lbs. Gross Cubage: 8500 cu. ft.

5. Facility requires a high-pressure filtered water delivery system, high pressure nitrogen gas line, hydrogen and fluorine gas delivery (including vent and detection systems), 208 Volt 40 Amp electrical service.

6. None.

7. Temperature and humidity stability are required to maintain alignment of spectroscopic systems and to maintain an acceptable operating environment for electronics equipment.

8. The facility could be replicated or relocated. If this facility were lost to the Department of the Navy, the electronics materials and device development programs would be severely impacted. It is extremely important that all materials growth, diagnostics equipment and device fabrication facilities be colocated in order to provide timely feedback during growth and process development.

9. Equipment was shipped to NRL by overland freight and was installed by NRL personnel and by vendor technical personnel. The facility has been evolving at its present site since 1979. Various parts of the facility have been added over the years as modernization and capability expansion was required.

10. The Optical Properties Laboratory supports areas 11.4 Electronic Devices and 11.5 Materials and Processes.

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11. Average utilization from FY89 to FY93 was 4 Work Years (WY) per year

12. Utilization is expected to be 4 WY per year for FY94 - FY97.

13. 4 people are required to operate the equipment.

14. No dedicated maintenance personnel are required.

15. Facility Photo Attached.

16. This facility is not shared with any other function. The facility is, however, shared with personnel in the Optical Sciences Division (7%) and the Condensed Matter and Radiation Sciences Division (10%) to characterize semiconductor and optical fiber materials for Navy Tech Base programs. Diabnostics performed at the facility have been used in support of a tri-service program to evaluate p-HEMT devices for the ARPA MMIC program (5%). The facility is used to characterize GaN material grown by a DoD contractor (5%). R

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11. Average utilization from FY89 to FY93 was 4 Work Years (WY) per year

12. Utilization is expected to be 4 WY per year for FY94 - FY97.

13. 4 people are required to operate the equipment.

14. No dedicated maintenance personnel are required.

15. Facility Photo Attached.

16. This facility is not shared with any other function. The facility is, however, shared with personnel in the Optical Sciences Division (7%) and the Condensed Matter and Radiation Sciences Division (10%) to characterize semiconductor and optical fiber materials for Navy Tech Base programs. Diabnostics performed at the facility have been used in support of a tri-service program to evaluate p-HEMT devices for the ARPA MMIC program (5%). The facility is used to characterize GaN material grown by a DoD contractor (5%).

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Technical Center Site	NRL/ESTD
Facility/Equipment Nomenclature or Title	Magnetic Resonance Facility

3.4.1 MAJOR EQUIPMENT AND FACILITIES

Electronic Materials Branch

1. The Magnetic Resonance Facility consists of 3 permanent magnet electron paramagnetic resonance (EPR) spectrometers and one superconducting magnet magnetic resonance spectrometer along with optical tables, lasers, optical monochrometers and detectors,variable temperature apparatus, and ancillary signal processing/control electronics. The spectrometers are used for conventional EPR, optically detected magnetic resonance (ODMR) and electron-nuclear double resonance (ENDOR). These diagnostic techniques are used to determine the effects of point defects on the electronic properties of semiconductors and are used integrally to provide analysis of materials quality for materials development and electronic device development.

2. The facility is moveable.

3. Replacement Value: $704K

4. Gross Weight: 8500 lb. Cubic Feet: 9320.

5. Equipment requires chilled cooling water for magnets; enhanced pressure city water; 208 Volt, 60 Amp electrical service; liquid helium; liquid nitrogen; and high purity nitrogen gas from liquid boil off.

6. Magnets require some load-spreading but is currently accommodated on flooring rated at 100 lbs/sq. ft.

7. Vacuum pump exhaust lines, temperature control and humidity control are required to maintain alignment of optical equipment and for stability of electronics.

8. The facility could be replicated or relocated. However, much of the facility is unique within the DoD. Loss of the facility would have a significant impact on the Navy because the facility has been tailored to support bulk and epitaxial materials growth programs and electronic device research and development programs for Navy electronics systems. Part of the side of the building will need to be removed to remove large optical tables.

9. Some of the equipment was developed in-house using NRL machine shop but most was delivered to NRL by overland freight and installed by NRL personnel and by manufacturer technical personnel. Major purchases were made in 1979, 1985, 1987 and 1988.

10. The Magnetic Resonance Facility supports area 11.4, Electronic Devices and 11.5, Materials and Processes.

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Technical Center Site	NRL/ESTD
Facility/Equipment Nomenclature or Title	Magnetic Resonance Facility

3.4.1 MAJOR EQUIPMENT AND FACILITIES

Electronic Materials Branch

1. The Magnetic Resonance Facility consists of 3 permanent magnet electron paramagnetic resonance (EPR) spectrometers and one superconducting magnet magnetic resonance spectrometer along with optical tables, lasers, optical monochrometers and detectors,variable temperature apparatus, and ancillary signal processing/control electronics. The spectrometers are used for conventional EPR, optically detected magnetic resonance (ODMR) and electron-nuclear double resonance (ENDOR). These diagnostic techniques are used to determine the effects of point defects on the electronic properties of semiconductors and are used integrally to provide analysis of materials quality for materials development and electronic device development.

2. The facility is moveable.

3. Replacement Value: $704K

4. Gross Weight: 8500 lb. Cubic Feet: 9320.

5. Equipment requires chilled cooling water for magnets; enhanced pressure city water; 208 Volt, 60 Amp electrical service; liquid helium; liquid nitrogen; and high purity nitrogen gas from liquid boil off.

6. Magnets require some load-spreading but is currently accommodated on flooring rated at 100 lbs/sq. ft.

7. Vacuum pump exhaust lines, temperature control and humidity control are required to maintain alignment of optical equipment and for stability of electronics.

8. The facility could be replicated or relocated. However, much of the facility is unique within the DoD. Loss of the facility would have a significant impact on the Navy because the facility has been tailored to support bulk and epitaxial materials growth programs and electronic device research and development programs for Navy electronics systems. Part of the side of the building will need to be removed to remove large optical tables.

9. Some of the equipment was developed in-house using NRL machine shop but most was delivered to NRL by overland freight and installed by NRL personnel and by manufacturer technical personnel. Major purchases were made in 1979, 1985, 1987 and 1988.

10. The Magnetic Resonance Facility supports area 11.4, Electronic Devices and 11.5, Materials and Processes.

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11. The average useage from FY89 - FY93 was 5 work years per year.

12. Expected usage (WY): FY94: 5; FY95: 5; FY96: 5; FY97: 5.

13. Number of people required to operate equipment: 4

14. Number of people required for maintenance: 0 (No dedicated technician. Service and repair performed by users as required.)

15. Facility Photo Attached.

16. This facility is not shared with any other function. However, the facility is used by other NRL divisions (Materials Science Division (10%) and Condensed Matter and Radiation Science Division (5%)) in support of Navy Tech Base programs. NRL personnel use the facility in support of tri-service Electronic Materials characterization programs. Samples are characterized for the Air Force Institute of Technology in a joint program with AFOSR (2%). R

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11. The average useage from FY89 - FY93 was 5 work years per year.

12. Expected usage (WY): FY94: 5; FY95: 5; FY96: 5; FY97: 5.

13. Number of people required to operate equipment: 4

14. Number of people required for maintenance: 0 (No dedicated technician. Service and repair performed by users as required.)

15. Facility Photo Attached.

16. This facility is not shared with any other function. However, the facility is used by other NRL divisions (Materials Science Division (10%) and Condensed Matter and Radiation Science Division (5%)) in support of Navy Tech Base programs. NRL personnel use the facility in support of tri-service Electronic Materials characterization programs. Samples are characterized for the Air Force Institute of Technology in a joint program with AFOSR (2%).

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Technical Center Site	NRL/ESTD
Facility/Equipment Nomenclature or Title	Far Infrared Spectroscopy Facility

3.4.1 MAJOR EQUIPMENT AND FACILITIES

Electronic Materials Branch

1.The far infrared laboratory is used for transient and steady state infrared spectroscopy covering the wavelength range from two microns up to two mm. Experiments are performed on electronic and optical materials used in near-term and far-term Navy electronics systems. This includes semiconductors, superconductors and glasses. Experiments are performed under applied magnetic fields up to 13 Tesla using a number of specialized far infrared lasers and interferometers.

2. The far infrared spectroscopy facility is moveable.

3. Replacement value: $685K

4. Gross Weight: 13000 lbs. Cubic Feet: 2400

5. Vacuum exhaust system, filtered water delivery and drain systems, chemical fume hood, dry nitrogen purge gas line from liquid boil-off system.

6. None

7. Environmental requirements: Temperature and humidity stability required to maintain alignment of optical systems and to maintain acceptable operating environment for electronics.

8. No government or commercial facility exists that has flexible capabilities afforded by this infrared facility. The facility could be replicated elsewhere but if the equipment were relocated, a part of the building would have to be removed to move large optical tables. Loss of this facility to the Navy would have a serious negative impact on the Navy's ability to develop advanced materials for electronics systems.

9. Delivered to NRL by overland freight, installed by NRL personnel and by factory representatives. Parts of spectrometer built by laboratory personnel. Part of building removed to install parts of the system. (1975 - present)

10. The far infrared spectroscopy facility supports areas 11.4 Electronic Devices and 11.5 Materials and Processes.

11. Average useage over the past 5 fiscal years is 5 work years per year.

12. Projected utilization FY94 - FY95: 5 work years per year

13. Number of personnel used to operate the facility: 5

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Technical Center Site	NRL/ESTD
Facility/Equipment Nomenclature or Title	Far Infrared Spectroscopy Facility

3.4.1 MAJOR EQUIPMENT AND FACILITIES

Electronic Materials Branch

1.The far infrared laboratory is used for transient and steady state infrared spectroscopy covering the wavelength range from two microns up to two mm. Experiments are performed on electronic and optical materials used in near-term and far-term Navy electronics systems. This includes semiconductors, superconductors and glasses. Experiments are performed under applied magnetic fields up to 13 Tesla using a number of specialized far infrared lasers and interferometers.

2. The far infrared spectroscopy facility is moveable.

3. Replacement value: $685K

4. Gross Weight: 13000 lbs. Cubic Feet: 2400

5. Vacuum exhaust system, filtered water delivery and drain systems, chemical fume hood, dry nitrogen purge gas line from liquid boil-off system.

6. None

7. Environmental requirements: Temperature and humidity stability required to maintain alignment of optical systems and to maintain acceptable operating environment for electronics.

8. No government or commercial facility exists that has flexible capabilities afforded by this infrared facility. The facility could be replicated elsewhere but if the equipment were relocated, a part of the building would have to be removed to move large optical tables. Loss of this facility to the Navy would have a serious negative impact on the Navy's ability to develop advanced materials for electronics systems.

9. Delivered to NRL by overland freight, installed by NRL personnel and by factory representatives. Parts of spectrometer built by laboratory personnel. Part of building removed to install parts of the system. (1975 - present)

10. The far infrared spectroscopy facility supports areas 11.4 Electronic Devices and 11.5 Materials and Processes.

11. Average useage over the past 5 fiscal years is 5 work years per year.

12. Projected utilization FY94 - FY95: 5 work years per year

13. Number of personnel used to operate the facility: 5

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14. Number of personnel needed to maintain the equipment: 0 (no dedicated technician required.

15. Facility Photo Attached.

16. This facility is not shared with any other function. The infrared properties facility performs characterization for focal plane array material used by ESTD and the Optical Sciences Division (20%) 6.2 programs. Characterization at this facility supports the tri-service Reliance Electonic Materials and Electro-optics subpanels of the Electronic Devices Panel. R

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14. Number of personnel needed to maintain the equipment: 0 (no dedicated technician required.

15. Facility Photo Attached.

16. This facility is not shared with any other function. The infrared properties facility performs characterization for focal plane array material used by ESTD and the Optical Sciences Division (20%) 6.2 programs. Characterization at this facility supports the tri-service Reliance Electonic Materials and Electro-optics subpanels of the Electronic Devices Panel.

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DATA CALL #12

Technical Center Site	NRL/ESTD
Facility/Equipment Nomenclature or Title	Reliability Facility

3.4.1 MAJOR EQUIPMENT AND FACILITIES

Microwave Technology Branch

1. Purpose of Facility/Equipment.
   Code 6855 operates and maintains a Reliability and Failure Analysis Facility for the study of semiconductor devices. Operational life times are determined by a number of acceleration and stressing methods. After failure is induced, the physical failure mechanisms are determined by such methods as electrical characterization, optical microscopy, scanning electron microscopy, infrared microscopy, energy dispersive X-ray analysis, and various other X-ray techniques. Failure mechanisms are modeled by the Monte Carlo method and the results are correlated with the experimental results to gain a better understanding of the failure mechanisms and to improve the reliability of the devices.

2. The equipment is installed in laboratories and is not portable.

3. Replacement value.
   The cost to replace the reliability and failure analysis equipment is approximately $1,800,000.

4. Gross weight and cubic volume.
   The gross weight of the reliability and failure analysis equipment is approximately 11,000 pounds. The total laboratory space required is about 4,500 cubic feet.

5. Special Utilities.
   None required.

6. Special budget requirements.
   None required.

7. Environmental control requirements.
   Standard temperature and humidity constraints appropriate for electronic equipment must be met.

8. Impact of facility loss.
   Certain types of equipment, such as the RF reliability accelerated life testing stations were built at NRL and could only be rebuilt at another location at a large expense. This combination of equipment and the staff trained to use it is unique in the military laboratories and its loss would leave the Navy without the ability to assess the

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Technical Center Site	NRL/ESTD
Facility/Equipment Nomenclature or Title	Reliability Facility

3.4.1 MAJOR EQUIPMENT AND FACILITIES

Microwave Technology Branch

1. Purpose of Facility/Equipment.
   Code 6855 operates and maintains a Reliability and Failure Analysis Facility for the study of semiconductor devices. Operational life times are determined by a number of acceleration and stressing methods. After failure is induced, the physical failure mechanisms are determined by such methods as electrical characterization, optical microscopy, scanning electron microscopy, infrared microscopy, energy dispersive X-ray analysis, and various other X-ray techniques. Failure mechanisms are modeled by the Monte Carlo method and the results are correlated with the experimental results to gain a better understanding of the failure mechanisms and to improve the reliability of the devices.

2. The equipment is installed in laboratories and is not portable.

3. Replacement value.
   The cost to replace the reliability and failure analysis equipment is approximately $1,800,000.

4. Gross weight and cubic volume.
   The gross weight of the reliability and failure analysis equipment is approximately 11,000 pounds. The total laboratory space required is about 4,500 cubic feet.

5. Special Utilities.
   None required.

6. Special budget requirements.
   None required.

7. Environmental control requirements.
   Standard temperature and humidity constraints appropriate for electronic equipment must be met.

8. Impact of facility loss.
   Certain types of equipment, such as the RF reliability accelerated life testing stations were built at NRL and could only be rebuilt at another location at a large expense. This combination of equipment and the staff trained to use it is unique in the military laboratories and its loss would leave the Navy without the ability to assess the

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reliability of electronic components and to conduct research in the area of reliability and failure physics.

9. Facility construction.
Most of the present equipment has been purchased or built over a period of time starting in 1985.

10. Areas of functional support:
Electronic devices.

11. Historical use average.
Over the period of 1989-1993 the facilities have required utilization of approximately 6 work-years per year.

12. Projected use to FY 1997.
Out to FY1997 the projected use is expected to be 6 work-years per year.

13. Personnel used to operate the equipment.
Six professionals are required to operate the equipment.

14. Personnel used to maintain the equipment.
Four professionals are required to maintain the equipment.

15. Facility photo attached.

16. This facility is not shared with any other function. This facility is unique to DoD and the Federal Government, because it allows RF life testing at microwave frequencies. No other government owned equipment does this.

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reliability of electronic components and to conduct research in the area of reliability and failure physics.

9. Facility construction.
Most of the present equipment has been purchased or built over a period of time starting in 1985.

10. Areas of functional support:
Electronic devices.

11. Historical use average.
Over the period of 1989-1993 the facilities have required utilization of approximately 6 work-years per year.

12. Projected use to FY 1997.
Out to FY1997 the projected use is expected to be 6 work-years per year.

13. Personnel used to operate the equipment.
Six professionals are required to operate the equipment.

14. Personnel used to maintain the equipment.
Four professionals are required to maintain the equipment.

15. Facility photo attached.

16. This facility is not shared with any other function. This facility is unique to DoD and the Federal Government, because it allows RF life testing at microwave frequencies. No other government owned equipment does this.

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TAB A

PATENTS

ELECTRONIC DEVICES

3.2.4 **Accomplishments During FY91-93:** For government personnel answer the following questions.

3.2.4.1 How many patents were awarded and patent disclosures (only count disclosures with issued disclosure numbers) were made? (BRAC Criteria I)

Electronic Devices Summary

CSF	Disclosures	Awarded	Patent Titles (List)
FY-91	63	52	See Listing
FY-92	135	52	
FY-93	93	50	
Total	293	155	

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CSF	Disclosures	Awarded	Patent Titles (List)
ED	X		Diamond and Diamond-Coated Filaments
	X		High Temperature, High Rate, Epitaxial Synthesis of Diamond in a Laminated Plasma
	X		Method For Synthesizing High Quality Doped Diamond Films, Crystals, and Devices
	X		Epitaxial Synthesis of Diamond Crystals at High Growth Rates
	X		Flame Plasma Synthesis of Diamond Under Turbulent and Transition Flame Conditions
	X	X	High Accuracy Digital Acousto-Optic Matrix Computer
	X	X	Reflectometers
	X	X	Room-Temperature, Flashpumped, 1.96 micron Solid State Laser
	X	X	Narrow -Bandwidth Diffraction-Limited Coupled Stable-Unstable Resonator Laser Cavity
	X	X	Laser Diode Pumped, Erbium-Doped, Solid State Laser With High Slope Efficiency
	X	X	Compact Optical RF Spectrum Analyzer
	X	X	Optically Stable, Large Time Bandwidth Acousto- Optic Heterodyne Spectrum Analyzed With Fixed Non-Zero Heterodyne Output
	X	X	Ultraviolet Optical Isolator Utilizing the KDP-Isomorphs
	X	X	Holmium Laser Pumped With a Neodymium Laser

	X	X	Method and Apparatus for Lasing
	X	X	Narrow-Bandwidth Unstable Resonator Laser Cavity
	X	X	Figure Eight Shaped Coherent Optical Pulse Source
	X	X	Differential Polarimetric Fiber Optic Sensor
	X	X	All-Optical Fiber Faraday Rotation Current Sensor With Heterodyne Detection Technique
	X	X	Bi-Directional Optical Transmission System For RF Electrical Energy
	X	X	Method of Growing Diamond Film on Substrates
	X		Efficiency Improvement of Wideband Fiber OPtic Signal Process
	X	X	Selective Readout of a Detector Array
	X	X	Thin Film Magnetic Memory Elements
	X	X	Method for Producing Substoichiometric Silicon Nitride of Preselected Proportions
	X	X	High Power, HIgh Sensitivity Microwave Calorimeter
	X	X	High accuracy digital acousto-optic matrix computer
	X	X	Field emitter array integrated distributed amplifiers
	X	X	Efficient dynamic phasepront modulation systems for free space optical communications
	X	X	Planar fiber-optic interferometric acoustic sensor
	X	X	Room-temperature, flashpumped, 1.96 micron solid state laser
	X	X	Programmable beam transform and beam steering control system for a phased array radar antenna
	X	X	Gas laser and pumping method therefor using a field emitter array
	X	X	Narrow-bandwidth diffraction-limited coupled stable-unstable resonator laser cavity
	X	X	Method of producing a thin silicon-on-insulator layer
	X	X	Laser diode pumped, erbium-doped , solid state laser with high slope efficiency
	X	X	Method for producing substoichiometric silicon nitride of preselected proportions

	X	X	TIW diffusion barrier for AUZN ohmic contact to P-type InP
	X	X	Thin film magnetic memory elements
	X	X	Compact optical RF spectrum analyzer
	X	X	Optically stable, large time bandwidth acousto-optic heterodyne spectrum analyzed with fixed non-zero heterodyne output
	X	X	Field emitter array comparator
	X	X	Holmium laser pumped with a neodymium laser
	X	X	Gyroklystron device having multi-slot bunching cavities
	X	X	Method and apparatus for lasing
	X	X	Process for three dimensional lithography in amorphous polymers
	X	X	Heterogeneous magneto-resistive layer
	X	X	Narrow-bandwidth unstable resonator laser cavity
	X	X	Zero cross-correlation complementary radar waveform signal processor for ambiguous range radars
	X	X	Sampled data processing
	X	X	Differential polarimetric fiber optic sensor
	X	X	Low capacitance field emitter array and method of manufacture therefor
	X	X	Selective readout of a detector array
	X	X	All-optical fiber Faraday rotation current sensor with heterodyne detection technique
	X	X	Heterostructure device useable as a far infrared photodector
	X	X	Bi-directional optical transmission system for RF electrical energy
	X	X	Method of growing diamond film on substrates
	X	X	Ultra-low-loss strip-type transmission lines formed of bonded substrate layers
	X		Metal semiconductor and junction field effect transistor (MESJFET)
	X		Systolic multiple channel band-partitioned noise canceller
	X		Wideband fiber optic FED array (NFOFA)
	X		Autonuling AC bridge using differential and integration feedback
	X		Epitaxial synthesis of diamond crystals at high growth rates
	X		Flame plasma synthesis of diamond under turbulent and transition flow conditions

	X		Single processing technique for increasing signal to noise ratio
ED	X		Diode Pumped Catheter With 2.8 micron Laser Source at Distal End
	X		New Glass Composition for Low-Loss Mid-IR Wavelength Transmission
	X		Fiber Optic Michelson Sensor and Arrays With Passive Elimination of Polarization Fading and Source Feedback Isolation
	X		Fiber Optic Electric Field and Voltage Sensor Based On Electrostrictive Effect
	X		Fiber Optic Gyroscopes With Depolarization Light
	X		Plasma Treatment of Glass Surface
	X		Method For Excess Noise Subtraction in a Fiber Optic Gyroscope
	X		Permanent Photowritten Optical Gratings in Irradiated Silicate Glasses
	X		Fiber Grating-Based Sensing System with Interferometric Wavelength Shifted Detection
	X		Fiber Optic Interferometer Configuration With Pump-Induced Phase Carrier
	X		Rare Earth Ion Doped Continuous Wave Cascade Fiber Laser
	X		Semiconductor Device and Method of Forming Such a Device
	X		Time Gated Image Detector Using Correlated Coherent Anti-Stokes Raman Scattering
	X		Electronic Phase-Tracking Open-Loop Fiber Optic Gyroscope
	X	X	Hot Isostatic Pressing of Fluoride Glass Materials
	X	X	Erbium-Doped Fluorozirconate Fiber Laser Pumped by a Diode Laser Source
	X	X	Resonantly Pumped, Erbium-Doped, 2.8 micron Solid State Laser With High Slope Efficiency
	X	X	Room-Temperature, Flashpumped, 2.09 micron Solid State Laser
	X	X	Tunable Solid State Laser With High Wavelength Selectivity Over a Preselected Wavelength Range
	X	X	Antiresonant Nonlinear Mirror for Passive Laser Modelocking
	X	X	Interferometer With Two Phase-Conjugate Mirrors
	X	X	Modulated High-Power Optical Source

	X	X	Inline Fiber Optic Sensor Arrays With Delay Elements Coupled Between Senson Units
	X	X	Flame or Plasma Synthesis of Diamond Under Turbulent and Transition Flow Conditions
	X	X	System and Method for Minimizing Input Polarization Induced Phase Noise
	X		Optical Signal Selection
	X		Microwave Detection of a Superconducting Infrared Sensor
	X	X	High Efficiency Fast Neutron Threshold Deflector
	X	X	Method of Making Substantially Single Phase Superconducting Oxide Ceramics Having A Tc Above 85 Degrees
	X	X	Pulsed X-Ray Lithography
	X	X	High Power Klystron Amplifier
	X	X	Process for single crystal growth of high Tc superconductors
	X	X	Floating gate magnetic field sensor
	X	X	Erbium-doped fluorozirconate fiber laser pumped by a diode laser source
	X	X	Planar gallium arsenide NPNP microwave switch
	X	X	Resonantly pumped, erbium-doped, 2.8 micron solid state laser with high slope efficiency
	X	X	Room-temperature, flashpumped, 2.09 micron solid state laser
	X	X	Buried heterostructure laser modulator
	X	X	Logarithmic-Periodic microwave multiplexer
	X	X	IFF authentication system
	X	X	Magnetic field sensor and device for determining the magnetrostriction of a material based on a tunneling tip detector and methods of using same
	X	X	Dual active layer photoconductor
	X	X	Preparation of high-temperature superconducting coated wires by dipping and post annealing
	X	X	Method and apparatus for increasing a radar's range with improved scan-to-scan integration of Doppler filtered signals
	X	X	Tunable solid state laser with high wavelength selectivity over a preselected wavelength range
	X	X	Method of nanometer lithography

	X	X	Cross entropy deconvolver circuit adaptable to changing convolution functions
	X	X	Antiresonant nonlinear mirror for passive laser modelocking
	X	X	Pulsed X-Ray lithography
	X	X	Modulated high-power optical source
	X	X	Fiber optic photoluminescence sensor
	X	X	Large-aperture sparse array detector system for multiple emitter location
	X	X	Method of making composite field-emitting arrays
	X	X	Field emitter array
	X	X	High data rate long pulse compression waveform communication system for M-ARY encoding voice messages for air traffic control systems
	X	X	Frequency diversity sidelobe canceller
	X	X	Method of pattern transfer in photolithography using laser induced metallization
	X	X	Flame or plasma synthesis of diamond under turbulent and transition flow conditions
	X	X	Method of controlling electron emission from field emitters and field emitter arrays
	X	X	High resolution metal patterning of ultra-thin films on solid substrates
	X		Extended length digital correlator threshold circuit
	X		Dual waveband signal processing system
	X		Coherent false target generator
	X		Method of manufacturing a high resolution high-contract, multicolor flat
	X		Diode pumped catheter with 2.8mm laser source at distal end
	X		Variable phase sine wave generator for active phased arrays
	X		Reglatable field emitter device and method of production thereof
	X		Contactless resistance measurement of semi-insulating semiconductors
	X		High temperature substrate mount for chemical vapor deposition
	X		Fiber optic electric field and voltage sensor based on electrostrictive effect
	X		Fiber optic gyroscopes with depolarization light

	X		Dielectric films for reduction of minimum feature size and reduction of proximity effects in high resolution electron beam lithography
	X		Method for excess noise substraction in fiber optic gyroscope
	X		Dielectric films for proximity effect reduction in mask fabrication by e-beam lithography
	X		Fiber grating-based sensing system with interferometric wavelength shift detection
	X		Voice communication processing system
	X		Fiber optic interferometer configuration with pump-induced phase carrier
	X		Rare earth ion doped continuous wave cascade fiber laser
	X		Semiconductor device and method of forming such a device
	X		Embedded fiber optic sensors
	X		An interferometric technique for evaluation of spatial characteristics of electronic imaging devices
	X		Electronic phase-tracking open-loop fiber optic gyroscope
	X		Continuous time adaptive learning circuit
	X		Optical switches and detectors utilizing indirect narrow-gap superlattice as the optical materials
	X		Junction field effect transistor with lateral gate voltage swing (GVS-JFET)
	X		Method and apparatus for a high resolution, flat panel cathodoluminescent display device
	X		Methods for Modification of Diamond Surfaces
	X		Flow Immunosensor
	X		A Device for Low Electric-Field Induced Switching of Ferroelectric Liquid Crystal Layed Films Using a Single Substrate
	X	X	High Resolution Patterning on Solid Substrates
	X	X	Laser Beam Stop
	X	X	Metallized Tubule-Based Artificial Dielectric
ED	X		Diode Pumped Tm:LiF4 Laser at 1.9 micron for Optimized CW Laser-Tissue
	X		Method and Apparatus for Parallel Readout and Correlation of Data on Optical Disks

	X		Improved Super Luminescent Light Source
	X		An Ultraviolet Faraday Rotator Glass
	X		Method and Apparatus for a Sensitive Fiber Optic Planar Hydrophone
	X		Method and Apparatus for a New Transduction Mechanism for Large Area Conformal Hydrophones
	X		Method For the Control of Bragg Wavelength of Intra-Core Fiber Grating Elements Using Electro-Optical Modulation
	X		Tm:YALO, 1.94 micron, Solid State Laser
	X		New Design for Broadband, Low V-Pi Electrooptic Modulators
	X		A Fiber Optic Network System With Low Crosstalk Using Code-Division Multiplexing
	X		Suppression of Backscatter and Stray Reflection Induced Phase Noise in Michelson Interferometers
	X		Method and Apparatus for Polarization-Maintaining Fiber Optical Amplification with Orthogonal Polarization Output
	X		A Compact Dual-Strip Fiber Optic Magnetostrictive Design With Predictabe Reproducibility
	X		Technique to Prepare High-Reflectance Optical Fiber Bragg Gratings With Single UV Exposure In-Line On Fiber Draw Tower
	X		Rapidly Deployable ASW Arrays
	X		Process to Fabricate Thick Coplanar Microwave Electrode Structures
	X		Fiber Optic Continuous True Time-Delay Modulator
	X		Tunable Ytterbium-Doped Solid State Laser
	X		Fiber-Optic True Time-Delay Array Antenna Feed
	X		Fiber Optic Flux Transformer
	X		Fiber Ring Laser Configuration Based On An In-Line, Spectrally-Selective Fiber Fabry-Perot (SSFFP) Transmission Filter Using a Bragg Grating Element
	X		Low-Frequency Electrostrictive Ceramic Plate Voltage Sensor
	X		Real Suspended Particle Detector
	X		Reflection Employing an Integrating Sphere and a Lens-Mirror Concentration
	X		Diamond Brazed to a Metal

	X		Substrate Temperature Control Technique For CVD Reactors
	X		Apparatus and Method for Eliminating Polarization Sensitivity Transducers
	X		Nanochannel Glass Matrix Used in Making Semiconductor Devices
	X		Nanochannel Filter
	X	X	Fabrication and Phase Tuning of an Optical Waveguide Device
	X	X	Resonantly Pumped, Erbium-Doped, GSGG, 2.8 micron, Solid State Laser With Energy Recycling and high Slope Efficiency
	X	X	Fiber Optic Gyroscope With Wide Dynamic Range Analog Phase Tracker
	X	X	Suppression of Relaxation Oscillations in Flashpumped, Two-Micron Tunable Solid State Lasers
	X	X	Fiber Optic Michelson Sensor and Arrays With Passive Elimination of Palarization Fading and Source Feedback Isolation
	X	X	Thermal Dilation Fiber Optical Flow Sensor
	X	X	Plasma Chemical Vapor Deposition of Halide Glasses
	X	X	System For Canceling Phase Noise in an Interferometric Fiber Optic Sensor Arrangement
	X	X	Heterodyne Array for Measurement of Target Velocity
	X	X	Nanochannel Filter
	X	X	Three-Axis Fiber Optic Vector Magnetometer
	X	X	Fabrication and Phase Tuning of an Optical Waveguide Device
	X	X	Color Center Laser With Transwerse Auxiliary Illumination
	X	X	System For End Pumping a Solid State Laser Using a Large Aperture Laser Diode Bar
	X	X	Method and Apparatus for Imaging an Object In or Through a Scattering Medium by Using Multiple-Wave Mixing
	X	X	Two-Micron Modelocked Laser System
	X	X	Nanochannel Glass Matrix Used In Making Mesoscopic Structures
	X	X	Nonlinear Optical Composites of Metal Cluster Laden Polymers

	X		Efficiency Improvement of Wideband Fiber OPtic Signal Process
	X	X	Self Initializing Circuit Link
	X	X	Imaging Radar Repeater
	X		Discrete Vacuum Ultra Violet Reflective Interference Filter
	X		Submicrosecond Synchronizable X-Ray Source
	X	X	Dual Cavity For A Dual Frequency Gyrotron
	X		Focused-Electron-Deflection Field Emission Array
	X		System for Conditioning An Electron Beam for Improved Free-Electron Laser Operation
	X	X	Method and apparatus for forming an agile plasma mirror effective as a microwave reflector
	X	X	Method for doping GaAs with high vapor pressure elements
	X	X	Fabrication and phase tuning of an optical waveguide device
	X	X	Method of manufacturing InP junction FETs and junction HEMTs using dual implantation and double nitride layers
	X	X	Method and apparatus for performing scanning tunneling optical absorption spectroscopy
	X	X	Resonantly pumped, erbium-doped, GSGG, 2.8 micron, solid state laser with energy recycling and high slope efficiency
	X	X	Metal-glass composite field-emitting arrays
	X	X	Fiber optic gyroscope with wide dynamic range analog phase tracker
	X	X	Optical switching devices
	X	X	Monocrystalline germanium film on sapphire
	X	X	Fiber optic Michelson sensor and arrays with passive elimination of polarization fading and source feedback isolation
	X	X	Resistive gate magnetic field sensor
	X	X	All-weather precision landing system for aircraft in remote areas
	X	X	Thermal dilation fiber optical flow sensor
	X	X	Layered thin-edged field-emitter device
	X	X	Calibration method and apparatus for collecting the output of an array of detector cells

	X	X	System for canceling phase noise in an interferometric fiber optic sensor arrangement
	X	X	Field emitter array memory device
	X	X	Nanochannel filter
	X	X	Focal plane antenna array for millimeter waves
	X	X	Method and apparatus for determining target elevation angle altitude and range and the like in a monopulse radar system with reduced multipath errors
	X	X	Method and apparatus of generating sum or difference signals corresponding to an apparent beam in a monopulse radar system
	X	X	Three-axis fiber optic vector magnetometer
	X	X	System for producing synchronized signals
	X	X	Method of forming nanometer-scale trenches and holes
	X	X	Layered parallel interface for an active antenna array
	X	X	Fabrication and phase tuning of an optical waveguide device
	X	X	Method for making a symmetrical layered thin film edge field-emitter-array
	X	X	System for end pumping a solid state laser using a large aperture laser diode bar
	X	X	Method of forming platinum and platinum silicide Schottky contacts of beta-silicon carbide
	X	X	Two-Micron modelocked laser system
	X		Multiphase parallel radar mode processor
	X		Diode pumped Tm:LiF4 laser at 1.9 microns for optimized CW laser tissue
	X		Imaging radar repeater
	X		Decoy target return signal simulator
	X		Method and apparatus for parallel readout and correlation of data on optical disks
	X		Perceptive radar emitter return signal simulator
	X		Method and apparatus for a sensitive fiber optic planar hydrophone
	X		Thin film edge emiter device and method of manufacture thereof
	X		Apparatus and method using low voltage scanning probe lithography
	X		A method for coherent deception countermeasures

	X		Method of producing a silicon membrane using a silicon alloy etch stop layer
	X		A new design and fabrication method for III-V heterostructure field-effect transistors
	X		Advanced IFF systems
	X		Leading edge canceller frequency selective limiter
	X		Microwave filter containing nonreciprocal signal branches with frequency-selective transfer characters
	X		Method for the control of BRAGG wavelength of intra-core fiber grating elements using electro-optical modulation
	X		Tm:YALO, 1.94-micron, solid state laser
	X		New design for broadband, low V electro-optic modulators
	X		A fiber optic network system with low crosstalk using code-division multiplexing
	X		Microwave multiplexer multiplexing channels with varying fractional bandwidths
	X		Method and apparatus for polarization-maintaining fiber optical amplification with orthoganal polarization output
	X		A compact dual-strip fiber optic magnetostrictive design with predictable reproducibility
	X		Reduced-signal friend-identification
	X		Technique to prepare high-reflectance optical fiber BRAGG grating with single UV exposure in-line on fiber draw tower
	X		Focused-electron-deflection field emission array
	X		Wireless shipboard data coupler
	X		Fiber optic continuous true time-delay modulator
	X		Tunable ytterbium-doped solid state laser
	X		Fiber-optic true time-delay array antenna feed
	X		Fiber ring laser configuration based on in-line, spectrally-selective fiber Fabray-Perot (SSFFP) transmission filter using a BRAGG grating element
	X		Ultra high density, non-voltage ferromagnetic random access mamory element
	X		Substrate temperature control technique for CVD reactors
	X		Method of fabricating sub-0.4-0.9 micron trenches and holes

	X		Method for forming adherent SiO2 layer on diamond
	X		Magneto-resistive linear displacement
	X		Nanochannel glass matrix used in making semiconductor devices
	X		Nanochannel filter
	X		Semiconductor device and method for such a device
	X		Platinum and platinum silicide contacts on B-silicon carbide
	X		Microwave multiplexer with channels of varying fractional bandwidths
	X		Efficiency improvement for wideband fiber-optic signal processing
	X		In-line fiber etalon strain sensor
	X		A lineraly polarized hybrid TE31 coupler for slotted waveguide
	X		The double cusp gyro-gun
	X		Microwave detected photoresponse in a resonant superconducting structure - A spatially resolved optical probe of the superconducting microwave current density
	X		Coating wires and other objects with superconductors
	X		Selective Metallization Process
	X	X	Method of Fabricating a Receptor-Based Sensor
	X	X	Fast Switching Ferroelectric Liquid Crystalline Polymers

Only Patent Awards and Disclosures relating to Electronic Devices.
Disclosures = Case Number
Awarded = Patent Number
Patent Titles = Sample:

Apparatus and Method for Minimizing Polarization-Induced Signal Fading in an Interferometric Fiber-Optic Sensor Using Input Polarization Control

*Latest NRL input for Patent Awards and Disclosures List attached. Just Highlight those related to Electronic Devices and return list to 6800B along with this input - no need to type in.

TAB B

PAPERS PUBLISHED

ELECTRONIC DEVICES

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3.2.4.2 How many papers were published in peer reviewed journals? (BRAC Criteria I)

Electronic Devices Summary

CSF	Number Published	Paper Titles (List)
ED		
FY-91	338	See Listing R - Revised
FY-92	359	
FY-93	335	R - Revised
Total	1,032	R - Revised

CY91

CSF	Reference	Paper Titles (List)
1 ED	Optics Letters, Vol. 16, pp132-134 1991	Mode Evolution of Induced Second-Harmonic Light in Optical Fiber
2	Applied Optics, Vol. 30, 1944-1957 1991	Correlation of Single Mode Fiber Radiation Response and Fabrication Parameters
3	Applied Optics, Vol. 30,(22),1-5 1991	An Interferometric Method for Concurrent Measurement of Thermo-Optic and Thermal Expansion Coefficient
4	IEEE Journal of Quantum Electronics, Vol. 27, No. 4, 1031-1038 1991	Spectroscopy and Laser Operation of Nd:ZBAN Glass
5	Proc. IEEE, Vol. 79, No. 3 1991	Advanced Channelization Technology for RF, Microwave, and Millimeter Wave Applications
6	7 Applied Physics, Vol 73,No.2,925-928 1991	Optical and Electrical Characterization of Magnesium-Doped Bismuth-Substited Lutetium Iron Garnet Thin Films
7	J.Appl.Phys., Vol. 70, No. 9, p. 5144 1991	A Thin Film Schottky Diode Fabricated from Flame Grown Diamond
8	Applied Optics, Vol. 31,No.1,120-125 1991	Image Speckle Contrast Reduction Resulting from Integrative Synthetic Aperture Imaging
9	Optical Engineering, Vol. 31, NO. 11, 2355-2365 1991	Short Wavelength Imaging Laser Radar Using a Digicon Detector
10	Opt. Letters, Vol. 16, No. 10 1991	Photorefractive Two Beam Coupling with White Light

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11	Applied Optics, 30, 401-406 1991	Laser Beam Propagation Under Turbulent Conditions
12	JOSA B, Vol 8, 2, pg. 300 1991	Spectral and Temporal Characterization of Spontaneous Raman Scattering in the Transient Reigime
13	Optics Communications, Vol. 86 1991	Second Stokes Generation in Deuterium
14	IEEE J. Quantum Elec.,Vol. Q1 27, #4, 895-897 1991	Tunable Laser Pumped 3 Micron Ho:YALO Laser
15	Chemical Physics, Vol. 149,401-407 1991	Photochemical Bleaching of Absorbed Rhodamine 6G as a Probe of Binding Geometries on a Fused Silica Surface
16	Optics Communications, Vol. 80,p.317 1991	Achromatic Multibeam Coupling in KNB03:Rb
17	IEEE JQE, Vol. 27, No. 9 1991	Laser and Spectral Properties of Cr:Tm:Ho:YAG at 2.1 Microns
18	Theory, JOSA B, 1843 1991	Incoherent Multimode Raman Amplification Theory
19	Opt. Commun, 83, 103, 1991	Correlation Effects in Pump Depleted Broadband Stimulated Raman Amplification
20	Letters, Vol 67, No. 4, 437-440, July 1991	Cavity Quantum Electrodynamic Enhancement of Stimulated Emission in Microdroplets
21	Optics Letters, Vol. 16, 1147 1991	Supression of Photorefractive Beam Fanning
22	Optics Leters, Vol. 16, 23, 1868 1991	Time-gated Imaging Through Scattering Media using Stimulated Raman Amplification
23	Optics Letters, Vol. 16, 1723, Nov. 1991	Effects of Absorption on Microdroplet Resonant Emission Structure
24	IEEE JQE, QE-27, No. 4, 1129-1131, May 1991	Short Pulse 2.1 Micron Laser Performance of Cr:Tm:Ho:YAG
25	Proc. IEEE, Vol. 79, No. 1, Jan 1991	Infrared Focal Plane Array Technology
26	Physical Review B, Vol. 43, 14715 1991	Comment on "Temperature-induced Intraband Transitions in the n-type HgTe/CdTe Superlattices"
27	Jour. Vac. Sci. Tech., B9(3) 1813, May/June 1991	Shubnikov-de Oscillations and Quantum Hall Effect in Modulation-doped HgTe-CdTe Superlattices

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28	Jour. Vac. Sci. Tech. B9, 1818 1991	Theory for Electron and Hole Transport in HgTe-CdTe Superlattices
29	Appl. Phys. Letts., 58, 2523 1991	Interface-Roughness Limited Mobility in HgTe-CdTe Superlattices
30	Jour. Appl. Phys., 69(8), 4178, Apr. 1991	Development of High Power CW KCL:Li(F2a) Color Center Laser
31	Phys. Rev. B., Vol. 44, 3455 1991	Magnetic Activation of Bipolar Plasmas in HgTe-CdTe Superlattices
32	Appl. Phys. Letts., 59 (7), p. 756, Aug.1991	Etalon Enhancement of Nonlinear Optical Response in BiSb
33	JOSA B, Vol. 8, No. 4, April 1991	Alexandrite Laser Excitation of a Tm:Ho:YAG Laser
34	Mat. Res. Soc. Proc. 206, 175 1991	Gold Cluster Laden Polydiacetylenes: Novel Materials for Nonlinear Optics
35	37 Appl. Phys., 70, 4317 1991	Effects of Energy Gap and Band Structure on Free Carrier Nonlinear Susceptibilities in Semiconductors
36	39 Appl. Phys. 69(3), p. 1648, Feb.1991	Intensity Dependent Upconversion Efficiencies of Er ions in Heavy-metal Fluoride Glass
37	Jour. Crystal Growth, 111, 693-696 1991	Strong Nonlinear Optical Enhancement in MBE Grown BiSb
38	Phys. Rev. B, 44, 8376 1991	Electron Mobilities and Quantum Hall Effect in Modulation-doped HgTe-CdTe Superlattices
39	Opt. Lettsl, 16, 232 1991	Continuous Wave 1.5 Micron Thulium Cascade Laser
40	Solid State Comms., 80, 95 1991	In-band Nonlinear Optical Properties of PbSnSe
41	Electronics Letters March 1991	Polarization Insensitive Fiber Optic Michelson Interferometer
42	Electronics Letters March 1991	Demonstration of a Hybrid Time Wavelength Division Multilpexed Interferometric Fiber Sensor
43	IEEE Photonics Letts. June 1991	Phase Tuning by Laser Ablation of LiNbO3 Interometric Modulators to Optimum Linearity

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44	Electronics Letters March 1991	Experimental Investigation of Polarization Induced Fading in Interferometric Fiber Sensor Array
45	Optical Pulses Applied Physics Letters July 1991	Response Of InP/GaInAsP/InP Heterojunction Bipolar Transistors to 1530 & 620nm Ultrafast Optical Pulses
46	Electronics Letters May 1991	50 Watt Broad Area Semiconductor Amplifier
47	Electronics Letters August 1991	Visibility Limits in a Fiber Optic Michelson Interferometer with Birefringence Compensation
48	Appl. Phys. Letts. July 1991	Low Frequency Magnetic Field Mixing Near Period Doubling Bifurcation of a Fiber Optic Magnetometer
49	IEEE Trans. on Magnetics, Vol. 27, #6, Nov 1991	Characteristics of a Parametric Magnetostrictive Oscillator
50	Optics Letters, Vol. 16, #18 Sept. 1991	A Fiber Optic DC & Low Frequency Electric Field Sensor
51	Electronics Letters August 1991	A Technique for Measuring Facet Reflectivity & Effective Index of a Laser Amplifier
52	Opt. Ltrs, V. 16, p 1902, 1991	57 Micron All Fiber Optic Gyroscope w/Noise Subtraction
53	Optics Letters, Vol. 16, #24 Dec 1991	Dispersion in Rare-earth Doped Fibers
54	Journal of Lightwave Technology, Vol. 9, No. 9 Sept. 1991	High Frequency Response of Fiber Optic Planar Acoustic Sensors
55	61 Underwater Acoustics May 1991	High Performance Fiber Optic Hydrophone
56	63 Underwater Acoustics, July 1991	Acoustic Noise Measurements Utilizing High Performance Fiber Optic Hydrophones in the Arctic
57	Nuclear Instruments and Methods A, 304,526 1991	Recent Advances in Free Electron Laser Theory
58	Physical Review Letters, 66, 1446, March 1991	Quantum Extension of Child-Langmuir Law
59	Applied Physics Letters, Volume 59, Page 2192 67 1991	50-Nanometer Linewidth Platinum Sidewall Lithography by Effusive-Source Metal Precursor Chemical Deposition and Ion-Assisted Etching

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60	Journal of Applied Physics, Volume70, Page 1793 (August 1991)	High Resolution Electron Beam Lithography with a Polydiacetylene Negative Resist at 50KV
61	Surface Science, Volume241, Page 357 (August 1991)	Infrared Refelection Absorption Spectroscopy Study of Chemisorption on the Ni(001)-c(2X2)Si Surface
62	Journal of Vacuum Science Technology, Volume 9, Page 1367 (March/April 1991)	Investigations of Undeveloped e-beam Resist with a Scanning Tunneling Microscope
63	Inorganic Chimica Acta, Volume 187, Page 207 (September 1991)	Primary and Secondary Neopentyl Arsines and Their Reactions with Trimethylgallium. Crystal and Molecular Structure of $[Me_2GaAs(CH_2CMe_3)_2]_2$
64	Surface Science, Volume 249, Page 159 (1991)	Submonolayer Cluster Formation at the Ge/Al_2O_3 (1102) Interface
		Revised-Deleted R
65	IEEE Transactions on Magnets, Volume 27, No. 2, Page 1406 (March 1991)	Preparation of Thin Films of YlBa2Cu3O7-x by Magnetron Sputtering Techniques
66	IEEE Transactions on Magnets, Volume 27, No. 2, Page 884 (March 1991)	Particle-Induced Modification of Thin Film YBa2Cu3O7-ΔTransport Properties and Microwave Device Performance
67	IEEE Transactions on Magnets, Volume 27, No. 2, Page 1536 (March 1991)	Detection of Light Using High Temperature Superconducting Microstrip Lines
68	Journal Applied Physics, 70, (9), Page 4995 (November 1991)	Light Detection Using High-Tc Microstrip Transmission Lines as a Probe of Film Homogeneity
69	Physical Review B, Volume 44, No. 17, Page 9609 (November 1991)	Response of Granular Superconducting YBa2.1Cu3.407-x to Light
70	Thin Solid Films, 206, Pages 128 - 131 (1991)	YBa2Cu3O7- =ΔThin Films Deposited by an Ultrasonic Nebulization and Pyrolysis Method
71	IEEE Transactions on Magnets, Volume 27, No. 2, Page 2540 (March 1991)	Microwave Devices Using YBa2Cu3O7-ΔFilms Made by Pulsed Laser Deposition
72	Supercond. Science Technology, 4, Pages 449 - 452 (1991)	High Temperature Superconductivity Space Experiment (HTSSE)

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73	Applied Physics Letters, 59 (23), Page 3033 (December 1991)	Penetration Depth and Microwave Loss Measurements with a YBa2Cu3O7-Δ/LaAlO3/YBa2Cu3O7-ΔTrilayer Transmission Line
74	IEEE Transactions on Magnetics, Volume 27, No. 2, Page 2533 (March 1991)	High Temperature Superconductivity Space Experiment (HTSSE)
75	IEEE Transactions on Magnets, Volume 27, No. 2, Page 1332 (March 1991)	Investigation of ErBa2Cu3O7/Cu2O/Normal Metal Tunnel Structures
76	Journal of Applied Physics, 70, (1), 4 (1991)	Beam Divergence from Sharp Emitters in a General Longitudinal Magnetic Field
77	IEEE Transactions on Microwave Theory and Techniques, 39, 1010 (1991)	Cold Tests of Quasi-Optical Gyrotron Resonators
78	Physics of Fluids B, 3 (11), 3177 (1991)	Depressed Collector Experiments on a Quasioptical Gyrotron
79	IEEE Journal of Quantum Electronics, 27, 2529 (1991)	Evolution of A Finite Pulse of Radiation in a High-Power Free- Electron Laser
80	Journal of Applied Physics, 69 (9), 6696 (1991)	High-Voltage Millimeter-Wave Gyro-Traveling-Wave Amplifier
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168	Physical Review B Volume 47(8) Page 4238 February 1993	First-Principles Calculations of Spin-Orbit Splittings in Solids using Nonlocal Separable Pseudopotentials
169	J. Vac. Sci. Technol. B. Volume 11(4) Page 1693 July/August 1993	Effect of Interfacial Bond Type on the Electronic and Structural Properties of GaSb/InAs Superlattices
170	Proceedings of the SOTAPOCS XVIII Conference by the Electro Chemical Society Volume 93-27 Page 263 1993	Characterization of Bulk Semi-Insulating GaAs Grown by a Vertical Molten Zone MethodSb Surface Segregation and Doping in Si(100) Grown at Reduced Temperature by Molecular Beam Epitaxy
171	Appl. Phys. Lett Volume 63(10) Pages 1381-1383 September 1993	Sb Surface Segregation During Heavy Doping of Si(100) Grown at Low Temperature by Molecular Beam Epitaxy
172	J. Vac. Sci. Techno. B Volume 11(3) Pages 1115-1119 May/June 1993	Sb Surface Segregation During Heavy Doping of Si(100) Grown at Low Temperature by Molecular Beam Epitaxy
173	Appl. Phys. Lett. Volume 63(5) Pages 702-704 August 1993	Field Emission from an Elliptical Boss: Exact Versus Approximate Treatments
174	Journal of Vacuum Science Technology B Volume 11(2) Pages 371-378 March/April 1993	Numerical Smulation of Field Emission from Silicon
175	Journal of Applied Physics Volume 73(6) Pages 3108-3110 March 1993	Deposition and Surface Characterization of High Quality Single Crystal GaN Layers
176	Journal of Applied Physics Volume 73(9) Pages 4700-4702 May 1993	Influence of Buffer Layers in the Deposition of High Quality Single Crystal GaN Over Sapphire Substrates
177	Superlattices & Microstructures Volume 13(2) Pages 271-273 1993	Radiative Recombination of Free Excitons in GaAs Quantum Wells
178	Springer Series in Chemical Physics Volume 55 Pages 472-474 1993	Radiative Recombination of Free Excitons in GaAs Quantum Wells

179	J. Vac. Sci.Technol. B. Volume 11(3) Pages 1003-1006 May/June 1993	Comparison of Optical Pyrometry and Infrared Transmission Measurements on Indium-Free Mounted Substrates During Molecular-Beam Epitaxial
180	Journal de Physique IV Volume 3 Pages 19-25 October 1993	Lifetime of Excitons in GaAs Quantum Wells
181	J. Vac. Sci. Technol. B Volume 11(3) Page 1154 May/June 1993	Optically Detected Magnetic Resonance of Sharp Luminescence from Si/Si1-xGex Superlattices
182	Electronics Letters Volume 29(19) Page 1727 September 1993	Observation of New Vibronic Luminescence Band in Semiconducting Diamond
183	IEE Proceedings-H Volume 140(3) Pages 147-164 1993	Waveguiding Structures Employing the Solid-State Magnetoplasma Effect for Microwave and Milimetre-Wave Propagation
184	1993 IEEE AP-S International Symposium Digest Volume 1 Pages 412-415 1993	Auxiliary Vector Function Method for Vector Variational Approach for The Solution of Complex Anisotropic Media Using Finite Element Numerical Method
185	1993 IEEE AP-S International Symposium Digest Volume 1 Pages 424-427 1993	Finite Element Method for Nonhermitian Bianisotropic Media
186	1993 IEEE AP-S International Symposium Digest Volume 1 Pages 189-192 1993	Fundamental Properties of Chiral Type Media
187	IEEE Proceedings-H Volume 140(3) Pages 242-248 1993	Nonreciprocal Electromagnetic Properties of Composite Chiral-Ferrite Media
188	1993 SBMO International Microwave Conference/Brazil Proceedings Volume 1 Pages 577-586 1993	Properties of Composite Chiral - Ferrite Media

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189	1993 SBMO International Microwave Conference/Brazil Proceedings Volume 1 Pages 597-602 1993	Weighted Residual Finite Element Method for General Nonhermitian Anisotropic Media
190	Journal of Applied Physics Volume 74(4) Pages 2633-2637 August 1993	Submillimeter Wave Low Temperature Admittance of N-GaAs and N-InP Diode Structures
191	IEEE Transactions on Electron Devices Volume 40(10) Pages 1740-1744 October 1993	Compressing Photodetectors for Long Optical Pulses Using a Lateral Blooming Drain Structure
192	J. of Electronic Materials Volume 22(12) Pages 1437-1440 1993	Diode Structures from Amorphous Low-Temperature GaAs
193	IEEE SOI Conference Proceedings Pages 70-71 10/05-07/93 1993	Electron Trapping in Simox with Supplemental Implant
194	Superlattices and Microstructures Volume 13(1) Page 93 1993	Theory of Electromagnetic Wave Propagation in Superlattices with Optically Anisotropic Layers
195	Physical Review B Volume 48(8) Page 5338 August 1993	Subband Structures of Strained A1Sb/InAs/A1Sb Quantum Wells
196	The Physics of Semiconductors World Scientific Co. Page 745 1993	Quasi-Two Dimensional Electrons in AlSb/InAs Quantum Wells
197	J. Appl. Phys. Volume 74(5) Pages 3091-3098 September 1993	Observation of Ion-Implantation-Damage-Created n-Type Conductivity in InP after High-Temperature Annealing
198	J. Appl. Phys. Volume 74(3) Page 1805 August 1993	Identification and Activation Energies of Shallow Donors in Cubic SiC
199	Physical Review B Volume 48(16) Page 12289 October 1993	Nitrogen Donor Excitation Spectra in 3C-SiC)
200	Physical Review B Volume 47(7) Pages 4115-4118 February 1993	Hydrogen Permeability in Thermally Grown Films of SiO2 on Silicon Substrates

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201	Physical Review B Volume 48(24) Pages 17-972-17-985 Decmber 1993	Evidence of Long-Range Density Gradient in SiO2 Films on Si from H2-Permeability Measurements
202	IEEE Transactions on Microwave Theory and Techniques Volume 41(6/7) Pages 1081-1086 June/July 1993	Losses in Y-Junction Stripline and Microstrip Ferrite Circulators
203	Microwave and Optical Technology Letters Volume 6(13) Pages 725-728 October 1993	Measurement of the Current-Density Distribution in High-Temperature Superconducting Microstrip by Means of Kinetic-Inductance Photoresponse
204	Proceedings of the Sixth European Conference - Academy of Mining and Metallurgy Materials Science Forum Volume 119-121 1993	Applications of the Coupling Model to Some Problems in Mechanical Spectroscopy of Metals
205	Macromolecules Volume 26(5) Pages 1065-1071 1993	Viscoelastic Properties of Amorphous Polymers. 2. Anomalous Temperature Dependence of the Steady-State Recoverable Compliance in Low Molecular Weight Polymers
206	Physical Review B Volume 47(9) Pages 5041-5046 March 1993	Extended Kronmuller Model for Cooperative Relaxations in Metallic Glasses
207	Journal of Non-Crystalline Solid Volume 155 Pages 189-193 1993	Single Particle Jumps and Correlated Ionic Motions in Glass-Ceramics
208	J. Chem. Phys. Volume 98 (9) Pages 7588-7592 May 1993	Comparisons Between Coupling Model and Molecular Dynamics Simulation for Local Chain Motions in Bulk Amorphous Polymers
209	J. Chem. Phys. Volume 98(8) Pages 6488-6491 April 1993	Breakdown of the Rouse Model for Polymers Near the Glass Transition Temperature
210	J. Chem. Phys. Volume 98(8) Pages 6424-6430 April 1993	Difference Between Nuclear Spin Relaxation and Ionic Conductivity Relaxation in Superionic Glasses

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211	Macromolecules Volume 26(11) Pages 2688-2690 May 1993	Intermolecular Cooperativity and the Temperature Dependence of Segmental Relaxation in Semicrystalline Polymers
212	Solid State Ionics Volume 61 Pages 345-353 1993	Comparisons Between 23 Na and 27 Al Nuclear Spin Relaxations and Electrical Conductivity Relaxation in Na b -Alumina
213	Proceedings of X11 International Conference on Defects in Insulating Materials 08/16-22/92 Volume 1 Pages 53-68 1993	Modelling Ionic Transport from the Structure of Silicate Glasses
214	Progress in Colloid & Polymer Science Volume 91 Pages 72-74 1993	Dynamic Lights Scattering Study of a 1,4-Isoprene-b-Styrene Copolymer
215	Progress in Colloid & Poymer cience Volume 91 Pages 135-137 1993	Solvent Reorientation Dynamics in Aroclor/Polymer Solutions
216	Journal of Molecular Liquids Volume 56 Pages 199-214 1993	Cooperative Dynamics in Relaxation: A Coupling Model Perspective
217	J. Chem. Phys. Volume 99(5) Pages 4201-4209 September 1993	Nonexponential Relaxtions in Strong and Fragile Glass Formers
218	Journal of Non-Crystalline Solids Volume 162 Pages 268-274 1993	Absence of Difference Between 11B Nuclear Spin Relaxation and Li Ion Conductivity Relaxation in (LiCl)0.6-(Li2O)0.7-B2O3)1.0 Superionic Glasses
219	Physical Review B Volume 48(18) Pages 13 481-13 485 November 1993	Analysis of NMR and Conductivity-Relaxation Measurements in Glassy Li2S-SiS2 Fast-Ion Conductors
220	Macromolecules Volume 26 (25) Pages 6824-6830 December 1993	Chemical Structure and Intermolecular Cooperativity: Dielectric Relaxation Results

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221	Physica C Volume 209 Pages 263-268 May 1993	Space Applications of High Temperature Superconductivity: The High Temperature Superconductivity Space Experiment (HTSSE)
222	Journal of Crystal Growth Volume 128 Pages 483-487 1993	Sequential Etching of GaAs
223	Semiconductor Science and Technology Volume 8 Pages S112-S116 1993	Magneto-Optic and Magnetotransport Study of InAs/Ga1-xInxSb Superlattices
224	Physical Review B Volume 48(15) Pages 439-442 October 1993	Magnet-Optical Determination of T-Point Energy Gap in Bismuth
225	Electronics Letters Volume 29(1) Pages 18 and 19 January 1993	Reactive Ion Etching of b-SiC in CC12F2/O2
226	Journal of Electronic Materials Volume 22(2) Pages 201-206 January 1993	Lattice Mismatched InGaAs on Silicon Photodetectors Grown by Molecular Beam Epitaxy
227	Applied Physics Letters Volume 62(5) Pages 533-534 February 1993	Proximity Effect Reduction Using Thin Insulating Layers
228	Proceedings of the IEEE Volume 81(9) Pages 1249-1274 September 1993	X-Ray Lithography- An Overview
229	Analytical Chemistry Pages 311R-333R June 1993	Surface Characterization
230	Journal of Vacuum Science Technology B Volume 11(6) Pages 2597-2602 1993	Determination of Acid Diffusion Rate in a Chemically Amplified Resist With Scanning Tunneling Microscope Lithography
231	IEEE Trans. on Appl. Superconductivity Volume 3 (1) Pages 1438-1441 March 1993	$YBa_2Cu_3O_{7-8}/LaAlO_3/YBa_2Cu_3O_{7-8}$ Trilayers Transmission Lines for Measuring the Superconducting Penetration Depth

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232	IEEE Trans. on Appl. Superconductivity Volume 3(1) Pages 1711-1714 March 1993	A Novel Microstrip-Compatible Technique for Depositing $YBa_2Cu_3O_{7-8}$ on Both Surfaces of a Substrate
233	Physical Review B Volume 47(5) Pages 2780-2795 February 1993	Structure of Intralayer and Interlayer Pairing Interactions, the Anisotropy of Order Parameters, and the Transition Temperature in Layered Superconductors
234	Physical Review A Volume 47(5) Part A Pages R3465-R3467 May 1993	Coordinate and Momentum Representations of the q-Deformed Oscillator and Their Interpretation
235	Frontiers in Solid State Sciences Volume 1 Pages 193-209 1993	Superconductivity in High Magnetic Fields from a Microscopic Theory
236	Phonons in Semiconductor Nanostructures (NATO/ASI Series) J. P. Leburton et al. (eds) Pages 353-361 1993	Phonon Assisted Optical Properties of Semiconductor Nanostructures
237	Physical Review B Volume 48(4) Page 2223 July 1993	Plasmons Localized at Point Charges in Semiconductor Quantum Wells
238	Physical Review B Volume 48(8) Page 5679 August 1993	Surface Modes of the Clean Reconstructed W(100) Surface
239	Physical Review B Volume 48(8) Page 5700 August 1993	Electron-Phonon Scattering Rates in Quantum Wires
240	Physical Review B Volume 48(16) Page 12338 October 1993	Coupling of Electrons to Interface Phonons in Semiconductor Quantum Wells
241	Physical Review B Volume 48(24) Page 18 037 December 1993	Effects of Boundary Conditions on Confined Optical Phonons in Semiconductor Nanostructures
242	Physical Review E Volume 48(1) Pages R17-R20 July 1993	Interaction of a Relaxing System with a Dynamical Environment

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243	Macromolecules 1992 Pages 83-95 1993	The Coupling Model for Cooperative Relaxations and Its Applications
244	Physical Review B Volume 47(14) Pages 8843-8850 April 1993	Vortex-Lattice Solutions of the Microscopic Gorkov Equations for a Type II Superconductor in a Strong Quantizing Magnetic Field
245	Journal of Physics and Chemical Solids Volume 54(10) Pages 1281-1282 1993	Manifestations of the Landau Quantization in Type II Superconductors in High Magnetic Fields
246	J. Appl. Phys. Volume 74(5) Pages 3303-3306 September 1993	Comparison of Interface Trap Densities Measured by the Jenq and Charge Pumping Techniques
247	IEEE Transactions on Nuclear Science Volume 40(6) Pages 1341-1349 December 1993	Effects of Post-Stress Hydrogen Annealing on MOS Oxides after ^{60}Co Irradiation or Fowler-Nordheim Injection
248	Applied Physics Letters Volume 63(19) Pages 2652-2654 November 1993	Random Telegraphic Noise in Double-Barrier Systems
249	J. Vac. Sci. Technol. B Volume 11(3) Page 994 May/June 1993	Variations in Substrate Temperature Induced by Molecular-Beam Epitaxial Growth on Radiatively Heated Substrates
250	Physical Review B Volume 48(23) Page17 172 December 1993	Planar Vibrational Modes in Superlattices
251	Proceedings of the 4th International Superconductive Electronics Conference, ISEC93 Pages 256-257 1993	YBCO Josephson-Effect Devices with YBCO/Insulator Composite Barriers
252	IEEE Trans. Applied Superconductivity Volume 3(1) Pages 1612-1615 1993	Electron Transport and Magnetic Penetration Depth in Niobium-Silicon Multilayers
253	IEEE Transactions on Electron Devices Volume 40(4) Pages 824-829 April 1993	Secondary Emission Properties as a Function of the Electron Incidence Angle

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254	J. Appl. Phys. Volume 73(12) Pages 8161-8168 June 1993	Lattice Position of Si in GaAs Determined by X-Ray Standing Wave Measurements
255	Physical Review B Volume 47(23) Page 16032 June 1993	Optical Absorption Spectroscopy of Single Defects in GaAs/$Al_xGa_{1-x}As$ Tunnel Structures
256	Appl. Phys. Lett. Volume 63(6) Page 749 August 1993	Fabrication of Silicon Nanostructures with a Scanning Tunneling Microscope
257	Appl. Phys. Lett. Volume 63(25) Page 3488 December 1993	Fabrication of GaAs Nanostructures with a Scanning Tunneling Microscope
258	IEEE Transactions on Nuclear Science Volume 40(6) Pages 1740-1747 December 1993	Reduction of Charge Trapping and Electron Tunneling in SIMOX by Supplemental Implantation of Oxygen
259	Journal of Applied Physics Volume 73(2) Pages 658-667 January 1993	Post-Irradiation Cracking of H_2 and Formation of Interface States in Irradiated Metal-Oxide-Semiconductor Field-Effect Transistorss
260	Physical Review B Volume 47(2) Page 681 January 1993	Low-Frequency Excitations in Sodium b-Alumina: An NMR Study
261	Diamond and Related Materials Volume 2 Page 87-91 1993	Photoluminescence and Cathodoluminescence Studies of Semiconducting Diamond
262	Electronics Letters Volume 29(1) Pages 26-27 January 1993	Application of Micro-Airbridge Isolation in High Speed HBT Fabrication
263	1993 International Semiconductor Devices Research Symposium Proceedings Volume 1 Pages 389-392 1993	DC and Large-Signal AC Electron Transport Properties of GaAs/InGaAs/AlGaAs Heterostructure Barrier Varactors
264	1993 International Semiconductor Devices Research Symposium Proceedings Volume 1 Pages 775-778 1993	Efficient Computer Aided Design of GaAs and InP Second Harmonic Millimeter Wave TEDs

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265	Solid State Electronics Volume 36(3) Pages 387-389 1993	Characterization of Molecular Beam Epitaxially Grown InSb Layers and Diode Structures
266	IEEE Transactions on Nuclear Science Volume 40(5) Pages 1342-1346 October 1993	Bonded Wafer Substrates for Integrated Detector Arrays
267	J. Appl. Phys. Volume 74(11) Pages 6686-6690 December 1993	Controlled p- and n-Type Doping of Homo- and Heteroepitaxially Grown InSb
268	SSDM 93 Japan Society of Applied Physics Pages 234-236 August/September 1993	Parametric Investigation of $Si_{1-x}Ge_x$/Si Multiple Quantum Well Growth
269	J. Vac. Sci. and Techno. B Volume 11(3) Pages 1077-1082 May/June 1993	Low Temperature Cleaning Processes for Si Molecular Beam Epitaxy
270	Physical Review B Volume 48(23) Page 17 031 December 1993	Optically Detected Magnetic Resonance of Shallow Donors in GaAs
271	Appl. Phys. Lett Volume 63(3) Pages 320-321 July 1993	Solid-Phase Regrowth of Amorphous GaAs Grown by Low-Temperature Molecular-Beam Epitaxy
272	IEEE Transactions on Plasma Science Volume 21(6) Pages 654-668 December 1993	Field Theory of a Traveling Wave Tube Amplifier with a Tape Helix
273	Semiconductor Science and Technology Volume 8 Pages S106-S111 1993	The Effect of Interface Bond Type on the Structural and Optical Properties of GaSb/InAs Superlattices
274	1993 IEEE MTT-S International Microwave Symposium Digest Volume 1 Pages 203-206 1993	Status of Ferrite Technology in the United States
275	Physical Review B Volume 47(3) Pages 1691-1694 January 1993	Enhancement of Cyclotron Mass in Semiconductor Quantum Wells
276	Applied Physics Letters Volume 63(25) Pages 3434-3436 December 1993	Dependence of InAs Phonon Energy on Misfit-Induced Strain

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277	Physical Review B Volume 47(11) Pages 6807-6810 March 1993	Spin-Resolved Cyclotron Resonance in InAs Quantum Wells: A Study of the Energy Dependent g-Factor
278	IEEE Transactions on Electron Devices Volume 40(5) Pages 1009-1016 May 1993	Simulation of Field Emission Microtriodes
279	Chemistry of Materials, 5:148-150 1993	Photopatterning and Selective Electroless Metallization of Surface-Attached Ligands
280	Thin Solid Films, 224:242-247 1993	Palladium Ion Assisted Formation and Metallization of Lipid Tubules
281	Liquid Crystals, 13(1):163-170 1993	Scanning Tunneling Microscopic Study of the Interfacial Order in a Ferroelectric Liquid Crystal
282	SPIE, 1924:30-41 1993	Soft X-ray (14nm) Lithography with Ultrathin Imaging Layers and Selective Electroless Metallization
283	ACS Symposium Series on Polymers for Microelectronics, 537:210 1993	Top Surface Imaging Using Selective Electroless Metallization of Patterned Monolayer Films
284	Optical Engineering, 32(10):30 1993	Projection X-ray Lithography with Ultrathin Imaging Layers and Selective Electroless Metallization
285	Science, 262:1669-1676 1993	Lipid Tubules: A Paradigm for Molecularly Engineering Structures
286	Japanese Journal of Applied Physics, 32(1:12B):5829-5839 1993	Patterning of Self-Assembled Films Using Lithographic Exposure Tools
287	Applied Physics Letters, 63(9):1285-1287 1993	Ferroelectricity in a Langmuir-Blodgett Multilayer Film of a Liquid Crystalline Side-Chain Polymer
288	Journal of Vacuum Technology B, 11(6):2155 1993	Lithographic Patterning of Self-Assembled Monolayer Films
289	Analytical Chemistry 1993	Continuous Flow Immunosensor for Detection of Explosives
290	Journal of Vacuum Science and Technology B, 11(6):2155-2163 1993	Lithographic Patterning of Self-Assembled Films

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291	NRL Review Page 154 May 1993	Risk Assessment and Directed Energy Weapons	R
292	Conference Record of 1993 IEEE Nuclear Science Symposium 1993	Laboratory Testing of a Volume Imaging Germanium Compton Camera	R
293	Conference Record of 1993 IEEE Nuclear Science Symposium 1993	Multiparameter Data Acquisition System for Germanium Compton Telescope	R
294	Proceedings of 3rd International Symposium of Diamond Materials Electrochemical Society Pages 498-504 1993	Diamond Deposition from ECR-Generated Plasmas	R
295	SPIE Conference on Photonics for Space Environments April 1993	Candidate NRL Space Experiments for the Microelectroncis and Photonics Test Bed (MPTB)	R
296	Proceedings of 23rd IEEE Photovoltaic Specialist Conference may 1993	One MeV Electorn Irradiation of Monolithic, Two-Terminal inP/InGaAs Tandem Solar Cells	R
297	Proceedings of SPIE Critical Review of Optical Science and Technology September 1993	A Review of Space Radiation Effects for Fiber Optic Data Links	R
298	Journal of Applied Physics Volume 73(1) Pages 60 January 1993	Optimizing the Radiation Resistance of InP Solar Cells: Effect of Dopant Density and Cell Thickness	R
299	1993 SPIE Proceedings Volume 1953 Pages 104-115 1993	Physical Interactions Between Charged Particles and Optoeledtronic Devices and Effects on Fiber Based Data Links	R
300	1993 SPIE April 1993	Microelectronics and Photonics Test Bed (MPTB)	R
301	Proceedings of IEEE 5th International Conference on InP and Related Materials April 1993	* 10 - Effects of Base Dopant Level and Thickness on the Radiation Response of $Ga_{0.47}In_{0.53}$ as Solar Cells	R
302	IEEE NSRC Workshop Proceedings July 1993	Radiation Hardness Assurance Characterization Testing of InGaAsP Fiber Optic Transmitter and Receiver Modules	R

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303	1993 SPIE Proceedings Volume 1953 Pages 27-36 1993	Photon Irradiation SEU Test Results for the SEDS MIL-STD-1773 Fiber Optic Datbus: Integrated Optoelectronics	R
304	Geophysical Research Letters Volume 20 Pages 975 May 1993	Plasma Dynamics Driven by Finite-Width Current Filaments and KV Potential Drops in Ionosphere-Magnetosphere Coupling	R
305	International Journal of Bifurcation and Chaos Volume 3 Pages 3773 1993	Refurring Anti-Phase Signals in Coupled Nonlinear Oscillators: Chaotic or Random Time Seriew?	R
306	Physical Review E Volume 48 Pages 718 August 1993	Stochastic Tracking in Nonlinear Dynamical Systems	R
307	Physics of Fluds B Volume 5 Pages 1391 October 1993	Sub-Alfvenic Plasma Expansion	R
308	Journal of Applied Physics] Volume 74 Pages 5432 November 1993	X-Ray Damage Testing to Optical Components Using a Laser-Plasma Source	R
309	IEEE Transactions on Plasma Science Volume 21 Pages 383 August 1993	Study of Gain in B-Band Deflection Cavities for a Frequency-Doubling Magnicon Amplifier	R
310	Physics of Fluds B Volume 5 Pages 2682 July 1993	New Results and Applications for the Quasioptical Gyrotron	R
311	Physics of Fluds B Volume 5 Pages 3045 August 1993	Nonlinear Analysis of a Magnicon Output Cavity	R
312	Physics of Fluds B Volume 5 Pages 2905 August 1993	Viscoresistive Stabilization of the Z Pinch	R
313	Physical Review E Volume 47 Pages 2798 April 1993	Escape Time of Heliumlike Alpha-Resonance-Line Photons Emitted from Optically Thick Plasmas	R

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314	Journal of Applied Physics Volume 74 Pages 4303 October 1993	Modeling the Coaxial Double Z-Pinch for the Al DXI-Mg IX Laser at 228	R
315	Proceedings of the 9th International Conference on High Power Particle Beams 1 Page 167 1993	Radiative Z-Pinch Coupling to an Inductive Generator	R
316	Proceedings of SPIE Volume1872 Pages 2 1993	High Power Relativistic Klystron Amplifier Research at the Naval Research Laboratory	R
317	Proceedings of SPIE Volume 1872 Pages 96 1993	The Two-Beam Simulation-Imposition of the Radiation Condition	R
318	International Journal of Infrared and Millimeter Waes Volume 14 Pages 335 1993	RF Convertor Simulation - Imposition of the Radiation Condition	R
319	Applied Physics Letters Volume 62 Pages 2772 May 1993	External Modulation of Intense Relativistic Electron Beams with Spatial and Velocity Inhomogeneities	R
320	11th International Conference on Laser Interaction and Related Plasma Phenomenba 1993	The Nike KRF Laser Program	R
321	Proceeding of 9th IEEE Pulsed Power Conference 1993	The Nike 60 cm Electron Beam-Pumped KrF Amplifier	R
322	Proceedings of the 9th IEEE Pulsed Power Conference 1993	ZFX - A 330 kj, 1 MV Pulsed Power Driver Using a Parallel Plate Water Capacitor	R
323	Proceedings of SPIE Volume 1870 Pages 163 1993	Effects of Random Phase Distortion and Nonlinear Optical Processes on Laser Beam Uniformity with Induced Spatial Incoherence (ISI)	R
324	Physical Review Letters Volume 70 Pages 2573 April 1993	Current Neutralizaiton of Intense MeV Proton Beams Transported in Low-Pressure Gas	R
325	Journal of Applied Phyusics Volume 73 Pages 4181 May 1993	Simulation of Electron Beam Transport in Low-Pressure Gas Conditioning Cells	R

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326	Il Nuova Cimento Volume 106A Pages 1705 1993	Physics of Gas Breakdown for Ion Beam Transport in Gas	R
327	Nuclear Instruments and Methods A Volume 331 Pages 6 1993	Electron BEam Qualtiy Limitations and Beam Conditioning in Free Electron Lasers	R
328	Nuclear Instruments and Methods A Volume 331 Pages 545 1993	Laser Synchrotron Radiation as a Compact Source of Tunable Short Pulse Hard X-Rays	R
329	IEEE Trans. Plasma Sci Volume 21 Pages 95 February 1993	Nonlinear Analysis of Relativistic Harmonic Generation by Intense Lasers in Plasmons	R
330	Physical Review Letters Volume 70 Pages 2896 May 1993	Methods for Conditioning Electron Beams in Free-Electron Lasers	R
331	Physics Review E Volume 48 Pages 3003 1993	Nonlinear Thomson Scattering of Intense Laser Pulses from beams and Plasmas	R
332	Nuclear Instruments and Methods A Volume 331 Pages 371 1993	Thomson Backscattered X-Rays from an Intense Laser Beam	R
333	Physics of Fluids B Volume 5 Pages 2690 July 1993	Optically Guided Laser Wake-Field Acceleration	R
334	International Journal of Infraree Millimeter Waves Volume 14 pages 335 1993	RF Convertor Simulation-Imposition of the Radiation Condition	R
335	IEEE Transactions on Particle Accelerators Pages 1623 1993	Fundamental and Harmonics of Thomson Backscattered X-Rays from an Intense Laser Beam	R

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Pages D-B-1R thru D-B-77 dated 16SEP94
Replaced in their entirety by
Pages D-B-1R thru D-B-86R dated 20SEP94

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3.2.4.2 How many papers were published in peer reviewed journals? (BRAC Criteria I)

Electronic Devices Summary

CSF	Number Published	Paper Titles (List)
ED		
FY-91	282	See Listing **R - Revised**
FY-92	277	
FY-93	292	**R - Revised**
Total	861	**R - Revised**

CY91

CSF	Reference	Paper Titles (List)
ED	Optics Letters, Vol. 16, pp132-134	Mode Evolution of Induced Second-Harmonic Light in Optical Fiber
	Applied Optics, Vol. 30, 1944-1957	Correlation of Single Mode Fiber Radiation Response and Fabrication Parameters
	Applied Optics, Vol. 30,(22),1-5	An Interferometric Method for Concurrent Measurement of Thermo-Optic and Thermal Expansion Coefficient
	IEEE Journal of Quantum Electronics, Vol. 27, No. 4, 1031-1038	Spectroscopy and Laser Operation of Nd:ZBAN Glass
	Proc. IEEE, Vol. 79, No. 3	Advanced Channelization Technology for RF, Microwave, and Millimeter Wave Applications
	7 Applied Physics, Vol 73,No.2,925-928	Optical and Electrical Characterization of Magnesium-Doped Bismuth-Substited Lutetium Iron Garnet Thin Films
	J.Appl.Phys., Vol. 70, No. 9, p. 5144	A Thin Film Schottky Diode Fabricated from Flame Grown Diamond
	Applied Optics, Vol. 31,No.1,120-125	Image Speckle Contrast Reduction Resulting from Integrative Synthetic Aperture Imaging
	Optical Engineering, Vol. 31, NO. 11, 2355-2365	Short Wavelength Imaging Laser Radar Using a Digicon Detector
	Opt. Letters, Vol. 16, No. 10	Photorefractive Two Beam Coupling with White Light
	Applied Optics, 30, 401-406	Laser Beam Propagation Under Turbulent Conditions

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	JOSA B, Vol 8, 2, pg. 300	Spectral and Temporal Characterization of Spontaneous Raman Scattering in the Transient Reigime
	Optics Communications, Vol. 86	Second Stokes Generation in Deuterium
	IEEE J. Quantum Elec.,Vol. Q1 27, #4, 895-897	Tunable Laser Pumped 3 Micron Ho:YALO Laser
	Chemical Physics, Vol. 149,401-407	Photochemical Bleaching of Absorbed Rhodamine 6G as a Probe of Binding Geometries on a Fused Silica Surface
	Optics Communications, Vol. 80,p.317	Achromatic Multibeam Coupling in KNB03:Rb
	IEEE JQE, Vol. 27, No. 9	Laser and Spectral Properties of Cr:Tm:Ho:YAG at 2.1 Microns
	Theory, JOSA B, 1843	Incoherent Multimode Raman Amplification Theory
	Opt. Commun, 83, 103,	Correlation Effects in Pump Depleted Broadband Stimulated Raman Amplification
	Letters, Vol 67, No. 4, 437-440, July	Cavity Quantum Electrodynamic Enhancement of Stimulated Emission in Microdroplets
	Optics Letters, Vol. 16, 1147	Supression of Photorefractive Beam Fanning
	Optics Leters, Vol. 16, 23, 1868	Time-gated Imaging Through Scattering Media using Stimulated Raman Amplification
	Optics Letters, Vol. 16, 1723, Nov. 15	Effects of Absorption on Microdroplet Resonant Emission Structure
	IEEE JQE, QE-27, No. 4, 1129-1131, May	Short Pulse 2.1 Micron Laser Performance of Cr:Tm:Ho:YAG
	Proc. IEEE, Vol. 79, No. 1, Jan	Infrared Focal Plane Array Technology
	Physical Review B, Vol. 43, 14715	Comment on "Temperature-induced Intraband Transitions in the n-type HgTe/CdTe Superlattices"
	Jour. Vac. Sci. Tech., B9(3) 1813, May/June	Shubnikov-de Oscillations and Quantum Hall Effect in Modulation-doped HgTe-CdTe Superlattices
	Jour. Vac. Sci. Tech. B9, 1818	Theory for Electron and Hole Transport in HgTe-CdTe Superlattices
	Appl. Phys. Letts., 58, 2523	Interface-Roughness Limited Mobility in HgTe-CdTe Superlattices
	Jour. Appl. Phys., 69(8), 4178, Apr.	Development of High Power CW KCL:Li(F2a) Color Center Laser

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"Evolution of a Finite Pulse of Radiation in a High-Power Free-Electron Laser"
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D.D. M. Ho, I. Haber, K.R. Crandall, S.T. Brandon
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J. Krall, C.M. Tang, G. Joyce, P. Sprangle
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R.F. Fernsler, S.P. Slinker, R.F. Hubbard
Physics of Fluids B, 3 ~~(9)~~, 2696, 1991 September

"Theory of Wake-Field Effects of a Relativistic Electron Beam Propagating in a Plasma"
H.S. Uhm, G. Joyce
Physics of Fluids B, 3 ~~(7)~~, 1587, 1991 July

"Time-Dependent Multimode Simulation of Gyrotron Oscillators"
A.W. Fliflet, R.C. Lee, S.H.Gold, W.M. Manheimer, E. Ott
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"Vlasov Simulations of Very-Large-Amplitude-Wave Generation in the Plasma Wake-Field Accelerator"
J. Krall, G. Joyce, E. Esarey
Physical Review A, 44, 6854, 1991 November

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PAGES 1 thru 59 replaced in their entirety by PAGES D-B-1R thru D-B-77 dated 16 SEP 94

3.2.4.2 How many papers were published in peer reviewed journals? (BRAC Criteria 1)

Electronic Devices Summary

CSF	Number Published	Paper Titles (List)
ED		
FY-91	280	See Listing
FY-92	277	
FY-93	290	
Total	847	

CY91

CSF	Reference	Paper Titles (List)
ED	Optics Letters, Vol. 16, pp132-134	Mode Evolution of Induced Second-Harmonic Light in Optical Fiber
	Applied Optics, Vol. 30, 1944-1957	Correlation of Single Mode Fiber Radiation Response and Fabrication Parameters
	Applied Optics, Vol. 30,(22),1-5	An Interferometric Method for Concurrent Measurement of Thermo-Optic and Thermal Expansion Coefficient
	IEEE Journal of Quantum Electronics, Vol. 27, No. 4, 1031-1038	Spectroscopy and Laser Operation of Nd:ZBAN Glass
	Proc. IEEE, Vol. 79, No. 3	Advanced Channelization Technology for RF, Microwave, and Millimeter Wave Applications
	J. Applied Physics, Vol 73,No.2,925-928	Optical and Electrical Characterization of Magnesium-Doped Bismuth-Substited Lutetium Iron Garnet Thin Films
	J.Appl.Phys., Vol. 70, No. 9, p. 5144	A Thin Film Schottky Diode Fabricated from Flame Grown Diamond
	Applied Optics, Vol. 31,No.1,120-125	Image Speckle Contrast Reduction Resulting from Integrative Synthetic Aperture Imaging
	Optical Engineering, Vol. 31, NO. 11, 2355-2365	Short Wavelength Imaging Laser Radar Using a Digicon Detector
	Opt. Letters, Vol. 16, No. 10	Photorefractive Two Beam Coupling with White Light
	Applied Optics, 30, 401-406	Laser Beam Propagation Under Turbulent Conditions

	JOSA B, Vol 8, 2, pg. 300	Spectral and Temporal Characterization of Spontaneous Raman Scattering in the Transient Reigime
	Optics Communications, Vol. 86	Second Stokes Generation in Deuterium
	IEEE J. Quantum Elec.,Vol. Q1 27, #4, 895-897	Tunable Laser Pumped 3 Micron Ho:YALO Laser
	Chemical Physics, Vol. 149,401-407	Photochemical Bleaching of Absorbed Rhodamine 6G as a Probe of Binding Geometries on a Fused Silica Surface
	Optics Communications, Vol. 80,p.317	Achromatic Multibeam Coupling in KNB03:Rb
	IEEE JQE, Vol. 27, No. 9	Laser and Spectral Properties of Cr:Tm:Ho:YAG at 2.1 Microns
	Theory, JOSA B, 1843	Incoherent Multimode Raman Amplification Theory
	Opt. Commun, 83, 103,	Correlation Effects in Pump Depleted Broadband Stimulated Raman Amplification
	Letters, Vol 67, No. 4, 437-440, July	Cavity Quantum Electrodynamic Enhancement of Stimulated Emission in Microdroplets
	Optics Letters, Vol. 16, 1147	Supression of Photorefractive Beam Fanning
	Optics Leters, Vol. 16, 23, 1868	Time-gated Imaging Through Scattering Media using Stimulated Raman Amplification
	Optics Letters, Vol. 16, 1723, Nov. 15	Effects of Absorption on Microdroplet Resonant Emission Structure
	IEEE JQE, QE-27, No. 4, 1129-1131, May	Short Pulse 2.1 Micron Laser Performance of Cr:Tm:Ho:YAG
	Proc. IEEE, Vol. 79, No. 1, Jan	Infrared Focal Plane Array Technology
	Physical Review B, Vol. 43, 14715	Comment on "Temperature-induced Intraband Transitions in the n-type HgTe/CdTe Superlattices"
	Jour. Vac. Sci. Tech., B9(3) 1813, May/June	Shubnikov-de Oscillations and Quantum Hall Effect in Modulation-doped HgTe-CdTe Superlattices
	Jour. Vac. Sci. Tech. B9, 1818	Theory for Electron and Hole Transport in HgTe-CdTe Superlattices
	Appl. Phys. Letts., 58, 2523	Interface-Roughness Limited Mobility in HgTe-CdTe Superlattices
	Jour. Appl. Phys., 69(8), 4178, Apr.	Development of High Power CW KCL:Li(F2a) Color Center Laser

	Phys. Rev. B., Vol. 44, 3455	Magnetic Activation of Bipolar Plasmas in HgTe-CdTe Superlattices
	Appl. Phys. Letts., 59 (7), p. 756, Aug.	Etalon Enhancement of Nonlinear Optical Response in BiSb
	JOSA B, Vol. 8, No. 4, April	Alexandrite Laser Excitation of a Tm:Ho:YAG Laser
	Mat. Res. Soc. Proc. 206, 175	Gold Cluster Laden Polydiacetylenes: Novel Materials for Nonlinear Optics
	J. Appl. Phys., 70, 4317	Effects of Energy Gap and Band Structure on Free Carrier Nonlinear Susceptibilities in Semiconductors
	J. Appl. Phys. 69(3), p. 1648, Feb.	Intensity Dependent Upconversion Efficiencies of Er ions in Heavy-metal Fluoride Glass
	Jour. Crystal Growth, 111, 693-696	Strong Nonlinear Optical Enhancement in MBE Grown BiSb
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	Opt. Lettsl, 16, 232	Continuous Wave 1.5 Micron Thulium Cascade Laser
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	Electronics Letters, March	Polarization Insensitive Fiber Optic Michelson Interferometer
	Electronics Letters, March	Demonstration of a Hybrid Time Wavelength Division Multilpexed Interferometric Fiber Sensor
	IEEE Photonics Letts., June	Phase Tuning by Laser Ablation of LiNbO3 Interometric Modulators to Optimum Linearity
	Electronics Letters, March	Experimental Investigation of Polarization Induced Fading in Interferometric Fiber Sensor Array
	Optical Pulses Applied Physics Letters, July	Response Of InP/GaInAsP/InP Heterojunction Bipolar Transistors to 1530 & 620nm Ultrafast Optical Pulses
	Electronics Letters, May	12 Watt Broad Area Semiconductor Amplifier
	Electronics Letters, August	Visibility Limits in a Fiber Optic Michelson Interferometer with Birefringence Compensation
	Appl. Phys. Letts., July	Low Frequency Magnetic Field Mixing Near Period Doubling Bifurcation of a Fiber Optic Magnetometer
	IEEE Trans. on Magnetics, Vol. 27, #6, Nov	Characteristics of a Parametric Magnetostrictive Oscillator

	Optics Letters, Vol. 16, #18, Sept.	A Fiber Optic DC & Low Frequency Electric Field Sensor
	Electronics Letters, August	A Technique for Measuring Facet Reflectivity & Effective Index of a Laser Amplifier
	Opt. Ltrs, V. 16, p 1902,	1.06 Micron All Fiber Optic Gyroscope w/Noise Subtraction
	Optics Letters, Vol. 16, #24, Dec	Dispersion in Rare-earth Doped Fibers
	Journal of Lightwave Technology, Vol. 9, No. 9, Sept. 1991	High Frequency Response of Fiber Optic Planar Acoustic Sensors
	J. Underwater Acoustics, May 1991	High Performance Fiber Optic Hydrophone
	J. Underwater Acoustics, July 1991	Acoustic Noise Measurements Utilizing High Performance Fiber Optic Hydrophones in the Arctic
	Applied Physics Letters, Volume 59, Page 2192 (1991)	50-Nanometer Linewidth Platinum Sidewall Lithography by Effusive-Source Metal Precursor Chemical Deposition and Ion-Assisted Etching
	Journal of Applied Physics, Volume70, Page 1793 (1991)	High Resolution Electron Beam Lithography with a Polydiacetylene Negative Resist at 50KV
	Surface Science, Volume241, Page 357 (1991)	Infrared Refelection Absorption Spectroscopy Study of Chemisorption on the Ni(001)-c(2X2)Si Surface
	Journal of Vacuum Science Technology, Volume 9, Page 1367 (1991)	Investigations of Undeveloped e-beam Resist with a Scanning Tunneling Microscope
	Inorganic Chimica Acta, Volume 187, Page 207 (1991)	Primary and Secondary Neopentyl Arsines and Their Reactions with Trimethylgallium. Crystal and Molecular Structure of $[Me_2GaAs(CH_2CMe_3)_2]_2$
	Surface Science, Volume 249, Page 159 (1991)	Submonolayer Cluster Formation at the Ge/Al_2O_3 (1102) Interface
	Langmuir, Volume 7, Page 683 (1991)	Modeling the Growth of Semiconductor Epitaxial Films via Nanosecond Time-scale Molecular Dynamics Simulations
	IEEE Transactions on Magnets, Volume 27, No. 2, Page 1406 (1991)	Preparation of Thin Films of YlBa2Cu3O7-x by Magnetron Sputtering Techniques
	IEEE Transactions on Magnets, Volume 27, No. 2, Page 884 (1991)	Particle-Induced Modification of Thin Film YBa2Cu3O7-ΔTransport Properties and Microwave Device Performance

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	Journal Applied Physics, 70, (9), Page 4995 (1991)	Light Detection Using High-Tc Microstrip Transmission Lines as a Probe of Film Homogeneity
	Physical Review B, Volume 44, No. 17, Page 9609 (1991)	Response of Granular Superconducting YBa2.1Cu3.407-x to Light
	Thin Solid Films, 206, Pages 128 - 131 (1991)	YBa2Cu3O7- =ΔThin Films Deposited by an Ultrasonic Nebulization and Pyrolysis Method
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	Supercond. Science Technology, 4, Pages 449 - 452 (1991)	High Temperature Superconductivity Space Experiment (HTSSE)
	Applied Physics Letters, 59 (23), Page 3033 (1991)	Penetration Depth and Microwave Loss Measurements with a YBa2Cu3O7-Δ/LaAlO3/YBa2Cu3O7-ΔTrilayer Transmission Line
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	IEEE Transactions on Magnets, Volume 27, No. 2, Page 1332 (1991)	Investigation of ErBa2Cu3O7/Cu2O/Normal Metal Tunnel Structures
	Journal of Applied Physics, 70, (1), 4 (1991)	Beam Divergence from Sharp Emitters in a General Longitudinal Magnetic Field
	IEEE Transactions on Microwave Theory and Techniques, 39, 1010 (1991)	Cold Tests of Quasi-Optical Gyrotron Resonators
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	Physical Review A, 43, 11, 6166 (1991)	Time-Dependent Multimode Simulation of Gyrotron Oscillators
	Optic Communications 86, 236 (1991)	Separation of Nuclear and Electronic Contributions to Femtosecond Four-wave Mixing Data
	IEEE Transactions of Nuclear Science, NS-38, Volume 6, Pages 1647 - 1654 (1991)	SEU Flight Data From the CRRES MEP
	Chemical Physics Letters, 178, 69	Dephasing and Relaxation in Coherently-excited Ensembles of Intermolecular Oscillators
	IEEE Trans. Nucl. Sci., 38, 525-530	Radiation Survey of the LDEF Spacecraft
	IEEE Trans. Nuc. Sci.,NS-38, Vol. 6, 1540-1545	Comparison of Experimental Charge Collection Waveforms with Pisces Calculations
	J. Appl. Phys. 70, 4995-4999	Light Detection Using High-T, Microstrip Lines as a Probe of Film Homogeneity
	IEEE Trans. on Magnetics, Vol 27,No. 2, p.2533	High Temperature Superconductivity Space Experiment (HTSSE)
	IEEE Trans. Nucl. Sci., NS-38	Radiation Damage Assessment of Nb Tunnel Junction Devices
	Nature 349, 678-680	Observation of Beryllium 7 on the Surface of the LDEF Spacecraft
	Advances in the Astronautical Sciences 74, 575-583	Discovery of Be-7 Accretion in Low Earth Orbit
	IEEE Trans. Nucl. Sci., NS-38,Vol.6,1153-1158	Space Radiation Effects in InP Solar Cells
	IEEE Trans. Nuc. Sco., NS-38,Vol. 6,1329-1335	Ionizing Space Radiation Effects on Surface Acoustic Wave Resonators
	IEEE Trans. Nuc. Sco.,NS-38,Vol. 6,1398-1402	Radiation Characterization of the ADSP2100A Digital Signal Processor
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	Journal of Applied Physics, 69, 1435	Deep Level Transient Spectroscopy of Irradiated p-Type in InP Grown by MOCVD

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	Journal of Applied Physics, 69,1119	Critical Current Enhancement in Proton-Irradiated T12CaBa2O8 Films
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	Journal of Applied Physics 69(9)	Deep Level Transient Spectroscopy Study of Proton Irradiated p-type InP
	IEEE Transactions on Magnetics 27,2665-2668	Superconducting Tunnel Junctions for use as Energy Resolving X-Ray Detectors
	J. Appl. Phys. 69,4891-4893	Magnetically Modulated Microwave Absorption Measurement of the Penetration Depth in a Polycrystalline $YBa_2Cu_3O_{7-x}$ Thin Film
	Applied Physics Letters, 59(20)	Critical-Current Enhancement in Particle-irradiated Cuprate Superconductors
	IEEE Transactions on Magnetics, 27,884	Particle-Induced Modification of Thin Film YBaCu3O7-Xll
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	J. of Superconductivity 4,57-60	Proton-Induced Reduction of R, Jc, and Tc in YBa,CU_3O_7-∂ Thin Films
	J. Superconductivity, 4,57	Proton-Induced Reduction of Rs, Jc and Tc in YBa2Cu3O7 Thin Films
	Phys. Rev. Lett. 66,1785-1788	Observation of Ultrahigh Critical Current Densities in High-Tc Superconducting Bridge Constrictions
	Solid State Communications 78,631-633	Comparative Study of Microwave Surface Impedance of High Tc Superconductor Samples, Solid State Communications
	IEEE Trans. on Magnetics 27, 884-887	Particle-Induced Modification of Thin Film YBa,CU307
	11 IEEE Trans. Nuc. Sci., NS-38, Vol. 6,1370-1376	Charge Collection in GaAs MESFETs and MODFETS
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	IEEE Trans.Nuc.Sci.,NS-38, Vol. 6,1457-1462	Quantitative Comparison of single Event Upsets Induced by Protons and Neutrons
	Science and Technology of Thin Film Superconductors 2 Plenum Press, NY, NY Pages 67-74	Thin Films of $Y_1Ba_2Cu_3O_{7-d}$Prepared by 3-Target Co-Sputtering
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	Proceedings of 2nd European Symposium on Reliability of Electron Devices Failure Physics and Analysis (ESREF 91) Pages 411-422	GaAs MMIC Reliability Studies
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	Proceedings of the 3rd Int'l. Symposium on Ultra Large scale Integration Science and Technology Electro Chemical Society Journal Volume 91-11 Pages 409-415	Dielectric Breakdown Strength Analysis of SiO_2 Using a Stepped-Field Method
	Physics of Fluids B, Volume B3(1) Page 212	Mode Selection by Priming in An Overmoded Electron Cyclotron Maser
	Surface Science Volume 248 Pages 201-206	Infrared Reflection Absorption Spectroscopy of Adsorbates on Semiconductors with Buried Metal Layers - O_2/GaAs
	J. Vac. Sci. Technol A American Vacuum Society Volume 9 (6) Pages 3169-3172	Growth of Ultrathin Ni Layers on Ni(100): Infrared Spectroscopy of Adsorbed Carbon Monoxide as a Structural Probe
	Physical Review B American Institute of Physics Volume 44 (20) Pages 11 149 - 11 158	Preparation and Characterization of Carbon-Terminated b-SiC(001) Surfaces
	3rd International Conf. on InP and Related Materials Volume TuP.31 Pages 300-303	Low-Frequency Gain Dispersion, Optical Response. and 1f Noise in Ion-Implanted InP JFETs
	IEE Electronics Letters (IEE/London, UK) Volume 27 (21) Pages 1909-1910	InA1As/InGaAs/InP HEMTs with High Breakdown Voltages Using a Double-Recess Gate Process
	Proceedings of NASECODE VII Pages 49-52	Quantum Transport: Novel Approaches in the Formulation and Applications to Novel Semiconductor Devices
	Proceedings of NASECODE VII Pages 1-2	Intrinsic High-Frequency Oscillations and Equivalent Circuit Model in the Negative Differential Resistance Region of Resonant Tunneling Devices
	Appl. Phys. Lett. Volume 59(2) Pages 192-195	Monte Carlo Particle Simulation of Radiation-Induced Heating in GaAs Field-Effect Transistors
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	Proceedings of 4th International Symposium on Silicon-On-Insulator Technology Devices The Electrochemical Society, Inc. Volume 90-6 Pages 278-287	Heavy Metal Gettering in SIMOX Using Implanted Carbon
	American Institute of Physics J. Appl. Phys Volume 70 (9) Pages 4784-4789	Evaluation of Pulsed Radiation Effects in Buried Oxides by Fast C-V Measurements
	American Institute of Physics J. Appl. Phys. Volume 70 (8) Pages 4584-4592	Silicon-on-Insulator Device Islands Formed by Oxygen Implantation Through Patterned Masking Layers
	Physical Review B Volume 43(15) Pages 12512	Nuclear Magnetic Resonance Studies of Strain in Isolvalently Doped GaAs
	IEEE Transactions on Magnetics Volume 27(2) Page 1536	Detection of Light Using High Temperature Supeconducting Microstrip Lines
	Journal of Applied Physics Volume 70 (9) Page 4995	Light Detection Using High T_c Microstrip Transmission Lines as a Probe of Film Homogeneity
	Physical Review B Volume 44 (17) Page 9609	Response of Granular Superconducting Y-$Ba_{2.1}Cu_{3.4}O_{7-x}$ Films to Light
	Journal of Crystal Growth Volume 109 Pages 314-317	Preparation and Characterization of MgO Thin Films Deposited by Spray Pyrolysis of Mg(2,4-Pentanedionate)$_2$
	IEE Electronics Letters Volume 27 (24) Pages 2265-2267	GaAs Vertical pin Diode Using MeV Implantation
	American Institute of Physics Journal of Applied Physics Volume 70 (3) Pages 1793-1799	High Resolution Electron Beam Lithography with a Polydiacetylene Negative Resist at 50 kV
	American Institute of Physics Appl. Phys. Lett. Volume 59 (11) Pages 1338-1340	Implantation Damage in GaAs-A1As Superlattices of Different Layer Thickness

	American Institute of Physics Appl. Phys. Lett. Volume 58 (22) Pages 2526-2528	Sub-30 nm Lithography in a Negative Electron Beam Resist with a Vacuum Scanning Tunneling Microscope
	J. Vac. Sci. Technol Volume B9(6) Pages 3024-3027	Scanning Tunneling Microscope Lithography: A Solution to Electron Scattering
	Applied Physics Letters Volume 58(8) Pages 825 - 827	X-Ray Rocking Curve Measurement of Composition and Strain in Si-Ge Buffer Layers grown on Substrates
	Journal of Applied Physics American Institute of Physics Volume 70, No. 3 Pages 1750 - 1757	High-Energy Si Implantation into InP:Fe
	Physical Review Letters Volume 67, No. 12 Page 1547	Exciton, Phonons, and Interfaces in GaAs/A1As Quantum-Well Structures
	IEEE Transactions on Microwave Theory and Techniques Volume 39 (8) Pages 1329-1337	Characteristics of Microstrip Transmission Lines with High-Dielectric-Constant Substrates
	IEEE Transactions on Electron Devices Volume 38(10) Pages 2229-2233	Design Parameters of a High Effciency 1.7 GHz Gyropeniotron Amplifier
	6th Conference on Semi-Insulating III-V Materials, Toronto, Canada Chapter 4 Pages 329-334	Photoreflectance Surface Characterization of InP:Fe Substrates
	Appl. Phys. Lett. Volume 58(24) Pages 2824	Photoreflectance of Semi-Insulating InP: Resistivity Effects on Exciton Phase
	Appl. Phys. Lett. Volume 58 (17) Pages 1905-1907	High Mobility InSb Grown by Organometallic Vapor Phase Epitaxy
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