DEPARTMENT OF DEFENSE
IN-HOUSE RDT&E ACTIVITIES

FY97
Management Analysis Report

Department of the Army
Department of the Navy
Department of the Air Force
DoD Agency (USUHS - AFRRI)
The DoD in-house RDT&E activities report and database project is the DDR&E's central source of information on laboratory status and serves four essential purposes: (1) since inception, it has been the only compilation of statistics organized by location on DoD RDT&E activities; (2) it provides the basis for prompt responses to many general queries about DoD RDT&E activities without recourse to special surveys, etc.; (3) it provides a historical database which can be used for tracking consolidations and organizational changes, and for special analyses and trend studies; and (4) it provides insight into the technical and organizational environment of the DoD laboratories and the financial manpower and facility investments made in them.
DEPARTMENT OF DEFENSE IN-HOUSE
RDT&E ACTIVITIES REPORT

for
Fiscal Year 1997

Prepared for:
The Office of the Secretary of Defense
Director, Defense
Research and Engineering
The Pentagon
Washington, DC 20301
FOREWORD

Introduction

The DoD In-House Research, Development, Test & Evaluation (RDT&E) Activities Report was started in the mid-1960s by the Office of Laboratory Management within the Office of the Secretary of Defense, at the request of the then Director of Defense Research and Engineering (DDR&E), Dr. John Foster. The annual report has been produced in official form since 1966.

The DoD In-House RDT&E Activities Report and database project is the DDR&E’s central source of information on laboratory status, and serves four essential purposes: (1) since inception, it has been the only compilation of statistics organized by location on DoD RDT&E Activities; (2) it provides the basis for prompt responses to many general queries about DoD RDT&E Activities, without recourse to special surveys, etc.; (3) it provides a historical database which can be utilized for tracing consolidations and organizational changes, and for special analyses and trend studies; and (4) it provides insight into the technical and organizational environment of the DoD Laboratories and the financial manpower and facility investments made in them.

The Office of the Deputy Director of Defense Research and Engineering for Laboratory Management and Technology Transition leads a Steering Group which is responsible for the preparation and oversight of the report and its underlying database. The Steering Group is composed of representatives from the offices of the Director of Defense Research and Engineering, the Director, Test Systems Engineering & Evaluation, the Deputy Assistant Secretary of the Army for Research and Technology, the Chief of Naval Research, the Deputy Assistant Secretary of the Air Force (Science, Technology and Engineering), and the Director of the Armed Forces Radiobiology Research Institute of the Uniformed Services University of the Health Sciences (USUHS). This year the Steering Group and the Science and Technology Business Process Reengineering Office developed an improved data collection process taking advantage of both the existing infrastructure at the activities and utilizing the latest Internet technologies. This improvement initiative has resulted in a more accurate and timely report.

A DoD organizational entity is considered to be a “DoD RDT&E Activity” when it is owned and operated by the Government, and a minimum of 25% of its total effort is devoted to research, exploratory or advanced development, engineering development, demonstration/validation, systems or operational support, or some combination thereof. Examples are a research laboratory; a research, development and engineering center (RDEC), a test center or proving ground, and a multi-functional entity such as a “warfare center.” An “In-House” RDT&E Activity is an organization where a minimum of 25% of the in-house manpower and/or 25% of the obligational authority used is devoted to research, exploratory or advanced development, engineering development, etc., conducted in-house.

Structure of Report

Selected data for the In-House RDT&E Activities of the Army, Navy, Air Force and the USUHS are summarized in tables in the first section of the report. Following the tables are individual sections which cover the In-House RDT&E Activities of the three Military Services and USUHS. Each Activity is described in a standard multi-page format.

Activities are listed alphabetically within their respective military departments. A partial organization chart, entitled “Abbreviated Functional Chart - Technical
Organizations", appears for each Activity to provide an overview of its technical operations. Funding data are broken down into the standard RDT&E sub-categories: 6.1 - Research, 6.2 - Exploratory Development, 6.3 - Advanced Development, 6.4 - Demonstration & Validation, 6.5 - Engineering and Manufacturing Development, 6.6 - Management Support, 6.7 - Operational Systems Development, and Non-DoD. All zero-filled report data fields reflect a zero amount reported.

Organizational changes for FY97 appear in Appendix A. Appendix B contains definitions of the data elements displayed in this report (any data element definition changes for FY97 are italicized). Appendix C defines selected abbreviations and acronyms.

Every effort has been made to provide accurate information. Each submission was reviewed and approved by the head of the reporting Activity. All numbers and statements submitted by each Activity were then thoroughly examined by the members and staff of the Steering Group. Please note, though, that this report does not represent the total DoD RDT&E program. It is also not an accounting or financial management document, but rather a “snapshot” of the operation of the individual Activities contained in the report. All funding data reflect total obligational authority received in FY97. The data in this report should not be summarized or used for detailed comparative analyses, because the Service labs/centers use a number of different business accounting systems to satisfy their special needs. See Appendix B for further explanations.

The report is used by numerous DoD organizations, as well as various committees of Congress, the Library of Congress and the General Accounting Office. The report provides easily accessible comprehensive and accurate information without frequent querying of field Activities.

Significant Changes for FY97

Funding

The funding tables now depict In-House Managing Out-of-House figures for each Activity. These are funds incurred in planning and administering out-of-house programs by personnel of the reporting organizations. In previous reports, the funding figures in this category were combined with Out-of-House total, which is the total amount for the fiscal year reporting period for direct mission oriented work performed, or to be performed, by other than government personnel at the reporting organization.

Personnel

Personnel figures for the FY97 report were obtained from end of FY personnel data, provided by the Services, to the Defense Manpower Data Center (DMDC). The goal of the In-House Report - DMDC data interchange, is to leverage DMDC data, which is the authoritative source of DoD personnel data, with In-House report data, to produce an indisputably accurate document. This interchange streamlines the reporting process through the utilization of existing data sources, which reduces data collection efforts at the Activity level. It also increases the consistency and comparability of DoD activity data.

DMDC data was reviewed by all activities and discrepancies were thoroughly researched and resolved. Additionally, activities were provided the opportunity to include footnotes in the final report regarding published personnel figures.
In-House Report Web Site

This report can be found in the DOCUMENTS section on the DDR&E/LM&TT Web Site at www.dtic.mil/labman, for on-line browsing. Web access to the FY97 Report has been expanded to allow it to be downloaded (by individual Activity, by Service, or in its entirety) not only as a Word document, but also in the Adobe Acrobat Portable Document Format (PDF).

Distribution

This publication should be given widespread distribution in the DoD Laboratories, both as an internal resources reference document at the Director and Commanding Officer level, and as a catalog of general activity at the bench level. It provides laboratory staff an opportunity to familiarize themselves with the functional capabilities of other DoD Laboratories, thereby encouraging scientists and engineers to communicate with their counterparts at other labs on problems of common interest.

In addition, this publication has proven helpful to those in the private sector interested in exploring the potential for technology cooperation/transfer with DoD Laboratories (for example, Cooperative Research and Development Agreements - CRADAs).

Lance A. Davis
Acting Director, Defense Research and Engineering

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For Government Agencies and contractors:  For all others:

Defense Technical Information Center (DTIC)  National Technical Information Service
U.S. Department of Defense  U.S. Department of Commerce
8725 John J. Kingman Rd., STE 0944  Technology Administration
Ft. Belvoir, VA 22060-6218  Springfield, VA 22161
703-767-9051  703-487-4650
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<td>296.850</td>
<td>259.705</td>
</tr>
<tr>
<td>Development Test Center</td>
<td>572.900</td>
<td>288.660</td>
</tr>
<tr>
<td>Flight Test Center</td>
<td>641.092</td>
<td>256.284</td>
</tr>
<tr>
<td>Phillips Laboratory</td>
<td>629.378</td>
<td>61.287</td>
</tr>
<tr>
<td>Rome Laboratory</td>
<td>470.137</td>
<td>76.472</td>
</tr>
<tr>
<td>Wright Laboratory</td>
<td>1,069.600</td>
<td>127.200</td>
</tr>
</tbody>
</table>
## TABLE 6. AIR FORCE RDT&E ACTIVITIES, FACILITY DATA, FY 1997

<table>
<thead>
<tr>
<th>INSTALLATION</th>
<th>LOCATION</th>
<th>SPACE (THOUSANDS OF SQUARE FEET)</th>
<th>COST (MILLIONS $)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>ACRES</td>
<td>LAB</td>
</tr>
<tr>
<td>Armstrong Laboratory</td>
<td>Brooks AFB, TX</td>
<td>96</td>
<td>1,034.000</td>
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<tr>
<td>Arnold Engineering Development Center</td>
<td>Arnold AFB, TN</td>
<td>39,081</td>
<td>1,063.600</td>
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<tr>
<td>Development Test Center</td>
<td>Eglin AFB, FL</td>
<td>463,533</td>
<td>2,321.171</td>
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<tr>
<td>Flight Test Center</td>
<td>Edwards AFB, CA</td>
<td>297,375</td>
<td>283.000</td>
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<tr>
<td>Phillips Laboratory</td>
<td>Kirtland AFB, NM</td>
<td>16,620</td>
<td>996.000</td>
</tr>
<tr>
<td>Rome Laboratory</td>
<td>Rome, NY</td>
<td>1,543</td>
<td>721.000</td>
</tr>
<tr>
<td>Wright Laboratory</td>
<td>WPAFB, OH</td>
<td>1,202</td>
<td>1,826.227</td>
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### TABLE 7. USUHS RDT&E ACTIVITIES, PROGRAM AND PERSONNEL DATA, FY 1997

<table>
<thead>
<tr>
<th>INSTALLATION</th>
<th>FUNDING DATA (MILLIONS $)</th>
<th>PERSONNEL DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TOTAL</td>
<td>IN-HOUSE</td>
</tr>
<tr>
<td>Armed Forces Radiobiology Research Institute</td>
<td>12.631</td>
<td>12.456</td>
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</table>


<table>
<thead>
<tr>
<th>INSTALLATION</th>
<th>LOCATION</th>
<th>SPACE AND PROPERTY</th>
<th>SPACE (THOUSANDS OF SQUARE FEET)</th>
<th>OTHER</th>
<th>TOTAL</th>
<th>REAL PROP</th>
<th>EQUIP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Armed Forces Radiobiology Research Institute</td>
<td>Bethesda, MD</td>
<td>10</td>
<td>61.750</td>
<td>34.257</td>
<td>23.908</td>
<td>119.915</td>
<td>15.000</td>
</tr>
</tbody>
</table>
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DEPARTMENT OF THE ARMY
DEPARTMENT OF THE ARMY

The Army's twenty-seven (27) In-House RDT&E Activities are:

Aberdeen Test Center .............................................................................................................. 2-2
Aeromedical Research Laboratory .......................................................................................... 2-8
Armament Research, Development and Engineering Center .............................................. 2-12
Army Materiel Systems Analysis Activity ........................................................................... 2-22
Army Research Institute ...................................................................................................... 2-28
Army Research Laboratory ................................................................................................. 2-32
Aviation Research, Development and Engineering Center .................................................. 2-42
Aviation Technical Test Center ............................................................................................ 2-46
CECOM Research, Development and Engineering Center ................................................ 2-50
Cold Regions Research and Engineering Laboratory ......................................................... 2-56
Construction Engineering Research Laboratories .............................................................. 2-60
Dugway Proving Ground ...................................................................................................... 2-64
Edgewood Research, Development and Engineering Center ............................................ 2-70
Institute of Surgical Research .............................................................................................. 2-72
Medical Research Institute of Chemical Defense ............................................................... 2-76
Medical Research Institute of Environmental Medicine .................................................... 2-82
Medical Research Institute of Infectious Diseases .............................................................. 2-86
Missile Research, Development and Engineering Center ................................................... 2-90
Natick Research, Development and Engineering Center .................................................... 2-100
OPTEC Test and Experimentation Command ...................................................................... 2-106
Redstone Technical Test Center ........................................................................................... 2-110
Tank Automotive Research, Development and Engineering Center .................................. 2-114
Topographic Engineering Center .......................................................................................... 2-124
Walter Reed Army Institute of Research .............................................................................. 2-128
Waterways Experiment Station ............................................................................................ 2-132
White Sands Missile Range .................................................................................................. 2-138
Yuma Proving Ground ......................................................................................................... 2-142
Aberdeen Test Center

Abbreviated Functional Chart - Technical Organizations

Aberdeen Test Center

- Automotive, Soldier and Ground Systems Support Directorate
- Armament and Ammunition Testing Directorate
- Live Fire Vulnerability Directorate
- Radiation Simulation & Analysis Directorate
Aberdeen Test Center
Aberdeen Proving Grd, MD 21005-5059
(410) 278-3574

Commander: Colonel Richard O. Bailer
Technical Dir.: James W. Fasig

MISSION

Aberdeen Test Center is the most diverse test facility within DoD, testing a broad spectrum of military weapons systems and equipment including armored vehicles, guns, ammunition, trucks, bridges, generators, night vision devices, individual equipment (boots, uniforms, helmets, etc.), and surface and underwater marine systems. As a multi-purpose proving ground, with a temperate climate, our primary mission is to plan, conduct, analyze and report on projects supporting research, development, test and evaluation (RDTE), design, engineering, production, surveillance and operational tests for DoD and other government agencies, contractors, foreign government, and private industry. In this single location, ATC can subject an item to a full range of tests from automotive endurance and full weapons performance with environmental extremes, to full-scale live fire vulnerability/survivability/lethality testing utilizing an extensive array of test ranges/facilities, simulators and models. In addition to testing domestic systems, we exploit foreign systems to assess the enemy threat. We also develop state-of-the-art test procedures (DoD, International), methodologies and instrumentation in order to meet the test requirements of advancing military technologies. ATC is partnered with CINCLANTFLT forming the Chesapeake Regional Range Complex which provides air, land and sea test and training support to the joint warfighter.
## CURRENT IMPORTANT PROGRAMS

<table>
<thead>
<tr>
<th>Program</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bradley Fighting Vehicle System</td>
</tr>
<tr>
<td>Wide Area Mine</td>
</tr>
<tr>
<td>M830A1 Cartridge, 120MM</td>
</tr>
<tr>
<td>M829A2 Cartridge, 120MM</td>
</tr>
<tr>
<td>M1A2 ABRAMS Tank</td>
</tr>
<tr>
<td>Heavy Assault Bridge</td>
</tr>
<tr>
<td>M88A2 Hercules Improved Recovery Vehicle</td>
</tr>
</tbody>
</table>

### Technology Transfer Efforts

**Federal Highways Administration/MD State Highway Administration/MD State Police/ATC**
- ATC has successfully developed and fielded an Aggressive Drive Imaging System prototype. The system integrates MD State Police LIDAR system with ATC developed advanced imaging technologies consisting of computer driven digital imaging video instrumentation and components.

**HP White Laboratories/ATC**
- The parties continue to cooperatively perform efforts focused in the research and development of intermediate level fire test technologies, hardware testing and fire hazard compliance issues. Currently, the partners are working to determine the capability of class B hand held fire extinguishers and the effectiveness on fuel fire in accordance with UL 711 (Fire Extinguishers, Rating and Fire Testing).

**Hartford Community College/ATC**
- Through a cooperative agreement, ATC and HCC shared audiovisual technologies to produce a promotional video for the college. HCC students and ATC engineers worked to complete the effort using the unique capabilities in the ATC production studio. Students gained hands-on training with advanced audiovisual tools and techniques.

**AV Technologies/ATC**
- Under a cooperative agreement ATC and AV successfully completed the first phase supporting the test and training initiative for the PANDUR commercialization program. This is the first combined test and training initiative between the private sector and this DoD facility. The PANDUR program will continue through FY98.

**Defensive Driving, Inc./ATC**
- Using ATC’s unique testing facilities, the New Jersey based company performed defensive driving courses for corporate members. The availability of the hard surfaced course provided the customer with the necessary elements to successfully complete the course requirements.

**University of California at Berkeley (UCB)/ATC**
- ATC provided four SOMTE soldiers to support UCB’s technology demonstration project during the National Automated Highway System Demonstration in San Diego in August 1997. The ATC personnel operated developmental Buick LeSabre automobiles that featured automated steering, lane control, and vehicle “platooning”. The Demonstration was the first public exposure to the technologies that will provide driverless transportation in the 21st century.
<table>
<thead>
<tr>
<th>EQUIPMENT/FACILITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>World-renowned automotive test/obstacle courses; numerous interior and exterior firing ranges; environmental simulation capabilities including rough-handling and vibration, electromagnetic interference and environmental conditioning capabilities; full transportability test capability to include rail, roadability, MIL-STD 209 pull and tie-down, internal and external air transport; Underwater Explosion test ponds and Depleted Uranium Containment Fixture (Superbox) for live fire vulnerability and lethality testing; sophisticated non-destructive test facilities; robotics test facilities; pulse radiation facility; Firing Impulse Simulator; state of the art industrial complex which includes maintenance and experimental fabrication capabilities; secure airfield.</td>
</tr>
</tbody>
</table>
## FY97 Funding Data (Millions $)

<table>
<thead>
<tr>
<th>Appropriation</th>
<th>In-House</th>
<th>In-House Management</th>
<th>Out-Of-House</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>RDT&amp;E:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.1 ILIR</td>
<td>0.000</td>
<td>NA</td>
<td>NA</td>
<td>0.000</td>
</tr>
<tr>
<td>6.1 Other</td>
<td>0.015</td>
<td>0.000</td>
<td>0.086</td>
<td>0.101</td>
</tr>
<tr>
<td>6.2</td>
<td>3.039</td>
<td>0.031</td>
<td>1.769</td>
<td>4.839</td>
</tr>
<tr>
<td>6.3</td>
<td>1.130</td>
<td>0.011</td>
<td>0.657</td>
<td>1.798</td>
</tr>
<tr>
<td>Subtotal (S&amp;T)</td>
<td>4.184</td>
<td>0.042</td>
<td>2.512</td>
<td>6.738</td>
</tr>
<tr>
<td>6.4</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>6.5</td>
<td>1.362</td>
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<td>0.792</td>
<td>2.168</td>
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<tr>
<td>6.6</td>
<td>33.540</td>
<td>0.120</td>
<td>13.068</td>
<td>46.728</td>
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<tr>
<td>6.7</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Non-DOD</td>
<td>1.481</td>
<td>0.010</td>
<td>0.852</td>
<td>2.343</td>
</tr>
<tr>
<td><strong>Total RDT&amp;E</strong></td>
<td><strong>40.567</strong></td>
<td><strong>0.186</strong></td>
<td><strong>17.224</strong></td>
<td><strong>57.977</strong></td>
</tr>
<tr>
<td>Procurement</td>
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<td>7.442</td>
<td>20.214</td>
</tr>
<tr>
<td>Operations &amp; Maintenance</td>
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<td>NA</td>
<td>2.133</td>
<td>5.316</td>
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<tr>
<td>Other</td>
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<td>7.380</td>
<td>21.705</td>
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<tr>
<td><strong>Total Funding</strong></td>
<td><strong>70.847</strong></td>
<td><strong>0.186</strong></td>
<td><strong>34.179</strong></td>
<td><strong>105.212</strong></td>
</tr>
</tbody>
</table>

## Military Construction (Millions $)

| Military Construction (MILCON) | 0.031 |

## Personnel Data (End of Fiscal Year 1997)

<table>
<thead>
<tr>
<th>Type</th>
<th>Scientists &amp; Engineers</th>
<th>Technical Support &amp; Other Personnel</th>
<th>End Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Doctorates</td>
<td>Other</td>
<td></td>
</tr>
<tr>
<td>Military</td>
<td>0</td>
<td>0</td>
<td>99</td>
</tr>
<tr>
<td>Civilian</td>
<td>5</td>
<td>260</td>
<td>628</td>
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<tr>
<td>Total</td>
<td>5</td>
<td>260</td>
<td>727</td>
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</table>

## Space and Property

<table>
<thead>
<tr>
<th>Building Space (Thousands of Sq Ft)</th>
<th>Property Acquisition Cost (Millions $)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lab</td>
<td>REAL PROPERTY</td>
</tr>
<tr>
<td>Admin</td>
<td>* NEW CAPITAL EQUIPMENT</td>
</tr>
<tr>
<td>Other</td>
<td>EQUIPMENT</td>
</tr>
<tr>
<td>Total</td>
<td>* NEW SCIENTIFIC &amp; ENG. EQUIP.</td>
</tr>
<tr>
<td>Acres</td>
<td></td>
</tr>
</tbody>
</table>

NA = Not Applicable
Aeromedical Research Laboratory

Abbreviated Functional Chart - Technical Organizations

Commander
U.S. Army
Aeromedical
Research Laboratory

Deputy Commander for
Administration

Resource Management
Branch

Logistics Branch

Detachment Commander

Research Systems
Branch

Flight Systems
Branch

Biomedical Technology Branch

Science Support Center

Deputy Commander for
Science

Aircrew Health &
Performance Division

Visual Sciences
Branch

Aircrew Protection
Division

Aeromedical Factors Branch

Special Staff
**Aeromedical Research Laboratory**
Fort Rucker, AL 36362-0577
(334) 255-6917

**Commander:** COL Cherry L. Gaffney
**Deputy Cdr/Sci:** COL Clyde D. Byrne

### MISSION
Conducts medical research related to the effects of military aviation, combat vehicles, and other weapons systems on soldier health and performance. Additionally, performs research on the impact of continuous operations on crew performance, on health hazards of emerging military materiel systems, develops training and operational strategies to cope with those detractors, and develops design criteria for aviator protective equipment and visual systems.

### CURRENT IMPORTANT PROGRAMS
- Investigation of Spatial Disorientation in the Rotary-Wing Environment and Counter Measures
- Airworthiness Certification Evaluations of Medical Devices Intended for Use Aboard U.S. Army Rotary-Wing Aircraft During Medical Evacuations
- Aviator Performance Effects of Sustained Operations, Sleep Cycle Disruption and Coping Mechanisms
- Aviation Life Support Equipment Retrieval Program
- Crew Coordination Analysis System Development (160th SOAR)
- Aviator Helmet Protective Capability and Tolerance to Head Supported Mass (In Support of Land Warrior, Air Warrior, and Comanche Programs)
- Visual Performance Comparison of Flat Panel and Analog Display Technologies
- Soldier Tolerance to Biomechanical Impact and Prevention of Impact Injury

### COOPERATIVE RESEARCH AND DEVELOPMENT AGREEMENTS (CRDA)
- Advanced Active Noise Reduction, Active Noise Cancellation (ANR/ANC) for Aviation Headsets and Microphones
- Research and Development on Advanced Aircrew Protection Systems (Simula)
- Research and Development of Advanced Restraint Systems (H. Koch and Sons)
- Research, Development, Test and Evaluation of Aeromedical Evacuation Equipment
- Gulf Coast Alliance for Technology Transfer (GCATT)
- Research Agreements with the University of Houston and the University of Alabama at Birmingham
## EQUIPMENT/FACILITIES

<table>
<thead>
<tr>
<th>Equipment/Facilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multi-Axis Ride Simulation System; Helmet Drop Test Tower and Impact Facility; Variable Center of Gravity Helmet Device; Head and Neck Inertial Loading Sled; Mass Properties (Center of Mass Location &amp; Mass Moments of Inertia) Measurement System; Biochemistry Lab; UH-60 Visual Flight Simulator for Aeromedical Research; Helicopter Inflight Monitoring System; Modified Aircraft for Inflight Medical Research (JUH-1 Huey; JUH-60 Blackhawk; C-12D); Data Acquision and Telemetry Systems for use in either JUH-1 or JUH-60; Sleep Study Center; Spatial Disorientation Laboratory; Crew Coordination Analysis Center; High Intensity Impulse Noise Generator (Shock Tube); Mobile Acoustics Lab; Anechoic and Reverberation Chambers; Scanning Laser Ophthalmoscope; Ophthalmic Telemedicine System; Corneal Physiology and Topography Center; Optical Testing Lab; Optical Fabrication Facility; Electro-Optical Testing Lab; Visual Displays Analysis Center; Scientific and Medical Research Information Center; MEDEVAC Equipment Testing Facility.</td>
</tr>
</tbody>
</table>
# FY97 Funding Data (Millions $)

<table>
<thead>
<tr>
<th>Appropriation</th>
<th>In-House</th>
<th>In-House Management</th>
<th>Out-Of-House</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>RDT&amp;E:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.1 ILIR</td>
<td>0.036</td>
<td>NA</td>
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<td>0.036</td>
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<tr>
<td>6.1 Other</td>
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<td>0.000</td>
<td>0.312</td>
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<tr>
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<td>4.169</td>
<td>0.047</td>
<td>0.000</td>
<td>4.216</td>
</tr>
<tr>
<td>6.3</td>
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<td>0.000</td>
<td>0.000</td>
<td>0.028</td>
</tr>
<tr>
<td>Subtotal (S&amp;T)</td>
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<td>4.592</td>
</tr>
<tr>
<td>6.4</td>
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<td>0.025</td>
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<tr>
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<td>0.089</td>
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<tr>
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<td>0.000</td>
<td>0.043</td>
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<tr>
<td>6.7</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Non-DOD</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>TOTAL RDT&amp;E</td>
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<td>0.047</td>
<td>0.000</td>
<td>4.749</td>
</tr>
<tr>
<td>Procurement</td>
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<td>NA</td>
<td>0.000</td>
<td>0.044</td>
</tr>
<tr>
<td>Operation &amp; Maintenance</td>
<td>0.106</td>
<td>NA</td>
<td>0.000</td>
<td>0.106</td>
</tr>
<tr>
<td>Other</td>
<td>2.548</td>
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<td>2.548</td>
</tr>
<tr>
<td>TOTAL FUNDING</td>
<td>7.400</td>
<td>0.047</td>
<td>0.000</td>
<td>7.447</td>
</tr>
</tbody>
</table>

**Military Construction (Millions $)**

| Military Construction (MILCON) | 0.000 |

**Personnel Data (End of Fiscal Year 1997)**

<table>
<thead>
<tr>
<th>Type</th>
<th>Scientists &amp; Engineers</th>
<th>Technical Support &amp; Other Personnel</th>
<th>End Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Doctorates</td>
<td>Other</td>
<td></td>
</tr>
<tr>
<td>Military</td>
<td>6</td>
<td>0</td>
<td>43</td>
</tr>
<tr>
<td>Civilian</td>
<td>6</td>
<td>7</td>
<td>29</td>
</tr>
<tr>
<td>Total</td>
<td>12</td>
<td>7</td>
<td>72</td>
</tr>
</tbody>
</table>

**Space and Property**

<table>
<thead>
<tr>
<th>Building Space (Thousands of Sq Ft)</th>
<th>Property Acquisition Cost (Millions $)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lab 102.000</td>
<td>Real Property 11.896</td>
</tr>
<tr>
<td>Admin 26.000</td>
<td>* New Capital Equipment 0.559</td>
</tr>
<tr>
<td>Other 20.000</td>
<td>Equipment 49.105</td>
</tr>
<tr>
<td>Total 148.000</td>
<td>* New Scientific &amp; Eng. Equip. 0.478</td>
</tr>
<tr>
<td>Acres 44</td>
<td>* Subset of previous category.</td>
</tr>
</tbody>
</table>

NA = Not Applicable
Armament Research, Development and Engineering Center

Abbreviated Functional Chart - Technical Organizations

- Armament Research, Development and Engineering Center
  - Legal Office
  - Fire Support Armaments Center
    - Warheads, Energetics & Combat-Support Armaments Center
  - Close Combat Armaments Center
  - Engineering Data Management Directorate
  - Engineering Support Directorate
  - Defense Ammunition Logistics Activity
  - Industrial Ecology Center
  - Quality Engineering Directorate
  - Garrison
  - Directorate for Business Operations
  - Acquisition Center
  - Army Fuze Management Office
Armament Research, Development and Engineering Center  
Picatinny Arsenal, NJ 07806-5000  
Commander: BG James W. Arbuckle  
Technical Dir: Mr. Carmine Spinelli  
(973) 724-6000  

MISSION

TACOM-ARDEC is a business center of the Tank-Automotive and Armaments Command (TACOM), a major subordinate command of the US Army Materiel Command (AMC). TACOM-ARDEC provides the United States military with the firepower to achieve decisive battlefield victory. Our mission is to conduct or manage research, development and life cycle engineering, including quality engineering for ammunition, weapons, fire control and associated items. This includes engineering support for production and integrated logistics support. We provide procurement and management of initial production quantities and technical support to soldiers and equipment in the field throughout their entire life cycle. TACOM-ARDEC is also the Army executive agent for research and development for pollution prevention.

The primary function of TACOM-ARDEC will continue to be the smart buyer for armaments. TACOM-ARDEC currently retains the technical knowledge and expertise for current, historical and future experimental and developmental ammunition and weapon systems, many of which have no counterpart in industry. This knowledge base allows TACOM-ARDEC to insure that the government does not waste time and money on efforts that have historically proven not to work. In order to develop and maintain this knowledge base, TACOM-ARDEC is active in all phases of the life cycle process. We maintain a technology base to assure that technologies transition to weapon systems developments which currently account for over 90% of the Army's lethality. TACOM-ARDEC performs unbiased system analyses that consider a diverse number of systems and technologies, both in-house and contractor developed, resulting in the best technical approach and best buy decisions. TACOM-ARDEC also performs unbiased technical assessments of the current state-of-the-art in ammunition and weapon systems that points the way to future developmental programs and technology transfer to industry.

CURRENT IMPORTANT PROGRAMS

Our core business areas and corresponding technical initiatives are:

SMART MUNITIONS: To develop self-contained munitions for all mission areas with the ability to autonomously sense, engage, and kill their intended targets.

INDIRECT FIRE: To maximize defeat of enemy personnel and vehicular targets by developing advanced artillery and mortars with extended range and accuracy. We will achieve autonomous operations, increase range, increase rate of fire, and reduce manpower requirements over current fielded systems.

DIRECT FIRE: To develop weapons and munitions which will defeat the most advanced enemy armor through increased frontal penetration, higher hit probabilities, and enhanced top attack capabilities, while reducing crew size and stress.

SOLDIER WEAPONS: To upgrade armaments for light infantry and special operation forces (SOF), and to develop advanced small caliber weapons that will significantly increase kill capability, enhance survivability and improve the capability to destroy hard targets, and to develop non-lethal weapons for low intensity/peacekeeping missions.
CURRENT IMPORTANT PROGRAMS (continued)

MINES & DEMOLITIONS: To defeat advanced helicopters, vehicles & personnel with highly intelligent minefields, with features such as wide area destruction, complete user control, and Identification Friend or Foe (IFF) capability.

FUZING & LETHAL MECHANISMS: To greatly increase the lethality of armament materiel by focusing on advanced chemical energy warheads (shaped charge and explosively formed penetrators), kinetic energy (KE) penetrators, associated warhead materials, and low collateral damage munitions. Also, to create fuzes with integrated sensors, signal processing, and guidance and control; capable of performing target/clutter discrimination and having multi-option capability for compatibility with autoloaders, and containing electronic safe and arm (S&A) functions.

FIRE CONTROL: To provide life cycle engineering and management of fire control subsystems, software, command, control, and communications; test, measurement and diagnostic equipment and training devices utilizing an integration of sensors, computers, advanced controls and artificial intelligence aids for a rapid response to command orders of engagement.

MUNITIONS SURVIVABILITY: Insure the survivability of the critical warfighting assets through Munitions Logistics, Munitions Survivability, and the Hazards of Electromagnetic Radiation to Ordnance (HERO) Certification. The program provides “built in” survivability improvements that will help preclude destructive reactions within logistics nodes, transportation assets and combat vehicles using proven/available technologies. The HERO effort assesses the susceptibility of high priority munitions to electromagnetic hazards.

TACOM-ARDEC is the Army agent for pollution prevention R&D, providing the Army with technical management for pollution prevention R&D, integration of pollution prevention concerns into the weapons system R&D process, and technical assistance and integration expertise to the Army, other government agencies, and industry.

Additionally, some of our key strategic system initiatives are:

- Light Weight 155 mm Howitzer. The Light Weight 155mm Howitzer will be a lighter towed howitzer with digital fire control and advanced navigation systems. It will replace our current light division general support artillery system - the M198. The system provides improvements in lethality, survivability and responsiveness.

- Low Cost Competent Munitions (LCCM). LCCM is an artillery fuze concept which will provide a low cost guidance capability for the existing stockpile of 155 mm projectiles as well as for future projectiles. LCCM greatly improves the accuracy of cannon artillery at extended ranges. LCCM will enhance the lethality and responsiveness of indirect fires, and ease the ammunition logistics burden.

- Intelligent Mine Field (IMF). IMF is a system of Wide Area Munitions, acoustic sensors, and command and control devices that can autonomously implement obstacle intent to hunt and kill moving armored vehicles. It enhances survivability and lethality, and will reduce the logistical burden associated with transporting large numbers of conventional mines.

- Extended Range Artillery Projectile (XM982). The XM982 is a 155 mm, DPICM extended range artillery projectile. It will allow current cannon systems to deliver improved submunitions out to a range of 37 km. It is an innovative design that combines base bleed and rocket assist technologies. It enhances the lethality and survivability of the force.
CURRENT IMPORTANT PROGRAMS (continued)

- **Advanced Sensor Submunition Technology (ASST).** ASST will be a rocket or missile delivered submunition that will detect, classify, maneuver and attack moving armor targets. It combines three types of sensors: infra red, millimeter wave and laser radar. It will match the best kill mechanism to the target type by using a selectable explosively formed penetrator warhead. ASST will have an “identification friend or foe” capability.

- **Objective Individual Combat Weapon (OICW).** OICW will be a lightweight weapon capable of firing kinetic energy projectiles and an air-bursting fragmentation munition. It will allow soldiers to effectively attack targets at greater ranges, and to attack targets in defilade. It combines leading edge technologies in miniaturized fuzing; integrated fire control; lightweight, high strength materials; and munitions effects. OICW will increase the lethality and survivability of the individual soldier. It is the sole lethality component of the Dismounted Battle Lab’s 21st Century Land Warrior (21 CLW) Top Level Demonstration.

- **Less than Lethal Defeat Mechanisms.** TACOM-ARDEC has taken a leading role in the development of Nonlethal Technologies. With increasing emphasis on peacekeeping, low-intensity conflict and humanitarian missions, it becomes important to devise weapons which restrain or immobilize. To this end, TACOM-ARDEC is developing weapons such as: sponge grenades (co-developed with ARL), which are designed to incapacitate without imparting serious injury; acoustic weapons, which project sound waves, causing nausea and disorientation; sting nets, which envelop a foe and deliver a nonlethal electrical shock to discourage struggle; laser and other directed energy munitions, which are designed to degrade vehicle sensors; and radio frequency and electromagnetic pulse weapons, which could be utilized against enemy equipment in order to disrupt their electronics. Many of these technologies serve as dual-use applications for use in riot-control and civil disturbance situations.

- **The Autonomous Intelligent Submunition (AIS).** AIS represents a major leap forward in sensors for force-multiplying systems. AIS increases smart submunition effectiveness against a wide variety of targets using breakthroughs in sensors and onboard computer software. Weapon system enhancements include intelligent target prioritization, selectable warheads and increased sensor footprint capabilities. The system concept that would use AIS combines high resolution infrared and millimeter-wave sensors with high-speed computing power and a steerable parafoil to find, prioritize and destroy armored vehicles, missile launch sites and a multitude of other militarily significant targets. The AIS lethal mechanism would be a multi-mode EFP which attacks the chosen target (with a target-specific effect) from above as the submunition loiters and descends over the general target area, while its advanced sensors and steerable parafoil permit the system to intelligently search a wide area for the most desirable target.

- **Cased Telescoped Ammunition and Gun Technology (CTAGT).** CTAGT is an innovative means of improving the packaging and design of conventional medium caliber ammunition. This concept combines improved propellants with dimensionally compressed ammunition to improve volumetric efficiency. Cased telescoped ammunition, when compared with conventional cartridge ammunition, is 30% smaller in volume, offers higher performance and is easier to handle. The introduction of CTAGT into gun systems allows for smaller, more reliable handling mechanisms with fewer parts.

- **TACOM-ARDEC has over 47 active CRADAs. Some of these are:**
  - **Picatinny Innovation Center (PIC) - County College Morris**
  - **Air rifle terminal ballistics - Forensic Pathology Associates**
  - **Material compatibility analyses with liquid propellant - General Dynamics**
  - **Proximity fuze sensors for munitions - KDI Precision Products**
CURRENT IMPORTANT PROGRAMS (continued)

- Epileptic sensor - New York State Center for the Disabled
- Recuperator designs and virtual reality modeling - NIKE
- Magnetron sputtering techniques - NJIT
- Advanced materials for imaging applications - Rensselaer Polytechnic Inst
- Environmentally friendly technologies for lead-based paint removal - Rutgers University
- Cubane derivatives - University of Rochester
- Improved shaped charge - Western Atlas, International
- Pharmaceutical applications of cubane derivatives - Yeshiva University

EQUIPMENT/FACILITIES

TACOM-ARDEC's Stereolithography Lab provides rapid prototyping for form, fit and function trials and produces masters for soft modeling and investment castings. The lab's capabilities range from the design and fabrication of a sheet “brass catcher” for the Squad Automatic Weapon to the modeling of complete scaled versions of the Crusader and Paladin recoil system prototypes. This service, available to TACOM-ARDEC engineers, academia and industry, reduces the developmental time and associated manufacturing and procurement costs by up to 75%.

The Automated Inspection Device for Explosive Charge in Shell (AIDECS) replaces visual x-ray film inspection of loaded artillery projectiles. The AIDECS pilot system at TACOM-ARDEC is the only operational unit of its kind, providing the capability to automatically examine 155mm rounds and smaller shells. Base separations, cracks, cavities and other critical defects in the explosive filler are detected by scanning the shell with x-rays. Radiation scattered from within the shell is electrically detected, and a computer analysis identifies and classifies each defect in the explosive. The computer makes an accept/reject decision for each shell and prints an inspection report. Benefits of the AIDECS system include improved reliability for detecting base separations and other critical defects accomplished in a totally automated manner, and cost savings due to elimination of x-ray film.

TACOM-ARDEC's Distributed Interactive Simulation (DIS) facility supports a full spectrum of battlefield simulation activities to determine how technology, weapons and weapon mixes can be used to maximize the effectiveness of the soldier. DIS analyses of weapons in combined arms scenarios can influence designs long before any metal has been “bent”, thereby minimizing cost and development time. Linkage to other sites allows real-time interaction on a virtual battlefield.

The Department of Defense's Center for X-Ray Diffraction at TACOM-ARDEC is well recognized for its complete line of sophisticated X-Ray equipment, including two of the latest diffractometers and spectrometers, as well as for the comprehensive knowledge and experience of its personnel. The facility is used to enhance ballistic performance by determining the optimal crystal orientation of warhead and penetrator materials.

Benet Labs represents the Army's capability for large caliber cannon research, design and development, prototype production and engineering support. Benet works closely with the Watervliet Arsenal's cannon production facility to provide rapid prototyping services in support of new and improved weapon systems. Some of Benet's facilities are:
### EQUIPMENT/FACILITIES (continued)

- **FATIGUE EXPERIMENTATION FACILITY:** capability of duplicating firing pressures in its breech mechanism facility and tube facility. This allows the rapid evaluation of new concepts of materials, and the establishment of safe firing lives for these components in the laboratory rather than the much more expensive experimental firing previously necessary. These combined facilities provide Benet with a capability not available anywhere.

- **GAS DYNAMICS LABORATORY:** The Gas Dynamics Laboratory is a new research multi-task facility which includes two firing bays, a high bay area and a laboratory. The high bay area is used for experiments for heavy weapons and weapon components. Instrumentation includes 12 channels of digital data capture and display in 3 synchronized nicolet oscilloscopes with 4K points per channel. There is also a data acquisition system with 10 channels at 256K points per channel.

- **INTEGRATED CAE/CAD/CAM FACILITY:** Benet Labs has a Computer Aided Design system, integrated with Watervliet Arsenal's Computer Aided Manufacturing system. This allows the ready interactive transmission of technical data electronically. Thus, the stress analysts' calculations can be integrated into the engineers' designs for final implementation on the manufacturing floor.

- **TURRET LABORATORY:** Benet Labs provides engineering support for Turret hardware (less fire control systems) for Tracked Combat Vehicles, including the M551 Light Weight Air Transportable Assault Vehicle, and M60A3 and M1A1 Main Battle Tanks. The Turret Laboratory currently houses all of these vehicles and the tools and equipment necessary for investigation of problems relating to field, depot and spare parts procurement activities.

- **TERRAIN SUSPENSION/TURRET ENVIRONMENT SIMULATOR:** This motion system consists of a large platform (18 ft x 10 ft) mounted on six large hydraulic cylinders, a hydraulic power supply unit and an electronic control cabinet. The simulator is a six-degree-of freedom system (vertical, transverse, longitudinal, put, roll and yaw) and can provide all six motions simultaneously. The maximum payload that can be carried by the simulator is 18,000 lbs. This, it is capable of evaluating a full size tank turret.

- **FULL SCALE INVESTMENT CASTING FOUNDRY:** Benet's investment casting foundry provides the necessary base from which technical support is provided to the Laboratory in the form of the development of new castings and providing prototype castings, to Watervliet Arsenal in the form of production castings to meet initial deliveries until a contractor can start full deliveries, and to Outside Contractors in the form of technical assistance to overcome problems encountered in meeting the requirements of castings for production.

- **MOLTEN SALD DEPOSITION FACILITY:** The refractory metals electrodeposition pilot plant has a its purpose the coating of large caliber gun tube liners and metals having a higher erosion and corrosion resistance than chromium. It has the ability to electrodeposit metals such a tantalum, niobium, molybdenum and tungsten.

- **VESSEL ELECTROPLATING FACILITY:** A full-scale pilot production facility, built and operated by Benet Laboratories in a joint venture with the Watervliet Arsenal, provides a new process technology and the capability for plating an improved form of chromium (LC chrome) on any size cannon tube up to and including the 30-foot long 155-mm “Extended Range Cannon” considered for the Howitzer Improvement Program.

- **5KW SURFACE TREATING LASER:** The 5KW, CO2 Laser Metalworking Center integrates a Spectra-Physics 975 industrial Laser system, with a CNC programmable 4-axis work positioner (including rotary tilt table). The Laser system currently provides improved process control via CNC programmability and system flexibility, plus the inherent capability of a Laser to focus large amounts of usable energy in a small area.
The Armament Technology Facility (ATF) is a 52,000 square foot, secure and environmentally safe integrated small and cannon-caliber design and test facility. The ATF co-locates simulation modeling, design, validation, and diagnostic engineering with the capability to immediately conduct confirmation experimental firings of interior and exterior ballistics. This concurrent engineering facility will support multi-service infantry, air defense, aircraft and combat vehicle armament systems and is available to government as well as private industry. It has four weapon validation bays with an environmental chamber capable of weather conditions between -65F to +165F; two indoor ranges - the first 100 meters in length and the second 300 meters. The latter can accept a Bradley Fighting Vehicle System firing its primary armament; or an Abrams-series tank firing secondary armament. The 300-meter range also has a -65F to +165F environmental chamber.

The Keith L. Ware Simulation Center is a research facility specializing in the analysis of helicopter armaments and small arms. The Ware Center is composed of two 100 meter indoor firing ranges and two 1000 inch indoor firing ranges. Small arms can be fired from any number of ground and vehicle mounts as well as several weapon mount simulators located at the center. Helicopter armaments are fired from the 6-Degree-of-Freedom simulator which is capable of mounting a helicopter fuselage and inputting vibration and other motions into it. This allows armaments to be investigated in realistic conditions at a great cost savings over field trials. A large environmental room is available connected to one of the 1000 inch firing ranges. This room can subject items to extreme temperatures from -65 degrees F to +160 degrees F as well as other environmental conditions such as humidity, salt fog, salt immersion, sand and dust. The Ware Simulation Center has extensive instrumentation capabilities to measure characteristic data and performance of weapon systems such as: accuracy, dispersion, rate of fire, round velocity, blast pressure, recoil force, temperature, strain, acceleration, linear and angular displacement, voltage and current. High speed video and regular speed video are also available.

Electric Armaments Research Center (EARC) has one of the largest capacitor-based pulse power supplies in the world. The EARC was used to conduct large caliber component experiments of electric gun systems, most notably a composite 90mm railgun. This gun tube was one of several different approaches being investigated for a future tank main gun. This tube and others of its class are capable of accelerating special anti-armor rounds to extremely high energies and velocities.

The Instrumentation and Measurements Lab includes cutting-edge capabilities in the art of data reduction, signal processing, shock resistant telemetry design and radar analysis. One of its facilities consists of a radio frequency anechoic chamber equipped with a radar cross-section (RCS) measurement system utilizing a supercomputer. RCS measurements of various systems, including projectiles, identify radar reflectivity patterns. This technology is used for artillery experiments to evaluate and improve projectile performance parameters such as range, yawing motion, spin and position. Some services and capabilities include: Development of telemetry concepts and systems Telemetry component technology; In-bore and in-flight telemetry techniques Secure telemetry systems; Qualification, compatibility and RFI Coordination of telemetry operations with test ranges; Collection and reduction of telemetered firing test data; Printed Circuit Board design, fabrication and assembly; Measurement System Design and Implementation Acoustic and Magnetic Signature Analysis Image Analysis/Processing; Industrial Control, Design and Implementation RF Anechoic Studies.

The Advanced Warhead Testing Facility provides a safe, armor plate, that will be attached to a 35 foot long tunnel. This allows for extended target standoff experiments for explosively formed penetrators, shaped charges and other experimental warheads.
Our subsonic, transonic and supersonic wind tunnels provide excellent opportunities to apply research to time and cost savings. The facility is used to design, develop and conduct experiments on tactical and training rounds for the Army. The facility has been awarded twelve U.S. patents in the last five years. One of the patents was for a stabilizer for the M831A1 TP-T tank training ammunition, developed using wind tunnel data. Optimization resulting from the experiments saved an estimated $40 million in annual production costs.

Electromagnetic Environmental Effects (E3) facilities perform assessments on weapon systems to determine their compliance against numerous electromagnetic environments such as Personnel Electrostatic Discharge (PESD), Helicopter Electrostatic Discharge (HESD), Hazards of Electromagnetic Radiation to Ordnance (HERO), Electromagnetic Vulnerability (EMV), and Electromagnetic Interference (EMI). High explosives are also assessed at our facilities.

ENVIRONMENTAL EXPERIMENTATION FACILITIES
- Air Guns for linear acceleration experiments: to 200,000 g with soft recovery.
- Rotary acceleration centrifuges: to 1300 g. have slip rings permitting measurement of arming time of fuzes and safing and arming devices.
- Altitude and climatic walk-in and bench chambers for the simulation of any world-wide temperature and humidity conditions.
- Drop facilities up to 110 ft.
- Jolt, Jumble, Leak, Load, Loose Cargo, Pressure, Rough Handling, Salt, and Fog experiments all with on-line data acquisition and analysis - Mechanical Shock experiments up to 30,000 g. - Water Immersion, Solar Radiation, Spin, Stacking, Thermal Shock, Vacuum-Steam-Pressure, and Vibration: Random, sine, and gunfire, simulating transportation and tactical vibration at extreme temperatures.


ADDITIONAL PROTOTYPE EXPERIMENTATION CAPABILITIES
- The ARL/FSAC Blossom Point Field Facility. The facility has a horizontal range of 6000 ft. (expandable to 12,000 ft.), a width of from 500 - 1000 ft., and a maximum ceiling of 10,000 ft. for high quadrant elevation (Q.E.) firings. Open field areas make fly-over, parachute and helicopter drops possible. Also, facilities are available for suspension of hardware. An on-site explosive loading room is available for the assembly of fuzes, ammunition, and explosive components. Temperature chambers provide for conditioning rounds or hardware to specified temperatures. The explosive range limit for any single surface detonation is 15 pounds net explosive weight.

- Instrumentation vans are available to acquire data using telemetry for ballistic firings and direct or remote coupling for static experiments. Photographic data can be acquired by either high resolution video or high speed photographer.

Army

DOD IN-HOUSE RDT&E ACTIVITIES REPORT FY97

Armament Research, Development and Engineering Center
Picatinny Arsenal, NJ 07806-5000
Commander: BG James W. Arbuckle
Technical Dir: Mr. Carmine Spinelli
(973) 724-6000

<table>
<thead>
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MILITARY CONSTRUCTION (MILLIONS $)

| Military Construction (MILCON) | 17.450 |

PERSONNEL DATA (END OF FISCAL YEAR 1997)

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SPACE AND PROPERTY

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ACRES | 6,493

NA = Not Applicable

2-20
Provide materiel and logistics systems analysis for the Army to support the decision making process.

CURRENT IMPORTANT PROGRAMS

The U.S. Army Materiel Systems Analysis Activity (AMSAA) has two primary mission areas: Materiel Systems Analysis and Logistics Systems Analysis. The materiel systems analyses are funded through AMSAA's RDT&E program; whereas, the logistics systems analyses are funded through AMSAA's OMA program. Materiel systems analysis is accomplished within three core mission functions: item and system level performance, modeling and simulation (M&S), and investment strategies. Wholesale and retail logistics analysis, logistics modeling and methodology development, and force projection and sustainment analysis comprise the core functions of Logistics Systems Analysis.

AMSAA is the Army's center for item and system level performance analysis and certified data. AMSAA utilizes automated databases and models to characterize the functionality of Army materiel systems. Unique models and methodologies have been developed to accurately predict critical performance variables, such as, weapon accuracy, target acquisition, rate of fire, the probability of inflicting catastrophic damage, and system reliability. This year standard performance data was provided to major Army and DoD studies, such as, analysis of alternatives (e.g. ATACMS/BAT P3I and Combat ID), Future Scout and Calvary System (FSCS) Cooperative Program Exploratory Analysis (CPEA), and Joint A2R2. As the Executive Agent for OSD for the tri-service Joint Technical Coordinating Group/Munitions Effectiveness program, AMSAA applies its item level performance expertise to manage the program and to ensure standardized weapons effectiveness assessments are used across the services. The publication of Joint Munitions Effectiveness Manuals (JMEM) provides single source documents for modelers, materiel developers, and strategic and operational planners. Examples of FY97 products include: JMEM Air-to-Surface Weapon System (JAWS), Joint Anti-Air Model (JAAM), and Weapons Characteristics JMEM.

Systems performance analysis is initiated in the technology base and evolves with the system through requirements definition, the analysis of alternatives process, insertion into the acquisition cycle, and then extends to fielding and sustainment. AMSAA's linkage with the Integrated Concept Team (ICT) process creates an opportunity for the Army to take advantage of systems analysis early in the acquisition process. AMSAA is positioned to support ICTs through early requirements trade-off analysis before specific solutions are identified. As technologies are inserted into the Advanced Technology Demonstration (ATD) and Advanced Concept Technology Demonstration (ACTD) processes, AMSAA has the capability to perform verification, validation, and certification of performance data, provide an analytical basis for the formulation of exit criteria, conduct system performance analysis, and verify, validate and accredit required models and simulations. These capabilities support the timely transition of warfighting technologies from the technology base to integration into specific weapon system programs. AMSAA provides Army project managers and decision makers with comprehensive systems performance and effectiveness capability analysis for systems in the development process. Examples of systems analyses executed in FY97 are: FSCS CPEA, Crusader, AAAV, PATRIOT, Follow-on to TOW (FOTT), the Extended Range MLRS, and Tank Extended Range Munition (TERM), and the Future Combat System (FCS). The integration of cost as an independent variable (CAIV) will help ensure the development of cost-effective systems that will provide critical war fighting capabilities to the Army After Next.
AMSAA's modeling and methodology capabilities support the development, linkage and accreditation of live, virtual, and constructive simulations, and provide unique tools that support systems analysis of both individual systems and combined arms environments. AMSAA has resident and maintains many models and simulations, most of which were developed in-house to address specific analytical voids. These models range from component level, physics-based models to force-on-force simulations. Also, AMSAA assists model developers with the development and execution of verification and validation plans to ensure new models and simulations faithfully represent actual systems. AMSAA has gained extensive experience in the planning, execution and analysis of Distributed Interactive Simulation exercises and in the verification and validation of Computer Generated Forces and System Simulators. In the Computer Generated Forces area, AMSAA led the Assessment Study that provided the basis for the Army's investment strategy and the decision to integrate the Modular Semi-Automated Forces and Close Combat Tactical Trainer. AMSAA is also actively engaged in developing new methodologies and models, such as Physics of Failure (PoF), to improve the reliability of systems. Target acquisition is another area that AMSAA is assisting in the development of new and improved methodologies.

Shrinking modernization budgets have forced the Army to increasingly focus its research and development efforts toward fewer critical systems and capabilities that will equip the force with the most "bang for the buck". AMSAA has developed and implemented new methodologies capable of examining decision alternatives in terms of value added, cost benefit, and total risk. The FSCS CPEA, recently completed for DA decision makers, is an example of how systems level performance and cost tradeoffs can be executed across various alternatives. The analysis focused on subsystem performance of sensors, signature management, C4I, mobility, integrated survivability, and firepower of the proposed weapon system alternatives. Similar analyses have and will be conducted on other acquisition programs, such as, FOTT and Combat ID.

AMSAA's logistics analysis expertise covers the full range of Army logistics needs, from the development and refinement of logistics models to the analysis of innovative or modified logistics concepts. AMSAA's studies have led to recommendations for major changes to the Army logistics system that will result in significant improvements in the supply, maintenance, and transportation processes.

AMSAA has developed a methodology, known as Readiness Based Sparing, that optimizes Class IX replenishment stocks while maintaining system readiness at a minimized cost at the division level. The methodology has been successfully demonstrated at several sites since 1990 and AMSAA is currently expanding the use of RBS in the National Guard. In addition, AMSAA is utilizing its logistics knowledge and capability in the development of a Predictive Logistics Supply concept to improve the supply process. The goals of the program are to provide increased flexibility and responsiveness to the customer, reduce the generation of excess, and to provide the best mix of supplies in a timely manner. The project will result in the development of a comprehensive Program Management Plan detailing a total system architecture. AMSAA logistics analyses support the Army acquisition process with level of repair analyses and initial provisioning analyses for materiel development programs ensuring initial stocks and maintenance concepts provide adequate logistics support and best value to the Army when systems are fielded.

AMSAA is heavily engaged in analysis to support the Army planning process for sustaining our forces during operations other than war, contingency operations, and in war. AMSAA has been tasked by the Army to study the entire War Reserves Automated Process in order to identify shortfalls in the current war reserves computation methodology and streamline the process. The results are expected to provide a considerable cost avoidance while improving the readiness of the Army's warfighting systems. AMSAA developed a methodology that it uses to determine contingency support packages for planned and potential operational deployments. Packages are developed for Class IX spare parts requirements at the Area Support Group, Core Support Group, and Direct Support Group and/or Organizational levels in support of wartime contingency planning.
CURRENT IMPORTANT PROGRAMS (continued)

These support packages have been instrumental in planning logistics support and have served to assist in Bosnia, Somalia, Rwanda and numerous other recent Army operations. Efforts are currently underway to expand the methodology to include all classes of supply.

AMSA works to support the Army in its operations. AMSAA executes the Field Exercise Data Collection (FEDC) program which provides quantitative and qualitative operational maintenance, manpower, reliability and logistical support data for fielded materiel systems. The FEDC program supports combat sustainment and war reserve requirements in support of contingency forces worldwide (e.g., Operation Desert Storm, Operation Vigilant Warrior, Haiti, etc.). Field data also serves to validate critical data elements required in scientific, engineering, and logistical support studies.

AMSA provides the Army with the critical information and analysis needed to facilitate the complex decisions required to move the Army into the next century. As resources become increasingly constrained, it is critical the Army leadership continue to have access to timely, reliable, and high quality analysis on which they can base the decisions required to shape the future Army. AMSAA has developed an integrated set of skills and tools focused on its core competencies to be responsive to the breadth and depth of systems analysis requirements for the Army now and into the next century.

EQUIPMENT/FACILITIES

Simulation facility for processing classified material. Simulation facility used for development and verification, validation, and accreditation of models and simulations. Additional equipment for use in support of our primary mission areas of materiel and logistics systems analysis.
Army Materiel Systems Analysis Activity  
Aberdeen Proving Gnd, MD 21005-5071  
(410) 278-6614

Director: Mr. John J. McCarthy  
Military Deputy: COL Charles J. McKenzie III

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MILITARY CONSTRUCTION (MILLIONS $)

| Military Construction (MILCON) | 0.000 |

PERSONNEL DATA (END OF FISCAL YEAR 1997)

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<tr>
<th>TYPE</th>
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SPACE AND PROPERTY

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NA = Not Applicable

2-26
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Army Research Institute

Abbreviated Functional Chart - Technical Organizations

- U.S. Army Research Institute for the Behavioral and Social Sciences
- Manpower & Personnel Research & Development Group
- Training Systems Research & Development Group
- Research and Advanced Concepts Office
- Army Personnel Survey Office
- Occupational Analysis Office
MISSION

Maximize individual and unit performance and readiness to meet the full range of world-wide Army missions through advances in the behavioral and social sciences. ARI achieves its mission through activities of its research units located at its headquarters in Alexandria, VA and elsewhere CONUS and OCONUS (see the following list). In all cases ARI is a tenant at these locations where the host activity provides services (e.g., facilities, utilities) for a fee. Research units: Simulator Systems Research Unit (Orlando, FL); Armored Forces Research Unit (Ft. Knox, KY); Infantry Forces Research Unit (Ft. Benning, GA); Reserve Component Training Research Unit (Boise, ID); Rotary-Wing Aviation Research Unit (Ft. Rucker, AL); Ft Leavenworth Research Unit (Ft. Leavenworth, KS). Scientific Coordination Offices: Ft. Bragg (Ft. Bragg, NC); Ft. Hood (Ft. Hood, TX); USAREUR SCO (Heidelberg, GE); and TRADOC SCO (Ft. Monroe, VA).

CURRENT IMPORTANT PROGRAMS

1. Improve battle commander's thinking, reasoning and problem-solving skills for transition to the new digitized C4I systems.

1. Identify the skills and attributes that quality soldiers need to perform effectively on the 21st Century battlefield.

1. Determine the best “mix” of live, virtual and constructive simulations to maximize learning and minimize training costs.

1. Develop prototype computer-based training programs to improve individual combat skills.

1. Develop methods to improve RC training and to meet evolving missions.

EQUIPMENT/FACILITIES

In-house experimental facilities include laboratory and computer facilities for real-time, man-in-the-loop experimentation. Unique assets include: combat arms simulators; Virtual Reality test bed; a modular, reconfigurable flight simulator for helicopter pilot research; simulators for UH-1Fs, AH-74A and UH-60A helicopters; research access to SIMNET; and Battle Command Experimentation Center.
### FY97 FUNDING DATA (MILLIONS $)

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### MILITARY CONSTRUCTION (MILLIONS $)

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<tr>
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NA = Not Applicable
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Army Research Laboratory

Abbreviated Functional Chart - Technical Organizations

- Army Research Laboratory
- Sensors & Electron Devices Directorate
- Human Research & Engineering Directorate
- Information Sciences & Technology Directorate
- Survivability/ Lethality Analysis Directorate
- Weapons & Materials Research Directorate
- Corporate Information & Computing Center
- Vehicle Tech Center
MISSION

The mission of ARL is to execute fundamental and applied research to provide the Army with the key technologies and analytical support necessary to assure supremacy in future land warfare.

ARL's vision:

-- A laboratory preeminent in key research areas of science, engineering and analysis relevant to land warfare.
-- A staff widely recognized as outstanding.
-- A laboratory seen by Army users as essential to their missions.
-- An intellectual crossroads for the technical community.

CURRENT IMPORTANT PROGRAMS

ARL's Grand Challenges:

Provide weapons systems technology for the future combat system (FCS)
Major Thrusts:
- Advanced armament propulsion and flight- Conventional, ETC, EM
- Advanced terminal effects
- Novel weapons concepts
- Material technology

Provide lighter, faster, more fuel-efficient mobile platforms to enhance deployability and reduce the logistics tail
Major Thrusts:
- Develop propulsion science and technology for future turbine engines
- Cooperate with DOE/Industry on efficient diesel engine technology
- Develop structural concepts and novel materials for light weight air and ground vehicles
- Improve loads and durability prediction technology

Provide commanders unprecedented real-time awareness of the battlefield
Major Thrusts:
- Electro-optic and photonics devices
- RF and electronic components
- Signal and imaging processing techniques

Significantly improve the battlefield soldier's ability to absorb information and make decisions
Major Thrusts:
- Digital battlespace architecture and operational capability
- Extend soldier's sensory perception
- Assimilation of battlefield information
- Data analysis and intelligent systems
- Simulation of C4I battlefield architectures
- Distribution of battlefield information
- Open simulation architecture
- Integrate soldier into Army systems and materiel
CURRENT IMPORTANT PROGRAMS (continued)

Solve the defensive information warfare problem
Major Thrusts:
- Survivability, lethality, and environmental analysis in support of Army milestone reviews
- Develop tools, techniques and models for vulnerability and lethality analysis
- Electromagnetic Environmental Effects (E3) technology
- Information warfare analysis

Technology Transfer
- New CRDAs = 35, New PLAs = 5
- SBIR awards of $14.7 million (Consisting of 43 phase I and 39 phase II (including 13 new-starts) and 7 STTR)
- New International agreements = 18

ARL Personnel Exchanges
- Guest researchers sent out to other labs: 110
- Guest researchers brought into ARL: 203
- Minimum stay is two weeks
- Guest researchers sent to foreign countries: 6

Reshape
- Downsized the Technology Transfer Office from 15 people to 10
- Decreased the Technology Transfer Office budget by 54%

EQUIPMENT/FACILITIES

Flame Research Facility
This facility enables us to conduct sophisticated studies in flame chemistry in support of propellant combustion simulation, so that advances can be made in gun propulsion. A wide variety of state-of-the-art spectroscopic and mass spectrometric diagnostic tools are used for experimental flame measurements. These measurements can be coupled with sophisticated flame computer models to support not only gun propulsion research but other flame research of military interest, such as fire suppression/extinction, hazardous waste incineration, and soot abatement.

Aerodynamics Range
This range is used to measure the actual flight motion of projectiles up to 37-mm caliber under realistic pressures, densities, and velocities. It is the only range in the U.S. capable of obtaining the accurate data on small and medium-caliber projectiles needed for the preparation of precise aiming data and firing tables.

Transonic Range
This facility measures the actual flight motion of large-caliber projectiles (up to 8-in. diameter) under realistic pressures, densities, and velocities. It is the only range in the free world capable of obtaining accurate data on large caliber projectiles needed for input to artillery fire-control computers and firing tables.

Tungsten Alloy Range
This range routinely conducts full-scale terminal-ballistic experiments with both kinetic-energy penetrators and shaped-charge warheads. It is able to fully instrument the terminal-ballistic tests of all advanced armors, including reactive armor.
**EQUIPMENT/FACILITIES (continued)**

**Large-Caliber Experimental Test Facility**
This self-contained diagnostic test range conducts full interior ballistic testing and evaluation, from the ignition and combustion of propelling charges, through projectile in-bore travel, to muzzle exit. The facility tests and evaluates advanced conventional gun propulsion technologies, electrical propulsion concepts, and innovative propulsion schemes, such as in-bore ram acceleration.

**Cannon-Caliber Electromagnetic Launcher Range**
This installation measures the launch and flight performance of electromagnetic cannons up to 30-mm caliber. Equipped with a nearly 2.0-MJ power supply and a range of 250m, it performs diagnostics on electrical, mechanical, and aerodynamic qualities of electromagnetic gun systems.

**Explosive Mechanics Facility**
At this facility, two enclosed blast chambers can test up to 23-kg of explosive material. The chambers feature high-speed photography (2 million frames per second), flash x-ray devices, four-channel x-ray cineradiography, and high-speed recording equipment. Projectiles are fired into the chambers from an adjacent gun room. The chambers are currently being used to study thresholds in special explosives for reactive armor and fundamental initiation processes in solid explosives. Blast Range Here, three air-driven shock tubes, 0.6, 1.7, and 2.4-m in diameter, simulate air blast from nuclear and conventional weapons. The largest air-driven shock tubes in the U.S., they allow flat-topped and exponentially decaying blast waves to be produced. All three Services use the range for R&D blast loading and response investigations of full-size and scale-model materiel. (Note: A recently constructed Large Blast/Thermal Simulator, to be operated by the U.S. Army Test and Evaluation Command, features a nitrogen-driven shock tube with a 167-m² test section. The facility is currently in its characterization phase.)

**Aircraft Vulnerability/Lethality Experimentation Facility (AVLEF)**
This test range gives ARL a modern, centralized complex to evaluate the effects of explosive blast and fragmentation warheads, armor-piercing incendiary and high-explosive incendiary projectile impacts, and experimental penetrators and weapons, as well as unconventional threats, on aircraft components, subsystems, and complete operating fixed and rotary-wing aircraft. This testing capability benefits our participation in the DoD Joint Live-Fire Army-Air Force Program, as well as future developmental, specification, and live-fire test and evaluation associated with major Army aviation and anti-aircraft systems. In addition to Army test requirements, AVLEF supports Air Force and Navy-sponsored anti-aircraft warhead lethality evaluations and Aircraft Battle Damage Repair techniques. Specialized test resources and facilities at AVLEF include a blast pad for the evaluation of the effects of large blast/fragment warheads (of up to 100-lb of high explosives) on operating helicopters or fixed-wing aircraft, a covered full-scale dynamic turbine engine and helicopter drive train test pad, indoor and outdoor small-to-medium-caliber ballistic ranges for component and subsystem testing, EPA-approved fuel systems test capability, helicopter rotor-blade static loading fixture, remotely operated helicopter ground test tie-down, mobile airflow generator capable of 500 knots of airflow directed at targets, and a centralized test preparation and control/instrumentation building. A dedicated full-scale dynamic structural test building with ballistic capability was also constructed within AVLEF.

**Obscure Munitions Threat Simulation Facility**
Employees at this facility design, develop, and produce munitions that emulate all known obscuration threats, so that we can accurately assess the survivability of developmental electro-optical and electromagnetic systems (e.g., Longbow, Hellfire Missile, and Javelin) on the “dirty” battlefield and advise how to make these systems more robust in these environments. We conduct experiments using simulators, fabricated in this facility, that produce threat smoke and obscurants designed to defeat systems operating in the visible, infrared, and millimeter-wave regions. The facility features a unique white-phosphorus filling machine as well as an analytical laboratory, munitions fabrication equipment, and associated processes.

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Screening Threat Simulation Facility
Accurate and realistic simulations of all threat smokes and a variety of experimental obscurants are produced here. Our people design and fabricate a variety of state-of-the-art large-area smoke-screen-generating equipment including foreign and experimental smoke generators, explosively disseminated pyrotechnic munitions and simulators, and indirect-fire simulators. The equipment may be mounted on various vehicles to provide for all-terrain capabilities. Field experiments conducted using this equipment support the analysis of survivability of developmental electro-optical systems and the subsequent design and selection of systems that will function in realistic battlefield environments.

Out-of-Laboratory Facility (OLF)
The OLF supports survivability analyses of developmental weapon systems and assists materiel developers in hardening systems to withstand the effects of electromagnetic pulse (EMP) and other electromagnetic environments. The facility obtains electromagnetic coupling and response measurements through two experimental techniques, radiated continuous-wave and current injection. The Continuous-Wave Instrumentation System (CWIS) radiates sinusoidal electromagnetic fields at selected frequencies between 10-kHz and 1-GHz using two antenna systems, a 1000-ft horizontal dipole and a log-periodic antenna with a large clear 2500-m$^2$ test volume. The OLF also features current injection devices capable of producing a broad range of double-exponential and dampened sinusoidal waveforms, including sources that meet MIL-STD-188-125 requirements. Data measured by both techniques are transmitted, via fiber-optic link and network analyzers, to the facility's instrumentation trailer. These, computational resources determine the time-domain response to transient electromagnetic radiation, including the EMP threat, and duplicate threat-level system response to EMP or other transient electromagnetic coupling.

Computerized Mobility/Portability Course
This calibrated obstacle course has become an Army standard for measuring the effects of soldier load on mobility and physiological functions. It consists of hard surfaces and wooded areas, along with obstacles that require the encumbered soldier to run, jump, crawl, climb, and maneuver on foot. The facility is computerized, with the capability for real-time data collection and management. A special feature is the biophysical telemetry system, which monitors the soldier's heart rate, skin and core temperatures, sweat rate, and "G" loading.

Computerized 600-m Small Arms Range
The Small Arms Range is a state-of-the-art facility for examining soldier weapon performance. It consists of multiple stationary and moving targets, controlled from a computer-equipped command and control center. The range permits the engagement of targets at a wide variety of distances, target exposure times, and angles. It features four firing lanes with target exposures from 10 to 550-m; these firing lanes can be operated simultaneously with different target scenarios. Each lane has five targets at 10 and 25-m for firing personal defense weapons and three targets each at 50, 75, 100, 150, 200, 250, 300, 400, 500, and 550-m for rifle firing. In addition to the fixed targets, each lane has three moving targets at 80, 130, and 180-m, which travel a distance of 15-ft at 90° to the shooter. Special in-house-designed targets and pneumatically operated target mechanisms are also featured. The computerized command and control center can present programmed arrays of targets at any distance, time interval, and sequence. The computer system has a software package that records and reduces range events, such as targets presented, target time, target hits, shots fired, and time of shot. The computer system also features an acoustic measurement system that provides horizontal and vertical coordinates of a hit or a near miss on a target.
Indoor/Outdoor Robotics and Automation Research and Test Facility
Application of robotics technology and automated systems to military operations can enhance weapon system effectiveness, create new capabilities, and reduce risks to soldiers. This facility allows the development of robotics and related technologies. It includes an outdoor 14-acre test area that features a 25-mph sustained-speed test track, a standardized obstacle course, and an explosive-ordnance-disposal robot court, along with perimeter safety barricades and a Global Positioning System (GPS) position-location system. The indoor section contains a 35,000-ft² test area with an RF position-location system, central data-acquisition equipment, and a computing facility.

High-Performance Computing Resources
As part of the DoD High-Performance Computing Modernization Program (HPCMP), ARL has become a DoD Major Shared Resource Center (MSRC). State-of-the-art scalable parallel architectures, workstation clusters, and large vector configurations, supporting both classified and unclassified missions throughout the DoD science and technology community, will be operated at the ARL Aberdeen MSRC facility. ARL provides DoD leadership in the development, acquisition, and implementation of the latest networking technologies through the HPCMP Defense Research and Engineering Network (DREN) initiative. In addition to the MSRC, the Army High-Performance Computing Research Center (AHPCRC), located at the University of Minnesota, provides resources and assistance toward these efforts.

Composites Processing Research Facilities
Advanced low-cost, reliable processing techniques are essential to the future application of structural polymer matrix composites to Army ground vehicles, aircraft, and other materiel. ARL's state-of-the-art composites processing research facilities, such as the fully automated high-temperature (800° F) and pressure (450-psi) autoclaves, provide the necessary research tools to address scientific and engineering problems in process optimization and automated process control.

Materials Characterization Facility
This unique facility enables ARL's scientists and engineers to conduct highly detailed measurements of the properties of ceramics, polymers, glasses, and composites. It includes extensive state-of-the-art instrumentation for analyzing the chemical properties of materials at a wide range of temperatures, as well as a full complement of optical and electron microscopy and other electron probe instruments for microstructural analysis, x-ray residual stress analysis, and electrical, magnetic, and thermal property characterization. It also features a unique combination of surface analysis equipment.

Ion Implantation Facility
At this facility, employees develop and demonstrate novel ion surface treatments and coating techniques for Army materiel, such as machine tools and parts subject to corrosive or high-wear environments. This technology is demonstrating significant improvements in the quality of protective coating techniques, such as cadmium and chromium plating. In addition, the ion-implantation process has proven to be environmentally acceptable as an alternative to cadmium, chromium, and other heavy-metal plating processes which, collectively, account for 90 percent of the hazardous wastes generated by all electroplating processes within DoD. A cooperative effort with the Corpus Christi Army Depot is demonstrating the effectiveness and cost benefits of ion-implanted machine tools such as taps, drills, and end-mills.
Special Meteorological Equipment
We have developed a variety of special meteorological equipment to meet unique Army and other customer requirements that cannot be satisfied with standard laboratory instrumentation. Some examples include specialized visible and infrared transmissometers used to evaluate Army electrooptical weapon systems operating in degraded and battlefield-obscured atmospheres, and an atmospheric profiler facility used to measure vertical profiles of wind speed, wind direction, and small-scale turbulence at altitudes up to 2-km in support of ballistic correction requirements. Most of this instrumentation falls within a 40-by-140-mile division-sized area of operations at White Sands Missile Range. We have a variety of automated and manned data-collection points throughout this area, including 20 automated surface observation stations, a meteorological rocket launch complex, and two 500-ft instrumented meteorological towers.

Mobile Acoustic Source (MOAS)
The MOAS is a pneumatic loudspeaker system that allows scientists to verify acoustic models with atmospheric effects. The system is a true exponential horn, 56-ft long, with full fidelity from 10 to 500-Hz; it will generate sound sufficient for testing acoustic propagation of sources up to 15-km away. Other features include the following: (1) it is transportable, mounted on an expandable flatbed trailer, (2) it can develop 20,000 acoustic watts of power, or over 160-dB, and (3) it may be controlled via radio-frequency link and fail-safe software to ensure safe operation. The MOAS can reproduce realistic signals simulating any sound at various ranges and under controlled conditions, and it can broadcast single tones, multiple tones, or tape playbacks. No other system with comparable features exists in the world today.

Electromagnetic Analysis Facility (EMAF)
This facility conducts full-scale investigations of the vulnerability of weapon systems to electronic warfare, including radio frequency countermeasures (RFCM), millimeter-wave countermeasures, and high-power microwaves (HPM). Electromagnetic susceptibility experiments use three anechoic chambers: the primary investigation anechoic chamber, a 94-ft long, 32-ft wide, and 25-ft high chamber; and two smaller chambers, one used for RFCM and one for millimeter-wave CM. Featuring externally modulated high-power amplifiers, the EMAF offers the capability to continuously sweep from 100-MHz to 18-GHz and to generate pulsed RF of up to 1-MHz and pulsed waves from 50-ns to continuous-wave. The facility can also generate AM, FM, and noise-modulated RF environments to expose the system under investigation to a comprehensive set of conditions that may be encountered in a battlefield. Resident state-of-the-art computational resources are available to provide equipment automation and real-time data analysis and storage. Also featured is a computer-controlled RF-threat emulator that provides complex high-fidelity single RF-threat radar waveforms for the RFCM investigations.

Electro-Optical Countermeasures Missile Flight Simulation Facility
This hardware-in-the-loop missile flight simulator evaluates the effectiveness of EO air defense missile systems in CM environments. The simulator includes major portions of actual missile-guidance and control hardware with software embedded in the simulation loop. Real-time representations are solved, using both digital and analog computers, for missile dynamics in six degrees of freedom and target motion in three degrees of freedom. A multiprocessor digital computer solves the missile aerodynamics and propulsion and the relative target-missile geometry. The analog computer models subsystems with bandwidths too high to allow real-time digital solution, such as the wing servo or gyro transfer function. A second digital computer functions as the simulation controller and supervises the real-time trajectory and field-of-view displays hosted on two PCs. The primary output from the simulation is miss distance at the point of closest approach to the target, a criterion from which the overall effectiveness of a CM technique may be assessed. Further processing of the miss distance into a digital end-game model can yield probability of hit (i.e., missile lethality) against specific threat aircraft.
Equipment/Facilities (continued)

Electro-Optical Data Acquisition System (EODATS)
The EODATS provides a unique capability of dynamically tracking and measuring target signatures during EW missile firing experiments. It consists of a 35-ft instrumentation van integrated with an automated tracking pedestal capable of controlling the operation of six electro-optical missile seekers in a captive track arrangement. Data collected from the captive seekers can be recorded for post-mission analysis. Video documentation of seeker responses to the ECM environment aids quick-look analysis. The EODATS is equipped with infrared through ultraviolet spectrometers, radiometers, and imagers to obtain signatures of targets, countermeasures, and backgrounds. Automatic target tracking is achieved with a highly modified Chaparral AN/DAW-1B missile seeker or digital/analog outputs from the control computer. Manual target tracking is also available via a joystick that operates the track mount (either remotely or directly by telescope optics). The motion of the track mount during a data run can be recorded to a computer file, which can be played back through the track mount to collect background signature data across the same path. The signature measurements of the background can then be subtracted from the target-plus-background data file to achieve target-only measurements. Acoustic/Seismic Countermeasure Vehicle ARL operates a modified 5-ton stake-bed truck that can evaluate acoustic and seismic countermeasures by functioning as an acoustic/seismic decoy and an acoustic jammer. The vehicle houses an acoustic loudspeaker system, consisting of a 12-kW power generator, subwoofer cabinets, and power amplifiers, that can reproduce any signal within a frequency range of 40 to 200-Hz. The vehicle also tows a 750-lb tank sprocket used to generate seismic energy that produces spectral lines similar to those of ground combat vehicles but at a smaller magnitude. To simulate a moving ground vehicle target, the vehicle radiates a pre-recorded target signature as it travels along the ground. To simulate an acoustic jammer, it radiates broad-band noise designed to protect accompanying target vehicles by masking their acoustic signatures. The vehicle is currently being used to examine the effects of decoying and jamming on the Wide-Area Mine System - a system that relies on the acoustic and seismic energies emanating from a ground combat vehicle to engage it as a target.

Air Defense Electronic Warfare Facility
This laboratory provides ARL with a quick-reaction capability for the implementation of EW techniques to ensure that all elements of the EW threat required for the vulnerability assessment process are addressed. Specialized hardware is developed and fabricated at this facility for the field experiments associated with surveillance, tracking, and guidance functions of Army systems. The facility supports a wide variety of special-purpose equipment, including airborne and ground-based RF jammers, EOCM equipment, passive RFCM equipment, and state-of-the-art field measurement systems. Although primarily developed to support EW vulnerability analyses, these resources have wide application and are routinely used by the other services as well as the international community.

Ultra Wideband (UWB) Synthetic-Aperture Radar (SAR) Testbed
This roof-top facility provides the capability to collect precise, repeatable SAR data to perform target detection and recognition studies suitable for implementation in an airborne SAR and to test the performance of various radar components. It features a rail-guided, robotically controlled cart that supports the radar on a 115-m laser-leveled-and-aligned track. The current radar system is a fully polarimetric UWB mechanization with an operating frequency range from 40-MHz to 1-GHz. The testbed also features a position-measurement system that defines and records the position of the radar system to generate high-resolution radar imagery of stationary targets in the clear and those embedded in foliage during seasonal changes. These data are used in developing automatic target recognition (ATR) algorithms. A mobile UWB SAR testbed, featuring a 150-ft measurement system, is being built to support vehicle-mounted ground-penetrating radar developments, including mine detection systems. The UWB radar on a 150-ft boom lift allows for collection of two-dimensional apertures to support three-dimensional image formation for improved target detection and identification.
**EQUIPMENT/FACILITIES (continued)**

**Millimeter-Wave Instrumentation Test Facility**
Here, specialists conduct basic research in propagation phenomena, remote sensing, and target signatures over the frequency range from 8 to 300-GHz. The facility is unparalleled in the breadth and depth of its instrumentation and analysis capability. Components and test equipment are available that can be readily configured for conducting feasibility studies of sensor concepts. Supporting tools include high-speed data acquisition and analysis systems, visualization tools, and model generation for performance evaluation. Through a synergistic relationship with the U.S. Army Combat Systems Test Activity (CSTA), ARL can conduct range testing using this facility with a minimum of in-house resources.

**Acousto-Fluidic Test Facility**
At this location, a full acoustic anechoic chamber allows the study of fluidic sensors, fluidic signal processors, and other microphone systems. Fluidic microphones, with a flat bandwidth down to a true zero hertz (DC), can be configured to be more sensitive than any commercially available microphone. In addition to the research being conducted on these fluidic microphones, they can also be used as a research tool for other programs requiring increased sensitivity and nonelectronic acoustic sensing. The chamber is anechoic pro.
### FY97 Funding Data (Millions $)

<table>
<thead>
<tr>
<th>Appropriation</th>
<th>In-House Management</th>
<th>Out-of-House</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>RDT&amp;E:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.1 ILIR</td>
<td>0.000</td>
<td>NA</td>
<td>0.000</td>
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<tr>
<td>6.1 Other</td>
<td>27.029</td>
<td>0.147</td>
<td>39.655</td>
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<tr>
<td>6.2</td>
<td>90.639</td>
<td>0.167</td>
<td>45.066</td>
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<tr>
<td>6.3</td>
<td>11.717</td>
<td>0.033</td>
<td>9.006</td>
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<td>Subtotal (S&amp;T)</td>
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<td>159.306</td>
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### Military Construction (Millions $)

| Military Construction (MILCON) | 96.618 |

### Personnel Data (End of Fiscal Year 1997)

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<th>Type</th>
<th>Scientists &amp; Engineers</th>
<th>Technical Support &amp; Other Personnel</th>
<th>End Strength</th>
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<tbody>
<tr>
<td></td>
<td>Doctorates</td>
<td>Other</td>
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<td>Military</td>
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<td>Civilian</td>
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<td>Total</td>
<td>319</td>
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### Space and Property

<table>
<thead>
<tr>
<th>Building Space (Thousands of Sq Ft)</th>
<th>Property Acquisition Cost (Millions $)</th>
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</thead>
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<tr>
<td>LAB 1,250.000</td>
<td>REAL PROPERTY 697.000</td>
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<tr>
<td>ADMIN 864.000</td>
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<td>OTHER 673.000</td>
<td>EQUIPMENT 561.587</td>
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<td>TOTAL 2,787.000</td>
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<td>Acres 5,335</td>
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NA = Not Applicable
Aviation Research, Development and Engineering Center

Abbreviated Functional Chart - Technical Organizations

- Aviation Research, Development and Engineering Center
  - Engineering Directorate
  - Advanced Systems Directorate
  - Business Management Office
  - Material Safety Office
  - Aviation Applied Technology Directorate
  - Aeroflight Dynamics Directorate
  - Life Cycle Software Engineering Directorate
  - Test and Evaluation Management Office
MISSION

Execute the DoD Rotorcraft Science and Technology program and provide 'one-stop' engineering support to all life cycle phases as required to achieve technologically superior, safe, and supportable Army aviation systems and equipment. The AVRDEC has the responsibility to plan and, in most cases, execute the fundamental basic research, exploratory development, and advanced development programs supporting DoD rotorcraft needs in the areas of aeromechanics, propulsion, structures, reliability and maintainability, survivability, weaponization, avionics mission equipment, and systems integration/simulation.

CURRENT IMPORTANT PROGRAMS

Rotorcraft Pilot's Associate; Joint Turbine Advanced Gas Generator and Integrated High Performance Turbine Engine Technology; Advanced Rotorcraft Transmission; Air-to-Air Starstreak Integrated Advanced Boresight Equipment; Integrated Fire and Flight Control, Advanced Cargo Handling System; Airborne Manned/Unmanned Systems Technology; Unit Maintenance Aerial Recovery Kit; Advanced Composite Structural field repair NDI/NDT; Rotary Wing Structures Technology, Light Weight, High temperature Uncooled Turbine; visual Electro-Optical Signature.

Current CRADAs include:


Materials Characteristics of Composite Rotor Blades - Advanced technologies, Inc.

Ballistic testing of Helicopter Composite drive shafts - Boeing Defense and Space Group

Evaluation of Articulated Boresight Equipment - Cubic Precision

Black Hawk Growth Rotor Evaluation - Sikorsky Aircraft

Associate Cockpit Technology - Sikorsky Aircraft

Appl of Human Factors Research to Short haul Civil Tiltrotor - Boeing Defense and Space Group

Aero and Structural Computer models for AH-64D Helicopter - McDonnell Douglas Helicopter

Collaborative Army Industry Rotorcraft Technology Exchange - Boeing Defense and Space Group

Collaborative Army Industry Rotorcraft Technology Exchange - Sikorsky Aircraft

Incompossible Navier-Stokes CFD analysis to Predict Fuselage Drag - Sikorsky Aircraft

AI Technology and Sensors to Army Air and Ground Vehicles - Aerobotics Corporation

Application of Conduit Control System Design Tool with Bell Helicopter

Comprehensive Identification from Frequency Response (CIFER) with Kaman Aerospace and Carnegie Mellon Robotics Institute.

2-43
# Equipment/Facilities

Crew Station Research and Development Facility: three blue/red team stations; fiberoptic helmets; one or two seat standard cockpit; Mission Equipment Simulation Evaluation Facility (MESEF) Cockpit; technical center can simulate 11 other aircraft, 99 threats, 20 moving targets, and C3.

Flying Laboratory for Integrated T&E (FLITE): modified AH-1S aircraft; Apache PNVS; reconfigurable voice I/O system; flight symboloty; fully integrated instrumentation.

NASA-Ames Vertical Motion simulator: four interchangeable cabins with virtual TV display; six DOF motion, acceleration, and velocities; sound generation system; pilot and co-pilot positions.

NASA-Ames Helicopter Human Factors Research Facility: four part-task simulators to investigate: geographic orientation, visual cues simulator, voice actuated controls, and pilot decision-making.

NASA-Langley 14x22 Wind Tunnel: VSTOL/200 knots/variable test section; flow visualization and diagnostics; acoustics capability.

Infra-Red Suppressor Facility: IR suppression fabrication shop; engine and test stand with indoor and outdoor test ranges; Sun workstation and software for: test data recording and analysis, and design and simulation of IR suppressors.

Ballistic Test Range: two outdoor and one indoor test range: fully instrumented for data collection and analysis; fuel recovery system; API and HEI up to 30mm in caliber. Experimental fabrication facility. Full scale aircraft and component structural test facility.

## FY97 FUNDING DATA (MILLIONS $)

<table>
<thead>
<tr>
<th>APPROPRIATION</th>
<th>IN-HOUSE MANAGED</th>
<th>IN-HOUSE OUT-OF-HOUSE</th>
<th>TOTAL</th>
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<tr>
<td>RDT&amp;E:</td>
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<td></td>
<td></td>
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<tr>
<td>6.1 ILIR</td>
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<td>17.684</td>
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<td>0.548</td>
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<td>TOTAL RDT&amp;E</td>
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<td>90.860</td>
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</table>

### PROCUREMENT
- 0.000
- 0.752
- 9.022
- 3.921
- 14.555

### TOTAL FUNDING
- 67.464
- 0.000
- 104.555
- 172.019

## MILITARY CONSTRUCTION (MILLIONS $)

| Military Construction (MILCON) | 0.000 |

## PERSONNEL DATA (END OF FISCAL YEAR 1997)

<table>
<thead>
<tr>
<th>TYPE</th>
<th>SCIENTISTS &amp; ENGINEERS (DOCTORATES)</th>
<th>TECHNICAL SUPPORT &amp; OTHER PERSONNEL (END STRENGTH)</th>
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<tbody>
<tr>
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<tr>
<td>CIVILIAN</td>
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## SPACE AND PROPERTY

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<thead>
<tr>
<th>BUILDING SPACE (THOUSANDS OF SQ FT)</th>
<th>PROPERTY ACQUISITION COST (MILLIONS $)</th>
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<tr>
<td>LAB</td>
<td>REAL PROPERTY</td>
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<tr>
<td>ADMIN</td>
<td>* NEW CAPITAL EQUIPMENT</td>
</tr>
<tr>
<td>OTHER</td>
<td>EQUIPMENT</td>
</tr>
<tr>
<td>TOTAL</td>
<td>* NEW SCIENTIFIC &amp; ENG. EQUIP.</td>
</tr>
<tr>
<td>ACRES</td>
<td>* Subset of previous category.</td>
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</tbody>
</table>

NA = Not Applicable
Aviation Technical Test Center

Abbreviated Functional Chart - Technical Organizations

- Aviation Technical Test Center
  - Flight Test Directorate
  - Data Systems Directorate
  - Test Support Directorate
Aviation Technical Test Center
Fort Rucker, AL 36362-5276
(334) 255-8000

Commander: COL Jack O. Shafer, Jr.
Tech Dir: Larry E. Eagerton

MISSION

Plan, conduct, analyze, and report the results of developmental tests and studies to include airworthiness flight testing of Army aviation systems and associated materiel/systems. To provide test, test support, development support, and evaluations of aviation materiel/systems; and provide other aviation support for authorized customers as directed by the U.S. Army Test and Evaluation Command.

CURRENT IMPORTANT PROGRAMS

AH-64D Long Bow
RAH-66 Comanche Program
Special Operations Aircraft Program
OH-58D Kiowa Warrior
T801 Engine Conversion for National Guard

EQUIPMENT/FACILITIES

Twenty six rotary and fixed-wing aircraft are currently assigned (1 AH-1F, 4 AH-64A, 3 CH-47D, 1 C-23A, 1 OH-58C, 2 OH-58D, 3 UH-1H, 5 UH-60A, 1 UH-60L, 1 U-21H, 2 T-34C, 1 EH-60A, 1 C-12F) as test beds. Helicopter Icing Spray System (HISS): a CH-47D with an integrated 1,800-gallon water tank and spray apparatus combined with a highly instrumented U-21A to provide cloud physics documentation, conducts in-flight icing evaluations under both artificial and natural conditions. Full flight test instrumentation capability exist. Analog and digital aircraft data can be recorded and/or telemetered to the ground. On-site data processing and display exist—real time and postmission. Capability to collect and process video, still, and high-speed pictures exists.
## FY97 Funding Data (Millions $)

<table>
<thead>
<tr>
<th>Appropriation</th>
<th>In-House</th>
<th>In-House Management</th>
<th>Out-Of-House</th>
<th>Total</th>
</tr>
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<td>0.000</td>
<td>0.000</td>
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<tr>
<td>Subtotal (S&amp;T)</td>
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<td>0.000</td>
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<td>6.4</td>
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<td>0.000</td>
<td>0.000</td>
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<tr>
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<td><strong>11.975</strong></td>
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## Military Construction (Millions $)

| Military Construction (MILCON) | 0.000 |

## Personnel Data (End of Fiscal Year 1997)

<table>
<thead>
<tr>
<th>Type</th>
<th>Scientists &amp; Engineers</th>
<th>Technical Support &amp; Other Personnel</th>
<th>End Strength</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Doctorates</td>
<td>Other</td>
<td></td>
</tr>
<tr>
<td>Military</td>
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<td>9</td>
</tr>
<tr>
<td>Civilian</td>
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<td>Total</td>
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## Space and Property

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<tr>
<th>Building Space (Thousands of sq ft)</th>
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</thead>
<tbody>
<tr>
<td>Lab</td>
<td>REAL PROPERTY</td>
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<td>Admin</td>
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<td>Other</td>
<td><strong>EQUIPMENT</strong></td>
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NA = Not Applicable
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CECOM Research, Development & Engineering Center

Abbreviated Functional Chart - Technical Organizations

- Army Systems Engineering Office
- SPO for Digitization
- C2 and Systems Integration
- Advanced Systems
- Space and Terrestrial Communications
- Night Vision and Electronic Sensors
- Intelligence and Information Warfare
MISSION

The Communications-Electronics Command (CECOM) Research, Development and Engineering Center (CERDEC), headquartered at Fort Monmouth, New Jersey, is the AMC Center for research, development and engineering in Command and Control, Communications, Computers and Intelligence (C4I); Information Warfare/Information Operations; Electronic Warfare; Night Vision and Electro Optics; Countersurveillance; Countermine; Power Sources; and Avionics. The CERDEC's mission is focused on providing support to the Program Executive Officers (PEOs) and Project Managers (PMs) and other customers; managing technology base programs by defining, developing and acquiring superior technologies; developing, acquiring, testing and evaluating non-major systems; and sustaining and enhancing systems and equipment for a trained and ready Army undergoing revolutionary changes.

CURRENT IMPORTANT PROGRAMS

Direct Broadcast Satellite (DBS) - The CERDEC is developing and demonstrating military applications of commercially available technology in the broadcasting of imagery, data and other information via the DBS system. DBS is a new commercial technology utilizing high power satellites to transmit digital signals to small, inexpensive receivers. Compression techniques enable data rates sufficient to transmit motion video, databases and other digital information. Program evolves to provide an in-theater capability using airborne relays to reduce independence on commercial satellites as well as development of a mobile uplink system.

Global Mobile Information Systems (GLOMO) - CERDEC efforts will develop a set of “Density and Asymmetry-Adaptive Wireless Networking” (DAWN) mechanisms which will provide flexible, survivable and scaleable solutions to solve problems in several crucial GLOMO communications areas. These areas include network connectivity, routing scaleability, jammer vulnerability, endpoint affiliation and virtual circuit formation.

Multi-Function Staring Sensor Suite (MFS3) Advanced Technology Demo (ATD) - Demonstrate a modular, re-configurable MFS3 utilizing sensor fusion and integrating multiple advanced sensor components including staring infrared arrays, multifunction laser, and acoustic arrays. The MFS3 will provide ground vehicles and surface ships with a compact, affordable sensor suite for long range non-cooperative target identification, low signature target acquisition, mortar/sniper fire location, and air defense targeting against low signature UAVs and long range helicopters.

Integrated Sensor and Targeting (ISAT) - Demonstrate HTI FR, missile and laser warning upgrades to the AN/ALQ-211 and -212, and AVR-2A that provides precision hostile situation awareness, target acquisition and geo-location plus combat ID assist for active emitters.

Lightweight, Airborne Multi-Spectral Countermine Detection System - Explore innovative concept and technology to support a lightweight, airborne stand-off mine detection capability for limited area (point) detection, limited corridor route reconnaissance and detection of nuisance mines along road. Investigate a variety of new component and focal plane array technologies such as 3-5 Staring FPAs, multi/hyper-spectral, passive polarization, active sources and electronic stabilization to support a lightweight, limited capability for future tactical UAVs.
CURRENT IMPORTANT PROGRAMS (continued)


Tactical Command and Control Protect Advanced Technology Demonstration - Develop, integrate, and validate hardware, software tools, tactics, techniques, and procedures that will secure the systems and networks of the Tactical Internet and the First Digitized Division.

Technology Transfer:

CERDEC, together with the NJ Commission on S&T, formed the Information Technology Innovation Center (ITIC). It will electronically connect CECOM's Digital Integrated Lab/Testbed to regionally based university technology centers and state sponsored incubators to provide a platform for innovation "incubation" efforts.

CERDEC hosted a Small Business Outreach Symposium which provided info on enabling small business R&D through tech leveraging, partnering and incubation and dual use technology innovation.

Promoted the development of partnerships with industry and academia to develop CERDEC core technologies through print and internet.

CERDEC has a Cooperative R&D agreement with Charles Stark Draper Lab to develop the Synchronized Course of Action Authoring Tool (SCAT). Draper has taken some interesting approaches around the pixel problem associated with presenting map info on less than desirable pixel densities.

EQUIPMENT/FACILITIES

The CERDEC boasts many world-unique and U.S. Government-unique facilities supporting a broad range of technical areas. A sampling of our state-of-the-art equipment and facilities follows.

Intelligence and Information Warfare Facility. This year, CERDEC opened its new R&D facility which houses the Automated Data Processing Lab/Common Ground Station, Anechoic Chamber and the System Integration Lab. The facility has limited access and Sensitive Compartmented Information Facility (SCIF) areas. It has enabled the CERDEC to expand our world-class R&D capabilities in the areas of signal intelligence, electronic jamming, meteorology sensing and electronic countermeasures.

The Digital Integrated Laboratory/Testbed is a dynamic world-class integrated facility that electronically links distributed CERDEC labs, industry facilities, Battle Labs, field sites, and joint activities. The DIL/T can be rapidly reconfigured to replicate diverse existing and evolving tactical C4I/CW battlefield environments for systems engineering, development, integration, and evaluation of the digital battlefield. The Army Digitization Office has mandated that all equipment and technology to be used in the Digital Battlefield must be tested and/or run through the DIL/T.

Signal Analysis Laboratory. This lab is the only U.S. in-house source of the critical signal processing required for technology development of highly classified signals and for rapid analyses and responses to changing threats emerging from areas of high national interest. The central facility combines hardware and software capabilities for signals analysis and waveform measurement. Some of the lab equipment has unparalleled capability in either government or industry.
Power Sources Battery Test Facility. This facility performs safety, performance, quality and reliability tests on state-of-the-art power sources for the Army. Everything from developmental prototypes to high volume production samples can be tested to include all types of primary and rechargeable batteries, hybrid power sources, fuel cells and thermophotovoltaic devices.

Survivability Integrated Laboratory (SIL). The SIL is an integrated assemblage of survivability hardware (production and developmental), simulation, stimulation and emulation devices that allow for the analysis and evaluation of electronic warfare systems in a multi-spectral environment. The SIL's objectives include determining the optimum survivability suites for ground and air platforms, verifying new countermeasure techniques and establishing the military worth of new concepts and development efforts.
## FY97 Funding Data (Millions $)

<table>
<thead>
<tr>
<th>Appropriation</th>
<th>In-House</th>
<th>In-House Management</th>
<th>Out-Of-House</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RDT&amp;E:</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.1 ILIR</td>
<td>1.770</td>
<td>NA</td>
<td>NA</td>
<td>1.770</td>
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<tr>
<td>6.1 Other</td>
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<td>140.284</td>
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<td><strong>Subtotal (S&amp;T)</strong></td>
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<td><strong>Total RDT&amp;E</strong></td>
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<td>Operations &amp; Maintenance</td>
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<td><strong>Total Funding</strong></td>
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<td><strong>457.065</strong></td>
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## Military Construction (Millions $)

| Military Construction (MILCON) | 0.000 |

## Personnel Data (End of Fiscal Year 1997)

<table>
<thead>
<tr>
<th>Type</th>
<th>Scientists &amp; Engineers</th>
<th>Technical Support &amp; Other Personnel</th>
<th>End Strength</th>
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<tbody>
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<td>7</td>
<td>28</td>
</tr>
<tr>
<td>Civilian</td>
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<td>Total</td>
<td>76</td>
<td>1,310</td>
<td>746</td>
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## Space and Property

<table>
<thead>
<tr>
<th>Building Space (Thousands of SQ FT)</th>
<th>Property Acquisition Cost (Millions $)</th>
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</thead>
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<tr>
<td>LAB</td>
<td>REAL PROPERTY</td>
</tr>
<tr>
<td>ADMIN</td>
<td>* NEW CAPITAL EQUIPMENT</td>
</tr>
<tr>
<td>OTHER</td>
<td>EQUIPMENT</td>
</tr>
<tr>
<td>TOTAL</td>
<td>* NEW SCIENTIFIC &amp; ENG. EQUIP.</td>
</tr>
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<td>Acres</td>
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NA = Not Applicable
Cold Regions Research & Engineering Laboratory

<table>
<thead>
<tr>
<th>Abbreviated Functional Chart - Technical Organizations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cold Regions Research and Engineering Laboratory</td>
</tr>
<tr>
<td>Research and Engineering Directorate</td>
</tr>
<tr>
<td>Technical Resources Center</td>
</tr>
<tr>
<td>RS/GIS Program Development</td>
</tr>
</tbody>
</table>
MISSION

Advancing knowledge of the cold regions through scientific and engineering research and putting that knowledge to work for the Army, Department of Defense and the Nation is the mission of the U.S. Army Cold Regions Research and Engineering Laboratory (USACRREL). Operating in cold regions requires appropriate equipment, training and doctrine, often very different from those used in more temperate conditions. These special requirements cover a broad range of military activities and can incur significant cost or capability penalties. Special challenges of cold regions exist on the more than 30% of the earth's surface that is covered by ice or underlain with permafrost. In addition, persistent and severe winter conditions occur in 50% of the earth's surface, including areas of Europe, Asia and North and South America. Bosnia/Herzegovina and North and South Korea are areas of interest today that experience severe winter conditions that are significantly impacting military operations.

USACRREL provides the technology to allow the Army to operate effectively in cold regions environments to maintain national security and foster peace. USACRREL research and development (R&D) focuses on all aspects of the cold/winter environment and its implications for military activities in garrison or on the battlefield; the singular exception being individual soldier clothing and equipment. CRREL also addresses the nation's winter water resources issues through the Civil Works program of the Corps of Engineers.

USACRREL is a single-focused R&D organization that is the primary source of cold regions expertise for the Department of Defense and both serves and leverages resources and efforts of other federal, state, and local agencies and the private sector.

CURRENT IMPORTANT PROGRAMS

USACRREL's current military programs are concentrated in four major research and development areas: Military Engineering, Battlespace Environments, Civil Engineering, and Environmental Quality.

The Military Engineering research provides innovative solutions to the difficult engineering problems that soldiers face in winter within the confines of existing and emerging equipment and manpower resources. This work is accomplished in conjunction with the primary materiel developer or with troop units to assist in focusing the research and provide direct transition and feedback. Focus areas are winter combat engineering, mobility, and operability. This research serves the cold regions requirements of all the military services and is directly relevant to current Army activities in Korea and Bosnia.

The Battlespace Environments research supports the design, test and evaluation of new systems through characterization, modeling and simulation of the highly varied world environmental conditions and their impact on systems (fielded or notional) performance. Winter and cold regions conditions are particularly difficult constraints for systems development and operation. Examples of direct support include icing problems for aircraft, modeling and simulation of the background environment and its impact on smart weapons systems, mine/countermine systems, and the ability to project environmental conditions in denied areas.
CURRENT IMPORTANT PROGRAMS (continued)

The Civil Engineering research generates technology for cost reductions in designing, building, operating, and maintaining military facilities in areas that experience harsh winter and severe cold weather; where infrastructure life-cycle costs and energy costs are high. USACRREL's efforts help solve critical Department of Defense civil engineering problems related to training, mobilizing, deploying, sustaining, protecting, and employing U.S. Forces in the cold environment.

The Environmental Quality research supports the test and evaluation of materiel systems through maintenance of training and test ranges, allowing their continued use while conserving the integrity of the environment. This is an especially difficult problem for ground vehicles and weapons systems that can have dramatic impacts on the flora and fauna of military ranges. The environmental quality area also has close ties to the Battlespace Environments area because of their common need for characterization and quantification of the geophysical processes that govern both the impact of the operating environment on military operations and systems, and the impact of activities on the quality of the natural environment. USACRREL research supports restoration and conservation goals focusing on special constraints imposed by winter conditions and cold climates.

USACRREL's current Civil Works programs are concentrated in three major research and development areas: Remote Sensing (RS), Geographic Information Systems (GIS), and Cold Regions Engineering.

The RS and GIS research programs support the development of oil spill and flood mapping. Support is also provided by conducting large area environmental assessments critical to emergency response efforts.

The Cold Regions Engineering research program addresses inland navigation, flood damage reduction, and water resource problems in cold regions. This program provides knowledge and mitigating solutions in the areas of ice on inland navigation, operation and maintenance of structures, river ice jams and related floods, ice hydraulics, ice damage to shorelines and shore structures, and hydrology and water resources of cold regions.

EQUIPMENT/FACILITIES

USACRREL has a complex of low temperature laboratories and experimental research facilities not found anywhere else in the world. The main laboratory consists of 24 low temperature research laboratories with a temperature range down to -50 degrees F. The 73,000 square feet Ice Engineering Facility houses three special-purpose research areas; a large low-temperature towing tank, a 100-foot long refrigerated flume for modeling rivers, and a large hydraulic-model room for studying ice impacts on civil works facilities, primarily locks and dams. The 29,000 square feet Frost Effects Research Facility (FERF) supports full-scale research on the impact of freeze-thaw cycles on pavements, foundations, and utility systems. The nationally unique FERF facility provides the capability to simulate natural 3-D freeze-thaw cycles to support research on the impact of these cycles on pavements, foundations, and utility systems. The unique 9000 square feet Low Temperature Materiel Test Facility provides additional capability to investigate composite materials performance subject to low-temperature and thermal cycling for potential use for future Army armor vehicles. USACRREL also has access to two permafrost research sites in Alaska.

In addition, USACRREL houses the 16,400 square foot Corps of Engineers' Civil Works Remote Sensing/Geographic Information System Center, and a state-of-the-art Department of Defense Cold Regions Technical Information Analysis Center (CRSTIAC). The 24,000 square foot CRSTIAC facility is home to the most comprehensive collection of cold regions science and engineering data in the world.
### FY97 FUNDING DATA (MILLIONS $)

<table>
<thead>
<tr>
<th>APPROPRIATION</th>
<th>IN-HOUSE</th>
<th>IN-HOUSE MANAGEMENT</th>
<th>OUT-OF-HOUSE</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RDT&amp;E:</strong></td>
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<td></td>
</tr>
<tr>
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<tr>
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<td>1.085</td>
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<td>Subtotal (S&amp;T)</td>
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<td>0.000</td>
</tr>
<tr>
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<td>6.7</td>
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<td>0.000</td>
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<tr>
<td>Operations &amp; Maintenance</td>
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<td>Other</td>
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### MILITARY CONSTRUCTION (MILLIONS $)

| Military Construction (MILCON) | 0.000 |

### PERSONNEL DATA (END OF FISCAL YEAR 1997)

<table>
<thead>
<tr>
<th>TYPE</th>
<th>SCIENTISTS &amp; ENGINEERS</th>
<th>TECHNICAL SUPPORT &amp; OTHER PERSONNEL</th>
<th>END STRENGTH</th>
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<td>DOCTORATES</td>
<td>OTHER</td>
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<td>0</td>
<td>0</td>
</tr>
<tr>
<td>CIVILIAN</td>
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<td>58</td>
<td>150</td>
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### SPACE AND PROPERTY

<table>
<thead>
<tr>
<th>BUILDING SPACE (THOUSANDS OF SQ FT)</th>
<th>PROPERTY ACQUISITION COST (MILLIONS $)</th>
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<td>REAL PROPERTY 3.200</td>
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<td>ACRES 207</td>
<td>* Subset of previous category.</td>
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NA = Not Applicable
Construction Engineering Research Laboratories

Abbreviated Functional Chart - Technical Organizations

- Construction Engineering Research Laboratory
- Facility Technology Laboratory
- Land Management Laboratory
- Planning and Management Laboratory
- Utility and Industrial Operations Laboratory
**MISSION**

OCE General Orders 17, 9 Sep 68, established USACERL as a Separate Field Operating Agency (SFOA) under the Chief of Engineers. By OCE General Orders 16, 20 May 74, USACERL was placed under the staff supervision of the USACE Research and Development Directorate. ER 10-1-26 assigns USACERL the mission of performing infrastructure and environmental sustainment research, development, studies and technical assistance to maintain a quality trained and ready Army; to set the standard in preserving and protecting its land, water and natural and cultural resources; and to repair, maintain and rehabilitate Civil Works facilities. It performs research and development for enhancing engineer capability to deploy rapidly and to sustain a full range of military operations. It executes the mission through various functional elements.

**CURRENT IMPORTANT PROGRAMS**

- Munitions Production Compliance Technologies.
- Sustainable Military Land Use and Stewardship of Army Lands (Military Land Management - LMS).
- Defense Environmental Network and Information Exchange (DENIX).
- Facility Seismic Risk Mitigation.
- Facility Delivery Process Improvement.
- Smart Structural Systems.
- Integrated Installation Management.
- Utilities Modernization and Optimization for Military Installations.
- Training Land Carrying Capacity.
- Protocols for Military Training to Reduce Impact on Threatened and Endangered Species.
EQUIPMENT/FACILITIES

Triaxial Earthquake and Shock Simulator (TESS): The United States' first large triaxial shaking table is a unique dual-mode shock and vibration test facility. The TESS, in its biaxial mode, simulates a wide range of transient shock vibrations typical of military applications requiring large accelerations over a wide frequency range with moderately heavy test specimens. In the triaxial mode, it can simulate a variety of vibration environments including earthquakes and random vibrations, as well as log-sweep and resonant searches. The TESS is one of the premier seismic experimental test facilities in this country, supporting experimental research that cannot be performed by any other U.S. organization.

Ion Plating Systems: Custom-designed to meet highly specialized research specifications to do small scale prototype thin film coating experiments; only facility of this kind (plasma-assisted physical vapor disposition) in the Army.

Heating, Ventilation and Air Conditioning Test Facility: A large 'mini-facility' with four rooms (zones) that can be thermally controlled separately to replicate a variety of HVAC systems and conditions, including dual or single duct and variable or constant air volume conditions; includes ventilation system, hot water supply loops, chilled water supply loops, HVAC systems configuration, facility controls, and data acquisition system; used to validate the energy thermodynamics analysis program and to analyze performance of proposed standard digital control panels; unique within DoD.

Acoustics Lab: The Impulse Noise Technology Center is a state-of-the-art lab facility for the quantification and reduction of impulse noise from cannon, helicopters, blast and small caliber weapons firing. Contains a variety of sophisticated noise monitoring, recording, and analysis instrumentation for research on impact assessment and mitigation of impulse noise related to human annoyance and animal disturbance. Also includes a one-of-a-kind noise impedance tube for the test of noise energy absorption along surfaces.

Paint Laboratory: Specialized equipment necessary to perform Qualified Product List testing on paints used by the Army (an 'honest broker' function); capability to manufacture lab size batches of experimental coatings and perform both real-time and accelerated performance testing of coatings; capability to perform forensic analysis of paint samples.

Equipment and facilities co-located at the University of Illinois, Urbana-Champaign: In 1966, the U.S. Army Corps of Engineers proposed a new laboratory for engineering research to support military construction. In national competition in 1967, the University of Illinois at Urbana-Champaign was selected for co-locating USACERL. This unique relationship between USACERL and the University of Illinois, annually cited as one of the top three engineering schools in the nation, has been touted by HQ USACE as a prime example of 'reinventing Government.' Of approximately 650 personnel working at USACERL, over 200 are University of Illinois faculty, staff or students. Designated as an allied agency of the University of Illinois, $250-500 million of University of Illinois research laboratory equipment is accessible.

Controlled Archeological Test Site (CATS): The CATS facility has been constructed with funding provided by the National Center for Preservation Technology and Training and will be utilized for research and training with geophysical applications in archaeology. The CATS facility replicates a range of archeological features commonly encountered in North American archaeological sites and offers a controlled environment for the application of non-destructive investigative techniques. The CATS facility will be available for research in a broad range of problems associated with archaeogeophysics such as, the effects of environmental conditions on geophysical expression, sensor type and configuration, spatial resolution, image processing and pattern recognition, operator variation, and feature variability. This research will contribute to our ability to interpret geophysical data and refine field methods for application in archeological investigations.
FAH97 FUNDING DATA (MILLIONS $)

<table>
<thead>
<tr>
<th>APPROPRIATION</th>
<th>IN-HOUSE</th>
<th>IN-HOUSE MANAGEMENT</th>
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<td>RDT&amp;E:</td>
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<td></td>
</tr>
<tr>
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<td>NA</td>
<td>0.066</td>
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<tr>
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<td>6.6</td>
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</tr>
<tr>
<td>Non-DOD</td>
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MILITARY CONSTRUCTION (MILLIONS $)

| Military Construction (MILCON) | 0.000 |

PERSONNEL DATA (END OF FISCAL YEAR 1997)

<table>
<thead>
<tr>
<th>TYPE</th>
<th>SCIENTISTS &amp; ENGINEERS</th>
<th>TECHNICAL SUPPORT &amp; OTHER PERSONNEL</th>
<th>END STRENGTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>MILITARY</td>
<td>DOCTORATES</td>
<td>OTHER</td>
<td></td>
</tr>
<tr>
<td>CIVILIAN</td>
<td>37</td>
<td>131</td>
<td>171</td>
</tr>
<tr>
<td>TOTAL</td>
<td>37</td>
<td>133</td>
<td>171</td>
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</table>

SPACE AND PROPERTY

<table>
<thead>
<tr>
<th>BUILDING SPACE (THOUSANDS OF SQ FT)</th>
<th>PROPERTY ACQUISITION COST (MILLIONS $)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAB 113.400</td>
<td>REAL PROPERTY 0.000</td>
</tr>
<tr>
<td>ADMIN 48.300</td>
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<td>ACRES 33</td>
<td>* Subset of previous category.</td>
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NA = Not Applicable
Dugway Proving Ground

## Abbreviated Functional Chart - Technical Organizations

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<tr>
<td>West Desert Test Center</td>
</tr>
<tr>
<td>Chemical Test Division</td>
</tr>
<tr>
<td>Life Sciences Division</td>
</tr>
<tr>
<td>Test Operations Division</td>
</tr>
<tr>
<td>Meteorology &amp; Obscurance Division</td>
</tr>
<tr>
<td>Program Analysis Division</td>
</tr>
<tr>
<td>COR Office</td>
</tr>
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</table>
## MISSION

Plan, conduct, analyze and report the results of exploratory, developmental, and production tests of chemical and biological defense systems, smoke and obscurant materiel and delivery systems, and illumination systems. Operates the proving ground as a DoD Major Range and Test Facility Base (MRTFB); and operate the Center for Environmental Technology Testing. DPG is the DoD-designated Chemical and Biological Defense Test and Evaluation Reliance test site.

Test illuminating and obscuring artillery, mortars and rockets. Perform tests of all material commodities to assess chemical and biological hardness and contamination/decontamination survivability. Test procedures and by-products of chemical and conventional weapons demilitarization. Perform tests and develops procedures for on-site verification inspections for chemical weapons treaties. Dugway provides the base of operation for the Joint Services Project, Chemical and Biological Joint Contact Point and Test, which provides chemical and biological defense information and operationally oriented tests and analysis to the Services and CINCS.

## CURRENT IMPORTANT PROGRAMS

Research, development and laboratory investigations. Joint-operations chemical and biological defense tests and studies for CINCS and Services. Munitions development/acceptance and production testing. Environmental studies to support DPG and Army programs.

## EQUIPMENT/FACILITIES

Instrumented grids for chemical, biological and smoke/obscurant systems. Artillery range for conventional and chemical metal parts. Ballistics and dissemination tests with field sample, sample mass analysis, meteorological (auto data acquisition and MESOMET network) system. Physical and environmental test facility (MIL SPEC 810) chambers for total agent containment. Operations supported by meteorological research on behavior of clouds. Chemical, life science technology, ecological survival of DPS. Capability for planning analysis, evaluation of tests and operations research. Labs equipped for wide range of chemical, microbiological, toxicological, immunological and pollution studies. Technical and mass array of fluorescent air tracers. External-communication and range safety system. Outstanding features are: large land area, restricted air space, long and flat artillery ranges, projectile recovery, sonic and electromagnetic sterility and diverse technical and scientific skills.
### FY97 FUNDING DATA (MILLIONS $)

<table>
<thead>
<tr>
<th>Appropriation</th>
<th>IN-HOUSE</th>
<th>IN-HOUSE MANAGEMENT</th>
<th>OUT-OF-HOUSE</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>RDT&amp;E:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.1 ILIR</td>
<td>0.000</td>
<td>NA</td>
<td>NA</td>
<td>0.000</td>
</tr>
<tr>
<td>6.1 Other</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
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</tr>
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<td>6.3</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Subtotal (S&amp;T)</td>
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<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
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<td>0.000</td>
<td>0.000</td>
</tr>
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<td>6.5</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>6.6</td>
<td>27.811</td>
<td>0.000</td>
<td>13.074</td>
<td>40.885</td>
</tr>
<tr>
<td>6.7</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Non-DOD</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>TOTAL RDT&amp;E</td>
<td>27.811</td>
<td>0.000</td>
<td>13.074</td>
<td>40.885</td>
</tr>
<tr>
<td>Procurement</td>
<td>0.000</td>
<td>NA</td>
<td>0.280</td>
<td>0.280</td>
</tr>
<tr>
<td>Operations &amp; Maintenance</td>
<td>0.782</td>
<td>NA</td>
<td>2.893</td>
<td>3.675</td>
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<tr>
<td>Other</td>
<td>0.547</td>
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<td>1.799</td>
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<tr>
<td>TOTAL FUNDING</td>
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<td>18.046</td>
<td>47.186</td>
</tr>
</tbody>
</table>

### MILITARY CONSTRUCTION (MILLIONS $)

| Military Construction (MILCON) | 0.000 |

### PERSONNEL DATA (END OF FISCAL YEAR 1997)

<table>
<thead>
<tr>
<th>Type</th>
<th>Scientists &amp; Engineers</th>
<th>Technical Support &amp; Other Personnel</th>
<th>End Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Doctorates</td>
<td>Other</td>
<td></td>
</tr>
<tr>
<td>Military</td>
<td>0</td>
<td>0</td>
<td>16</td>
</tr>
<tr>
<td>Civilian</td>
<td>20</td>
<td>73</td>
<td>361</td>
</tr>
<tr>
<td>Total</td>
<td>20</td>
<td>73</td>
<td>377</td>
</tr>
</tbody>
</table>

### SPACE AND PROPERTY

<table>
<thead>
<tr>
<th>Building Space (Thousands of Sq Ft)</th>
<th>Property Acquisition Cost (MILLIONS $)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lab 64,000</td>
<td>REAL PROPERTY: 183,000</td>
</tr>
<tr>
<td>Admin 182,000</td>
<td>* NEW CAPITAL EQUIPMENT: 0.000</td>
</tr>
<tr>
<td>Other 2,254,000</td>
<td>EQUIPMENT: 102,000</td>
</tr>
<tr>
<td>Total 2,500,000</td>
<td>* NEW SCIENTIFIC &amp; ENG. EQUIP.: 3.000</td>
</tr>
<tr>
<td>Acres 798,855</td>
<td>* Subset of previous category.</td>
</tr>
</tbody>
</table>

NA = Not Applicable
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## Abbreviated Functional Chart - Technical Organizations

|-------------------------|---------------------------------------|------------------------|-------------------------------------|-------------------------|------------------------|-----------------------------|

Edgewood Research, Development and Engineering Center
Edgewood Research, Development and Engineering Center
Aberdeen Proving Ground, MD 21010-5423
Acting Technical Director: Dr. James A. Baker
(410) 671-3838

MISSION

A research, development and engineering center for executing the chemical and biological defense programs for the Army and the Joint Services (JS). Provide research, development and acquisition as well as life cycle engineering support for chemical/biological defense and smoke/obscurant equipment under DODD 5160.5. Act as DoD lead lab for the JS chemical/biological/smoke technology base. The Edgewood RDEC technical director is also the manager of the Edgewood NBC RDA Enterprise which includes PM NBC Defense Systems, PM Smoke/Obscurants, Program Director of Biological Defense Systems, and the Edgewood RDEC. Responsible for the Domestic Preparedness Program, preparing the United States for the possibility of a terrorist attack involving nuclear, biological or chemical weapons.

CURRENT IMPORTANT PROGRAMS

- Nuclear, Biological and Chemical (NBC) Reconnaissance, Detection and Identification.
- Individual and Collective Protection.
- NBC Decontamination.
- Smoke and Obscurants and Target Defeating Materials.
- Chemical Treaty Verification.
- Chemical and Biological Remediation.
- CB counterterrorism.
- Domestic Preparedness.

EQUIPMENT/FACILITIES

Major equipment is contained in a complex of R&D engineering/laboratory areas and includes: Process engineering facility; Production and facility design chamber for studies of respiratory protection design drivers; Simulant agent challenge test chamber; Rubber/elastomer mold facility; Specialized chemical agent labs; Pyrotechnic mixing, loading, handling facility; subsonic, supersonic, transonic wind tunnel; Complete analytical chemistry (trace analysis/tandem mass spectrometry); Obscurant test chambers for transmission measurements; Laser spectroscopy lab; Robotic toxic agent lab; CAD/CAE/CAM network; Supertox facility; Design Evaluation Chemical Surety Lab; Decontamination/Decontamination Facility; Explosive test chamber; Toxic Dissemination Test Chamber; Inhalation Toxicology Laboratories; Molecular Modeling Facility; Microland Laboratory with electron microscopy and surface spectropy; Experimental Fabrication Facility; Nephelometry laboratory/Single Particle Laboratory; Smoke Breeze Tunnel; Controlled Environment; Soil-Core Microism Unit Chambers; Decontamination Test Facility; World Certified Treaty Laboratory.
## FY97 FUNDING DATA (MILLIONS $)

<table>
<thead>
<tr>
<th>APPROPRIATION</th>
<th>IN-HOUSE</th>
<th>IN-HOUSE MANAGEMENT</th>
<th>OUT-OF-HOUSE</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>RDT&amp;E:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.1 ILIR</td>
<td>1.621</td>
<td>NA</td>
<td>NA</td>
<td>1.621</td>
</tr>
<tr>
<td>6.1 Other</td>
<td>1.788</td>
<td>0.042</td>
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<td>3.930</td>
</tr>
<tr>
<td>6.2</td>
<td>15.676</td>
<td>0.355</td>
<td>17.404</td>
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<tr>
<td>6.3</td>
<td>4.968</td>
<td>0.171</td>
<td>8.407</td>
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</tr>
<tr>
<td>Subtotal (S&amp;T)</td>
<td>24.053</td>
<td>0.568</td>
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<td>52.532</td>
</tr>
<tr>
<td>6.4</td>
<td>14.759</td>
<td>0.414</td>
<td>20.324</td>
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<tr>
<td>6.5</td>
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<td>1.064</td>
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<td>0.000</td>
<td>0.000</td>
<td>0.200</td>
</tr>
<tr>
<td>Non-DOD</td>
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<td>0.009</td>
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<td>8.660</td>
</tr>
<tr>
<td>TOTAL RDT&amp;E</td>
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<td>2.154</td>
<td>105.778</td>
<td>174.158</td>
</tr>
<tr>
<td>Procurement</td>
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<td>NA</td>
<td>155.189</td>
<td>174.657</td>
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<tr>
<td>Operations &amp; Maintenance</td>
<td>33.647</td>
<td>NA</td>
<td>38.877</td>
<td>72.524</td>
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<tr>
<td>Other</td>
<td>18.491</td>
<td>NA</td>
<td>1.163</td>
<td>19.654</td>
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<td>TOTAL FUNDING</td>
<td>137.832</td>
<td>2.154</td>
<td>301.007</td>
<td>440.993</td>
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</table>

## MILITARY CONSTRUCTION (MILLIONS $)

| Military Construction (MILCON) | 0.000 |

## PERSONNEL DATA (END OF FISCAL YEAR 1997)

<table>
<thead>
<tr>
<th>TYPE</th>
<th>SCIENTISTS &amp; ENGINEERS</th>
<th>TECHNICAL SUPPORT &amp; OTHER PERSONNEL</th>
<th>END STRENGTH</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DOCTORATES</td>
<td>OTHER</td>
<td></td>
</tr>
<tr>
<td>MILITARY</td>
<td>2</td>
<td>11</td>
<td>37</td>
</tr>
<tr>
<td>CIVILIAN</td>
<td>26</td>
<td>426</td>
<td>611</td>
</tr>
<tr>
<td>TOTAL</td>
<td>28</td>
<td>437</td>
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## SPACE AND PROPERTY

<table>
<thead>
<tr>
<th>BUILDING SPACE (THOUSANDS OF SQ FT)</th>
<th>PROPERTY ACQUISITION COST (MILLIONS $)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAB 760.000</td>
<td>REAL PROPERTY</td>
</tr>
<tr>
<td>ADMIN 431.000</td>
<td>* NEW CAPITAL EQUIPMENT</td>
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<tr>
<td>OTHER 635.000</td>
<td>EQUIPMENT</td>
</tr>
<tr>
<td>TOTAL 1,826.000</td>
<td>* NEW SCIENTIFIC &amp; ENG. EQUIP.</td>
</tr>
</tbody>
</table>

NA = Not Applicable
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Institute of Surgical Research

Abbreviated Functional Chart - Technical Organizations

- Laboratory Division
  - Pathology
  - Comparative Medicine
  - Microbiology
  - Biochemistry
  - Surgical Study
  - Mechanical Trauma

- Clinical Division
  - Burn Study
  - Extremity Trauma
  - Nursing Suc
  - RT
  - Internal Medicine
  - Reconstruction and Rehabilitation

- Support Division
  - Bioengineering
  - Logistics
  - Resource Mgt
  - AV
  - Library
  - Medical Company
MISSION

Provide medical solutions and products for injured soldiers by integrating laboratory and clinical research.

CURRENT IMPORTANT PROGRAMS

The center of research at this Institute is the Clinical Operations Protocol, which supports the care of burned and extremity trauma patients. Thermal injury is the only human model with a severity-quantifiable disease (dose of injury: percent of total body surface area burned), allowing stratification into meaningful statistical designs. This unique setting provides a foundation for other clinical and laboratory research protocols that investigate the pathophysiology and treatment of trauma and its complications. The clinical protocol assures delivery of standardized care essential for controlled clinical trials and outcomes research. The Extremity Trauma program broadens this Institute's influence in the study of all types of trauma. Another important program is the training of flight teams to provide aeromedical transfer and care of injured soldiers. At the same time, in-house programs provide military surgeons, medical students, fellows, and medical staff from foreign countries intensive training and participation in the care of combat casualties and other severely injured patients. Taken together, this integration of physician-investigator and basic scientist promotes the foundation of basic science, as well as, applied science directly testable in trauma patients, and offers a highly focused, unique program for the military related to warfighting activities. No other such resource exists in the United States military.

EQUIPMENT/FACILITIES

The USAISR's equipment inventory of basic and clinical research equipment valued at over $15,600,000. The Institute consists of a 40 bed inpatient research unit of 50,300 square feet on the 4th floor of Brooke Army Medical center and the laboratory located in an adjacent 84,000 square foot research facility dedicated in FY96. Capabilities include: integrated clinical and laboratory research facilities and injured soldier test platforms; mass casualty burn care; aeromedical transport teams for multiple trauma victims with burn injuries; instruction in resuscitation and long term burn care; a computerized database of over 40 years of data on injury specific research subjects; a nutrition and metabolic study program; comprehensive orthopedic surgery and extremity research staff and research program; ballistics research laboratory; state-of-the-art animal operating suites; an image analysis facility; biocontainment suite for studying the effects of hazardous materials; materials testing apparatus and tissue engineering capabilities; and the only research clinical evaluation/management facility for injured soldiers in the U.S. military.
## FY97 Funding Data (Millions $)

<table>
<thead>
<tr>
<th>Appropriation</th>
<th>In-House</th>
<th>In-House Management</th>
<th>Out-of-House</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>RDT&amp;E:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.1 ILIR</td>
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<td>0.092</td>
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<tr>
<td>6.1 Other</td>
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<td>5.256</td>
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<td>0.158</td>
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</tr>
<tr>
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<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Non-DOD</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td><strong>TOTAL RDT&amp;E</strong></td>
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<td>0.000</td>
<td>0.000</td>
<td>5.989</td>
</tr>
<tr>
<td>Procurement</td>
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<td>NA</td>
<td>NA</td>
<td>0.000</td>
</tr>
<tr>
<td>Operations &amp; Maintenance</td>
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<td>0.000</td>
<td>0.001</td>
</tr>
<tr>
<td>Other</td>
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<td>NA</td>
<td>NA</td>
<td>0.000</td>
</tr>
<tr>
<td><strong>TOTAL FUNDING</strong></td>
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<td>0.000</td>
<td>0.000</td>
<td>5.990</td>
</tr>
</tbody>
</table>

### Military Construction (Millions $)

| Military Construction (MILCON) | 0.000 |

### Personnel Data (End of Fiscal Year 1997)

<table>
<thead>
<tr>
<th>Type</th>
<th>Scientists &amp; Engineers</th>
<th>Technical Support &amp; Other Personnel</th>
<th>End Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Doctorates</td>
<td>Other</td>
<td>Total</td>
</tr>
<tr>
<td>MILITARY</td>
<td>21</td>
<td>25</td>
<td>140</td>
</tr>
<tr>
<td>CIVILIAN</td>
<td>4</td>
<td>27</td>
<td>21</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>25</td>
<td>52</td>
<td>161</td>
</tr>
</tbody>
</table>

### Space and Property

<table>
<thead>
<tr>
<th>Building Space (Thousands of Sq Ft)</th>
<th>Property Acquisition Cost (Millions $)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAB</td>
<td>REAL PROPERTY</td>
</tr>
<tr>
<td>ADMIN</td>
<td>*NEW CAPITAL EQUIPMENT</td>
</tr>
<tr>
<td>OTHER</td>
<td>EQUIPMENT</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>*NEW SCIENTIFIC &amp; ENG. EQUIP.</td>
</tr>
<tr>
<td>ACRES</td>
<td>* Subset of previous category.</td>
</tr>
</tbody>
</table>

NA = Not Applicable
Medical Research Institute of Chemical Defense

Abbreviated Functional Chart - Technical Organizations

- Medical Research Institute of Chemical Defense
- Research Operations Division
- Drug Assessment Division
- Pharmacology Division
- Comparative Medicine Division
- Administrative Division
MISSION

The U.S. Army Medical Research Institute of Chemical Defense is the Department of Defense's lead laboratory for the development of medical countermeasures against chemical warfare (CW) agents and responsible for training personnel on the medical management of chemical casualties. This mission includes: fundamental and applied research on mechanisms of action of CW threat agents, candidate pretreatment, treatment, and personal or skin decontamination compounds in order to establish a scientific and technical base from which to plan and formulate enhanced medical countermeasures to CW threats and to develop improved prevention and treatment modalities for CW casualties; test and evaluation of drugs, decontaminants, and medical equipment in development for the prevention, resuscitation, treatment, and management of chemical casualties; assistance in the integration of the concepts and products from these research, development, test, and evaluation mission activities into the logistical, doctrine and organizational development, and training systems; and training of both medical and non-medical personnel in the prevention and management of chemical casualties. In addition, the Institute has the mission to conduct research on medical defense against low molecular weight toxins.

CURRENT IMPORTANT PROGRAMS

Research programs at the Institute emphasize preservation of combat effectiveness by timely provision of medical countermeasures to chemical warfare (CW) agents in response to DA and DOD requirements. These programs maintain the technologic capability to meet present requirements and to counter future CW and neurotoxin threats, provide individual level prevention and protection against these threats, and enhance the medical management of CW and neurotoxin casualties, enhancing survival and expediting and maximizing return to duty.

The Institute conducts basic research, exploratory development, non-system development, and, on a reimbursable basis, advanced development of medical countermeasures for CW and neurotoxin agents, investigates the biomedical effects of CW agents, neurotoxins, and candidate medical countermeasures to these threats, conducts safety and efficacy studies of candidate pretreatment and prophylactic countermeasures, develops analytical technologies for medical countermeasures, and performs advanced research into CW and neurotoxin casualty care technology. We have met the FY97 objective of demonstrating efficacy of candidate countermeasures against vesicant injury in an animal model, and are on target to meet the FY00 deadline to demonstrate safety and efficacy of a methemoglobin former for pretreatment against cyanide, and have made a milestone (MS) I transition of this product in FY95. The search for additional cyanide countermeasures is presently in technology watch. In addition to the development of mutant human butyrylcholinesterase as a biological scavenger, we are now developing mutant human carboxylesterase as another approach to meeting the FY99 MS 0 transition goals. We have also applied information gained in the bioscavenger program to the development of a cholinesterase containing sponge which is reusable, and would be capable of being used for nerve agent decontamination of patient wounds. Candidate advanced anticonvulsants are presently undergoing evaluation. We have demonstrated the efficacy and safety of a class of drugs as an advanced anticonvulsant to serve as an adjunct or component for the soldier/buddy-use nerve agent antidote. This accomplished an objective to achieve a MS 0 transition of this product by FY97. The advanced anticonvulsant is more effective in rapidly terminating on-going seizures, in preventing their reoccurrence, and in protecting against nerve agent-induced, seizure related brain damage, and also lacks any abuse potential; all these features
represent significant improvements over the current anticonvulsant product. Efforts to demonstrate by FY02 safety and efficacy sufficient for a MS 0 transition of the technology for a reactive topical skin protectant that will provide protection against penetration and will detoxify both vesicant and nerve CW agents are on track. This product will represent a significant increment in protection over the topical skin protection which is presently in advanced development. The Institute has developed a pathophysiology database on respiratory agents which are currently in a technology watch.

The Chemical Casualty Management effort identifies and utilized new technologies to improve decontamination and clinical diagnosis, prognosis, and management of chemical agent casualties. A noninvasive methemoglobin prototype monitor was received for evaluation and direct comparison with results from blood samples analyzed by a hemoximeter. This device will monitor therapy used to provide protection against or treatment for cyanide exposure. The cholinesterase Test System received approval by the FDA and a M 1/3 transition is being coordinated by MRMC. The use of CO2 laser debridement for sulfur mustard wounds of the skin produced accelerated healing through improved viability and organization of the epidermis.

During FY97, 37 courses on the Medical Management of Chemical Casualties were conducted where over 2190 students were trained. The Institute also provided training to members of the 520th Theater Army Medical Laboratory on how to work with chemical warfare agents and on instrumentation and methods to detect these agents. Finally, considerable effort was continued on determining the effectiveness of our current medical countermeasures against several novel threat agents.

The Institute maintained a total of 1 Cooperative Research and Development Agreements (CRDA) and 31 Material Transfer Agreements (MTA) during FY 97.

The Institute's facilities support chemical casualty care training, physiology, drug assessment, pathophysiology, pharmacology, analytical chemistry, neurotoxicology, veterinary surgery, chemical safety/surety, medical maintenance, information and resource management, supply and quality assurance. A technical library with 6,000 books, 1,000 journal titles, and access to many databases is an integral part of our Institute. Video facility, computer facility and 7,000 SF animal facility also supports our researchers. Radioisotope chemical antidote and biochemical analysis, histochemistry, behavioral testing, drug screening, pharmacokinetics, molecular modeling, liquid, gas, column and affinity chromatography, quantitative image enhancement/analysis, electrophoresis, spectroscopy, fluorometry and spectropolarimetry, GC mass spectrometry, electron spin resonance and peptide synthesis/sequencing, amino acid analysis, monoclonal haptenantibodies; electron, scanning and X-ray microscopy, cell cloning, and receptor analysis are also supported.

Major Facilities and Equipment:

Building E-3100: Main Medical Chemical Defense Research Laboratory and Administrative Building.

Building E-3081: Unique to DOD. Contains a Chemical Surety Materiel Laboratory for Medical Chemical Defense Research.

Building E-3156: Large Animal Holding/Chemical Research Facility.

Building E-3244: Biotoxin Research Facility.

Building E-3103/E-3106: Chemical Casualty Care Training Facility.
### EQUIPMENT/FACILITIES (continued)

<table>
<thead>
<tr>
<th>Building E-3103/Classroom: Chemical portion of the Management of Chemical and Biological Casualties Course (6H-F26) is conducted here.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hazardous Materiel Storage and 90-Day Hazardous Waste Sites: These sites meet stringent specifications which conform to the environmental requirements for the storage and disposition of chemicals and hazardous materials.</td>
</tr>
<tr>
<td>Building E-3105: Information Management Support Facility.</td>
</tr>
<tr>
<td>Building E-3107: Equipment Turn-in Facility.</td>
</tr>
<tr>
<td>Building E-3104: Environmentally Controlled Building for Electronic Equipment.</td>
</tr>
<tr>
<td>Building E-2180: Equipment Storage and Turn-in Facility.</td>
</tr>
<tr>
<td>Building E-3083: Equipment storage for Medical Chemical and Biological Casualties course.</td>
</tr>
<tr>
<td>Building E-5826: Animal Care Equipment Storage Facility.</td>
</tr>
<tr>
<td>Direct Digital Control HVAC System: System provides constant control and 24-hour remote monitoring of chemical fume hoods in the Surety Area of building E-3081, controls HVAC throughout remainder of laboratories and administrative areas, and controls and remotely monitors all animal rooms in buildings E-3081, E-3100, E-3156, and E-3244.</td>
</tr>
<tr>
<td>Walk-in Coolers in Building E-3081, E-3100: Storage of chemicals used for research.</td>
</tr>
<tr>
<td>Chillers, Building E-3100: Installed in 1994 to meet EPA requirements. Each unit produces 350 tons of cooling using 123 refrigerant.</td>
</tr>
<tr>
<td>Medical Waste Incinerator: Required to burn animal bedding, carcasses, and medical waste generated by the Institute.</td>
</tr>
<tr>
<td>Air Compressor: Required to supply laboratories with bench air for research.</td>
</tr>
<tr>
<td>Chemical/Biological/Radiological (CBR) Filter Trains: Provided for all 77 chemical/biological hoods located in buildings E-3100, E-3081, and E-3244. Each CBR filter train consists of a housing unit containing prefilter, as well as the appropriate number and size of High Efficiency Particulate (HEPA) and High-Efficiency Gas-Phase Absorber (HEGA) filters. All filter trains are in support of the Chemical/Biological Defense Program and are in compliance with Environmental Protection Agency, State, and Federal Standards. Exterior Walk-in (adjacent Bldg E-3100): Storage of animal carcasses prior to incineration.</td>
</tr>
<tr>
<td>Auxiliary Chillers (E-3100): Provides renovated laboratories with additional cooling to support electronic equipment.</td>
</tr>
<tr>
<td>Decontamination Showers Required to conduct research in accordance with regulations.</td>
</tr>
</tbody>
</table>
## EQUIPMENT/FACILITIES (continued)

Building E-3156/Associated Animal Pens and rooms: Quarantine area for newly arrived large animal species. Required for the care of animals used in research.

House Water Distillation System (Bldgs E-3100, E-3081, E-3244): This central system feeds water to satellite polishing systems in the individual laboratories. Pure laboratory water is needed in virtually all segments of laboratory research. High-purity water is used for reagent buffers and sensitive instrumental analyses (such as High Pressure Liquid Chromatograph, Gas Chromatograph/Mass Spectrometer, as well as inwashing and/or preparing biological solutions such as media for tissue culture.

Hazardous Materiel and 90-Day Hazardous Waste Sites: These sites meet stringent specifications which conform to the environmental requirements for the storage and disposition of chemicals and hazardous materials.

Emergency Generator (Bldg E-3100): Provides emergency power for lighting, freezers, incubators, and other specialized equipment which must remain operational.

Administrative and Laboratory Emergency Generator (Bldg E-3081): Provides emergency power for lighting, freezers, incubators, and other equipment which must remain operational.

Surety Area Back-up Generator (Bldg E-3081): Supplies emergency power to the entire chemical surety wing to include all fume hoods, heating, ventilation and air conditioning systems, and electrical systems.

Uninterruptable Power System (UPS) (Bldg E-3081): System supplies immediate power to the fume hood exhaust blowers in the chemical surety area until the emergency generator starts and transfers power.

Surety Area Holding Tanks (Bldg E-3081): Consists of two 10,000 gallon tanks which hold all waste water generated in the surety wing. This ensures that chemical spills will not escape into the sanitary sewer.
## FY97 FUNDING DATA (MILLIONS $)

<table>
<thead>
<tr>
<th>APPROPRIATION</th>
<th>IN-HOUSE MANAGEMENT</th>
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</tr>
<tr>
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<td>Non-DOD</td>
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## MILITARY CONSTRUCTION (MILLIONS $)

| Military Construction (MILCON) | 0.000 |

## PERSONNEL DATA (END OF FISCAL YEAR 1997)

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<thead>
<tr>
<th>TYPE</th>
<th>SCIENTISTS &amp; ENGINEERS</th>
<th>TECHNICAL SUPPORT &amp; OTHER PERSONNEL</th>
<th>END STRENGTH</th>
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<tbody>
<tr>
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<td>DOCTORATES</td>
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<tr>
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<tr>
<td>CIVILIAN</td>
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## SPACE AND PROPERTY

<table>
<thead>
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<th>BUILDING SPACE (THOUSANDS OF SQ FT)</th>
<th>PROPERTY ACQUISITION COST (MILLIONS $)</th>
</tr>
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<tbody>
<tr>
<td>LAB 37.419</td>
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<td>* Subset of previous category.</td>
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NA = Not Applicable
Medical Research Institute of Environmental Medicine

Abbreviated Functional Chart - Technical Organizations

- U.S. Army Research Institute of Environmental Medicine
  - Biophysics & Biomedical Modeling Division
  - Military Nutrition & Biochemistry Division
  - Military Performance Division
  - Thermal & Mountain Medicine Division
  - U.S. Army Center for Environmental Health Research (Ft. Detrick, MD)
MISSION

Conduct basic and applied research to determine how exposure to extreme heat, severe cold, high terrestrial altitude, occupational tasks, physical training, deployment operations and nutritional factors affect the health and performance of military personnel. Conduct research, development, testing, and validation of new methods and products for measuring chemical contaminants and their impact on the health and performance of US forces in garrison and during deployment.

CURRENT IMPORTANT PROGRAMS

Environmental Injury: Demonstrate the efficacy of strategies to predict, prevent and treat environmental illnesses, injuries and performance decrements.

Performance Limits: Develop and validate models to predict the effects of heat, cold, high altitude, hydration, nutrition status and clothing and equipment on performance.

Nutritional Strategies: Identify and demonstrate nutritional strategies to maintain health and enhance soldier performance, to include maintaining immunocompetence.

Musculoskeletal injuries and physical performance: Demonstrate the efficacy of methods to reduce the incidents of musculoskeletal injuries and optimize performance during military training and operations. Special emphasis is being placed on Defense Women's Health Research.

Warfighter Physiological Status Monitor: Develop ambulatory monitoring instruments to assess the physiological status of the individual soldiers.

Medical Chemical Defense: Investigate/define mechanism(s) of vesicant injury.

Deployment Toxicology: Develop new assays, methods and products for measuring chemical contaminants and their impact on the health and performance of U.S. forces in garrison and during deployment.

USARIEM's Technology Transfer Program included five new and fully negotiated Cooperative Research & Development Agreements during FY 97, bringing the total number of agreements to 17. The new agreements are:

-- Aircast, Inc. - “The Parachute Ankle Brace (PAB) and the Reduction of Ankle Injuries Associated with Airborne Operations and Other Military Activities”
-- ESA, Inc. - “A Disposable, Integrated Sampling and Sensing Device and Hand-Held Reader for Blood Lead Analysis, Utilizing Traditional Exchange Chemistries and Anodic Stripping Voltammetric Methods of Analysis”
-- The Ohio State University - “Correlation of Reproduction Endocrine Effects on Body Temperature and Neuronal Activity”
-- Boston University - “Factors Affecting Muscle Fatigue and Exercise Performance”
-- Brown University - “The Use of Voice Onset Timing to Assess the Incidence and Severity of Acute Mountain Sickness”

The USARIEM Technology Transfer Program involved the participation of 20 scientists and engineers.
**EQUIPMENT/FACILITIES**

Unique facilities include: altitude chambers, animal care facility accredited by AAALAC (American Association for Accreditation of Laboratory Animal Care), biophysical evaluation chambers, biomechanics laboratory, electron microscopy laboratory, environmental chambers, human/animal physiology laboratories, physical performance laboratory, Pikes Peak research facility, psychology laboratory, water immersion laboratory, access and primary user of the Doriot Climatic Chambers (a co-located facility assigned to Soldier Systems Command). Facilities located at the U.S. Army Center for Environmental Health Research (Fort Detrick, MD) include: aquaculture and aquatic toxicology laboratories, immunotoxicology laboratory, and mobile analytical chemistry laboratories and lab facilities at Colorado State University.
**FY97 FUNDING DATA (MILLIONS $)**

<table>
<thead>
<tr>
<th>APPROPRIATION</th>
<th>IN-HOUSE</th>
<th>IN-HOUSE MANAGEMENT</th>
<th>OUT-OF-HOUSE</th>
<th>TOTAL</th>
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<tr>
<td><strong>RDT&amp;E:</strong></td>
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<tr>
<td>6.1 ILIR</td>
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<tr>
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<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Non-DOD</td>
<td>0.000</td>
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<tr>
<td><strong>TOTAL RDT&amp;E</strong></td>
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<tr>
<td>Operations &amp; Maintenance</td>
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<tr>
<td>Other</td>
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</table>

**MILITARY CONSTRUCTION (MILLIONS $)**

| MILITARY CONSTRUCTION (MILCON) | 0.000 |

**PERSONNEL DATA (END OF FISCAL YEAR 1997)**

<table>
<thead>
<tr>
<th>TYPE</th>
<th>SCIENTISTS &amp; ENGINEERS</th>
<th>TECHNICAL SUPPORT &amp; OTHER PERSONNEL</th>
<th>END STRENGTH</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DOCTORATES</td>
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<tr>
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**SPACE AND PROPERTY**

<table>
<thead>
<tr>
<th>BUILDING SPACE (THOUSANDS OF SQ FT)</th>
<th>PROPERTY ACQUISITION COST (MILLIONS $)</th>
</tr>
</thead>
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<tr>
<td>LAB</td>
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<tr>
<td>ADMIN</td>
<td>* NEW CAPITAL EQUIPMENT</td>
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<tr>
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<tr>
<td>TOTAL</td>
<td>* NEW SCIENTIFIC &amp; ENG. EQUIP.</td>
</tr>
</tbody>
</table>

<table>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>* Subset of previous category.</td>
</tr>
</tbody>
</table>

NA = Not Applicable
Medical Research Institute of Infectious Diseases

Abbreviated Functional Chart - Technical Organizations

- Medical Research Institute of Infectious Diseases
  - Diagnostic Systems Division
  - Virology Division
  - Pathology Division
  - Toxinology Division
  - Logistics Division
  - Medical Division
  - Bacteriology Division
  - Veterinary Medicine Division
  - Operational Medicine Division
  - Research Programs Office
  - Safety and Radiation Protection Office
  - Product Development and Regulatory Affairs Office
  - Medical Company
  - Biometrics and Information Management Division
  - Human Resources Office
  - Physical Security Office
Medical Research Institute of Infectious Diseases
Fort Detrick, MD 21702-5011
Commander: COL David R. Franz
Dep. Commander: LTC Gerald B. Jennings

MISSION

USAMRIID's mission is to conduct research to develop strategies, products, information and training for medical defense against biological warfare threats and against naturally occurring infectious agents of military importance that require special containment. Medical countermeasures developed to protect military personnel against biological attack include vaccines, therapeutic drugs, diagnostic capabilities, and various medical management procedures. These products are intended to eliminate or minimize the effects of disease and preserve fighting strength. The Institute is the lead research laboratory in the Medical Biological Defense Research Program and participates in crucial aspects of the Infectious Disease Research Program. The Institute serves a key role in national defense and in infectious disease research as the only biological containment laboratory in the Department of Defense for the study of hazardous diseases. In addition, USAMRIID provides critical and timely training in medical management of biological casualties to military health care providers. As a world-renowned resource, USAMRIID serves not only as the DoD reference laboratory for identification of biological agents and diagnosis of diseases caused by them, but as a reference center for the U.S. Centers for Disease Control and Prevention and the World Health Organization.

CURRENT IMPORTANT PROGRAMS

Development of medical countermeasures for biological warfare threats continues to be the highest mission priority. New vaccine candidates based on naked DNA or constructed using a benign virus vector have been generated using genetic engineering approaches and are in various stages of advanced preclinical testing. Production of pilot lots of candidate vaccines for Venezuelan equine encephalitis and for botulinum toxins A and B was initiated using facilities and procedures that follow current Good Manufacturing Practices as specified by the Food and Drug Administration. An intensive research program in antiviral drug therapy for orthopox viruses has yielded promising results; one drug in particular was identified as a top candidate for possible human efficacy trials in treatment of monkeypox infections. Another drug has been identified as potentially efficacious for treatment of infections with filoviruses such as Ebola and Marburg. Continued interactions with the pharmaceutical industry through Cooperative Research and Development Agreements allow researchers access to drugs that are in clinical development for commercial purposes so that they can be tested against the agents of military interest at USAMRIID.

In cooperation with other DoD and federal laboratories, as well as with industry, USAMRIID demonstrated the feasibility of rapid diagnostic identification of biological agents in a briefcase-sized system using microminiaturized technology for polymerase chain reaction analysis of nucleic acids. Changes of only one nucleic acid could be detected in under 30 minutes. The reference laboratory capabilities for identification of biological threat agents was expanded to include additional technologies and diagnostic materials.
CURRENT IMPORTANT PROGRAMS (continued)

Preliminary data from the clinical study to assess the possibility of reducing the dosage schedule for anthrax vaccine appear very promising. Final analysis of the data must await the completion of the study in FY 98. The interactive distance learning program designed to increase our capability to train military health-care providers in the Medical Management of Biological Casualties was broadcast in September 1997 to hundreds of sites, reaching thousands of enrolled students. The program was an enormous success and proved to be a highly cost-effective mechanism for providing this training. A video version of the training is now available and a compact disc version will be available in 1998. USAMRIID also is recognized as an important national resource for support in countering biological terrorism. The formal response team established to assist other responsible agencies in this arena participated in numerous exercises, presentations, and training sessions, providing technical expertise and laboratory capabilities to address this problem.

EQUIPMENT/FACILITIES

Three buildings provide 347,000 square feet with approximately 15% of the laboratory space capable of operations at biosafety level 3 and approximately 3% capable of operations at biosafety level 4 (maximum containment). These containment laboratories are a unique international resource for the safe study of high hazard disease agents, and are the only such laboratories within the DOD. A complete renovation of the containment and maximum containment areas of Building 1412 was completed recently.

Other unique facilities include: a 16-bed clinical research ward; high containment patient care facility and support functions; containment patient care facility and support functions; contained dynamic aerosol laboratory exposure systems; cell culture and hybridoma laboratory; and electron microscopy equipment. The laboratory facilities also include a farm for the care and housing of large animals used in research.
### FY97 FUNDING DATA (MILLIONS $)

<table>
<thead>
<tr>
<th>APPROPRIATION</th>
<th>IN-HOUSE</th>
<th>IN-HOUSE MANAGEMENT</th>
<th>OUT-OF-HOUSE</th>
<th>TOTAL</th>
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<td>RDT&amp;E:</td>
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<td>Non-DOD</td>
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### MILITARY CONSTRUCTION (MILLIONS $)

| Military Construction (MILCON) | 0.000 |

### PERSONNEL DATA (END OF FISCAL YEAR 1997)

<table>
<thead>
<tr>
<th>TYPE</th>
<th>SCIENTISTS &amp; ENGINEERS</th>
<th>TECHNICAL SUPPORT &amp; OTHER PERSONNEL</th>
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<tbody>
<tr>
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<td>DOCTORATES</td>
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<tr>
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### SPACE AND PROPERTY

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<thead>
<tr>
<th>BUILDING SPACE (THOUSANDS OF SQ FT)</th>
<th>PROPERTY ACQUISITION COST (MILLIONS $)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAB</td>
<td>REAL PROPERTY</td>
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<tr>
<td>ADMIN</td>
<td>* NEW CAPITAL EQUIPMENT</td>
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<tr>
<td>OTHER</td>
<td>EQUIPMENT</td>
</tr>
<tr>
<td>TOTAL</td>
<td>* NEW SCIENTIFIC &amp; ENG. EQUIP.</td>
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<tr>
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<td>* Subset of previous category.</td>
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</table>

NA = Not Applicable
Missile Research, Development & Engineering Center

Abbreviated Functional Chart - Technical Organizations

- Structures Directorate
- System Engineering & Production Directorate
- Software Engineering Directorate
- Missile Guidance Directorate
- Technical Management Directorate
- Systems Simulation & Development Directorate
- Weapons Sciences Directorate
- Propulsion Directorate
- Product Assurance Directorate
MISSION

To plan, manage and conduct research, exploratory and advanced development for guided missile and rocket weapon systems and related components; to provide scientific, engineering, and technical support for weapon system programs over the complete life cycle; and to manage computer resources embedded in battlefield automated systems. MRDEC provides the technical expertise to enable the services to be smart buyers and users of missiles, rockets, unmanned vehicles and their unique command and control systems, directed energy, non-lethal technology, computer resources embedded in battlefield automated systems, and related models and simulation and, as such, is an essential part of the acquisition process.

MRDEC's science and technology base mission includes planning, managing, and conducting research, advanced development, and exploratory investigation in response to Army system needs. MRDEC's national defense mission includes mutually beneficial relationships with the private sector for those areas where parallel paths should be and can be reduced by cooperation. MRDEC's life cycle systems engineering mission includes planning, establishing, and managing the Missile Command programs to develop new weapon systems, evaluate system and subsystem performance, and maintain high readiness status, assure effectiveness of fielded systems, and control both acquisition and O&S costs. Selective research and component development is conducted to generate new manufacturable technology, reduce development lead time and system cost, and improve reliability.

MRDEC is the Army's lead organization for technologies in missile propulsion, guidance and control/terminal homing, high energy lasers, missile systems simulation, and unmanned vehicles. MRDEC is the System Integrator for the Joint Program Office for Unmanned Aerial Vehicles. MRDEC has the DoD Lead in the Rapid Force Projection Initiative (RFPI), a major Advanced Concept and Technology Demonstration (ACTD) that includes AMC-wide simulation/demonstration/residual support. In addition, MRDEC is the lead Center within the U.S. Army Materiel Command for the Early Entry, Lethality, and Survivability Battle Lab at Fort Monroe, Virginia.


STRATEGIC GOALS:
1. Demonstrate feasibility of new systems concepts that significantly enhance warfighting capabilities by integration of enabling technology into demonstration efforts.
2. Focus the science and technology base on the new realities.
3. Increase market share: broaden the marketplace.
4. Improve the responsiveness, affordability, and quality of MRDEC products and engineering services.

ENABLING STRATEGIES:
1. Keep workforce fully engaged in state-of-the-art technology work to preserve capability as smart buyer.
2. Develop a superior workforce and a quality environment.
**CURRENT IMPORTANT PROGRAMS**

**Ducted Rocket Engine (DRE)** - This effort is a joint research and development program with Japan to develop and demonstrate a ducted rocket engine for medium surface-to-air missile to significantly increase the intercept envelope against aircraft, cruise missiles, and tactical ballistic missiles when compared to surface-to-air missiles using current solid rocket propulsion technology.

**Multimode Airframe Technology (MAT)** (formerly known as Long Range Fiber Optic Guided Missile (LONGFOG)) - This program will provide a 40 km day/night, multiple and high value time sensitive point target strike capability while inflicting minimum collateral damage. The LONGFOG system will provide the capability to select priority targets after launch, conduct limited man-in-the-loop BDA, and provide target area reconnaissance in addition to target attack by means of variable cruise velocity over areas of interest.

**Future Missile Technology Integration (FMTI)** (formerly known as The Army Combined Arms Weapon Systems (TACAWS)) - This project provides for the demonstration of advanced tactical missile technologies including seekers, propulsion, airframes, warheads, and guidance and control. The project will demonstrate lightweight multi-role missile technology in support of ground-to-ground, ground-to-air, air-to-air, and air-to-ground missions. Combined, flexible capability allows one system or variants of one system to replace many, realizing potential extensive savings in development costs, logistics, training, etc. The FMTI demonstration program is transitioning technology to the TOW Follow-on Engineering and Manufacturing Development (EMD), (Follow-on-to-TOW (FOTT)) program which begins in FY98, the EFOG-M ATD program in FY97/98, and the Joint Advanced Weapons System (JAWS), an Army/Marine Corps multi-purpose, multi-platform missile.

**Guided MLRS ATD** - This program will demonstrate a low cost guidance and a control package for the MLRS rocket. At extended ranges, large quantities of baseline rockets are required to defeat the target. With the addition of a guidance system, an improved delivered accuracy will be achieved. The number of rockets required to defeat the target will be reduced to one-sixth the current quantity at maximum ranges.

**Rapid Force Projection Demonstration** - The integrated system of systems concept of the ACTD provides lightweight, responsive precision fires to destroy threat armor forces during day, night, and adverse weather. This ACTD will evaluate the value added by the insertion of these new technologies into the force structure of an existing light unit in a lift constrained environment. The inserted systems will consist of forward sensors (hunters), advanced C2, and a suite of standoff killers.

**Compact Kinetic Energy Missile (CKEM) Technology** - This project demonstrates the compact kinetic energy missile technology necessary for a LOSAT P3I. The LOSAT P3I will match the lethality of the LOSAT while reducing the LOSAT take off weight by 40-50%, missile diameter by 20%, minimum range to peak velocity by 40-50%, and provide the maneuver capability required to destroy attacking fixed and rotary wing aircraft. Compatible with the LOSAT target acquisition and tracking system and could be compatible with the fire control system for close combat and short range air defense missions.
CURRENT IMPORTANT PROGRAMS (continued)

Low Cost Precision Kill (LCPK) 2.75" Guided Rocket - This project provides for demonstration of a low cost, accurate (1-m CEP) guidance and control retrofit package for the 2.75" Hydra-70 rocket that provides a stand-off range for a high single shot probability of hit (Ph > or = 0.7) against the long range target, exceeding the current unguided 2.75" rocket baseline by 1 or 2 orders of magnitude and thereby providing a 4 to 1 increase in stowed kills at 1/3 the cost per kill compared to current guided missiles. The increased accuracy will minimize collateral damage, reduce risk of fratricide, and will reduce mission times and sorties resulting in increased system survivability. Two separate retrofit guidance package approaches, one based on a solid state (strapdown) mechanization of semi-active laser (SAL) guidance, and the other, based on a potentially much lower cost innovative laser beam follower mode of guidance denoted Scatterider, will be developed and tested in parallel, with user participation, to assure the most cost effective solution is obtained in the neckdown to one system for the transition to EMD.

Counter Active Protection Systems (CAPS) - This project develops and demonstrates technologies which can be applied to Anti Tank Guided Weapons (ATGW) for improving their effectiveness against threat armor equipped with Active Protection Systems (APS). Current technology development is concentrated in the following areas: Radio Frequency (RF) Counter-measure (RFCM) technology for jamming or deceiving APS sensors used for detection, acquisition, and tracking; warhead integration and ballistic hardening of ATGW to reduce vulnerability to fragment impact.

Cooperative Research and Development Agreements (CRDAs):

COMPANY: Sy Technologies, Inc.
DURATION: 5/94 through 1/99
SUBJECT: Development and analysis of designs, and fabrication and test of these designs of binary optic elements for use in unique state-of-the-art optical systems.
PAYOFF: Reduction in costs, increase in reliability and performance of optical elements used in Army missile and optics systems.

COMPANY: Rockwell International Corp
DURATION: 7/94 through 1/97
SUBJECT: Development and verification of advanced analytical design methodology and design tool that optimizes the structural performance of components made of composite materials by tying material properties directly to the manufacturing process.
PAYOFF: Acceleration of the use of lightweight, high strength structures in the development of advanced Army missile systems and aircraft.

COMPANY: Signature Products
DURATION: 7/94 through 1/97
SUBJECT: Increasing the production rate and improving the C(60) reactor process for Radar Absorbing Materials (RAM).
PAYOFF: Increasing efficiency (higher impulse) in missile propulsion systems.

COMPANY: Optical Processing Technology Systems
DURATION: 4/95 through 9/97
SUBJECT: Development of components and algorithms required for demonstration of a diverse pattern recognition system using optical processors.
PAYOFF: High throughput, smaller size, decreases power consumption, and lower costing processors.
<table>
<thead>
<tr>
<th>COMPANY</th>
<th>DURATION</th>
<th>SUBJECT</th>
<th>PAYOFF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hughes Missile Systems</td>
<td>5/95 through 12/96</td>
<td>Development of a comprehensive Tolerance Optimization and Variability Reduction (TOVAR) process and methodology model which can be integrated into both product development and production processes.</td>
<td>Increased production yields, lower production costs, and increased product reliability and robustness.</td>
</tr>
<tr>
<td>Optical Corp of America</td>
<td>5/96 through 9/97</td>
<td>Optical Processing Architectures and Algorithms for Automatic Target Recognition - This research, development, and demonstration of revolutionary optical processing architectures and algorithms for automatic target recognition for military and commercial applications.</td>
<td>Reduction in the production cost of military systems.</td>
</tr>
<tr>
<td>Rochester Photonics Inc.</td>
<td>9/96 through 5/99</td>
<td>E-Beam Fabrication Technology - This research will evaluate the technique of direct E-Beam fabrication for diffractive optical components and performance of replication studies.</td>
<td>Lower cost of optical components.</td>
</tr>
<tr>
<td>Georgia Tech Research Corp</td>
<td>11/92 through 1/99</td>
<td>Development of advanced manufacturing processes and equipment in the areas of microelectronics and photonics.</td>
<td>Reduction in the production costs of military systems.</td>
</tr>
<tr>
<td>Optelecom</td>
<td>8/97 through 9/99</td>
<td>Navigation Grade Interferometric Fiber Optic Gyroscope (IFOG) coils. This project is to qualify new coil winding patterns and mounting designs to achieve navigation grade performance IFOGs of substantially reduced volume. This research will have direct commercial applications such as aircraft navigation, ships, mining, and surveyors.</td>
<td>Low cost miniaturized gyroscopes for navigational operations.</td>
</tr>
<tr>
<td>Hughes Missile Systems</td>
<td>7/97 through 6/99</td>
<td>Computer Aided Modeling Design and Analysis (CAMDA) - This research will be used as a tool to investigate advanced missile concepts and have direct commercial applications in computer modeling and simulation.</td>
<td>Enhanced computer-aided modeling with commercial and military applications.</td>
</tr>
<tr>
<td>Northrop Grumman Corp</td>
<td>6/97 through 1/99</td>
<td>Adaptive Rocket Payload Configuration (ARPC) - This research will have direct commercial applications in the area of foreign military sales for multiple payload configurations and missile technology using large nose cone missiles launched from existing small launch tubes.</td>
<td>Reduction in the production cost of military systems.</td>
</tr>
<tr>
<td>Honeywell, Lucent Technologies &amp; Northrop Grumman</td>
<td>12/96 through 12/00</td>
<td>Plastic Encapsulated Microcircuits in Severe Storage Environments -This effort involves cooperative research and development to determine the risk in using plastic encapsulated microcircuits in severe storage environments.</td>
<td>Low cost hardened electrical circuits.</td>
</tr>
</tbody>
</table>
CURRENT IMPORTANT PROGRAMS (continued)

COMPANY: Nichols Research Corp
DURATION: 12/96 through 10/01
SUBJECT: Adaptive Radio Interface Device - The radio infrastructure developed under this effort will be designed with the intent of supporting multiple communications protocols, multiple physical radio implementations, and multiple form factors.
PAYOFF: Multiple protocols for military communications.

TECHNOLOGY TRANSFER HIGHLIGHTS:
Six new Cooperative Research and Development Agreements (CRDAs) were approved during FY97, and one existing CRDA was amended and extended through FY99. CRDAs were signed with the following companies: Optelecom, Hughes Missile Systems, Northrop Grumman, Nichols Research Company, and Honeywell, Lucent Technology and Northrop Grumman; with technologies ranging from Gyroscopes, computer-aided modeling design and analysis, radio interfaces, payload configuration and encapsulated microcircuits.

Sixteen (16) Domestic Technology Transfer Awards were presented by the MRDEC Director. These awards were given to each outstanding contributor for their effort to bring MRDEC technologies to the commercial market place.

EQUIPMENT/FACILITIES

Propellant Aging and Mechanical Properties Facility - This is the most modern facility in the world dedicated to solid rocket motor structural integrity and service life extension investigation. Completed in 1988, it meets DoD's latest safety requirements for handling hazardous propulsion materials.

Gel Propellant Rheology Facility - This facility is used to determine rheological properties of gelled propellants over the full range of the Army operational temperature limits and for shear rates equivalent to those imposed on the gels by engine injectors. This information is required to minimize the volume and weight of gel propulsion systems.

Ducted Rocket Test Facility - This is the most modern, economical, sub-scale direct connect air facility in the world and is used for testing ducted rockets and ramjets. Completed in 1995, it utilizes state of the art computer control to deliver a wide range of air flow rates and temperatures during a single test run, in effect 'flying' a mission while on the test stand.

Signature Characterization Facility (SCF) - This facility is used to characterize the exhaust plumes of rocket motors. The facility consists of a static test stand mounted inside an environmental chamber. Small test motors can be fired under any atmospheric condition of temperature and humidity, and evaluated as to their exhaust characteristics. These include visible and infrared flash, visible and infrared smoke attenuation, toxicity, particle analysis, and mm wave radar absorption.

Target and Seeker Measurement Facility (TSMF) - Used by the Army and Air Force for sensor/seeker design measurements, this facility includes a 300 foot tower and elevator combination allowing an operator access to equipment at any elevation up to the maximum. It also includes a 70 ton capacity target turntable with multiple degrees of freedom.
## EQUIPMENT/FACILITIES (continued)

**Advanced Simulation Facility** - This center is unequalled in the free world providing hardware-in-the-loop-simulation capability. Consisting of 10 hardware-in-the-loop simulation facilities, the Center provides unique capabilities for closed guidance loop system performance evaluation in a laboratory environment of missiles and submunitions guided and/or fused by: microwave and millimeterwave radar; scanning and staring infrared sensors; other electro-optical signals; and by inertially sensed motion. Its international reputation is demonstrated by previous and on-going international programs and consultations with the representatives of Australia, Belgium, France, Germany, Israel, Korea, and the United Kingdom.

**The AMCOM Distributed Simulation (DS) Center** - This facility provides ten interconnected application rooms for the development and operation of virtual prototype simulators, multiple local area networks, and supporting hardware and software essential to the conduct of DS exercises. It houses the node, or gateway, to the Defense Simulation Internet and an extensive WAN which includes HWIL simulations, weapons system hardware, and virtual prototypes of systems.

**The Advanced Prototyping, Engineering and Experimentation (APEX) Laboratory** - This facility is a DS compliant laboratory network of the areas of weapon system developers in the areas of weapon system design and effectiveness studies. It provides the infrastructure necessary to link live, virtual and constructive elements in common synthetic environments.

**Guidance and Control Analysis Facility** - An all digital facility for check out of flight systems, this capability is unprecedented in its system bandwidth. It is currently used for real time check out of extremely high bandwidth ADKEM guidance and control components.

**Anechoic RF Test Chamber** - This facility is world renowned for its wide anechoic bandwidth and physical size. A specially designed floor provides realistic simulation of surface wave propagation - a unique capability.

**Fire Support System Integration Lab** - Designed for end-to-end weapon system hardware check out, this facility contains distributed, netted communication nodes which can perform high and low level system tests. The facility is currently uniquely configured to check out the MLRS family of munitions.

**Army Missile Optical Range** - A one of a kind, very large aperture (2m) compact laser range capable of illuminating large targets, under simulated far field conditions, at short range. This facility is used extensively for measurement of Strategic Defense Targets.

**UAV System Integration Laboratory** - A world class facility unique in its ability to integrate multiple UAV systems and test common subsystem integration interfaces.

**Weapon System Interoperability Test Facility** - Designed for weapon system software and communication testing, this is the only facility in the U.S. Government having, in residence, Army deployed tactical air defense systems, Unmanned Aerial Vehicle C3 assets, and other ground and fire support weapon and C3 systems. It is regularly used for joint interoperability certification testing, AWE and field demonstration preparation, and soldier training.

**Composites Manufacturing Facility** - Wholly Government owned and operated, the Composites Manufacturing Facility provides MRDEC engineers with a 'hands on' capability in missile composites manufacturing from project concept, through fabrication, and testing. This facility is the Government's principal repository of technical expertise in this area.

**Propellant Signature Characterization Facility** - This environmentally controlled 'smoke tunnel' is used by all Services to evaluate contractor propellants and conduct detailed analysis of propellant insensitive munition properties.
Automated Manufacturing Cells - Contains a uniquely automated, fiberoptic winding capability and a cell for automated inspection of printed circuit boards down to 1-2 mils line width.

Laser Induced Chemistry Facility - Unique facility which includes lasers covering ultraviolet to infrared and analytical instrumentation to identify compounds resulting from laser induced reactions.

Laser Range - The Physical Sciences Building was designed for high energy laser operation. A laser range was built behind the building which allows the operation and use of the range from inside the building either by the hi-bay or directly from the lab. The range is approximately 1720 ft long with four islands each with a large mirror mount and electricity. A concrete bridge designed to support an M1 tank connects the islands with the hi-bay area. Access to the range is restricted by chain link fence and interlocks on the interior doors. Warning lights are positioned down the centerline of the range and on the access doors and gates.

Automated Laser Seeker Performance Evaluation System (ALSPES) - This $2M, one-of-a-kind facility provides complete open-loop test capability for semi-active laser (SAL) seekers/sensors operating at 1.064 microns. ALSPES provides characterizations on prototype/R&D hardware including specification compliance requirements, functional performance, and active electro-optical countermeasures (EOCM) susceptibility, and it has taken a commanding lead in EOCM susceptibility analysis. The facility has been used to test/characterize both foreign and domestic hardware, such as Copperhead, HELLFIRE, HELLYIRE II, Krasnopol, Vehicle defensive-aid suites, and 2.75” laser guided rockets. The modular equipment/software interface allows numerous systems to be tested with minimal changeover downtime.

The Laser Guidance Analysis Facility - This facility, which provides for real time, closed loop evaluation of semi-active laser guidance hardware, has and continues to be instrumental in the development and life cycle support of such systems as HELLYIRE and Copperhead. It is currently being utilized in the development and demonstration of new laser guidance concepts for the LCPK 2.75 Inch Guided Rocket program.
## FY97 FUNDING DATA (MILLIONS $)

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<tr>
<th>APPROPRIATION</th>
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<th>IN-HOUSE MANAGEMENT</th>
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## MILITARY CONSTRUCTION (MILLIONS $)

| Military Construction (MILCON) | 0.000 |

## PERSONNEL DATA (END OF FISCAL YEAR 1997)

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## SPACE AND PROPERTY

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<tr>
<td>ADMIN 237.330</td>
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<td>* Subset of previous category.</td>
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NA = Not Applicable
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Natick Research, Development & Engineering Center

Abbreviated Functional Chart - Technical Organizations

- Natick Research, Development and Engineering Center
- Mobility Directorate
- Survivability Directorate
- Science & Technology Directorate
- Sustainability Directorate
NRDEC's mission is to research, develop, engineer, test, evaluate, and integrate the best technologies for warrior systems that enhance individual combat effectiveness and quality of life. Our core products include food, shelters, airdrop, individual protection, field service and other warrior-related technologies and systems. Key services include integration of all individual warrior-related technologies and systems for everything the warrior wears, carries, "jumps" and consumes, and related support equipment.

NRDEC is the executive agent for the Department of Defense's (DOD) Food and Nutrition Research, Development, Testing, and Engineering Program as well as a DOD Center of Excellence for Clothing & Textiles. Additionally, NRDEC is the DOD agency for Helicopter Sling Loading and the Army agent for Internal Air Transport Certification.

1. Develop technologies for insertion into 21st century integrated, modular, individual fighting systems that link the soldier to the digitized command and control network on the battlefield of the future. The Force XXI Land Warrior (LW) S&T program efforts focus on technology insertions to the architectural backbone of the system with microelectronics and telecommunications to achieve lightweight, miniaturized components. The Military Operations in Urban Terrain (MOUT) program encompasses a breadth of technologies including advanced individual precision weapons, combat identification, counter-sniper technologies, nonlethal weapons, and advanced sensors, situational awareness and personal protection. The operational capability realized will be a series of advanced systems or components forming a MOUT "System of Systems" to ensure effective interoperability and functionality.

2. Maximize the warrior's survivability through development of integrated, modular system components that provide individual protection from ballistic, percutaneous chemical and biological, environmental, flame, surveillance, and directed energy threats.

One Cooperative Research and Development Agreement (CRDA) supports ballistic protective fibers produced through genetic engineering techniques for ballistic impact applications. Four new CRDAs are in place to support the RDT&E of new materials and configurations for protective clothing and individual equipment systems.

3. Provide soldiers with systems that enhance combat readiness and quality of life in the field through the development, integration, and fielding of advanced field services equipment and base camp systems in all environments and field conditions.

4. Develop a family of performance-enhancing combat rations (special-purpose and standard individual/group) and modularized, rapidly deployable field feeding equipment/systems (kitchens, burners, sanitation) for all the services to support the full spectrum of tactical scenarios.
CURRENT IMPORTANT PROGRAMS (continued)

12 CRDAs support combat rations and field feeding R&D innovative methods to provide processed meals in microwave retort pouches, irradiation, radio frequency, and non-thermal processes in the preservation of foods; improved capability for preparing special microencapsulated performance-enhancing nutrients; shelf-stable, eat-out-of-hand ration components; candidate replacements for the Flameless Ration Heater (FRH); and research for the production of fresh-like fruit and vegetables with reduced weight and volume.

5. Enhance the mobility of the combatant with the following systems: terrain traversal, personnel augmentation equipment, personnel airdrop, and cargo airdrop.

One CRDA supports airdrop R&D in the area of cushioning airdrop payloads by using gas-injected airbag technology. Another CRDA is using a phased approach to explore the flight control characteristics of high glide, semi-rigid wings, and to assess the feasibility of increasing range by use of a glide augmentation system.

6. Develop advanced shelters and shelter systems that provide new capabilities or enhancements, such as high-pressure, airbeam-supported maintenance shelters (lighter weight, less cube, quicker erection); command posts; and collective protection medical treatment facilities and hospital complexes.

EQUIPMENT/FACILITIES

Unique facilities at Natick include: man-rated climatic chambers capable of simulating world-wide environmental conditions; the Defense Simulation Internet (DSI) Facility which connects to the worldwide DSI for inserting fully outfitted dismounted infantrymen into the world of distributed interactive simulation; the aircraft and airdrop load roller conveyor, static, and drop test facilities; the soft shelters prototype fabrication facility which has many unique state of the art tentage fabrication machines and tools, including radio frequency fabric welders, hot wedge and hot air seam sealers, and is collocated with the rain test tower; food packaging facilities capable of prototype plant scale operations and simulation of rough handling; food processing pilot plant facilities; the food service equipment, engineering and evaluation lab including hooded work areas for chemical and combustion testing, a machine shop, an energy utilization panel, portable diagnostic and gas measurement instruments, and sound levels equipment; a complete laser laboratory with an alexandrite (variable frequency) laser; a fiber spinning and recycling facility; a dyeing, printing, and finishing fabrics pilot plant; a seams lab; a microbiology lab with a molecular modeling graphics workstation; a biotechnology lab with automated respirator; fermentation facility; a microscopy lab with optical, electron, and atomic force microscopes; a taste test lab; and a terrain analysis system.

Other equipment at Natick includes spectrophotometers, a CCD camera imaging system, robotic chemical agent stimulant materials test apparatus, oligonucleotide & peptide synthesizers, peptide sequencers, thermal analysis equipment, chambers for simulating artificial light, multi-layer film extrusion system, ballistics high speed impact test equipment, a materials testing machine (100 lb capacity), a computer video-analysis system, three-dimensional head and full body scanners, instrumented manikins, a small flight test/ultralight aircraft, a computerized pattern generating and grading system, a computerized rapid prototype machine, a twin screw extruder, and chromatographs with capabilities including GC, GC/MS, GDC, and HPLC.
BIOMECHANICS LABORATORY. This unique lab was established jointly by Natick and the U.S. Army Research Institute of Environmental Medicine (USARIEM). This Center for Military Biomechanical Research, the only facility of its kind within DOD, is designed for the study of ergonomic aspects of clothing and individual equipment, occupational medicine, and physical performance.

FUEL CELL. Selected as one of the DoD national test program sites for fuel cell technology, Natick became home to New England's first electricity-generating, nonpolluting fuel cell. The hot water is used by the steam distribution systems for heating and cooling. Use of the fuel cell technology will improve air quality and reduce costs by $70,000 per year.
### FY97 FUNDING DATA (MILLIONS $)

<table>
<thead>
<tr>
<th>Appropriation</th>
<th>In-House</th>
<th>In-House Management</th>
<th>Out-Of-House</th>
<th>Total</th>
</tr>
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<tbody>
<tr>
<td>RDT&amp;E:</td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>6.1 ILIR</td>
<td>0.392</td>
<td>NA</td>
<td>NA</td>
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<tr>
<td>6.1 Other</td>
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<tr>
<td>6.4</td>
<td>3.712</td>
<td>0.173</td>
<td>2.969</td>
<td>6.854</td>
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<td>6.388</td>
<td>0.413</td>
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<td>Non-DOD</td>
<td>3.703</td>
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<td>TOTAL RDT&amp;E</td>
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<td>Procurement</td>
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<td>Operations &amp; Maintenance</td>
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### MILITARY CONSTRUCTION (MILLIONS $)

| Military Construction (MILCON) | 0.000 |

### PERSONNEL DATA (END OF FISCAL YEAR 1997)

<table>
<thead>
<tr>
<th>Type</th>
<th>Scientists &amp; Engineers</th>
<th>Technical Support &amp; Other Personnel</th>
<th>End Strength</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Doctorates</td>
<td>Other</td>
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<tr>
<td>MILITARY</td>
<td>0</td>
<td>9</td>
<td>24</td>
</tr>
<tr>
<td>CIVILIAN</td>
<td>10</td>
<td>129</td>
<td>270</td>
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<tr>
<td>TOTAL</td>
<td>10</td>
<td>138</td>
<td>294</td>
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### SPACE AND PROPERTY

<table>
<thead>
<tr>
<th>Building Space (Thousands of sq ft)</th>
<th>Property Acquisition Cost (MILLIONS $)</th>
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<tbody>
<tr>
<td>LB 368.474</td>
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<tr>
<td>ADMIN 32.336</td>
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<td>* NEW SCIENTIFIC &amp; ENG. EQUIP. 0.455</td>
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</tbody>
</table>

NA = Not Applicable
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OPTEC-Test and Experimentation Command

Abbreviated Functional Chart - Technical Organizations

- Close Combat Directorate
- Aviation Directorate
- Command, Control and Communications Directorate
- Engineering, Combat Support Directorate
- Information Mission Area Directorate
- TEXCOM Experimentation Center
- Airborne and Special Operations Directorate
- Air Defense Artillery Directorate
- Intelligence and Electronic Warfare Directorate
- Fire Support Directorate
- Advanced Concepts Test and Integration Directorate
MISSION

Support the Army material acquisition and force development processes by executing the User Testing Program and conducting operational testing to support force development.

CURRENT IMPORTANT PROGRAMS

<table>
<thead>
<tr>
<th>Program</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANDVT</td>
<td>Advanced Narrowband Digital Voice Terminal (AIRTERM/KY-100)</td>
</tr>
<tr>
<td>AKMS</td>
<td>Automated Key Management System</td>
</tr>
<tr>
<td>ASV</td>
<td>Armored Security Vehicle</td>
</tr>
<tr>
<td>ATCCS VI</td>
<td>Army Tactical Command and Control System</td>
</tr>
<tr>
<td>BFVS A3</td>
<td>Bradley Fighting Vehicle</td>
</tr>
<tr>
<td>BIDS P3I</td>
<td>Biological Integrated Detection System</td>
</tr>
<tr>
<td>CCTT</td>
<td>Close Combat Technical Trainer</td>
</tr>
<tr>
<td>DIV XXI</td>
<td>Division XXI</td>
</tr>
<tr>
<td>EMUT</td>
<td>Enhanced Manpack Ultra-High Frequency Terminal</td>
</tr>
<tr>
<td>FBCB2</td>
<td>Force Battle Command Brigade and Below</td>
</tr>
<tr>
<td>ISYSCON</td>
<td>Integrated System Control</td>
</tr>
<tr>
<td>IVMMD</td>
<td>Interim Vehicle Mounted Mine Detector</td>
</tr>
<tr>
<td>MAIS</td>
<td>Mobile Automated Instrumentation Suite</td>
</tr>
<tr>
<td>MICAD</td>
<td>Multipurpose Integrated Chemical Agent Alarm</td>
</tr>
<tr>
<td>RAH-66</td>
<td>Comanche Helicopter</td>
</tr>
<tr>
<td>TF XXI</td>
<td>Task Force XXI</td>
</tr>
</tbody>
</table>

EQUIPMENT/FACILITIES

Position location, high angle modular integrated target, video, data acquisition and reduction, thermal imaging, fiber optics and video multiplexer/demultiplexer, range timing, microwave, environmental measurement and survey.
### FY97 FUNDING DATA (MILLIONS $)

<table>
<thead>
<tr>
<th>APPROPRIATION</th>
<th>IN-HOUSE</th>
<th>IN-HOUSE MANAGEMENT</th>
<th>OUT-OF-HOUSE</th>
<th>TOTAL</th>
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<tr>
<td>RDT&amp;E:</td>
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<tr>
<td>6.1 ILIR</td>
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<td>NA</td>
<td>0.000</td>
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<tr>
<td>6.1 Other</td>
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<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
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<td>0.000</td>
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<td>6.6</td>
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<td>0.000</td>
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<tr>
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<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Non-DOD</td>
<td>0.000</td>
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<tr>
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<td>0.000</td>
</tr>
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<tr>
<td>Other</td>
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<tr>
<td>TOTAL FUNDING</td>
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### MILITARY CONSTRUCTION (MILLIONS $)

| Military Construction (MILCON) | 0.000 |

### PERSONNEL DATA (END OF FISCAL YEAR 1997)

<table>
<thead>
<tr>
<th>TYPE</th>
<th>SCIENTISTS &amp; ENGINEERS</th>
<th>TECHNICAL SUPPORT &amp; OTHER PERSONNEL</th>
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<td>0</td>
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<tr>
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<td>94</td>
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### SPACE AND PROPERTY

<table>
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<th>BUILDING SPACE (THOUSANDS OF SQ FT)</th>
<th>PROPERTY ACQUISITION COST (MILLIONS $)</th>
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<tbody>
<tr>
<td>LAB 19.900</td>
<td>REAL PROPERTY 6.300</td>
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<tr>
<td>ADMIN 41.000</td>
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<td>OTHER 0.000</td>
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<td>ACRES 22</td>
<td>* Subset of previous category.</td>
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</table>

NA = Not Applicable
Redstone Technical Test Center

Abbreviated Functional Chart - Technical Organizations

- Redstone Technical Test Center
- Test Management Division
- Electronic Test Division
- Mechanical Test Division
- Firing Test Division
MISSION

Plan, conduct, analyze, and report the results of technical tests of subsystems and components of major weapon systems and associated systems/materials; conduct life cycle technical testing of small rockets/guided missiles, and serve as DOD Lightning Test Facility for hazardous items. RTTC provides testing and test support for rocket and missile research, development, test, and evaluation and other missions of authorized customers within the Department of Defense and outside the DOD, to include government and non-government organizations, domestic and foreign.

CURRENT IMPORTANT PROGRAMS

Air-To-Ground Missile System (HELLFIRE).

Air-To-Ground Missile System (LONGBOW).

TOW Missile System.

Improved Target Acquisition System (ITAS).

Improved Bradley Acquisition Subsystem (IBAS).

Javelin Missile System.

Multiple Launch Rocket System (MLRS).

ATACMS/BAT.

MPIM SRAW.

AMCOM Missile Repair Parts Program.

AMCOM Missile Shelf Life/ Surveillance Program.

Enhanced Fiber Optic Guided Missile (EFOG-M).

M72.

Bunker Defeat Munition (BDM).

FOTT.

Super Dragon.
### EQUIPMENT/FACILITIES

Extensive equipment/instrumentation for performing complete functional tests in the laboratory and field, of weapon system subsystems and components including IR, millimeter wave, and laser seekers and guidance sections, IR and visual target acquisition systems, antennas, fire control systems, gyroscopes, batteries, electronic and mechanical safe and arm devices, passive components, circuit cards, integrated circuits and other electronic, mechanical, optical, and RF devices. Testing can be accomplished at environmental extremes and test methodology is rapidly expanding to incorporate hardware-in-the-loop (HIL) and state-of-art modeling and simulation (M&S) techniques to project subsystem/component test data to system level performance. Specialized and automated test instrumentation is available/can be developed for particular weapon system application in either a laboratory or remote site environment. Flight test ranges up to 8KM are fully equipped with video and film fixed and tracking cameras, Doppler radars, GPS, telemetry and hard-line instrumentation, and tactical and simulated air and ground targets. A simulation/Test Acceptance facility provides a unique, non-destructive HIL test capability for acceptance testing of all-up-round (AUR) MMW-guided missiles. A 2000 acre, 5KM, laser/optical range for designator/sensor testing has an elevated mound, a 75 ft tower with enclosed 2-story cab, and equipment/instrumentation/aircraft for captive carry and dirty battlefield scenarios. State-of-art instrumentation is available to accurately determine aircraft/target/sensor positions, provide atmospheric transmission measurements, determine target-to-background contact measurements, and provide target thermal signatures. Development of high resolution, three dimensional, interactive, validated terrain models of RTTC ranges in the visual, infrared, and MMW bandwiths is in progress. Facilities for static and dynamic warhead testing are fully equipped with speed cameras and flash radiography. Full range of equipment/chambers is available for nondestructive and climatic testing. Static test facilities can accommodate static and liquid rocket motors up to 150K pounds vertical thrust and 10M pounds horizontal thrust. Rocket motor dissection capability exists and a thermal ablative/ducted rocket engine test facility is nearing completion. Dynamic test capabilities include vibration, shock, drop, centrifuge, and rail impact testing. E3 facilities conduct EMRH/EMRO, EMI, antenna and RCS measurements. A radar Environment Emulation system housed in a broadband, 100 DB shielded, anechoic chamber provides capability to test weapon systems to high power, pulse modulated EMR environments.
## FY97 Funding Data (Millions $)

<table>
<thead>
<tr>
<th>Appropriation</th>
<th>In-House</th>
<th>In-House Management</th>
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<tr>
<td>6.1 Other</td>
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<tr>
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<td>Subtotal (S&amp;T)</td>
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<td>6.7</td>
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## Military Construction (Millions $)

| Military Construction (MILCON) | 0.000 |

## Personnel Data (End of Fiscal Year 1997)

<table>
<thead>
<tr>
<th>Type</th>
<th>Scientists &amp; Engineers</th>
<th>Technical Support &amp; Other Personnel</th>
<th>End Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>MILITARY</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>CIVILIAN</td>
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<td>TOTAL</td>
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<td>94</td>
<td>56</td>
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## Space and Property

<table>
<thead>
<tr>
<th>Building Space (Thousands of Sq Ft)</th>
<th>Property Acquisition Cost (Millions $)</th>
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</thead>
<tbody>
<tr>
<td>LAB 460,000</td>
<td>REAL PROPERTY 146,000</td>
</tr>
<tr>
<td>ADMIN 52,000</td>
<td>* NEW CAPITAL EQUIPMENT 0.000</td>
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<td>OTHER 133,000</td>
<td>EQUIPMENT 0.000</td>
</tr>
<tr>
<td>TOTAL 645,000</td>
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<tr>
<td>ACRES 14,000</td>
<td>* Subset of previous category.</td>
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</table>

NA = Not Applicable
Tank-Automotive Research, Development & Engineering Center

Abbreviated Functional Chart - Technical Organizations

Tank-Automotive RD&E Center

- Systems & Technology Integration Office
- Operations Group
- Research Group
- Engineering Group
- Development Group
- Virtual Prototyping Group
- National Automotive Center
MISSION

Conduct research, development, engineering and leverage advanced automotive and logistics technology to provide our soldiers with the world's technologically superior ground vehicle systems and logistics support equipment.

Provide the life-cycle management, engineering, and technical support necessary to guarantee continuous system's readiness.

Serve as the Army's focal point for all ground system integration of all supporting technologies and subsystems as well as the development of dual-use automotive technologies and their application to military ground vehicles.

Provide life-cycle management, engineering and technical support necessary to guarantee continuous systems readiness.

Respond to our customer and the broad concerns of the public while providing a safe working environment for our associates.

Conduct our operations prudently and provide quality products and services which meet our customer's expectations.

CURRENT IMPORTANT PROGRAMS

In FY97, TACOM-TARDEC was responsible for five Defense Technology Objectives (DTOs) as well as 6% of the Army's 200 STOs which include four Advanced Technology Demonstrations (ATDs). The five DTOs for ground vehicles are: Advanced Ground Vehicle Systems, Ground Vehicle Integrated Survivability, Advanced Ground Vehicle Mobility Systems, Ground Vehicle Electronic Systems, and Ground Vehicle Chassis and Turret Technologies. The four ATDs consist of the Composite Armored Vehicle ATD, Hit Avoidance ATD, Crewman's Associate ATD, and Future Scout and Cavalry System (FSCS) ATD.

--- ADVANCED TECHNOLOGY DEMONSTRATIONS (ATDs) focus TARDEC's Science and Technology (S&T) programs on current and future customer requirements while showcasing technological opportunities for advanced ground vehicle warfighting capabilities. Composite Armored Vehicle (CAV): A new benchmark in lightweight, ground combat vehicle structures and armor was achieved with the rollout of the CAV demonstrator on 18 Feb 97. The CAV demonstrator structure has a measured 35% weight savings versus an all metallic structure with equivalent ballistic protection. Test results of the demonstrator radar and thermal signatures have met or exceeded expectations by combining the structure design and material solutions. Automotive testing has been completed and initial durability testing is in progress. Composite technology transfer has occurred with the incorporation of CAV technology into the current Crusader howitzer turret design. Ongoing and future technology transition efforts will concentrate on the Future Scout Cavalry System (FSCS) as well as the Future Infantry Vehicle (FIV).
CURRENT IMPORTANT PROGRAMS (continued)

The Future Scout and Cavalry System (FSCS) ATD concept development, technology tradeoff assessments and program formulation began this year. In FY98 the ITT (RFP) will be finalized and released to Industry and a Source Selection will be accomplished. Two ATD contracts will be awarded. Cost tradeoffs and initial design will be accomplished in FY99. This ATD will be cooperatively executed with the United Kingdom. Specific international roles and responsibilities have been established.

The Hit Avoidance (HA) ATD has completed demonstrations in signature management, electronic warfare, and active protection technologies. The integration of these technologies known as the Integrated Defense System (IDS), provides the vehicle crew with the capability to automatically detect threats and position thus offering increased vehicle and crew survivability. We developed and demonstrated a sensor module pertaining to hit avoidance technologies for ground vehicles, conducted a system demonstration of protection concepts, demonstrated a low-cost near-term active protection system, developed system specifications for the IDS, demonstrated the IDS decision aid and provided system specifications, evaluated systems engineering simulation models developed through the integration of threat, sensor, countermeasure and ancillary support models, demonstrated and evaluated a commander’s decision aid which identifies the threat and then provides an optimal countermeasure response. We are continuing to examine Armor/Anti-Armor Technology, Threat Oriented Survivability Optimization Model (TOSOM), Laser Protection Ground Vehicle Visual Perception, and Non-Ozone Depleting Substance Technology to further enhance survivability in the field.

Crewman’s Associate ATD was successfully completed on time and within cost by the end of the fiscal year, and demonstrated crew station performance enhancements through the application of advanced technologies compared with current M1A2 four-man crew performance. The end product will be a Systems Integration Lab (SIL) that demonstrates how electronics integration, user-friendly interface, and advanced digital information handling systems can be combined so that the crew can fight and win the information war.

-- TECHNOLOGY DEMONSTRATIONS are comprised of TARDEC’s non-ATD S&T programs and are formulated by Army agencies as a Science and Technology Objective (STO). Individually approved by the warfighting customer, each STO delivers a measurable new warfighting capability or a cost saving method to streamline ground vehicle acquisition and support investments. New STOs currently under development and that have attained provisional status from the warfighter customer include full spectrum active protection - a universal combat vehicle defensive system; propulsion demonstrator for future combat system - technologies demonstration to meet future combat system mobility and power requirements; advanced electronics for future combat systems - ultra high power electronics and crew station architecture; light weight chassis and turret structures - high efficiency, minimum weight, modular structural designs for ground combat vehicles; and future combat system integrated demonstrator - system integration demonstration of the above advanced subsystems technologies. Other non-STO efforts include robotic ground vehicle and Halon replacement. The new robotic effort was initiated to develop and demonstrate robotic ground vehicle technology extended to autonomous navigation on off-road terrain. Development and demonstration continues for a crew compartment explosion and fire suppression agent replacement of Halon 130.
CURRENT IMPORTANT PROGRAMS (continued)

-- TECHNOLOGY DEVELOPMENT: The Ground Vehicles subarea of the 1997 DOD Ground and Sea Vehicles Defense Technology Area Plan (DTAP) identifies unique technology efforts, called Defense Technology Objectives (DTOs), critical to fielding of technologically superior warfighting systems. In FY97, three additional DTOs were added in DTAP to the five of the previous year. The new DTOs are integrated hit/kill avoidance optimization; reconnaissance, surveillance and targeting vehicle; and tactical mobile robotics. Again this year, the ground vehicle Science and Technology investments were consolidated in a planning document entitled Technology Development Approached (TDA). The TDA represents an integrated Science and Technology investment by Government, Industry and Academia for ground vehicles. The TDA identifies soldier needs, unique technology opportunities and establishes, by a consensus decision-making process, quantified technology goals with resultant ground vehicle system payoffs. The product of the TDA is a set of technology programs, e.g. STOs and ATDs, which are focused on high payoffs efforts and maintain a consistent direction over multiple budget years. A full team of Government, Industry and Academia representatives met for the first time in this year to review and comment on the TDA and to exchange ideas.

-- VEHICLE PERFORMANCE SIMULATION/VIRTUAL PROTOTYPING efforts are centered on exploiting advances in High Performance Computing and Simulation software to analyze and assess wheel and track ground vehicle performance over the entire life cycle of the vehicle system, from concept design through fielded system support. Our expertise in multi-body/flexible body analysis as well as finite element/structural analysis is used to analyze engineering issues as finite as individual component performance, on up to whole vehicle system performance. Our expertise is used extensively to provide new vehicle system Source Selection Authorities additional insight into how proposed vehicle designs will perform while carrying out their directed missions. We are also called in to support Weapon System Managers, Program Managers and other decision makers to provide engineering solutions to problems in the field which preclude their system from meeting their mission requirement. Many of the state of the art simulation tools we have at our disposal have been developed by the Researchers with TACOM-TARDEC's Virtual Prototyping group as part of our ongoing research program that keeps the Army's Simulation capabilities on the cutting edge of the technology. This technology allows TACOM-TARDEC to provide vehicle system decision makers with timely, accurate answers to their real world engineering questions, thereby keeping the Army's vehicle fleet the safest, and most effective in the world.

-- EMERGING SYSTEMS are based on recommendations of warfighter-lead Integrated Concept Teams (ICTs) sponsored by the US Army Training & Doctrine Command (TRADOC). ICTs this year focusing on future systems include: Future Combat System (FCS), Future Scout & Cavalry System (FSCS), and Future Infantry Vehicle (FIV). An ICT also proposed upgrades to the M1 Abrams Main Battle Tank. In addition to ICT recommendations, a Petroleum Quality Analysis system is an emerging logistic system initiated with strong backing from the Combat Service Support warfighter organizations.
- Provided concept and manufacturing drawings, and built prototype combat identification panels for tracked vehicles, and for the HMMWV; designed, produced and fielded combat identification panels to U.S. Army Europe Units.
- Provided mine resistant components and panels to the soldiers in Bosnia and other locations. These vehicles were provided to allow greater survivability in areas with high concentrations of land mines as experienced in Bosnia and other overseas locations.
CURRENT IMPORTANT PROGRAMS (continued)

-- SUPPORT TO PEO's ie. M1A2 System Enhancement Package (SEP), Bradley M2A3, includes Digitization of the Battlefield, Heavy Dry Support Bridge, Tactical Vehicle Mine Protection.

Other Support to PEOs:
- Provided electronics architecture and/or embedded mapping consultation to PMs for Abrams, Bradley and CMS.
- Developed and provided digital map editing station to provide usable, integratable DMA-based maps for embedded vehicle use by PM Abrams and Bradley during M1A2 SEP and M2A3 test and evaluation.
- A PLS-based DEMO III truck full scale hardware development and integration effort has been completed including up horsepower, new transmission, independent suspension, disc brakes and concepts for weight reduction.

-- WEAPON SYSTEM MANAGEMENT and CONFIGURATION CONTROL for 19 systems in development, 34 systems in production/deployment and 2801 systems in sustainment (vehicles and end items). This encompasses over 850,000 military ground vehicles, 300,000 unique spare parts equating to 2.5 billion components (average of 3,000 parts per vehicle). Configuration control is maintained via 934,000 drawings. System support includes: materiel & combat development integration, acquisition, concurrent engineering, manufacturing & producibility engineering, product assurance, engineering data management, validation of technical data, field technical assistance, specifications and standards, tech adaptation/development/integration/transition and test management.

-- TECHNOLOGY TRANSFER EFFORTS:
- Participated in a joint military/commercial light truck demonstrator program, using advanced commercial technologies.
- Continued development, demonstration and deployment of the Automotive Product Development Framework (APDF), a comprehensive, integrated virtual prototyping system for ground vehicles with advanced capabilities to automatically integrate and operate existing, dissimilar software products in a unified operating environment.
- Demonstrate new environmentally compliant and pollution prevention initiatives for petroleum and related products by introducing recycling capabilities for DOD and new non hazardous/non toxic petroleum product substitutes.
- Demonstrated military ground vehicle and missile applications of selectively reinforced, silicon carbide whisker - aluminum metal matrix composite (AL-MMC) materials.
- Continued joint TARDEC/industry projects to prolong lead-acid battery life, and to reduce their use, through ultracapacitor starting aids, smart electronic battery management, and modeling tools which improve vehicle electrical system behavior.
- Organized a night vision conference with participation of our industry partners to demonstrate successful technical transfer accomplishments.
- Continued research in several areas of diesel engine technology including the evaluation of the High Output Diesel Engine and the insertion of advanced automotive technologies to the Army vehicle fleet to reduce operation and support cost.
- Continued participation in the Partnership for a New Generation of Vehicles (PNGV) for systems analysis, four stroke directed injected engine and manufacturing.
- Initiated development of an environmentally friendly, low cost waste oil disposal system with recovery of residual waste oil energy for vehicle use.
EQUIPMENT/FACILITIES

TARDEC is the only Army/DOD Tank-Automotive Research, Development and Engineering Center committed to overall ground vehicle technology and integration.

NATIONAL AUTOMOTIVE CENTER, a joint venture with the American automotive industry and TARDEC, is leading the way in 'dual use' of critical technologies.

PROPULSION LABORATORY: Has six R&D computer-controlled engine and transmission test cells, three vehicle test cells and an airflow lab featuring a chassis dynamometer facility, a truck driveline test cell, a unique environmentally-controlled large-tracked vehicle dynamometer test chamber with wind, ambient temperature, and solar radiation simulation capability, brake, heat exchanger, air cleaner, and battery testing facilities.

TIRE LABORATORY: Provides full range of tire and roadwheel performance, endurance, and shock testing capability.

TRACK and SUSPENSION LABORATORY is used to conduct testing and evaluation of current and prototype combat vehicle components. Specific test systems include a track pad test machine, 1/4 HMMWV suspension test platform, three degree of freedom track loading, torsion bar test and linear shock absorber test. Generic capabilities are available for high static loading and endurance/fatigue test scenarios. Available linear and rotary hydraulic components and instrumentation allow for flexible test design and configuration.

ARMOR INTEGRATION LAB performs armor system fabrication and ballistic testing.

VISUAL PERCEPTION LABORATORY augments available field test data by providing a controlled environment to measure the detectability of signature management systems using trained military observers.

LASER PROTECTION LABORATORY develops and evaluates materials and techniques to harden combat vehicle surveillance vision optics against multiple laser hazards and threats.

ENVIRONMENTAL TEST CELL performs high-temperature performance tests on vehicles.

VEHICLE ELECTRONICS (VETRONICS) LABORATORIES include: Combat Vehicle Systems Integration Lab composed of ADA based vehicle-ready electronics, computer systems, and crew stations for proof-of-principle demonstrations of advanced and open electronic architecture approaches; Crew Station Simulator Lab composed of the following DIS compatible man-in-the-loop virtual simulators and support environments: 2/3 Man Tank, M2A3 HMMWV, MODSAF, ITEMS and virtual world/terrain modeling; Drivers Automation Lab composed of several tactical wheeled and combat vehicle systems with a variety of autonomous and semi-autonomous driving aids and sensors (e.g. collision avoidance system) and a base station for tele-operated field demonstrations.

COMBAT VEHICLE COMMAND AND CONTROL FACILITY provides an automated command and control system for armor/infantry vehicles, a tactical situation display in all vehicles, and supports the Army Horizontal Technology Insertion Program.
| TACOM GROUND VEHICLE SYSTEMS SIMULATION LABORATORY | houses national resources for full-scale motion based vehicle simulation. The laboratory consists of a variety of simulators to perform Man-in-the-loop crew stations turret motion base simulator CS/TMBS is the center piece of this laboratory. This unique 6 degree of freedom simulator is used to reproduce dynamic conditions encountered by combat vehicle crew stations and turret systems (up to 25 tons) traverses a variety of terrain environments. In addition to the CS/TMBS, a ride motion simulator (due to be installed FY98), a single crew person, six DOF high fidelity simulator, offers the capability of recreating the ride motion of any land based military vehicle system. In order to perform durability schedules, reconfigurable “poster” simulators are used to provide dynamic load inputs to ground vehicle systems and/or subsystems (tanks/trucks, hulls, frames, etc). In order to better test trailer systems, the laboratory has yet another unique one-of-a-kind simulator the Pintle Motion Base Simulator (PMBS). The PMBS is capable of providing both terrain disturbance inputs and dynamic pintle loads due to truck/trailer interaction. |
| The TACOM HIGH PERFORMANCE CENTER (HPC) which operates a 64 processor Power Challenge Array (PCA) Parallel Processor Super computer is Collocated in this facility and is one of only eleven DOD national shared-resource high-performance computer centers. In addition, this center provides computational capability for real time inputs needed by the Ground Vehicle System Simulation Laboratory. |
| TACOM-TARDEC VIRTUAL PROTOTYPING LABORATORY is capable of displaying interactive computer-aided design solid model virtual mock-up of present and future ground vehicle systems. A wide range of state-of-the art 3-D stereo display devices (helmet, boom, projection, and holographic) are used for interactive virtual mock-up of vehicle systems and manufacturing facilities. In addition state-of-the art CAD work stations directly networked to the HPC PCA will allow real-time interactive immersive environments for virtual mock-up of vehicle systems. |
| BRIDGE TEST FACILITY used in testing static or dynamic cyclic loads on various bridge designs. |
| WATER QUALITY AND WATER TEST CELL LABORATORIES used for the testing of various water filter elements, water filter systems, and provides chemical analytical support to water purification engineer functions. |
| FUEL EQUIPMENT TEST LABORATORY used for testing and evaluating fuel pumps, fuel filter elements, fuel filter separators, fuel nozzles and engine fuel filter elements. |
| GREASE AND FLUID LABORATORY performs development, evaluation, and environmental compliance assessments of hydraulic fluids, semi-solid lubricants, solid lubricants, antifreeze, and solvents to enable introduction of new technologies and development of new performance standards. |
| FUELS AND POWERTRAIN LUBRICANTS LABORATORY performs development, evaluation, and environmental compliance assessments of fuels, alternative fuels, and powertrain lubricants (i.e., engine oils, gear lubricants, and transmission fluids) to enable introduction of new technologies and development of new performance standards. |
| TARDEC FUELS AND LUBRICANTS RESEARCH FACILITY (SWRI) a Government owned, contractor operated facility at the Southwest Research Institute, is a one-of-a-kind resource where integrated fuels-lubricants-engine systems research and development programs can be performed involving combustion, performance characterization, engine cleanliness, vulnerability assessments, and tribology can be performed. |
EQUIPMENT/FACILITIES (continued)

OTHER facilities and equipment include: software engineering, signature, dynamic motion simulator (seat simulator), fabrication, computer-aided design, Laminate Object Manufacturing (LOM) rapid prototyping system, packaging engineering, model shop, metallurgical, mechanical test, animation capabilities used in support of virtual prototyping, rapid prototyping, visualization capabilities, sheet/metal welding, machine shop, assembly shop, electrical, battery test, instrumentation, IR imaging, thermal wave microscopy, applied engineering, scanning electronic microscope, and material spectrum analyzer.
## FY97 Funding Data (Millions $)

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<th>Appropriation</th>
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<th>In-House</th>
<th>Out-Of-House</th>
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## Military Construction (Millions $)

| Military Construction (MILCON) | 0.000 |

## Personnel Data (End of Fiscal Year 1997)

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<tr>
<th>Type</th>
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<th>Technical Support &amp; Other Personnel</th>
<th>End Strength</th>
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<td>Doctorates</td>
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## Space and Property

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<td>Admin</td>
<td>New Capital Equipment</td>
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<tr>
<td>Other</td>
<td>Equipment</td>
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<tr>
<td>Total</td>
<td>New Scientific &amp; Eng. Equip.</td>
</tr>
<tr>
<td>Acres</td>
<td>* Subset of previous category</td>
</tr>
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</table>

NA = Not Applicable

2-122
Topographic Engineering Center

Abbreviated Functional Chart - Technical Organizations

U.S. Army
Topographic Engineering Center

Topographic Research Division
Topographic Systems Division
Force Development Division
Operations Division
Geospatial Information Division
MISSION

The U.S. Army Topographic Engineering Center (TEC) is a field operating activity under the
command of the U.S. Army Corps of Engineers (USACE). TEC’s mission is to provide America’s
soldiers and their commanders with superior knowledge of the battlefield and to support the nation’s
civil and environmental initiatives through research, development and the application of expertise in
topographic and related sciences. The mission involves research and development (R&D), system
acquisition, operations and maintenance (OMA), and civil works programs. Military and civil R&D
programs are guided by the USACE Director of Research and Development. System development
programs are directed by the Program Executive Officer Command Control Communications
Systems (PEO C3S), Program Executive Officer Intelligence and Electronic Warfare (PEO IEW),
Deputy Chief of Staff, Operations (DSCOPS), and other agencies. Operations and Maintenance,
Army (OMA) programs are under the guidance of the Deputy Chief of Staff for Intelligence
(DCSINT) and the Office of the Chief of Engineers - Pentagon. The Engineer Strategic Studies
Center (ESSC), under the operational control of the Deputy Chief of Engineers, serves as the Chief of
Engineers’ center of creative, innovative, analytical thought.

Vision: The preferred provider of quality geospatial research, development, products, and services.

CURRENT IMPORTANT PROGRAMS

Military and civil R&D efforts make extensive use of remote sensing technologies and geospatial
data generation and portrayal. Research and development areas include: rapid generation of
geospatial data; terrain analysis and characterization; passive and active spectral signature
identification; photogrammetry; terrain visualization; battlefield and terrain related simulation and
modeling; precision surveying and mapping; image analysis; data management; geographic
information systems; and data/image fusion. As USACE’s Center of Expertise in surveying and
mapping, TEC provides support to Corps of Engineer headquarters, divisions, and districts, as well as
other civil agencies, to ensure consistency of surveying and mapping products, to maintain the
capability to manage complex, nation-wide survey systems, and to allow for the expert data analysis.
TEC also has skills in systems engineering, acquisition management, sustainment, and support. TEC
provides developmental and demonstration support to PM, Joint Precision Strike, developmental
support to the Army Space Programs Office and PEO C3S for the Combat Terrain Information
Systems.

Operationally, TEC serves as the Army’s primary agent for terrain analysis and the Department of
Defense’s (DoD) primary agent for water detection. Support for contingency plans, military
operations, and operations other than war is provided to terrain teams, DoD, DA staff, MACOMs, and
joint commands. TEC serves as the Army’s technical expert to combat and materiel developers and
field topographic units and other users of geospatial information. TEC provides technical leadership
for the orderly, cost effective integration of digital terrain data into Army systems and activities, and
advises the Department of the Army Headquarters on all technical aspects of geospatial information
requirements and standards.
CURRENT IMPORTANT PROGRAMS (continued)

TEC Technology Transfer in FY97: Completed two Construction Productivity Advanced Research (CPAR) Cooperative Research and Development Agreements (CRADAs). Titles and partners were Construction Vehicle Navigation and Automation with Caterpillar, Inc., and Advanced Hydrographic Surveying and Dredging System with Coastal Oceanographics, Inc. Initiated one new CRADA with ERDAS Inc. The purpose was to integrate DrawLand, the TEC-developed 3-dimensional terrain visualization software program, into a commercially available software product of ERDAS; investigated and coordinated nine new Technology Transfer opportunities with the private sector; initiated TEC's first annual Technology Transfer training for engineers and scientists in May 1997. Topic areas included terminology, concepts, responsibilities, statutory and regulatory basis, process, intellectual property, and current TEC Technology Transfer agreements; nominated two TEC engineers for the prestigious Federal Laboratory Consortium (FLC) 1997 Awards for Excellence in Technology Transfer; and provided a member for the FLC Training and the FLC Mid-Atlantic Region Nominating Committees. The FLC is composed of over 600 Federal laboratories and technical facilities. The FLC Mid-Atlantic region is composed of approximately ninety organizations in the states of Virginia, Maryland, Delaware, Pennsylvania, and West Virginia.

EQUIPMENT/FACILITIES

TEC facilities include: the Space Research Test Bed (SRTB); the Synthetic Environments Evaluation and Demonstration Site (SEEDS); the Virtual Laboratory; the Integration and Evaluation Center (IEC); the Spectral Research Facility; the Global Positioning System (GPS) and Survey Engineering Laboratory; the Battlefield Visualization Test Bed; the Terrain Information Extraction System, (TIES); and the Collection Management Office (CMO). SRTB provides an imagery exploitation test bed to support TEC reimbursable, technology base R&D operational programs. The SEEDS facility provides hardware and software for the integration, text, evaluation, and demonstration of cutting-edge modeling and simulation geospatial technologies. The Virtual Laboratory links the national and tactical imagery intelligence and topographic communities to the CINCs and operational Army elements. The IEC provides access to forces worldwide through the use of Army Global Grid connectivity, dedicated T-1 and T-3 lines to key installations, Asynchronous Transfer Mode (ATM) access, and Deployable Very Small Aperture Terminal (VSAT) supporting wideband satellite communications for conducting large-scale warfighting experiments. The spectral research facility contains a Digital Multi-Spectral Video camera, and multiple spectral radiometers and fluorometers used in studying both passive and active phenomena in the visible, near infrared, and thermal electromagnetic regions. The GPS and Survey Engineering Laboratory contains eight (8) geodetic-quality GPS receivers, permanent differential GPS reference stations with broadcast capabilities, and conventional survey equipment. Equipment for precise survey and point positioning is deployable on short notice. The Battlefield Visualization Test Bed is an assemblage of high-speed computers and peripherals that uses various data sources and processing techniques to produce realistic images of terrain for battlefield scenarios. The TIES provides a capability for extracting up-to-date terrain data from remotely sensed images. The CMO provides TEC the capability to rapidly query status and order National Imagery in hardcopy or softcopy formats.

TEC's computer inventory includes many powerful independent work stations as well as personal computers for the majority of the workforce.
Topographic Engineering Center
Alexandria, VA 22315-3864
(703) 428-6654

FY97 FUNDING DATA (MILLIONS $)

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<tr>
<th>Appropriation</th>
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<th>In-House Management</th>
<th>Out-Of-House</th>
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MILITARY CONSTRUCTION (MILLIONS $)

| Military Construction (MILCON) | 0.238 |

PERSONNEL DATA (END OF FISCAL YEAR 1997)

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<th>Type</th>
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<th>Technical Support &amp; Other Personnel</th>
<th>End Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Doctorates</td>
<td>Other</td>
<td></td>
</tr>
<tr>
<td>MILITARY</td>
<td>0</td>
<td>2</td>
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</tr>
<tr>
<td>CIVILIAN</td>
<td>11</td>
<td>201</td>
<td>164</td>
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<tr>
<td>TOTAL</td>
<td>11</td>
<td>203</td>
<td>169</td>
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SPACE AND PROPERTY

<table>
<thead>
<tr>
<th>Building Space (Thousands of Sq Ft)</th>
<th>Property Acquisition Cost (MILLIONS $)</th>
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</thead>
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<tr>
<td>LAB</td>
<td>REAL PROPERTY</td>
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<tr>
<td>ADMIN</td>
<td>* NEW CAPITAL EQUIPMENT</td>
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<td>TOTAL</td>
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<td>ACRES</td>
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</table>

NA = Not Applicable
Walter Reed Army Institute of Research

Abbreviated Functional Chart - Technical Organizations

Walter Reed Army Institute of Research

- Biochemistry Division
- Biometrics Division
- Pathology Division
- Preventive Medicine Division
- Surgery Division
- Medicine Division
- Special Foreign Activities and Detachments
- Communicable Diseases & Immunology Division
- Neurosciences Division
- Neuropsychiatry Division
- Veterinary Medicine Division
- Retrovirology Division
- Experimental Therapeutics Division
Walter Reed Army Institute of Research
Washington, DC 20307-5100
(202) 782-3551

Director: COL Martin H. Crumnine
Deputy Director: COL Daniel L. Jarboe

MISSION

The Walter Reed Army Institute of Research (WRAIR) has one primary mission: biomedical research focused on soldier health and readiness. Whether in full scale war or in other operations, the WRAIR provides America's fighting men and women with the tools and knowledge to survive in hostile, disease-ridden, and health-threatening environments. The Institute fulfills its mission by conducting innovative research in naturally occurring infectious diseases, combat casualty care, operational health hazards, and medical defense against chemical and biological weapons.

CURRENT IMPORTANT PROGRAMS

Conduct research and develop drugs and vaccines to protect against infectious diseases to deployed soldiers. Conduct research and develop means to prevent operational stress in the combat environment. Conduct research and develop technologies for far forward combat casualty care and evacuation. Conduct research and develop strategies and technologies to prevent injuries from blast and directed energy sources and prevent progressive damage following traumatic wounds. Conduct research to develop medical strategies for the protection of soldiers from chemical and biological warfare threats. Evaluation of military health hazards of Army weapon systems and manpower programs, in coordination with AMC, TRADOC, and ODSCP
er. Transfer military medical science and technology into commercially viable products through cooperative research and development agreements, (CRADAS) outreach programs, and patent licensing, such as CRADAS with commercial companies on the development of drugs and vaccines to prevent malaria.

There are approximately 21 persons assigned to WRAIR under CRADAs.

EQUIPMENT/FACILITIES

Complete analytical chemistry capability to include gas chromatography and mass spectrometry; drug development from computer-aided drug design and synthesis to field testing for efficacy and safety; vaccine development from basic research and computer assisted recognition of relevant vaccine candidates to biological model development and production, testing and production, testing and licensing; complete infectious disease diagnosis to include isolation and culture of causative agents and physiological, serological and genetic diagnosis; perform comprehensive human behavioral research studies both in the laboratory setting and in the field; evaluate health hazards from blast, toxic, gas, and laser energy as well as materiel, and approaches to combat casualties from these same sources; perform complete epidemiology on military medical threats and accidents from infectious diseases and toxins; through pathological evaluation to include histopathological diagnosis and transmission and scanning electron microscopy studies; basic research studies into the pathophysiology of disease utilizing modern cell physiology and hematological techniques; testing of drugs, vaccines and medical doctrine in overseas locations in Brazil, Germany, Thailand and Kenya.
Facility Locations:

A. WRAMC AND FOREST GLEN

Headquarters and site of main research programs. The full spectrum of biomedical research is conducted to include: infectious disease and vaccine development research, HIV research, operational medicine, combat casualty care, and medical and chemical biological defense research.

B. CONUS DETACHMENTS

Wright Patterson Air Force Base - Occupational toxicology research.

Brooks Air Force Base - Medical effect of laser and microwave irradiation.

Blood Storage Preservation Research - located in leased space in Rockville.

Dental Research Detachment - Great Lakes, IL (Naval Base).

C. OCONUS DETACHMENTS

US Army Medical Research Unit (USAMRU) - Germany - Operational Stress and Human Dimensions Research related to Operational Medicine.

USAMRU - Kenya - Infectious diseases endemic to Sub-Saharan Africa.

USAMRU - Brazil - Infectious diseases endemic to South America including malaria, leishmaniasis, dengue, shigella, and enteric diseases.

Armed Forces Research Institute of Medical Sciences (AFRIMS) - Bangkok Thailand - Infectious diseases and vaccine development for those diseases endemic to Southeast Asia to include malaria and HIV.
### FY97 Funding Data (Millions $)

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<thead>
<tr>
<th>Appropriation</th>
<th>In-House</th>
<th>In-House Management</th>
<th>Out-Of-House</th>
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<tr>
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<tr>
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<tr>
<td>Non-DOD</td>
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<td>0.000</td>
</tr>
<tr>
<td>Operations &amp; Maintenance</td>
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### Military Construction (Millions $)

| Military Construction (MILCON) | 0.000 |

### Personnel Data (End of Fiscal Year 1997)

<table>
<thead>
<tr>
<th>Type</th>
<th>Scientists &amp; Engineers</th>
<th>Technical Support &amp; Other Personnel</th>
<th>End Strength</th>
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<tbody>
<tr>
<td></td>
<td>Doctorates</td>
<td>Other</td>
<td></td>
</tr>
<tr>
<td>Military</td>
<td>52</td>
<td>100</td>
<td>192</td>
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<tr>
<td>Civilian</td>
<td>76</td>
<td>87</td>
<td>240</td>
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<td>Total</td>
<td>128</td>
<td>187</td>
<td>432</td>
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### Space and Property

<table>
<thead>
<tr>
<th>Building Space (Thousands of Sq Ft)</th>
<th>Property Acquisition Cost (Millions $)</th>
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<tbody>
<tr>
<td>Lab</td>
<td>Real Property</td>
</tr>
<tr>
<td>Admin</td>
<td>* New Capital Equipment</td>
</tr>
<tr>
<td>Other</td>
<td>Equipment</td>
</tr>
<tr>
<td>Total</td>
<td>* New Scientific &amp; Eng. Equip.</td>
</tr>
<tr>
<td>Acres</td>
<td>* Subset of previous category.</td>
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</table>

NA = Not Applicable
Waterways Experiment Station

Abbreviated Functional Chart - Technical Organizations

- Waterways Experiment Station
  - Coastal and Hydraulics Laboratory
  - Environmental Laboratory
  - Geotechnical Laboratory
  - Information Technology Laboratory
  - Structures Laboratory
Waterways Experiment Station
Vicksburg, MS 39180-6199
(601) 634-2504

Director: Dr. Robert W. Whalin
Cdr & Dpty Dir: COL Robin R. Cababa

MISSION

The US Army Engineer Waterways Experiment Station (WES) is the largest Civil Engineering/Environmental Quality R&D complex in the Nation and is the DoD Category 3 Reliance lead Laboratory in the Civil Engineering Areas of Airfields and Pavements, Survivability and Protective Structures, and Sustainment Engineering. WES is the DoD Reliance lead Laboratory in the Environmental Quality subarea for Installation Restoration. WES operates and maintains the first DoD High Performance Computing Major Shared Resource Center for the Director, Defense Research and Engineering. The Tri-Service Computer Aided Design Drafting and Geographic Information System Technology Center is managed, operated and maintained by WES. The Corps of Engineers Central Processing Center is operated and maintained for the purpose of processing management information systems information for about 60% of Corps offices worldwide. WES manages 7 DoD Information Analysis Centers (IAC): Airfields, Pavements, and Mobility (IAC); Coastal Engineering (IAC); Concrete Technology (IAC); Hydraulic Engineering (IAC); Soil Mechanics (IAC); Environmental (IAC); and the Shock and Vibration (IAC). WES manages and executes 85% of the Army Corps of Engineers Civil Works Research and Development Program in the areas of hydraulic, coastal, geotechnical, structural, and environmental engineering, and information technology. Primary research and development missions encompass weapons effects; fighting positions; terrorist threat protection; structural hardening; fixed facility camouflage, concealment, and deception; vehicle/terrain interaction; military hydrology; lines of communications, construction, and repair; airfields and pavements; coastal engineering; coastal oceanography; littoral processes; hydraulic engineering; flood control and navigation; dynamic modeling and simulation; environmental impact; environmental restoration, aquatic plant control, zebra mussels, recreation, dredging and contaminated sediments; groundwater modeling; wetlands processes; environmental site characterization; ecosystem processes; reservoir, riverine, estuarine, and coastal water quality; mobility analyses; seismic response of structures; earthquake engineering; dredging and dredged material disposal; natural resources management; concrete technology; structural dynamics; and geotechnical engineering.

CURRENT IMPORTANT PROGRAMS

Unparalleled synergism exists between the $111M US Army Civil Works R&D Programs (listed as Non-DoD under FUNDING DATA) and the other DoD RDTE. Construction materials and methods for rapid establishment of in-theater transportation network required for force protection; designs, materials, and construction practices for force protection (on the battlefield, from terrorist threats, and against advanced conventional weapons); engineer operations planning software for inclusion in the Army Tactical Command and Control System; accurate and reliable PC-based mobility models for command and control systems, combat models and simulations, and virtual prototyping; methodologies to predict coastal effects on Logistics-Over-The-Shore operations; Airfields and Pavements research for durable and cost-effective pavements for roads, airfields, and other operating surfaces including the development of design criteria for semi-prepared operating surfaces for the C-17 aircraft; effective remediation of sites contaminated with explosives, organics, and heavy metals; methods for investigation, characterization, and monitoring of potential hazardous waste sites; prediction of subsurface transport of contaminants in subsurface groundwater; effective chemical analysis techniques for accurate identification of suspected contaminants at DoD sites; Unparalleled synergism exists between the $111M US Army Civil Works R&D Programs (listed as Non-DoD under FUNDING DATA) and the other DoD RDTE.
**CURRENT IMPORTANT PROGRAMS** (continued)

Construction materials and methods for rapid establishment of in-theater transportation network required for force protection; designs, materials, and construction practices for force protection (on the battlefield, from terrorist threats, and against advanced conventional weapons); engineer operations planning software for inclusion in the Army Tactical Command and Control System; accurate and reliable PC-based mobility models for command and control systems, combat models and simulations, and virtual prototyping; methodologies to predict coastal effects on Logistics-Over-The-Shore operations; Airfields and Pavements research for durable and cost-effective pavements for roads, airfields, and other operating surfaces including the development of design criteria for semi-prepared operating surfaces for the C-17 aircraft; effective remediation of sites contaminated with explosives, organics, and heavy metals; methods for investigation, characterization, and monitoring of potential hazardous waste sites; prediction of subsurface transport of contaminants in subsurface groundwater; effective chemical analysis techniques for accurate identification of suspected contaminants at DoD sites; Materials/Structural Engineering; Innovative Design and Construction; National Wetlands Characterization and Restoration; Zebra Mussel research; Repair, Evaluation, Maintenance, and Rehabilitation; Aquatic Plant Control research; Earthquake Engineering research, tunnel and underground facility detection research; and the Dredging Operations and Environmental Research Program. Technology Transfer Activities include: seventeen Cooperative Research and Development Agreements were approved, five Patent License Agreements were approved, and three additional patent license agreements were in negotiations.

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**EQUIPMENT/FACILITIES**

The US Army Engineer Waterways Experiment Station (WES) has an unmatched combination of experimental and computational facilities for research in hydraulic, geotechnical, structural, environmental, and coastal engineering, and information technology. Some of the more significant facilities are:

**Hazardous and Toxic Waste Research Center (HTWRC) (17,000 sq ft):** This is the only DoD-permitted (RCRA) facility to conduct large volume HTW research, development, test, and evaluation. EPA recognizes the HTWRC as the Nation's premier facility.

**Environmental Chemistry Laboratory:** 8000 sq ft analytical laboratory supporting the DoD environmental research, analytical, and quality assurance support for water quality, contaminated sediments, and environmental restoration facilities. This existing facility will be replaced in FY98 with a new 20,000 sq ft state-of-the-art facility in time to meet the expanded Corps environmental mission with demands for high hazard research (i.e. dioxins and dibenzofurans) at detection levels that meet requirements of health and regulatory risk-based hazard assessments.

**Fate and Effects R&D Center (30,000 sq ft):** Complete experimental radioisotope, microbiology, toxicity, and instrumentation laboratories for investigations of contaminant fate and effects on ecosystems.

**DoD High Performance Computing Major Shared Resource Center (55,000 sq ft):** Includes multiple, state-of-the-art High Performance Computing systems which provide the most powerful scientific and engineering capability in DoD with 47000+ MegaWords of memory, 1700 Gigabytes of high-speed disk, and 500 Terabytes of high-speed robotic archival storage. Includes a $4.1M Scientific Visualization Center to identify and develop innovative methods of interpreting large data sets from modelings/simulation, field data collection, and Computer Aided Design and Drafting (CADD) applications.
**EQUIPMENT/FACILITIES (continued)**

<table>
<thead>
<tr>
<th>Facility Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airfields &amp; Pavements Research Center (25,000 sq ft)</td>
<td>State-of-the-art facility contains the DoD unique Joint Sealant Laboratory and an Automated Data Acquisition System for acquiring rheological data on creep, strength, resilient moduli, and fatigue of a variety of paving materials.</td>
</tr>
<tr>
<td>Materials Testing Center</td>
<td>Full-service, state-of-the-art laboratory for conventional and specialized soil, rock, concrete, asphalt, and aggregate testing.</td>
</tr>
<tr>
<td>Soils Research Center (10,000 sq ft)</td>
<td>The largest soil mechanics research facility in DoD, it has a loading capability of 250,000-lb on triaxial specimens up to 15 inches in diameter. Also included are direct shear devices for 3 to 24 inch specimens, automated consolidometers and rock-testing capabilities including anchor pullout tests.</td>
</tr>
<tr>
<td>Mass Construction Materials Laboratory (20,000 sq ft)</td>
<td>A concrete research and development laboratory for determining physical, chemical, and mineralogical properties of concrete and other construction materials as well as the structural response of subscale models.</td>
</tr>
<tr>
<td>Full-Scale Aircraft Loading Facility</td>
<td>Simulates aircraft loading with different wheel loads and gear geometry applied to full scale constructed test pavements; response and performance data for development of new design and behavior theories; current fighter and transport aircraft simulators.</td>
</tr>
<tr>
<td>Projectile Penetration Facility</td>
<td>Unique to DoD, this facility enables investigation of anti-penetration shielding technology techniques employing geologic and manmade structural materials against a wide variety of threats. An 83-mm diameter gas gun has the capability of launching projectiles with masses up to 2.8kg at velocities in excess of 2km/sec and launching projectiles with masses of 12kg at velocities of 1km/sec.</td>
</tr>
<tr>
<td>Coastal Facilities</td>
<td>Approximately 400,000 sq ft under roof for 3-D high-precision coastal experiments. Contains over 850-ft of spectral wave generators (including a 90-ft long Directional Spectral Wave Generator) designed to reproduce waves of 2-ft in height.</td>
</tr>
<tr>
<td>Field Research Facility, Duck, NC (175 acres)</td>
<td>Recognized worldwide for cooperative multinational and multi-agency high precision field experiments in coastal and nearshore processes; 1970-ft concrete and steel pier, 1 mile of beachfront, full suite of installed coastal processes instrumentation, special purpose beach and amphibious vehicles, etc.</td>
</tr>
<tr>
<td>RipRap Experimental Facility</td>
<td>The largest curved channel experimental facility in the world, used for study of effects of channel bendways on flow fields, specifically aimed at developing design criteria for riprap protection of bendways.</td>
</tr>
<tr>
<td>Hydraulic Engineering Experimental Facilities</td>
<td>Approximately 2,500,000 sq ft under roof for high-precision experiments relating to rivers, estuaries, hydraulic structures, and navigation.</td>
</tr>
<tr>
<td>Mobility Instrumentation Facility</td>
<td>30,000 sq ft complex for conducting research and development investigations of cross-country mobility, trafficability, and terrain data acquisition. This research requires complex design and fabrication of real-time data collection and analysis hardware unique to quantifying the performance of all types of wheeled, tracked, and amphibious military vehicles. A 14,000 sq ft annex is optimally structured to support modeling and simulation in distributive interactive simulations and virtual prototyping in support of battlefield automation.</td>
</tr>
<tr>
<td>Aquatic and Wetlands Ecosystem Research Center</td>
<td>10,000 sq ft research center provides the capability to evaluate the impact of DoD activities on aquatic and wetland ecosystems, including impacts on threatened and endangered species, and wetland identification, delineation, and evaluation.</td>
</tr>
</tbody>
</table>
Geophysics Research, Applications, and Test Facility: the most extensive near-surface geophysics
equipment and applications capability in DoD. Specializing in engineering, environmental,
archeological, and groundwater geophysics, the facilities support the DoD requirements for founda-
tion investigations, installation restoration, cultural resource assessments, military groundwater supply,
tunnel detection, and environmental site characterization. In addition, a 15,000 sq ft Engineering
Geophysics Training Facility consisting of metallic and non-metallic targets buried at various depths
and orientations, is used for evaluating geophysical instruments and providing hands-on training with
the equipment.

Centrifuge Research Center: Uniquely large and powerful, the research centrifuge weighs 85 tons
and has a 21-ft radius; it can apply a maximum g-force of 1256 g-tons operating at 350g's for a 2.2
ton payload and at 143g's for an 8.8 ton payload (1g = normal gravity). A 27.5-year event can be
replicated in one day operating at 350g's. Research applications include all areas of civil and
environmental engineering with particular focus on earthquake engineering, coastal engineering,
structural engineering, blast phenomena, and groundwater behavior. Under Secretary of the Army,
the Honorable Robert M. Walker, represented the Secretary of the Army and was the keynote speaker
at the dedication of the Centrifuge Research Center on 20 November 1997.

Mobile Ballistic Research System: provides the DoD with the capability to conduct projectile
penetration field experiments at geologic sites of interest. The truck-mounted, breach-loaded ballistic
gun can launch large-scale (up to 155-mm) projectiles at velocities as high as 1km/sec. Associated
diagnostic instrumentation and analysis hardware are contained within a support trailer.

Geodynamics Research Facility: unique to DoD, this facility houses a wide variety of high-pressure
dynamic devices that simulate explosive loadings under controlled stress states on geologic and man-
made construction materials. The characterization of their material behavior is required for weapons
effects assessment against military fixed assets.
## FY97 FUNDING DATA (MILLIONS $)

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<th>APPROPRIATION</th>
<th>IN-HOUSE</th>
<th>IN-HOUSE MANAGEMENT</th>
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<td>RDT&amp;E:</td>
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</tr>
<tr>
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## MILITARY CONSTRUCTION (MILLIONS $)

| Military Construction (MILCON) | 0.455 |

## PERSONNEL DATA (END OF FISCAL YEAR 1997)

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<th>SCIENTISTS &amp; ENGINEERS</th>
<th>TECHNICAL SUPPORT &amp; OTHER PERSONNEL</th>
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<tr>
<td></td>
<td>DOCTORATES</td>
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## SPACE AND PROPERTY

<table>
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<td>OTHER 48.330</td>
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<td>ACRES 2,812</td>
<td>* Subset of previous category.</td>
</tr>
</tbody>
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NA = Not Applicable
White Sands Missile Range

Abbreviated Functional Chart - Technical Organizations

- White Sands Missile Range
  - Direct Test Support
    - Electronic Proving Ground
    - Office of the National Range Directorate
    - Materiel Test Directorate
    - Directorate of Applied Technology, Test & Simulation
      - Nat'l Range Oper Dir
      - Nat'l Range Develop Dir
      - Dir Of Environ & Safety
MISSION

WSMR’s mission is to provide quality management and operation of the premiere MRTFB with a unique combination of real estate, airspace, instrumentation, laboratories, launch facilities, and technical expertise, to support the RDT&E requirements of the Tri-Services, DoD agencies, other government agencies, commercial entities and foreign governments. Due to the large land mass and controlled airspace, WSMR supports a variety of combat training activities. To support advanced weapons testing, WSMR is a key resource for development of state-of-the-art instrumentation, not only for WSMR, but for the entire MRTFB community. WSMR supports the full range of Command, Control, Communications, and Intelligence (C4I) systems, electromagnetic effects and nuclear environments testing. C4I testing is conducted by WSMR/Electronic Proving Ground (EPG) located at Fort Huachuca, AZ and Fort Lewis, WA. We challenge, enrich, and develop our most precious asset, our human resources, while continuing to improve productivity and quality of life.

CURRENT IMPORTANT PROGRAMS

White Sands Missile Range, including the Electronic Proving Ground, Fort Huachuca, Az., has a variety of equipment, facilities and features that make it a premier test range. These features include: the largest overland test range, WSMR managed restricted airspace and varied terrain features. WSMR also has range instrumentation which includes the Multiple Object Tracking Radar (MOTR), Air Surveillance System, Miss Distance Indicating (MIDI) Radar, WEIBEL Radar, Remote Control Optical Tracking Mounts, Global Positioning System (GPS) and Telemetry and Radar Instrumentation. WSMR has a complete environmental and scientific laboratory suite (including a Microbiological Test Chamber, Large Environmental Test Chamber, Chemistry Lab, Metallurgy Lab, and Dynamics Lab) and Nuclear Effects Testing Facilities such as the Solar Furnace, Electromagnetic Pulse, Linear Electron Accelerator, Electro-magnetic Radiation Effects transmitters and the Large Blast Thermal Simulator. Big Crow is an airborne electronic warfare asset that includes and aircraft and helicopters. WSMR is also the site of the Aerial Cable Range, a three mile cable suspended from two mountain peaks. The Smart Munitions Test Suite allows us to track submunitions. At our Electronic Proving Ground site we operate the Electromagnetic Environment Test Facility using computer modeling/simulation, C4I, hardware-in-the-loop and controlled field test environment. We also operate the System Interoperability Computer Software Test Facility, the Realistic Battlefield Frequency Measurement Environment Facility, the EMI/EMC/Tempest Transverse Electromagnetic/Reverberation Chamber and operate the Antenna Test Measurement Facility. EPG has a 12,000 foot paved runway and numerous paved and unimproved UAV runways. EPG is also the site of the only beacon testing facility in the United States licensed to test and approve for certification commercial emergency rescue beacons.
**FY97 FUNDING DATA (MILLIONS $)**

<table>
<thead>
<tr>
<th>APPROPRIATION</th>
<th>IN-HOUSE MANAGEMENT</th>
<th>OUT-OF-HOUSE</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>RDT&amp;E:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.1 ILIR</td>
<td>0.000</td>
<td>NA</td>
<td>0.000</td>
</tr>
<tr>
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<tr>
<td>6.2</td>
<td>0.710</td>
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<td>3.782</td>
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<td>4.119</td>
<td>9.089</td>
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<tr>
<td>6.7</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Non-DOD</td>
<td>24.813</td>
<td>46.684</td>
<td>71.497</td>
</tr>
<tr>
<td><strong>TOTAL RDT&amp;E</strong></td>
<td><strong>192.136</strong></td>
<td><strong>84.119</strong></td>
<td><strong>276.255</strong></td>
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<tr>
<td>Procurement</td>
<td>13.653</td>
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<tr>
<td>Operations &amp; Maintenance</td>
<td>5.535</td>
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<td>Total</td>
<td>214.122</td>
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<td>303.395</td>
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**MILITARY CONSTRUCTION (MILLIONS $)**

- Military Construction (MILCON): 0.000

**PERSONNEL DATA (END OF FISCAL YEAR 1997)**

<table>
<thead>
<tr>
<th>TYPE</th>
<th>SCIENTISTS &amp; ENGINEERS</th>
<th>TECHNICAL SUPPORT &amp; OTHER PERSONNEL</th>
<th>END STRENGTH</th>
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<tbody>
<tr>
<td></td>
<td>DOCTORATES</td>
<td>OTHER</td>
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<tr>
<td>MILITARY</td>
<td>2</td>
<td>8</td>
<td>418</td>
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<tr>
<td>CIVILIAN</td>
<td>12</td>
<td>606</td>
<td>1,630</td>
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<tr>
<td>TOTAL</td>
<td>14</td>
<td>614</td>
<td>2,048</td>
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</table>

**SPACE AND PROPERTY**

- **BUILDING SPACE (THOUSANDS OF SQ FT):**
  - LAB: 1,870.620
  - ADMIN: 957.528
  - OTHER: 1,568.209
  - TOTAL: 4,396.357

- **PROPERTY ACQUISITION COST (MILLIONS $):**
  - REAL PROPERTY: 510.558
  - NEW CAPITAL EQUIPMENT: 0.000
  - EQUIPMENT: 532.033
  - NEW SCIENTIFIC & ENG. EQUIP.: 0.000

**Subset of previous category.**

NA = Not Applicable
Yuma Proving Ground

<table>
<thead>
<tr>
<th>Abbreviated Functional Chart - Technical Organizations</th>
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<tbody>
<tr>
<td>Yuma Proving Ground</td>
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<tr>
<td>Materiel Test Directorate</td>
</tr>
<tr>
<td>Range Support Directorate</td>
</tr>
<tr>
<td>Garrison Directorate</td>
</tr>
<tr>
<td>Cold Regions Test Center</td>
</tr>
</tbody>
</table>
Plan, conduct, analyze and report the results of development and other tests of aircraft weapons, long-range artillery, military vehicles, armored vehicles, tank weapons, munitions of all types and aerial delivery systems (parachutes). YPG also conducts tests of military equipment in the natural desert terrain and environment. YPG has responsibility for natural environment testing at the Cold Regions Test Center (Alaska) and Tropic Test Site (Panama).

CURRENT IMPORTANT PROGRAMS

M1-A1 Abrams Tank.
M-2 Bradley IFV.
Palletized Load System (PLS).
Search and Destroy Armor (SADARM).
Tank Main Armament System (TMAS).
Liquid/Propellant Gun.
C-17 Cargo Aircraft.
Low Altitude Retrorocket Recovery System (LARRS).
OH-58D Kiowa Warrior.
Unmanned Aerial Vehicle Close Range (UAV-CR).
RAH-66 Comanche Target Acquisition Systems.
AH-64D Apache Longbow.
Wide Area Mine (WAM).
SafeAir.
Cold Weather Clothing and Equipment.
<table>
<thead>
<tr>
<th>EQUIPMENT/FACILITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>WEAPONS FIRING CHAMBER:</strong> Capable of testing full-sized combat/tactical vehicles and helicopters, artillery and direct fire systems from -65°F to 160°F with humidity from 5% to 95%.</td>
</tr>
<tr>
<td><strong>WEAPONS ACCURACY RANGE:</strong> The artillery range is sufficiently large to fire all artillery to maximum range and is fully instrumented with radar, multi-camera tracking mounts, telemetry and microwave systems, specially developed instrumented impact fields and communications systems. The aircraft weapons range is specially developed for helicopter armament and instrumented with multiple laser trackers, radars, telemetry video, multi-camera tracking mounts, remote control moving targets, GPS-based moving target tracking system and integrated real-time mission control and data processing center. The aircraft range includes specialty sites for ground mounted tests of aircraft weapons. All range areas are under restricted airspace to a minimum of 80,000 ft.</td>
</tr>
<tr>
<td><strong>AUTOMOTIVE TEST COURSES:</strong> Paved, unpaved, hilly, Middle East, gravel, dust, fording basin, vehicle swimming, dynamometer capability for all Army systems. Complete shop and overhaul capability for Army vehicles and weapons systems.</td>
</tr>
<tr>
<td><strong>AIRCARGO TEST FACILITY:</strong> Army airfield, two (2) runways to 6,000 ft., two (2) hangars, Air Cargo Complex for tests of airdrop systems and airdrop qualification of military systems and ammunition.</td>
</tr>
<tr>
<td><strong>TEST ENVIRONMENT:</strong> Complete environment test capability including 30,000 lb. vibration tables, rain, humidity, dust and other chambers. Laboratory facilities including X-ray, chemical and materials lab.</td>
</tr>
<tr>
<td><strong>NATURAL ENVIRONMENT:</strong> Cold weather, tropic and desert testing.</td>
</tr>
</tbody>
</table>
### FY97 Funding Data (Millions $)

<table>
<thead>
<tr>
<th>Appropriation</th>
<th>In-House</th>
<th>In-House Management</th>
<th>Out-Of-House</th>
<th>Total</th>
</tr>
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<tr>
<td>RDT&amp;E:</td>
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</tr>
<tr>
<td>6.1 ILIR</td>
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<td>NA</td>
<td>NA</td>
<td>0.000</td>
</tr>
<tr>
<td>6.1 Other</td>
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</tr>
<tr>
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<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>6.3</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Subtotal (S&amp;T)</td>
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<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
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<td>0.000</td>
<td>0.000</td>
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<td>6.6</td>
<td>15.234</td>
<td>0.279</td>
<td>81.190</td>
<td>96.703</td>
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<tr>
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<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Non-DOD</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td><strong>Total RDT&amp;E</strong></td>
<td><strong>15.234</strong></td>
<td><strong>0.279</strong></td>
<td><strong>81.190</strong></td>
<td><strong>96.703</strong></td>
</tr>
<tr>
<td>Procurement</td>
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<td>1.695</td>
<td>3.721</td>
</tr>
<tr>
<td>Operations &amp; Maintenance</td>
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<td>NA</td>
<td>4.287</td>
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</tr>
<tr>
<td>Other</td>
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<td>9.889</td>
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<tr>
<td><strong>Total Funding</strong></td>
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<td><strong>0.279</strong></td>
<td><strong>90.508</strong></td>
<td><strong>118.897</strong></td>
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### Military Construction (Millions $)

| Military Construction (MILCON) | 1.500 |

### Personnel Data (End of Fiscal Year 1997)

<table>
<thead>
<tr>
<th>Type</th>
<th>Scientists &amp; Engineers</th>
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<th>Technical Support &amp; Other Personnel</th>
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<td>End Strength</td>
</tr>
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<td>Military</td>
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<td>0</td>
<td>110</td>
<td>110</td>
</tr>
<tr>
<td>Civilian</td>
<td>0</td>
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<tr>
<td>Total</td>
<td>0</td>
<td>123</td>
<td>712</td>
<td>835</td>
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### Space and Property

<table>
<thead>
<tr>
<th>Building Space (Thousands of Sq Ft)</th>
<th>Property Acquisition Cost (Millions $)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAB 28.209</td>
<td>REAL PROPERTY 156.596</td>
</tr>
<tr>
<td>ADMIN 141.199</td>
<td>* NEW CAPITAL EQUIPMENT 28.700</td>
</tr>
<tr>
<td>OTHER 2,075.873</td>
<td>EQUIPMENT 228.655</td>
</tr>
<tr>
<td>TOTAL 2,245.281</td>
<td>* NEW SCIENTIFIC &amp; ENG. EQUIP. 0.601</td>
</tr>
<tr>
<td>ACRES 1,009,403</td>
<td>* Subset of previous category.</td>
</tr>
</tbody>
</table>

NA = Not Applicable
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DEPARTMENT OF THE NAVY
DEPARTMENT OF THE NAVY

The Navy's fifteen (15) In-House RDT&E Activities are:

Naval Aerospace Medical Research Laboratory .................................................. 3-2
Naval Air Warfare Center ..................................................................................... 3-8
Navy Clothing and Textile Research Facility ......................................................... 3-22
Naval Command, Control and Ocean Surveillance Center ................................... 3-26
Naval Dental Research Institute ........................................................................... 3-34
Naval Facilities Engineering Service Center ....................................................... 3-38
Naval Health Research Center ............................................................................. 3-42
Naval Medical Research Institute ...................................................................... 3-48
Naval Medical Research Unit #2 ........................................................................ 3-56
Naval Medical Research Unit #3 ........................................................................ 3-62
Navy Personnel Research and Development Center ......................................... 3-66
Naval Research Laboratory .................................................................................. 3-70
Naval Submarine Medical Research Laboratory ............................................... 3-82
Naval Surface Warfare Center ........................................................................... 3-86
Naval Undersea Warfare Center ......................................................................... 3-98
Naval Aerospace Medical Research Laboratory

Abbreviated Functional Chart - Technical Organizations

Naval Aerospace Medical Research Laboratory

Science & Technology Directorate

Resources Management Directorate
Naval Aerospace Medical Research Laboratory  
Pensacola, FL 32508-1046  
(850) 452-3286  

CO: Captain L.H. Frank, MSC  
Technical Director: Dr. Robert Stanny

<table>
<thead>
<tr>
<th>MISSION</th>
</tr>
</thead>
<tbody>
<tr>
<td>The laboratory’s mission is to conduct research and development in aviation medicine and allied sciences to enhance the health, safety, and readiness of Navy and Marine Corps personnel.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CURRENT IMPORTANT PROGRAMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENHANCED HEARING PROTECTION FOR HIGH-NOISE ENVIRONMENTS: Current hearing protection devices can be inadequate in high-noise operational environments. We have developed and patented a new sound-attenuating technology that significantly improves hearing protection devices and sound attenuation in general. We are determining optimal engineering parameters for the new technology, applying them to hearing protectors and sound-attenuating materials, providing prototype models for formal test and evaluation, and developing design specifications for eventual manufacture.</td>
</tr>
</tbody>
</table>

| NAVAL AVIATION PILOT PREDICTION SYSTEM: This project is (1) centralizing existing training and mishap data for naval aviators from accession through winging and beyond; (2) determining the feasibility of using training and fleet-performance criteria to identify marginal performers; (3) developing predictive models for selection, classification, and review/mishapboard analysis; and (4) developing a networked system for accessing the database and associated predictive models. |

| SPATIAL AWARENESS IN NAVAL AVIATION: We are developing tactile navigation and orientation displays that enhance spatial awareness and reduce operator workload. We have developed displays that pilots and special forces personnel can use to navigate and maintain situational and spatial awareness in the absence of visual information. |

| NAVAL AVIATION SELECTION TOOLS DEVELOPMENT: We have developed an Internet version of the Aviation Selection Test Battery (ASTB) that will improve the Navy/Marine Corps aviator selection process by reducing test administration and maintenance costs, enhancing test security, and providing new opportunities to develop and validate better test items. The paper-and-pencil ASTB is taken by approximately 10,000 examinees annually at over 200 remote sites around the world. This volume of remote testing makes the ASTB an ideal candidate for implementing in a client/server format. |

| LANDING CRAFT AIR CUSHION (LCAC) VEHICLE NAVIGATOR SELECTION SYSTEM: In the late 1980s, LCAC operators and engineers had training attrition rates as high as 40-60%. Consequently, the Naval Safety Center asked us to develop a selection system to reduce this rate. With funding from the Naval Air Systems Command, the revised LCAC selection system was delivered in 1992, and attrition rates dropped to 10-20%. Similar attrition problems among LCAC navigators led to an additional tasking to develop a selection system for this position. A task analysis was completed, and a selection system was developed and validated. Preliminary screening began in May 1996. The final system is in development; a full product will be delivered in October 1998. |

| ATTENTION-DIRECTING FLIGHT INSTRUMENT DISPLAY: All current flight instrument displays require pilots to scan instruments, one after another, and mentally integrate the data to produce flightpath information. We have developed a new technique that integrates flight information in a single display, thus permitting pilots to understand their positions in flight at a glance. The new display reduces time spent on instruments to approximately 15% of that required with traditional displays and almost eliminates routine scanning. |
CURRENT IMPORTANT PROGRAMS (continued)

| UNMANNED AERIAL VEHICLE (UAV) HUMAN FACTORS: | The objective of this project is to characterize the cognitive skills needed to pilot UAVs, and to evaluate human-factors design and interface issues in UAV control systems, panels, and displays. |
| VISUAL SCANNING AS AN INDEX OF PILOT SKILL DEVELOPMENT: | The objective of this project is to develop teaching aids that facilitate the acquisition of instrument-scan patterns by student pilots. |
| NIGHT VISION FOR SPECIAL WARFARE: | We are developing a field-worthy, operationally relevant night vision test that: (1) has known and definable relations to tests in the optometric literature and (2) is predictive of operational performance under a variety of nighttime conditions. |
| VIRTUAL DISPLAYS IN ACCELERATION ENVIRONMENTS: | This basic-research project is characterizing the effects of actual motion on spatial perception and the motor responses of human operators in virtual environments. |
| VESTIBULAR TEST DEVELOPMENT: | The objective of this project is to improve aviation selection and training by developing tests that detect vestibular and other disorders of spatial orientation incompatible with military aviation. |
| SPATIAL ORIENTATION DESIGN AND TRAINING ISSUES: | This project is aimed at improving cockpit design standards by defining relations between control compatibility, pilot spatial awareness, and pilot performance, as well as enhancing pilot performance by developing training programs that incorporate accurate models of sensory-spatial awareness. |
| APPROACHES TO SPATIAL DISORIENTATION: | Our task is to develop basic knowledge and models of systems involved in the control of whole-body motion relative to the earth. Current models are insufficient to predict the perceptual and sensorimotor reactions that occur in complex motion conditions. The ultimate objective is to develop mathematical models that will predict spatial orientation dynamics in complex environments of flight simulators and real flight. |
| SOPITE SYNDROME: | The term Sopite Syndrome was coined to describe the extreme fatigue and drowsiness that can occur in motion and virtual environments. The project entails characterizing basic neurophysiological and behavioral effects of the syndrome, developing fleet recommendations and guidelines, and relating the syndrome to similar maladies, such as Simulator Sickness and Space Adaptation Syndrome. |
| MARINE CORPS FIELD CASUALTY MONITORING/TRACKING SUPPORT: | We are developing a flexible, user-friendly, information-management system for real-time correlation of tactical operations, patients, and echelons 1 through 4 evacuation and treatment resources. The system should improve medical regulating significantly on battlefields of the future. |
| HEALTH RISK APPRAISAL OF NAVAL SPECIAL FORCES PERSONNEL: | The Department of the Navy lacks baseline epidemiological and health data needed to adequately assess and track the health status of naval Special Operations Forces (SOF) personnel. In this project, we are gathering baseline health and health risk factor data on active duty, reserve, and retired naval SOF personnel. |
| PERFORMANCE-BASED OCCUPATIONAL STRENGTH TESTING FOR CANDIDATE NAVY PILOTS/NAVAL FLIGHT OFFICERS: | Goals of this project are threefold: (1) to identify selected strength-critical tasks in the Joint Primary Aircraft Trainer System (JPATS), 2) to replicate those tasks on a strength screening device, and (3) to develop strength enhancement programs that will enable individuals to meet or exceed the strength standards (control force requirements) specified in the JPATS MIL-SPECS. |
The VISION LABORATORY includes a mobile night vision device (NVD) training facility ('NITE Lab') that can be used to train NVD users in the field. The 'NITE Lab' is equipped with numerous NVD demonstrations and training aids as well as optical testing and vision equipment. The laboratory has facilities for recording, digitizing, and mathematically filtering and enhancing visual images. In cooperation with the helicopter training facility at Whiting Field (TRAWING FIVE), the laboratory is able to noninvasively record the instrument scan patterns of pilots flying the motionbased, full-scale helicopter instrument trainer.

The SPATIAL DISORIENTATION LABORATORY capability is a unique national asset consisting of many one-of-a-kind research devices.

The CORIOLIS ACCELERATION PLATFORM (CAP) is the only device worldwide capable of applying combined linear and angular acceleration to the human subject. It is also the only device in the DOD inventory available to study chronic exposure to altered G environments. It uses two, independently controlled power servomechanism drive systems to generate acceleration stimuli caused by rotation about an Earth-vertical axis and/or rectilinear translation along an Earth-horizontal axis. This device has enabled scientists to make accurate simulations of many bizarre combinations of force stimuli and their effects on aerospace crewmen under carefully controlled conditions. Data gathered in various studies using the CAP continue to contribute significantly to the success of the space program and to the safety and well being of astronauts.

The HUMAN DISORIENTATION DEVICE (HDD) can accelerate an instrumented human subject about two head-centered axes simultaneously. It is used to help differentiate the relative roles played by the various sensory systems involved in the production of disorientation, as well as to examine the contribution of each system and subsystem to motion sickness. The HDD is also employed to study the effects of disorientation caused by rotation and tumbling. The HDD differs substantially from the Pate device in that the axes of rotation can be made to pass through the intersection of the interaural and naso-occipital lines. This permits isolating the function and stimulation of specific portions of the organs of balance in the inner ear. The device has provided direct support for many basic and applied research projects sponsored by both the Navy and NASA.

The LINEAR ANGULAR ROTATOR (LAR) is a new, short-arm (6-foot), human centrifuge capable of high rotation speeds (to 80 rpm) and precise, simultaneous, linear movement of the human along the arm. It is located in a large, cylindrical chamber upon which visual stimuli can be projected. The LAR and chamber combination will permit displaying visual stimuli at various distances from the center of rotation, to about 25 feet from the subject. Due to its ability to produce accurate linear and rotational stimuli, the LAR will afford precise measurements of unilateral labyrinthine function, which should lead to improved clinical tests for detecting vestibular abnormalities. Because the device will afford linear and rotational stimuli coupled with near and distant visual stimuli, it will enable studies of visual suppression of vestibulo-ocular reflexes, and of visual information processing under conditions in which target and background stimuli vary in distance and move at different speeds.

The VESTIBULAR VISUAL SPHERE DEVICE (VVSD) is a new device for studying visual-vestibular interactions. The VVSD is a 12-foot sphere that can be rotated about two axes to approximately 29 RPM. A subject seated in the center of the sphere can rotated about two axes to approximately 57 RPM. Visual stimuli displayed on the interior of the sphere yield compelling, visually induced motion illusions. The VVSD permits displaying real, moving stimuli to stationary or moving subjects. Measurements of three-dimensional, visual-vestibular responses should provide gold-standard data for evaluating virtual-reality displays, and for evaluating the effects of these displays on stationary and moving observers. The device will also permit exploring conditions in which the visual suppression of vestibulo-ocular reflexes (hence the ability to track visual targets) is enhanced relative to normal. Findings from these studies should lead to techniques for optimizing information delivery through head mounted displays.
The PENDULAR INERTIAL GRAVITATIONAL (PIG) devices (PIG IA and PIG IB) are fixed on the CAP linear track and are used to position a human subject at various angles off vertical axis while the CAP room is rotated. The PIGs can be oriented in four different directions.

The EQUITEST SYSTEM employs computerized dynamic posturography to systematically examine the effectiveness of visual, vestibular, and somatosensory inputs to balance and the timing, strength, and coordination of postural movements. This permits evaluating visual, vestibular, and somatosensory contributions to equilibrium.

The PATE DEVICE resembles a patient litter and is capable of rotating a subject about the longitudinal body axis and/or the horizontal axis through the pelvis. This apparatus has slip rings, which permit physiological monitoring, and is currently being used to study eye movements in response to rotation or perceived motion generated by moving patterns projected on a hemispheric screen in front of the subject.

The OCULAR COUNTERROLL DEVICE is used to measure ocular counterroll in response to total body tilting movement and provide information on possible changes related to aging.

The OFF-VERTICAL-ROTATOR (OVR) is used to gain measures of semicircular canal and otolith function and related spatial orientation performance.

The PERIODIC ANGULAR ROTATOR (PAR) is a novel servorotator designed for studies of the dynamic response of the vestibulo-ocular system. The PAR is a high-performance motion-inducing instrument that rotates a seated subject about the Earth-vertical axis in a wide variety of stimulus waveforms.

The PSYCHOACOUSTICS LABORATORY includes acoustical test chambers, an ANSI standards compliant Real-Ear Attenuation Test Facility, a semireverberant test chamber for simulating various Navy operational environments, and a high-level noise test chamber. In addition, equipment is available to support analog and digital signal processing, speech analysis, spectral analysis, and radio voice communications monitoring. The psychacoustics laboratory also houses unique equipment for the design, fabrication, and testing of innovative hearing protection devices and sound attenuating materials.

We have three ENVIRONMENTAL CHAMBERS, two of which are in adjacent rooms. One is 8 x 8 ft; the other is 10 x 16 ft. The smaller chamber, used primarily for cold exposure, has active temperature control from -5 to 25 degrees C. The larger room has active temperature control from 0 to 50 degrees C. The third environmental chamber is a free-standing room 8 x 10 ft with precise temperature (0-60 degrees C) and humidity (20-80%) control.

This command has also developed and equipped several MOBILE FIELD LABORATORIES to study the visual, vestibular, and auditory sensory systems. These tests, by virtue of the trailers' mobility, permit our researchers to collect data at training sites, in Navy and Marine Corps operational settings, and on board ships.
### FY97 FUNDING DATA (MILLIONS $)

<table>
<thead>
<tr>
<th>Appropriation</th>
<th>In-House</th>
<th>In-House Management</th>
<th>Out-of-House</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>RDT&amp;E:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.1 ILIR</td>
<td>0.000</td>
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<tr>
<td>6.1</td>
<td>0.671</td>
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<td>0.066</td>
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<tr>
<td>6.2</td>
<td>0.715</td>
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<td>0.135</td>
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<tr>
<td>6.3</td>
<td>0.404</td>
<td>NA</td>
<td>0.041</td>
<td>0.445</td>
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<tr>
<td>Subtotal (S&amp;T)</td>
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<td>6.4</td>
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<td>0.074</td>
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<td>Non-DOD</td>
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<td>NA</td>
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<td><strong>TOTAL RDT&amp;E</strong></td>
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<td>Procurement</td>
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<tr>
<td>Operations &amp; Maintenance</td>
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<tr>
<td>Other</td>
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<td>0.132</td>
<td>0.686</td>
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<td><strong>TOTAL FUNDING</strong></td>
<td><strong>3.145</strong></td>
<td>NA</td>
<td><strong>0.453</strong></td>
<td><strong>3.598</strong></td>
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</table>

### MILITARY CONSTRUCTION (MILLIONS $)

| Military Construction (MILCON) | 0.000 |

### PERSONNEL DATA (END OF FISCAL YEAR 1997)

<table>
<thead>
<tr>
<th>Type</th>
<th>Scientists &amp; Engineers</th>
<th>Technical Support &amp; Other Personnel</th>
<th>End Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Doctorates</td>
<td>Other</td>
<td></td>
</tr>
<tr>
<td>Military</td>
<td>9</td>
<td>2</td>
<td>13</td>
</tr>
<tr>
<td>Civilian</td>
<td>3</td>
<td>8</td>
<td>15</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>12</strong></td>
<td><strong>10</strong></td>
<td><strong>28</strong></td>
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</table>

### SPACE AND PROPERTY

<table>
<thead>
<tr>
<th>Building Space (Thousands of SQ FT)</th>
<th>Property Acquisition Cost (MILLIONS $)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAB 102.900</td>
<td>REAL PROPERTY</td>
</tr>
<tr>
<td>ADMIN 6.700</td>
<td>* NEW CAPITAL EQUIPMENT</td>
</tr>
<tr>
<td>OTHER 10.200</td>
<td>EQUIPMENT</td>
</tr>
<tr>
<td><strong>TOTAL 119.800</strong></td>
<td>* NEW SCIENTIFIC &amp; ENG. EQUIP.</td>
</tr>
<tr>
<td><strong>ACRES 3</strong></td>
<td>* Subset of previous category.</td>
</tr>
</tbody>
</table>
Naval Air Warfare Center

Abbreviated Functional Chart - Technical Organizations

Naval Air Systems Command

Commander East Area Command

Commander NAWCAD

1.0 Program Management

3.0 Logistics

5.0 Test and Evaluation

7.0 Corporate Operations

2.0 Contracts

4.0 Research & Engineering

8.0 Shore Station Management

Commander NAWCTSD

1.0 Program Management

3.0 Logistics

7.0 Corporate Operations

2.0 Contracts

4.0 Research & Engineering

8.0 Shore Station Management

Commander West Area Command

Commander NAWCWD

1.0 Program Management

3.0 Logistics

5.0 Test and Evaluation

8.0 Shore Station Management

2.0 Contracts

4.0 Research & Engineering
Naval Air Warfare Center  
Patuxent River, MD 20670  
(301) 757-7692

Commander NAVAIR: VADM John A. Lockard  
Dep Commander NAVAIR: Dr. Alan Somoroff

MISSION

Our mission is to be the Navy's full spectrum research, development, test and evaluation, engineering, and fleet support center for air platforms, autonomous air vehicles, missiles, weapons and sensors used to conduct air warfare; and to be the principal Navy center for acquisition and product support of training systems.

The Naval Air Warfare Center is composed of three Divisions: The Aircraft, Weapons, and Training Systems Divisions. The Commander of the Training Systems Division reports to the Commander, Aircraft Division who is also designated as the Commander, East Area Command. The Commanders of the Aircraft and Weapons Divisions report directly to the Commander of the Naval Air Systems Command who holds responsibility for the Naval Air Warfare Center activity.

CURRENT IMPORTANT PROGRAMS

EAST AREA COMMAND

AIRCRAFT DIVISION

V-22 Full Scale Development

MV-22 Engineering and Manufacturing Development

F/A-18 E/F Integrated Test Team flew seven Engineering and Manufacturing Development test aircraft (five single seat "E" and two two-seat "F"s). Completed initial carrier suitability sea trials.

F/A-18 E/F Low Production Qualification environmental/special tests completed in Naval Air Warfare Center Aircraft Division Trenton's sea level cells.

F/A-18 Production and Systems Development completed AMRAAM Weapons Separation Flights, AN/ALR-67 (V)3 Gun Fire, CVS catapult/arrested landing flights, ASCIET detachment flight evaluations, ATARS Digital Tape Recorder flight evaluations, ATARS Engineering Development Model (EDM) Data Link flight evaluations, several ALPS certifications, Departure Demonstration Phase I, Centerline Tank Configuration, Improved Fresnel Optical Landing System (IFOLS) flights, JDAM Adjacent Stores Loads/Safe Separation flights, catapult/arrested landings, and began Leading Edge Flap flight evaluation.

F-14 completed Digital Flight Control System (DFCS) training, Tactical Air Reconnaissance Pod System Digital Imaging System (TARPS (DI)), ground and flight tests for carrier suitability and Electromagnetic Compatibility. Completed Low Altitude Navigation/Targeting Infrared For Night (LANTIRN) Targeting System (LTS) for F-14D and F-14B Upgrade.

C-9B/DC-9 (ACAT IVM Program) for avionics upgrades passed Milestone III approval for full rate production review. Initial prototype installation completed.

Joint Strike Fighter (JSF) Flight Demonstrations Program will use Patuxent River as one of its two major test sites in FY 2000. Patuxent River used as primary Modeling and Simulation Facility for entire JSF Program.
CURRENT IMPORTANT PROGRAMS (continued)

Air Combat Environmental Test and Evaluation Facility (ACETEF) designated as JSF prime modeling and simulation site. Completed several Engineering and Manufacturing Development test objectives including clean wing flutter envelope definition, clean wing flight loads survey, clean wing carrier suitability test, Electronic Warfare ground tests (using both the Anechoic Chamber and ACETEF facilities), and Radar Cross Section measurements.

S-3B AWW-13 Data Link POD conducted ground testing of the AWW-13 Data Link POD on a VS-31 S-3B to support fleet demonstration of S-3B control of the Standoff Land Attack Missile (SLAM). Developed the initial loading, release, and control checklist. First Improved Extended Echo Ranging (IEER) system flight test in the S-3B.

ES-3A completed Developmental Testing on the Communications Improvement Program, Link 11, Fleet Issue 4 Software and the new missions systems data loader.


P-3 Maverick Missile completed modification of 17 of the 18 scheduled fleet P-3 aircraft. Separation testing of Maverick from wing stations 11 and 16 was completed.

Standoff Land Attack Missile (SLAM) completed separation testing of SLAM from wing stations 11, 13, 14, & 16.

ASUW Improvement Program (AIP) rapidly progressing toward independent Operations Testing after completing 244 flight hours dedicated to Developmental Testing & Joint Developmental Testing/Operational Testing. Demonstrated improved ASUW capabilities.

EP-3 Special Sensor Improvement Program (SSIP) completed Phase I of DT IIIB for first production. SSIP aircraft and associated software under budget and on schedule.

AIRCRAFT SYSTEMS AND TACTICAL AIRCRAFT SYSTEMS:

ELECTRONIC WARFARE:
TACAIR EW Electro-Optics and Infrared R&D Electronic Research, EW Development.

ANTI-SURFACE WARFARE:
Undersea Warfare Advance Technology, ASW System Development.

TECHNOLOGY BASE:
### CURRENT IMPORTANT PROGRAMS (continued)

#### TRAINER PROGRAMS:

#### AIR LAUNCH RECOVERY EQUIPMENT (ALRE):
Electromagnetic Aircraft Launch Systems (EMALS), Radfale Aircraft Support.

#### COMMON SUPPORT EQUIPMENT (CSE):
Standard Engine Test Systems (SETS), Universal Jet Air Start Unit (UNIJASU), Consolidated Automatic Support System (CASS).

#### OTHER:
Vessel Tracking System, Propulsion/Materials exploratory and advanced development product support, targets and simulators for air-launched systems, threat simulator development, operation of land and sea ranges.

### TRAINING SYSTEMS DIVISION

#### RESEARCH AND TECHNOLOGY
Instructional Technology, Simulation Technology, Tactical Decision Making Under Stress, Embedded Training Technology, Deployable Training, Virtual Environment Training Technology, Sensor Simulation, Weapons Teams Simulation (including work for the National Institute of Justice), Scenario Development, Training Effectiveness Assessment Methodology, Transportable Strike/Assault Rehearsal Systems, Live Fire Test Program, SBIR, Distributed/Joint Training, and Technology Transfer including the following Cooperative Research and Development Agreements (CRADAs):

- Commercialization of Simulation Technology: Investigate the commercialization of military technology for entertainment applications.
- Firearms Training Systems for Commercial Applications: Application of research methods to demonstrate and evaluate firearms training systems for commercial applications.
- Transportability of Flight and Simulation Software To Digital Equipment Company (DEC) Equipment: Demonstrating and evaluating the probability of simulation software to DEC equipment in support of Distributive Interactive Systems (DIS).
- Network Interface Unit for DIS: Collaborate on DIS projects.
- Prototype Training Systems Using Low Cost PC Based Image Generator Technology: Jointly develop and assess rapid prototypes of training systems using P10, a PC-based image generator and supporting software.

### MARINE CORPS GROUND PROGRAMS
### CURRENT IMPORTANT PROGRAMS (continued)

#### AVIATION


#### SURFACE


#### UNDERSEA


#### WEAPONS DIVISION

**Weapons systems Test and Evaluation:**
- AMRAAM, HARPOON, JDAM, JSOW, SLAM, SPARRROW, Standard Missile, and Tomahawk.

**Weapons System Integration:**
- EA-6B Aircraft, AH-1W Aircraft, F-14 Aircraft, F/A-18 Aircraft, JSF.

**Weapons Systems:**
- Evolved Sea Sparrow (ESSM), Gator, HARM, HARPOON, HELLFIRE, JDAM, Phoenix, SLAM ER, Rolling Airframe Missile (RAM), Sidewinder, Tomahawk, Penguin.

**Electronic Warfare and Information Warfare Systems:**

**Other:**
- Crew systems; Parachutes; materials research, Propulsion/materials exploratory and advanced development product support, Targets and simulators for air-launched systems, Threat simulator development; warheads; fuzes; insensitive munitions; TAMPS; aircraft survivability; sensor systems; laser/optical systems; nuclear safety; guidance & control systems; foreign military sales support; operation of land and sea ranges for RDT&E and fleet training.
EAST AREA COMMAND

AIRCRAFT DIVISION

Patuxent River Station, MD:
Facilities include: Chesapeake Test Range, Manned Flight Simulator, Air Combat Environmental Test and Evaluation Facility (ACETEF), Antenna and Avionics Test Facility, Electronics Systems Test Facility, Landing Systems Test Facility, Catapult and Arresting Facility, Ship Ground Station, RDT&E hangars, aircraft maintenance facilities, catapult launch system, landing systems test facility, automatic carrier landing system, marine air traffic control, range EW and flight radar cross-section facility, aircraft electrical and environmental evaluation facility, helo-ship data link evaluation, EW integrated systems test lab, anechoic chamber, electromagnetic environmental effects facility, EW closed loop facility, target support facility, solar radiation facility.

FACILITIES ASSOCIATED WITH THE NAWCAD PATUXENT RIVER COMPONENT

Aircraft Electrical Evaluation Facility (AEEF) - Provides RDT&E on aircraft electrical systems.

Aircrew Systems Test Facility - Provides RDT&E of aircraft life support systems.

Aircraft Stores Certification Facility - Provides T&E of fixed and rotary wing aircraft/armament compatibility.

Flight Control Computer Test - Part of ACETEF Manned Flight Simulator System.

Integrated Aircraft Test Laboratory - Provides for DT&E of avionics systems into tactical aircraft, and supports technology demonstrator aircraft.

Aircraft Support Systems Test Facility - Conducts DT&E of fixed-wing and rotary wing command and peculiar support equipment (SE).

Airborne Strategic Communication Engineering and Test (ASCET) Facility - DT&E and system engineering function for Navy Airborne Strategic Communications aircraft and mission systems.

E-2C Systems Test and Evaluation Laboratory (ESTEL) - DT&E and system engineering on Navy Airborne Early Warning aircraft and mission systems.

Helicopter Missions Systems Support Center (HMSSC) - Provides DT&E support of mission systems for maritime rotary wing and VTOL aircraft.

Fixed Wing ASUW & ASW Lab - Design, test and evaluation of operational hardware and software for S-3 and P-3 aircraft.

Project Beartrap Facility - Support avionics systems in the fleet units assigned to CNO Project K-416 (Project Beartrap).

ACETEF (Air Combat Env T&E Facility) - A fully integrated ground RDT&E facility - full spectrum evaluation of highly integrated aircraft and systems.

C7 Catapult, MK7 Arresting Gear and Take-Off Assist Fac - Shore based tests to determine structural and functional capabilities of a/c for operations aboard a/c carriers.
Landing System Test Facility (LSTF) - Supports air traffic control, approach, and landing systems.

Propulsion System Evaluation Facility - Perform RDT&E of aircraft propulsion systems and their components and accessories.

Ship Ground Station - Supports DT&E between ship and air mission elements of helicopters, fixed-winged maritime and UAVs.

A/C Armament Sys Simulation Eng Est Station - Analyze the compatibility of the interface between aircraft and stores.

EW/Avionics Flight Test Facilities - Part of Atlantic Range's Chesapeake Test Range (EW systems performance and RC measurements).

Antenna Testing Lab Automated System (ATLAS) - Conduct in-flight antenna measurements and analysis of antenna systems (part of ESTF).

Aircraft Test and Evaluation Facility (ATEF) - DT&E of installed aircraft subsystems and controlled environmental during static and engine operating conditions.

Electro-Optical & RECCE System Test Facility - DT&E of weapon systems on electro-optic (EO) and reconnaissance (REECE) systems.

Combat Identification Data Analysis Center - DT&E and systems engineering of identification systems (part of ESTF).

Ground Range Antenna Test Fac (GRATF) - Conduct ground range antenna radiation pattern measurements on aircraft antennas (part of ESTF).

Acoustic Test Facility (ATF) - Supports laboratory and flight test evaluations of ASW Acoustic Sensor Processing and software programs.

Communication Tests and Evaluation Lab (COMTEL) - Integrated communication and information data links/antenna system (part of ESTF).

Surveil and Topographical Analysis Radar System Lab - T&E of airborne surveillance, weather, and topographical analysis radar systems (part of ESTF).

Communications Facility - Provide communication support for range instrumentation of the Chesapeake Test Range.

Telemetry Data Center - Receive, record, process, and display data telemetered from test vehicles.

Aircraft Modification & Instrumentation Facility - Aircraft instrumentation, modification, and prototyping for RDT&E Flight Programs.

NAWCAD Pax Riv/NASA Wallops/Key West/Solomons Island - Target Support Facilities - Aerial, ship and other target support for Atlantic Range.

T&E Data Processing (Software and Applications) - Real-time and post-flight analyses and reduction of test data.
### EQUIPMENT/FACILITIES (continued)

#### ADDITIONS - NAWCAD PATUXENT RIVER COMPONENT

**Acoustic Sensor Development Lab** - RDT&E of airborne acoustic sensors and data acquisition systems.

**Aerodrome** - RDT&E aircraft hangar facilities, maintenance, runways and air operations.

**Air Interoperability Center** - Integrated ACETEF with the other laboratories and facilities at Patuxent River.

**Air Vehicle R&D Laboratory** - Conduct research and development for naval airframes and air vehicle subsystems.

**Aircraft RDT&E Tower** - Mounting aircraft right side up or upside down, in an electromagnetic free space environment.

**Anechoic Chamber** - Provides secure, no-echo test environment for single tactical-sized aircraft system simulation.

**Anechoic Chamber; Large** - Provides secure, no-echo test environment for multi-system simulation (large/multiple a/c).

**Anechoic Chambers** - Three anechoic chambers provide for scaled antenna and radar cross section measurements.

**Antenna RDT&E Tower** - Long range antenna RDT&E facility.

**Chesapeake Test Range (CTR)** - Synergistic full-spectrum RDT&E for a/c systems tech, flyingquals, propulsion, avionics and a/c-ship interfaces.

**Computer R&D Laboratory** - Conduct research and development of aircraft computer and supporting system hardware.

**Ejection Tower** - RDT&E of ejection seats, restraint systems, or the injury potential of any man-mounted equipment.

**Electronic Systems Test Facility (ESTF)** - Provides ground and flight RDT&E for the full range of communications systems.

**Electronics Sensor R&D Laboratory** - Conduct research and development of EW, EO, IR, and RF sensors.

**Horizontal Accelerator** - Used for the verification and validation of aviator’s equipment performance as part of their quals before fleet introduction.

**Hydraulics Research Lab** - Provides developmental testing of naval aircraft hydraulic components.

**Navy Aircraft Materials** - RDT&E Facility - Provides materials RDT&E for naval aircraft and the ocean environment.

**Navy IFF T&E Lab** - Provides systems engineering and T&E of identification systems (part of ESTF).
NAWCAD Lakehurst Outdoor Aero-propulsion Test Site (OTS) - Variable attitude uninstalled engine facility.

Propulsion Systems Evaluation Facility (PSEF) - RDT&E of small scale engines, engine accessories, fuels and lubrication systems.

Ship and Shore Electronic Systems RDT&E Facility - Provides RDT&E for ATC system, ID system, SPECWAR, communication, shipboard data link & systems external communication.

Technical Info Dept Television Production Facilities - Provides mission-related VI technical documentation (video) and VI technical reports.

Technical Information Department Photographic Laboratory - Provides ground and aerial photographic and video services to NAWCAD, NAS, and tenant activities.

V-22 Electronic System Test Lab (VESTL) - Provides development testing facility to playback flight history of parameters on multi-function displays.

Vertical Flight Laboratory - Provides RDT&E of Helo fleet avionics and software products.

VH Facility (HS-2) - Verifies and validates VH avionics hardware and software in a controlled environment.

VP Program Hardware Integration Center (PHIC) - Provides hardware support for the P-3C aircraft.

VP Software Development and Support Facility - Computer program generation facility that supports mission software used by the P-3C aircraft.

VS Software Development and Support Facility - Provides development and life cycle support for the S-3A/B Weapon System software.

FACILITIES AT NAWCAD/NAES LAKEHURST SUBORDINATE ORGANIZATION

Steam Catapult Complex - RDT&E on catapult systems (C-13 MOD0, C-13 MOD2), and components, conduct ISE investigations, evaluate aircraft compatibility.

Runway Arrested Landing Site - RDT&E on arresting gear systems and comp (MK7 MOD2/MOD3, E-28); conduct ISE investigations, evaluate aircraft compatibility.

Jet Blast Deflector Site - RDT&E on shipboard JBD systems and components; conduct ISE investigations, evaluate aircraft compatibility.

Test Runway - 12K ft runway dedicated to a/c launch and recovery equipment (ALRE) and Visual Landing Aids (VLA) system, evaluate aircraft compatibility.

Jet Car Tracks (3) - Develop arresting systems in safe environment, aircraft barricade tests, ISE investigations; evaluate aircraft compatibility.

Elevated Fixed Platform/RAST - RDT&E for helo RAST systems, develop and evaluate aircraft tie-downs and helo securing and traversing systems.

Universal Lighting Pad - RDT&E of VLA configuration for helos; evaluate aircraft tie-downs and helo securing and traversing systems.
### Support Equipment Mobility Site
Development and prototype evaluation of wheeled, shipboard ground support equipment (SE).

### Prototype Manufacturing Facility
RDT&E prototype facility for ALRE and SE; manufacturing facility for flight critical ALRE components.

### Automatic Test Equipment Software Center
CASS/common ATE software support active, develop P31 for CASS systems software; support in-service SE software.

### Environmental Test Lab
Simulate shipboard environmental conditions for ALRE and SE development and evaluations.

### Electromagnetic Interference Test Facility
Simulate shipboard electromagnetic interference conditions for ALRE & SE development and evaluations.

### Product Development Lab
ALRE and SE engineering design and development and system integration, support ISE investigations.

### Component Analysis Lab
ALRE-SE EI of mechanical/metallurgical failures; component/material quality validation.

### ADMACS/ISIS Facility
RDT&E, mock-up and evaluate shipboard configuration for ISIS, aviation data management control system & AWMS.

### Electro-Optics Lab
Develop and test electro optical tracking, infrared imaging, and laser based equipment for ship VLA & LSO systems.

### Power Lab
Evaluate electro-magnetic launcher components and subsystems.

### Photometrics Lab
Photometric/radiometric measurements for ALRE VLA systems and product development; evaluate VLA compatibility with NVG.

### Visual Landing Aids Lab
RDT&E of new VLA concepts and VLA design codes; conduct ISE investigations for VLA systems.

### Aircraft/Weapons Compatibility Lab
Provide aircraft carrier deck cycle, maximum density and operational spotting analysis for ship/aircraft compatibility.

### Wind Measuring Instrumentation (WM) Lab
RDT&E and product improvements for WMI systems; ISE investigations.

### Metrology and Calibration Lab
Provide calibration of mechanical and electronic devices used in ALRE and SE development.

### Data Handling Center
Analyze and archive shipboard and ground-based launch and recovery data.

### Landing Guidance Development Facility
Develop advanced landing guidance systems and simulate performance with advanced hardware and man in the loop.

### Gyroscopic Test Stand (part of OTS)
Test full-scale propulsion systems to demonstrate aircraft engine operability under simulated conditions.
EQUIPMENT/FACILITIES (continued)

Variable Attitude Test Stand (part of OTS) - Test aircraft engineer operations under variable conditions.

Turntable Test Stand (part of OTS) - Test aircraft engines rotated through positions showing various profiles.

Parachute/Drop Zone - Support joint service parachute jump and cargo drop training.

Trenton, NJ:
Facilities include: large and small engine altitude test area, large engine sea level test cells, rotor spin facility, fuel and lubricants facility, helicopter transmission test facility.

TRAINING SYSTEMS DIVISION

Facilities at the Naval Air Warfare Center Training Systems Division Orlando, Florida consist of a three building complex located on 40.5 acres of Navy owned land in the Central Florida Research Park, adjacent to the University of Central Florida. This modern complex is the result of a $23.5M FY 85 Navy MILCON project that the organization occupied in mid-1988. The facility totals 298,020 square feet of office and laboratory space, cafeteria, conference and meeting rooms, a high bay area, and HVAC/mechanical complex along with several acres of paved parking. In addition, NAWCTSD occupies approximately 19,563 square feet of administrative and storage space as a tenant elsewhere in the Orlando Navy complex and nationwide at the 43 field site locations.

WEAPONS DIVISION

MISSILE ENGAGEMENT SIMULATION ARENA (MESA): MESA is used by all services to evaluate and verify interactions between air vehicle targets and missile sensors for determination of missile lethality, air-vehicle survivability, measurement of end-game properties, and development of new anti-air weapons to meet evolving threats.

MISSILE AND AIRCRAFT WEAPON SOFTWARE SUPPORT ACTIVITIES (WSSA):
NAWCWPNS uses specially equipped laboratories to support weapon system integration onto aircraft, independent software verification, validation and performance testing, and provides the unique capability to integrate weapon systems to platforms at a single site.

EXPLOSIVES & PROPULSION LABORATORIES: A complex of laboratories which provides facilities for research in the fundamentals of propellant and explosives technology.

FULL-SCALE SURVIABILITY & VULNERABILITY FACILITY: This facility provides the capability to test and evaluate the vulnerability and lethality of air systems through full-scale, live-fire testing and computer simulations.

FUZE AND SENSORS LAB: Provides consolidated engineering laboratory space for air-to-air, air-to-surface, and surface-to-air, and fuze and sensor research, development, test and evaluation in direct support of NAWCWPNS assigned programs.
**EQUIPMENT/FACILITIES (continued)**

**RADAR CROSS-SECTION MEASUREMENT FACILITY:** The Junction Ranch Radar Cross-Section Measurement facility is used to measure radar cross-sections of low-observable vehicles.

**INFORMATION & ELECTRONIC WARFARE (I&EW) SYSTEMS LABORATORIES:** The various NAWCWPNS I&EW systems laboratories provide life-cycle support for airborne EW systems, including warning receiver, jammer, EO/IR, missile-warning, countermeasures, and support systems; software support for the EA-6B aircraft as well as for prime multiplatform EW systems; and system engineering support, including system design and integration, development of information systems, and fleet system software upgrades for warning, jamming, and decoy systems.

**ELECTRONIC COMBAT RANGE CAPABILITIES:** At the Electronic Combat Range, NAWCWPNS provides a free-space laboratory for engineering support, testing, analysis, training, and development of systems and technologies that counter or penetrate air defenses. These capabilities are essential to full-spectrum electronic warfare system testing.

**HARDWARE-IN-THE-LOOP SIMULATIONS:** Extensive simulation capabilities supporting weapons design and development include six-degree-of-freedom (6 DOF) hardware-in-the-loop (HWIL) facilities.

**AIR WARFARE EVALUATION FACILITY:** A 121,000 sq. ft. missile system evaluation laboratory which can perform secure missile-in-the-loop seeker-performance testing under simulated operational conditions and against high-fidelity target presentations.

**MISSILE & AIRCRAFT SOFTWARE VALIDATION & TESTING LABORATORIES:** Laboratories are available to support independent software verification, validation and performance testing.

**WEAPON SYSTEM INSTRUMENTATION & DATA ANALYSIS:** These facilities support instrumentation requirements related to tactical missile, aircraft, and other product testing areas. The data analysis laboratories provide near-real-time data extraction and evaluation for timely assessment of aircraft/weapon integration and missile system performance.

**RANGE CAPABILITIES:** The air, land, and sea ranges and test facilities contain 1,700 square miles of dedicated land, underlying more than 17,000 square miles of restricted air space, and 36,000 square miles of sea test range with overlying air space.

**OTHER SPECIAL CAPABILITIES:** Specialized facilities are used for electronics research leading to complete life-cycle support of fire-control systems, guidance-and-control systems for missile weaponry, sensors, and fuzes. In addition, NAWCWPNS has unique capabilities provided by its EO/IR laboratories, anechoic chambers, strategic-systems propulsion test facilities, complete photographic laboratory, and a large industrial machine shop.
### FY97 FUNDING DATA (MILLIONS $)

<table>
<thead>
<tr>
<th>APPROPRIATION</th>
<th>IN-HOUSE</th>
<th>IN-HOUSE MANAGEMENT</th>
<th>OUT-OF-HOUSE</th>
<th>TOTAL</th>
</tr>
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<tbody>
<tr>
<td>RDT&amp;E:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.1 ILIR</td>
<td>3.377</td>
<td>NA</td>
<td>NA</td>
<td>3.377</td>
</tr>
<tr>
<td>6.1 Other</td>
<td>2.330</td>
<td>NA</td>
<td>4.784</td>
<td>7.114</td>
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<tr>
<td>6.2</td>
<td>29.522</td>
<td>NA</td>
<td>48.266</td>
<td>77.788</td>
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<tr>
<td>6.3</td>
<td>34.747</td>
<td>NA</td>
<td>29.386</td>
<td>64.133</td>
</tr>
<tr>
<td>Subtotal (S&amp;T)</td>
<td>69.976</td>
<td>NA</td>
<td>82.436</td>
<td>152.412</td>
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<tr>
<td>6.4</td>
<td>93.531</td>
<td>NA</td>
<td>64.683</td>
<td>158.214</td>
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<tr>
<td>6.5</td>
<td>165.392</td>
<td>NA</td>
<td>137.419</td>
<td>302.811</td>
</tr>
<tr>
<td>6.6</td>
<td>205.520</td>
<td>NA</td>
<td>181.184</td>
<td>386.704</td>
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<tr>
<td>6.7</td>
<td>151.446</td>
<td>NA</td>
<td>112.119</td>
<td>263.565</td>
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<tr>
<td>Non-DOD</td>
<td>0.084</td>
<td>NA</td>
<td>0.248</td>
<td>0.332</td>
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<tr>
<td>TOTAL RDT&amp;E</td>
<td>685.949</td>
<td>NA</td>
<td>578.089</td>
<td>1,264.038</td>
</tr>
<tr>
<td>Procurement</td>
<td>317.368</td>
<td>NA</td>
<td>1,515.704</td>
<td>1,833.072</td>
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<tr>
<td>Operations &amp; Maintenance</td>
<td>340.582</td>
<td>NA</td>
<td>320.391</td>
<td>660.973</td>
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<tr>
<td>Other</td>
<td>55.439</td>
<td>NA</td>
<td>98.678</td>
<td>154.117</td>
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<tr>
<td>TOTAL FUNDING</td>
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<td>2,591.564</td>
<td>4,064.824</td>
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</table>

### MILITARY CONSTRUCTION (MILLIONS $)

| Military Construction (MILCON) | 0.253 |

### PERSONNEL DATA (END OF FISCAL YEAR 1997)

<table>
<thead>
<tr>
<th>TYPE</th>
<th>SCIENTISTS &amp; ENGINEERS</th>
<th>TECHNICAL SUPPORT &amp; OTHER PERSONNEL</th>
<th>END STRENGTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>MILITARY</td>
<td>4</td>
<td>215</td>
<td>2,434</td>
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<tr>
<td>CIVILIAN</td>
<td>238</td>
<td>5,240</td>
<td>8,579</td>
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<tr>
<td>TOTAL</td>
<td>242</td>
<td>5,455</td>
<td>11,013</td>
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### SPACE AND PROPERTY

<table>
<thead>
<tr>
<th>BUILDING SPACE (THOUSANDS OF SQ FT)</th>
<th>PROPERTY ACQUISITION COST (MILLIONS $)</th>
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<tbody>
<tr>
<td>LAB 6,391.720</td>
<td>REAL PROPERTY</td>
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<tr>
<td>ADMIN 3,031.092</td>
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<td>OTHER 15,042.288</td>
<td>EQUIPMENT</td>
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<tr>
<td>TOTAL 24,465.100</td>
<td>* NEW SCIENTIFIC &amp; ENG. EQUIP.</td>
</tr>
<tr>
<td>ACRES 1,145,213</td>
<td>* Subset of previous category.</td>
</tr>
</tbody>
</table>

NA = Not Applicable
Navy Clothing and Textile Research Facility

Abbreviated Functional Chart - Technical Organizations

- Clothing and Textile Research Facility
  - Dress Clothing
  - Protective Clothing
  - Systems Evaluation & Engineering
  - Technical & Logistical Management
MISSION

Conduct research, development, test and evaluation and provide engineering support in clothing, textiles, and related fields associated with service clothing and environmental protective clothing.

CURRENT IMPORTANT PROGRAMS

1. Joint Services Lightweight Integrated Suit Technology Pre-Planned Product Improvement which is a joint service program to upgrade garments which will be protective in chemical-biological contaminated environments and can be used in one form or another by all services.

2. Shipboard Protective Clothing Program is designed to provide state-of-the-art, commercially available, firefighter’s protective clothing, flame resistant utility uniforms, anti-exposure suits, cold and wet weather ensembles and life-support systems and equipment for Navy personnel which meet appropriate performance requirements for the shipboard environment. Performance requirements/testing procedures are developed at NCTRF to enable commercial products to be qualified through NCTRF laboratory testing and Fleet evaluation. Testing includes conformance to standards and Navy unique requirements designed to analyze the protective capabilities of materials and clothing.

3. Electrochemical Compressor - New technology to power a personal microclimate cooling system which will result in lower weight and more efficient cooling capacity.

4. Phase Change Materials - New technology which will be used to extend the range of comfort for individuals exposed to warm and cold environments, as well as to enhance the performance of protective clothing. This technology can also be useful to the private sector.

5. A CRADA has been established between NCTRF and Batelle, Natick Operations for the purpose of furthering technologies of mutual interest for utilization in protective clothing and equipment.

EQUIPMENT/FACILITIES

Major equipment and facility capabilities include:

A thermal manikin system is used to measure insulation values of protective clothing in both an air and water immersion environment. This is one of only four known manikins worldwide capable of being used in both water and air; the thermal hand and thermal foot are used to measure insulation values of handwear and footwear, respectively. Worldwide, there are only three other known thermal hands and one other known thermal foot; the environmental test chambers reproduce extremes from 0F to 130F at 5% to 95% relative humidity, with wind speeds up to .5 to 15.7 mph. The hydro-environmental simulator is the only known chamber within the Navy that is able to independently control both air and water temperatures simultaneously, and thus simulate any air/water interface. A Gerber Micromark/Silhouette computer-aided design system to grade, alter, and trace patterns, and to cut hard patterns; a shipboard laundry laboratory; a thermal flammability laboratory; physiological test and evaluation equipment. Instron testers, weatherometers, fadeometers, launderometer, tear tester, etc., used to determine the physical characteristics of clothing and textiles. A traversing thermocouple instrumented manikin, used to evaluate fire resistant protective clothing at variable heat flux levels and exposure times, when exposed to a propane-fueled fire in an enclosed area.
Navy Clothing and Textile Research Facility  
Natick, MA 01760-0001  
(508) 233-4172  

Officer in Charge: CDR D. R. Smith  
Technical Dir: Barbara A. Avellini, Ph.D.

### FY97 FUNDING DATA (MILLIONS $)

<table>
<thead>
<tr>
<th>Appropriation</th>
<th>In-House</th>
<th>In-House Management</th>
<th>Out-Of-House</th>
<th>Total</th>
</tr>
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<tbody>
<tr>
<td>6.1 ILIR</td>
<td>0.000</td>
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<td>6.1 Other</td>
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<td>Subtotal (S&amp;T)</td>
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<td>6.5</td>
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<td>0.000</td>
<td>NA</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Non-DOD</td>
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<td>NA</td>
<td>0.000</td>
<td>0.040</td>
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<tr>
<td><strong>Total RDT&amp;E</strong></td>
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<td><strong>NA</strong></td>
<td><strong>0.361</strong></td>
<td><strong>1.691</strong></td>
</tr>
<tr>
<td>Procurement</td>
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<td>NA</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Operations &amp; Maintenance</td>
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<tr>
<td>Other</td>
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<td>0.071</td>
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<td><strong>Total Funding</strong></td>
<td><strong>2.862</strong></td>
<td><strong>NA</strong></td>
<td><strong>1.254</strong></td>
<td><strong>4.116</strong></td>
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### MILITARY CONSTRUCTION (MILLIONS $)

| Military Construction (MILCON) | 0.000 |

### PERSONNEL DATA (END OF FISCAL YEAR 1997)

<table>
<thead>
<tr>
<th>Type</th>
<th>Scientists &amp; Engineers</th>
<th>Technical Support &amp; Other Personnel</th>
<th>End Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>MILITARY</td>
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<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CIVILIAN</td>
<td>1</td>
<td>13</td>
<td>44</td>
</tr>
<tr>
<td>TOTAL</td>
<td>1</td>
<td>14</td>
<td>45</td>
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### SPACE AND PROPERTY

<table>
<thead>
<tr>
<th>Building Space (Thousands of SQ FT)</th>
<th>Property Acquisition Cost (MILLIONS $)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAB 12.667</td>
<td>REAL PROPERTY 9.478</td>
</tr>
<tr>
<td>ADMIN 16.000</td>
<td>* NEW CAPITAL EQUIPMENT 0.400</td>
</tr>
<tr>
<td>OTHER 5.630</td>
<td>EQUIPMENT 2.803</td>
</tr>
<tr>
<td>TOTAL 34.297</td>
<td>* NEW SCIENTIFIC &amp; ENG. EQUIP. 0.228</td>
</tr>
</tbody>
</table>

NA = Not Applicable
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Naval Command, Control and Ocean Surveillance Center

Abbreviated Functional Chart - Technical Organizations

Naval Command, Control and Ocean Surveillance Center

NCCOSC RDT&E Division
- Navigation and Applied Sciences Department
- Command and Control Department
- Fleet Engineering Department
- Surveillance Department
- Communications and Information Systems Department
- NRaD Activity, Pacific

NCCOSC ISE East Division
- Air Traffic Control, Environmental Effects, & Integration of C4I Systems
- Communications Systems Department
- Command and Control Systems Department
- Intelligence & Information Warfare (I2W) Systems Engineering Department

Navy Management Systems Support Office

Technical departments only. Staff offices and business departments not shown.
Naval Command, Control and Ocean Surveillance Center  
San Diego, CA 92147-5088  
(619) 524-7014  
Director: Paul Wessel  
Deputy Cmdr: CAPT T. R. Brown  

MISSION  
To be the Navy's full-spectrum research, development, test and evaluation, engineering, and fleet support center for command, control and communication systems and ocean surveillance—and the integration of those systems which overarch multi-platforms. Leadership areas:  
- Command, Control and Communication Systems  
- Command, Control and Communication Systems Countermeasures  
- Ocean Surveillance Systems  
- Command, Control and Communication Modeling and Analysis  
- Ocean Engineering  
- Navigation Support  
- Marine Mammals  
- Integration of Space Communication and Surveillance Systems  

CURRENT IMPORTANT PROGRAMS  
Global Command and Control System.  
Global Positioning System.  
Joint Maritime Command Information System (JMCIS).  
High Frequency Management System (HFMS).  
Navy Tactical Command Systems Afloat (NTCS-A).  
Contingency Theater Air Planning System (CTAPS).  
Operations Support System (OSS).  
Relocatable Over the Horizon Radar (ROTHER).  
Ship Automated Communications and Control System (SACCS).  
IT-21.  
Base Level Information Infrastructure (BLII).  
Joint Tactical Information Distribution System.  
Link 16/Link 11.  
Multifunction Information Distribution System.  
SHF/EHF/UHF Satellite Communications.  
Submarine Communications.  
Tactical Receive Equipment (TRE)/TRE Related Applications.  
Theater Missile Defense.  
Air Traffic Control (ATC).  
Environmental Effects Prediction.  
T-AGS 60 Class Project.  
Navy Tactical Command System-Afloat.  
Fixed Surveillance Systems.  
Tactical Support Center/TSC Communications.  
Mobile-Miniature Operations Control Center (MOCC).  
Naval Modular Automated Communications Systems (NAVMACS II ASHORE).  
Universal Protocol Translator (UPT).  
Maritime Air Operations Center (MAOC).  
Naval Satellite Control Station (NSCS) Interface Unit (NIU).  
OSIS Baseline Upgrade (OBU).  

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CURRENT IMPORTANT PROGRAMS (continued)

Modular maintenance systems including Strategic Systems Programs (SSP)
Marine Corps Security, and depot level repair and manufacture of C41 systems
Intelligence and Information Warfare Systems
INFOSEC Systems (EIP, AMODSM, SOVR, and Electronic Key Management Systems)

Technology Transfers, RDT&E Division (no personnel currently assigned to firms or institutions):

<table>
<thead>
<tr>
<th>Company</th>
<th>Title/Work Being Done</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bien Logic</td>
<td>Planet Earth - Next Generation Home Page</td>
</tr>
<tr>
<td>Conductus</td>
<td>Hybrid Thin Film CMOS/Supeconducting Circuits</td>
</tr>
<tr>
<td>Environmental Tech Group</td>
<td>Naval Simulation Systems (NSS) Cooperative Development</td>
</tr>
<tr>
<td>Grumman</td>
<td>Excimer Laser Materials Processing</td>
</tr>
<tr>
<td>HI Space Center</td>
<td>Undersea Acoustics &amp; Multi-Mode Source Technology</td>
</tr>
<tr>
<td>Lockheed Sanders</td>
<td>HDR Ship to Ship &amp; Ship to Shore Communications</td>
</tr>
<tr>
<td>Loral</td>
<td>Metal Composite Coating</td>
</tr>
<tr>
<td>LuminOre</td>
<td>NCCOSC RDTE DIV AHA Software Development</td>
</tr>
<tr>
<td>Marketpath Corporation</td>
<td>SOS Display Technology</td>
</tr>
<tr>
<td>Optron Systems</td>
<td>Tether Development Project</td>
</tr>
<tr>
<td>Perry Technologies</td>
<td>UTOSOS for Display Applications</td>
</tr>
<tr>
<td>Proxima</td>
<td>Microwave CMOS Micromachined Sensors</td>
</tr>
<tr>
<td>RF Microsystems</td>
<td>3-D Volumetric Display System</td>
</tr>
<tr>
<td>RGB &amp; NEOS</td>
<td>Oil Spill Alarm System</td>
</tr>
<tr>
<td>Spectragram</td>
<td></td>
</tr>
<tr>
<td>UNISYS Govt. Systems Group</td>
<td>Parallelization of High Order Languages</td>
</tr>
</tbody>
</table>

Technology Transfers, ISE East Coast Division (2 personnel currently assigned):

<table>
<thead>
<tr>
<th>Company</th>
<th>Title/Work Being Done</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scientific Research Corporation</td>
<td>Explore Development of a Set of Modular Automation Hardware and Software Components</td>
</tr>
</tbody>
</table>

EQUIPMENT/FACILITIES

AN/GPN-27 RADAR SITE (BLDG 3104): An Air Traffic Control (ATC) Airport Surveillance Radar (ASR-8) which provides modification and standardization testing.

ANTARCITC SUPPORT LAB (BLDG T-12): Provides support for Antarctic systems.

ATC LAB AND TESTING FACILITY (BLDG 3442): Provide capability for test of air traffic control systems and support the Emergency Communications System (ECS) Flight Data Input/Output (FCIC), UHF/VHF Program, and houses a FM repeater.

ATC SOFTWARE SUPPORT LAB (BLDG T-6): Provides geo processing and air traffic control software support for ISEA systems.

ATC SYSTEMS SUPPORT LAB (BLDG 3440): Provides CDM support to NAVAIR ATC systems and provides airfield lighting control testing.

AUTOMATED FUEL HANDLING (AFH) (BLDG 3137): Provides software development and hardware integration for the Defense Logistics Agency's Automated Fuel Handling Equipment (AFHE) program. Facility also provides PITCO.

CODE 74 ELECTRONIC SECURITY SYSTEMS (BLDG 22430): Engineer/re-engineer electronic security systems.
COMMAND AND CONTROL FACILITY (ST. INGOES BLDG 185): Contains systems engineering, development, test and evaluation capabilities.

COMMAND SSO AND CMS FUNCTIONS (BLDG 3415): Dual usage facility housing SSO and CMS.

Cryptographic Repair Facility supports all Navy cryptographic equipment worldwide.

CRYPTOLOGIC AND INTELLIGENCE SYSTEMS: Provide INFOSEC engineering design guidance, certification and accreditation testing, TEMPEST testing, and Non-Development Item testing of systems. Support to various systems included Tier 1, Tier 2, Mission Computer Upgrade, High Performance Computer Modernization Office, Joint Tactical Combat Training Systems (JTCTS), Cooperate Engagement Capability (CEC), and Embeddable INFOSEC Product (EIP).

CRYPTOLOGIC QUICK REACTION LAB (BLDG 3411): SCIF hardware/software development and testing, systems integration for special operating forces and quick reaction.

DEPOT FACILITY (NORFOLK BLDG EMC): Depot level repair and manufacture of C41 systems. E3: Simulation and test laboratories to support EMC, EMI, and RADHAZ efforts. MIL-STD 461D test enclosure for development of test procedures and applications to directly support the analysis and resolution of fleet EMI problems.

ENGINEERING/LAB FACILITY: Multiple-use facility comprising office space, video teleconferencing laboratory and shock and vibration testing. Provides mock-up capability for integration of MISSI and other network security products such as Firewalls, Standard Mail Guards, Fortezza, etc. Provides capability for test, evaluation and integration of Navy cryptographic equipment. Also, houses a comprehensive TEMPEST test facility, NKMS deployment facility and INFOSEC ISEA capability.

ENVIRONMENTAL TESTING: Environmental test equipment to support temperature, humidity, altitude, shock, vibration, salt spray, etc. testing.

ESS TOWER: Tower for test and evaluation of electronic surveillance sensors. Fleet Maintenance Agent TSTP Lab providing in-service maintenance engineering, design analysis, and evaluation of satellite navigation systems, automated communications equipment, and message processing distribution systems.

FLEET TACTICAL COMMUNICATIONS FACILITY (NORFOLK BLDG 1555): Provides shipboard communications, equipment and test beds, which are linked to various other labs and test beds by land lines, fiber optic cables, data links and other forms of secure communications, and which allow design, fabrication, assembly, testing, and certification of communication interface units and special communications applications. This facility includes RF equipment consisting of HF, VHF, UHF, and SHF transmitters, receivers and associated antenna systems.

INFOSEC LABS (BLDG 3113): Lab 6 provides a comprehensive TEMPEST test facility, Tier 2 test facility, EKMS deployment facility, and the INFOSEC ISEA capability. In addition, provides capability for test, evaluation and integration of Navy cryptographic equipment. Lab 5 provides mock-up capability for integration of network security products such as Firewalls, Mail Guards, Fortezza, etc.

INTEGRATED VIDEO SYSTEMS (IVS) (BLDG T-8): Facility houses two video systems for ISEA and IRF purposes.

ST INGOES BLDG 125 closed due to organizational realignment.
INTEGRATION LAB FACILITY (BLDG 3112): Multi-purpose facility housing project/support areas, SCIF and conference center.

INTEL LINK/VTC/NMFO (BLDG 3400): SCIF classified Internet/video teleconferencing/contracting.

IW ENGINEERING AND INTEGRATION WAREHOUSE (BLDG 3113): Multiple use facility comprising office space, video teleconferencing laboratory and shock and vibration testing.

IW EXPLOIT SYSTEMS LBFT (BLDG 3410): LBFT/COTS/MDI support facility. Also, hardware/software development and testing, systems integration of IW exploit systems.

METEROLOGY CALIBRATION LABORATORY (BLDG 450): Specialized facility for electronic and mechanical calibrations.

METOC FACILITY (BLDG 3443): Navy unique test facility for Meteorological and Oceanography (METOC) systems such as ASOS, METFAC, MRS and NEXRAD. Microelectronics Laboratory for the manufacture of products unavailable commercially.

MODULE MAINTENANCE FACILITY (MMF): Serves as a third level maintenance activity for SSP. MMF comprises laboratory, shops and classroom areas. Work performed includes electronic, electrical, optical and mechanical maintenance, upgrades and ISEA support for DOD security systems. Utilized for fiber optic repair and training for arms, ammunition and explosive (AA & E).

NAVAL TACTICAL COMMAND SUPPORT SYSTEMS ENGINEERING TEST FACILITY (NORFOLK BLDG 183): Contains shipboard configurations for SNAP III, SNAP I and II, NALCOMIS with fiber optic and copper LANs with interconnection to other JMCIS labs at St. Juliens Creek Annex. Also, incorporates the Radio Wireline Interface (RWI) Labs.

NAVIGATION SYSTEMS LABORATORY (NORFOLK BLDG 1558): Provides test beds for NAVSSI, conventional navigation, aircraft alignment, inertial navigation and RLGN programs.

Outboard Calibration Facility: the only West Coast signal generation site designed to provide controlled stimulus to calibrate direction finding capability on OUTBOARD ships.

PRECISE TIME AND TIME INTERVAL (PTTI) FACILITY (NORFOLK BLDG 165): Cesium beam frequency and time standards are repaired and maintained on-line.

RADAR OPERATIONAL FACILITY (BLDG 3446): A mock-up air traffic control facility which serves as an interim repair depot for ATC equipment.

RADIAC STANDARDIZATION AND CALIBRATION FACILITY (BLDG 3414): Houses an AN/UDM-1 Calibration Range using Cesium 137 source, the Navy’s prime standard for gamma radiation; an ANUDM-7 Calibration using Plutonium 239, the Navy’s prime standard for alpha radiation instrument calibration; and a MX-9335 Fast Neutron Range, the Navy’s prime standard for Neutron radiation indication and computation instrument calibration. In addition to these standardization systems, this building houses a RADIAC calibration laboratory.

RADIAC TEST AND EVALUATION FACILITY (BLDG 3413): Navy unique test facility of concrete masonry slab on grade construction with special 30-inch thick concrete wall panels housing various high level ionizing radiation sources and environmental test chambers.
### EQUIPMENT/FACILITIES (continued)

Research, Evaluation and Systems Analysis (RESA) Facility: a large-scale computer-based simulation/wargaming system used to support a variety of applications including C3I architecture assessment, concept of operations development, advanced technology evaluation, joint exercises, and test and evaluation of advanced systems.

**RF COMMUNICATIONS TOWER:** Provides air traffic control communications capabilities.

SEOC/TDC/C4I DATA RESOURCES (NORFOLK BLDG 171): Lab provides special C4I configuration to allow flag officer shore based participation in sea exercises. Ship Antenna Model Range includes ground planes, model ships, track, towers, control systems, test equipment, and data reduction computers allowing simulation and modeling of ship communications.

**SHIP COMMUNICATIONS LAB (NORFOLK BLDG 277):** Facility provides a joint base for SACC software development and maintenance and ROTHR software configuration management.

**SHORE AUTOMATED COMMUNICATIONS CONTROL SYSTEM LAB (BLDG 3450):** Established Shore Remote Control System (SRCS) testing and diagnostic laboratory which provides technical assistance to operational commands worldwide. Developing Automated Network Control Center/Automatic Technical Control (ANCC/ATC) and Automatic Digital Multiplexing System (ADMS) maintenance and diagnostic laboratory. Provides Pre-Installation, Test, and Check-out (PITCO) support for USCG installations.

**SHORE COMMUNICATIONS SYSTEMS CENTER (NORFOLK BLDG 166):** Contains operational secure communications interconnected to provide integrated systems and fleet support for Shore Secure Voice, Ship Secure Voice (Single Auto Systems) and SHF Baseband subsystems. Direct land line and on-the-air connectivity to the active Naval Communications Networks enhance Secure Voice ISEA capability by providing end-to-end system validation, remote technical assistance worldwide, development and test of field changes, and design of subsystem interface elements.

Simulated Ships Motion Facility (SCORSBY); large ship motion simulators with the capacity to accommodate navigation systems weighing up to 3,000 lbs. Designed to apply controlled roll, pitch, and heading motions to new technology navigation systems.

**SOFTWARE DEVELOPMENT/SPECIAL OPERATING FORCES (BLDG T-5):** Software development lab. Southern California communications networking test range that maintains and controls sites at Pt. Mugu, San Nicolas Island, San Clemente Island, Seal Beach, and NRaD, SD, for use in multiforce communications testing and support of west coast fleet exercises.

Surveillance Test and Integration Center (STIC): an RFI-shielded vault that can receive and process data from various sources through on-line communications.

**Tactical Systems Support Complex:** a Sensitive Compartmented Information facility supporting electronic support measures systems.

**USMC ELECTRONIC SECURITY SYSTEM (ESS) SUPPORT (BLDG T-2):** Houses lab and engineering repair, training and technical data of ESS/USS DOLPHIN (AGSS 555), a unit of Submarine Development Group One, used for research and development of advanced sonar equipment and systems.

**VTC/JMCIS/IXS LAB (NORFOLK BLDG 167):** JMCIS AE and ISEA lab for test and design of new tech life cycle support, configuration management and exercise support.
### FY97 FUNDING DATA (MILLIONS $)

<table>
<thead>
<tr>
<th>APPROPRIATION</th>
<th>IN-HOUSE</th>
<th>IN-HOUSE MANAGEMENT</th>
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### MILITARY CONSTRUCTION (MILLIONS $)

| Military Construction (MILCON) | 0.000 |

### PERSONNEL DATA (END OF FISCAL YEAR 1997)

<table>
<thead>
<tr>
<th>TYPE</th>
<th>SCIENTISTS &amp; ENGINEERS</th>
<th>TECHNICAL SUPPORT &amp; OTHER PERSONNEL</th>
<th>END STRENGTH</th>
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### SPACE AND PROPERTY

<table>
<thead>
<tr>
<th>BUILDING SPACE (THOUSANDS OF SQ FT)</th>
<th>PROPERTY ACQUISITION COST (MILLIONS $)</th>
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<tr>
<td>LAB 1,886.000</td>
<td>REAL PROPERTY 208.000</td>
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<tr>
<td>ADMIN 929.000</td>
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NA = Not Applicable
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Naval Dental Research Institute

Abbreviated Functional Chart - Technical Organizations

- Applied Laboratory Science Department
- Applied Science Department
- Resource Management Department
- NDRI Detachment Bethesda
MISSION

To research, develop, test, and evaluate new methods and materials that limit oral disease, reduce dental emergencies, maximize operational readiness, and promote dental wellness for Navy and Marine Corps personnel.

CURRENT IMPORTANT PROGRAMS

1. Test rapid chairside risk assessment tests for dental caries (patent pending), advanced prototypes completed with Editek, Inc.

2. Develop rapid chairside oral disease risk assessment tests (two patents pending), advanced prototype manufacture underway with Devaron Inc. Develop use of fluorescence polarization as technique for rapid diagnosis (NDRI patent pending) with Jolley Consulting and Research Inc.

3. Test system and apparatus to remove mercury from dental waste water (two patents pending). Industrial mercury recovery compound adapted for dental use with Nalco, Inc. Begin evaluation of battlefield/afloat system applications.

4. Develop radiographic system to identify dental disease progression, human testing initiated.

5. Evaluate the Navy-Wide managed dental care delivery system.

6. Collect and analyze dental epidemiologic data.

7. Develop multimedia dental diagnostic and treatment system for forward remote site use, prototype complete.

8. Develop multimedia dental examiner calibration system.

9. Develop improved patient tracking/data collection with Smart card and optical mark recognition.

10. Develop rapid non-invasive salivary assays for presence of antibodies to tuberculosis and other infectious diseases.

11. Test salivary levels of bis-phenol A associated with oral resin systems in collaboration with National Institute of Dental Research (NIDR).


13. Collect and analyze operational dental emergency data.


15. Develop techniques for dental materials fracture analysis/prediction with National Institute of Standards and Technology (NIST).

16. Evaluate new periodontic and endodontic treatment techniques, equipment, and materials.
**EQUIPMENT/FACILITIES**

<table>
<thead>
<tr>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>44,235 square feet AAALAC-accredited animal colony.</td>
</tr>
<tr>
<td>A comprehensive dental research library, numerous volumes and journals with direct MEDLINE access.</td>
</tr>
<tr>
<td>Extensive computer and data processing facilities.</td>
</tr>
<tr>
<td>Direct access to large military populations and the Navy's only Recruit Training Center.</td>
</tr>
<tr>
<td>Direct access to the American Dental Association, three university dental schools, two large VA hospitals, a large Naval Hospital, a major Naval Dental Center, and the headquarters of nearly 50 leading dental organizations.</td>
</tr>
<tr>
<td>A gas chromatography microbial identification system.</td>
</tr>
<tr>
<td>Numerous other state-of-the art equipment.</td>
</tr>
<tr>
<td>Direct access to the National Institute of Dental Research, National Library of Medicine, the National Institute of Standards and Technology, and National Institutes of Health (NDRI Bethesda Detachment).</td>
</tr>
<tr>
<td>Atomic Absorption Spectrometer.</td>
</tr>
<tr>
<td>Co-located with U.S. Army Dental Research Detachment.</td>
</tr>
<tr>
<td>Total facility capacity = 75,000 sq. ft.</td>
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**DOD IN-HOUSE RDT&E ACTIVITIES REPORT FY97**

**Navy**

**Naval Dental Research Institute**
Great Lakes, IL 60088-5259
(847) 688-5647

**Commanding Officer:** CAPT Gordon K. Jones, DC

**Chief Scientist:** Dr. Lloyd G. Simonson

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**FY97 FUNDING DATA (MILLIONS $)**

<table>
<thead>
<tr>
<th>APPROPRIATION</th>
<th>IN-HOUSE</th>
<th>IN-HOUSE MANAGEMENT</th>
<th>OUT-OF-HOUSE</th>
<th>TOTAL</th>
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<tr>
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**MILITARY CONSTRUCTION (MILLIONS $)**

| Military Construction (MILCON) | 0.000 |

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**PERSONNEL DATA (END OF FISCAL YEAR 1997)**

<table>
<thead>
<tr>
<th>TYPE</th>
<th>SCIENTISTS &amp; ENGINEERS</th>
<th>TECHNICAL SUPPORT &amp; OTHER PERSONNEL</th>
<th>END STRENGTH</th>
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**SPACE AND PROPERTY**

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<tr>
<td><strong>TOTAL 35.260</strong></td>
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**ACRES** | 0 |

NA = Not Applicable

3-37
Naval Facilities Engineering Service Center
Port Hueneme, CA 93043-4328
Commanding Officer: CAPT Donald G. Morris
Business Mgr.: Robert N. Cordy

MISSION
Delivers specialized facilities engineering and technology products and services in Shore, Ocean and Waterfront Facilities, Environment, Amphibious and Expeditionary Operations, Energy and Utilities. Provides solutions to problems through engineering, design, construction, consultation, test and evaluation, technology implementation, and management support.

CURRENT IMPORTANT PROGRAMS

EQUIPMENT/FACILITIES

Deep Ocean Simulation Laboratory - This is the largest facility of its kind on the West Coast. It contains 12 pressure vessels capable of simulating the deep ocean environment under controlled conditions. It is used for certifying fleet hardware and support technology validation and testing.

Shallow Water Dive Tank - A 30-ft diameter, 65,000 gallon seawater tank for testing oceanographic equipment, diver construction techniques, diver tools and underwater non-destructive technical (NDT) equipment.

Motor Vessel Independence - A 200-ft vessel outfitted to support ocean engineering research and undersea equipment validation testing. The Independence has an A-Frame well and crane system for installation and retrieval of underwater systems.

Research Support Vessel (RSV) - A 50-foot nearshore vessel outfitted to support diving operations and oceanographic equipment testing and operations.

Remotely Operated Underwater Vehicle (ROV) - A 2000 foot capable ROV system which includes a PHANTOM vehicle, control van, handling system and experienced operating crew. May be deployed from shore or onboard surface vessels.
<table>
<thead>
<tr>
<th>EQUIPMENT/FACILITIES (continued)</th>
</tr>
</thead>
</table>

**Advanced Waterfront Technology Test Site (AWTTS)** - A half-scale 160' foot test pier with removable deck sections for testing constructability and durability (under constant stress) of waterfront construction and repair materials and systems in a corrosive marine environment. Decks can be statically loaded up to 300,000 lbs. Embedded instrumentation facilitates monitoring performance of structural components. Supports testing programs for the USA CERL, USA WES, Composites Institute and the CERF.

**Linear Cable Engine (LCE)** - Cable deployment system for 8000 lbs. line pull at a maximum line speed of 500 ft/min.

**Environmental Control Systems Fabrication and Test Laboratory** - This facility supports breadboard through prototype fabrication and T&E operations. A chemical analytical laboratory for environmental engineering support is contained within the same complex.

**High Temperature Pavements Test Facility** - Controlled high temperature blast facility, which simulates the jet blast of an aircraft auxiliary power unit. Used to test concrete mixtures from the effects of blasts from F-18s, B-1s and AV-8Bs.

**Cable Survivability Test Flume** - 100-ft by 50-ft by 3-ft deep salt water tank provides survivability testing of full-sized seafloor cabling in a flowing water environment.

**Seawater Test Facility** - Test site for development, test and evaluation of seawater desalination equipment and expeditionary water treatment devices for production of potable water.

**Crash Fire Rescue Vehicle Test Facility** - Controlled performance testing of AFFF delivery systems for crash trucks. Test facility is extensively used by the USAF Vehicle maintenance training School.

**Cold Test Chamber** - Environmental chamber for testing equipment down to -50 degrees.

**Battery Laboratory** - This facility supports testing and evaluation of batteries for Deep Submergence Rescue Vehicles under simulated ocean conditions in conjunction with the pressure vessels of the Deep Ocean Simulation Laboratory. Large battery chargers, load banks, cell monitoring voltage scanners and electrolyte handling equipment are used to conduct tests on silver-zinc batteries for the Navy.

**Flexor Test Stand** - Computer controlled test rig capable of applying cyclical test loads of up to 300,000 lbs. for dynamic barge loading tests of Flexor Pontoon connectors.

**Fiber Optics Laboratory** - A 2000 sq. ft facility with temperature controlled cleanrooms for preparing glass optical fibers for precision optical measurements.

**Geotechnical Modeling Test Facility** - The only Navy facility for controlled testing involving dragging of implements through soils at metered rates for monitoring soil behavior. The facility is used for testing model anchors, site assessment tools, cable plows, and other implements for penetrating the seafloor.
### FY97 FUNDING DATA (MILLIONS $)

<table>
<thead>
<tr>
<th>APPROPRIATION</th>
<th>RDT&amp;E:</th>
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### MILITARY CONSTRUCTION (MILLIONS $)

| Military Construction (MILCON) | 0.912 |

### PERSONNEL DATA (END OF FISCAL YEAR 1997)

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<tbody>
<tr>
<td></td>
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<tr>
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<tr>
<td>CIVILIAN</td>
<td>22</td>
<td>327</td>
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<td>327</td>
<td>226</td>
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### SPACE AND PROPERTY

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<thead>
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<th>BUILDING SPACE (THOUSANDS OF SQ FT)</th>
<th>PROPERTY ACQUISITION COST (MILLIONS $)</th>
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<tr>
<td>LAB 68.000</td>
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<td>EQUIPMENT 8.700</td>
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<tr>
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</tr>
<tr>
<td>ACRES 10</td>
<td>* Subset of previous category.</td>
</tr>
</tbody>
</table>

NA = Not Applicable
**MISSION**

The Mission of the Naval Health Research Center is: To plan, direct and execute research, development, test, and evaluation programs to enhance the operational readiness, health and safety of Navy and Marine Corps personnel.

**CURRENT IMPORTANT PROGRAMS**

The R&D mission at Naval Health Research Center addresses three programmatic areas. For updated information on all NAVHLTRSCHCEN programs please visit the Programs/Publications section of our Homepage at: http://www.nhrc.navy.mil/

1. **Human Performance Department** - The smaller force structure, coupled with constantly evolving mission and tactical requirements, makes it imperative that each warfighter be at peak operational readiness. This program focuses on optimizing Navy and Marine Corps operational performance through assessment of personnel performance and quantification of mission stressors that negatively influence mission success. The research includes controlled laboratory studies and studies in which researchers deploy to training locations. These research teams are widely recognized for excellence in conducting research meeting critical Fleet and Corps requirements and insuring rapid technology transfer.

   **Environmental Extremes** - With a worldwide theater of operations, Navy and Marine Corps personnel operate in environments that can substantially degrade performance. This research quantifies the effects of exposure to environmental stressors (e.g., heat, cold, g-forces) and identifies, develops, and evaluates countermeasures to performance degradation. Marine Corps and Naval Special Warfare (SEAL) cold weather operations are a core area of research.

   **Special Operations** - Recognizing the unique requirements of Naval Special Warfare and Marine Corps Special Operations Capable personnel, this program focuses on effectively enhancing mission performance under the most arduous of operational conditions. The program is strongly user oriented, with special operations personnel involved extensively in all steps of the research process.

   **Protective Equipment Evaluation** - Protective equipment designed to safeguard personnel in hazardous environments often places substantial physiological strain on the individual. Understanding the complex interaction of protection from the environment and the resulting impact on physiology and performance is critical to developing interventions that enhance personnel safety and operational capability.

   **Physical Readiness Standards** - This program established the Navy’s physical readiness and body fat standards. While work has continued in this area, it has expanded to encompass occupation specific, gender neutral standards that will lead to enhanced operational readiness for Navy and Marine Corps personnel.

   **Occupational and Exercise-related Injuries** - These injuries have a substantial negative impact on manpower availability, cost, and combat readiness. The research focuses on identifying prevalent risk factors for musculoskeletal injury, evaluating the efficacy of rehabilitation modalities, and injury prevention. A new area of investigation incorporates cutting-edge technologies using tissue metabolism markers to predict those at increased risk of injury, thus enhancing personnel safety and reducing the burden on the medical care system.
CURRENT IMPORTANT PROGRAMS (continued)

2. Medical Information Systems & Operations Research Department:

Medical Decision Support: Systems are developed that integrate information from multiple sources to generate indices and displays for reducing information overload and facilitating rapid responses during crises.

Occupational Health Management: Methods are developed to provide occupational safety and health managers improved capability to plan and execute environmental inspections, better identify high risk conditions, and project the cost of occupational illness and injury.

Theater Medical Information: Systems are designed to capture medical information in an operational theater, compile the information needed to support the continuity of care, project the impact on medical resources, and improve medical situational awareness.

Telemedicine: Information is gathered and analyzed to assess the impact of telecommunication technology on clinical care and medical readiness in remote operational environments.

Medical Readiness Modeling and Simulation: Models and simulations are developed to project patient load in deployed operational environments, to manage the handling of casualties, and to estimate the impact on medical resources.

Operator State Modeling: Psychophysiological (e.g., electroencephalographic, eye tracking) and behavioral data are used to model states of drowsiness and cognitive overload in order to develop real-time cognitive monitoring technologies. These technologies are central to human performance optimization.

Interpersonal Violence: Data related to victimization and perpetration of aggression are collected to develop treatment, prevention, and intervention programs associated with health-care utilization.

3. Health Sciences & Epidemiology Department:

Shipboard Health Studies - Survey data are provided by men and women serving aboard ship. Shipboard Medical Departments provided information regarding sick call visits, availability of supplies, pregnancy rates; reproductive health; stress; lifestyle factors; self-reported occupational exposures; and self-reported health conditions. These programs provide decision support for shipboard health care policy.

Persian Gulf War Unexplained Illness - Currently, 7 research studies of Gulf War veterans and their families are being conducted in the areas of hospitalizations, symptoms, exposures, physical performance, infertility, and pregnancy outcomes.

Global Surveillance for Emerging Illnesses - As the U.S. Navy Node of the DoD Global Surveillance and Response Program for Emerging Illnesses, NHRC is conducting epidemiologic studies of a number of pathogens which cause emerging illnesses. Active surveillance currently includes studies of the epidemiology of Streptococcus pyogenes, Streptococcus pneumoniae, Mycoplasma pneumoniae, Chlamydia pneumoniae, Bordella pertussis, adenovirus, and Ureaplasma urealyticum.

Respiratory Disease Epidemiology - This research area focuses on the epidemiology of respiratory disease in military populations, particularly in populations of trainees with a high aggregation of susceptible individuals.

Health Promotion - Addresses the Navy’s need to reduce health risks and associated health care costs. Current work focuses on the effectiveness of interventions for weight management, smoking cessation, and alcohol abuse rehabilitation.
Suicide and Mental Illness - NHRC maintains a casualty record database for Navy and Marine Corps suicides since 1983. The primary objective of this research area is to provide epidemiologic information relevant to prevention programs that are targeted to military populations.

Musculoskeletal Overuse Injury Prevention Research - Goals: 1) determination of the operational, fiscal, and personal impact of musculoskeletal injury in training and operational forces; 2) development of predictive profiles for injury susceptibility; and 3) development, implementation and evaluation of interventions to reduce the incidence and negative impact of these injuries.

Alcohol Misuse Prevention Research - Goal: 1) develop a cognitive-behavioral intervention program to reduce heavy drinking among junior Marine Corps personnel and promote responsible attitudes toward alcohol use, with a particular emphasis on behavior during deployments; 2) develop complementary training programs for senior enlisted and officers aimed at deglamourizing alcohol use; and 3) measure the effectiveness of intervention programs using hard outcome measures, as well attitudes and behavioral intentions.

Sexually Transmitted Disease and Unplanned Pregnancy Prevention Research - Develop cognitive skills building interventions to reduce the high-risk behaviors associated with STD acquisition and unplanned pregnancy in operational military populations. This research area includes a program in HIV which is defining the epidemiology of HIV in military populations and includes molecular subtyping of HIV strains to pinpoint likely locations of acquisition of HIV infection.

HIV Central Registry - NHRC maintains the Navy HIV Central Registry, a computerized database devoted to the study of the acquisition of, and clinical course of HIV infection. The HIV Central Registry contains extensive demographic and career history information for all active-duty Navy and Marine Corps personnel tested for HIV.

Epidemiologic Research Database Development - The primary resource for hospitalization studies is the Career History Archival Medical and Personnel System (CHAMPS) Research Database which a computerized medical (inpatient events) and career history database that provides extensive information for Naval epidemiologic occupational health research. This longitudinal database includes information for Navy enlisted personnel dating back to 1973 and is currently being expanded to include Navy officer and Marine Corps personnel.
Occupational and Environmental Physiology Laboratory:
This 8000 square foot facility, built in 1997, provides a unique ability to address operational issues rapidly and, when required, under operational conditions. The state-of-the-art equipment in the laboratory was selected to ensure high mobility and multifunction capability. Enhanced mobility allows researchers to set up temporary, yet fully operational, laboratories on site at Fleet and Marine Corps facilities, both in CONUS and OCONUS. The laboratory's proximity to the West Coast Fleet maximizes technology transfer to the Fleet and Marine Corps operational forces. A satellite laboratory for cold-weather and altitude studies is maintained at the Marine Corps Mountain Warfare Training Center, Bridgeport, CA.

Equipment:
- Thermal physiology: two environmental chambers with temperature ranges of -20° to 180° F; humidity 20-85%, each capable of holding three treadmills for exercise studies; immersion tank allowing whole-body exposure to water between 45° and 110° F.
- Swim flume: one of the worlds largest swim flumes allows studies of immersion in static water or swimming in moving water (up to 4 knots) at temperatures between 45° and 90° F. The proximity of the flume to the environmental chambers allows research on serial wet-dry exposures such as those encountered during special operations or littoral warfare.
- Biomechanics: force plates for motion and ground reaction forces, electromyography, kinesthesiology, electrogoniometry, accelerometry, 3-D motion analysis system.
- Biochemistry laboratory: basic clinical and hormonal chemistries; tissue sample preparation and analyses.
- Body composition: anthropometry, bone densities (dual energy x-ray absorptometry [DEXA]), bioimpedence, hydrodensitometry allow determination of body composition using the four-compartment model.
- Ergometry: treadmills (2 with eccentric [downhill] capability), mechanically- and electrically-braked bicycle ergometers; 7 automated and semiautomated metabolic measurement systems; incremental lifting machine; equilibrium testing; pulmonary function testing; Cybex, Kincom, and Ariel computerized muscle function testing systems.
- Thermal imaging: infrared camera for dynamic measurement of weighted and gradient skin surface temperatures.
- Whole body calorimetry: fluid-based tube suit for measuring heat flux from six body regions to protective ensembles or the environment.

Medical Information Systems & Operations Research Specific Equipment:
- Several Concurrent and Silicon Graphics computer systems form the backbone of the electroencephalographic and electro-oculographic laboratory, currently used for Operator-State Assessment projects. The systems enable multi-channel real-time signal acquisition and subsequent analysis of psychophysiological and behavioral data.
- Two ASL 4000 series video-based eye tracking systems (one remote, one head mounted optics) and an electromagnetic head tracking system.

Health Sciences & Epidemiology Equipment Wet Laboratory capabilities:
Primary focus on specimen preparation, cold storage, packaging, and some limited in-house laboratory analyses. Current laboratory analytic capabilities include: viral culture, with a current focus on identification and typing of adenovirus; culture and performance of antibiotic resistance testing on a variety of bacterial pathogens, including Streptococcus pyogenes and Streptococcus pneumoniae; serological assays for antibody titers to various pathogens are also performed. - Future laboratory analytic capabilities include use of PCR techniques to expand the scope of viral and bacterial pathogens under study.
# FY97 Funding Data (Millions $)

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**Operations & Maintenance** 1.461 NA 1.476 2.937
**Other** 0.000 NA 0.046 0.046

**Total Funding** 5.588 NA 8.545 14.133

# Military Construction (Millions $)

| Military Construction (MILCON) | 0.387 |

# Personnel Data (End of Fiscal Year 1997)

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# Space and Property

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| Acres | 0 | * Subset of previous category. |

NA = Not Applicable

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**MISSION**

To conduct research, development, tests and evaluations to enhance the health, safety, and readiness of Navy and Marine Corps personnel in the effective performance of peacetime and contingency missions, and to perform such other functions or tasks as may be directed by higher authority.

The specific functions to be accomplished are:

- a. Provide basic and applied research on infectious diseases, tissue transplantation, diving and hyperbaric medicine, casualty care, and environmental medicine and human factors which are directly related to military requirements and operational needs.

- b. Maintain a program of basic biomedical research in areas of military importance to develop knowledge in anticipation of future problems.

- c. Provide the scientific potential for the application of new biomedical knowledge to operational problems.

- d. Provide biomedical research capabilities to support field laboratories, hospitals and other naval activities in problems beyond their scope.

- e. Provide a source of scientific advisors and consultants readily available to operational commands.

**CURRENT IMPORTANT PROGRAMS**

**BONE MARROW RESEARCH DEPARTMENT:**

A research leader in the Department of Defense Marrow Donor Program (C. W. Bill Young Marrow Donor Recruitment and Research Program), the Bone Marrow Research Department provides military contingency support for casualties with marrow toxic injury due to radiation or chemical warfare agents. The department performs laboratory research which supports technology innovations to make highly reliable and cost effective DNA-based typing for marrow transplants.

**COMBAT CASUALTY CARE DEPARTMENT:**

**Immune Cell Biology Program:** The Immune Cell Biology centers its research efforts upon three basic scientific and clinical applications of immunology, namely a) the development of novel, safe and effective methods to suppress undesired immune responses in organ transplantation, autoimmune disease, and superantigen toxin exposure; b) the development of strategies to enhance immune responses so as to improve defenses against a variety of infectious processes, including HIV; and, c) the development of methodologies that will allow for the ex vivo expansion of bone marrow for use in transplantation of patients with seriously injured marrow. In addition, this last research thrust area focuses upon strategies to generate specific types of blood cells of therapeutic interest.
Transfusion and Cryopreservation Research Program: The Transfusion and Cryopreservation Research Program centers its research efforts upon four scientific research and clinical applications of Cryobiology, namely: a) the development of safe and effective methods of extending the refrigerated storage of red cells, the post-thaw shelf-life of frozen red cells and optimization of a transfusible polymer cryoprotectant; b) the examination of the radical discovery that proteins unfolded in cold do not necessarily reverse to the native state and to assess this effect on function; c) the prevention of phagocytosis of red cells following transfusion which may result from the rapid degeneration of leukocytes following blood collection, the release of cytokines and the development of apoptotic cells which can absorb on red cells and stimulate phagocytosis; and d) the utilization of vitrification instead of freezing for the cryopreservation of tissues as a means of long term storage to achieve surgical reconstruction of traumatic tissue loss.

Resuscitative Medicine Research Program: The Resuscitative Medicine Research Program is focused upon the investigation of mechanisms responsible for cell death during hemorrhage and upon various approaches for pharmacological intervention to improve the survival of personnel who have sustained combat casualties. Program efforts are centered upon four specific research methodological targets: a) the development of treatment regimens for the depression of metabolic rate in both cell cultures and animal models of hemorrhage and ischemia; b) the examination of the involvement of both the vascular endothelium and circulating blood cells in acute inflammatory responses and subsequent cellular injury observed during severe trauma, hemorrhagic shock and ischemia; c) the identification of methods to modulate leukocyte-induced tissue damage triggered by hypoxia/hemorrhage; and, d) the characterization of mechanisms such as hypothermia and hibernation to identify key mechanisms to create low metabolic states to induce resistance to damage and to study mechanisms of natural tolerance to hypoxia.

DIVING AND ENVIRONMENTAL PHYSIOLOGY DEPARTMENT:

Thermal Stress Research Program: The primary objective of the Thermal Stress Program is to develop effective interventions, both physiological and pharmacological, and provide guidelines to minimize the impact of diving and extreme temperature. Recommendations are provided to the operational community to improve both physical and cognitive performance in harsh environments. These recommendations may take the form of pharmacological, nutritive or training interventions.

Decompression Research Program: The primary objective of the Decompression Research Program is to perform basic and applied research that is aimed at finding new ways to accelerate decompression safely after long deep dives, as well as prevent and treat decompression sickness (DCS) in deep sea divers and crewmembers of disabled submarines. The program includes research procedures in decompression, DCS epidemiology and risk prediction, development of gas exchange kinetics and bubble dynamics models, biochemical decompression, DCS pathophysiology, and control of contaminants in confined atmospheres. Direct taskings involve research for the Explosive Ordnance Disposal, Naval Special Warfare, and Fleet Submarine and Diving communities.

Oxygen Toxicity Research Program: The primary objective of the Oxygen Toxicity Research Program targets the etiology of neurological toxicity, resulting in convulsive seizures, by the breathing of pure oxygen under pressure. The Oxygen Toxicity Program seeks to understand the mechanism underlying this toxicity, and thereby to identify methods for prevention of oxygen-induced seizures. The program addresses the problem at various levels, from biochemical to cellular to animal models.
CURRENT IMPORTANT PROGRAMS (continued)

INFECTIOUS DISEASES DEPARTMENT:

Malaria Research Program: The primary objective of the Malaria Program is to develop vaccines that prevent malaria in military personnel. The Malaria Program is part of the Department of Defense Malaria Vaccine Program, along with the Division of Communicable Diseases and Immunology, Walter Reed Army Institute of Research, and Navy and Army overseas laboratories in Indonesia, Thailand, Kenya, Brazil, and Peru.

Enteric Diseases Research Program: Globally, diarrheal diseases are a major cause of morbidity and mortality. The Enteric Diseases Research Program is composed of 8 distinct and separately funded research projects. However, the program may be viewed as functionally consisting of two principal thrust areas.

These areas are: 1) development of a Campylobacter vaccine, and 2) basic research and epidemiology of emerging disease threats (which is currently focused on newly discovered toxic phenotypes of E. coli).

Viral and Rickettsial Diseases Research Program: This program focuses primarily on two major diseases of military importance: Dengue Fever and Scrub Typhus. Dengue fever is an important acute viral disease that is widely distributed throughout the tropical and sub-tropical areas of the world. Research efforts concerned with the development of an efficacious vaccine against dengue fever have employed molecular genetic approaches to define the genetic sequences of the virus that are actually responsible for human virulence and to develop "naked" DNA vaccine by expressing subunits of the dengue virus RNA genome as copy DNA for direct inoculation into laboratory animal models. The Scrub Typhus Program is focused on the development of improved diagnostic assays and the characterization of antibiotic resistance.

Infectious Disease Threat Assessment Research Program: The purpose of this program is to systematically acquire and assess infectious disease risk data from research projects and from collaborations with Navy CONUS and OCONUS medical treatment and research facilities for use in operational planning and research prioritization, and to develop prevention and control, diagnostic, and treatment strategies for infectious disease threats worldwide.

Biological Defense Research Program: The objective of the Biologic Defense Research Program is to improve diagnostic assays for the detection of biological and chemical agents during peacetime and wartime. This program has recently designed, developed, and tested a new prototype immunochromatographic assay device which enables multiple assays to be performed simultaneously.

Cooperative Research and Development Agreements

The Institute for Genomic Research - The broad intent of the work performed under the auspices of this agreement is to obtain the entire DNA sequence of at least two species of malaria parasites, of the genus Plasmodium. The DNA sequences will provide the foundation for the discovery of new antimalarial drugs, vaccines, and diagnostics, and for greater elucidation of the biology of malaria parasites.

Genelabs - Specialized work on sera of hepatitis patients.

Indx - Serological testing on Dengue patients.

MicroCarb, Inc. (Antex) - Large-scale production of a safe and effective vaccine for the prevention of diarrhea caused by the enteropathogenic Campylobacter in humans.
### CURRENT IMPORTANT PROGRAMS (continued)

**SmithKline Beecham Corp.** - Research, development and commercialization of a genetically engineered bacterial toxin, LT-R192G, for use as a safe and efficacious mucosal adjuvant (immune enhancer) to be administered with oral vaccines.

**SmithKline Beecham Corp.** - Development of chimeric and humanized anti-bodies useful for the prevention of malaria.

**Cel-Sci Corporation** - The Naval Medical Research Institute and Cel-Sci Corporation are sharing equipment and facilities to facilitate collaborative research partnerships and enhance the research capabilities of each organization. The broad intent of the work performed under the auspices of this Agreement is to develop and test heteroconjugate peptide-based Plasmodium vaccines which contain B or T cell epitopes of the Plasmodium yoelii circumsporozoite protein (CSP) or sporozoite surface protein 2 (SSP2) and T cell binding ligands. These vaccines will be tested for their efficacy in the prevention of sporozoite induced malaria. The active collaboration of staff from both organizations will allow for accelerated development and execution of various Research Projects. Utilizing this model of collaboration and cooperation, research efforts at both organizations will be less costly resulting in increased productivity with less fiscal support.

**The University of Illinois** - The purpose of this agreement is to investigate the interactions of human and nonhuman primate hematopoietic stem cells (HSC) with porcine brain microvascular endothelial cells (PMVECs). The proposed studies will evaluate the expansion and self-renewal potential of hematopoietic stem cells from normal and diseased subjects with the ultimate goal of fundamentally improving gene marking and gene therapy protocols. In addition, the PMVEC hematopoietic supportive microenvironment will be characterized in regard to adhesion and/or contact-mediated interactions.

**Chembio Diagnostic Systems, Inc** - Scrub typhus is an acute, febrile disease caused by infection with Orientia (formerly Rickettsia) tsutsugamush. It accounts for up to 23% of all fever in endemic regions of Asia-Pacific. NMRI is involved in the technology development on the diagnosis, threat assessment and treatment of rickettsial diseases. CHEMBIO has developed the capability to produce simple, rapid, highly sensitive and specific diagnostic tests using a variety of antigens. Working together this CRADA hopes to develop rapid serological diagnostic tests including detection of specific IgM antibody and total immunoglobulin against rickettsiae.

**Biogen** - Both partners wish to develop therapies to specifically prevent the rejection of organs or tissues transplanted from one individual to another. The partners agree that the ideal therapy should be safe, durable, and specific (that is, immune responses other than those directed against the transplant should be left intact). For the joint effort, the ICBP brings experience and scientific expertise in molecular and cellular immunology, and in animal models including primate transplant models. BIOGEN's participation is to provide sufficient quantities of an agent that modulates the function of the cell surface receptor pair called CD40: CD40L, and to provide partial financial support for the primate transplant studies planned. BIOGEN also contributes manufacturing capability to produce drug of the highest (known as good manufacturing practice or GMP) quality, and expertise in both the conduct of human clinical trials and in marketing.

**CpG Immunopharmaceuticals Incorporated** - The intent of this cooperative agreement is to develop and test the clinical application of oligonucleotide sequences for enhancement of immunogenicity and efficacy of anti-malarial vaccines for the prevention of malaria. Proprietary oligonucleotides that have been identified, engineered and developed as potent pharmacological immune modulators by CpG Inc. will be provided to the Malaria Program at the Naval Medical Research Institute for use in malaria vaccine development. The joint cooperative effort between CpG Inc. and the Naval Medical Research Institute constitutes a major commitment by both parties to advance anti-malarial vaccines for human use by combining CpG oligonucleotide based immune modulation and advanced DNA and/or protein based vaccinology.
<table>
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<tr>
<th><strong>CURRENT IMPORTANT PROGRAMS (continued)</strong></th>
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</table>

**Biosource Technologies** - NMRI/ICPB has developed a novel patented porcine microvascular endothelial cell line growth medium to expand human stem cells. Biosources Technologies, Inc. will utilize its capabilities to work with NMRI/ICPB isolating and identifying the specific peptide(s) responsible for the unique growth factor properties of the growth medium.

**Corixa** - The Parties intend to collaborate in the evaluation of LeIF, a novel adjuvant from Corixa Corporation, for potential efficacy as a component of malaria vaccines. Malaria vaccines will include synthetic peptide vaccines; recombinant protein vaccines; and DNA vaccines. In joint studies the NMRI Malaria Program and Corixa Corporation will utilize purified LeIF recombinant protein formulations as well as LeIF encoding DNA together with Plasmodium yoelii antigens or antigen encoding genes (DNA vaccines) to immunize various strains of mice. Specific cellular and humoral immunological responses will be evaluated and the animals will be challenged with parasites to determine protective efficacy. If shown to be efficacious as an adjuvant of P. yoelii vaccines in mice, LeIF will be further assessed as an adjuvant for Plasmodium vaccines in nonhuman primates. Various routes of immunization, immunization schedules and mixtures of antigens will be studied to optimize protective immunity with LeIF as a adjuvant. If successful these preclinical experiments will lead to collaborative efforts by the Parties to prepare and test candidate vaccines with LeIF adjuvant in human subjects, eventually leading to the submission of appropriate documentation to the FDA seeking approval to market such a malaria vaccine.

**Nextran** - Both partners wish to develop therapies to specifically prevent the rejection of organs or tissues transplanted from pigs into man. The partners agree that the ideal therapy should be safe, durable, and specific (that is, immune responses other than those directed against the transplant should be left intact) and that donor organs should be manipulated when possible to avoid immune attack by the recipient. For the joint effort, the ICBP brings access to several agents which modulate the function of cell surface receptor pairs called CD28: B7 (B7 has two discrete members called CD80 and CD86), and CTLA4 (or CD152): B7. In addition access to hu-5C8, a monoclonal antibody directed toward CD40 ligand (CD154) will be provided. This is provided through a separate CRADA between the NMRI and the BIOGEN Corporation, the sole owner of hu-5C8, specifically allowing the ICBP to participate in pre-clinical trials in xenotransplantation. The ICBP also brings experience and scientific expertise in molecular and cellular immunology, and in animal models including porcine to primate transplant models. Further the ICBP brings experience and expertise in clinical organ transplantation. NEXTRAN's participation is to provide sufficient access to pigs genetically engineered to express one or more human transgenes felt to be important in protecting the organ against hyperacute discordant xenograft rejection. These animals are to serve as donors for transplantation and transplant related studies. NEXTRAN also brings expertise in histological evaluation of transgene expression and evaluation of xeno-specific immune responses. NEXTRAN will also provide partial financial support for the expensive primate transplant studies planned.

**University of Kentucky Research Foundation** - Acute lung injury (ALI) and its most severe progressive form Acute Respiratory Distress Syndrome (ARDS - collectively ALI/ARDS) often results from the inhalation of smoke and combustion byproducts. Since its initial recognition as a distinctive lung disease in 1967 important discoveries have been made about the causes and development of ALI/ARDS; however, a great deal of additional research is still necessary to determine risk factors and to develop improved methods to assess novel treatment regimens for this continuum of lung diseases. NMRI/TD and UKRF each have specialized research capabilities which when combined could make significant strides toward satisfying some of these research requirements.

**Dyad Pharmaceuticals** - It is the goal of this CRADA to design and investigate the protective effects of antisense molecules against the inflammation associated with septic shock and inflammatory diseases in animals, cell cultures, and human subjects with the results and processes made available for public use.

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### CURRENT IMPORTANT PROGRAMS (continued)

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<td>Integrated Diagnostics Inc.</td>
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<td>Vical, Inc.</td>
<td>Evaluation of novel vaccine approaches for prevention of malaria using genetic material encoding malarial protein antigens.</td>
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<td>Entremed</td>
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<td>Organ, Inc.</td>
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### EQUIPMENT/FACILITIES

Complex of 7 buildings (1 off site) containing approximately 160,000 square feet of laboratories.

The laboratory includes the following specialized facilities or equipment:

1. **Man-rated, Deep-dive Hyperbaric Research Chamber Complex**: A DOD unique diving medical research chamber capable of reaching simulated depths of 300 meters, with full research quality level support systems, and composed of 5 separate, interconnected chambers, one with wet-pot capability.


3. **Emergency Hyperbaric Treatment Chamber**: Special chamber designed for treatment of hyperbaric injuries or other clinical hyperbaric treatments.

4. **Scanning Transmission Electron Microscope**: Standard research quality instrument approximately 10 years old.

5. **Fluorescence Cytometers**: Three fully capable instruments, two with double laser capability, one with triple beam capability.

6. **Digital Imaging System**.
### FY97 Funding Data (Millions $)

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### Military Construction (Millions $)

| Military Construction (MILCON) | 0.000 |

### Personnel Data (End of Fiscal Year 1997)

<table>
<thead>
<tr>
<th>Type</th>
<th>Scientists &amp; Engineers</th>
<th>Technical Support &amp; Other Personnel</th>
<th>End Strength</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Doctorates</td>
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### Space and Property

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NA = Not Applicable
Naval Medical Research Unit # 2
Jakarta, Indonesia, APO AP 96520-8132
(62) 421-4452
Commanding Officer: CAPT H.V. Peterson, MSC
Exec. Officer: CDR J.P. Burans, MSC

MISSION

The U.S. Naval Medical Research Unit No.2 (NAMRU-2) is a Department of Defense infectious Diseases laboratory located on the grounds of the Indonesian National Institutes of Health Research and Development in downtown Jakarta. Its Mission is to study infectious diseases of mission aborting potential in Southeast Asia and to assist host government health agencies with infectious diseases problems of mutual interest. NAMRU-2 is also part of the Department of Defense (DOD) Global Surveillance Program and has recently been designated the Southeast Asia Regional Collaborating Center for Emerging Diseases by the World Health Organization (WHO). The Unit has been in Asia since 1942 having moved from Guam to Taiwan and subsequently to the Philippines and Indonesia where it has operated since 1970. NAMRU-2 serves the United States military by providing an environment for the study of tropical diseases of importance to both military and civilian populations. Of particular emphasis, both historically and currently, are studies of malaria, cholera, typhoid fever, dengue fever, severe diarrhea, viral hepatitis, HIV and Japanese encephalitis.

Noteworthy contributions include the pioneering work for development of oral rehydration therapy that prevents death due to water loss in severe diarrheal diseases like cholera, the identification and characterization of hepatitis B in Asia and the demonstration by NAMRU-2 scientists and their Indonesian colleagues of the efficacy of the current oral typhoid vaccine. NAMRU-2 has also been in the forefront of the discovery and surveillance of the spread of drug resistant malaria parasites and emerging diseases. CAPT Henrik V. Petersen, MSC, USN is the current Commanding Officer of the Unit which is staffed by 14 military officers, five enlisted members, one civilian Scientific Director, one civilian investigator, and 92 Foreign Service National (FSN) staff.
**CURRENT IMPORTANT PROGRAMS**

The research institute is composed of scientific research programs which include the; Emerging Diseases Program, Viral Diseases Program, Parasitic Diseases Program, Bacterial Disease Program and Administrative and Logistical Support. These scientific programs have state of the art equipment to support the numerous ongoing infectious disease research projects at NAMRU-2.

**The Emerging Diseases Program** conducts field studies throughout the Indonesian archipelago and other countries in Southeast Asia such as Vietnam, Laos and Cambodia. The efforts of this program are primarily focused on surveillance for new, emerging and re-emerging infectious diseases using NAMRU-2’s extensive infectious disease diagnostic and epidemiological capabilities.

**The Parasitic Diseases Program** is primarily focused on basic and applied research on malaria. Research efforts include: evaluation of new diagnostic assays, evaluation of new prophylactic and therapeutic drugs, characterization of the immune response to malaria infections to facilitate the development of potential vaccines for malaria and development and characterization of field sites for new malaria vaccine evaluations. This program utilizes sophisticated equipment such as a flow cytometer, DNA sequencer and DNA thermocyclers to conduct basic immunology and molecular biology studies of malaria. The program also has an extensive entomology capability which includes the in house breeding of mosquitoes.

**The Bacterial Diseases Programs** conducts research to; determine the causes of acute diarrheal disease in Southeast Asia, evaluate vaccines for cholera and to support emerging disease surveillance with a comprehensive diagnostic medical microbiology capability which includes sophisticated equipment and reagents necessary for the biomolecular identification and characterization of microbial pathogens.

**The Viral Diseases Program** conducts research on the molecular biology and epidemiology of HIV and several viral diseases such as Dengue. The program supports NAMRU-2’s emerging disease surveillance efforts with extensive diagnostic capabilities for the isolation and identification of human viral pathogens. The Viral Diseases Program also includes a modular Biosafety Level 3 Containment Laboratory which when fully operational will exceed all current requirements for work with Biosafety Level 3 pathogens. This laboratory is the only one of its kind in Southeast Asia and will allow NAMRU-2 personnel and Indonesian collaborators to work safely with samples potentially containing BSL-3 agents.
**EQUIPMENT/FACILITIES**

Background: Naval Medical Research Unit No 2 (NAMRU-2) and its satellite lab component in Jayapura, Irian Jaya has conducted infectious disease research throughout the Indonesian archipelago and in other areas of Southeast Asia for over 30 years. NAMRU-2 is located in Jakarta, Indonesia on the compound of the National Institutes of Health (LITBANGKES), Indonesian Ministry of Health. The research unit has a staff of 19 military, 2 civilian and 92 Foreign Service National (FSN) scientific, technical and support staff. Research laboratories, administrative offices and logistical support spaces are integrated into buildings owned by the Indonesian Ministry of Health. NAMRU-2 currently has 16.4 k sq ft of laboratories, 11.4 k sq ft of administrative offices and 31.0 k sq ft of logistical support spaces.

The administrative and logistical support components provide: administrative oversight and personnel support, contracting, disbursing, purchasing, warehousing, transportation, facilities maintenance, medical repair, veterinary services, automated data processing, publication services, library services and American staff housing support. In order to provide these administrative and logistical support services NAMRU-2 has and maintains an animal facility, scientific library, computer network, in house maintenance facility, motorpool (includes vehicles for home to work transportation and logistical support) and facility electrical backup (5 diesel generators with total of 1,170 KW).

NAMRU-2’s field laboratory in Jayapura, Irian Jaya, which is 4,500 Km from Jakarta, is used to support malaria and other important infectious diseases studies being conducted in more remote areas of Irian Jaya. The Jayapura laboratory has 4.5 k sq ft of lab space, a guest house, electrical generator backup and a vehicles use for transportation to remote field sites. related laboratory assays and also to process research specimens for shipment to the Jakarta lab.
### FY97 Funding Data (Millions $)

<table>
<thead>
<tr>
<th>Appropriation</th>
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<th>In-House Management</th>
<th>Out-Of-House</th>
<th>Total</th>
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### Military Construction (Millions $)

- Military Construction (MILCON): 0.000

### Personnel Data (End of Fiscal Year 1997)

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<tr>
<th>Type</th>
<th>Scientists &amp; Engineers</th>
<th>Technical Support &amp; Other Personnel</th>
<th>End Strength</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Doctorates</td>
<td>Other</td>
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<tr>
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<tr>
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<tr>
<td>Total</td>
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### Space and Property

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<th>Building Space (Thousands of Sq Ft)</th>
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NA = Not Applicable
Naval Medical Research Unit # 3

Abbreviated Functional Chart - Technical Organizations

U.S. Naval Medical Research Unit #3

Research Sciences Department

Basic Laboratory Science Division
  - Central Research Lab Branch
  - Enteric Microbiology Branch
  - Rapid Diagnostics Branch

Animal Resources Division

Applied/Field Science Division
  - Clinical Investigation Division
  - Risk Assessment Branch
  - Medical Zoology Branch
  - Virology Branch
MISSION

To conduct research to enhance the health, safety and readiness of Department of Defense personnel assigned to Southwest Asia and Africa in the performance of peacetime and contingency missions, and to perform other such functions as may be directed by higher authority.

Conduct infectious disease (ID) surveillance and response activities.

Conduct interactive ID research with other DoD medical R&D laboratories, specifically in the areas of preventive medicine, epidemiology and tropical medicine.

Develop and maintain the capability to provide ID risk assessment information and conduct research and development to improve prevention, diagnosis, and treatment of ID in the Fleet and Fleet Marine Force.

Maintain a technology base and scientific and technical expertise in infectious diseases and tropical medicine to provide advisory assistance when requested.

CURRENT IMPORTANT PROGRAMS

Epidemiological studies of regionally important enteropathogens.

Enterotoxigenic E. coli vaccine trials in Egyptian populations.

Evaluation of diarrhea prophylaxis drug in U.S. operational forces.

Population-based cohort study on the epidemiology of Helicobacter pylori.

Isolation and characterization of viral threat agents.

Description of epidemiology and identification of associated risk factors of viral disease.

Development of vaccine test sites for enteropathogens and viruses.

Identification and description of regional insect vectors of infectious diseases and their distribution.

Evaluation of insect control measures (i.e., repellents).

Development of malaria field site for epidemiological studies, drug trials and vaccine testing.
The equipment and resources at NAMRU-3 make it competitive with any major research laboratory in the United States.

**BIOMEDICAL RESEARCH SCIENCE BUILDING:**

**LIBRARY:**
Heavily used by local scientists/physicians as well as NAMRU-3 staff. Subscriptions to over 75 scientific journals. Houses over 7,000 books.

**INSECTARY:**
Supports colonies of disease vectors such as ticks, mosquitoes and sand flies.

**ANIMAL FACILITY:**
Directed by U.S. Army Veterinarian and enlisted (91T) Veterinary Technician. AAALAC-International accredited state-of-the-art animal facility houses rodents, sheep, rabbits and pigeons; barrier facility for breeding inbred mouse strains.

**PUBLIC WORKS FACILITY:**
Directed by U.S. Navy Civil Engineering Corps Officer. Responsible for engineering, maintenance, construction, design, transportation. Shops: automotive, electrical, mechanical, sheet metal, carpentry, paint and plumbing.

**OTHER SUPPORT FACILITIES:**
Administration, Finance, Supply, Public Works, Pharmacy, Medical Equipment Repair, Safety, Occupational Health, Computer and Post Office.

**ACCESS TO ABBASSIA FEVER HOSPITAL:**
Largest Ministry of Health infectious disease hospital in Egypt with 1,500 beds adjacent to NAMRU-3. NAMRU-3 conducts studies in the following wards: Fever of Unknown Origin (FUO), Enteric Fever and Meningitis.
### FY97 Funding Data (Millions $)

<table>
<thead>
<tr>
<th>Appropriation</th>
<th>IN-House</th>
<th>IN-House Management</th>
<th>Out-of-House</th>
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### Military Construction (Millions $)

| Military Construction (MILCON) | 0.000 |

### Personnel Data (End of Fiscal Year 1997)

<table>
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<tr>
<th>Type</th>
<th>Scientists &amp; Engineers</th>
<th>Technical Support &amp; Other Personnel</th>
<th>End Strength</th>
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</thead>
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</tr>
<tr>
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### Space and Property

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<th>Building Space (Thousands of sq ft)</th>
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<tr>
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<td>REAL PROPERTY</td>
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<tr>
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<td>* NEW SCIENTIFIC &amp; ENG. EQUIP.</td>
</tr>
<tr>
<td>ACRES</td>
<td>* Subset of previous category.</td>
</tr>
</tbody>
</table>

NA = Not Applicable
Abbreviated Functional Chart - Technical Organizations

Navy Personnel Research and Development Center

- Workforce Management
- Personnel & Organizational Assessment
- Classroom & Afloat Training
Navy Personnel Research and Development Center  
San Diego, CA 92152-7250  
(619) 553-7812  
CO: CDR William M. Keeney  
Technical Dir: Mr. Murray W. Rowe

### MISSION

NPRDC serves as the Navy's principal research laboratory for developing Manpower, Personnel and Training (MPT) technologies. We maintain and enhance fleet readiness by developing state-of-the-art technology solutions to significant operational problems in Workforce Management, Personnel and Organizational Assessment, and Classroom and Afloat Training. The Center's expertise also encompasses personnel surveys, multicultural and gender research, quality of life issues, productivity enhancement, and drug abuse research.

### CURRENT IMPORTANT PROGRAMS

**WORKFORCE MANAGEMENT** - A comprehensive program to improve the Navy's management of its personnel resources. Products include suites of integrated, computer-based models, databases and systems which enable: Rapidly collecting and displaying information on personnel force characteristics in easily understood graphic and tabular forms; Testing the effects of alternative policies on the workforce by mathematically simulating force dynamics under varying test policies; Developing and updating manning plans to reflect budgetary and end-strength constraints, and statistically forecasting losses and gains at several levels of detail within the enlisted and officer workforce.

Major projects include the Enlisted Strength Planning System, which enables monitoring all personnel force transactions on a daily basis; the Navy Training Reservation System (NTRS), designed to improve the way students are scheduled for Navy schools, while cutting times lost while students transition to and from schools; a Job Advertisement and Selection System (JASS), an on line information and decision system for both sailors and detailers; and Computer-Based Technology for Detailers, which (1) optimally matches rotating sailors to available jobs while considering moving costs, (2) meets sailors' location preferences, and (3) enables maximum use and reuse of individual skills. The department also provides R&D support for the Navy Drug and Alcohol Prevention Program, with tasks addressing detection, prevention, education and substance abuse modeling.

**PERSONNEL AND ORGANIZATIONAL ASSESSMENT** - The goal of the overall research program is to enhance both personnel and organizational readiness. Efforts in Personnel Assessment address enlisted and officer selection, personnel testing, job classification, and performance measurement. The Center has a strong program to improve the sensitivity and effectiveness of computer adaptive testing in general. Innovative measurement technologies, including computer-based dynamic measures, are also being explored for their usefulness in personnel assessment.

Organizational Assessment investigates and develops organizational solutions to meet Navy goals. Research projects focus on organizational and workgroup behavior. Major projects involve personnel surveys and attitude assessment, multicultural and gender integration, the role of quality of life factors in relation to readiness, and technical innovations to enhance workgroup productivity.

**CLASSROOM AND AFLOAT TRAINING** - A broad training and education research program that incorporates advanced instructional and computer-based training technologies to create new and better ways to teach complex warfighting skills. The goals of this program are to reduce the costs of initial skills training as well as costs of maintaining highly perishable but infrequently practiced job skills.
CURRENT IMPORTANT PROGRAMS (continued)

This broad-based research program explores the use of multimedia technologies to develop automated classrooms, applications of video teletraining to deliver training worldwide, and the use of high fidelity simulations of complex physical systems to enhance training effectiveness.

One major thrust area involves the application of "intelligent", knowledge-based training systems to improve the effectiveness of technical skills training. These PC-based training systems provide feedback as students progress through the instructional modules, providing expert guidance on courses of action to be taken.

A 1997 new start exploits multimedia approaches to deliver educational, preventive messages on core values concepts, leadership and substance abuse. Pilot-testing is underway at the Recruit Training Command, Great Lakes, Illinois.

BRAC REALIGNMENT - Per BRAC 95, NPRDC's Classroom and Afloat Training research program will transfer to the Naval Air Warfare Center, Training Systems Division on 1 February 1998. Similarly, NPRDC's Workforce Management and Personnel and Organizational Assessment research programs will realign into the Navy Personnel Command, Memphis in October, 1999 becoming the Research, Studies and Technology Department. Upon completion of the Memphis transfer, NPRDC will be disestablished.

EQUIPMENT/FACILITIES

The Center occupies approximately 63,100 square feet of space in converted World War II barracks buildings. Much of this is configured to accommodate the social science and mathematical analysis tasks performed on microcomputers and minicomputers. The facilities include upgraded electrical capability and air conditioning of the most equipment-intensive rooms. In addition, there are two facilities which contain computer rooms with raised flooring, central air conditioning, and upgraded electrical power, both components of the Center Research Computing Facility (RCF):

One installation occupies 2000 square feet and houses an IBM 4381 mainframe computer facility. It is used to develop, process, and maintain statistical and forecasting systems; very large complex personnel and training databases, and large software system applications.

A separate Sun Systems facility, operating under the UNIX operating system occupies 1600 square feet. It provides network (internal and external) services, data analysis software, text processing support, graphics/video image processing software, and electronic mail/news services. The data analysis, text processing, and graphics/video image processing software is specialized and, in some cases, custom written for NPRDC applications. Some of the RCF services required modifications to the UNIX operating system kernel, necessitating an NPRDC source license for the UNIX operating system.
**FY97 FUNDING DATA (MILLIONS $)**

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<tr>
<th>APPROPRIATION</th>
<th>IN-HOUSE</th>
<th>IN-HOUSE MANAGEMNT</th>
<th>OUT-OF-HOUSE</th>
<th>TOTAL</th>
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<tbody>
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</tr>
<tr>
<td>6.1 ILIR</td>
<td>0.151</td>
<td>NA</td>
<td>NA</td>
<td>0.151</td>
</tr>
<tr>
<td>6.1 Other</td>
<td>0.021</td>
<td>NA</td>
<td>0.005</td>
<td>0.026</td>
</tr>
<tr>
<td>6.2</td>
<td>2.568</td>
<td>NA</td>
<td>0.915</td>
<td>3.483</td>
</tr>
<tr>
<td>6.3</td>
<td>3.027</td>
<td>NA</td>
<td>5.476</td>
<td>8.503</td>
</tr>
<tr>
<td>Subtotal (S&amp;T)</td>
<td>5.767</td>
<td>NA</td>
<td>6.396</td>
<td>12.163</td>
</tr>
<tr>
<td>6.4</td>
<td>0.000</td>
<td>NA</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>6.5</td>
<td>0.369</td>
<td>NA</td>
<td>0.386</td>
<td>0.755</td>
</tr>
<tr>
<td>6.6</td>
<td>0.250</td>
<td>NA</td>
<td>0.622</td>
<td>0.872</td>
</tr>
<tr>
<td>6.7</td>
<td>0.000</td>
<td>NA</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Non-DOD</td>
<td>0.000</td>
<td>NA</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>TOTAL RDT&amp;E</td>
<td>6.386</td>
<td>NA</td>
<td>7.404</td>
<td>13.790</td>
</tr>
<tr>
<td>Procurement</td>
<td>0.000</td>
<td>NA</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Operations &amp; Maintenance</td>
<td>2.371</td>
<td>NA</td>
<td>5.247</td>
<td>7.618</td>
</tr>
<tr>
<td>Other</td>
<td>0.302</td>
<td>NA</td>
<td>0.263</td>
<td>0.565</td>
</tr>
<tr>
<td>TOTAL FUNDING</td>
<td>9.059</td>
<td>NA</td>
<td>12.914</td>
<td>21.973</td>
</tr>
</tbody>
</table>

**MILITARY CONSTRUCTION (MILLIONS $)**

| Military Construction (MILCON) | 0.000 |

**PERSONNEL DATA (END OF FISCAL YEAR 1997)**

<table>
<thead>
<tr>
<th>TYPE</th>
<th>SCIENTISTS &amp; ENGINEERS</th>
<th>TECHNICAL SUPPORT &amp; OTHER PERSONNEL</th>
<th>END STRENGTH</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DOCTORATES</td>
<td>OTHER</td>
<td></td>
</tr>
<tr>
<td>MILITARY</td>
<td>0</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>CIVILIAN</td>
<td>29</td>
<td>53</td>
<td>34</td>
</tr>
<tr>
<td>TOTAL</td>
<td>29</td>
<td>59</td>
<td>42</td>
</tr>
</tbody>
</table>

**SPACE AND PROPERTY**

<table>
<thead>
<tr>
<th>BUILDING SPACE (THOUSANDS OF SQ FT)</th>
<th>PROPERTY ACQUISITION COST (MILLIONS $)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAB 42.200</td>
<td>REAL PROPERTY 1.147</td>
</tr>
<tr>
<td>ADMIN 16.400</td>
<td>* NEW CAPITAL EQUIPMENT 0.000</td>
</tr>
<tr>
<td>OTHER 4.500</td>
<td>EQUIPMENT 5.133</td>
</tr>
<tr>
<td>TOTAL 63.100</td>
<td>* NEW SCIENTIFIC &amp; ENG. EQUIP. 0.399</td>
</tr>
<tr>
<td>ACRES 3</td>
<td>* Subset of previous category.</td>
</tr>
</tbody>
</table>

NA = Not Applicable
Naval Research Laboratory

Abbreviated Functional Chart - Technical Organizations

Naval Research Laboratory

- Systems Directorate
- Materials Science and Component Technology Directorate
- Ocean and Atmospheric Science Technology Directorate
- Naval Center for Space Technology
**MISSION**

Operate as the Navy's full spectrum corporate laboratory. To conduct a broadly based multidisciplinary program of scientific research and advanced technological development directed toward maritime applications of new and improved materials, techniques, equipment, systems and ocean, atmospheric, and space sciences and related technologies. In fulfillment of this mission, the Naval Research Laboratory:

1. Initiates and conducts broad scientific research of a basic and long-range nature in scientific areas of interest to the Navy.
2. Conducts exploratory and advanced technological development deriving from or appropriate to the scientific program areas.
3. Within areas of technological expertise, develops prototype systems applicable to specific projects.
4. Assumes responsibility as the Navy's principal R&D activity in areas of unique professional competence upon designation from appropriate Navy or DoD authority.
5. Performs scientific research and development for other Navy activities and, where specifically qualified, for other agencies of the Department of Defense and, in defense-related efforts, for other Government agencies.
6. Serves as the lead Navy activity for space technology and space systems development and support.
7. Serves as the lead Navy activity for mapping, charting, and geodesy (MC&G) research and development for the National Imagery and Mapping Agency.

LEADERSHIP AREAS: NRL, the Navy's single, integrated corporate laboratory, provides the Navy with a broad foundation of in-house expertise from scientific through advanced development activity. Specific leadership responsibilities and expertise are maintained in the following areas:

1. Primary in-house research for the physical, engineering, space, and environmental sciences.
2. Broadly based exploratory and advanced development program in response to identified and anticipated Navy needs.
3. Broad multidisciplinary support to the Naval Warfare Centers.
4. Space and space systems technology, development, and support.
## CURRENT IMPORTANT PROGRAMS

Radar Modernization Program (RMP) to provide enhanced capabilities for Naval AEW platforms; All Optical Distributed Sensor System (AODS); High Resolution EO/IR Reconnaissance Camera; Environmental Remote Sensing Programs - Hyperspectral Remote Sensing Technology (HRST) demonstration and a passive microwave ocean WIND SATellite (WINDSAT); Relocatable, meso/tactical-scale dynamical ocean and atmospheric prediction systems; Upper atmospheric/space weather sensors, data analysis, and modeling; Interim Control Module (ICM) to provide interim attitude control and reboost functions for the International Space Station; Army Airborne Command and Contract System (A2C2S) - The critical airborne communications link for the Army's digitized warfighting capability; Hyperspectral Remote Sensing Technology (HRST) Program - To demonstrate hyperspectral imagery for characterization of the littoral battlespace environment and littoral model development.

### Cooperative Research and Development Agreements

| Title: Diamond CVD Plasma Reactor Development Program |
| CRADA Between NRL and 3M, St. Paul, MN |
| The objective of this CRADA is to develop technology to create low cost, large area, chemical vapor deposited (CVD) diamond coatings or films. |

| Title: Microtubule Based Controlled Release Coatings |
| CRADA Between NRL and Biocompatibles Ltd., Middlesex UB8 3PQ, England |
| The objective of this CRADA is to conduct research into lipid-derived microtubule-based controlled release systems for the control of biofouling and to evaluate innovative concepts. |

| Title: Case-Based Reasoning Research |
| CRADA Between NRL and Cognitive Systems, Inc., Stamford, CT |
| The objective of this CRADA is to extend and develop the ReMind CBR software tool to include concepts developed at NRL that will improve representation and performance in order to effect a reliable and valid problem solution. New user interface requirements will be generated to improve ease of use. |

| Title: New Paint Formulations for Fluorinated Polyurethane Resins |
| CRADA Between NRL and 21st Century Coatings, Inc. |
| The objective of this CRADA is to produce and test new paint formulations of the NRL fluorinated polyurethane resins manufactured under license by 21st Century Coatings, Inc. The current fuel tank coating systems utilizing the NRL resins do not meet the EPA VOC and heavy metal standards for several states. NRL and 21st Century Coatings will work together to develop new formulations and systems that meet or exceed the current standards announced for future implementation. |

| Title: Electronic Support Systems |
| CRADA between NRL and AIL Systems, Inc., Deer Park, NY |
| The objective of this CRADA is to conduct experiments on receiver systems for the purpose of demonstrating the performance of an integrated system design and to determine the performance and commercialization value of such a receiver system. |

<p>| Title: Molecular Dynamic Study of Acoustic Damping |
| CRADA Between NRL and IBM Almaden Research Center, San Jose, CA |
| The objective of this CRADA is to use parallel-computer molecular dynamics codes using atomistic descriptions of matter to study mesoscopic systems. |</p>
<table>
<thead>
<tr>
<th>CURRENT IMPORTANT PROGRAMS (continued)</th>
</tr>
</thead>
</table>
| **Title: Laser-Heated Thermoluminescent Glass**  
CRADA between NRL and Keithley Instruments, Inc., Cleveland, OH  
The objective of this CRADA is to conduct research towards improving the performance of the laser-heated thermoluminescent glass by modifying the composition of the material by changing concentrations of ions and semiconductor nanocrystalites. It is anticipated that this will lead to a significant cost reduction for the laser-heated thermoluminescence reader. |
| **Title: Laser Oligonucleotide Array Fabrication for Genetic Analysis**  
CRADA Between NRL and Molecular Tool, Inc., Baltimore, MD  
The objective of this CRADA is to develop NRL's DNA immobilization chemistry and surface patterning technologies to create a viable testbed comprised of medium-density DNA arrays for multiplexed genetic analyses using MTI proprietary biochemical genetic analysis technologies. To accomplish this, there is a need to (1) develop a stable, covalent method for attaching DNA probes to a solid phase in a biochemically active state; (2) improve attachment strategy so up to forty (40) compositionally distinct DNA oligomers can be attached to a 7mm area; (3) that manufacturing protocols can be applied to yield oligonucleotide arrays useful in conjunction with MTI's genetic analysis biochemical and analytical methods. |
| **Title: Liquid Crystal Alignment Layer Program**  
CRADA between NRL and Shipley Company, L.L.C., Marlborough, MA  
The objective of this CRADA is to provide an optical alignment layer capable of uniform alignment of nematic liquid crystals with a contrast ratio greater than 10. The CRADA will demonstrate a pre-tilt angle in the range of 2° to 5° (suitable for both passive and active matrix TN displays) on one set of substrate surfaces and for one liquid crystal sample material. The CRADA will also demonstrate the robustness of the alignment layer by showing switching for a period of 3 months or more of a prototype TN cell fabricated using the various surfaces. |
| **Title: Virtual Environments for Simulation Based Design**  
CRADA Between NRL and Lockheed Martin Corporation (LMC) acting by and through Lockheed Martin Missiles and Space Advanced Technology Center, Palo Alto, CA |
| **Title: Downwell Optical Fiber Acoustic and Pressure Monitoring Systems for Oil, Gas and Geothermal Reservoir and Well Management**  
CRADA Between NRL and CIDRA Corporation, Wallingford, CT  
The objective of this CRADA is to determine the feasibility of downwell acoustic (seismic) and pressure measurement with a serially-multiplexed array of fiber optic Bragg gratings used directly as the means to sense a measurand or indirectly as a means to spatially resolve measurements. The parties will also design, fabricate and test one or more laboratory demonstration units to investigate and determine the system performance then educate, train and instruct CIDRA personnel in the design, fabrication, assembly and testing of passive and active fiber Bragg grating sensor readout systems with ultra-high measurement sensitivity. |
| **Title: Evaluation of Dye Sorption Phenomena on Nano-Sized Spherical Particles**  
CRADA between NRL and Shipley Company, L.L.C., Marlborough, MA  
The objective of this CRADA is to increase the level of understanding of the nature of the dye-coated Ludox particles as colorants for particle/polymer composite color filter fabrication. |
| **Title: Research on DNA Sequencing Using an Atomic Force Microscope**  
CRADA between NRL and Stratagene, La Jolla, CA  
The objective of this CRADA is to carry out cooperative research and development relating to the measurement of forces resulting from breaking individual DNA base-pairs in a peeling configuration and to use such forces to directly sequence nucleic acids. |

3-73
| Title: Radiation Hardness in Thin Simox  
CRADA Between NRL and Ibis Technology Corporation, Danvers, MA  
The objective of this CRADA is to determine optimal processes parameters to maximize radiation hardness of thin box simox. |
|---|
| Title: Naval Surface Ship Electronic Warfare Research  
CRADA between NRL and Digital System Resources, Inc., Fairfax, VA  
The objective of this CRADA is to conduct Electronic Warfare research for Naval Surface Ship applications and evaluate innovative concepts for adaptation in Commercial Off The Shelf (COTS) digital equipment and operating systems in support of the AIEWS and similar advanced electronic warfare system concepts. |
| Title: Proof-of-Principle Experiment of the Vacuum Beat Wave Accelerator  
CRADA between NRL and Omega-P, Inc., New Haven, CT  
The objective of this CRADA is to conduct research on the Vacuum Beat Wave Accelerator (VBWA). VBWA is an efficient scheme of charged particle acceleration that can produce high energy particle beams in significantly shorter interaction distances. The utilization of processes that can accelerate particles in vacuum eliminates many difficulties encountered when an accelerating medium is used. Development of intense lasers and the study of their interaction with plasmas and electron beams are advanced technologies with many potential Navy and/or DoD applications. In addition to advancing the forefront of scientific research in the interaction of lasers with matter, this work could also lead to new technologies in areas such as material processing, manufacturing, and characterization. The VBWA proof-of-principle experiment integrates with other on-going programs at NRL that utilize intense lasers and the RF electron gun facility. |
| Title: Fiber Bragg Grating Sensors Development  
CRADA between NRL and Astro Technology, Inc., Houston, TX  
The objective of this CRADA is to examine the use of fiber Bragg grating sensors in various applications where the use of electrically passive sensors is extremely important. These include strain monitoring in liquefied gas fuel composite tanks and strain monitoring of rocket motor casings and nozzles in long term storage, and static motor testing. The CRADA will result in field testing of instrumentation in these application areas, which will enhance the understanding and knowledge of distributed strain sensor systems for other closely related Navy and DoD applications. |
| Title: Private Communications Using Chaotic Dynamical Systems  
CRADA Between NRL and Dynetics, Inc., Huntsville, AL  
The objective of this CRADA is to develop a prototype device and/or a market product that uses chaotic dynamics in electronics circuits to achieve a functional private or secure communications system. Research and development will focus on more secure approaches to encoding or masking information with chaotic waveforms than the simple approaches that have been tried thus far in the field. |
| Title: Development of Microsensor Coatings  
CRADA between NRL and Microsensor Systems, Inc., Bowling Green, KY  
The objective of this CRADA is to explore Pulsed Laser Deposition as technology for developing new and more effective coatings for solid-state chemical microsensors. |
<table>
<thead>
<tr>
<th>Title: Patterned Bimolecular Surfaces for High Throughput Biological and Chemical Diagnostics</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRADA Between NRL and Biological Detection, Inc., Pittsburgh, PA</td>
</tr>
<tr>
<td>The objective of this CRADA is to determine the efficacy of NRL’s technology for fabricating two and three-dimensionally patterned bimolecular surfaces for use with BioDx’s fluorescence-based micro-imaging technology, and to evaluate the different patterning techniques with regard to potential commercial viability. It is envisioned that the results of this effort will lead to the development and production of prototype diagnostic devices in a subsequent NRL-BioDx collaborative program.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Title: Fiber Optic Sensor Techniques for Blood Glucose Measuring Instruments</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRADA between NRL and Sunshine Medical Instruments, Inc., Foster City, CA</td>
</tr>
<tr>
<td>The objective of this CRADA is to investigate modulation methods and devices for use with polarized light to improve the performance of Sunshine’s prototype blood glucose measuring instruments.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Title: Investigation of Spin Wing/Stop Rotor Concept</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRADA Between NRL and Advanced Aerospace Technologies, Inc., St. Louis, MO</td>
</tr>
<tr>
<td>The objective of this CRADA is to computationally evaluate the concept of a Spin Wing/Stop Rotor vehicle capable of a smooth transition between the helicopter and airplane (forward flight) modes. The results of the analysis will be used to provide technical support towards the development of the Spin Wing/Stop Rotor concept into an improved vehicle capable of operating efficiently in both hover and forward flight modes.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Title: NQW Devices for Optical Non-Destructive Evaluation of Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRADA Between NRL and Rice System, Inc., Irvine, CA</td>
</tr>
<tr>
<td>The objective of this CRADA is to evaluate the utility of NRL developed multiple quantum well devices for use in optical non-destructive evaluation of structural and mechanical materials and their potential commercial viability.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Title: Ion Implantation Technology for GaN and Related Alloys</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRADA Between NRL and Implant Sciences Corporation, Wakefield, MA</td>
</tr>
<tr>
<td>The objective of this CRADA is to develop and implement for device and IC fabrication an implantation technology for GaN and its related alloys.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Title: Digital Library Research</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRADA Between NRL and Visual History Foundation, Universal City, CA</td>
</tr>
<tr>
<td>The objective of this CRADA is to conduct basic Digital Library Research and evaluate innovative concepts.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Title: Liquid Crystal Material Research</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRADA Between NRL and Spatialight, Inc., Novato, CA</td>
</tr>
<tr>
<td>The objective of this CRADA is to couple NRL’s electroclinic liquid crystal materials with the monocristalline silicon active matrix substrates developed by Spatialight, Inc., and thereby develop and test high performance spatial light modulators for both military and commercial applications.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Title: High Power Fiber Amplifiers</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRADA Between NRL and Clark-MXR, Inc., Dexter, MI</td>
</tr>
<tr>
<td>The objective of this CRADA is to test the suitability of a broad stripe diode pumped fiber amplifier to replace the Master Oscillator Power Amplifier (MOPA) pumped amplifier currently used in the Clark-MXR Erf stretched pulsed modelocked fiber laser. In the course of this work the characteristics of the amplifier will be modified to attain suitability. A further objective is to maintain a low-cost robust design of the laser amplifier. It is expected that with minor (if any) modifications the fiber amplifier developed at NRL will provide a substitute for the MOPA pumped amplifier at a substantially reduced cost.</td>
</tr>
</tbody>
</table>
CURRENT IMPORTANT PROGRAMS (continued)

Title: Extending the Capabilities of an Optically-gated Scatter Reflectometer
CRADA Between NRL and Virginia Polytechnic Institute and State University: Fiber and Electro-Optics Research Center (VPI-FEORCE), Blacksburg, VA.
The objective of this CRADA is to explore the possibility of extending the operation of the NRL developed optically-gated scatter reflectometer (OGSR) to new wavelengths and enhancing other capabilities. OGSR is an extremely useful technique for probing the subsurface region of translucent materials such as ceramics, composites, plastics, and diamond translucent materials such as ceramics, composites, plastics, and diamond films. Using scanning techniques, OGSR can be used to directly image two-dimensional planes at or below the surface of such materials. NRL has developed optically-gated reflectometry device operating at 1.3 microns that can scan millimeter-sized subsurface regions of materials in approximately 2 seconds with a spatial resolution of less than 10 microns. The development of an OGSR that operates in the mid-IR or deep red wavelengths would allow for the detection of signals at much greater depths in certain materials.

Title: Diamond Based Materials Research
CRADA Between NRL and Diamond Microelectronics Corporation, Boston, MA
The objective of this CRADA is to develop cost-effective diamond-based, high power/high frequency switches and assorted vacuum electronics.

Title: Germanium Strip Detectors for X-ray and Gamma-ray Spectrometry and Imaging
CRADA between NRL and Physical Sciences Inc., Andover, MA
The objective of this CRADA is to develop a commercial supplier of double-sided Germanium Strip Detectors and associated low-power read out electronics to make a functional system. These detectors provide high energy resolution and imaging of gamma-rays in the 10-1000 keV energy range. Commercial applications range from medical imaging, radioactive waste surveys, non-destructive testing to nuclear monitoring.

Title: Bragg Grating Technology for Use in Marine Seismology via Towed Arrays, Permanent Seabed Installations
CRADA Between NRL and CIDRA Corporation
The objective of this CRADA is to establish the feasibility of using optical fiber and Bragg grating sensors for marine seismic profiling. Bottom-mounted seismic arrays using fiber Bragg grating seismic sensors will be small, lightweight, and require significantly less electric power than conventional piezoelectric sensors. Because the cabling and sensors are fiber optic, the arrays will have larger bandwidths and a higher dynamic range.

Title: Improved Methods for Generating Target Motion for Closed Loop Simulation Facilities
CRADA Between NRL and CARCO Electronics, Menlo Park, CA
The objective of this CRADA is to conduct joint research to gain a better understanding of CARCO’s technology through participation in the testing and validation of the Dual Target Motion System at NASA’s Ames Research Center. CARCO will conduct an extensive series of experiments/trials in Hangar 2 at the Ames Research Center to support the quantification, development, and verification of the Dual Target Motion System’s performance. Data collected from these trials will be forwarded to NRL for analysis as to the credibility of the system for use in the conduct of advanced countermeasures research. NRL will review the data with special emphasis placed on the fidelity of target motion with respect to positioning accuracy and accelerations achieved. The results of this research activity will yield a fundamental understanding of the performance boundaries for such systems and the range of research topics to which low cost electromechanical systems could be applied as compared to higher cost of electronic systems.
### CURRENT IMPORTANT PROGRAMS (continued)

<table>
<thead>
<tr>
<th>Title</th>
<th>CRADA Between</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Title: Wide Bandgap Semiconductor Research</strong></td>
<td>NRL and CREE Research, Inc.</td>
<td>Durham, NC</td>
</tr>
<tr>
<td>The objective of this CRADA is to conduct basic research on the</td>
<td></td>
<td></td>
</tr>
<tr>
<td>properties of wide bandgap semiconductor and their possible impact</td>
<td></td>
<td></td>
</tr>
<tr>
<td>on civilian and military applications. The role of intrinsic defects</td>
<td></td>
<td></td>
</tr>
<tr>
<td>and impurities in materials and device performance will be studied</td>
<td></td>
<td></td>
</tr>
<tr>
<td>by spectroscopic techniques and correlations with materials</td>
<td></td>
<td></td>
</tr>
<tr>
<td>processing parameters will be investigated.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Title: Product Evaluation of LDR Switches</strong></td>
<td>NRL and AT&amp;T Corp.,</td>
<td>Washington, DC</td>
</tr>
<tr>
<td>The objective of this CRADA is to demonstrate and provide</td>
<td></td>
<td></td>
</tr>
<tr>
<td>enhanced functionality into future Navy telecommunication products.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Title: Radiation Testing and Modeling of InP Solar Cells</strong></td>
<td>NRL and Essential Research, Inc., Cleveland, OH</td>
<td></td>
</tr>
<tr>
<td>The objective of this CRADA is to determine the radiation response of</td>
<td></td>
<td></td>
</tr>
<tr>
<td>particular high quality p/n InP solar cells and to initiate the</td>
<td></td>
<td></td>
</tr>
<tr>
<td>data base needed to implement the displacement damage dose model for</td>
<td></td>
<td></td>
</tr>
<tr>
<td>this cell technology in order to establish the characteristic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>radiation curve for this type of solar cell.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>**Title: Thin Films of Phosphors Based on the Alkaline-Earth</td>
<td>NRL and ETOM Technologies</td>
<td>Rockville, MD</td>
</tr>
<tr>
<td>Chalcogenides for Storage Applications**</td>
<td>Corporation of</td>
<td></td>
</tr>
<tr>
<td>The objective of this CRADA is to demonstrate that thin film</td>
<td></td>
<td></td>
</tr>
<tr>
<td>phosphors based on the alkaline-earth chalcogenides can be</td>
<td></td>
<td></td>
</tr>
<tr>
<td>deposited by pulsed laser deposition (PLD) under high vacuum</td>
<td></td>
<td></td>
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<tr>
<td>conditions (&lt;10^-6 Torr) and that the PLD phosphor thin films</td>
<td></td>
<td></td>
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<tr>
<td>exhibit bulk-like optical storage properties.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Title: Development of Bi-Stable, High Resolution Reflective Display</strong></td>
<td>NRL and Opticom ASA</td>
<td></td>
</tr>
<tr>
<td>The objective of this CRADA is to develop and build a bi-stable,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>high resolution reflective display using conducting polymer based</td>
<td></td>
<td></td>
</tr>
<tr>
<td>plastic substrates and further, to explore technical issues</td>
<td></td>
<td></td>
</tr>
<tr>
<td>involved with a high definition electrical read and write memory</td>
<td></td>
<td></td>
</tr>
<tr>
<td>device using a bi-stable cholesteric display and conducting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>polymer substrates.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Title: Multi-Quantum Well Solar Cells</strong></td>
<td>NRL and International</td>
<td>Houston, TX</td>
</tr>
<tr>
<td>Stellar Technology, Inc., Houston, TX</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The objective of this CRADA is to measure and analyze the radiation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>induced degradation of multi-quantum solar cells. It is expected</td>
<td></td>
<td></td>
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<tr>
<td>that these cells will show radiation characteristics similar to</td>
<td></td>
<td></td>
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<tr>
<td>standard solar cells except that the output efficiency of the</td>
<td></td>
<td></td>
</tr>
<tr>
<td>multi-quantum well cells is expected to be improved because of the</td>
<td></td>
<td></td>
</tr>
<tr>
<td>effect of the quantum wells.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Title: Marine Geophysical Systems</strong></td>
<td>NRL and C&amp;C Technologies,</td>
<td>Lafayette, LA</td>
</tr>
<tr>
<td>Inc., Lafayette, LA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The objective of this CRADA is to optimize geoscience software and</td>
<td></td>
<td></td>
</tr>
<tr>
<td>instrumentation for naval mine countermeasure missions and for</td>
<td></td>
<td></td>
</tr>
<tr>
<td>commercial applications related to the petroleum and</td>
<td></td>
<td></td>
</tr>
<tr>
<td>telecommunications industries. Software and instrumentation will be</td>
<td></td>
<td></td>
</tr>
<tr>
<td>made user-friendly to facilitate commercialization.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Title: LOCUTUS Software Support  
CRADA between NRL and Fred Griswold Engineering, Inc., Fredonia, AZ  
The objective of this CRADA is to develop a bug-free, accurate, user-friendly program with non-critical hardware demands. Each party will provide expert consultation and technical data to the other with the intent to integrate the Local User Terminal Upgrade System (LOCUTUS) with a number of Local User Terminals (LUTs) that are tuned into the frequency of antennae or receiving dishes of Low Earth Orbit (LEO) satellites. If the cooperative R&D is successful, NRL-SSC will transition a Graphic User Interface (GUI) to the Naval fleet to enhance tactical operations through the manipulation of oceanographic and meteorological data on a real-time basis in a combat or exercise environment. FG intends to market LOCUTUS-based LUTs to university and Government scientists who acquire environmental data for LEO satellites, and to the commercial fishing industry.

Title: Deep-Towed Acoustic/Geophysical System  
CRADA between NRL and Seafloor International, Inc., Seattle, WA  
The objective of this CRADA is to improve the State of the Art of DTAGS and the SSI developed Integrated Short Base Line (ISBL) navigation systems through research. Joint research between the parties will determine whether coupling the DTAGS with the ISBL would improve the geographical accuracy of NRL’s seismic seafloor data interpretation. The joint research would also evaluate whether the ISBL is suitable for deep ocean applications. A second objective of the research is to publish peer-reviewed articles related to basic research and exploratory development achieved cooperatively by the parties. The goal of the research is to improve the knowledge of seafloor environmental features for Naval operations.

Title: Biocides for Ocean and Littoral Applications  
CRADA Between NRL and Magellan Companies, Inc. (MCI)  
The objective of this CRADA is to test and evaluate MCI biocides and application techniques for ocean and littoral use. As a partner in this CRADA, NRL will evaluate the effects of MCI antifouling materials and application techniques on optical sensor windows, in both laboratory and natural conditions. Through this effort, promising materials that resist biofouling will be identified, and guidance developed on how to improve the materials and application techniques for use in ocean and littoral environments.
- **EO/IR Low Observables Facility**: The NRL NP-3D is an airborne testbed for multiple applications. Equipped with the AN/APS-145 AEW radar and the latest version of the Cooperative Engagement Capability, this platform supports both the Radar Modernization Program (RMP) and technology demonstrations for cruise missile defense (CMD). It provides the airborne node to demonstrate data sharing in real time between shipboard and airborne sensors for improved fleet defense against cruise missiles.

- **High Performance Computation and Communications Facility**: SGI Orgin2000 with 128 processors, 32 Gbytes memory, 52 Gflops peak; HP/Convex Exemplar SPP-2000 with 64 processors, 16 Gbytes memory, 46 Gflops peak; Sun HPC Ultra system with 40 processors, 4 Gbytes memory, 5 Gflops peak; Two TMC CM-500e systems. One with 256 nodes, 32 Gbytes memory, 40 Gflops peak; the second with 32 nodes, 4 Gbytes memory, 5 Gflops peak; EMASS AML/E storage system with 128 Gbytes disk and 50 Tbytes tape; Extensive graphics and visualization facilities; Local ATM networking at 155 and 622 Mbps, regional ATDnet network using ATM/SONET at 2.5 Gbps, and development of all-optical networks.

- **Nanoelectronics Processing Facility (NPF) and Penthouse Facility**: The NPF maintains a tool base for micrometer and nanometer device and structure fabrication. There is a strong emphasis on computer-aided design and lithography utilizing an e-beam lithography system with a 10-nanometer spot size. Other processes include reactive ion etching, deep ultra violet photolithography, ultra clean oxidation and annealing, and polysilicon and silicon oxide deposition. The micro-assembly lab provides a full sawing, bonding and chip mounting capability. A hands-on capability for compound semiconductor processing is provided in the Penthouse Facility.

- **EPI center**: This facility is dedicated to molecular beam epitaxial (MBE) film growth and in-situ characterization of Group II-VI and Group III-V semiconductors. Through the use of a high vacuum sample transfer system, samples can be moved between the two growth chambers as well as two analysis chambers without exposing the semiconductor structures to atmospheric contamination. In one analysis chamber, an angle-resolved electron spectrometer is used to determine the structure and chemical identity of the epitaxial layers near the film surface. In the second chamber, a scanning tunneling/atomic force microscope is employed to determine surface morphology and near surface electronic properties of the epitaxial layers.

- **Mass Spectrometry Facility**: Principal research instruments include a Finnigan TSQ-70 triple quadrupole mass spectrometer equipped with particle bombardment, electrospray, atmospheric pressure chemical ionization, thermal desorption, electron ionization and chemical ionization and tandem mass spectrometry capabilities.

- **Structural Acoustic Pools**: A steel, cylindrical tank (55 feet in diameter, 50 feet deep, containing 800,000 gallons of de-ionized water), which is vibration and temperature isolated, and instrumented with in-water robotic scanners to generate nearfield acoustic holographic and 3-dimensional laser vibrometric radiation and scattering databases for studying structural acoustics phenomena of scale-model submarines and mines. A second, somewhat smaller "sister" pool, that is similarly instrumented has a sandy bottom for studying buried/near bottom targets.

- **Hyperspectral Towed Array**: The only towed, optical, hyperspectral oceanographic array in the world, which is Ethernet-based with a 40-meter aperture and can be lowered to depths in excess of 100 meters. The array allows the simultaneous measurement of temperature, conductivity, high spectral absorption and attenuation (100 channels), and high spectral downwelling/upwelling irradiance (512 channels), as well as tilt, roll, and depth.
EQUIPMENT/FACILITIES (continued)

- **300KV Transmission Electron Microscope (TEM) Laboratory**: Each TEM magnifies up to 1.5 million times, yielding resolutions of 1.7 angstroms. The TEM Lab includes: an Environmental Cell for real-time observation of reactions in gaseous or liquid environments; a Scanning Image Observation device; and Electron Dispersive Spectroscopy; and Electron Energy Loss Spectrometer, and, multiple imaging devices including a sheet film camera.
### FY97 Funding Data (Millions $)

<table>
<thead>
<tr>
<th>Appropriation</th>
<th>In-House</th>
<th>In-House Management</th>
<th>Out-of-House</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>RDT&amp;E:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.1 ILIR</td>
<td>0.000</td>
<td>NA</td>
<td>NA</td>
<td>0.000</td>
</tr>
<tr>
<td>6.1 Other</td>
<td>76.695</td>
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<td>18.616</td>
<td>95.311</td>
</tr>
<tr>
<td>6.2</td>
<td>80.205</td>
<td>NA</td>
<td>70.802</td>
<td>151.007</td>
</tr>
<tr>
<td>6.3</td>
<td>75.056</td>
<td>NA</td>
<td>95.797</td>
<td>170.853</td>
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<tr>
<td><strong>Subtotal (S&amp;T)</strong></td>
<td>231.956</td>
<td>NA</td>
<td>185.215</td>
<td>417.171</td>
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<tr>
<td>6.4</td>
<td>20.029</td>
<td>NA</td>
<td>31.389</td>
<td>51.418</td>
</tr>
<tr>
<td>6.5</td>
<td>21.333</td>
<td>NA</td>
<td>30.135</td>
<td>51.468</td>
</tr>
<tr>
<td>6.6</td>
<td>2.604</td>
<td>NA</td>
<td>5.984</td>
<td>8.588</td>
</tr>
<tr>
<td>6.7</td>
<td>11.083</td>
<td>NA</td>
<td>19.979</td>
<td>31.062</td>
</tr>
<tr>
<td><strong>Non-DOD</strong></td>
<td>31.440</td>
<td>NA</td>
<td>67.789</td>
<td>99.229</td>
</tr>
<tr>
<td><strong>TOTAL RDT&amp;E</strong></td>
<td>318.445</td>
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<td>340.491</td>
<td>658.936</td>
</tr>
<tr>
<td>Procurement</td>
<td>26.564</td>
<td>NA</td>
<td>60.348</td>
<td>86.912</td>
</tr>
<tr>
<td>Operations &amp; Maintenance</td>
<td>12.265</td>
<td>NA</td>
<td>15.950</td>
<td>28.215</td>
</tr>
<tr>
<td>Other</td>
<td>8.461</td>
<td>NA</td>
<td>11.356</td>
<td>19.817</td>
</tr>
<tr>
<td><strong>TOTAL FUNDING</strong></td>
<td>366.621</td>
<td>NA</td>
<td>429.339</td>
<td>795.960</td>
</tr>
</tbody>
</table>

### Military Construction (Millions $)

| Military Construction (MILCON) | 0.285 |

### Personnel Data (End of Fiscal Year 1997)

<table>
<thead>
<tr>
<th>Type</th>
<th>Scientists &amp; Engineers</th>
<th>Technical Support &amp; Other Personnel</th>
<th>End Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Doctorates</td>
<td>Other</td>
<td></td>
</tr>
<tr>
<td>MILITARY</td>
<td>0</td>
<td>0</td>
<td>183</td>
</tr>
<tr>
<td>CIVILIAN</td>
<td>854</td>
<td>921</td>
<td>1,378</td>
</tr>
<tr>
<td>TOTAL</td>
<td>854</td>
<td>921</td>
<td>1,561</td>
</tr>
</tbody>
</table>

### Space and Property

<table>
<thead>
<tr>
<th>Building Space (Thousands of Sq Ft)</th>
<th>Property Acquisition Cost (Millions $)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAB</td>
<td>REAL PROPERTY</td>
</tr>
<tr>
<td>ADMIN</td>
<td>* NEW CAPITAL EQUIPMENT</td>
</tr>
<tr>
<td>OTHER</td>
<td>EQUIPMENT</td>
</tr>
<tr>
<td>TOTAL</td>
<td>* NEW SCIENTIFIC &amp; ENG. EQUIP.</td>
</tr>
<tr>
<td>ACRES</td>
<td>* Subset of previous category.</td>
</tr>
</tbody>
</table>

NA = Not Applicable
Naval Submarine Medical Research Laboratory

Abbreviated Functional Chart - Technical Organizations

Submarine Medical Research Laboratory

Vision Department
-Visual Sonar
-Tactical Displays
-Stress & Visual Performance

Submarine Systems Department
-Auditory Sonar
-Hearing Conservation
-Otoacoustic Emissions

Biomedical Sciences Department
-Submarine Rescue
-Submarine Medical Qualifications
-Submariner Screening
Naval Submarine Medical Research Laboratory  
Groton, CT 06349-5900  
CO: CAPT Mark T. Wooster, MSC  
XO: CDR Corley E. Puckett, MSC

<table>
<thead>
<tr>
<th>MISSION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provide timely, high quality R&amp;D to the submarine force to enhance auditory and visual sonar operator performance, submariner health and physical standards, closed environment atmospheric monitoring, submarine escape and rescue, and hearing conservation both in air and under the sea.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CURRENT IMPORTANT PROGRAMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific research efforts include:</td>
</tr>
<tr>
<td>Submarine escape and rescue.</td>
</tr>
<tr>
<td>Enhancement of auditory and visual sonar displays.</td>
</tr>
<tr>
<td>Hearing conservation in divers.</td>
</tr>
<tr>
<td>Evoked otoacoustic emissions.</td>
</tr>
<tr>
<td>Medical qualifications affecting submariners.</td>
</tr>
<tr>
<td>Evaluation of submarine atmospheres.</td>
</tr>
<tr>
<td>Color vision screening techniques.</td>
</tr>
<tr>
<td>Tactical display recommendations.</td>
</tr>
<tr>
<td>Effects of sonar transmissions on divers.</td>
</tr>
<tr>
<td>Evaluation of visual navigation aids.</td>
</tr>
<tr>
<td>Mortality of nuclear submariners.</td>
</tr>
<tr>
<td>Psychiatric screening of submariner candidates.</td>
</tr>
<tr>
<td>Noise reducing stethoscope.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>EQUIPMENT/FACILITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fully equipped auditory, visual, and physiological laboratories, two man-rated hyperbaric chambers, large anechoic chamber, medical research library, and graphic arts capabilities.</td>
</tr>
</tbody>
</table>
**Naval Submarine Medical Research Laboratory**  
Groton, CT 06349-5900  
(860) 449-3263  

**CO:** CAPT Mark T. Wooster, MSC  
**XO:** CDR Corley E. Puckett, MSC

### FY97 FUNDING DATA (MILLIONS $)

<table>
<thead>
<tr>
<th>APPROPRIATION</th>
<th>IN-HOUSE</th>
<th>IN-HOUSE MANAGEMENT</th>
<th>OUT-OF-HOUSE</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>RDT&amp;E:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.1 ILIR</td>
<td>0.000</td>
<td>NA</td>
<td>NA</td>
<td>0.000</td>
</tr>
<tr>
<td>6.1 Other</td>
<td>1.098</td>
<td>NA</td>
<td>0.000</td>
<td>1.098</td>
</tr>
<tr>
<td>6.2</td>
<td>0.150</td>
<td>NA</td>
<td>0.000</td>
<td>0.150</td>
</tr>
<tr>
<td>6.3</td>
<td>1.858</td>
<td>NA</td>
<td>0.000</td>
<td>1.858</td>
</tr>
<tr>
<td><strong>Subtotal (S&amp;T)</strong></td>
<td><strong>3.106</strong></td>
<td><strong>NA</strong></td>
<td><strong>0.000</strong></td>
<td><strong>3.106</strong></td>
</tr>
<tr>
<td>6.4</td>
<td>0.363</td>
<td>NA</td>
<td>0.000</td>
<td>0.363</td>
</tr>
<tr>
<td>6.5</td>
<td>0.000</td>
<td>NA</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>6.6</td>
<td>0.000</td>
<td>NA</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>6.7</td>
<td>0.000</td>
<td>NA</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Non-DOD</td>
<td>0.187</td>
<td>NA</td>
<td>0.000</td>
<td>0.187</td>
</tr>
<tr>
<td><strong>TOTAL RDT&amp;E</strong></td>
<td><strong>3.656</strong></td>
<td><strong>NA</strong></td>
<td><strong>0.000</strong></td>
<td><strong>3.656</strong></td>
</tr>
<tr>
<td>Procurement</td>
<td>0.000</td>
<td>NA</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Operations &amp; Maintenance</td>
<td>0.119</td>
<td>NA</td>
<td>0.000</td>
<td>0.119</td>
</tr>
<tr>
<td>Other</td>
<td>0.967</td>
<td>NA</td>
<td>0.000</td>
<td>0.967</td>
</tr>
<tr>
<td><strong>TOTAL FUNDING</strong></td>
<td><strong>4.742</strong></td>
<td><strong>NA</strong></td>
<td><strong>0.000</strong></td>
<td><strong>4.742</strong></td>
</tr>
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</table>

### MILITARY CONSTRUCTION (MILLIONS $)

- **Military Construction (MILCON)**: 0.000

### PERSONNEL DATA (END OF FISCAL YEAR 1997)

<table>
<thead>
<tr>
<th>TYPE</th>
<th>SCIENTISTS &amp; ENGINEERS</th>
<th>TECHNICAL SUPPORT &amp; OTHER PERSONNEL</th>
<th>END STRENGTH</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DOCTORATES</td>
<td>OTHER</td>
<td>end strength</td>
</tr>
<tr>
<td>MILITARY</td>
<td>8</td>
<td>0</td>
<td>16</td>
</tr>
<tr>
<td>CIVILIAN</td>
<td>7</td>
<td>9</td>
<td>12</td>
</tr>
<tr>
<td>TOTAL</td>
<td>15</td>
<td>9</td>
<td>28</td>
</tr>
</tbody>
</table>

### SPACE AND PROPERTY

<table>
<thead>
<tr>
<th>BUILDING SPACE (THOUSANDS OF SQ FT)</th>
<th>PROPERTY ACQUISITION COST (MILLIONS $)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAB 46.190</td>
<td>REAL PROPERTY 8.223</td>
</tr>
<tr>
<td>ADMIN 15.798</td>
<td>* NEW CAPITAL EQUIPMENT 0.000</td>
</tr>
<tr>
<td>OTHER 0.000</td>
<td>EQUIPMENT 4.020</td>
</tr>
<tr>
<td>TOTAL 61.988</td>
<td>* NEW SCIENTIFIC &amp; ENG. EQUIP. 0.175</td>
</tr>
<tr>
<td>ACRES 0</td>
<td>* Subset of previous category.</td>
</tr>
</tbody>
</table>

NA = Not Applicable
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Naval Surface Warfare Center

Abbreviated Functional Chart - Technical Organizations

Naval Surface Warfare Center

Carderock Division
- Ship and Ship Systems (Includes Submarine HM&E)
  - Signatures and Silencing
  - Vulnerability and Survivability
  - Machinery and Components
  - Hull Forms and Propulsors
  - Structures and Materials
  - Environmental Quality Control
  - In-Service Engineering of HM&E

Dahlgren Division
- Surface Ship Combat Systems
  - Surveillance, Detection, Control and Engagement
  - Electronic Warfare
  - Theater Air Defense
- Littoral Warfare Systems
  - Mine Countermeasures
  - Amphibious and Special Warfare
  - Diving
- Navy Strategic Weapon Systems

Pt. Hueneme Division
- Surface Ship Combat Systems
  - Combat Direction Systems
  - Operational Programs
  - Software Support
- Surface Ship Combat and Weapons Systems ILS
  - Systems Technology
  - In-Service Engineering of Combat Systems
- Ship Systems
  - Underway Replenishment

Indian Head Division
- Ordnance
  - Energetic Systems
  - Energetics, Manufacturing Technology & Material Development
  - Underwater Warhead RDT&E
  - Tri-Service CAD/PAD Technology Support
  - Explosive Safety Standards
  - Ordnance Environmental Protection
  - Missile In-Service Energetics Engineering

Crane Division
- Surface Ship Combat Systems
  - Microwave Component Technology
  - Microelectronic Technology
  - Electrochemical Power Systems Engineering
  - Gun Weapons Systems Technology
  - Radar Engineering & Industrial Support
  - Electronic Warfare Systems Technology
  - Ammunition Management
  - Physical Security Ashore & Afloat

3-86
MISSION

Operate the Navy's full spectrum RDT&E, engineering and fleet support center for ship hull, mechanical and electrical systems, surface ship combat systems, coastal warfare systems, and other offensive and defensive systems associated with surface warfare.

CURRENT IMPORTANT PROGRAMS


Cooperative Research and Development Agreements

Dahlgren Division

1. Development of New Software Products Based on NSWCDD Supersonic Airflow Programs. The objective of this task is to develop new software products embodying (a) previously developed original work of NSWCDD on supersonic airflow programs embodied in the software package
<table>
<thead>
<tr>
<th>CURRENT IMPORTANT PROGRAMS (continued)</th>
</tr>
</thead>
</table>

identified as ‘ZEUS’ and (b) the derivative work embodying trade secret data received from NEAR making the software products more suitable for commercialization by NEAR.

2. Development of a New and Improved Launcher for the Shoulder-Launched Multi-Purpose Assault Weapon (SMAW). The objectives of this task are: (1) to develop and transition to production the SMAW lightweight launcher, (2) to develop and transition to production a new SMAW spotter round with acceptable ballistics and lower production cost, (3) the successful transfer of the current SMAW technical data package, and (4) to investigate and incorporate other system improvements, as appropriate.

3. Research and Development Contributing to the Understanding of High-Voltage Connector Technology in Low-Inductance Environments. The objective of this task is the research and development contributing to the understanding of high-voltage connector technology in low-inductance environments along with multiple usage scenarios. NSWCDD and Raymond Engineering (RE) will evaluate and characterize the performance of the RE-developed removable Exploding Foil Initiator (EFI) and connector.

4. Amphibious, Marine Corps, and Mine Warfare C4I. The objective of this task is to develop a communication architecture and command and control overlay for the real-time command of maneuver units within a littoral scenario. In particular, this agreement focuses on the information exchange requirements of maneuver units in an amphibious assault that includes mine countermeasures operations. This effort will address the suitability of land-based maneuver control system suites including radio and/or cellular communications devices to extend Joint Maritime Command Information System (JMCIS) to the individual unit/sailor or marine. The objective of this agreement is to significantly reduce the cost and shorten the development and deployment cycle of an integrated voice and data communication system that meets the near-term needs of current littoral operations and provides an architecture for joint operations and growth in the future.

5. PCR Destruction of Volatile Organic Compounds. The objective of this CRADA with Physics International is to perform a parametric study of the NSWCDD PCR in search of the least power deposited into the corona discharge per unit air flow that still destroys more than 98% of a 500 ppm toluene impurity in an atmospheric pressure air flow. Parameters involved in this investigation include (but are not limited to) voltage risetime, applied voltage pulse width, amplitude and rep-rate, and air flow through the PCR and humidity.

6. Compliant Barium-Compound Substrate Technology for Chemically Deposited PbS and PbSe Monolithic Focal Plane Arrays. The objective of this CRADA with Sensarray Corporation is to develop an enabling technology that would allow the integration of infrared optical detector arrays and silicon electronic circuitry onto a single substrate. The integrated sensors must satisfy the requirements for state of the art infrared detection in terms of spectral response, sensitivity, and temperature of operation. They should also have the capability of on-chip signal processing. The output of the sensors must be directly applicable for electronic decision-making and be commensurate with more complicated electronic processing for target detection and pattern recognition.

7. Technical Assistance to CIT. The objective of this agreement with Virginia Center for Innovative Technology is to transfer technology from NSWCDD to those companies in the Commonwealth of Virginia that through the CIT have requested such technology. It is expected that technology is the fields of Devices and Sensors, Information and Systems Sciences, Advanced Data Processing Methods, Pulsed Power Technology, Simulation and Modeling, and Electromagnetic Environmental Effects will be of the most interest for Cooperative Research.
CURRENT IMPORTANT PROGRAMS (continued)

8. Evaluation of Loral on Environmental Remediation (13 Feb 1995 - 30 June 1996). Loral Federal Systems - Akron is conducting an internal R&D program to determine if an airborne laser is a suitable sensor to use for environmental remediation projects, such as, looking for small artillery shells scattered on the sea bed in shallow water. Coastal Systems Station (CSS) will provide information on past experiences with boat-mounted lasers, provide information on test sites, give reviews of test and analysis reports, and list recommendations on the suitability of the airborne laser. This supports the CSS project MUDSS (Mobile Underwater Debris Sensor System).

9. Archaeology Survey Using SINS (13 March 1995 - 13 March 1998). The Florida State University Marine Laboratory is conducting underwater archaeological surveys using traditional subsea mapping techniques. The Coastal Systems Station is providing to FSU manpower and equipment to map these regions with the SEAL In-shore Navigation System. This is providing CSS with the opportunity to test new equipment in controlled conditions and compare with traditional systems. FSU is gaining additional techniques in mapping and the use of new Navy equipment not commercially available.

10. OMNI Directional Vehicle Technology for Helicopter Support. AIR TRAX Inc. is developing new ground support vehicles for use with helicopters. Key to these vehicles is the development of a new ground platform which incorporates the OMNI Direction Vehicle technology which has been developed at the Coastal Systems Station. The Coastal Systems Station is benefiting through the development of new support platform of potential military use.

11. SDV-X Test and Evaluation (30 Sept 1996 - 30 September 1999). Columbia Research Corporation has preliminary design concepts for a Swimmer Delivery Vehicle which they wish to market to a foreign government. CC desires to use the expertise and facilities of the Coastal Systems Station to test and evaluate design and prototype vehicles.

12. Composite Manufacturing Process for Special Operation Forces Maritime Craft - CSS and SCI Inc. have entered into this agreement to develop concepts in composite materials manufacturing. This concept will lead to an innovative composite material preform framing system, to produce integrated frame structures during a single cure cycle. This technology will result in light weight, rugged, reproducible, components that can physically and mechanically withstand the water environment better than previously available composite systems.

13. Navy Experimental Diving Unit and Diving Systems International - Development of hybrid Dive/Gas Mask - The NEDU and DSI entered into this agreement in order to design, construct, and perform engineering analysis of a prototype Hybrid Dive/Gas Mask. DSI intends to manufacture and market this device if it proves successful. In addition to the commercial application of this concept to the private sector, unique applications to the SEAL community have been identified.

14. CSS and Stidd Systems Inc - Submersible Boat Development and Commercialization - This CRADA covers engineering and test services in support of Stidd Sytems, Inc.'s production and development of the SEAL submersible Boat. This CRADA will provide Stidd Systems with engineering support in any or all of the following areas: naval architecture, mechanical, hydraulic, and electronic systems; composite materials; thruster design; ballast systems; engineering analysis; and testing of prototype vehicle.

Carderock Division

1. Precision Sea Systems Corp. In an agreement with Precision Sea Systems Corp., NSWCCD will provide assistance in designing an impeller driven system to assist deep sea divers with a propulsion system that will give more thrust and power with a smaller and lighter unit.
CURRENT IMPORTANT PROGRAMS (continued)

2. Use of Spinning Microfilters to Separate Oil from Water for Abatement of Marine Oil Spills. Working with Marine Spill Response Corporation, CDNSWC personnel will demonstrate technology to separate seawater from oil spill fluids in a wide range of viscosities using nonclogging spinning microfilter oil/water separator technology.

3. Technical Assistance to the University of Maryland Technology Extension Service. The objective of this Agreement is to transfer technology from CDNSWC to those companies in the State of Maryland that, through UMCP, have requested technology assistance. It is expected that technology in the fields of chemical processing, testing, manufacturing technology, safety, electronics and environmental technology will be of the most interest for Cooperative Research.

4. Ben Franklin Technology Center (BFTC). The objective of this Agreement is to transfer technology from CDNSWC to those companies in the Philadelphia metropolitan region that through the BFTC have requested such technology. It is expected that technology in the fields of 1) Acoustics, 2) Advanced Materials and Structures, 3) Environmental, 4) Machinery Systems and 5) Ship Technology will be of the most interest for Cooperative Research.

5. NAVATEK II Model Tests. The objective of this agreement with the Pacific Marine and Supply Company, Ltd. is to broaden CDNSWC's database for SWATH technology and validate model prediction techniques. A second objective is to improve the powering performance of NAVATEK II, and its seakeeping characteristics to refine and facilitate the commercialization of this technology by Pacific Marine and Supply Company.

6. Double Hull and Composite Material/Structure Technologies. Ingalls and CDNSWC will perform a cooperative research and development effort to develop composite material/structures and double hull structures and associated subelements and technology for surface ships. It is anticipated that the work conducted will result in designs that can be realized in advanced surface combatants, retrofit activities to same, and commercial applications alike. The goals for these new designs will be tailored for each maintenance, and comparable cost, or lower. Ingalls, upon successful completion of development, intends to carry out a plan for marketing the technologies for a variety of naval and commercial applications.

7. Shipboard Power Systems Improvement Program. The intent of this CRADA with Westinghouse Electric Corp., Instrumentation & Control Systems Dept. (WI&CSD) is to evaluate specific applications of WI&CSD developed power and control system designs and concepts to Navy and commercial ships. Successfully proven applications may later be shared with other Westinghouse Departments to improve commercial product lines.

8. Study of Reduced Fire Hazard Silicone Materials for Navy Applications. The objectives of the CRADA with Dow Corning Corporation are to develop, document and evaluate silicone-based or silicone modified advanced fire resistant materials. Also, reformulate and optimize processing characteristics of the above mentioned polymeric materials to conform to Navy selected fabrication techniques. Facilitate successful fire resistant materials for use in commercial applications. Organize technical workshops involving Navy and Dow Corning personnel to further understand the needs and capabilities of the partners.

9. Modular Utility Core. The objective of this partnership with the Ben Franklin Technology Center is to jointly develop a modular utility core for low/moderate income housing. This core will be a prototype modular unit containing the mechanical, electrical and energy management systems for residential housing. The prototype modular utility core is intended to be fabricated at Naval Surface Warfare Center, Carderock Division - Philadelphia, PA, transported to a residential site and installed into an existing house being rehabilitated.
10. Recycling of Navy Ship Plastic Waste Into Marine Pilings. The objective of the work performed under this Agreement with Seaward International, Inc. is to determine if Navy ship waste plastic can be used as a core in the construction of SEAPILE composite marine pilings without degradation of their performance characteristics.

11. The Intelligent Shock Mitigation & Isolation System Through Applied RSPM Technology. The objective of the CRADA with the ISMIS Consortium is to first perform the remaining development work to refine and upgrade RSPM control algorithms for Naval applications to meet a compelling need for Naval isolation technology; and secondly to scale up and test the fully integrated systems in mock-ups and simulators to verify the technology. The objective of the overall RSPM program is to create a commercially available family of ISMIS products through applied RSPM that will both meet the compelling need for Naval isolation technology and satisfy the uses of ISMS in seismic protection of structures.

12. Light Scattering Measurement Techniques and Practices. The technical objective of the CRADA with the Surface Optics Corporation is to develop standard materials for verifying polarized BRDF measurements in the visible and infrared spectral region. Currently there are no accepted standard materials for verifying Mueller matrix BRDF measurements in general, or for unpolarized scattering measurements in the infrared. Work performed under this CRADA will produce well characterized sample materials that can be theoretically analyzed to predict the polarized BRDF which can be used to verify the experimental measurements.

13. Technical Assistance to the Center for Innovative Technology (CIT). The objective of this Agreement is to transfer technology from CDNSWC to those companies in the Commonwealth of Virginia that, through CIT, have requested technology assistance. It is expected that technology in the fields of acoustics, advanced materials, environmental technology, hydromechanics, machinery and ship technology will be of the most interest for Cooperative Research.

14. Centrifugal Casting Technology. The objectives of the CRADA with U.S. Bronze and Machine, Incorporated are to: 1) Develop techniques for synthesis of remeltable TIC/bronze and/or WC/bronze or both, metal matrix composite ingots; 2) Develop centrifugal casting procedures; 3) Scale up ingot size from laboratory to production size, including centrifugal casting procedures from bench scale to large size castings respectively; 4) Produce wear resistant full size components such as cylinder liners, bearing races, gears, flywheels and others as need arises; and 5) Commercialize the technology and the product for U.S. markets beyond Navy (and DoD) components and applications.

15. Resonance Apparatus. The objective of this Agreement with the Rohm and Haas Company is to obtain resonance apparatus evaluation of twelve samples covering a wide range of frequencies by the use of time-temperature superposition of data obtaining in the kilohertz region as a function of temperature. These results will be analyzed for the insight possible into the molecular mechanisms responsible for the dynamic behavior. Of particular interest is to compare the data obtained with the resonance apparatus to the data obtained from commercial equipment for the same purpose. It is hoped that the potential advantages of using the resonance apparatus will be demonstrated by these measurements.
## CURRENT IMPORTANT PROGRAMS (continued)

### Crane Division

1. **Southern Indiana Development Commission (21 June 1995 through 21 June 1998).** The Southern Indiana Development Commission (SIDC) will provide Technology Access Services through this Agreement to technologically based companies having technical needs that are similar to Crane Division, Naval Surface Warfare Center's (CRDNSWC) skills. This technology access service program at SIDC will provide technology assessments, technology information services, and technology transfer engagements to firms in the region and CRDNSWC personnel. The purpose of this CRADA is to foster the transfer of technology from CRDNSWC to companies, in particular small businesses, who request technologies through SIDC's technology access service. While all the types of technology that are available to be transferred and may be determined by CRDNSWC and SIDC to be of mutual interest are not specifically identified herein, the primary areas are:

   1) Microelectronic Technology.
   2) Microwave Technology.
   3) Acoustic Sensor Technology.
   4) Failure Analysis/Materials.
   5) Night Vision/Electro-Optics Technology.
   6) Non Destructive Test.

2. **Cinergy Technology, Inc. (9 August 1996 through 9 August 1999).** CTI is entering into a CRADA with NAVSURFWARCENDIV Crane for the development and evaluation of the Proton Exchange Membrane (PEM) Fuel Cell Technology. NAVSURFWARCENDIV Crane intends to provide CTI further insight and recommendations in the development of the PEM fuel cell technology including its operating characteristics and reliability under various test applications. This CRADA will enable CTI to gain necessary information for the development of the PEM technology for commercial and industrial applications. NAVSURFWARCENDIV Crane is a leading U.S. military base in electrochemistry and power systems designs and applications and will add to its knowledge base with a focus of the technology to military applications. These applications include shipboard, submarine and man portable uses. The primary technology assessment vehicle is the Ballard Power Generating System (PGS) 103.

3. **Martin Marietta Corp. Automation Systems Company (24 March 1996 through 20 September 1999).** This Agreement provides the framework for the reconfiguration of existing Consolidated Automated Support System (CASS) assets into a deployable Integrated Maintenance Management System (IMMS) for use on L Class and DDG Class Navy combatants.

4. **American Competitiveness Institute (20 September 1996 through 20 September 1999).** The Electronics Manufacturing Productivity Facility (EMPF), operated by the American Competitiveness Institute (ACI), is entering into a CRADA with NAVSURFWARCENDIV Crane for the development, application and transfer of new electronic manufacturing technologies to both military and commercial sectors. Under this cooperative agreement, Crane provides linkages with Navy and DoD programs to evaluate electronic manufacturing technology needs in light of Navy and DoD requirements. Crane is unique in that they represent in excess of 150 major and minor Navy customers within their organization, and have as one of their primary missions that of assisting these programs to field quality, reliable hardware that meets the intended mission parameters. EMPF/ACI’s mission of providing the latest manufacturing technologies to the nation’s electronics industry will be enhanced by Crane’s participation in this agreement.

5. **Rose Hulman Institute of Technology (Educational Partnership) (27 March 1996 through 27 March 2001).** The purpose of this Agreement is to aid in the educational experience of Rose Hulman students by providing a mechanism by which the students can benefit from the staff expertise, unique facilities and equipment related to undersea.
### CURRENT IMPORTANT PROGRAMS (continued)

6. **Analytic Sciences Corporation (ASC).** This CRADA will develop and initiate the Computer Assisted Technical Transfer (CATT) Program. The CATT Program digitizes technical data package information in a new format using multimedia capability and internet links.

7. **Center for Battery Information & Technology, Inc. (CBIT).** This CRADA will establish protocols and improve both the performance and life cycle cost of power systems.

8. **EG&G.** The purpose of this CRADA is to develop an amorphous silicone process for flat panel displays.

The agreements 9 - 12 are for sale of test services to private industry under statute 10-USC 2539b.


10. **Bath Iron Works.** To develop procedures for cell matching, testing and refurbishment of No-Brake Power Supply Battery for DDG-51 Class Ships.

11. **Hughes Technical Services Company.** Blowing Dust Test for AN/AWM-101 Hellfire Test Set.

12. **Center for Battery Information and Technology, Inc. (CBIT).** Batteries and Ancillary Equipment Test and Evaluation.

13. **Memorandum of Agreement (MOA)/Memorandum of Understanding (MOU) with American Plastics Partners to provide consultation, materials, and failure analysis of plastics.**

14. **MOA/MOU with Betc to provide testing and evaluation of electrochemical power sources for electric vehicles and hybrid electric vehicles.**

15. **MOA/MOU with Naval Post Graduate School to exchange data, research, technical expertise, and the use of equipment and facilities.**

### Indian Head Division:

1. **Evaluation of Near Net Shape Casting for the Fabrication of Specialty Aerospace Components.** The objective of the CRADA is to evaluate the feasibility, advantages and impact of fabricating metal aerospace components using net shape casting technology. This will be done through analysis of characteristics, building and loading specially designed prototype hardware and subjecting the loaded assemblies to environmental and performance tests.

2. **Environmentally Safe Demilitarization Technologies for Conventional Ammunition.** The objective of the CRADA is to mutually develop environmentally safe process for removal of energetic material from reusable motor casings.

3. **Applied Research into Composite Air Bag Propellants.** The objective of the CRADA is to utilize IHDIV manufacturing technology to develop processes originating with OEA, Inc. The ultimate goal would be a controlled release of a gas producing energetic material.

4. **Technical Assistance to the University of Maryland's Technology Extension Service.** The objective of this CRADA is to transfer technology from IHDIV to those companies in the State of Maryland that, through University of Maryland at College Park, have requested technology assistance. It is expected that technology in the fields of chemical processing, testing, manufacturing technology, safety, electronics and environmental technology will be of the most interest for cooperative research.
CURRENT IMPORTANT PROGRAMS (continued)

5. Application of Radiation Processing Technologies to the Manufacture and Demilitarization of Energetic Materials. The objective is for Damilic Corporation and IHDIV to mutually determine the feasibility of safely curing energetic materials and removing energetic material through radiation processing technology.

6. Applied Research into Instructional and Information Exchange Technologies. The objective of the CRADA is to develop, demonstrate, introduce and transfer new and evolving information technologies relating to training and instructional approaches. The technology will be transferred from the innovator (US Navy) to the user (Charles County Community College, Maryland) and further developed to meet mutual needs.

7. Applied Research into Laser Initiated Explosive Subsystems. The objective of the CRADA is to use a process designed by Ensign-Bickford Company to determine sensitivity and safety aspects with Navy propellant formulations.

8. Advanced Modular Arm-Fire Device for Multiple Applications. The objectives to integrate advanced technology, such as found in EFI detonators, ‘smart electronics’ and miniaturized sensors, for the purpose of demonstrating and evaluating low cost, advanced explosive initiation technology.

9. Evaluation of Biotechnology to the Treatment of Nitrate Ester Contaminated Wastewater with High Inorganic Nitrates. The objective is to evaluate the effectiveness, efficiency, and compatibility of applying EFX’s biotechnology solutions to explosive processing waste streams.

Port Hueneme Division

1. United Defense Limited Partnership to jointly explore the potential application of advanced materials, specifically titanium, for use in marine applications. Performing a study on the cost-benefits of titanium for use in above deck components such as the Vertical Launching System MK 41. A prototype hatch is being manufactured which will undergo testing at the Surface Warfare Engineering Facility (SWEF) and Self-Defense Test Ship (SDTS) in early 1998.

2. Agreement with Ventura County Economic Development Association (VCEDA) to explore technologies for enhancing communication between Port Hueneme and support contractors. Included is the use of the World Wide Web of technology transfer through providing information and easy access to intellectual property within NSWC, and unique facilities.

Personnel Exchange

Dr. Harold Szu of NSWCDD served as a Lamson Professor and the Director of the Center for Advanced Computer Studies at the University of Southwestern Louisiana (Lafayette, LA) during the 95-96 academic year. In addition to being Director of the Center, he taught neural networks and wavelets courses at the graduate level.

EQUIPMENT/FACILITIES


Carderock Division - Bayview, ID: Acoustic Research Detachment.

Carderock Division - Memphis, TN: Large Cavitation Channel (LCC).

Carderock Division - Norfolk, VA: Combatant Craft Engineering Detachment.

Carderock Division - Portsmouth, VA: Shock Trials Instrumentation.

Carderock Division - Cape Canaveral, FL: Research Vessel Hayes.

Carderock Division - Fort Lauderdale, FL: South Florida Test Facility.
<table>
<thead>
<tr>
<th>Equipment/Facilities (continued)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Carderock Division - Panama City, FL:</strong> Lauren &amp; Athena Research Vessels/Ship Systems.</td>
</tr>
<tr>
<td><strong>Carderock Division - Bremerton, WA:</strong> Carr Inlet Test Facility.</td>
</tr>
<tr>
<td><strong>Carderock Division - Ketchikan, AK:</strong> Southeast Alaska Facility.</td>
</tr>
<tr>
<td><strong>Indian Head:</strong> Continuous processing facility. Composite case/component overbraiding facility. Synthesis and scale-up facilities for all types of energetic materials. Test facilities. Surface Warfare Engineering Facility. Electrostatic Discharge (ESD) facility.</td>
</tr>
<tr>
<td><strong>Port Hueneme Division, Port Hueneme, CA:</strong> Surface Warfare Engineering Facility. Self-Defense Test Ship (SDTS).</td>
</tr>
<tr>
<td><strong>Port Hueneme Division, Dam Neck, VA:</strong> Software program generation and life-cycle maintenance laboratories.</td>
</tr>
</tbody>
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## FY97 Funding Data (Millions $)

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<thead>
<tr>
<th>Appropriation</th>
<th>In-House</th>
<th>In-House Management</th>
<th>Out-of-House</th>
<th>Total</th>
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<tr>
<td><strong>RDT&amp;E:</strong></td>
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<td>6.1 ILIR</td>
<td>4.868</td>
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<td>NA</td>
<td>4.868</td>
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<tr>
<td>6.1 Other</td>
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<td>3.167</td>
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<td>6.2</td>
<td>70.908</td>
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<td>6.3</td>
<td>49.701</td>
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<td><strong>Subtotal (S&amp;T)</strong></td>
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<td><strong>265.785</strong></td>
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<td>6.5</td>
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<td>6.6</td>
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<td>22.267</td>
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<td>Non-DOD</td>
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<td>0.000</td>
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<tr>
<td><strong>TOTAL RDT&amp;E</strong></td>
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<td><strong>434.512</strong></td>
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<td>Procurement</td>
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<td>Operations &amp; Maintenance</td>
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<td>Other</td>
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<td><strong>TOTAL FUNDING</strong></td>
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<td><strong>NA</strong></td>
<td><strong>1,321.712</strong></td>
<td><strong>2,964.814</strong></td>
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## Military Construction (Millions $)

| Military Construction (MILCON) | 27,600 |

## Personnel Data (End of Fiscal Year 1997)

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<thead>
<tr>
<th>Type</th>
<th>Scientists &amp; Engineers</th>
<th>Technical Support &amp; Other Personnel</th>
<th>End Strength</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Doctorates</td>
<td>Other</td>
<td></td>
</tr>
<tr>
<td>Military</td>
<td>0</td>
<td>0</td>
<td>489</td>
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<tr>
<td>Civilian</td>
<td>390</td>
<td>6,843</td>
<td>8,595</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td><strong>390</strong></td>
<td><strong>6,843</strong></td>
<td><strong>9,084</strong></td>
</tr>
</tbody>
</table>

## Space and Property

<table>
<thead>
<tr>
<th>Building Space (Thousands of SQ FT)</th>
<th>Property Acquisition Cost (Millions $)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lab</td>
<td>REAL PROPERTY</td>
</tr>
<tr>
<td>ADMIN</td>
<td>* NEW CAPITAL EQUIPMENT</td>
</tr>
<tr>
<td>OTHER</td>
<td>EQUIPMENT</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>* NEW SCIENTIFIC &amp; ENG. EQUIP.</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
</tr>
<tr>
<td>Acres</td>
<td><strong>71,767</strong></td>
</tr>
</tbody>
</table>

NA = Not Applicable
Naval Undersea Warfare Center

Abbreviated Functional Chart - Technical Organizations

Naval Undersea Warfare Center

Newport Division
Newport, RI

- Submarine Combat Systems Directorate
- Surface Undersea Warfare Directorate
- Weapons Systems Directorate
- Business Resources Directorate

Keyport Division
Keyport, WA

- Submarine Electromagnetic Systems Department
- Undersea Warfare Analysis Department
- Engineering, Test and Evaluation Department
- Undersea Vehicles Group
- USW Test, Training & Evaluation Group
- Combat Systems Support Group
- Fleet Operational Support Department
### MISSION

The Naval Undersea Warfare Center (NUWC) Mission promulgated by OPNAVNOTE 5450 Ser 09B22/1US10577 dtd 23 Dec 91 is as follows:

'Operate the Navy’s full spectrum research, development, test and evaluation, engineering, and fleet support center for submarines, autonomous underwater systems, and offensive and defensive weapon systems associated with undersea warfare.'

### CURRENT IMPORTANT PROGRAMS

#### SCIENCE AND TECHNOLOGY

The Naval Undersea Warfare Center conducts a comprehensive Science and Technology program in support of its mission that spans In-House Laboratory Independent Research (ILIR), Basic Research, Applied Research and participation in Advanced Technology Demonstrations. Current emphasis areas include:

- **Submarine Combat Control** - contact management, weapon targeting, engagement planning and advanced information management concepts;
- **Submarine/Surface Ship Sonar** - shallow water active classification, high gain systems, active surveillance systems, full signature processing, deployable surveillance systems;
- **Torpedoes** - propulsion and control systems, hydrodynamics/drag reduction, supercavitating technology noise reduction/acoustics, countermeasure technologies, UUV’s, launchers; and advanced concepts;
- **Submarine Communications** - advanced submarine communications architectures, communication at speed and depth, mast antenna technology, and advanced Arctic communications.

#### UNDERSEA WARFARE MODELING AND ANALYSIS

- New USW Program Capability Assessment
- Analysis of Alternative (AOA)
- Investment Strategy Options Development
- Intelligence Data Assessment
- USW Requirements Analysis
- Derivation of USW Technology Goals
- Coordinated ASW Force Assessments
- Submarine and USW Synthetic Environments
- Battle Group Net Base USW
- Submarine System Engineering and Analysis
- SSN Tactical Development
- Test and Training Enabling Architecture

#### SUBMARINE, SURFACE SHIP AND AIR LAUNCHED TORPEDOES, TORPEDO/SONAR COUNTERMEASURES, UUVS, ASSOCIATED LAUNCHER SYSTEMS AND MISSILES

- Torpedo MK 48 / MK 48 ADCAP / ADCAP MODS Program
- Torpedo Mk 50 Program
- Torpedo MK 46 Program (with Service Life Extension Program)
- Lightweight Hybrid Torpedo Program
- Torpedo M46/Mk 48 FMS Program
- Torpedo Alternate Fuels Program
## CURRENT IMPORTANT PROGRAMS (continued)

- Mk 30 ASW Target Program
- Near Term Mine Reconnaissance System Program
- Long Term Mine Reconnaissance System Program
- ONR UUV Program
- ADC Mk 2/3/4 Countermeasure Program
- Affordable Common Countermeasure Program
- Tomahawk Cruise Missile (Submarine-Launched)
- Encapsulated Harpoon Weapon System
- Submarine Weapon Simulators and Test Vehicles
- Integrated Diagnostic Support System
- Submarine Torpedo Tubes
- SSN-21 Launcher Systems
- Turbine Pump Ejection Systems
- Submarine Weapon Handling
- SSN-688 Vertical Launch System
- Surface Ship Torpedo Tubes
- New SSN Launcher Systems
- Submarine External Countermeasure Launchers
- Submarine Internal Auxiliary Launchers
- Elastomeric Ejection Systems
- Submarine Advanced Launch Technology
- Adaptable High Speed Undersea Munitions
- Vertical Launch ASROC

### SUBMARINE SONAR

- Acoustic Rapid COTS Insertion
- AN/BQQ-5
- AN/BQG-5 Wide Aperture Array
- TB-16F, -23 and -29 Submarine Towed Arrays
- Submarine Sonar Advanced Development
- AN/WLY-1 AN/WLR-9
- New SSN Sonar Subsystem
- AFTAS
- RATTRAP
- Sonar Advanced Development
- Transducer Tech Direction/Support Program
- AN/BSY-1 Acoustics
- Submarine Ancillary Sonar Systems
- Affordable Array Technology
- Ultra Thin Line Array
- Thin Optical Towed Array
- Acoustic Comms
- Submarine Safety (SUBSAFE) Program
- Multi-Chip Module Laboratory
- NATO FORACS AUTEC (NFA)
- Underwater Tactical Training Range Development
- AUTEC Hydrophone Replacement Program
- Tri-Service Signature Measurement and Database System
- Pinger Program
- Undersea Battlespace
### CURRENT IMPORTANT PROGRAMS (continued)

#### SURFACE SHIP SONAR AND ASW SYSTEMS

- AN/SQQ-89 ASW Combat System
- Multistatic Sonar
- Surface Ship Torpedo Defense
  - AN/SQR-19 Towed Array Sonar
- AN/SQS-53 A,B,C,D Active Hull Sonar
- AN/SQQ-28 Sonobuoy Processor
- KINGFISHER
- OK-520/SQQ Common Winch
- AN/SSN-2(V) Precise Integrated Navigation System
- AN/SYQ-13 Navigation, Command & Control System
- AN/SSQ-94 Combat System Integrated Training Equipment
- AN/WQN-1 Detecting-Ranging Set
- Echo Track/Target Classifier
- Shallow Water Active Detection Classification
- Surface Combatant 21st Century
- DD-21
- Lightweight Broadband Variable Depth Sonar
- Towed Active Receiving System (TARS)
- Sonar Insitu Mode Assessment System (SIMAS)
- Weapon System Accuracy Trails (WSAT) Program
- ASW Systems Consolidated Operability Test (SCOT) Program
- Carrier Tactical Systems Center
- AN/SQQ-30 Mine Classifying-Detecting Set
- AN/SQQ-32(V) Mine Hunting Sonar

#### SUBMARINE COMMUNICATIONS, ELECTRONIC WARFARE SUPPORT MEASURES (ESM), ELECTRO-OPTICS SYSTEMS/PERISCOPE

- Submarine Connectivity
- On-Hull Extremely Low Frequency (ELF) Antenna
- SHF High Data Rate (HDR) Phased Array Antenna Advanced Technology Demonstration
- Submarine High Data Rate (HDR) Antenna System
- OE-538 Multifunction Mast Antenna
- Submarine Integrated Antenna System (SIAS)
- Extremely Low Frequency (ELF) Communications
- Navy Extremely High Frequency (EHF) Satellite Communication Program (NESP)
- Submarine Communication Support System (SCSS)
- Integrated Electronic Support Measures (ESM) Mast (IEM)
- Advanced Submarine Tactical Electronic Combat System (ASTECS)
- AN/BST-1 Submarine Emergency Communications Buoy
- AN/WLR-8 High Probability of Intercept (HPI) Receiver
- Photonics Mast
- Electro-Optic Sensor Development and Acquisition
- Submarine Periscopes Program
- Submarine Shipboard Electromagnetic Compatibility Improvement Program (SEMCIP)
- EMC Advisory Boards (EMCAB)
- R&D Submarine Program
- Shallow Water Diesel Submarine Target

#### NEW SSN, SEAWOLF, LOS ANGELES AND TRIDENT CLASS SUBMARINE COMBAT, AND COMBAT CONTROL SYSTEMS

- NSSN
- AN/BSY-2, AN/BQG-5 Submarine Combat System
- Combat Control Systems MK 2
### CURRENT IMPORTANT PROGRAMS (continued)

- Seawolf Non-Propulsion Electronics
- Trident Command and Control System
- Missiles: Combat Control
- Module Test and Repair Program
- Trainers
- Sensor Performance Computer Based Tactical Aids
- COMOPTEVFOR USW Trusted Agent
- Advanced Tomahawk Weapons Control System

### UNDERSEA RANGES:

- Atlantic Undersea Test and Evaluation Center (AUTEC)
- Fleet Operational Readiness Accuracy Check Sites (FORACS)
- Tactical Underwater Range Development
- Southern California ASW Range
- SWIFT Tracking System
- Barking Sands Tactical Underwater Range Development
- Range Technology Development
- Dabob Bay Range Development and Operation
- Nanosee Deep Water Tracking Range Development and Operation
- Quinault Shallow Water Range Development and Operation
- Hawaiian Island Underwater Range (HAIUR) Site
- San Clemente Island Underwater Range (SCIUR) Development and Operation
- Air Operations Post-operational Analysis Critique and Exercise Review (PACER)

### METROLOGY AND MECHANICAL INSPECTION PROGRAM

#### TECHNOLOGY TRANSFER:

The Naval Undersea Warfare Center conducts an extensive technology transfer program that is structured to make technology developed for defense purposes available to the academic and industrial communities. The main mechanics for technology transfer are:

- **Patent Program** - The Naval Undersea Warfare Center operates a highly efficient patent program believed to be the most productive in U.S. government (patents per scientist/engineer). In FY97, 170 invention disclosures were recorded, 123 patent applications were filed, and 96 patents were issued or allowed (76 patents and 20 classified allowances (D-10)). Some significant examples are:
  - Patent No. 5,632,218 - Debris Deflector Detection by a Threat Projectile
  - Patent No. 5,637,826 - Method and Apparatus for Optimal Guidance
  - Patent No. 5,654,937 - Acoustic Element Tester for an Array of Hydrophones
  - Patent No. 5,673,645 - Agile Water Vehicle

- **Cooperative Research and Development Agreements (CRADAs)** - A CRADA is an agreement between one or more federal laboratories and one or more nonfederal parties. Under a CRADA, the government laboratories provide personnel, services, facilities, equipment or other resources with or without reimbursement (but not funds to nonfederal parties). The nonfederal parties provide funds, personnel, services, facilities, equipment or other resources toward the conduct of specified research and development efforts that are consistent with the missions of the laboratory. Significant CRADAs with NUWC include:
<table>
<thead>
<tr>
<th>CURRENT IMPORTANT PROGRAMS (continued)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lockheed-Martin</strong> - Explore and exploit massively parallel processing as applicable to sonar processing.</td>
</tr>
<tr>
<td><strong>MedAcoustics, Inc.</strong> - Demonstrate signal-processing algorithms to process acoustic signals within the cardiac cycle.</td>
</tr>
<tr>
<td><strong>Institut Superieur d-Electronique</strong> - Investigate the physics of close-packed acoustic array element interaction phenomena.</td>
</tr>
<tr>
<td><strong>Precision Signal, Inc.</strong> - Develop state-of-the-art equipment to map deep- and shallow-water ocean floors.</td>
</tr>
<tr>
<td><strong>General Dynamics/Electric Boat Division</strong> - Further the development of Computational Fluid Dynamics to meet current and future Navy needs.</td>
</tr>
<tr>
<td><strong>Connecticut Municipal Electric Energy Cooperative</strong> - Investigate electric vehicle electromagnetic interference, measurement and mitigation.</td>
</tr>
<tr>
<td><strong>University of Maine</strong> - Develop a method of predicting the deformation of nets deployed in an ocean environment.</td>
</tr>
<tr>
<td><strong>Lucent Technologies</strong> - Develop ultra-thin array technology.</td>
</tr>
<tr>
<td><strong>Yale University School of Medicine</strong> - Bio-medical model development.</td>
</tr>
<tr>
<td><strong>Loctite Corporation</strong> - Material property measurement.</td>
</tr>
<tr>
<td><strong>Draper Laboratory</strong> - Co-development of unmanned underwater vehicle technology.</td>
</tr>
<tr>
<td><strong>Foster-Miller, Inc.</strong> - Demonstrate low-cost, expendable bottom-crawling vehicles for ocean-bottom explorations.</td>
</tr>
<tr>
<td><strong>Public Service Electric and Gas Co.</strong> - Material development, testing and evaluation for shielding capability in electromagnetic fields.</td>
</tr>
<tr>
<td><strong>Rhode Island Technology Transfer Center</strong> - Technical assistance to Rhode Island’s technically-based companies.</td>
</tr>
<tr>
<td><strong>CytoTherapeutics, Inc.</strong> - Prototype packaging for medical devices using stereolithography.</td>
</tr>
<tr>
<td><strong>Westfall Manufacturing Co.</strong> - Design verification and representation of a static fluid mixing device for water treatment processing.</td>
</tr>
<tr>
<td><strong>Niche Medical, Inc.</strong> - Assistance in the design of a surgical smoke plume collector.</td>
</tr>
<tr>
<td><strong>Deep Creek Technology, Inc.</strong> - Assistance with the integrated diagnostics support system.</td>
</tr>
<tr>
<td><strong>Michigan State University</strong> - Development and application of controllable fluids.</td>
</tr>
<tr>
<td><strong>Automata, Inc.</strong> - Assistance with the integrated diagnostics support system.</td>
</tr>
<tr>
<td><strong>Western Geophysical</strong> - Very low frequency projector technology.</td>
</tr>
<tr>
<td><strong>Dr. Alan Semine</strong> - Medical image processing for breast cancer.</td>
</tr>
<tr>
<td><strong>Flight Safety Technologies, Inc.</strong> - Modeling and simulation of the acoustic signature of atmospheric disturbances.</td>
</tr>
<tr>
<td><strong>Connecticut Technology Associates, Inc.</strong> - Technical assistance to the State of Connecticut’s technological companies.</td>
</tr>
<tr>
<td><strong>TRACOR Corporation</strong> - Develop a graphical Environmental Management Information System (EMIS) to track hazardous materials and hazardous waste.</td>
</tr>
<tr>
<td><strong>Virtual I/O, Inc.</strong> - Develop head-mounted display system hardware and software for military applications including shipboard systems battlefield training simulations.</td>
</tr>
<tr>
<td><strong>4-Cycle, Inc.</strong> - Develop conversion kits for small, high-output internal combustion 2-cycle and 4-cycle engines.</td>
</tr>
<tr>
<td><strong>Economic Development Council of Kitsap County</strong> - Foster technology transfer between NUWC Division, Keyport and small businesses in the Kitsap County, WA, region.</td>
</tr>
<tr>
<td><strong>Sound Ocean Systems, Inc.</strong> - Develop deep diving (to 6000 meters) recovery capability with flexible attachments capable of performing a wide variety of tasks.</td>
</tr>
</tbody>
</table>
CURRENT IMPORTANT PROGRAMS (continued)

- Educational Partnership Agreements (EPA’s) - Education Partnership Agreements are authorized for defense laboratories. Those laboratories may enter into one or more such Agreements with educational institutions in the United States, including local education agencies, colleges, universities and nonprofit institutions that are dedicated to improving science, mathematics and engineering education, for the purpose of encouraging and enhancing study in scientific disciplines at all levels of education. NUWC EPAs include:

  - Oceangisences, Inc. - to provide undersea science and technology educational guidance and assistance for an ocean sciences camp and museum to further math and science education.
  - The University of Massachusetts - to aid in the undersea science and technology education of students and faculty.
  - Yale University - to aid in the fluid mechanics, acoustics, and mathematics education of students and faculty.
  - The University of Rhode Island - to aid in the ocean science, engineering, technology, and policy applications of these disciplines to encourage student interest in these areas.
  - The University of Massachusetts/Lowell, Institute for Plastics Innovation - to encourage student interest in the low-density extruded plastic materials applications of their individual disciplines.
  - Rutgers, the State University of New Jersey - to aid in the ocean science, engineering, technology, and policy applications of these disciplines to encourage students interest in these areas.

EQUIPMENT/FACILITIES

The Naval Undersea Warfare Center maintains and continuously improves numerous facilities on both coasts designed to support the Research, Development, Test, and Evaluation of Undersea Warfare (USW) systems.

NUWC DIVISION, NEWPORT
On the Atlantic Coast, NUWC Division, Newport, RI, facilities are grouped into 9 major complexes:

UNDERSEA WARFARE ANALYSIS COMPLEX
This complex has developed and maintains a suite of USW models, databases and U.S. and foreign weapon system hardware-in-the-loop simulations. These are exercised in support of requirements analysis, tactical development, concept development and performance assessment from system level through force and theater levels. This complex comprises two components:

The Undersea Warfare Analysis Laboratory (USWAL) component consists of distributed computer servers linked together via a high speed network and tied to a centralized file server. This architecture, combined with an intelligent queuing system provides the USWAL with a specialized simulation environment that outperforms the combined power of multiple supercomputers. The Weapons Analysis Facility (WAF) simulation component provides a massively parallel processing synthetic environment which integrates a variety of actual weapon hardware and software within its specialized architecture. Thus, real weapons are allowed to perform mission scenarios in the highest fidelity virtual environment the U.S. Navy has developed. The combined computing engines in this complex achieve a maximum throughput exceeding 40 GigaFlops.
### EQUIPMENT/FACILITIES (continued)

#### SUBMARINE COMBAT SYSTEMS COMPLEX (SCSC)
This complex is a unique set of 4 world-class facilities that combine leading-edge synthetic environment and analysis technology with submarine tactical system hardware representing current and future combat systems in a networked laboratory setting. Linked and interconnected with other NUWC and external government, private industry and university facilities, the complex provides expanded virtual environments for conducting research and development (R&D) in technical and operational problems confronting the submarine force. Areas of R&D include information management, weapon employment, joint operability, battle group interoperability and battle space management. SCSC's facilities are available for use by government organizations, private industry, and academic institutions.

#### SONAR COMPLEX
This complex is a unique set of 6 facilities that include platform independent and federated laboratories and robust simulation and stimulation used to explore the underlying science and technology common to submarine and surface ship sonars. These facilities encompass the research, development and test of acoustic sensors, transducers, and arrays for use in tactical, calibration and standards applications at sites ranging from laboratory test beds and large scale pressure vessels to inland lakes and ponds. This complex provides the Navy with the capability to explore the technologies and science associated with transduction materials, fiber optics, environmental acoustics, and measurement and analysis techniques, leading to development of hull mounted, towed, and expendable sensors and arrays. Sonar systems laboratories consist of specialized sites for the investigation of signal processing, operator displays, detection and classification algorithms, acoustic communication, acoustic intercept, system architecture, onboard trainers, and commercial off-the-shelf applications utilizing robust simulation/stimulation capabilities to perform system evaluation, performance analysis and life cycle support.

#### SUBMARINE ANTENNA TEST COMPLEX
This complex of four facilities permits full characterization of submarine exterior communications, electronic and imaging warfare systems and their related antennas/sensors by using unique laboratories and in-the-field test facilities. Stimulation/simulation equipment that replicates advanced radio frequency (RF) emitters, specialized test equipment, and RF anechoic chambers provides highly accurate measurement of systems baseline performance, transmit and receive patterns, and radar cross section signatures. An Overwater Arch in Newport, RI, and a remote, electromagnetically quiet, test site on Fishers Island, NY, are used to measure systems performance with antennas/sensors operating in the sea water environment simulating actual submarine operations.

#### SUBMARINE LAUNCHER SYSTEM TEST AND EVALUATION COMPLEX
This complex is a unique array of 5 major facilities dedicated to full spectrum support to submarine launcher programs for weapons, vehicles, and countermeasures from submarines. The facilities provide the capabilities for evaluating new launcher developments and improvements, land-based acceptance testing, and troubleshooting Fleet problems. The Transient Flow, Impeller Test Facilities are the only known facilities in the world capable of conducting hydrodynamic and hydroacoustic tests of transient flows and torpedo ejection pumps. The Submerged Launcher Test Facility replicates full-scale launch systems on SSN-688 and SSBN-726 class submarines and is capable of firing dummy weapons at simulated depths from surface to submarine test depth. Dual ejection capability allows for concurrent, side-by-side firing comparisons of any two current or future candidate ejection systems. The Advanced Submarine Launcher Facility replicates the full-scale launch system on SSN-21 and is capable of launch system performance testing and measuring radiated sound pressure levels in a unique Ocean Simulation Tank.
EQUIPMENT/FACILITIES (continued)

WEAPONS DEVELOPMENT FACILITY COMPLEX
This complex includes 7 major facilities for design, development, test, and life cycle support of Navy torpedoes, countermeasures, unmanned undersea vehicles, and undersea targets. Torpedo and other vehicle system designs are developed and maintained in the complex’s state-of-the-art UUV, Target, Torpedo R&D Facility. Its Propulsion Test Facility supports electric and thermal (open and closed cycle) propulsion system developments and includes the Deep Depth Propulsion Test Facility, the only land-based facility capable of testing entire torpedoes to maximum power and depth; a total containment High Energy Chamber, designed to contain the total energy content of advanced propulsion systems in an environmentally safe manner; and the Propulsion Noise Test Facility, the only land-based facility capable of measuring radiated noise of operational underwater vehicles on land. The complex also includes the world’s quietest anechoic wind tunnel, a 64,000 cubic foot anechoic chamber, the largest Reverberant Acoustic Tank of its kind in the country, the Navy’s only large scale sea-water tow tank (3000 feet long) and an advanced materials laboratory, all of which provide comprehensive hydrodynamic, structural and acoustic data on components, as well as on full systems. Development and evaluation of vehicle sonars, guidance and control systems and software are accomplished in the unique Torpedo Life Cycle Support Facility. It includes undersea vehicle testbeds, allowing the capability to integrate new software with vehicle guidance and control hardware and test it under simulated in-water operating conditions.

ATLANTIC UNDERSEA TEST & EVALUATION CENTER (AUTEC)
AUTEC is a comprehensive open ocean test and evaluation complex located in the ocean waters off Andros Island in the Bahamas. The AUTEC ranges allow testing of aircraft, surface ships, and submarines in an instrumented, calibrated 230-square-mile ocean area with precision tracking in three dimensions of all platforms. AUTEC also provides measurement systems for basic acoustic, environmental, and oceanographic research and test programs. As part of the AUTEC complex, there is a shallow-water OPAREA that consists of a minefield adjacent to a 90 square-mile ocean area with precision tracking in three dimensions of all platforms. The real-time positional information can be displayed on location or linked back to one of AUTEC’s display centers at Andros or West Palm Beach. There is also a Portable Tracking System (50 nmi) that can be deployed in OPAREAs of opportunity and provides three dimensional precision tracking of all platforms. AUTEC’s facilities are available for use by U.S. and allied foreign government organizations, private industry, and academic institutions.

LITTORAL UNDERSEA WARFARE COMPLEX
The complex is a unique combination of test and tracking facilities and test environments in the Northeast. These facilities and environments represent potential areas of regional conflict (Persian Gulf, Gulf of Oman, coast of Korea) and have been well characterized, contain baseline performance data on existing systems, and can be supported cost effectively by nearby shore activities. The unique Gould Island Elevator/Launch System, deep water piers, and test areas immediately adjacent to NUWC Division, Newport are especially effective for testing systems in shallow water in an effective and affordable manner. Also, the decommissioned diesel submarine USS SALMON provides sonar targets for development of new systems and acts as a training aid for submarines transiting the area aiding in detection and classification of bottom targets.

SHIPBOARD ELECTRONIC SYSTEMS EVALUATION FACILITIES (SESEF)
The primary purpose of the SESEF is to improve Fleet readiness by providing Fleet units with an operational and material evaluation of all shipboard electromagnetic radiating and receiving systems. NUWC Division, Newport operates and maintains one SESEF site, located in Norfolk, Virginia.
EQUIPMENT/FACILITIES (continued)

SUBMARINE PERISCOPE COMPLEX
This complex is a unique combination of 8 facilities that provides full spectrum support for the development, test, evaluation, and in-service engineering for current and future submarine, periscopes and imaging systems. Facilities include the Trident Periscope Facility, Special Mission Electro-Optic Sensor Support Facility, Periscope Regional Maintenance Facility, EHF SATCOM Development Terminal, Emsort Development and Support Facility, Photonics Mast Land Based Test Site, Imagery Archive and Video Editing Facility, and Periscope Engineering RDT&E Facility.

NUWC DIVISION, KEYPORT
On the Pacific coast, NUWC Division, Keyport, WA, maintains and operates a variety of testing and engineering equipment and facilities to support their mission of providing test and evaluation, in-service engineering, maintenance and repair, fleet support, and industrial base support for undersea weapons systems, countermeasures, and sonar systems. Major facilities for NUWC Division, Keyport include:

NORTHWEST RANGE COMPLEX
There are three unique, highly instrumented test sites in NUWC Division, Keyport's Northwest Range complex, with over 100 square miles of littoral and mid-depth underwater tracking area, including inshore shallow water sites. While these sites are principally underwater test ranges, they also have extensive surface and in air tracking capability. Water depths, specialized instrumentation, bottom recoverability, acoustic quietness, and security factors facilitate a wide range of undersea warfare vehicle and platform tests from research and development tests to production acceptance tests and Fleet evaluation/exercises. All range sites are linked to the Range Information Display Center (RIDC) at Keyport, explained below. The Northwest Range sites include Dabob Bay, Nanoose, and Quinault. Both Nanoose and Dabob Bay are used extensively for development tests due in part to the capability to recover one-of-a-kind test vehicles intact, even if they sink.

The NANOOSE RANGE site is jointly operated and maintained on a shared basis by the United States and Canada and is located in the Strait of Georgia near Vancouver Island in British Columbia, Canada. Canada provides extensive range craft support and facilities at no cost to the United States. Nanoose is an excellent site for countermeasure testing because of its robust, short-baseline tracking configuration, which has the capability to track while most countermeasures are in use.

The DABOB BAY RANGE site is located in Hood Canal near Naval Submarine Base, Bangor, and is among the quietest and most secure instrumented underwater range sites in the world. This is especially important in the testing of new, quiet, and leading-edge technologies which are under development.

The QUINAULT RANGE site is approximately 10 miles off the coast of Washington State and offers a fully-instrumented, shallow underwater environment. It meets the NATO 40-meter shallow water requirement and can provide support for the expanding shallow water antisubmarine warfare emphasis, including mine warfare testing and training.

RANGE LAUNCH, RECOVERY, AND TARGET VESSELS
Yard Torpedo Test (YTT) craft are an integral part of the range operations for both U.S. and Canadian ranges. These unique, highly specialized vessels provide launch, fire control, and bottom recovery for the full spectrum of the Navy's undersea weapons, targets, and countermeasures. The YTT's were built specifically for use at the Northwest Range. The ability of specially designed torpedo recovery systems installed on these craft to recover, intact and undamaged, torpedoes that have become embedded in the soft mud bottoms of the Northwest Range is a unique Navy asset. Smaller support craft satisfy other specialized range needs such as surface retrieval, acoustic measurement, and target deployment.
RANGE INFORMATION DISPLAY CENTER (RIDC)
The RIDC facilitates efficient range operations by minimizing travel to the range sites. Using large screen video and associated monitors, it provides encrypted real-time displays and fusion of range data (tracking, acoustics, and telemetry, plus two-way video and secure communications) from all Northwest Range sites.

UNDERSEA WEAPON EVALUATION FACILITY (UWEF)
The UWEF is a hardware-in-the-loop test system which permits land-based captive testing of undersea weapons and other vehicles operating under their own power in a land-based water-filled test chamber.

SHIPBOARD ELECTRONIC SYSTEMS EVALUATION FACILITIES (SESEF)
The primary purpose of the SESEF is to improve Fleet readiness by providing Fleet units with an operational and material evaluation of all shipboard electromagnetic radiating and receiving systems. NUWC Division, Keyport operates and maintains three SESEF sites, located in Southern California at Point Loma, San Diego; in MIDPAC at Barbers Point, Hawaii; and in PACNORWEST at Ediz Hook, Port Angeles, Washington.

UNDERSEA WEAPONS REPAIR AND MAINTENANCE DEPOT
This highly specialized state-of-the-art complex is the Nation's only defense repair and maintenance depot for the Navy's full arsenal of developmental, in-service and retiring undersea weapons, torpedoes, mobile mines, and targets. This complex consists of specialized weapons shops, repair facilities, and testing laboratories. Since depot repair processes require responsible handling of hazardous materials, wastes, and explosive components, unique explosive handling and environmental storage equipment and facilities have been developed. Special environmental equipment and facilities are on-line to handle the decontamination, storage, reclamation and disposal of hazardous materials such as OTTO fuel II and lithium.

TORPEDO EXPLOSIVE OPERATING COMPLEX
The complex includes eight buildings for the explosive assembly, disassembly and repair of all undersea weaponry currently in the active U.S. Navy inventory. This complex has been sited within the same Explosives Safety Quantity Distance arcs as their adjacent torpedo storage magazines.

TORPEDO STORAGE MAGAZINES
These 72 specially constructed magazines constitute the Navy's only resource for consolidation of torpedoes being laid-up or 'bunkered' as a result of reductions in Fleet platforms. The U.S. Navy's entire MK 48 torpedo inventory and approximately one half of the MK 46 torpedo inventory will be bunkered over the next few years. These magazines are dedicated to torpedo storage and as such, represent the only explosive torpedo storage facilities available to accommodate the thousands of torpedoes to be bunkered.

WEAPON ACCEPTANCE AND OPERATIONAL TEST FACILITY
Provides data reduction and analysis for R&D testing, Operational Testing (conducted by COMOPTEVFOR), and weapon acceptance testing (Proofing) for underwater weapons and vehicles.

HARDWARE ENVIRONMENTAL TEST FACILITY
This facility consists of four test laboratories, each specifically equipped for one of the four major test functions of dynamic/climatic testing, mechanical testing, electrical testing, and explosive testing. The primary role of these facilities is testing Naval undersea weapons, targets, mines, countermeasures, and combat systems, but the facility also supports other weapon systems, government agencies, and commercial activities.
### EQUIPMENT/FACILITIES (continued)

**COMBAT SYSTEMS FACILITY**
This facility was designed and built in 1994 specifically to meet the needs of operational Combat Systems. This facility includes integrated labs comprised of Fast Attack Submarine (SSN) Combat Systems, Fleet Ballistic Missile Submarine (SSBN) Combat Systems, Aircraft Carrier Tactical Systems Center, and ancillary equipment. The installed Fleet hardware provides a means for the test and evaluation as well as in-service system supportability for the Fleet.

**TARGET MK 30 IMAS, AND RANGE TRACKING PINGER IMAS**
Target turnaround facilities are located at Barking Sands, Kauai, Hawaii, North Island, San Diego, California, and Keyport, Washington. Pinger facilities are located at Lualualei, Oahu, Hawaii; North Island; and Keyport. The Navy's only pinger repair depot is located with the pinger IMA at Lualualei.

**TRANSUDER AUTOMATED TEST FACILITY**
Acoustic tests are conducted in a 30-foot diameter by 30-foot deep, freshwater filled, redwood tank. A four-foot diameter, acoustically transparent, graphite-epoxy pod is available for transducers acoustically while being subjected to pressures of up to 2,000 pounds per square inch.

**ACOUSTIC TEST FACILITY (ATF)**
Acoustic transducer calibrations are performed in sea water, approximately 30 feet deep at this floating facility which is moored to a pier on the NUWC Division, Keyport waterfront. Precision fixtures and automated instrumentation provide efficient calibrations of a wide variety of underwater acoustic devices, including torpedo and target simulator transducers, and underwater range instrumentation. ATF calibration is part of many torpedo and mobile target depot repair and ORDALT processes.

**UNDERWATER NOISE ANALYSIS FACILITY (UNAFAC)**
Comprised of state-of-the art signal playback, processing, and analysis systems used in the assessment of the acoustic performance of torpedoes, countermeasures, acoustic targets, and other underwater vehicles.

**MIDPAC RANGE COMPLEX**
This range complex consists of the Hawaiian Island Underwater Range (HAIUR), the Hawaiian Area Tracking System (HATS), Fleet Operational Readiness Accuracy Check Site III (FORACS III), and Surface Ship Radiated Noise Measurement (SSRNM) test facilities. All areas except HATS are located within 20 nautical miles of Pearl Harbor, on the western coast of the island of Oahu, Hawaii. HAIUR is instrumented with a long baseline, asynchronous tracking system and offers depths from 2500 ft to 3500 ft. HATS, located near the island of Maui, has a nominal water depth of 600 ft and is instrumented with a shallow water, long baseline, tracking system. The Range System provides test and evaluation support for NAVSEA-sponsored RDT&E programs and the Fleet. The Barbers Point Shipboard Electronic Systems Evaluation site (SESEF) cited earlier is part of this MIDPAC complex as well.

**SOCAL RANGE COMPLEX**
This facility is located in the San Diego, California area at San Clemente Island. The range system consists of the San Clemente Island Underwater Range (SCIUR), Surface Ship Radiated Noise Measurement (SSRNM), and Fleet Operational Readiness Accuracy Check Site I (FORACS I). This site offers a long baseline, asynchronous tracking system with depths to 3900-ft. Surface and air tracking, as well differential GPS capabilities are also provided.
RAPID PROTOTYPING AND FABRICATION FACILITIES

A wide variety of state-of-the-art equipment, fabrication techniques, and processes are available for prototype in support of RDT&E and emergent Fleet requirements.

Other facilities operated by NUWC Division, Keyport in support of RDT&E programs include: Material, Chemical and Failure Analysis Laboratories; Mechanical and Electronic Repair and Assembly Facilities; Industrial Waste Treatment Facility; Recycling Facility; Hyperbaric Chamber; Post-operational Analysis Critique and Exercise Review (PACER) Facility; and Navy Mine Depot Hawthorne, NV.
### FY97 FUNDING DATA (MILLIONS $)

<table>
<thead>
<tr>
<th>APPROPRIATION</th>
<th>IN-HOUSE</th>
<th>IN-HOUSE MANAGEMENT</th>
<th>OUT-OF-HOUSE</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>RDT&amp;E:</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>6.1 ILIR</td>
<td>1.664</td>
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<td><strong>Subtotal (S&amp;T)</strong></td>
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<td>Non-DOD</td>
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<tr>
<td><strong>TOTAL RDT&amp;E</strong></td>
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<td>Operations &amp; Maintenance</td>
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<td><strong>TOTAL FUNDING</strong></td>
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<td><strong>NA</strong></td>
<td><strong>415.600</strong></td>
<td><strong>851.600</strong></td>
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</table>

### MILITARY CONSTRUCTION (MILLIONS $)

| MILITARY CONSTRUCTION (MILCON) | 0.000 |

### PERSONNEL DATA (END OF FISCAL YEAR 1997)

<table>
<thead>
<tr>
<th>TYPE</th>
<th>SCIENTISTS &amp; ENGINEERS</th>
<th>TECHNICAL SUPPORT &amp; OTHER PERSONNEL</th>
<th>END STRENGTH</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DOCTORATES</td>
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</tr>
<tr>
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<tr>
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<td>TOTAL</td>
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### SPACE AND PROPERTY

<table>
<thead>
<tr>
<th>BUILDING SPACE (THOUSANDS OF SQ FT)</th>
<th>PROPERTY ACQUISITION COST (MILLIONS $)</th>
</tr>
</thead>
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<tr>
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NA = Not Applicable
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DEPARTMENT OF THE AIR FORCE
DEPARTMENT OF THE AIR FORCE

The Air Force's seven (7) In-House RDT&E Activities are:

Armstrong Laboratory ................................................................. 4-2
Arnold Engineering Development Center .................................. 4-6
Development Test Center ............................................................ 4-10
Flight Test Center ................................................................. 4-16
Phillips Laboratory ................................................................. 4-22
Rome Laboratory ................................................................. 4-26
Wright Laboratory ................................................................. 4-30
Armstrong Laboratory

Abbreviated Functional Chart - Technical Organizations

Armstrong Laboratory

- Aerospace Medicine Directorate
- Crew Systems Directorate
- Human Resources Directorate
- Environics Directorate
- Occupational & Environmental Health Directorate
**MISSION**

Advance and apply technology to provide the Air Force with superior capabilities in the areas of human resources, crew systems, aerospace medicine, environics, and occupational/environmental health through integrated execution of research, development, and operational support. Sponsor and conduct research and development in the fields of biodynamics, biocommunications, environmental compliance, site restoration, toxic hazards, radiation/directed energy bioeffects, aero medical selection/retention, human engineering, crew protection/life support, logistics and human factors, force acquisition and management, job skill development and retention, instructional strategies, and training devices.

**CURRENT IMPORTANT PROGRAMS**

The resources of the Armstrong Laboratory are organized into five integrated 'thrusts' which bridge specific research programs and projects. Technical thrust areas are: crew systems; human resources; aerospace medicine; occupational and environmental health; and environmental quality. The Armstrong Laboratory is also host to 'Tri-Service Research Centers' in toxicology and directed energy, created in accordance with the Project Reliance initiative for DoD laboratory consolidation. The principle types of technology transferred to commercial industry by Armstrong Laboratory are: environmental compliance and remediation, intelligent training, human safety standards and equipment, health care, logistics and human performance enhancement.

**EQUIPMENT/FACILITIES**

The Armstrong Laboratory conducts S&T at Wright-Patterson AFB OH, Brooks AFB TX, Tyndall AFB FL, and Mesa AZ. Equipment and facilities include: Two human centrifuges, a high on-set rate centrifuge located at Brooks AFB and a multi-axis centrifuge located at Wright-Patterson AFB; hypobaric and hyperbaric chambers with capability to simulate high altitude subzero conditions; anechoic chambers for study of human and noise interactions; 'virtual worlds' for systems and training research; inhalation toxicology chambers; directed energy laboratory to research bioeffects of lasers and RF radiation; human isolation facility for controlled study of group dynamics in simulated air operations; a TEMPEST secure facility with simulators for EW research and training; a facility for testing subjects (mostly new recruits) in S&T of computer automated training and force management tools; energetics research facility at Tyndall AFB with highly specialized research equipment to study the dynamic effects of contaminates on air and groundwater to include: a model aquifer for tracking groundwater plumes, an environmental spherical chamber for studying atmospheric fate and transport of contaminates, and a perfusion chromatograph system for separation of environmental macromolecules.
**FY97 FUNDING DATA (MILLIONS $)**

<table>
<thead>
<tr>
<th>APPROPRIATION</th>
<th>IN-HOUSE</th>
<th>IN-HOUSE MANAGEMENT</th>
<th>OUT-OF-HOUSE</th>
<th>TOTAL</th>
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<tr>
<td>RDT&amp;E:</td>
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<tr>
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<td>5.081</td>
<td>2.528</td>
<td>56.147</td>
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<tr>
<td>Non-DOD</td>
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<td><strong>TOTAL RDT&amp;E</strong></td>
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<td>Other</td>
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<td><strong>6.465</strong></td>
<td><strong>135.247</strong></td>
<td><strong>208.363</strong></td>
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**MILITARY CONSTRUCTION (MILLIONS $)**

| Military Construction (MILCON) | 0.000 |

**PERSONNEL DATA (END OF FISCAL YEAR 1997)**

<table>
<thead>
<tr>
<th>TYPE</th>
<th>SCIENTISTS &amp; ENGINEERS</th>
<th>TECHNICAL SUPPORT &amp; OTHER PERSONNEL</th>
<th>END STRENGTH</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DOCTORATES</td>
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<tr>
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<tr>
<td>CIVILIAN</td>
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<td>414</td>
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<td>836</td>
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**SPACE AND PROPERTY**

<table>
<thead>
<tr>
<th>BUILDING SPACE (THOUSANDS OF SQ FT)</th>
<th>PROPERTY ACQUISITION COST (MILLIONS $)</th>
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<tbody>
<tr>
<td>LAB</td>
<td>REAL PROPERTY</td>
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<tr>
<td>ADMIN</td>
<td>* NEW CAPITAL EQUIPMENT</td>
</tr>
<tr>
<td>OTHER</td>
<td>EQUIPMENT</td>
</tr>
<tr>
<td>TOTAL</td>
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</tr>
<tr>
<td>ACRES</td>
<td>* Subset of previous category.</td>
</tr>
</tbody>
</table>

NA = Not Applicable
Arnold Engineering Development Center

Abbreviated Functional Chart - Technical Organizations

Arnold Engineering Development Center

Test Operations Directorate

Operations Business Management Division

Aircraft Systems Test Division

Aeropropulsion Systems Test Division

Applied Technology Division

Space and Missile Systems Test Division

Test Operations and Maintenance Division

Investments Division
Arnold Engineering Development Center
Arnold AFB, TN 37389-5000
(615) 454-3000

Commander: Col Robert W Chedister
Executive Director: John M. Rampy

MISSION

The AEDC mission is to:

(1) Test and evaluate aircraft, missile, and space systems and subsystems at the flight conditions they will experience during a mission to: help customers develop and qualify the systems for flight, improve system designs and establish performance before production, and to help users troubleshoot problems with operational systems.

(2) Conduct research and technology programs to develop advanced testing techniques and instrumentation, and to support the design of new test facilities. The continual improvement helps satisfy testing needs and keeps pace with rapidly advancing aircraft, missile, and space system requirements.

(3) Maintain and modernize the Center's existing test facilities.

CURRENT IMPORTANT PROGRAMS

The following list contains some of the more important test programs at the Arnold Engineering Development Center:

**F-22 Fighter**: Wind tunnel testing and analysis accomplished supporting the engineering/manufacturing/development phase; majority focused on store separation testing.

**F119 Engine for F-22**: Significant testing completed on altitude development and ram accelerated mission test qualification supporting the initial flight release, the first flight milestone, and development of the engine towards initial service release milestone.

**F-15 Fighter**: Weapons separation test and analysis completed for a number of stores.

**F100 Engine for F-15 and F-16**: Component improvement program testing conducted on two F100 models. Altitude development and qualification testing of redesigned components for both the F100-PW-220 and F100-PW-229 performed to overcome performance and durability problems. New hardware evaluated on 3rd stage fan blades, 4th stage low-pressure turbine blades, and fuel manifold and afterburner components.

**F-18 Fighter**: Store separation testing conducted on the E/F version of the aircraft.

**Joint Strike Fighter**: Testing accomplished for both competing contractors.

**F119 Engine for Joint Strike Fighter**: Pre-test planning, coordination, and test cell modifications accomplished in preparation for the FY98-99 testing of the two competing propulsion system candidates.

**JASSM**: Wind tunnel testing conducted on both competing weapon versions in support of downselect.

**JDAM**: Testing in support of time critical weapon modifications.
CURRENT IMPORTANT PROGRAMS (continued)

F414 for F/A-18E/F: Altitude test program completed in support of the limited product qualification milestone.

Evolved Expendable Launch Vehicle: Provided simulated altitude test services for the RL-10B-2 upper-stage engine to be used on the Boeing Delta III and Delta IV launch vehicles. Also, provided the vacuum environment to demonstrate the separation and dynamic motion of the vehicle payload fairing to protect the payload from aerodynamic and thermal environments during launch.

Peacekeeper Intercontinental Ballistic Missile (ICBM): Provided simulated altitude test services for aging surveillance of the Post Boost Propulsion System.

Minuteman III ICBM: Provided simulated altitude test services for aging surveillance of the second and third stage solid rocket motors. Also, hosted the historical technical database for the Propulsion System Rocket Engine.

Minuteman III Propulsion Replacement Program: Provided simulated altitude test services for development of the replacement second and third stage solid rocket motors.

Ground Based Interceptor: Calibrated and tested the sensor and focal planes using target simulation packages traceable to national standards. Evaluated in a vacuum, cryogenic environment that closely simulated their actual operating conditions.

EQUIPMENT/FACILITIES

AEDC represents a $6 billion investment in the most advanced and largest complex of flight simulation facilities in the world with test units having capabilities unmatched elsewhere. AEDC encompasses 3 main business areas: Turbines, Aerodynamics, and Space and Missiles.

The Turbine Business Area includes 11 turbine engine test cells supporting aircraft and missile system research and development simulating flight tests over a wide range of Mach numbers and altitudes to determine operational characteristics of air breathing propulsion systems. Test capabilities include engine performance and operability, engine/inlet integration, and environmental/climatic testing. Unique military requirements supported include afterburner use, high altitude flight, high speed low altitude flight, maneuverability, fighter/bomber engine/inlet integration, and environmental testing.

The Aerodynamics Business Area includes 7 wind tunnels (conventional, continuous-flow, and intermittent blowdown) supporting flight simulation, store separation simulations, computational fluid dynamics, and engineering approximations of relatively large-scale models of high speed aircraft, missiles, and spacecraft. Unique military requirements supported include high performance fighter flight simulations, full scale engine/inlet/exhaust testing, and store separation simulations.

The Space and Missile Business Area includes altitude rocket facilities, propulsion research test cells, aerospace chambers, continuous flow arc-heated facilities, and free-flight ranges providing test capabilities for rockets, spacecraft, and hypersonic/re-entry systems. Unique military requirements supported include large solid and liquid rocket altitude tests, high speed impact/counter fire, high speed large model launches, soft model recovery, digitally controlled scene generation, and multi-functional focal plane array.
**FY97 FUNDING DATA (MILLIONS $)**

<table>
<thead>
<tr>
<th>APPROPRIATION</th>
<th>IN-HOUSE</th>
<th>IN-HOUSE MANAGEMENT</th>
<th>OUT-OF-HOUSE</th>
<th>TOTAL</th>
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<tr>
<td><strong>RDT&amp;E:</strong></td>
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<td><strong>Subtotal (S&amp;T)</strong></td>
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<tr>
<td><strong>Non-DOD</strong></td>
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<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td><strong>TOTAL RDT&amp;E</strong></td>
<td>249.146</td>
<td>1.351</td>
<td>27.018</td>
<td>277.515</td>
</tr>
<tr>
<td>Procurement</td>
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<td>NA</td>
<td>0.000</td>
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<tr>
<td>Operations &amp; Maintenance</td>
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**MILITARY CONSTRUCTION (MILLIONS $)**

| Military Construction (MILCON) | 3.885 |

**PERSONNEL DATA (END OF FISCAL YEAR 1997)**

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<th>TYPE</th>
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<td></td>
<td>DOCTORATES</td>
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<td></td>
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**SPACE AND PROPERTY**

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<th>PROPERTY ACQUISITION COST (MILLIONS $)</th>
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NA = Not Applicable
Development Test Center

Abbreviated Functional Chart - Technical Organizations

- Development Test Center
- 46th Test Wing
- Staff Directorates
- 96th Airbase Wing
### MISSION

The Air Force Development Test Center (AFDTC) plans, directs and conducts test and evaluation of US and allied non-nuclear munitions and navigation/guidance systems. AFDTC operates the largest air base in the free world, providing host support to 50 tenant units, and supports the largest single base mobility commitment in the Air Force. The Test Center accomplishes its mission through its two component wings - the 46th Test Wing and the 96th Air Base Wing.

### CURRENT IMPORTANT PROGRAMS

<table>
<thead>
<tr>
<th>Program</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Advanced Medium Range Air-to-Air Missile</strong></td>
<td>T&amp;E includes flight test and hardware-in-the-loop testing at the Guided Weapons Evaluation Facility (GWEF) for an improved autopilot repackaged electronics, extended rocket motor, shortened control actuator, and improved electronic counter-counter measures (ECCM).</td>
</tr>
<tr>
<td><strong>Hellfire</strong></td>
<td>Production lot and pre-planned product improvement (P3I) testing of Hellfire and Longbow Apache Hellfire Modular Missile Systems.</td>
</tr>
<tr>
<td><strong>CHICKEN LITTLE</strong></td>
<td>A joint Army-Air Force smart weapons test and evaluation organization hosted at Eglin. This organization conducts seeker/sensor, lethal mechanism, and system effectiveness evaluations.</td>
</tr>
<tr>
<td><strong>Joint Stars</strong></td>
<td>Tests are conducted on Eglin ranges to evaluate Joint Stars capability to detect and track multiple targets in various environments.</td>
</tr>
<tr>
<td><strong>SEEK EAGLE</strong></td>
<td>Air Force stores compatibility program hosted at Eglin AFB. Flight tests to verify weapon separation simulations are conducted on Eglin ranges.</td>
</tr>
<tr>
<td><strong>F-15E Tactical Electronic Warfare Systems (TEWS)</strong></td>
<td>Electronic counter measures performance testing.</td>
</tr>
<tr>
<td><strong>Sensor Fuse Weapons</strong></td>
<td>Production lot testing and P3I testing.</td>
</tr>
<tr>
<td><strong>Joint Tactical Information Distribution System</strong></td>
<td>Testing of information transfer among various types of JTIDS terminals is conducted on Eglin ranges.</td>
</tr>
<tr>
<td><strong>Joint Direct Attack Munition</strong></td>
<td>JDAM is a joint Air Force-Navy program. Development, Test and Evaluation test planning and flight testing are conducted.</td>
</tr>
<tr>
<td><strong>Joint Stand Off Weapon</strong></td>
<td>JDAM is a joint Air Force-Navy program. Development, Test and Evaluation test planning and flight testing are conducted.</td>
</tr>
<tr>
<td><strong>AIM-9X (Air launch, Intercept Mission)</strong></td>
<td>This program is a joint Air Force-Navy program led by the Navy. The 46th Test Wing is principal Air Force test office. Captive flight testing, separation testing, and live launches will be conducted during the next three years.</td>
</tr>
</tbody>
</table>

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4-11
## CURRENT IMPORTANT PROGRAMS (continued)

<table>
<thead>
<tr>
<th>Program Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Advanced Short Range Air-to-Air Missile (British) and Various Allied Weapons</strong></td>
<td>A component of allied munitions testing. The ASRAAM TRIALS (Development, Test and Evaluation) are being conducted by a British Aerospace establishment team at Eglin.</td>
</tr>
<tr>
<td><strong>Wind Corrected Munition Dispenser</strong></td>
<td>WCMD allows standard cluster bombs to become smart weapons. Development, Test and Evaluation are being conducted.</td>
</tr>
<tr>
<td><strong>Joint Air-to-Surface Standoff Missile</strong></td>
<td>JASSM is a joint Navy and Air Force program to acquire a next generation air launch, long range, precision guided standoff missile weapon system. Planning and Testing for the Program Definition and Risk Reduction Phase are ongoing for both contractors.</td>
</tr>
<tr>
<td><strong>US Navy Aerial Targets</strong></td>
<td>The F-16 has been selected as a launch platform for the AQM-37 and BQM-74 aerial targets. Flight testing planning and execution are being conducted to provide a limited flight clearance for the F-16 to launch the drones during US Navy operations.</td>
</tr>
<tr>
<td><strong>A-10 Testing</strong></td>
<td>Three major programs have been conducted to enhance the capability of the aircraft. The Low Altitude, Safety, and Targeting Enhancement (LASTE) program introduced new software capabilities. The Embedded Global Positioning System and Inertial Navigation System (EGI) Program increased the navigation accuracy of the aircraft. The 600-Gallon Tank program resolved stability and control questions needed to increase loiter time.</td>
</tr>
<tr>
<td><strong>Low Cost autonomous Attack System</strong></td>
<td>Testing of the unpowered LOCAAS is being conducted over Eglin land ranges to evaluate the systems ability to acquire, classify, and attack ground targets.</td>
</tr>
<tr>
<td><strong>Anti-Jam GPS Technology Flight Test</strong></td>
<td>The AGTFT, which is similar to a JDAM, is designed to resist GPS jamming and is currently being evaluated by the 46th Test Wing.</td>
</tr>
<tr>
<td><strong>Air Force Mission Support System (AFMSS)</strong></td>
<td>Testing of the core software and many of the 50 plus aircraft/weapon/electronic system software modules for mission planning.</td>
</tr>
<tr>
<td><strong>The following are Technology Transfer Programs</strong></td>
<td>Providing unique T&amp;E facilities/capabilities for commercial use. Capabilities are followed by actual commercial test efforts (if applicable).</td>
</tr>
<tr>
<td><strong>Advanced Transportation and Automotive</strong></td>
<td>Accomplish vehicle and automated highway systems tests in varying climatic conditions; test sensors under controlled electromagnetic environment; collision avoidance sensor tests.</td>
</tr>
<tr>
<td><strong>Law Enforcement and Security</strong></td>
<td>Intrusion, surveillance, access control, and weapons and ammunition testing.</td>
</tr>
<tr>
<td><strong>Medical Equipment</strong></td>
<td>Characterize electromagnetic emissions of equipment; test compatibility with helicopters, aircraft, or ambulances; test systems under controlled climatic conditions.</td>
</tr>
</tbody>
</table>
### CURRENT IMPORTANT PROGRAMS (continued)

**Communications Aviation** - Test aircraft in climatic chamber; evaluate electromagnetic compatibility in large anechoic chamber; test on open air ranges. Interstate Electronics - advanced GPS navigation equipment.

**Environmental** - Use infrared and other technologies to test forest fire detection, and pollution detection. Apply expertise in environmental monitoring, restoration and field data collection. Accu-Weather - software evaluation for weather assessment.

**Software/Modeling and Simulation** - Access CRAY Supercomputer; use AFDTC developed software products.

At Holloman AFB, Hypersonic lethality testing for Threat Missile Defense (TMD), Crew Escape System Technology (CREST) tests, Global Positioning System (GPS) integration, field tests of the Federal Aviation Administration's (FAA) GPS navigational and landing aids, and electromagnetic testing including radar cross section and antenna pattern measurements of such advanced systems as the F-117, B-2, and other advanced technology.

*Navy and Air Force Joint Programs

**Army and Air Force Joint Programs*

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### EQUIPMENT/FACILITIES

Capabilities and facilities include those for armament and C4I (Command, Control, Communication, Computer System) testing. The only DOD location with contiguous major land (724 sq. mi.) and water test ranges (125,000 sq. mi.), and the largest climatic test facility in the free world. Equipment and facilities include: a DoD High Performance Computing Center (real time and post mission support); airborne and ground based multispectral signature measurement; kinetic energy test facility (sled track); static warhead arenas; gun test facility; combined hardware and simulations testing (Guided Weapons Evaluation Facility - GWEF) and Preflight Integration of Munitions and Electronic Systems (PRIMES) facility; time-space-position information; telemetry systems facilities including airborne relay; airborne and surface targets; ground threat systems; base installation and security systems (BISS) test facility; photographic laboratory; marine operations (over water test support); and aircraft maintenance (test associated) facilities.

Also, at Holloman AFB, High Speed Test Track (HSTT): The world's longest sled track (50,788 ft), the Project Reliance lead for all DoD test tracks, and the Center of Excellence for ejection seat testing. The HSTT supports sled speeds exceeding Mach 8 and accelerations up to 200G for aerodynamic tests, impact tests, and missile simulations in various controlled environments of rain, particle, and blast/shock wave; (b) Central Inertial Guidance Test Facility (CIGTF): America's most seismically stable (0.01 micro G isolated background level) test bed for truth reference validation of navigation systems. CIGTF has the largest collection of precision rate tables (10), multi-axis tables (12), and precision centrifuges (3) in DoD; (c) Radar Target Scatter (RATSCAT) Mainsite and RATSCAT advanced measurement for full-scale and sub-scale systems—up to 100,000 lbs at Mainsite and 30,000 lbs at RATSCAT Advanced Measurement Site (RAMS). Both facilities have computer resources to support Radar Cross Section (RCS) target predictions, detection profiles, model validation, and real-time diagnostic imaging; and (d) 586th Flight Test Squadron: Aircraft support for testing of air-to-air missiles, air-to-ground ordnance, photo/safety chase, inertial navigational systems, and Global Positioning Systems. The squadron owns two T-38's, rents an F-15 and F-16 from Eglin AFB, and rents a C-12 from the Army when needed.
## FY97 FUNDING DATA (MILLIONS $)

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## MILITARY CONSTRUCTION (MILLIONS $)

| Military Construction (MILCON) | 5.780 |

## PERSONNEL DATA (END OF FISCAL YEAR 1997)

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NA = Not Applicable

1 63 personnel included here are summer hires.
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Flight Test Center

Abbreviated Functional Chart - Technical Organizations

Flight Test Center

- 95th Airbase Wing
- Staff Directorate
- 412th Test Wing

- Test Support & Operations Groups
- Test Pilot School
MISSION

The Air Force Flight Test Center (AFFTC) is charged with supporting the Air Force Material Command (AFMC) mission by conducting and supporting research, development, test and evaluation of manned and unmanned aerospace systems. This mission involves not only all aspects of testing of aerospace systems and subsystems, but also includes development testing of aerodynamic decelerators and the operation of the Air Force Test Pilot School. To support this testing the AFFTC operates and manages the Edwards Flight Test Range. The Center operates a fleet of test bed aircraft for early development and check out of new avionics. The Center also operates a fleet of Advanced Range Instrumentation Aircraft (ARIA) for worldwide support to a variety of space and missile tests. The Center supports and participates in research, development, test and evaluation programs for other Air Force Commands, other Departments of Defense and government agencies, as well as for contractors and foreign governments.

CURRENT IMPORTANT PROGRAMS

B-1 BOMBER AVIONICS AND CONVENTIONAL WEAPONS UPGRADES

The B-1B is a flexible bomber with a large payload capability and long range that makes it an ideal aircraft to support our deterrent posture across the full spectrum of conflict. The B-1B has been designated to form the core of future conventional bomber capability. The challenge of a conventional role requires the development of an extensive offensive and defensive capability without compromising current capability. The conventional mission upgrade program is planned to accomplish the changes required for the B-1B aircraft to become an effective conventional bomber.

B-2 BOMBER FOLLOW-ON PROGRAM

The B-2 Follow-on Flight Test Program is a Development Test and Evaluation program. The program is a continuance of the test critical technical characteristics. The evaluation includes signature, composite structure, flight control system, air data system, and software integration. Testing will support activity in the following priority: safety of flight, initial system capability, and full capability. Must verify specification compliance for operational assessment.

B-52 BOMBER UPGRADES.

The advanced weapons integration program will span all smart weapon development/integration on the B-52 to include Joint Direct Attack Munitions (JDAM), Joint Stand-Off Weapons (JSOW), Joint Air-to-Surface Stand-Off Missile (JASSM) etc.
CURRENT IMPORTANT PROGRAMS (continued)

C-17 TRANSPORT FOLLOW-ON PROGRAM

The C-17 Follow-On Flight Test Program is a Development Test and Evaluation program. This program will support the fielded system which results from the C-17 Weapon System Production, Field Support or Flexible Sustainment contract and support enhancements to C-17 capabilities by supporting the authorized Producibility Enhancement/Performance Improvement Program. The program will encompass, but is not limited to, testing needed for engineering studies, preplanned product improvements, performance improvements, system upgrades, modifications of production equipment, field problem evaluations, production cut ins, and mission changes. The program will provide data for use in design studies, system development, field problem resolution specification compliance and performance characteristic evaluations.

C-130J TRANSPORT

The C-130J Test and Evaluation program is scheduled to be flight tested at Edwards AFB. The tests support the development and demonstration of the basic Lockheed C-130J aircraft and unique USAF C-130J systems. Other activities included takeoff and landing performance testing, enhanced cargo handling system development and demonstration evaluations and auto thrust control testing. Additionally, air drop testing, which required chase/photo compatible aircraft, was accomplished.

F-15 FIGHTER

The F-15 Development Test and Evaluation (DT&E) program provides general avionics laboratory and overhead support for the F-15 System Program Office DT&E program requirements. Specific program objectives, descriptions and requirements are in support of radar, avionics operational flight program updates and the F-15E. The F-15 test aircraft at Edwards support a variety of non F-15 SPO programs such as B-1B Avionics Testing, Engine Testing, and F-15E/LANTIRN Integration DT&E.

F-16 FIGHTER

The F-16 Follow-on DT&E program is a continuing effort to add enhanced tactical capabilities and correct previously identified deficiencies. Testing centers around the development and integration of major production blocks 30B, 40, 50. A/B model testing will center on planned retrofit of selected capabilities. Testing will be conducted by a large test force and will involve virtually every technical discipline within the AFFTC mission. Additional test efforts will involve evaluations of the improved performance version of the Pratt and Whitney F100 and General Electric F110 engines.

F-117 FIGHTER

The F-117 test program provides for the continuous test of all systems as they are made available to the test team. As the aircraft systems mature, testing to include maintainability, reliability, survivability and effectiveness are evaluated. The goals of the test program are to ensure the F-117A stealth fighter can be deployed anywhere in the world at a moments notice and carry out its intended mission—to employ stealth technology and precision weapon delivery on time and on target.
### CURRENT IMPORTANT PROGRAMS (continued)

**F-22 ADVANCED TACTICAL FIGHTER**

The F-22 is being developed to meet air superiority requirements for the 1990's and beyond. This aircraft will incorporate state of the art materials, avionics, weapons and control systems. Testing facilities will be required on a very large scale. Some new facilities may be required. It is anticipated that the program will make extensive use of avionics ground test facilities at Edwards and several off-site locations. Provisions will be made for adequate IOT&E testing, climatic tests and technical order validation and verification. Testing is planned for airframe, engine, and envelope expansion test. Avionics will be installed and integrated incrementally.

**JOINT STRIKE FIGHTER**

The Joint Strike Fighter (JSF) Test and Evaluation (T&E) Support Office is responsible for all AFMC T&E support conducted in executing the JSF Concept Demonstration Phase (CDP) and planning for the E&MD Phase. The JSF T&E Support Office provides a single point of contact for the member services, Office of the Secretary of Defense, AFMC and the Weapon Systems Contractors for AF T&E related matters. Specifically, the JSF T&E Support Office: coordinates AFMC test facilities and T&E resources; provides input to the Test and Evaluation Master Plan and the Flight Certification Plan; helps coordinate the combined DT and OT activities; serves as liaison between the Weapon Systems Contractors and government ground and flight test teams; helps coordinate the systems' safety requirements and helps develop and execute the Concept of Operations for the Concept Demonstration Aircraft. Personnel spread across the 412th Test Wing are currently accomplishing these actions. This proposed change would bring these people together and provide a single AFMC T&E team to support the customer needs.

**LANTIRN**

The test effort supports the continued development and refinement of the LANTIRN navigation and targeting pod. Efforts include continuing software development and area tracker testing.

**BIG CROW**

The Big Crow Electronic Warfare Vulnerability Assessment Program. The overall mission of Big Crow is to project an electronic warfare environment for electronic warfare vulnerability assessments. The system contains the capability to capture data required to accomplish vulnerability assessments for the Department of Defense C2I weapon systems. Follow-on modification assistance includes support of engineering design, engineering drawing and quality reviews.

### EQUIPMENT/FACILITIES

Major unique facilities and equipment include: Integrated Facility for Avionics System Test (IFAST), Benefield Anechoic Facility (BAF), and Test & Evaluation Mission Simulator (TEMS) as part of the Electronic Combat Integrated Test (ECIT) complex; Edwards Flight Test Range (EFTR) which includes the real time mission control facilities, Precision Impact Range Area (PIRA) used for bombing/gunnery/infrared systems integration, personnel and cargo parachute drop zones, photo resolution range, and instrumented low level terrain following course; hydrant refueling system for heavy aircraft; aircraft weight and balance facility complex; photo/video lab for airborne and ground testing; intermediate aircraft maintenance support capability; Pacer Comet (jet engine test facility); horizontal aircraft thrust stand; and aircraft gun system harmonization range (GUNBUTTON).
### FY97 FUNDING DATA (MILLIONS $)

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<tr>
<th>APPROPRIATION</th>
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| MILITARY CONSTRUCTION (MILCON) | 21.750 |

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Phillips Laboratory

Abbreviated Functional Chart - Technical Organizations

Phillips Laboratory

- Geophysics
- Propulsion
- Space Technology
- Lasers and Imaging
- Space Experiments
- Advanced Weapons and Survivability
MISSION

I. The mission of Phillips Laboratory (PL) is to advance science and technology to provide the developments and improvements needed to continue the accomplishment of the Air Force mission. PL is primarily charged with planning, organizing, directing, executing, and controlling USAF research and development in the following areas: a) Space and Missiles Technology; b) Space Experiments; c) Directed Energy Weapons, and Weapons Effects; d) Survivability; and e) Geophysics Technical Developments and Effects on Systems.

II. Phillips Laboratory reorganized in October 1997 under the Air Force Research Laboratory. This will be the last Phillips Laboratory survey.

CURRENT IMPORTANT PROGRAMS

The following are some of the current important programs (thrusts) on which the laboratory is working:

(a) **Space and missiles technology** focuses on spacecraft structures, power and thermal management, sensors, and electronics.

(b) **Space experiments** are conducted in a ground, balloon-borne, aircraft or space mode. Also included are related ground acceptance and space/launch environmental testing.

(c) **Propulsion technology** focuses on advanced concepts involving motors, propellants and test techniques. Most of this work is performed by Phillips Laboratory employees at Edwards Air Force Base.

(d) **Airborne laser technology** will be able to acquire, track, and kill theater ballistic missile during their boost phase.

(e) **Lasers and imaging technology** involves demonstrating the technical and engineering feasibility of lasers and imaging systems.

(f) **Advanced weapons and survivability** develops high-energy plasma and microwave technologies, electromagnetic pulse hardening, space systems survivability, and advanced techniques and computer simulations for weapon effects.

(g) **Geophysics** conducts research to further Air Force understanding of the environment between the Earth and Sun and its effects on systems and operations. This work is conducted by Laboratory people at Hanscom Air Force Base.
### EQUIPMENT/FACILITIES

Primary operating locations are: Kirtland AFB NM, Edwards AFB CA, and Hanscom AFB MA. Unique facilities include: at Kirtland AFB, the Space Structures/Composites Laboratory, Aerospace Engineering Facility, High Energy Research and Technology Facility, High Energy Microwave Laboratory, High Energy Plasma Laboratory, Starfire optical Range, and underground tunnels in the Manzano Weapons Storage Area; at Edwards AFB, rocket test stands, Hydrodynamic Test laboratory, Chemical Experiments Laboratory, National Hover Test Facility; at Hanscom AFB, Haskell Observatory, Satellite Communications Facility, LIDAR Facility, Ionospheric Modification Laboratory, Air Force Interactive Meteorological System Laboratory, Weather Characterization & Advanced Weather System Laboratory, Cryogenic Simulation Facility, and IR Detection Facility.
### FY97 FUNDING DATA (MILLIONS $)

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<td>179</td>
<td>272</td>
</tr>
<tr>
<td>CIVILIAN</td>
<td>214</td>
<td>331</td>
<td>601</td>
</tr>
<tr>
<td>TOTAL</td>
<td>261</td>
<td>510</td>
<td>873</td>
</tr>
</tbody>
</table>

### SPACE AND PROPERTY

<table>
<thead>
<tr>
<th>BUILDING SPACE (THOUSANDS OF SQ FT)</th>
<th>PROPERTY ACQUISITION COST (MILLIONS $)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAB 996.000</td>
<td>REAL PROPERTY: 1,051.200</td>
</tr>
<tr>
<td>ADMIN 652.000</td>
<td>* NEW CAPITAL EQUIPMENT: 8.000</td>
</tr>
<tr>
<td>OTHER 846.000</td>
<td>EQUIPMENT: 1,109.500</td>
</tr>
<tr>
<td>TOTAL 2,494.000</td>
<td>* NEW SCIENTIFIC &amp; ENG. EQUIP.: 12.000</td>
</tr>
<tr>
<td>ACRES 16,620</td>
<td>* Subset of previous category.</td>
</tr>
</tbody>
</table>

NA = Not Applicable
Rome Laboratory

Abbreviated Functional Chart - Technical Organizations

<table>
<thead>
<tr>
<th>Rome Laboratory</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Command, Control and Communications Directorate</strong></td>
</tr>
<tr>
<td><strong>Surveillance and Photonics Directorate</strong></td>
</tr>
<tr>
<td><strong>Intelligence and Reconnaissance Directorate</strong></td>
</tr>
<tr>
<td><strong>Electromagnetics and Reliability Directorate</strong></td>
</tr>
</tbody>
</table>
**MISSION**

Advance the state-of-the-art of science and technology in Command, Control, Communications, Computing and Intelligence (C4I) research and development and transition these technologies to meet customer needs. To achieve this, the laboratory:

a. Conducts vigorous research, development, and test programs in all applicable technologies.

b. Transitions technology to current and future systems to improve operational capability, readiness, and supportability.

c. Provides a full range of technical support to Air Force Materiel Command product centers and other Air Force organizations.

d. Conducts selected acquisition programs for low-volume, limited quantity intelligence and software systems.

e. Promotes transfer of technology to the private sector.

Rome Lab supports this mission by developing techniques and equipment for the surveillance of ground and aerospace objects, and for inter-theater and intra-theater survivable communications. Rome Laboratory develops technologies for battle management information systems and the handling of intelligence data. The laboratory is also pursuing the following technologies: artificial intelligence/expert systems, solid state sciences and materials, electromagnetics, photonics, signal processing, computer architectures, and reliability, maintainability and compatibility of electronic systems.
CURRENT IMPORTANT PROGRAMS

The following are some of the important programs on which the laboratory is working: Offboard Augmented Theater Surveillance and High Performance Computing for Joint STARS; Multichannel Airborne Radar Measurements Program; Intelligence data handling; Information For The Warrior; Information Warfare; Secure survivable communication; SPEAKEasy Program; Space Communications Protocol Suite; Low Data Rate Reachback from Airborne Platforms; ARPA/Rome Lab Planning Initiative; Imagery Product Archive; Force Level Execution; Integrated Sensor System; VHDL Design Environment for Legacy Electronics; Signal Exploitation & Hostile Target Identification; Sensor exploitation; Photonics; Optical signal processing, storage and transmission; Timeline Analysis System; Artificial Intelligence; Speech Processing; Storage & Retrieval; Analytical Environments; Concept Based Indexing & Retrieval; Imagery Exploitation; Situation Assessment & Target Analysis; Evolutionary Design of Complex Software; and Real-Time Signal Processor Enhancement.

The Technology Transfer program includes: Utilizing the Education Partnership with Syracuse University to complete market assessments of three Laboratory technologies (Erasable Optical Memory, Two Transistor DRAM Cell, and All Polymer Battery); CRDAs between the Laboratory and New York State Technology Enterprise Corporation (NYSTEC) being executed in the areas of Advanced Communications for the NY State Police and Fraud, Waste and Abuse Tracking for the NY Dept of Social Services; the Laboratory's Partnership Intermediary Agreement with NYSTEC led to the co-development of an In-Vehicle Voice Verification System for the Immigration and Naturalization Service to aid in the traffic flow at US Border Crossings; The Laboratory's Patents data base was increased to include new patents issued that were retrieved from inventors; participated in the joint training exercise Global Apache 97 using advanced communications technology to enhance the capabilities of the warfighter in the field.

EQUIPMENT/FACILITIES

Primary operating locations are: Rome Laboratory, NY and Hanscom AFB, MA. Equipment and facilities include: Reconnaissance Exploitation facility; Photonics facility; Electronic Intelligence (ELINT) Development facility; Electronic Counter-Countermeasures (ECCM) and Signal Processing facility; Solid State Device Failure Analysis facility; Command and Control Technology Center; Communications Experimental facility; Radio Transmission facility; Electro-Magnetic Vulnerability facility; Surveillance facility; Distributed Systems Evaluation Environment facility; Space Time Adaptive Process facility; Airborne Radar Technology Development facility; Audio/Speech Processing facility; SPEAKEASY Test facility; ICARUS Prototype Development & Demonstration facility; Intelligence Support facility, Mass storage facility; Optical Beamforming facility; Integrated Photonics Characterization facility; Materials Synthesis and Development facility; Intelligence facility; Imagery Data Base facility; Network Design facility; Distributed Systems Evaluation Environment Testbed; Software Engineering and Artificial Intelligence facility; and a variety of antenna facilities.
### FY97 Funding Data (Millions $)

<table>
<thead>
<tr>
<th>Appropriation</th>
<th>In-House</th>
<th>In-House Management</th>
<th>Out-Of-House</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>RDT&amp;E:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.1 ILIR</td>
<td>0.000</td>
<td>NA</td>
<td>NA</td>
<td>0.000</td>
</tr>
<tr>
<td>6.1 Other</td>
<td>2.583</td>
<td>2.031</td>
<td>12.020</td>
<td>16.634</td>
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<tr>
<td>6.2</td>
<td>48.309</td>
<td>5.033</td>
<td>124.844</td>
<td>178.186</td>
</tr>
<tr>
<td>6.3</td>
<td>5.289</td>
<td>4.161</td>
<td>107.428</td>
<td>116.878</td>
</tr>
<tr>
<td>Subtotal (S&amp;T)</td>
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<td>11.225</td>
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<td>1.412</td>
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<td>0.122</td>
<td>24.121</td>
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<td>6.6</td>
<td>0.311</td>
<td>0.245</td>
<td>4.019</td>
<td>4.575</td>
</tr>
<tr>
<td>6.7</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Non-DOD</td>
<td>0.281</td>
<td>0.220</td>
<td>5.093</td>
<td>5.594</td>
</tr>
<tr>
<td><strong>Total RDT&amp;E</strong></td>
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<td>13.224</td>
<td>296.992</td>
<td>368.938</td>
</tr>
<tr>
<td>Procurement</td>
<td>1.193</td>
<td>NA</td>
<td>5.693</td>
<td>6.886</td>
</tr>
<tr>
<td>Operations &amp; Maintenance</td>
<td>10.084</td>
<td>NA</td>
<td>77.756</td>
<td>87.840</td>
</tr>
<tr>
<td>Other</td>
<td>6.473</td>
<td>NA</td>
<td>0.000</td>
<td>6.473</td>
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<tr>
<td><strong>Total Funding</strong></td>
<td>76.472</td>
<td>13.224</td>
<td>380.441</td>
<td>470.137</td>
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</table>

### Military Construction (Millions $)

| Military Construction (MILCON) | 0.000 |

### Personnel Data (End of Fiscal Year 1997)

<table>
<thead>
<tr>
<th>Type</th>
<th>Scientists &amp; Engineers</th>
<th>Technical Support &amp; Other Personnel</th>
<th>End Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Doctorates</td>
<td>Other</td>
<td></td>
</tr>
<tr>
<td>Military</td>
<td>9 54</td>
<td>54</td>
<td>54</td>
</tr>
<tr>
<td>Civilian</td>
<td>79 405</td>
<td>422</td>
<td>476</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>88 459</td>
<td>476</td>
<td>1,023</td>
</tr>
</tbody>
</table>

### Space and Property

<table>
<thead>
<tr>
<th>Building Space (Thousands of SQ FT)</th>
<th>Property Acquisition Cost (Millions $)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAB 721.000</td>
<td>REAL PROPERTY 52.287</td>
</tr>
<tr>
<td>ADMIN 236.000</td>
<td>* NEW CAPITAL EQUIPMENT 0.000</td>
</tr>
<tr>
<td>OTHER 438.000</td>
<td>EQUIPMENT 113.700</td>
</tr>
<tr>
<td><strong>Total 1,395.000</strong></td>
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</tr>
<tr>
<td>Acres 1,543</td>
<td>* Subset of previous category.</td>
</tr>
</tbody>
</table>

NA = Not Applicable

2 26 personnel included here are summer hires.
Wright Laboratory

Abbreviated Functional Chart - Technical Organizations

Wright Laboratory

Materials Directorate
Manufacturing Technology Directorate
Aero Propulsion and Power Directorate
Avionics Directorate
Armament Directorate
Flight Dynamics Directorate
### MISSION

Lead and focus aerospace technology to meet our customer needs.

### CURRENT IMPORTANT PROGRAMS

The following are some of the current important programs/thrusts on which the laboratory is working:

- Aero Propulsion and Power Technology.
- Air Vehicles Technology.
- Avionics Technology.
- Conventional Armament Technology.
- Materials Technology.
- Manufacturing Technology.

CRDAs to develop a user friendly program to track hazardous materials; a cost effective rehabilitation of ailing infrastructure (bridges) using composite materials; an understanding of a fire suppression system on high speed vehicles including aircraft; durable coatings on aluminum ice cube trays which has application to aircraft parts; design of a single turbo-fan engine aviation aircraft and fabricate and characterize devices using new organic nonlinear optical materials.
Primary Operating locations are: Wright-Patterson AFB OH and Eglin AFB FL. Equipment and facilities include:

(a) **Turbine Research Laboratory** to simulate all relevant engine conditions governing turbine operation.

(b) **Compressor Research Facility** capable of testing full-scale, multi-stage, and single shaft fans and compressors at speed/powers of 3,000 to 16,000 rpm at 3,000 hp and 16,000 to 30,000 rpm at 15,000 hp.

(c) **Kinetic Kill Vehicle Digital and Hardware-In-The-Loop Simulation Facility** to realistically simulate launch-to-impact scenario for guided interceptors.

(d) **Integrated Avionics Lab** for real-time dynamic testing of integrated avionics systems in realistic operational scenarios.

(e) **In-Flight Simulator** to examine the flight characteristics and properties of different aircraft, different flight control systems and cockpit layouts.

(f) **Variable Stability In-Flight Simulator Test Aircraft** for flight control, pilot-vehicle interface and avionics/flight control integration research programs.

(g) **Subsonic Aerodynamic Research Laboratory** with Mach range from 0.2 to 5.0, for high angle of attack testing, very low turbulence, very large force measuring, and testing power-simulated vehicles.

(h) **DoD Landing Gear Development Facility** for aircraft tire/wheel testing, 350 mph top speed, 150,000 to 1 lb. max load = 20 deg yaw and camber, and aircraft brakes/wheels/tire testing, 200 mph top speed, 350,000 to 1 lb. max load, 220 M ft. lbs. max energy.

(i) **Laser Hardened Materials Evaluation Lab** provides well characterized 100+ kw continuous wave, carbon dioxide laser for materials response phenomenology, geometric scaling, and sub-scale component testing.

(j) **Device Research Laboratory** for extensive experimental growth and characterization of electronic and optical properties of III-V materials and devices.

(k) **Structures Test Facility** with capability for static and fatigue testing of complete aerospace vehicles.

(l) **Compact Radar Cross Section Range** with down range imaging capability and capability to measure small targets with accuracy.

(m) **Optical Research Facility** which can measure far-field patterns of large (up to 2.4 meters in diameter) antenna systems under controlled temperatures and pressure conditions (simulate altitudes up to 270,000 feet).

(n) **Aeroballistics Research Facility** which is designed to study free-flight characteristics of projectiles and missile configurations under controlled atmospheric conditions (22 +/- deg. centigrade, less than 50% relative humidity). Test range is instrumented for 207 m., 2.66 m. square cross section for first 69 m.
### FY97 FUNDING DATA (MILLIONS $)

<table>
<thead>
<tr>
<th>APPROPRIATION</th>
<th>IN-HOUSE</th>
<th>IN-HOUSE MANAGEMENT</th>
<th>OUT-OF-HOUSE</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>RDT&amp;E:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.1 ILIR</td>
<td>0.800</td>
<td>NA</td>
<td>NA</td>
<td>0.800</td>
</tr>
<tr>
<td>6.1 Other</td>
<td>10.000</td>
<td>1.000</td>
<td>19.900</td>
<td>30.900</td>
</tr>
<tr>
<td>6.2</td>
<td>110.200</td>
<td>31.200</td>
<td>212.700</td>
<td>354.100</td>
</tr>
<tr>
<td>6.3</td>
<td>3.700</td>
<td>21.100</td>
<td>347.700</td>
<td>372.500</td>
</tr>
<tr>
<td>Subtotal (S&amp;T)</td>
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<td>53.300</td>
<td>580.300</td>
<td>758.300</td>
</tr>
<tr>
<td>6.4</td>
<td>0.300</td>
<td>2.700</td>
<td>23.300</td>
<td>26.300</td>
</tr>
<tr>
<td>6.5</td>
<td>0.000</td>
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<td>92.300</td>
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<td>6.6</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>6.7</td>
<td>1.000</td>
<td>6.800</td>
<td>42.200</td>
<td>50.000</td>
</tr>
<tr>
<td>Non-DOD</td>
<td>1.000</td>
<td>13.000</td>
<td>91.000</td>
<td>105.000</td>
</tr>
<tr>
<td>TOTAL RDT&amp;E</td>
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<td>76.000</td>
<td>828.900</td>
<td>1,031.900</td>
</tr>
<tr>
<td>Procurement</td>
<td>0.000</td>
<td>NA</td>
<td>4.200</td>
<td>4.200</td>
</tr>
<tr>
<td>Operations &amp; Maintenance</td>
<td>0.200</td>
<td>NA</td>
<td>4.300</td>
<td>4.500</td>
</tr>
<tr>
<td>Other</td>
<td>0.000</td>
<td>NA</td>
<td>29.000</td>
<td>29.000</td>
</tr>
<tr>
<td>TOTAL FUNDING</td>
<td>127.200</td>
<td>76.000</td>
<td>866.400</td>
<td>1,069.600</td>
</tr>
</tbody>
</table>

### MILITARY CONSTRUCTION (MILLIONS $)

| Military Construction (MILCON) | 0.000 |

### PERSONNEL DATA (END OF FISCAL YEAR 1997)

<table>
<thead>
<tr>
<th>TYPE</th>
<th>SCIENTISTS &amp; ENGINEERS</th>
<th>TECHNICAL SUPPORT &amp; OTHER PERSONNEL</th>
<th>END STRENGTH</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DOCTORATES</td>
<td>OTHER</td>
<td></td>
</tr>
<tr>
<td>MILITARY</td>
<td>47</td>
<td>182</td>
<td>87</td>
</tr>
<tr>
<td>CIVILIAN</td>
<td>201</td>
<td>1,124</td>
<td>729</td>
</tr>
<tr>
<td>TOTAL</td>
<td>248</td>
<td>1,306</td>
<td>816</td>
</tr>
</tbody>
</table>

### SPACE AND PROPERTY

<table>
<thead>
<tr>
<th>BUILDING SPACE (THOUSANDS OF SQ FT)</th>
<th>PROPERTY ACQUISITION COST (MILLIONS $)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAB 1,826.227</td>
<td>REAL PROPERTY 983.500</td>
</tr>
<tr>
<td>ADMIN 559.638</td>
<td>* NEW CAPITAL EQUIPMENT 0.500</td>
</tr>
<tr>
<td>OTHER 569.220</td>
<td>EQUIPMENT 2,107.190</td>
</tr>
<tr>
<td>TOTAL 2,955.085</td>
<td>* NEW SCIENTIFIC &amp; ENG. EQUIP. 12.000</td>
</tr>
<tr>
<td>ACRES 1,202</td>
<td>* Subset of previous category.</td>
</tr>
</tbody>
</table>

NA = Not Applicable
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The only In-House RDT&E Activity within USUHS is the Armed Forces Radiobiology Research Institute (AFMRI).
MISSION

The mission of Armed Forces Radiobiology Research Institute shall be to conduct research in the field of radiobiology and related matters essential to the operational and medical support of the Department of Defense and military services.

CURRENT IMPORTANT PROGRAMS

- Develop medical countermeasures to treat radiation injuries.
- Optimize combinations of protective agents to promote survival and combat effectiveness following irradiation at high or low dose rates.
- Development of reliable biodosimetry assays/techniques.
- Evaluation of early and late effects of radiation exposures at low dose rates.
- Counterproliferation of weapons of mass destruction.
- Impact of imbedded depleted uranium shrapnel on biological systems.
- Continue to support studies of residents of the former Soviet Union who were exposed to chronic radiation through environmental contamination.

EQUIPMENT/FACILITIES

Functions: operate facilities for conducting radiobiology research and disseminating results, conduct advanced training, provide analysis consultation on bioeffects of radiation, and perform such other research functions as required. Major equipment includes: pulse and steady state nuclear reactor, 100,000-Curie Cobalt-60 irradiator, electron linear accelerator, and steady state X-ray source. Support services include: measurement of radiation fields, provision and care of laboratory animals, equipment design and fabrication assistance, real-time data acquisition system, television and film documentation of experiments, personnel and environmental monitoring, editorial assistance in report preparation, and a large technical library.
## FY97 FUNDING DATA (MILLIONS $)

<table>
<thead>
<tr>
<th>APPROPRIATION</th>
<th>IN-HOUSE</th>
<th>IN-HOUSE MANAGEMENT</th>
<th>OUT-OF-HOUSE</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>RDT&amp;E:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.1 ILIR</td>
<td>0.000</td>
<td>NA</td>
<td>NA</td>
<td>0.000</td>
</tr>
<tr>
<td>6.1 Other</td>
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<tr>
<td>Subtotal (S&amp;T)</td>
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<td>0.175</td>
<td>11.168</td>
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<td>0.000</td>
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</tr>
<tr>
<td>Non-DOD</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>TOTAL RDT&amp;E</td>
<td>10.993</td>
<td>0.000</td>
<td>0.175</td>
<td>11.168</td>
</tr>
<tr>
<td>Procurement</td>
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<td>NA</td>
<td>NA</td>
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<tr>
<td>Operations &amp; Maintenance</td>
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<td>TOTAL FUNDING</td>
<td>12.456</td>
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<td>12.631</td>
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</table>

## MILITARY CONSTRUCTION (MILLIONS $)

| Military Construction (MILCON) | 0.000 |

## PERSONNEL DATA (END OF FISCAL YEAR 1997)

<table>
<thead>
<tr>
<th>TYPE</th>
<th>SCIENTISTS &amp; ENGINEERS</th>
<th>TECHNICAL SUPPORT &amp; OTHER PERSONNEL</th>
<th>END STRENGTH</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DOCTORATES</td>
<td>OTHER</td>
<td></td>
</tr>
<tr>
<td>MILITARY</td>
<td>10</td>
<td>22</td>
<td>30</td>
</tr>
<tr>
<td>CIVILIAN</td>
<td>41</td>
<td>26</td>
<td>33</td>
</tr>
<tr>
<td>TOTAL</td>
<td>51</td>
<td>48</td>
<td>63</td>
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</table>

## SPACE AND PROPERTY

<table>
<thead>
<tr>
<th>BUILDING SPACE (THOUSANDS OF SQ FT)</th>
<th>PROPERTY ACQUISITION COST (MILLIONS $)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAB 61.750</td>
<td>REAL PROPERTY</td>
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<tr>
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<td>OTHER 23.908</td>
<td>EQUIPMENT</td>
</tr>
<tr>
<td>TOTAL 119.915</td>
<td>* NEW SCIENTIFIC &amp; ENG. EQUIP.</td>
</tr>
<tr>
<td>ACRES 10</td>
<td>* Subset of previous category.</td>
</tr>
</tbody>
</table>

NA = Not Applicable
APPENDIX A
DISESTABLISHMENT, ESTABLISHMENT,
OR CHANGE IN ORGANIZATION NAME
APPENDIX A

DISESTABLISHMENT, ESTABLISHMENT, OR CHANGES IN ORGANIZATION NAME BETWEEN FY96 AND FY97

DEPARTMENT OF THE ARMY

The Research Institute for Behavioral and Social Sciences is now referred to as the Army Research Institute.

DEPARTMENT OF THE NAVY

The Naval Biodynamics Laboratory closed on 30 September 1996.

DEPARTMENT OF THE AIR FORCE

No changes.

DEPARTMENT OF DEFENSE AGENCIES

No changes.

Note: Activities in bold typeface were reported in the FY 96 edition of this report as separate Activities.
APPENDIX A

DISESTABLISHMENT, ESTABLISHMENT, OR CHANGES IN ORGANIZATION NAME BETWEEN FY96 AND FY97

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APPENDIX B
DEFINITIONS OF REPORT ELEMENTS

INTRODUCTORY PRECAUTIONARY NOTE

Data in this report should not be summarized or used for comparative analyses between Activities and/or across Services because labs/centers use different business systems to satisfy their special needs. Some organizations (e.g., Navy) operate on an industrial funding basis; that is, they charge their customers for all operating costs, including maintaining their physical plants and providing other necessary support services (e.g., human resources office, finance and accounting support). Other labs/centers (e.g., Air Force) are institutionally funded; that is, they receive most of their funding as direct appropriations from Congress and use these funds for operating support costs as well as for research. In addition, most institutionally funded labs/centers are tenants on larger military bases and receive their support services at reduced or no charge from their host. Even those that own their own facilities receive separate funding support services and do not charge their customers for these overhead costs. Efforts are underway to institute common business practices across the DOD RDT&E labs, but until that occurs comparisons may be misleading.

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Narratives ................................................................................... B-2
Funding ..................................................................................... B-3
Personnel ................................................................................... B-7
Space and Property ................................................................. B-9

Definitional changes for FY97 are italicized.
APPENDIX B

DEFINITIONS OF REPORT ELEMENTS

ABBREVIATED FUNCTIONAL CHART - TECHNICAL ORGANIZATIONS

This is a partial organization chart, provided by each Activity, to provide an overview of its technical operations. It does not depict the entire organizational structure and is abbreviated for purposes of this report.

NARRATIVES

Mission Statement
Stated is the mission of the laboratory or Activity.

Current Important Programs Narrative
Summarized are current important programs on which the laboratory or Activity is working. Any Technology Transition efforts like Cooperative Research and Development Agreements (CRADAs) are identified.

- Technology Transfer
  Data supplied are any major Technology Transfer efforts underway, including the number of scientists and engineers exchanged with industry or academia.

Equipment/Facilities Narrative
Summarized are the major equipment and facility capabilities of the laboratory or Activity including any unique equipment and facilities not available to the commercial or academic R&D community anywhere else.
APPENDIX B

DEFINITIONS OF REPORT ELEMENTS

FUNDING

RDT&E Budget Activities (BAs)

<table>
<thead>
<tr>
<th>BA</th>
<th>BA Title</th>
<th>Applicable Research Categories</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Basic Research</td>
<td>6.1</td>
</tr>
<tr>
<td>2</td>
<td>Applied Research</td>
<td>6.2</td>
</tr>
<tr>
<td>3</td>
<td>Advanced Technology Development</td>
<td>6.3</td>
</tr>
<tr>
<td>4</td>
<td>Demonstration and Validation (Dem/Val)</td>
<td>6.4</td>
</tr>
<tr>
<td>5</td>
<td>Engineering &amp; Manufacturing Development (EMD)</td>
<td>6.5</td>
</tr>
<tr>
<td>6</td>
<td>RDT&amp;E Management Support</td>
<td>6.6</td>
</tr>
<tr>
<td>7</td>
<td>Operational Systems Development (OSD)</td>
<td>6.7</td>
</tr>
</tbody>
</table>

In-House RDT&E Activities

These Activities are organizational entities which perform at least 25% of their work in any or all of the categories of research, development, test and evaluation (RDT&E). In addition, at least 25% of an Activity's In-House manpower and/or 25% of the obligation authority used In-House is devoted to one or more of the categories of RDT&E.

Current Year Obligation Authority

Authority for the financial resources available for obligation in the specific year being reported. This excludes unobligated authority carried forward from the prior year. The appropriation category refers to the original funding source, even if it may reimburse a different funding category.

In-House

The total amount for the fiscal year reporting period for mission-oriented work directly performed, or to be performed, by government personnel of the reporting organization.

- **Included**: funding regardless of source (i.e., own Service, sister Service, ARPA, OSD, etc.); costs of supplies and equipment essentially of an off-the-shelf nature, which are procured for use in-house; direct labor, direct material, direct travel, direct equipment, direct computer support, other direct support; and all overhead costs.

- **Excluded**: expenses for planning and administering contracts and grants for out-of-house work and expenses for activities performed by contractors of the reporting organization.

In-House Managing Out-of-House

The total amount of funds incurred in planning and administering out-of-house programs by personnel of the reporting organization. (This data element is not applicable for the Navy. The Navy includes these funds in the In-House category).

- **Included**: travel and other supporting services.

Out-of-House

The total amount for the fiscal year reporting period for direct mission-oriented work performed, or to be performed, by other than the government personnel at the reporting organization.

- **Included**: RDT&E work by other departmental or DoD organizations, industrial firms, educational institutions, not-for-profit institutions, and private individuals.

- **Excluded**: all overhead costs.
APPENDIX B
DEFINITIONS OF REPORT ELEMENTS

FUNDING (continued)

6.1 Basic Research

6.1 In Laboratory Independent Research (ILIR)
The total amount for research 6.1 (Navy PE=0601152N) In-Laboratory Independent Research program elements.

6.1 Other In-House/Out-of-House
The total amount for Basic Research 6.1 program elements which are not ILIR but are conducted in-house/out-of-house.

6.1 In-House Effort Managing Out-of-House Contracts (In-House-Management)
The total amount for expenses incurred in planning and administering Basic Research 6.1 programs, by personnel of the organizational entity, which are conducted out-of-house.

6.2 Applied Research

6.2 In-House/Out-of-House
The total amount for Applied Research 6.2 program elements conducted in-house/out-of-house.

6.2 In-House Effort Managing Out-of-House Contracts (In-House-Management)
The total amount for expenses incurred in planning and administering Applied Research 6.2 programs, by personnel of the organizational entity, which are conducted out-of-house.

6.3 Advanced Technology Development

6.3 In-House/Out-of-House
The total amount for Advanced Technology Development 6.3 program elements conducted in-house/out-of-house.

6.3 In-House Effort Managing Out-of-House Contracts (In-House-Management)
The total amount for expenses incurred in planning and administering Advanced Development 6.3 programs, by personnel of the organizational entity, which are conducted out-of-house.

6.4 Demonstration and Validation (Dem/Val)

6.4 In-House/Out-of-House
The total amount for Dem/Val 6.4 program elements conducted in-house/out-of-house.

6.4 In-House Effort Managing Out-of-House Contracts (In-House-Management)
The total amount for expenses incurred in planning and administering Dem/Val 6.4 programs, by personnel of the organizational entity, which are conducted out-of-house.
APPENDIX B

DEFINITIONS OF REPORT ELEMENTS

FUNDING (continued)

6.5 Engineering and Manufacturing Development (EMD)

6.5 In-House/Out-of-House
The total amount for EMD 6.5 program elements conducted in-house/out-of-house.

6.5 In-House Effort Managing Out-of-House Contracts (In-House-Management)
The total amount for expenses incurred in planning and administering Engineering and Manufacturing Development 6.5 programs, by personnel of the organizational entity, which are conducted out-of-house.

6.6 RDT&E Management Support

6.6 In-House/Out-of-House
The total amount for RDT&E Management Support 6.6 program elements conducted in-house/out-of-house.

6.6 In-House Effort Managing Out-of-House Contracts (In-House-Management)
The total amount for expenses incurred in planning and administering Management Support 6.6 programs, by personnel of the organizational entity, which are conducted out-of-house.

6.7 Operational Systems Development (OSD)

6.7 In-House/Out-of-House
The total amount for all OSD 6.7 with RDT&E funds conducted in-house/out-of-house. This item is interpreted in its broadest sense to include operational developments outside the systems areas, and not included in any of the above categories.

6.7 In-House Effort Managing Out-of-House Contracts (In-House-Management)
The total amount for expenses incurred in planning and administering Operational Systems Development (OSD) 6.7 programs, by personnel of the organizational entity, which are conducted out-of-house.

Non-DoD

Non-DoD In-House/Out-of-House
The total amount for all In-House/Out-of-House RDT&E not included in 6.1-6.7 as defined above.

Non-DoD In-House Effort Managing Out-of-House Contracts (In-House-Management)
The total amount for expenses incurred in planning and administering RDT&E not included in 6.1-6.7 programs, by personnel of the organizational entity, which are conducted out-of-house.

Procurement

Procurement In-House/Out-of-House
The total amount for procurement appropriations in-house/out-of-house regardless of source.
APPENDIX B
DEFINITIONS OF REPORT ELEMENTS

FUNDING (continued)

Operation and Maintenance (O&M)

O&M In-House/Out-of-House
The total amount for O&M appropriations in-house/out-of-house regardless of source.

Other

Other In-House/Out-of-House
The total amount for all other appropriations in-house/out-of-house regardless of source. Included are Military Pay and Allowances (MPA) if applicable.

Military Construction (MILCON)

MILCON
This is the total amount for Military Construction appropriations.

Totals

Total RDT&E
The sum of the total amount, regardless of source, for both In-House, In-House Managing Out-of-House, and Out-of-House funding for the following categories:

- ILIR 6.1
- Basic Research 6.1
- Applied Research 6.2
- Advanced Technology Development 6.3
- Demonstration and Validation (Dem/Val) 6.4
- Engineering and Manufacturing Development (EMD) 6.5
- RDT&E Management Support 6.6
- Operational Systems Development 6.7
- Non-DOD

Total Funding
The sum of Total RDT&E, Procurement, Operations & Maintenance and Other.
APPENDIX B
DEFINITIONS OF REPORT ELEMENTS

PERSONNEL

Military

Military End Strength
*Military end strength is the September 30 strength of Active duty military*
- Included: Transients, trainees, holdees and students.
- Excluded: Cadets.

Military Scientist and Engineering Doctorates
The total number of military scientists and engineers (officer and enlisted) whose most advanced degree is a doctorate. Degrees must be earned from an accredited college or university. Honorary degrees are excluded. Included are full-time military scientific, engineering, mathematical, and medical personnel actively engaged in RDT&E activities. Lawyers, accountants, chaplains, social workers and educators are excluded.

Other Military Scientists and Engineers
The total number of military scientists and engineers (officer and enlisted) who do not hold a doctor's degree, but who are considered professionals. Included are full-time military scientific and engineering personnel actively engaged in RDT&E activities. Lawyers, accountants, chaplains, social workers and educators are excluded.

Military Technical Support and Other Personnel
The total number of Military Technical Support and Other Personnel. This includes all military personnel not listed in the above two categories.

Civilian

Civilian End Strength
*Military end strength is the September 30 strength of DoD civilian direct hires in a paid, active duty status who are paid from appropriated funds (RDT&E and other appropriations).*
- Included: Part time and temporary personnel.
- Excluded: Defense Intelligence Agency and National Security Agency personnel.

Civilian Scientist and Engineering Doctorates
The total number of civilian scientists and engineers whose most advanced degree is a doctorate. Degrees must be earned from an accredited college or university. Honorary degrees are excluded. Included are full-time Government scientific, engineering, mathematical, and medical personnel actively engaged in RDT&E activities. Lawyers, accountants, chaplains, social workers and educators are excluded.

Other Civilian Scientists and Engineers
The total number of civilian scientists and engineers who do not hold a doctor's degree, but who are rated as professionals. Included are full-time Government scientific and engineering personnel actively engaged in RDT&E activities. Lawyers, accountants, chaplains, social workers and educators are excluded.
APPENDIX B
DEFINITIONS OF REPORT ELEMENTS

PERSONNEL (continued)

Civilian Technical Support and Other Personnel
The total number of Civilian Technical Support and Other Personnel. This includes all civilian personnel
not listed in the above two categories.
APPENDIX B
DEFINITIONS OF REPORT ELEMENTS

SPACE AND PROPERTY

Acreage
The total number of acres owned, combined with the total number of acres occupied, rounded to the nearest acre. In cases involving tenants who are also RDT&E Activities, the tenants report only the acreage occupied solely by them. The owning Activity reports the remainder including any acreage occupied by non-R&D tenants.
   • Included: land which is public domain.
   • Excluded: all easements and permits.

Laboratory Space
The total number of square feet (in thousands)* of permanent and semi-permanent (e.g., fixed-site trailers) building space that is laboratory space.
   • Included: only walled and roofed building space; facilities assigned to, leased by, or occupied by the reporting organization.
   • Excluded: parking lots; open storage areas; lean-tos.

Administrative Space
The total number of square feet (in thousands)* of building space that is administrative space (usually that portion occupied by the headquarters and support services staff, and excluding scientists' or engineers' offices in a laboratory which is reported as Laboratory space).
   • Included: facilities assigned to, leased by, or occupied by the reporting organization.

Other Space
The total number of square feet (in thousands)* of all remaining building space (e.g., hangars, warehouses, garages, etc.).
   • Included: facilities assigned to, leased by, or occupied by the reporting organization.

*Square feet is expressed in thousands. For example 15,200 square feet is entered as 15.2.

Acquisition Cost of Real Property
The total acquisition cost (in millions $)** of all land, buildings, and capital equipment and their improvements. An RDT&E owner does not report this information for the facilities assigned to, or occupied by its RDT&E tenants, as they report this information separately.
   • Included: the cost of installed physical plant equipment, such as HVAC; facilities assigned to, leased by, or occupied by the reporting organization.
   • Excluded: The cost of acreage or buildings rented from private owners.

Each reporting activity is responsible for determining and reporting the cost of real property. This includes the cost of installed equipment. This figure represents the true total investment over the life of the activity for real property on hand as of the reporting date.

New Capital Equipment
The total acquisition cost (in millions $)** for new capital equipment (i.e., installed physical plant equipment such as HVAC) acquired during the fiscal year reporting period. This amount is also included in the entry for Acquisition Cost of Real Property.
APPENDIX B
DEFINITIONS OF REPORT ELEMENTS

SPACE AND PROPERTY (continued)

Acquisition Cost of Equipment
The total acquisition cost (in millions $)** of all "personal property" equipment. An RDT&E owner does not report this information for the facilities assigned to, or occupied by its RDT&E tenants, as they report this information separately.
- **Included:** The cost of installed equipment directly related to mission execution, such as lab test equipment; the cost of equipment in facilities assigned to, leased by, or occupied by the reporting organization.
- **Excluded:** The cost of physical plant equipment reported under Acquisition Cost of Real Property (explained previously).

Each reporting activity is responsible for determining and reporting the cost of personal property. This cost includes those costs incurred by the acquisition (including installation when applicable) of all property other than real property. It includes personal property such as machine tools, environmental test equipment, furniture, laboratory equipment, vehicles, etc. Items having a unit cost of less than $200 are excluded. The figure represents the cost of all personal property acquired throughout the life of the activity, to the reporting date, that is still on hand.

New Scientific & Engineering Equipment
The total acquisition cost (in millions $)** for new scientific & engineering equipment acquired during the fiscal year reporting period. This amount is also included in the entry for Acquisition Cost of Equipment.
- **Included:** The cost of installed equipment directly related to mission execution, such as lab test equipment.

** Dollars are expressed in millions rounded to the nearest thousand. For example, $2,517,830 is entered as 2.518.
APPENDIX C
SELECTED STANDARD ABBREVIATIONS
AND ACRONYMS
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACTD</td>
<td>Advanced Concept and Technology Demonstration</td>
</tr>
<tr>
<td>AI</td>
<td>Artificial Intelligence</td>
</tr>
<tr>
<td>ASW</td>
<td>Antisubmarine Warfare</td>
</tr>
<tr>
<td>ATC</td>
<td>Air Traffic Control</td>
</tr>
<tr>
<td>ATCCS</td>
<td>Army Tactical Command and Control System</td>
</tr>
<tr>
<td>ATD</td>
<td>Advanced Technology Demonstration</td>
</tr>
<tr>
<td>BRAC</td>
<td>Base Realignment and Closure</td>
</tr>
<tr>
<td>BW</td>
<td>Biological Warfare</td>
</tr>
<tr>
<td>C2</td>
<td>Command and Control</td>
</tr>
<tr>
<td>C4I</td>
<td>Command, Control, Communications, Computers, and Intelligence</td>
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<tr>
<td>CAD</td>
<td>Computer Aided Design</td>
</tr>
<tr>
<td>CAE</td>
<td>Computer Aided Engineering</td>
</tr>
<tr>
<td>CAM</td>
<td>Computer Aided Manufacturing</td>
</tr>
<tr>
<td>CB</td>
<td>Chemical Biological</td>
</tr>
<tr>
<td>CBR</td>
<td>Chemical, Biological, Radiological</td>
</tr>
<tr>
<td>CG</td>
<td>Commanding General</td>
</tr>
<tr>
<td>CINC</td>
<td>Commander in Chief</td>
</tr>
<tr>
<td>CM</td>
<td>Countermeasures</td>
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<tr>
<td>CNO</td>
<td>Chief of Naval Operations</td>
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<tr>
<td>CONUS</td>
<td>Continental United States</td>
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<tr>
<td>COTS</td>
<td>Commercial off-the Shelf</td>
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<td>CRADA</td>
<td>Cooperative Research and Development Agreement</td>
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<td>CW</td>
<td>Chemical Warfare</td>
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<td>DA</td>
<td>Department of the Army</td>
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<tr>
<td>DOD</td>
<td>Department of Defense</td>
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<tr>
<td>DON</td>
<td>Department of the Navy</td>
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<td>DREN</td>
<td>Defense Research and Engineering Network</td>
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<tr>
<td>DT&amp;E</td>
<td>Development, Test, and Evaluation</td>
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<tr>
<td>DTAP</td>
<td>Defense Technology Area Plan</td>
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<td>ECCM</td>
<td>Electronic Counter-Countermeasures</td>
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<td>ECM</td>
<td>Electronic Countermeasures</td>
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<td>ELINT</td>
<td>Electronic Intelligence</td>
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<td>EMI</td>
<td>Electromagnetic Interference</td>
</tr>
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<td>EMP</td>
<td>Electromagnetic Propagation</td>
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<td>Electromagnetic Vulnerability</td>
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<td>EMW</td>
<td>Electromagnetic Warfare</td>
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<td>EOD</td>
<td>Explosive Ordnance Disposal</td>
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<td>EPA</td>
<td>Environmental Protection Agency</td>
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<td>EW</td>
<td>Electronic Warfare</td>
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<td>FSN</td>
<td>Foreign Service National</td>
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<td>GPS</td>
<td>Global Positioning System</td>
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<tr>
<td>HF</td>
<td>High-Frequency</td>
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<tr>
<td>HVAC</td>
<td>Heating, Ventilation, and Air Conditioning</td>
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<td>IAC</td>
<td>Information Analysis Center</td>
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<tr>
<td>IEW</td>
<td>Intelligence Electronic Warfare</td>
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<tr>
<td>IFF</td>
<td>Identification, Friend or Foe</td>
</tr>
<tr>
<td>IIIR</td>
<td>In-Lab Independent Research</td>
</tr>
<tr>
<td>IR</td>
<td>Infrared</td>
</tr>
<tr>
<td>IR&amp;D</td>
<td>Independent Research and Development</td>
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<tr>
<td>KE</td>
<td>Kinetic Energy</td>
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<tr>
<td>LAN</td>
<td>Local Area Network</td>
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### APPENDIX C

**SELECTED STANDARD ABBREVIATIONS AND ACRONYMS**

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>M&amp;S</td>
<td>Modeling and Simulation</td>
</tr>
<tr>
<td>MOA</td>
<td>Memorandum of Agreement</td>
</tr>
<tr>
<td>MOU</td>
<td>Memorandum of Understanding</td>
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<td>MRTFB</td>
<td>Major Range and Test Facility Base</td>
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<tr>
<td>MSRC</td>
<td>Major Shared Resource Center</td>
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<td>NBC</td>
<td>Nuclear, Biological and Chemical</td>
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<td>NVD</td>
<td>Night Vision Devices</td>
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<td>OCONUS</td>
<td>Outside the Continental United States</td>
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<td>OSD</td>
<td>Office of the Secretary of Defense</td>
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<tr>
<td>PEO</td>
<td>Program Executive Officer</td>
</tr>
<tr>
<td>PM</td>
<td>Program Manager</td>
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<tr>
<td>POL</td>
<td>Petroleum, Oil, Lubricants</td>
</tr>
<tr>
<td>R&amp;D</td>
<td>Research and Development</td>
</tr>
<tr>
<td>RDT&amp;E</td>
<td>Research, Development, Test and Evaluation</td>
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<tr>
<td>RF</td>
<td>Radio Frequency</td>
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<tr>
<td>SOF</td>
<td>Special Operations Forces</td>
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<tr>
<td>S&amp;T</td>
<td>Science and Technology</td>
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<td>SBIR</td>
<td>Small Business Innovation Research</td>
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<tr>
<td>STO</td>
<td>Science and Technology Objective</td>
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<td>Test and Evaluation</td>
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<td>TF XXI</td>
<td>Task Force XXI</td>
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<td>UAV</td>
<td>Unmanned Aerial Vehicle</td>
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<td>USCG</td>
<td>United States Coast Guard</td>
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<td>United States Marine Corps</td>
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<td>Undersea Warfare</td>
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<td>UUV</td>
<td>Unmanned Undersea Vehicle</td>
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<td>UV</td>
<td>Ultraviolet</td>
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<tr>
<td>WAN</td>
<td>Wide Area Network</td>
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C-2