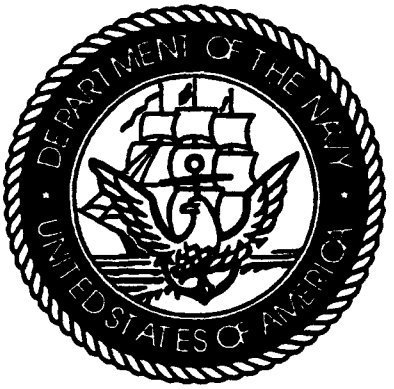
DEPARTMENT OF THE NAVY
DOMESTIC TECHNOLOGY TRANSFER



ANNEX B

OCTOBER 1993

Section 4224, Public Law 102-484, October 23, 1992

This report responds to the above statute. It is an assessment of the potential of certain designated Navy activities to promote technology transfers, and recommendations of the manner in which each such activity might better promote such transfers.

ANNEX B

DEPARTMENT OF THE NAVY DOMESTIC TECHNOLOGY TRANSFER

CONTENTS:

1. INTRODUCTION

1.1 BACKGROUND

This report is submitted in partial satisfaction of the requirements of Section 4224 of the Defense Authorization Act (Public Law 102-484). The subject section requires the following:

> (1) An assessment of the potential of each defense laboratory to promote the transfers described in 2514(c) of title 10, United States Code, as added by subsection (a).
>
> (2) Recommendations on the manner in which each such laboratory might better promote such transfers. [This describes what each lab is planning to do to improve.]
>
> (3) A description of the extent to which each such laboratory has implemented effectively the plan established for the laboratory under subsection (c) during the year preceding the date of the report. [The initial report will simply state what the labs are doing and will serve as the basis for comparison for subsequent reports.]
>
> (4) Recommendations of the Secretary for improvement of the Federal Defense Laboratory Diversification Program established pursuant to such section 2514(c).

In compliance with Section 4224, this report describes the capabilities and efforts of the designated Navy activities to conduct technology transfer with the private sector. Designated activities have been selected based upon the criteria specified by Congress; namely, laboratories whose Research, Development, Test, and Evaluation (RDT&E) budget is more than $50M. The Navy activities so defined are--

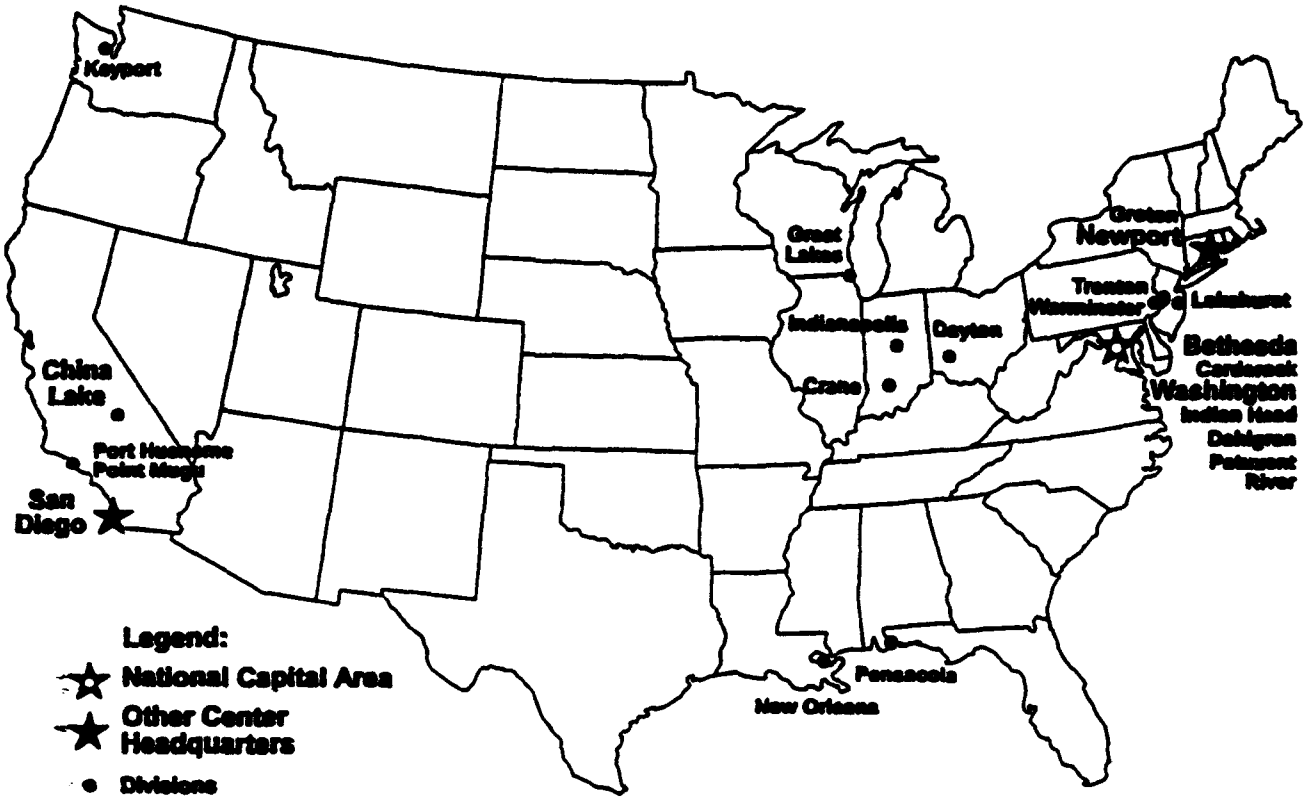
- Naval Research Lab
- Naval Air Warfare Center
- Naval Surface Warfare Center
- Naval Medical Research & Development Center
- Naval Command, Control & Ocean Surveillance Center
- Naval Undersea Warfare Center

Locations of these center headquarters and their divisions are shown in Figure 1.

1.2 THE REPORT IS STRUCTURED AS FOLLOWS

The six reporting commands are presented in separate sections. The Naval Medical Research and Development Command and the Naval Research Laboratory each include one overall summary sheet, which details their mission, capabilities as related to technology transfer, and unique facilities. The remaining four reporting Centers include overall summary sheets, but in addition include separate sheets for each reporting Division. In addition to these summary sheets, data on technology transfer activities is given for all reporting Commands. At the end of the report, Navy technology transfer success stories are given.

Navy Technology Transfer Reporting Command



Naval Research Laboratory
- Headquarters: Washington, DC

Naval Medical Research and Development Center (NMRDC)
- Headquarters: Bethesda, MD
- Dental: Great Lakes, IL; Bethesda, MD
- Infectious Disease: Bethesda, MD; San Diego, CA; Egypt; Indonesia; Peru; (only CONUS shown)
- Chemical Defense: Dayton, OH; San Diego, CA
- Biological Defense: Washington, DC
- Human Systems: Washington, DC; Groton, CT; New Orleans, LA; Pensacola, FL
- Combat Casualty Care: Washington, DC

Naval Air Warfare Center (NAWC)
- Headquarters: Washington, DC
- Aircraft Division: Indianapolis, IN; Lakehurst, NJ; Patuxent River, MD; Warminster, PA; Trenton, NJ
- Weapons Division: China Lake, CA; Point Mugu, CA

Naval Command, Control and Ocean Surveillance Center (NCCOSC)
- Headquarters: San Diego, CA
- Research, Development, Test and Evaluation Division (NRaD): San Diego, CA
- West Coast In-Service Engineering Division (NISE West): San Diego, CA
- East Coast In-Service Engineering Division (NISE East): San Diego, CA

Naval Surface Warfare Center (NSWC)
- Headquarters: Washington, DC
- Carderock (MD) Division
- Crane (IN) Division
- Dahlgren (VA) Division
- Indian Head (MD) Division
- Port Hueneme (CA) Division

Naval Undersea Warfare Center (NUWC)
- Headquarters: Newport, RI
- Newport (RI) Division
- Keyport (WA) Division

* Reporting from some smaller activities is included in parent command

Figure 1. Navy Technology Transfer Reporting Commands.

1.3 DEPARTMENT OF THE NAVY (DON) SBIR PROGRAM

1.3.1 The DON SBIR Program solicits Phase I proposals for six-month/$100K contracts (typical) semiannually. DON topics in the DoD Program solicitation (FY) 94.1 solicited proposals in twenty-two science and technology areas. The program supports R&D proposals preferred by qualified U.S. small businesses on the basis of four criteria: (1) technical quality, (2) potential for commercialization, (3) adequacy for fulfilling the topic requirement and (4) qualifications of proposed investigators. Pre-solicitation announcements are published by the Small Business Administration. Technical and administrative assistance with preparing of proposals is available to eligible businesses from the Defense Technical Information Center and Defense Contract Management Districts/Area Organizations, respectively, among others. Twenty-eight DON administrative offices assist with proposal receipts and evaluations, as well as with contract planning, awards and technical monitorings/ assessments. Phase II contract awards (up to two years/$750K) and Phase III awards (to be supported by non-SBIR, government or private funding) are implemented and planned, respectively, as required. The program has been reprogrammed as Exploratory Development (6.2) in FY94 and the out-years in order to enhance development and support of dual-use applications.

1.3.2 FIGURE 2 SUMMARIZES FISCAL DATA FOR THE DON SBIR PROGRAM. FY93 funding information is incomplete as most of it had not been released to the Warfare Centers/Laboratory at the time of this report preparation. However, the allocations will approximate the same proportions of the FY92 funding managed by each listed activity.

DON SMALL BUSINESS INNOVATION RESEARCH PROGRAM

	FY 92($K)			FY 93($K)		
LAB/CTR*	I	II	III	I	II	III
NSWC/CD	606	226	0	TBD	TBD	TBD
NSWC/DD	3,294	9,402	2,174	TBD	TBD	TBD
NSWC/DD/CSS	209	0	0	100	1,108	TBD
NSMC/CRANE	459	200		TBD	TBD	TBD
NSWC/PTHU	99	0	0	273	303	TBD
NSWC/IH	250	212	0	TBD	TBD	TBD
NSWC(subtotal)	4,917	10,040	2,174	373	1,411	TBD
NAWC/W/CL	314	1,114		TBD	TBD	TBD
NAWC/W/MUGU	149	284	0	TBD	2,862	3,359
NAWC/A/FTEG	0	2,946	0	TBD	TBD	TBD
NAWC/A/IND	0	0	0	TBD	TBD	TBD
NAWC/A/LKE	102	0	400	156	820	TBD
NAWC/A/TRE	186	55	0	304	177	TBD
NAWC/A/WAR	102	578	100	1,404	2,157	TBD
NAWC/NTSC	0	509	0	97	483	TBD
NAWC(subtotal)	853	5,486	100	1,805	5,679	3,359
NCCOSC	313	2,817	0	391	487	TBD
NUWC	420	262	0	TBD	TBD	TBD
NRL	338	0	0	243	808	TBD
NMRDC	48	383	0	48	270	TBD
NCEL	99	0	0	TBD	TBD	TBD
NPRDC	0	0	0	TBD	TBD	TBD
SUBTOTAL	6,988	18,992	2,674	3,016	7,847	3,359
ONR/SYSCOMs:		17,764			70,705	325
GRAND TOTAL: I + II		43,406			81,244	
I + II + III			46,080			84,928

FIGURE 2

* Some of the activities listed in the SBIR are not otherwise included in this report because they do not meet the $50M RDT&E budget guideline.

1.4 DON PATENTS SUMMARY

1.4.1 PATENTS STATISTICS

It is Navy policy to maintain close surveillance of the Navy's research and development effort, both in-house and through contract/grant, to obtain disclosures of inventions from Navy and contractor/grantee employees. Each disclosure, except those on inventions on which the contractor/grantee has elected to file a patent application, is evaluated so as to enable selection of only the most essential inventions for which the Navy will expend manpower and funds for applications for patent. The following is a summary of the patent statistics for FY 92 and FY 93 (part-year):

NAVY PATENT STATISTICS

PATENTS ISSUED FY 1992 - 319

NAWC - 77
NSWC - 60
NUWC - 45
NCCOSC - 54
NRL - 58
NMRDC - 2

NON-REPORTING ACTIVITIES

NAVSEA HDQ - 6
SUB SPEC PROJ OFF - 15
ONR - 2

PATENT APPLICATIONS FILED FY 1992 - 473

NAWC - 96
NSWC - 109
NUWC - 83
NCCOSC - 54
NRL - 99
NMRDC - 14

NON-REPORTING ACTIVITIES

NAVSEA HDQ - 4
SUB SPEC PROJ OFF - 7
ONR - 7

PATENT LICENSES GRANTED FILED FY 1992 - 11

NAWC - 2
NSWC - 0
NUWC - 1
NCCOSC - 1
NRL - 2
NMRDC - 1

NON-REPORTING ACTIVITIES

NAVAL CIVIL ENG LAB (NCEL) - 3
NAVAL ACADEMY - 1

INVENTIONS LICENSED FY 1992

15

ROYALTY INCOME FY 1992

$206,135

PATENTS ISSUED FY 1993 (AS OF 6/30/93) - 237

NAWC - 55
NSWC - 60
NUWC - 41
NCCOSC - 17
NRL - 46
NMRDC - 6

NON-REPORTING ACTIVITIES

NAVSEA HDQ - 6
SUB SPEC PROJ OFF - 4
ONR - 2

PATENT APPLICATIONS FILED FY 1993 (AS OF 6/30/93) - 345

NAWC - 66
NSWC - 60
NUWC - 60
NCCOSC - 37
NRL - 92
NMRDC - 9

NON-REPORTING ACTIVITIES

NAVSEA HDQ - 11
SUB SPEC PROJ OFF - 2
ONR - 8

PATENT LICENSES GRANTED FY 1993 (AS OF 6/30/93) - 13

NAWC - 0
NSWC - 4
NUWC - 0
NCCOSC - 2
NRL - 3
NMRDC - 1

NON-REPORTING ACTIVITIES

NCEL/NTSC - 2
ONR - 1

INVENTIONS LICENSED FY 1993

18

ROYALTY INCOME FY 1993

$353,927

FY 1992: Two (2) licenses were with academia and involved three (3) patents. All other licenses were with industry partners.

FY 1993: One (1) license was with academia and involved one (1) invention. All other licenses were with industry partners.

DEPARTMENT OF THE NAVY
DOMESTIC TECHNOLOGY TRANSFER

2. REPORTING COMMANDS

2.1 NAVAL RESEARCH LABORATORY (NRL)
WASHINGTON, DC

2.1.1 OVERVIEW
2.1.2 DATA (INCLUDING DTIC REPORTS)
2.1.3 PLANS

2.1.1 OVERVIEW

NAVAL RESEARCH LABORATORY
ORTA CODE 1003.1
4555 OVERLOOK AVE.
WASHINGTON, DC 20375

Contact: Dr. Richard H. Rein
Tel 202-767-3744
Fax 202-404-7920

Mr. Steven A. Roberts
Tel 202-404-8411
Fax 202-404-7920

SYNOPSIS: NRL has a broadly-based multidisciplinary program of scientific research and advanced technological development directed toward new and improved materials, equipment, techniques, systems, ocean, atmospheric and space sciences and related technologies.

EXPERTISE:

Materials Physics, Physical Metallurgy, Mechanics and Structural Properties, Composites and Ceramics, Environmental Effects

Biologically Derived Microstructures, Biosensors, Combat Casualty Care, Environmental Quality, Polymers and Liquid Crystals, Surfaces and Interfaces

Chemical Diagnostics, Materials Chemistry, Surface/Interface Chemistry, Combustion and Fuels

Electronic Materials, Microwave Technology, Solid State Devices, Vacuum Electronics

Optical Materials, Advanced Concepts, Applied Optics, Laser Physics, Electro-Optical Technology, Optical Techniques

Communications Systems, Human/Computer Interaction, High Assurance Computer Systems, Transmission Technology, Advanced Information Technology

Remote Sensing, Astrometry, Radio Science, Image Research/Systems

UNIQUE FACILITIES:

HIGH MAGNETIC FIELD FACILITY (HMFF) - The HMFF has two types of magnets: Bitter-type solenoids and superconducting magnets. These magnets are driven by a 6-MW semiconductor rectifier power supply. There are five superconducting magnets at HMFF. One unique aspect of HMFF is a wealth of far infrared apparatus, including laser sources, interferometers, and radiation detectors.

WALDORF MICROWAVE SPACE RESEARCH FACILITY - This seven acre facility is comprised of a solid-surface Aeronca antenna, a mesh-Kennedy antenna, and assorted buildings for antenna control, power supply and other support functions.

WIND/WAVE CHANNEL - Studies nonlinear wave interactions, wave effects on structures, wake hydrodynamics, and other marine and environmental fluid mechanics research. Experiments to study wave-breaking mechanisms for deep-water ocean waves have been done since 1983.

FIBER OPTIC SENSOR SYSTEM FACILITY - This facility has a unique capability for the characterization and performance evaluation of fiber optic sensors and sensor systems.

DIGITAL IMAGE PROCESSING LABORATORY (DIPL) - A central image processing facility (DIPL) provides NRL with a powerful software/hardware complex for the support of various ongoing programs. The laboratory conducts research in computer-aided image enhancement, image interpretation, and image presentation. It also provides image processing services to various DOD organizations on a special need basis.

BULK CRYSTAL GROWTH FACILITY - The bulk crystal facility has the capability of producing polished wafers of compound semiconductors starting from the elements. Crystal growth capabilities include high pressure Czochralski, Vertical Bridman, Vertical and Horizontal Gradient Freeze and vertical Zone Melt.

2.1.2 DATA

2.1.2.1 Offices of Research and Technology Application (ORTAs) and DTT Focal Points.

ORTA and DDT Focal Point staffing and budget: FY 92 $223,578, FY 93 (to date) $318,448.7. Staffing: GM-15 Engineer; GS-13 Scientist; GS-12 Engineer; GS-6 Secretary

Publicity/publications. See attached Brochure, 1(f).

2.1.2.2 DTIC Reports

(a) NRL Technical Reports Submitted to DTIC

FY92	FY93 (3 qtrs)	Total
483	136	619

(b) Representative Titles

"Atomistic simulation of the nanoindentation of diamond and graphite surfaces."

"Direct measurement of the temperature-dependent piezoelectric coefficients of composite materials by laser doppler vibrometry."

"High frequency scattering from spherical shells and internal reflection resonances."

"Rayleigh backscatter-induced noise effects in remotely addressed fiber Michelson interferometers."

"The role of expert systems in ocean forecasting."

"Sole isotope fractionation by sulfate-reducing bacteria in corrosion products."

"Transport in ultra-dense plasmas produced by a picosecond laser pulse."

2.1.2.3 Publications

(a) Representative names of scientific, technical, and professional journals in which NRL published:

Journal of Computational Physics
IEEE Journal of Quantum Electronics
Journal of the Optical Society of America
Physical Review Letters
Journal of the Acoustical Society of America
Computer Physics Communications

(b) Approximate number of publications (including conference proceedings and books):

FY 92: 1,113; FY 93 (to date): 733

(c) Representative titles of publications:

"Optical Fiber Sensor Technology"
"Depth Distribution of Energy Deposition by Ion-Bombardment"
"Optical Waveguides Formed by Thermal Migration Ions in Glass"
"Anomalous Magnetization of Amorphous TbFe2, Gd Fe2 and YFe2"

"Flux-Corrected Transport. 3 Minimal-Error FCT Algorithms"

2.1.2.4 Conference & Symposia

		FY92	FY93 (to date)
(a)	Number Hosted by NRL:	175	105
(b)	Number Participated in by NRL:	2,153	1,158
(c)	Average number of attendees for Conferences Hosted by NRL is:	27	23
(d)	Conferences Participated in by NRL:	Not Available	
(e)	Number of attendees at conferences: conferences:	range is 10-14,000	

2.1.2.5 Exchange Programs & Visits (Industry, academia, state & local government, foreign)

(a) Exchanges with industry, academia, state & local government.

	FY92	FY93 (to date)
USNA Summer Faculty Program	11	12
ASEE Summer Faculty Program	29	40
ASEE Sabbatical Leave Program	4	4
ONR Graduate Fellows	8	6
NRC Post Doc Program	34	23
ONR Post Doc Program	26	12
IPA	5	5
Summer Hires-Students	65	60
1040 Students	41	19
Co-op Students	39	27
Science & Engg. Appren. Program	90	66
Student Volunteers	4	7

(b)	Foreign visitors	1,780	1,008
(c)	Foreign visits by laboratory personnel	859	534

2.1.2.6 Grants and Cooperatives Agreements

(a) Donations of equipment to universities (include GFE turned over to universities) — No information available for equipment

	FY92	FY93 (to date)
Number of Grants to universities:	45	27
Total $ of Grants:	$5,972,659	$6,374,115

(b)	Investments in university facilities	None	None

(c) Education Partnerships

USNA Summer Faculty Program
ASEE Summer Faculty Program
ASEE Sabbatical Leave Program
ONR Graduate Fellows
NRC Post Doc Program
ONR Post Doc Program
IPA
Summer Hires-Students
1040 Students
Co-op Students

Science & Engineering Apprenticeship Program
Student Volunteers
NRL Ballou Award
Black History Contest
Youth Leadership Program
Science Fair
Tours
Career Day
Young Astronauts Program
National Association of Partners in Education
Equipment Loan Program
Book Donations
Student Employment Program
Tutoring and Mentoring Program
Shadowing Program

(d) URI & Centers of Excellence: Not an NRL function

2.1.2.7 Use of laboratory facilities

(a) Agreement other than CRADAs that involve company use of DoD facilities

	FY92	FY93 (to date)
Number of Special Deposits:	88	46
Total $ of Special Deposits:	$3,251,329	$2,508,148

(b) Industry use of test centers. Give subject matter of effort and the level of effort ($s and/or Man-days) N/A, since NRL is not a test center

2.1.2.8 CRADAs

(a) Active CRADAs:

Louisiana State University	academia
ManLabs	academia
CER Corporation	industry
Johnson Controls Battery Group, Inc.	industry
Ingalls Ship Building, Inc.	industry
Alliant Tech Systems, Inc.	industry
Amoco Production Company	industry
US Alcohol Testing of america, Inc.	industry
Shipley Company, Inc.	industry
Harmonic Lightwaves, Inc.	industry
Sealar Corporation	industry
Thiokol Corporation	industry
Technology Assessment and Transfer, Inc.	industry
Ft. Belvoir	state & local
Quantum Magnetics	industry
Virginia Center for Innovative Technology	industry
University of Alaska-Fairbanks	academia

(b) CRADAs under negotiation, number 10

(c) Lab investment (estimate); $2,310,000

(d) Incoming producing (yes or no, if "no" what about the future?)

Louisiana State University	yes
ManLabs	no
CER Corporation	yes
Johnson Controls Battery Group, Inc.	no
Ingalls Ship Building, Inc.	no
Alliant Tech Systems, Inc.	no
Amoco Production Company	yes
US Alcohol Testing of America, Inc.	yes
Shipley Company, Inc.	yes
Harmonic Lightwaves, Inc.	yes
Sealar Corporation	yes
Thiokol Corporation	no
Technology Assessment and Transfer, Inc.	no
Ft. Belvoir	no
Quantum Magnetics	no
Virginia Center for Innovative Technology	no: yes for future
University of Alaska-Fairbanks	no

(e) Criteria for deciding if income is desired:

Income is desired when needed to cover NRL's costs associated with cooperative agreements.

(f) Describe non-monetary contributions;

Facilities and equipment which are not otherwise depreciated and part of overhead costs are available for these agreements.

(g) Reason(s) for backlog, if any

Normal delays result from the routing process. No backlog exists beyond that.

2.1.2.9 Intellectual Property, Including Patents, Copyrights, and Trade Secrets

	FY92	FY93 (to date)
(a) Patents (number & titles) Titles too numerous to list.	58	48
(b) Patent Applications (number & titles) Titles too numerous to list.	99	96

(c) Licenses:

Ovanic Synthetic Materials Company	industry
Edge Technologies	industry
Ultrafine Powder Technology	industry
GMD Systems, Inc.	industry
Iowa State University Research Foundation	academia
U.S. Alcohol Testing of America, Inc.	industry
Cardolite Corporation	industry
Edge Technologies	industry
Sandoil Company	industry
QE Technology, Inc.	industry
GEO-Center/Shipley	industry
Allied Corporation	industry
Hampshire Instruments, Inc.	industry
Insect and Aquatic Management Systems, Inc.	industry

(d) Royalty Income

	FY92	FY93 (to date)
Ovanic Synthetic Materials Company	$ 5,000	$ 2,500
Edge Technologies	$ 5,000	$ 5,000
Ultrafine Powder Technology	$0	$ 4,250
GMD Systems, Inc.	$0	$ 1,000
Iowa State University Research Foundation	$0	$ 4,500
U.S. Alcohol Testing of America, Inc.	$75,000	$127,000
Cardolite Corporation	$10,000	$ 2,000
Edge Technologies	$ 5,000	$ 10,000
Sandoil Company	$ 5,000	$ 5,000
QE Technology, Inc.	$ 3,000	$ 3,000
GEO-Center/Shipley	$0	$ 20,000
Allied Corporation	$0	$0
Hampshire Instruments, Inc.	$0	$0
Insect & Aquatic Management Systems, Inc.	$182.65	$28.41

(e) CRADAs that provide trade secrets, know-how, copyrights

Shipley Company, Inc.
Virginia CIT
US Alcohol Testing of America, Inc.
Technology Assessment, Inc.

(f) Describe backlog in patent applications: None

(g) Attorneys supporting DTT, including patent attorneys.

Thirteen attorneys support DTT, representing a total of 7.0 MY ($1,050,000) (all attorneys located in Washington headquarters.)

Attorney travel budget - $7,500

The attorneys teach scientists and engineers regarding patent and license requirements through direct communications, seminars, talks, booklets, and articles.

2.1.2.10 Technology Reinvestment Project Efforts

(a) Manhours and resources provided to support the TRP staff, proposal team formation/ proposal development, and sources selection	1.5 person months
(b) Number of proposals received in each Deployment Activity, Technology Focus Area, and Education Activity.	(Not available)

2.1.2.11 Interactions with non DoD organizations — Too numerous to list

2.1.2.12 **Efforts carried out under legal authorities other than the Steven-Wydler Technology Innovation Act of 1980, as Amended (Describer the efforts, if any, and the legal authority.**

Special Deposits	Navy Regulation § 0835
Columbia University	Navy Regulation § 0835
Ferrite Consortium	31 U.S. Code § 6305
GFE donations	Redelegation of Authorities and Responsibilities from the Secretary of the Navy to Navy Organizations for Science and Engineering Education, 7 January 93

2.1.3 PLANS

Improving the local technology transfer process.

(a) The principal thrust of NRL's Technology Transfer Program will focus on licensing of patents and the development of CRADAs with U.S. industry. This emphasis is based on our belief that it represents that most effective means of transitioning technology resources from our laboratory to the U.S. private sector for the purpose of creating jobs and enhancing the international competitiveness of our economy.

(b) Our approach will be to focus on a limited number of technologies. To accomplish this, we will endeavor to use a structured three step approach:

1) Identifying Technology	2) Developing a transition Strategy	3) Finding a Partner
Elements	Elements	Elements
• Does the Technology satisfy a market need? • Does it offer significant advantages? • Is it ready for transition? • Is there a committed champion?	• Create a vision of the commercial opportunity • Catalog the end markets • Identify companies serving the markets • Recognize strengths required of the partner Technology, Marketing, Manufacturing, Financial	• Protect Champion Recommendations • Data Bases • Networking • Marketing Program

(c) The number of meetings and conferences dealing with Technology Transfer has increased significantly recently. NRL intends to limit its participation in these activities and will continue to monitor the benefits. Industrial interest in NRL's technology has been and is anticipated to continue to be greatest in the fields of Advanced Materials, Chemistry, Sensors, Biomolecular Engineering, Microelectronics and Optics.

(d) Acceptable measures of performance for Technology Transfer do not exist within the Federal laboratories, although efforts are being made to establish a system. NRL will monitor licensing income and levels of CRADA research on a periodic basis and monitor the efforts to establish a national system.

DEPARTMENT OF THE NAVY
DOMESTIC TECHNOLOGY TRANSFER

2. REPORTING COMMANDS

2.2 NAVAL MEDICAL RESEARCH AND DEVELOPMENT CENTER (NMRDC) BETHESDA, MD

2.2.1 OVERVIEW
2.2.2 DATA (INCLUDING DTIC REPORTS)
2.2.3 PLANS

2.2.1 OVERVIEW

NAVAL MEDICAL RESEARCH AND DEVELOPMENT COMMAND
Bethesda, MD 20889-5606

ORTA and Director of Research and Development (Code 04)

CONTACT: Captain Robert Carter, Ph. (301) 295-0883, Fax 295-4033, email rdc04@nmrdc1.nmrdc.nnmc.navy.mil.

SYNOPSIS: The Naval Medical Research and Development Command (NMRDC) is one of the most efficient Cooperative Research and Development Agreement (CRADA) generators in the Federal Government (23 CRADAs/$105M). NMRDC is a system of 11 laboratories worldwide with a headquarters in Bethesda MD. NMRDC integrates resources from dozens of sponsors and manages the performance of hundreds of government and extramural performers in biomedical R&D ranging from basic research to engineering development. Complete listings of CRADAs or work units and performers are available from the contact cited above.

EXPERTISE: Infectious disease expertise is found in NMRDC overseas laboratories in Cairo (Egypt), Jakarta (Indonesia) and Lima (Peru). They have capabilities for tropical medicine and field trials of pharmaceuticals, especially those related to malaria, HIV, cholera, dengue, schistosomiasis, campylobacter, enterotoxigenic E. Coli, and leishmaniasis. Medical entomology related to diseases at overseas sites includes antigen detection, pesticides and pesticide resistance. Other infectious disease research capabilities are available at Bethesda, MD.

Aviation medicine expertise resides at Pensacola, FL. There are capabilities in environmental pathophysiology, protection and assessment of vision and hearing, spatial disorientation and motion sickness, and aviator selection and performance.

DOD Dental research is collocated at Great Lakes, IL. Additional Navy dental capabilities are in Bethesda, MD and the overseas laboratories. Dental capabilities include oral microbiology, manufacturing technology for unique (dental prosthetic) items, dental materials, sterilization techniques, and immunobiology of bone.

Undersea Medicine research at Groton, CT features expertise in auditory and visual perception, including evoked auditory emissions and novel techniques for presentation of signals in noise to enhance their detection.

Diving medicine research at Bethesda, MD emphasizes treatments for decompression sickness and arterial gas embolism, high-pressure neurophysiology, hydrogen diving, and work in cold water. Decompression tables based on probabilistic reasoning and data from decompression experiments is another capability; potential applications include a decompression meter.

Research in Biodynamics, acceleration measurement, high-speed photogrammetry, neuro-electrophysiology, ship motion, and impact acceleration are accomplished at New Orleans.

San Diego CA capabilities include physiological measurement of states of attention, exercise and sports physiology, physiology of hot and cold environments, physiological testing of microclimate cooling devices, sleep management and epidemiology.

Toxicologic research, including behavioral toxicology, is conducted in Dayton, OH. Capabilities for measurement of bioeffects and bioabsorption of radiofrequency radiation (e.g., for hypothermic rewarming) are at San Antonio TX and Pensacola FL.

Biomedical expertise at Bethesda, MD, includes wound healing, septic shock, hypothermia, blood substitutes, rapid assays, immunology and transplantation.

UNIQUE FACILITIES:

New Orleans, LA facilities include a man-rated three-degree-of-freedom ship motion simulator capable of a 22-foot heave, man-rated vertical and horizontal impact accelerators and a data base of human and monkey head and neck responses to impact acceleration.

Thomas Domes toxicology facilities are in Dayton, OH.

Spatial orientation test facilities in Pensacola, FL include a rotating room and several multiple-degree of-freedom devices.

NMRDC has unique overseas field test sites for infectious disease vaccines, prophylaxis and treatments.

Microwave and other radiofrequency radiation generators for bioeffects testing, and "green man" technology for assessment of bioabsorption are in Pensacola, FL and San Antonio, TX.

Heat/cold research facilities are available in Bethesda, MD; San Diego, CA; and Pensacola, FL.

Bethesda, MD has a hyperbaric facility man-rated to 3300 feet of sea water, with extensive experience in mixed-gas and saturation diving. Groton, CT, has a 10-foot diameter hyperbaric man-rated to 350 feet of seawater. Both of these facilities have capabilities for immersion.

ALAC-accredited animal facilities are in Great Lakes, IL and Pensacola, FL.

Area of Laboratory Expertise, by ASBREM Joint Technical Coordinating Group (JTCG) Categories

JTCG 1, Dental
Naval Dental Research Institute, Great Lakes, IL
Research Department, National Naval Dental Center, Bethesda, MD

JTCG 2, Infectious Disease
Naval Medical Research Institute (NMRI), Bethesda, MD
Naval Medical Research Unit-2, Jakarta Indonesia
Naval Medical Research Unit-3, Cairo Egypt
NMRI Infectious Disease Detachment, Lima Peru
Naval Health Research Center (NHRC Epidemiology Dept), San Diego, CA

JTCG 3, Chemical Defense
NMRI Toxicology Detachment, Dayton OH
NHRC (Applied Physiology Dept re heat problems of protective garments), San Diego, CA

JTCG 4, Biological Defense
NMRI
Naval Research Laboratory, Washington, DC
NHRC (Applied Physiology Department)

JTCG 5, Human Systems
NMRI (deep sea diving, diver performance, heat/cold stress)
NHRC (sustained/continuous operations, work physiology, conditioning, nutrition, fitness standards, neuroscience, personnel measurements)
Naval Submarine Medical Research Laboratory, Groton, CT (deep sea diving, submarine medicine, nutrition, vision and hearing conservation/measurement, sonar displays, human factors, fitness standards)
Naval Biodynamics Laboratory, New Orleans, LA (impact acceleration, aviation crew safety systems, ship motion, SECNAV-approved human research volunteers)
Naval Aerospace Medical Research Laboratory, Pensacola FL (spatial orientation, aviator selection, radiofrequency radiation bioeffects, continuous/sustained operations)

JTCG 6, Combat Casualty Care
NMRI (septic shock, would healing, non-freezing cold injuries, blood products and substitutes)
NHRC (casualty rate estimation, electronic "dog tag", computer-assisted diagnosis, orthopedic injuries from physical training)

2.2.2 DATA

2.2.2.1 Offices of Research and Technology Application (ORTA) and Defense Technology Transfer Focal Points

(a) Naval Medical Research and Development Command maintains a headquarters ORTA and ORTAs in some subordinate laboratories having more technology transfer activity. The Headquarters ORTA POC is the Director of Research and Development (CAPT Carter). He is supported by a part-time management assistant to maintain files of technology transfer regulations and to keep track of patent prospects and CRADAs under review throughout his staff. He has the support of a full-time Intellectual Property Counsel.

(b) Subordinate laboratories with part-time ORTAs include Naval Aerospace Medical Research Laboratory (LCDR Dolgin), and Naval Medical Research Institute (CAPT Gaugler).

(c) Navy medicine has provided two focal points for the Defense Technology Transfer Program. CDR Peter Kent is focal point for trauma care, and CAPT Ronald Turco is focal point for medical information systems.

(d) As part of its technology transfer outreach, NAVMEDRSCHDEVCOM published a solicitation for CRADA partners in Commerce Business Daily (Attachment A). This generated dozens of inquiries. The same solicitation is on national electronic mail networks.

(e) In addition, NAVMEDRSCHDEVCOM has published and distributed 700 copies of a directory (Attachment B) of its principal investigators. This directory facilitates private sector searches for ongoing projects and capabilities with potential for spin-off.

(f) Naval Medical Research and Development Command has published four new instructions during the past year to define its technology transfer processes. It distributed copies of its Broad Agency Announcement to all Historically Black Colleges and Universities.

2.2.2.2 DTIC Reports

(a) NMRDC Technical Reports Submitted to DTIC

FY92	FY93 (3 qtrs)	Total
58	25	83

(b) Representative Titles

"Diagnosis, treatment, and prevention of malaria."
"The effects of digital sampling rate and bit quantization on passive auditory sonar target detection performance."
"The endemic infectious diseases of Somalia."
"Heterosexual transmission of viral hepatitis and cytomegalovirus among United States military personnel stationed in the Western Pacific."
"Hydrogen-rated systems for in vitro studies at pressure: operating procedures and emergency procedures."
"Steroids in pneumococcal meningitis."
"Vivax malaria resistant to treatment and prophylaxis with chloroquine."
"Potential Clinical Applications of Signal Transduction
"Measurements in Marrow Transplantation and HIV-1 Infection."

2.2.2.3 Publications published in 62 journals.

(a) Representative Names of Journals (total of 62):
- American Journal of Physiology
- Behavioral and Neural Biology
- Cellular Immunology
- Electroencephalography and Clinical Neurophysiology
- Immunology Today
- Journal of Applied Physiology
- Medicine and Science in Sports and Exercise
- Pharmacology, Biochemistry, and Behavior

(b) Number of Publications including conference proceedings and books: 287

(c) List of representative titles:

- "T cell-receptor mediated recognition of self-ligand induces signaling in immature thymocytes before negative selection."

- "Variations in thymocyte susceptibility to clonal deletion during ontogeny. Implications for neonatal tolerance.

- "Potential clinical applications of signal transduction measurements in marrow transplantation and HIV-1 infection."

- "Characterization of the Mls^{r} system. II. Identification of Mouse Mammary Tumor Virus Proviruses involved in the clonal deletion of self-Mls^{r}-reactive T cells."

- "Tyrosine Reverses a Cold-Induced Memory Deficit in Humans."

- "Biological Responses to Exchange Transfusion with Liposome-Encapsulated Hemoglobin."

- Makeig, S., and Inlow, M., "Lapses in alertness: coherence of fluctuations in performance and EEG spectrum" Electroencephalography and Clinical Neurophysiology (at press)

- Makeig, S., Elliott, F.S., and Postal, M., "First Demonstration of an Alertness Monitoring/Management System". Naval Health Research Center, San Diego, CA. (in preparation)

2.2.2.4 Conferences and Symposia

(a) More than 500 attendees: 55

Examples:

- Schrot, J (Apr 1992). Effects of L-tyrosine administration on cold-induced memory deficits. Naval Surface Warfare Center, Silver Spring, MD - more than 500 attendees.

- Armstrong, DW (May 1992). Aerobic fitness in women affects metabolic and endocrine responses to 3.5° air. American College of Sports Medicine, Dallas, TX - more than 500 attendees.

- Shurtleff, D (Oct 1992). Tyrosine reverses a cold-stress-induced memory deficit in humans. Annual Meeting for the Society for Neuroscience, Anaheim, CA - more than 500 attendees.

- June, CH (Aug 1992). Potential Clinical Applications of Signal Transduction Measurements. Fifth Annual Meeting of the Association of Medical Laboratory Immunologists, Arlington, VA - over 500 attendees.

- Kessler, SW (Dec 1991). Hematopoietic Regulatory Functions of Dengue Virus Infected Stromal Cells in Cultures of Human Marrow. American Society of Hematology - over 500 attendees.

- Kessler, SW (Dec 1991). Changes in human bone marrow long term cultures after infection of stromal cell layers with HIV-1. American Society of Hematology - over 500 attendees.

(b) 100-500 attendees: 8

Examples:

- Kessler, SW (Oct 1991). Reverse purging of marrow by CD34+ cell positive immunoselection. Third International Symposium on Bone Marrow Purging and Processing, San Diego, CA - 100/500 attendees.

- June, CH (Feb 1993). Potential role of CD28 and CTLA-4 in autoimmune disease. Dana Farber Cancer Institute, Boston MA - 100/500 attendees.

(c) Under 100 attendees: 17

- Harlan, DM (Jan 1993). Role of costimulatory molecules in Diabetes. The University of Michigan Medical Center, Endocrinology Research Conference - under 100 attendees.

2.2.2.5 Exchange Programs and Visits

(a) Exchanges with industry, academia, state and local government: 58

Examples:

- Dr. Scott Koenig, MedImmune, Inc., Gaithersburg, MD.

- Dr. A. Landay, Department of Immunology, Rush Presbyterian Medical Center, Chicago, IL.

- Dr. Hiroyuki Hirano, Experimental Immunology Branch, National Cancer Institutes, National Institutes of Health.

- Dr. Mary Ann C. Principato, Division of Virulence Assessment, Immunobiology Branch, Food and Drug Administration.

- Dr. Katsuyuki Yui, Department of Pathology and Laboratory Medicine, University of Pennsylvania.

(b) Foreign visitors: 26

Examples:

- B. Foxwell, Ph.D. (1993), Kennedy Institute of Rheumatology, London, U.K.

- Dr. Rina Guy, The Lautenberg Center for General and Tumor Immunology, The Hebrew University-Hadassah Medical School Jerusalem, Israel, June/1993.

- Dr. Yasuo Ishida, Division of Molecular Genetics, Center for Neurobiology and Molecular Immunology, School of Medicine, Chiba University, Japan, March/1993 and Sept/1992.

- Dr. Didier LaGards, Centre D'Etudes e de Recherches de Medecine, Aerospatiale Bretigny-sur-Orge Cedex, France

(c) Foreign visits by laboratory personnel: 10

Examples:

- Dr. H. Goforth (NHRC), Defence and Civil Institute of Environmental Medicine, Toronto, Ontario, Canada

- LCDR D. Dolgin (NAMRL), Lufthansa Airlines and German Aerospace Research Establishment (DLR), Hamberg, Germany

2.2.2.6 Use of Laboratory Facilities (Not applicable)

2.2.2.7 CRADAs

Cooperative Research and Development Agreements (CRADAs) are frequently utilized by the Naval Medical Research and Development Command and its subordinate facilities. There is no backlog of CRADAs; normal minimal processing is the only significant delay. Processing time for a standard CRADA, which the NAVMEDRSCHDEVCOM Commanding Officer can sign, is as little as a week. CRADAs are planned to be revenue neutral; income offsets costs of government employee incremental workload and of incremental use of other government assets. Net incremental lab investment is, therefore, zero. Gross lab investment is approximately $10 million; about 15% of personnel are directly involved in CRADA.

Descriptions of 25 CRADAs executed as of 7/13/93 follow:

NMRI/Futrex, Incorporated
Goals: To investigate the feasibility of a non-invasive instrument that uses transdermal near-infrared spectroscopy for monitoring percent body fat and total water.

NHRC/Symtonic USA, Incorporated
Goals: To investigate the value of the electromagnetic sleep induction device (LEET) for facilitating sleep in subjects who must work after shifting time zones or are moved from the day to the night shift.

NBDL/Snell Memorial Foundation
Goals: To analyze human dynamic responses to impact acceleration and to determine the correlation of these responses with injury potential.

NAMRL/[An Airline]
Goals: To exchange data and information about the performance of pilots who have served with both the Navy and the Airline.

NAMRL/Maxwell Safety Products, Ltd
Goals: To provide Maxwell with data, not otherwise obtainable by a small business, to present to OSHA and the FCC in order to gain approval, endorsement and permission regarding the use of the RFR suits in industry and to provide the Navy with this data for its internal use.

NMRI/Cellco, Incorporated
Goals: To develop technology that will permit in vitro culture and expansion of human hematopoietic progenitor cells.

NMRI/Pharmingen
Goals: To ensure the full use of the results of the Federal Government's investment in research by developing and making the products of the DS1 cell line available to the interested public.

(MOU) NBDL/Tulane University
A general agreement to work with the University.

NMRI/USAMRDC/Eniricerche
Goals: To investigate, develop and optimize agents used in the prevention or treatment of *P. falciparum* malaria.

NAMRL/University of Illinois
Goals: To investigate the effects of fatigue on human information processing.

NAMRU-3/The Bioanthropology Foundation
Goals: To develop information on the distribution and risk factors for encountering poisonous snakes in various geographical areas in Egypt.

(MOU) NAMRL/University of West Florida
A general agreement to work with the University.

NMRI/[*A Medical Research Company*]
Goals: To investigate, develop, and optimize agents used in biochemical, tissue culture and animal model systems to evaluate their capacity to inhibit the activity or infectivity of Dengue fever virus, P. falciparum, or other selected pathogens.

NMRI/Genelabs Technologies Inc.
Goals: To study and develop information about the epidemiology, immunology, and molecular biology of the hepatitis E virus.

NAMRU-3/Merck and Company, Inc.(a)
Goals: To research, develop, and evaluate formalin inactivated alum-adjuvanted hepatitis A vaccine, and to perform a clinical research study.

NDRIDB/Colla-Tec, Inc.
Goals: To compare the clinical attachment gain in mandibular class II molar furcation defects by guided tissue regeneration utilizing either a resorbable collagen membrane or a non-resorbable polytetrafluoroethylene membrane.

NDRIDB/LifeNet
Goals: To compare the amount of bone formed using two different particle sizes of demineralized freeze-dried bone allograft.

NHRC/Stephen Newmark, M.D., Inc.
Goals: To investigate the effects of carbohydrate metabolism on heat, stress, exercise, and hydration.

NMRI/Repligen Corporation
Goals: To evaluate bone regeneration around hydroxyapatite-coated dental implants placed in fresh extraction sockets both with or without decalcified freeze-dried bone allograft (DFDBA) placed in the residual socket, and to compare such results with bone regeneration and crestal bone resorption around plasma-sprayed titanium dental implants placed in extraction sockets following grafting of the residual socket with DFDBA at the time of implant placement.

NAMRL/Otis Elevator Company
Goals: To investigate the physiological responses to a variety of acceleration profiles encountered in high-speed, large displacement elevators.

NMRI/Genetic MediSyn Corporation
Goals: To design and investigate the protective effects of antisense molecules against the inflammation associated with septic shock in animals, cell cultures, and human subjects.

NMRI/Integrated Diagnostics, Inc.
Goals: To develop new rickettsial assays for the serodiagnosis of various species of rickettsiae in clinical specimens, and to investigate and test the sensitivity and specificity of these assays.

(MOU) NBDL/University of New Orleans
A general agreement to work with the University.

NAMRL/Electronic Health Technologies, Inc.
Goals: To investigate the potential usefulness of a medical device that would be used to increase the flow rates of blood and lymphatic fluid in the extremities by combined use of mild hyperthermia and deep-layered muscle contraction in an effort to accelerate wound healing rates by virtue of localized increased oxygen perfusion.

2.2.2.8 Intellectual Property, Including Patents, Copyrights, and Trade Secrets

(a) Patents: 14
Patent applications: 30

(b) Licenses - At the moment, licenses in NAVY are negotiated by ONR. This Laboratory command does not have any at this time, but offers are out on U.S. Patent № 4,685,462 and 5,160,828.

Royalty Income - Under the Pharmingen CRADA, some reimbursement money is received on a periodic basis that is the equivalent of a royalty. By that CRADA, a hybridoma producing an antibody useful in analytic tests was transferred to industry. Pharmingen sells several commercial products including the antibody. No patent royalties have been received at this time.

(c) Backlog in Patent Disclosures - At this time there are 27 invention disclosures awaiting preparation of an application. All have been evaluated. Four will be filed as SIRs, two or three will be filed by a CRADA partner. Bids are now being requested for the preparation of applications for the remainder. Some have been pending two years. The backlog built up because three years ago, the Command hired a patent attorney to service the command and as the attorney aggressively marketed his services (articles and speeches) invention disclosures, CRADAs and other legal issues overwhelmed capacity.

(d) Attorneys supporting DTT - The Command is headquarters for 8 laboratories in 14 different locations employing 1,262 military and civilian persons augmented by visiting scientists, intergovernmental transfers, research fellows, *etc.* The subordinate laboratories are located from Cairo, Egypt to Jakarta, Indonesia. The Command employs one GM-15 patent attorney, supported by one GS-6 assistant to prepare all patent applications and CRADAs for all subordinates as well as handle other IP questions and act as liaison for general legal problems. In addition, the Command receives requests for the attorney's assistance from other BUMED organizations. The attorney works closely with the Director of Research/ORTA and his staff to evaluate all invention disclosures, review work statements of CRADAs in accordance with established Command instructions and make the business decisions to continue prosecution of pending applications or pay maintenance fees on issued patents.

(e) The attorney trains the staff in technology transfer by articles in the Command newsletter, lectures at the subordinate commands, laboratory visits, and constant telephone FAX and E-mail contacts with individual scientists. The attorney has delivered talks on tech transfer to personnel at BUMED and in conferences sponsored by tech transfer and bar association organizations.

2.2.2.9 Defense Technology Reinvestment Program (TRP)

Approximately 250 manhours were devoted to the trauma care focus area of the TRP between April 29 and June 29 1993 at Naval Medical Research and Development Command. A comparable investment was made in the medical information systems focus area. Approximately 200 inquiries and expressions of interest were received in the trauma care focus area alone.

2.2.2.10 Interactions with Non-DOD Organizations

(a) CRADA with Genetic MediSyn Inc. Genetic MediSyn provides oligodeozynucleotides and expertise, NMRI provides testing (both in vitro and in vivo. We have 7 patent applications in various stages. These patents are shared between the partners.

(b) Dr. Lee and Dr. Davis established a Cooperative Research and Development Agreement (CRADA) between Naval Medical Research and Development Command (NMRDC) and Cellco, Inc. CRADA was established June 25, 1992.

(c) CRADA with Genetic MediSyn, Inc. In this agreement Genetic MediSyn provides oligodeoxynucleotides and expertise, NMRI provides testing (in vitro and in vivo). Seven shared patent applications are in various stages.

(d) CRADA with Glycomed. In this agreement Glycomed will provide various products to be tested as antiflammatory agents and NMRI will conduct the in vivo testing.

(e) Collaboration with Dr. Arthur Trask, Fairfax Hospital. Dr. Trask will provide human vascular tissue, Dr. McKenna will use this tissue to measure the effects of LPS and cytokine mediators on vascular contractility on this tissue.

(f) Collaboration with Dr. Jack Lee at the University of Pennsylvania, Magnetic Resonance Center. NMRI is studying the effect of sepsis on oxygen delivery and intracellular oxygen utilization using magnetic resonance spectroscopy. NMRI conceived of the idea, and is providing the septic models, and funds for the instrument time. The Magnetic Resonance Center is providing the magnetic resonance expertise, the animals, and personnel to conduct the experiments.

(g) Collaboration with Dr. Yang at the National Institutes of Health. Dr. Lee has provided monoclonal antibodies against newly discovered neuropeptides that have been isolated by Dr. Young.

(h) Collaboration with Dr. Charles Odya, University of Indiana, Bloomington. While Dr. Odya was visiting at NMRI, Drs. Lee and Odya developed monoclonal antibodies against bradykinin receptors.

(i) Collaborative research with the American Red Cross on gene therapy.

(j) NASA (NAMRL)

(k) University of West Florida (NAMRL)

(l) University of Space Research Association (NAMRL)

(m) MIT (NAMRL)

(n) University of South Alabama (NAMRL)

(o) Northern Arizona University (NHRC)

(p) San Diego State University (NHRC)

(q) University of Wisconsin (NHRC)

(r) UCLA (NHRC)

(s) University of California, San Diego (NHRC)

(t) California State University at Long Beach (NHRC)

(u) FL State University (NHRC)

(v) University of South Carolina (NHRC)

(w) VA Hospitals in San Diego and Allen Park (MI) (NHRC)

2.2.2.11 Efforts Carried Out Under Legal Authorities Other than the Stevenson-Wydler Technology Innovation Act of 1980, As Amended

Not Applicable

2.2.3 PLANS

Improving the local technology transfer process

(a) Laboratory technical expertise:
As part of the on-going Department of Defense downsizing, laboratory infrastructures are undergoing sizeable reductions. A supportive policy toward laboratories with technology transfer success would be a desirable OSD policy.

(b) The Naval Medical Research and Development Command is enhancing laboratory technical expertise in two specific ways, despite infrastructure reductions. We are emphasizing quality of research and development as indicated by external scientific peer review. Peer review is a basis (along with requirements) for selection of new projects and for improvement of ongoing work units. Quality is a value which transcends defense and civilian sectors, and enhances transferability of defense technology. In addition, we are seeking to hire a senior executive as Director of Research and Development for the Navy medical R&D system. Both of these initiatives planned for FY94 will enhance laboratory technical expertise and improve domestic technology transfer.

(c) ORTA:
Naval Medical Research and Development Command has reorganized its ORTA function to bring the Intellectual Property Counsel and his legal secretary under the ORTA (Director of Research and Development). This should unify effort and facilitate technology transfer in FY94.

(d) Tech Reports, DTIC:
Naval Medical Research and Development Command has initiated a program to ensure DTIC documentation of all intramural and extramural work units in Navy medical R&D. This effort to ensure complete documentation of work units conducted over the past few years will make technology transfer opportunities more conspicuous to the private sector. Naval Medical Research and Development Command distributes widely a quarterly listing of all technical reports, for easy access. These initiatives should bear fruit in FY94. It should be noted that timely and complete publication of technical reports can be destructive of intellectual property, and hence of DOD recognition for technology transfer.

(e) Publications:
Publications in reputable journals is being encouraged by external scientific peer reviews of Navy medical research and development. This should result in increased quality of publications in FY94.

(f) Conferences and Symposia:
Ample travel budgets are made available for participation in Conferences and Symposia. Presenters are encouraged to emphasize technology transfer implications in FY94.

(g) Exchange programs and visits:
Navy Medical Research and Development Command is an active participant in Postdoc programs managed by Office of Naval Research and by the National Research Council. We conduct an increasing fraction of our in-house programs with contract temporary "visiting" scientists. We utilize IPAs. Navy medical R&D has formally-sanctioned international exchange programs with many countries including Great Britain and Canada. Each of these programs has been revitalized recently, and should pay dividends in medical technology transfer in FY94.

(h) Contracts, Grants and Cooperative Agreements:
Navy Medical Research and Development Command will maintain an extramural program in FY94. We are enhancing communication between intramural and extramural principal investigators (via our Principal Investigator Directory), which should facilitate technology transfer. We are increasingly aware of the need to write support contracts so that they ensure Navy rights to intellectual property developed by the support contractor working with government laboratory personnel.

(i) Small Business Innovation Research (SBIR):
Navy Medical Research and Development investment in SBIR is planned to triple in FY94. Collaborative efforts between past and present small business extramural performers and Navy medical research performers are planned for FY94, including testing of non-invasive (trans-cutaneous) blood anality measurements.

(j) Use of Laboratory Facilities:
Any significant use of Navy medical laboratory facilities by industry is exclusively via Cooperative Research and Development Agreement or through FAR. This policy will continue in FY94.

(k) Cooperative Research and Development Agreements:
Naval Medical Research and Development Command recently has been delegated authority to approve standard CRADAs. This should increase CRADAs in FY94.

(l) Intellectual Property:
Naval Medical Research and Development Command has changed its internal processes for evaluation of patent prospects, and has contracted for administrative tasks associated with establishment of intellectual property. This is a force multiplier for our single patent attorney.

(m) Technology Reinvestment Program:
This program is managed through ARPA. Our effectiveness in TRP is controlled to a large extent by the actions of ARPA. We will continue to do assigned tasks with distinction in FY94.

(n) Interactions with non-DOD organizations:
Naval Medical Research and Development Command interacts intensively with many non-DOD organizations. For example, we interact with the FDA, the Patent Office, the National Marrow Donor Registry, various parts of the NIH, the Agency for International Development, governments of host countries for our laboratories, the State Department, the National Academy of Sciences, The National Research Council, the Veterans Administration and numerous non-DOD extramural research performers. This should continue in FY94.

(o) The Stevenson-Wylder Act will continue to be the primary legislative basis for technology transfer by Naval Medical Research and Development Command in FY94. It needs to be extended to include computer programs and biomolecular products like cell lines.

DEPARTMENT OF THE NAVY
DOMESTIC TECHNOLOGY TRANSFER

2. REPORTING COMMANDS

2.3 NAVAL AIR WARFARE CENTER (NAWC) ARLINGTON, VA

2.3.1 OVERVIEW
2.3.2 PLANS
2.3.3 DTIC REPORTS
2.3.4 OVERVIEW, DATA & PLANS: AIRCRAFT DIVISION - INDIANAPOLIS SITE
2.3.5 OVERVIEW, DATA & PLANS: AIRCRAFT DIVISION - LAKEHURST SITE
2.3.6 OVERVIEW, DATA & PLANS: AIRCRAFT DIVISION - PATUXENT RIVER SITE
2.3.7 OVERVIEW, DATA & PLANS: AIRCRAFT DIVISION - WARMINSTER SITE
2.3.8 OVERVIEW, (DATA & PLANS NOT AVAILABLE): WEAPONS DIVISION - TRENTON SITE
2.3.9 OVERVIEW, DATA & PLANS: WEAPONS DIVISION
- CHINA LAKE SITE
- POINT MUGU SITE

2.3.1 OVERVIEW

NAVAL AIR WARFARE CENTER (NAWC)
Arlington, VA 22243-6000

NAWC POC: Arno K. Witt Code 01T
(703) 746-7730; ext 2210
William H. Clark Code 01T1
(703) 746-7730; ext 2214

SYNOPSIS: The NAWC mission is to be the Navy's full spectrum research, development, test and evaluation, engineering and fleet support center for air platforms, autonomous air vehicles, missiles, and missile subsystems, weapons systems associated with air warfare, and for sensor systems used to conduct anti-submarine warfare from air platforms.

EXPERTISE: The NAWC leadership areas include:

- air warfare analysis and modeling
- air vehicles, manned and unmanned
- air vehicle propulsion systems
- aircraft crew equipment and life support
- airborne surveillance systems
- tactical aircraft combat and combat control systems
- air ASW systems and sensors
- missiles and missile subsystems
- free-fall and unguided weapons
- aircraft and missile active and passive signatures
- aircraft and missile survivability and vulnerability
- parachute systems and components
- aircraft and weapons ranges
- major range and test facility base management
- aviation ground support equipment
- aircraft launch and recovery systems
- air platform systems integration
- targets and simulators for air launched systems

UNIQUE FACILITIES: The NAWC is made up of two divisions, aircraft and weapons, with sites as follows:

Aircraft Division:
- Warminster (formerly Naval Air Development Center)
- Lakehurst (formerly Naval Air Engineering Center)
- Trenton (formerly Naval Air Propulsion Center)
- Patuxent River (formerly Naval Air Test center)
- Indianapolis (formerly Naval Avionics Center)

Weapons Division:
- Albuquerque (formerly Naval Weapons Evaluation Facility)
- White Sands (formerly Naval Ordnance Missile Test Station)
- Point Mugu (formerly Pacific Missile Test Center)
- China Lake (formerly Naval Weapons Center)

The NAWC manages the Naval Western Test Range Complex containing 1,700 square miles of dedicated land, underlying more than 17,000 square miles restricted air space and 36,000 square mile of sea test range with overlying airspace. The Eastern Chesapeake Test Range Complex contains 50,000 square mile of restricted air space over the Chesapeake Bay and Atlantic Ocean.

2.3.2 PLANS

NAWC PLANS FOR IMPROVING DOMESTIC TECHNOLOGY TRANSFER

The NAWC has initiated actions to consolidate the functions of the eight current ORTA's to enable a single, coordinated plan for increasing partnerships between the NAWC and non-DoD organizations. Currently, the eight ORTA's are located at China Lake, Point Mugu, Indianapolis, Warminster, Trenton, Lakehurst, Patuxent River and at the Naval Training Systems Center (NTSC), Orlando. The NTSC will stand up as the NAWC's third division, the Training Systems Division, at the beginning of FY94.

During FY94, a "Technology Transfer Board" will be established to represent the NAWC on DTT issues. The Board, consisting of ORTA's from each site with an elected chairperson, will report to the NAWC's Chief Scientist/Technologist who will serve as advisor to the Board and will interface with ONR and other headquarters offices as required. The Board will request funding from the NAWC and from ONR to enable increased activities in the DTT areas. These expanded activities will include:

- distribution of brochures describing all NAWC sites technology transfer opportunities
- partnership developments via CRDA's, the Technology Reinvestment Project and other appropriate cooperative agreements
- creation of a data base containing information on all NAWC CRDA's, patent licenses, patents, and other cooperative agreements
- workshops at the sites with industry, academia and government to encourage partnerships and provide information on available technologies
- establishments of DTT awards to recognize outstanding technical support achievement
- regular publication of a NAWC DTT newsletter
- advertising in major technical journals soliciting partnerships for dual use programs
- a marketing study and survey to determine the most promising dual use technology transfer efforts.

2.3.3 DTIC REPORTS

(a) NAWC Technical Reports submitted:

FY92:	259
FY93 (three quarters):	109
Total:	368

(b) Representative titles:

"Applications of Automatic Control Theory to Sensor Scheduling"
"Environmental degradation of high temperature composites"
"Integrated Launch and Recovery Television Surveillance (ILARTS) Service Bulletin Number 0-92"
"Investigation of the Contribution of Cerebrospinal fluid to Cephalic Impedance Waveforms"
"Macromolecules for Inhibition of Corrosion and Wear"
"A Microwave Instrumentation System for Measurement of Water in Hydraulic Fluids"
"Naval Aircraft Collision Warning System Proof of Concept Testing"
"Thermodynamic Analysis of Pigment-Polymer Interactions and Their Effects on Coating Properties"

2.3.4 DATA & PLANS: AIRCRAFT DIVISION - INDIANAPOLIS SITE

2.3.4.1 Overview

NAVAL AIR WARFARE CENTER AIRCRAFT DIVISION
ORTA, Code 811C
Indianapolis, IN 46219-2189

Contact: Larry Halbig Phone: 317-353-3838
Fax: 317-353-3583

SYNOPSIS: Indianapolis provides leadership to the Naval Air Warfare community in the areas of:

Avionic Systems
Electronic System Transition to Production
Pilot/Emergency Production
Advanced Electronics Manufacturing

EXPERTISE: Expertise at Indianapolis which is applicable to technology transfer includes the following areas:

Avionic Systems - The Indianapolis site is the "Center of Excellence" for systems engineering, technology management, and application in avionics. Its involvement in advanced concepts for avionics includes developing requirements, conducting analyses, and providing technology evaluations. It is instrumental in defining and evaluating avionics architecture for new and upgraded aircraft by providing extensive simulation, stimulation, and hot bench capabilities. Our principal product areas include navigation/flight, communications, computers, electronic warfare, radar, telemetry, receiving, displays, and sensors.

Manufacturing Technology - NAWC-AD Indianapolis fulfills its avionics manufacturing leadership responsibilities by introducing, maintaining, and continuously improving essential capabilities in the areas of technology insertion, design engineering, fabrication, test facilities, logistics, and management. It introduces leading-edge technology in product design, manufacture, and quality assurance through the utilization of complex computer networks which combine computer aided design (CAD), computer aided manufacturing (CAM), and computer integrated manufacturing (CIM) functions. Specific manufacturing capabilities include CAD/CAM, reverse engineering, electronics assembly, cable and wire harness fabrication, printed circuit board fabrication, hybrid microelectronics fabrication, small parts machining, heat treatment, plating, welding, stereolithography, and Computer-Aided Acquisition and Logistics Support.

UNIQUE FACILITIES:

Advanced Microelectronics Facility
Rapid Acquisition of Manufactured Parts Facility
Flexible Machining System
Electronics Manufacturing Productivity Facility
Digital Avionic Systems Laboratory
Materials Laboratory
Failure Analysis Laboratory
Electro-Optics Laboratory

2.3.4.2 ORTA and Domestic Technology Transfer Office (DTTO) Focal Point.

(a) The DTTO focal point, or the ORTA as referred to by the legislation, is located in the Product Technology Competency Center, Code DP7010N, which reports to the Avionic?Electronic Systems Fleet/User Support Director, Code DP70N. The DTTO administers the technology efforts of the NAWCADIND. These efforts include coordination and administration of the Navy's Best Manufacturing Practices (BMP) technology transfer program, the Small Business

Innovation Research (SBIR) program, the Manufacturing Technology (MANTECH) program, and the Independent Research and Development (IR&D) program. The DTTO is supported by the administrative staff of the Product Technology Competency Center, and through the part-time involvement of the scientists and engineers located at the Indianapolis site.

(b) The DTTO focuses primarily on the transfer of technology from the NAWCADIND to the private sector, state and local government, and academia, with secondary emphasis on the technology transfer within the NAWC, Navy, DoD, and the federal government. Relationships have been established with leaders within the state and local government, leaders in private industry (both commercial and military), and academia. These relationships have provided the network and resources for promoting and facilitating technology assistance, patent licensing, technology transfer awareness, and access to the NAWCADIND resources.

2.3.4.3 Technical Reports. Technical reports are generated by the scientists and engineers, controlled by the documentation annex, and filed with the DTIC. The emphasis at the NAWCADIND is not on the generation of technical reports, although we produce a minimal amount, but on the application of the information contained in them. The DTTO occasionally gets involved with locating special documents, but normally refers this activity to the NAWCADIND Technical Library and the Documentation Annex.

The Best Manufacturing Practices (BMP) Program has generated 60 technology transfer reports, all describing the best practices of each company that has been surveyed by the BMP Survey Team. These reports are also available in a database. National Benchmarking organizations are using this program output for their benchmarking activities. The NAWCADIND DTTO is a key participant in the BMP Program.

2.3.4.4 Publications. Technical Publications are generated by NAWCADIND personnel in various scientific and technical journals but at a minimal amount. Emphasis has been on the retrieval of state-of-the-art technology from these knowledge sources and it's application to new product and processing systems.

2.3.4.5 Conferences and Symposiums. The NAWCADIND has representation at almost every technical conference held in the U. S. Participation ranges from being an attendee to chairing the conference. The DTTO encourages attendees to take more active roles in conferences and symposiums. Some of these activities include:

- National Federal Laboratory Consortium Conference, Indianapolis, IN, May 1992 (NAWCADIND DTTO is Chairman of the Conference).
- American Society for Naval Engineers (ASNE), Louisville, KY, June 1992 (NAWCADIND, DTTO is Co-chairman, provided nine speakers).
- Best Manufacturing Practices (BMP) Workshop, San Diego, September 1992 (NAWCADIND, DTTO provided planning, speakers, and administrative support).
- NASA Mid-West Technology Transfer Conf., October 1993 (NAWCADIND DTTO invited to be a presenter).

2.3.4.6 University Programs. Informal relationships exist between the DTTO, the scientists and engineers, and the academia within the state. For example:

- The DTTO provides technical assistance matching between academia and the NAWCADIND.
- Purdue, Notre Dame, and Rose Hulman interfaces with NAWCADIND on fiber optics technology.
- Open door policy in effect with all mid-west academia.

2.3.4.7 Work for Others Agreements. The DTTO has initiated efforts to perform work for the commercial industry. This work is performed by the NAWCADIND for the purpose of getting products to the marketplace faster and help companies be more competitive in the global market. The program performs 'work for others' when the work cannot be provided by the private sector, either because of the uniqueness of the technology, timeless of the deliverable, availability of the resources, etc. These agreements can be formal or informal, depending on the type and magnitude of the work performed.

2.3.4.8 Use of NAWCADIND Facilities. These facilities include:

(a) The full range of avionics manufacturing capability that includes the processes of design, fabrication, test, facilities, management and logistics.

(b) Specific capabilities include:

- computer aided design
- computer aided manufacturing
- reverse engineering techniques
- digital avionics simulation lab
- failure analysis lab
- materials lab
- flexible machining system
- small parts machining
- cable and wire harness fabrication
- printed circuit board fabrication
- hybrid microelectronics fabrication
- heat treating
- plating
- welding
- stereolithography

(c) Access to the resources of the NAWCADIND is developed on a case by case basis, with the important decision factors being that we are not competing against private industry and that the resource is being applied to the commercial industry for getting a product to the marketplace faster.

2.3.4.9 CRADA's. NAWCADIND has sponsored a single CRADA to date. This CRADA is an agreement between the NAWCADIND, the NSWC Crane, and the University of Indiana Purdue University of Indianapolis (IUPUI), which forms the Navy's Electronics Manufacturing Productivity Facility (EMPF). The EMPF is one of four National Centers of Excellence sponsored and partially funded by the Navy's Manufacturing Technology (MANTECH) Office. The mission of these national centers is to focus specific technical areas and the needs identified by industry requiring help. The centers execute to a plan that addresses these areas and transfers the results to industry.

2.3.4.10 Intellectual Property. Patent activity was law until the DTTO was established in 1987. The number of patent interests and submissions has been steadily increasing every year. In FY92, approximately 30 inventions were discussed, 10 were submitted, and five are in the review cycle, two have been assessed as having commercial potential. In FY93 to date, 50 have been discussed, 15 were submitted, nine in the review cycle, three have been assessed as having commercial potential.

2.3.4.11 Technology Reinvestment Program.

(a) The NAWCADIND has been requested to partner with industry, local economic development groups, academia, and non-for-profit groups on eight different TRP's. In some cases, this partnering is accomplished through the EMPF CRADA that already exists.

(b) The DTTO will conduct a Defense Conversion focus session at the annual BMP Workshop, with speakers from NIST, ARPA, Department of Commerce, and industry.

2.3.4.12 Plans for Improving Domestic Technology Transfer.

(a) DTTO Activity. The NAWCADIND domestic technology transfer activities is considered on target and effective within the budget constrains of the DTTO. Therefore, the DTTO is generating a strategy of redirection and obtaining of funds.

- Redirection to align with the NAWC technology transfer initiatives. This should not require much change in the current DTTO agenda, but some directed to improving coordination and communications with the other NAWC sites.

- Obtain funding to meet the present and future demands that are most certain from the current administration, as well as, the economic well being of the U. S. that can be positively impact through technology transfer efforts.

(b) Benefits. The following benefits will accrue from the DTT program:

- Access of private industry to the technology of the NAWCADIND, the NAWC, and the federal government.

- Long range economic security necessary to support a strong military security.

- Leveraging of manpower, facilities, and resources of both government and the private sector.

- Increase awareness of private sector technology resources and needs by the government.

- Increase awareness of government technology resources and needs by the private sector

- Increase partnerships between government and the private sector

(c) Recommendations.

- Develop the mechanisms to improve communications between the NAWC sites, to share in future joint programs, to identify resources at the NAWC sites, and to encourage improved cooperation in all technology transfer matters.

- Encourage and facilitate patent submissions and licensing.

- Encourage partnerships either formally or informally. Utilize CRADA's were applicable.

2.3.5 DATA PLANS: AIRCRAFT DIVISION - LAKEHURST SITE

2.3.5.1 Overview

Naval Air Warfare Center Aircraft Division
ORTA, Code 09R
Lakehurst, NJ 08733-5000

Contact: William R. Foor Phone: 908-323-7640
Fax: 908-323-7243

SYNOPSIS: Lakehurst provides leadership to the Naval Air warfare community in the areas of:

- Integration of Aircraft and Platform Operations
- Aircraft Launching, Recovery, and Servicing
- Aircraft Repair
- Aircraft Maintenance Shops
- Automatic Test Systems Hardware and Software
- Maintenance Software
- Aircraft Identification and Landing Aids
- Environmental Sensors
- Integrated Logistics Support Management
- Aircraft Maintenance Standards

EXPERTISE: Expertise at Lakehurst which is applicable to technology transfer includes the following areas:

High Energy Generation and Control - Aerospace, mechanical, and electrical engineering technologies involved in the safe launching and arresting of multi-ton aircraft in the limited space of sea-going vessels.

Composite Structure Repair and Testing - Materials engineering and repair technologies required to rapidly assess repair requirements of damaged aircraft with special emphasis on repairing new materials such as composites.

Nondestructive Testing - Sensing and passive examination of large areas of an aircraft to assure structural integrity and stealthiness.

Environmental Sensing and Information Display - Development and/or application of state-of-the-art environmental sensors such as wind velocity and direction instrumentation in support of aircraft operations at sea.

Aircraft Engine Test and Repair - Test and repair technologies applicable to advanced aircraft propulsion systems to be removed and repaired in a combat ready environment.

Automatic Testing Hardware and Software - Automatic testing technology applicable to complex aircraft subsystems including avionics, electromechanical, hydraulic, and pneumatic weapon repairable assemblies.

High Strength Cables and Harnesses - Design and manufacture of cables capable of withstanding multiple impacts of multi-ton aircraft under typical flight operations and harnesses capable of safely stopping a fast-moving aircraft under emergency landing conditions at sea.

Design of Aircraft Prime Movers - Design and prototype development of a wide variety of aircraft movement and servicing vehicles needed to operate an "airport at sea."

Advanced Computer and Data Processing Applications - Development of a wide variety of computer-assisted tools for logistics planning, flight operations, aircraft servicing and reporting systems.

UNIQUE FACILITIES:

A 4000-acre test area.

Approximately 3,000 feet of relatively unsaturated airspace with a radius of five nautical miles.

An operational airfield.

Catapults capable of launching up to 90,000 pounds and produce speeds up to 185 knots normally and to 300 knots for special tests.

A jet car test site for conducting development tests of arresting gear engines.

A runway arresting landing site that allows testing of arresting equipment and aircraft under safe, controlled conditions in preparation for fleet use.

A manufacturing technology facility capable of prototype manufacturing of heavy equipment and devices needed in support of air operations systems development.

2.3.5.2 Offices of Research and Technology Applications (ORTA) and DTT Focal Points

(a) Domestic Technology Transfer. The NAWCADLKE Domestic Technology Transfer (DTT) effort is administered by the Office of Technology and Development, Code 02T. The Director of Office of Technology and Development reports directly to the Chief Engineer. The T&D Director administers all of the Science and Technology programs. These programs include Advanced Technology Demonstration, Block Programs for 6.2 and 6.3 research, in-house laboratory Independent Research and Independent Exploratory Development (ILIR/IED), Small Business Innovative Research (SBIR), University Programs, Corporate Investment R&D Programs, and the Office of Research and Development Transfer Activity (ORTA).

(b) ORTA and DTT focal points:

(1) ORTA: William Foor, Code 02T
Naval Air Warfare Center
Aircraft Division
Lakehurst NJ 08733-5000
Tel: 908-342-2842
DSN: 624-2842

(2) DTT: Fred Ligouri, Code 02T(FL)
Naval Air Warfare Center
Aircraft Division
Lakehurst NJ 08733-5000
Tel: 908-342-2842
DSN: 624-2842

2.3.5.3 Publicity/Publications, DTT Outreach Programs

In 1990, the position of Technology Assessment Officer was created and the incumbent was assigned as the representative to the Federal Laboratory Consortium (FLC). Since then NAWCADLKE has participated annually in FLC meetings and various local and national technology exchange programs involving both formal presentations and one-on-one discussions with industry representatives. Among the DTT outreach activities in which NAWCADLKE played an active role are:

(a) The Annual High Tech Conference for Small Business sponsored by the New Jersey Commission on Science and Technology.

(b) The Annual Government/Industry Technology Transfer Conference in Arlington, Va.

(c) Historically Black Colleges and Universities Conference hosted by NAWCADWAR 22 April 1993.

Since no appropriations or established budgets have been available to support either technology transfer or DTT programs, the publications distributed at the outreach activities consisted of already available brochures describing NAWCADLKE capabilities and interests along with specially prepared lists of technologies of interest and points of contact. A sample of the brochure distributed is provided as part of Attachment A. This brochure, entitled "Technical Highlights", is currently being revised to reflect the NAWCADLKE nomenclature that replaces the previous designation of the Naval Air Engineering Center. The revised brochure was not available at the time of this data call. Samples of the specially prepared data sheets are provided as part of Attachment A.

2.3.5.4 Technical Reports

NAWCADLKE issues hundreds of reports per year controlled by the issuing department. Most are for internal or limited distribution. Only formal reports are distributed through DTIC. As of the date of this report, 11 formal Technical Reports were issued by NAWCADLKE in FY92 and FY93. Five dealt with aircraft carrier launch and recovery, one on visual landing aids, two on expeditionary landing fields, two on heads up displays, and one on wind measurement.

2.3.5.5 Publications

Our staff publishes reviewed and Navy approved technical papers from time to time, but no record is kept of these publications.

2.3.5.6 Conferences and Symposia

Staff members participate in conferences and symposia as attendees, speakers, panel session members and session organizers on a regular basis. No comprehensive record of participation is maintained so a listing is not available.

2.3.5.7 Exchange Programs and Visits

(a) Exchange Programs: To date no formal exchange programs have been initiated; however, NAWCADLKE has always maintained close liaison with various educational institutions through its student Co-Op program, R&D contract awards and joint efforts with professional societies. During 1992 and 1993 27 speakers were provided for various community and school activities and eighty employees volunteered as judges for school science fairs.

(b) Visits: NAWCADLKE openly encourages visitors and in a typical year hosts hundreds of informal tours and information exchange meeting with members of the technical staff. The 75th Anniversary Jubilee held in 1992 attracted 40,000 visitors.

2.3.5.8 Grants and Cooperative agreements

In FY92, a $50,000 grant was awarded to Northeastern University 92 under a technology sharing program.

2.3.5.9 Lab Use/Agreements Other Than CRADAs

Two notable efforts are in progress:

(a) In a 6.2 R&D effort we are currently working with Croft Engineering Associates of Hampton, Virginia to develop an autonomous robotic vehicle for a multiplicity of hazardous shipboard operations. We are developing advanced decision and control logic and they are building the prototype vehicle. When developed there should be significant spin-off applications in various industries both in manufacturing and/or police and fire fighting use.

(b) Under a current Manufacturing Technology program we are working with the National Center of Excellence in Metalworking to rectify production problems in manufacturing low loss, high pressure valves used in aircraft launching systems. By computer modeling the process it can be optimized to eliminate many of the unanticipated manufacturing defects. It is anticipated that modeling will predict critical areas during mold fill and cool down of castings. The techniques developed should have significant spin-off value for numerous industrial manufacturing applications in the commercial sector.

2.3.5.10 CRADAs

At present NAWCADLKE has two active and promising CRADAs in process:

(a) NAWCADLKE is in the process of signing a CRADA (Cooperative Research and Development Agreement) with Smith Industries of Florham Park, New Jersey involving the use of neural networks to analyze aircraft engine performance for maintenance purposes. Some of the innovative algorithms and techniques we have developed under an ongoing 6.2 R&D project have already been shared with Smith Industries and we plan to continue working closely with them.

(b) NAWCADLKE is pursuing a CRADA with McDonnell Douglas Aircraft Company of St. Louis, Missouri based on original work performed here in computer-assisted test program development for avionic system maintenance. The software system we developed is currently being tested for use in converting existing test programs to operate on the new Navy CASS (Consolidated Automated Support System) testers.

2.3.5.11 Intellectual Property

No patents or licensing agreements have been filed or granted in the FY92-93 time frame. Up until recent legislation, there has been little incentive for individuals to go through the demanding process of filing for patents. Furthermore there has been no budget for establishing training programs to encourage patent applications. The CRADAs in process do not involve trade secrets.

2.3.5.12 Technology Reinvestment Project Efforts

Among the programs currently being proposed under the Defense Conversion Act are the following:

(a) The application of fuzzy logic for enhancing various imaging systems currently used in military and civilian applications. Our primary objective under a 6.2 R&D effort is to utilize fuzzy logic techniques for a wide variety of defense related tasks including terminal guidance and support of aircraft. We believe that the techniques developed would be very useful in medical scanning systems to improve imaging detail and accuracy. We would like to expand current efforts into medical applications by working closely with knowledgeable medical instrumentation manufacturers and/or medical facilities.

(b) The application of fuzzy logic techniques for the analysis of commercial aircraft engine performance or automotive maintenance processes. We believe that our work in Naval aircraft engine performance analysis could be applied in the commercial aircraft and automotive industries and propose to work jointly with representatives of these industries with funds obtained under the Defense Conversion Act appropriation.

2.3.5.13 Interaction with Non-DOD Organizations

NAWCADLKE involvement with non-DOD organizations as well as local and state government agencies is substantial but no detailed record is kept.

2.3.5.14 Efforts Other Than Under Stevenson-Wydler Act: None.

2.3.5.15 Plans: Incorporated into NAWC Plan (Section 2.3.2)

2.3.6 AIRCRAFT DIVISION - PATUXENT RIVER SITE

2.3.6.1 Overview

NAVAL AIR WARFARE CENTER AIRCRAFT DIVISION
ORTA, Code CT-22
Patuxent River, MD 206700-5304

Contact: Daniel Watters **Phone:** 301-826-1144
Fax: 301-826-1134

SYNOPSIS: Patuxent River provides leadership to the Naval Air Warfare community in the areas of:

- Aircraft and Support Systems Test and Evaluation
- Avionics Research, Development, Test, and Evaluation (RDT&E)
- Electromagnetic Environmental Effects Test and Evaluation
- Flight Simulation RDT&E
- Flight Test Instrumentation RDT&E
- Airborne Surveillance Systems RDT&E
- Aircrew Equipment and Life Support Systems RDT&E
- Propulsion Systems Test and Evaluation

EXPERTISE: Expertise at Patuxent River which is applicable to technology transfer includes the following areas:

Aerospace Test and Evaluation Engineering - The Patuxent River site provides timely test and evaluation of aircraft training, weapons, and requisite support systems including flight test instrumentation, simulation, and support equipment. In the area of flight instrumentation, the site designs, fabricates, calibrates, tests, and installs a wide variety of specialized airborne test instrumentation. This instrumentation includes transducers, serial digital interfaces, signal processors, high-speed cameras, tape recorders, telemetry transmitters, and automated calibration and checkout equipment. The site's facilities also provide aerodynamic and structural analysis engineering capabilities to support aircraft RDT&E.

Computer Hardware and Software - Patuxent River's personnel and facilities provide complete RDT&E capabilities for microprocessor-based computers (airborne and ground) and associated software systems including airborne flight recorders, real-time telemetry processing, and artificial intelligence and neural network systems.

Aircrew Systems - The Patuxent River site provides complete RDT&E radios, advanced helmet mounted displays, and human factors engineering.

Simulation - Patuxent River's Manned Flight Simulator and Rotorcraft Simulation System provide complete RDT&E simulation capabilities for all military and some civilian-type aircraft and their subsystems. Their standard air vehicle simulation model structure supports flight testing and training and related flight research.

UNIQUE FACILITIES:

Electromagnetic Environmental Effects Test Facilities - A copper-clad shielded hangar permits testing for electromagnetic environmental effects in isolation from external radiation. Included in this facility are the electromagnetic compatibility/interface, lightning, and electrostatic discharge facilities and a full capability anechoic chamber. Other adjacent E3 facilities are the electromagnetic vulnerability, vertical/horizontal electromagnetic pulse, and radiation hazard facilities.

Manned Flight Simulator - The Manned Flight Simulator enables engineers and pilots to test scenarios and train personnel more effectively and at a much lower cost than traditional in-flight methods. Together with a tightly coupled computer network, aircraft cockpits, and crew stations, it is a full flight and avionics system

simulation facility. The simulator includes high- and low-fidelity flight dynamics system simulations, avionics system simulations, a wide field-of-view visual system for man-in-the-loop evaluations, and a motion base system to provide acceleration cues for conventional takeoff and landing tasks as well as vertical and short takeoff and landing, over, and transition.

Aircraft Test and Evaluation Facility - The aircraft Test and Evaluation Facility permits full system aircraft ground runups in a "hush house" (noise abated at full military power). Special instrumentation and equipment permit fixed-wing aircraft installed systems testing.

Electrical and Electronic Test Facilities - Airborne systems, subsystems, and component stresses can be duplicated for Qualified Product List certification. Developmental environmental testing, such as temperature, altitude, vibration, shock, and humidity is also provided at these facilities.

Flight Instrumentation - Flight instrumentation facilities include a ready pool of standard airborne instrumentation, a mechanical design and fabrication facility, and an on-site calibration laboratory traceable to the National Bureau of Standards. Precise data from the airborne sensors may be recorded onboard the flying aircraft or down-linked to ground tracking stations at Patuxent River or NASA Wallops.

Real-Time Telemetry Processing System - The Real-Time Telemetry Processing System receives up to 2,007 independent data measurements from each six aircraft operating simultaneously. Each of these six channels samples data measurements at rates of up to 200K times per second. Each channel can operate from airborne recorded tapes or telemetered data at a receiving rate of 10M bits per second.

Range Facilities - While the Real-Time Telemetry Processing System gives insight to what is happening inside flying aircraft, the Chesapeake Test Range provides exact space positioning information on the aircraft. These three-axis dynamic tracking data can be fed directly to the Real-Time Telemetry Processing System through range computers. Tracking and Surveillance data are computed and displayed in real time to range flight controllers on interactive color graphic CRT's and a large projection screen.

Antenna and Avionics Flight Test Facility - This facility provides a comprehensive capability to evaluate aircraft avionic systems. The Antenna Testing Laboratory Automated System is a key component that provides the unique capability to accurately measure all aircraft antenna patterns in flight.

Other Facilities:

Manned Flight Simulator
Rotorcraft Simulation Systems Test Laboratory
Engine Test Stand Facility
Electronic Weapons Integration Systems Test Laboratory
Aircrew Systems Test and Evaluation Facility
Ordnance Test Facility
Communications, Navigation, and Identification Laboratory
Offensive Sensors Laboratories
Ship Ground Station Facility
Closed-Loop Threat Simulator Facility
Artificial Intelligence and Neural Network Laboratory
Unmanned Vehicle Test and Evaluation Facility
Inertial and Satellite Navigation Test Laboratory
Catapults and Arresting Gear

2.3.6.2 Office of Research and Technology Applications (ORTA) and DTT Focal Points

(a) **Current Activities.** The ORTA, established by the Stevenson Wydler Act of 1980, has been maintained at NAWCADPAX as legally required. The new administration has made DTT a high priority, resulting in an increase in DTT activity at NAWCADPAX starting in FY93. The ORTA function continues to be staffed with part-time participants to initiate DTT activities. Many contacts have been initiated with the private sector and a technology transfer brochure has been prepared cooperatively with NAWCADWAR.

(b) **ORTA and DTT Focal Points.** The ORTA and the other DTT focal points at NAWCADPAX are located in the OCP, Code CT20. The Director of Corporate Planning reports directly to the Executive Director giving the activity direct access to top management. In addition to the ORTA, the other DTT activities supported are SBIR, IHAT, ILIR/IED, and IR&D. The staff includes the director, three senior scientists and engineers, and a secretary.

2.3.6.3 Publications. The 27 publications by the NAWCADPAX technologists during the reporting period include articles in scientific and technical journals, conference proceedings, and symposiums. Representative items:

"Buckling Behavior of a Gusset Stiffened Joint," Dwayne Drake (CSD), presented at NASTRAN World Users Conference, 3 February 1992.

"TECNET Research and Development Initiatives," (Abstract), George Hurlburt, 8 June 1992.

"Pitch Control Margin at High AOA-Quantitative Requirements," J. Lackey and CAPT Hadfield, presented at NAVAIRSYSCOM, 27 May 1992.

"Flying Qualities of a Remotely Piloted Vehicle," Kevin Brenneman and Mark Lower (SA), presented at AIAA Biannual Flight Test Conference, 18 June 1992.

"Ground Based Simulation in T&E Education," R. Miller and R. Richards (TPS), presented at AHS Conference/AIAA Biannual Flight Test, 24 June 1992.

"The Next Generation Computer Resources Program and the Testing Issues of Standardized Real-Time Operating Systems," Tim Jodoin (SA), 23 September 1992.

"Propulsion," Larry Thomas (SA), 16 October 1992.

"Multichip Module Conformal Electronics," Karin Lovett (TRW), 27 January 1993.

2.3.6.4 Conferences and Symposia. The technologists at NAWCADPAX have participated in many conferences and symposia during the reporting period. Some of these have been hosted by NAWCADPAX. Participation in outside conferences and symposia entails giving a significant presentation during the proceedings. During the reporting period, approximately 65 presentations were given. Approximately 16 conferences were hosted at NAWCADPAX during the reporting period, most significantly the first Navy Domestic Technology Transfer Conference and Systems Engineering Conference.

2.3.6.5 University Programs. NAWCADPAX has an active exchange with universities and colleges. Included are:

(a) Direct RDT&E contracts with universities such as the University of Maryland, Georgia Tech, Penn State, MIT, and the University of Texas.

(b) Scientist and Engineer professor RDT&E assist at NAWCADPAX.

(c) Scientist and Engineer professor RDT&E assist at NAWCADPAX from the Naval Academy and the Naval Post Graduate School and other universities.

(d) PAXTENN co-op program with Tennessee A&M.

(e) Intern program with St. Mary's State College.

Also many NAWCADPAX scientists teach at local colleges and universities. Several research programs were sponsored at universities during 1992.

2.3.6.6 Cooperative Agreements. The NAWCADPAX has frequently entered into short term cooperative agreements with the private sector, primarily for use of the unique test facilities located at NAWCADPAX, see item (_), below.

2.3.6.7 Use of NAWCADPAX Laboratory and Test Facilities. These facilities include:

(a) Air Combat Environment Test and Evaluation Facility

- Advanced Manned Flight Simulator
- Anechoic Chamber
- Shielded Hangar
- Electromagnetic Environment Generating System
- Offensive Sensors Laboratory
- Communications, Navigation and Identification Laboratory
- Electronic Warfare Integrated System Test Laboratory
- Aircrew Systems Evaluation Facility
- Aircraft TEMPEST Test Laboratory

(b) Test Range Facilities (Chesapeake Test Range)

- Range Radar, Electro-Optical and Multilateral Tracking Systems
- Aircraft Instrumentation Laboratory
- Real-Time Telemetry Processing System (RTPS)
- Telemetry Relay Airborne Command System (TRACS)
- Electronic Warfare Flight Test Facility
- Flight Test Emitter Simulation Facility
- Target Support Facility

(c) Carrier Suitability Test Facilities

- T-7 Steam Catapult System
- M 7 Mod 3 Arresting Gear System
- Aircraft Hot Refueling Facility
- Landing Aids Test Facility
- Takeoff Assist Ramp (Ski-Jump)

(d) U. S. Naval Test Pilot School Facility

- Forty Test Aircraft (Twelve types)
- Fixed and Rotary Wing Test Pilot School Curriculum

(e) Aircraft Electrical and Environmental Evaluation Facility

- Electromagnetic Interference Facility
- Wing Tunnel Facility
- Jet Engine Simulator
- Combined Environmental Test Facility (Temperature, Humidity, Cooling Air and Vibration)
- Ten Temperature/Altitude Chambers
- Salt Fog Environmental Facility
- Mechanical Interface Test Facilities
- Vibration/Shock Test Facility

(f) Aircraft Test and Evaluation Facility

- Enclosed Aircraft Engine-Run "Hush House"
- Engine/Propulsion Thrust Facility
- UHF Communications Link with RTPS

(g) Captain Stephen A. Hazelrigg Flight Test Facility

- 60,000 ft^2 hangar space
- 50,000 ft^2 engineering offices and laboratories
- 11,000 ft^2 warehouse

(h) Ordnance Firing Tunnel Facility

During the reporting period, many private industries, both domestic and foreign, have used these facilities. Access to these facilities is through informal and formal agreements such as Memorandum of Understanding (MOU) and CRDA's. Best examples are the full-scale, on-site testing of the McDonnell Douglas F/A-18 aircraft and the IBM Lamps M II SH-60 helicopter.

2.3.6.8 CRADAs. NAWCADPAX has one CRADA, NCRDA-NATC-90-001, with SBS Engineering, Incorporated, the first software CRADA ever signed. This CRADA provides for NAWCADPAX to develop software for the NA/AYK-14 (V) COMPUTER CONTROL UNIT EMULATOR (CCU/E). NAWCADPAX has received $68,000 in license and royalty fees including $28,000 during the reporting period. NAWCADPAX is negotiating about six other CRADA's.

2.3.6.9 Intellectual Property. At NAWCADPAX, a program of disclosing and patenting inventions has been ongoing since 1975. The following is a list of patent disclosures received and filed:

(a) Force Deflection Anemometer, Curtis L. Meyerhoff, et al, filed 14 April 1993.

(b) Reconfigurable Stick Mount, Thomas M. Kelso, et al, filed 31 March 1993.

(c) Spinning Target Electro-Optical Line Scanner Resolution Tester, Michael J. Jenquin, filed 22 February 1993.

(d) E-2C+ Fuel Nozzle Purge System, Edward D. Piontek, et al, filed 23 December 1991.

(e) Hydrolic Separator/Transfer Tank, John L. Standish, Sr., et al filed 1 May 1990, Case No. 73,432.

(f) Crank Handle Stop, Watkins Crockett IV, et al, filed 29 January 1990, Case No. 73,443.

(g) Latching Tool for AERO-1B, Theodore P. Malone, filed 15 March 1991, Case No. 73,529

2.3.6.10 Technology Reinvestment Program. Following the Commerce Business Daily announcement of 15 March 1993, we attended a regional meeting at Johns Hopkins University in Baltimore on 7 May 1993. We participated in the NAWCADWAR 2 June 1993 Technology Transfer Conference. We have been asked to be a participant or partner in six different proposals, including those submitted by RTTC/FLC, University of Maryland, Maryland Department of Economic Development and the International Electric Vehicle Consortium.

2.3.6.11 Plans for improving Domestic Technology Transfer
(See also NAWC Plan)

(a) DTT Activity. If private industry can be made aware of our DTT capability and our technologies, the necessary technology pull from the private sector can be created. The NAWCADPAX understands its technology, and has ideal about how it can be commercialized. However, a commercial company has to accept the risks of bringing to fruition a new product using our technology. A large effort is required to bring about a match between a private sector entity and NAWCADPAX for DTT. The efforts made to respond to the TRP were fairly successful.

These efforts will be continued using CRADA's as the contractual vehicle, and including technology licensing where applicable. Arrangements with local economic development agencies are being developed to help increase NAWCADPAX contact with the private sector.

(b) **Benefits.** The following benefits will accrue from the DTT program:

- access of the private sector to NAWCADPAX technology will lead to new processes and/or products,
- leveraging of our manpower, facilities, and resources,
- provides exclusive licenses to private industry,
- provides access to our unique laboratory facilities,
- increases our awareness of private sector technology which may be of sue in military applications,
- increases awareness in the private sector of military technology needs,
- identifies to the private sector the capabilities of the NAWCADPAX.

(c) **Recommendations.**

- Develop the mechanisms to improve communications between the NAWC sites, to share in future joint programs, to identify resources at the NAWC sites, and to encourage improved cooperation in all technology transfer matters.
- Encourage and facilitate patent submissions and licensing.
- Encourage partnerships either formally or informally. Utilize CRADA's where applicable.

2.3.7 DATA & PLANS: AIRCRAFT DIVISION - WARMINSTER SITE

2.3.7.1 Overview

NAVAL AIR WARFARE CENTER AIRCRAFT DIVISION
ORTA
CODE 01B
Warminster, PA 18974-5000

Contact: Angel Carrerras **Phone:** 215-441-1143
Fax: 215-441-3946

SYNOPSIS: Warminster provides leadership to the Naval Air Warfare community in the areas of:

Manned and Unmanned Air Vehicles
Aircrew Equipment and Life Support
Airborne Surveillance Sensors
Air Antisubmarine Warfare Systems and Sensors
Aircraft Electronic Warfare Test and Evaluation
Air Platform Systems Integration
Aircraft Active and Passive Signatures
Aircraft Modeling and Analysis

EXPERTISE: Expertise at Warminster, which is applicable to technology transfer, includes the following areas:

Technologies: Aerospace Engineering - Developing new aircraft system concepts is a major thrust at Warminster. Higher standards of performance from existing aircraft are sought and advanced designs and technologies for future aircraft explored.

Materials: Warminster researchers are investigating hybrid materials such as organic/metallics, metallic/ceramics, and ceramic/organics with mechanical, electrical, thermal or physical properties superior to conventional materials.

Aircraft Subsystems: The following is a sampling of the major subsystems work performed:

- Acoustic and nonacoustic sensors use a wide variety of techniques such as infrared photography, radar, and sonobuoys to detect an aircraft, ship, or submarine. Our development of electro-optic methods is advanced by developmental work in lasers, acoustics, fiber optics, and other sensor technologies. Naval nonacoustic techniques include microwave radar, blue-green laser radar, and magnetics.

- Flight Control Systems: Modern Naval aircraft incorporate advanced flight control systems consisting of digital computers, inertial sensors and sophisticated actuators. The flight control system processes pilot inputs and sensor feedback to generate the complex signals required to stabilize and maneuver the aircraft.

- Crew Systems: Research and development efforts concentrate on making the aircrew's flight environment more comfortable, efficient and safe. Crew system scientists and engineers use facilities such as the dynamic flight simulator, the ejection tower, an environmental chamber and other realistic environments to aid in designing and testing new equipment that provides our nation's aircraft crews with the best chance for survival.

- Software systems play an increasingly important role in the achievement of Warminster's program goals. Software engineers at the center follow an engineering approach to computer software development and use a diverse set of military and nonmilitary computers and programming languages.

UNIQUE FACILITIES:

Dynamic Flight Simulator
Fuel Fire Test Facility
Vehicle Subsystem Technology Integration and Demonstration Laboratory Facility
Computer Aided Engineering and Documentation System
Man-Machine Integration Laboratory
Ejection Seat Tower
Human Horizontal Accelerator
Human Vertical Decelerator
Structural Test Facility
Aircraft Technologies Laboratory
Unmanned Vehicle Laboratory
Multi-Main Frame Central Computing System
Defense Data Network Access
Sonar Development Simulation Facilities
Antenna Test Facility
Deep Water Test Facility
Navy Standard Signal Processor Facility
Environmental Physiology Laboratory
Acoustic Signal Processing Facilities
Radar Signal Processing Facilities
Radar, Laser, and Infrared Airborne Sensor Platforms
Materials Laboratory
Aircraft Composites Facility
Rapid Solidification Technology Laboratory
Nondestructive Evaluation Laboratory
Low Observable Materials Laboratory
Surface Interactions Laboratory
Advanced Organic Coatings Laboratory

2.3.7.2 ORTA

(a) **Current Activities.** The ORTA established by the Stevenson Wydler Act of 1980, has been maintained at NAWCADWAR as legally required. The new administration has made DTT a high priority, resulting in an increase in DTT activity at NAWCADWAR starting in FY93. The ORTA function has recently been staffed with a full time participant to initiate DTT activities. Many contacts have been initiated with the private sector, a technology transfer brochure has been prepared and a Technology Transfer Conference has been held for local small business. Twenty one proposals, with NAWCADWAR in partnership with private sector entities, have been submitted to the TRP.

(b) **ORTA and DTT Focal points.** The ORTA/Technology Transfer (T^2) Program Manager and the other DTT focal points at NAWCADWAR are located in the OS&T, Code 01B. The Director of Science and Technology reports directly to the Executive Director, giving the activity direct access to top management. In addition to the ORTA, the other DTT activities supported are SBIR, NPCP, ILIR/IED, and the University Programs. The staff includes the director, seven senior scientists and engineers, and a secretary.

ORTA/T2 Program Manager: Angel Carreras, Jr., Code 01B
Naval Air Warfare Center
Aircraft Division
Warminster, PA 18974-5000

2.3.7.3 Publications. The 123 publications by the NAWCADWAR technologists during the reporting period include articles in scientific and technical journals, conference proceedings, and symposia. Representative publications:

"Analysis of Workload Predictions Generated by Multiple Resource Theory," paper and presentation at the 28th Department of Defense Human Factors Engineering Technical Group Meeting, August 1992.

Agarwala, V. S., "Electrochemical Concepts for Control of BMI Degradation," Proceedings of Tri-Service Conference on Corrosion, May 1992, Plymouth, MA, Army Materials Technology Laboratory, Watertown, MA (under publication), 1993.

Armstrong-Carroll, E. and R. Cochran, "Improvement of Delamination Resistance with Carbon Non Woven Mat Interleaves," Proceedings of the ASTM Fifth Symposium on Composite Materials: Fatigue and Fracture, May 1993.

Chen, J. S. J., T. J. Praisner, L. A. Fields, R. T. Norhold and W. E. Frazier, "Rapid Solidification Processing of Titanium Aluminides by Melt Spinning," New York, NY; ASME, November 1992.

DeLuccia, J. J., J. B. Boodey, and E. U. Lee, "Stress Corrosion and Corrosion Fatigue of RST Al Alloy Extrusions Containing

Molybdenum," Proceedings of ADVMAT/91, NACE, San Diego, CA, June 1991.

2.3.7.4 Conferences and Symposia. The technologists at NAWCADWAR have participated in many conferences and symposia during the reporting period. NAVCADWAR have hosted some of these. Participation in outside conferences and symposia entails giving a significant presentation during the proceedings. During the reporting period, 57 presentations were given and 12 conferences hosted.

(a) Representative topics presented were:

Chan, A., "Micromechanical and Microstructural Characterization of Reinforcement Matrix Interaction in SiC Reinforced $MoSi_2$," Third Annual R&D Information Exchange Conference, Naval Surface Warfare Center, Silver Spring, MD, 8 April 1992.

Conte, A. A. Jr., "Tribo-Materials Concepts for Advanced Composite Bearings," Third Annual R&D Information Exchange Conference, Naval Surface Warfare Center, Silver Spring, MD,
10 April 1992.

Fala, Glenn, "Al Approaches to Autodebugging Classification," Southeast Pennsylvania Chapter of the Association for Computing Machinery, 15 September 1992.

Gabrielson, T. B., "Fundamental Noise Processes in Micromachined Acoustic and Vibration Sensors," Acoustical Society of America, Sponsored Session on Miniature Sensors, New Orleans, November 1992.

Hegedus, C., D. Hirst and A. Eng, "Self-Priming Topcoats for Steel Applications," Federation of Societies for Coatings Technology Pain Show, October 1992.

Hegedus C. and K. Clark, "Maintenance Technology Training Workshop," NAWCADWAR, Warminster, PA, 9-12 March 1993.

Lee, E. U., "Thermal-Mechanical Fatigue of Titanium Aluminide and its Composite," 15th Annual Discontinuous Reinforced MMC Working Group Meeting, Park City, UT, 2-4 February 1993.

Thomas, M., D. Price, M. Wilson, I. Perez, and A. B. Harker, "Diamond Coatings of IR Ge Windows," Presented at the Diamond Applications Conference, Auburn, AL, August 1991.

(b) Selected conferences hosted:

Infra-red Window Protection and Non-Destructive Testing Symposium, 19-20 May 1992.

Technology Transfer Conference, 26 August 1992.

Small Business Fair, 24 March 1993.

The Technical Cooperation Program, JAG-16 Committee, 19-22 April 1993.

Avionics Conference, 4-5 May 1993.

Historically Black Colleges and Universities, 22 April 1993.

2.3.7.5 **University Programs.** NAWCADWAR has an active exchange with universities and colleges. Included are:

(a) the summer faculty program for professors to conduct research on site during the summer months, in some cases with their graduate students included,

(b) the sabbatical program for extended research of a year or more by university professors on site,

(c) the postdoctoral program for new graduates,

(d) a program for graduate students to do summer work,

(e) an exchange program with the U.S. Naval Academy where professors execute research work, which includes an extended visit on- site of one or two weeks to become acquainted with the work assignment, of a duration of several months.

Participation in the program for the reporting period is:

	FY92	FY93
Summer professors	16	17
Sabbaticals	1	1
Post doctoral	2	4
Graduate student	5	1
U.S. Naval Academy	0	9

Also, more than forty NAWCADWAR scientists teach at local colleges and universities Forty two research programs were sponsored at universities during 1992.

2.3.7.6 **Cooperative Agreements.** The NAWCADWAR has frequently entered into short-term, cooperative agreements with the private sector, primarily for use of the unique test facilities and technical expertise located at NAWCADWAR. The number of cooperative agreements between NAWCADWAR and non-Navy federal agencies, as well as the private sector, are listed below for FY92 and FY93.

Sponsor	No. of Agreements		Total Funding $K	
	FY92	FY93	FY92	FY93
Coast Guard	2	4	38.0	221.9
FAA	5	4	982.6	843.0
NASA	1	4	485.0	626.0
DARPA	20	8	3,840.5	4,885.0
Army	40	21	4,681.6	1,952.8
Air Force	41	43	3,867.7	3,781.2
Other than DOD	32	20	2,456.8	1,120.8
Private Party	52	46	580.2	479.5
TOTALS	193	150	16,932.4	13,910.2

2.3.7.7 Use of NAWCADWAR Laboratory Facilities. These facilities include:

- the Dynamic Flight Simulator - a centrifuge capable of subjecting a participant to 11 times the acceleration of gravity in an operating situation,

- a controlled fire pit for testing apparatus in fire situations,

- a linear accelerator which simulates crash conditions.

During the reporting period, many private industries have been able to use our laboratory facilities. Access to these facilities is through informal agreements with the private entities. As an example, the Crew Systems Laboratories have had 13 contracts in FY91 for $295,000, three contracts for $191,300 in FY92 and four contracts for $171,410 in FY93 to date with commercial industry.

2.3.7.8 CRADAs. NAWCADWAR has sponsored two CRADA's. They are:

(a) NCRADA-NAWCADWA-89-001, General Dynamics Corporation, use of the Dynamic Flight Simulator (centrifuge) to test response to g-stress.

(b) NCRADA-NAWC-AD-93-001, Grumman Aircraft, to develop a buffet and fatigue resistant aircraft structure (in negotiation).

2.3.7.9 Intellectual Property. At NAWCADWAR, a program of disclosing and patenting inventions created by the technologists has been ongoing since 1980. Approximately 90 patent disclosures are received annually. Patent applications are then pursued with an award rate of 30 to 40 per year. During the reporting period, 64 patents have been granted and a total of 36 applications are on file. Three of NAWCADWAR's patents are under license to the private sector.

2.3.7.10 Technology Reinvestment Program. Following the *Commerce Business Daily* announcement of 15 March 1993, we attended the regional meetings in New York on 12 April and in Philadelphia on 12 May. An active on-center education program for the TRP was conducted by OS&T for our technologists. On 2 June, a Technology Transfer Conference was held in the NAWCADWAR auditorium which was attended by 50 local small businesses, universities, and local economic development agencies. As a result of these activities, 21 proposals by the private sector, with NAWCADWAR as a participant, are being submitted to the TRP. NAWCADWAR has spent $120,000.00 in support of TRP.

2.3.7.11 Plans for Improving Domestic Technology Transfer.
(See also NAWC Center Plan)

(a) DTT Activity. If private industry can be made aware of our DTT capability and our technologies, the necessary technology pull from the private sector can be created. The NAWCADWAR understands its technology, and has ideas about how it can be commercialized. However, a commercial company has to accept the risks of bringing to fruition a new product using our technology. A large effort is required to bring about a match between a private sector entity and NAWCADWAR for DTT. The efforts made to respond to the TRP were fairly successful. These efforts will be continued using CRADA's as the contractual vehicle and including technology licensing where applicable. Arrangements with local economic development agencies are being developed to help increase NAWCADWAR contact with the private sector.

(b) Benefits. The following benefits will accrue from the DTT program:

- access of the private sector to NAWCADWAR technology will lead to new processes and/or products,

- leveraging of our manpower, facilities, and resources,

- Provides exclusive licenses to private industry,

- provides access to our unique laboratory facilities,

- increases our awareness of private sector technology which may be of use in military applications,

- increases awareness in the private sector of military technology needs,

- identifies to the private sector the capabilities of the NAWCADWAR.

(c) Recommendations.

- Develop the mechanisms to improve communications between the NAWC sites, to share in future joint programs, to identify resources at he NAWC sites, and to encourage improved cooperation in all technology transfer matters.

- Encourage and facilitate patent submissions and licensing.

- Encourage partnerships either formally or informally. Utilize CRADA's where applicable.

2.3.8 OVERVIEW

NAVAL AIR WARFARE CENTER AIRCRAFT DIVISION
ORTA Code PE3
P.O. Box 7176
Trenton, NJ 08628-0176

Contact: Mr. Albert Martino Phone: 609-538-6838
Fax: 690-538-6562

SYNOPSIS: To provide superior technical and engineering services, particularly test and evaluation, for air-breathing propulsion systems, power drive systems, fuels and lubricants, to the Naval Air Systems Command, Navy Program Executive Offices, the Fleet, and other U.S. or International customers who require our capabilities. We conduct rigorous testing, investigate and resolve technical problems, provide comprehensive, independent technical evaluations of development and in-service systems and programs, and manage and conduct research and development leading to new of improved propulsion system.

EXPERTISE: Expertise at NAWCADTRN which is applicable to technology transfer includes the following areas:

- Develop, test and evaluate engines under unusual operating conditions such as gyroscopic loads and variable attitudes;
- Develop, test and evaluate helicopter gearboxes, transmissions and drive trains under simulated operational loads;
- Conduct independent analysis and make recommendations, via test and evaluation, of critical turbine engine rotating parts for strength and life under simulated operating loads and fatigue cycles;
- Test and evaluate aircraft engine accessories, such as starters and auxiliary power units under simulated operating conditions;
- Provide technical and engineering support to the design, development, test and in-service support of aircraft engines, their components and accessories;
- Plan, manage and execute the propulsion technology base program for the Navy (Including 6.2 block manager in propulsion and propulsion materials for ONT);
- Provide engineering and technical support, research and development services, and testing of aircraft fuels and lubricants.
- Develop and manage all Navy propulsion specifications and apply them to acquisition programs.

UNIQUE FACILITIES: Special Equipment and Computers. Describe any special equipment or computers used at NAWCADTRN.

This facility has a special real-time data acquisition and analysis systems that support its engine test facility. These systems acquire large amounts of test data and perform engineering analysis on that data utilizing specialized computational techniques and computerized engine models. The number of parameters acquired and speed of analysis are appropriate for engine testing, and in most areas meet test requirements. Two of the 15 test systems are certified to acquire and process classified data.

This facility has special equipment as follows: Scanning Electron Microscope, Energy Dispersion X-Ray Unit, Emission Spectrometer, Low Temperature Fuel Flow Bench, Infrared Measurement System, Data Base Machine, Ballistic Flow Calibrator, Vibration Test Stand, Pres. Transducer Calibrator, High Response Data System, 1.5M in-lb Torquemeter, Hot Gas Facility Data Acquisition, Rotor Spin Facility Data Acquisition, Outdoor Test Site Data Acquisition, Intrusion/Detection Equipment, Display & Alarm System (3E, 1W, 2W), Air Heater (High Pressure), Air Heater (Low Pressure), Dynamometer/Tensioner, Air Heater (Hot Gas Facility), Dynamometer, Air Compressor, Bldg. 55 Slab Equipment, Power Absorber (Low Speed), Altitude Test Stand, Variable Speed Drive, Central Computer System, LETA Data Acquisition System, SETA Data Acquisition System, Transmission Facility equipment, Engine Exhaust Diffuser, Multi-Axis Thrust Stand, 3E Data Acquisition System, Instrumentation/Measurement, Hybrid Computer.

2.3.9 OVERVIEW, DATA, AND PLANS - WEAPONS DIVISION

2.3.9.1 Overview

(a) China Lake Site

NAVAL AIR WARFARE CENTER WEAPONS DIVISION
CHINA LAKE SITE

ORTA and DTT Focal Point:

Chuck Newmyer
Head, Industrial and Government Liaison Office
Code C0254
China Lake, CA 93555-6001
Phone: 619-939-1074

SYNOPSIS: The mission of the Naval Air Warfare Center Weapons Division is to be the Navy's full spectrum research, development, test, evaluation, and in-service engineering center for weapon systems associated with air warfare (except antisubmarine warfare systems), missiles and missile subsystems, aircraft weapons integration, and assigned airborne electronic warfare systems and to maintain and operate the air, land, and sea Naval Western Test Range Complex.

EXPERTISE: Fundamental research at NAWCWPNS spans an array of science and technology areas applicable to weapon systems including:

- Applied Mathematics
- Electronic Devices
- Energetic Materials
- Instrumental Analysis
- Microwave Devices
- Optical Device
- Propellants
- Propulsion
- Superconducting Devices
- Terminal Ballistics

Major areas of NAWCWPNS technology work are the following:

- Advanced Software Systems
- Airborne Electronic Warfare Systems
- Airborne Fire Control
- Atmospheric Properties and Effects on Sensors
- Embedded Computer Technology
- Fuzing
- Guidance and Control
- High Energy Laser Components
- Information Processing
- Hardware Integrated Simulations
- Insensitive Munitions
- Intelligent Machines Including Neural Networks
- Infra Red/Electro Optic Devices
- Propulsion
- Microwave Devices
- Scoring Devices
- Target Signatures and Modeling
- Test Data Collection and Transmission Processing
- Threat Simulation
- Weapons Aerodynamics, Airframes, and Materials

UNIQUE FACILITIES: The Naval Western Range Complex integrates the air, land and sea ranges and test facilities at Point Mugu, China Lake, and the Naval Ordnance Missile Test Station at White Sands. The Complex contains 1700 square miles of dedicated land, underlying more than 17000 square miles of restricted airspace and 36000 square miles of sea test range with overlying airspace.

The NAWCWPNS also includes unique laboratories and test facilities including:

Air Warfare Evaluation Facility
Electronic Warfare Systems Integration Lab
Encounter Simulation Lab
Explosives and Propulsion Labs
Full Scale Survivability and Vulnerability Facility
Missile and Aircraft software validation and Testing Lab
Reliability and Product Assurance Test Labs
Weapons Simulation Facilities
Weapon System Instrumentation and Data Analysis Labs

(b) Point Mugu Site

NAVAL AIR WARFARE CENTER WEAPONS DIVISION
ORTA, Code P34
POINT MUGU SITE
Point Mugu, CA 93042-5001

Contact:	Richard C. Murphy	Phone: 805-989-8801
		Fax: 805-989-3938
	Dr. Mike Sullivan	Phone: 805-989-8801
		Fax: 805-989-3938

SYNOPSIS: NAWCWPNS Point Mugu is a full spectrum research, development, test and evaluation, and in-service engineering center for weapons systems for air warfare and electronic warfare.

EXPERTISE: Expertise at NAWCWPNS Point Mugu which is applicable to technology transfer includes Electronics, Optics, Sensors, Systems Engineering, and Design of Experiments. Specific expertise is available in:

Missile Performance
Aircraft Weapons Integration
Tactical Computer Hardware and Software
Data Processing, Fusion, Display
Human Factors Engineering
E/O and RF Signatures
RF Communication and Datalinks
Electronic Warfare Systems
Microelectronics Design and Fabrication
Test Instrumentation Systems
Geophysics Systems

UNIQUE FACILITIES:

Environmental Test Chambers: Fully instrumented sea-level chambers ranging in size from full aircraft to individual missiles. Can accommodate explosive systems such as warheads and rocket motors.

Missile Hardware-in-the-Loop Laboratories: Self-contained test labs with full RF, E/O, EW stimulation for Sparrow, Phoenix, AMRAAM, and Standard Missiles.

RCS Anechoic Chambers: Full-spectrum mono-static and bi-static radar cross section measurements in far field for missiles and target vehicles.

Air and Sea Test Range: 32,000 square miles of fully instrumented (E/O, Radar, GPS, Telemetry, Impact Scoring) sea test surface area and accompanying air and undersea space. Live fire missile engagements from one-on-one to Battle Group level can be

accommodated. Control center has real-time links to virtually every DoD lab and range in the SW United States.

Instrumented Aircraft: A fleet of five RP-3A aircraft which can provide surveillance, telemetry tracking/relay. E/O signature measurement and photographic documentation services any where in the world.

2.3.9.2 Offices of Research and Technology Application (ORTAs) and DTT Focal Point

(a) ORTA and DTT Focal Point staffing and budget

ORTA (China Lake):

Chuck Newmyer, Head
Industrial & Government Liaison Office
Code C0254
Gerry Peterson, Secretary
Budget: Direct: $25K/yr (from ONR)
Center Overhead: 35K/yr (1 manyear)

ORTA (Pt. Mugu):

Dick Murphy
Sea Range Customer Group
Code P341
Budget: Direct: $10K/yr (from ONR)
Center Overhead: $40K/yr (1 manyear)

Office of Research & Technology Applications:
(China Lake)

(This group primarily handles the business and legal aspects of the DTT program at China Lake)

Elaine Wunderlich, Head, Code C027
Martha Harrington, Program Analyst
Bonnie Richardson, Secretary
Budget: Center Overhead: FY92 - $148.5K
FY93 - $151.3K

(b) Publicity/publications.

(1) "Technology Transfer - A general guide to licensing NWC technology"

(2) "Technology Transfer in the U.S. Government" - a general description of the Government's Technology Transfer Program

(3) "Industrial Liaison" - a listing of technology areas that we are involved in and that have potential for cooperative work

(4) "White papers" - descriptions of a number of our technologies that are available for cooperative efforts

(5) "Best Practices" - description of our outreach programs

(6) "Patents are Rewarding" - a guide for employees on obtaining patents

(7) "Technology Transfer Program" - overview brochure with white papers on available technologies

2.3.9.3 Publications

(a) Examples of the 75 scientific, technical, and professional journals in which NAWCWD publishes:

Optical Engineering
Proceedings of the Society of Photo-Optical Instrumentation Engineers
Applied Physics
Chemical Materials
Journal of American Ceramic Society
Journal of Electroanalytical Chemistry and Interfacial Electrochemistry
Journal of the Optical Society of America
Progress in Energy and Combustion Science

(b) Approximate number of publications (including conference proceedings and books): 400

(c) Representative titles:

A Symbolic Theory of Decision-Making Applied to Human Resource Management
Recent Developments in Surface Roughness Characterization
High-Speed Shutter Technology for Frequency Agile Laser Eye Protection
Recognition Mechanism for Saturating Sigmold Neural Networks
A Low-Cost Ph Meter for the Classroom
Examination of the Chemistry Involved in Microwave Plasma Assisted Chemical Vapor Deposition of Diamond
Study of Combustion Dynamics for Passive and Active Control
Mixing Characteristics of Supersonic Shrouded Jets

2.3.9.4 Conferences & Symposia

(a) Number hosted by or participated in as a presented:

FY92: 160
FY93: 168

(b) Breakdown according to estimated number of attendees: (Less than 100, between 100 and 500, more than 500)

	Less than 100	100 to 500	More than 500
FY92:	6	153	1
FY93:	13	139	16

Some representative conferences and symposia:

TITLE/NAME	LOCATION	ATTENDEES
Fifth Symposium of Numerical and Physical Aspects of Aerodynamic Flows	Long Beach, CA	Less 100
National Institute of Standard & Technology Workshop on Characterizing Diamond Films	Gaithersburg, MD	Less 100
Surface Roughness & Scattering Conference	Tucson, AZ	100-500
NSWC Neural Network Symposium	Dahlgren, VA	100-500
World Congress on Neural Networks	Portland, OR	100-500

TITLE/NAME	LOCATION	ATTENDEES
American Institute of Aeronautics, Aircraft Design Conference	Irvine, CA	100-500
10th Applied Aerodynamics Conference	Palo Alto, CA	100-500
Experimental Nuclear Magnetic Resonance Conference	Pacific Grove, CA	100-500

2.3.9.5 Exchange Programs & Visits (Industry, academia, state & local government, foreign)

(a) We had 20 employees on Fellowships in FY92 and have 9 in FY93

(b) IPA with Chico State, Chico, CA

(c) United Kingdom Computer Technology Review (US/UK Bilateral Agreement IEP B-88

(d) CalState, Irvine - Transfer of images/imagery for research

(e) Academia Summer Faculty Program:
- San Jose State University
- West Texas State University
- Oregon State University
- College of Staten Island City University of New York

(f) Other Government Agencies - NAWCWPNS has interactions with at least 30 Government Agencies outside of DoD, including NASA (Ames, Lewis, Langley, and Boulder), Oak Ridge National Laboratory, Drug Enforcement Administration, ARPA, NIST, Jet propulsion Laboratory, and FAA.

As a result of its technical expertise and ideal location for a pilot facility, NAWCWPNS (China Lake) joined NASA in the further development of a concept called SELENE (Space Laser Energy) for beaming laser power to satellites to extend their lifetime. A significant part of this effort involved discussions with Russian scientists regarding the purchase of a 200 Kw free electron laser from the Budker Institute of Nuclear Physics at Novosibirsk.

(g) State and local government

City of Ridgecrest - Small Business Incubator
City of Ridgecrest - technical consultation
Cerro Coso Community College - technology transfer program
CalState, Bakersfield - technology transfer program
State of California Department of Health - technical consultation
Georgia Technology Research Institute - technology exchanges
Colorado State Police - night vision cameras

(h) Industry - NAWCWPNS has technical exchanges ongoing with over 100 companies, including:

Industry/University Consortia: Micro Electronics and Computer Corporation (MCC) - Affiliate
Sandia Corporation - technical exchanges
Texas Instruments - technical exchanges
Motorola - technology exchanges
General Electric - technology exchanges
3M Corporation - technical exchanges
Air Products, Inc. - technical exchanges
Dupont - technical exchanges
GM Research Labs - technical exchanges
Kodak - technical exchanges
National Center for Manufacturing Science - technical exchanges

(i) Academia - NAWCWPNS has ongoing technical exchange programs with over 60 major universities; the nature of these exchanges range from courses taught by NAWCWPNS personnel to sponsorship of university research projects. Some examples are:

Oregon State University - Co-Authoring of reports/papers
Carnegie Mellon University - technical exchanges
University of Wisconsin-Madison - taught course on Advanced Industrial Laser Welding
University of California, Santa Barbara - research project sponsorship
Howard University - technical seminar
Clark Atlanta University - technical exchanges
Fitchburg State College - technical exchange
Massachusetts Institute of Technology - technical exchanges
Princeton University - technical exchanges
Stanford University - technical exchanges
University of Maryland - technical exchanges
Utah State University - technical exchanges

(j) Interactions with Foreign Governments:

Canadian Armed Forces - FMS, testing, technical consultation
Royal Australian Air Force - FMS, technical consultation
Spanish Air Force, Navy, Air ministry and Consulate - technical consultation
Kuwait Air Force - FMS, technical consultation
Egyptian Air Force - FMS, technical consultation
French Consulate, Nice - FMS, technical consultation
Philippine Consulate - FMS, technical consultation
Japanese Consulate - FMS, technical consultation
UK - IR models/missile signatures
Republic of Germany - FMS, technical consultation
Japanese Defense Force - FMS, technical consultation

(k) Foreign visitors: 901

(l) Foreign visits by laboratory personnel - There have been more than 35 foreign visits by NAWCWPNS personnel in FY92 and FY93 thus far. Some examples are:

NATO Research Study Group (RSG-13)
Members: US, Canada, Denmark, France, UK, Germany, Greece, Italy, Netherlands, and Norway
Information exchange with Russia on Neural Network Simulation
Institute of Optical Research, Royal Institute of Technology - Stockholm, Sweden
Conference on Commercial Applications of Precision Manufacturing - London, England
Second Pacific Polymer Conference - Otsu, Japan
NATO Advanced Study Institute on Modern NMR Technology - Dalaman, Turkey
Fourth NATO Workshop on Passive Infrared Optical Materials - Malvern, UK
The Fourth International School and Workshop of Crystallography, Computational Methods in X-Ray Powder Diffraction Analysis - Aswan, Egypt

2.3.9.6 Grants and Cooperative Agreements

(a) Donations of equipment to universities (include GFE turned over to universities): None

(b) Investments in university facilities: None

(c) Education Partnerships

- NAWCWPNS has a memorandum of understanding (MOU) with the local Sierra Sands School District as a part of the Adopt-A-School program.
- NAWCWPNS has a MOU with California State University, Bakersfield, to work with their School of Business on technology transfer related projects.
- NAWCWPNS is working with the local Cerro Coso Community College on programs related to utilizing lab technology for small businesses, either as start-ups or enhancing existing capabilities.
- Also, see Attachment 11 for other interfaces academia.

(d) URI & Centers of Excellence

We have informal interfaces with a number of the Centers of Excellence but not formal agreements. We would like to be working closer with these Centers, but funding is not available.

2.3.9.7 Use of laboratory facilities

(a) Agreements other than CRADAs that involve company use of DoD facilities:

We use special deposits to allow companies to utilize our unique test facilities, such as the test ranges. For example, companies have conducted flight tests against various targets to evaluate new and/or improved missile system concepts. Also, unique lab test capabilities are utilized by industry for materials evaluation.

(b) Industry use of test centers - There have been more than 25 instances of industry use of test centers, with nearly $3M of funding from private industry.

2.3.9.8 CRADAs

(a) Active CRADAs: 9

TITLE	PARTNER CATEGORY
Chemical Element Investigation	Industry
Software Applications for Computer Networking	Industry
Information Module on Markov Processes	Industry
Phased-Array Covert Radar Altimeter	Industry
Conductive Transparent Polymer	Industry
Embedded Computer Institute	Industry
Injection Loading Technology	Industry
Infrared Flare Countermeasures Simulator Technology	Industry
Embedded Computer Institute	Industry

- Under the earlier MCTL system, this was in the category 14.1 - Optical Sensor Technology; under the new system, it fits in category 6.2 - Optical Sensors.

(b) CRADAs under negotiation, number: 15

(c) Lab investment (estimate)

NAWCWPNS investment, for FY92 and FY93, in the 9 existing CRADAs is approximately $500K.

(d) Income producing (yes or no, if "no," what about the future?)

5 of our nine CRADAs are income producing; 2 of the others will involve future income.

(e) Criteria for deciding if income is desired

Prior to negotiations on a CRADA, detailed discussions are held with our scientists and engineers regarding use of Government resources. The resources required of the potential partner(s) is also discussed. During negotiations, including review of the statement of work, resource contributions of all parties are discussed and evaluated. Based on the relative worth of these contributions, as well as consideration of prior investments in the subject technology by all parties, a determination is made regarding the appropriateness of receiving funding from the non-Government partner(s). Attention is paid o parity and reciprocity.

(f) Describe nonmonetary contributions

In all of our CRADAs, we contribute personnel. We feel that our main contribution to any CRADA is the technical expertise of our people. In most cases, we are also providing facilities and equipment that support the technology. This can include prototype hardware, software, test equipment, fabrication of components, etc.

(g) Reason(s) for backlog, if any

Ignorance of the real purpose and parameters of the DTT program on the part of non-Government partners.

DTT professional resources (personnel and other) are extremely limited and materially impact our ability to handle the quantity of technologies available for transfer.

2.3.9.9 Intellectual Property, Including Patents, Copyrights, and Trade Secrets

(a) Patents: 63

(b) Patent Applications: 58

(c) Licenses

TITLE	PARTNER CATEGORY
Chemiluminescent Light Stick	Industry
Chemiluminescent Light Stick	Industry
Method of Making Near Infrared Polarizers	Industry
Calcification Tablet	Industry
Nondestructive Analysis of Multilayer Roughness Correlation	Industry
Stripline Conformal Antenna	Industry

(d) Royalty Income: $35K/yr

(e) CRADAs that provide trade secrets, know-how, copyrights

We have one CRADA that deals with industry trade secrets. Clauses have been added to the agreement to protect these trade secrets.

We feel that all of our CRADAs provide know-how. The technical expertise of our personnel is our primary contribution to these agreements.

Where appropriate, we include the necessary clauses to cover the potential of copyright by the non-Government party. The Government has nonexclusive license rights to use the copyright material free of royalties. Five of our CRADAs have copyright clauses included.

(f) Describe backlog in patent applications

The NAWCWPNS patent office has a backlog of 123 cases. The reason for the backlog is that there are not enough in-house patent attorneys to process the large number of invention disclosures received from the NAWCWPNS technical community. Also, there aren't sufficient resources to contract out the paten case backlog.

(g) Attorneys supporting DTT

The NAWCWPNS patent office consists of five patent attorneys. Of these, one attorney spends 20 to 25 percent of his time on DTT. This equates to approximately $30K per year in salary. Travel costs are approximately $40K per year.

At present, there is no formal training of scientists and engineers (S&Es) regarding patent and license requirements and responsibilities. Discussions with S&Es regarding DTT in general will usually include information on patent and licenses. If it then seems appropriate, the scientist or engineer will have a meeting with one of the attorneys to talk in more detail. The S&Es ar not directly involved in the licensing of patents. They do provide any necessary technical interfacing with the licensee.

2.3.9.10 Technology Reinvestment Project Efforts

NAWCWPNS has provided support by providing general information on the TRP, defining how NAWCWPNS can participate, and have worked with eight teams in their proposal development. We have expended approximately 160 manhours in this effort. We are not part of the source selection team.

2.3.9.11 DoD Organizations - see 2.3.9.5 (f)

2.3.9.12 Efforts carried out under legal authorities other than the Stevenson-Wydler Technology Innovation Act of 1980, As Amended. Describe the efforts, if any, and cite the legal authority.

NAWCWPNS utilizes the Navy Potential Contractor Program (NPCP) extensively to provide technology information to industry.

2.3.9.13 Just as Technology Transfer legislation continues to evolve, so do our efforts to implement the process of Technology Transfer through our evolving set of "Best Practices."

- TEAM APPROACH: From the beginning of our involvement, we believed that a variety of skills and experiences would provide the NAWCWPNS, China Lake with the "most bang for the buck," and so developed a team to work the problem. The team consists of several individuals with education and experience in business and finance, a technical discipline and law. Each individual brings a different perspective to the table. The end result is a thorough evaluation of each unique idea, resulting in what we believe to be the best approach to use for the given situation.

- TECHNOLOGY ASSESSMENT: We recognize that technology assessment is an area which is difficult to deal with effectively. Currently, we are in the experimental mode using several different techniques to grapple with the task:

(a) A Navy Reserve Unit composed of about 16 individuals, many of whom are scientists who work for private industry, is located at our Base. We have arranged for Unit members to review a number of our existing patents looking for potential commercial applications; (2) We have

established a relationship with a local State University which incorporates a module in their business curriculum whereby students review existing patents, assess their commercial potential, develop a marketing plan and provide a list of potential partners as part of their course of study' (3) We are also utilizing the services of the NASA Regional Technology Transfer Center in our region to do technology assessment and marketing for three targeted technologies; and (4) We continue to explore utilizing a variety of commercial companies to provide very specialized services (technology assessment, market profiling, and listing of potential partners).

- OUTREACH: We believe that awareness of ourselves, our capabilities and the program must be created both inside and outside of the NAWCWPNS, China Lake. Toward that end we have developed a standard information package which includes our marketing material (Technology Transfer Brochure, Industrial Liaison Bulletin, philosophy statement, sample CRADA, sample SOW, non-disclosure form, and sample license). This package is distributed to all who inquire about the program, both from within China Lake and outside. We conduct informational discussions at Department, Division, Branch, and group meetings at the NAWCWPNS, China Lake as well as at local functions (Rotary Meetings, local Contractor meetings, etc.). We also attend a variety of technical meetings so that we may be aware of emerging technologies as well as make the technologists aware of our program. We have many one-day technology sharing meetings between technologists and company management. This year, we had a three day technology sharing meeting ("Industry Days") between ourselves and many of the companies with which we had participated in IR&D programs.

- MARKETING: There are several general efforts which we believe to be particularly effective. They are:

(a) The development and distribution of marketing packages which include the previously mentioned Technology Transfer Brochure, Industrial Liaison Bulletin, philosophy statement, sample CRADA, sample SOW and sample License Agreement, as well as appropriate summary sheets which give details of technologies ready for commercialization.

(b) Participation at Technology Trade Shows/Fairs increases and broadens visibility and knowledge of our Center as well as highlights candidate technologies.

(c) Use of a variety of techniques for marketing (including use of TELTECH, working with NASA RTTC, utilizing contractor firms for marketing, etc.). We believe the focused approach is the most effective. Marketing is an area in which we continue to experiment and grow.

- PUBLICITY: We believe that publicity is an important aspect of a proactive Technology Transfer program. We also believe that it is not the same as marketing. We work with the NAWCWPNS, China Lake Public Affairs Office to publicize noteworthy happenings in the Technology Transfer area.

Selected Vehicles for the Technology Transfer:

- BACKGROUND: There are many vehicles for transferring technology. The enabling technology transfer legislation speaks to several but does not limit technology transfer to just the obvious (patent licensing and Cooperative Research and Development Agreements). The spirit of that legislation speaks to creating an environment conducive to enhancing the global competitiveness of American private enterprise. Many other elements are important ingredients in creating and maintaining that environment and making technology transfer activities productive and effective. Some of those other elements are: The Navy Potential Contractor Program (formerly the NICRAD Program), Technical Assistance, Special School Programs, attendance at Conference, Symposia, Technical Exchange Meetings, published works, participation in IRAD programs, Work for Others, and participating with Small Business Incubators.

Cooperative Research and Development Agreement (CRADA): [This is a vehicle which can facilitate technology transfer from Government laboratories to the private sector and vice versa. The CRADA is a document which describes a relationship, one that is very different from a procurement contract--which is the traditional one usually experienced by the Government and private industry. This relationship is one of equal partners working together to advance technology.]

Patent License Agreement: This has been a vehicle for technology transfer for many years. It is perhaps the most straight forward method of transfer because the relationship is one with which most of the participants are very familiar. Owners of patented technology negotiate license agreements with potential utilization. The licensee that produces (or has produced) items which contain the technology and make a profit. Some of the licenses' revenues are returned to the originator of the technology in the form of royalties.

NPCP (Navy Potential Contractor Program): This is a cooperative data-sharing agreement for private companies and Navy Laboratories to share information. The agreement is short and simple; there are no implied or actual commitments and no work is performed in conjunction with this agreement. The NPCP provides a means for U.S. Industry to obtain valuable information to assist them in formulating their internal research and development programs. Usually, the Government receives information in return that provides some insight into the capabilities of private industry and the strength of the U.S. industrial base.

- TECHNICAL ASSISTANCE: Technical Assistance can take many forms and often can be as simple and short in duration as a single telephone call or a two hour visit to the government laboratory.

SPECIAL SCHOOL PROGRAMS: There are probably as many Special School Programs as there are government laboratories. Activities in this area include giving scientific demonstrations and participating in school laboratory experiments, judging science fairs, speaking at Career Days, helping schools solve scientific problems, setting up and participating in "mentor" programs in which students interested in science work in the laboratory under the guidance of a senior "mentor" for school credit, loaning excess scientific equipment and apparatus, as well as numerous other activities which provide opportunities for interface and instruction "technology transfer" for students.

ATTENDANCE AT CONFERENCES, SYMPOSIA, AND TECHNICAL EXCHANGES:

PUBLISHED WORKS: Publishing the results of scientific investigation has long been acknowledged as a most basic way to transfer technology.

PARTICIPATING IN IRAD PROGRAM: Participating in the IRAD program has allowed the public and private sectors to exchange ideas and help focus the research efforts of the private sector.

WORK FOR OTHERS: In instances where expertise does not exist in the commercial sector, but it does reside in the public sector, "work for others" can be performed. No actual intellectual property is transferred, but since the government laboratory has a unique skill, facility, or capability, and the requirement is one of short duration and non-recurring, "work for others" is the vehicle of transfer. The government can materially benefit many in private industry with its unique facilities and often at a cost which enables the private party to remain competitive.

Non-traditional relationships are also being considered:

SMALL BUSINESS INCUBATORS: A relatively new aspect of technology transfer, at least for DOD labs, is to work with Small Business Incubators. Although these relations usually are established by the licensing of patents and through

CRADAs, there will be a need to initially establish an understanding of the technology transfer concept and how the relationship with the incubator will be created.

COLLEGES AND UNIVERSITIES: There area many ways to create working relationships with colleges and universities in the furtherance of technology transfer. One vehicle that has been used is working with the business school of a local university first to provide them an understanding of the technology transfer process and then working directly with their business classes to investigate specific aspects of technology transfer such as marketing, evaluation of patents, brain storming on potential commercial applications, etc. The students tend to look at technology transfer from a completely different point of view and their term papers provide the lab with some unique insight for potential uses of their technology.

SMALL BUSINESS DEVELOPMENT CENTERS: The small Business Development Centers (SBDCs) can be very helpful in assisting the small businessman in taking advantage of the technology available through the Federal lab system.

DEPARTMENT OF THE NAVY
DOMESTIC TECHNOLOGY TRANSFER

2. REPORTING COMMANDS

2.4 NAVAL COMMAND, CONTROL, AND OCEAN SURVEILLANCE CENTER (NCCOSC) SAN DIEGO, CA

2.4.1 CENTER OVERVIEW
2.4.2 DTIC REPORTS
2.4.3 DIVISION OVERVIEWS: (NRaD and NISE WEST)
2.4.4 DATA & PLANS: RESEARCH, DEVELOPMENT, TEST & EVALUATION (RDT&E) DIVISION

2.4.1 CENTER OVERVIEW

NAVAL COMMAND, CONTROL AND OCEAN SURVEILLANCE CENTER (NCCOSC)

NCCOSC POC: DR KEN CAMPBELL (619) 553-3014 (FAX -2089)

SYNOPSIS: The NCCOSC mission is to be the Navy's full spectrum research, development, test and evaluation engineering and fleet support center for command, control and communications systems and ocean surveillance and the integration of those systems which overarch multiplatforms.

EXPERTISE: The assigned NCCOSC leadership areas, and therefore the areas of expertise, are as follows:

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

MAJOR FACILITIES: The Naval Command, Control and Ocean Surveillance Center is composed of three major divisions as follows:

- NCCOSC RDT&E Division (NRaD), San Diego CA
- NCCOSC West Coast In-Service Engineering Division (NISE West), San Diego CA
- NCCOSC East Coast In-Service Engineering Division (NISE East), San Diego CA

The NCCOSC NISE East Division is composed of four (4) separate commands, also liste as follows:

- Naval Electronic Systems Engineering Center (NESEC) Portsmouth, Portsmouth, VA
- Naval Electronic Systems Engineering Center (NESEC) Charleston, SC
- Naval Electronic Systems Engineering Activity (NESEA) St. Inigoes, MD
- Naval Electronic Systems Security Engineering Center (NESSEC) Washington, DC

The NCCOSC Command Brochure included details, the location of the three division of NCCOSC and their various components. At each of these locations, there are many unique facilities that could play a significant role in technology transfer. Some of these are detailed in the following description of the NRaD and NISE divisions.

2.4.2 DTIC REPORTS

(a) NCCOSC Technical Reports Submitted to DTIC

FY92	FY93 (3 qtrs)	Total
222	121	343

(b) Representative Titles

- "Advanced unmanned search system (AUSS) surface navigation, underwater tracking, and transponder network calibration."

- "Evaluation of sediment contamination in Pearl Harbor."

- "Low-orbiting satellites in remote deployable undersea surveillance systems."

- "Nonlinear resonance: noise-assisted information processing in physical and neurophysiological systems."

- "Subsurface screening of petroleum hydrocarbons in soils via laser induced fluorometry over optical fibers with a cone penetrometer system."

- "Technical manual, redesigned ARC-2A automatic radon counter."

- "Terrain modelling using the split-step parabolic equation method."

- "Triplet states and optical absorptions in finite polyenes and conjugated polymers."

2.4.3 DIVISION OVERVIEWS: (NRaD and NISE WEST)

2.4.3.1 Overview: Research, Development, Test & Evaluation (RDT&E) Division

NAVAL COMMAND, CONTROL AND OCEAN SURVEILLANCE CENTER RDT&E DIVISION (NRaD)

NRaD POC: DIANA JACKSON (619) 553-2101 (FAX 2089)
Code 014

SYNOPSIS: The NCCOSC RDT&E Division's mission is to be the Navy's research, development, test and evaluation center for command, control and communication systems and ocean surveillance and the integration of those systems which overarch multiplatforms.

EXPERTISE: The assigned NRaD leadership areas are as follows:

- Command, control, and communication systems
- Command, control, and communication systems countermeasures
- Ocean surveillance systems
- Command, control, and communication modeling and analysis
- Ocean engineering
- Navigation support
- Marine mammals
- Integration of space communication and surveillance Systems

MAJOR FACILITIES:

- GPS Central Engineering Activity (CEA) Laboratory
- Inertial Test Facility (INFAC)
- Simulated Ships Motion Facility (SCORSBY)
- JTIDS C3 Laboratory
- SOCAL Communications Networking Test Range
- Information Transfer Management System (ITMS)
- Super High frequency (SHF) Satellite Communication Test Facility
- Optical and Radiometric Calibration Facilities
- Extremely High Frequency (EHF) Satellite Communications Terminal Test Facility
- Commercial satellite communication (SATCOM) Facility
- Navy Tactical Command System-Afloat Testbed and Integration Facility
- Navy Command and Control System-Ashore (NCCS-A) Integration and Test Facility
- Ocean Surveillance Information System (OSIS) Evolutionary Development (OED) Laboratory
- High-Performance Computing Laboratory
- Distributed Command and Control Laboratory
- Display Technology Laboratory
- Ship Antenna Model Range
- Survivable Adaptable Fiber-Optic Embedded Network Development Site
- Navy UHF Satellite Communications Test Facility (NUSTF)
- Research, Evaluation and Systems Analysis Facility (RESA)
- Materials Research Laboratory
- Electronic Materials Sciences Laboratory

2.4.3.2 Overview: In-Service Engineering (ISE) West Coast Division

NCCOSC NISE WEST COAST DIVISION (NISE WEST)

NISE WEST POC: DR FRANK GORDON (619) 524-4000 (FAX 3274)
Code 01

SYNOPSIS: The NCCOSC ISE West Coast Division's mission is to be the Navy's engineering and fleet support center for assigned command, control and communicatio systems and ocean surveillance and the integration of those systems which overarch multiplatforms.

EXPERTISE: The assigned NISE West leadership areas are as follows:

- Shipboard satellite communications
- Maritime Defense Zone/USMC support
- Low Frequency/Very Low Frequency (LF/VLF) communications
- Mobile tactical command and control (C2)
- Submarine electronic support measures (ESM) systems
- Shipboard and aircraft navigation
- Pacific in-service engineering activity (ISEA) support

MAJOR FACILITIES:

- Tactical Systems Support Facility (TSSC)
- Fleet Maintenance Agent (FMA) Total Ship Test Program (TSTP) Laboratory
- Caribbean Regional Operations Center (CARIBROC) Processing and Display Systems (PDS) Laboratory
- Environmental Testing Laboratory

2.4.4 DATA AND PLANS: RESEARCH, DEVELOPMENT, TEST AND EVALUATION (RDT&E) DIVISION

2.4.4.1 Offices of Research and Technology Applications (ORTA) and DTT Focal Points: Diana Jackson, Dale Gurley, Lois Richards-Means.

Part of overall budget of Code 014. As of August 1993, this function will have three full-time GS-13 level professional staff and one secretary GS-5 level, as part of the Code 014 organization

PUBLICITY: CRADA handbook (being revised), patent listing, patent floppy with keysearch program, multi-display in lobby, fliers at exhibits, speeches, and FLC regional coordinator efforts. This lab participated in four National Technology Initiative (NTI) meetings in 1992.

2.4.4.2 Publications:

(a) Approximate number of publications: 339 in-house publications and 249 conference proceedings, symposia and open literature.

(b) Representative titles:

"An Adaptive Antenna Environment Emulator - The Wavefront Simulator," in Proceedings, 4th Navy R&D Information Exchange Conference, April 1993.

"Tactical Symbology Standards," Proceedings, 36th Annual Meeting, Human Factors Society, October 1992.

"Attentional Sensory Processing that is Mnemonic," Proceedings, World Congress on Neural Networks (WCNN), July 1993.

"Diamond-Based Microelectronics," Proceedings, GUMAC, November 1992.

"Global Positioning System (GPS) Brochure," TD 2543 93-273.

"On the Generation of Multilevel Distributed Intelligence Systems Using Petri Nets," TD 2473 93-159.

"Measurement of EM Properties of Composite Materials," TD 2457 93-132.

"Decomposition of Large Sparse Symmetric Systems for Parallel Computation," TR 1572 93-105.

2.4.4.3 Conferences:

(a) Hosted: NRaD hosted 36 conferences in 1992. We gave papers at 438 conferences, but actually sent 613 attendees to those conferences.

(b) The following is representative of those attended and presented:

36th International Symposium on Electron, Ion, and Photon Beams, May 1992.

SPIE's International Symposium on Lasers, Sensors and Spectroscopy, January 1992.

123rd Meeting of the Acoustical Society of America, May 1992.

IEEE Instrumentation & Measurement Technology Conference, May 1992.

DOD Fiber Optic Conference, March 1992.

Material Research Society, November 1992.

American Chemical Society Division of Industrial and Engineering Chemistry Annual Meeting, August 1992.

International Conference on Acoustics, Speech and Signal Processing, April 1993.

(c) The following is representative of those hosted:

NATO Tri-Service Group on Communications & Electronics (TSGCE) Subgroup 9 ad hoc Working Group on OSI Management (<100)

The Technical Cooperation Program (TTCP) Subgroup Technical Panel 8 (STP 8) Meeting (<100)

Armed Forces Communications and Electronics Association (AFCEA) West Intelligence Symposium (>500)

Joint Directors of Laboratories Technology Panel on Electronic Warfare (<100)

Tactical Advanced Computer TAC) 4 Working Group Meeting

Canadian/United States Navy Fleet Satellite Communications Program Review (<100)

US/Japan Cooperative Program in Natural Resources (UJNR) Marine Facilities Panel (<100)

Tri-Service Open System Architecture Working Group (<100)

(d) Presentations/Papers at Conferences: 249 papers. Some representative titles:

Author: Nelthropp, D., Tanju, B.
Meeting: Institute of Navigation National Technical Meeting, San Francisco, CA
Date: 01/20/93
Presentation Title: Test and Evaluation of Embedded GPS Systems
Publication: Proceedings, Institute of Navigational National Technical Meeting, January 1993.

Author: Minarik, S.
Meeting: Adaptive Antenna Systems Symposium, Melville, NY
Date: 11/19/92
Presentation Title: An Adaptive Antenna Environment Emulator - The Wavefront Simulator
Publication: Proceedings, Adaptive Antenna Systems Symposium, November 1992.

Author: Goodman, I.R.
Meeting: Fifth International Fuzzy Systems Association World Congress, Seoul, Korea
Date: 07/04/93
Presentation Title: Conditional Events and Fuzzy Conditional Events Viewed for a Product Probability Space Perspective
Publication: Proceedings, Fifth International Fuzzy Systems Association World Congress, July 1993.

Author: Waagen, D., McDonnell, J.
Meeting: Second Annual Conference on Evolutionary Programming, La Jolla, CA
Date: 02/25/93
Presentation Title: Probability Density Model and Parameter Estimation Using Evolutionary Programming
Publication: Proceedings, Second Annual Conference on Evolutionary Programming, February 1993.

2.4.4.4 Exchange Programs and Visits:

This laboratory has a significant number of foreign visitors annually, from a wide variety of countries, such as United Kingdom, Belgium, Portugal, France and Egypt. We send may lab people to foreign meetings, conferences, and NATO exercises, which include Korea (Data Exchange Agreement), France (Guidelines/IPO), and AUSCANNZUKUS (Operational Neets). Countries with the majority of contacts are Australia, Canada and the UK.

We also have exchange programs, such as:

NSF Industry/University Centers - Center for Integrated Systems and Circuits (ICAS) at UCSD and the Center for High Speed Image and Signal Processing (CHIP) at UC Irvine.

Summer Faculty Program - Navy/American Society of Engineering Education (ASEE) - allows faculty to spend ten weeks at NRaD during the summer. This year 16 faculty will participate.

ONR Graduate Fellow - NRaD invites ONR and NDSW graduate fellows to spend up to three months during the summer. This year two fellows will visit.

Postdoctoral Fellows - The ONT Postdoctoral Fellow Program with seven post docs and the NRC Resident Research Associateship Program with two postdocs.

Sabbatical Leave - As part of the Navy/ASEE program with one faculty member now on sabbatical leave at NRaD.

Local University Interaction - Each spring faculty at SDSU and UCSD are briefed on NRaD academic and research programs. This year, ten faculty participated in our proposal meetings.

2.4.4.5 Grants and Cooperative Agreements:

(a) Cooperative agreements with colleges to provide paid student labor to this laboratory:

- San Diego State University
- Southwestern Junior College
- Grossmont Junior College
- Penn State University

(b) Education partnerships include:

- Gompers High School to develop interest in sciences and technology for students
- San Diego Math Engineering & Science Achievement Program.
- MESA for tours at our lab and meetings with our professional, with some some monitoring
- Volunteer Service Program for free student labor with college credit.

2.4.4.6 Use of laboratory facilities:

Agreement other than CRADAs: Our laboratory "work for private parties" process allows small efforts that are not cooperative. Generally, this arrangement has been used for defense contractors but in recent times, we have used it for others. For FY93, we have 24 customers sending us $925K to date, including $225K from Westinghouse for range support services, $93K from Sonalyst for Research, Evaluation, and System Analysis (RESA), and $84K from Raytheon for environmental engineering.

2.4.4.7 CRADAs:

(a) Current NRaD CRADAs:

Category	Title	Company
Superconducting Electronic Devices	Fabrication Science of Thin Film Silicon (TFS) on Sapphire	Peregrine Semiconductor
Superconducting Electronic Devices	Thin Film Silicon (TFS) on Sapphire	Hughes
Robotics/Telerobotics	Development of Integrated Mobile Robotics Security System	Cybermotion, Inc.
Superconducting Electronic Devices	Hybrid Thin Film CMOS/Superconducting Circuits	Conductus
Marine Passive Acoustics	Passive Detection and Target Recognition	Santa Barbara Analysis
Robotics/Telerobotics	Exterior Security Robots	Cybe Vehicles
Computer Hardware/Software Service Support Center	Ruggedized Polymer	Multi-Access Data Devices
Optical & Electro-optical Components	Advance Technology ASW Display	Kaiser Electro-optics
Radar	Shipboard Array Antenna System (SA^2S)	Ball Communication System Div
Human Factors	Software for Advanced Algorithm	Market Path Corp.
Communications Switching	Enhancement of Navy C4I Testbed Environment	GTE Government Services
Environmental Sensors	Cone Penetrometer System	Hogentogler & Company
Marine Passive Acoustic Systems	Polymer Drag Reduction	Baker Performance Chemicals

(b) Partial industry funding was provided on the first two CRADAs (Peregrine and Hughes). However, in the majority of cases, our CRADAs have consisted of joint development efforts, with each side funding itself. Since to this point in time, we are not allowed to "make a profit" on a CRADA, any funding received can only be costed on a reimbursable basis. The closer to the objectives of an ongoing project at our lab, the less likelihood of funding being sought.

(c) Several of our CRADAs are on the verge of bringing in large amounts of "sponsor" funds, i.e., Conductus and GTE.

(d) Backlogs in CRADAs are created by legal implications, loss of funding, change in management, etc., and other factors that are external to the actual CRADA effort. During the last several months, attention focused on submitting ARPA TRP proposals delayed some decision making as companies turned to that potential source of support.

2.4.4.8 Intellectual Property:

(a) We have approximately 650 patents and 200 patent applications in our portfolio that are LICENSABLE. We have licensed 8 patents to a dozen different licensees. Six patent negotiations are in process. Total royalty income to date is $168K.

(b) Lack of copyright protection for federal software creates difficulty in obtaining industry commitment to our technology.

(c) All our CRADAs to some extent provide know-how and assistance. The government has no copyrights of its own other than those it may have acquired from non-federal entities. To date we have not used such copyrights in a CRADA.

(d) The patent backlog is at least 2 workyears at current staffing. It exists in part because a large backlog was "inherited" from the time ONR was in charge of the Navy patent organization. It continues partly due to understaffing , accretion of duties, and budget constraints.

(e) Four full time patent attorneys, plus a general counsel, support technology transfer through patent licensing, CRADAs, including negotiating, document drafting and review and interfacing with ONR. This staff also provides counseling and education for lab employees.

(f) Cumulative salaries for five attorneys is approximately $350K/year and their total travel budget is approximately $10K.

(g) Engineers and scientists are trained via one-on-one counseling and through occasional group presentations.

2.4.4.9 Technology Reinvestment Project Efforts:

(a) Laboratory involvement for the TRP included initial training courses, efforts to market our capabilities, long term assistance to ARPA (Jeff Haun), at least one proposal evaluator, two Navy points of contact listed in nationally disseminated TRP information, and negotiation on projects that were actually submitted to ARPA (13) or kept for consideration of other efforts

(b) This effort equates to at least .25 of a workyear in total.

(c) Listing of submitted TRP projects:

NRaD ARPA TRP PARTNERSHIPS

Category	Title	Partner
Technology Transfer	T2 Support from NTTC	NTTC
Energy Conversion and Power Systems	Advanced Energy Transfer System for Electric Vehicle	TRW, etc.
Technology Transfer	Conversion of NRaD Warminister to a New Business Facility	Bucks County Office of Commissioners
Technology Transfer	Conversion of NRaD Warminister Technologies	Solutions Now
Inertial Navigation Systems	Superconducting Gyroscopes	Kearfoot, Stephens Institute Linear Switch Corporation
Optical Sensors	Analog Opto-Electronic Module Development	Hughes, etc.
Optical Sensors	Wide Dynamic Range Fiber-optic Links for Remote Sensing and Communications Applications	AEL, etc.
Marine Passive Acoustic Systems	Drag Reducing Polymers	Baker Performance
High Performance Computing	Building a Scalable America	National Consortium for HPC
Computer Network Technology	Software Beta Test Site	ORINCON
Command, Control, and Intelligence Systems	Emergency Response Command and Control	State of Alaska, GTE

2.4.4.10 Interactions with non-DOD organizations:

(a) Our laboratory performs work for a variety of non-DOD government as well as outside organizations. We interact frequently with industry by joint attendance at meetings and conferences, both for technologies and for networking purposes. Some of our work for non-DOD organizations includes the Drug Enforcement Administration "chemical acoustic discrimination"; Office of Drug Control Policy "special projects"; Customs Service "Link-Il Display System (LEDS)"; FAA "Application of GPS to Air Traffic Control"; Coast Guard "Integration of GPS on Platforms"/"Radial Wireline Interface (RWI); NOAA "Coastal Waterway Survey Program"/IUSS System Capability"; and San Diego City of the Future Advisory Committee "electronic access to public services".

(b) Defense conversion activities on all sides have established a priority to deal with external groups. Currently we are participating heavily in transportation efforts, i.e., CALTRANS (California Transportation), the RTTA (Regional Transportation Technology Alliance), and San Diego Service Authority for Freeway Emergencies (SAFE).

(c) We actively participate in a significant number of professional organizations related to our technologies.

2.4.4.11 Efforts carried out under legal authorities other than Stevenson-Wyler of 1980:

Per NAVCOMP Manual procedures, we have received funds from private parties to conduct limited work, for small, segregable, uncomplicated efforts and utilized a "Work for Private Parties" process. We are also investigating the possibility of using cooperative agreements as defined in U.S. Code 63 Using Contracts and Agreements, paragraph 6305, Using cooperative agreements.

2.4.4.12 NRad Plan for Improving Domestic Technology Transfer: Improving the Local Technology Transfer Process

(a) Laboratory Technical Expertise.

- Select several focus areas for NCCOSC RDTE DIV technology transfer development that apply to recognized areas of commercial growth and also match core capabilities.

1) Prepare marketing plans for the selected technology transfer areas.

2) Continue to encourage department heads and management to support a search for "new business" alliances and funding with non-DOD government agencies, industry and universities.

3) Continue to encourage NCCOSC RDTE DIV leadership to include the consideration and practice of defense conversion activities in the normal performance evaluation process.

4) Prepare Defense Technology Transfer brochures to promote focus these areas.

- Identify key mature technologies developed by NCCOSC RDTE DIV that are near production that can be adapted to commercial applications.

1) Find low-cost vehicles to alert target market areas to potential applications for the product.

2) Promote use of NCCOSC RDTE DIV technical staff to adapt the technology to the commercial application.

- Establish NCCOSC RDTE DIV as a community-valued regional asset.

1) Link NCCOSC RDTE DIV's areas of expertise and facility strengths to the key technology areas selected by the community for regional economic development.

2) Within the geographical region distribute Defense Technology Transfer brochures about areas of expertise.

- Submit records to the National Technology Transfer Center for all technologies and facilities identified in 1.a, 1.b.

- Work with Sandia to utilize their new TIE-IN system to support access to relevant NCCOSC RDTE DIV computer applications.

(b) Offices of Research and Technology applications and DTT focal points.

- Become a recognized leader in Defense Laboratory technology transfer. Participate fully with industry, academia, other public sector agencies, and other Federal laboratories, (through the Federal Laboratory Consortium) to develop innovative approaches to identify, promote, and partner in technology transfer.

- Develop a technology transfer strategy for NCCOSC RDTE DIV management review that is integrated with NCCOSC RDTE DIV's overall strategic plan:

1) Organize ORTA office to respond effectively to purpose and intent of the strategy.

- Assign one or more senior staff scientists or engineers to the ORTA to support strategic planning and implementation.

- Determine the knowledge, skills and abilities required for ORTA staff personnel. Establish training program to assure ORTA staff is current in all required areas.

2) Obtain internal resources and funding commensurate with technology transfer strategy.

3) Conduct internal technology transfer and training seminars. Include a segment on technology transfer in NCCOSC RDTE DIV's Program Manager training course.

- Devise novel approaches to leverage technology reinvestment from the SBIR and the Navy Potential Contractor Program (NPCP - authorizes qualified contractors access to technical information that will enable them to become better qualified bidders for helping solve DoD problems). Include SBIR and NPCP staff leaders in technology transfer planning.

- Establish aggressive internal business practices that make NCCOSC RDTE DIV an efficient partner to industry in technology transfer. Emphasize quick response to queries; highly efficient processes for preparing agreements; preparation of accurate technical and cost proposals, long-term procedures to apply appropriate metrics to technology transfer efforts in order to measure successes, etc.

- Identify all types of teaming/partnership agreements that are available to the laboratory during FY94. Prepare internal guidelines on when and how to use the agreements.

- Provide recognition within NCCOSC RDTE DIV for successful technology transfer activities via internal and regional media publicity, and awards progr

(c) Technical Reports.

- Establish a simple review process during the publication review cycle that will identify reports with technology transfer potential.

- Consider developing a semi-annual catalog of new reports that could be distributed to an established technology transfer mailing list.

(d) Publications.

- Develop a strategy to promote specific NCCOSC RDTE DIV technologies and facilities through a select set of technical journals. Publish articles; consider advertising; and using the mailing lists to distribute NCCOSC RDTE DIV's Defense Technology Transfer brochures.

(e) Conferences & Symposia.

- Participate in a regional technology fair. Exhibit items identified in 2.4.4.13 (a).

- Encourage technical presentations at major conferences held in non-defense application areas such as visualization, transportation, and commercial intelligence.

- Target appropriate technology transfer conferences for presentations and exhibits.

(f) Exchange Programs & Visits.

- Encourage technology transfer agreements that allow for an exchange of the personnel to perform the work, or, obtain cross training on the commercial/ military technology application areas.

- Conduct briefings and tours of selected NCCOSC RDTE DIV technical capabilities for appropriate representatives from industry or the public sector.

- Maintain our existing exchange programs, i.e., ASEE, NSF, ONR.

(g) Contracts.

- Use CBD announcements, such as Broad Agency Announcement, to attract interest in the selected technology transfer focus areas (see 2.4.4.13(a)).

(h) Grants and Cooperative Agreements.

- Develop an appropriate agreement instrument that allows NCCOSC RDTE DIV to perform technology adaptation for non-defense public sector organizations.

- Work with San Diego Economic Development Council to incorporate appropriate NCCOSC RDTE DIV capabilities into the California Transportation Laboratory proposal.

- Establish a relationship with the City College Center for Applied Competitive Technology (CACT) to share facilities, resources, and data to assist in the development and education of Division and CACT users.

- Discuss entering into a Memorandum of Understanding with other regional Federal Laboratories to conduct joint developments to support regional economic development objectives in information technology, transportation, and biomedical research.

(i) SBIR & STTR

- Implement a strategy to recommend topics that emphasize commercialization of the proposed technology. Allow proposals to develop patents and technologies from NCCOSC RDTE DIV.

(j) Use of Laboratory Facilities

- Identify NCCOSC RDTE DIV facilities most likely to be of regional value for research and development, test and evaluation, training, etc. Utilize regional and community access points (See 2.4.4.14) as well as marketing methods to promote facility usage. Focus on small to medium enterprises.

(k) CRADAs

- Educate NCCOSC RDTE DIV personnel regarding the purpose and processing of CRADAs.

- Establish an awards process to recognize R&D departments and the principal investigator upon final approval of CRADAs.

(l) Intellectual Property, Including Patents, Copyrights, and Trade Secrets

- Utilize commercial vendors to assist in assessing and marketing patents. Train ORTA staff on procedures.

- Incorporate the existing patent portfolio into a database that can be used for both in-house management of the patent process and marketing purposes.

- Exhibit the patent portfolio at relevant conferences.

(m) Technology Reinvestment Project Efforts

- Quickly establish CRADAs or other business agreements with the winning teams in which the NCCOSC RDTE DIV is a participant.

- Encourage NCCOSC RDTE DIV staff to maintain contact with teams or companies that made ARPA TRP inquiries or entered negotiations during the 1993 solicitation.

(n) Interaction with non-DOD Organizations

- Participate in regional economic outreach programs to discuss NCCOSC RDTE DIV capabilities and potential technology transfer.

1) Understand the technology focus areas selected by regional economic development organizations and determine how NCCOSC RDTE DIV's capabilities fit those initiatives.

2) Understand the technical requirements of selected regional organizations in order to intelligently propose the conversion of relevant NCCOSC RDTE DIV technologies to their needs.

(o) Other Efforts Carried Out Under Legal Authorities Other Than the Stevenson-Wydler Technology Innovation Act of 1980, as Amended

- Develop a set of agreement/contract instruments that can be used in differing technology transfer applications. Optimize use of available instruments. Make recommendations to NCCOSC RDTE DIV leadership for modifications to instruments and procedures, or the addition of new instruments.

- Continue efforts to identify other federal, state and local agencies that could benefit from the insertion of NCCOSC RDTE DIV technologies, technologists and facilities.

DEPARTMENT OF THE NAVY
DOMESTIC TECHNOLOGY TRANSFER

2. REPORTING COMMANDS

2.5 NAVAL SURFACE WARFARE CENTER (NSWC) ARLINGTON, VA

2.5.1 CENTER OVERVIEW
2.5.2 DTIC REPORTS
2.5.3 OVERVIEW, DATA, AND PLANS: CARDEROCK DIVISION
2.5.4 OVERVIEW, DATA, AND PLANS: CRANE DIVISION
2.5.5 OVERVIEW, DATA, AND PLANS: DAHLGREN DIVISION
2.5.6 OVERVIEW, DATA, AND PLANS: INDIAN HEAD DIVISION
2.5.7 OVERVIEW, PORT HUENEME DIVISION (DATA AND PLANS N/A)

2.5.1 CENTER OVERVIEW

NAVAL SURFACE WARFARE CENTER (NSWC)
ARLINGTON, VA 22242-5160

NSWC POC: ALLEN FORD (703) 602-7482,2 (FAX - 4986);
RICHARD BLOOMQUIST (703) 602-0632 (EXT 2214)(FAX - 8474)

SYNOPSIS: The NSWC mission is to operate the Navy's full-spectrum research, development, test and evaluation, engineering and fleet support center for ship hull, mechanical and electrical systems, surface ship combat systems, coastal warfare systems, and other offensive and defensive systems associated with surface warfare.

EXPERTISE: The assigned NSWC leadership areas, and hence the areas of expertise, are as follows:

- Surface Warfare Modeling and Analysis
- Surface Ship Combat and Combat Control Systems
- Surface Ship Electronic Warfare
- Surface Ship Electromagnetic and Electro-Optic Reconnaissance, Search and Track Systems
- Surface Ship Weapons Systems (Including Shipboard Missile Integration)
- Surface Ship Vulnerability and Survivability (Includes Submarine HM&E)
- Ship Active & Passive Signatures (Includes Submarine HM&E)
- Surface and Undersea Vehicle Hull, Machinery, Propulsors and Equipment)
- Platform Systems Integration
- Strategic Targeting Support (Including Fire Control, Targeting and Re-Entry Systems)
- Amphibious Warfare Systems
- Special Warfare Systems
- Warheads
- Mine, Mine Countermeasures, Mine Clearance Systems

The RDT&E, engineering, and fleet support associated with the assigned leadership areas naturally leads to a vast reservoir of knowledge from which appropriate technology transfer to U.S. industries can occur.

UNIQUE FACILITIES: The Naval Surface Warfare Center is made up of five major Divisions. The name of each Division and the Headquarters location of the Division are as follows:

- Carderock Division, NSWC, Bethesda, MD
- Crane Division, NSWC, Crane, IN
- Dahlgren Division, NSWC, Dahlgren, VA
- Indian Head Division, NSWC, Indian Head, MD
- Port Hueneme Division, NSWC, Port Hueneme, CA

The accompanying U.S. map details the location of the five Divisions of NSWC. At each of these NSWC Divisions and their detachments, there are many unique facilities that could play a significant role in technology transfer. These facilities are detailed in the following description of each NSWC Division. Port Hueneme, which principally provides in service engineering to the Fleet, is not reporting on technology transfer activities. A Division overview only is provided.

2.5.2 DTIC REPORTS

(a) NSWC Technical Reports Submitted to DTIC

FY92	FY93 (3 qtrs)	Total
424	128	552

(b) Representative Titles

- "Advanced Magnetic Sensor Concepts for the Next Generation of Superconducting Gradiometer Systems"
- "The Effect of Fouling on the Seawater Corrosion Behavior of Alloy 625 Base Plate and Weldments"
- "Fractal Representation of Environmental Data"
- "Improved Invert Emulsion Hydraulic Fluids -- Preliminary Investigation"
- "An Investigation of the Performance of a Large-Scale Magnetohydrodynamic (MHD) Seawater Propulsion System; Hydroacoustic Performance. Volume 2"
- "Nonlinear Resistive Grid Wavelet Transformations for Texture Feature Extraction"
- "Processing and Property Evaluation of Silver or Aluminum Matrix YBa2Cu306+x Superconducting Materials"
- "Ultraviolet/Oxidation Treatment of Wastewater from Nitrate Ester Manufacture and Processing

2.5.3 OVERVIEW DATA, AND PLANS: CARDEROCK DIVISION

2.5.3.1 Overview

CARDEROCK DIVISION, NAVAL SURFACE WARFARE CENTER (CDNSWC)

CDNSWC POC: Dr. Joseph Corrado (301) 227-1417
FAX (301) 227-5657

SYNOPSIS: The mission of CDNSWC is to provide research, development, test and evaluation, fleet support, and in-service engineering for surface and undersea hull, mechanical, and electrical systems, and propulsors; provide logistics R&D, and provide support to the Maritime Administration and the maritime industry. Assigned leadership areas to support accomplishment of the mission are: ship vulnerability and survivability (includes submarines); ship active and passive signatures (includes submarines); surface and undersea vehicle hull, machinery, propulsors and equipment; and platform systems integration.

EXPERTISE: CDNSWC technical expertise supporting the mission and leadership areas and having technology transfer potential to U.S. industry are:

- Materials Technology (metals and alloys, composites, synthetic fluids and lubricants, magnetic materials, and superconductive conductors, materials processing)
- Industrial Production Technology (CAD/CAE, computer-aided manufacturing/inspection/testing, computer-aided servicing/maintenance, NDE and service life prediction, coatings, and bearings)
- Computer Technology (high performance computing, signal processing, image processing, CALS)
- Marine Systems Technology (vehicle concepts, hull forms, submersible vehicles, power generation systems, electrical power distribution/control, propulsors/propulsor systems, acoustic noise reduction, hydrodynamics, structural reliability, advanced materials applications, superconducting machinery)
- Aerospace Structures and Systems (aircraft concepts, aerodynamics, aircraft high-performance structures)
- Vehicle Survivability
- Power Systems (energy conversion/power systems, energy storage, power conditioning/pulsed power systems)
- Environmental Quality (materials, processes, and systems for abating pollution caused by hazardous materials, solid and plastic waste, oil spills, oily and non-oily waste fluids)
- Simulation and Modeling (advanced computational methods for fluid dynamics, acoustics, structural mechanics, and electromagnetics)

FACILITIES: Several CDNSWC facilities have been used by industry for various applications. Those which have potential for future use include:

- Fire Research and Air Contamination Control Facility (used to conduct small- and intermediate-scale fire and smoke tests of materials and material systems)
- Anechoic Flow Facility (low speed wind tunnel dedicated to acoustic measurements)

  Electric Power Technology Laboratory (consists of power generation and distribution facility; electroacoustics lab; solid state power equipment development lab; sensor development lab; machinery systems simulation facility)

  David Taylor Model Basin Complex (consists of three water basins with carriages capable of towing large models at up to 60 mph; includes instrumentation for measuring all performance/flow characteristics)

  Maneuvering and Seakeeping Basin (a larger wave making basin for modeling the full-scale motions of ship, platforms, and mooring systems in seaways)

- Large Cavitation Channel (this is the largest recirculating water test facility in the world with a 10 ft X 10 ft X 46 ft test section)
- Circulating Water Channel (free-surface circulating water channel with a test section 22 ft wide, 9 ft deep, and 60 ft long; primarily used for flow visualization)
- Metallic Materials and Processing Laboratory (consists of equipment and instrumentation for welding, nondestructive evaluation, near net shape processing, physical metallurgy, and fatigue and fracture evaluations)
- Marine Composites Material Laboratory
- Marine Coatings and Corrosion Control Facility
- Marine Tribology Laboratory
- Deep Submergence Pressure Tanks (a battery of pressure tanks to test structures, components, and systems in an environment that simulates the ocean depths)
- Structural Evaluation Laboratory)a 100 ft X 40 ft test bed with automatically controlled hydraulic jacks for conducting static and fatigue tests of large- and full-scale structures)
- Deep Ocean Pressure Simulation Facility (pressure tank for machinery, materials, and full-scale manned and unmanned underwater vehicles to ocean depths of 27, 000 ft)
- Wind Tunnels (two 8 ft X 10 ft subsonic (160 mph) tunnels and a 7 ft X 10 ft transonic (Mach 1.15) tunnel)

2.5.3.2 Offices of Research and Technology Applications (ORTAs) and DTT Focal Points.

(a) The current staffing of the ORTA Office consists of 2 employees. The bulk of the budget (95%) to cover the expenses of the ORTA office is derived from the CARDEROCKDIV G&A overhead funds.

(b) The ORTA Office is responsible for executing various technology transfer related functions such as SBIR, MCTL, IR&D, and FLC interactions. ORTA Office coordinates with an active support of the Director's Office, Director of Technology Office, Legal & Associate Counsels as well as CARDEROCKDIV Directorates such activities as Invention Evaluation Board, CRADA's, NPCP's.

(c) It should be pointed out that in a broader sense the CARDEROCKDIV technology transfer process involves to some extent almost every employee.

(d) ORTA Office uses various mechanisms and techniques to actively promote and help transfer the Division's R&D technology to the private sector & local and state governments. These include: publication of the R&D articles in the U.S. Navy Domestic Technology Transfer Fact Sheet; CARDEROCKDIV quarterly publication Technical Review Report; summary article on CARDEROCKDIV environmental protection work in "Cooperative Technology RD&D Report" (Jan 1993); publication of DTRC -91/CT07 report (Oct '91) and CARDEROCKDIV - 92/CT02 report (Dec '92), "a Catalog of DTRC Patents" and "a Compendium of Carderock Division NSWC Patents," Available for Licensing by the Private Sector; publication of CARDEROCKDIV -92/CT08 report (Dec '92) "Compendium of CARDEROCKDIV articles published in Navy Domestic Technology Transfer Fact Sheet, Jan 1990 through Dec 1992; and CARDEROCKDIV brochure "Technology Transfer Opportunities.

The above publications are being distributed to industry, other government agencies, and local & state governments at various conferences and exhibitions in which ORTA Office takes active parts; for example, FLC Annual and Semiannual conferences & workshops, SNAME Annual meeting and International Exposition, FLC/TTC Conferences, NASA Technology 2002. ORTA Office provided inputs on CARDEROCKDIV facilities & capabilities to FLC, NTTC and MTAC, data bases; as a result an active networking and increasing assistance to U.S. industry is being continually provided from our research engineers and scientists in relevant dual-use technology areas.

2.5.3.3 Publications

(a) Examples of Scientific, Technical & Professional Journals in which the Lab Publishes

American Society of Naval Engineers (ASNE)
Engineering Fracture Mechanics
Journal of Acoustics Society of America
Journal of Composites Science and Technology
Journal of Marine Structures
Journal of Vibration and Acoustics
Physics of Fluids
SNAME- Journal of Ship Research

(b) Approximate Number of Publications

Approximate number of publications (including conference proceedings and books) for 1992 and 1993 is 350.

(c) Representative Titles

"Interactive Electronic Technical Manuals"
Eric L. Jorgensen and Joseph J. Fuller
ASNE/SOLE Logistics Symposium Proceedings (March 1993)

"The Coupling of Finite Elements & Boundary Elements for Scattering from Fluid-Filled Structures"
G.C. Everstine and R.S.-C. Cheng
Computer Technology - 1992 - Advances and Applications,
PVP-Vol. 234, edited by R.S. Gallagher and G.M. Hulbert,
The American Society of Mechanical Engineers, New York, pp. 43-47 (June 1992).

"Visualization of Structure-Borne Power in Finite Element Plate Models,"
Hambric, S.A.,
Proceedings of Inter-Noise '92, pp. 533-536, Toronto, Canada (July 1992).

"The Calculation of Turbulent Flow Using a Vorticity Transport Closure Scheme,"
Gorski, J.J., Ph.D. Thesis, University of Maryland, College Park, In preparation.
Kihl, D.P., "Stochastic Fatigue Damage Accumulation in High Strength Welded Steel Joints," Doctoral Dissertation, The George Washington University, Washington, DC (1991).

Ship Integration and System Considerations, H. O. Stevens, Proceedings of MHDS 91 Symposium, Kobe, Japan

"NbTi Superconducting Wire with Aluminum Stabilization," 1992 Applied Superc/C Conference, 9/92"Superconducting Magnet for the Full Scale Current Collector Test Facility," 1992 Applied Superc/C Conference, 9/92

"Flow Characteristics in Liquid Metal Sliding Electrical Contacts, Part 1: Turbulent OHD Calculations" R.M.C. So, H. Zhang, S. Brown and N. Sonderegaard,European Journal of Physics(B), 1993.

2.5.3.4 Conferences & Symposia

(a) Less than 100 attendees: 36

(b) 100 to 500 attendees: 39

(c) Greater than 500 attendees: 26

Representative Conferences are:

- American Society of Mechanical Engineers, Pressure Vessel and Piping Technology Conference, location varies, 1000 attendees
- 3rd International Symposium on Flow-Induced Vibration and Noise, Anaheim,CA. 600 attendees
- First Navy Scientific Visualization and Virtual Reality Seminar, Carderock, 200 attendees, hosted
- International Symposium on Superconducting Magnetohydrodynamic Ship Propulsion, Kobe, Japan (4 participants/presenters, 2 session chairmen), More than 500 attendees.
- 1992 Applied Superconductivity Conference, 23-28 Aug 92, Chicago, IL,over 100 attendees.
- "NSWC Programs Which Have Applications to the More Electric Initiative, Dayton, OH, Apr 93, SAE Spring Conference. 100 attendees.

3rd Annual All Government, Gaithersburg, MD <100 attendees Workshop on Supercritical Water Oxidation Technology

International Conference on Orlando, FL <100 attendees Computerization of Welding Information

2.5.3.5 **Exchanges with U.S. Industry, Academia, State & Local Government**

Some Examples:

(a) Student Exchange Program with Naval Postgraduate School.

(b) Academic Exchange: Under the summer faculty research program, Scientists and engineers are hosted annually and work on-site at Carderock Division, NSWC for 8-10 weeks in the summer contributing actively to research projects. Presently we have 14 summer professors as part of ASEE Summer Faculty Program, 1 Sabbatical Professor, 2 Intergovernmental Personnel Act Professors in FY 93, 1 Postdoctoral visitor, and 3 ONR graduate fellows, contacts with industry include 12 Phase I SBIR in FY 93.

(c) SEAP: Science and Engineering Apprentice Program brings several high school students to work on research projects. George Washington University administers this program.

(d) USNA Ensigns:About 2 or 3 work on R&D projects while awaiting assignments following graduation (usually for about 6 months).

(e) 2 employees visited FRG (3 sites) to discuss programs in innovative electric motor designs and electric drive.

(f) Reviewed innovative proposals from private sector to CNO, established dialogue with proposer, and evaluated technical validity of claims.

(g) Briefed Trane Air Conditioners regarding Navy expertise in the areas of harmonic control and motor noise.

(h) Initiated discussions with Westinghouse and other vendors regarding the availability of Navy expertise (via the "dual-use technology" path) in motor design and noise control for application to wind tunnel.

(i) Visits to various industries such as Electric Boat, McDonnell Douglas, Northrop Aviation, Teledyne Inet, and Boeing to explain NSWC's technical strengths and seek commercial partners.

2.5.3.6 Foreign Visitors

Regular visits to Carderock Division, NSWC are made by participants in TTCP-P (Materials) including engineers from United Kingdom, Canada, Australia, New Zealand. Also hosted are other visiting military personnel and engineers from: France, Taiwan, Israel, Scandinavian countries, Belgium, Netherlands, India, Italy, Germany, Korea, Sweden, and other countries. Hosted UK, Germany, and Netherlands. Hosted Japanese visitors under Department of Commerce program.

(a) Data Exchange programs (with NAVSEA) with UK, Germany, and Netherlands Navies for Electrical Power Technology.

(b) Exchange program with Canadians: A naval architect military officer, usually at the LT or LCDR level, at Carderock for a 2-year tour. There have been 5 such tours.

(c) French naval architects: several visits to Carderock re ship design programs.

(d) Exchanged information (in the form of technical papers) with scientists and engineers in France (CETIM), Germany (German Federal Ministry of Defence), Finland (Technical Research Centre of Finland), and Canada (Universities of Toronto and Ottawa).

(e) Exchange Program IEP-ABCA-7 with British, Canadian, and Australian Navies, Cooperative R&D Programs with Italian and British Navies

(f) Co-operative Research Ship (CRS): An agreement with:

- Maritime Research Institute Netherlands (MARIN) and the navies of Australia, U.K.,Netherlands, France and Germany and DREA-Canada.
- Shipping Companies: British Petroleum, Exxon, Shell
- Classification Societies: Am. Bureau of Shipping, Det Norske Veritas, Lloyd's Register of Shipping
- R&D Organizations: British Maritime Technology, Cortec Ltd.
- Shipbuilders: Chantiers de l'Atlantic, MASA Yard, Astilleros Espanoles, Fincantieri, Royal Scheld Shipyard.

2.5.3.7 Foreign Visits by Laboratory Personnel

Carderock Division scientists and engineers are recognized throughout the world as experts in their fields. They are often called upon to interact on an international level with other experts from around the globe. Exchange programs and the Carderock Division mission has taken Division personnel to many nations. Some examples are as follows:

Japan- W.C.Lin/R. Stenson/G. Karafiath
China -PRC- F. Peterson, S. Jessup, W. Morgan/ C.W. Lin/ M. Wilson
France - Scott Gowing/L. Motter/ W. McCreight/Y.T. Lee/F. Nobless
Germany -Scott Gowing/Y.T. Lee/N. Phuc/F. Peterson
England - D. Walden/ L. Thomas/W.C. Lin/W. Morgan/G. Karafiath/ T. Smith
Netherlands - D. Walden/L. Thomas/B. Day/M. Wilson/ K. Forgach/W. Morgan/ J. Dalzell
Korea - Dr. In Young Koh (3 trips)/ D. Anthony/T. Huang/ C.W. Jiang/Y.H. Kim/K. H. Kim/ J. McCarthy/ C.W. Lin/M. Wilson
Bulgaria- Dr Morgan & Bob Etter
Canada- W. Morgan/J. Odea/Eisenberg/E. Batis
Italy-D. Walden
Norway - E. Zarnick

2.5.3.8 Grants & Cooperative Agreements

(a) Donations of Equipment to Universities:

- General Radio Model No. 2515 Data Acquisition System to Widner University (Transfer in Progress)
- A Sun work station (~$25K) was provided to Naval Postgraduate School.
- Engine Test Facility at Naval Academy
- Virginia Polytechnic Institute and State University Laser equipment loaned for support of advanced Navy High Pressure Fan Design
- Pumps on loan to Johns Hopkins University MIT; for flow characterization and acoustic research

(b) Investments in Univ Facilities:

Approximately $60 K for cyclic test capabilities at George Washington University.

(c) Educational Partnerships:

- George Washington University - agreement to offer on-site graduate degree program for our employees
- University of Maryland; technical POC for Center contract supporting a minority doctoral student in the area of gas turbine emissions
- In September 1992, the Carderock Division, Naval Surface Warfare Center developed a consortium that submitted a proposal to the DoD - HPC Working Group for the implementation of a DoD-Shared High Performance Computing Center in Carderock. Members of the consortium included George Mason University, Concurrent Technologies Corporation, and a Consortium of Historically Black Colleges and Universities/Minority Institutions. Although the proposal was not accepted, it was favorably received. A new round of selections will be announced shortly and we expect our proposal to include the same consortium members. Once the proposal is accepted, formal agreements will be made with the non-DoD members.
- The independent research program has resulted in a number of useful partnerships in conjunction with University Professors involved in the ASEE or the IPA programs:

Composites -	Dr. M. Hyer - VA Tech
	Dr. R. Chaudluri - Utah U.
	Dr. D. Pecknold - Ill. U.
Structures -	Dr. V. Dally - Md. U.
Environmental -	Dr. G. Foutch - Okla. St. U.

(d) URI & Centers of Excellence:

We are co-participants and Technical Manager for a National Center of Excellence project entitled "Optimized Weldment Properties for Full Penetration Butt Welds in HY-100 Steel Submarine Structures." Our partner is the National Center for Excellence in Metalworking Technology (Concurrent Technologies Corp.), Johnstown, Pa. The value of this program is approximately $2M/year.

2.5.3.9 Use of Laboratory Facilities

(a) Examples of non-DoD organizations that have purchased computer time on the Carderock Division, Naval Surface Warfare Center Cray Supercomputer include:

Other Government Agencies:
Department of Energy
Commercial Customers
AMI Research
Nielson Engineering & Research, Inc.
Weidlinger Associates
Greenhorne & O'Mara
NFK Engineering
Global Associates LTD
Tracor
SAIC
AT&T Bell Labs
Cambridge Acoustics Associates
Enig Associates
McKinnon Searle
Universities
Johns Hopkins University - Applied Physics Laboratory

(b) The following non-DoD organizations have been involved in Pressure testing or use of pressure tanks at Carderock Division, NSWC:

Draper Labs
Norfolk Southern
Dupont
AT&T Bell Labs
APL
Electric Boat (DARPA)
Southwest Research Institute

(c) Several manufacturers of fluid system components such as valves and manifolds take advantage of the unique combination of flow and acoustics of the Submarine Fluid Dynamics Facility. Commercial use of the facility has occurred during each of the last approximately 20 years. For fiscal year 93 the following organizations have engaged us:

CPV	Valves	$ 7.5K
ARD	Valves	$29.3K
Marrotta	Manifolds	$18.0K

(d) SBIR Topic No. N86-186 - Industrial Quality - Technology developed was used to inspect the CV-66 US America NAVTRUSS Dech Edge Elevator Doors at the Norfolk Naval Base, Norfolk, VA. The SBIR program has provided many working opportunities for Small Businesses.

2.5.3.10 CRADAs

(a) Active CRADAs

Title: Computer Aided Warehouse Design Project (NCRDA-DTRC-90-001)
Partner: Georgia Institute of Technology
MCTL Category: 2.1 AUTOMATION OF INDUSTRIAL PROCESSES, SYSTEMS, AND FACTORIES
Partner Category: Academia

Title: R&D of composite surface ship structures (NCRDA-DTRC-91-003)
Partner: Ingalls Shipbuilding, Inc.
STATUS: CRADA signed in March 1991.
MCTL Category: 1.2 COMPOSITE MATERIALS
Partner Category: Industry

(b) CRADAs Under Negotiation

Carderock Division, NSWC currently has ten (10) CRADAs in various stages of negotiation and processing.

(c) Lab Investment

Current investment by the Carderock Division in processing CRADAs is about one quarter manyear of effort. The Division's financial contribution to the Georgia Tech CRADA effort is about $30K. The contribution to the Ingall's CRADA effort has been about $400K.

(d) Income Producing

None are income producing at present, but the Division is taking initiative to license patents in the future. The CRADA with Georgia Institute of Technology provides a small amount of funding needed for the "upkeep" of the software package.

(e) Criteria for Deciding if Income is Desired

No criteria have been developed yet.

(f) Non-monetary Contributions

The Carderock Division's non-monetary contribution in the Georgia Tech CRADA effort has been to provide access to its computer aided warehouse design software which resides on a computer at the Carderock site and is accessed by remote dial-in.

The Carderock Division's non-monetary contribution under the Ingall's CRADA has been to provide guidance in maintaining a Navy focus, assistance in the design of the composite structures, and leadership in the testing and analysis of the models.

(g) Backlog

There is no backlog in processing CRADAs at this time. However, we have noticed in the last year that more people from industry are inquiring and are interested in cooperative undertakings with CARDEROCKDIV. In view of the increased CRADA effort demands, additional resources (manpower) for the technology transfer activities, including the CARDEROCKDIV Legal Counsel Office are needed.

2.5.3.11 Intellectual Property, Including Patents, Copyrights, and Trade Secrets

(a) Patents Issued In FY92: 12

(b) Patents Issued In FY93 To-Date: 28

(c) Patent Applications Filed In FY92: 53

(d) Patent Applications Filed In FY93 To-Date: 13

(e) Licenses

U.S. Patent No. 4,689,305
Title: Solid-State Photometer Circuit

(f) Royalty Income

FY92: $833
FY93: $833

(g) **CRADAs**

- Georgia Institute of Technology
- Ingalls Shipbuilding Inc.

(h) **Backlog in Patent Applications**

Have about fifteen (15) cases to be filed.
Not considered to be a backlog.

(i) **Attorneys Supporting DTT**

Number: Three
Location: David Taylor Model Basin in Bethesda, Maryland (Carderock Division of Naval Surface Warfare Center
Cumulative Salaries: $171,503
Travel Budgets: Approximately $10,000

Describe how they train engineers and scientists.
Answer: Formal training as such is not provided. Informal training/advice is provided on an individual or small group basis.

2.5.3.12 Technology Reinvestment Project Efforts

Manhours and resources provided to support the TRP staff, proposal team formation/proposal development: 2000 work hours (primarily senior scientists and engineers.) (Note: this does not include any time provided for source selection since we have not yet been involved in this part of the process.

2.5.3.13 Interaction with non-DoD Organizations

(a) Other Federal Government

- DEPARTMENT OF COMMERCE - The experimental and theoretical work at the National Institute of Standards and Technology (NIST) is incorporated into on-going investigations at Carderock Division, NSWC. Professional and technical interaction occurs in such areas as composites, manufacturing, Non Destructive Inspection and Fire Research and testing involve cooperative research.

- DEPARTMENT OF ENERGY - work at the National Laboratories in structures, materials and fabrication has direct relationships to Carderock Division work; and specific contacts at Oak Ridge and Lawrence Livermore Labs are maintained. Professional and technical interactions occur in such areas as fuel cells, fuel characterization and energy conservation, and low weight low vibration Diesel engines. Contacts are also maintained at Lawrence Berkeley and Sandia Labs. A collaboration is in place with Knolls Atomic Power Laboratory to share information on quieting electric motors.

- DEPARTMENT OF TRANSPORTATION - The work at CD/NSWC supports national initiatives for improving the infrastructure. Technical exchanges in steels, welding, inspection, shock, corrosion, composites, structural analyses, testing methods have and will continue to occur with the Federal Highway Administration. Clearly there is much mutual support and interest with the U.S. Coast Guard. There is specific technical cooperation in fire research, protection methods and devices, lifeboats, double hull technologies,corrosion control, vibrations, and seaway loads and structural response. Development is underway for the US Coast Guard to improve spill recovery equipment. Carderock Division, NSWC is a participant in the Commercial Aircraft Hardening Program (Against Terrorist Bombs) with the Federal Aviation Administration (FAA). High performance steels for bridge construction have also been developed for the Federal Highway Administration

- ENVIRONMENTAL PROTECTION AGENCY - Carderock Division, NSWC provides technical support for emission standards and certification for marine engines, diesel and gas turbine and conducts research on emission reduction technologies.

- NASA - Professional and technical interaction is on going between Carderock Division, NSWC and NASA on various topics of mutual interest. Exchange of technical results, analytical and testing methods in the application of materials and structures. NASA Langley and their work with composite materials and non-destructive evaluation are two important areas of complementary work. A memo of agreement is in place for software development support for the ISMS program. A technology exchange on electric power system design and non-linear system stability analysis is on going.

- Dialogue has been established with National Oceanic & Atmospheric Association (NOAA) to commence supporting them with vibration efforts.

- Carderock Division, NSWC maintains professional and technical interaction with other regulatory agencies as well, including:

  National Marine Fisheries - Environmental compliance
  Department of the Interior - Environmental compliance.

(b) State & Local Government

Technology transfer potential is large, and ideas are shared in how to capitalize on Carderock Division technical results with local governments. Probably the area with most potential is in Waste Handling, where technology under development offers municipalities cost and energy saving potential. Unfortunately funds do not exist in the Defense budgets (or we have not identified them) to pay for the federal side of the necessary technology development/transfer. Also high priority Navy work and a limited work force in this rapidly expanding area add additional constraints. Technology Transfer programs currently interface with:

- Pennsylvania Technical Assistance Program
- Delaware Valley Industrial Resource Center
- Ben Franklin Technology Center
- Philadelphia Industrial Development Corporation
- Florida - Environmental compliance
- California - Environmental compliance

(c) Industry

The Carderock Division, NSWC regularly interacts with numerous ARPA contractors in support of the ARPA Advanced Submarine Technology Program, including:

General Dynamics, Electric Boat Div, Hercules, Grumman, McDonnell Douglas, and Lockheed. As part of that program we have passed on to those contractors computer software (ABAFAIL) they are using in design of the ARPA contract deliverables.

There are many and frequent interactions of all types with all segments of U. S. Industry since the Carderock Division work cuts across all aspects of the Navy's products and services. While hard to generalize, many of the engineers at Carderock Division will have several contacts monthly with their counterparts in industry. Industry segments involved in the work include the material suppliers, primary manufacturers (forgers, etc.), secondary fabricators, sub-component manufacturers, tooling and machining companies, design and analyses companies, large and small manufacturing firms, shipyards, and service (inspection, maintenance and repair) industries. Interactions with more than 147 companies include:

- exploring ideas for new methods/materials for Navy application
- providing industry with ideas/leads to sell to the Navy
- keeping industry informed of trends/opportunities
- awarding contracts for particular products or concepts
- establishing cooperative R&D efforts
- explaining the output and significance of in-house Navy developments

Carderock Division maintains professional and contractual interactions with all major shipbuilders and design companies, many aerospace companies, small manufacturers and engineering companies. Some examples of the types of interactions are:

- General Dynamics, Electric Boat Div - Testing, analysis and specifications

- Tenneco, Newport News Shipyard and Dry Dock Co - Testing, analysis and specifications

- Meeting with Cummings Engine Company, Inc. and Department of Energy. Discussion of a proposal submitted by DARPA on Advanced Engine Diesel, combining materials manufacturing and systems engineering to develop a lighter weight composite diesel.

- Air Vehicle Diagnostic System - Project on fatigue life prediction modeling of critical components in CH-46 helicopter mix box and aft transmission. Work with Westland Helicopters

- Babcock & Wilcox - Programmable Automated Welding System (PAWS) was presented.

- LaQue Center for Corrosion Technology - To initiate stress corrosion crack testing of high strength HY-100 weld metal specimens.

(d) Academia

There is an on-going dialogue and hiring of students from the local educational institutions. This is part of the effort to encourage and support scientific and engineering careers for promising students. As with U.S. Industry, interactions with universities are frequent and cover a diversity of topics within the Carderock Division. Typically, the contacts are made (initiated by either NSWC or the professor) in order to:

- add a basic understanding to the in-house application work
- explore a fundamental portion of Navy development work
- provide a "real world" perspective to University research
- create opportunities for personnel exchanges
- encourage "seamlessness" of Navy R & D projects
- intellectually stimulate both parties
- foster new ideas and opportunities for the application of basic research developments

More than 35 Academic Institutions have linkages with the Carderock Division including:

George Washington University
Massachusetts Institute of Technology
Texas A&M University
University of California
University of Maryland
University of Wisconsin

2.5.3.14 Efforts carried out under legal authorities other than Stevenson-Wydler Technology Innovation Act of 1980

Carderock Division, NSWC efforts are carried out under U.S.Congress Acts of 1896 and 1936.

2.5.3.15 Plan for Improving Domestic Technology Transfer

(a) Laboratory Technical Expertise

- Complete a strategic assessment of all key technical areas in terms of appropriate level of resource allocation.
- Incorporate technology transfer considerations in strategic planning decisions associated with level of resource allocation, i.e. manpower for each technology area.

(b) Offices of Research and Technology Applications

- Refocus the effort based on a Navy Laboratory survey briefed by NRL to the NLCCG in June 1993 with greater emphasis being placed on Patent Licensing and associated CRADA'S. Increase level of internal support and funding.

(c) Technical Reports

- Initiate program to include an electronic version of technical reports to reduce distribution time and cost of distribution.

(d) Publications

- Emphasize publication in journals that maximize technology transfer within each technical area.

(e) Conferences & Symposia.

- Sponsor and hold at least 1-2 technical symposia at the Division next year.

(f) Exchange Programs & Visits

- Maintain our current foreign exchange program and expand our efforts in establishing effective technical exchanges with the Former Soviet Union (FSU) in the area of "WIG's" (Wing in Ground Effects Vehicles), materials, and material processes.
- Hold an "Industry Day" to brief and tour representatives from industry, both locally and nationally.
- Establish a working dialogue with state activities such as Maryland Marine Biological Laboratory.
- Maintain our ASEE Summer Faculty Program at 15 visiting professor / year level.

(g) Contracts

- Increase use of Broad Agency Announcements (BAA) where appropriate in order to solicit the widest possible base of industrial support.
- Continue improvement of internal contracting processes in order to reduce contracting time and improve responsiveness.

(h) Grants and Cooperative Agreements

- Working through the Navy's Hydrodynamic / Hydroacoustic Technology Center, located at the Carderock site, establish a broad working relationship with Universities supplying advanced computational software. Provide validation / certification support and consultation.

(i) SBIR & STTR

- Implement a change in strategy for the selection of topics to emphasize commercialization of 6.1 through 6.3A technologies.

- Select, award and monitor at least 10 Phase I SBIR's.

(j) Use of Laboratory Facilities

- Promote increased use of facilities through advertisements, promotional programs and direct industry contacts. (Note: The Division historically has and still supports a very broad spectrum of users of the facilities consistent with our mission to support the Navy and the maritime industry.)

(k) CRADAs

- Simplify and streamline the Division's internal process for establishing CRADA's.

- Establish an FY 96 goal of 15 CRADA's/year and allocate the resources to achieve it.

(l) Intellectual Property, Including Patents, Copyrights, and Trade Secrets.

- Establish the following planning goals to guide resource allocation and planning priorities. Achieve by the end of FY 96 the Divisional goals:
  Invention Disclosures- 75/year
  Patent Applications- 45/year
  Patent Awards- 35/year

- Hire an outside consultant to assist in the development of an effective process of patent licensing. Establish a FY 96 goal to bring in $50K in patent license income

- Update and republish a Divisional patent guide.

- Maintain the Invention Evaluation Board response time to review the technical merits of invention disclosure under 2 months from the time of submittal.

(m) Technology Reinvestment Project Efforts

- Play a more active role in horizontal consortiums, e.g., NIST's Manufacturing Centers, US Car, etc as means of establishing meaningful and effective government/industry relationships.

(n) Interaction with Non-DoD Organizations (Labs)

- Continue the cooperative relationship with National Technology Transfer Center and the Federal Laboratory Consortium in terms of highlighting the technical strengths and core capabilities of the Division

- Consider establishment of a marine industry wide technical bulletin/newsletter/data base as a means for the Division to promote its technologies having potential commercial or practical applications.

- Provide active support to the National Research Councils' Marine Board with a focus on supporting its proposed "National Strategy for Uses of the Ocean". (The Marine Board consists of representatives from all relevant branches of federal and state governments, industry, academia, and appropriate private environmental groups.)

(o) Other efforts not under Stevenson-Wydler Technology Innovation Act of 1980

- Continue using the Division's Business Impediment Group to identify innovative ways to improve the organizations overall effectiveness in meeting its mission. Continue the "Best in Practice" field surveys focused on Technology Transfer.

2.5.4 OVERVIEW, DATA, AND PLANS: CRANE DIVISION

2.5.4.1 Overview:

Crane Division, Naval Surface Warfare Center

ORTA Focal Point:
Dave Fisher, Code PM1
Department of the Navy
Crane Division
Naval Surface Warfare Center
300 Highway 361
Crane, IN 47522-5001

Point of Contact:
Marvin Pate, Code 05M
Department of the Navy
Crane Division
Naval Surface Warfare Center
300 Highway 361
Crane, IN 47522-5001

SYNOPSIS: The Crane Division of the Naval Surface Warfare Center is a consolidation of the previous Naval Weapons Support Center Crane and the Naval Ordnance Station Louisville. It combines the expertise and assets of both facilities into an integrated command supporting the development, production, evaluation, installation, and maintenance of electronic ordnance and mechanical products integral to combat and weapon systems.

EXPERTISE: Expertise at the Crane Division of the Naval Surface Warfare Center which is applicable to technology transfer includes:

- Electronic Warfare - Engineering and Repair, Corrosion Control
- Gun and Gun Fire Control Systems - Overhaul and Repair, Corrosion Control
- Microelectronic Technology and Electronic Module Test and Repair - Prototype Printed Circuit Board Fabrication, Multilayer Printed Wiring Assembly and Electronic Module Manufacturing
- Microwave Components - Tube and Components Engineering and Repair
- Electrochemical Power Systems - Electrochemical Power Systems Test, Material Analysis, Lithium Battery Safety Test
- Acoustic Sensor Test - Hydroacoustic Test, Repair and Transducer Prototype; Sonar Systems Engineering and Repair
- Surface Missile System Launchers - Depot Maintenance, Missile Systems Test
- Small Arms - Engineering and Overhaul, Repair
- Conventional Ammunition Engineering - Arms, Ammunition and Explosives Security
- Pyrotechnics - Test, Loading and Manufacturing
- Mechanical Devices - Engineering, Overhaul, and Repair; Design and Analysis; Prototyping and Pilot Production
- Metal Parts Fabrication - Metal Plating/Surface Finishing, Precision Machining, Heat Treating
- Management and Distribution of Naval Drawings - Central Index For Navy Engineering Drawings
- Physical Security - High Security Locking Systems, Communication Systems, Intrusion Detection Systems

UNIQUE FACILITIES:

- Electronics Manufacturing Productivity Facility - Transfer of electronics manufacturing technology to the defense industrial base
- Failure Analysis - Construction/failure evaluation of electronic components and assemblies
- Material Analysis - Physical, thermal and analytical labs for explosive material; analysis of organic and inorganic samples in solid, liquid and gaseous phases
- Radiation Test Labs - Test and evaluation of radiation tolerant electronic components for nuclear and space environments; Failure analysis of radiation effects on circuits and devices
- Lighting/Night Vision Lab - 449 square foot safety certified laser lab; 2000 square foot disassembly/test/overhaul/assembly area; 350 square foot collimation room; 1,000 meter laser safety certified outdoor firing range; 100 meter indoor firing range
- Surface Treatment Facility - All commercially available plating processes; Electro-deposition, Anodic coatings, Chromic conversion coating; Phosphate coatings, Black oxide
- Hydroacoustic Test Facilities - Lake facility: 120 feet deep x 3/4 mile long; Anechoic facility: 3 tanks with capacity to 50,000 gallons; 2500 PSI; 2-50 degrees C; Low frequency: 2 tanks with pressures to 10,000 PSI temperatures 2-50 degrees C; Extraneous noise: 7 tanks with capacity to 650 gallons, 2,000 PSI

2.5.4.2 Offices of Research and Technology Application (ORTAs) and DTT Focal Points

(a) ORTA and DTT Focal Point staffing and budget (ORTAs)

Dave Fisher, telephone (812) 854-3667, there is not a specified budget.

(b) Publicity/publications: Brochure entitled "Focusing on the Future of American Electronics Manufacturing" (attached)

2.5.4.3 Publications

(a) Examples of scientific, technical, and professional journals in which the Crane Division publishes.

(1) Institute of Electrical and Electronic Engineers (IEEE) Transactions and Letters
(2) Circuits Assembly Magazine
(3) Electronics Packaging and Production Magazine
(4) Indiana High Technology Directory
(5) Electronic Manufacturing Productivity Facility (EMPF) "Emphasis" Newsletter
(6) Manufacturing Technology Information Analysis Center (MTIAC) Current Awareness Bulletin
(7) Electronic Manufacturing Engineering
(8) Indianapolis Business Expansion Guide

(b) Approximate number of publications, including conference proceedings and books. 100

(c) List of representative titles.

(1) "Trends in the Total Dose Response of Modern Bipolar Transistors"
(2) "Single-Event Burnout of Power Bipolar Junction Transistors"
(3) "Charge Separation in Bipolar Transistors"
(4) "Converting a Bulk Radiation-Hardened BiCMOS Technology into a Dielectrically Isolated Process"
(5) "Hardness Assurance and Testing Issues for Bipolar/BiCMOS Devices"

2.5.4.4 Conferences & Symposia

(a) Hosted by Crane Division: 13

(b) Less than 100 attendees: 121

(c) 100 to 500 attendees: 86
Examples:

- 1992 Western Simulation Multiconference on Object-Oriented Simulation; LaJolla, CA; 17-20 Jan 93; Paper/Published in Proceedings: "Combining Object-Oriented Simulation and Intelligent Knowledge Capture for Testbed Simulation," Attendees: 250.

- ASNE; Louisville, KY; 1-3 Sep 92; Presentation: "A Hierarchical Modeling Approach to System-Level Testability and Diagnosis," Attendees: 100.

- National Electronic Packaging Conference-West; Anaheim, CA; 10 Feb 93; Presentation/Published in Proceedings; "Ultrasonic Cleaning on Fine-Pitch Components--Establishing a New Standard," Attendees: 100.

- Department of Defense Forestry Workshop Joint Services Technical Session; Richmond, VA; 29 Oct 92; Presentation; "Thirty Years of Professional Forest Management at Crane Division: A Success Story," Attendees: 250.

- Next Generation Computer Resources Users Conference; Crystal City, VA; 17 Feb 93; Presentation: "Lessons Learned on Prototyping Open Systems Standards," Attendees: 25.

- Government Microcircuit Applications Conference; 11 Nov 92; Presentation: "Reliability Technology to Achieve Insertion of Advanced Packaging (RELTECH);" Attendees: 75.

2.5.4.5 Exchange Programs & Visits (Industry, academia, state & local gov't, foreign)

(a) Exchanges with industry, academia, state & local government.

Over the course of a year, Crane Division is visited by as many as 50,000 people. These visitors include: students (see School Partnership Program breakdown under item 8); local, state, and federal government; civic groups; and persons doing business with Crane Division.

- Industry:

  Examples: AT&T, Brulin Corporation, MBMD, Control Data Corporation, Cummings Electric, Delco, Digital Equipment Corporation, Defense Electronics, Edison Welding Center.

- Academia:

  Examples: Universities of Arkansas, Illinois, Indiana Maryland, Texas, Iowa, Louisville, Vincennes and Iowa State.

- State & Local Government: Indiana Lt. Governor, State Representatives, Southern Indiana Mayors' Roundtable, Chambers of Commerces for the cities and counties in the vicinity, Various Economic Development Committees

(b) Foreign visitors

(1) For the past several years, Crane Division has hosted one or two officers of the Royal Australian Navy annually for a week of on-the-job ordnance training. In calendar year 1994, Crane personnel will begin training members of the Taiwanese Navy.
(2) Data exchange agreement on pyrotechnics with France and the UK
(3) Korean Buying Mission Representatives
(4) NATO Representatives
(5) MSA Ltd., Britain
(6) Hawker Energy Products, England
(7) Dowty Batteries, United Kingdom
(8) Industry representatives from Germany and Canada

(c) Foreign visits by laboratory personnel

Crane Division personnel have visited France, Norway, Germany, UK, China, Sweden, and Canada.

2.5.4.6 Grants and Cooperative Agreements

(a) Donations of equipment to universities (include GFE turned over to universities)

Through the local office of the Defense Reutilization and Marketing Office, Crane Division has donated a variety of equipment and materials to area schools. The Division has also donated considerable amount of equipment, primarily for chemistry laboratories, to the Bloomington, Indiana campus of Indiana University.

(b) Investments in university facilities

University of Arizona and Georgia Tech for packaging research

(c) Education Partnerships

- Crane Division School Partnership Program includes:

Science and Engineering Fair	25 schools	337 students
School Science Fairs	2 schools	275 students
Science Fair Workshop	13 schools	461 students
Tutoring Program	116 tutors	492 students
Career Days	3 schools	350 students
Shadowing	5 schools	125 students
Class Presentations	20 schools	600 students
Work Area Tours	45 schools	1,800 students

- Offering undergraduate, graduate, MBA, and associate degree programs; public management certificates; and special seminars through ten educational institutes in the Indiana-Kentucky area.

- Offering graduate courses in engineering through the National Technological University (NTU). This is a consortium of approximately 30 universities that deliver their courses via satellite and is a state-of-the-art operation in terms of distance education.

- Crane Division participates in Cooperative Education Program that has approximately 200 student trainees from an estimated 50 universities, colleges and technical schools.

(d) URI & Centers of Excellence (Title, Value, Partner, MCYTL category)

At the Electronic Manufacturing Productivity Facility (EMPF) (see attached brochure), 12 companies utilized manufacturing and test equipment on factory floor. Ten companies contracted for electronic assembly cleaning test facilities ($50K typical test charge).

2.5.4.7 Use of Laboratory Facilities

(a) Agreements other than CRADAs that involve company use of DoD facilities.

- Tamsco uses facilities for environmental testing of electronic components; $10K
- Sandia Labs use facilities to test, perform failure analysis, rework, and modify batteries for use in the STARS Program; program costs $100K.

(b) Industry use of test centers

- Linear Accelerator for about 1/3 workyear per year
- Agreement with Moltech to use facilities at no cost to assembly battery.
- Tested (FAT) NR-1 batteries for BST ($20K)
- Battelle Memorial Institute--battery testing for multiple aviation battery system applications; $163K.
- Concorde Battery Corporation--battery testing; $4K.
- Litton and Martin have used conformance test facility to debug SAFENET products; 1 workyear
- Testing by contractors for Air Force - $40K

2.5.4.8 CRADAs

(a) Active CRADAs

- Electronic Manufacturing Productivity Facility (EMPF), NCRDA-NSWCCD-90-001. Partners are Naval Surface Warfare Center, Crane Division; Naval Air Warfare Center, Aircraft Division Indianapolis; and Indiana University-Purdue University Indianapolis. Together they provide a transfer of manufacturing technology, increase domestic productivity, conduct applied research projects to assist manufacturers, provide hands-on training to students, and conduct workshops and seminars that foster exchange of electronics manufacturing information.

- Federal Foam Technology, NCRDA-NSWCCD-92-002, partner with industry. Purpose is to provide holders for blasting caps.

- Product Data Exchange Using STEP (PDES), Inc., NCRDA-NSWCCD-92-003, partner with industry. Purpose is for technical development of product engineering definition standards in digital format.

- Microlithics Corporation, NCRDA-0NSWCCD-93-004, partner with industry. Purpose is jointly develop a method to address component obsolescence in Navy electronic equipment. The effort will pursue the development of universal Standard Electronic Modules.

(b) CRADAs under negotiation number 2

(c) Lab investment (estimate)
Information unavailable at this time.

(d) Income producing

Companies utilize EMPF facilities and the typical test charge is $50K. There is the possibility the other CRADA's will be income producing as they become more fully developed.

(e) Criteria for deciding if income is desired
Dependent upon purpose of CRADA and partnership

(f) Describe non-monetary contributions:

Electronic Manufacturing Productivity Facility (EMPF) received 159 helpline calls in FY92 and 172 calls in FY93. These calls were regarding electronic manufacturing process issues and average time was 16 hours per call.

(g) Reason(s) for backlog, if any

No backlog at this time.

2.5.4.9 Intellectual Property, including Patents, Copyrights, and Trade Secrets

(a) Patents:

The Crane Division does not have any patents. Crane Division personnel interested in obtaining patents are referred to the Naval Sea Systems Command Patent Office for guidance.

(b) Patent Applications:

- Non-Intrusive Temperature Measurement Device for Surface Mount PC Boards
- Dual Load IRCM
- Tethered Rectilinear Flare
- S&A Igniter for Decoys
- Kinematic IRCM

(c) Licenses:

Manual Soldering Performance Monitoring System (MSPMS)
--industry

(d) Royalty income--none

(e) CRADAs that provide trade secrets, know-how, copyright

None

(f) Describe backlog in patent applications.
(g) Attorneys supporting DTT, to include patent attorneys.

- Donald Sherfick, Naval Air Warfare Center
- Jim Tura, Naval Air Warfare Center Warminster
- Jim Becktel, Naval Air Warfare Center Warminster
- Pedro DeJesus, Naval Surface Warfare Center, Crane Division
- Ike Levy, Indiana University, Indianapolis

(h) List numbers, locations, and cumulative salaries & travel budgets

Number and location provided above; salaries and travel budgets unknown.

(i) Describe how they train engineers and scientists regarding patent and license requirements & responsibilities

Naval Air Warfare Center offers technology transfer training sessions

2.5.4.10 Technology Reinvestment

(a) Manhours and resources provided to support the TRP staff, proposal team formation/proposal development, and source selection (Labs & ARPA)

- Currently investigating teaming with Mission Research Corporation to develop automated design tools for semiconductors. This will involve approximately one workyear of resources.

- Presently involved with the Mid-America Electric Vehicle Consortium (members are GM Allison Transmission, Delco-Remy, Indiana Power & Light, Public Service Indiana/Michigan Power, TVA, Aerovironment, ETVI, EMPF, Electrotek and Crane Division). Crane Division will be provided with 15 S-10 pickup trucks and three hybrid electric buses. Crane will provide a "proving ground" involving military buses and pickup trucks performing normal base level functions. Crane has provided approximately 40 hours of labor to the Consortium to prepare a proposal to ARPA under Research Agreement 93-23 which was funded by ARPA on 30 June 1993.

- Presently involved in a Chrysler Corporation Consortium (members are Norvik, Eldec Corporation, Acme Electric Corporation, Battelle, Ovonics Corporation, Sparton Corporation, Reading Alloys, International Nickel Corporation, Wright-Patterson Laboratories, and Crane Division). The ARPA TRP areas that proposal will be submitted for Dual Use Technology and Advanced Manufacturing Processes. Some of the proposal which Crane Division is being included on by the consortium are as follows:

- Develop DoD service-wide applications study for advanced universal fast charger technology.

- Develop Dod service-wide applications study for USABC mid-term performance Nickel Metal-Hydride battery technologies.

- Characterize selected military batteries to the Norvik technologies control methodology. Crane Division will perform comparison tests of universal airborne charger in conjunction with sealed lead-acid, sealed nickel-cadmium, and vented nickel-cadmium aircraft batteries to determine the effects on service life. Crane will also evaluate the effect of the Norvik fast charge technology on cycle life of Navy silver-zinc battery technology.

- Crane Division will also be involved with the development/test of nickel metal-hydride battery for aircraft starting applications.

- 120 hours for 5 abstracts and proposals. A proposal was presented to Raytheon to participate as a team member in the event ARPA selects Raytheon OSEM TRP for award. Testing of military and commercial modules would be provided.

(b) Number of proposals received in each Deployment Activity, Technology Focus Area and Education Activity. Relate Technology Focus Areas to MCTL taxonomy (ARPA)

- Six proposals in preparation for FY93 in the areas of Electronic Manufacturing Process R&D and Electronics Manufacturing Training & Education. 3,500 hours minimum developing proposals. DoD Key Technology Areas: Electronic Devices and Materials and processes.

- Participating in an ARPA project with Moltech lead consortium to develop rechargeable lithium battery.

2.5.4.11 Interactions with non-DoD Organizations

(a) Example of other Government Agencies:

- New York Transit Authority--provide information on sealing materials used on nickel-cadmium battery cases
- NASA Goddard Space Center, NASA Lewis Research Center, NASA Marshal Space Center, and NASA Jet Propulsion Laboratory--perform test
- SANDIA National Laboratories--evaluate test data
- The Aerospace Corporation--receive guidance and test direction in support of DoD tests
- National Security Agency

(b) State & local government

- Support Indiana Business Modernization & Technology Corporation
- Member of Indiana Economic Development Council, Southern Indiana Development Commission, Southwestern Indiana Development Council, and various local city and county economic development committees
- Member of Indiana Chamber of Commerce and local city and county chambers of commerce

(c) Industry examples:

(1) Battery manufacturers that include Eagle Picher Industries, Yardney Technical Products, Johnson Controls, Hughes Aircraft, and Gates Aerospace Batteries--procure test samples, test and evaluate cells.
(2) Acme Electric Corporation--development of fibrous nickel-cadmium battery technology and regulated power converters
(3) Aerospace Energy Products--development of lithium batteries
(4) Bell Helicopter Textron, Inc., Boeing Helicopters, McDonnell Douglas Helicopter, Sikorsky Aircraft Company--integration and production support of helicopter battery systems
(5) Computing Devices, Inc., Smiths Industries--integration and production support for avionics battery systems
(6) Concorde Battery Corporation, Hawker Energy Products, Teledyne Battery Corporation--development, production and in-service engineering of various sealed lead-acid batteries
(7) GEC Ltd.--integration and production support for CATSEYE battery systems
(8) Dowty Battery Corporation--development, production and in-service engineering of various primary and secondary lithium batteries

(d) Academia examples:

- Crane Division is a co-sponsor of the Electronic Manufacturing Productivity Facility (EMPF) with the Aircraft Division of the Naval Air Warfare Center at Indianapolis and Indiana University-Purdue University at Indianapolis (IUPUI). The EMPF, which is located in downtown Indianapolis, was established to disseminate electronics manufacturing technology developed by Navy activities to the academia and private industry.
- Johns Hopkins University, Applied Physics Laboratory
- Sub-contractors through Mission Research Corporation with Auburn University for investigation of reliability of cryogenic electronics, University of Arizona for DMOS Gate rupture and the Future of IC development, and with Vanderbilt University for semiconductor modeling.
- A professor at Rutgers University calls on several occasions to obtain battery information and copies of the battery P-document to be used in his classes he teaches on batteries.
- University of Arizona--funding for technical work and member of Board of Advisors
- University of Maryland--member of CALCE consortium for advanced electronic packaging and reliability procedures

- Georgia Tech--funding reliability work in advanced electronic packaging
- See comments under paragraph 2.5.4.7(c) regarding participation of Crane Division in educational programs

2.5.4.12 Efforts carried out under legal authorities other than the Stevenson-Wydler Technology Innovation Act of 1990, as amended

None at this time.

2.5.4.13 Plans for Improving Domestic Technology Transfer

(a) Laboratory Technical Expertise--Increase technological areas and expand the ones currently involved in through more active involvement with ARPA, private industry and other government activities.

(b) ORTA and DTT Focal Points--Better define the responsibilities of the point of contact in these areas.

(c) Publications--Give special recognition to the Crane Division authors who have articles published.

(d) Conferences & Symposia--Increase participation in conferences and the number of conferences the Crane Division host.

(e) Exchange Programs--Work closely with industry, academia and government representatives to make them aware of the Crane Division's various technologies and the benefits to everyone concerned in exchanging information.

(f) Contracts--Increase consideration of the potential to commercialize technology when contracting.

(g) Grants and Cooperative Agreements--Improve the contacts with universities.

(h) Use of laboratory facilities--Consider the options of using Crane Division facilities in CRADA's and ARPA involvements.

(i) CRADAs--Actively pursue more involvement in establishing CRADAs.

(j) Intellectual Property--Give special recognition to Crane Division personnel inventors.

(k) Technology Reinvestment--Maintain compatibility with commercial process to maximum extent possible. Expand commercial and multiple use applications during the development cycle.

(l) Interactions with non-DoD organizations--Increase efforts to become involved with private industry, academia and other government organizations.

(m) Efforts carried out under legal authorities other than the Stevenson-Wydler Technology Innovation Act of 1990--Become more knowledgeable of what is available in these areas.

2.5.5 OVERVIEW, DATA, AND PLANS: DAHLGREN DIVISION

2.5.5.1 Overview

NAVAL SURFACE WARFARE CENTER DAHLGREN DIVISION
Code D4T
10901 New Hampshire Avenue
Silver Spring, MD 20903-5640

Contact: Mr. Ramsey D. Johnson: (301)394-1505
FAX: (301)394-4332
Dahlgren, VA site: (703)663-8151
FAX: (703)663-8975

SYNOPSIS: NSWCDD conducts a broad range of R&D activities involving electronic warfare, coastal zone warfare, search and track, guidance and control, missile and weapon dynamics, energetic materials, electromagnetic and nuclear effects, magnetic and CBW countermeasures, underwater acoustics, artificial intelligence, and systems simulation, engineering and analysis. NSWCDD's mission is to provide research, test and evaluation, engineering and fleet support for: surface ship combat systems; surface warfare; ordnance; strategic systems; mines; mines countermeasures; amphibious warfare systems; and special warfare systems.

EXPERTISE: NSWCDD expertise supporting the many technologies associated with this mission-related work and having commercialization potential includes:

- non-metallic materials (plastics, elastomers, ceramics, composites, carbon, graphite, and potting and encapsulation compounds)
- metallic materials (metal matrix composites, alloy development, metal applications and processing).
- non-destructive evaluation (ultrasonic, eddy current, radiography, time delay spectroscopy, surface evaluation)
- electrochemistry (battery research, environmentally acceptable disposal technologies)
- simulation and modeling (computational fluid dynamics, materials failure studies, sensor fusion, virtual reality, computer aided systems engineering, dynamic and hydrodynamic modeling of underwater vehicle systems)
- non-medical biotechnology (biocorrosion, biofouling, biodegradation of heavy hydrocarbons and explosives)
- information sciences (molecular computing, computational statistics for image segmentation and pattern recognition, artificial intelligence, chaos control/nonlinear dynamics, artificial neural networks)
- devices (photonic components, fiber optic devices, electromagnetic sensors, chemical/biological sensors, signal processing components)
- sensors (high resolution sensors, magnetometers/gradiometers, electro-optics and associated signal and image processing)

FACILITIES: NSWCDD actively encourages private parties to use its specialized facilities and associated services that include:

- Hydroballistics Facility: accommodates testing of large-scale water entry devices, including 3-dimensional trajectories, velocity, and acceleration and pressure data from onboard instrumentation.
- Hypersonic Wind Tunnel: aerodynamic simulation and instrumentation capabilities for Mach Numbers of 8 to 18.
- Hydrospace Facility: engineering evaluations of swimmer/dive equipment, deep-sea and saturation diving subsystems, and related life support equipment.
- Metallic Prototype and Analysis Facility: metallic, metal matrix, superconducting materials and fabrication capability, plus analytical tools for the fabrication process.

- Navy Experimental Diving Unit Ocean Simulation Facility: research facility for developing, testing, and certifying manned diving and working systems, including swimmer propulsion devices.
- Nondestructive Evaluation Facility: capabilities for research, investigation and analysis of materials and structural integrity issues.
- Nonmetallic Materials Research Facility: prototyping and R&D facility for ceramics, plastics, organic composites, and elastomers.
- Surface Evaluation Facility: development of new materials and devices; research on fundamental properties of solid surfaces; analytical services for troubleshooting materials problems.
- Thermal Analysis Facility: measurement and analysis of changes in physical or chemical properties of materials resulting from temperature changes.
- Nonmagnetic Test Facility: magnetically clean test area that includes a nonmagnetic motion testing facility; a large Fanislau coil capable of producing controlled field environments in a test pool.

2.5.5.2 Offices of Research and Technology Application (ORTAs) and DTT Focal Points

(a) Staffing and budget: 2.0 WY; $160K

(b) Publicity/publications & outreach

- Science & Technology Transitions (NAVSWC MP 90-332)
- TT Summary Report (prepared annually by FY)
- "Catalog of Available Technologies" - summary descriptions of technology Application Assessments released by NSWCDD.
- Technology application Assessments - descriptions of in-house R&D having potential commercial applications; provided to NTIS and NTTC.
- CRADA Guidebook published to promote and assist CRADA preparation.
- Articles in "Navy DTT Fact Sheet."
- "Technology Resources: Facilities - Services - Expertise" - resources available to non-Government users.
- "Materials Degradation Research" - brochure on environmental degradation and corrosion R&D.
- Outreach.

- NSWCDD participates in various Government-Industry TT exchanges and conferences (FLC and NASA sponsorship), trade-shows such as AFCEA, and NSWC "Earth Day" at Indian Head, MD. Participation includes technical presentations and display booth/handouts.
  - Technical articles in "Navy DTT Fact Sheet."
  - Hosts specialized technical seminars for industry, such as composite materials workshop.
  - Commerce Business Daily announcements for CRADA partners.
  - 17 entries in NTTC/NTIS "Directory of Federal Laboratory and Technology Resources (1993-1994 edition).
  - Listing in FLC Laboratory Directory.
  - Listing in "Industry Guide to Federal Laboratories in the Mid-Atlantic Region".
  - 17 entries in FLC Facilities Directory.
  - Listed in Suburban Maryland Technology Council and Montgomery County High Technology Council technology transfer guide, "From Laboratory to Marketplace." (a Technology Transfer guide)
  - NSWCDD participates in the "Science and Engineering Apprentice" and the "Bay Partners in Education" programs. These provide experience and exposure to the scientific workplace for high school students via paid apprenticeships during summer months. FY92=78 students; FY93=62 students.
  - Division outreach includes support of nearby high schools with mentors and judges for science fairs. Division staff members also serve as volunteer math and science tutors in local elementary, middle, and high schools.

2.5.5.3 Publications

(a) Scientific, Technical, & Professional Journals: 162

Examples:

Journal of Group Theory in Physics
Molecular Electronics and Biological Computing Newsletter
IEEE Transactions on Electrical Insulation
IEEE Transactions on Automatic Control
Proceedings of the Allerton Conference on Communication, Control, and Computing
Proceedings of the International Society of Photo-Optical Instrumentation Engineers
8th Software Maintenance and Re-engineering Conference
Proceedings of the Symposium on Artificial Intelligence (AI) Applications for Acquisition, Logistics and Personnel Management

(b) Approximate Number of Publications: 675

(c) Representative Publications Title (representative but not all-inclusive):

"Fourier Transform Infrared and Resonance Apparatus for QC of Sound and Vibration Damping Materials:

"A Fully Self-Consistent Nonlinear Theory of Current Modulation in Relativistic Klystron Amplifier"

"Modified Wavelets That Accommodate Causality"

"Plasma Wakefield Effects on High Current Relativistic Electron Beam Propagation in the Ion Focus Regime"

"Implementing the Minimum-Misclassification-Error Energy Function for Target Recognition"

"Continuum Neural Network Based on Aggregate Field of Local Nonlinear Coupling"

"Speedup Performances on MIMD Machines"

"Directional Energy Detector Sonobuoy"

2.5.5.4 Conferences & Symposia

(a) Conferences - Hosted: 8

(b) Conferences/Symposia - Participant (one or more presentations each event): 271

- less than 100 attendees: 43
- 100 to 500 attendees: 166
- greater than 500 attendees: 62

Examples:

Artificial Neural Networks in Engineering
St. Louis, MO; Attendees: 100-500

1993 Software Engineering Standards
Brighton, England; Attendees: 100-500

National Conference on High Power Microwave Technology
Attendees: >500

1992 Symposium on Gallium Arsenide and Related Compounds
Attendees: 100-500

Society of Photo-Optical Instrumentation Engineers Conference
Boston, MA; Orlando, FL; San Jose, CA; Attendees: >50

4th International Conference on Parallel & Distributed Computing and Systems
Washington, DC; Attendees: 100-500

Society for Photonics and Instrument Engineers (SPIE) Conference
Orlando, FL; Attendees: >500

Acoustical Society of America
Houston, TX; Attendees: 100-500

Applied Superconductivity Conference
Chicago, IL; Attendees: 100-500

2.5.5.5 Exchange Programs & Visits (industry, academia, state & local government, foreign)

(a) Exchanges (domestic)

- Cooperative Education Program
  FY92: 107 students/32+ colleges
  FY93: 87 students/24+ colleges

- Junior Fellowship Program
  FY92: 2 students/2 colleges
  FY93: 1 student/1 college

- Stay-In-School Program
  FY92: 11 students
  FY93: 9 students

- Federal Aviation Administration as part of Department of Commerce Fellowship Program: 1991-1992; Extended FAA assignment until Jan 93

- University/NSWCDD Exchanges
  Old Dominion University
  University of Virginia
  Mississippi State
  Virginia Polytechnic Institute and State University
  University of Maryland
  U.S. Naval Academy
  North Carolina State University

- Numerous other industrial and academic exchanges.

(b) Foreign Exchanges/Visitors

- Countries/Organizations: 12

  Examples: University of St. Andrews, U.K.
  University of Strathclyde, Glasgow
  Canada
  France
  Australia
  Sweden

- Exchanges (examples):

  Hosted meetings (2 in FY93) involved with International Defense Exchange Agreements. One with the UK and the other with France.
  Software Kinetics Ltd, Dartmouth, Nova Scotia (Canadian Navy contractor).
  Israeli Visitors to NSWC to discuss CB. Visit under DEA UK and CA
  Visitors to NSWC for International Task Force 18 on Characterization of Biological Aerosol Clouds
  Visit by Dr. Graham Pearson, Director General, Chemical and Biological Defence Establishment, UK, Oct 199
  Visit by Representative of the Defense Research Establishment, Suffield, Canada, June 1993

- Foreign Visitors to NSWCDD: Approximately 300

(c) Foreign Visits by NSWCDD (200+)

Japan
Germany
U.K. (9)
Australia
Sweden
France (2)
Canada
Belgium

2.5.5.6 Grants and Cooperative Agreements

(a) Education Partnerships: 14

Examples:

- Agreement with the Florida Agricultural and Mechanical University (FAMU) and the Florida State University (FSU) concerning the Joint Institute for Graduate Engineering Education and Research.
- Computer Science resources Consortium with the Computer Science Department at Virginia Polytechnic Institute and State University (VPI&SU) to strengthen and create interactions among VPI&SU professors, the government, and the industrial technical community.
- Systems Research Center - joint effort with VPI&SU and the Naval Sea Systems Command emphasizing R&D in computer science and computing technology.
- University of South Florida (medical image processing).
- George Mason University (computation statistics).
- Dartmouth University (acoustic signal processing).

(b) Education Grants: $30K in student tuitions are to be paid under present delivery orders.

2.5.5.7 Use of Laboratory facilities

(a) NSWCDD is in the process of signing a Memorandum of Understanding with the Southern Maryland Regional Technology Council (SMARTCO) to use NSWCDD facilities to solve private industry problems.

(b) Industries have used NSWCDD test facilities to evaluate a Boeing 747 and a McDonald-Douglas MD-11 commercial airplane for electromagnetic interference. ($120,000 - 24 man days).

(c) A portion of NSWCDD's technical efforts involves cooperation with private industry for test and evaluation purposes. Industry will find a solution for a problem and then test it in NSWCDD facilities to verify its effectiveness. NSWCDD also helps industry to design systems before the evaluate state. ($300,000-$400,000 a year)

(d) Old Dominion University - laser labs and semiconductor processing; 50K, 6 man months.

(e) Quantum Diagnostics--testing of high-power Pulsatron Switch - 30K.

(f) Harry Diamond Laboratories

(g) George Mason University

(h) Exchange program participants at NIST conducted experiments in NSWCDD laser facility measuring the diffraction efficiency of photorefractive thin films - June 1993.

(i) Environmental Test Facilities utilized by industry companies at a combined level of $75K (FY92 and FY93).

(j) Raytheon Corporation use of NSWCDD Fort Lauderdale test facilities and personnel to make acoustic stability measurements - $450K.

(k) Letter of agreement for equipment/facilities sharing between Materials Research Facilities in the Greater Washington, DC area (Naval Research Laboratory, NSWC Dahlgren Division, National Institute of Science and Technology, U.S. Naval Academy, NSWC Carderock Division).

2.5.5.8 CRADAs

(a) Active CRADAs (By titles, MCTL categories, & partnering)

- Software Development Related to Supersonic Airflow (MCTL category 9.5.4; industry partner)
- Software Development for Enhanced Command & Control (MCTL category 5.4; industry partner)
- Titanium Piping Systems (MCTL category 1.1.1; industry partner)
- Semiconductors: Material Processing and Electronic Properties (MCTL category 6.2; academia partner)

(b) CRADAs under negotiation (number): 2

(c) Lab investment (estimate): $10K

(d) Income producing: First agreement of paragraph (9)(a)= $18K

(e) Criteria for deciding if income is desired:
Function of benefits derived by respective participants, licensing arrangements, and commercial potential of products/services based on an agreement.

(f) Describe non-monetary contributions (examples include personnel, services, facilities, and equipment):

(1) NSWCDD: FY93 = $10K, personnel

(2) Non-government: FY92 = $27K, personnel
FY93 = $77K, personnel

(g) Reason(s) for backlog, if any: None

2.5.5.9 Intellectual Property (including patents, copyrights, and trade secrets)

(a) Patents: FY92 - 38 FY93 - 35

It is important to note that patents issued generally reflect patent applications filed before FY 92 and may include patents that were filed as much as a decade ago but which were under a secrecy order and did not issue until declassified during the period under study. It is also important to note that NSWCDD has many additional patents available for licensing that issued before FY92, but have not expired. A utility patent has a 17-year lifespan, and may be licensed and transferred any time during its life providing the maintenance fees have been paid.

(b) Patent Applications : FY92 - 55 FY93 - 65

(c) Licenses (numbers and titles - signed in FY92 and FY93):

"Real Time Cardiac Arrhythmia Stabilizing System";
MCTL category: none (medical application)

(d) Royalty Income: FY92 = $5K; FY93 = $5K

(e) CRADAs (having trade secrets, know-how, copyrights): none

(f) Describe backlog in patent applications (what it is it and why does it exist?):

- The NSWCDD patent backlog is first controlled by a selective interface with our technical codes and individual inventors at initial contact. If the invention in question clearly lacks patentability or Navy interest, the inventor generally does not go through the lengthy and time-consuming process of providing an invention disclosure. Of the invention disclosures submitted, NSWC Dahlgren office has a backlog of approximately six months, or about 12 disclosures covering all art fields at our Dahlgren site, and about two years or 40 disclosures in the electrical/mechanical arts, and two years or 30 disclosures in the chemical arts at our White Oak facility. The two facilities have recently been consolidated and new disclosures are now assigned to the individual attorney based on field of art rather than geography.

- The backlog exists because of a lack of resources. The Dahlgren Division patent office is the most productive patent group in the Navy, when balanced against resources available. NSWCDD will file sixty-plus patents in FY 93 with only three attorneys and $65,000 of contracting money. This is considerably less than the other Navy patent offices. It is important to note that NSWCDD patents filed and eventually issued appear truncated by the resource limit. With a well-funded program and a command emphasis, the Dahlgren Division has the potential to file well over one hundred patent applications each year.

- At the NSWCDD Coastal Systems Station, the attorney docket for patent applications has a listing of 24 files. NAVSEASYSCOM has 11 of these files and are in the process of preparing patent applications for them. The other 13 files are being held pending further instructions. The reason for this backlog is that the CSS patent attorney position has been vacant since June 1991.

(g) Attorneys Supporting DTT: The three patent attorneys at NSWCDD do not have any specific budget allotted to DTT or Travel for DTT. The combined accelerated budget comprises $254,362 for salaries of the three patent attorneys, two at White Oak and one at Dahlgren. Our C7 Division has $4,200 in the FY93 budget for travel for seven attorneys and five

support staff. All patent three attorneys train individual or small groups of NSWCDD scientists and engineers when asked. No formal training or regularly scheduled training exists as the patent office resources preclude. Any additional drain on the patent attorney's time relates directly to a decrease in patent applications filed. The attorneys do pre-negotiation services with industry and respond to interrogations from our technical codes on patent licensing, CRADAs, and technology transfer. We also provide a legal review of all agreements, CRADAs, etc. during the drafting stage.

2.5.5.10 Technology Reinvestment Project Efforts

(a) Approximately 5200 hours provided to support the following TRP efforts:

- NSWCDD currently has a joint proposal with the Center for Engineering and Medical Image Analysis at the University of South Florida and E-Systems. This proposal is the area of Health Care Technology/Trauma Care.

- NSWCDD has a Memorandum of Understanding between NSWCDD and CEMIA/USF. This MOU serves as a first step in future collaborations between the two sites.

- The Biomedical Engineering Department of the University of Virginia and NSWCDD have submitted a proposal to NIH on the use of MRI to assess arteriosclerosis deposition.

- NSWCDD has written a white paper to NCI/NASA in support of a new federal research initiative in digital mammography. Out of 40 labs that submitted white papers, this proposal along with 15 others were identified as possessing technologies of use in the digital mammography area.

- Kaiser Permanente, Cray Research, CEMIA/USF, Johns Hopkins University, and NSWCDD have formed a team to respond to the upcoming call for proposals from the U.S. Army. The focus of this call is improved mammographic screening.

(b) Approximately 200 man hours provided towards proposal team formation and proposal development. Proposal effort has resulted in firm commitment of funding from Harbor Branch Oceanographic Institution (non profit, educational), Florida Power and Light (utilities company), United Technologies (defence contractor), and Palm Beach County Business Development Board. Project is to extract electric energy from Gulf Stream using facilities and technologies of above team members and NSWC, Fort Lauderdale.

(c) Approximately 500 man-hours on support to develop EMV test technology for commercial aircraft.

(d) Approximately 80 manhours to develop a proposal with West Virginia Institute of Technology to submit to Congress. This involved the use of DoD technology in West Virginia industries.

(e) Senior technical personnel (3) are cooperating with ARPA for Battery Technology evaluation.

(f) 2 proposals being submitted in Metal Matrix Composites

(g) 1 proposal being submitted in ceramic applications to the Advanced Diesel Engine Program

2.5.5.11 Interactions with non-DoD organizations

(a) Other Government Agencies (representative sampling)

- U.S. Department of Agriculture (USDA); Investigating possibility of designing an autonomous pattern recognition system for real time detection of agricultural products in luggage, and/or parcels.

- Department of Energy
  - Autonomous Vehicle
  - Hazardous waste and cleanup technology

- FBI - Image Processing for potential fingerprint analysis application

- NASA Goddard Flight Center - Transportable Applications Environment (TAE+) technical support office

- National Institute for Standards and Technology - fiber optic measurement issues

- Environmental Protection Agency (EPA) interagency agreement for cooperative effort on corona destruction of chemical agents, 1992.

- Office of National Drug Control and Policy (ONDCP)

- NASA meeting on TASD radar cloud applications

- Participated in tests on a decommissioned Boeing 707 aircraft at AMARC, Davis Monthan AFB in Tucson, Arizona, to determine the reverberation characteristics of large airframes.

- Worked with the Environmental Protection Agency (EPA) to find hazardous waste and unspent ordnance safely.

- Offered technical assistance to the Federal Emergency Management Agency (FEMA) to install electromagnetic pulse protection in private, state, and local government radio stations.

- Interaction/involvement with non-DOD organization such as DOT, NASA, FAA, and DOE; industry; and academia regarding the Shock and Vibration Information Analysis Center which facilitates technical information exchange as related to shock and vibration related data. This interaction is in the form of telephone calls, meetings, and symposia.

(b) State and local governments

- The NSWCDD Coastal Systems Station is a participant in the Gulf Coast Alliance for Technology Transfer (GCATT) with 16 other organizations including Army, Navy, Air Force, and college and universities. The purpose of this alliance is to aid in technology transfer activities to state and local governments, and private enterprise. Discussions with state and local governments regarding reparation of Environmental Impact Statements for RDT&E test purposes. This interaction is in the form of telephone calls and meetings.

- Montgomery County/Suburban Maryland High Technology Council - NSWCDD in regional directory for access by area high technology companies.

(c) Industry

- Electronics Industry Association/Telecommunications Industry
- Association - fiber optic standards issues
  Committee 2.0 - Optical Communication Systems
  Committee 6.0 - Fiber Optics
- EPRI Electric Power Research Institute - consultations
- Tennessee Valley Authority - cooperative development
- Research Triangle N.C. - cooperative testing
- Air Products Inc. - cooperative development
- Advanced Systems Technologies - to develop a passive sonar demo using START/ES for ONT Mid-year Review.
- Engineering Research Associates of Vienna VA, to determine usefulness of technology for ASDCS project.
- David Sarnoff Research Center - Topic: VR Head Mounted Display technology

(d) Academia (representative sampling)

- NSWCDD Coastal Systems Station has an indefinite quantities contract with Florida A&M University and Florida State University. This contract provides a means for the government to buy technical services in the form of R&D and allows the universities to access the expertise and equipments of NSWCDD personnel and facilities.
- Wake Forest University invited to lecture on the subject of artificial intelligence, neural networks, and establish dialogue with the research faculty.
- University of South Florida; Memorandum of understanding and currently pursuing joint work in medical image processing and general TRP.
- University of Virginia; Joint NIH proposal in the area of medical image processing.
- George Mason University; Currently formulating a joint ONR proposal with the GMU Center for Computational Statistics on the application of virtual reality to simulation, training, and targeting.
- Columbia University - Topic: Virtual Reality (VR)/Augmented Reality applications
- Contact with Carnegie Mellon University - Topic: VR for distributed simulation
- Johns Hopkins University - Topic: Multimedia and VR Applications
- University of Illinois at Champaign-Urbana and New Jersey Institute of Technology: working group meetings to provide and give feedback on assigned tasks.
- University of Colorado - modal distributions in optical fibers

2.5.5.12 Efforts carried out under legal authorities other than the Stevenson-Wydler Technology Innovation Act of 1980, as amended.

None

2.5.5.13 Plans for Improving Domestic Technology Transfer

(a) ORTA Functions: Review in-house staffing and funding levels. Increased support desirable, but fiscal constraints may preclude expansion. Staffing increase would permit greater exploitation efforts of commercially promising RDT&E. Additional funding would increase promotional material such as handouts, displays, and brochures and also increase participation in technology exchanges and conferences.

(b) Reports/Publications/Conf. & Symp.: NSWCDD has historically fostered a work environment that strongly encourages and promotes its technical staff to publish and present technical achievements. This is highlighted by the response to these items presented by this FY92, FY93 report. All levels of NSWCDD management will continue to support these modes of technical information exchanges, and will further emphasize their importance to an effective technology transfer program.

(c) Exchanges, etc.: NSWCDD actively supports technical exchanges with industry, academia, and state/local governments, although the emphasis has been on Navy-related application and topics. Similarly, foreign contact has primarily been in association with mission-related tasks. These interactions can be expanded to involve more commercially oriented exchanges as technology transfer efforts increase.

(d) Contracts: DoD sponsorship is the principle source of NSWCDD's RDT&E contracting funds. The availability of alternatively funded projects from non-DoD sponsors is being investigated. To the extent that such contracts are awarded to NSWCDD, corresponding growth in associated RDT&E contract awards is anticipated.

(e) Grants & Cooperative Agreements: NSWCDD is interested in further opportunities for collaborations with academia. Donations of excess equipment to educational institutions can be initiated pending clarification of excess equipment disposal by NAVSUPSYSCOM.

(f) SBIR: NSWCDD has been very active in the SBIR Program, and will continue to actively seek technical management roles in these projects.

(g) Use of Laboratory Facilities: NSWCDD has routinely offered use of its unique facilities to outside organizations. This policy remains unchanged and is promoted at technical exchange conferences and via a technology transfer booklet and various national databases.

(h) CRADAs: The goal is to increase awareness of CRADAs within the technical Departments, and actively solicit industry partnerships. DoD funded sponsorship of NSWCDD would increase interest in these agreements within NSWCDD technical departments.

(i) Patents, etc.: Subject to budgetary and billet constraints, the plan to increase patenting activity at NSWCDD includes:

- Maintain present legal and support staffing levels even as vacancies occur;
- Hire a patent attorney for the CSS site;
- Fill a vacancy created by a recent retirement; &
- Increase patent contracting services to leverage patent counsel workforce.

(j) Technology Reinvestment Project: NSWCDD has been active in the initial year of the TRP, and will continue to seek industrial partners as the program continues in subsequent years.

(k) Interactions: NSWCDD remains receptive to interactions with non-DoD organizations, and will seek opportunities for technology exchanges.

(l) General Comments:

- Consider an expanded process to publicize opportunities for technology transfer. The objective is to help scientist and engineers become aware of a broader range of technical problems outside their lab, possibly leading to additional applications of their expertise.

- One group within NSWCDD has potential to deal with technology transfer related to marine education and ocean engineering technologies. The impediments to domestic technology transfer are identification of people and organizations who would benefit from these technologies. Start up funding for marketing a technology transfer effort is an issue since this group is a service cost center and must have funding provided from user organizations.

- Approximately 18 months ago the Harbor Branch Oceanographic Institution (HBOI) finished building a marine education and conference center for teaching college level and graduate level courses, and for holding conferences. NSWCDD should investigate taking a proactive role in supporting the HBOI activities and marine education. Additionally the marine education and conference center could be used as a focal point for our local Ft. Lauderdale, FL technology transfer efforts.

2.5.6 OVERVIEW, DATA, AND PLANS: INDIAN HEAD DIVISION

2.5.6.1 Overview

NAVAL SURFACE WARFARE CENTER
INDIAN HEAD DIVISION
ORTA Code 590D
101 Strauss Avenue
Indian Head, MD 20611

Contact:	Mr. Frank Valenta	Ms. Pam Nugent
	Ph. 301-743-4398	Ph. 301-743-4575
	Fax 301-743-4262	Fax 301-743-6425

SYNOPSIS: The Indian Head Division (IHDIV) provides an integrated, flexible, and full-spectrum capability in energetics research, development, engineering, test and evaluation, and fleet/operational support. We have the specialized technical expertise and unique manufacturing/test facilities and equipment to support our position as a leader in Energetics Technology.

EXPERTISE: Expertise in Energetics Technology which includes propellants, explosives, pyrotechnics, chemicals and devices at IHDIV applicable to technology transfer includes the following areas:

- Energetics technology including design, formulation, fabrication, process development, manufacturing, and testing.
- Industrial Production Technology including automation of industrial processes, systems and facilities using Computer-Aided Design, Engineering, Service and Maintenance (CAD, E, S/M).
- Electronics technology including circuit design/fabrication, computer-aided software engineering (CASE).
- Computer Technology including modeling and simulation for performance prediction, dynamic training, design analysis.
- Environmental technology including design and engineering of energetic materials and chemical products and processes to provide environmentally sound solutions to hazardous materials.
- Explosives and Industrial Safety Technology including design of processes, equipment, and facilities, analysis and design of lightning detection/protection and grounding and bonding systems; investigation and analysis of incidents related to the ordnance environment

UNIQUE FACILITIES related to Technology Transfer:

- Continuous Processing Facility: A facility dedicated to the development of twin screw mixing and extrusion process for highly solids filled energetic materials.
- Composite Case/Component Braiding Facility: A flexible composite structure fabrication capability based on braiding technology.
- Cartridge/Propellant Actuated Devices (CAD/PAD) Manufacturing Facilities: Provides complete life-cycle capabilities for munitions devices.

- Test facilities: A broad spectrum capability including chemical analysis, mechanical properties, non-destructive evaluation such as real-time x-ray, environmental (e.g., vibration, shock, salt spray, temperature altitude, humidity etc.) and functional testing including Multi-component Test Stands and multi-axis propulsion test stand.

- Electronics Design/Fabrication Facility: The full capability to design, manufacture, and test prototype/production devices and printed circuit boards in support of training rounds, simulators, avionics, and other related electronic equipment.

- Electrostatic Discharge Facility: The full capability to measure the electrostatic susceptibility of energetic materials and hardening of ordnance in the electrostatic environment.

2.5.6.2 Office of Research and Technology Application (ORTAs) and DTT Focal Points:

(a) ORTA and DTT Focal Point staffing budget (ORTAs)

Frank J. Valenta (Code 590D), Commercial: (301) 743-4398,
Fax: (301) 743-4262

Staffing/budget: 1 man-year/$95K (overhead funded)

(b) Publicity/Publications: The ORTA Office at the Indian Head Division just recently became active (with the appointment of a full time ORTA) in December 1992. Since that time, much of the publicity efforts have been directed to internal education about the DTT program and opportunities. However, we have pursued external publicity as indicated by the following:

- An IHDIV booth on Technology Transfer Opportunities at the Annual Meeting and Exhibition of the American Institute of Chemical Engineers (AIChE) in Houston, TX.

- Manning the NSWC booth at the Armed Forces Communications and Electronics Association (AFCEA) in Washington, DC.

- A listing in "Industry Guide to Federal Laboratories in the Mid-Atlantic Region".

- Listings under various technology focus areas in the FLC's "Directory of Federal Laboratories with Programs in TRP Technology Focus Areas."

- A short article on a patent pending mixing/casting apparatus for processing high viscosity polymeric materials. The intent was to offer licensing opportunities. The article appeared in the June 1992 "Navy Domestic Technology Transfer Fact Sheet."

(c) Outreach Programs: The IHDIV DTT outreach program is focused on identifying IHDIV technologies/capabilities/intellectual property which may be of interest to the non-Defense sector and being responsive to industry inquiries and/or approaching industry on CRADA or licensing opportunities. Additionally, Indian Head has a very active outreach to all the schools in Charles County, MD (elementary through Community College) in promoting science and engineering. This activity is consistent with our objectives to support a technology focus in the schools. Funding for these efforts is not included in the ORTA budget.

2.5.6.3 **Publications**

(a) Names of scientific, technical, and professional journals in which the activity publishes:

- Explosive Safety Technical Bulletin (NAVSEA)
- Abstract Digest for the Smoke/Obscurants
- Survival and Flight Equipment Proceedings
- ADPA Proceedings

(b) Approximate number of publications (including conference proceedings and books): 140

(c) List representative titles.

"Characterization of Polyethylene and Polypropylene"
"Treatment of Nitrate Ester Contaminated Wastewater by Granular Activated Carbon"
"Photocatalytic Decomposition of Nitroglycerine-Contaminated Airborne Voc's"
"A Microtensile Test Specimen for Testing Double-Base Sheet-Stock"
"A Survey of the Toxic, Toxicological, & Environmental Effects of Lead"
"Cryogenic Processing of Magnesium Teflon Viton (MTV) Pyrotechnics"
"Ultraviolet/Oxidation Treatment of Wastewater from Nitrate Ester Manufacturing"
"Solar Detoxification of Nitroglycerin Contaminated Water Using Immobilized Titan"

2.5.6.4 **Conferences & Symposia**

(a) Number hosted by or participated in as a presenter: 14

(b) Representative listing:

NAVSEA International Logistics Symposium, June 29, 1993, "Advanced Logistics Technology for the International Community" estimated 650 attendees.

Fifth International Conference - EUROPYRO'93, June 1993, Strasbourg, France, "The Stability of Pyrotechnic Delay Compositions," estimated 100-500 attendees.

Combustion Instability Workshop- December 1991, Yorktown, VA
International Security Systems Symposium-(P), November 1992, "Emergency Destruction of Computer Hard Disk Drives."

SAFE Symposium, 1992, Las Vegas, NV "Applying Analog Integrated Circuits for HERO Protection."

AIAA/SAE/ASME/ASEE Joint Propulsion Conference, June 1993, "Laser Initiation Systems Meeting Current and Future Development of Defense Specification Requirements."

Sixth Annual Joint Ordnance Commanders Group, December 1992, "Continuous Processing of PBX," and "Injection Loading of PBX."

2.5.6.5 **Exchange Programs & Visits** (Industry, academia, state & local govt, foreign (HQs & Labs)

(a) Exchanges with industry, academia, state & local government:

- Each year the IHDIV hosts about 50,000 visitors. Some of the visitors include students, local, state, and federal government representatives, civic groups, and Sponsors/Customers we support.

- We also, in concert with Directorate 2400 located at St. Indigoes, Maryland have developed a consortium whose charter is to investigate technology transfer opportunities for its membership. This consortium is comprised of high level representatives from various Navy field activities, the private sector, and academia. The short term objectives of this consortium are to develop methodologies/strategies that will enable automated tools/equipment, originally designed and developed for DoD applications to be efficiently transferred to high benefit/high use areas such as state and local educational systems. The primary long term goal of the consortium is to exploit the vast and diverse talent and experience brought to the table by its members to identify potential workload that will in turn provide equitable opportunities for each faction represented in the consortium. This will be done through careful and continuous investigation of emerging technologies and related requirements both within, and outside, DoD.

(b) Foreign Visitors.

Over the past several years, the IHDIV has hosted visitors from all over the world. We have worked with representatives from Israel, France, the United Kingdom, Norway, Germany, Netherlands, Canada, Switzerland, Korea, Kuwait, the Royal Australian Air Force Australia, and Argentina.

(c) Foreign visits by laboratory personnel.

IHDIV personnel visited numerous foreign countries. Some include; SNPE Headquarters - France, AWA Defense Industry - Australia, Israeli Military Industry - Israel, NATO Ad Hoc BICT, Fraunhofer Institute for Chemical Technology, and ICT IKA - Germany, Royal ARS West Woolwich, Royal Ordnance, Defense Research Agency, and RARDE Ft. Halstead - United Kingdom, Harpoon Program - Indonesia, Japan Defense Agency - Japan, Bofors Explosives - Sweden, Federal Armed Forces Defense Agency - Germany, NATO A/C 310 SGI Working Group, TNO Prins Murits Lab - Netherlands, NATO A/C 310 SGI, Defense Res Est Valcartier - Canada, and Army - Egypt.

2.5.6.6 Grants and Cooperative Agreements

(a) Donation of equipment to universities (include GFE turned over to universities): None.

(b) Investments in university facilities: None.

(c) Education partnerships:

- The IHDIV supports the Charles County Board of Education in numerous ways. We provide judges/awards for Science and Engineering Fairs, our Community Action Program (CAP) is an outreach program designed to promote interest in various activities from business through scientific and technical. We have an extensive network of volunteers in the Charles County Literacy program which teaches area residents reading skills, math skills, english, etc.

- We offer undergraduate, graduate, MBA and associate degree assistance programs to the IHDIVs employees.

- We have a cooperative education program with 20 students from several universities.

(d) URI & Centers of Excellence (Title, Value, Partner, MCTL category): None.

2.5.6.7 Use of Laboratory Facilities

(a) Agreements other than CRADAs that involve company use of DoD facilities: None.

(b) Industry use of test centers:

We are working with the University of Missouri at Rolla providing technical and consulting services in analytical chemistry as applied to energetic materials ($50K in FY93).

2.5.6.8 CRADAs

(a) Active CRADAs - We currently have none, however, we will sign a CRADA within the next month entitled "Applied Research Relating to Injection Loading Machine," NCRDA-IHDNSWC-93-001. All negotiations are completed and CNR has approved. We are awaiting the signing ceremony.

(b) CRADAs under negotiations - We currently have four CRADAs under negotiations. The areas are; Demil of Excess Ordnance, Air Bag Propellant Processing, Molten Salts Oxidation of Energetic Materials, and Environmental Technology.

(c) Lab investment - Minimal.

(d) Income producing - None currently.

(e) Criteria for deciding if income is desired. This will be individually determined based on the scope and division of work for a specific CRADA.

(f) Describe non-monetary contributions - With the CRADA that is ready to be signed, we are providing personnel, facilities, and equipment. The work will be performed at our Yorktown, Virginia facility.

(g) Reason for backlog - None.

2.5.6.9 Intellectual Property, Including Patents, Copyrights, and Trade Secrets

(a) Patents: 2 in FY92/93

(b) Patent applications: 13 in FY92/93

(c) Mr. John Lewis of the Office of Legal Counsel at NSWC Dahlgren Division, serves as Patent Attorney for the Indian Head Division. He travels here approximately one day every other month to meet with engineers and scientists who have questions on patents, to help people fill out patent applications, and to provide information on this subject to anyone who needs it.

2.5.6.10 Technology Reinvestment Project Efforts

(a) We have advertised our capabilities relative to the TRP categories of interest through the Federal Laboratory Consortium (FLC) and have met with several companies on joint efforts proposed for TRP.

(b) We are currently developing several technologies that should be of interest to industry in technology transfer areas. We are leading the work on several transfer issues relating to the commercial uses of military explosives. Last fall we began a program with ICI Explosives to determine if waste propellant from manufacturing could be used as a commercial explosive. Another on-going effort is in the dual-use technology area. Automobile air bags use initiators and propellants very similar to those used in CADs/PADs and gas generator ordnance applications. We have developed a process for an air-bag propellant

that is very close technically to gun propellants. We are working with industry on uses.

2.5.6.11 Interactions with non-DOD Organizations

(a) Other Government Agencies:

- National Aeronautics and Space Administration
- Drug Enforcement Administration
- Advanced Research Projects Agency
- Department of Energy
- USCG
- Department of Justice
- CIA
- Environmental Protection Agency

(b) State and local government:

- Maryland Department of the Environment, for permits and information exchange; also they called upon us to help draft new Volatile Organic Compound regulations for the State,

- Maryland State Police - verbal agreement which provides backup service for emergencies

- Charles County Government, good working relationship with elected commissioners

- Charles County School System, excellent working relationship due to our Community Action Program which brings Career Seminars to schools from elementary through high school, and provides advisors and judges to annual County Science Fair

- Charles County Sheriff's Department - Memorandum of Agreement for Law Enforcement

- Charles County Youth Division - Memorandum of Understanding for battered spouse, child abuse, etc.

(c) Industry - We have working relationships with virtually all energetics related companies. The following is a partial listing of some of the companies:

- McDonnell-Douglas
- HiTech, Inc.
- Teledyne-McCormick Selph
- Sandia National Laboratories
- Meridian
- Royal Ordnance, Mfg.
- Hercules
- Morton Thiokol

(d) Academia

- Massachusetts Institute of Technology
- Charles County Community College, LaPlata, MD
- University of Maryland, University College, College Park, MD
- University of Missouri, Rolla, MO

2.5.6.12 Plans for Improving Domestic Technology Transfer

(a) provide formal training for the ORTA Rep.

(b) initiate efforts to increase participation in SBIR program.

(c) designate DTT POC's in each technology organization

(d) identification and centralization of data relating to DTT efforts and accomplishments

(e) preparation and Command approval of an implementing directive on DTT to ensure top management visibility and support

(f) increase IHDIV programs in technology areas (relating to energetics, simulation, and information)

(g) increased emphasis on entering into CRADAs (bringing the four being negotiated to signing and establishing at least one CRADA with a university)

(h) increased emphasis on filing for patents

(i) increased emphasis on publications and presentations at conferences and symposia

2.5.7 OVERVIEW: PORT HUENEME DIVISION (DATA & PLANS N/A)

2.5.7.1 Port Hueneme Division Naval Surface Warfare Center
Director of Business Operations (CODE 002C)
4363 Missile Way
Port Hueneme, CA 93043-4307

Contact: Mr. Terry Oehler, Phone: (805)982-8260
Fax: (805)985-7284
E-mail: Terry_Oehler%00%CMMD@bld363.nswses.navy.mil

SYNOPSIS: The Port Hueneme Division Naval Surface Warfare Center (PHD NSWC) has the multi-disciplined capability to sustain and expand usage of existing technologies, and support applications testing and insertion of emergent technologies for combat and weapon systems and their components.

EXPERTISE: PHD NSWC expertise applicable to technology transfer includes Systems Engineering, Human Factors Engineering, Electromagnetic Engineering, Environmental Factors Engineering, Data Collection and Analysis Technology, Fiber Optics Technology, Telemetry and Guidance Systems Technology, Advanced Materials Technology, Electronic Devices and Components, Computer and Information Technology.

- Integrated systems engineering technology in sustaining operability.
- Human factors technology applications in optimization of operator-equipment interfaces.
- Data collection, reduction and analysis tools and methods technologies for use in developmental and operational testing of systems and components.
- Advanced materials technology use in hydraulic/mechanical equipment applications, as replacements for hazardous substances.
- Corrosion resistant, anti-fouling, and explosive-bonding metals and alloys use in materials technologies.
- Diamond film usage in high power microwave devices, vacuum and solid state electronics.
- Software generation, simulation and engineering tools technologies.
- Advanced computer architectures, communications networks and telecommunications technology.
- Advanced computer architectures, and integrated and expert digital systems technology.
- Electronic devices and components technology for use in systems operability and integration testing.

UNIQUE FACILITIES:

- Surface Warfare Engineering Facility: Integrated engineering lab housing combat and weapon systems and components under PHD cognizance, use includes conduct technology insertion testing, upgrade testing prior to fleet installation, and failure analysis.

- Microwave Laboratory: Adapted weapon system modulators instrumentation used for high power (up to 1.5-megawatt) testing and network analyzer for low power (average 6-testing of "C" and"X" band frequencies. Also contains thermal video systems for non-contact thermal analysis of microwave and other equipment.

- Software Program Generation and Life-Cycle Maintenance Labs: Computer systems and associated peripherals required for software development, testing and integration in numerous computer languages, for use in development and testing of program engineering tools, simulation programs, mockups and computer programs.

- Integrated Combat Systems Test Facility: 13,600 sq. ft. of militarized and commercial computer equipment, for developmental and integration testing of systems' prototypes and programs.

- Test System Development Facility: Design, fabrication and testing equipment for use in development and testing of electronic and electrical test systems.

DEPARTMENT OF THE NAVY
DOMESTIC TECHNOLOGY TRANSFER

2. REPORTING COMMANDS

2.6. NAVAL UNDERSEA WARFARE CENTER (NUWC) NEWPORT, RI

2.6.1 OVERVIEW

NAVAL UNDERSEA WARFARE CENTER (NUWC)

NUWC POC: Dr. William I. Roderick (203) 440-4305
Fax: (203) 440-4329

SYNOPSIS: The NUWC mission is to operate the Navy's full-spectrum research, development, test and evaluation, engineering and fleet support Center for submarines, autonomous underwater systems, and offensive and defensive weapon systems associated with Undersea Warfare.

EXPERTISE: The assigned NUWC leadership areas and, hence, the areas of expertise are as follows:

- Undersea Warfare Modeling and Analysis
- Submarine Combat and Combat Control Systems
- Surface Ship and Submarine Sonar Systems
- Submarine Electronic Warfare
- Submarine Unique on-board Communication Systems and Communication Nodes
- Submarine-Launched Weapons Systems (except strategic ballistic missile systems, cruise missiles and related systems)
- Undersea Ranges
- Submarine Electromagnetic, Electro-optic and Nonacoustic-effects Reconnaissance, Search and Track Systems
- Undersea Vehicle Active and Passive Signature (except HM&E)
- Submarine Vulnerability and Survivability (except HM&E)
- Torpedoes and Torpedo Countermeasures

The Naval Undersea Warfare Center seeks to provide its customers with the highest quality technologies, products, and service at the best value to ensure the United States continuing superiority in undersea warfare. The center supports technology transfer through Cooperative Research and Development Agreements (CRADAs), Small Business Innovative Research (SBIR), Intergovernmental Personnel Act (IPA) Program, Navy Potential Contractor Program (NPCP), use of laboratory facilities, and licensing of intellectual property and patents.

UNIQUE FACILITIES: The Naval Undersea Warfare Center is comprised of two Divisions - the Newport Division in Newport, Rhode Island, and the Keyport Division in Keyport, Washington. In addition to its two main sites in Newport and Keyport, NUWC has detachments geographically spread over the United States and in the Bahamas and British Columbia. The accompanying map details the locations of NUWC Headquarters, Divisions and major Detachments. Located at each of the Divisions and Detachments are unique facilities supportive of technology transfer. These facilities are detailed in the following NUWC Division descriptions.

2.6.2 DTIC REPORTS

(a) NUWC technical reports submitted to DTIC

FY92:	42
FY93 (3 QTRS):	40
TOTAL	82

(b) Representative Titles

"A Complete Set of Field Equations for the Dynamic Evaluation of a Towed Cable System"
"An Approach to Experimentally Determining Hydrophone Array-Current Interaction Coefficients"
"Design and Analysis of an Apparatus for Measuring the Drag Coefficients of Flexible Wire Cable"
"The Direct Measurement of Damping Coefficients Using an Inverse Eigenvalue Method"
"Experimental Studies of the Superconducting Electromagnetic Thruster, Phase 2, Low to Medium Power, Sea Water Test Results
"Micromechanical Hydrophone Potential Applications"
"A Multibeam Approach to Terminal Homing Imaging"
"A Nonconforming Approximate Solution to a Specially Orthotropic Axisymmetric Thin Shell Subjected to a Harmonic Displacement Boundary"

2.6.3 DIVISION OVERVIEWS, NEWPORT AND KEYPORT

2.6.3.1 Overview

NAVAL UNDERSEA WARFARE CENTER DIVISION, NEWPORT
Code 105
1176 Howell Street
Newport, RI 02841-1708

Contact: Ms. Margaret M. McNamara (203) 440-4590;
FAX (203) 440-5458

SYNOPSIS: The Newport Division performs research, development, test and evaluation, engineering, and field support for submarine systems, autonomous underwater systems, sonar systems of all types, and various undersea weapon systems. Some areas of special expertise include: Acoustic components and arrays of all types; acoustic signal processing; multiple-source information management; turbulent and laminar flow hydrodynamics; high power density underwater propulsion; communications, especially very low and very high RF; underwater testing of systems and vehicles; large scale numerical computation; modeling and analysis of very complex systems, including real time.

EXPERTISE: The Division has identified certain mission-relevant technical disciplines that are central to excellence in its leadership responsibilities and also applicable to technology transfer:

- Modeling, simulation, and analysis
- Acoustic sensors, transducers, and arrays
- Signal processing
- Structural acoustics and target physics
- Information processing, data fusion, and operability
- Unmanned Underwater Vehicle (UUV) propulsion, navigation,guidance and control
- Electromagnetics, electro-optics, imaging, and communications
- Hydrodynamics
- Shallow and deep water ocean physics
- System engineering, integration, and test
- Large scale real-time software and systems
- Large scale numerical modeling and analysis
- Affordability engineering and analysis
- Integrated systems logistics technology

FACILITIES: NUWC Newport Division has numerous specialized facilities, many with the potential for a variety of dual-use applications:

- Acoustic Display Research Facility
- Acoustic Test Tank: the largest indoor acoustic test tank in the U.S., it is the Navy's primary test bed for the acoustic evaluation of sonars for underwater vehicles and targets.
- Advanced Submarine Launcher Facility
- Advanced Underwater Vehicle Propulsion Research and Development Facility: Comprehensive, state-of-the-art development and test facilities for R&D efforts in underwater vehicles.
  Atlantic Undersea Test and Evaluation Center (AUTEC)
- Combat Control Systems Laboratory
  Combat System Evaluation and Analysis Laboratory
  Dodge Pond Acoustic Measurement Facility: provides real time results of all transducer test parameters through highly accurate computerized test systems and instrumentation.
- Extremely Low Frequency (ELF) RF Simulation Facility
- High Energy Propulsion Test Chamber

- Integrated Transducer Design Facility: provides full spectrum transducer design capabilities from systems concepts to final prototyping and includes chemistry, materials, and modeling facilities specifically focused on the development of underwater transducers.
- Langley Seawater Tow Tank
- Man/Machine Sonar Test Bed: Designed to support the entire range of man-machine interface studies which apply to submarine sonar systems.
- Propulsion Noise Test System
- Propulsion Test Facilities
- Quiet Water Tunnel Experimental Facility: measures turbulence-induced self-noise of various hydrophones.
- Seneca Lake Acoustic Measurement Facility: used to evaluate single active and passive underwater acoustic devices as well as large sonar systems.
- Submarine Antenna Overwater Arch Facility
- Submarine Antenna Test Range
- Submersible Sensor Test Platform
- Superconducting Electromagnetic Thruster and Seawater Magnetohydrodynamics Test Facility: incorporates seawater flow and a high magnetic field (seven Tesla) for the study of applications of superconductivity in undersea propulsion and quiet launch technology, using very large magnetic fields.
- Towed Array Complex: used to develop, fabricate, and test all submarine, torpedo, and tactical surface ship towed array systems.
- Transient Flow Loop Facility
- Transient Impeller Test Facility
- Underwater Optical Test Facilities
- Weapons Analysis Facility

2.6.3.2 *Overview*

NAVAL UNDERSEA WARFARE CENTER DIVISION, KEYPORT
Code 0521
610 Dowell Street
Keyport, WA 98345-7610

Contact: Debbie Abrahams (206) 396-2763; FAX (206) 396-7906

SYNOPSIS: The Keyport Division provides test and evaluation, in-service engineering, maintenance and repair, fleet support, and industrial base support for undersea weapons, countermeasures, underwater targets and undersea warfare systems. Some areas of special expertise include: undersea warfare testing and analysis, submarine combat and combat control systems, surface ship and submarine sonar systems, submarine launched weapons systems, undersea ranges, USW electromagnetic, electro-optic and nonacoustic effects, tracking systems, undersea vehicles, torpedoes, targets, and torpedo countermeasures.

EXPERTISE: The Keyport Division maintains a high level of expertise in the following mission-related areas and which are applicable to technology transfer:

- Depot operation; undersea system repair and maintenance
- Industrial Technology
- Acquisition acceptance proofing, evaluation of undersea vehicles and systems
- Environmental testing
- Material, chemical, and failure analysis of high-energy propulsion compounds
- Automated testing
- Full-spectrum light industrial manufacturing
- Computer-aided logistics
- Automated Document and Engineering Data systems
- Oceanographic and acoustic studies

FACILITIES:

Undersea Weapon Systems

- Environmental Test Facilities: Climatic, environmental test facility for all-up round testing of torpedoes and containers.
- Full Spectrum Light Industrial Manufacturing Facilities
- Material, Chemical, and Failure Analysis Laboratories
- Machining: 48,000 square feet consisting of over 130 machine tools including numerically controlled machining centers with two- to five-axis mobility and precision automated screw machines.
- Sheetmetal: 8,000 square feet with numerically controlled 45-ton punch and automated finishing/deburring machine.
- Welding: 12,000 square feet with a waterjet cutting system, electron beam welding, and two robotic welding systems.
- Painting: 10,000 square feet with electrostatic painting, dry powder coating, and robotic painting systems.
- Heat Treatment: 5,000 square feet with computer-controlled furnaces, including vacuum and atmospheric furnaces, and a fully equipped process control laboratory.
- Plating: 10,000 square feet with anodizing (Types I, II, and III), chemical etching, precious metals (silver, gold, and rhodium), and selective plating capabilities.
- Mechanical Assembly: 50,000 square feet with heavy and precision assembly, molding, potting and encapsulation, robotic painting, and hydrostatic testing (10,000 psi) capabilities.
- Electrical Assembly: 22,000 square feet with printed circuit board manufacturing, wave soldering, cable fabrication, and microwelding capabilities all complying to MIL-STD-2000 requirements.
- Weapons & Combat Systems ISE Laboratories: Over 80,000 square feet of laboratories and facilities support ISE efforts.

Test & Evaluation

- Nanoose, Quinault, Dabob Bay and San Clemente Island Underwater Ranges.
- The Range Information Display Center (RIDC): Remotely displays, at one location, in real time or in a replay mode, the full air, surface, and subsurface track of the ranges at Quinault, Dabob Bay and Nanoose.
- Undersea Weapon Evaluation Facility: Navy's only land-based SW vehicle test site, capable of fully testing vehicle acoustic guidance, control, and propulsion functions simultaneously in a captive mode.
- Automated Transducer Test Facilities (ATTF) (2): Can accommodate handle full-sized vehicles at maximum depth; proximate to range, depot, and test facilities
- Shipboard Electronic Systems Evaluation Facility (SESEF): Operate and maintain three Shipboard Electronic Systems Evaluation Facilities (Puget Sound, Southern California, and Hawaii).
- Surface Ship Radiated Noise Measurement (SSRNM): Operate and maintain two facilities (Southern California and Hawaii).

2.6.3.3 Offices of Research and Technology Applications (ORTAs) and DTT Focal Points

The Naval Undersea Warfare Center's ORTA was established in 1971 as the NUSC Office of Special Programs Development and redesignated, after passage of the Stevenson-Wydler Technology Innovation Act of 1980, as the Office of Research and Technology Applications or ORTA. The ORTA head is:

Ms. Margaret M. McNamara
Code 105
Naval Undersea Warfare Center Division, Newport
New London, CT 06320
Phone: (203) 440-4590/Fax: (203) 440-5458

The DTT focal point in the NUWC Keyport Division is:

Mr. Alan Lindstrom
Code 57
Naval Undersea Warfare Center Division Keyport
Keyport, Washington 98345-5000
Phone: (206) 396-6645/Fax: (206) 396-4426

The ORTA also is staffed by one GS-7 Program Assistant who spends full time on ORTA programs which include a contracted student services program and an Intergovernmental Personnel Act Mobility Program. Professional staff expertise and other support services are made available to the ORTA on an as-needed basis.

ORTA budget:

FY92: $115,237
FY93 to date: $114,889

In April 1993, the DTT function was expanded through the establishment of a Defense Technology Conversion (DTC) Program within the Science and Technology Directorate. The DTC Program encompasses the entire range of DTT activities including technology reinvestment, technology transfer, commercialization and dual-use technology. The head of the DTC Program is Dr. W. I. Roderick, NUWCDIVNPT Code 10. A DTC Steering Group is composed of a member from each of the Division's product lines; legal issues are handled by Office of Counsel; a liaison person has been designated for NUWC Headquarters.

Other DTC Program assignments are as follows:

Policy, Education, Guidance:	Ms. M. M. McNamara
Infrastructure: Governmental	Ms. M. M. McNamara
Industrial	Dr. A. M. Colella
Identification of Defense Conversion Technologies and Needs:	Dr. S. C. Dickinson
Pilot Programs & Proposal Evaluations:	Mr. R. F. LaPlante

A call for DTC preproposals resulted in about 50 submissions which are now under evaluation. Ten resulted in partnership submissions to the ARPA Technology Reinvestment Project.

DTC responsibilities were assigned in mid FY93 and duties were subsumed into already established functions. A DTC budget will be established beginning in FY94.

Items 1, 2 and 3 are updated as appropriate. Item 5 is a NUWC innovation and will be added to and enhanced on a continuing basis.

National outreach is achieved through:

Membership in and participation in the activities of the Federal Laboratory Consortium for Technology Transfer (FLC).

- The FLC network of laboratories, ORTAs and Regional Coordinators
- The FLC Laboratory Locator System
- FLC publications--national and regional brochures and annual brochure
- FLC exhibits--approximately six per year
- FLC Government/Industry conferences aimed at reaching research directors of Fortune 1000 companies
- FLC Small Business Workshops
- FLC National (Spring) meetings--directed at reaching out to industry

National exhibits such as the Armed Forces Communications and Electronics Association and NASA's Technology 2000 series.

Interaction with the National Technology Transfer Center. Requests for information are received through its Gateway system.

Regional outreach is achieved through:

Participation in FLC Northeast Region activities

- Small business incubator briefings
- Chamber of Commerce ChamberTech seminars

Interaction with the Economic Innovation Center of Rhode Island

Interaction with the Connecticut Technical Assistance Center

- Attend and exhibit at annual technology dinner

Interaction with the Center for Technology Commercialization, the NASA Regional Technology Transfer Center.

2.6.3.4 Publications

Names of journals in which NUWC publishes:

Journal of the Acoustical Society of America
U.S. Navy Journal of Underwater Acoustics
Journal of Science and Engineering Corrosion
IEEE Transactions on Communications
Journal of Vibration and Acoustics
Journal of Fluids Engineering
Journal of Sound and Vibration
IEEE Journal of Oceanic Engineering
Perceptual and Motor Skills Journal
Journal of the American Institute of Aeronautics and Astronautics
Journal of Computational Physics
Journal of the Electrochemical Society
IEEE Transactions on Magnetics.

Approximate number of publications:

FY 1992:	31
FY 1993 to date:	32

Representative titles:

"Hydroacoustic Research at the Quiet Water Tunnel Facility of the Naval Underwater Systems Center"
"A Study of Low Frequency Sound in Shallow Water Ducts"
"Object Classification and Acoustic Imaging with Active Sonar"
"Signal to Noise Ratio Improvement by Likelihood Ratio Techniques Under Model and Environmental Mismatch"
"Signal Detectors for Random Ocean Media"
"Finite Element Analysis Technique for EMC Applications: Lessons Learned"

A major output of NUWC professional staff are technical documents and technical reports. From 1 October 1991 to the end of Calendar Year 1992, over 150 publications were issued.

2.6.3.5 Conferences & Symposia

NUWC personnel participated in the following technology transfer-related conferences/symposia:

10/22-23/91	Federal Laboratory Consortium (FLC) Laboratory/Industry Conference, Washington, DC - less than 100

11/4-7/91	FLC Semiannual Meeting, Atlantic City, NJ - between 100 and 500
12/2-4/91	NASA's Technology 2001, San Jose, CA - over 500
2/28/92	Economic Innovation Center of Rhode Island, Newport, RI between 100 and 500
4/6-8/192	Navy Technology Transfer Conference, Patuxent River, MD - between 100 and 500
5/4-7/92	FLC Semiannual Meeting, Indianapolis, IN - between 100 and 500
7/26-29/92	National Conference of State Legislatures Annual Meeting, Cincinnati, OH - over 500
9/23/92	New Haven Science Park Incubator Briefing, New Haven, CT - less than 100
11/2-5/92	FLC Semiannual Meeting, Scottsdale, AZ - between 100 and 500
12/1-3/92	NASA's Technology 2002, Baltimore, MD - over 500
4/19-22/92	FLC Semiannual Meeting, Pittsburgh, PA - over 500
6/8-10/92	Armed Forces Communications and Electronics Association (AFCEA) Annual Meeting, Washington, DC - over 500
6/10-11/92	Small Business Innovation Research Phase III Conference, Orlando, FL - between 100 and 500
5/19/92	Defense Conversion Workshop, Keyport, WA - less than 100
6/11/92	Defense Conversion Workshop, Warwick, RI - between 100 and 500

The technology transfer-related conferences provide opportunities for staff to identify and interact with potential CRADA partners, patent licensees and other Federal technology users and also to discuss methodology and process with technology transfer peers.

NUWC technical staff members also attend a broad spectrum of purely technical conferences and symposia each year where the subject matter of papers and other presentations matches their area of expertise and professional/corporate responsibilities. Some of the conferences in 1993 include: the annual meeting of the Acoustical Society of America, Ottawa, Canada, where five staff members presented papers; Oceans 93, Victoria, British Columbia, at which six staff members presented papers; and the Cryogenic Engineering Conference in Albuquerque, New Mexico. Over 800 NUWC staff members attended conferences and symposia in FY92 and FY93 where they interacted with their professional peers from other segments of the scientific community, an essential step in the technology transfer process.

2.6.3.6 Exchange Programs and Visits

NUWC used the mobility provisions of the Intergovernmental Personnel Act (IPA) of 1970 to share information and expertise with academia and State/local government. University faculty, most holding PhDs, are detailed to the Center, usually on an intermittent basis, full time summer, and occasionally for a sabbatical leave year. They have the opportunity to apply their theoretical knowledge to practical, hands-on science and engineering programs. In addition to the benefits to Center programs, they take the practical experience back to their classroom and university research assignments.

During FY92, 17 faculty members were assigned to NUWC from 12 colleges/ universities. During FY93, 21 professors from 14 academic institutions held IPA assignments at NUWC. Sponsoring institutions included the University of

Massachusetts, University of Rhode Island, University of South Carolina and University of Southern Colorado. Areas of research included target detection performance, advanced propulsion systems, computer simulation and design modeling for various types of electric motor systems and design of real-time system software applications.

During both FY92 and 93, one outgoing assignment from NUWC to the State of Connecticut Economic Development Department provided a senior staff member to assist in identifying defense diversification and defense conversion opportunities for the State.

NUWC has contracts with the University of Rhode Island to obtain student technical services for Center programs (DoD Authorization Act of 1982, 10 USC 2360). Students are full-time undergraduate and graduate college/university students. They work up to 20 hours/week during the academic year and/or full time summers, holidays and semester breaks.

During FY92 130 students from 31 universities participated in the program. In FY93 to date, 146 students represented 25 universities. The academic institutions of the students included the Universities of Rhode Island, Connecticut, Pennsylvania, Notre Dame, Brown University, Yale University, Cornell University, and the Massachusetts Institute of Technology. The students assisted in the development of test equipment and data bases, data reduction, and software an hardware installation. Since the inception of the program in 1984, 34 students have been hired as full-time staff members. Therefore the program, in addition to its technology transfer value, is a good recruiting mechanism.

During FY92, NUWC hosted visitors from the following foreign countries: Australia, Canada, France, India, Italy, Korea, Netherlands, Philippines, United Kingdom,

During FY93 to date, the Center hosted visitors from: Australia, Canada, China, Dominica, Denmark, Belgium, Egypt, Ireland, Spain, Argentina, France, Greece, India, Israel, Italy, Korea, United Kingdom

Subject matter for the foreign visits included.

Research associated with low frequency sonar and submarine ranges
Underwater propulsion and underwater tracking
Review of the ADA language system
Stationary signal processing
Towed array research
Demonstration and training on the Cambridge (UK) massively parallel processor.

During FY92, NUWC personnel visited the following foreign countries: Australia, Canada, Bahamas, France, Greece, Italy, Denmark, Germany, Norway, New Zealand, Netherlands, United Kingdom

During FY93, NUWC personnel visited the following foreign countries: Australia, Canada, France, Greece, Germany, Italy, Japan, Guam, Korea, Norway, Russia, Spain, Sweden, Turkey, United Kingdom, United Arab Emirates, New Zealand, Belgium, Bahrain

Subject matter of the foreign visits included:

Shallow water acoustics/sensors and signal processing
Provision of technical support for outfitting submarines with the encapsulated HARPOON
Submarine torpedo countermeasure data exchange
Provision of technical training, support, advice and equipment inspection
Combat system analysis support.

2.6.3.7 Grants and Cooperative Agreements

NUWC has a number of pieces of scientific equipment such as generators, amplifiers, microscopes, on loan to the University of Rhode Island (URI). The Center also has Memoranda of Understanding with: URI for the transfer of supercomputing technology, the National Science Foundation (NSF) for sharing supercomputer resources, NSF in the area of communications capability in Antarctica, Woods Hole Oceanographic Institution for cooperative development of Unmanned Underwater Vehicle technology, and others.

2.6.4.8 Use of Laboratory Facilities

NUWC has many unique facilities related to acoustic, communications and propulsion research and development, and all related to its undersea warfare mission. Industrial use of NUWC test centers is performed through a variety of mechanisms, including reimbursable work for others agreements. In addition, a large portion of industrial test activities are performed as part of Navy or Government contracts, or at the request of Navy sponsors.

- Work at the Seneca Lake Acoustic Facility is done for Raytheon, Spartan, Sanders of New Hampshire, Bendix, Norden and basically all large companies in the acoustic measurement business, and for other Navy laboratories as well. Approximately 85-90 percent of the facility use is in this category.

- About two percent of the testing in the Combat System Evaluation and Analysis Laboratory is done for companies such as: General Dynamics, Magnavox, Photonics, Martin Marietta, and a number of small companies that have developed some technique, such as flat panel displays, that they need tested.

- About five percent of work time in the Acoustic Test Tank is used on a reimbursable basis by large and small companies such as Raytheon, Benthos, Sippican, Hazeltine and Martin Marietta. Level of effort is about 500 manhours.

- The NUWC Periscope Facility is used about one to two percent of the time for testing for companies such as General Dynamics/Electric Boat or Sperry Marine who may be under contract to NUWC or a Center sponsor to test failed periscopes or for "shake and break" testing on newly constructed periscopes or before sea trials.

2.6.3.9 CRADAs

Active CRADAs

- Combat System Simulation and Modeling, Industry Partner
- Massive Parallel Processing - Parallel Architectures, Beamforming, Automated Detection and Tracking and Advanced Display Techniques - Industry Partner

CRADAs under negotiation: four - two with industry, one with a university laboratory, one with a municipal cooperative.

One CRADA is under development with a small business.

Laboratory investment in active CRADAs: $1.5 million.

Projected laboratory investment in CRADAs under negotiation and in development: $2.5 million.

Three CRADAs under negotiation and one under development are expected to produce income.

Criteria for deciding if income is desired: Major criterion is the relative benefits to NUWC and the CRADA partner.

Nonmonetary contributions either currently being furnished or planned include personnel, services, facilities and equipment.

Reasons for backlog: Experience to date has been that review by the partner's legal staff is extensive and time-consuming.

2.6.3.10 Intellectual Property

Intellectual Property, including patents, provides the property rights in Navy developed innovations that enable us to license the technology in such a way as to interest private parties.

a. Patents (+ D10's - classified applications allowed): A list is enclosed.

b. Patent Applications: A list is enclosed.

c. Licenses: 1
U.S. Patent Nos. 4,166,921 and 4,774,519
Spears Associates (Industry)

d. Royalty Income: $2,000.00

e. CRADAs: 2

f. Backlog: 258 disclosures - Our backlog is not one of patent applications but rather of disclosed inventions. It represents all inventions disclosed to NUWC which have not yet been filed in the U.S. Patent Office or inactivated. This backlog exists due to a five year surge in reporting of inventions coupled with a shortage of patent attorneys.

g. Attorneys: 4 at Newport, RI

Cumulative Salaries	FY92: $227,500 FY93: $239,400 (projected to end of FY)
Travel Budget	FY92: 10K FY93: 12K

Regarding training of scientists and engineers on intellectual property, workshops are offered at various laboratory sites open to all scientists and engineers, and all new professionals are trained as part of their in-processing orientation.

2.6.3.11 Technology Reinvestment Project Efforts

NUWC participated as a partner in 14 TRP proposals with large and small business, academia and State governments.

2.6.3.12 Interactions with non-DoD organizations

Other Government Agencies: U.S. Department of Agriculture, Commerce, Energy, Health and Human Services, Interior, Justice, Transportation, Environmental Protection Agency, Central Intelligence Agency, National Aeronautics and Space Administration, National Science Foundation, Tennessee Valley Authority, Veterans Administration and others.

State and local government: State of Connecticut, State of Rhode Island, State of Washington

Industry: General Dynamics/Electric Boat, Martin-Marietta, Grumman Corp., Raytheon, CG International, Analysis & Technology, Edo Corporation, Kildare Corporation, Alliant Tech. Systems, Rockwell International, Electro Energy, Inc., International, Solar Car Corporation, and many others.

Academia: University of Rhode Island, University of Connecticut, University of Massachusetts, University of New Hampshire, Yale University, Brown University, Cornell University, Massachusetts Institute of Technology, and many others.

Types of interactions include request receipt and referral services for large and small business, personnel exchanges, student services, information exchange, CRADAs, Memoranda of Understanding.

2.6.3.13 Plans for Improving Domestic Technology Transfer

(a) NUWC has expanded its ORTA function and amplified its technology transfer program through the establishment in April 1993 of a Defense Technology Conversion (DTC) Program (see Section II.2). DTC includes technology transfer, dual-use technology, defense diversification, and all that they imply. Plans to improve domestic technology transfer include:

(1) Identification:

- Of NUWC technologies available for transfer, of the adaptive engineering needed to bring them closer to commercialization and of the NUWC S&E talent that can be made available to industry for the adaptation processes

- Of the technological needs of industry, academia and State/local government that match NUWC R&D mission responsibilities and expertise

- Of mechanisms to increase the interaction between NUWC and the industrial/academic/other governmental community, including CRADAs, patent licenses, personnel exchanges.

(2) Education:

- Sensitize in-house management and staff to technology transfer issues and opportunities

- Organize DTC-specific workshops; present technology transfer opportunities sessions during Center Industrial R&D and Small Business Opportunities Conferences; participate in national technology transfer exhibitions; educate NUWC staff to look at every interaction as a potential technology transfer contact.

- Include technology transfer in S&E laboratory position descriptions, promotion policies and performance evaluations.

(3) Documentation:

- Of transfer opportunities, including patents available for licensing and CRADA opportunities, as marketing tools

- Of technology transfer successes to encourage increased S&E staff activities, and as a marketing tool

(4) Secure additional resources--ORTA professional staff and space, technical and support personnel, and operating and travel budgets--to perform the identification, education and documentation tasks.

(5) Use membership in the Federal Laboratory Consortium, as the major national technology outreach and educational vehicle to the best advantage of NUWC.

(6) Cooperate with the National Technology Transfer Center in its request/response gateway function; and use it to advertise NUWC technology transfer opportunities.

(7) Develop agreements with local, State and regional governments/ organizations to provide assistance to their businesses in the area of defense diversification and conversion.

(b) Improving the Report

- Reaction to the current report submissions, by ONR, DoD and Congress, should be relayed in detail to the Center POCs.

- Please make that information, and the specifics of next year's data call, available to POCs at the earliest possible date, so that data not previously captured at the Center/laboratory level or not captured in the form required, can begin to be collected.

- If responses to data points seem to the reviewers to be off-target, please advise the POCs.

- If the data requests are for information that is strictly technology transfer-related, please specifically so state in the next data call.

3. EXAMPLES OF NAVY COMMERCIALIZED TECHNOLOGIES

3.1 NAVAL RESEARCH LABORATORY

GPS Navigation

Today's widely used Global Positioning System (GSPS) is based on NRL's TIMATION research program, begun in 1964. The Laboratory's Dr. R. Easton is recognized for conceiving the idea of a time-based navigational system, which eventually led to the GPS. In demonstrating the feasibility of such a system, NRL conducted basic tests of the TIMATION technique through the use of two small experimental satellites, TIMATION I and TIMATION II.

The successful launch, in the late 70's of NTS-2, as the first GPS satellite, marked the beginning of a new era in navigation and timekeeping history.

Civilian applications of GPS are numerous. For example, emergency vehicles and delivery vehicles could have GPS receivers linked to electronic map displays to direct them to within a few feet of any address. This navigation technology helps insure that no aircraft will ever stray off course and no ship or boat will ever run around in fog because of navigation errors.

Firefighting Foam

NRL has conducted research on fire suppression that eventually led to one of the most far-reaching benefits to worldwide aviation safety -- the development of NRL patented Aqueous Film-Forming Foam (AFFF). This firefighting foam is now used on all U.S. Navy aircraft carriers and by major airports, refineries, and other areas where potentially catastrophic fuel fires can occur. This NRL-developed fire suppressant is used by more than 90 airports in the U.S. alone, as well as in many civilian fire departments.

Permanent Magnet Materials

In 1980 NRL researchers discovered a family of rare earth-iron-boron alloys, for permanent magnet use. NRL scientists hold the fundamental U.S. patents which have been licensed to several firms and products are being offered commercially. Since 1983 commercial alloys have been in production and these materials provide almost twice the magnetic energy density of the best materials previously available.

Fluoropolymers

NRL has developed a family of fluorinated polymers which can be applied as coatings to surfaces to provide protection from corrosion. The materials are used to protect the interior of fuel storage tanks from corrosion. Four patents have been issued to NRL and licensed for commercial purposes. The polymers are used to coat DoD fuel storage tanks and commercial applications are being developed.

Phthalonitrile Composite Resins

Six NRL patents describing phthalonitrile resins have been licensed to a commercial resin manufacturer. The materials are being offered as a polymer matrix material for composites used in high temperature structural applications. NRL also has signed a Cooperative Research and Development Agreement (CRADA) with a company to explore the use of this material in an application of interest to them.

Single Crystal Gallium Arsenide

NRL developed a new and inexpensive technique of compounding and growing single crystals of gallium arsenide (GaAs) of high enough purity to be used for microwave and millimeter wave devices and integrated circuits.

The NRL technology was adopted by major U.S. industrial firms, such as Rockwell International, Westinghouse, and Hughes Research, and by international firms as well. According to a major manufacturer, the NRL method is expected to decrease the production cost of each GaAs wafer from $3500 to $1000.

Microlithography

NRL developed a new lithographic technique for fabricating ultrahigh-resolution patterns on a variety of solid substrates. In 1989, the NRL patents were licensed for commercialization patents and a Cooperative Research and Development Agreement (CRADA) was established to develop this lithographic technique. This technology has the potential of significantly impacting the commercial sector, while providing the technology base for the development of the next generation of more sophisticated electronics necessary for the nation's defense. The first commercial product will be offered in 1993.

Biologically-based Sensors

A biosensor has been developed by NRL for the detection of explosives and drugs of abuse. This biosensor was developed and patented in 1991. The patent was subsequently licensed to a company and a Cooperative Research and Development Agreement was established to develop portable commercial instruments for on-site drug detection. This instrument can be operated by personnel who lack scientific training and can be used outside of a laboratory environment. The system received FDA approval in May of 1993 and will be offered commercially later this year.

In recognition of this successful transfer of technology, NRL's F. Ligler and A. Kusterbeck were honored with the 1992 Technology Transfer Award for Drug Enforcement by the Office of National Drug Control Policy.

3.2 NAVAL MEDICAL RESEARCH AND DEVELOPMENT CENTER

Mature Commercialization of the Frozen Blood Bank System (NMRDC)

The Office of Naval Research and the NMRDC have supported the basic, exploratory and applied research to develop a frozen blood bank system to freeze nonrejuvenated and rejuvenated human red blood cells at -80 C for at least 20 years, freeze human platelets at -80 C for at least 2 years, maintain fresh frozen human plasma at -80 C for at least 7 years, and freeze human bone marrow and peripheral blood pluripotential mononuclear cells at -80 C for at least 1.5 years and at -135 C for at least 2.5 years in mechanical freezers.

The Department of Defense has deployed frozen blood bank systems to stockpile universal donor O-positive and O-negative red cells frozen in mechanical freezers to treat combat casualties. Frozen rare red cells and frozen autologous red cells are being used by the civilian community.

The utilization of the frozen blood bank system by both the military and civilian communities over the past 20 years represents a mature commercialization of the research and development of the frozen blood bank system supported by ONR and NMRDC.

Technology transfer successes arising from CRADAs

Naval Medical Research Institute (NMRI) and Futrex, Inc:

Under this CRADA the diving research team conducted comparisons of a new device for measuring body fat to the standard acceptable test in the field to support the efficacy of the collaborators product for licensing.

Naval Biodynamics Laboratory (NBDL) and Snell Memorial Foundation:

Under this CRADA, NBDL provides test data from files to support Snell's work in setting standards for bicycle and motorcycle helmets.

Naval Aerospace Medical Research Laboratory (NAMRL) and Private Commercial Airline:

Under this CRADA, NAMRL is helping the Airline adapt to the reduction in trained military pilots available by developing tests to evaluate pilot candidates.

NAMRL and Maxwell Safety Products, Ltd:

Under this CRADA, NAMRL provided testing services not otherwise available allowing a start-up company on Long Island, New York, to obtain OSHA, and FCC licensing and open its doors creating several new jobs.

3.3 NAVAL AIR WARFARE CENTER

Chemiluminescent Light Sticks

Chemiluminescence is the process by which two chemicals mix to produce light. The light sticks are made of a plastic called radiated polyolefin. Chemicals inside the tube combine in a catalytically controlled reaction to produce light that is visible at ranges up to 4 miles. The light is actuated by bending the plastic tube to break the inner ampule, allowing the chemicals to mix. In just a few seconds, this mixture produces light that lasts up to 12 hours. This is a low-cost, convenient, safe, and reliable light source, without the hazards of other low-level, emergency lighting. The Navy development of this technology was for use in lighting for ship-to-ship transfers, marking landing areas, locating downed pilots, emergency lighting, and as recently as Desert Storm, in marking mine fields. Commercially, these light sticks are being sold as novelties. They are often seen as small flexible green lights at ball games and amusement parks. Other applications are in traffic safety, emergency lighting, deep sea fishing lures and general recreation. This patent has been licensed to three separate U. S. companies.

Calcification-Prevention Tablets

Calcification-prevention tablets solve the serious problem of calcium buildup in Navy ship sewage systems. The development of these tablets has solved a problem that has plagued the Navy for many years. Seawater used in all Navy ship collection, holding, and transfer (CHT) systems interacts with urine, causing calcium carbonate to precipitate in the CHT pipes. The tablet ingredients are proven to be extremely effective in sea water, biodegradable, and nontoxic. The release rates and pH targets are very reproducible. The tablets can be used in urinals, commodes, drains, holding tanks, and other water-flushed pipes and vessels. Typical users would be commercial ships, pleasure craft, service stations, fast-food restaurants, and high-rise buildings. Another use being investigated is the descaling of evaporative cooling units. This patent has been licensed to a U. S. company.

Method of Making Near Infrared Polarizers

This patent disclosed a method of producing near infrared polarizers using holographic techniques. The interference pattern from two intersecting laser beams is used to produce a plane grating in a layer of photoresist which has been deposited on a layer of conductive material which in turn has been used to coat a substrate. Ion milling reproduces the plane grating in the conductive material layer by selectively etching away a uniform level of material. This technology has application in military infrared missile systems and test equipment. The licensee is looking at utilizing this technology in a photocopy machine. This patent has been licensed to a Japanese company.

3.4 NAVAL COMMAND, CONTROL AND OCEAN SURVEILLANCE CENTER

Conductus, Inc., a small business from Sunnyvale, CA, entered into a Cooperative Research & Development Agreement (CRADA) with NCCOSC RDT&E Division (NRaD) in July 1992 with the Solid State Electronics Division. This partnership has developed and demonstrated for the first time a compatible process to form a monolithically integrated circuit comprised of YBCO (a high temperature superconductor) on sapphire devices and CMOS on sapphire devices. An elusive dream for the past few years, this

demonstration opens up for the first time numerous options for combining the two well-developed technologies to be explored under this CRADA. In addition, two papers have been published, another submitted for publication and one joint patent has been filed.

3.5 NAVAL SURFACE WARFARE CENTER

3.5.1 CARDEROCK DIVISION

Small Waterplane Area Twin-Hull Ship - The vast portion of this entirely new ship concept and its supporting technology was developed in the Navy laboratory system. The concept permits what are basically displacement ships and their less sophisticated (and less costly) technology to be built with open ocean seaway performance characteristics superior to those of very much larger conventional ships. Starting in the mid-eighties commercialization of this ship concept has grown rapidly in the U.S. Japan and the European countries have more recently increased their exploitation of SWATH ships.

Hydrofoil Ship with Fully Submerged Foils - The ship concept and much of the technology was developed by the U.S. Navy for all-weather offshore high speed (45 kts +) operations. The Boeing Company exploited this technology for commercial purposes (primarily people ferries). Recent commercialization of this ship concept and technology has taken place in Japan and Europe.

Highly Skewed Propellers - Highly skewed ship propeller technology was developed for the U.S. Navy. Because of its inherent characteristics of greatly reducing the fluid induced vibrations on a ship this technology has become widely accepted on all forms of commercial ships of all sizes. First exploited commercially on a large Oil-Bulk-Ore carrier in the U.S. the concept is now used by virtually every nation in the world.

Ship Design Methods - Several ship design methods developed for the U.S. Navy have been transferred to private sector design-engineering firms for use in the design of both military and commercial ships.

HSLA Steel - Under the U.S. Navy exploratory development program, a family of new High Strength Low Alloy steels were cooperatively developed with industry. Commercial applications are taking place or being considered for offshore oil rigs, pressure vessels for boilers and oil refineries, highway bridges, electrical transmission towers.

Quiet Fans - A number of U.S. car models embodied high technology achievements in propeller (fan) quieting in their designs from the early to mid 80's. Many of these technologies were adaptable even though inexpensive manufacturing technologies were used to produce the cooling fans. Foreign commercialization is not known to have taken place for these technologies.

Low Cost/High Quality Composites - under the U.S. Navy exploratory development program a vacuum assisted resin transfer molding (VARTM) process has been cooperatively developed and demonstrated with industry. The VARTM process is currently being used commercially for sailboats and a deckhouse on a hovercraft ferry. Other potential applications include automobiles, offshore oil platforms, and ship hulls.

Aluminum Ship Design/Fabrication - design, fabrication, inspection, and repair technology/guidance for aluminum ship structures, developed under the U.S. Navy exploratory development program, has transitioned to the commercial sector. This technology has been made available for use in the design and fabrication of Coast Guard ships and offshore oil platform work boats.

Organo-Metallic Polymer Ship Hull Coatings - Organo-metallic coatings with very high performance characteristics were developed by the U.S. Navy. These materials were commercialized first in Europe and Japan for ship anti-fouling paints. Currently the state-of-the-art for foreign ships (in terms of performance), these materials were licensed through the Dept. of Commerce; no U.S. concern bothered to take out

licenses because they could not get any degree of exclusivity under the then in force laws. It is believed that under current laws such as Stevenson-Wydler, U.S. firms would have been first to have exploited this technology commercially.

3.5.2 DAHLGREN DIVISION

Computer Aided Diagnosis (CAD for Digital Mammography)

This technology was developed in support of the Tomahawk mission planning effort and had roots in various IR and IED projects. The work, in the general area of automatic target recognition, utilizes computational statistics for image segmentation and pattern recognition of high data rate sources.

In order to ensure that this technology is transferred in an efficient and effective manner, collaborations are being formed with representatives of the Center for Engineering and Medical Imaging Analysis at the University of South Florida. This collaboration was begun as part of the Federal Laboratory Consortium (FLC) technology demonstration project and in response to the National Cancer Institute (NCI)/NASA mammography initiative. Additional teaming may take place as needs dictate.

Experimental Control of Chaos

Chaos is a phenomenon that has been known for some time to manifest itself in many natural phenomena. The problem has been to identify and to control it. Chaos occurs in mechanical systems, electrical systems, biological and chemical systems, fluid dynamics and probably in almost every natural or man-made complex structure. It often masquerades as noise, such as the apparently random and complex twirlings of smoke rising from an extinguished match, but chaos is deterministic and therefore may be controlled.

Scientists at NSWCDD, were able to produce chaotic motion in a nonlinear ribbon in the laboratory, to measure and record the ribbon's motion, to show rigorously that the motion was chaotic, and subsequently to control the chaos.

This work culminated in the first experimental control of chaos and paved the way for:

Control of Heart Arrhythmias

- Experimental evidence suggests that several types of heart arrhythmia (including a trial and ventricular fibrillation) are actually a chaotic beating of the heart. As such the experimental work pioneered by NSWCDD on controlling chaos in rabbit hearts may lead to new and better types of cardiac pacemakers and defibrillators. A patent has been applied for and has been licensed to Medtronix Inc. for further research and development.

Control of Chemical Reactions

- Researchers at Ohio University and at West Virginia University independently applied the original NSWCDD technique to two different chemical systems. This type of control is important for large-scale industrial chemical processes since an improvement of even a few percent in the yield of such large-scale reactions may lead to savings of millions of dollars.

Control of Epilepsy

- Recent research suggests a link between chaos and epilepsy. Joint work is currently underway by NSWCDD and researchers at Children's Hospital in Washington, DC, to use chaos control to defeat epilepsy and similar brain disorders.

Magnetostrictive Alloys (TERFENOL)

Materials research at NSWCDD with rare earth-iron alloys resulted in the development of "TERFENOL", a magnetostrictive material capable of delivering high mechanical strain under heavy loads. The initial research supported military applications such as sonar transducers and directional hydrophones. This invention has been licensed and subsequent dual-use commercial applications of this military technology include high-powered sound sources for oceanography and oil field mapping, micropositioners, hydraulics and pumps, valves/fuel injection systems, and robotic linkages. The material has also been used by NASA to develop a small, high-torque rotary motor.

Computer Memory

Computer memory research and development at the NSWCDD has resulted in patents for the Crosstie Random Access Memory (CRAM) and the Ferroelectric Random Access Memory (FRAM). These are nonvolatile memories; they can be turned off without loss of data. Both can be radiation hardened, and are suitable for space applications. In addition to nondestructive readout, CRAM has the potential to cost less, weigh less, and need less volume than conventional memories. The FRAM is a modification of the highly successful Dynamic Random Access Memory (DRAM), while requiring less power in a comparable density. Both FRAM and CRAM units have been developed commercially.

Centrifugal Casting of Composites

An economical spin casting process to form symmetrical shapes from reinforced metal composites has been developed by NSWCDD. Castings can have a selectable distribution of reinforcement in cross-sectional wall areas. The process yields clean metal (fewer oxides than poured-metal product, and no sand, gas pockets, or oxides than poured-metal product, and no sand, gas pockets, or impurities), dense metal (free from shrinkage and porosity), minimal waste of materials, and refined grain size. Also, the outer or inner layers of the casting can be clad with a monolithic layer of matrix metal, or a different composite alloy. The automobile industry will benefit by the ability to make high performance parts (e.g. wear resistance, high temperature strength and high stiffness) superior to its monolithic counterparts at reasonable cost. Process simplicity is the primary feature of centrifugal casting.

Resonance Apparatus

A Resonance Apparatus to measure the dynamic mechanical properties of materials under demanding conditions such as factory environments has been developed by NSWCDD. Unlike similar laboratory-type instruments, this device utilizes a computer program to perform data acquisition and analysis. Thus the unit does not require a skilled operator, and the operator is not required to be in continuous attendance during data collection as required to be in continuous attendance during data collection as with the prior laboratory-type instruments. Materials manufacturers can realize cost savings from more reliable and efficient quality control testing of materials.

3.6 NAVAL UNDERSEA WARFARE CENTER

Technology Area: Quieting, a stealth technology developed in the 1970's for NUWC (NUSC) by Bolt, Beranek and Newman--used to quiet torpedoes, propellers, etc.

Transition: Now used in fans of all modern automobiles to reduce noise in auto engines.