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NRaD Command History Calendar Year 1996

Naval Command, Control and Ocean
Surveillance Center RDT&E Division
San Diego, CA 92152–5001

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Naval Command, Control and Ocean Surveillance Center
RDT&E Division, San Diego, CA 92152–5001

NAVAL COMMAND, CONTROL AND OCEAN SURVEILLANCE CENTER RDT&E DIVISION
San Diego, California 92152–5001

H. A. WILLIAMS, CAPT, USN
Commanding Officer

R. C. KOLB
Executive Director

ADMINISTRATIVE INFORMATION

This technical document was prepared in response to OPNAVINST 5750.12E. The document summarizes the major activities and achievements of the Naval Command, Control and Ocean Surveillance Center's RDT&E Division in 1996. This document was prepared by the Technical Information Division using in-house funding.

Released by
E. R. Ratliff, Head
Publications Branch

Under authority of
M. E. Cathcart, Head
Technical Information Division

Preface

The Naval Command, Control and Ocean Surveillance Center RDT&E Division, or NRaD, Command History for calendar year (CY) 96 is submitted in conformance with OPNAVINST 5750.12E. The history provides a permanent record of CY 96 activities at NRaD. Although the history covers one calendar year, much of the information was only available on a fiscal year (FY) basis and is so noted in the text.

The history is divided into two main sections. The first section gives an introduction to NRaD and describes developments in organization, personnel, and funding. The second section documents technical programs underway during 1996.

Because the results of scientific work often develop out of many years' effort, programs are not always documented annually. Previous command histories provide extensive background articles on many major programs. When possible, background articles are prepared for new or previously untreated programs. By consulting command histories written over a period of several years, a reader can follow the broad thrusts of Division research and development. In this year's History, background articles appear as featured programs in Calendar Year 1996 Highlights. These articles were originally printed in the NRaD *Outlook* (JoAnne Newton, Editor).

Appendices to this document provide supplementary Command information. Appendix A lists achievement awards given in CY 96. Appendix B lists patents awarded in CY 96. Appendices C and D provide lists of distinguished visitors hosted by NRaD and major conferences and meetings at NRaD, respectively.

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Introduction and Administrative Developments

Introduction to NCCOSC RDT&E Division (NRaD)

The Naval Command, Control and Ocean Surveillance Center (NCCOSC) RDT&E Division (or NRaD) is a full-spectrum RDT&E laboratory serving the Navy, Marine Corps, and other Department of Defense and national sponsors within its mission, leadership assignments, and prescribed functions. NCCOSC is one of the Navy's four major warfare centers and reports directly to the Commander, Space and Naval Warfare Systems Command (SPAWAR).

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 multiplatforms.

Leadership Areas

Command, control, and communications systems
Command, control, and communications systems countermeasures
Ocean surveillance systems
Command, control, and communication modeling and analysis
Ocean engineering
Navigation systems and techniques
Marine mammals
Integration of space communication and surveillance systems

NRaD's Vision

To be the nation's pre-eminent provider of integrated C^4ISR solutions for warrior information dominance.

Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C^4ISR)—Integrating disparate units and functions into coordinated operational capabilities.

Information Dominance—Providing the warrior sufficient and timely information and associated tools to plan and execute effectively while denying—through both active and passive means—the enemy adequate information on which to plan and execute effectively.

Unique Technology, Facilities, and Capabilities

As a government laboratory, we provide world-class science and technology with strong ties to industrial, academic, and scientific research and development

(R&D) communities. Our R&D is focused by knowledge of user needs and proven by a record of successful transitions of technology to industry and the user community. Our comprehensive facilities and laboratories are primarily located in San Diego, close to major customer organizations and integrated and networked with worldwide government, industrial, and academic laboratories, and with Navy and joint service operational users. Our software systems engineering processes are controlled and locally guided by the NRaD Software Engineering Project Office, which is nationally recognized for its expertise and training capabilities. Efficient contracting and financial support processes assist our technical teams in meeting the challenges.

Domain Knowledge and Expertise

We provide and support large integrated information systems architectures for systems evolving from legacy components to seamlessly integrate the latest state-of-the-art hardware and software capabilities. Our solutions are optimized for the total systems requirements, not just for specific components. We provide total interaction management that includes rapid insertion of new technologies and commerical off-the-shelf (COTS) from concept through installation, testing, training, and systems support. We develop and maintain state-of-the-art technologists through hiring, training, and hands-on research. As government employees, we provide long-term continuity for the programs. Our technical breadth allows us to quickly form teams of experts from within NRaD and the government, industrial, and customer communities.

Unique Location and Relationship with Sponsor and Customer

We enjoy the benefits of being a government organization that is colocated in San Diego with our major sponsor while also being geographically positioned near all major components of our Navy and Marine Corps customer community. In addition to our main workforce being located near the customers in San Diego, NRaD personnel are permanently duty-stationed with the U.S. Atlantic Command (USACOM) and U.S. Pacific Command (USPACOM), providing systems engineering functions. We are also located outside the continental U.S. (CONUS) with particular emphasis in the Pacific Rim where we have permanent detachments in Hawaii, Guam, and Yokosuka, Japan. We provide on-site representation and support for the C^4ISR community. Additionally, we serve as the smart buyer from the total systems perspective with our focus on delivering products vice profits. We act as the trusted agents for our customers, sponsors, and industrial partners, providing R&D through In-Service Engineering Agent (ISEA) functions on the same team. Our tasking is flexible and can be quickly modified as the situation evolves vice lengthy contracting processes. This flexibility is extremely important in the C^4ISR mission area where technology is changing every 18 months.

Our Assigned Mission—C^4ISR

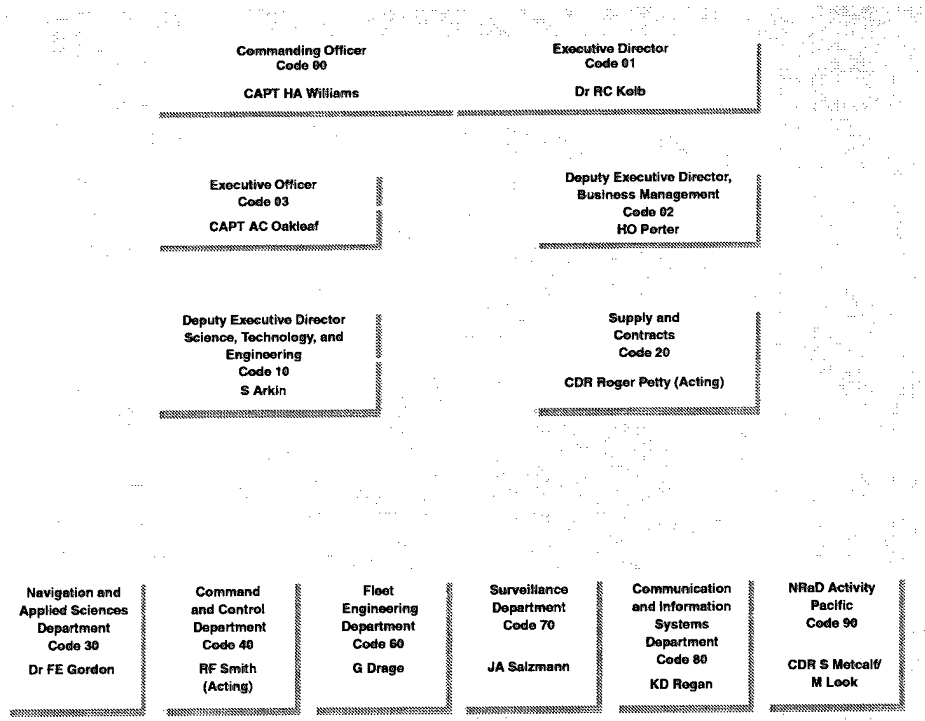
C^4ISR provides information dominance to meet a wide variety of Navy, Marine, and joint requirements. It is the link that integrates disparate units and functions into coordinated operational capabilities. With the Navy's C^4ISR RDT&E mission assignment, NRaD is uniquely positioned in this important area. By providing C^4ISR solutions to the Navy and Marine Corps, NRaD has demonstrated domain knowledge expertise and experience in land-based, marine surface and subsurface, and air warfare. This gives NRaD a unique competitive advantage over other labs in joint service developments, which is reflected by our participation in many joint service programs.

Other Important Leadership Areas and Competencies

In addition to our primary C^4ISR mission, our leadership areas and competencies include ocean engineering, marine environmental responsibilities, and the Navy's Marine Mammal program. The impact of limited warfare and military operations on marine mammals and the marine environment is increasing in importance. These programs, although separate from our main focus in C^4ISR, have been located at NRaD for many years, primarily because of our location in San Diego and the unique expertise that we have developed in these areas.

Organization

NRaD has seven major staff and technical departments: Science, Technology, and Engineering; Navigation and Applied Sciences; Command and Control; Fleet Engineering; Surveillance; Communication and Information Systems; and NRaD Activity, Pacific. Organization is shown as of October 1996.



New NRaD Organization Announced

(Note that the organization chart above reflects management personnel as of October; see the Personnel section below for major personnel changes).

In March 1996, NRaD Commanding Officer CAPT Kirk Evans and NRaD Executive Director Richard Shearer announced the NRaD organization changes that reflect the realignments associated with disestablishment of NCCOSC In-Service Engineering West Coast Division (NISE West). The new organization was based on six technical departments—Codes 30, 40, 60, 70, 80, and 90 (see the note at end of this section regarding code designations)—all partially or substantially reorganized.

The Navigation and Applied Sciences Department, Code 30, is headed by Dr. Frank Gordon. The seven divisions are the following: Global Positioning System, Code 31; Marine Navigation, Code 32; Airspace Systems, Code 33; Special Programs, Code 34; Biosciences, Code 35; Environmental Sciences, Code 36; and Advanced Systems, Code 37.

Three new groups were added to the Command and Control Department, Code 40, headed by Dr. Robert Kolb. They are staff offices 4503, Joint/Foreign Liaison, and 4504, Link Project Office; and Technology Development and Insertion, Code 4525.

CAPT Michael Gehl and Gary Drage, of the former NISE West, headed the new Fleet Engineering Department, Code 60. (Note: CAPT Gehl transferred to another command in May 1996.) The major divisions of this code are as follows: Terrestrial Communications Fleet Engineering, Code 61; SATCOM Systems Fleet Engineering, Code 62; Communications Network Fleet Engineering Systems, Code 63; Command and Control Fleet Engineering, Code 64; Test Engineering and Restoration, Code 65; and Engineering Services,Code 66.

The Surveillance Department, Code 70, headed by Tracy Ball, added two groups to its organization. The Submarine Electronic Support Measures project has been combined with the Signals Warfare Division, Code 77. The Ocean Engineering Division, previously in the former Code 50, became Code 74.

The Communication and Information Systems Department, Code 80, is headed by Ken Regan. Functions realigned were: Information Systems and Network Technology, Code 82; Submarine Communications and Command, Control, Communications, Computers and Intelligence (C^4I) Systems, Integrated Satellite and Link Communications Systems, Code 83; Electromagnetic and Advanced Technology, Code 85; Communications and Infosec System Support and Integration, Code 87; Propagation, Code 88; and Solid State Electronics, Code 89.

NRaD Activity, Pacific is headed by CDR Sherman Metcalf and Mike Look. Code 91 is the C^4I Engineering Activity, Hawaii; Code 92 is the NRaD Facility, Japan; and Code 93 is the NRaD Facility, Guam. Code 90 provides C^4I systems engineering and installation for shore communications sites and C^4I shipboard systems engineering in the Pacific area.

Note regarding code designations: Beginning FY 97 (October 1996), NRaD codes were preceded with the letter "D," e.g., D30, D40, D60. The remainder of this document uses the letter designation to aid current reference.

Personnel

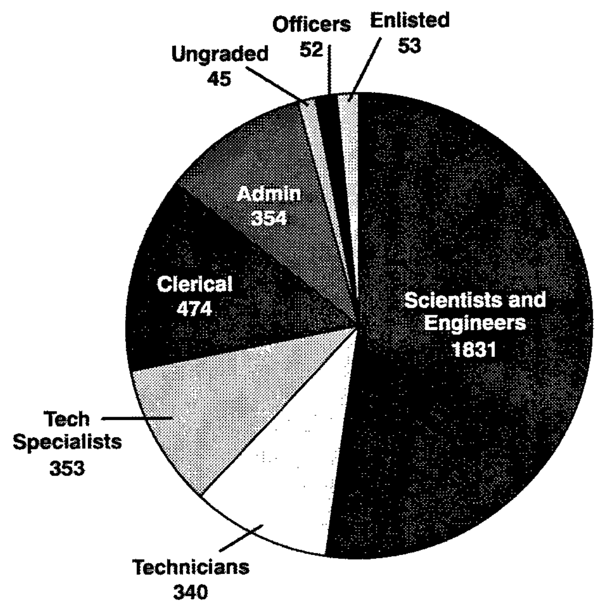
CAPT H. A. Williams relieved CAPT K. E. Evans as Commanding Officer in June 1996. R. T. Shearer retired in June and Dr. R. C. Kolb, after acting for several months, was selected as Executive Director in August. CAPT A. C. Oakleaf relieved CAPT S. P. Marvil in February as Executive Officer/Base Operations Manager.

The Command and Control Department was headed by Dr. R. C. Kolb until June 1996; R. F. Smith became acting head.

J. A. Salzmann was selected to head the Surveillance Department in August 1996. Former head, T. F. Ball retired from government service in September.

The following chart shows NRaD personnel categories of 31 August 1996.

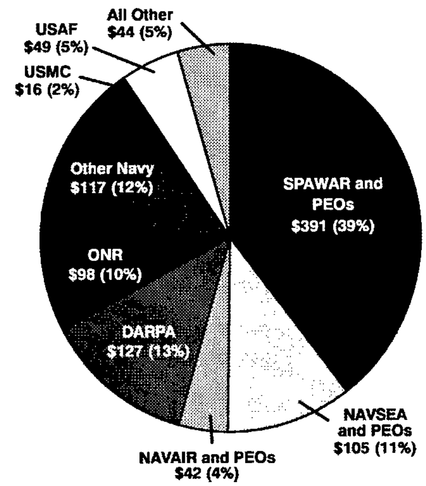
NRaD PERSONNEL
31 August 1996
(TOTAL 3502)



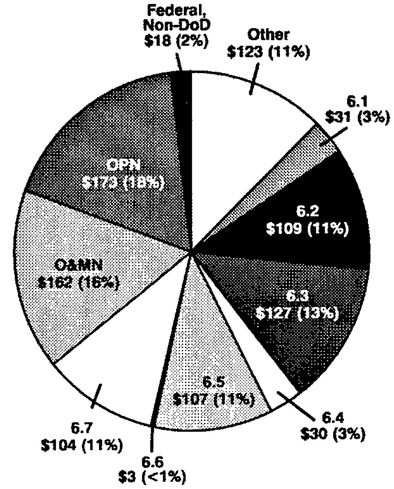
Funding

NRaD receives funding from sponsors that include the Space and Naval Warfare Systems Command (SPAWAR), the Naval Sea Systems Command (NAVSEA), the Naval Air Systems Command (NAVAIR), the Office of Naval Research (ONR), and the Defense Advanced Research Projects Agency (DARPA). Funding for 1997 is shown below.

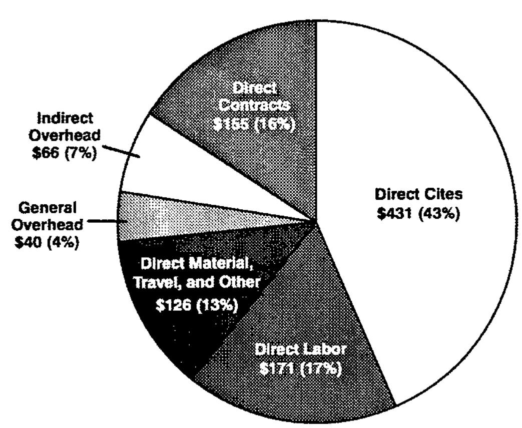
NRaD FUNDING BY SPONSOR, FY 1997 (BUDGETED $989 MILLION)



NRaD FUNDING BY APPROPRIATION, FY 1997 Planned $989 Million (Includes direct cites $431 Million)



DISTRIBUTION OF FUNDS, FY 1997 (BUDGETED $989 MILLION)



Technical Program Accomplishments

Calendar Year 1996 Highlights

The programs featured in this section were documented in the NRaD *OutLook* (JoAnne Newton, Editor) and were published in compliance with DoD Instruction 5120.4 (11/84). Additional technical accomplishments are grouped by major work areas following the featured articles in this section.

Chronology of Highlights

- January 1996—Advanced Deployable System (ADS) program completed a rigorous system requirements review (SRR)
- January/February 1996—JTIDS conducted First Joint Class 2 Interoperability Testing
- February 1996—NRaD Facility, Guam assists Joint Humanitarian Effort
- March 1996—Global Positioning System (GPS) Team Excellence Award presented to the GPS VME (Versa Module EuroCard) Receiver Card (GVRC) Acquisition Integrated Product Team
- April 1996—Shipboard electronic equipment upgrades bring Bravo Zulus
- April 1996—Site Characterization and Analysis Penetrometer System (SCAPS) participated in several high-level events surrounding Earth Day celebrations
- May 1996—All-Optical Deployable System (AODS): successfully deployed and operated by NRaD and the Naval Research Laboratory (NRL)
- May 1996—SWellEX–96 landmark passive acoustic experiment completed by NRaD and the Naval Research Laboratory (NRL)
- June 1996—Multi-Link Display System (MLDS) certified for interoperable use in Link–11 (TADIL–A) operations
- June 1996—Sub HDR SATCOM Program completed requirements through first SPAWAR streamlined major acquisition program
- August 1996—Common Operational Modeling, Planning, and Simulation Strategy (COMPASS) project successfully participated in JWID 96
- September 1996—Fifth and final Mobile Integrated Command Facility (MICFAC) van delivered to the Commander, Mine Warfare Command (COMINWARCOM) Corpus Christi, Texas.
- October 1996—Peripheral Support Group (PSG) system completed evaluation testing and achieved initial operating capability
- October 1996—TAS demonstrated during live HARM firing
- October 1996—Universal Radar Moving Target Transponder (URMTT) successfully demonstrated to representatives from seven North Atlantic Treaty Organization (NATO) countries

- October/November 1996—Soldier 911 demonstrated in South Korea
- November 1996—Phase Two of EOPACE conducted at NRaD
- Ongoing 1996—CARIBROC undergoes upgrade effort led by NRaD
- Ongoing 1996—DARPA/NRaD Counter Sniper Program advances
- Ongoing 1996—Mobile Detection Assessment Response System (MDARS) continues to make significant program advances
- Ongoing 1996—NRaD continues lead role in the Marine/Navy Position Location Reporting System (PLRS) and the Army's Enhanced Position Location Reporting System (EPLRS)

The following featured programs are grouped alphabetically.

Advanced Combat Direction System (ACDS)

ACDS Peripheral Support Group Achieves Initial Operational Capability

On 8 October 1996, the Peripheral Support Group (PSG) system completed evaluation testing and achieved initial operating capability as the shore-based and ship-borne replacement for many of the Navy's legacy peripheral systems.

The PSG consists of two commercial off-the-shelf (COTS) hardware units, a peripheral support unit (PSU), and a peripheral control station (PCS). These units use nondevelopmental item (NDI) processor hardware, COTS operating systems, and utility software.

The PSG AN/SYQ–24 (V)l is a critical item of the LHA (helicopter carrier/amphibious assault ship—general purpose) Advanced Combat Direction System (ACDS) developed under the sponsorship of NAVSEA.

The PSG replaces five Navy legacy electromechanical peripherals with small microprocessor-based, general-purpose hardware that is relatively lightweight, reliable, and logistically supportable. The PSG uses AN/UYQ–70 hardware and software elements and incorporates UNIX-based real-time operating system and commercial standard versa-module EuroCard (VME) architecture.

Legacy peripheral systems supported include the RD–358 magnetic tape unit, the AN/UYH–3 magnetic disk drive, the AN/USQ–69 data terminal set, the TT–624 teleprinter, and the Link–l4 adapter of the AN/UGC–13.

Additionally, the PSG provides a new capability to perform system operator functions on the ACDS AN/UYK–43 computer sets from a remote location via an auxiliary display control unit (ADCU). The PSG is controlled and operated from a Navy Standard Tactical Advanced Computer–4 (TAC–4) workstation.

The Special Projects Project Team, under the leadership and program management of William Thorpe, designed and developed the PSG over a period of 18 months. The Special Projects Project Team is part of the Systems Integration Group, NRaD Code D4325, headed by Chuck Ledwin. The PSG development team membership includes both NRaD personnel and contractor personnel from INTERLOG and Hughes Technical Services Company (HTSC).

NRaD employees include William Thorpe, program manager; James Culligan, senior systems programmer, responsible for the design and development of the AN/USQ–69 data terminal set emulation and establishment of the PSG development and production library systems; Burton Carlson, programmer/analyst, who designed and developed the ADCU; John McCormick, programmer/analyst, responsible for the system casualty backup capability and touch panel display; Dr. George Chen, senior systems analyst, responsible for the design and development of the RD–358 magnetic tape unit emulation; Robert Smith, hardware system analyst, providing the team with hardware fabrication and software delivery and installation; and Chuck Dickerhoff, system programmer, providing the team with laboratory expertise and ACDS operating system operational capability.

The personnel from HTSC include Wayne Stepat, senior programmer, who designed and developed the AN/UYH–3 magnetic disk device (MDD), the TT–624 teletype, the Link–14 emulator, and the generic emulation module (GEM) that is key to all of the emulations in the PSG. Stepat also implemented all of the interface software for the PSG. J. C. McCoard, HTSC system programmer, designed and developed the PSG human-machine interface between the TAC–4 PCS and the PSU. B. J. Gardner, INTERLOG senior systems analyst, provided the team with software and hardware engineering design analysis, testing requirements, development specifications, and PSG system user manuals. John Krebs and Larry Swinford are the Naval Surface Weapons Center, Point Hueneme Detachment, East Coast Operations—Dam Neck members of the team. They provide the PSG hardware design support, acquisition, fabrication, and logistics support.

The PSG is currently installed in NRaD Lab 360, Building 600, Seaside, and is used to support the LHA upgrade project.

Advanced Deployable System (ADS)

ADS Completes SRR

The underwater segment of the Advanced Deployable System (ADS) program completed a rigorous system requirements review (SRR) during the last week of January 1996. An integrated product process development (PPD) approach was instituted and an accelerated technical program review schedule was planned. The SRR was the first of a series of program reviews that, with the use of integrated product teams, are intended to develop and field a system at a quicker pace than Navy acquisition programs of the past.

ADS will be a low-cost underwater surveillance system used to detect and track multiple targets in shallow-water coastal regions of the world. ADS responds to the Navy's mission to quickly identify threats during regional conflicts. It will fulfill important joint surveillance mission requirements with future regional crises and conflicts. Currently there is no Navy capability for rapidly deployed and sustained undersea surveillance in forward littoral areas. ADS is intended to provide enduring littoral surveillance capabilities against any regional undersea threat on short notice for an extended time period.

NRaD became involved with the ADS program during the concept exploration phase that began in 1991. Four separate contracts were awarded to IBM (now

Lockheed Martin), Lockheed, McDonnell Douglas, and AT&T for engineering studies and tasks related to the concept. System requirements reviews and system design reviews were held with each team. Personnel from NRaD and several other Navy/university laboratories supported the effort.

The government team collected large amounts of data in littoral waters and analyzed the threat, environment, and operations concept. NRaD participated in data collection, performance assessments, and array design concepts. NRaD assisted the SPAWAR in writing the documents required for Milestone I. An Acquisition Decision Memorandum, dated November 1994, authorized program entry into the demonstration and validation (DEM/VAL) phase. SPAWAR awarded the DEM/VAL prime contract on 10 April 1995. NRaD played a major role in support proposal evaluation and selection of the ADS prime contractor for the DEM/VAl phase of the program.

ADS is an Acquisition Category II program sponsored by the Chief of Naval Operations. The program manager is SPAWAR PMW–183, Advanced Deployable System, Mr. Tom Higbee. Lockheed Martin Federal Systems of Manassas, Virginia, has teamed with other contractors to design and produce this undersea surveillance system.

NRaD Code D7105, the Deployable Systems Program Office, is identified as the government's laboratory to ensure that all phases of the development are carried out efficiently and effectively. The team is led by Steve Whiteside.

NRaD engineers are currently involved in all areas of the integrated product teams. Three at-sea tests are planned for the program with the final DEM/VAL test scheduled for the first quarter of calendar year 1999. After the final sea test, a Milestone II decision will be made.

In addition, NRaD worked with the Naval Research Laboratory (NRL) on the technology demonstration of all-optictical acoustic sensors; this technology is called the All-Optical Deployable System (AODS).

All-Optical Deployable System (AODS)

NRaD and NRL Cooperate on Optical Deployable System

On 1 May 1996, a team from NRaD and NRL successfully deployed and operated the All-Optical Deployable System (AODS) 14 kilometers from NRaD's Point Loma complex. AODS uses optical sources to interrogate arrays of optical hydrophones to sense the acoustic energy in the ocean. The AODS was cabled to NRaD's tidepool complex, where data were collected and processed for 18 days of AODS testing and the joint NRaD, NRL, and Scripps Marine Physical Laboratory (MPL) SWellEx–96 test.

Under the sponsorship of the Advanced Deployable System (ADS) (SPAWAR, PMW–183) project office, NRL developed the optical hydrophones and optical telemetry concepts used in the AODS. Two 32-element optical arrays were assembled by NRL and Litton for this test. Each hydrophone is all-optical in the sense that it is a fiber-optic Michelson interferometer composed of two fiber arms and a fiber-optic coupler. The fiber-optic interferometer measures the optical phase of the light propagating through the sensing fiber, which is exposed to the acoustic environment, compared to that propagating through the reference fiber. The fiber-optic hydrophones have an air-backed polycarbonate plastic mandrel that increases the responsiveness while simplifying the construction. The hybrid wavelength/time-division multiplexed (WTDM) approach allowed all 64 hydrophones to be telemetered to shore on a single optical fiber.

NRaD is the systems engineering facility for AODS and is responsible for system requirements and testing. In addition, NRaD's experience in fiber-optic microcables and packaging was used to design, develop, and manufacture the pressure housings for the optical sources, optical amplifiers, and lithium batteries. NRaD developed a deployment concept and designed and manufactured all the deployment hardware for the sea test.

The optical data from the two arrays were brought ashore to a van housing the NRL receiving station, the NRaD processing and recording system, and other processing systems provided by the ADS program office. This van was staffed 24 hours a day during the AODS testing and the SWellEx–96 test.

One-half terabyte (500 gigabytes) of data were collected during the 18 days of testing. The test was a major success, with the optical sensors and telemetry concept meeting all system expectations.

"The test successfully highlighted the cooperative efforts of NRL and NRaD to bring the talents of both laboratories together," commented AODS systems engineer Gary Dorrance of the Advanced Systems and Acoustic Sensors Branch, NRaD Code D713.

The deployment team was led by Lynn Collins, Marine Systems Branch (Code D742). Code D742 member Paul Kennedy designed all the packaging hardware, and Jesus Zuniga, Dave Hannum, and Jim Kaawaloa assisted in the system deployment. Jim Reese and Al Aburto, Advanced Applications Branch (Code D714), operated the AODS processing and recording system during the test. Assistance was provided by Dr. Dale Barbour and Randy Brannan, Acoustic Analysis Branch (Code D712), and LCDR Schmidt of the NRaD Naval Reserve Unit. The NRL team was headed by Gary Cogdell with chief scientist Dr. Tony Dandridge and NRL engineers Clay Kirkendall and Allen Davis who developed and built the optoelectronics for AODS.

Caribbean Regional Operations Center (CARIBROC)

CARIBROC Undergoes Upgrade Effort Led by NRaD

NRaD is designated as the lead field activity for upgrading the mainframe computers, communications, radars, and facilities for the Caribbean Regional Operations Center (CARIBROC). CARIBROC is located in Key West, Florida, at Naval Air Station Key West. CARIBROC is a joint command, composed of representatives from the Navy, Air Force, Army, and Marine Corps.

The CARIBROC upgrade effort uses state-of-the-art technology in all developmental areas. The Multiple Input Tracking and Control System (MTRACS), a shore-based processing and display system, will upgrade CARIBROC's current system. The updated system will include multisensor track correlation, multisource data fusion, up to 30 radars displayed on up to 32 consoles, four Relocatable Over-the-Horizon Radar (ROTHR) feeds, tactical data links (4A, 11, and 16), and flight plan data, among many other enhanced features.

The communication system upgrade will include the Secure/Clear Digital Communications Control System. This system will provide automated assignment and switching of red/black circuits to touchscreen phones, provide the operator with access to telephone, STU–III (secure phone), intercom, and secure/clear radio sets with the ability to monitor and control remote communication radio assets.

The "Condor Key" system provides automated input of electronic intelligence data and an interface to various electronic systems such as the Tactical Information Broadcast System (TIBS), the Joint Maritime Command Information System (JMCIS), and the Anti-Drug Network.

The CARIBROC facility receives surveillance data from several sources, including numerous ground-based radar sensors, ROTHR, tethered aerostats, tactical data links, and special sources from within the United States Atlantic Command (USACOM) area of responsibility. The data are processed, correlated, and fused for analysis at operator situation display consoles. Action is initiated commensurate with their analysis and mission instructions. While the primary mission of CARIBROC is to provide surveillance reconnaissance operation support for USACOM, their secondary mission is to provide counter-narcotics detection and monitoring for the Joint Inter-Agency Task Force–East.

The major claimant for the program is USACOM/J3. The program manager is Naval Air Systems Command/PMA–213.

NRaD Code D333, CARIBROC Branch, acts as technical manager, in-service engineering agent, software support activity, system integration agency, integrated logistics support and field activity, and life-cycle manager for all system and test beds developed in support of the CARIBROC upgrade. The CARIBROC Branch consists of 18 engineers and technicians, led by Jim Straus. Other Code D333 personnel responsible for this effort are Yoli Pantig, Noel Acevedo, Gary Alexander, Andy Gali, Lynn Gutierrez, Linh Le, Scott Leonard, Carolyn Luong, Colleen McCall, Rolando Medina, Cyndi Ngo, Mary Nguyen, Tuan Nguyen Samir Othman, David Slade, Ray Tejidor, Loi Troung, and Nghia Vu.

Many of the Code D333 personnel have worked with the program since 1988 and successfully completed many past efforts. One such effort occurred in 1994 with a complete construction of the CARIBROC facility at Truman Annex in Key West. Code D333 accomplished installation of all equipment, a local-area network (LAN), circuits, hardware, and software for the associated programs that make up the CARIBROC effort. The facility was officially "accepted" on 13 July 1994 and those involved received a letter of commendation from the Deputy Commander for Acquisition and Operations at Naval Air Systems Command. After successful testing and acceptance of the new integrated system, cutover will occur and CARIBROC will transition from their current location at the Naval Air Station Key West, Florida, to this new facility at Truman Annex, in Key West.

A lab in development at NRaD's Old Town Campus will support CARIBROC by providing life-cycle support to the system, as well as serving as a platform for upgrades and future development. The lab will provide the same MTRACS and communications hardware and will be capable of processing, fusing, and displaying live radar data. As in-service engineering activity, the lab will support systems engineering testing, integration engineering, and integrated logistics support as well as software and hardware support responsibilities.

Common Operational Modeling, Planning, and Simulation Strategy (COMPASS)

COMPASS Completes Third and Most Successful JWID Demonstration

For the third consecutive year, NRaD's Common Operational Modeling, Planning, and Simulation Strategy (COMPASS) project successfully participated in the Joint Chiefs of Staff sponsored Joint Warrior Interoperability Demonstration (JWID) series. The Defense Modeling and Simulation Office (DMSO) sponsored the COMPASS project and its participation in JWID.

The COMPASS project showcased distributed collaborative planning services and access to distributed modeling and simulation (M&S) resources to the joint service plan development process. COMPASS allowed operational planners at all sites to develop joint plans in every warfare area in collaborative sessions and then assess, rehearse, and refine those plans using a variety of models and simulations.

COMPASS services enhanced development of joint air/ground, theater missile defense, air defense, and special operations. Warfighters developed operational plans at command sites and then passed plan elements to NRaD's M&S Operations Support Cell (a prototype for the broader DMSO-sponsored M&S Operational Support Activity) for assessment and insight from distributed M&S assets.

For JWID 96, the U.S. Army served as the lead service with U.S. Central Command as the host Commander in Chief (CINC). JWID 96 included approximately 40 demonstrations designed to support CINC and joint service interoperability objectives. These demonstrations showed advanced capabilities in responding to a realistic scenario and directly supported the Department of Defense M&S Master Plan C^4I-to-Simulation initiative. The JW–035 demonstration focused on using COMPASS-distributed collaboration services between eight C^4I and eight M&S systems to gain insight into plans from simulation results. COMPASS-capable systems contributed to improved joint ground and air plans and warfighter responses to crisis action planning and theater missile defense operational threads.

COMPASS was part of the JW–035 demonstration, "Command, Control, Communications, Computers, and Intelligence (C^4I)/Modeling & Simulation (M&S) Integration for the Warfighter," from 12 through 30 August at 11 sites. Under the management of CDR Dan Donoghue, Program Staff for the Communication and Information Systems Department (Code D805), the COMPASS team participated with the Army's Chemical Biological Defense Command, the Defense

Special Weapons Agency, the Technical Cooperation Program, and the What If Simulation System for Advanced Research and Development facility.

High-ranking military and civilian officials observed COMPASS as part of the JW–035 demonstration. JWID 96 provided an interoperability forum to demonstrate benefits of M&S to joint warfighters. With its proven capabilities and integration into the Global Command & Control System (GCCS)/Defense Information Infrastructure (DII) version 1.0, COMPASS showed value added for collaboration of M&S with operational planners and its potential impact on battlespace dominance.

Based on the scenario that exercised a flexible deterrent option within the U.S. Central Command's area of responsibility, JWID 96 used seven major sites for representing the Joint Task Force and service component headquarters. These demonstration sites included the Joint Demonstration and Evaluation Facility in Arlington, Virginia (National Command Authority); MacDill Air Force Base, Florida (CINC and Joint Special Operations Task Force sites); Fort Bragg, North Carolina (Commander Joint Task Force); Fort Gordon, Georgia (Army Force Commander); Shaw Air Force Base, South Carolina (Air Force Commander and joint Force Air Component Commander); USS *Kearsarge* (Naval Force Commander, at sea and in port, Norfolk, Virginia); and Camp Lejeune, North Carolina (Marine Force Commander).

In the JW–035 demonstration, COMPASS scored a series of "firsts" during JWID 96:

- Distributed interactive simulation sessions combining air simulations from Naval Air Station, Oceana, Virginia, with other distributed air/ground simulations for plan assessment and insight.
- Sharing of chemical, biological, and radiological dispersal model effects with COMPASS-capable ground and air C^4I systems to assess impact of these effects on collaboratively built joint plans.
- Collaborative use of Army, Marine, and special operations forces ground planning systems and their contribution to integration of ground and air campaign planning.
- Cross-service/cross-warfare collaborative information exchange and discussions at various echelons of the chain-of-command.

The COMPASS team consists of command-wide staffing from the Command and Control Department (Code D40), Surveillance Department (Code D70), and Communication and Information Systems Department (Code D80). The prime contractor is Science Applications International Corporation, with support from AB Technologies, ARINC, JAYCOR, MITRE, and Whitney, Bradley & Brown. Representatives from BMH, Cambridge Research Associates, GDE, ISX, KAMAN, OptiMetrics, Sanders, and Ternion became members of the JW–035 demo team in supplementing available resources needed for operating 16 COMPASS-capable applications on 30 workstations.

Upon completion of JWID, the COMPASS team began focusing on warrior familiarization and evaluation, leaving COMPASS-capable applications at a number of Air Force, Army, Marine, Navy, and special operations forces operational sites. This initiative will assist warfighters in further developing operational requirements for

COMPASS services and enhance planned fielding in operational systems, such as the Air Force Mission Support System and the Navy/Marine Corps Tactical Automated Mission Planning System, and for service-wide implementation in FY 97.

Counter Sniper Program

DARPA/NRaD Counter Sniper Program Advances

The Defense Advanced Research Projects Agency (DARPA), under the direction of Dr. Edward Carapezza of the Tactical Technology Office (TTO), tasked NRaD Code D754, the Electro-Optics Branch, to develop advanced high-resolution counter sniper systems that accurately detect and localize gunfire events. The spatial resolution of the azimuth and elevation of the shooter was to be between 1 to 3 milliradians and the prediction of the range was to be less than 5 percent. This high spatial resolution capability is required for three modes of operation: (1) man-transportable sensor systems, (2) vehicle-mounted sensor systems, and (3) man-wearable sensor systems.

There has been a long history of gunfire detection and localization using acoustic-only sensors. Systems of this sort have been deployed by the U.S. and foreign militaries for many years. The first successful gunfire detection systems were developed and deployed on U.S. helicopters during the Vietnam conflict. This technology has been exploited so that U.S. and foreign markets now offer many off-the-shelf gunfire detection systems. The best systems available claim predictions of the shooter's azimuth and elevation to 2 to 20 degrees. In real-test scenarios, these systems were found to have 5- to 10-degree errors in azimuth and elevation, 30- to 50-percent errors in range, and very high false-alarm rates. The goal of the DARPA Counter Sniper Program was to rework and redevelop some of the commercially available computer algorithms to optimize performance. Better peformance was achieved by performing controlled live-fire field measurements, incorporating environmental effects into the algorithms, and re-exploring some of the theory in the propagation of sound using optimized frequencies of acoustic muzzle blast and acoustic shock wave of the bullet.

Under the direction of the NRaD program manager David Law, a team was formed from Code D754 consisting of Todd Hintz, Ron Tong, Gerald Edwards, Carol Taylor, and Chris Csanadi. Phase 1 Acoustic Systems Demonstration field tests were performed in the spring of 1996. These tests were held at U.S. Marine Corps Base Camp Pendleton, Military Operations Urban Training (MOUT) facility. The objectives of these tests were to quantify the spatial resolution estimation capability of these prototypes and determine their ability to accurately classify the type of bullet fired in a challenging urban-like setting. Five prototypes developed by U.S. companies and one Israeli-developed prototype were tested.

The prototype systems were designed to exploit acoustic muzzle blast and shock wave signatures and to spatially resolve the location of gunfire events and associated shooter locations using either single or multiple volumetric arrays. The output of these acoustic systems is an estimate of the shooter location and a classification estimate of the caliber of the weapon. A portable display and control unit was provided to give both graphical and alphanumeric shooter location information integrated on a two-dimensional digital map of the defended area.

Shot angles and shooter locations for these field tests were based on an urban scenario. The counter sniper sensor systems were positioned to protect the area near the town square while shots were fired into the MOUT city complex. These tests were structured to provide challenging gunfire-related scenarios with significant reverberation and multi-path conditions. Special shot geometries and false alarms were included in these tests to probe potential system vulnerabilities and determine the peformance and robustness of the systems. During the final May test series. three Marine and Navy SEAL sniper teams fired a total of 333 shots from six different rifles. Shot lines were carefully chosen to ensure 360-degree azimuthal coverage, ranges from 100 to 650 meters, different elevation angles, and varying shot line miss distances from the individual sensor arrays.

The prototype developed by Bolt, Berenek and Newman (BBN), Incorporated Systems and Technology, performed best in these tests. Six ruggedized systems of the BBN prototype were fabricated and delivered in September 1996 to the Army Dismounted Battle Lab at Fort Benning, Georgia, for final certification and troop training.

The Phase I Acoustic-Only Counter Sniper prototypes were forward-deployed as a man-transportable system. Continuing work tasks include testing and ruggedization of the Phase I Acoustically Queued Infrared Imaging Counter Sniper prototype and the Phase 1 Infrared Bullet Tracker Counter Sniper prototype for support of the Phase II delivery of these systems. These Phase II prototypes will include vehicle-mounted systems as well as man-wearable systems. Final testing and deployment of these systems will occur in July 1997. Other more advanced and higher risk technologies are also being investigated in parallel.

Electro-Optical Propagation Assessment In Coastal Environments (EOPACE)

Phase Two of EOPACE conducted at NRaD

(Note: This section combines two *Outlook* articles on EOPACE: the first published in November 1996; the second published in January 1997.)

Electro-Optical Propagation Assessment in Coastal Environments (EOPACE) is an Office of Naval Research (ONR) sponsored, 5-year international experiment to improve the performance assessment capability for electroooptical systems operating in coastal environments. Coastal conditions may differ significantly from those in the open ocean and have not yet been fully accounted for in the LOWTRAN/MODTRAN propagation codes. The specific objectives of EOPACE are (1) to assist in the development of mesoscale and data assimilation models, (2) to evaluate the performance of EO systems in coastal regions, and (3) to investigate coastal aerosols by studying surf production, coastal air mass characterization, and near-ocean-surface transmission characteristics.

The EOPACE measurement campaign began in January 1996 and is being conducted in the California coastal region. Four measurement campaigns were conducted during 1996: 1) the surf impact study on infrared (IR) propagation conducted at Scripps Institution of Oceanography (Scripps Pier, San Diego, CA, January/February 1996; (2) the surf impact study and near-ocean-surface transmission study, Moss Landing, Monterey, CA, March 1996; and the aerosol and near-surface transmission study, San Diego Bay, San Diego, CA, November 1996.

THE EOPACE operational scenario consisted of military and civilian aircraft, operational Navy ships, chartered civilian surface crafts, meteorological buoys, and selected land sites. An unprecedented compilation of specialized instrumentation to assess the IR propagation characteristics resulted from this international effort. Emphasis was placed on low-level IR transmission over the ocean and air mass characterization for aerosol modeling.

Phase Two was conducted over a 3-week period in the San Diego Bay with the cooperation of the Naval Submarine Base in San Diego, the Naval Amphibious Base in Coronado, and the San Diego Port Commission. EOPACE is a 3-year effort under the leadership of the Propagation Division, Code D88, Dr. Juergen Richter. It is directed by Dr. Douglas Jensen, Tropospheric Branch, Code D883. EOPACE is funded by Dr. Scott Sandgathe of the Office of Naval Research, Ocean, Atmosphere, and Space Department.

Dr. Jensen explained that the Navy is increasingly concerned with operations in coastal environments. One key threat to ships is the easily launched high-precision anti-ship weaponry readily available in the world arms market. Fleet units operating in either the open ocean or in coastal regions must be able to determine the standoff ranges at which they can detect and or track such sophisticated weaponry.

The Navy is currently developing and using IR technology for the detection and identification of such threats. Atmospheric aerosol extinction, refraction, turbulence, and infrared sea and terrain background models in LOWTRAN and MODTRAN (the names for commonly used atmospheric transmission codes) are presently inadequate for representing infrared propagation close to the ocean surface and in coastal environments. This requires accurate models to describe the effects of low-level ocean and coastal aerosols to be incorporated into LOWTRAN and MODTRAN for determining the prediction performance of EO systems used for detecting low-altitude targets.

Not much is known concerning atmospheric aerosols near the ocean surface and the coastal air mass characteristics required for advanced aerosol models. IR transmission characteristics near the ocean are also poorly understood. The objectives of this EOPACE effort are two-fold: (1) to determine if the air mass parameters in various coastal locations can be derived, to a practical degree, from satellite imagery, and (2) to quantify IR propagation characteristics for two wavebands (3 to 5 and 8 to 12 microns) for near-ocean transmission.

To accomplish this, IR transmission links for both the 3- to 5- and 8- to 12-micron wavebands were established over the San Diego Bay. Dr. Carl Zeisse, Code D88, assisted by Dr. Brett Nener from the University of Western Australia, and Bill Moision, Code D883, designed and operated the NRaD transmissometer between the Naval Submarine Base in San Diego and the Naval Amphibious Base in Coronado.

The second transmission link was established between the Submarine Base and the Imperial Beach pier by Dr. Gerrit de Leeuw, Arie de Jong, and Petrus Fritz of the Physics and Electronics Laboratory, The Netherlands Organization for Applied Scientific Research.

The transmissometers were operated day and night. Dr. Zeisse indicated that refractive and turbulence effects near the ocean surface on IR propagation were larger than expected, especially during the Santa Ana conditions encountered during November.

The transmission measurements were supplemented by meteorological buoys provided by Dr. Ken Davidson and Keith Jones from the Naval Postgraduate School, Monterey, California, and were deployed mid-path on each of these transmission paths. An instrumented boat, containing the same aerosol/meteorological package used during the Surf EOPACE effort (*Outlook*, 9 February 1996), transited the paths during high-intensity operational modes under the direction of Stuart Gathman, Code D883. Stu Gathman is developer of the Navy Aerosol Model (NAM) presently in MODTRAN, the Vertical Navy Aerosol Model (NOVAM) being incorporated into MODTRAN, and the Advanced Navy Aerosol Model (ANAM) presently in its evaluation stages. His measurements will be important for validating the aerosol models.

Meteorological stations, under the direction of Kathleen Littfin, Code D883, were positioned on each path at the end points and on the boat. Dr. Mike Smith, Sunderland University, United Kingdom, provided aerosol data for air mass characterization for the coastal aerosol modeling effort. Satellite imagery was provided by the Naval Postgraduate School for all operational periods.

Under the direction of Charles McGrath, Code D883, an aircraft instrumented by NRaD provided meteorological support measurements. Atmospheric aerosols were also measured on all operational platforms. These measurements were supplemented by weather data collected from the Internet and by time-lapse video recordings of the surf. Polarization studies for image enhancement were conducted by Dr. A. Cooper, Naval Postgraduate School, utilizing targets of opportunity as they entered and departed San Diego Bay.

Additional participants in the EOPACE effort included Terry Battalino from the Naval Air Warfare Center, Point Mugu; Dr. Andy Goroch, Naval Research Laboratory, Monterey, California; and Jeannette van den Bosch, Jet Propulsion Laboratory, Pasadena, California.

The next EOPACE effort will be a continuation of the surf impact study and will be on Scripps Pier, La Jolla, in April. An additional EOPACE transmission operational period will be conducted in San Diego in August 1997.

Detailed information on EOPACE can be obtained from the EOPACE home page on the World Wide Web (http://sunspot.nosc.mil:80/543/eopace/eomain.html).

Global Positioning System (GPS)

GPS ReceivesTeam Excellence Award

The Global Positioning System (GPS) Team Excellence Award was presented to the GPS VME (Versa Module EuroCard) Receiver Card (GVRC) Acquisition

Integrated Product Team at the GPS Joint Program Office on 14 March 1996. The GVRC team was recognized for outstanding performance in taking the program from concept to contract award in just over 1 year.

Under tremendous schedule constraints, the team undertook the monumental task of identifying a vehicle for comprehensive replacement of the aging 3S receiver, which would also incorporate newer and more advanced capabilities onto a single plug-in card for the Navy's Navigation Sensor Systems Interface (NAVSSI). The NAVSSI is being installed on all major combatant ships to interface with shipboard navigation sensors, analyze and manage the data for the sensors, and distribute the best navigation data for each user system.

This effort required a total inside-out study of the Navy's future shipboard GPS requirements, including consideration for current Joint Program Office (JPO) product improvement initiatives such as Integrity, Enhanced Anti-Jam, Differential GPS, and Direct-Y capabilities.

The NRaD members of the GVRC team were Global Positioning System Division (Code D31) personnel LCDR Bruce Mathers, LCDR Jeff Hailey, Jack Schwartz, John Walsh, John Fenstermacher, Chris Lisica, Bob Copsey, Charles Falchetti, Dan Matthews, and James Hodson. The Marine Navigation Division representative was Steve Kravets. Twenty-five government and contractor personnel throughout the JPO completed the team and provided valuable assistance. Navy GPS Program Manager CAPT Barry Schwoerer attended the ceremony and assisted in the award presentation.

In late 1994, SPAWAR Headquarters identified the requirement for a GPS receiver card to be ready for integration by early 1996. In response to this challenge, the team, headed by LCDR Bruce Mathers, issued a "Congressional Business Daily" announcement on 2 December 1994 and conducted a market survey.

The team held two industry briefings to determine the technology advancement that industry could support within the program time constraints. They worked in parallel with the team developing the then-evolving GPS Receiver Applications Module (GRAM) Guidelines to produce a GVRC Specification and Interface Control Document consistent with GRAM requirements.

After release of the GVRC Letter Request for Bid Sample and Technical Proposal, key players were formed into a Technical Evaluation Team to evaluate the proposals, conduct bid sample testing at NRaD, and provide a comprehensive briefing to the Technical Evaluation Authority, BG (Sel) John Clay, GPS Joint Program Director.

In September 1995, LCDR Mathers transferred and LCDR Jeff Hailey relieved him as the GVRC program manager. The Invitations for Bid were issued on 8 December 1995 to those vendors who successfully completed the initial source selection screening. The contract was awarded on 22 December, slightly over 1 year after initiation of the procurement.

The GVRC contract was awarded to Trimble Navigation, Ltd. in Sunnyvale, California. Trimble's winning bid offers GVRC units at less than $3000 each for the first year, graduating down to under $2000 each in the last year of the 5-year, firm, fixed-price contract. The 3S receiver, which the GVRC replaces, costs $80,000 to $120,000 each, depending on the implementation.

As a reprogrammable card, the GVRC can be upgraded as new technology is developed by simply loading new software using a personal computer. The GVRC also provides increased reliability, service time, enhanced security features, autonomous integrity, and considerable size, power, and weight savings.

The GVRC eliminates the large repair and replacement costs associated with the 3S receiver by incorporating a manufacturer's 5-year warranty. At the end of the warranty period, the GVRC becomes a throwaway card.

On 18 March, the government accepted delivery of five GVRC units. On completion of developmental testing, 20 additional units were scheduled for delivery to support initial NAVSSI integration and test efforts. Subsequent deliveries will occur in each of the option years through 2001.

The application of the GVRC is not limited only to the NAVSSI shipboard use. Because it is a VME-based card, it can be used on any platform with a VME chassis in any other Service or any North Atlantic Treaty Organization country.

Possible applications include ships, submarines, low-performance aircraft, armored vehicles, and guided weapons platforms.

The result from this program will be replacement of 1980s-vintage GPS line replacement units with a single reprogrammable SRU card using state-of-the-art technology. The SRU is more reliable and more capable at a fraction of the size, weight, power, and cost. It incorporates integrity and enhanced anti-jam capability. GVRC will provide Navy ships and submarines with a GPS configuration that will prevail well into the 21st century.

Joint Tactical Information Distribution System (JTIDS)

JTIDS Conducts First Joint Class 2 Interoperability Testing

Operational units from the Navy, Air Force, and Army conducted the first Joint Tactical Information Distribution System (JTIDS) Class 2 interoperability testing. The testing was conducted during the Mountain Top Cooperative Engagement Capability (CEC) Advanced Concept Technology Demonstration (ACTD). Operational JTIDS units involved included USS *Cape St. George* (CG 71); USS *Anzio* (CG 68); USS *Lake Erie* (CG 70); Air Force Airborne Early Warning and Control System (AWACS) TS–3; and an Amry Patriot missile battery. The successful demonstration of Link–16's ability to provide CEC information to joint units and enable them to successfully engage targets in the medium is a significant accomplishment.

These Army, Navy, and Air Force units conducted a series of JTIDS tests that involved sharing situation awareness and passing simulated engagements on tracks among all units using Link–16. This was the first interoperability demonstration involving all three Services employing the Tactical Digital Information Link–J (TADIL–J) message standard. Surveillance tracks exchanged among the units also showed the operational feasibility of using JTIDS-provided tracks for fire-control cueing. The ability for CEC and Link–16 to complement each other in joint operations with CEC data provided to Joint units by Link–16.

The CEC ACTD, referred to as "Mountain Top," was conducted from 19 January to 2 February at the Pacific Missile Range Facility (PMRF) at Kauai, Hawaii.

The initial demonstration, 19 January to 26 January, explored the use of airborne sensors in extending peformance of existing weapon systems against low-flying cruise missiles in a CEC environment. The units of the CEC environment consisted of an Aegis guided-missile cruiser (CG), USS *Lake Erie* (CG 70), the PMRF Kokee landsite, and an Army Patriot battery.

Following the initial demonstration, these units were joined by two additional Link–16-capable Aegis cruisers, *Cape St. George* and *Anzio*; several Air Force units including an E–3, F–15s, F–16s King Crow and Big Crow jammers, and various support aircraft. These units, during the Enhanced Exercises from 26 January to 2 February, conducted a series of scenarios that collected data and demonstrated joint operations. The scenarios involved cruise missile defense and air defense in the littoral environment against a variety of threats. The CGs and the PMRF Kokee landsite were CEC participants. The CGs, E–3, Kokee landsite (using an NRaD JTIDS "mini-rack"), AWACS, and the Patriot Battery were Link–16 participants.

During the initial demonstration, the role of JTIDS was to pass translated CEC tracks from the Kokee landsite to the Patriot battery, enabling their virtual engagement using their prototype Passive Acoustic Classification–S (PAC–S) active seeker missile against a beyond line-of-sight (BLOS) cruise-missile threat. The PAC–3 seeker was employed in a test aircraft as a captive carry test. Data from the Radar Surveillance Technology Experimental Radar (RSTER), an experimental phased-array antenna, and the Mk 74 fire-control system were input to CEC at the Kokee Mountain Top site.

The CEC data was converted to TADIL–J messages and then transmitted via a Navy Class 2 terminal to an Army 2M JTIDS terminal in the Patriot Information Coordination Central (ICC) located on the beach. The Patriot Engagement Control System (ECS) uplinked this track information via the AN/MPQ53 radar to the Patriot missile in-flight for track updates and mid-course guidance. Once the cruise missile was in the acquisition basket, hand-over occurred. Then the interceptor seeker activated, autonomously acquiring and guiding the missile to a hit-to-kill intercept. These events were flown against live flying drones and F–16s. The virtual engagement and kill were displayed on a Silicon Graphics computer display.

During the enhanced exercises, Link–16 was used in the Joint Amphibious Test event by all JTIDS-capable units and JTIDS Joint Situation Awareness test events among Army, Navy, and Air Force units. In addition to situation awareness testing, all units performed Link–16 interoperability testing, exchanging identification changes, force orders, engagements, and electronic warfare TADIL–J messages. JTIDS voice provided automatically relayed voice between PMRF land test sites, the AWACS, and the ships.

LT Gary Nowicki of the Link Project Office conducted pre-installation checks for the Link–16 "mini-rack" system, which consists of the TADIL–J host simulator and Link–16 Gateway systems. In addition to providing a Link–16 capability to the Kokee Mountain Top site, the mini-rack was used for Link–16 test coordination, data extraction, VIP viewing, and passing of the operational TADIL–J situation display.

The TADIL–J situation display was sent out of theater to Program Executive Officer Space Communications and Sensors, the Advanced Tactical Data Link

Systems Program Office (PMW–159), the NRaD Systems Integration Facility (SIF), the Patriot Software Engineering Directorate (SED), and the Theater Battle Arena (TBA) in the Pentagon. During CEC operations, the CEC tactical and situation awareness picture was provided over Link–16 by the Kokee landsite. This information was provided to PMW–159, NRaD SIF, Patriot SED, and TBA via Link–16 Gateway, allowing those facilities to see Mountain Top operations in real time.

David Andersen, the NRaD Link–16 program manager, was the team leader supporting PMW–159 as the JTIDS Mountain Top project manager. JTIDS ship riders on each of the Aegis cruisers were Bob Sheehy, S–Con, who provided technical support on *Cape St. George*; Robert Rosado, Digital Wizards Inc., who provided technical support on *Anzio*; and Myron MacNeil, NRaD, who provided technical support on *Lake Erie*. Gateway support was provided on-site by Dave McDermott and Bruce Shervey of Digital Wizards Inc. Hale Simonds and Ron Moreland, NRaD, conducted JTIDS antenna propagation analysis and systems engineering support.

This was the first major event that had both JITDS and CEC coexisting in the same environment. From a JTIDS point of view, the demonstration of Link–16's ability to provide CEC information to joint units and enable them to successfully engage targets in the medium is a significant accomplishment. This exercise was a good first step toward providing the joint warfighter an integrated tactical picture.

Mobile Detection Assessment Response System (MDARS)

MDARS Program Advances

The joint Army/Navy Mobile Detection Assessment Response System (MDARS), originally conceived as a versatile and cost-effective automated security system for military and government sites, continued to make significant program advances during 1996.

MDARS is managed by Jerry Edwards of the Physical Security Equipment Management Office, Fort Belvoir, Virginia. Bart Everett, Associate for Engineering (NRaD Code D3701) in the Advanced Systems Division, serves as the MDARS technical director. As systems integrator, he leads a diverse team of NRAD employees, government laboratories, and contractors.

The program is divided into two parallel thrusts. The "interior" effort, headed by John Bott, targets semi-structured warehouse environments. The "exterior" effort, managed by Tracy Heath-Pastore, addresses unstructured outdoor storage areas such as depots or airfields.

The need for security at many storage and industrial compounds was addressed in the past by security guards, trained dogs, and various electronic surveillance equipment such as cameras and motion sensors. MDARS has the potential of replacing these with a multifaceted robotic platform capable of patrolling the area and sending and receiving audio and video information while continually inventorying designated equipment on site.

The robots navigate and perform intruder surveillance, and fire, smoke, and flood assessment without human intervention. A human security guard is alerted when any unusual occurrence or anomaly takes place. This allows human judgment calls to he made, case by-case, at a central guard post. An MDARS robot is currently in operation and successfully performing these tasks at NRaD's Camp Elliot warehouse.

The MDARS system operates multiple robotic platforms from a single host console running under NRaD's Multiple Robot Host Architecture (MRHA).

According to Robin Laird. who heads the software development team, "The MRHA is basically a sophisticated command and control architecture that schedules and tracks the activities of a number of remote platforms and prioritizes for display any unusual events requiring human interaction."

The MRHA software development is modularized to isolate all operating system and interface dependencies. Microsoft's "open database connectivity" is employed to make the task of inventory tracking easily adaptable to several different commercial back-end databases. All server-specific software is appropriately isolated.

Both interior and exterior applications use the same inventory assessment hardware, which can perform mass readings of special radio frequency transponder tags attached to high-value or sensitive inventory in surrounding spaces. In contrast to conventional practices of maintaining inventories through periodic manual scanning of individual bar codes, the MDARS robots can continually monitor the presence and general location of tagged items and report any discrepancies with the database computer's record of expected stock on hand.

The tag interrogation uses an omnidirectional antenna that does not require line of sight. The robots send wake-up signals to the tags and the tags transmit in return. These data are "packetized" and sent back to the host, then stored in the inventory database where it can be used for displaying status or printing reports. Unlike current barcode labels that represent only the product stock number, the battery-operated tags can hold up to 256 bytes of relevant data.

An upcoming challenge is a seamless interface between the MRHA's product assessment system and the current Defense Supply and Standard Depot System. This will allow MDARS to be effectively used to enhance current systems by adding automated inventory capabilities without disrupting warehouse and storage activity.

According to Gary Gilbreath, MDARS' senior software engineer, the first and greatest hurdle was robust unattended navigation in the target environment. He said that much progress has been made on this over the past several years. "At first we were lucky if a robot ran 2 to 3 hours before getting lost. Recently, the robots have run 10 to 14 nights in a row without incident," he said.

The robotic platforms for both interior and exterior programs look noticeably different for their disparate functions. The outdoor unit is necessarily more rugged, much like an all-terrain vehicle.

Another significant requirement was developing a sophisticated intruder detection suite, optimized for robotic installation , that could provide a high probability of detection with a low-nuisance alarm rate. Ongoing efforts in intelligent security assessment areas have resulted in several innovative patents aud subsequent transfer of the technology to the private sector under a Cooperative Research and Development Agreement with Cybermotion, Incorporated, of Salem, Virginia.

At present, MDARS interior robots are being beta tested, from a navigational perspective, in several warehouse and office environments at NRaD. In addition to the Building A–33 unit and the robots patrolling nightly in the NRaD warehouse at Camp Elliott, another robot patrol is at NRaD, Seaside in field house F–36. The MDARS exterior platform, under development by Robotic Systems Technology in Westminster, Maryland, was scheduled for an in-progress review demonstrating autonomous outdoor navigation in early October.

Mobile Integrated Command Facility (MICFAC)

MICFAC Van Final Delivery

The fifth and final Mobile Integrated Command Facility (MICFAC) van was delivered in September 1996 to the Commander, Mine Warfare Command (COMINWARCOM) Corpus Christi, Texas. The MICFAC prototype designed by direction of the Chief of Naval Operations, was fielded in 1992, then re-engineered and delivered in only 4 years. After delivery, NRaD will develop systems upgrades as required, and NCCOSC In-Service Engineering East Coast Division, St. Inigoes, will perform in-service engineering.

"This was an amazing effort. A development cycle isn't normally accomplished this quickly," said program manager Marc Sorensen, NRaD Code D4213. "It was an overall NCCOSC development effort by NRaD, including the former NISE West and NISE East," he said.

MICFAC provides the Navy with a completely self-contained mobile command center ashore for use at any location. MICFAC began as an offshoot of the Fleet Mobile Operational Command Center (FMOCC). It was first developed because of the Navy's inability to colocate its component commander ashore with the joint commander during Operation Desert Storm. The naval component commander had to remain deployed with the carrier battle groups to maintain command and control of Navy assets.

"The Navy realized the new business of joint warfare needs the Navy component commander to be co-located with the commander, joint task force. After Desert Storm, we were directed to develop a mobile command capability to move component commanders ashore," Sorensen said.

NRaD was chartered to develop the FMOCC, which was successfully demonstrated in Ocean Ventures '92 and has subsequently been re-engineered and is now being delivered to the Fleet. Components of the original FMOCC are currently providing Commander Fifth Fleet/Commander U.S. Naval Forces Central Command (C5F/COMUSNAVCENT) with C^4I capability in Bahrain. The re-engineering program was retitled Joint Maritime Operational Command Centers, or JMOCC, and the development was planned in three phases, the third of which was canceled due to budget constraints.

The first tier is a rapid-response system called the Mobile Ashore Support Terminal (MAST), which provides basic command control, communications, computers, and intelligence (C^4I) capability for a naval liaison detachment ashore. MAST was developed primarily by NRaD Code D91, C^4I Engineering Activity, Hawaii, under the leadership of Gordon Mattis. The original MAST, developed as part of the FMOCC, was used during operations in Somalia and is still operational with COMUSNAVCENT in Bahrain. The re-engineered MAST is a fully integrated self-contained modular design that can be delivered on one C–130 aircraft and made operational in 2 to 3 hours by a crew of six. MAST command centers were delivered during FY 95 to Commander in Chief, U.S. Pacific Fleet (CINCPACFLT). Commander in Chief, U.S. Atlantic Fleet (CINCLANTFLT), Commander in Chief, U.S. Naval Forces, Europe (CINCUSNAVEUR), and USNAVCENT, Bahrain.

The second tier is the MICFAC, which was designed to support up to a flag level naval component commander ashore. The prototype was deployed in Operation Southern Watch and other operations in the Persian Gulf. In the reengineered MICFAC, the NCCOSC team was responsible for the system design, hardware fabrication and production, integration of the hardware and software, and testing and fielding. It was successfully demonstrated at Joint Warrior Interoperability Demonstration '95, where it hosted the naval component commander ashore and provided support for the Defense Advanced Research Projects Agency Advanced Technology Demonstrations.

MICFAC is based on Joint Maritime Command Information System 2.2 and will support the Global Command and Control System. MICFAC uses the same Genser Integrated-Information Display C^4I suite as that of the Tactical Flag Command Center (TFCC) aboard an aircraft carrier, U.S. Navy flagship, amphibious assault ship, etc. This system is "repackaged" into standard military mobile shelters that are transportable by air or ground transportation and virtually moves the TFCC ashore.

The MICFAC is a three-van system: the C^4I van, a triple-wide operations center van for staff, and a storage/maintenance van. MICFAC can be deployed on a C–5A aircraft and is operational in 8 to 10 hours on site. At NRaD Old Town Campus, the vans are loaded and integrated with the software and made functionally correct. NCCOSC personnel travel on site to set up and train operational personnel.

The first MICFAC was delivered to Bahrain in December 1995. Others were delivered to CINCUSNAVEUR, Sigonella, Italy, CINCPACFLT, CINCLANTFLT, and COMINWARCOM.

Program Manager for MICFAC and MAST at SPAWAR is Bill Josie. System engineer at SPAWAR is Tracy Matthias. The original NRaD program manager was Jim Kadane and is now Marc Sorensen. Systems engineer is Todd Almond. Program integration engineers include Jack Davis, Tim Smith, Mark Joplin, Manuel Gomez, Garry Stricker, and Doug Hawthorne.

Multi-Link Display System (MLDS)

MLDS Certified for Link–11 Operations

On 6 June 1996, the Navy Center for Tactical Systems Interoperability certified the Multi-Link Display System (MLDS) for interoperable use in Link–11

(TADIL–A) operations. Certification was awarded after successfully completing testing of the MLDS Version 5.0 software utilizing the Data Terminal Set Simulator and the Multiple Unit Test and Operational Training System. Certification testing requires that functional areas of data link operations are exercised in strict compliance with Operational Specification OS–411.2 (series). As a result of these tests, 22 new problem statements were identified and 103 of the previous 105 trouble reports were closed out.

The MLDS was developed by NRaD Code D45, Integration and Interoperability Division, and Science Applications International Corporation, System Integration and Engineering Division. The effort was completed under joint sponsorship of the Naval Air Systems Command, PMA–213, Air Traffic Control and Land Systems Program Management Office, and the Program Executive Office for Space, Communications and Sensors, PMW–159, Program Manager for Advanced Tactical Data Link Systems. Rick Hollandsworth, NRaD Code D4502 system engineer, acted as program manager. Project engineers included Al Lopez and Brian Britt of Code D4522, Systems Integration.

The Link–11 Display System (LEDS), precursor to the current MLDS version, was developed and hosted on an IBM Advanced Technology personal computer for processing Link–11 track data for illegal drug interdiction at the U.S. Customs/U.S. Coast Guard Command, Control, and Communications Center, Miami, Florida. The system is used at the Caribbean Regional Operations Center, Key West, Florida and the Commander U.S. Naval Forces, Central Command, Manama, Bahrain, for joint data link interoperability, as well as onboard 12 ships and seven EP–3 aircraft. Over a dozen research, development, test, and evaluation sites use this low-cost, Link–11 capability to support hardware and software integration efforts.

MLDS features real-time Link–11 message processing and track display; multinet capability configured for local and satellite networks with manual data forwarding and TADIL–B link capability; real-time Link–11 performance monitoring with connectivity lines; Naval Tactical Data System (NTDS) symbols, graphic aids, message data read out, and integrated map displays; certified compliant received/transmit capabilities that are interoperable with NTDS, Advanced Combat Direction System, and Aegis Link–11 platforms; MIL–STD 1397 interfaces that include passive and active taps; off-line scenario generation/playback with MIL–STD 1397 data extraction; command and control systems interfaces (e.g., Joint Maritime Command Information System) for forwarding Link–11 track information; satellite navigation inputs for manual gridlock and position correction; sensor inputs and auto radar tracker system interfaces; remote control of USQ–111/125 Link–11 data terminal sets; off-line diagnostic test and check out functions; and interface to Tactical Data Information Exchange/communications support system providing message packets for time-division, multiple-access message generation.

MLDS uses standard NTDS symbology and has regional maps integrated into the software. It can operate with multiple networks and act as a gateway for interconnecting geographically distant ships using satellite Link–11 to provide a multimedia wide-area network called the Link–11 Test Network. Efforts are ongoing to upgrade MLDS with additional Link–11 message capabilities. MLDS units and associated communication equipment can be installed for operation in a wide variety of platforms, including ships, aircraft, and shore sites that require a TADIL–A/Link–11 capability.

NRaD Facility, Guam

NRaD Facility, Guam Assists Joint Humanitariam Effort

"Since my arrival in June there hasn't been a dull moment," said LCDR Michael Francis, Officer in Charge, NRaD Facility, Guam.

"We have been visited by the Chief of Naval Operations; Commander in Chief, U.S. Forces Pacific; Commander in Chief, U.S. Pacific Fleet; Typhoon Dale; and thousands of Kurdish refugees," he said.

NRaD Facility, Guam provides command, control, communications, computer, and intelligence (C^4I) engineering services and connectivity for the many federal agencies involved in the Kurdish refugee effort. These agencies include the Departments of State, Defense, Justice, Transportation, and the Central Intelligence Agency.

"This effort is very typical of the humanitarian mission increasingly performed by U.S. forces. The ability of these various organizations to work as a team is, in large part, due to the C^4I backbone originally fielded for military operations," LCDR Francis said.

All military officers, including LCDR Francis who is the Operation Pacific Haven Electronics Material Officer (EMO), are involved with the Joint Task Force (JTF) effort to assist refugees seeking asylum in the United States. Guam is a staging area. The Kurds are flown by the U.S. Air Force from Turkey to Andersen Air Force Base. Once they arrive, the JTF houses, feeds, and provides medical care, while the Immigration and Naturalization Service provides processing outside of the normal application for immigration.

The Kurds have typically been granted asylum because of the widely documented human rights violations, atrocities, and genocide perpetrated on them by Saddam Hussein. The first group of about 2000 persons was composed of individuals and their families who provided support to Coalition forces during the Gulf War and after.

"As the JTF EMO, I assist the other federal agencies in transferring information, lots of it, to make this operation work. Much of the information is of a sensitive/classified nature. Since Guam's information infrastructure was primarily built by the Department of Defense (DoD) after World War II, and NRaD is the Navy's engineering facility for C^4I, NRaD's capabilities are a key element in the continuing success of this operation," LCDR Francis said.

NRaD has assisted some of the non-DoD agencies in their efforts to connect to the Secure Internet Protocol Router Network (SIPRNET)/Non-Classified Internet Protocol Router Network (NIPRNET). NRaD has provided information resources such as the Joint Worldwide Intelligence Community System (JWICS) and completed installation of a Joint Deployable Intelligence System at Head Quarters, Commander of U.S. Naval Forces, Marianas. NRaD assisted the Air Force in correcting a circuit stability problem with a SIPRNET connection off-island.

"A key element of this story is the essential, fundamental role NRaD is playing in one of the key mission areas of our military force: humanitarian operations. These operations are executed by joint and/or coalition forces. These operations cannot succeed without information transfer capability. We are providing that capability and engineering interfaces with other DoD and non-DoD activities to make things work better. In this case, it is particularly gratifying because we, the JTF, are literally saving entire families from torture and death—and you just don't get to do that sort of thing everyday," LCDR Francis said.

Position Location Reporting System (PLRS)/Enhanced Position Location Reporting System (EPLRS)

NRaD Code D342 Continues Lead Role in ISEA/PDSS for PLRS/EPLRS

(NOTE: The original article that appeared in the *Outlook* was modified for this document.)

The Marine/Navy Position Location Reporting System (PLRS) and the Army's Enhanced Position Location Reporting System (EPLRS), initiated during the later stages of the Vietnam conflict, were developed and established as a system to prevent troop casualties through "friendly fire," known as "fratricide." PLRS/EPLRS is a multi-service system employed by the Army, Navy, and Marines as either a stand-alone battlefield capability or as a partner in joint-service operations.

NRaD Code D342, Joint Combat Support Systems Branch, is responsible for in-service engineering and post-deployment software support (ISEA/PDSS) of PLRS/EPLRS. Code 342 defined and executed a cost-effective approach to transition "legacy" fully operational software from older, limited computers into modern open architecture target and host operating environments.

As a result of the software transition, the procurement costs and future software and hardware maintenance were reduced by a factor of nearly 10 times. For the Navy, this means that a PLRS/EPLRS shipboard installation will now cost $300,000 versus the earlier $3 million price tag.

One of the greatest dangers on a battlefield is not knowing where friendly troops are positioned, and a high priority has been placed on technology that prevents fratricide. The PLRS/EPLRS system has lessened the problem by providing battle units and their components with friendly ground position location through tactical information dissemination. PLRS/EPLRS offers a greater rapid response time to fleet and ground forces, an expansion of system capabilities to support joint warfare commands, and a reduction in cost and software maintenance requirements.

The PLRS/EPLRS system incorporates new technology that is not captive to the unique architecture that made the systems difficult to update in the past. The open system ensures the PLRS/EPLRS user that the newest and most sophisticated technology will be available rapidly and at minimal cost.

Code D342 Head Lee Purrier said, "The PLRS/EPLRS is an excellent example of the 'Forward-from-the-Sea' policy, which proposes taking 'systems' that work and moving them to more modern environments/technology for extended life cycles for low-cost, low-risk efforts. NRaD's Code 342 Software Transition Team has demonstrated their capabilities in this area with their successful efforts on PLRS/EPLRS. This transition approach can also be applied in the future to other legacy systems designated for extended life cycles, through migration to the Unified Build/Joint Maritime Command Information System/Global Command and Control System common operating environment pathway."

The modernized PLRS/EPLRS system provides authorized user's positioning of all system-equipped tactical elements: targeting data, combat orders, situation reports, intel data, messages, and other command and control information as well as automated friendly equipped units.

Ships, planes, helicopters, infantry units, and battle posts can all communicate using PLRS/EPLRS and establish plans of attack, exact locations of personnel and equipment, and specifics of terrain and circumstances. These data can be rapidly disseminated among all units of a battle group to ensure an integrated attack, with sharply reduced fratricide risk.

The basic radio unit for the user is a 23-pound device that can be carried in a manpack, mounted in a vehicle/airframe, or set up in a foxhole. The data are scrambled to prevent enemy interception and are protected against most enemy jamming or blocking. All of the armed forces are scheduled to acquire PLRS/EPLRS capabilities. A fully integrated network of communication between forces is the ultimate goal to reduce fratricide and provide the capability to fight smarter.

Tests conducted by Code D342 included a very successful demonstration in December 1995. The demonstration included operation of the PLRS/EPLRS system versions of all three services linked to units deployed from Point Loma to Camp Pendleton.

Code D342 also presented a full exhibit of the system's background and capabilities at TECHNET '96, with great success.

"The Marines were the first to use PLRS in actual combat operations, and it contributed heavily to our victory in Desert Storm by providing a complete and accurate, fully integrated, overview of the battlefield," Lee Purrier said.

The Navy has installed PLRS systems aboard amphibious support ships, LHDs 1 through 4. Code D342 also completed test, qualification, and installation planning for LHDs 5 and 6. During 1996, Code D342 developed major upgrades to PLRS/EPLRS software and firmware to incorporate capabilities to use the global positioning system for mobile tracking and to provide a quantum increase in PLRS/EPLRS communications capacity. Code D342 delivered upgraded software versions and provided training for USS *Saipan* (LHA2) and the Second Marine Expeditionary Force for potential deployment to Bosnia. Deliveries were also made to USS *Boxer* (LHD 4).

Code D342 also completed test, qualification, and installation planning of the downsized PLRS for LHDs 5 and 6. The Navy is planning PLRS/ EPLRS installations aboard LHA 1 and LDP 17 amphibious support classes.

The Army uses EPLRS with an add-on radio known as the "hi-hat" for high-speed communications to the basic user unit. This provides a quantum increase in communication capabilities and capacity for higher echelons. During 1996, Code D342 provided in-house testing of the EPLRS and support for Field Test 1 and 2 at Fort Huachuca, AZ.

Code D342 completed development of the first Marine Downsized Master Station, referred to as DSMS. The DSMS enables roll-on, roll-off capability from a wide variety of air, surface, and "from-the-sea" transport vehicles. Successful demonstration of DSMS capabilities was performed in September 1996.

The Air Force and Air National Guard have recently joined the PLRS/EPLRS community of users by installing EPLRS radios in F–16 and C–130 aircraft to provide friendly force situation awareness and in-flight digital information exchange. In this capacity, EPLRS is a reduced capability, low-cost substitute for platforms not designated to receive the Joint Tactical Inforumation Distribution System.

Shipboard Electronic Equipment Upgrades

Codes D40 and D60 Personnel Receive Bravo Zulus for Upgrades

With less than 6 months until deployment, the USS *Tarawa* (LHA 1) was provided by Commander Naval Surface Force Pacific (COMNAVSURFPAC) with funding for extensive shipboard electronic equipment upgrades—if NRaD's in-service engineering personnel could meet the challenge. NRaD rose to the occasion to perform ordering, coordinating, installation, testing, and training of the ship's crews for a large number of command, control, communications, computers, and intelligence (C^4I) installations. The C^4I installation efforts came together with many of the finishing touches put in place less than 24 hours before the ship's departure to significantly improve *Tarawa's* warfighting capacities and her habitability.

The hard work and impressive number of installations were performed by many personnel in both Code D60 and Code D40. Their success earned them a Bravo Zulu from *Tarawa* (200407Z APR 96), Bravo Zulu (301320Z APR 96) from the commander of their amphibious readiness group COMPHIBGRU THREE, and verbal plaudits from Commander, Space and Naval Warfare Systems Command Rear ADM Wagner for meeting the ship's needs and accomplishing all proposed installations on the "wish list." NRaD technicians and engineers remained on the ship until a few hours before actual departure. They ensured all final tests and training were complete with many new and expanded C^4I capabilities as well as quality-of-shipboard-life improvements. LT Kevin Peterson served as lead C^4I coordinator and "did a magnificent job intefacing with the *Tarawa*, COMPHIBGRU THREE, and the type commander," according to supervisor LCDR Carlos Rexach.

The secure briefing television system, known as the SXQ–8 emulator system, was a particularly interesting installation. Working closely with the ship's intelligence officer were Paul Rigdon, Robert Pangelinan, Ely Cabugan, Dee Goff, Steve Aho, Steve Schaefer, Joe Richetti, and Fritz Petrie. They designed and installed a fully commercial off-the-shelf system that provides enhanced capabilities at a fraction of the cost. The system allows *Tarawa* to conduct secure briefings to tactical decision-makers by orchestrating voice and video feeds from several critical areas in the ship. Drastic reduction in equipment space needs now allows *Tarawa* to realize real sea and land intelligence fusion by placing both Navy and Marine intelligence personnel in the same work space.

Dave Kukula and Les Hubbard installed a television system, called TVRO, that includes a commercial satellite dish. The dish tracks satellites, receives all video modes including encrypted satellite, and interfaces with the ship's site TV system.

A significant upgrade from former phone conditions onboard was accomplished. The full-scale automatic digital programmable phone switch Mitel 2000 PBX, installed by Chris Von Mueller, John Hairl, Richard Martinez, David Lukasik, Kenneth Koepfer, Roger Kelso, and Paul Drosi will enable ship's personnel to access external phone lines from over 50 shipboard locations. They will have access to POTS ("plain old telephone system"), Stanford Telecommunication (STEL), and International Maritime Satellite (InMarSat) phones. Eric Diaz installed the battle group cellular phones for the *Tarawa's* Amphibious Readiness Group. With a base station on *Tarawa,* it operates on three channels to a range of 30 to 50 nautical miles.

Dan Kinsey and Conrad Whittaker installed a Global Command and Control System (GCCS) remote to replace the previous World Wide Maritime Command and Control System. The GCCS uses a 486 personal computer (PC) to tie to a satellite communication radio via an Ethernet connection, a Joint Maritime Command Information System (JMCIS) router, and cryptologic equipment.

John Beaton installed the Tactical Intelligence Subsystem Upgrade (TACINTEL 11+) to expand the primary automated satellite communication subsystem for special compartmented information message traffic. Larry Goetsch and Glenn Jimenez installed the tactical data terminal, known as USQ–125(V)4 Link–11 TDT for monitoring and polling Link–11 participants and incorporating the inputs via satellite.

Jim Senese modified *Tarawa's* Tactical Environmental Support System (TESS III) to enhance its meteorological and briefing systems. Senese realized it was feasible to display satellite weather imagery on the JMCIS LAN with an Ethernet connection from the TESS III UNIX workstation to a TAC–3 computer. SPAWAR, NAVSEA, and COMNAVSURFPAC signed off on this idea and he implemented it successfully.

ETC (SW) Ray Midence and Dan Kinsey installed the Contingency Theater Automated Planning System remote PC for receiving aviation tasking orders, constructing automatic mission plans, and disseminating them on the JMCIS LAN. The Tactical Flag Command and Control Information Management System, known as TIMS, consists of PCs that network with the JMCIS LAN. The PCs were installed by Dan Kinsey and Rick Jack. Kinsey and Jack, along with Jim Acosta, installed the Navy Tactical Command Systems—Afloat JMCIS. The JMCIS 2.2 installation features a fiber-optic distributed data interface LAN connected to Tactical Flag Command and Control (TFCC) Information Management System (TIMS) computers. Of the many installations performed, this was the most extensive.

Dan Kinsey and Ken Amos installed a Voice, Video, Fax Data Terminal System, a PC-based system with video camera and scanner. It uses a high-speed, high-frequency (HF) modem and cryptologic equipment for transmission of files via HF.

Lauren Lee installed an enhanced super high-frequency (SHF) antenna for increased gain and higher data rates. This 7-foot antenna was mounted on a large platform approximately 12 feet in diameter built on top of the mast. It increased *Tarawa's* overall mast height.

Gene Howard and Ron Dumin installed the Naval Modular Automated Communications System (NAVMACS II) to provide the latest in naval message processing and distribution technology.

These various installations will improve conditions aboard *Tarawa* as the new capabilities enable sailors to perform tactical exercises with greater potential and power. The ship's crew will benefit from greater accessibility to external phone lines and a wider scope of television and video options.

Site Characterization and Analysis Penetrometer System (SCAPS)

High-Level Events Surround SCAPS for Earth Day 1996

The Site Characterization and Analysis Penetrometer System (SCAPS) participated in several high-level events surrounding Earth Day celebrations in April 1996.

SCAPS is a mobile platform for deploying environmental sensors to locate and characterize hydrocarbon contamination in soil. It is a real-time, fiber-optic-based, chemical sensor system in a probe that is pushed into the ground using the reaction mass of a 20-ton, all-wheel-drive cone penetrometer truck. The probe transmits ultraviolet light energy into the soil and measures flourescence response from specific fuel products. The chemical sensor system was originally developed by NRaD's Fiber-Optic Chemical Sensor Group, directed by Dr. Stephen Lieberman, and subsequently integrated into the SCAPS system in collaboration with the Army and Air Force.

On Earth Day, 22 April, one of the three NRaD-built SCAPS trucks was on static display for briefings and walk-throughs at Andrews Air Force Base, Washington, D.C. The display included working hardware exhibits and posters showing new sensors and tools.

Dr. Stephen Lieberman and Dr. David Knowles, of the Environmental Sciences Division (Code D361), were joined by personnel ffom Naval Facilities Engineering Service Center (NFESC) and the operational crew from the Public Works Center (PWC), Jacksonville, Florida, to support the exhibit. Visitors included Commander, Naval Facilities Engineering Command (NAVFACFNGCOM), Rear ADM David Nash and Bill Quade, Director of Environment Safety and Health, NAVFACENGCOM. The Deputy Undersecretary of Defense, Environmental Security, Sherri Goodman also visited the display.

"Because of the publicity and visible success of the SCAPS program, Ms. Goodman suggested we display the truck. What is behind the publicity is good solid technology that has stood the test of review and was developed right here at

NRaD," Tom Hampton, Environmental Technology Transition Office, Code D3604, said.

On 23 April 1996 the display and personnel relocated to the lawn of the Mall entrance to the Pentagon. Visitors to the exhibit included Secretary of the Navy John Dalton and Deputy Assistant Secretary of the Navy, Environment and Safety Elsie Munsell.

The SCAPS truck was displayed at the Naval Station, Washington, DC on 29April. SCAPS participated in a joint Navy/U.S. EPA exhibition of innovative technologies verified for performance by the U.S. EPA's Consortium for Site Characterization Technologies (CSCT). Of the 16 technologies exhibited, SCAPS was the only non-private sector system presented. The U.S. EPA announced the successful completion of the SCAPS verification program followed by briefings and walk-throughs during both a morning session (for federal agency attendees) and an afternoon session (for state and regional attendees). Over 100 invited guests from numerous federal agencies and over 20 states and EPA regions looked over both the Navy SCAPS and NRaD's Cooperative Research and Development Agreement partner, Loral Corporation's commercial version called the Rapid Optical Scanning Tool (ROST).

"Two years ago the U.S. EPA selected SCAPS technology as the flagship to launch the CSCT. We successfully demonstrated the technology twice, and the U.S. EPA is issuing an innovative technology evaluation report stating that SCAPS passed the test review process," Hampton said.

A SCAPS truck was on display for briefings and walk-throughs at the request of the California Environmental Protection Agency (Cal/EPA) for the Earth Day Fair on the state capital grounds at Sacramento. Posters showing new sensors and tools were presented. Tom Hampton and Ron Falldorf, from the Environmental Technology Transition Office, Code D3604, were joined by personnel from NFESC, the operational crew from PWC, San Diego, and personnel from Computer Sciences Corporation and PRC Environmental Management, Incorporated.

Visitors to the state exhibit of SCAPS included California Secretary for Environmental Protection James Strock, who announced, in a press release, state certification of SCAPS and was quoted saying, "The Navy's penetrometer system is an excellent example of how a new technology can be used to improve our nation's environment," he said.

"Cal/EPA has a certification program more intense in its evaluation than the federal agency. We applied to the review program and after a year and a half of involvement we passed with flying colors. The Cal/EPA report is now being signed off. Cal/EPA subsequently decided to promote certified technologies because they believe that those with Cal/EPA certification are proven to have value," Hampton said.

California is a member of the Western Governors Association (WGA). The 26 member states collaborate with one another and federal agencies in environmental clean-up efforts. The WGA's Interstate Technology and Regulatory Cooperation (ITRC) working group chose SCAPS as one of four technologies to test cooperation between member states to approve technology.

"I'm happy to say we have seven out of seven of the ITRC Task Group in agreement to accept certification of SCAPS technology. The ITRC will make this recommendation in June to the 26 member states. California has become our advocate by recommending SCAPS to the WGA," Hampton said.

"SCAPS is now being recognized and accepted by other states of the nation. We put the technology out there and invented a 'road map' to regulatory acceptance. In the beginning there was no established way to get technologies accepted by the U.S. EPA or Cal/EPA, but we launched the effort and took every opportunity to demonstrate and market it. We wrote up the plan, ran demos, and filed reports with enough solid data that the western and national governors are buying into the SCAPS program," he said.

Soldier 911

Soldier 911 Demonstrated in South Korea

From 4 October through 6 November 1996, Robert James and Clark Hendrickson, Signal Processing and Communications Technology Branch, Code D855, made important progress in installing and demonstrating the Soldier 911 system in South Korea. Soldier 911 is a geo-location, situational awareness and border alert system installed in U.S. Army UH–60 helicopters flying near the North-South Korean border. They are used by U.S. Army soldiers on foot patrol near the Serbia–Macedonia border and in the joint security area (JSA) along the North–South Korean border.

The Soldier 911 program is sponsored by the Defense Advanced Research Projects Agency (DARPA) and U.S. Air Force LCOL Beth Kaspar is the program manager. NRaD is the technical agent and responsible for the overall integration of the Soldier 911 system. The NRaD team consists of Dr. Skip Hoff, program manager; Robert James, project leader; and team members David Buck, Clark Hendrickson, Roger Hail, Kristine Hironaka, and Diana Ly.

DARPA began the Soldier 911 program in September 1994 to support a request to electronically monitor U.S. Army soldiers on foot patrol along the Serbia-Macedonia border. DARPA integrated a global positioning system (GPS) multichip module into an existing PRC–112 military search-and-rescue radio to provide a quick-reaction system capability. A ground-based system is now operational in Macedonia. After a U.S. Army OH–50 helicopter was downed over North Korea in late 1994, the Soldier 911 system was expanded to include a helicopter system for the U.S. Army in Korea.

The Korea Soldier 911 system consists of a Soldier 911 computer located at air traffic control (ATC), Yongsan, Korea, which controls several remote ground-based ultrahigh frequency (UHF) radio transceivers using the Differential Global Positioning System (DGPS). It communicates with and monitors flights of eight operational Soldier 911 systems installed on OH–60 Blackhawk helicopters. The equipment is capable of border alert, emergency, canned and text message exchange, and precise position location for the pilot and ATC. The Soldier 911 system provides UHF line-of-sight airborne relay, and satellite connectivity between ATC and the helicopter.

The October demonstrations in South Korea involved enroute navigation, border warning, and position report-back. The U.S. Army is evaluating the Soldier 911 system and discussions are underway to transition the system.

Soldier 911 ground-based systems are operational and operating at three remote sites: Warrior mountaintop, Evenreach mountaintop, and Camp Humphreys ATC tower. Two Soldier 911 computers are used at ATC to monitor north and south sector traffic. The JSA ground-based Soldier 911 system was installed and is operational. Improved GPS wiring kits were installed in four 17th Aviation helicopters. Flexible UHF antennas were installed on the belly of all Soldier 911 helicopters. Four medical evacuation (MEDEVAC) helicopters were wired for the Soldier 911 system, and three MEDEVAC Soldier 911 helicopter consoles are installed and operational.

The three UH–60 MEDEVAC helicopters and the system were demonstrated to COL Purigini, MEDEVAC Battalion Commander, 121st General Hospital, Yongsan, Korea. Of particular interest to the MEDEVAC community is the ability of the Soldier 911 system to exchange text messages directly from the hospital emergency room to the MEDEVAC helicopter in the field. LTG Banks, the U.S. Army Surgeon General, flew on a Soldier 911 MEDEVAC helicopter and was introduced to the system. He asked if the system could be used for telemedicine. BG Hill, Chief of the Medical Service Corps, was given a demonstration of the Soldier 911 system and asked what he could do to support the system.

LTG Timmons, Commander of the Eighth U.S. Army, requested installation of the Soldier 911 system in his aircraft, flew with the system, and commented that he liked the system.

GEN Tilleli, Commander of the United Nations Command/U.S. Forces Korea and Combined Forces Command, was provided with a portable Soldier 911 system for use in the Commander in Chief Blackhawk helicopter (CINCHAWK).

Submarine High-Data-Rate (Sub HDR) Satellite Communications Program

Sub HDR SATCOM Program Completes Requirements Through First SPAWAR Streamlined Major Acquisition Program

The Submarine High-Data-Rate (Sub HDR) Satellite Communications Program addressed submarine communications requirements through SPAWAR's first streamlined major acquisition program. Project leaders are Submarine Communications Program Office (PMW–173), headed by CAPT Dennis Murphy; Joint Maritime Communications Strategy (JMCOMS) Program Office (PMW–176), headed by CAPT Kenneth Slaght; Office of the Chief of Naval Operations; and sponsors, Director, Submarine Warfare Division (N87) and Navy Space Division (N63).

In 1994, the operational submarine communities, with the assistance of the Submarine Communications Program Office, conducted a workshop to determine the communications requirements for submarines to efficiently and effectively participate in a post-Cold War conflict. The results indicated that while several submarine communications initiatives were headed in the right direction (such as extremely high-frequency (EHF) Low-Data-Rate (LDR), miniaturized demand-assigned multiple-access (mini-DAMA), and EHF Medium-Data-Rate (MDR)), submarine forces required more communications capability and flexibility to carry out their current military roles. These roles, which include surveillance, strike, special warfare, and battle group operations, require large amounts of information transfer, such as imagery, video, and tactical data files. In addition, these capabilities are required now.

Higher data rates require larger antennas. This requirement is balanced by the fact that operations at higher data rates inherently require more time on the surface to communicate, while retaining EHF LDR capabilities. If the mission dictates a more survivable and covert posture, the Sub HDR engineering team determined that the 5.5-inch EHF antenna must be expanded to 16 inches for communications at 256 kilobits per second. A second outcome is to design increased flexibility in submarine communications and integrate multiple communications bands such as military and commercial SHF into the HDR system.

The first issues addressed were performance, acquisition strategy, management, and funding. Market surveys were conducted by the Submarine Communications Program Office and the JMCOMS Program Office. With the systems engineering support of the Naval Undersea Warfare Center (NUWC), New London, and Booz-Allen and Hamilton Incorporated, the answers from this market survey were used to structure a program to satisfy the requirements. CAPT Murphy, as chairman of the Sub HDR Acquisition Coordination Team (ACT), worked with CAPT Ken Slaght to define program objectives and constraints.

Brian Shaw from NRaD Code D84, Integrated Satellite and Link Communication Systems Division, was appointed Submarine HDR Integrated Product Team (IPT) project manager. Shaw organized the Sub HDR team and optimized the HDR acquisition strategy to satisfy the many diverse stakeholders represented by voting members of the IPT. These members include NUWC, acting as technical design agent; NRaD, providing technical guidance and support in EHF and SHF satellite communications, operational tests, and evaluation force (OPTEVFOR); and SPAWAR, providing contracting and legal services.

The Sub HDR IPT reports to the ACT, an integrated body of decision-makers from the acquisition, requirements, and budgeting communities. The HDR ACT includes decision-making authorities from PMW–173, PMW–176, N87, N63, the OPTEVFOR, and the acquisition and financial codes within SPAWAR as well as the Sub HDR project manager.

The first performance-related question addressed was: Can the submarine HDR requirements be satisfied within one multiband system? The reason for this question is twofold. First, procuring a single system is less expensive. Second, since a submarine is constrained in available space and weight, both in the radio room and outboard in the sail, a single integrated system is advantageous. The limiting factor in satisfying the HDR requirements in one system would be antenna technology. The results of the market survey revealed that, while not nondevelopmental, a reasonable amount of creative multiband antenna concepts exist that could be applied to this submarine application and fit within the 16-inch antenna constraint. After analysis, it was decided that the submarine HDR system could be a multiband system and would be capable of supporting the EHF and military SHF bands, with the commercial SHF band as an objective.

The second performance related question was: Can the principal elements of acquisition reform, especially the use of nondevelopmental items (NDIs), be effectively applied to satisfy this requirement? The limiting factor here is whether NDI exists that can be applied to a submarine environment since clearly there is no commercial market for submarine equipment. If available, it would reduce development investments as well as the development schedule. The results of the market survey revealed that a reasonable amount of open-system architecture NDI and commercial off-the-shelf/government off-the-shelf (COTS/ GOTS) equipment exists that can be applied to the submarine HDR system. The engineering challenge was integrating existing NDI and COTS/GOTS into a complete submarine HDR system. To this end, it was determined that system-level procurement would be more advantageous than component integration.

After these questions were answered, a performance-based specification for the submarine HDR system was generated by NRaD, SPAWAR, and NUWC with the assistance of government contractors Booz-Allen and Hamilton, Resource Consultants Incorporated, and Tele-Consultants Incorporated. The specification was released for industry review via SPAWAR's electronic bulletin board on several occasions in order to obtain industry insights.

"This dynamic and thorough method of building a performance specification has defined the HDR system as a benchmark of reengineering submarine satellite communications. This program has literally wiped the slate clean, and we plan on facilitating the HDR design from the bottom up," said Brian Shaw.

Shaw said that aside from reengineering the acquisition strategy based on the market survey, the submarine HDR IPT has instituted other acquisition reform concepts. Examples include performance specifications, minimum use of military standards, and minimum oversight and documentation requirements. In addition, a paperless acquisition process is in use to reduce time and administrative costs. To this end, maximum use of video teleconferencing is employed, and e-mail and Lotus Notes were used constantly in the pre-solicitation period.

"Everything is scarce these days," Shaw remarked. "This includes time, funding, and even people. I can't imagine how any Navy program has the time or money to do anything but employ these technologies to their fullest. We just do not have the time to put an engineer on an airplane and fly him or her to a meeting somewhere. Unless it's critical to be face-to-face, we do it electronically," he said.

"Streamlining of acquisition has become a critical measure of success for any DoD program," Shaw said. "Rigorous management of time, money, and performance are all vital elements of any successful program. A good example of Sub HDR streamlining is working with OPNAV to formulate a nontraditional capstone operational requirements document (ORD) to capture the complementary EHF (LDR and MDR), SHF, commercial, and submarine high-data-rate requirements from relevant stand-alone ORDs. Similarly, the HDR IPT has combined the acquisition plan and the acquisition strategy report and produced a refined and specific document. This document was then routed quickly through the Pentagon and SPAWAR for flag-level approval," Shaw said.

He said it was this type of innovation in streamlined management and acquisition that earned the Sub HDR program a special certificate of commendation from

Assistant Secretary of the Navy for Research, Development and Acquisition and Commander, Space and Naval Warfare Systems, Commander Rear ADM George Wagner at the recent Department of Defense acquisition stand-down.

Shaw reported that the Sub HDR program represents the first of major streamlined acquisition programs within SPAWAR.

"From the outset, it has capitalized on the proven ACT and IPT management approach to streamline requirements definition, contracting, specification development, acquisition, and testing strategies. A strong customer focus was maintained, continually emphasizing submarine high-data-rate schedule and performance requirements. Program flexibility was maximized, emphasizing NDI, COTS/GOTS, and open-system architecture. Multi-disciplinary teamwork has been fostered and team members are each empowered to accomplish the tasks at hand. The final element, risk, has been proactively identified and is being used as a tool of sorts," he said. "The risk is there, but the payoff is very high. That's what makes the job so worthwhile and satisfying!"

SWellEX–96

Landmark Passive Acoustic Experiment Completed

A coalition of NRaD, Scripps Marine Physical Laboratory (MPL) and Naval Research Laboratory (NRL), projects under the sponsorship of the Office of Naval Research, Space and Naval Warfare Systems Command (SPAWAR), and Naval Sea Systems Command (NAVSEA), joined forces to conduct SWellEX–96 during May 1996. SWellEX–96 was the fifth in a series of shallow-water evaluation cell (SWell) experiments designed primarily to determine the limits of passive detection of submarines in littoral waters.

When SWellEX–96 was completed on 18 May, 160 hours of towed-source data and 40 hours of USS *DOLPHIN* (AGSS 555) data were recorded on three vertical and two horizontal arrays. Beamforming and data processing during the experiment provided quick-look results and feedback that was used to modify the experiment plan, enabling all projects to better meet their objectives. The sailboat *La Salsa* supplemented the acoustic data with 9 days of sound-speed structure measurements.

SWellEX–96 started as an Acoustic Branch, NRaD Code D881 Environmentally Enhanced Array Processing project (ONR–32 1 US) experiment to test matched-field beamforming on *DOLPHIN*, a diesel-electric submarine homeported at NRaD. The primary sensors were tilted and vertical line arrays deployed from the MPL research platform floating instrument platform (FLIP).

The NRL Environmentally Enhanced Signal Processing (EESP) project (ONR–321US) joined the experiment to test acoustic inversion techniques, which determine bathymetry and genacoustic parameters and matched-field tracking. The NRL contribution to the experiment included the satellite-linked vertical line array and funding for the ship to tow the acoustic source.

The SPAWAR, PMW–183, Advanced Deployable System (ADS) project relocated an earlier test of the All-Optical Deployable System (AODS) and the

Generic Multi-Processor (GMP) to join the experiment. AODS participation, managed by Code D71, Acoustic Systems and Technology Division, added two optical horizontal line arrays, a bevy of real-time processing, and 3 days of towed acoustic source data.

The coalition of projects became complete when the NAVSEA PMS-395 *DOLPHIN* Project provided *DOLPHIN* services. The *DOLPHIN* Project, managed by the Applied Technology Branch, Code 745, obtained calibration measurements of the *DOLPHIN* Programmable Acoustic Signal System (DPASS).

The NRaD Naval Reserve Unit, Code 03R, supplemented the multi-laboratory workforce, preparing hardware and standing watches during the experiment. The reserve participation enabled the experiment to field a towed acoustic source, which provided a calibrated basis for comparison with the *DOLPHIN*.

The following NRaD leadership made the experiment a success: Acoustics Branch (Code D881) SWellEX–96 chief scientist Newell Booth; SWellEX–96 test director LT John Furgerson; *DOLPHIN* chief scientist Richard Shockley; *La Salsa* test director Randy Judd; *La Salsa* chief scientist Mark Stevenson; matched-field processing scientist Phil Schey; Advanced Applications Branch (Code D714) AODS project manager Gary Dorrance; AODS scientists James Reese and Al Aburto; Marine Systems Branch (Code 742) AODS deployment manager Lynn Collins; Applied Technology Branch (Code 745) *DOLPHIN* Project manager Dave Carlton; *DOLPHIN* DPASS engineer Glenn Hunsaker, and Towed Acoustic Sources manager Howard Lynch; *DOLPHIN* Commanding Officer CMDR Joseph Peterson and Executive Officer LCDR John Kummer; NRaD Naval Reserve Unit, Code 03R, and SWellEX–96 coordinator CMDR (Sel) Steve Schmidt.

Targeting Avionics System (TAS)

TAS Demonstrated During Live HARM Firing

NRaD engineers played a key role in a successful program to increase the attack capabilities of the Navy-Marine Corps F/A–18 aircraft. Engineers from the Radar Branch (Code D755) and Radio Frequency (RF) Sensors Branch (Code D752) have lead development of the Targeting Avionics System (TAS), a very accurate radar frequency locating system that is mounted within the pylon of an F/A–18 aircraft.

On 29 October, TAS successfully demonstrated its ability to cue the High-Speed Anti-Radiation Missile (HARM) in its most-effective "range-known" mode during a live missile firing at the Naval Air Warfare Center–Weapons Division (NAWC–WD), China Lake.

The TAS sensor was used to provide real-time cueing information (including passive range) to a HARM Block III missile against a simulated Surface-to-Air Missile target, said project manager Melanie Marriott. Once cued, the HARM was launched from behind a mountain range, traveled to the location indicated by TAS, then made a lethal pass against the emitter. This live firing marks the first time that an F/A–18, or any Navy platform, was able to cue the HARM in range-known mode using an onboard sensor.

She said this latest series of flight tests was conducted on a range at China Lake following a 5-year development that began as a concept demonstration. Under sponsorship of the Office of Naval Research (ONR), NRaD and NAWC-WD China Lake worked in cooperation with the Naval Air System Command Defense Suppression Systems Program Office (PMA–242) on the technical demonstrations. James Hall of ONR Code 31 is the sponsoring scientific officer.

The success of the demonstration has led PMA–242 to investigate the applicability of TAS variants on other U.S. and international aircraft as a targeting system for HARM.

The TAS effort began in 1991 as a concept demonstration to package an autonomous, high-accuracy, extended-range, passive targeting system entirely within the AN/SUU–63A multipurpose pylon of the F/A–18. Loral Aeronutronic (now Lockheed Martin Aeronutronic) won a competitive TAS Demonstration (TASD) contract to package such a system.

System requirements included forward and side field-of-view coverage with precision direction-finding accuracy, high sensitivity for detection at standoff ranges, and ability to interface with other onboard avionics. Requirements also precluded major hardware modifications to the aircraft.

The developed system communicates with the aircraft's mission computer via the onboard 1760 multiplex bus, and data are shown on existing displays. Simple installation and integration require no aircraft hardware modification, and the new system will not affect the pylon's normal functions.

With support from McDonnell Douglas Aerospace, Naval Air Systems Command (PMA–265) and the F/A–18 Weapons Systems Support Activity, the TASD concept was successfully demonstrated during pedestal ground and flight testing.

After the initial concept demonstrations, TAS was selected for Fleet evaluation under the Navy Technology Insertion Program (NTIP), a Navy initiative to evaluate mature research and development technologies in an operational Fleet environment.

"Under that program, a single TAS pylon will be provided to an Atlantic Fleet squadron in 1997 to evaluate the system in operational environments," Marriott said.

She said evaluation would be conducted during air wing workups and possibly a carrier deployment.

NRaD team members on the development were: Melanie Marriott, project manager (replacing Jack Henderson, who retired in September 1995); Ben Forman, project engineer; and Bruce Jenkinson, field test engineer.

Universal Radar Moving Target Transponder (URMTT)

URMTT successfully demonstrates to seven NATO countries

The Universal Radar Moving Target Transponder (URMTT) successfully demonstrated its ability to transpond realistic radar targets over the air against the 996 (frequency agile) air/surface search radar on the HMS *Westminster*, a United Kingdom frigate. A demonstration was made to representatives from seven NATO countries who are members of the Fleet Operational Readiness Accuracy Check Sites (FORACS) Steering Committee. Representatives from Shipboard Electronic Systems Evaluation Facility (SESEF), Naval Sea Systems Command (NAVSEA), and NRaD were also present during this event.

This demonstration was set up in conjunction with the annual steering group meeting, at their request, because these representatives were very interested in using URMTT to test NATO ship radars at their FORACS sites and wanted to see URMTT exercised on one of their ships.

Viewed as a marketing opportunity, the Code D80 Communication and Information Systems Department's major bid and proposal was used to help fund this demonstration, which took place at Port Canaveral, Florida, on 18 October in rainy weather.

A hurricane was lingering off Cuba and provided URMTT with a chance to demonstrate operation under challenging inclement weather conditions. This is a key advantage with URMTT, as compared with using target drones and actual aircraft for radar targets that normally would not operate under these conditions.

In addition to the "anytime and any weather" advantage, URMTT provides a substantial cost avoidance advantage over drones and real aircraft, which are very expensive to operate.

During the demonstration, the HMS *Westminster* was located at a pier in Canaveral Harbor and URMTT was set up in the hallway of a small one-story building about a mile from the ship. URMTT used small-horn antennas mounted on top of a 100-foot portable tower to receive and retransmit radar signals. The NATO representatives, located in *Westminster's* command information center (CIC), observed very realistic incoming and outgoing radar targets, with speeds varying from 100 to 2900+ knots. Target size, location, and acceleration were also varied. The *Westminster* crew successfully detected, tracked, and displayed numerous URMTT targets on the 996 radar display monitors.

URMTT is a portable radar moving target transponder system developed by the Advanced Electromagnetic Technology Branch (Code D856) under sponsorship of SESEF URMTT is a generic system that was designed to remotely test most types of radars including frequency-agile radars such as the SPY–l. URMTTs are also being built for the U.S. Air Force at Edwards Air Force Base and the Naval Air Warfare Center at Patuxent River.

The 996 radar is a very sophisticated frequency-agile radar and was used to demonstrate UMRTT's ability to transpond to frequency-agile radars. This is the 10th radar that URMTT has been tested on and the 10th successful test. During these tests, no technical information about these radar was required to make URMTT work. There may currently be no other radar transponder system in the world that can transpond moving targets to this many radars without inputting technical knowledge on these systems. This makes URMTT very convenient and easy to use while testing radars.

An e-mail compliment was paid to the URMTT team members: Dr. Will Cronyn, Chris Holmes, Mike Wills, Jim Wildermuth, Code D856; Ed Holler, Code

D8503; and Hoa Phan, San Diego State University. Also included were Howard Pruett, Code D533; and Neil Gibbs, Ahntech, who developed and built the antenna interface unit and console interface unit (part of the URMTT system used in the demonstration) and participated in the demonstration.

E-mail From Michael Finnerty Headquarters, NAVSEA, thanked the team for a very successful new URMTT demonstration for the NATO FORACS Steering Committee,

During the 45-minute, dockside demonstration, URMTT generated numerous incoming and outgoing targets of various sizes (1 square meter to 10 square meters) with speeds from 100 knots to 2500 knots for the United Kingdom's new 996 radar. In this brief time, the ship was able to check the radar bearing accuracy along the line of sight to the URMTT antenna, check the ability of the radar to detect targets, determine minimum detectable target size, check accuracy of the radar range detection, and check the accuracy of the speed detection functions of the radar.

Ed Holler said, "This was the first shipboard test for URMTT and it delivered all that was advertised. The ability of URMTT to perform generically with any radar was proven because it worked so superbly with the new 996 radar without knowing any radar specifications."

This demonstration significantly raised the level of interest for URMTT from all the NATO countries that attended the demonstration. It is anticipated that sometime in the near future URMTT will be purchased to provide NATO FORACS sites with generic radar testing capability for all their ships.

For the U.S. Navy, the SESEF site at NRaD already has an URMTT installed and the SESEF site at Fort Story Virginia, URMTT was scheduled to be operational in late January 1997.

For the U.S. Air Force, URMTT has successfully passed its acceptance test and is scheduled for installation at Edwards Air Force Base.

Command and Control (C^2)

Advanced Combat Direction System (ACDS)

The Advanced Combat Direction System (ACDS) is a major development program that will upgrade the current Navy Tactical Data System (NTDS) on aircraft carriers, LHDs, and selected LHAs. ACDS is being developed in two phases designated as Block 0 and Block 1. ACDS Block 0 is intended to provide for the installation of upgraded Navy-standard computers, displays, and peripheral hardware, and the rehosting and enhancement of existing Model 4 NTDS software to operate on this hardware. ACDS Block 1 is intended to provide a major software upgrade to Model 5 NTDS by using the same hardware as installed for Block 0. In addition to the Model 5 capability, principal software enhancements provided by the Block 1 computer program include increased surveillance ranges and capacities, automation of the track management process, integration of electronic surveillance measures (ESM) and nonorganic surveillance assets, enhanced ability to identify system tracks based on contributing sensor sources, improved multiship gridlock achieved in concert with JTIDS, and system adaptability through operator-defined doctrine processes.

ACDS Peripheral Support Group

The ACDS Peripheral Support Group completed evaluation testing and achieved initial operating capability as the shore-based and ship-borne replacement for many of the Navy's legacy peripheral systems. (See feature article in Calendar Year 1996 Highlights above.)

Advanced Combat Direction System (ACDS) Block 0/Block 1

The Advanced Combat Direction System Block 0 (ACDS Block 0) program is the initial step in the upgrade of NTDS as implemented on CV/CVN, LHD, and LHA platforms. ACDS Block 0 development is a phased approach via levels (or versions). As one level is being deployed to the Fleet, another level is in the testing phase, and a third level is in the development phase.

Thus far, this Universal Library development through life-cycle support (LCS) effort is up to Level 10 and centers on combat direction system computer programs, other support programs, and related equipment documentation. NRaD provides lead laboratory management, direction, system engineering, and program development to the ACDS Block 0 program. This effort will define, engineer, test, and certify new version releases that correct reported problems, improve system performance, or accomplish equipment changes.

Advanced Combat Direction System Block 1 (ACDS Block 1) is a replacement and upgrade for the Naval Tactical Data System that will provide significant enhancements in the areas of sensor management, tactical data exchange, warfare area coordination, and system reliability. NRaD provides lead laboratory management and direction. NRaD is developing ACDS Block l and performing planning and system engineering leading to development of Block 1 versions for designated combatants and amphibious ships.

Other FY 96 accomplishments included the following:

ACDS Block 0, Level 8. Completed the System Integration Test onboard USS *John C. Stennis* (CVN 74) in support of the Acceptance Trials.

ACDS Block 0, Level 9. In January 1996, completed delivery of Block 0, Level 9 version to Fleet Combat Training Center, Atlantic, in Dam Neck, VA. Installed on USS *Independence* (CV 62) and USS *Enterprise* (CVN 65), which resulted in a very successful FOT&E in on CVN 65 in April 1996.

ACDS Block 0, Level 10. Installed on USS *Kearsarge* (LHD 3) in support of successful RAM CSQT in first LHD class ship. Also installed on LHD 6 CSACF in support of Bon Home Richard CS validation.

ACDS Block 0. Completed Operational Test IIIA (OT–IIIA). Received a message from the Commander, Operational Test and Evaluation Force (COMOPTEVFOR) Test Director on USS *Enterprise* (CVN 65) that OT–IIIA of the ACDS Block 0 was completed as scheduled. Completed installations on USS *John F. Kennedy* (CV 67) and USS *Kearsarge* (LHD 3).

Advanced Communications Intelligence Voice Processor (ACVOP)

The Advanced Communications Intelligence Processor (ACVOP) project will combine the technologies of language identification, speaker identification, and noise cleanup with signal sorting algorithms. ACVOP will enable intelligence analysts to sort and analyze hundreds more signals of interest on each shift than analysts can currently handle.

ACVOP is a government-industry team project with NRaD, Rome Labs, and Lockheed-Martin as team members. The project is a new 3-year, $10M Advanced Technology Demonstration funded by SPAWAR.

Automated Stand-Alone Intelligence Support Terminal (ASIST)

The Automated Stand-Alone Intelligence Support Terminal (ASIST) project provides the ASIST database and supporting software programs for use on NRaD modified laptop computers. The database, maintained at the Office of Naval Intelligence (ONI), is used for submarine intelligence operations.

CY 96 accomplishments included the following:

- Provided support and software to ONI required to convert the ASIST database to a new format.
- Provided ONI the capability to produce classified ASIST CD-ROMs in-house.
- Identified factors and potential problems with migrating the ASIST database to the Joint Deployable Intelligence Support System (JDISS).

- Provided hardware support and maintenance for 60 NRaD-modified Toshiba T6600 computers.
- Provided ASIST users with multimedia methods to assist in their mission briefs.

Command and Control Advanced Research Network (CCARNet)

Command and Control Advanced Research is addressing the use of ATM Technologies in the design and development of a High-Performance Multimedia Services backbone network, up to the SECRET level, for the intraconnection of C^2 spaces of D40 and interconnection to wide-area networks such as DREN, ATD, AAI, and services such as DISA DSInet, NIPRnet, and SIPRnet.

CY 96 accomplishments included the following:

- Established a classified ATM backbone connecting Seaside and Topside C^2 D40 spaces and providing connectivity to DISA-classified ATM services.
- Developed the environment and connectivity between Command Center of the Future (CCOF) and D40.
- Supported the beta testing of the ATM FASTLANE data cell encryption device.
- Supported the Corporate Initiative Group demo by providing equipment and technology to showcase the capability of the unclassified ATM backbone to transfer broadcast quality video, studio quality audio, and data transfer between Topside and Seaside locations.

Command and Control Multi-User Virtual Environment (C^2MUVE)

The Command and Control Multi-User Virtual Environment (C^2MUVE) project is developing the technologies and architectures to provide a distributed virtual environment for CINC-level planning.

CY 96 accomplishments included the following:

- Demonstrations were given to 3rd Fleet, Naval Postgraduate School, DISA, the IS&T panel, DSTO, and the CCTWG Intellink community.

Command and Control Processor (C^2P)

The addition of the Joint Tactical Information Distribution System (JTIDS) into ships will provide the first major upgrade of tactical digital infromation link (TADIL) communications to C^2 ships since the introduction of Naval Tactical Data System (NTDS). It is anticipated that there will be follow-on improvements/additions to ship's TADIL communications, such as an improved

Link–11 and EHF SATCOM Link. The Command and Control Processor (C^2P) will provide for the control and management of these diverse TADIL communications assets in multithreat environment. The primary objective of the C^2P is to provide real-time interoperability between widely dispersed C^2 ships by efficient use of all of each ship's TADIL communications equipment/systems.

The program provides for the development, test, independent verification and validation (IV&V), and evaluation of a C^2P system intended for the management and control of TADIL communications aboard major surface ships. The C^2P will provide an isolation and buffering function between ownship's C^2 systems and data link transmission and reception protocols.

The C^2P is being developed in two configurations. One of the configurations, termed "(V0)," is intended to allow the introduction of the JTIDS/Link–16 into ships with "Model 4" CDSs. The second version of C^2P, termed "(V1)," is intended to provide full TADIL–J/Link–16 service on the ships scheduled to receive the new "Model 5" ACDS Block 1 CDS.

NRaD is the Technical Direction Agent (TDA) for the C^2P and is leading the government acceptance test and product validation effort. NRaD is also the designated Software Support Activity (SSA) for the system.

FY 96 accomplishments included the following:

C^2P Models 4 and 5. Delivered, installed, and tested numerous Model 4 and Model 5 versions to ships and shore sites.

C^2P Rehost. Completed Acceptance Testing of the C^2P Model 4 Rehost. It successfully demonstrates the capability to implement all Model 4 (Link–4A/11) ship C^2P requirements. Rehost implements C^2P functionality using commercial off-the-shelf (COTS) hardware.

C^2P TADIL–J Link. Demonstrated the C^2P's TADIL–J link at sea. USS *Nimitz* (CVN 68) and USS *Callaghan* (DDG 994) exchanged TADIL–J track data via C^2P and UHF demand-assigned multiple-access (DAMA) satellite communications.

C^2P/ACDS. Certified for Joint Use. C^2P and ACDS Block 0 have been fully certified for Joint use based on the final results of Operational Maintenance Test (OMT) 183 conducted 27 November through 1 December 1995. OMT 183 was conducted by the Joint Interoperability Test Command (JITC) at Ft. Huachuca, AZ, with several test participants located nationwide including USMC's Marine Air Command Control System (MACCS), Army's Patriot, and the Air Force E–3.

Command Forces (CFOR)

The Command Forces (CFOR) project continued to integrate advanced technologies in the areas of representing in software, C^2, and automated decision–making behaviors. This project integrates C^2 infrastructure among the Synthetic Force elements mentioned above, allowing them to pass C^2 messages, events, and directives between simulations. The project also provides software Commanders (Command Entities), such as an USA Company Commander or a

USMC Rifle Platoon Commander, who can issue and receive commands, orders, or reports to other simulated commanders or directly invoke other simulations' behaviors. Initial prototypes were tested and demonstrated throughout the year and development continues.

Developmental Command and Control Network (DCCN)

The Developmental Command and Control Network (DCCN) project demonstrated DCCN Phase 2. Previously, Phase 1 demonstrated the feasibility of replacing existing point-to-point cable connections of a set of legacy shipboard combat systems with local-area networks (LANs). Phase 2 makes data from the formerly closed legacy connections available to new users on the network by translating the various legacy system messages into a relatively small set of "standardized' messages. DCCN proves a transition concept that Navy systems can be modernized around networks using a phased approach.

Distributed Janus (DJ)

The Distributed Janus (DJ) project continued to integrate advanced technologies in the area of linking new-generation, entity-based simulation forces with an existing aggregate-based simuation (USA's JANUS simulation). Specifically, the project uses this technology to distribute the JANUS simulation for the Army National Guard reserves, who are typically geographically dispersed units, with the goal of providing more training opportunities for the National Guard. It was also demonstrated and tested with the United Kingdom, who also uses JANUS and is interested in the distributed implementation.

E-2C Airborne Tactical Data System Software Support

The objectives of the E-2C Airborne Tactical Data System Software Support program are to plan, design, construct, test, and deliver E-2C Airborne Tactical Data Systems (ATDS) computer programs to the Fleet; to correct, update, modify and distribute operational programs in accordance with evolving Fleet requirements; to provide ancillary computer programs to support life-cycle maintenance; to provide technical assistance to shore sites; to provide tactical, diagnostic, and support software of the highest quality; and to rapidly respond to Fleet requirements.

FY 96 accomplishments included the following:

E2C ATDS. Passed Joint Link-11 certification.

Exercise Generation (EXGEN)

The Exercise Generation (EXGEN) project began in early 1996 to integrate advanced technologies in the area of exercise generation and initialization for large distributed simulation exercises. Work continues in defining the components necessary for initializing a distributed exercise, such as force organization and laydown, weather and environment editors, communication nets, exercise control tools, and other scenario generation and execution requirements. Development of these capabilities is necessary to ease the resource requirements (hardware, personel, time) necessary to set up and use the distributed simulation systems for large exercises.

FastFleet (Navy Synthetic Forces (Navy SF) and Joint Countermine Operational Simulation (JCOS SF))

This project continued to integrate advanced technologies in the areas of computer-generated forces (Synthetic Forces) for the Navy, specifically the development of ship platforms and systems (hull, sensors, communications, weapons, etc.) to support Amphibious, Strike, and Self-Defense operations. This included an emphasis on mine countermine systems and operations, and an initial effort to establish connectivity to C^4I systems such as JMCIS. FastFleet has also been introduced into the Fleet on two fronts, as a simulation driver in connection with BFTT for Fleet exercises; and as a test case for model verification and validation, and database certification by the Fleet Project Team's Modeling and Simulation effort. The FastFleet prototype was used in two FY 96 Joint Fleet Exercises (JTFEX 96–1 & 96–2), using the BFTT facility at FCTCPAC and providing a limited number of simulated entities seen on the JMCIS consoles in the TFCC mockup at FCTCPAC and on the Vinson/Tarawa Battle Group displays.

Global Command and Control System (GCCS)

The Global Command and Control System (GCCS) will provide Joint and service component commanders with a set of automated tools and communications for operations planning, execution monitoring, and logistics sustainment of Joint warfighting efforts. GCCS will be derived from the core system formed by JMCIS. NRaD is the systems engineering advisor and integrator of the core GCCS components for the U.S. Fleet Navy hardware.

FY 96 accomplishments included the following:

Global Command and Control System (GCCS). Provided support to COMSEVENTHFLT. The consolidated NRaD response to C7F needs responded in both a CASCOR and a Bravo Zulu message from C7F.

Joint Maritime Command Information System (JMCIS)

The Joint Maritime Command Information System (JMCIS) will provide the primary C^4I system for the U.S. Navy and Joint Task Force Commander. JMCIS is an integrated hardware and software product consisting of the core Unified Build (UB) segment and those segments developed by numerous agencies to meet specific operational requirements. NRaD provides systems engineering and integration and is the Software Support Activity.

JMCIS is a class of command, control, communications, and intelligence (C^3I) software variants and hardware architectures that are fielded to operational sites using NDI commercial hardware and a Common Operating Environment (COE). The JMCIS Superset is composed of segments made up of computer software configuration items (CSCIs). Two key segments are the Environment and the UB. The UB segment provides the core services (communications, display manager, track database, etc.) that applications use.

FY 96 accomplishments included the following:

JMCIS 2.2 System Installations. Installed JMCIS 2.2 on USS *Blue Ridge* (LCC 19) and USS *Tarawa* (LHA 1). Based on the successful Operational Evaluation (OPEVAL) on USS *George Washington* (CVN 73), conducted 2.2 software installations on *Blue Ridge* (in Japan) and *Tarawa*.

JMCIS/Operation Support System (OSS). Installed the latest U.S. Fleet release version of the JMCIS OSS variant at MARLANT HQ Halifax, Nova Scotia, Canada. NRaD also provided user training on the Water Space Management and the Antisubmarine Warfare (ASW) Support functionality.

JMCIS/OSS. Provided on-site support to the Canadian Maritime Command HQ in Halifax, Nova Scotia, Canada. Assistance was requested for the expansion in the number of machines on their JMCIS/OSS variant, which is now operational and integrated with their MCOIN system. NRaD provided two 2-day operator training courses with eight operators on each. The Canadians expressed their satisfaction with the training and technical assistance received.

Joint Maritime Operations Functional Process Improvement (JMO FPI) and C^4ISR Architecture and Engineering Support

The Joint Maritime Operations Functional Process Improvement (JMO FPI) project is providing the Maritime Operational Architecture components, including recommended improvement opportunities, activity models, and data models, to support the development and dissemination of warfare information architectures and standards.

The C^4ISR Architecture and Engineering Support project is working to define the Operation, System, and Technical Architectures for the next generation of integrated C^4ISR systems at the Naval and Joint level.

In CY 96, the Office of the Secretary of Defense (OSD) assigned the Navy as the lead for a review of Joint Maritime Operations. SPAWAR 051–1 is the lead program office and Chief of Naval Operations (CNO–N51) is the executive agent.

Joint Simulation System (JSIMS)

NRaD is developing the Maritime segment of the Joint Simulation System (JSIMS) to improve the Navy's ability to supplement live forces with highly realistic synthetic forces in both shore and sea-based training exercises. JSIMS is intended to reduce the cost and improve the effectiveness of joint training.

FY 96 accomplishments included the following:

JSIMS. Led the development effort of two key products in support of JSIMS Maritime Development Agent, NAVSEA PMS 430: the Operational Requirements Document Project Team, and the Naval Doctrine Command.

Joint Tactical Information Distribution System (JTIDS)

The Joint Tactical Information Distribution System (JTIDS) is an integrated communications-navigation-identification system featuring multichannel, multinet, high-data-rate communications and relative navigation capabilities for tactical operations.

Operating across the C and D bands in the TACAN frequency region, the JTIDS system uses spread-spectrum, anti-jam techniques to achieve its performance requirements while interoperating with the TACAN. In 1986, SECNAV decided to embrace the Air Force's TDMA terminal development effort. The terminal contractor was then placed under contract to develop a block of terminals to satisfy unique Navy operational needs. PMA/PMW–159 has since conducted a number of design and progress reviews with GEC Marconi and awarded a contract for the development of Block 2 terminals. Block 2 terminals have been successfully tested in the SIF and installed in the *Carl Vinson* Battle Group. Block 2 terminals are installed at NRaD and on USS *Arkansas* (CGN 41), USS *Antietam* (CG 54), and USS *Carl Vinson* (CVN 70). Full-rate production was authorized for additional U.S. Navy JTIDS terminals for 10 battlegroups.

NRaD performs the following tasks:

- Provides system engineering support to PEO SCS (PMW–159) in support of the JTIDS Program.
- Performs ship integration engineering and installation test support. Continues development of the JTIDS shipboard.
- Performs test and evaluation planning for terminal and platform integration testing.
- Maintains, operates, and continues development of the System Integration Facility (SIF). Conducts validation and certification testing of Navy and Marine Corps JTIDS terminals.
- Validates JTIDS integration aboard F–14, E–2C, and other Navy platforms.

FY 96 accomplishments included the following:

Joint Tactical Information Distribution System (JTIDS). Installed JTIDS on USS *Jefferson City* (SSN 759).

JTIDS. Conducted first joint Class 2 interoperability testing. (See feature article in Calendar Year 1996 Highlights section above.)

JTIDS/C^{2}P Follow-on Test and Evaluation (FOT&E) Developmental Test IIIA (DT–IIIA). Conducted JTIDS/C2P FOT&E DT–IIIA with the USS *Carl Vinson* (CVN 70) Battle Group.

JTIDS/Link–16. Performed successfully at All Services Combat Identification Evaluation Team (ASCIET) 95. ASCIET was the follow-on to the April 1994 Joint Air Defense Operation/Joint Engagement Zone (JADO/JEZ) exercise to assess the ability of all four services to coordinate fully integrated air defense operations in air, land, and sea environments.

Korean English Language Technologies (KELT)

The objective of the Korean English Language Technologies (KELT) was to develop a bi-directional Korean and English phrasebook software application that allows spoken or typed input and output. The software is intended to facilitate Combined Forces operations in the Republic of Korea. The project was transitioned to the Marine Corps Tactical Systems Support Activity at Camp Pendleton in September 1996. At its transition, KELT contained over 400 words and phrases covering military operations and humanitarian aid missions. The project was managed by Christine Dean, Code D441.

LeatherNet (Marine Corps Synthetic Forces (MC SF)

This project continued to integrate advanced technologies in the areas of computer-generated forces (Synthetic Forces) for the Marine Corps, specifically the development of individual combatants and specialized USMC teams; and in the three-dimensional visualization of the battlespace with the immersive technologies of Command View and Command Talk, allowing the Marine to interact with the simulation in a more natural environment. The LeatherNet facility and prototype configuration is fielded at the 29 Palms USMC Base, 29 Palms, CA, and was demonstrated to several high ranking officials over the past year including the Secretary of Defense, William Perry, the Commandant of the Marine Corps, and others. Currently it is being used on-site at 29 Palms by the USMC in their training rotations as a mission planning and rehearsal simulation prototype.

Mobile Integrated Command Facility (MICFAC)

The Mobile Integrated Command Facility (MICFAC) will provide the Navy a completely self-contained mobile command center ashore at any location. First fielded as a prototype in 1992, MICFAC was re-engineered and delivered in only 4 years. MICFAC provides the Navy a completely self-contained mobile command center ashore at any location. (See feature article in Calendar Year 1996 Highlights section above.)

In February 1996, the second MICFAC was delivered to Commander in Chief U.S. Navy Europe (CINCUSNAVEUR) in Italy. In May, the third MICFAC was delivered to Commander in Chief Pacific (CINPAC) in Hawaii. The fourth MICFAC was delivered in August to Commander in Chief Atlantic (CINCLANT) in Norfolk, VA.

Modular Reconfigurable C^4I Interfaces (MRCI)

This project began in early 1996 and has been an effort to generate a modular reconfigurable C^4I interface to such simulation efforts as described above. This includes the development of prototype interfaces for each service, designed to capture modular functionality that is in common to all C^4I interface construction, so that these modules are ready for reuse and/or reconfiguration. The current interface prototypes are being built for the following C^4I systems (primary services), CTAPS (USAF), MCS/P (USA), and AFATDS (USA/USMC).

Multifunction Information Distribution System (MIDS)

Built with more recent hardware, Multifunctional Information Distribution System (MIDS) terminals provide JTIDS functionality with lower weight and cost. NRaD is the primary U.S. Navy systems engineer supporting both the MIDS terminal development within the international community and its application in the U.S. lead platform, the F/A–18.

FY 96 accomplishments included the following:

MIDS Integration. Completed the first of six Developmental Test (DT) phases that will verify full integration of Link–16 in the F/A–18 Hornet. This initial test, DT–IIA–1, assessed the progress being made implementing Link–16 in the Operational Flight Program (OFP) of the Hornet. Initial Operational Capability (IOC) for both the MIDS terminal and the F/A–18(E/F) Hornet is the year 2000.

AN/SLQ–20B. Completed Technical Evaluation (TECHEVAL), a major step toward production and operational use by the U.S. Fleet.

Multi-Link Display System (MLDS)

The Multi-Link Display System (MLDS) was certified for interoperable use in Link–11 (TADIL–A) operations. Certification was awarded after completing testing of MLDS Version 5.0 software using the Data Terminal Set Simulator and the Multiple Unit Test and Operational Training System. (See feature article in Calendar Year 1996 Highlights section above.)

Multimodal Watchstation

The Multimodal Watchstation project will research and develop the human-computer interface and watchstation for the Surface Combatant 21st Century Program (SC 21). The Multimodal Watchstation will combine flat-panel and virtual displays, 3-D audio, multiple PC components, and workload management systems, including intelligent aiding. A 15M, 4-year effort, it will support warfighter cognitive, visual, decision, and ergonomic needs in new, innovative ways. The project will culminate in Fleet usability tests in FY 99 and FY 00, with full connectivity to the Aegis ADS MK6+ weapons systems and SC 21 ADCON 21 network by FY 01. NRaD will take a lead role in the project conducted at four Navy laboratories.

Real-Time Information Transfer and Technology (RITN)

This project continued to integrate advanced technologies in the area of simulation infrastructure and networking, specifically to increase the throughput and efficiency in using WANs to provide a scaleable solution in support of large distributed simulation exercises.

RedStorm (Opposing Forces (OPFOR))

This project began in early 1996 and has been an effort to combine the computer-generated forces (Synthetic Forces) for each service's Opposing Forces. Specifically, it has also had the requirement to improve the Opposing Force's behaviors using realistic data from the Opposing Force's region in coordination with the Defense Intelligence Agency and its supporting service intelligence centers and to generate additional platforms relevant to the OPFOR region, including some neutral platforms. Development is underway and initial efforts have been demonstrated.

Scalable HPC Environment for C^{4}I (SHEC)

The Scalable HPC Environment for C^{4}I (SHEC) program is a DDR&E-funded HPCMP-CHSSI program that provides scalable solutions using HPCMP HPC computers for existing C^{4}I systems such as GCCS and JMCIS. The project includes development of a Scalable, Parallel, Concurrent, and Distributed (SPCD) segment for job control and management and parallelization of an existing GCCS segment.

CY 96 accomplishments included the following:

Developed the Project Implementation Plan (PIP) and Software Development Plan (SDP) for SHEC's Scalable, Parallel, Concurrent, Distributed (SPCD) segment.

Software Engineering for C^3

The Infostructures Technologies project is examining alternative methods for constructing systems from components. Project research examined Common Object Request Broker Architecture (CORBA) component wrapper methods that can be used to build C^3 systems. A Technology Research and Development Project (TRDP) is being initiated with the French Ministry of Defense for the construction of a software development infrastructure. The Infostructure Technologies project will experiment with alternative tool integration methods for populating the infostructure with tools needed for an actual project. Integration methods applied will include CORBA and Java techniques. During FY 96, additional work was taken on to evaluate CMS–2 to Ada translators.

CY 96 accomplishments included the following:

- Three technical reports were published: "Software Reuse for C^3 Domain Using Common Object Request Broker Architecture (CORBA)," Bradshaw, NRaD, TN 1771, Apr. 1996; "Technical Report Study/Services for Software Reuse through CORBA," SofTech, Oct. 1996; and "CMS–2 to Ada Translator Evaluation Plan," Chiara, Mumm, Riegle, Aug. 1996.

- Completed initial French Technology Research and Development Project (TRDP) planning.
- Successfully completed two CORBA integration demonstrations.

Synthetic Force Express (SF Express)

This project began in early 1996 to integrate advanced technologies in the areas of scaleable parallel processing for Synthetic Force simulation, specifically aimed at increasing the number of simulation entities and interactions that can occur during a large distributed simulation exercise, and the further evolving of the technologies of the RITN project. Development of a scaleable simulation architecture continues.

Synthetic Theater of War (STOW)

This project continued to integrate and test all of the Synthetic Force work developed above with the Synthetic Forces and Synthetic Environments developed across the country and in the United Kingdom. STOW Engineering Demonstration #1 was completed in October 1995 as a Joint service distributed simulation demonstration. It tested the advancement in technology of the Army, Navy (FastFleet), Marine Corps (LeatherNet), and Air Force Synthetic Forces behaviors with environmental effects, the first representation of command decision-making behaviors (Command Forces), and the use of dynamic multicasting for network scaleability (RITN). STOW tests continue as a series of combined tests (CTs) aimed at further integration and test of new and advanced technologies in support of the STOW 1997 Advanced Concept Technology Demonstration (ACTD).

Tactical Advanced Computer (TAC)

The Tactical Advanced Computer (TAC) Office mission is to provide the most customer-friendly method of acquiring COTS Information Technology for the Navy, Marine Corps, and Coast Guard.

CY 96 accomplishments included the following:

- The establishment of 12 Blanket Purchase Agreements (BPAs) for COTS information technology for notebooks, PCs, workstations, and servers, including all associated hardware, software, and services.
- Awarded the Hammer Award for saving the government $6M+ in less than a year by establishing innovative purchasing procedures for COTS information technology for the Navy, Marine Corps, Coast Guard, and other Department of Defense activities.

Virtual Collaboratory (VCL)

The VCL will be a distributed, object-oriented, collaborative development and planning environment based on a Joint Common Operating Environment that will allow information and applications to be effectively stored and retrieved for execution. It will be a flexible, scaleable virtual site that will be on-call to scientists and engineers to conduct experiments utilizing geographically dispersed hardware and/or personnel through the unclassified World Wide Web or through private, secure LANs.

CY 96 accomplishments included the following:

- Established audio/video/shared whiteboard connection between NRL and NRaD using various televiewing technologies.
- Established the initial VCL distributed collaborative planning and repository capability at NRaD and NRL
- Specified the initial Common Operating Environment (COE), developed requirements and methodology for VCL demonstration
- Initiated the development of the VCL Prototype with the environments of Air Operations and multi-project management.

Communications

Advanced Technology Demonstration (ATD) AEM/S

The Advanced Technology Demonstration (ATD) AEM/S achieved its AEM/S Milestone. USS *Arthur W. Radford* (DD 968) was successfully tested by Norfolk Shipboard Electronic System Evaluation Facilities (SESEF). The SESEF collects azimuth patterns of all radiating shipboard systems and these data form the baseline performance reference for the AEM/S System. The AEM/S System will replace the aft mast of *Radford* with an all-composite antenna enclosure.

Automated Communication Management System (ACMS)

The objective of Automated Communication Management System (ACMS) program is to provide an integrated planning system for the Milstar EHF SATCOM communication system. Using an open and distributed workstation architecture, ACMS will support the apportionment, allocation, and configuration of satellite payload resources and the definition and distribution of EHF terminal databases.

The ACMS program will follow an "evolutionary/incremental" approach. Build 1 includes all of the Milstar planning capabilities. Build 2 integrates in the UHF Follow-On/E (UFO/E) and advanced EHF planning functions. Build 1 consists of four "incremental" products, the last two of which are released to the users.

NRaD was tasked by the Air Force Space and Missile Command to perform as the prime item developer of the ACMS. This tasking includes system engineering, software requirements analysis, design and implementation, and software testing for the ACMS.

FY 96 accomplishments included the following:

Automated Communications Management System (ACMS). Demonstrated ACMS to representatives of the Military Strategic-Tactical and Relay (MILSTAR) Operations Center (MOC) and Satellite System Operational Management Organization (SOMO); the Joint Technology/Tactical Program Office (JTPO); and the U.S. Army and their support contractors. The network capability includes Secured Telephone Units, Third Generation (STU-IIIs), and Network Encryption Systems (NES) over the Internet Protocol (IP) net.

Battle Force HF E-Mail

The Battle Force HF E-Mail project completed a series of briefings, installations, trials, and demonstrations including: California Army National; HF Subcommittee of Federal Telecommunications Subcommittee Commander, Naval Air

Forces, U.S. Pacific Fleet (COMNAVAIRPAC)/Commander, Naval Surface Force, U.S. Pacific Fleet (COMNAVSURFPAC) Communications Conference; USAF C^4 Agency; Lincoln Battle Group to Nimitz Battle Group; four Australian Navy warships; USS *Kidd* (DDG 993); and U.S. Army's 110th Battalion. Four HF E-Mail fixed site gateways are now in operation across the country, each equipped with automatic link establishment radio equipment and Internet access using the NRaD Battle Force E-Mail protocol.

BMDO ATM Track Fusion Demonstration

The Ballistic Missile Defense Office (BMDO) Asynchronous Transfer Mode (ATM) Track Fusion Demonstration participated (Joint U.S./Australian team) in the first launch coverage of the BMDO ATM Track Fusion Demonstration. The Innovative Science and Technology Experimentation Facility (ISTEF) optical mount control computer successfully received a "First Motion" signal, notification that the rocket had left the rail, which then began driving the mount on a preprogrammed trajectory. The operator provided manual updates to the nominal trajectory and the mount successfully tracked the rocket for approximately 300+ seconds, over 160 seconds beyond post-second stage burnout.

Common Operational Modeling, Planning, and Simulation Strategy (COMPASS)

COMPASS is an approach that brings distributed collaborative planning and modeling and simulation services to a wide range of C^4I systems, providing interoperability among incompatible systems. COMPASS middleware facilitates DCP by providing session management, shared overlays, mission preview/ rehearsal, shared whiteboard, and video teleconferencing.

The Common Operational Modeling, Planning, and Simulation Strategy (COMPASS) project successfully participated in the Joint Chiefs of Staff sponsored Joint Warrior Interoperability Demonstration (JWID). The COMPASS project showcased distributed collaborative planning services and access to distributed modeling and simulation (M&S) resources. COMPASS allowed operational planners at all sites to develop joint plans in every warfare area in collaborative sessions and then assess, rehearse, and refine those plans using a variety of models and simulations. (See feature article in Calendar Year 1996 Highlights section above.) The project received approval from the director of the Space Warfare Center (SWC) for installation of three COMPASS-capable systems at the National Test Facility, Falcon AFB, Colorado Springs, CO. The project also received approval for including COMPASS middleware as a Mission Planning Module within the fielded version of TAMPS.

Electromagnetics Technologies

The Electromagnetics Technologies program develops communications and related technologies such as Soldier 911, a system that provides border alert warning for aviators, and the Universal Radar Moving Target Transponder

(URMTT), which generates over-the-air radar targets for most radars, including frequency-hopping radars.

Universal Radar Moving-Target Transponder (URMTT). NRaD completed milestone testing of URMTT. A major technological breakthrough for radar transponders, URMTT is a powerful radar test system useful for many other applications such as training, deception, and information warfare. (See feature article in Calendar Year 1996 Highlights section above.)

Soldier 911. NRaD installed, tested, and demonstrated the Soldier 911 system in Korea. The Soldier 911 Korea system was demonstrated using both the line-of-sight (LOS) and Satellite Communication (SATCOM) modes. The Korea system is a version of the Defense Advanced Research Projects Agency (DARPA) Soldier 911 hand-held Global Positioning System (GPS) Search and Rescue radio built by Motorola. The Korea version has both SATCOM and ultra-high frequency, LOS data links with up to 36 users networked together. (See feature article in Calendar Year 1996 Highlights section above.)

Electro-Optical Propagation Assessment In Coastal Environments (EOPACE)

Electro-Optical Propagation Assessment in Coastal Environments (EOPACE) is an ONR-sponsored effort that includes international participation to better understand environmental effects on electro-optical systems operating within a coastal region. EOPACE field-measurement exercises were conducted in April and November 1996, with transmission points at the Naval Submarine Base, the Naval Amphibious Base, the Imperial Beach Pier, the Scripps Pier, and the tip of Point Loma. Specialized instruments were used to gather data from aircraft, boat, and buoys as well as from the land sites. Emphasis was placed on low-level infrared (IR) transmission over the ocean and air mass characterization for background aerosol. Results of this work will aid the Fleet units operating in coastal regions to determine the standoff ranges at which they can detect and/or track sophisticated anti-ship weaponry. (See feature article in Calendar Year 1996 Highlights section above.)

Integration of C^{4}I Systems

Integration of C^{4}I Systems program objectives are to develop and integrate the Submarine Message Buffer and Navy EHF Communication Controller, the Baseband Switch, JMCIS, JTIDS, and Link–11 into the SCSS architecture.

Communication Support Systems (CSS)

The Communications Support System (CSS) is a communication architecture that enhances battle force communications connectivity, flexibility, and survivability through multimedia access and media-sharing.

FY 96 accomplishments included the following:

Communication Support Systems (CSS). Demonstrated a significant operational improvement to modern maritime networking, bringing the U.S. Fleet "on-line" to the information superhighway during JWID 95. CSS will phase out the existing Navy "stovepipe" networks and provide seamless interoperable voice, video, and data services to allow the U.S. Fleet to communicate over the expansive commercial and Defense Switched Network (DSN) anytime, anywhere.

Navy EHF Communication Controller (NECC)

The Navy EHF Communication Controller (NECC) is the initial implementation of the CSS. NECC is a sophisticated communications server that will be used to transfer information between ships and between ship and shore installations. The NECC uses satellite connectivity to support tactical data exchange system requirements of the Tactical Data Processors (TDPs).

NRaD's objective is to provide the Fleet with the capability to use Navy EHF Satellite Program (NESP) terminals for tactical communications in an automated network environment. In particular, this program is to provide reliable, internetted communication services for the TDP users. Multimedia access, making use of multiple EHF and UHF SATCOM resources, will be supported.

FY 96 accomplishments included the following:

Navy EHF Communications Controller. Successfully passed the THEODORE ROOSEVELT BATTLE GROUP system Integration Test (BGSIT). Installation and checkout of the NECC in USS *ANNAPOLIS* (SSN 760) was successfully completed.

NATO Interoperable Submarine Broadcast System (NISBS)

To provide NATO Standard Agreement (STANAG) 5030 compatibility, VERDIN developed the NATO Interoperable Submarine Broadcast System (NISBS). This PC-based system intercepts the VERDIN baseband signal and replaces one or all channels with STANAG 5030-compatible channels. VERDIN is a VLF/LF communications system designated the AN/URC–62. It provides one, two, or four channels of encrypted information employing Minimum Shift Keying (MSK) modulation.

FY 96 accomplishments included the following:

NATO Interoperable Submarine Broadcast System (NISBS). Successfully tested the Standard Configuration.

Local-Area Networks/Wide-Area Networks

The Local-Area Networks (LANs)/Wide-Area Networks (WANs) program develops LANs and WANs technology and architecture to provide high-data-rate connectivity between ashore an afloat locations. The program also develops prototypes to standardize and facilitate sharing of information.

FY 96 accomplishments included the following:

USS *Blue Ridge* (LCC 19) LAN Upgrade. Completed the installation, testing, and crew training of the USS *Blue Ridge* (LCC 19) LAN upgrade. The new LAN includes a Fiber-optic Distributed Data Interface (FDDI) backbone network with seven Ethernet hubs and provides service to approximately 165 workstations. The entire project, including design and hardware procurements, was completed in less than 5 months.

Radio Propagation Over Terrain (RPOT)

Radio Propagation Over Terrain (RPOT) was developed as an interim capability to compute and display radar propagation effects over water, across coastlines, and over varying terrain in range-dependent refractive environments for both land-based and sea-based radars. RPOT is a Microsoft® Windows 95 software suite developed by NRaD Code D883 (Tropospheric Branch) to assess atmospheric effects on electromagnetic systems operating in the band nominally from 100 MHz to 20 GHz. RPOT was fielded to Commander, Sixth Fleet (COMSIXTHFLT) under the Naval Technology Insertion Program and was quickly recommended for further distribution by SPAWAR PMW–185 as an interim capability for the Tactical Environmental Support System Next Century [TESS(NC)]. It was distributed Fleet-wide in September 1996, completing concept through development to the Fleet in FY 96. The Chief of Naval Research cited RPOT as one its Blue Book success stories for its support of the Bosnia mission.

Submarine HDR SATCOM

The Sub HDR Satellite Communications program completed requirements through the first SPAWAR streamlined major acquisition program . (See feature article in Calendar Year 1996 Highlights section above.)

Unified Endeavor (UE–96–1)

Unified Endeavor (UE–96–1). Successfully completed UE–96–1 at the Joint Training Analysis Simulation Center (JTASC) in Norfolk, VA. NRaD supported this 7-day exercise by deploying approximately 700 individual network connections spanning three levels of security and two-dozen unique client server architectures that included many C^4I systems. Over 250 PCs were configured, tested, and installed in seven major wargaming areas. Following the exercise, all equipment was returned to its pre-exercise configuration with 0% downtime on all systems.

Intelligence, Surveillance, and Reconnaissance

Advanced Deployable System (ADS)

The Advanced Deployable System (ADS) program is developing a rapidly deployable surveillance capability for regional conflict scenarios. ADS will function in shallow as well as deep ocean environments. Design of the architecture will be such that the systems will be modular and components interchangeable to allow rapid configuration to accommodate the environment, life requirement, and scenario as threat situations develop.

The underwater segment of the ADS program completed a rigorous system requirements review (SRR) during the last week of January 1996. An integrated product process development (PPD) approach was instituted and an accelerated technical program review schedule was planned. The SRR was the first of a series of program reviews that, with the use of integrated product teams, are intended to develop and field a system at a quicker pace than Navy acquisition programs of the past. (See feature article in Calendar Year 1996 Highlights section above.)

All-Optical Deployable System (AODS)

On 1 May 1996, a team from NRaD and NRL successfully deployed and operated the All-Optical Deployable System (AODS) 14 kilometers from NRaD's Point Loma complex. AODS uses optical sources to interrogate arrays of optical hydrophones to sense the acoustic energy in the ocean. The AODS was cabled to NRaD's tidepool complex, where data were collected and processed for 18 days of AODS testing and the joint NRaD, NRL, and Scripps Marine Physical Laboratory (MPL) SWellEx–96 test. (See feature article in Calendar Year 1996 Highlights section above.)

Bottom-Limited Active Classification (BLAC)

The objective of the Bottom-Limited Active Classification (BLAC) project is to develop and demonstrate environmentally adaptive techniques to extend low-frequency active surveillance into bottom-limited and littoral environments.

During CY 96, a high-performance testbed was completed on the Intel Paragon that allowed testing active adaptive beamforming and classification algorithms within a system context and with sufficient quantities of real-world data to make a statistically meaningful conclusion regarding the potential benefits of these new algorithms within the framework of a full sonar system under a variety of environmental conditions. The Active LFM Mixer Adaptive (ALMA) beamformer (U.S. Patent 5,532,700, "Preprocessor and Adaptive Beamformer for Active Signals of Arbitrary Waveform," J. C. Lockwood, 2 July 1996) was shown to provide a 2- to 3-dB gain in detectability with no significant degradation to classification performance.

Compact Low-Frequency Active Transmit System (CLTS)

NRaD provided technical support during the design and testing of a next-generation LFA transducer technology. This new generation is an inverse flextensional transducer that uses a Terfenol–D electrostrictive driver. The transducer's performance is such that the LTS acoustic performance criteria can be achieved with an array of sources that weigh half of those used in the current technology. NRaD's electroacoustic modeling capability was used to improve first-generation transducer design by implementing a velocity-control methodology.

NRaD also provided technical and modeling support during the design and testing of two alternate CLFA technologies. These alternate technologies are PZT-driven slotted cylinder and PMN-driven flextensional projectors. Scale-size prototypes are currently being manufactured and will be tested during the fourth quarter of FY 97.

Counter Sniper Program

(See feature article in Calendar Year 1996 Highlights section above.)

Multistatic ASW Capabilities Enhancement (MACE)

NRaD provides acoustic modeling and simulation support for MACE system concept development and performance assessments; develops a high-fidelity end-to-end acoustic modeling and simulation capability for the MACE program; and provide technical support to the Office of Naval Research for the development, testing, and evaluation of this autonomous acoustic source.

NRaD developed a source array testbed for the MACE program. This testbed will be used for validation of projected acoustic performance criteria during a FY 98 at-sea test. The testbed consists of a 10-element array of flextensional projectors, power amplifiers, and a signal generation capability that supports spatial and temporal shading of waveforms.

NRaD also provide technical expertise during the evaluation of submitted proposals and evaluated transducer and system performance criteria.

Marine Mammal Acoustic Tracking System (MMATS)

The Marine Mammal Acoustic Tracking System (MMATS) provides on-site data collection of the northern right whale mitigations.

FY 96 accomplishments included the following:

Marine Mammal Acoustic Tracking System (MMATS). Successfully completed on-site data collection of the northern right whale mitigation exercise at

Jacksonville Beach, FL. A total of 13 acoustic sightings were made using MMATS, and a significant collection of infrared sightings were made using a shipboard infrared detection system. MMATS demonstrated the Navy's capability to successfully detect the northern right whale in Navy port areas, resulting in marine mammal mitigation and wide public awareness of the Navy being environmentally responsible.

Mobile Undersea Warfare System, System Upgrade (MIUW–SU)

The objective of the Mobile Undersea Warfare System, System Upgrade (MIUW–SU) program is to upgrade existing MIUW vans by adding remote sensors, enhanced C^4, upgraded acoustic processing, and electronic support measures (ESM). NRaD provides comprehensive systems engineering and software development and support throughout the production and post-delivery phases of the program. During CY 96, three upgraded vans, Portable Sensors Platforms, and Mobile Sensor Platforms were delivered to the Fleet. A logistics program was implemented to provide ISEA services, including depot support, field technical assist visits, and operations and maintenance training. Production and integration on four additional systems for scheduled delivery in CY 97.

Missile Test and Readiness Equipment (MTRE)

NRaD successfully completed the final phase of the MTRE/Fire Control integration testing at the Lockheed Martin Defense Systems (LMDS) Advanced Development facility. The NRaD-developed MTRE software is now ready for initial installation at the Trident Training Facility (TTF), Atlanta, Georgia; to be followed by installation onboard the first Trident II submarine.

Non-acoustic Distributed Sensor Components (NADSC) Project

NRaD successfully completed testing of the Non-acoustic Distributed Sensor Components project acoustic/electromagnetic array at the Dabob Bay test range. Significant "firsts" include 13 runs of phase synchronized acoustic and electromagnetic source tows and 17 runs of acoustic and electromagnetic measurements on a diesel electric submarine. The shore processing system worked very well, providing detections and three-dimensional target tracks in real time.

Predator Unmanned Aerial Vehicle/SSN/Special Forces Operations

NRaD successfully completed a demonstration of the interoperability between an Unmanned Aerial Vehicle (UAV) and an SSN submarine. As part of this demonstration, the control and guidance of a Predator UAV was handed off to an SSN in flight. The UAV was then used as an eyeball in the sky by the submarine crew to aid in the coordination of a Special Operations Forces across-the-beach attack. All feedback received from the Joint Project Office indicates that the demonstration was conducted flawlessly.

Standard Tactical Receive Equipment Display 1995 (S–TRED*95)

The Standard Tactical Receive Equipment Display 1995 (S–TRED*95) passed Operational Readiness Testing (ORT). Using the facilities and equipment at NRaD's Tactical Systems Laboratory (TSL), three TSL personnel along with two military operators successfully completed Phase 2 of the ORT process for S–TRED*95. The ORT process was conducted in two phases: Phase 1, which examined the functionality of the new software, and Phase 2, regression testing to ensure modifications made after Phase 1 were correct and did not degrade overall system functionality.

Tomahawk Inflight Position Reporting System (TIPRS)

NRaD completed successful test flight. TIPRS successfully flew on Tomahawk OTL–190. The mission flew from a launch in the Gulf of Mexico into Eglin AFB, Florida. Transmissions from additional transmitters were received by the two NRaD-developed Tomahawk Receiver Units (TRU) at CINCPAC, Camp Smith, Hawaii. The transmitted data were successfully forwarded to Washington, DC, in real time. Performance was close to 100% on one channel and approximately 30% on the second (alternate) channel used by the system. This performance exceeds the real time performance specifications of the TRU.

Multipurpose Surveillance and Security Mission Platform (MSSMP)

NRaD successfully completed test demonstrations. The MSSMP consists of an NRaD-developed sensor package integrated into the Sikorsky Cypher UAV. The MSSMP was demonstrated to interested law enforcement agencies at the U.S. Army Military Police School, Ft. McClellan, Alabama. The test was a phenomenal success. Not only did the aircraft, software, and sensors work well in a simulated counter-drug operation, NRaD also demonstrated two NRaD-developed sensor packages operating simultaneously with two control units over the same radio network.

Project Spinnaker: Iceshelf–96

The objectives of the Project Spinnaker program are to develop and deploy lightweight low-power, low-cost ocean surveillance or sensor array systems. Such technology provides quick, covert, affordable, and rapidly deployable ocean surveillance/sensor capability. The immediate goal of Project Spinnaker is the deployment of arrays in the Arctic. Project Spinnaker is a joint U.S./Canada program. The U.S. (NRaD Code D881, Acoustic Branch) developed the array, node, and fiber-optic components; Canada developed autonomous undersea vehicle fiber-optic trunk cable deployment. The Iceshelf series includes Spinnaker field tests and experiments.

FY 96 accomplishments included the following:

Iceshelf–96. Completed Phase 1. Iceshelf–96 is the arctic on-ice deployment phase of Project Spinnaker, a joint U.S./Canada effort to deploy lightweight low-power, low-cost acoustic arrays in the arctic ocean. The Theseus vehicle successfully returned to the launch point after deploying the fiber-optic trunk cable to the first array site.

Iceshelf–96. Completed a successful under-ice deployment of a complex acoustic array and 180 km of small single-fiber cable in arctic water. Two-way communication (data and commands) over the long fiber-optic link were made by the use of low-loss, temperature-stable Polarization Independent Narrow Channel Wavelength Division Multiplexors (PINC WDMs) operating in the low-attenuation 1550-nanometer band. Both the steel-tubed, fiber-optic cable, and the PINC WDMs were developed by ONR's Distributed Surveillance Technology Project at NRaD.

Shallow-Water Environmental Cell Experiment–96 (SWELLEX–96)

NRaD completed SWELLEX–96, which involved several NRaD codes, NRL, Scripps MPL, and many support contractors. Primary sponsors were ONR, NRL, SPAWAR, and NAVSEA. Acoustic arrays used included the All-Optical Distributed System (NRaD/NRL), Satellite-Linked Vertical Line Array (NRL), Scripps Vertical Line Array (VLA – MPL), and Scripps Tilted Vertical Line Array (MPL). MPL's vertically anchored research platform, FLIP, served as experiment hub. (See feature article in Calendar Year 1996 Highlights section above.)

Ultra-Lightweight Sensor System (ULITE)

NRaD successfully completed an in-water test of an ultra-lightweight sensor system at the mouth of San Diego harbor to quantify system noise, cross-talk, and throughput performance in a quasi-operational environment. This field test was the first field verification of ULITE's feasibility as a low-power surveillance system. The electro-optic node operated with a new 3.3 V analog-to-digital (A/D) converter and programmable logic device (PLD), yielding a node power consumption of roughly 35 mW, about a factor of five better than the original system goal. The array dynamic range was adequate for the noisy test environment, with clipping seen only during periods when vessels passed directly overhead the array. The time-division, analog multiplexing scheme was also successfully verified.

Ocean Engineering

Mobile Detection Assessment And Response System (MDARS)

The objective of the Mobile Detection Assessment and Response System (MDARS) project is to develop and implement an automated intrusion detection and inventory assessment capability for use in DoD warehouses and storage sites. MDARS will provide multiple robotic platforms that perform random patrols in interior and exterior warehouse and storage site environments. The project will develop the Multiple Robot Host Architecture (MRHA), which will control and coordinate many autonomous robotic platforms.

MDARS completed Technical Feasibility Testing and began preparing for Early User Appraisal.

Multipurpose Surveillance and Security Mission Platform (MSSMP)

The objective of the Multipurpose Surveillance and Security Mission Platform (MSSMP) project is to design, develop, and demonstrate an air mobile system that will provide a distributed network of remote sensing packages and control stations to provide a rapidly deployable, extended-range surveillance capability for a wide variety of security operations and other tactical missions.

The MSSMP system was demonstrated at the Military Operations in Urban Terrain (MOUT) facility at Ft. Benning, Georgia, and in a counter-drug demonstration at the U.S. Army Military Police School, Ft. McClelland, Alabama. These tests were a phenomenal success, demonstrating system utility in counter-drug and MOUT environments as a surveillance platform. The evaluations also demonstrated the operation of two sensor packages over the same radio network, as well as the ability to carry and use additional payloads, such as a communications relay emplaced on a rooftop, an unattended sensor, a laser range finder/target designator and a non-lethal gas dispersant.

USS *DOLPHIN*

The deep-diving submarine USS *Dolphin* is unique, both in equipment and capability. NAVSEA PMS–395 has tasked NRaD with providing engineering support to this vessel to ensure that equipment repairs and refurbishment meet the special needs of deep submergence work.

FY 96 accomplishments included the following:

USS *Dolphin* Projects. Received recognition from Submarine Development Group ONE for successful search and location of the sunken Navy ship, USS

Agerholm (DD 826). *Dolphin's* employment of sophisticated sensors, particularly the recently installed High-Resolution Electronic Imaging Undersea System (HELIUS), during near-bottom operations at depths to 2600 feet were critical to the success of this operation. Location of this ship was necessary to evaluate the ecological impact of sunken ships in an effort to lift restrictions on future sinking exercises necessary for Navy training, research, development, and test operations. *Dolphin* employed an HF E-Mail System developed by NRaD to transmit near real-time images of the *Agerholm.*

Navigation

Global Positioning System (GPS)

The Global Positioning System (GPS) program provides accurate, continuous, worldwide, three-dimensional position and velocity and precise time to all DoD users through development and applications engineering of the GPS user equipment for Navy aircraft, surface ships, and submarines. The program manages, directs, and/or coordinates other participating activities and industry in support of the Joint Service Program as the Navy's lead laboratory in GPS user equipment.

FY 96 accomplishments included the following:

GPS. Completed GPS laboratory evaluation of the E-Systems and Wilcox Cat IIIb Differential GPS (DGPS) automatic landing systems for the Federal Aviation Administration (FAA). The testing demonstrated that both systems could provide repeatable accuracies of 10 to 15 cm under simulated landing approach conditions. Received Team Excellence Award. (See Calendar Year 1996 Highlights section above.)

GPS Inertial Navigation Assembly (GINA)

NRaD successfully completed carrier qualification tests during Commander, Operational Test and Evaluation Force's (COMOPTEVOR's) Operational Assessment of the T–45A aircraft's Cockpit 21 modification testing. GINA is an 0.8-nmi/hr ring laser gyro navigator with an embedded single board GPS receiver.

Navigation Services

NRaD completed several navigation installations: completed AN/WRN–6 installation on U.S. Coast Guard Ship USCGC *Munro*; completed interface cabling on USS *Fahrion* (FFG–22); installed and trained the crew aboard the USS *Boxer* (LH–4) for integrated AN/KSQ–1 and Position Location Reporting Systems (PLRS).

Position Location Reporting System/Enhanced PLRS

(See Calendar Year 1996 Highlights section above.)

Marine Mammals

Marine Mammal Systems (MMS)

The objectives of the Marine Mammal Systems (MMS) include the following: develop, produce, and support operational Fleet MMS for object detection, location, marking and recovery missions; enhance MMS for SW/VSW (MCM), develop improved methods for care and maintenance of marine mammals and to predict performance on long-term deployments to a variety of environments; support efforts in determining impact of Navy tests and operations on marine mammals in the wild; and conduct research in biosonar.

FY 96 accomplishments included the following:

Fleet MK 4 and MK 7 MMS MRCI. The Fleet MK 4 and MK 7 MMS successfully completed Mission Readiness Certification Inspections (MRCI). The MK 4 MMS is a moored mine-hunting system and the MK 7 MMS is an ocean-bottom mine-hunting system. These mine-hunting systems demonstrated their ability to meet operational specifications in mine detection, marking, and search rates. This is the first MRCI for the MK 67 MMSA that included buried mines. The MRCI is conducted every 2 years for the Fleet MMS to verify their availability as warfighters. NRaD supports the Fleet systems readiness with Technical Representatives for animal and personnel training, replenishment animals and hardware, and technical and logistic support.

The MK 7 MMS located a missing pallet of "live" rocket launchers. The pallet of ordnance was lost during the transport between two ships by helicopter off the coast of Camp Pendleton, CA. Search efforts by other Navy assets were unable to locate the pallet. MK 7 MMS quickly adapted to the new target (pallet versus mines) and located the pallet in 80 feet of water. The pallet and ordnance were recovered successfully.

JTFEX 96. The EX 8 MMS participated in the JTFEX 96 that was conducted off the coast of Camp Pendleton, CA. EX 8 MMS is the marine mammal detachment of the newly formed Very Shallow Water Test Detachment that is undergoing mine-hunting feasibility demonstrations. The feasibility demonstrations are being conducted by joint NRaD and military personnel. EX 8 MMS is scheduled to become an NRaD acquisition category (ACAT) IV program in FY 98.

Demonstration of Exercise Mine Recovery. A joint Fleet and NRaD team of MK 5 MMS sea lions, personnel, and equipment participated in a Naval Air Force, Pacific Fleet, feasibility demonstration of exercise mine recovery at San

Clemente Island, CA, in January 1996. Other recovery systems had been tried at the San Clemente Island range but were too costly and too long to complete the recovery of mines. The MK 5 MMS demonstrated it could recover exercise mines dropped from Navy aircraft at San Clemente Island quickly and cost effectively. Four additional mine-recovery operations were conducted successfully by MK 5 MMS in 1996. Because of the success of MK 5 MMS, the operational air squadrons practice range has been moved from Santa Rosa Island, CA, to San Clemente Island, CA.

MK 5 MMS Replenishment Program. The MK 5 MMS replenishment program at NRaD achieved a milestone by demonstrating a sea lion mine recovery at a depth of 1000 feet. This enhancement doubled the current capability and allows the potential expansion of practice ranges.

Electronic Sciences and Technology

Optoelectronic RF Switch

NRaD fabricated the first optoelectronic RF switch using a sub-micron (0.15 um) Indium Phosphide (InP) high-electron mobility transistor (HEMT). This experiment demonstrated the technological feasibility on a patented optoelectronic (OE) switch concept, based on photovoltaic control of a tuned Field Effect Transistor (PV–FET), using a mmWave InP HEMT. The test results have shown high performance in several key parameters and substantial improvement (factor of 2) on the device capacitance and device on-resistance over the current InP Junction Field Effect Transistor (JFET) approach. This effort will determine the possible advantage of using InP HEMTs in the OE switch circuits.

Trident Missile

The NRaD Trident Missile program provides navigation and fire-control support for Trident missile programs.

FY 96 accomplishments included the following:

Trident D5 Missile Program. Fabricated wafers for Trident program and demonstrated promising results. Wafers from the first lot of 1k ferroelectric, non-volatile memory readout circuits processed at Battery Ashburn showed a 33% yield. These circuits were made using NRaD's Ultra-Thin Silicon-on-Sapphire (UTSOS) technology. After testing and die removal at NRaD, the circuits were bump-bonded to ferroelectric capacitors made at Raytheon. The completed modules that showed functionality retained 85% correct read-out after 1000 seconds of retention and power-down. Non-destructive read-out (NDRO) operation was maintained to at least 1 million read cycles. These memory modules, which occupy less than half of a cubic centimeter of space, will eventually replace a plated wire memory in the Trident missile that occupies about a cubic foot.

Environmental Assessment

NRaD develops marine environmental risk assessment and remediation technology, and through its Marine Environmental Support Office, provides direct support for aquatic environmental issues to the Fleet and to Navy shore facilities.

QWIKLITE

NRaD installed the third QWIKLITE bioluminescence toxicity system at Norfolk Naval Shipyard. The QWIKLITE system will be used by Norfolk laboratory personnel to test outfall discharges from the shipyard. With QWIKLITE units installed at several locations, the QWIKLITE program is now in a position to conduct comparative interlaboratory testing using Environmental Protection Agency (EPA)-approved methodologies and QWIKLITE. EPA approval of QWIKLITE as an alternate toxicity test methodology is being sought on the basis of in-house use and cost savings.

Shipboard Solid Waste Discharge Project

NRaD participated in field tests to assess the wake dispersion characteristics of a shipboard pulper system installed on the USS *Vandergrift* (FFG 48). The RV *Acoustic Explorer*, outfitted with fluorescence sensors and a high-volume sampling system, was used to follow the frigate while it discharged fluorescent dye and paper from its pulper system. The tests included the measurement platform following the frigate at various separation distances in a variety of configurations to determine the mass dispersion as a function of distance behind the vessel. An initial assessment of the data supports previous results from modeling and smaller scale field efforts.

Site Characterization and Analysis Penetrometer System (SCAPS)

The objective of the Site Characterization and Analysis Penetrometer System (SCAPS) program is to develop and deploy a fiber-optic-based, laser-induced fluorescence sensor for petroleum, oil, lubricant (POL) contaminants for rapid assessment of hazardous waste sites at reduced costs.

SCAPS is a tri-service technology effort led by the U.S. Army. Initial integration of a fiber-optic-based laser induced florescence sensor for POC contaminants into a standard geotechnic cone penetrometer was a collaborative effort with U.S. Army Waterways Experiment Station (WES) and NRaD. Technical success has generated high sponsor interest for rapid maturation and introduction of the technology to POL contaminated hazardous waste sites. Acquisition and dual-use of SCAPS for continued technological development and regulatory acceptance and preliminary site characterization as a strategy has been adopted.

FY 96 accomplishments included the following:

Site Characterization and Analysis Penetrometer System (SCAPS). Participated in several high-level events surrounding Earth Day celebrations in April 1996. SCAPS is a mobile platform for deploying environmental sensors to locate and characterize hydrocarbon contamination in soil.

SCAPS. Two of four sites at Naval Radio Receiver Facility, Imperial Beach were recommended for case closure by San Diego County Department of Environmental Health officials based on SCAPS data. The County letter represents a significant step in regulatory acceptance of laser-induced fluorescence technology as implemented by NRaD aboard SCAPS.

SCAPS. Participated in Earth Day 1996. (See Calendar Year 1996 Highlights section above.)

Fleet Support and In-Service Engineering

NRaD Activity Pacific

NRaD Activity Pacific continued to provide electronic systems engineering support to Navy and Marine Corps and Joint Service component forces in the Western Pacific and Indian Oceans. Support included long-range planning, design, installation, platform integration, end-to-end testing, analysis, evaluation and validation, training, and life-cycle technical guidance and assistance for ship and shore C^4I. Specific accomplishments included the following.

AFCEA Asia-Pacific Conference and Exposition. Established a display booth to highlight NRaD's ability to integrate state-of-the-art technologies with legacy systems in a cost-effective manner. A 112-kps ISDN line was installed to connect the display booth to an internal LAN. Several different operating systems (Windows NT, WIN95, and WFWG) were run in a remote LAN environment. In addition, a firewall was set up to demonstrate ADP system security.

Air Force Command and Control Networking LAN (AFC^2N LAN). Successfully installed and networked a Top Secret router-based system for subscribers to any Air Force WWMMCCS Host. These systems were installed for over 60 Army, Navy, and Air Force sites in Hawaii, Alaska, Korea, Japan, and Guam. This project took 2 1/2 years and was completed in July 1996.

AUTOMATED AN/FRM–19. Successfully completed the hardware and software upgrades of all the AUTOMATED AN/FRM–19 Test Systems worldwide. The hardware upgrades included a Pentium computer, a 15-inch monitor, and a millivoltmeter. The software upgrades included additional programs such as the Task Scheduler, TDR test, Store Signal Test, and Total Power test. NRaD ACT PAC is the In-Service Engineering Agent (ISEA) for this automated test system.

Automated Network Control Center (ANCC). Provided direct technical assistance in response to casualty report (CASREP) to successfully resolve switching problems at the ANCC NCTAMS EASTPAC. The CASREP involved uncontrolled switching of the MTRX–100 and MTRX–200 switches controlling critical Common User Digital Information Exchange (CUDIXS) and Fleet broadcast circuits running through NCTAMS EASTPAC's Technical Control Facility.

Communications/C⁴I Systems. Successfully removed, upgraded, and reinstalled all Communications/C⁴I systems in the newly renovated Joint Intelligence Center (JIC) for COMSEVENTHFLT. Installation and checkout were completed in time to immediately support exercise TEMPO BRAVE that commenced the day after the installation.

COMNAVSECGRU Relocation. Relocated all mission supports from NCTAMS EASTPAC to NSGA Kunia, Hawaii. Due to the complexity of the project it was divided into two phases. Phase I was the actual relocation, and Phase II was an upgrade of Army technical control equipment to Navy equipment. The task involved the installation and checkout of various types of multiplexers, modems, terminals, and cryptographic equipment, and ADP communication systems such as OPINTEL, MUSIC, and TACINTEL. Engineers installed over 50 equipment cabinets and 100 patch panels.

Electromagnetic Radiation Hazard Surveys. Completed on-site instrumented electromagnetic radiation hazard surveys to ensure that safety and compatibility guidelines were met at NAF Atsugi, NRTF Totsuka, NAVRADSTA Jim Creek and for RSTER at PMRF, and 15 other sites.

Information Technology 21st Century (IT21). Implemented the expansion of COMSEVENTHFLT's worldwide area network (WAN) to Theater Network Initiatives (TNI) to support Task Force Commanders utilizing mostly COTS hardware and software. This effort was then expanded to Global Network Initiatives (GNI), which is now known as Information Transfer for the 21st Century (IT21).

INFOSEC. Installed firewalls throughout the Pacific, including CINCPACFLT, COMNAVAIRPAC, COMNAVSURFPAC, NCTAMS EASTPAC, PMRF, and NCTSFE in Yokosuka, Japan. Firewalls are used to protect Navy ADP systems attached to the Internet from external threats. The firewall forms a barrier between the outside Internet and the internal Command Network. All traffic between the external Internet and the internal protected network must pass through the firewall.

Joint Worldwide Intelligence Communications Systems (JWICS). Completed installation, test, and checkout for Joint Worldwide Intelligence Communications Systems (JWICS) at JICPAC, Camp Smith, and Fort Shafter. These engineering efforts included site preparation for the JWICS equipment suites and working with CINCPAC J2 and Defense Intelligence Agency personnel to activate fractional trunks on-island and to WESTPAC JWICS sites. In addition, engineering support was provided in testing and checking out JWICS trunks at Camp Courtney, Okinawa.

NRaD Facility Guam Humanitarian Efforts. (See Calendar Year 1996 Highlights section above.)

Pacific Missile Range Facility (PMRF). Provided Network Security Engineering Support to PMRF Barking Sands, Kauai. Designed and installed a complete video teleconferencing (VTC) studio for PMRF providing VTC capability to commands within the Pacific Area.

USS *Independence* (CV 62) Direct Fleet Support. Responded to an immediate request for assistance to correct USS *Independence* Secret NT server that was connected to the GNI SPRNET during the middle of RIMPAC 96. There were no backup tapes to get the server working onboard. Within hours, an engineer from NRaD, Japan built up a new NT server for USS *Independence*, flew to Hawaii, arrived aboard USS *Independence*, and successfully reinstalled the server and brought back communication.

Worldwide Area Network (WAN). Successfully designed, installed and tested a classified WAN for the FBI to connect their headquarters in Washington, DC, with Atlanta, Georgia, for the Summer Olympics. After successful completion of this effort, this classified WAN was used to cover the Republican National Convention in San Diego and the Democratic National Convention in Chicago.

Ship Electronic Equipment Upgrades

(See Calendar Year 1996 Highlights section above.)

SHF SATCOM

The Super High-Frequency (SHF) Satellite Communication (SATCOM) System provides high-data-rate communication services to Naval vessels via the Defense Satellite Communication System (DSCS) satellite constellation. The satellite links are terminated at Navy Control and Telecommunications Area Master Stations (NCTAMS). AN/WSC–6 (V)4 systems were installed on five ships. Antenna system upgrades were accomplished on eight additional ships. NRaD also prepared and offered three courses to the Fleet Technical Service Center (FTSC) and ships personnel to supplement their knowledge of SHF SATCOM maintenance requirements.

EHF SATCOM

AN/USC–38(V)

CY 96 accomplishments included the following:

AWG. Chaired the Antenna Working Group (AWG) to resolve current LDR antenna issues and work closely with SPAWAR on MDR specifications, shipboard installation issues, and requirements.

AN/USC–38(V) Waveguide Component. Completed the design of a new AN/USC–38(V) waveguide component that will be used in fast-attack submarine installations.

EHF ISEA Laboratory. Completed the transfer of the EHF ISEA laboratory from Vallejo, California. With two operational AN/USC–38(V) terminals, it is an excellent test bed to support in-service, as well as research and development needs.

Optical Blockage Surveys. Completed 15 optical blockage surveys to determine the precise antenna foundation locations and blockage locations. These measurements were subsequently used to produce Adaptation data tapes that will ensure uninterrupted connectivity to the communications satellites.

NECC. The Navy EHF Communications Controller (NECC) or C–12509/USC–38(V) is the newest addition to the NESP communications suite. It allows the members of a battle group to conduct netted simulcast data exchange between each other. This drastically reduces the time needed to get Tomahawk targeting information to the warfighter. As the ISEA for both the AN/USC–38(V) and C–12509/USC–38(V) NRaD procured and installed this new capability on four ships, and provided on-the-job training (OJT) to their crews

AN/USC–38(V) Equipment Groups. Performed Pre-Installation Testing and Check-Out (PITCO) of 12 AN/USC–38(V) equipment groups prior to their installation on ships.

AN/USC–38(V) Installations. Completed three AN/USC–38(V) installations on Pacific Fleet ships. Additionally, performed 12 System Operational Verification Tests (SOVT) to accept installations performed by other activities.

UHF SATCOM

NRaD managed system development and implementation on a variety of communication systems. As In-Service Engineering Agent for most UHF communication systems such as the AN/WSC–3(V), OE–82(V), WSC–1(V), INMARSAT, AN/WSC–5(V), and AN/SSR–1A, Code D60 engineers and technicians routinely initiate and implement innovative engineering, management, and logistic solutions that are vital to the Fleet.

Legacy Systems (AN/WSC–3, OE–82, AN/WSC–5, AN–SSR–1, TD–1271)

CY 96 accomplishments included the following:

- Provided technical advice to the Field Change Implementation Program's (FCIP) installation of the Constant Key Alarm Field Change in the Fleet.
- Engineered and participated in the development of a field change to allow all SATCOM WSC–3 radio sets to operate on the 5-kHz downlink frequency offset from 73.1 MHz.
- Completed the development of training material required to conduct the SATCOM SELF SUSTAINABILITY SURVEY, an Intensive Equipment Groom and personnel training sessions that will be held onboard Fleet units.

- Provided, installed WSC–3 assets to support the JTIDS Range Extension Program during "Operation Roving Sands 96" in El Paso, TX.
- Developed a 1A1A9A1 daughter board for an engineering study that was requested by SPAWAR PMW 173. The ECP was approved and a prototype will be delivered to NUSC New London for further testing by the submarine community. This modification prevents operators from inadvertently keying the radio and damaging the AN/BRA–34 Submarine Antenna System.
- Developed the Field Change Bulletin to be used to install the Constant Key Alarm circuitry to all SATCOM WSC–3 radio sets.
- Provided ISEA and logistic support as well as life-cycle equipment management for all systems.
- Completed the engineering evaluation of the lightweight antenna and made plans to test them in-house

INMARSAT

CY 96 accomplishments included the following:

- Developed INMARSAT Technical Manual, completed the User's Logistics System Summary (ULSS), and completed four INMARSAT–M systems installation.
- Mini-DAMA/5-kHz Initiatives
- Performed Engineering studies to support 5-kHz/SLICE initiatives.
- FMS Support
- Provided engineering support, SATCOM equipment, and installation plans for the government of New Zealand to install SATCOM capabilities on the HMNZS. We installed a SATCOM Vinson communications circuit for a ship from the United Arabs Emirate Navy.
- Assembled and shipped six Modified Transmit Signal Characteristics (MTSC) for a FMS Netherlands project.
- Provided technical support and Engineering proposals to support SATCOM systems for France, United Kingdom, New Zealand, and other FMS programs.

Installations

- Completed four WSC–3 and 10 Dual-DAMA installations on Navy ships.
- Completed Expeditionary Warfare Demonstration Systems installations on three ships.

Automated Communications IXS

Tactical Intelligence (TACINTEL)

The Tactical Intelligence (TACINTEL) II+ Program provides Tactical Special Intelligence (SI) communications for Navy Operational Commanders. Its primary role is to exchange time sensitive encrypted sensor data and SI record message delivery between ships and shore commands. TACINTEL II+ is the SI Community's gateway to Joint Maritime Communications System (JMCOMS)/ Advanced Digital Network System (ADNS). Program accomplishments in CY 96 included the following:

- Completed 45 TACINTEL II+ Subscriber Upgrade (TSU) installations for Phase 1 of the TACINTEL II+ Program. This included AGF–11, MCS–12, 10 DDs, 17 CG/CGNs, 5 CV/CVNs, 7 LHA/LHD/LPDs, 3 TAGOS ships and COMUSNAVCENT Bahrain. Phase 1 upgrades the TACINTEL shipboard subscriber from a UYK–20 to a TAC–3 and VMEC.
- Published the original issue of the TACINTEL Subscriber Subsystem AN/USQ–124(V)3 Technical Manual.
- Published an updated version of the TACINTEL Information Exchange Subsystem Link Control Facility (TLCF) AN/USQ–124(V)1 Technical Manual.
- Completed integration, testing, and shipment of AN/USQ–124(V)3 TACINTEL II equipment for SCN ships, USS *DONALD COOK* (DDG–75) and USS *HARRY S. TRUMAN* (CVN–75).
- Published the original issue of the Carry-On TACINTEL Subscriber Subsystem Installation Guide. This handbook provides general information pertaining to the installation, verification and removal of the Carry-On TACINTEL Subscriber Subsystem. Carry-On TACINTEL is a portable, lightweight, tactical message processing subsystem conceived as a temporary rapid deployment asset for use onboard U.S. Navy ships that are not equipped with the AN/USQ–69(V)5 or AN/USQ–124(V)3 TACINTEL Subscriber Subsystems. Carry-On TACINTEL is designed to utilize existing UHF satellite communications systems without the need for special preparations or changes to the ship's physical or material configuration.
- Our Joint Integrated Communications Facility (JICF) hosted a TACINTEL II+ pre-TECHEVAL assessment. Eleven TACINTEL Subscriber Upgrade MVME–162 (TSU–162) shipboard-based workstations were installed and operational. Five of them (one instructor and four student) were installed in the Computer-Based Training (CBT) room of the JICF. For the TACINTEL II+ Build 1 Pre-TECHEVAL software testing, four workstations were installed, one functioned as an upgraded Shore TACINTEL Link Control Facility (TLCF) suite, the other two were "stand-alone" workstations for software support purposes. Two separate TACINTEL networks were operational in the JICF, one for TACINTEL Build 1 software testing and the other for associated training in the CBT room. All systems were trunked to the JICF COMSEC, DAMA, satellite radios, and 70-MHz IF satellite simulators. This arrangement allowed us to conduct live on-air and simulated satellite-delayed off-air testing, in either DAMA or non-DAMA modes.
- Completed an independent Government evaluation of the TACINTEL II+ Build 1 (Software Releases 36, 41 and 55) in the JICF in preparation for TECHEVAL. Stress testing began by using a satellite simulator and

concluded with over-the-air (OTA) testing 2 days later. Over 42,000 messages were processed by the system during the OTA testing.

- Completed TACINTEL II+ Phase 2, Build 1, Operator and Maintenance training classes in the JICF in preparation for TECHEVAL. Students in attendance included personnel from the USS *John C. Stennis* (CVN 74), USS *Kearsarge* (LHD 3), USS *Normandy* (CG 60), NSGA Northwest, OPTEVFOR, and the Naval Technical Training Center Corry Station.
- Completed Level III software lead site testing support for the Royal Navy at Digby, England 19 September 1996 in support of the Royal Navy Link Control Facility (RNLCF) relocation program.
- Completed the TACINTEL II+ Phase 2, Build 1 backfit installations on USS *John C. Stennis* (CVN 74), USS *Kearsarge* (LHD 3) and USS *Normandy* (CG 60) for TECHEVAL on 24 November 1996.
- Completed the relocation of NSGA Naples' TLCF equipment to Building 440 in Capodichino, Italy.

Common User Digital Information Exchange Subsystem (CUDIXS)

The Common User Digital Information Exchange Subsystem (CUDIXS) delivers GENSER message traffic to all U.S. Navy surface ships, Coast Guard, and Allied nations via UHF SATCOM. Significant program accomplishments in CY 96 include:

- Published the final CUDIXS II Technical Manual.
- Completed relocation of CUDIXS equipment at NCTAMS EASTPAC in support of Defense Message System (DMS) equipment installations.
- Participated in the Configuration Control Board for CUDIXS Release 11.0. Release 11.0 primarily implements changes required to operate with NAVCOMPARS II.

Submarine Satellite Information Exchange Subsystem (SSIXS)

The Submarine Satellite Information Exchange Subsystem (SSIXS) delivers GENSER & SI message traffic to U.S. and allied submarines via UHF SATCOM. During CY 96 we completed SCSI disk-drive upgrades at COMSUBGRU–7 in Yokosuka, Japan; COMSUBGRU–8 in Naples, Italy; COMSUBGRU–9 in Bangor, WA; COMSUBGRU–10 in Kings Bay, GA; COMSUBPAC in Pearl Harbor, HI; and FTC in Norfolk, VA.

Joint Deployable Information Support System (JDISS)

The Joint Deployable Information Support System (JDISS) provides hardware and software capabilities to allow connectivity and interoperability between intelligence systems. Program accomplishments in CY 96 included: completed JDISS terminal and software installations on three Navy ships; completed JDISS retrofits on two ships; and completed JDISS terminal installations and testing in support of NRTI on the USS *LEYTE GULF* (CG 55) and the USS *VELLA GULF* (CG 72).

Tactical IXS

Advanced Communications Display System (ACDS)

CY 96 accomplishments included the following:

- Accomplished installation of ACDS Command Table on USS *Eisenhower* and USS *Wasp*. The ACDS transfers displays from other command systems to one central table.

Automated Network Control Center (ANCC)

CY 96 accomplishments included the following:

- Accomplished installation of a new microwave system to link NAVCOMMSTA Stockton and the Naval Transmitting Radio Facility Dixon. This system replaced an obsolete microwave system that could no longer be supported. The new microwave system increased the reliability and quality of communications, and allowed for improved transfer/control of audio/digital information via ANCC.
- Replaced DMSI Redundant Matrix Switch Assembly (RMSA) 4000 with a RMSA 500 at NAVCOMMSTA Stockton. This action yielded cost savings by using the appropriately sized RMSA there and using the RMSA 4000 in a facility requiring a larger RMSA.

Battle Group Information Exchange System (BGIXS I)

CY 96 accomplishments included the following:

- Completed an installation of the Battle Group Information Exchange System (BGIXS I) on the USS *Coronado*.
- Installed the Battle Group Information Exchange System II (BGIXS II) on 10 ships. BGIXS II transfers tactical information and image files between submarines and surface vessels.
- Provided five technical assists to the fleet on BGIXS II operation and equipment.

U.S. Agency For International Development (USAID) Very Small Aperture Terminal (VSAT) Network

NRaD supported the U.S. Agency For International Development (USAID) Very Small Aperture Terminal (VSAT) Network. The USAID VSAT Network provides data connectivity among USAID headquarters and USAID missions worldwide. The Fleet Engineering Department installed equipment for the Indian Ocean Region hub and tested its corresponding satellite transponders. Specifically, we installed two VSAT systems and commissioned 13 sites in the Indian Ocean Region satellite, and redirected and commissioned VSAT systems at two sites from the Atlantic Region satellite to the Indian Ocean Region satellite. We also increased network data capacity via the Atlantic Region satellite. Finally, we provided on-site technical support at five sites, distributed spares to remote sites worldwide, and initiated procurement of additional spares.

NRaD also installed VSAT TVRO digital receivers at 29 sites in Europe and Turkey in support of the U.S. Information Agency (USIA). The VSAT TVRO network receives USIA Worldnet broadcast throughout their missions worldwide.

Other Accomplishments

Established the Defense Message System (DMS) Service center at NRaD, San Diego, CA. This is the single ordering point for DMS products on the Lockheed contract for the Navy and U.S. Coast Guard.

Accomplished an EHF/Mission Data Update (MDU) via the Generic Front-End Communications Processor (GFCP) aboard the USS *John Young*, USS *Carl Vinson*, USS *Coronado*, USS *Shiloh*, USS *Independence,* USS *Hewitt*, USS *Mobile Bay*, USS *Blue Ridge*, and USS *Eisenhower.*

Designed and installed a Secure Briefing system for the USS *Tarawa* using COTS equipment to replace an unsupported system previously installed. The entire project, from design to installation and ckeckout, took less than 2 months.

Installed a Bathymetric 2000 (B2K) System on the USCGC Polar Sea. The B2K is a three-dimensional mapping system used by the U.S. Geological Service.

Fleet Information Technologies Support

Naval Modular Automated Communications System (NAVMACS)

The Fleet Engineering Department installed the Naval Modular Automated Communications System (NAVMACS) on four ships. The AN/SYQ–7(V), or NAVMACS family of equipment, is designed for shipboard use. It provides reliable message processing using automatic processing and management of record message traffic. NAVMACS II is the Navy's choice for tactical DMS implementation. The NAVMACS II design employs COTS equipment that uses reduced instruction set computer (RISC) microprocessor technology with processing speeds in excess of 77 MIPS. The NAVMACS II uses a modular, open-system architecture design. It provides 16 full-duplex variable speed, high-data-rate circuit and high-capacity storage to meet today's demand for high-volume message exchange. The Graphical User Interface (GUI) streamlines operator training with click menu options and windows.

Low-Level Communications Conversion

We installed the Low-Level Communications Conversion on two ships. The Low-Level Communications Conversion provides enhanced capabilities to the existing shipboard communications suites. The Red and Black Multi-Function Low-Level Teletype Patch Panel System consists of several SB–4124C/WSC low-level patch panels connected to the teletype and computer data systems. The system is connected to all HF Receivers, Teletype Converters, Teletype Data Cryptographic Equipment and the QUAD DAMA, SHF, EHF, and FCC–100 interfaces. The remote spaces served include the Metrology Office (METRO), Supplemental Plotting (SUPPLOT), and the Ship's Signals Exploitation Space (SSES).

Navy Order Wire (NOW)

The Navy Order Wire (NOW) system was installed on three ships. NOW is a teleprinter replacement system for teletype orderwires. NOW Release 4.0 is capable of interfacing up to four full-duplex circuits to one personal computer. NOW 4.0 combines the functions of NOW 3.0 and EHF NOW 3.11 into one product with additional enhancements to allow character for character data transmission with increased baud rates to 19.2 kbps.

Naval Tactical Command Support System (NTCSS)

Installed the Naval Tactical Command Support System (NTCSS) on five ships. NTCSS connects SNAP III and ATIS with a fiber-optic LAN. It replaces the Shipboard Non-Tactical Automated Data Processing (SNAP II) system. NTCSS is a non-tactical ADP system based on either the Desktop Tactical Computer (DTC–2), Tactical Advanced Computer (TAC–3) or (TAC–4) hardware, and COTS hardware, peripherals, and software. The system will support office automation applications and LAN operation applications. It consists of a Processor Group, Mass Storage Group, Intelligent Terminal (IT) Server Group, Basic Intelligent Workstations, and various peripherals.

Advanced Narrowband Digital Voice Terminal (ANDVT)

Installed the Advanced Narrowband Digital Voice Terminal (ANDVT) Tactical Terminal (TACTERM) AN/USC–43(V)1 on one ship. ANDVT provides narrowband Secure Voice capabilities for tactical military users in aircraft, ships, vehicles, and shelters.

System Telecommunications Engineer Manager-Base Level (Stem–B) Program

The System Telecommunications Engineer Manager-Base Level (Stem–B) Program is designed to assist with the design, costing, installation, maintenance, and training of Command, Control, Communications, Computers, and Intelligence (C^4I) systems throughout the Air Force. The program consists of many minor programs and several major programs such as: design, costing, and installation of the base Asynchronous Transfer Mode (ATM) network; the base telephone switching systems; installation and maintenance of the base's Defense Communications System (DMS); video teleconferencing (distance learning); and Combat Communications Control Center. The Fleet Engineering Department completed one installation for Holloman Air Force Base

Automated Technical Control (ATC)

The Automated Technical Control (ATC) shore communication facility is designed to be controlled remotely by computer. The system consists of Data-Comm Management MTRX switches controlling a mixture of high- and low-speed data communications circuits. ATC was installed at ATC, North Island, San Diego, CA; NAVCOMSTA, Stockton, CA; NAVCOMSTA, Dixon, CA; Fort Richardson, Anchorage, AK; and Elmendorf ABF, Anchorage, AK.

Command and Control Fleet Engineering

Received SPAWAR approval for three Engineering Change Proposals (ECPs) developed for the Combat DF system. The ECPs provide a COTS printer, replaces the AN/UYK–79 computer with a TAC–4 system, and adds Random Access Memory (RAM), and hard-drive capability.

Progressed with the design and development of the first Meteorological Mobile Facility (METMF) for the Marine Corp. The first production unit will be fielded in July 1997. METMF represents a significant design and integration effort. The system has been reduced from five vans to one van while retaining full capability. The new design is IT–21 and JMCIS 98 compatible.

Completing the design and hardware integration of the Command and Control Processor (C^2P) rehost for LINK–16. The new design replaces the AN/UYK–43 computer with a COTS computer. The first installation is scheduled for June 1997.

Completed the design of the LINK–16 Interactive Electronic Technical Systems manual. The project is now in the verification and validation stage. The IETM will be implemented in the Fleet in June 1997

Participated in a number of special exercises and demonstrations including ASCIET and BADD for the SH–60B and P–3 aircraft. Performed numerous LINK–16 installations this year, including nine AITs and FMS installations in Italy (shore site) and the first JDA DDG in Japan.

Implemented a semi-organic Interface Software Support Activity for JTIDS. We teamed with GEC Marconi to produce and field two new versions of the JTIDS terminal software.

Submitted engineering reviews for all major software and firmware components of the MIDS terminal. Participated in numerous critical design reviews, preliminary quality testing, and Integration Product Team meetings. Completed JMCIS, JMCIS–98, CTAPS, GCCS and LINK–11 Installations on numerous ships.

Life-Cycle Engineering Support

Assisted NAVSEA PMO450, the New Attack Submarine Program Office, in successfully completing Phase I of the Small Business Innovative Research (SBIR) project entitled VME Test Tools. The VME bus Test Tools SBIR efforts are being incorporated into the Acoustic Rapid COTS Insertion (ARCI) architecture and have led to teaming opportunities with private industry, and a commitment from Lockheed Martin to evaluate the tool for incorporation into the architecture for the New Attack Submarine. The VME Test Tools utilize vendor-supplied diagnostic routines to test auxiliary processor hardware, correlate results, and provide detailed fault isolation information similar to the way applications executing in a general purpose processor (GP) communicate with auxiliary processors. For this effort, D651 acted as the technical point of contact and provided program management support. In addition, D651 facilitated the transition from the Phase 1 to a Phase II by assisting in the review and selection of the SBIR Phase II proposal.

Established the AN/UYQ–70 User's Group. The forum was developed to provide an avenue for the exchange of information which overarch multiple platforms. It offers opportunities to share solutions across program lines. What started as a claimancy wide initiative, spread to include participants from the SYSCOMS, Warfare Centers, COMOPTEVFOR and private industry. In forming this group we provided a means to leverage future technology requirements that may be common among various users.

Supported SPAWAR 05L as they move from Washington, DC to San Diego, CA. We developed a 05L Homepage to expand SPAWARs business operations. D651 conducted an 05L Logistics Engineering Workshop to develop Logistics Assessment Metrics and Evaluation Tools.

Advanced Test Engineering Technology

Developed a Life-Cycle Support Plan for the AN/FSM–52(V) series test systems, completed the development of 15 Test Program Sets, and developed the Intermediate Maintenance Activity (IMA) Plan for the AN/WLQ–4 ESM System. They completed the AN/WLR–8(V) HPIR Depot Development Plan, and implemented the establishment of the AN/BQH–5 depot support capability.

Cryptographic and RADIAC Systems

Established an equipment pool of Ready-For-Issue units. This "Exchange Pool" has already proven to be very popular with the Fleet by making assets available to them immediately. It has had the additional benefit of improving internal shop operations. Currently, we are developing a computerized tracking system that will coordinate all Navy CRF operations throughout the world.

C^{4}I Systems Support

Developed depot support capability for the AN/UMK–3, AN/TPN–30, OE–82 antenna system, AN/TPS–73, and various SHF equipment. By creating a rotatable pool of spares we have reduced the time required to provide critical parts to the Fleet. We accomplished the first AN/WLR–8 overhaul without cutting a removal patch in the hull of the submarine, thereby reducing the cost and time required. We manufactured $2 million worth of equipment in support of NAVICP. Completed the repair/overhaul of over 8,000 items of equipment.

Engineering Services

We are the Navy Program Manager for Pathways for Continuous Improvement (PCI) which is sponsored by ONR's Manufacturing Technology Directorate. PCI was established to provide small and medium-sized manufacturing businesses with the integrated process tools necessary to modernize their facilities and become more competitive. The ultimate goal is a stronger industrial base. The PCI Program is currently being introduced both in the private sector and in the Navy.

Completed a task in support of U.S. Customs to acoustically determine the contents of 50-gallon drums. The technology provides U.S. Customs with a powerful weapon in the war on illegal drugs. Current methods require Drug Enforcement Administration (DEA) agents to don full chemical protection suits and a breathing apparatus before they unseal and sample each container. The new instrument verifies the contents of sealed liquid containers acoustically. The system accurately measures sound speed across the medium and compares it against a database of known profiles to make a "go/no go" recommendation, or to identify the chemicals inside the container. Field tests of the prototype were very successful and resulted in a decision to assemble five more for field testing by U.S. Customs and DEA agents.

Installation Activities

The Fleet Engineering Department, Code D60, performed over 400 C^4I systems installations on Navy ships and shore activities. Table 1 lists Code D60's installation activity during 1996.

Table 1. 1996 Installation Activity.

System Name	Unit Name	Hull ID	Installer
ACDS/JMCIS Interface			
	USS *KITTY HAWK*	CV 63	NRaD_D611
ADNS			
	AIC NORFOLK	N/A	NRaD_D631
	USS *NASSAU*	LHA 4	NRaD_D631
USS *THEODORE ROOSEVELT*		CVN 71	NRaD_D631
AMCS			
USS *PAUL HAMILTON*		DDG 60	NRaD_D633
	USS *RUSSELL*	DDG 59	NRaD_D633
AN/ARC–182			
	ACU1 LCU 1616	LCU 1616	NRaD_D611
	ACU1 LCU 1666	LCU 1666	NRaD_D611
AN/FCC–100(V)2 REPL			
USS *CONSTELLATION*		CV 64	NRaD_D611
AN/GRC–211			
	USS *RENTZ*	FFG 46	NRaD_D611
	USS *RUSHMORE*	LSD 47	NRaD_D611
AN/SQQ–33A SACCS			
USS *ABRAHAM LINCOLN*		CVN 72	NRaD_D611
AN/SXQ–8 emulator			
	USS *TARAWA*	LHA 1	NRaD_D632
AN/UMK–3 X-Windows UPG			
	USS *NASSAU*	LHA 4	NRaD_D643
AN/URQ–23			
	USS *GARY*	FFG 51	NRaD_D611
	USS *RENTZ*	FFG 46	NRaD_D611
AN/URT–23E UPG			
	USS *KITTY HAWK*	CV 63	NRaD_D611
AN/USC–38 EHF SATCOM SYS1			
USS *BELLEAU WOOD*		LHA 3	NRaD_D622
	USS *BLUE RIDGE*	LCC 19	NRaD_D622
	USS *BOXER*	LHD 4	NRaD_D622
	USS *ESSEX*	LHD 2	NRaD_D622
	USS *NASSAU*	LHA 4	NRaD_D622
AN/USC–43(V)1 ANDVT PHASE II			
USS *CHANCELLORSVILLE*		CG 62	NRaD_D611
USS *VALLEY FORGE*		CG 50	NRaD_D611

Table 1. 1996 Installation Activity. (Continued)

System Name	Unit Name	Hull ID	Installer
USS *LAKE CHAMPLAIN*		CG 57	NRaD_D611
AN/USQ–125(V)4 LINK 11			
	USS *BOXER*	LHD 4	NRaD_D611
	USS *CONSTELLATION*	CV 64	NRaD_D645
	USS *CORONADO*	AGF 11	NRaD_D611
	USS *CUSHING*	DD 985	
	USS *ESSEX*	LHD 2	NRaD_D611
USS *JOHN PAUL JONES*		DDG 53	NRaD_D645
	USS *MERRILL*	DD 976	NRaD_D645
	USS *SHILOH*	CG 67	NRaD_D611
	USS *TARAWA*	LHA 1	NRaD_D611
	USS *VALLEY FORGE*	CG 50	NRaD_D611
AN/USQ–125(V)4 LINK 11 DTS			
	USS *CHANDLER*	DDG 996	NRaD_D611
AN/USQ–64 UHF SAT			
	USS *GUARDIAN*	MCM 5	NRaD_D623
	USS *PATRIOT*	MCM 7	NRaD_D623
AN/VRC–46 ANT			
	USS *CORONADO*	AGF 11	NRaD_D611
AN/WSC–3 #6			
	USS *CONSTELLATION*	CV 64	NRaD_D623
AN/WSC–3 SAT #6 & #7			
	USS *VALLEY FORGE*	CG 50	NRaD_D623
AN/WSC–6(V)4 SHF			
	USS *BOXER*	LHD 4	NRaD_D621
	USS *INCHON*	MCS 12	NRaD_D621
USS *JOHN F KENNEDY*		CV 67	NRaD_D621
	USS *NASSAU*	LHA 4	NRaD_D621
	USS *PELELIU*	LHA 5	NRaD_D621
	USS *SAIPAN*	LHA 2	NRaD_D621
ANDVT ECP–60			
	ACU5 LCAC79	LCAC79	NRaD_D611
HQ COMMCEN CG DIST 11		N/A	NRaD_D611
	MIUWU VAN #103	VAN103	NRaD_D611
	MIUWU VAN #105	VAN105	NRaD_D611
	MIUWU VAN #113	VAN113	NRaD_D611
NSWC DIV PORT HUENEME		N/A	NRaD_D611

Table 1. 1996 Installation Activity. (Continued)

System Name	Unit Name	Hull ID	Installer
	USCGS ACUSHMENT	WMEC 167	NRaD_D611
	USCGS EDISTO	WPB 1313	NRaD_D611
	USCGS LONG ISLAND	WPB 1342	NRaD_D611
	USCGS SAPELO	WPB 1314	NRaD_D611
	USNS ASSERTIVE	TAGOS9	NRaD_D611
	USNS VICTORIOUS	TAGOS19	NRaD_D611
USS *JEFFERSON CITY*		SSN 759	NRaD_D611
	USS *JOHN S MCCAIN*	DDG 56	NRaD_D611
	USS *LA JOLLA*	SSN 701	NRaD_D611
	USS *SAFEGUARD*	ARS 50	NRaD_D611
BAS			
	USS *CORONADO*	AGF 11	NRaD_D611
BATHYMETRIC SYS			
	USCGS POLAR SEA	WAGB 11	NRaD_D632
BDCS			
	USS *CONSTELLATION*	CV 64	NRaD_D623
BF E-MAIL			
	USS *CLEVELAND*	LPD 7	NRaD_D611
	USS *ESSEX*	LHD 2	NRaD_D611
	USS *HARPERS FERRY*	LSD 49	NRaD_D611
	USS *RAINIER*	AOE 7	NRaD_D623
BGIXS II			
	USS *BOXER*	LHD 4	NRaD_D632
	USS *CONSTELLATION*	CV 64	NRaD_D632
	USS *CUSHING*	DD 985	NRaD_D632
	USS *ESSEX*	LHD 2	NRaD_D632
	USS *HELENA*	SSN 725	NRaD_D632
	USS *KEY WEST*	SSN 722	NRaD_D632
	USS *KITTY HAWK*	CV 63	NRaD_D632
	USS *MERRILL*	DD 976	NRaD_D632
USS *SALT LAKE CITY*		SSN 716	NRaD_D632
	USS *SANTA FE*	SSN 763	NRaD_D632
C-Band SHF Com. SATCOM			
	USS *BELLEAU WOOD*	LHA 3	NRaD_D621
C^2P for non-DTB CV/CVN			
USS *DWIGHT D EISENHOWER*		CVN 69	NRaD_D643
C^2P SOFTWARE UPGRADE			

Table 1. 1996 Installation Activity. (Continued)

System Name	Unit Name	Hull ID	Installer
	USS *CHOSIN*	CG 65	NRaD_D64
	USS *LAKE ERIE*	CG 70	NRaD_D64
Camera Upgrade			
	USCGS POLAR SEA	WAGB 11	NRaD_D632
CSS			
	USS *COWPENS*	CG 63	NRaD_D611
	USS *KITTY HAWK*	CV 63	NRaD_D611
CTAPS (Cross-Deck)			
	USS *BOXER*	LHD 4	NRaD_D645
	USS *ESSEX*	LHD 2	NRaD_D611
CTAPS HOST (VER 5.2)			
	USS *CONSTELLATION*	CV 64	NRaD_D645
CTAPS REMOTE (VER 5.2)			
	USS *TARAWA*	LHA 1	NRaD_D611
DAMA UPG/OTCIXS			
	USS *ARDENT*	MCM 12	NRaD_D623
	USS *CHIEF*	MCM 14	NRaD_D623
	USS *GLADIATOR*	MCM 11	NRaD_D623
	USS *GUARDIAN*	MCM 5	NRaD_D623
	USS *PATRIOT*	MCM 7	NRaD_D623
DEFINITY 75			
	USS *BLUE RIDGE*	LCC 19	NRaD_D633
DISCONE CAGE ANTENNA RPL			
	USS *OGDEN*	LPD 5	NRaD_D611
DUAL DAMA			
	USS *OGDEN*	LPD 5	NRaD_D623
E09 S/W UPGRADE FOR EHF SATCOM			
	USS *ANTIETAM*	CG 54	NRaD_D622
	USS *CHOSIN*	CG 65	NRaD_D622
	USS *CONSTELLATION*	CV 64	NRaD_D622
	USS *COWPENS*	CG 63	NRaD_D622
	USS *ESSEX*	LHD 2	NRaD_D622
	USS *KITTY HAWK*	CV 63	NRaD_D622
	USS *LAKE ERIE*	CG 70	NRaD_D622
USS *SALT LAKE CITY*		SSN 716	NRaD_D622
	USS *SANTA FE*	SSN 763	NRaD_D622

Table 1. 1996 Installation Activity. (Continued)

System Name	Unit Name	Hull ID	Installer
EHF CONSCAN Motor			
	USS *BOXER*	LHD 4	NRaD_D622
	USS *CORONADO*	AGF 11	NRaD_D622
EHF SATCOM			
	USS *CHOSIN*	CG 65	NRaD_D622
USS JOHN PAUL JONES		DDG 53	NRaD_D622
	USS *LAKE ERIE*	CG 70	NRaD_D622
	USS *PAUL F FOSTER*	DD 964	NRaD_D622
EHF SATCOM – MDU AER			
	USS *CORONADO*	AGF 11	NRaD_D632
	USS *INDEPENDENCE*	CV 62	NRaD_D632
EHF UFO Jumpers			
	USS *BOXER*	LHD 4	NRaD_D622
	USS *CORONADO*	AGF 11	NRaD_D622
EHF Waveguide Cover			
	USS *BELLEAU WOOD*	LHA 3	NRaD_D622
	USS *BOXER*	LHD 4	NRaD_D622
EXCOMMS Assess & Repair			
	USS *CORONADO*	AGF 11	NRaD_D611
FCIP			
			NRaD_D612
	SSC, NTC	N/A	NRaD_D612
	USCGS ACTIVE	WMEC 618	NRaD_D612
	USCGS ALERT	WMEC 63	NRaD_D612
	USCGS BOUTWELL	WHEC 719	NRaD_D612
	USCGS GENTIAN	WLB 290	NRaD_D612
	USCGS LE GARE	WMEC 912	NRaD_D612
	USCGS MELLON	WHEC 717	NRaD_D612
	USCGS MIDGETT	WHEC 726	NRaD_D612
	USCGS POLAR SEA	WAGB 11	NRaD_D612
	USCGS POLAR STAR	WAGB 10	NRaD_D612
	USCGS SHERMAN	WHEC 720	NRaD_D612
	USCGS STEADFAST	WMEC 62	NRaD_D612
	USNS RAPPAHANNOCK	TAO204	NRaD_D612
	USNS SIOUX	TATF171	NRaD_D612
	USS *ASHEVILLE*	SSN 758	NRaD_D612
	USS *BENFOLD*	DDG 65	NRaD_D612

Table 1. 1996 Installation Activity. (Continued)

System Name	Unit Name	Hull ID	Installer
	USS *CARL VINSON*	CVN 70	NRaD_D612
	USS *CAVALLA*	SSN 684	NRaD_D612
USS *CHANCELLORSVILLE*		CG 62	NRaD_D612
	USS *CHICAGO*	SSN 721	NRaD_D612
	USS *CHOSIN*	CG 65	NRaD_D645
	USS *CORONADO*	AGF 11	NRaD_D612
	USS *CURTIS WILBUR*	DDG 54	NRaD_D612
	USS *CUSHING*	DD 985	NRaD_D612
	USS *DENVER*	LPD 9	NRaD_D612
	USS *DUBUQUE*	LPD 8	NRaD_D612
	USS *ELLIOT*	DD 967	NRaD_D612
	USS *FITZGERALD*	DDG 62	NRaD_D612
	USS *FORT FISHER*	LSD 40	NRaD_D624
	USS *HAWKBILL*	SSN 666	NRaD_D612
	USS *HELENA*	SSN 725	NRaD_D645
	USS *HUE CITY*	CG 66	NRaD_D612
	USS *INGRAHAM*	FFG 61	NRaD_D612
	USS *JARRETT*	FFG 33	NRaD_D612
USS *JEFFERSON CITY*		SSN 759	NRaD_D612
USS *JOHN PAUL JONES*		DDG 53	NRaD_D612
USS *JOHN PAUL JONES*		DDG 53	NRaD_D612
	USS *JOHN YOUNG*	DD 973	NRaD_D612
	USS *KAMEHAMEHA*	SSN 642	NRaD_D612
	USS *KEY WEST*	SSN 722	NRaD_D645
	USS *LA JOLLA*	SSN 701	NRaD_D612
	USS *LAKE ERIE*	CG 70	NRaD_D612
	USS *MCKEE*	AS 41	NRaD_D612
	USS *MERRILL*	DD 976	NRaD_D612
	USS *MOUNT HOOD*	AE 29	NRaD_D612
	USS *MOUNT VERNON*	LSD 39	NRaD_D612
	USS *OGDEN*	LPD 5	NRaD_D612
	USS *OLENDORF*	DD 972	NRaD_D612
	USS *OLYMPIA*	SSN 717	NRaD_D612
	USS *PAUL HAMILTON*	DDG 60	NRaD_D612
	USS *POGY*	SSN 647	NRaD_D612
	USS *PRINCETON*	CG 59	NRaD_D612
	USS *RENTZ*	FFG 46	NRaD_D612

Table 1. 1996 Installation Activity. (Continued)

System Name	Unit Name	Hull ID	Installer
	USS *RUSSELL*	DDG 59	NRaD_D612
	USS *SACRAMENTO*	AOE 1	NRaD_D612
	USS *SANTA FE*	SSN 763	NRaD_D612
	USS *SCOUT*	MCM 8	NRaD_D612
	USS *SHASTA*	AE 33	NRaD_D612
	USS *SIDES*	FFG 14	NRaD_D612
	USS *VANDEGRIFT*	FFG 48	NRaD_D612
	USS *WADSWORTH*	FFG 9	NRaD_D612
Fiber Optic LAN Upgrade			
	USS *RENTZ*	FFG 46	NRaD_D632
GCCS (Global Command & Control System)			
	USS *BOXER*	LHD 4	NRaD_D611
	USS *CARL VINSON*	CVN 70	NRaD_D611
	USS *CORONADO*	AGF 11	NRaD_D611
	USS *ESSEX*	LHD 2	NRaD_D611
	USS *KITTY HAWK*	CV 63	NRaD_D611
	USS *NEW ORLEANS*	LPH 11	NRaD_D611
	USS *NIMITZ*	CVN 68	NRaD_D645
	USS *PELELIU*	LHA 5	NRaD_D611
	USS *TARAWA*	LHA 1	NRaD_D611
GFCP Upgrade			
	USS *CHOSIN*	CG 65	NRaD_D632
	USS *LAKE ERIE*	CG 70	NRaD_D632
Harris Modem RF–5710			
	USS *ANCHORAGE*	LSD 36	NRaD_D611
Hazeltine UHF SPR			
	USS *CLEVELAND*	LPD 7	NRaD_D623
	USS *ESSEX*	LHD 2	NRaD_D623
	USS *HARPERS FERRY*	LSD 49	NRaD_D623
HF Cable Harnesses			
	USS *ELLIOT*	DD 967	NRaD_D611
HF RADIO GROUP (HFRG) INSTALL			
USS *ABRAHAM LINCOLN*		CVN 72	NRaD_D611
	USS *PELELIU*	LHA 5	NRaD_D611
HF SPUN ALUM ANT			
	USS *PRINCETON*	CG 59	NRaD_D611

Table 1. 1996 Installation Activity. (Continued)

System Name	Unit Name	Hull ID	Installer
INMARSAT M			
	USS *ARDENT*	MCM 12	NRaD_D623
	USS *DEXTROUS*	MCM 13	NRaD_D623
IPRA			
	USS *THORN*	DD 988	NRaD_D641
IVCS 1,3,5–MC UPGRADE			
	USS *CONSTELLATION*	CV 64	NRaD_D633
	USS *CORONADO*	AGF 11	NRaD_D633
JDISS			
	USS *BOXER*	LHD 4	NRaD_D631
	USS *ESSEX*	LHD 2	NRaD_D631
	USS *INDEPENDENCE*	CV 62	NRaD_D631
USS *ABRAHAM LINCOLN*		CVN 72	NRaD_D631
	USS *NIMITZ*	CVN 68	NRaD_D631
JFACC / CTAPS HOST			
	USS *CARL VINSON*	CVN 70	NRaD_D611
JMCIS/JFCP			
	USS *KINKAID*	DD 965	NRaD_D611
JMCIS/NTCS–A 2.x			
	USS *FITZGERALD*	DDG 62	NRaD_D611
JTIDS			
USS *DWIGHT D EISENHOWER*		CVN 69	NRaD_D643
JTIDS FC–4			
	USS *ARKANSAS*	CGN 41	NRaD_D643
	USS *CALIFORNIA*	CGN 36	NRaD_D643
JTIDS MODEL 4 (3 ph install)			
USS *JOHN PAUL JONES*		DDG 53	NRaD_D643
JTIDS URN–25 FC–4 (rplc DCF)			
	USS *CARL VINSON*	CVN 70	NRaD_D643
JTIDS/C^2P			
	USS *CHOSIN*	CG 65	NRaD_D643
	USS *HUE CITY*	CG 66	NRaD_D643
	USS *KEARSARGE*	LHD 3	NRaD_D643
	USS *LAKE ERIE*	CG 70	NRaD_D643
	USS *MONTEREY*	CG 61	NRaD_D643
	USS *VELLA GULF*	CG 72	NRaD_D643
	USS *WASP*	LHD 1	NRaD_D643

Table 1. 1996 Installation Activity. (Continued)

System Name	Unit Name	Hull ID	Installer
LINK 16 NICP			
	USS *CONSTELLATION*	CV 64	NRaD_D643
	USS *KITTY HAWK*	CV 63	NRaD_D643
LINK 16 NICP / JTIDS FC4			
	USS *LAKE ERIE*	CG 70	NRaD_D643
	USS *SHILOH*	CG 67	NRaD_D643
	USS *VICKSBURG*	CG 69	NRaD_D643
Low-Level Conversion			
USS *ABRAHAM LINCOLN*		CVN 72	NRaD_D611
	USS *CARL VINSON*	CVN 70	NRaD_D611
LWCA			
	USNS *FLINT*	TAE32	NRaD_D611
	USS *BELLEAU WOOD*	LHA 3	NRaD_D611
	USS *CALIFORNIA*	CGN 36	NRaD_D611
	USS *FORT MCHENRY*	LSD 43	NRaD_D611
	USS *HARPERS FERRY*	LSD 49	NRaD_D611
	USS *LEFTWICH*	DD 984	NRaD_D611
USS *MAHLON S TISDALE*		FFG 27	NRaD_D611
LWCA IMPEDENCE MATCH			
	USS *CONSTELLATION*	CV 64	NRaD_D624
MCIXS			
	USS *HARPERS FERRY*	LSD 49	NRaD_D611
	USS *RAINIER*	AOE 7	NRaD_D623
	USS *REID*	FFG 30	NRaD_D611
USS *SALT LAKE CITY*		SSN 716	NRaD_D611
	USS *SANTA FE*	SSN 763	NRaD_D611
	USS *TARAWA*	LHA 1	NRaD_D611
MCIXS (Base)			
	USS *CARL VINSON*	CVN 70	NRaD_D611
	USS *CONSTELLATION*	CV 64	NRaD_D624
	USS *KITTY HAWK*	CV 63	NRaD_D611
MCIXS (BG CELL, BASE STATION)			
	USS *ESSEX*	LHD 2	NRaD_D611
MDU FOR EHF SATCOM			
	USS *BLUE RIDGE*	LCC 19	NRaD_D632
	USS *MOUNT WHITNEY*	LCC 20	NRaD_D632
MITEL SX–2000			

Table 1. 1996 Installation Activity. (Continued)

System Name	Unit Name	Hull ID	Installer
	USS *TARAWA*	LHA 1	NRaD_D633
NAVMACS (V)5 WIRING CHANGE			
	USS *COWPENS*	CG 63	NRaD_D611
	USS *CURTIS WILBUR*	DDG 54	NRaD_D611
	USS *LAKE ERIE*	CG 70	NRaD_D611
	USS *PAUL HAMILTON*	DDG 60	NRaD_D611
	USS *RAINIER*	AOE 7	NRaD_D611
NAVMACS II			
USS *ABRAHAM LINCOLN*		CVN 72	NRaD_D611
	USS *BOXER*	LHD 4	NRaD_D631
	USS *CORONADO*	AGF 11	NRaD_D611
	USS *NIMITZ*	CVN 68	NRaD_D634
	USS PELELIU	LHA 5	NRaD_D611
Navy Orderwire (NOW)			
	USS *ABRAHAM LINCOLN*	CVN 72	NRaD_D611
	USS *CARL VINSON*	CVN 70	NRaD_D611
	USS *CONSTELLATION*	CV 64	NRaD_D611
NECC			
	USS *BLUE RIDGE*	LCC 19	NRaD_D622
	USS *LEYTE GULF*	CG 55	NRaD_D622
	USS *NASSAU*	LHA 4	NRaD_D622
	USS *RAMAGE*	DDG 61	NRaD_D622
	USS *VELLA GULF*	CG 72	NRaD_D622
NTCS IVS (Integrated Video System) (23TV)			
	USS *CORONADO*	AGF 11	NRaD_D611
NTCS–A 2.1 / JMCIS 2.2 Upgrade			
	USS *PELELIU*	LHA 5	NRaD_D611
	USS *TARAWA*	LHA 1	NRaD_D611
OUTBOARD OVHL			
	USS *PAUL F FOSTER*	DD 964	NRaD_D641
QUAD DAMA/SECOND UHF SATCOM			
	USS *BOXER*	LHD 4	NRaD_D623
	USS *ESSEX*	LHD 2	NRaD_D623
R–2368 HF			
	USS *CALIFORNIA*	CGN 36	NRaD_D611
	USS *CALLAGHAN*	DDG 994	NRaD_D611

Table 1. 1996 Installation Activity. (Continued)

System Name	Unit Name	Hull ID	Installer
R–2368 LF/MF			
	USS *CALIFORNIA*	CGN 36	NRaD_D611
	USS *OGDEN*	LPD 5	NRaD_D645
R–2368 LF/MF/HF			
	USS *RUSHMORE*	LSD 47	NRaD_D611
R–2368A/URR (R–1051 REPLACE)			
	USS *GARY*	FFG 51	NRaD_D611
S–TADIL–J (demo)			
	USS *ARKANSAS*	CGN 41	NRaD_D643
	USS *CALIFORNIA*	CGN 36	NRaD_D643
	USS *SHILOH*	CG 67	NRaD_D643
SATCOM TADIL J / LINK–16			
	USS *CARL VINSON*	CVN 70	NRaD_D643
SHF HPA			
	USS *BOXER*	LHD 4	NRaD_D621
	USS *ESSEX*	LHD 2	NRaD_D621
SHF SATCOM – 7 ft. Antenna			
USS *ABRAHAM LINCOLN*		CVN 72	NRaD_D621
	USS *BELLEAU WOOD*	LHA 3	NRaD_D621
	USS *BOXER*	LHD 4	NRaD_D621
	USS *CARL VINSON*	CVN 70	NRaD_D621
	USS *CONSTELLATION*	CV 64	NRaD_D621
	USS *CORONADO*	AGF 11	NRaD_D621
	USS *ENTERPRISE*	CVN 65	NRaD_D621
	USS *ESSEX*	LHD 2	NRaD_D621
USS *JOHN F KENNEDY*		CV 67	NRaD_D621
	USS *KEARSARGE*	LHD 3	NRaD_D621
	USS *KITTY HAWK*	CV 63	NRaD_D621
	USS *MOUNT WHITNEY*	LCC 20	NRaD_D621
	USS *NASSAU*	LHA 4	NRaD_D621
	USS *PELELIU*	LHA 5	NRaD_D621
	USS *SAIPAN*	LHA 2	NRaD_D621
	USS *TARAWA*	LHA 1	NRaD_D621
USS *THEODORE ROOSEVELT*		CVN 71	NRaD_D621
SHF SATCOM – AN/WSC–6(V)4			
	USS *BOXER*	LHD 4	NRaD_D621
	USS *ESSEX*	LHD 2	NRaD_D621

Table 1. 1996 Installation Activity. (Continued)

System Name	Unit Name	Hull ID	Installer
	USS *KEARSARGE*	LHD 3	NRaD_D621
SIPRNET (DNS)			
	USS *CONSTELLATION*	CV 64	NRaD_D645
SNAP III			
USS CHANCELLORSVILLE		CG 62	NRaD_D611
	USS *BOXER*	LHD 4	NRaD_D613
SNAP III (Temp install)			
	USS *CURTIS WILBUR*	DDG 54	NRaD_D611
SNAP III (Temp; removal)			
	USS *CURTIS WILBUR*	DDG 54	NRaD_D611
SSTS Upgrade			
	USS *CORONADO*	AGF 11	NRaD_D633
SVMMS			
	USCGS POLAR SEA	WAGB 11	NRaD_D632
TAC TERM (was PTCCN)			
	USS *MOUNT WHITNEY*	LCC 20	NRaD_D631
	NSGA NW NORFOLK	N/A	NRaD_D631
TACINTEL II+			
COMUSNAVCENT BAHRAIN		N/A	NRaD_D631
	USNS CAPABLE	TAGOS16	NRaD_D631
	USNS LYNCH	TAGOR7	NRaD_D631
	USNS STALWART	TAGOS1	NRaD_D631
	USS *ANTIETAM*	CG 54	NRaD_D631
	USS *BOXER*	LHD 4	NRaD_D631
	USS *BUNKER HILL*	CG 52	NRaD_D631
USS *CHANCELLORSVILLE*		CG 62	NRaD_D631
	USS *CLEVELAND*	LPD 7	NRaD_D631
	USS *CORONADO*	AGF 11	NRaD_D631
	USS *CUSHING*	DD 985	NRaD_D613
	USS *DENVER*	LPD 9	NRaD_D631
	USS *DUBUQUE*	LPD 8	NRaD_D613
	USS *ESSEX*	LHD 2	NRaD_D631
	USS *FIFE*	DD 991	NRaD_D631
	USS *INGERSOLL*	DD 990	NRaD_D631
	USS *JUNEAU*	LPD 10	NRaD_D631
	USS *KINKAID*	DD 965	NRaD_D613
	USS *MERRILL*	DD 976	NRaD_D631

Table 1. 1996 Installation Activity. (Continued)

System Name	Unit Name	Hull ID	Installer
	USS *MOBILE BAY*	CG 53	NRaD_D631
	USS *PRINCETON*	CG 59	NRaD_D613
	USS *TARAWA*	LHA 1	NRaD_D631
	USS *VALLEY FORGE*	CG 50	NRaD_D631
TACINTEL II+ SOVT			
USS *ABRAHAM LINCOLN*		CVN 72	NRaD_D631
TADIXS B TRE Cross-Deck			
	USS *NEW ORLEANS*	LPH 11	NRaD_D611
	USS *PELELIU*	LHA 5	NRaD_D632
	USS *TARAWA*	LHA 1	NRaD_D611
Telephone Sys Upgrade			
	USS *GERMANTOWN*	LSD 42	NRaD_D633
TESS 3 MAXION H/W UPG			
	USS *ENTERPRISE*	CVN 65	NRaD_D642
TESS 3/SMOOS			
	USS *BELLEAU WOOD*	LHA 3	NRaD_D642
	USS *BOXER*	LHD 4	NRaD_D642
	USS *CONSTELLATION*	CV 64	NRaD_D642
	USS *CORONADO*	AGF 11	NRaD_D642
	USS *PELELIU*	LHA 5	NRaD_D642
TESS X-WINDOW UPGRADE			
	USS *BOXER*	LHD 4	NRaD_D642
	USS *ESSEX*	LHD 2	NRaD_D642
	USS *GUAM*	LPH 9	NRaD_D642
	USS *INDEPENDENCE*	CV 62	NRaD_D642
	USS *KEARSARGE*	LHD 3	NRaD_D642
	USS *LASALLE*	AGF 3	NRaD_D642
	USS *NIMITZ*	CVN 68	NRaD_D642
	USS *NEW ORLEANS*	LPH 11	NRaD_D642
TESS/SMOOS S/W UPGRADE			
	USS *CONSTELLATION*	CV 64	NRaD_D642
TFCC / ASW Mod			
	USS *CARL VINSON*	CVN 70	NRaD_D611
TIBS X–D			
	USS *KITTY HAWK*	CV 63	NRaD_D632
TLAM MDU FOR EHF			
	USS *MOBILE BAY*	CG 53	NRaD_D632

Table 1. 1996 Installation Activity. (Continued)

System Name	Unit Name	Hull ID	Installer
	USS *SHILOH*	CG 67	NRaD_D632
	USS *HEWITT*	DD 966	NRaD_D632
	USS *CHOSIN*	CG 65	NRaD_D622
	USS *LAKE ERIE*	CG 70	NRaD_D622
	USS *CONSTELLATION*	CV 64	NRaD_D622
	USS *KEY WEST*	SSN 722	NRaD_D622
	USS *ANTIETAM*	CG 54	NRaD_D622
	USS *COWPENS*	CG 63	NRaD_D622
	USS *KITTY HAWK*	CV 63	NRaD_D622
USS *SALT LAKE CITY*		SSN 716	NRaD_D622
	USS *SANTA FE*	SSN 763	NRaD_D622
TRE (Cross-Deck)			
	USS *BOXER*	LHD 4	NRaD_D632
	USS *ESSEX*	LHD 2	NRaD_D632
	USS *KITTY HAWK*	CV 63	NRaD_D632
TV RECEIVE ONLY			
	USS *CONSTELLATION*	CV 64	NRaD_D621
	USS *TARAWA*	LHA 1	NRaD_D621
UHF SATCOM UPG			
	USS *RAINIER*	AOE 7	NRaD_D632
UHF SATCOM UPGRADE			
	USS *FORT FISHER*	LSD 40	NRaD_D623
	USS *CHOSIN*	CG 65	NRaD_D623
	USS *LAKE ERIE*	CG 70	NRaD_D623
	USS *ANTIETAM*	CG 54	NRaD_D623
	USS *COWPENS*	CG 63	NRaD_D623
VEXCEL SCANNER X–D			
	USS *KITTY HAWK*	CV 63	NRaD_D611
VHF COMM SINCGARS (PARTIAL)			
	USS *FORT FISHER*	LSD 40	NRaD_D611
VHF COMM SYSTEM IMPROVE (partial)			
	USS *BOXER*	LHD 4	NRaD_D611
	USS *ESSEX*	LHD 2	NRaD_D611
VHF COMM SYSTEM IMPROVEMENTS			
	USS *BOXER*	LHD 4	NRaD_D611
	USS *CLEVELAND*	LPD 7	NRaD_D611

Table 1. 1996 Installation Activity. (Continued)

System Name	Unit Name	Hull ID	Installer
	USS *HARPERS FERRY*	LSD 49	NRaD_D611
	USS *MOUNT VERNON*	LSD 39	NRaD_D611
VHF COMM SYSTEM IMPROVEMENTS (SINCGARS)			
	USS *CONSTELLATION*	CV 64	NRaD_D624
	USS *KITTY HAWK*	CV 63	NRaD_D611
VHF SINCGARS (PARTIAL)			
	USS *OGDEN*	LPD 5	NRaD_D611
VIXS / JWICS / VTC			
	USS *CONSTELLATION*	CV 64	NRaD_D631
	USS *KITTY HAWK*	CV 63	NRaD_D631
WIDEBAND COMMERCIAL SATCOM			
	USS *BLUE RIDGE*	LCC 19	NRaD_D621
	USS *CARL VINSON*	CVN 70	NRaD_D621
	USS *CONSTELLATION*	CV 64	NRaD_D621
	USS *ENTERPRISE*	CVN 65	NRaD_D621
USS *JOHN F KENNEDY*		CV 67	NRaD_D621
	USS *KITTY HAWK*	CV 63	NRaD_D621
USS *THEODORE ROOSEVELT*		CVN 71	NRaD_D621
WSC–3 SATCOM 3rd RDO			
	USS *JARRETT*	FFG 33	NRaD_D623

Independent Research (IR)

Independent Research

Independent Research (IR) programs support initial research in many areas of interest to the Navy, including command and control, communications, ocean surveillance, and multimission research. The NRaD FY 96 IR program consisted of 31 projects totaling $2763K. FY 96 accomplishments in Independent Research included the following:

Optical Fiber Devices. The properties of optical-fiber multiplexers used in optical-fiber communication systems were studied by modeling the effect of index of refraction changes of the glass during the fabrication process. Good agreement with measurements was found.

Tidal Exchange at the Bay-Ocean Boundary. Environmental impact assessment was investigated by a method that combined the use of shipboard acoustic Doppler current measurements with a unique bay-ocean tracer technique to provide visualization of pollutant exchange.

Detection in Correlated Gaussian Mixture Noise. Ocean-surveillance-related phenomena were studied in a program that demonstrated that Gaussian mixture probability densities and, more generally, hidden Markov models, may be used to model ocean acoustic noise dominated by a few moving sources, and to model radar backscatter from the sea surface.

Environmentally Adaptive Radar Waveforms. The physics of low-altitude, radio-frequency electromagnetic propagation in littoral environments was modeled for the purpose of developing waveforms and signal-processing methods to improve detection of threats such as low-altitude cruise missiles. Propagation model technology developed under this project has been transitioned to two Navy advanced technology projects.

Appendix A
Achievement Awards

1996 Achievement Awards

GENERAL AWARDS

Vice President's Golden Hammer Award

Beth Sundheim
Nancy Wheeler
Frank White

Guam Ancient Order of Chamorri for Community Service

Commander Gary Durante, USN

National Security Industrial Association Vice Admiral Martell Award for Antisubmarine Warfare Technical Excellence

Dr. David Morin

Global Positioning System Team Excellence Award

VME Receiver Card
Acquisition IPT
(NRaD members)

Bob Copsey
Charles Falchetti
John Fenstermacher
LCDR Jeff Hailey, USN
James Hodson
Steve Kravets
Chris Lisica
LCDR Bruce Mathers, USN
Dan Matthews
Jack Schwartz
John Walsh

Special Act Awards

Dr. Donald Gingras
Harvey Hanson
Lois Harper
Dr. Eric Hendricks

NAVY AWARDS

Secretary of the Navy/Chief of Naval Operations Environmental Award for Natural Resources Conservation

Don Lydy

Navy Superior Civilian Service Award

Larry Core and Douglas Romig for leadership on the Tactical Advanced Computer (TAC)–4 acquisition program. Core served as project leader, managing and coordinating the $672 million program. Romig was the TAC–4 Contracting Officer's Technical Representative and Configuration Control Board chairman.

Navy Meritorious Civilian Service Award

Nona Ai for technical and programmatic support in fielding shipboard cryptological systems and the first Joint Maritime Command Information System capabilities

David Aldous for leading the merger of administrative and financial functions and for technical leadership on several high profile U.S./NATO programs

Les Anderson for leading the successful Distributed Command and Control Technology Program and for leadership in the joint distributed technology business area

Roy Axford for contributions to Navy high-data-rate ship and aircraft satellite communications and demonstrations of Global Broadcast System on Navy platforms

Jim Boyle for his leadership of the Fleet Liaison Office and support of the Naval Technology Insertion Program

Carye Concha for increasing command professionalism in her service as the Commanding Officer's executive assistant

Sam Corrao for coordinating numerous planning and construction projects to provide appropriate lab and work spaces for relocation of former Warminster Detachment programs and personnel

Angela DiAmico for leadership in multistatic active programs and contributions to active acoustic bistatic processing

Mary Eva Escalante for her service as command legal counsel, dealing with contentious and volatile issues

Charles Falchetti for managing development of tri-service receivers for the Global Positioning System for aircraft, shipboard, submarine and ground support applications

James Feeley for contributions to the Fleet Ballistic Missile Program and to production and operational cost reductions for missile test readiness equipment

Robert Franco for leadership of an integrated project team for the Ultra High Frequency Satellite Communications Information Exchange System

Debra Gookin for conceiving and defining the initiative to provide transitional support to Space and Naval Warfare Systems Command during its move to San Diego

Jeff Greenhill for leadership of developments on the Very Low-Frequency Digital Information Network (VERDIN) program for submarine communications capabilities

Larry Harris for directing a team of scientists and engineers in formulating a program to evaluate and document the performance of the Fixed Distributed System for undersea surveillance

Roger Harris for technical support in acquisition of the Fixed Distributed System and the migration of Sound Surveillance System processing into a new equipment suite

Robert Hoffman for efforts in institutionalizing the Naval Technology Insertion Program, with the potential to improve substantially the process of providing new technology to the warfighter

John Iaia for leading consolidation of former Navigation Department and former NCCOSC In-Service Engineering West Coast Division into the Integration and Interoperability Division, and for contributions to deployment of the first Inverse Synthetic Aperture Radar on a Navy helicopter

Rick Kataoka for leadership in improving the fleet's capability to detect and mark buried mines using marine mammal systems

Doug Lange for supporting software design, simulation and rapid prototyping of tactical decisions aids for the Operations Support System

Shing Li for improving shipboard communication system analysis and design and developing the first computational tools for that effort

Jon Losee for contributions to technology advances in underwater sensors and to a Chief of Naval Operations Priority One national security program

George Lowenstein for establishing NRaD as the central DoD engineering activity for testing Global Positioning System (GPS) receivers and directing integration of GPS equipment on platforms for all the services

Roy Makio for leadership in providing quality engineering and installation services supporting the Navy Satellite Operations Center, VHF satellite communications and the Automated Network Control

Michael Nguyen for leadership of test and evaluation efforts, particularly in the field of non-intrusive diagnostic testing using thermal imaging

Charles Nichols for directing a successful government-contractor development on the Low Frequency Active program and its transmit subsystem

Sally Norvell for numerous software developments and for contributions to the Navy Extremely High Frequency Communication Controller

Stephen Pappert for developing microwave/millmeter wave fiber optic and optoelectronic technology for a variety of Navy systems

James Reese for contributions to various acoustics and towed array programs

Ken Register for playing a key role in the establishment of the Link Program Office and establishment of the command as a key player in the fleet and life cycle support arena

Ronald Sato for supervising installations of SHF and EHF satellite defense systems

Ron Seiple for conceptualizing and obtaining funding for a program to introduce new technology into the fleet and the Fleet Marine Force rapidly

Pete Seligman for managing the Environmental Sciences Division

Barbara Sotirin for leadership in developing a number of technologies related to underwater acoustics measurements, particularly in the unique acoustic environment of the Arctic

Beth Sundheim for efforts to create a multi-agency Tipster program which was selected for a vice presidential Golden Hammer Award

Ed Wunner for managing the upgrade of the command and control electronic suite at the Caribbean Regional Operations Center

Glenn Yee for service as head of the C^4I Shipboard Engineering Department, which provided the fleet with reliable, cost-effective working systems. He also served as fleet liaison officer for Hawaii.

Thomas Zimmerman for establishing a team to monitor contractor decisions and provide technical direction for a planning and decision aid system for the Government Program Management Office

Navy Award of Merit for Group Achievement

AN/WLR–8 High Probability of Intercept System for SSN–688 Class Submarines Development Team

Luke Chu
Mark Freedman
Erik Helgeson
Eric Kareh
Jon Krueger
Robert Meigs
John Mitchell
Alan Outhier
Bill Sullivan
Sean Zion

C^4I Alteration Installation Team

Randall Case
Lt. Kevin Peterson
James Rodenkirch
Susan Senese
Glenn J.P. Yee

Caribbean Regional Operations Center (CARIBROC) Upgrade Program Team

Noel Acevedo
Gary Alexander
Fernando Gali
Lynn Gutierrez
Linh Hong Le
Scott Leonard
Carolyn Luong
Colleen McCall
Rolando Medina
Cyndi Ngo
Mary Nga Nguyen
Tuan Anh Nguyen
Samir Othman
Yoly Pantig
David Slade
Ray Tejidor
Loi Truong
Nghia Vu
Matthew Wuest

C^3 Department Division Program Funds Management Team

Edna Addenbrooke
Patricia Crist
Twyla Garrett–Phillips
Mary Medeiros
Rita Mejares
Margaret Powell
Sharron Roundtree

Communications Central Network – Phase II Team

Kris Blackstad
Paul Martin
Deidre Olson
Lorelei Rodefer

Electronic Systems Engineering Program Funds Management Team

Linda Ericson
Jeanette Harris
Glenna Mick
Louann Rodda
Rixalina Senica

Funds Program Management Identification/Control Number Development Team

Barbara Barber
Douglas Karr

Donna Koltz
Robert Stanzione

Joint SHF/EHF Installation aboard USS *George Washington* (CVN–73)

Jane Astle
Edsel Connor
Mark Evans
Keith Truong
Robert Walulis
Robert Wolborsky

Link–16/JTIDS ISEA Team

Robert Bennett
Lloyd Bound
John Carbone
Peter Donovan
Douglas Freeman
Myron MacNeil
Alfred Medrano
Rita Mejares
Glen Penoyer
John Peterson
Mary Jo Portley
William Rich
Elvin Roeske
Jack Sears
Babette Stoutmire Gail Stroud
Terry Tovar
August Troncale
Thomas Woodland

NAVSTAR GPS Team

Kenneth Avedisian
Debra Clark
Rosauro DeLeon
Evangeline Encarnacion
Danny Fields
Efrain Flores–Colon
Dayanand Gollapudi
Carmen Miranda
Athanison Monroe
Malcolm Onuma
Joseph Osa
Rosa Puig–Scott
Jaime Radulovich
Dale Steimlosk
Craig Stroing
Teodoro Tanag
Rubin Thornton
Roy Villa
Thomas Wingate

Navy Inventory Control Point Team

Joseph Bullock
Tellis Capell
George Hoover
Dale Johnson
Andre LaBerge
Michael McCaslin
John Mueller

Navy Tactical Command System-Afloat Tiger Team

Steve Brenneman
Wayne Duke
Patrick Garcia
Jack Gerrard

Richard Snow
Randy South
Herb Stillings

Position Location Reporting System Team

Jeanne Abriel
Richard Downie
Cary Meriwether
James Neighbors
Leland Purrier
George Titus

Procurement and Installation Team for AN/WLQ–4(V) 1 System for USS *Seawolf* (SSN–21)

Willard Baker
Johnny Chavez
Leon Faitek
Paul Jenkins
Nguyet Le
Gary Marx
James Olds

Range Air Surveillance System Team

Lewis Baca
Michael Batey
William Brodeur
Antonio De Guzman

Relocatable Over-The-Horizon Radar (ROTHR)

Richard Caetano
Kevin Clark
Mary Edwards
Robert Lematta
Ronald Martineau
Ulysses Miller
Dr. John Misner
Leo Mulcahy
Robert Musil
Nguyen D. Nguyen
Kimlerly Swecker
Thomas Utschig
Dr. William Yssel

State Immunization Information System Program Team

Edna Addenbrooke
Laurence Anderson
Visita Balintec
Annette Buenafe
Rene Cruz
Bruce Dunn
Julian Evola
Kenneth Higa
Sarah Victoria Jones
William Jones
Gregory Lee
Willie Levett
Rafael Maldonado
Milton Martinez
Su Huu Nguyen
Bernard Portley
Juan Rivera
David Talley
Jose Villanueva
Larry White

U.S. Agency for International Development Very Small Aperture Terminal Team

Israel Arenas
Bruce Dunn
Bruce Flory
Kenneth Higa
John Kmet
Harvey Krell
Gregory Lee
Julio Rivera
Michael Robinson
Michael Toczek
Michael Veytsman
Robert Wolborsky

NRaD AWARDS

Lauritsen-Bennett Award

Steve Brenneman for excellence in engineering for his leadership and major contributions to a number of programs, including the Tactical Flag Command Center, the Tactical Advanced Computer acquisition program, the Joint Maritime Command Information System and the Ocean Surveillance Information System (OSIS) Baseline Upgrade and OSIS Evolutionary Development programs.

Dr. Adi Bulsara for excellence in science for his research into the role played by background noise within the nervous system in processing information by certain classes of neurons, applying the stochastic resonance effect to help solve non-linear problems in the field of signal processing.

Bob Frye for excellence in staff/support for technical expertise and leadership as command Comptroller, particularly for integration of various financial functions at the several commands consolidated to form NRaD and for leading development of claimancy-wide business rules and processes.

Secretarial Awards

Patricia Cantwell–Smith
Vicki Goren

Group Award

Sonia Feiler
Joy Green
Pamela Wilson

Safety and Environmental Incentive Awards

"Total Quality
Landscape Group"

Drew Aitken
Sam Corrao
Tom Gaydos
Gabe Haduch
Ed Hazlin
Henry Hugo
Don Lydy
Gene Olaes
Randy Peacock
Scott Pogue
Terry Rakestraw
Leonard Scott
Jim Sharp
Dave Willis

Ionizing Radiation Control Committee

Russ Clement
Dr. Alan Gordon
Tom Knoebel
Gary Mastny
Dr. Lynn Parnell

Exemplary Achievement Awards

James Acosta
Scott Adams
Elaine Allen
David Andersen
Neil Barnett
Gerald Baumgartner
Edward Beach
Willis Bebinger
Kenneth Boman
Ronnie Brockus
Donna Burzette
David Carlton
Gerald Castro
Dallas Cartwright
Rico Cheng
Daryl Ching
Russel Chun
Jeff Clarkson
Debra Conwell
Gerald Cruz
Stacey Curtis
Evelyn De Guzman
Vincent Dicristofaro
Vivian Dicristofaro
Gary Dorrance
Jeffy Driesenga
Wadad Dubbelday
Vincent Duenas
Steve Dunham
Judith Dyer
Mark Ebesu
Doris Eiswald
Edwin Fenn
Bruce Flory
Kathy Foster
Robert George
Larry Goetsch
Manuel Gomez
Joseph Gentile
Douglas Grimmett
Richard Hall
Harvey Hanson
Susan Hearold
Carl Henry
Alan Hermansen
David Hill
Edward Hoffman
Walter Horikawa
John Hoxsie
Tri Hua
Lee Insley
David Ishigo
Diana Jackson
Teresita Jaleco
Carolyn Jarnigan
James Kaawaloa
Dennis Kaida
Sharon Katano
Sharon Keith
Michael Kono
Carl Lantz
Greg Lawrence
Chuck Ledwin
John Leon–Guerrero
Kathleen Littfin
Ron Major
Angel Maldonado
William Marsh
Jay Martin
Gary Mastny
Emerson Mateo
Gordon Mattis
Paul Meisinger
Travis Metcalf
Steven Minarik
Margaret Minor
Chuck Mirabile
Linda Modica
Michael Morgan
Robert Mullen
Edward Murrill
Lloyd Nakamura
William Naputi
Brian Nguyen
Nguyen Nguyen
Clifford Nishimuro
John Nugent
Richard Orazi
Eric Otte
Francisco Pangelinan
Perry Partow
Randy Peacock
Katherine Pedersen
Cecilia Perez
George Peterson
Chreyl Putnam
Doris Quon
William Radar
William Rask
Donald Ream
James Rethwish
Belinda Romero
Steve Roa
Ed Rynne
Jay Sakai
Timothy Schofield
Peter Shaw
Barry Siegel
John Skadberg
Mark Sloane
David Smith
Jacqueline Smith
Ralph Smith
Charles Suggs
John Tamagawa
Bereket Tanju
Teodoro Tanag
Leigh Thaeler
Elliot Tung
Katherine Viglianese
Thomas Waldschmidt
Margaret Walter
John Wilson
Stanford Wong
Thomas Woodland
Ruthann Zombolas

Joint Warrior Interoperability Demonstration (JWID 95) Certificates

Steve Roa (NRaD JWID Director)
Carrie Alexander
Peter Almazan
Todd Almond
James Babcock
Raymond Barrera
Jane Campbell
Terry Danielson
Gaylord Doerck
Peter Donich
CDR Dan Donoghue, USN
Sonia Feiler
Daundelyn Green
Yau–Keung Hom
Doug Kirby
Marlan Kvigne
Tom LaPuzza
Aaron Lerner
Nikki Lightfoot
Lyn Macpherson
Paul Payne
CDR David Reidy, USN
Donald Schirr
CDR Bill Sitz, USN
Bob Stephenson
Paul Strazdus
Jackie Stull
Marian Varela
Kimngan Vo
CDR Susan Walters, USN
Frank White

MILITARY AWARDS

Legion of Merit

Captain Kirk Evans for service as Commanding Officer of NRaD from June 1993 to June 1996

Navy Commendation Medal

CDR James Harris for service as fleet support officer–surface projects at NCCOSC

Navy and Marine Corps Achievement Medal

Captain Richard Williamson, USMC, for service as NRaD Marine Corps Liaison Officer during Joint Warrior Interoperability Demonstration (JWID 95)

Navy Achievement Medal

Lt. Jerry Dismuke for service as the officer conducting the System Operational Verification Test for the Advanced Digital Network System

ET3 Tiffany Milne for performance of duty as AN/USC–29 (V) satellite terminal maintainer and operator at NRaD

Sailor of the Year

YN1 (AW) Diana Weaver received a Letter of Commendation from Commanding Officer, NCCOSC RDT&E Division for outstanding professionalism, exceptional dedication, and exemplary leadership, culminating in her selection as the 1996 NCCOSC RDT&E Division Sailor of the Year

Good Conduct Awards

ETCS Timothy Scarborough
RMC Nikolas Simon
OS1 Gary Hebard
EN1 Israel Irizarry
RM1 Arthur Verdugo
OS2 Carl Dick
BM2 Eric Kennedy
SK2 Nhory Rapaido
BM3 Bruce Willie

Kuwait Liberation Medal

CDR Bill Sitz
CDR Dan Donoghue
CDR Robert Hartman
LCDR Matthew Avila
LCDR John Riggs
LCDR Gregg Mangus
LT James O'Byrne
LT Kirk Felbinger
LT Richard Hirasuna
LT Jonathan Dien
LT Michael Holland
ETCS Timothy Scarborough
OSCS Philip Soto
OSCS Leonard Wieberg
OSC James Fitzgerald
RMC Nikolas Simon
EW1 Merrell Browning
RM1 Terri Halstead
EN1 Brian Maloney
OS1 Stanford Neering
HT1 Michael O'Sullivan
OS1 Jeffrey Shott
BM2 Benjamin Barker
OS2 Carl Dick
OS2 Michael Gniady
BM2 Eric Kennedy
BM3 Bruce Willie

Appendix B
Patents

PATENT AWARDS—CY 96

Inventor(s)	Title	Patent No.	Date
Shoemaker, Patrick A.	Floating Gate Injection Voltage Regulator	5,481,492	2 Jan 1996
Mummery, Herbert L. Koyamatsu, Anthony H. Young, Michael B.	Cable Recovery Winder	5,585,972	23 Jan 1996
Bond, James W. Schlosser, Thomas W. Velez, William	Method and Apparatus for Suppressing Interference from Bandspread Communication Signals	5,495,497	27 Feb 1996
Smurlo, Richard P. Everett, Jr., Hobart R.	System for Detecting Perturbations in an Environment Using Temporal Sensor Data	5,493,273	20 Feb 1996
Sexton, Douglas A. Russell, Stephen D. Albares, Donald J.	Laser Textured Surface Absorber and Emitter	5,493,445	20 Feb 1996
Straus, James E. Allman, Richard L. Frisch, Willis L. Nicholson, Matthew J. White, Richard W.	System for Estimating Far-Field Acoustic Tonals	5,493,540	20 Feb 1996
Mastny, Gary F.	Detection of Subsurface Fissionable Nuclear Contamination through the Application of Photonuclear Techniques	5,495,106	27 Feb 1996
Bond, James W. Velez, William	Method and Apparatus for Suppressing Linear Amplitude Interference from Bandspread Communication Signals	5,495,496	27 Feb 1996
Bond, James W.	Weight-Value Controlled Adaptive Processor for Spread Spectrum Receiver	5,491,716	13 Feb 1996
Bond, James W. Marchette, David J. Priebe, Carey E. Schlosser, Thomas W.	Two-Dimensional Kernel Adaptive Interference Suppression System	5,499,399	12 Mar 1996
Scheps, Richard	Differential Imaging for Sensitive Pattern Recognition	5,506,616	9 Apr 1996
Bond, James W.	Non-Adaptive Amplitude Diference Interference Filter	5,510,088	16 Apr 1996
Aklufi, Monti E.	Low Temperature Plasma Film Deposition Using Dielectric Chamber as Source Material	5,510,088	23 Apr 1996

PATENT AWARDS—CY 96 (Continued)

Inventor(s)	Title	Patent No.	Date
Bond, James W. Marchette, David J. Priebe, Carey E. Schlosser, Thomas W.	Kernel Adaptive Interference Suppression System	5,517,531	14 May 1996
Copeland, Howard D. Losee, Jon R. Mastny, Gary F.	Detection of Thermal Neutrons through the use of Internal Wavelength Shifting Optical Fibers	5,519,226	21 May 1996
Walker, Howard W. Garcia, Graham A.	Low and High Minority Carrier Lifetime Layers in a Single Semiconductor Structure	5,521,412	28 May 1996
Koyamatsu, Anthony H. Mummery, Herbert L. Hahn, Warren L.	Fiber-Optic Cable Payout System	5,522,561	4 Jun 1996
Scheps, Richard	Repetitively Q-Switched Laser Pumped by Laser Diodes and Q-Switched with an Intracavity Variable Speed Moving Aperture	5,528,611	18 Jun 1996
Scheps, Richard	Laser with Multiple Gain Elements	5,528,612	18 Jun 1996
Rast, Howard E.	Direction-Finding Apparatus Using Tunable Fiber-Optic Delay Line	5,530,778	25 Jun 1996
Scheps, Richard	Low Threshold Diode-Pumped Tunable Dye Laser	5,530,711	25 Jun 1996
Whitesell, Eric J.	Data Repacking Circuit Having Toggle Buffer for Transferring Digital Data from P1Q1 Bus Width to P2Q2 Bus Width	5,537,624	16 Jul 1996

Appendix C
Distinguished Visitors

JANUARY

16 Rear Admiral Fred Scourse, RN
Director
General Surface Ships
United Kingdom Ministry of Defence

19 Rear Admiral Francis W. Harness, USNR
Commander
Naval Surface Reserve Force/
Commander
Naval Surface Group SIX

26 Dr. Marv Langston
Deputy Assistant Secretary for C^4I/
Space and Electronic Warfare Programs
Office of the Assistant Secretary of the Navy
(Research, Development and Acquisition)

FEBRUARY

1 Rear Admiral Edward Moore, Jr., USN
Commander
Cruiser Destroyer Group THREE

5–9 Rear Admiral George F.A. Wagner, USN
Commander
Space and Naval Warfare Systems Command

Rear Admiral Osie Combs, USN
Chief Engineer
Space and Naval Warfare Systems Command

7 Admiral James R. Hogg, USN (Ret.)
Director
Strategic Studies Group
Office of the Chief of Naval Operations

10 Mr. Gary Vest
Principal Assistant Deputy Under Secretary of Defense
(Environmental Security)
Office of the Secretary of Defense

Rear Admiral Luther Schriefer, USN
Director
Environmental Protection
Safety and Occupational Health Division (N45)
Office of the Chief of Naval Operations

14 Vice Admiral George Sterner, USN
Commander
Naval Sea Systems Command

Rear Admiral George F. A. Wagner, USN
Commander
Space and Naval Warfare Systems Command

15 Mr. William Andahazy
Professional Staff Member
Armed Services Committee
U.S. House of Representatives

15 Rear Admiral (Select) William Pickavance, USN

21 Chief
Information Systems Branch
Communication/Information Systems Division
Supreme Headquarters Allied Powers Europe (SHAPE) Technical Center

22 Rear Admiral Timothy Beard, USN
Commander
Carrier Group ONE

MARCH

26–28 Mr. Edward Zdankiewicz
Deputy Assistant Secretary of the Navy (Mine/Undersea Warfare)

Vice Admiral Brent M. Bennitt, USN
Commander
Naval Air Force
U.S. Pacific Fleet

Vice Admiral James R. Fitzgerald, USN
Navy Inspector General

Mr. John Bachkosky
Deputy Under Secretary of Defense (Advanced Technology)

Major General James Jones, USMC
Director
Expeditionary Warfare Division (N85)
Office of the Chief of Naval Operations

Rear Admiral Marc Pelaez, USN
Chief of Naval Research

Rear Admiral Raymond C. Smith, Jr., USN
Commander
Naval Special Warfare Command

Rear Admiral Edward Moore, Jr., USN
Commander
Cruiser Destroyer Group THREE

Rear Admiral Edmund P. Giambastiani, USN
Director
Submarine Warfare Division (N87)
Office of the Chief of Naval Operations

Rear Admiral Michael Cramer, USN
Director

Naval Intelligence (N2)
Office of the Chief of Naval Operations

Dr. Edward C. Whitman
Technical Director
Office of the Oceanographer of the Navy

27 Mr. Tom Evans
Chairman
CNO Executive Panel Task Force
Office of the Chief of Naval Operations

29 Rear Admiral Rodney Rempt, USN
Director
Theatre Air Defense (N865)
Office of the Chief of Naval Operations

Mr. Charles Nemfakos
Deputy Under Secretary of the Navy/
Executive Director
Organization Management and Infrastructure Team
Office of the Secretary of the Navy

APRIL

8 Mr. Nobuhiro Beppu
Director General
Research and Development
Japan Defense Agency

10 Dr. Ralph W. Alewine, III
Deputy Assistant to the Secretary of Defense for Nuclear Treaty Programs

Captain First Rank Gregory Korolkov
Captain First Rank Vladimir Sborshikov
Department of the Navy
Ministry of Defense, Russian Federation

12 The Honorable Bruce Babbitt
Secretary of the Interior

15 Mr. Eugene P. Angrist
Deputy Counsel of the Navy

Mr. Kevin Moody
Director
Command and Control (OASD C^3I)
Office of the Secretary of Defense

16 Rear Admiral Mike Coyle, USN
Deputy Chief of Staff
Fleet Maintenance
Commander–in–Chief, U.S. Pacific Fleet

25 Rear Admiral Richard Wilson, USN
Deputy Director
Space and Electronic Warfare (N6B)
Office of the Chief of Naval Operations

29 Dr. Marv Langston
Deputy Assistant Secretary for C^4I/Space and Electronic Warfare Programs
Office of the Assistant Secretary of the Navy
(Research, Development & Acquisition)

29 Major General Kenneth R. Israel, USAF
Assistant Deputy Under Secretary of Defense
(Airborne Reconnaissance)
Director
Defense Airborne Reconnaissance Office

30 Mr. Walter C. Hersman
Professional Staff Member
Surveys and Investigations Staff
Appropriations Committee
U.S. House of Representatives

Mr. Byron Wear
City Council Member
City of San Diego

Rear Admiral Joseph S. Walker, USN
Commander
Naval Base San Diego

MAY

8 Brigadier General Michael W. Ackerman, USA
Vice Director
C^4 Systems (J6)
The Joint Staff

Vice Admiral Conrad C. Lautenbacher, Jr., USN
Commander
Third Fleet

Rear Admiral Robert Nutwell, USN
Commander
Carrier Group THREE

20 Mr. Doug Towers
Director
Military Communication Programmes
Ministry of Defence
United Kingdom

JUNE

1 Mr. Michael Meermans
Professional Staff Member

Technical and Tactical Subcommittee
Permanent Select Committee on Intelligence
U.S. House of Representatives

6 Mr. Paul Sutcliffe
Deputy Chief Scientist
(Research & Technology)
Ministry of Defence
United Kingdom

11 Honorable Emmett Paige
Assistant Secretary of Defense (C^4I)

19–20 Rear Admiral George F.A. Wagner, USN
Commander
Space and Naval Warfare Systems Command

Rear Admiral Osie Combs, USN
Chief Engineer
Space and Naval Warfare Systems Command

24–27 Major General Joseph Redden, USAF
Director
Joint Warfare Center

Brigadier General David E. Baker, USAF
Deputy Director, Military Support
National Reconnaissance Office

Mr. Guy Dubois
Director
Operational & Tasking Directorate
Central Imagery Office

26 Vice Admiral Pierre Salles, French Navy
Head
Armament Corps (Research and Development)
Naval Construction Directorate

27 Rear Admiral Paul Tobin, USN
Oceanographer of the Navy

28 Rear Admiral Marsha Evans, USN
Superintendent
Naval Postgraduate School

JULY

15–26 Rear Admiral Paul Gaffney, USN
Chief of Naval Research/
Executive Director
Naval Research Advisory Committee

16 Mr. Richard Ledesma
Deputy Director, Test & Evaluation
Office of the Secretary of Defense

17 Ms. Susan Bales
Director
Naval Science Assistance Program

25–26 Honorable John W. Douglass
Assistant Secretary of the Navy
(Research, Development and Acquisition)

Dr. Marv Langston
Deputy Assistant Secretary for C^4I/Space and
Electronic Warfare Programs
Office of the Assistant Secretary of the Navy
(Research, Development and Acquisition)

Rear Admiral Richard Riddell, USN
Director of Navy Test & Evaluation & Technology Requirements
(N0–91)
Director
Special Programs Division (N89)
Office of the Chief of Naval Operations

30 Admiral James Hogg, USN (Retired)
Director
Strategic Studies Group
Office of the Chief of Naval Operations

31 Rear Admiral Osie Combs, USN
Chief Engineer
Space and Naval Warfare Systems Command

AUGUST

1 Major General Boonsrang Niumpradit
Thailand Supreme Command

13 Rear Admiral Richard Riddell, USN
Director of Navy Test & Evaluation & Technology Requirements
(N0–91)/
Director
Special Programs Division (N89)
Office of the Chief of Naval Operations

15–16 Dr. Ronald Taylor
Director
Naval Studies Board
National Research Council

29 Mr. Greg Colocotronis
Comptroller
Defense Advanced Research Projects Agency

29 Rear Admiral Thomas F. Stevens, USN
Commander
Naval Security Group Command

SEPTEMBER

13 Rear Admiral Timothy K. Beard, USN
Commander
Carrier Group ONE

16 Mr. Barry Goldberg
Mr. Ralph Mehl
Professional Staff Members
Surveys & Investigations Staff
Committee on Appropriations
U.S. House of Representatives

17 Vice Admiral Conrad Lautenbacher, USN
Commander
Third Fleet

25–26 Ms. Susan Bales
Director
Naval Science Assistance Program

OCTOBER

7 Vice Admiral Walter J. Davis, USN
Director
Space and Electronic Warfare (N6)
Office of the Chief of Naval Operations

8 Major General Edward Hanlon, Jr., USMC
Director
Expeditionary Warfare Division (N85)
Office of the Chief of Naval Operations

15 Vice Admiral Herbert Browne, USN
Prospective Commander
Third Fleet

15–16 Rear Admiral Stephen I. Johnson, USN
Commander
Naval Information Systems Management Center
Program Director
Information Systems Support Directorate (PD 15)
Space and Naval Warfare Systems Command

21–23 Honorable Steven Honigman
General Counsel
Department of the Navy

23 Mr. George Lauffer
Ms. Julie Kemp–Rief
Professional Staff Members
Armed Services Committee
U.S. Senate

31 Dr. Edward Feigenbaum
Chief Scientist
U.S. Air Force

NOVEMBER

8 Rear Admiral James L. Taylor, USN
Deputy Chief of Staff for Fleet Maintenance (N43)
Commander-in-Chief, U.S. Pacific Fleet

18 Honorable R. Noel Longuemare
Principal Deputy Under Secretary of Defense
for Acquisition & Technology

Vice Admiral Brent Bennitt, USN
Commander
Naval Air Force
U.S. Pacific Fleet

Rear Admiral Luther F. Schriefer, USN
Director
Environmental Protection
Safety and Occupational Health Division (N45)
Office of the Chief of Naval Operations

Mr. Garry Jones
Deputy Secretary for Acquisition
Australia

Mr. Pierre Lagueux
Assistant Deputy Minister for Material
Canada

21 Major General Robert S. Dickman, USAF
Space Architect
Department of Defense

21 Dr. Charles Herzfeld
CNO Executive Panel
Office of the Chief of Naval Operations

26 Mr. Alan Bersin
U.S. Attorney
Southern District of California

DECEMBER

2 Dr. Susan Bales
Director
Naval Science Assistance Program

6 Mr. Greg Walters
Professional Staff Member
Appropriations Committee
U.S. House of Representatives

9 General Carmine Cianci
Director
General Telecommunications
Department of Defense, Italy

11 Rear Admiral Rodney Rempt, USN
Program Executive Officer
Theatre Air Defense
Office of the Assistant Secretary of the Navy
(Research, Development & Acquisition)

12 Rear Admiral Robert M. Nutwell, USN
Deputy Commander
C^4ISR Systems Integration
Space and Naval Warfare Systems Command

Vice Admiral Alexander J. Krekich, USN
Commander
Naval Surface Force
U.S. Pacific Fleet

Dr. John Hanley
Deputy Director
Strategic Studies Group
Office of the Chief of Naval Operations

Appendix D
Major Conferences and Meetings

JANUARY

23–25 Jan: Advisory Group on Electron Devices

29 Jan–2 Feb: Australia–Canada–New Zealand–United Kingdom–United States (AUSCANNZUKUS) Ad Hoc Working Group Meeting on X.400/X.500

FEBRUARY

1 Feb: Senior Executive Service West Coast Meeting

6–7 Feb: Navy/Marine Corps Global Position System Users Conference

6–8 Feb: Office of Naval Research/NRaD Tracker Workshop

8 Feb: NATO ADSIA Tours

8–9 Feb: Interservice Mission Planning Working Group (Interoperability Sub-Group)

13–14 Feb: Workshop on Error–Resilient Image and Video Compression

14–15 Feb: Navy Multi–Link Working Group

22 Feb: Technology Planning Process Working Group Meeting

MARCH

4–7 Mar: Department of the Navy Information Management/Information Technology (IM/IT) Meeting

5–7 Mar: Navigation MITRE Interface Subsystem Meeting Trident II (D5)

13 Mar: AFCEA Board of Directors Luncheon Meeting

13 Mar: DoD Natural Resources Managers Meeting

20–29 Mar: NATO Allied Naval Communications Maritime Air Communications/Submarine Communications Working Group

25 Mar: Defense Advanced Research Projects Agency Human Computer Interaction Workshop

26–28 Mar: National Security Industrial Association Undersea Warfare Conference

APRIL

9 Apr: Defense Acquisition Workforce Integration Act (DAWIA) Workshop

9–10 Apr: Integrated Weapon System Management Meeting

15–18 Apr: Submarine Communications Working Group Meeting

16 Apr: Australia–Canada–New Zealand–United Kingdom–United States (AUSCANNZUKUS) Ad Hoc Working Group Meeting

22–23 Apr: Joint Countermine Operational Simulation Meeting

22–26 Apr: Joint Maritime Command Information System (JMCIS) Joint Requirements Working Group Meeting

29 Apr–3 May: Exploitation Technology Symposium

MAY

1–2 May: KG–189 Final Customer Meeting

7–9 May: NRaD/AFCEA Joint C4I Symposium

7–9 May: Global Positioning System Joint User Equipment Supportability Review

14–15 May: Information Warfare Technology Exchange

14–16 May: Freedom of Information and Privacy Conference

21–23 May: US/UK Submarine Communications Technology Symposium

31 May: Defense Acquisition Workforce Integration Act (DAWIA) Reform Acceleration Day Training

JUNE

3–6 Jun: First Meeting of the Joint US/France Technical Research and Development Project on Software Engineering Tools

11–13 Jun: Fourth Annual Military Display Workshop on Shortening Technology Insertion Paths

11–14 Jun: Intelink Mission Support Conference

24–27 Jun: National Reconnaissance Office Training and Exercise Support Symposium

25–27 Jun: Intelligence, Surveillance and Reconnaissance (ISR) and Modeling and Simulation Technical Planning Integrated Product Team Meeting

JULY

1–3 Jul: Seminar on Information Technology for Coalition Force Command and Control

15–26 Jul: Naval Research Advisory Committee (NRAC) Summer Study

AUGUST

15–16 Aug: Naval Studies Board Committee on Fire Suppression Substitutes and Alternatives to Halon

26–30 Aug: Joint Maritime Operations/Function Process Improvement Joint Fire Support Workshop

27–29 Aug: U.S. Coast Guard C4I Objective Architecture, Technology Framework Planning Sessions

SEPTEMBER

10–12 Sep: Radio Communications and Wireless Networks Workshop

10–12 Sep: Office of Naval Research 321 U.S. Active Sonar Peer Review

11 Sep: Year 2000 Workshop

16–17 Sep: Ninth Australian/U.S. Joint Study Meeting

17–19 Sep: Ballistic Missile Defense Organization Interoperability Architecture Working Group Meeting

17–20 Sep: TDDS/TADIXS–B Users Working Group Conference

18–20 Sep: Multi–Level Security System Initiative Technical Implementation/ Installation Working Group

27 Sep: Surface Warfare Officers Acquisition Professional Symposium

OCTOBER

1–3 Oct: Information and Technology Panel Meeting

8 Oct: Commercialization of Defense Technology Conference

8–9 Oct: Defense Information Infrastructure Developers Conference

9–10 Oct: Ballistic Missile Defense Organization Theater Missile Defense Battle Management Command, Control and Communications Integration Group

10 Oct: AN/UYQ–70 Users' Meeting

17–18 Oct: Infrared Signal Processing and Tracking Working Group Meeting

21 Oct: Greater San Diego Paraprofessional Library Conference

22–23 Oct: Office of the General Counsel of the Navy 1996 Field Seminars

22–24 Oct: Infrared Multi–Spectral Workshop

NOVEMBER

5–7 Nov: Battlefield Awareness and Data Dissemination (BADD) Joint Forces Interoperability Demonstration

18–20 Nov: Australia/Canada/U.S. Fifth Trilateral Forum

DECEMBER

2–6 Dec: NATO Research Study Group – 16 Meeting

3–5 Dec: 1996 Battlespace Atmospherics Conference

10–11 Dec: Ballistic Missile Defense Organization Active/Passive Radar/ Lidar Program Review

10–11 Dec: Federal Business Council Information Technology Expo

12 Dec: Tactical Advanced Signal Processor Common Operating Environment

16 Dec: Naval Studies Board Panel on Technology for the Future

17 Dec: Space and Naval Warfare Systems Command Industry Day

Acronyms

A/D	Analog-to-Digital
ACAT	Acquisition Category
ACDS	Advanced Combat Direction System
ACDS	Advanced Communications Display System
ACDS Block 0	Advanced Combat Direction System Block 0
ACDS Block 1	Advanced Combat Direction System Block 1
ACMS	Automated Communication Management System
ACT	Acquisition Coordination Team
ACTD	Advanced Concept Technology Demonstration
ACVOP	Advanced Communications Intelligence Processor
ADCU	Auxiliary Display Control Unit
ADNS	Advanced Digital Network System
ADS	Advanced Deployable System
AFC2N LAN	Air Force Command and Control Networking LAN
ALMA	Active LFM Mixer Adaptive
ANAM	Advanced Navy Aerosol Model
ANCC	Automated Network Control Center
ANDVT	Advanced Narrowband Digital Voice Terminal
AODS	All-Optical Deployable System
ARCI	Acoustic Rapid COTS Insertion
ASCIET	All Services Combat Identification Evaluation Team
ASIST	Automated Stand-Alone Intelligence Support Terminal
ASW	Antisubmarine Warfare
ATC	Air Traffic Control
ATC	Automated Technical Control
ATD	Advanced Technology Demonstration
ATDS	Airborne Tactical Data Systems
ATM	Asynchronous Transfer Mode
AUSCANNZUKUS	Australia-Canada-New Zealand-United Kingdom-United States
AWACS	Airborne Early Warning and Control System
AWG	Antenna Working Group
B2K	Bathymetric 2000
BADD	Battlefield Awareness and Data Dissemination
BBN	Berenek and Newman
BGIXS I	Battle Group Information Exchange System
BGIXS II	Battle Group Information Exchange System II
BGSIT	BATTLE GROUP system Integration Test
BLAC	Bottom-Limited Active Classification
BLOS	Beyond Line-of-Sight
BMDO	Ballistic Missile Defense Office
BPA	Blanket Purchase Agreement

C^2MUVE	Command and Control Multi-User Virtual Environment
C^2P	Command and Control Processor
C^3I	Command, Control, Communications, and Intelligence
C^4I	Command Control, Communications, Computers, and Intelligence
C^4I	Communications, Computers and Intelligence
C^4ISR	Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance
C5F/COMUSNAVCENT	Commander fifth Fleet/Commander U.S. Naval Forces Central Command
Cal/EPA	California Environmental Protection Agency
CARIBROC	Caribbean Regional Operations Center
CASREP	Casualty Report
CBT	Computer-Based Training
CCARNet	Command and Control Advanced Research Network
CCOF	Command Center of the Future
CEC	Cooperative Engagement Capability
CFOR	Command Forces
CG	Aegis Guided-Missile Cruiser
CIC	command information center
CINCLANT	Commander in Chief Atlantic
CINCLANTFLT	Commander in Chief, U.S. Atlantic Fleet
CINCPACFLT	Commander in Chief, U.S. Pacific Fleet
CINCUSNAVEUR	Commander in Chief U.S. Navy Europe
CINCUSNAVEUR	Commander in Chief, U.S. Naval Forces, Europe
CINPAC	Commander in Chief Pacific
CINC	Commander in Chief
CINCHAWK	Commander in Chief Blackhawk helicopter
CLTS	Compact Low-Frequency Active Transmit System
CNO–N51	Chief of Naval Operations
COE	Common Operating Environment
COMINWARCOM	Commander, Mine Warfare Command
COMNAVAIRPAC	Commander, Naval Air Forces, U.S. Pacific Fleet
COMNAVSURFPAC	Commander Naval Surface Force Pacific
COMNAVSURFPAC	Commander, Naval Surface Force, U.S. Pacific Fleet
COMOPTEVFOR	Commander, Operational Test and Evaluation Force
COMPASS	Common Operational Modeling, Planning, and Simulation Strategy
COMSIXTHFLT	Commander, Sixth Fleet
CONUS	Continental U.S.
CORBA	Common Object Request Broker Architecture
COTS	Commercial Off-the-Shelf
COTS/GOTS	Commercial Off-the-Shelf/Government Off-the-Shelf
CSCIs	Computer Software Configuration Items
CSCT	Characterization Technologies
CSS	Communications Support System
CT	Combined Test
CUDIXS	Common User Digital Information Exchange Subsystem
DAMA	Demand-Assigned Multiple-Access
DARPA	Defense Advanced Research Projects Agency
DAWIA	Defense Acquisition Workforce Integration Act

DCCN	Developmental Command and Control Network
DEA	Drug Enforcement Administration
DEM/VAL	Demonstration and Validation
DGPS	Differential Global Positioning System
DII	Defense Information Infrastructure
DJ	Distributed Janus
DMS	Defense Communications System
DMS	Defense Message System
DMSO	Defense Modeling and Simulation Office
DoD	Department of Defense
DPASS	DOLPHIN Programmable Acoustic Signal System
DSCS	Defense Satellite Communication System
DSN	Defense Switched Network
DT	Developmental Test
DTC–2	Desktop Tactical Computer
ECPs	Engineering Change Proposals
ECS	Engagement Control System
EESP	Environmentally Enhanced Signal Processing
EHF	Extremely High-Frequency
EMO	Electronics Material Officer
EOPACE	Electro-Optical Propagation Assessment in Coastal Environments
EPA	Environmental Protection Agency
EPLRS	Enhanced Position Location Reporting System
ESM	Electronic Support Measures
ESM	Electronic Surveillance Measures
EXGEN	Exercise Generation
FAA	Federal Aviation Administration
FCIP	Field Change Implementation Program's
FDDI	Fiber-optic Distributed Data Interface
FLIP	Floating Instrument Platform
FMOCC	Fleet Mobile Operational Command Center
FORACS	Fleet Operational Readiness Accuracy Check Sites
FOT&E	Follow-on Test and Evaluation
FTSC	Fleet Technical Service Center
GEM	Generic Emulation Module
GCCS	Global Command and Control System
GFCP	Generic Front-End Communications Processor
GINA	GPS Inertial Navigation Assembly
GMP	Generic Multi-Processor
GNI	Global Network Initiatives
GP	General Purpose Processor
GPS	Global Positioning System
GPS VME	Versa Module EuroCard
GRAM	GPS Receiver Applications Module
GUI	Graphical User Interface
GVRC	GPS VME Receiver Card

HARM	High-Speed Anti-Radiation Missile
HELIUS	High-Resolution Electronic Imaging Undersea System
HEMT	High-Electron Mobility Transistor
HF	High-Frequency
HTSC	Hughes Technical Services Company
ICC	Information Coordination Central
ICEX	Ice Exercise
IM/IT	Information Management/Information Technology
IMA	Intermediate Maintenance Activity
InMarSat	International Maritime Satellite
InP	Indium Phosphide
IOC	Initial Operational Capability
IP	Internet Protocol
IPT	Integrated Product Team
IR	Independent Research
IR	Infrared
ISEA	In-Service Engineering Agent
ISEA/PDSS	In-Service Engineering and Post-Deployment Software Support
ISR	Intelligence, Surveillance and Reconnaissance
ISTEF	Innovative Science and Technology Experimentation Facility
IT	Intelligent Terminal
IT21	Information Technology 21st Century
IT21	Information Transfer for the 21st Century
ITRC	Interstate Technology and Regulatory Cooperation
IV&V	Independent Verification and Validation
JADO/JEZ	Joint Air Defense Operation/Joint Engagement Zone
JCOS SF	Joint Countermine Operational Simulation
JDISS	Joint Deployable Information Support System
JFET	Junction Field Effect Transistor
JIC	Joint Intelligence Center
JICF	Joint Integrated Communications Facility
JITC	Joint Interoperability Test Command
JMCIS	Joint Maritime Command Information System
JMCOMS	Joint Maritime Communications Strategy
JMCOMS	Joint Maritime Communications System
JMO FPI	Joint Maritime Operations Functional Process Improvement
JPO	Joint Program Office
JSA	Joint Security Area
JSIMS	Joint Simulation System
JTASC	Joint Training Analysis Simulation Center
JTF	Joint Task Force
JTFEX	Joint Fleet Exercises
JTIDS	Joint Tactical Information Distribution System
JTPO	Joint Technology/Tactical Program Office
JWICS	Joint Worldwide Intelligence Communications Systems
JWICS	Joint Worldwide Intelligence Community System
JWID	Joint Warrior Interoperability Demonstration

KELT	Korean English Language Technologies
LAN	Local-Area Network
LCS	Life-Cycle Support
LDR	Low-Data-Rate
LEDS	Link-11 Display System
LMDS	Lockheed Martin Defense Systems
LOS	Line-of-Sight
M&S	Modeling And Simulation
MACCS	Marine Air Command Control System
MACE	Multistatic ASW Capabilities Enhancement
MAST	Mobile Ashore Support Terminal
MC SF	Marine Corps Synthetic Forces
MDARS	Mobile Detection Assessment Response System
MDARS	Mobile Detection Assessment and Response System
MDD	Magnetic Disk Device
MDR	Medium-Data-Rate
MDU	Mission Data Update
MEDEVAC	Medical Evacuation
METMF	Meteorological Mobile Facility
METRO	Metrology Office
MICFAC	Mobile Integrated Command Facility
MIDS	Multifunction Information Distribution System
MILSTAR	Military Strategic-Tactical and Relay
mini-DAMA	Miniaturized Demand-Assigned Multiple-Access
MIUW-SU	Mobile Undersea Warfare System, System Upgrade
MLDS	Multi-Link Display System
MMATS	Marine Mammal Acoustic Tracking System
MMS	Marine Mammal Systems
MOUT	Military Operations in Urban Terrain
MPL	Marine Physical Laboratory
MRCI	Mission Readiness Certification Inspections
MRCI	Modular Reconfigurable C4I Interfaces
MRHA	Multiple Robot Host Architecture
MSK	Minimum Shift Keying
MSSMP	Multipurpose Surveillance and Security Mission Platform
MTRACS	Multiple Input Tracking and Control System
MTRE	Missile Test and Readiness Equipment
MTSC	Modified Transmit Signal Characteristics
NADSC	Non-Acoustic Distributed Sensor Components
NAM	Navy Aerosol Model
NATO	North Atlantic Treaty Organization
NAVAIR	Naval Air Systems Command
NAVFACFNGCOM	Naval Facilities Engineering Command
NAVMACS	Naval Modular Automated Communications System
NAVSEA	Naval Sea Systems Command
NAVSSI	Navigation Sensor Systems Interface

NAWC-WD	Naval Air Warfare Center-Weapons Division
NCCOSC	Naval Command, Control and Ocean Surveillance Center
NCTAMS	Navy Control and Telecommunications Area Master Stations
NDI	Nondevelopmental Item
NDRO	Non-Destructive Read-Out
NECC	Navy EHF Communications Controller
NES	Network Encryption Systems
NESP	Navy EHF Satellite Program
NFESC	Naval Facilities Engineering Service Center
NIPRNET	Non-Classified Internet Protocol Router Network
NISBS	NATO Interoperable Submarine Broadcast System
NISE West	NCCOSC In-Service Engineering West Coast Division
NOVAM	Navy Aerosol Model
NOW	Navy Order Wire
NRAC	Naval Research Advisory Committee
NRAD	NCCOSC RDT&E Division
NRL	Naval Research Laboratory
NTCSS	Naval Tactical Command Support System
NTDS	Naval Tactical Data System
NTDS	Navy Tactical Data System
NTIP	Navy Technology Insertion Program
NUWC	Naval Undersea Warfare Center
Navy SF	Navy Synthetic Forces
OE	Optoelectronic
OFP	Operational Flight Program
OJT	On-the-Job Training
OMT	Operational Maintenance Test
ONI	Office of Naval Intelligence
ONR	Office of Naval Research
OPEVAL	Operational Evaluation
OPFOR	Opposing Forces
OPTEVFOR	Operational Tests, and Evaluation Force
ORT	Operational Readiness Testing
ORD	Operational Requirements Document
OSD	Office of the Secretary of Defense
OSIS	Ocean Surveillance Information System
OSS	Operation Support System
OTA	Over-the-Air
PAC-S	Passive Acoustic Classification-S
PC	Personal Computer
PCI	Pathways for Continuous Improvement
PCS	Peripheral Control Station
PINCWDMs	Polarization Independent Narrow Channel Wavelength Division Multiplexors
PITCO	Pre-Installation Testing and Check-Out
PIP	Project Implementation Plan
PLD	Programmable Logic Device
PMRF	Pacific Missile Range Facility

POL	Petroleum, Oil, Lubricant
PSG	Peripheral Support Group
PSU	Peripheral Support Unit
PLRS	Position Location Reporting System
PPD	Product Process Development
PV-FET	Photovoltaic Control of a Tuned Field Effect Transistor
PWC	Public Works Center
RSTER	Radar Surveillance Technology Experimental Radar
RF	Radio Frequency
REPOT	Radio Propagation Over Terrain
RAM	Random Access Memory
ROST	Rapid Optical Scanning Tool
RITN	Real-Time Information Transfer and Technology
RISC	Reduced Instruction Set Computer
RMSA	Redundant Matrix Switch Assembly
ROTHR	Relocatable Over-the-Horizon Radar
RNLCF	Royal Navy Link Control Facility
S-TRED*95	Standard Tactical Receive Equipment Display 1995
SATCOM	Satellite Communication
SBIR	Small Business Innovative Research
SC 21	Surface Combatant 21st Century Program
SCAPS	Site Characterization and Analysis Penetrometer System
SDP	Software Development Plan
SED	Software Engineering Directorate
SESEF	Shipboard Electronic Systems Evaluation Facility
SF Express	Synthetic Force Express
SHAPE	Supreme Headquarters Allied Powers Europe
SHEC	Scalable HPC Environment for C4I
SHF	Super High-Frequency
SI	Special Intelligence
SIF	System Integration Facility
SIPRNET	Secure Internet Protocol Router Network
SNAP II	Shipboard Non-Tactical Automated Data Processing
SOMO	Satellite System Operational Management Organization
SOVT	System Operational Verification Tests
SPAWAR	Space and Naval Warfare Systems Command
SPCD	Scalable, Parallel, Concurrent, Distributed
SRR	System Requirements Review
SSA	Software Support Activity
SSES	Ship's Signals Exploitation Space
SSIXS	Submarine Satellite Information Exchange Subsystem
STANAG	Standard Agreement
STEL	Stanford Telecommunication
STOW	Synthetic Theater of War
STU–IIIs	Secured Telephone Units, Third Generation
SUPPLOT	Supplemental Plotting
SWC	Space Warfare Center
SWELLEX–96	Shallow-Water Environmental Cell Experiment–96

SWell	Shallow-Water Evaluation Cell
Stem-B	System Telecommunications Engineer Manager-Base Level
Sub HDR	Submarine High-Data-Rate
TAC	Tactical Advanced Computer
TAC–3	Tactical Advanced Computer–3
TAC–4	Tactical Advanced Computer–4
TACINTEL	Tactical Intelligence
TACINTEL 11+	Tactical Intelligence Subsystem Upgrade
TACTERM	Tactical Terminal
TADIL	Tactical Digital Infromation Link
TADIL–J	Tactical Digital Information Link–J
TAS	Targeting Avionics System
TASD	TAS Demonstration
TBA	Theater Battle Arena
TDA	Technical Direction Agent
TDPs	Tactical Data Processors
TECHEVAL	Technical Evaluation
TESS III	Tactical Environmental Support System
TESSNC	Tactical Environmental Support System Next Century
TFCC	Tactical Flag Command Center
TFCC	Tactical Flag Command and Control
TIBS	Tactical Information Broadcast System
TIPRS	Tomahawk Inflight Position Reporting System
TLCF	TACINTEL Information Exchange Subsystem Link Control Facility
TLCF	TACINTEL Link Control Facility
TNI	Theater Network Initiatives
TRDP	Technology Research and Development Project
TRU	Tomahawk Receiver Units
TSL	Tactical Systems Laboratory
TSU	TACINTEL II+ Subscriber Upgrade
TSU–162	TACINTEL Subscriber Upgrade MVME–162
TTF	Trident Training Facility
TTO	Tactical Technology Office
UAV	Unmanned Aerial Vehicle
UB	Unified Build
UE-96-1	Unified Endeavor
UFO/E	UHF Follow-On/E
ULITE	Ultra-Lightweight Sensor System
ULSS	User's Logistics System Summary
URMTT	Universal Radar Moving Target Transponder
USAID	U.S. Agency For International Development
USACOM	United States Atlantic Command
USIA	U.S. Information Agency
USPACOM	U.S. Pacific Command
VERDIN	Very Low-Frequency Digital Information Network
VCL	Virtual Collaboratory
VLA	Vertical Line Array

VME	Versa Module EuroCard
VSAT	Very Small Aperture Terminal
VTC	Video Teleconferencing
WANs	Wide-Area Networks
WAN	Worldwide Area Network
WES	Waterways Experiment Station
WGA	Western Governors Association
WTDM	Wavelength/Time-division Multiplexed

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