

AD-A270 884

2

NUWC-NPT Technical Document 10,184
1 April 1993

A Register of Underwater Acoustic Test Facilities in the United States, Canada, and the United Kingdom

C. A. Ledoux
Weapons Technology and Undersea Systems Department

DTIC
ELECTE
OCT 18 1993
S E D



Naval Undersea Warfare Center Division
Newport, Rhode Island

Approved for public release; distribution is unlimited.

93-24060



93 10 10 40

PREFACE

This document was prepared under NUWC
Project No. 482F01, "Acoustic Test Facility,"
principal investigator C. A. Ledoux (Code 8211).

Reviewed and Approved: 1 April 1993

A handwritten signature in black ink, appearing to read "F. L. White", with a stylized flourish at the end.

F. L. White

Head, Weapons Technology and Undersea Systems Department

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
<small>Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.</small>				
1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE 1 April 1993		3. REPORT TYPE AND DATES COVERED
4. TITLE AND SUBTITLE A Register of Underwater Acoustic Test Facilities in the United States, Canada, and the United Kingdom			5. FUNDING NUMBERS	
6. AUTHOR(S) C. A. Ledoux				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Undersea Warfare Center Division 1176 Howell St. Newport, RI 02841-1708			8. PERFORMING ORGANIZATION REPORT NUMBER TD 10,184	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)			10. SPONSORING/MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution is unlimited.			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) This document provides a register of underwater acoustic facilities in the United States, Canada, and the United Kingdom. The data included in the register were derived from information received from 25 of the 57 organizations contacted. An active search of the United Kingdom facilities was not conducted because those organizations were previously listed in a register of Western Europe facilities.				
14. SUBJECT TERMS Underwater Test Facilities Underwater Acoustics Acoustic Test Facilities			15. NUMBER OF PAGES 74	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT SAR	

TABLE OF CONTENTS

Section	Page
1. INTRODUCTION	1
2. LISTING OF FACILITIES	3
2-1. U.S. GOVERNMENT FACILITIES	5
2-2. U.S. COMMERCIAL FACILITIES	7
2-3. CANADIAN GOVERNMENT FACILITIES	13
2-4. CANADIAN COMMERCIAL FACILITIES	14
2-5. U.K. GOVERNMENT FACILITY	14
3. DESCRIPTION OF FACILITIES	15
3-1. U.S. GOVERNMENT FACILITIES	17
3-2. U.S. COMMERCIAL FACILITIES	28
3-3. CANADIAN GOVERNMENT FACILITIES	47
3-4. CANADIAN COMMERCIAL FACILITIES	54
3-5. U. K. GOVERNMENT FACILITY	60
APPENDIX — OTHER SURVEYS OF UNDERWATER ACOUSTIC FACILITIES	A-1

Accession For	
NTIS	CRA&I <input checked="" type="checkbox"/>
DTIC	TAB <input type="checkbox"/>
Unannounced <input type="checkbox"/>	
Justification	
By	
Distribution /	
Availability Codes	
Dist	Avail and/or Special
A-1	

A REGISTER OF UNDERWATER ACOUSTIC TEST FACILITIES IN THE UNITED STATES, CANADA, AND THE UNITED KINGDOM

1. INTRODUCTION

This document provides a register of underwater acoustic facilities located in the United States (U.S.), Canada, and the United Kingdom (U.K.). The data included in the register were derived from information received from 25 of the 57 organizations contacted. An active search of U.K. facilities was not conducted because those organizations were previously listed in a register of Western Europe facilities.*

Section 2 lists all 57 organizations and their locations; section 3 describes those facilities from which responses were received. An appendix is included that lists other surveys of underwater acoustic facilities.

Requests for this register should be addressed to

Naval Undersea Warfare Center Division
Attn: Technical Library
1176 Howell Street
Newport, RI 02841-1708

*See "A Register of Underwater Acoustic Facilities, Volume 1: Western Europe," NUSC Technical Document 7903-1, Naval Underwater Systems Center, New London, CT, 1 March 1987.

2. LISTING OF FACILITIES

This section lists the 57 U.S. Government, U.S. Commercial, Canadian Government, Canadian Commercial, and U.K. Government facilities that were contacted in this survey. An asterisk following the facility name indicates its participation in this survey.

2-1. U.S. GOVERNMENT FACILITIES

Coastal Systems Station
Naval Surface Warfare Center
Panama City, FL 32407
Tel (904) 235-5431 Fax (904) 234-4886
Attn: Douglas G. Todoroff
Facility: Outdoor saltwater site

Dodge Pond Acoustic Measurement Facility*
Naval Undersea Warfare Center Detachment, New London
Bldg 28
New London, CT 06320-5000
Tel (203) 440-4940 Fax (203) 440-6854
Attn: Jan Wilczynski
Facility: Outdoor freshwater site

Naval Air Warfare Center, Aircraft Division*
Warminster, PA 18974
Tel (215) 441-2830 Fax (215) 441-2490
Attn: Dick Coughlan
Facility: Indoor and outdoor freshwater sites

Naval Research Laboratory
4355 Overlook Ave
Washington, DC 20375
Tel (202) 404-8051 Fax (202) 404-8055
Attn: Brian H. Houston
Facility: Indoor site

Naval Surface Warfare Center, Dahlgren Division Detachment*
1650 S.W. 39th St
Fort Lauderdale, FL 33315
Tel (305) 359-2000 Fax (305) 359-2031
Attn: Anthony D. Bond
Facility: Ocean test range
Round-robin participant

Naval Surface Warfare Center Detachment, Puget Sound
Range Operations Branch
Bremerton, WA 98314-5215
Tel (206) 476-4613 Fax (206) 476-2774
Attn: Richard S. Chwaszczewski
Facility: Ocean test range

Naval Surface Warfare Center Division, Crane*
Bldg 41NE
Crane, IN 47522-5070
Tel (812) 854-4270 Fax (812) 854-4554
Attn: George T. Moody
Facility: Indoor and outdoor freshwater sites (freshwater test range)

Naval Surface Warfare Center*
Bldg 217
Silver Spring, MD 20903-5640
Tel (301) 394-2050 Fax (301) 394-4129
Attn: William Phelps
Facility: Indoor and outdoor freshwater sites
Round-robin participant

Naval Surface Warfare Center*
Carderock Division
Acoustic Research Detachment
Bayview, ID 83803-0006
Tel (208) 683-2321 (x4030) Fax (208) 683-2068
Attn: George Guedel
Facility: Outdoor deep freshwater site

Naval Undersea Warfare Center Detachment, New London*
Bldg 80/1122, ATF
New London, CT 06320
Tel (203) 440-5495 Fax (203) 440-5016
Attn: Christopher A. Wyatt
Facility: Indoor site

Naval Undersea Warfare Center Division, Newport*
Bldg 103
Newport, RI 02840
Tel (401) 841-4269 Fax (401) 841-3047
Attn: Shelton T. Hood
Facility: Ocean test range

Naval Undersea Warfare Center Division, Newport*
Bldg 1171/ATF
Newport, RI 02840
Tel (401) 841-2426 Fax (401) 841-2482
Attn: Claude Ledoux
Facility: Indoor site
Round-robin participant

Naval Undersea Warfare Center Division, Keyport
Keyport, WA 89345-5000
Tel (206) 396-2311 Fax (206) 396-7897
Attn: Walt Hardin
Facility: Indoor and outdoor saltwater sites

Seneca Lake Sonar Test Facility*
Naval Undersea Warfare Center Detachment, New London
Bldg 28
New London, CT 06320-5000
Tel (203) 440-5811 Fax (203) 440-5717
Attn: Lynn Carlton
Facility: Outdoor deep freshwater site

TRANSDEC Topside
Naval Undersea Command and Control Center
271 Catalina Blvd
San Diego, CA 92152-5000
Tel (619) 553-3494 Fax (619) 553-3468
Attn: Leonard Orysiek
Facility: Outdoor freshwater site

Underwater Sound Reference Detachment*
Naval Research Laboratory
P.O. Box 8337
Orlando, FL 32856
Tel (407) 857-5246 Fax (407) 857-5101
Attn: A. L. Van Buren
Facility: Indoor and outdoor freshwater sites
Round-robin coordinator

2-2. U.S. COMMERCIAL FACILITIES

Airmar Technology Corp
69 Meadowbrook Dr
Milford, NH 03055
Tel (603) 673-9570 Fax (603) 673-4624
Attn: Dehua Huang

Aliant Marine Systems Division
MS 3D2
6500 Harbor Heights Parkway
Everett, WA 98204-1409
Tel (206) 356-3000 Fax (206) 356-3185
Attn: D. Kurt Peterson

Applied Physics Laboratory
University of Washington
1013 N. E. 40th St
Seattle, WA 98105
Tel (206) 685-1971 Fax (206) 543-6785
Attn: Eric Boget
Facility: Outdoor saltwater site

Applied Research Laboratories
Pennsylvania State University
P.O. Box 30
State College, PA 16804
Tel (814) 865-1721 Fax (814) 863-7270
Attn: Jack Hughes
Facility: Indoor site

Applied Research Laboratories*
University of Texas
P.O. Box 8029
10,000 Burnett Rd
Austin, TX 78713-8029
Tel (512) 835-3241 Fax (512) 835-3259
Attn: James Stockton
Facility: Outdoor freshwater site
Round-robin participant

Argotec Inc*
P.O. Box 520760
Longwood, FL 32752
Tel (407) 331-9372 Fax (407) 830-0530
Attn: Cindy Cerce
Facility: Outdoor freshwater site
Round-robin participant

Atlantic Applied Research Corp
4A Burlington St
Burlington, MA 01803
Tel (617) 273-2400 Fax (617) 229-6951
Attn: Steven A. Affrick
Facility: Indoor site

Benthos Inc
Edgeton Dr
North Falmouth, MA 02556
Tel (508) 563-1000 Fax (508) 563-6444
Attn: Thomas J. DeGroot
Facility: Indoor site

Datasonics Inc
P.O. Box 8
Cataumet, MA 02534
Tel (508) 563-5511 Fax (508) 563-9312
Attn: David Habershaw
Facility: Indoor site

EDO Western
2645 South 300 West
Salt Lake City, UT 84115
Tel (801) 486-7481 (x333) Fax (801) 484-3301
Attn: Michael Dawes

GE Ocean and Radar Systems
P.O. Box 4840
EP 5-309
Syracuse, NY 13221-4840
Tel (315) 456-1418 Fax (315) 456-1429
Attn: Richard M. Williams
Facility: Outdoor deep freshwater site
Round-robin participant

Glen Reid, Acoustic Consultant
Silver Spring, MD 20901
Tel (301) 439-3175
Attn: Glen Reid

Hazeltine Ocean Systems
115 Baystate Dr
Braintree, MA 02184
Tel (617) 848-3400 Fax (617) 843-2153
Attn: Dan Mills
Facility: Outdoor site

HI TECH Inc
1390 29th Ave
Gulfport, MS 39501
Tel (601) 868-6632 Fax (601) 868-6645
Attn: Steve Spychalski

Hydroacoustics Inc
P.O. Box 3818
Rochester, NY 14692
Tel (716) 359-1000 Fax (716) 359-1132
Attn: Robert De Lacroix

International Transducer Corp*
869 Ward Dr
Santa Barbara, CA 93111-2920
Tel (805) 683-2575 (x505) Fax (805) 967-8199
Attn: William A. Bunker
Facility: Indoor site
Round-robin participant

John Sound Laboratory
9243 Fairlawn St
Santee, CA 92071
Tel (619) 258-8342 Fax (619) 562-0832
Attn: Earl Johnson

Lockheed-Sanders Inc*
Antisubmarine Warfare Directorate
MAN-O6-2000
P.O. Box 868
Nashua, NH 03061-0868
Tel (603) 645-5713 Fax (603) 645-5731
Attn: Jason Osborn
Facility: Outdoor freshwater site

Magnavox Government Electronics Systems Co*
Transducer Engineering Dept 25-36
1313 Production Rd
Fort Wayne, IN 46808
Tel (219) 429-5013 Fax (219) 429-6598
Attn: Thomas Gebhard
Facility: Indoor and outdoor freshwater sites
Round-robin participant

Marine Physical Laboratory*
Scripps Institute of Oceanography
La Jolla, CA 92093-0701
Tel (619) 534-1797 Fax (619) 553-0764
Attn: William A. Gaines
Facility: Outdoor freshwater site
Round-robin participant

Martin-Marietta Aero and Naval Systems*
MP 95
103 Chesapeake Park Plaza
Baltimore, MD 21220
Tel (410) 682-2380 Fax (410) 682-0205
Attn: Bryon Shirk
Facility: Outdoor freshwater site

Massa Products Corp
280 Lincoln St
Hingham, MA 02043
Tel (617) 749-4800 Fax (617) 740-2045
Attn: Fred Strout

McDonnell-Douglas Aerospace
Mail 31-2
West 5301 Bolsa Ave
Huntington Beach, CA 92647
Tel (714) 896-2132 Fax (714) 896-1313
Attn: Keith Olson
Facility: Indoor site

Norden Systems
75 Maxess Rd
Melville, Long Island, NY 11747
Tel (516) 845-2895 Fax (516) 845-2906
Attn: John Devine
Facility: Indoor site

Raytheon Co
MS 120
1847 West Main Rd
Portsmouth, RI 02871
Tel (401) 847-8000 (x3615) Fax (401) 842-5200
Attn: Richard Grenier
Facility: Indoor site

Raytheon Co
Submarine Signal Division
1847 West Main Rd
Portsmouth, RI 02871
Tel (401) 847-3533 Fax (401) 842-5200
Attn: Raymond Dagwan
Facility: Indoor site

Real Time Systems Inc
152 South MacQuesten Parkway
Mount Vernon, NY 10550
Tel (914) 667-0425 Fax (914) 667-0425
Attn: Arthur Citrin

Rockwell International, Defense Electronics
Autonetics Marine and Aircraft Systems
3370 Miraloma Ave
Anaheim, CA 92803
Tel (714) 762-3427 Fax (714) 762-0146
Attn: Walter Massengale

SeaBeam Instruments Inc*
141 Washington St
East Walpole, MA 02032-1155
Tel (508) 660-6000 Fax (508) 660-6061
Attn: Thomas Baldassarre
Facility: Outdoor freshwater site

Sparton Electronics*
2400 E. Ganson St
Jackson, MS 39202
Tel (517) 787-8600 Fax (517) 787-8046
Attn: Alton E. Knoll
Facility: Indoor site
Round-robin participant

Syntech Materials Inc
P.O. Box 5242
Springfield, VA 22150
Tel (703) 339-6524 Fax (703) 339-6781
Attn: Mark S. Broding
Facility: Indoor site

Vector Research Co Inc
Suite 1200
6903 Rockledge Dr
Bethesda, MD 20817
Tel (301) 493-5500 Fax (301) 816-5517
Attn: Wayne Reader

Westinghouse Electric Corp
Oceanic Division
MS 9845
P.O. Box 1488
Annapolis, MD 21404
Tel (410) 260-5673 Fax (410) 260-5424
Attn: Leslie M. James
Facility: Indoor site

2-3. CANADIAN GOVERNMENT FACILITIES

Canadian Centre for Marine Communications
P.O. Box 8454
St. John's Newfoundland, Canada A1L 3N9
Tel (709) 579-4872 Fax (709) 579-0495
Attn: Robert MacIsaac
Facility: Indoor site

Canadian Forces Maritime Experimental and Test Ranges
P.O. Box 188
NanOOSE Bay, British Columbia, Canada V0R 2R0
Tel (604) 756-5006 Fax (604) 756-5055
Attn: Louis Belanger
Facility: Outdoor saltwater site (ocean test range)

Defence Research Establishment Atlantic*
P.O. Box 1012
Dartmouth, Nova Scotia, Canada NS B2Y 3Z7
Tel (902) 426-3100 (x210) Fax (902) 426-9654
Attn: Steven J. Hughes
Facility: Indoor and outdoor saltwater sites
Round-robin participant

2-4. CANADIAN COMMERCIAL FACILITIES

C-Tech Ltd*
525 Boundary Rd
Cornwall, Ontario, Canada K6H 6N7
Tel (613) 933-7970 Fax (613) 933-7977
Attn: Dennis Derouin
Facility: Outdoor freshwater site
Round-robin participant

Guigné International Ltd
Box 13, Site 21
Paradise, Newfoundland, Canada A1L 1C1
Tel (709) 895-3819 Fax (709) 895-3822
Attn: Jacques Guigne
Facility: Indoor and outdoor sites

Hermes Electronics Ltd*
40 Atlantic St
Dartmouth, Nova Scotia, Canada B2Y 4A1
Tel (902) 466-7491 Fax (902) 463-6098
Attn: Bruce Armstrong
Facility: Indoor site
Round-robin participant

Sparton of Canada Ltd
90 Ash St
London, Ontario, Canada N5Z 4V3
Tel (519) 455-6320 Fax (519) 452-3967
Attn: Linas Siurna

2-5. U.K. GOVERNMENT FACILITY

National Physical Laboratory*
Teddington, Middlesex, U.K. TW11 0LW
Tel 011-44-81-977-3222 Fax 011-44-81-943-2155
Attn: Roy Preston
Facility: Indoor site
Round-robin participant

3. DESCRIPTION OF FACILITIES

This section describes those facilities that responded to the survey. Of the 57 organizations contacted, 25 responded. They are included here in the following order:

- U.S. Government Facilities
- U.S. Commercial Facilities
- Canadian Government Facilities
- Canadian Commercial Facilities
- U.K. Government Facility.

3-1. U.S. GOVERNMENT FACILITIES

Facility Name and Location: Acoustic Test Facilities, Lake Pend Oreille, Bayview, ID

Facility Type: Outdoor deep freshwater site

Cognizant Organization: Naval Surface Warfare Center, Ship Acoustics Department, Bayview, ID

Major Users: U.S. Navy and commercial contractors.

Technical Areas Supported: Underwater acoustics experiments in deep quiet water, sealed models flow noise, sealed models target studies, and analytical and computer models.

Unique Features: Ambient noise below sea state zero; isothermal at 39.5°F; deeper than 1000 feet over a 26-square-mile area; multiplicity of test sites, acoustic, and haul down; multiplicity of test platforms and support boats; excellent shore facilities; and a variety of personnel support.

Significant Equipment: A wide variety of test equipment and test systems support the multiple facilities. Models exist for flow noise and radiated noise studies.

Significant Software: Specialized software supports the wide variety of test equipment.

Local Environment: A large glacial trench lake; elevation is approximately 2000 feet above sea level. Northern Idaho weather conditions.

Present and Future Plans: Continue expansion of the facilities, test equipment, and software to keep pace with changing R&D requirements.

Mailing Address: Naval Surface Warfare Center
Acoustic Research Detachment
P.O. Box 129
Bayview, ID 83803-0129

Contact Person: George Guedel
Tel (208) 683-2321

Narrative Description: —

Facility Name and Location: Acoustic Test Facility, Newport, RI

Facility Type: Indoor site

Cognizant Organization: Naval Undersea Warfare Center Division, Newport, RI

Major Users: In-house programs, U.S. Navy R&D programs, and commercial organizations.

Technical Areas Supported: Transducer tests, target studies, material studies, classified R&D, systems tests, and radiated noise evaluations.

Unique Features: Largest reverberant test tank in the U.S., three-dimensional positioning within 0.001° and 0.001 inch, acoustically transparent pressure vessel, overhead cranes usable up to 6 English tons, laser alignment system, and three-axis probe positioning system.

Significant Equipment: Fully automated computerized test system, Hewlett-Packard (HP) 9000 computers, Real-Time Systems (RTS) acoustic test system, variety of general and specialized equipment, variety of power amplifiers, and specialized reverberant measurements systems.

Significant Software: User software is developed in-house. An extensive program, continuously evolving, is now being used by approximately 10 other measurement facilities as a result of the technology transfer program.

Local Environment: Indoors, stable, swimming pool quality freshwater tank, isothermal with yearly temperature variations from 60°F to 70°F.

Present and Future Plans: Installation of anechoic lining, further improvements in acoustic holography, and further improvements in hardware and software to keep pace with changing R&D requirements.

Mailing Address: Naval Undersea Warfare Center Division
Code 8211, Bldg 1171
Newport, RI 02841

Contact Person: Claude Ledoux
Tel (401) 841-2426

Narrative Description: The Acoustic Test Facility features a 700,000-gallon test tank measuring 60 feet long, 40 feet wide, and 35 feet deep. The tank is fitted with viewing and access ports and is supported by a variety of handling and positioning equipment, including overhead cranes, rotators, and movable test bridges. The test tank provides a maximum 50-foot test distance, with 2 msec of reflection-free test time. One-man operation is possible with minimal setup time, and two or more simultaneous test setups can be accommodated. Tests are controlled and test data collected by the facility's integrated computer system — the Acoustic Evaluation System.

Facility Name and Locations: Atlantic Undersea Test and Evaluation Range, West Palm Beach, FL, and Tongue of the Ocean, Bahamas

Facility Type: Ocean test range

Cognizant Organization: Naval Undersea Warfare Center Division, Newport, RI

Major Users: U.S. Navy, other navies, and commercial contractors.

Technical Areas Supported: Silencing programs, fleet operations, weapons trials, combat systems tests, advanced underwater weapons RDT&E, and defensive weapons certification.

Unique Features: Ocean Haul Down Facility, Weapons Range, wide variety of support vessels, FORACS Range, sensors deployable to 2500 feet, and extensive shore support facilities and personnel.

Significant Equipment: Data acquisition systems, portable measurement system, deployable acoustic monitoring system, deployable noise measurement system, portable sonobuoy measurement system, and complete communication and timing systems.

Significant Software: Extensive specialized software and computer control and data reduction facilities.

Local Environment: Open-ocean environment, deep water, 5500 feet; tropical climate conditions.

Present and Future Plans: Maintain state-of-the-art responsiveness.

Mailing Address: Naval Undersea Warfare Center Division
Bldg 103
Newport, RI 02841

Contact Person: Shelton Hood
Tel (401) 841-4269

Narrative Description: —

Facility Name and Location: Dodge Pond Acoustic Measurement Facility, Niantic, CT

Facility Type: Outdoor freshwater site

Cognizant Organization: Naval Undersea Warfare Center Division, Newport, RI

Major Users: U.S. Navy and commercial sonar system development and maintenance activities.

Technical Areas Supported: Sonar transducer, towed arrays, domes, baffles, and materials research test and evaluation; first article specification compliance testing; target strength measurements; echo reduction measurements; and broadband noise and tonal analysis.

Unique Features: A 33-acre lake, 50 feet deep, with over 30 feet of soft mud bottom (low reflectivity). Three test barges are grouped at the end of a 300-foot-long truck accessible causeway in the lake's center. The test specimen weight handling capacity measures up to 5 tons. Test ranges are to 70 feet on the barges and to 300 feet using a moveable float. Test shaft extensions facilitate testing to a 35-foot depth.

Significant Equipment: AN/FQM-12(V) digital acoustic measurement system; AN/FQM-10(V) analog acoustic measurement system; integrated digital measurement system; azimuth error computer and display used to determine bearing error of AN/WLR-9 multimode hydrophones; dual-concentric test shafts that allow independence of joint rotation and of transducers within domes; and a 1000-psi glass filament-wound acoustically transparent pressure test vessel with variable temperature capability from 3°C to 40°C.

Significant Software: The AN/FQM-12(V), a computer-controlled system that uses UNIX and the C programming language, is a user-friendly menu-driven system where pre-test scripts are created by the operator. The computer sets up the proper instrument configurations, interfaces, input/output limits, pulse/timing control, impedance matching, frequency sweep rates, and data output formats.

Local Environment: A wooded area within the small quiet village of Niantic, CT, ambient water noise is below sea state 0, and water temperature varies with the seasons.

Present and Future Plans: Installation of a new test barge; develop capability to perform cold water (-3°) testing; develop very low-frequency test capability; and develop simulated deep-water test capability.

Mailing Address: Naval Undersea Warfare Center
New London Detachment, Code 3832
New London, CT 06320

Contact Persons: Mark Hammond
Tel (203) 440-6663

Rick Colangeli
Tel (203) 440-4558

Narrative Description: —

Facility Name and Location: Fort Lauderdale Facility, Dania, FL

Facility Type: Outdoor site (ocean test range)

Cognizant Organization: Naval Surface Warfare Center, Dahlgren Division, Dania, FL

Major Users: Naval Surface Warfare Center, Coastal Systems Station Detachment, White Oak Detachment, and Carderock Detachment.

Technical Areas Supported: Acoustic and nonacoustic SSN and SSBN security exercises; mine and mine countermeasure development; ocean engineering; and full-scale trials are conducted of air, surface, and underwater weapons systems under a variety of oceanographic conditions.

Unique Features: Only land-based, deep-water test and evaluation facility located on the eastern seaboard. The 7- x 22-mile Atlantic test range features a deep-water cable monitoring system and a shore tracking system. Develops, installs, maintains, and operates ship tracking and offshore positioning equipment. Recovers test hardware to 3280 feet.

Significant Equipment: A 260-foot offshore construction platform SEACON with a dynamic position-keeping system, high accuracy three-dimensional underwater tracking arrays, remotely operated underwater vehicle TONGS, and bottom-mounted acoustic Doppler current profiler.

Significant Software: Fort Lauderdale Integrated Tracking System used for target tracking and environmental data. Nonlinear cable and buoy dynamics models.

Local Environment: Open-ocean environment with deep water close to shore. Least wide continental shelf on the east coast.

Present and Future Plans: Facilities are being consolidated to a jetty site. New buildings and piers are being constructed, new underwater tracking systems provided by NAVSEA are being added to the range, and renewed commitments are being made to improve the quality of the materials and services provided by the facility to the range user.

Mailing Address: Naval Surface Warfare Center, Fort Lauderdale, Detachment
8010 North Ocean Blvd
Dania, FL 33004

Contact Person: Anthony D. Bond, Access/Scheduling
Tel (305) 359-2000

Narrative Description: The Navy established the Fort Lauderdale Facility in 1952 to support the underwater mine warfare program. Through the years, Detachment personnel have kept pace with diverse and complex testing techniques required by today's advanced weapons systems and components. As the Navy's principal research, development, test and evaluation Center for surface ship weapons systems, ordnance, mines, and strategic systems support, the Naval Surface Warfare Center (NSWC) relies on its Fort Lauderdale Detachment to support rigorous field trials in conditions comparable with the actual operating environment. Tracking, ranging, and plotting are the principal functions conducted with NSWC's extensive Atlantic Ocean test ranges in conjunction with airdrops and ranging of surface ships and submerged submarines. A system of 400 miles of underwater cable monitors the performance of test hardware at depths to 2000 feet. (Underwater cable types include multi-conductor, coaxial, and fiber optic.) Each range may be equipped with underwater tracking systems and telephones.

Facility Name and Location: Hydroacoustic Measurements Facility, Naval Surface Warfare Center (NSWC) Detachment, White Oak

Facility Type: Indoor and outdoor freshwater sites

Cognizant Organization: Naval Surface Warfare Center Detachment, White Oak

Major Users: NSWC, Dahlgren Division; NSWC, Carderock Division (David Taylor Research Center); Explosive Ordnance Disposal Technical Center (EODTC), Indian Head, MD; Naval Ordnance Station (NOS), Indian Head, MD; and private industry.

Technical Areas Supported: Basic R&D, mines, warheads, and ship silencing.

Unique Features: Two sites available for testing — the redwood tank for high-frequency measurements and the barge on a lake for low-frequency measurements.

Significant Equipment: White Oak Site — This site uses an RTS model 4650A measurement system, a precision 2-ton lifting system for horizontal and vertical positioning of test items, a horizontal positioner for transducers, and two rotators (single-axis, heavy-duty 4000-pound capacity and single-axis 2000-pound capacity).

Brighton Dam Site — This site uses FFT analyzers for noise measurements, tracking spectrum analyzers for swept sine continuous wave measurements, the HP 3040A network analyzer system for pulsed operations, and the rotation system for directivity patterns.

Significant Software: All tests and measurements are done by HP 9000 computers using HP Basic. Some software is available for plotting radiated noise data in 1/3-octave, 1/1-octave, and 2.5-octave bands.

Local Environment: White Oak Site — The redwood tank is located below grade level in a quiet area, which provides shielding from acoustical, mechanical, thermal, and electrical disturbances.

Brighton Dam Site — The test barge is located on an 800-acre lake with water depths of 40 to 56 feet depending on reservoir levels. Water temperature varies with the seasons from 36°F to 70°F.

Present and Future Plans: Do some marketing to increase business and obtain a new measurement system for the Brighton Dam site.

Mailing Address: Naval Surface Warfare Center
White Oak Detachment
Code G82, Bldg 217
Silver Spring, MD 20903-5640

Contact Person: William Phelps, Code G82
Tel (301) 394-1947 Fax (301) 394-4129
Email address: wphelps@relay.nswc.navy.mil

Narrative Description: The NSWC Hydroacoustic Measurements Facility manages and operates the White Oak site and the Brighton Dam site. White Oak has a circular redwood tank 30 feet in diameter and 20 feet deep with an ambient background of approximately sea state 1. This site provides a stable environment for measurements in pulse mode over a frequency range of 2 kHz to 2 MHz. The handling capacity at this site is 4000 pounds.

The Brighton Dam site has a test barge anchored and moored 200 feet offshore on the Triadelphia Reservoir approximately 1500 feet from the dam. This reservoir, impounded by Brighton Dam, forms a lake of 800 surface acres containing approximately 7 billion gallons of water. Water depth under the barge is normally 55 feet, but can vary from 40 to 56 feet depending on the precipitation or maintenance required on the dam. Items up to 1000 pounds can be lowered to any desired depth for testing. The free field environment of the lake site provides the ability to perform a full range of underwater acoustic measurements either in the continuous wave or pulse mode over a frequency range of 10 Hz to 2 MHz. Ambient background levels may vary from sea state 1 to 6 caused by noise sources of the environment or noise generated by water flowing through pipes in the dam (e.g., power boats are not allowed on the lake).

Facility Name and Location: Hydroacoustic Test Services, Crane, IN

Facility Type: Indoor and outdoor freshwater sites (freshwater range)

Cognizant Organization: Naval Surface Warfare Center, Crane Division

Major Users: U.S. Navy and commercial contractors.

Technical Areas Supported: Acoustic sensors tests, military systems and subsystems tests, and equipment and components testing.

Unique Features: Anechoic test facility 15 feet in diameter by 46 feet long, open indoor tank, pressurized low-frequency calibrators, hydrostatic pressure tests to 2000 psi, outdoor freshwater test site, 1-mile-long tow facility, and extraneous noise test facility.

Significant Equipment: The numerous analog and digital test systems for each facility are listed under unique features (above).

Significant Software: Extensive specialized software, developed in house, provides automated testing and data reduction.

Local Environment: Southern Indiana weather conditions.

Present and Future Plans: Continue hardware and software improvements to keep pace with changing R&D needs.

Mailing Address: Naval Surface Warfare Center, Crane Division
Bldg 41NE
Crane, IN 47522-5070

Contact Person: George T. Moody
Tel (812) 854-4270

Narrative Description: —

Facility Name and Location: Seneca Lake Sonar Test Facility, Dresden, NY

Facility Type: Outdoor deep freshwater site

Cognizant Organization: Naval Undersea Warfare Center, New London Detachment

Major Users: U.S. Navy and commercial companies.

Technical Areas Supported: Low-frequency high-power sonar arrays and transducers, and general underwater acoustic testing.

Unique Features: Heavy load handling, 200 English tons; deep water up to 525 feet; two barges with variable separation; and sonar array test system.

Significant Equipment: Automated sonar array measurements, high-power amplifiers, wide variety of test equipment, 4 1/2-acre shore site, service barges and transport boats, and a 175-kVA power amplifier.

Significant Software: Specialized programming.

Local Environment: Deep freshwater lake with moderate temperatures from April through mid-December and cold temperatures from December through March. The lake does not freeze; it is isothermal during the winter at 5°C and develops a gradient in summer to a depth of approximately 246 feet.

Present and Future Plans: Continue improvements in hardware and software to keep pace with changing test requirements.

Mailing Address: Naval Undersea Warfare Center Detachment
New London, CT 06320

Contact Person: Lynn Carlton
Tel (203) 440-5811

Narrative Description: —

Facility Name and Location: Sonar Development Simulation Facilities, Warminster, PA

Facility Type: Indoor and outdoor freshwater sites

Cognizant Organization: Naval Air Warfare Center, Aircraft Division, Warminster, PA

Major Users: U.S. Navy and commercial contractors.

Technical Areas Supported: Sonobuoy development, underwater transducers, suspension hardware, surface waves interactions, and flow simulation.

Unique Features: Indoor test tanks, open freshwater facility, laboratory calibrator for hydrophones, pressure evaluation to 10,000 psi, sea state simulation, suspension observation tower, and tow rails and water impact launcher.

Significant Equipment: Test systems to accommodate the laboratory calibrator, transducer testing, and Gradient Room.

Significant Software: —

Local Environment: Isothermal open-water quarry site, low ambient noise, and mild weather conditions.

Present and Future Plans: Maintain readiness status.

Mailing Address: Naval Air Warfare Center, Aircraft Division
Warminster, PA 18974

Contact Person: Dick Coughlan
Tel (215) 441-2830

Narrative Description: —

Facility Name and Location: Underwater Sound Reference Detachment, Orlando, FL

Facility Type: Indoor and outdoor freshwater sites

Cognizant Organization: Naval Research Laboratory, Orlando, FL

Major Users: U.S. Navy and commercial contractors.

Technical Areas Supported: Acoustic calibrations; underwater acoustic reference transducers; R&D of measurement methods, theory, and materials; and R&D of sonar transduction.

Unique Features: Acoustic materials and transduction facilities, acoustic measurements facilities, model shop, computing and electronics facilities, and anechoic test tanks.

Significant Equipment: Standing wave and traveling wave systems, multiple analog and digital test systems to support the facilities listed under unique features (above), and an extensive variety of general-purpose test equipment.

Significant Software: Extensive specialized software, developed in-house, to support test systems and data reduction.

Local Environment: Semi-tropical Florida climate.

Present and Future Plans: To continue research in the various mission areas and to continue the development and updates of facilities, hardware, and software.

Mailing Address: Underwater Sound Reference Detachment
Naval Research Laboratory
P.O. Box 8337
Orlando, FL 32856

Contact Person: A. L. Van Buren
Tel (407) 857-5246

Narrative Description: —

3-2. U.S. COMMERCIAL FACILITIES

Facility Name and Location: Argotec/Longwood Acoustic Test Facility, Longwood, FL

Facility Type: Outdoor freshwater site

Cognizant Organization: Argotec Inc
3750 Hacienda Blvd
Fort Lauderdale, FL 33314

Major Users: Argotec/Longwood Manufacturing Facility, under contract with NUWC/Keyport, NCCOSC/Hawaii, Canadian Forces Base/BC GEC/Marconi/U.K.

Argotec/Fort Lauderdale Engineering Facility, under contract with NUWC/New London, NSWC/Carderock, NUWC/Keyport, AT&T/Whippany, Thomson-Sintra/France, NDRE/Sweden.

Technical Areas Supported: Active and passive transducer calibration; frequency range of 10 Hz to 100 kHz; signal power up to 1 kW; measurement distance up to 13 feet; 360° rotation in a horizontal plane; beam pattern/directivity plots; pulsed, gated calibration; CW calibration; narrowband / 1/3-octave spectrum analysis; maximum depth of 33 feet; maximum size is 3 feet x 7 feet x 7 feet; and maximum weight is 100 kilograms.

Unique Features: Conveniently located close to NRL/USRD to facilitate immediate availability of Navy standard transducers. Also convenient for Argotec/Longwood manufacturing facility because of the rubber molding, pressure testing, and assembly capabilities.

Significant Equipment: B&K pulsed, delayed gate signal processor system; HP 3566 amperes 16-channel spectrum analyzer system; HP 3562 amperes dynamic wave analyzers (2); HP 3582 amperes spectrum analyzers (2); Rockland system 90 signal analysis workshops (3); Argotec Inc synchronous rotator with polar plotter; Instruments Inc 1 kW power amplifier; Techron 1 kW power amplifiers (4); Crown 100 watts power amplifier; HP X-Y plotters (2); NRL/USRD H-52 hydrophone; NRL/USRD F-33 transducer; NRL/USRD F-37 transducer; Argotec Model 215 low-frequency projector; Argotec Model 220 high-power projector; and Argotec Model SS-3 infrasonic projector.

Significant Software: Argotec Rotator/Plotter Control Program

Local Environment: Standard mid-Florida weather which is warm year-round and rainy during summer months, rural low ambient noise, and water temperature is 70°F to 80°F.

Present and Future Plans: The Underwater Acoustic Test Facility is involved in acceptance testing of a production line of sonar pingers requiring approximately 50 percent of available time. Depending on changes in future production quantities, this availability rate is expected to continue; however, the schedule can be adjusted to accommodate most other requirements.

Mailing Address: Argotec Inc
P.O. Box 520760
Longwood, FL 32752

Contact Person: Bernard S. Willard
Tel (305) 584-7900

Narrative Description: Argotec's test facility consists of a 10-foot x 15-foot barge moored over the deepest part (30 feet) of a freshwater pond located in a rural setting northeast of Orlando, FL. The barge is totally enclosed, air conditioned, and is outfitted with a 208-volt, three-phase, as well as standard single-phase, power. A single well in the platform is 10 feet long x 2 feet wide with outboard extensions to 13 feet long; a pipe stringer handling system facilitates the rigid mounting of test devices down to 30 feet; a synchronous rotator and polar plotter system facilitates the measurement of directivity and beam patterns in the horizontal plane; a pulsed, delayed gate signal processor facilitates reflection-free data analysis; and a large, exceptionally diverse inventory of state-of-the-art acoustic signal analyzers facilitates multichannel simultaneous measurements of up to 16 channels as well as real-time signal ratio measurements, such as transmitting current response or impedance. A minimum complement of Navy standard reference transducers is maintained on a continuing lease basis from NRL/USRD, and items not on hand can be obtained within a few hours. An equally large complement of power amplifiers is also available on short notice.

Facility Name and Location: International Transducer Corp (ITC) Facility, Santa Barbara, CA

Facility Type: Indoor site

Cognizant Organization: International Transducer Corp, Santa Barbara, CA

Major Users: International Transducer Corp

Technical Areas Supported: —

Unique Features: Ability to quickly change setups for production, single item, or R&D jobs.

Significant Equipment: —

Significant Software: —

Local Environment: Mild year-round climate.

Present and Future Plans: Plan to switch from analog to a digital system that can compete with the speed and ease of use presently offered.

Mailing Address: International Transducer Corp
869 Ward Drive
Santa Barbara, CA 93111

Contact Person: William A. Bunker
Tel (805) 683-2575

Narrative Description: The ITC Facility has three redwood test tanks (two are 15 feet in diameter and 12 feet deep, one is 20 feet in diameter and 15 feet deep). Polar or linear formats can be taken in /Z/, /Y/, Phase, G, B, R, X, transmit voltage response transmit current response, receive sensitivity, and directivity patterns. Frequency range in the transmit mode is from 2 kHz to 1 MHz, and in the receive mode it is from 100 Hz to 1 MHz. Power capabilities are 75 watts to 1 MHz and 2 kW up to 100 kHz. Also available are three pressure chambers capable of 1000 psi, 3000 psi, and 10,000 psi.

Facility Name and Location: Lake Travis Test Station (LTTS) Acoustic Test Facility, Austin, TX

Facility Type: Outdoor freshwater site

Cognizant Organization: Applied Research Laboratories, University of Texas, Austin, TX

Major Users: ARL:UT, U.S. Navy, and other U.S. Government agencies.

Technical Areas Supported: General underwater acoustical measurements, transducer calibration and evaluation, system evaluation, and target strength measurements.

Unique Features: Free field/farfield conditions over a wide frequency range, water depths to 150 feet, test distances to several miles, year-round access and testing.

Significant Equipment: Digital transducer measurements system, power amplifiers to 3 kVA, lifting capacity to 30 tons, self-propelled mobile test platform, and test bed AN/SQQ-14 sonar system.

Significant Software: Standard transducer calibration, transducer reciprocity calibration, and target strength measurements.

Local Environment: Freshwater, man-made, variable level, flood-control lake impounded by a hydroelectric-power-generating dam located approximately 18 miles from the city of Austin. An average daytime ambient noise level is 60 dB, reference 1 V per micro Pascal, normalized to a 1-Hz bandwidth, measured with an omnidirectional hydrophone. Surface water temperature ranges from approximately 55°F in mid-winter to 85°F in mid-summer. Wind conditions seldom influence test results.

Present and Future Plans: No major changes or modifications are planned. However, it is expected that the facility will operate for at least the next 30 years.

Mailing Address: Lake Travis Test Station
4398 Ranch Road 620 North
Austin, TX 78732

Contact Person: James Stockton
Tel (512)835-3241

Narrative Description: The LTTS Facility consists of two floating metal barges anchored near shore, several small boats, a mobile self-propelled acoustics test barge, and numerous equipment transport and support platforms. A 24-hour security surveillance is maintained at the site. Water thermal conditions are excellent from October through February because during this period the lake is cooling and, except for occasional transit afternoon surface heating, the water is isothermal from just below the surface to 70 feet or deeper. From March through September, thermoclines develop in the 15- to 20-foot-depth regions normally used for acoustic testing. However, by selecting the time of day or weather conditions (e.g., overcast), useful measurements can be achieved. Water temperature profiles are sampled and plotted hourly to a depth of 60 feet.

Barge No. 1 comprises nominally 11,460 sq ft of deck space and houses an AN/SQQ-14 test bed sonar set, sanitary facilities, office space, a diving locker, three climate-controlled instrumentation cubicles, and approximately 1000 sq ft of space used primarily for special projects. An overhead bridge crane provides 10 tons of lifting capacity, and a multipoint mooring system provides stability typically

less than $\pm 2^\circ$ during rough weather conditions and less than 0.2° on calm days. Power on the barge is 120 Vac, one phase, 208 Vac, three phase, 60 Hz, and 400 Hz in all work spaces. In addition, rough power for operating rotating machinery and fine power for instrumentation are available. Each instrumentation area is near an interior well where equipment can be lowered into the water on test shafts. Various standard transducers leased from the Naval Research Laboratory/Underwater Sound Reference Division are available.

Barge No. 2 was designed to handle large heavy transducer arrays. The platform measures 47 feet x 51 feet, with an 18-foot x 18-foot well in the center. A rotatable hoist is centered above the well with a lifting capacity of 60,000 pounds. The nature of the mooring system on this barge allows transit to and from shore for load transfer and precludes stability. On an average, the barge swings about 5° on its moorings, depending on weather conditions; on calm days stability is on the order of a $\pm 1^\circ$ swing.

Laboratory scuba divers — principally scientists/engineers and technical staff — install, service, and maintain underwater hardware. A remotely operated vehicle (ROV) is available for inspecting objects and observing activities under water through an onboard closed-circuit television system. When underwater visibility is limited, a high resolution sonar system is also normally available for use with the ROV.

Principally, administrative support for LTTS is provided by personnel and facilities located at the main laboratory. However, local, long-distance, and cellular telephone service; a facsimile machine; and a copy machine are available on site at LTTS.

The cost of using LTTS is based on a rate developed under a methodology approved by the Business Manager, University of Texas, and concurred with by the Office of Naval Research Resident Representative. The rate methodology follows guidelines dictated by the Federal Acquisition Regulations and the rate is updated quarterly.

Facility Name and Location: Lockheed-Sanders Acoustic Test Facility, Milford, NH

Facility Type: Outdoor freshwater site

Cognizant Organization: Lockheed-Sanders Inc, Nashua, NH

Major Users: Lockheed-Sanders Inc Antisubmarine Warfare Directorate

Technical Areas Supported: Acoustic testing of passive/active underwater hydrophones and transducers.

Unique Features: The facility consists of a water-filled granite quarry measuring approximately 300 feet long x 190 feet wide x 80 feet deep, which is instrumented for acoustic transducer development testing. The Acoustic Test Facility is housed in a 14- x 20-foot heated barge, anchored at the center of the quarry. A walkway provides access to the barge, and a 4- x 8-foot opening in the deck permits the immersion of transducers under test.

Significant Equipment: A retractable, rotatable, operator-controlled shaft is capable of test depths up to 50 feet. The rotator is synchronized with a polar plotter for directivity patterns. A complete transducer calibration system provides the capability of measuring transmitting responses and patterns at power levels, commensurate with a 20-kW capability, and receiving responses and patterns are also measured. Duplicate receiving channels allow measurements of amplitude and phase tracking between sine, cosine, and omnichannels of directional hydrophones. Both pulse and continuous wave capabilities are available. Test frequency range is 10 Hz to 100 kHz.

Through the use of null-balance, as well as conventional transducer calibration techniques, measurements can be made with the following accuracies: power linearity (± 0.25 dB), amplitude response (0.25 dB), phase tracking ($\pm 1^\circ$), pattern response (± 0.25 dB), and pattern null depths (30 dB).

Other equipment installed at the test facility includes a 3-ton capacity crane for handling large transducers, a sonobuoy accelerator, and a tow trolley for flow noise measurements. A Federal Scientific Ubiquitous spectrum analyzer, averager, and frequency translator, as well as several X-Y and strip-chart recorders and a multitrack instrumentation tape recorder, are located in a blockhouse on shore and are used for intermodulation distortion and other tests. The barge, tow trolley, and blockhouse are interconnected by multichannel shielded signal cabling. Circulators keep the working areas of the quarry ice free during the winter.

Significant Software: Software at the test facility consists of programs that control a two-channel measurement system centered around a Nicolet 660A dual-channel spectrum analyzer to perform TVR, Y, Z, phase, etc., measurements versus frequency over the 10-Hz to 100-kHz range.

Local Environment: The quarry is situated in a rural/residential environment. Ambient noise levels are considered to be very low.

Present and Future Plans: To maintain the facility as required to meet Lockheed-Sanders acoustic development test needs.

Mailing Address: Lockheed-Sanders Inc
Antisubmarine Warfare Directorate
MAN-06-2000
P.O. Box 868
Nashua, NH 03061-0868

Contact Persons: Nelson R. Disco, Manager, Engineering and Technology
Lockheed-Sanders ASW Directorate
Tel (603) 645-5726 Fax (603) 645-5731

Jason Osborn, Manager, Acoustic Engineering
Lockheed-Sanders ASW Directorate
Tel (603) 645-5713 Fax (603) 645-5731

Narrative Description: An open-water acoustic test facility at a water-filled granite quarry in Milford, NH is maintained by the Lockheed-Sanders ASW Directorate. The quarry is approximately 300 feet long x 190 feet wide x 80 feet deep. On site is a blockhouse and storage trailer that houses power converters and recording equipment. Also available is a 3-ton capacity crane used for handling heavy equipment and test units. Acoustic projector development and testing is conducted from a 14- x 20-foot barge anchored at the center of the quarry. A 4- x 8-foot opening in the deck permits the immersion of transducers under test.

Facility Names and Locations: Magnavox Facilities — Dreisbach Acoustic Laboratory (Fort Wayne, IN), Lapel Acoustic Facility (Lapel, IN), CBS Calibration System (Whitley, IN).

Facility Type: Indoor and outdoor freshwater sites

Cognizant Organization: Magnavox Electronics Systems Co, Fort Wayne, IN

Major Users: —

Technical Areas Supported: All engineering disciplines (all Magnavox facilities).

Unique Features: Fort Wayne — Two 30-foot diameter x 26-foot-deep acoustic tanks, with a dynamic range of 800 Hz through 150 kHz; one 10-inch diameter x 6-foot deep 15,000-psig hydrostatic vessel; one 18-inch diameter x 3.2-foot deep 1100-psig hydrostatic vessel; acceleration tables 4- x 6-foot 5 g, vertical and horizontal plane; strum and flow test; compliant resilience test; and temperature and humidity chambers from 1 x 1.5 x 2 feet to 6 x 8 x 10 feet.

Lapel — A 37-acre quarry with an average depth of 150 feet; a depth increase at 15 to 18 feet per year; a 30- x 32-foot floating test barge anchored in place; a 1000-foot tow system .05-through 5-knot speed range; and an acoustic test dynamic range 30 Hz through 150 kHz.

Whitley County — A 1-foot diameter x 1.5-foot cast vessel with a 6-inch-diameter access port; and a dynamic range of 3 Hz through 2400 Hz, -3°C through +35°C, and ambient through 600 psig.

Significant Equipment: Fort Wayne — HP 9000 series controlled automatic test equipment (ATE), HP 5183 waveform recorder digitizers, and HP 7550 plotters.

Lapel — HP 9000 series controlled ATE and HP 9000 series controlled strum-flow system.

Whitley County — HP 9000 series controlled ATE.

Significant Software: Menu-driven software covering all acoustic test measurements and display parameters (all Magnavox facilities).

Local Environment: Fort Wayne and Whitley County — Located within an industrial complex where mechanical, electrical, chemical, and environmental engineering facilities and expertise are readily available.

Lapel — Abandoned limestone quarry at the edge of Lapel, IN, located 8 miles north of I69 at the junction of SR32 and SR13; no heavy industry is located within 10 miles.

Present and Future Plans: Fort Wayne and Whitley County — Upgrade of existing ATE to maintain a state-of-the-art system.

Lapel — HP 9000 series controlled tow system to be installed in 1993.

Mailing Address: Magnavox Electronic Systems Company
Transducer Engineering Department, 25-36
1313 Production Rd
Fort Wayne, IN 46808

Contact Persons: Peter J. LeStrange, Manager Transducer Engineering
Tel (219) 429-5632

Thomas P. Gebhard, Access/Scheduling
Tel (219) 429-5013

Thomas A. Whitmore, Coordinator Acoustic Test Facilities
Tel (219) 429-5987

Narrative Description: —

Facility Name and Location: R.V. Paganelli Facility, Lansing, NY

Facility Type: Outdoor deep freshwater site

Cognizant Organization: General Electric, Ocean and Radar Systems Division, Syracuse, NY

Major Users: General Electric

Technical Areas Supported: Acoustic testing of projectors, hydrophones, and arrays; testing and evaluation of acoustic and optical systems.

Unique Features: Enclosed internal test well (17 x 20 feet).

Significant Equipment: A 100-foot long x 34-foot beam moored barge; computer-controlled test instrumentation; 100 Hz to 500 kHz at up to 20 kVA; 10-ton crane over centerwell; power is 150 kVA at 440, 220, or 110 volts; and a 32-foot workboat.

Significant Software: Computer-controlled measurements of transmit response, source level, receive response, beam patterns, and complex impedance.

Local Environment: Moored on Cayuga Lake in 280 feet of water, approximately 1100 feet offshore, year-round operation.

Present and Future Plans: Available for contracted testing.

Mailing Address: GE Ocean and Radar Systems
P.O. Box 4840
EP 5-309
Syracuse, NY 13221-4840

Contact Person: Richard M. Williams
Tel (315) 456-1418

Narrative Description: The R.V. Paganelli Facility provides automated or specialized testing of sea-going development or production equipment, including acoustic transducers, transducer arrays, or optical systems. The enclosed centerwell affords comfortable year-round testing under conditions closely approximating a free-field ocean environment.

Facility Name and Location: Oceangraphic Research Barge (ORB), San Diego, CA

Facility Type: Outdoor freshwater site

Cognizant Organization: Marine Physical Laboratory (MPL), La Jolla, CA

Major Users: MPL

Technical Areas Supported: Deep and shallow water acoustic tests/calibrations of sources and receivers.

Unique Features: Capability to deploy large cable-tethered systems (arrays) to deep depths vertically or horizontally. These arrays can be moved over substantial horizontal distances, 2+ Km, when in a shallow water moor (30 days endurance moored on station, extended with resupply).

Significant Equipment: A winch with the capability to handle a 12-ton payload.

Significant Software: —

Local Environment: Seasonal, with a moderate climate throughout the year.

Present and Future Plans: Continue operation as a floating research barge supporting acoustic testing and at-sea experiments.

Mailing Address: University of California, San Diego
Marine Physical Laboratory
Scripps Institution of Oceanography
La Jolla, CA 92093-0701

Contact Persons: William A. Gaines, Assistant Director, Access/Scheduling
Tel (619) 534-1797

William S. Hodgkiss, Associate Director
Tel (619) 534-1797

Narrative Description: The ORB is a 69- x 45-foot rectangular shaped, nonpropelled research barge developed and built by MPL to support projects requiring launch, retrieval, implantation, or handling of large equipment in the open ocean. ORB has a draft of 6 feet, an overall height from keel to upper deck of 26 feet, and displacement is 369 long tons. ORB must be towed to station and can be towed at 5 knots. Tow boats having 1200 to 2000 horsepower are suitable.

ORB is designed to follow the sea surface to simplify the task of deploying and retrieving large objects in the sea. The centerwell is 15 x 20 feet with closable well doors that, when closed, provide a semi-dry working area and safely support a weight of 12,000 kg. Loads up to 12 tons can be lowered to a maximum depth of 5000 feet. In addition to supplying the strain support for the equipment, the umbilical cable is slip-ring connected through the handling winch and can provide 100 kVA, three-phase, 60-Hz power to the package. The coaxial transmission line, in addition to providing power, has a usable signal bandwidth of approximately 15 MHz for telemetry. The three-phase transmission line voltage is 3600 volts rms.

The winch system includes a number of automatic features. A special cable tensioning system greatly reduces surge caused by sea surface action. Wire pay-in/pay-out speed can be controlled from 0 to 115 feet per minute. The tread load of a 12-ton tracked vehicle was regulated at 0.1 psi. ORB has been moored in water depths up to 13,000 feet, but is better suited for shallow water employment.

ORB has living accommodations for 20 crew members, including the 4- to 5-man crew, a fully equipped electronic work space, and room for repair parts stowage. Food, water, and fuel stowage is sufficient to support 30 days on station. Water-making equipment is installed. The platform has three ac generators providing up to 165 kVA, three-phase, 230-volt 60-Hz electrical power.

Facility Name and Location: SeaBeam Instruments Inc Facility, East Walpole, MA

Facility Type: Open-water quarry (Gloucester, MA) and indoor test pool (East Walpole, MA)

Cognizant Organization: SeaBeam Instruments Inc, East Walpole, MA

Major Users: —

Technical Areas Supported: Multibeam sonar systems and Navy transducers.

Unique Features: A 350- x 550- x 100-foot depth quarry.

Significant Equipment: Instrumentation equipped with a full complement of sonar test equipment, including an RTS 4700 digital test system, and amplifier power of 30-kW pulse to 50 kHz, and 6.5-kW pulse to 150 kHz.

Significant Software: —

Local Environment: Water temperature ranges from 32°F in winter (ice free) to about 70°F in summer.

Present and Future Plans: —

Mailing Address: SeaBeam Instruments Inc
141 Washington St
East Walpole, MA 02032

Contact Person: Thomas Baldassarre
Tel (508) 660-6000

Narrative Description: SeaBeam Instruments Inc conducts testing in an open-water quarry located in Gloucester, MA, and an indoor test pool located in East Walpole, MA. The open-water quarry facility, easily accessible at a 350- x 500- x 100-foot depth, has a permanently moored test barge powered with 110 and 220 (3 Ø) volts, 200 amperes. Water temperatures range from 32°F in winter (ice free) to about 70°F in summer. Facility capabilities include max transducer weight of 2 tons, low-frequency limit of 50 Hz, and a test depth to a 30-foot maximum on rotator/100-foot maximum.

The indoor test pool area is temperature and humidity controlled, measures 16 x 32 x 16 feet deep, and is covered with a 2- x 2-foot computer flooring. Water temperature averages 68°F, and operating power options of 110, 220 (3 Ø), and 440 (3 Ø) are available. Facility capabilities include a max transducer weight of 1000 pounds, a low-frequency limit of 1 kHz, and a test depth to a 10-foot maximum.

Facility Name and Location: Sparton Electronics Technical Center (SETEC) Facility, Jackson, MI

Facility Type: Large redwood test tank

Cognizant Organization: Sparton Corp

Major Users: U.S. Navy

Technical Areas Supported: Design and development of underwater transducers and equipment.

Unique Features: Response curves (TVR, TCR, FFVS) in the large redwood test tank (20 feet deep x 8 feet in diameter) are from 1500 Hz to 1 MHz using pulsed continuous waves. Pressure data are to 500 psig using the nylon pressure tanks, sound pressure level data are to 5 kVA input power, and low-frequency hydrophone data are 5 Hz to 2500 Hz in the traveling wave tube (includes FFVS and phase curves). Pressure characteristic is 1000 psig and temperature-related changes are from 35°F to 95°F. Polar beam patterns are available from both facilities. In addition, a 15-psig pressure tank with inside dimensions of 12 inches in diameter x 48 inches deep is available for high pressure testing. A 40-foot deep x 8-foot diameter fiberglass deployment tank with multilevel viewing ports is operational.

Significant Equipment: A 15-kpsig pressure tank, a 1-kpsig traveling-wave tube, a large redwood test tank, and a large fiberglass deployment tank.

Significant Software: ANSYS FEA/Chief and 10 other transducer design programs are used in addition to several other programs for automatic testing of transducers.

Local Environment: Indoor facility.

Present and Future Plans: Currently working on several multiyear Navy programs and plan to be very active in Navy R&D projects.

Mailing Address: Sparton Electronics
Technical Center
2400 E. Ganson Street
Jackson, MI 49202

Contact Persons: John Bodde
Al Knoll
Art Luempert
Tel (517) 787-8600

Narrative Description: —

Facility Name and Location: Syntech Materials Inc Acoustic Test Facility, Lorton, VA

Facility Type: Indoor site

Cognizant Organization: Syntech Materials Inc, Springfield, VA

Major Users: Syntech Materials Inc

Technical Areas Supported: Transmission and reflection measurements on bulk material panels
(10 kHz - 100 kHz).

Unique Features: Almost exclusively off-the-shelf equipment to reduce downtime and low-cost service.

Significant Equipment: NRL/USRD F-33 and H-52 hydrophones and a custom-built preamplifier/filter.

Significant Software: Custom data acquisition software, using GPIB code, controls all measurement parameters such as pulse length and receive window.

Local Environment: Industrial Park

Present and Future Plans: For reflection measurements, a high-receive sensitivity dual transmit/receive hydrophone or a highly sensitive PVDF receiver would provide a more averaged measurement over the panel surface.

Mailing Address: Syntech Materials Inc
Acoustic Test Facility
P.O. Box 5242
Springfield, VA 22150

Contact Person: Mark S. Broding
Tel (703) 339-6524

Narrative Description: Syntech Materials Inc's Acoustic Test Facility is capable of measuring acoustic transmission and reflection properties of materials between 10 kHz and 100 kHz. Measurements are made at ambient temperature and pressure in a 6- x 6- x 10-foot pool. Short-pulse techniques are used to eliminate wall reflection and panel diffraction effects. Standard test panel sizes of 30 x 30 inches are required to effectively measure properties in the lower frequency range.

For all measurements, an NRL/USRD type F-33 projector is used consisting of two piezoelectric ceramic arrays mounted coaxially. Both outer and inner arrays are driven between 10 kHz and 30 kHz, but only the inner array is driven between 30 kHz and 100 kHz. By using only the inner array of the F-33 transducer above 30 kHz, the projector to hydrophone separation meets the criteria for farfield measurements.

Insertion loss measurements use a projector to panel distance of 122 cm and a panel to hydrophone distance of 3 cm, with sound at normal incidence from 10 kHz to 100 kHz. Typically, the incident signal is an eight-wavelength, nonshaped sinusoidal pulse. Measurements of 0.5 kHz are made on the third through sixth wavelength of the transmitted and received pulses by a USRD type H-52 hydrophone.

Echo reduction measurements use a projector to panel distance of 400 feet and a panel to hydrophone distance of 105 feet, with sound at normal incidence from 15 kHz to 100 kHz. Tank and panel dimensions contribute to unreliable data taken at frequencies lower than 15 kHz. Typically, the incident signal is a five-wavelength, nonshaped sinusoidal pulse. Measurements of 0.5 kHz are made on the third and fourth wavelengths of the transmitted and reflected pulses. A 3/8-inch-thick steel plate is used for all reference measurements.

Syntech Materials Inc has proven itself as an innovator in the design and manufacture of composite underwater acoustic materials. In this regard, it has been shown that the Acoustic Test Facility is a reliable method of evaluating material acoustic performance over a range of frequencies.

Facility Name and Location: Transducer Calibration Facility, San Vicente Lake, San Diego, CA

Facility Type: Outdoor freshwater site

Cognizant Organization: Marine Physical Laboratory (MPL), La Jolla, CA

Major Users: MPL

Technical Areas Supported: Transducer calibration

Unique Features: Moored in an extremely quiet area where the water depth is 120 to 160 feet, depending on lake level.

Significant Equipment: Barge and power source as required.

Significant Software: —

Local Environment: Seasonal, with a moderate climate throughout the year.

Present and Future Plans: Continue operation as a transducer calibration facility.

Mailing Address: University of California, San Diego
Marine Physical Laboratory
Scripps Institution of Oceanography
La Jolla, CA 92093-0701

Contact Person: William A. Gaines, Access/Scheduling
Tel (619) 534-1797

Narrative Description: The Transducer Calibration Facility at San Vicente Lake is a 24- x 50-foot general-purpose research platform moored in 120 to 160 feet of water with approximately 4500 feet of unobstructed range. The barge is supplied with 440 volts of three-phase ac power as well as with 110- to 220-volt unregulated single-phase ac power. System frequency response is from 1 kHz to 100 kHz. Boat and loading facilities are available. Equipment handling gear and tool set are included on the barge. Test capabilities at the facility include source and receiver responses, directivity pattern plots, null-balance measurements and Z and ρ measurements. A set of calibrated PZT4 cylindrical crystals are available to accomplish the tests. Checkout procedures and rules are provided on request, as well as a complete facility electronic equipment description and a set of suggested operational test procedures.

3-3. CANADIAN GOVERNMENT FACILITIES

Facility Name and Location: CCMC Underwater Acoustic Test Tank, Marine Institute,
St. John's Newfoundland

Facility Type: Indoor site

Cognizant Organization: Canada Centre for Marine Communications (CCMC)

Major Users: —

Technical Areas Supported: —

Unique Features: —

Significant Equipment: HP 310 computer, variety of data acquisition devices, calibrated precision measuring equipment, B&K hydrophones, and signal conditioning/amplifying equipment.

Significant Software: —

Local Environment: —

Present and Future Plans: —

Mailing Address: Canadian Centre for Marine Communications
P.O. Box 8454
St. John's Newfoundland, Canada A1L 3N9

Contact Person: Robert MacIsaac
Tel (709) 579-4872

Narrative Description: CCMC operates an underwater acoustic test tank at the Marine Institute, St. John's, Newfoundland. The facility is offered to interested groups who require a dedicated R&D environment for underwater acoustics and is available on a preferred basis to CCMC member companies and to others on a cost-recovery basis.

The free surface of the tank is 5.5 x 4 meters (18 feet x 13 feet); the tank is 4 meters (13 feet) deep, with 3 meters (10 feet) below grade. Features of the tank include underwater lighting, large viewing ports, and filtered and treated freshwater.

The tank is covered with a sectional, removable steel gridwork. The two-stage transducer positioning system features an azimuthal rotational stage and a three-axis translational stage. Both stages are driven by a stepper motor under manual or computer control.

Data acquisition is controlled by an HP 310 computer via the GPIB bus. A large variety of data acquisition devices and calibrated precision measuring equipment is available, as are a wide range of B&K hydrophones and signal conditioning/amplifying equipment.

Transducer characterization has been performed from the low kilohertz region to frequencies in excess of 200 kHz.

Facility Name and Locations: CFMETR Test Ranges, Nanoose Bay, Hotham Sound, and Jervis Inlet, British Columbia, Canada

Facility Type: Outdoor saltwater site (ocean test range)

Cognizant Organization: Canadian Forces Maritime Experimental and Test Ranges (CFMETR), Nanoose Bay, British Columbia, Canada

Major Users: —

Technical Areas Supported: —

Unique Features: Three-dimensional tracking range for subsurface, surface, and air targets.

Significant Equipment: —

Significant Software: —

Local Environment: Quiet and sheltered inlet.

Present and Future Plans: —

Mailing Address: Canadian Forces Maritime Experimental and Test Ranges
P.O. Box 188
Nanoose Bay, British Columbia, V0R 2R0

Contact Person: Louis Belanger
Tel (604) 756-5006

Narrative Description: CFMETR operates and maintains the joint Canada/U.S. test ranges and acoustic facilities at Nanoose Bay, Hotham Sound, and Jervis Inlet, all in the inland coastal waters of British Columbia.

Nanoose Bay is a three-dimensional, instrumented tracking range covering nearly 100 square kilometers and is capable of tracking subsurface, surface, and air targets. Water depth is approximately 410 meters (1345 feet). The majority of CFMETR sonobuoy testing is conducted at the western end, independent of exercises being conducted on the three-dimensional range.

Hotham Sound, a very quiet and sheltered inlet with ambient noise typically below 63 dB/ μ Pa/Hz @ 10 Hz, is used primarily to conduct sonobuoy hydromechanical noise testing and other tests that require very low ambient noise levels. Water depth ranges from 350 to 500 meters (1150 to 1640 feet), and a deep-water mooring buoy is maintained in the area.

Jervis Inlet is a smaller, uninstrumented test area reserved for joint range operations. Maximum water depth is 660 meters (2165 feet), with a deep-water mooring buoy maintained in the area.

The Acoustics Barge is a support facility for testing the AN/AQS 502 helicopter dipping sonar. The barge is equipped to test the in-water performance of the sonar; to verify specification conformance of the hydrophone and projector; and to measure directivity, transducer sensitivity, source levels, and efficiency.

Facility Name and Location: DREA Acoustic Barge, Bedford Basin, Nova Scotia, Canada

Facility Type: Indoor site and outdoor saltwater sites

Cognizant Organization: Defence Research Establishment Atlantic (DREA), Bedford Basin,
Nova Scotia, Canada

Major Users: DREA, Department of National Defence

Technical Areas Supported: Hydrophone and projector calibration and checkout of sonar systems for DREA research programs.

Unique Features: Large rectangular well open to the sea, transducers accommodated up to 7 tons, transducers mounted and rotated from a 2- to 40-meter (7- to 131-foot) depth, transducers (200 kg) can be placed anywhere in well, and transducers (7 tons) can be placed at ends of well or at end of deck.

Significant Equipment: B&K 8000 series hydrophones, USRD J-series projectors, B&K amplifier (100 watts), Macintosh amplifier (600 watts), Instruments Inc S11-16 amplifier (16 kVA), crane (10 tons) on outer deck, and bridge crane (5 tons) in deckhouse.

Significant Software: LSI 11/23 data acquisition system offers hydrophone sensitivity by comparison (tone-burst, pseudo random noise), projector transmitting response by reference to standard hydrophone, reciprocity measurements, admittance and impedance measurements, and directivity pattern measurements.

Local Environment: A 300-ton-welded steel barge, 36 meters long x 17 meters wide (118 feet long x 56 feet); rectangular well, 18 x 9 meters (59 feet x 30 feet), open to the sea; and a water depth of 42 meters (138 feet).

Present and Future Plans: Upgrade data acquisition hardware and software by replacing the LSI 11/23 with Apple Macintosh Quadra computers and by replacing FORTRAN software with LabVIEW virtual instruments. Upgrade instrumentation with the VXI-based system.

Mailing Address: Defence Research Establishment Atlantic
P.O. Box 1012
Dartmouth, Nova Scotia
B2Y 3Z7
Canada

Contact Persons: Steven Hughes, Leader, Transducer Group
Tel (902) 426-3100 (x210)

David Lewis, Access/Scheduling
Tel (902) 426-3100 (x213)

Narrative Description: The DREA Acoustic Barge is a welded steel vessel anchored in a sheltered cove about 42 meters (138 feet) deep in Bedford Basin, located approximately 5 km from DREA. A rectangular well in the hull of the barge measuring 18 x 9 meters (59 x 30 feet) is open to the sea, and the main work area, including the well, is covered by a deckhouse.

DREA also operates a large pressure vessel, 36 inches inside diameter x 96 inches in height, with a maximum pressure capability of 8500 psi. A 5-ton crane is used to lower test units into the vessel.

Facility Name and Location: DREA Acoustic Tank, Dartmouth, Nova Scotia, Canada

Facility Type: Indoor site and outdoor saltwater sites

Cognizant Organization: Defence Research Establishment Atlantic (DREA), Bedford Basin,
Nova Scotia, Canada

Major Users: DREA, Department of National Defence

Technical Areas Supported: Hydrophone and projector calibration.

Unique Features: Large redwood tank 7.3 meters (24 feet) in diameter x 4.5 meters (15 feet) deep with insulcrete lining for reverberation reduction.

Significant Equipment: B&K 8000 series hydrophones, USRD J-series projectors, B&K amplifier (100 watts), and Macintosh amplifier (600 watts).

Significant Software: LSI 11/23 data acquisition system offers hydrophone sensitivity by comparison (tone-burst, pseudo random noise), projector transmitting response by reference to standard hydrophone, reciprocity measurements, admittance and impedance measurements, and directivity pattern measurements.

Local Environment: Deep redwood tank measuring 7.3 meters (24 feet) in diameter x 4.5 meters deep (15 feet), insulcrete lining for reverberation reduction, and the tank mounted on rubber pads for vibration isolation.

Present and Future Plans: Upgrade data acquisition hardware and software by replacing LSI 11/23 with Apple Macintosh Quadra computers and by replacing FORTRAN software with LabVIEW virtual instruments. Upgrade instrumentation with the VXI-based system.

Mailing Address: Defence Research Establishment Atlantic
P.O. Box 1012
Dartmouth, Nova Scotia
B2Y 3Z7
Canada

Contact Persons: Steven Hughes, Leader, Transducer Group
Tel (902) 426-3100 (x210)

David Lewis, Access/Scheduling
Tel (902) 426-3100 (x213)

Narrative Description: The DREA Acoustic Tank is a circular redwood tank 7.3 meters (24 feet) in diameter x 4.5 meters (15 feet) deep. Both the work bridge and the tank are mounted on rubber pads for isolation from ground vibrations above 10 Hz. Two identical transducer mounting stations are rotatable under remote control and incorporate digital shaft encoders for readout of the shaft rotation angle. The tank is partially lined with wedge-shaped blocks of insulcrete to reduce the reverberation time.

DREA also operates a large pressure vessel, 36 inches inside diameter x 96 inches in height, with a maximum pressure capability of 8500 psi. A 5-ton crane is used to lower test units into the vessel.

3-4. CANADIAN COMMERCIAL FACILITIES

Facility Name and Location: C-Tech Ltd Underwater Test Facility, Cornwall, Ontario, Canada

Facility Type: Outdoor freshwater site

Consultant Organization: C-Tech Ltd, Cornwall, Ontario, Canada

Major Users: Canadian and International Navies/Departments of Defense, Canadian and International Defense Contractors, and Government/Civilian Agencies.

Technical Areas Supported: Acoustic design, engineering, and manufacturing.

Unique Features: Year-round outdoor environmental testing and monitoring; variable speed, variable depth turntable; and C-Tech acoustic design, engineering, and manufacturing support is available to clients.

Significant Equipment: Hydrostatic pressure vessel 1500 psig, variable speed and variable depth turntable, target simulator, VAX/II/730 design computer, a 2000-pound electric hoist, and a Wang model 700 computer.

Significant Software: Microtec C computer (ORCAD PALASM); Microtec Cross Assemblies; C, 08020/30, TMS34010 assembly (graphics) (Wordperfect); Borland C++; Autocad 12 3D 4W AME (Quattro Pro); TANGO (schematic + PCB); NI-DAQ/LAB windows (AMIPRO); X-Ray; Lotus 1.2.3; and BRIEF.

Local Environment: This outdoor acoustic test facility is an abandoned quarry approximately 3 acres in area and 15 meters (50 feet) in depth. Although ice forms on the surface of the spring-fed quarry during winter, the construction of the barge permits testing to continue without interruption because the well does not freeze over. Temperature at lower depths remains nearly constant throughout the year.

Present and Future Plans: Expand availability of the Underwater Test Facility to outside contract requests.

Mailing Address: C-Tech Underwater Test Facility
C/O C-Tech Ltd
P.O. Box 1960, 525 Boundary Rd
Cornwall, Ontario, Canada K6H 6N7

Contact Person: Dennis Derouin
Tel (613) 933-7970

Narrative Description: C-Tech Ltd's main plant purchased in 1982 is a modern, single-story building, providing 90,000 square feet of manufacturing space and 25,000 square feet of office space. Office space includes 10,000 square feet for R&D laboratories and the computer facility, which maintains all organizational functions except for its Underwater Test Facility. The manufacturing space provides environmentally controlled mechanical and electrical assembly and finishing areas. A small machine shop is fully equipped to perform most metal work in-house.

C-Tech Ltd owns a second facility located on a 10-acre tract of land near Summerstown, Ontario. Approximately 3 acres of this tract is an abandoned quarry, about 15 meters (50 feet) in depth. Although ice forms on the surface of the spring-fed quarry during winter, the construction of the test barge allows testing to continue because the well does not freeze over. Temperatures at lower depths remain nearly constant throughout the year.

A Scientific Atlanta controlled turntable sits at the center of the well area which measures 7 x 2 meters (20 x 7 feet). Suitable equipment is present to attach all types of transducers and towed bodies to the rotating member of the turntable and to lower them to the desired depth. Proper mounting frames are available for horizontal and vertical mounting for testing. Positioned at a determinable distance from the transducer is a standard hydrophone provided by the United States Naval Research Laboratory/Underwater Sound Reference Division, Orlando, FL. Hydrophones are exchanged and recalibrated every 6 months. The company owns and uses an acoustically transparent filament wound pressure vessel to simulate the environmental effect of lowering transducers to 340 meters (1115 feet) in sea water.

C-Tech maintains an efficient and effective quality controlled program that is planned and developed in conjunction with all management functions. The quality control system conforms to the following government/military requirements:

- DND1015, Quality Program Requirements for Contractors, Department of National Defense (Equivalent to Quality Program Requirements, U.S. Military Specification MIL-Q-9858A).
- Quality Program Requirements, SEM, U.S. Military Specification MIL-M-28787.
- Quality Assurance Program, NATO AQAP/1 Specification.
- MIL-STD-2000, Electrical and Electronic Assembly Quality Requirements. (Facility solderers and quality assurance personnel have been trained by MIL-STD-2000 certified instructors. The facility has been in full compliance to the specification since the fourth quarter of 1990.)

Facility Name and Location: Underwater Acoustic Test and Calibration Facility, Paradise,
Newfoundland, Canada

Facility Type: Indoor and outdoor sites

Cognizant Organization: Guigné International Ltd, Paradise, Newfoundland, Canada

Major Users: —

Technical Areas Supported: —

Unique Features: —

Significant Equipment: —

Significant Software: —

Local Environment: —

Present and Future Plans: —

Mailing Address: Guigné International Ltd
Box 13, Site 21
Paradise, Newfoundland, Canada A1L 1C1

Contact Person: Jacques Guigné
Tel (709) 895-3819

Narrative Description: Guigné International Ltd operates a small acoustic tank and a near-shore acoustic calibration facility. The acoustic tank is 1.5 meters (5 feet) long, 0.5 meter (2 feet) wide, and 1 meter (3 feet) deep. Calibrations can be performed in the tank over the frequency range from 1 kHz to 1 MHz, and a B&K turntable is available for directivity measurements.

The near-shore acoustic calibration facility is located in water at least 4 meters (13 feet) deep. Transducers are mounted on a series of rods floated at the surface, and calibrations done here are from 500 Hz to 20 kHz.

Guigné uses a parametric array source with a beam width of 1° to 2°. B&K hydrophones are used as standards for calibration by substitution.

The data acquisition system is PC-based, is all digital, and uses Guigné's own data acquisition software developed over a 10-year period.

Facility Name and Location: Hermes Underwater Test Facility, Dartmouth, Nova Scotia, Canada

Facility Type: Indoor site

Cognizant Organization: Hermes Electronics Ltd, Dartmouth, Nova Scotia, Canada

Major Users: Internal

Technical Areas Supported: —

Unique Features: An 8- x 9- x 9-meter (25- x 28- x 30-foot) tank for ambient pressure hydrophone and projector calibrations; a normal complement of programmable filters, amplifiers, and scopes.

Significant Equipment: —

Significant Software: Prony

Local Environment: —

Present and Future Plans: —

Mailing Address: Hermes Electronics Ltd
40 Atlantic St
P.O. Box 1005
Dartmouth, Nova Scotia,
Canada
B2Y 4A1

Contact Person: Bruce Armstrong
Tel (902) 466-7491

Narrative Description: —

Facility Name and Location: Sparton of Canada Ltd Underwater Test and Calibration Facility,
London, Ontario

Facility Type: —

Cognizant Organization: Sparton of Canada Ltd, London, Ontario, Canada

Major Users: —

Technical Areas Supported: —

Unique Features: —

Significant Equipment: —

Significant Software: —

Local Environment: —

Present and Future Plans: —

Mailing Address: Sparton of Canada Ltd
90 Ash St
London, Ontario, Canada N52 4V3

Contact Person: Linas Siurna
Tel (519) 455-6320

Narrative Description: Sparton of Canada Ltd manufactures sonobuoys and transducers for sonar systems and operates an acoustic tank to support research activities. The tank, made of redwood, is 6 meters (20 feet) in diameter x 6 meters (20 feet) deep. The facility is used for hydrophone calibration using the substitution method with a noise source, and standard hydrophones are checked on a regular basis.

3-5. U.K. GOVERNMENT FACILITY

Facility Name and Location: NPL Underwater Acoustical Tank Facility, Teddington, Middlesex, U.K.

Facility Type: Indoor site

Cognizant Organization: National Physical Laboratory, Division of Radiation Science and Acoustics, Teddington, Middlesex, U.K.

Major Users: Commercial companies, academic institutions, medical establishments, and other government departments mainly from the U.K., but also from Europe.

Technical Areas Supported: All aspects of the calibration of small reference hydrophones in the frequency range of 10 kHz to 20 MHz include measurements of transmit and receive sensitivities, impedance and directional responses, as well as research into the calibration uncertainties.

Unique Features: An accurate micro-positioning system over a free-standing 2- x 1.5- x 1.5-meter (7- x 5- x 5-foot) tank, laser interferometer used for the measurement of acoustic displacement calibration of hydrophones at frequencies in the range of 300 kHz to 20 MHz, and systematic metrological studies into the calibration methods and sources of uncertainty are carried out. Work is undertaken within the framework of a rigorous quality scheme requiring measurement procedure documents, traceable calibration of relevant equipment, and detailed assessment of calibration accuracy.

Significant Equipment: For frequency range 10 to 315 kHz — HP 9000 computers, waveform recorder/digitiser, programmable oscillator, programmable attenuators, impedance analyzer. Various power amplifiers, preamplifiers, programmable filter, gating unit, oscilloscopes, current probes (e.g., Krohn-Hite, Brüel & Kjær, ENI, Tektronix). Micro-positioning system manufactured by micro-control with programmable Klinger stepper motors and drivers mounted over a 2- x 1.5- x 1.5-meter (7- x 5- x 5-foot) tank.

For frequency range of 300 kHz to 20 MHz — NPL laser interferometer, HP computers and function generators, Tektronix digitising oscilloscopes, and ENI power amplifiers.

For frequency range of 63 to 315 Hz — Brüel & Kjær 4223 air-pistonphone to perform hydrophone calibrations in air relative to standard half-inch microphone.

Significant Software: Extensive suite of software written in-house to perform calibrations of hydrophones by the three-transducer spherical-wave reciprocity method and by laser interferometry, as well as electrical impedance measurements and directional response measurements. Data reduction and graphical representation are provided automatically. Software is written in HP Rocky Mountain BASIC for use on HP 9000 computers.

Local Environment: The facility is situated on the ground floor of the laboratory building, close to the parkland, away from local noise sources (e.g., road traffic noise).

Present and Future Plans: To construct a larger 5- x 4- x 4-meter (16- x 13- x 13-foot) tank below ground level and to accredit other U.K. laboratories, making them traceable to national standards held at NPL.

Mailing Address: National Physical Laboratory
Division of Radiation Science and Acoustics
Teddington, Middlesex TW11 0LW
United Kingdom

Contact Persons: Roy C. Preston
Stephen P. Robinson
Graham R. Doré

Narrative Description: NPL is the national standards laboratory for the U.K. with responsibility for the standards of underwater acoustics (10 to 315 kHz) and of medical ultrasonics (300 to 20 kHz).

The facilities are used in the provision of national primary standards for the calibration of reference hydrophones in the frequency range of 10 to 315 kHz and medical ultrasonic hydrophones in the frequency range of 0.3 to 20 MHz.

The main underwater acoustics facility consists of a medium-sized 2- x 1.5- x 1.5-meter (7- x 5- x 5-foot) laboratory tank fitted with an accurate micro-positioning system. Associated electronic and computer equipment allow for the automatic acquisition of data and calculation of relevant calibration parameters.

A second primary standard, the NPL laser interferometer, is used for the calibration of hydrophones at frequencies above 300 kHz. Mainly, the laser interferometer is used for the calibration of pvdf membrane hydrophones, but can be adapted for use in calibration of other hydrophones.

The following references provide further information on the above facilities:

- NPL Handouts, numbers DRSA 070 and DRSA 076 (available on request from NPL).
- S. P. Robinson, R. C. Preston, and G. R. Doré, "Standards for Hydrophone Calibration in the U.K.," *Proceedings of the Institute of Acoustics*, 1990, vol 12, pp. 199-207.
- S. P. Robinson, R. C. Preston, and G. R. Doré, "Measurement Standards for Underwater Acoustics in the UK," *Proceedings of the European Conference on Underwater Acoustics*, Luxembourg, September 1992, M. Weydert, ed., Commission of the European Communities, Elsevier, London, 1992, pp. 52-56.
- D. R. Bacon, "Primary Calibration of Ultrasonic Hydrophones by Optical Interferometry," *IEEE Trans. Ultrason. Ferroelec. Freq. Control*, 1988, vol 35, pp. 152-161.

APPENDIX
OTHER SURVEYS OF UNDERWATER ACOUSTIC FACILITIES

The following lists other surveys of underwater acoustic facilities:

1. "Underwater Acoustic Transducer Research, Development, Test and Evaluation and Calibration Facilities," Director of Navy Laboratories, Washington, DC, July 1973 (UNCLASSIFIED).
2. "Report of the Underwater Acoustic Transducer Calibration Facilities Review Committee," Director of Navy Laboratories, Washington, DC, 2 April 1976 (UNCLASSIFIED).
3. S. P. Robinson and R. C. Preston, "A Survey of European Calibration Facilities for Underwater Acoustics," National Physical Laboratory, Teddington, Middlesex, U.K., April 1992 (UNCLASSIFIED).
4. "A Register of Underwater Acoustic Facilities, Vol. 1: Western Europe," NUSC Technical Document 7903-1, Naval Underwater Systems Center, New London, CT, March 1987 (UNCLASSIFIED).

INITIAL DISTRIBUTION LIST

Addressee	No. of Copies
Commander Training Command Atlantic	2
Commander Training Command Pacific	2
Commander Operational Test and Evaluation Force	2
Assistant Secretary of the Navy (Research, Development, and Acquisition)	2
Director Defense Research and Engineering	1
Defense Technical Information Center	2
Center for Naval Analyses	1
Defense Advanced Research Projects Agency	1
Chief of Naval Operations (NOP-06, NOP-096, NOP-098, NOP-983)	4
Chief of Naval Research (OCNR-00, OCNR-10)	2
Naval Research Laboratory (USRD)	2
Naval Oceanographic and Atmospheric Research Laboratory	1
Naval Postgraduate School	1
Woods Hole Oceanographic Institution	1