

NAVAL RESEARCH LABORATORY

# IRI FACT BOOK

2014



the **NAVY's** corporate laboratory

The NRL Fact Book is a reference source for information about the Naval Research Laboratory (NRL). It is updated and placed on NRL's Web site (<http://www.nrl.navy.mil>) annually. It is printed every other year. To provide additional information to the reader, a point of contact is listed for each activity.

NRL has a continuing need for physical scientists, mathematicians, engineers, and support personnel. Vacancies are filled without regard to age, race, creed, sex, or national origin. Information concerning current vacancies is furnished on request. Address all such inquiries to:

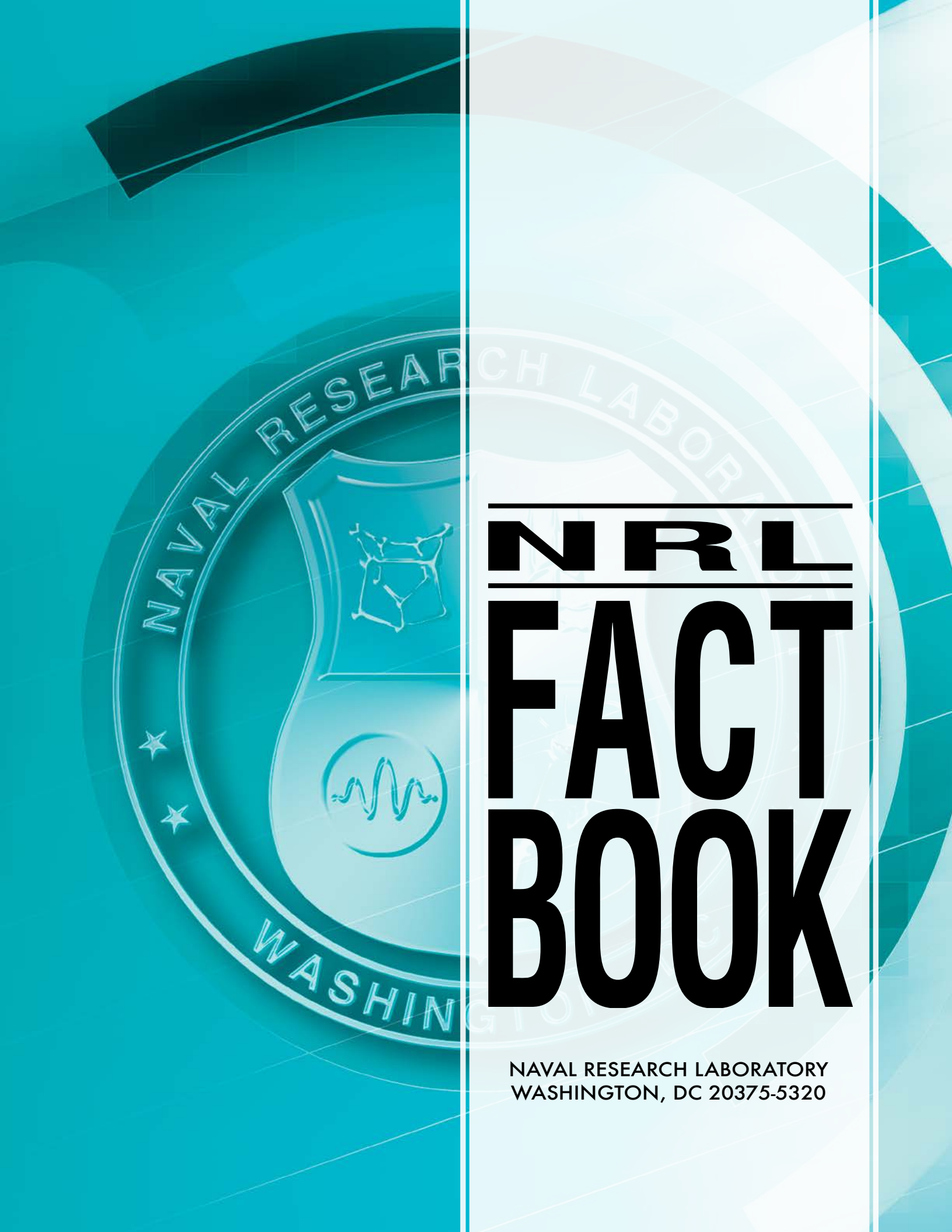
Human Resources Office  
Personnel Operations Branch (Code 1810)  
Naval Research Laboratory  
Washington, DC 20375-5320

<http://www.nrl.navy.mil>

### Quick Reference Telephone Numbers

	<b>NRL WASHINGTON</b>	<b>NRL- SSC</b>	<b>NRL- MONTEREY</b>	<b>NRL CBD</b>	<b>NRL VXS-1 Patuxent River</b>
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Personnel Locator	(202) 767-3200	(228) 688-3390	(831) 656-4763	(410) 257-4000	(301) 342-3751
DSN	297- or 754-	828	878	—	342
Direct-in-Dialing	767- or 404-	688	656	257	342
Public Affairs	(202) 767-2541	(228) 688-5328	(202) 767-2541	—	(202) 767-2541

Additional telephone numbers are listed on pages 140 and 141.



# **NRL**

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# **FACT**

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# **BOOK**

NAVAL RESEARCH LABORATORY  
WASHINGTON, DC 20375-5320



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# Introduction to the Naval Research Laboratory

## Mission

To conduct a broadly based multi-disciplinary program of scientific research and advanced technological development directed toward maritime applications of new and improved materials, techniques, equipment, systems, and ocean, atmospheric, and space sciences and related technologies.

### The Naval Research Laboratory

- Provides primary in-house research for the physical, engineering, space, and environmental sciences;
- ★ Provides broadly based exploratory and advanced development programs in response to identified and anticipated DON needs;
- ★ Provides broad multidisciplinary support to the Naval Warfare Centers;
- Provides space and space systems technology development and support; and
- Assumes responsibility as the Navy's corporate laboratory.



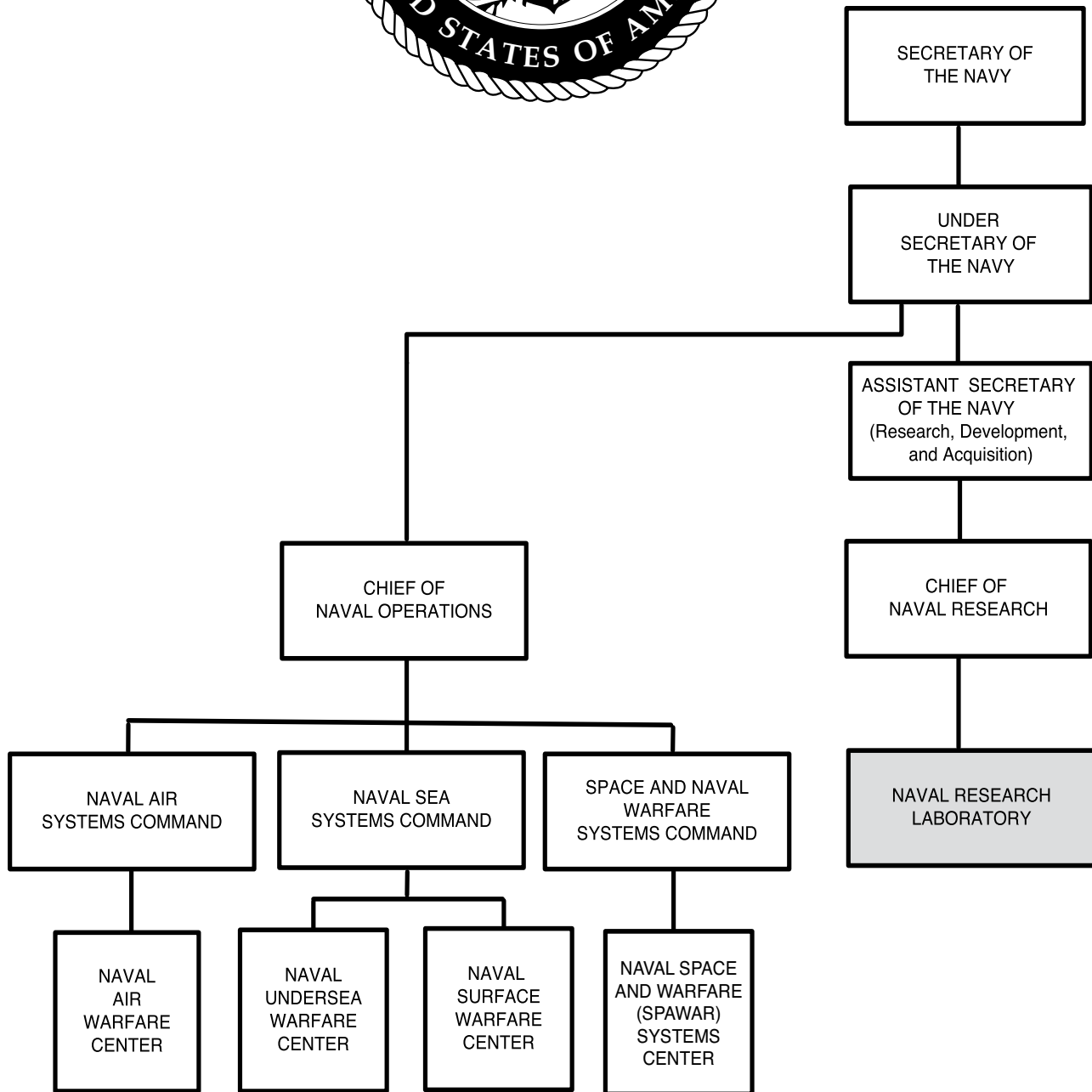
The Naval Research Laboratory is located in Washington, DC, on the east bank of the Potomac River.



The NRL Marine Meteorology Division is located in Monterey, California (NRL-MRY).



The Naval Research Laboratory Detachment is located at Stennis Space Center, Bay St. Louis, Mississippi (NRL-SSC).





## **The Naval Research Laboratory in the Department of the Navy**

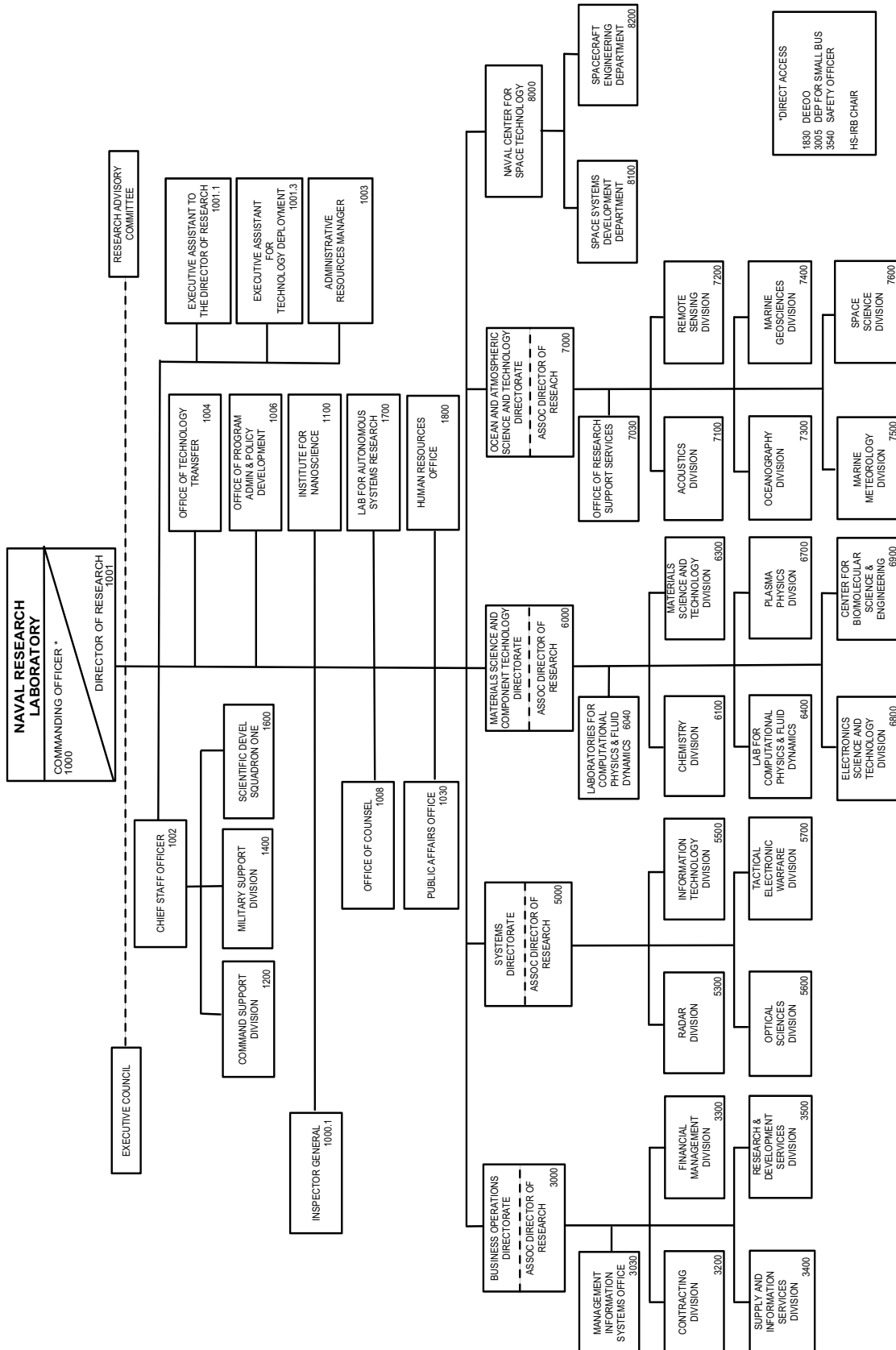
The Naval Research Laboratory is the Department of the Navy's corporate laboratory, and it reports to the Chief of Naval Research. As the corporate laboratory of the Navy, NRL is the principal in-house component in the Office of Naval Research's (ONR) effort to meet its science and technology responsibilities.

NRL has had a long and fruitful relationship with industry as a collaborator, contractor, and through Cooperative Research and Development Agreements (CRADAs). NRL values this linkage and continues to develop it.

NRL is an important link in the Navy Research, Development, and Acquisition (RD&A) chain. Through NRL, the Navy has direct ties with sources of fundamental ideas in industry and the academic community throughout the world and provides an effective coupling point to the R&D chain for ONR.



# NRL Functional Organization



# Current Research

The following areas represent broad fields of NRL research. Under each, more specific topics that are being investigated for the benefit of the Navy and other sponsoring organizations are listed. Some details of this work are given in the *NRL Review*, published annually. More specific details are published in reports on individual projects provided to sponsors and/or presented as papers for professional societies or their journals.

## Advanced Radio, Optical, and IR Sensors

- Advanced optical sensors
- EM/EO/meteorological/oceanographic sensors
- Satellite meteorology
- Precise space tracking
- Radio/infrared astronomy
- Infrared sensors and phenomenology
- UV sensors and middle atmosphere research
- Image processing
- VLBI/astrometry
- Optical interferometry
- Imaging spectrometry
- Liquid crystal technology

## Autonomous Systems

- Algorithms for control of autonomous systems
- Cognitive robotics
- Human-robot interaction
- Perception hardware and algorithms
- High-level reasoning algorithms
- Machine learning and adaptive algorithms
- Sensors for autonomous systems
- Power and energy for autonomous systems
- Networking and communications for mobile systems
- Swarm behaviors
- Test and evaluation of autonomous systems

## Computer Science and Artificial Intelligence

- Standard computer hardware, development environments, operating systems, and run-time support software
- Methods of specifying, developing, documenting, and maintaining software
- Human-computer interaction
- Intelligent systems for resource allocation, signal identification, operational planning, target classification, and robotics
- Parallel scientific libraries
- Algorithms for massively parallel systems
- Digital progressive HDTV for scientific visualization
- Adaptive systems: software and devices
- Advanced computer networking
- Simulation management software for networked high performance computers
- Interactive 3D visualization tools and applications
- Real-time parallel processing
- Scalable, parallel computing
- Petaflop computing, globally distributed file systems, terabit-per-second networking

## Directed Energy Technology

- High-energy lasers
- Laser propagation
- Solid-state and fiber lasers
- High-power microwave sources
- RAM accelerators
- Pulse detonation engines
- Charged-particle devices
- Pulse power
- DE effects

## Electronic Electro-optical Device Technology

- Integrated optics
- Radiation-hardened electronics
- Nanotechnology
- Microelectronics
- Microwave and millimeter-wave technology
- Hydrogen masers for GPS
- Aperture syntheses
- Electric field coupling
- Vacuum electronics
- Focal plane arrays
- Infrared sensors
- Radiation effects and satellite survivability
- Molecular engineering

## Electronic Warfare

- EW/C2W/IW systems and technology
- COMINT/SIGINT technology
- EW decision aids and planning/control systems
- Intercept receivers, signal processing, and identification systems
- Passive direction finders
- Decoys and offboard countermeasures (RF and IR)
- Expendable autonomous vehicles/UAVs
- Repeaters/jammers and EO/IR active countermeasures and techniques
- Platform signature measurement and management
- Threat and EW systems computer modeling and simulations
- Visualization
- Hardware-in-the-loop and flyable ASM simulators
- Missile warning infrared countermeasures
- RF environment simulators
- EO/IR multispectral/hyperspectral surveillance

## Enhanced Maintainability, Reliability, and Survivability Technology

- Coatings
- Friction/wear reduction
- Water additives and cleaners

- Fire safety
- Laser hardening
- Satellite survivability
- Corrosion control
- Automation for reduced manning
- Radiation effects
- Mobility fuels
- Chemical and biological sensors
- Environmental compliance

## **Environmental Effects on Naval Systems**

- Meteorological effects on communications
- Meteorological effects on weapons, sensors, and platform performance
- Air quality in confined spaces
- Electromagnetic background in space
- Solar and geomagnetic activity
- Magnetospheric and space plasma effects
- Nonlinear science
- Ionospheric behavior
- Oceanographic effects on weapons, sensors, and platforms
- EM, EO, and acoustic system performance/optimization
- Environmental hazard assessment
- Contaminant transport
- Biosensors
- Microbially induced corrosion

## **Imaging Research/Systems**

- Remotely sensed signatures analysis
- Real-time signal and image processing algorithms/systems
- Image data compression methodology
- Image fusion
- Automatic target recognition
- Scene/sensor noise characterization
- Image enhancement/noise reduction
- Scene classification techniques
- Radar and laser imaging systems studies
- Coherent/incoherent imaging sensor exploitation
- Remote sensing simulation
- Hyperspectral imaging
- Microwave polarimetry

## **Information Technology**

- High-performance, all-optical networking
- Antijam communication links
- Next-generation, signaled optical network architectures
- Integrated voice and data
- Information security (INFOSEC)
- Voice processing
- High performance computing
- High performance communications
- Requirements specification and analysis
- Real-time computing
- Wireless mobile networking
- Behavior detection
- Machine learning

- Information filtering and fusion
- Integrated internet protocol (IP) and asynchronous transfer mode (ATM) multicasting
- Reliable multicasting
- Wireless networking with directional antennas
- Sensor networking
- Communication network simulation
- Bandwidth management (quality of service)
- High assurance software
- Distributed network-based battle management
- High performance computing supporting uniform and nonuniform memory access with single and multithreaded architectures
- Distributed, secure, and mobile information infrastructures
- Simulation-based virtual reality
- High-end, progressive HDTV imagery processing and distribution
- Defensive information warfare
- Virtual reality/mobile augmented reality
- 3D multimodal interaction
- Model integration (physical, environmental, biological, psychological) for simulation
- Command decision support
- Data fusion

## **Marine Geosciences**

- Marine seismology, including propagation and noise measurement
- Geoacoustic modeling in support of acoustic performance prediction
- Geomagnetic modeling in support of nonacoustic system performance prediction
- Static potential field measurement and analysis (gravity and magnetic) in support of navigation and geodesy
- Geotechnology/sediment dynamics affecting mine warfare and mine countermeasures
- Foreshore sediment transport
- Geospatial information, including advanced seafloor mapping, imaging systems, and innovative object-oriented digital mapping models, techniques, and databases

## **Materials**

- Superconductivity
- Magnetism
- Biological materials
- Materials processing
- Advanced alloy systems
- Solid free-form fabrication
- Environmental effects
- Energetic materials/explosives
- Aerogels and underdense materials
- Nanoscale materials
- Nondestructive evaluation
- Ceramics and composite materials
- Thin film synthesis and processing
- Electronic and piezoelectric ceramics
- Thermoelectric materials

Active materials and smart structures  
Computational material science  
Paints and coatings  
Flammability  
Chemical/biological materials  
Spintronic materials and half metals  
Biomimetic materials  
Multifunctional materials  
Power and energy  
Synthetic biology

## **Meteorology**

Global, theater, tactical-scale, and on-scene  
numerical weather prediction  
Data assimilation and physical initialization  
Atmospheric predictability and adaptive  
observations  
Adjoint applications  
Marine boundary layer characterization  
Air/sea interaction; process studies  
Coupled air/ocean/land model development  
Tropical cyclone forecasting aids  
Satellite data interpretation and application  
Aerosol transport modeling  
Meteorological applications of artificial  
intelligence and expert systems  
On-scene environmental support system  
development/nowcasting  
Tactical database development and  
applications  
Meteorological tactical decision aids  
Meteorological simulation and visualization

## **Ocean Acoustics**

Underwater acoustics, including propagation,  
noise, and reverberation  
Fiber-optic acoustic sensor development  
Deep ocean and shallow water environmental  
acoustic characterization  
Undersea warfare system performance  
modeling, unifying the environment,  
acoustics, and signal processing  
Target reflection, diffraction, and scattering  
Acoustic simulations  
Tactical decision aids  
Sonar transducers  
Dynamic ocean acoustic modeling  
Underwater acoustic communications

## **Oceanography**

Oceanographic instrumentation  
Open ocean, littoral, polar, and nearshore  
oceanographic forecasting  
Shallow water oceanographic effects on  
operations  
Modeling, sensors, and data fusion  
Bio-optical and fine-scale physical processes  
Oceanographic simulation and visualization  
Coastal scene generation  
Waves, tides, and surf prediction  
Coupled model development

Sea-ice modeling  
Coastal ocean characterization  
Oceanographic decision aids  
Global, theater, and tactical-scale modeling  
Remote sensing of oceanographic parameters  
Satellite image analysis

## **Space Systems and Technology**

Space systems architectures and requirements  
Advanced payloads and optical communications  
Controllers, processors, signal processing, and VLSI  
Precision orbit estimation  
Onboard autonomous navigation  
Satellite ground station engineering and  
implementation  
Tactical communication systems  
Spacecraft antenna systems  
Launch and on-orbit support  
Precise Time and Time Interval (PTTI) technology  
Atomic time/frequency standards/instrumentation  
Passive and active ranging techniques  
Design, fabrication, and testing of spacecraft and  
hardware  
Structural and thermal analysis  
Attitude determination and control systems  
Reaction control  
Propulsion systems  
Navigation, tracking, and orbit dynamics  
Spaceborne robotics applications

## **Surveillance and Sensor Technology**

Point defense technology  
Imaging radars  
Surveillance radars  
Multifunction RF systems  
High-power millimeter-wave radar  
Target classification/identification  
Airborne geophysical studies  
Fiber-optic sensor technology  
Undersea target detection/classification  
EO/IR multispectral/hyperspectral detection and  
classification  
Sonar transducers  
Electromagnetic sensors, gamma ray to RF  
wavelengths  
SQUID for magnetic field detection  
Low observables technology  
Ultrawideband technology  
Interferometric imagery  
Microsensor system  
Digital framing reconnaissance canvas  
Biologically based sensors  
Digital radars and processors

## **Undersea Technology**

Autonomous vehicles  
Bathymetric technology  
Anechoic coatings  
Acoustic holography  
Unmanned undersea vehicle dynamics  
Weapons launch



# Major Research Capabilities and Facilities

## Institute for Nanoscience (Code 1100)

Clean room (5000 sq ft), quiet (4000 sq ft), and ultra-quiet (1000 sq ft) laboratories  
35 dB and 25 dB acoustically isolated zones  
20°C  $\pm$  0.5°C and 0.1°C controlled temperature zones  
Vibration isolation  
Vertical (mm, pp) <0.1 @ 70–500 Hz  
Horizontal (mm, pp) <0.1 @ 70–500 Hz  
Clean electrical power, free from SCR spikes and other interferences, and <  $\pm$ 10% voltage change  
<0.5 mG at 60 Hz EMI  
45  $\pm$  5% relative humidity  
Class 100 clean room  
Source of water meeting ASTM D5127 spec. Type E1.2  
Clean Room Major Equipment  
Monitoring system (toxic gas, hazmat, temperature)  
Laminar flow wet benches for localized Class 1/10 ambient in clean room  
Air purification unit to remove local organic contamination  
DI water system  
Wire bonder  
Two electron-beam writers  
Two scanning electron microscopes  
Atomic force microscope  
Metallurgical optical microscopes  
3D optical profiler  
Mask aligners (2, 1, and 0.2  $\mu$ m)  
Electron beam evaporation systems  
Low pressure chemical vapor deposition (LPCVD) system  
Magnetron sputter deposition system  
Reactive ion etching systems  
Dual-beam focused ion beam workstation  
Optical pattern generating system  
Laser micromachining system  
Plasma-enhanced chemical vapor deposition (PECVD) system  
Plasma-enhanced atomic layer deposition system  
Chlorine reactive ion etching system  
Other Major Equipment  
Transmission electron microscope  
UHV multi-tip scanning tunneling microscope/nanomanipulator

## Laboratory for Autonomous Systems Research (Code 1700)

Prototyping High Bay: (150 ft by 75 ft by 30 ft), contains real-time motion capture system, directional environmental sounds, GPS repeater and simulator  
Four human-systems interaction labs contain eye trackers and multiuser, multitouch monitors  
Littoral High Bay with 45 ft by 25 ft by 5.5 ft deep pool with 16-channel wave generator and slope that allows simulation of littoral environments; multiple sediment tanks (from 5 ft to 16 ft); GPS repeater and simulator; portable tank 4 ft by 36 ft

Desert High Bay with a 40 ft by 14 ft area of sand 2.5 ft deep, and 18 ft high rock walls; high speed fans and variable lighting  
Tropical High Bay, a 60 ft by 40 ft greenhouse, contains a re-creation of a southeast Asian rain forest with native plants; nominal 80 degrees temperature and 80% humidity; can generate rain events up to 6 in. per hour; Rainforest contains waterfall, stream, and pond  
Outdoor test range is a 1/3 acre highland forest with a waterfall, stream and pond, and terrain of differing difficulty including large bolder structures and earthen berms  
Sensor lab contains environmental chambers (small and walk-in) with maximum temperature range of –50°F to 375°F, relative humidity from 10% to 95% and for smaller chamber, barometric pressure of –9000 feet to 100,000 feet; lab also contains various fume hoods, biosafety cabinet, anechoic chamber, vapor generators, and other specialized equipment  
Power and energy lab contains specialized equipment including a battery dry room, glove box, isolation room, and fume hoods

## Research and Development Services Division (Code 3500)

Military construction  
Research support engineering  
Planning  
Full range of facility contracting, including construction, architect/engineering services, facilities support, and reserved parking  
Transportation  
Telephone services  
Maintenance and repair of buildings, grounds, and communication and alarm systems  
Shops for machining, sheet metal, carpentry, and welding  
Safety and Occupational Health/Industrial Hygiene  
Explosives safety  
Health physics  
Environmental Program

## Radar Division (Code 5300)

Shipboard radar research and development test beds:  
FlexDAR demonstration system (every element digital beamforming)  
AN/SPS-49-A(V)1  
S-Band radar waveform development testbed  
Airborne research radar facility, AN/APS-137D(V)5  
High Power 94 GHz radar system  
Ultra-high resolution radar (Microwave Microscope)  
Radar signature calculation facility  
Electromagnetic numerical computational facility  
Compact range and nearfield antenna measurement laboratory

Electronic Protection (EP) and adaptive pulse compression (APC) testbed  
 Electronics and mechanical computer aided design facility  
 High Frequency (HF) Multiple-Input Multiple-Output (MIMO) testbed  
 HF Surface Wave Radar Testbed  
 Microwave and RF instrumentation laboratories

### **Information Technology Division (Code 5500)**

Extended Spectrum Experimentation Laboratory  
 Robotics and Autonomous Systems Laboratory  
 Immersive Simulation Laboratory  
 Warfighter Human-Systems Integration Laboratory  
 Audio Laboratory  
 Mobile and Dynamic Network Laboratory  
 Integrated Communications Technology Test Lab  
 General Electronics Environmental Test Facility  
 Key Management Laboratory  
 Crypto Technology Laboratory  
 Navy Cyber Defense Research Laboratory  
 Communications Security (COMSEC) Laboratory  
 Navy Shipboard Communications Testbed  
 Behavior Detection Laboratory  
 Virtual Reality Laboratory  
 Service Oriented Architecture Laboratory  
 Distributed Simulation Laboratory  
 Motion Imagery Laboratory  
 Laboratory for Large Data Research  
 Affiliated Resource Center for High Performance Computing  
 Ruth H. Hooker Research Library

### **Optical Sciences Division (Code 5600)**

Optical probes laboratory to study viscoelastic, structural, and transport properties of molecular systems  
 Short-pulse excitation apparatus for kinetic mechanisms investigations  
 IR laser facility for optical characterization of semiconductors  
 Facilities for synthesis and characterization of optical glass compositions and for the fabrication of optical fibers  
 Silica and IR fluoride/chalcogenide fiber fabrication facilities  
 Environmental testing of fiber sensors (acoustic, magnetic, electric field, etc.)  
 Laser diode pumped solid-state lasers  
 Mid-IR, low-phonon crystal growth facility  
 Infrared countermeasure techniques laboratory  
 Mobile, high-precision optical tracker  
 EO/IR technology/systems modeling and simulation capabilities  
 Field-qualified EO/IR measurement devices  
 Focal plane array evaluation facility  
 Facilities for fabricating and testing integrated optical devices

Panchromatic and multi- and hyperspectral digital imaging processing facilities  
 NRL P-3 aircraft sensor pallet  
 Airborne EO/IR and radar sensors  
 VNIR through SWIR hyperspectral systems  
 VNIR, MWIR, and LWIR high-resolution systems  
 Wideband SAR systems  
 RF and laser data links  
 High-speed, high-power photodetector characterization  
 Communication link characterization to >100 Gbps  
 RF phase noise, noise figure, and network analysis  
 Ultrahigh-speed A/O converters

### **Tactical Electronic Warfare Division (Code 5700)**

Visualization display room  
 Transportable step frequency radar  
 Vehicle development laboratory  
 Offboard test platform  
 Compact antenna range facility  
 Millimeter-Wave Antenna Range Facility  
 TEWD Mechanical Fabrication Shop  
 RFCM techniques development chamber facility  
 Low-power anechoic chamber  
 High-power microwave research facility  
 Electro-optics mobile laboratory  
 Infrared-electro-optical calibration and characterization laboratory  
 Infrared missile simulator and simulator development laboratory  
 Secure supercomputing facility  
 CBD / Tilghman Island IR field evaluation facility  
 Ultrashort pulse laser effects research and analysis laboratory  
 Central Target Simulator facility  
 Flying Electronic Warfare laboratory  
 High-power RF explosive laboratory  
 Classified material lay-up facility  
 Classified computing facilities  
 RF measurement laboratory  
 Wet chemistry laboratory  
 Ultra-near-field test facility  
 RF and millimeter-wave laboratory  
 Optical laboratory  
 Paint room  
 Secure laboratories for classified projects

### **Laboratories for Computational Physics and Fluid Dynamics (Code 6040)**

1120-core x86 cluster  
 (3) 64-core SGI Altix systems  
 184-core x86 cluster  
 256-core SGI ICE  
 256-processor Opteron cluster  
 More than sixty SGI, Apple, and Intel workstations  
 Three-quarter-terabyte RAID disk storage systems  
 All computers and workstations have network connections to NICENET and ATDnet allowing access

to the NRL CCS facilities (including the DoD HPC resources) and many other computer resources both internal and external to NRL

### **Chemistry Division (Code 6100)**

Synthesis/processing facilities  
Paint formulation and coating  
Functional polymers/elastomers/composites  
Nanotubes/Nanofibers  
Surface modification  
Thin film deposition/etching with in situ control  
Marine Corrosion Facility (at Key West, FL)  
Fire/Damage Control Test Facility (at Mobile, AL)  
Wave pool (at Mobile, AL)  
Large and small boat test platforms (at Mobile, AL)  
Characterization facilities  
General-purpose chemical analysis/trace analysis  
Surface diagnostics  
Nanometer scale composition/structure/properties  
Magnetic resonance NDI  
Tribology  
Polymer structure/function/dynamics  
Special-purpose capability  
Environmental monitoring/remediation  
Combustion and fire research  
Alternate and petroleum-derived fuels  
Trace explosive detection test beds  
Trace vapor generation and detection test beds  
Simulation/modeling  
Synchrotron radiation beam lines (at NSLS, Brookhaven, NY)  
Pressurized test chambers (small, medium, large)

### **Materials Science and Technology Division (Code 6300)**

Synthesis and Processing  
Hot and cold isostatic presses  
Isothermal heat treating facility  
Vacuum arc melting facility  
Rapid Solidification System  
Composites processing autoclave  
200 keV ion-implantation facility  
Class 1000 clean room  
Metallic film deposition systems  
Laser direct write system  
Excimer laser film deposition facility  
Dip pen lithography  
3D-printing of polymers  
Polymer synthesis and characterization  
Polymer extruder  
Channel reactors for fuels synthesis  
Tape caster  
Laser cutting facility  
Biomechanical surrogate fabrication facility  
Physical Property Characterization  
Conductive AFM  
Magnetometry  
Cryogenic facilities  
High-field magnets

High-resolution analytical scanning transmission electron microscope (STEM)  
High-energy dispersive X-ray analytical system  
Electron microprobe, SEM, SAM, and STEM systems  
Quantitative metallography  
Accelerator mass spectrometry facility  
Thermal analysis characterization suite (TGA/DSC/DMA/DEA/rheometer)  
Dielectric characterization facility  
Microwave device test facility  
Bomen infrared spectrometer facility  
Diffuse light scattering facility  
Femtosecond laser facility  
Surface characterization facility  
Gas chromatography  
X-ray computed microtomography  
X-ray diffractometers  
Powder characterization  
Contact angle and surface tension analyzer  
Mechanical Property Characterization  
Robotic multiaxial loading system  
Stress corrosion cracking measurement systems  
Computer-aided experimental stress analysis  
2D and 3D strain imaging and measurement  
Material drop tower test facility  
Helmet drop tower test facility  
Shock tube  
Gas gun  
Portable, high speed data acquisition system  
Imaging, Modeling, and Simulation  
High speed video cameras  
Infrared camera  
Quantum cascade lasers  
Live biological cell confocal imaging and manipulation system  
Live biological cell mechanical loading system  
High performance computer clusters

### **Plasma Physics Division (Code 6700)**

Mercury, 6 MV, 360 kA, magnetically insulated inductive voltage adder  
Gamble II, 1 MV, 1 MA pulsed power generator  
HAWK, 1 MA inductive storage facility  
Table-Top Terawatt (T<sup>3</sup>) laser system  
Table-Top Ti: Sapphire Femtosecond Laser (TFL) systems (10 Hz and 1 kHz)  
NIKE krypton fluoride laser facility  
Space Physics Simulation Chamber  
Plasma Applications Laboratory  
Microwave facility for processing of advanced materials (2.45, 35, 83, and 60–120 GHz)  
ELECTRA, test bed for high-rep 5 Hz KrF laser  
Railgun Materials Testing Facility  
Directed Energy Physics Facility  
SWOrRD laser facility

### **Electronics Science and Technology Division (Code 6800)**

Solar Cell Characterization Laboratory

- Optoelectronic Scanning Electron Characterization Facility
- Infrared Sensor Characterization Laboratory
- Ultrafast Laser Facility
- Millimeter-Wave Vacuum Electronics Fabrication Facility
- Ultraviolet Photolithography Laboratory for Sub-millimeter-Wave Devices
- Compound Semiconductor Processing Facility
- Atomic Layer Deposition System
- Epicenter
- Laboratory for Advanced Materials Synthesis
- Advanced Silicon Carbide Epitaxial Research Laboratory
- High Pressure Laboratory

### **Center for Bio/Molecular Science and Engineering (Code 6900)**

- Optical equipment
  - Confocal microscope
  - Raman microscope
  - UV-visible absorption spectrophotometers
  - Transmission electron microscope
  - Scanning electron microscope
  - Microscope/atomic force microscope
  - Nanosight (nanoparticle tracking analysis)
- Analytical instruments
  - Gas chromatography mass spectrometer
  - HPLC
  - LC/MS/MS system
  - FluroMax-3 spectrofluorometer
  - Titration workstation
- General facilities
  - X-ray scattering
  - Cold room for storage and preparation
  - High-speed and microanalytical ultracentrifuges
  - Inert atmosphere dry box
  - NMR
  - FTIR
  - Ellipsometer
  - Dynamic mechanical analyzer
  - Differential scanning calorimeter
  - Circular dichroism
  - Minimill injection mold machine
  - Multi RF centrifuge
  - Perkin Elmer BioChip Arrayer I
  - Freeze-dry system
  - Affymetrix Gene Chip system
  - Surface plasmon resonance (SPR)
  - Isothermal calorimeter
  - High-resolution 3D Printer

### **Acoustics Division (Code 7100)**

- Laboratory Measurements
  - One-million-gallon, vibration-isolated underwater acoustic holographic/3D laser vibrometer facility for studying structural acoustic phenomena
  - Large, sandy-bottom, acoustic holographic pool facility for investigating echo characteristics of under-

- water buried/near-bottom targets and sediment acoustics

- In-air structural acoustics facility with high spatial density near-field acoustic holography and 3D laser vibrometry for diagnosing large structures, including aircraft interiors and rocket payload fairings

- Salt water acoustic tank (20 ft by 20 ft by 10 ft deep) with environmental control and substantial optical access for studying the acoustics of bubbly media, acoustic metamaterials, and laser induced sound

- Micro-Nanostructure Dynamics Laboratory to study the structural dynamics and performance of high Q oscillators and other micromechanical systems using laser Doppler vibrometers, super resolution nearfield scanning optical microscope, and low temperature calorimeter

- Model Fabrication Laboratory to fabricate rough topographical surfaces in various materials for acoustic scattering and propagation studies and measurements.

- Sonomagnetic Laboratory with doubly insulated Faraday cage for conducting experiments to measure weak electromagnetic fields generated by mechanical/acoustic vibrations of a conducting medium in an arbitrary magnetic field

#### **Seagoing Assets**

- Acoustic arrays (towed/moored/suspended)
  - 64-channel broadband source-receiver array with time-reversal mirror functionality over a frequency band of 500 to 3500 Hz
- High-powered sound sources and source arrays
- Autonomous acoustic sources
- Acoustic communications array and data acquisition buoy
- Portable, ocean-deployable synthetic aperture acoustic measurement system (100-meter rail with precise positioning)
- Containerized, seagoing multichannel data acquisition system
- High-speed, maneuverable towed body with MK-50 and synthetic aperture sonars to measure high frequency scattering and coherence

### **Remote Sensing Division (Code 7200)**

- WindSAT satellite instrument (joint with Code 8000)
- WindSat processing facility
- Hyperspectral Imager for the Coastal Ocean (HICO)
  - International Space Station (ISS) instrument
- Ground-based water vapor millimeter-wave spectrometer (WVMS)
- SAR processing facility
- SCI processing facility
- SEALAB
- SAP facility
- Hyperspectral imaging, sensors, and processing
- Optical remote sensing calibration lab/facility
- Navy Precision Optical Interferometer (NPOI)



NRL/NRAO 74 MHz Very Large Array long-wave radio receiver system  
 Free surface hydrodynamics laboratory (including a 10 m wave tank)  
 In-water lidar facility  
 Aerosol and field measurement facility  
 NRL RP-3A aircraft sensors  
 Airborne polarimetric microwave imaging radiometer (APMIR)  
 Millimeter-wave imager  
 Interferometric synthetic aperture radar (InSAR)  
 Flight-level meteorological sensors  
 Visible/near infrared (VNIR) hyperspectral imaging systems  
 VNIR polarimetric multispectral imager  
 Short-wave IR (SWIR) hyperspectral imaging systems  
 Midwave infrared (MWIR) indium antimonide (InSb) imaging system  
 Long-wave infrared (LWIR) quantum well IR photodetector (QWIP) imaging system

### **Oceanography Division (Code 7300)**

Towed sensor and advanced microstructure profiler systems for studying upper ocean fine and microstructure  
 Integrated absorption cavity and optical profiler systems for studying ocean optical characteristics  
 Self-contained bottom-mounted upward-looking acoustic profilers for measuring ocean variability  
 Acoustic Doppler profiler for determining ocean currents while under way  
 Remotely operated underwater vehicle (ROV)  
 Bottom-mounted acoustic Doppler profilers  
 Towed hyperspectral optical array  
 SCI processing facility  
 Satellite receiving stations for AVHRR, MODIS, DMSP, and JPASS ocean color processing facility  
 Environmental scanning electron microscope, confocal laser scanning microscope, and Inspect S low vacuum scanning electron microscope for detailed studies of biocorrosion in naval materials  
 Real-time Ocean Observations and Forecast Facility for monitoring and tracking of ocean physical and bio-optical conditions  
 Slocum Electric Gliders for performing wide-area ocean surveys of temperature, salinity, and optical characteristics  
 SCANFISH MKII, a towed undulating vehicle system, designed for collecting 3D TS profile data of the water column  
 Bottom-mounted Shallow water Environmental Profiler in Trawl-safe Real-time configuration (SEPTR) for measuring temperature, salinity, and optical parameters in addition to current profiles and pressure  
 Bio-optical Physical Pop-up Environmental Reconnaissance System to measure bio-optical and physical properties of the water column

Cytosense Scanning Flow Cytometer to identify individual phytoplankton and zooplankton for ecological model development and validation  
 Shipboard Lidar Optical Profiler to measure optical properties of the water  
 Raleigh Bernard Convective Tank and a Hybrid Underwater Camera for providing object detection and identification in extremely turbid underwater environments  
 Collaborative system for propagating environment error distributions through disparate dynamical systems

### **Marine Geosciences Division (Code 7400)**

Airborne gravimetry, magnetics, and topographic measurements suite coupled with differential GPS yielding position accuracies of <1.0 meter  
 100 and 500 kHz sidescan sonar with 2–12 kHz chirp profiler and Cs magnetometer for seafloor characterization/imaging and shallow subbottom profiling  
 Deep-towed acoustic geophysical system operating at 220–1000 Hz characterizes subseafloor structure including gas clathrate accumulations and dissociation of methane hydrates  
 Acoustic seafloor classification system operating at 8–50 kHz provides underway, real-time prediction of sediment type and physical properties  
 Seafloor probes for measuring sediment pore water pressures, permeability, electrical resistivity, acoustic compressional and shear wave velocities and attenuations, and dynamic penetration resistance  
 300 kV transmission electron microscope with environmental cell for study of sediment fabric, especially impact of organic matter  
 Map data formatting facility compresses map information onto CD-ROM media for masters for use in aircraft digital moving map systems  
 Comprehensive geotechnical and geoaoustics laboratory capability  
 Airborne electromagnetic (AEM) bathymetry system  
 Ocean bottom magnetometer system  
 3D, multispectral, subbottom swath imaging system  
 Ocean bottom seismographs (OBS)  
 In situ sediment acoustic measurement system (IS-SAMS)  
 Instrumented mine shapes to measure hydrodynamics of free-fall in the water column, dynamics of deceleration in seafloor sediments, and rates and depths of scour burial  
 Hydrothermal plume imaging data acquisition and analysis system  
 Integrated digital databases analysis and display system for bathymetric, meteorological, oceanographic, geoaoustic, and acoustic data  
 Stereometric video image processing system for use in foreshore morphology measurement  
 Sediment gas-content sampler

Acoustic tomographic probes for surf zone sands and gassy muds  
 Computed tomography (CT) system and real-time radiography unit with a 0–225 keV @ 0–1 mA micro-focus X-ray tube and a 225 mm image intensifier  
 Patented Geospatial Information Data Base (GIDB™) for rapidly accessing disparate geospatial content on the Internet. <http://dmap.nrlssc.navy.mil>  
 Human-centered display design through the application of human factors principles in the design of geospatial displays (e.g., analysis of clutter in electronic displays)  
 GPS-based survey vehicles and equipment to measure foreshore and nearshore bathymetry (camera towers, jet ski, and push cart)  
 Geospatial lab for rapid 2D and 3D visualization, analysis, and prototyping  
 Small oscillatory flow tunnel to observe sediment dynamics under forcing from waves and currents  
 Tomographic particle image velocimetry system for three-dimensional volumetric velocity measurements of fluid flow

### **Marine Meteorology Division (Code 7500)**

The USGODAE Data Server (Global Ocean Data Assimilation Experiment) for collection and broad distribution of near-real-time METOC data and higher-level products from Navy, DoD, and other providers to the global ocean and atmospheric research community  
 A Cray Xe-6 Supercomputer for numerical weather prediction systems development provided by the DoD High Speed Computing Modernization Program (HPCMP) through a Dedicated HPC Project Investment (DHPI) grant  
 Bergen Data Center with an extensive disk file storage capacity and research data tape backup/archival capability  
 Data visualization center for developing shipboard briefing tools, displaying individual and merged observations and model output, and integrating meteorological parameters into tactical simulations  
 Classified and unclassified radar and satellite data processing facility  
 Two Mobile Atmospheric Aerosol and Radiation Characterization Observatories (MAARCO) used to collect atmospheric data around the world  
 Technical research library  
 New Marine Meteorology Center for the Meteorological Applications Development Branch, Secure IT Facility, Division Administrative support, and Front Office Management Team

### **Space Science Division (Code 7600)**

Development and test facilities for satellite, sounding rocket, and balloon instruments, to perform solar terrestrial, astrophysical, astronomical, solar, upper/middle atmospheric, and space environment sensing  
 Solar Coronagraph Optical Test Chamber (SCOTCH)  
 Vacuum Ultraviolet Calibration Facility (VUCF)  
 Gamma Ray Imaging Laboratory (GRIL)

Rocket Assembly and Checkout Facility  
 Neutron Characterization Laboratory  
 Semiautomatic Probe Station  
 Solar Irradiance Calibration Facility  
 Suborbital Instrument Assembly and Test Facility  
 SuperMISTI reconfigurable and adaptable stand off gamma ray and neutron radiation detection systems for detection of special nuclear material and other radiological/nuclear Weapons of Mass Destruction  
 Very high angular Resolution Imaging Spectrometer (VERIS) sounding rocket instrument  
 Helium Resonance Scattering in the Corona and Heliospheric (HERSCHEL) sounding rocket instrument  
 Remote Atmospheric and Ionospheric Detection System (RAIDS) International Space Station instrument  
 Michelson Interferometer for Global High-resolution Thermospheric Imaging (MIGHTI) satellite instrument  
 Extreme Ultraviolet Imaging Spectrometer (EIS) satellite instrument  
 Large Angle Spectrometric Coronagraph (LASCO) satellite instrument  
 Sun Earth Connection Coronal and Heliospheric Investigation (SECCHI) satellite instrument suite  
 Solar Orbiter Heliospheric Imager (SoloHI) satellite instrument  
 Wide-field Imager (WISPR) satellite instrument  
 Compact Coronagraph (CCOR) satellite instrument  
 Special Sensor Ultraviolet Limb Imager (SSULI) satellite instrument  
 Winds Ions Neutrals Composition Suite (WINCS) small satellite instrument suite  
 Extensive computer-assisted data manipulation, interpretive, and theoretical capabilities for space science instrumentation operations, data imaging, and modeling  
 SECCHI Payload Operations Center (POC)  
 Fermi Gamma-ray Space Telescope (formerly GLAST) Science Analysis Center (SAC)  
 SoftWare for Optimization of Radiation Detectors (SWORD)  
 Mountain Wave Forecast Model (MWFM)  
 Mass Spectrometer and Incoherent Scatter Radar empirical atmospheric model (NRLMSISE)  
 Horizontal Wind Model (HWM)  
 Ground to Space empirical atmospheric model (G2S)  
 Navy Gloval Environmental Model (NAVGEN)  
 Integrating the Sun-Earth System for the Operational Environment (ISES-OE)

### **Space Systems Development Department (Code 8100)**

Payload test facility and processor development laboratory

- Laser communications and electro-optics laboratories
- Tactical Technology Development Laboratory (TTDL)
- Precision oscillator (clock) test facility
- RF payload development laboratory with anechoic chamber
- Precision high-frequency RF compact range anechoic chamber facility
- Transportable ground station development, assembly, and test facility
- Multiplatform FPGA/ASIC/VLSI development laboratory
- Satellite telemetry, tracking, and satellite control at Blossom Point, MD
  - L/C/S/X-band fixed antenna resources
  - Connectivity to the Air Force Satellite Control Network (AFSCN)
- Pomomoye field site: large antenna, space communications, and research facility
- Midway Research Center space communications and research facility
- Optical telescope facility

## **Spacecraft Engineering Department (Code 8200)**

### Chambers:

- Thermal-vacuum
- Acoustic reverberation
- Large, tapered horn, RF anechoic chamber
- EMI/EMC testing chamber

### Facilities:

- Spacecraft high-reliability electronic and electrical rework facility
- Spacecraft electronic systems integration and test facility
- Radio frequency (RF) system development facility
- RF microcircuit fabrication clean room facility
- Large tapered horn RF anechoic chamber facility
- Frequency sources laboratory
- Shock and vibration test
- Clean rooms (multiple classes and sizes)
- Spacecraft fabrication and assembly
- Fuels testing
- Autoclave
- Space robotics laboratory
- Proximity operations testbed
- CAD/CAM
- Propulsion system welding
- Static loads test
- Star tracker characterization
- Spacecraft spin balance
- Modal analysis
- Computational astrodynamics simulation and visualization

## NRL Sites and Facilities

SITE	ACREAGE		BUILDINGS/ STRUCTURES
	LAND OWNED/LEASED	EASEMENT/ LICENSE- PERMIT	
<b>District of Columbia</b> NRL and Joint Base Anacostia-Bolling*	131/0	0/10.13	93/33
<b>Virginia</b> Midway Research Center Quantico*	162/0	0/0	7/11
<b>Maryland</b> NRL Scientific Development Squadron One (VXS-1), NAS Patuxent River*	Tenant		
Chesapeake Bay Section and Dock Facility Chesapeake Beach*	168/0	.6/.02	44/73
Multiple Research Site Tilghman Island*	3/0	0/0	3/3
Free Space Antenna Range Pomonkey*	141/0	0/0	11/10
Blossom Point Satellite Tracking and Command Station Blossom Point*	0/0	0/265	21/23
<b>Florida</b> Marine Corrosion Facility Key West	Tenant		
<b>California</b> NRL Monterey Monterey*	Tenant		
<b>Mississippi</b> Stennis Space Center Bay St. Louis*	Tenant		
<b>Alabama</b> Ex-USS <i>Shadwell</i> (LSD-15) Mobile Bay  Decommissioned 457-ft vessel used for fire research	Tenant		

### PROPERTY

<b>Land:</b>	605 acres	<b>Buildings:</b>		<b>Replacement Costs:</b>	
		RDT&E	3,138,104 ft <sup>2</sup>	Buildings Plant Replacement	
		Administrative	276,246 ft <sup>2</sup>	Value (PRV) <sup>1</sup>	\$1,184.7 million
		Other	280,190 ft <sup>2</sup>	Equipment Costs <sup>2</sup>	\$523.7 million

<sup>1</sup>Per DON Facilities Asset Data System standard cost factors.

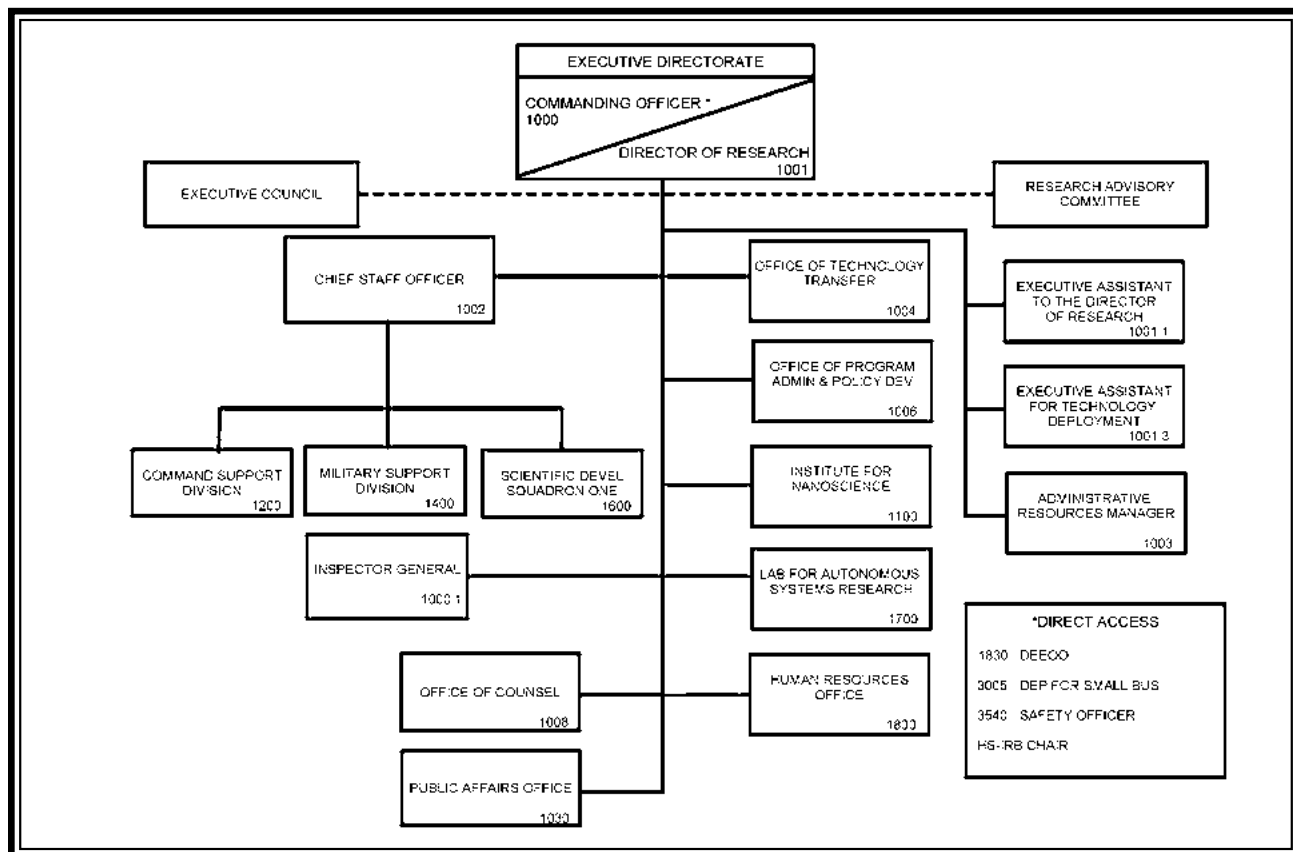
<sup>2</sup>NRL Accountable Property Acquisition Costs

\*See maps in the General Information section (page 131).



# **EXECUTIVE DIRECTORATE**





### Key Personnel

Name	Title	Code
CAPT A.J Ferrari, USN	Commanding Officer	1000
Dr. J.A. Montgomery	Director of Research	1001
Mr. D.J. DeYoung	Executive Assistant to the Director of Research	1001.1
Ms. C.L. Downing	Head, Strategic Workforce Planning	1001.2
Dr. G. Sandhoo	Executive Assistant for Technology Deployment/STILO	1001.3
Dr. L. Slater	NRL Historian	1001.15
CAPT K. Szczublewski, USN	Chief Staff Officer/Inspector General	1002/1000.1
Ms. B.L. Gibson*	Command Management Review	1000.12
Dr. R.C. Manak	Head, Office of Technology Transfer	1004
Ms. M.E. Dixon	Head, Office of Program Administration and Policy Development	1006
Mr. J.N. McCutcheon	Head, Office of Counsel	1008
Mr. R.L. Thompson	Head, Public Affairs Office	1030
Dr. E.S. Snow <sup>+</sup>	Director, Institute for Nanoscience	1100
Mr. T. Brewer	Head, Command Support Division	1200
CDR D.A. Ursini, USN*	Head, Military Support Division	1400
CDR J. Plaisance, USN	Commanding Officer, Scientific Development Squadron One (VXS-1)	1600
Mr. A.C. Schultz <sup>+</sup>	Director, Laboratory for Autonomous Systems Research	1700
Ms. C.L. Downing*	Director, Human Resources Office	1800
Ms. L.L. Hill	Deputy Equal Employment Opportunity Officer	1830
Vacant	Deputy for Small Business	3005
Mr. K.J. Pawlovich	Head, Safety Branch	3540

\*Acting

<sup>+</sup>Additional Duty

# **EXECUTIVE DIRECTORATE**

## **Code 1000 and Code 1001**

The Commanding Officer (Code 1000) and the Director of Research (Code 1001) share executive responsibility for the management of the Naval Research Laboratory. In accordance with Navy requirements, the Commanding Officer is responsible for the overall management of the Laboratory and exercises the usual functions of command including compliance with legal and regulatory requirements, liaison with other military activities, and the general supervision of the quality, timeliness, and effectiveness of the technical work and of the support services.

The Commanding Officer delegates line authority and assigns responsibility to the Director of Research for the Laboratory's technical program, its planning, conduct, and staffing; evaluation of the technical competence of personnel; liaison with the scientific community; selection of subordinate technical personnel; exchange of technical information; and the effective execution of the NRL mission.

Within the limits of Navy regulations, the Commanding Officer and the Director of Research share authority and responsibility for the internal management of the Laboratory. The Commanding Officer retains all authority and responsibility specifically assigned to him by higher authority.

The mission of the Laboratory is carried out by three science and technology directorates and the Naval Center for Space Technology, supported by the Business Operations Directorate and the Executive Directorate. In addition, the Laboratory's operating staffs provide assistance in their special fields to the Commanding Officer and to the Director of Research. The operating staffs are listed on the following pages of this publication.

## Commanding Officer

**Captain Mark Bruington** is the 38th Commanding Officer of the Naval Research Laboratory, assuming command on August 1, 2014. As NRL's Commanding Officer, he directs the activities of more than 2,500 scientists, engineers, and support personnel in their mission to conduct leading-edge research and provide new technological capabilities to the Navy and Marine Corps. Prior to his assumption of command of NRL, he was the Principal Director, Programs at the Defense Security Cooperation Agency where he led a team charged with DoD humanitarian assistance, building partnership capacity and Foreign Military Training and Equipping U.S. partner nations.

Captain Bruington, a native of California, received his commission through the Aviation Officer Candidate School program after graduating from San Francisco State University with a B.S. in physics. He received his Wings of Gold at NAS Beeville, Texas, in 1992 and is a graduate of the United States Naval Test Pilot School, Class 117, in 2000. He also holds an M.S. in systems engineering from Johns Hopkins University and an M.S. in national resource strategy from the Industrial College of the Armed Forces (ICAF).

His sea tours include an assignment in the A-6 Intruders with VA-165, "The Boomers," aboard USS *Nimitz* (CVN 68) in support of Operation Southern Watch. Following the decommissioning of the A-6E, Captain Bruington transitioned to the F-14 Tomcat. He next reported to VF-11, "The Red Rippers," aboard the USS *John C. Stennis* (CVN 74) for its maiden, around-the-world cruise, again in support of Operation Southern Watch. Following the events of September 11th, Captain Bruington joined VF-211, "The Fighting Checkmates," again aboard USS *John C. Stennis*, in the initial phases of Operation Enduring Freedom, where he led numerous strikes in support of coalition troops in Afghanistan. Following his Department Head tour in VF-211, Captain Bruington transitioned to the Aerospace Engineering Duty Officer community.

His shore tours include attendance at United States Naval Test Pilot School (USNTPS), and upon graduation, he reported to Air Test and Evaluation Squadron 23 (VX-23) as the squadron's Safety Officer and F-14 project officer. At VX-23 he worked on numerous F-14 and F/A-18 A-F projects including F-14 digital flight controls systems, envelope expansion and LANTIRN pod integration. His next shore assignment was as the senior fixed wing instructor at USNTPS where he led curriculum development and was integral in the introduction of the F/A-18 Hornet out-of-control flight syllabus implemented at all F/A-18 Fleet Replacement Squadrons. He next spent three years in the F-35 Lightning II Joint Strike Fighter program office as the Vehicle Systems Integrated Product Team (IPT) lead. He was responsible for developing the F-35 A/B/C flight controls, propulsion integration, aircraft subsystems and all aircrew systems. He led his IPT through three F-35 Preliminary Design Reviews (PDRs) and Critical Design Reviews (CDRs), directly leading to the flight clearances and first flights of the F-35A Conventional Take-Off and Landing (CTOL) and F-35B Short Take-Off and Vertical Landing (STOVL) variants. Following this tour, he attended ICAF where he earned distinguished graduate honors. Following his tour at ICAF, he was assigned as the "Deputy CAG," as part of the OPNAV N88 staff, responsible for development of requirements and budget submissions for all Naval tactical aircraft, E-2/C-2, unmanned combat air systems and weapons programs across the Naval Aviation Enterprise. Following his tour on the Navy staff, Captain Bruington next served as the Deputy Program Manager for the F/A-18 E/F and EA-18G air vehicle and Royal Australian Air Force (RAAF) F/A-18F programs as part of Program Manager AIR (PMA) 265 in NAS Patuxent River, Maryland. He led a diverse team of over 1,000 government and industry professionals to execute a \$2.7B annual budget, delivering 40-plus Super Hornets and Growlers to the fleet each year. He was also instrumental in the final delivery of all 24 F/A-18F aircraft to the RAAF.

Captain Bruington has flown more than 70 combat missions above Iraq and Afghanistan, flown 41 different types of aircraft while amassing 3,200 flight hours and over 500 carrier-arrested landings. His decorations include the Defense Meritorious Service Medal, Meritorious Service Medal, four Air Medals (Strike/Flight), and numerous personal, campaign, and unit level awards.





## Director of Research

**D**r. John A. Montgomery joined the Naval Research Laboratory in 1968 as a research physicist in the Advanced Techniques Branch of the Electronic Warfare Division, where he conducted research on a wide range of Electronic Warfare (EW) topics. In 1980, he was selected to head the Off-Board Countermeasures Branch. In May 1985, he was appointed to the Senior Executive Service and was selected as Superintendent of the Tactical Electronic Warfare Division. He has been responsible for numerous systems that have been developed/approved for operational use by the Navy and other services. He has had great impact through the application of advanced technologies to solve unusual or severe operational deficiencies noted during world crises, most recently in Afghanistan, Iraq, and for Homeland Defense and in the Pacific theater. Dr. Montgomery has accumulated 45 years of civilian service to-date at the Naval Research Laboratory.

Dr. Montgomery received the Department of Defense Distinguished Civilian Service Award in 2001. He was recognized by the Department of the Navy Distinguished Civilian Service Award in 1999 and by the Department of the Navy Meritorious Civilian Service Award in 1986. As a member of the Senior Executive Service, he received the Presidential Rank Award of Distinguished Executive in 1991 and again in 2002, and the Presidential Rank Award of Meritorious Executive in 1988, 1999 and again in 2007. He also received the 1997 Dr. Arthur E. Bisson Prize for Naval Technology Achievement, awarded by the Chief of Naval Research in 1998. Further, he has received the Association of Old Crows (Electronic Defense Association) Joint Services Award in 1993. He was an NRL Edison Scholar, and is a member of Sigma Xi. He served as the U.S. National Leader of The Technical Cooperation Program's multinational Group on Electronic Warfare from 1987 to 2002, and served as its Executive Chairman. In 2006, Dr. Montgomery received the Laboratory Director of the Year award from the Federal Laboratory Consortium for Technology Transfer, and in 2011, he received the Roger W. Jones Award for Executive Leadership from American University's School of Public Affairs. In 2013, he was elected to membership in the National Academy of Engineering.

Dr. Montgomery received his bachelor's of science degree in physics from North Texas State University in 1967 and his master's degree, also in physics, in 1969. He received his PhD in physics from the Catholic University of America in 1982. As Director of Research at the Naval Research Laboratory, Dr. Montgomery oversees research and development programs with expenditures of approximately \$1.2 billion per year.



## Executive Council



The Executive Council consists of executive, management, and administrative personnel. Executive Council members include the following:

- Commanding Officer, Chairperson
- Director of Research
- Executive Assistant to the Director of Research
- Associate Directors of Research
- Chief Staff Officer
- Director, Naval Center for Space Technology
- Associate Director, Naval Center for Space Technology
- Heads of Divisions
- Director, Laboratories for Computational Physics and Fluid Dynamics
- Director, Center for Bio/Molecular Science and Engineering
- Director, Human Resources Office
- Public Affairs Officer
- Deputy Equal Employment Opportunity Officer
- Administrative Resources Manager
- Head, Office of Program Administration and Policy Development
- Safety Officer
- Head, Office of Counsel
- Head, Office of Technology Transfer
- Head, Management Information Systems Staff
- Head, Office of Research Support Services
- Representative, Administrative Advisory Council
- Director, Institute for Nanoscience
- Director, Laboratory for Autonomous Systems Research

## Research Advisory Committee



The Research Advisory Committee advises the Commanding Officer and the Director of Research on scientific programs and the administration of the Laboratory. The committee assists in planning the long-range scientific program, coordinating the scientific work, reviewing the budget, accepting or modifying problems, considering personnel actions, and initiating such studies as may be necessary or desirable. The membership consists of the following:

- Director of Research, Chairperson
- Commanding Officer
- Associate Directors of Research
- Director, Naval Center for Space Technology
- Chief Staff Officer (Observer)



### **Chief Staff Officer/Inspector General Code 1002/1000.1**



CAPT K. SZCZUBLEWSKI, USN

The Chief Staff Officer serves as the Deputy to the Commanding Officer and acts for the Commanding Officer in his absence. The Command Support Division (Code 1200), the Military Support Division (Code 1400), and the Scientific Development Squadron One (VXS-1) (NAS Patuxent River, MD, Code 1600) report directly to the Chief Staff Officer. When directed, the Laboratory's Inspector General investigates, inspects, and/or inquires into matters that affect the operation and efficiency of NRL. These matters include but are not limited to: effectiveness, efficiency, and economy; management practices; and fraud, waste, and abuse. He serves as principal advisor to the Commanding Officer on all inspection matters and audits and is the principal point of contact and liaison with all agencies outside NRL.

### **Public Affairs Officer Code 1030**



MR. R.L. THOMPSON

The Public Affairs Officer (PAO) advises the Commanding Officer and Director of Research on public affairs matters, including external and internal relations and community outreach, and serves as the Commanding Officer's principal assistant in the area of public affairs. To do this, the PAO plans and directs a program of public information dissemination on official NRL activities. The PAO coordinates responses to requests from the news media and the public for unclassified information or materials dealing with the Laboratory, coordinates participation in community relations activities, and directs the internal information programs. The PAO is also responsible for coordinating all actions within the Laboratory that respond to requirements of the Freedom of Information Act (FOIA).

### **Deputy Equal Employment Opportunity Officer Code 1830**



MS. L.L. HILL

The Deputy Equal Employment Opportunity Officer (DEEOO) is the EEO program manager and the advisor to the Commanding Officer on all EEO matters. The DEEOO manages the discrimination complaint and reasonable accommodation processes and directs the Laboratory's affirmative action plans and special emphasis programs (Federal Women's, Hispanic Employment, African American Employment, Asian-Pacific Islanders, American Indian Employment, Individuals with Disabilities, including Disabled Veterans). The DEEOO recruits quality candidates for those areas when underrepresentation exists. Duties also include reviewing, coordinating, and monitoring implementation of EEO policies and developing local guidance, directives, and implementation procedures for the EEO programs.

# Office of Technology Transfer

**Code 1004**



DR. R.C. MANAK

## Basic Responsibilities

The Technology Transfer Office (TTO) is responsible for NRL's implementation of the Federal Technology Transfer Act of 1986 (Public Law 99-502). The law requires the transfer of Government innovative technologies to industry for commercialization as products and services for public benefit. TTO negotiates Cooperative Research and Development Agreements (CRADAs) under which NRL investigators collaborate with investigators from industry, academia, state or local governments, or other Federal agencies to develop NRL technologies for government and/or commercial use. It markets NRL's patented inventions, negotiates patent license agreements under which the Navy grants a licensee the right to make, use, and sell NRL inventions (in exchange for receiving licensing fees and a percentage of sales), and enforces licenses to assure diligence in commercialization efforts.

**Personnel:** 5 full-time civilian; 1 SCEP student

## Key Personnel

Title	Code
Head, Technology Transfer	1004
Sr. Licensing Associate	1004
Sr. Licensing Associate	1004
Licensing Associate	1004
Management Analyst	1004
Administrative Assistant (SCEP)	1004

**Point of contact:** Code 1004, (202) 767-7229

## Office of Program Administration and Policy Development

**Code 1006**



Ms. M.E. DIXON

### Basic Responsibilities

The Office of Program Administration and Policy Development provides managerial, technical, and administrative support to the Director of Research (DOR) in such areas as program and policy development, intra-Navy and inter-Service Science and Technology (S&T) program coordination; liaison with other Navy, DoD, and government activities on matters of mutual concern; and support to the Executive Directorate in planning and directing NRL's S&T (6.1, 6.2) program. Specific functions include: monitoring and providing background information on technical and policy matters that come under the purview of the DOR; representing NRL, ONR, and/or the Navy on tri-Service or DoD-wide coordination matters; performing special studies or chairing ad hoc study groups regarding program decisions or policy positions; performing special studies involving major NRL programs and resource issues; providing administrative support in the areas of personnel, budget, facilities, equipment, and security; providing executive management information and analyses for various aspects of the S&T program effort; coordinating VIP visits to NRL; managing the NRL directives system; administering the NRL response to Congressional requests; maintaining the NRL R&D achievements file; developing the S&T guidance for monitoring and reporting the NRL S&T program; administering NRL's various postdoctoral fellowship programs; and managing the Facility Modernization Program.

**Personnel:** 16 full-time civilian

### Key Personnel

Title	Code
Head, Office of Program Administration and Policy Development	1006
Head, Program Administration Staff	1006.1
VIP Coordinator / Protocol Officer / Administrative Officer	1006.2
Head, Executive Management & Policy Development Staff	1006.3
Directives	1006.31
Head, NRL Facilities Staff	1006.4
Special Assistant	1006.6

**Point of contact:** Code 1006.2, (202) 767-3370

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\*Acting

## Office of Counsel

**Code 1008**



Mr. J.N. McCutcheon

### Basic Responsibilities

The Office of Counsel is responsible for providing legal services to NRL's management in all areas of general, administrative, intellectual property, and technology transfer law. The Office reviews all procurement-related actions; reviews NRL scientific papers prior to publication; prepares patent applications and prosecutes the applications through the Patent and Trademark Office; defends against contract protests, other contract litigation, and personnel cases; and advises on other legal matters relating to technology transfer, personnel, fiscal, and environmental law.

NRL Counsel also serves as legal advisor to the Commanding Officer and Director of Research.

**Personnel:** 30 full-time civilian

### Key Personnel

Title	Code
Head, Office of Counsel	1008
Associate Counsel/General Law	1008.1
Associate Counsel/Intellectual Property	1008.2
Associate Counsel/SSC Legal Matters	1008.3

**Point of contact:** Code 1008.1, (202) 767-7605

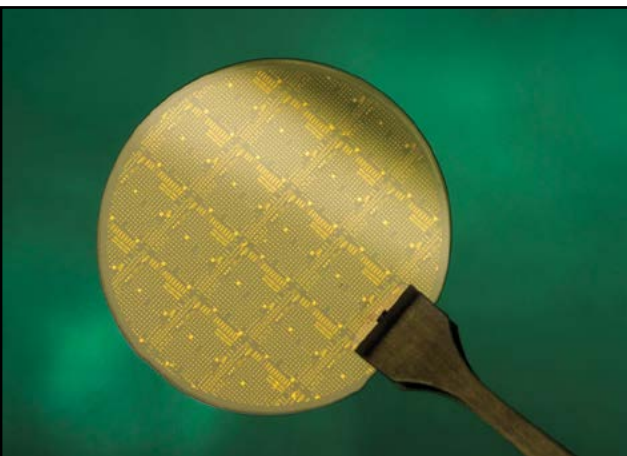
# Institute for Nanoscience

## Code 1100 Staff Activity Areas

- Interdisciplinary nanoscience that enables:
  - Low-power, high-speed electronics
  - Lightweight, high-strength materials
  - Highly sensitive molecular sensors
  - Efficient energy generation and storage



NRL researchers working in the Class 100 clean room in the Institute for Nanoscience.



Wafer on graphene transistors.



Transmission electron microscope located in one of the Institute for Nanoscience's environmentally controlled laboratories.



DR. E.S. SNOW<sup>+</sup>

## Code 1100

### Basic Responsibilities

The Institute for Nanoscience has two primary responsibilities: to administer an interdisciplinary research program in nanoscience and to provide NRL scientists with high-quality laboratory space and state-of-the-art nanofabrication facilities.

The mission of the research program is to conduct highly innovative, interdisciplinary research at the intersections of the fields of materials, electronics, and biology in the nanometer size domain. The Institute exploits the broad multidisciplinary character of NRL to bring together scientists and engineers with disparate training and backgrounds to attack common goals at the intersection of their respective fields at this length scale. The Institute's S&T programs provide the Navy and DoD with scientific leadership in this complex, emerging area and help to identify opportunities for advances in future defense technology.

The Institute also operates a nanoscience research building containing nanofabrication facilities and environmentally controlled measurement laboratories. The central core of the building, a 5000 sq ft Class 100 clean room, has been outfitted with the newest tools to permit nanofabrication, measurement, and testing of devices. In addition to the clean room facility, the building also contains 5000 square feet of controlled-environment laboratory space, which is available to NRL researchers whose experiments are sufficiently demanding to require this space. There are 12 of these laboratories within the building. They provide shielding from electromagnetic interference, and very low floor vibration and acoustic levels. Eight of the laboratories control the temperature to within  $\pm 0.5$  °C and four to within  $\pm 0.1$  °C.

**Personnel:** 3.5 full-time civilian

### Key Personnel

Title	Code
Director, Institute for Nanoscience	1100
Position Assistant	1100
Facilities Manager	1100
Facilities Manager	1100

**Point of Contact:** Code 1100, (202) 767-1804

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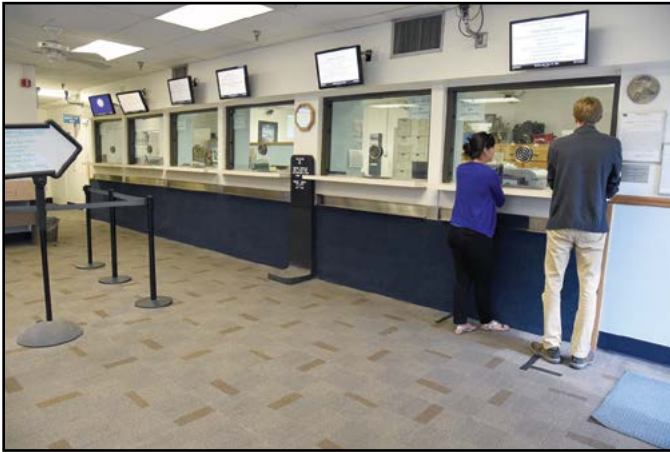
<sup>+</sup>Additional Duty



# Command Support Division

## Code 1200 Staff Activity Areas

- Security



Incoming visitor reception area

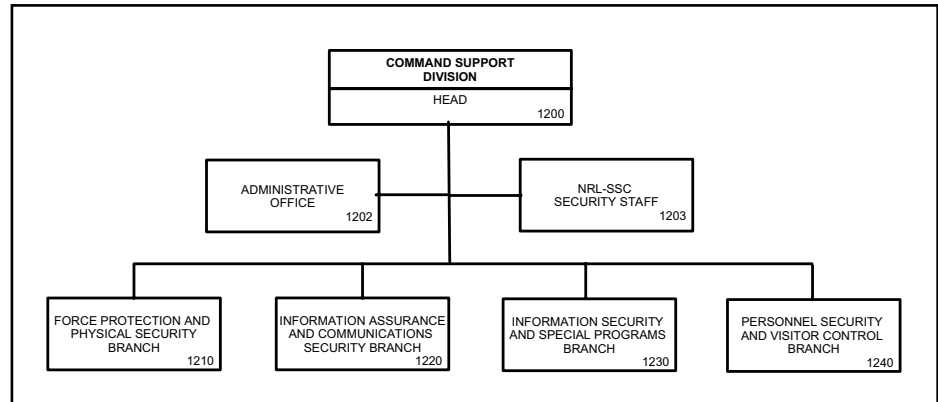


Security monitoring





MR. T. BREWER



## Basic Responsibilities

The Command Support Division is responsible for NRL security policy, management, and enforcement. The Division Head is the NRL Security Manager. The primary areas of security are: information assurance, information security, personnel security, industrial security, classification management, public release, foreign disclosure, physical security, force protection, antiterrorism, operations security, special security programs, and communications security. Provides security education across all security disciplines. Conducts local inspections for compliance with current internal and external policies. Provides advice and guidance to senior NRL management concerning the security posture of the Command. Provides administrative budget support to the Military Support Division (Code 1400) and Scientific Development Squadron One (VXS-1, Code 1600).

**Personnel:** 66 full-time civilian

## Key Personnel

Title	Code
Head, Command Support Division	1200
Administrative Officer	1202
Head, Stennis Space Center Security Staff	1203
Head, Force Protection and Physical Security Branch	1210
Head, Information Assurance and Communications Security Branch	1220
Head, Information Security and Special Programs Branch	1230
Head, Personnel Security and Visitor Control Branch	1240

**Point of contact:** Code 1202, (202) 767-6987

# Military Support Division

## Code 1400 Staff Activity Areas

- Operations
- Administrative Operations



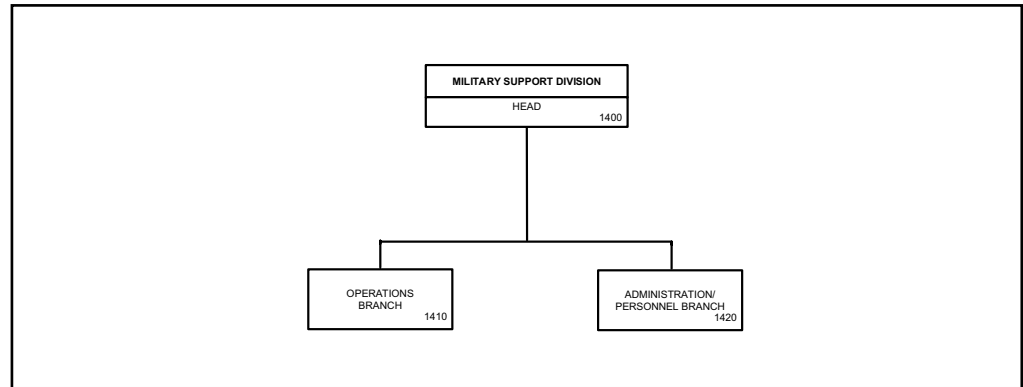
P-3 airborne research platform



Administration



CDR D.A. Ursini, USN\*



## Basic Responsibilities

The Military Support Division provides military operational and administrative services to NRL.

The Operations Branch assists NRL research directorates in planning and executing project flight missions, develops deployment schedules and military operational and training objectives, and coordinates the Research Reserve Program within NRL.

The Military Administration Branch is responsible for the coordination and efficient functioning of all military administrative operations for NRL (including site detachments). These duties specifically include: personnel actions, maintenance of personnel records, performance evaluations, awards and training; advising the Chief Staff Officer on manpower matters and organization issues; and preparing and administering the military operational budget.

**Personnel:** 1 full-time contractor; 7 military

## Key Personnel

Title	Code
Head, Military Support Division	1400
Project Officer	1410
Project Officer	1410
Project Officer	1410
Administrative Officer	1420
Administrative Yeoman	1420

**Point of contact:** Code 1420, (202) 767-2103

# Scientific Development Squadron ONE (VXS-1)

## Code 1600 Staff Activity Areas

- Projects
  - Operations
  - Safety/NATOPS/Training
- Administration
- Maintenance
  - Quality assurance
- Configurations
  - Project Liaison Officer



VXS-1 maintains two RC-12 aircraft dedicated to airborne research. They are smaller, more cost-efficient alternatives to the P-3 Orion. Each aircraft is outfitted with a research electrical load center and has a roll-on roll-off capability, which enables it to be equipped with project stations. The RC-12s can support a broad spectrum of project configurations.



Aircraft maintenance



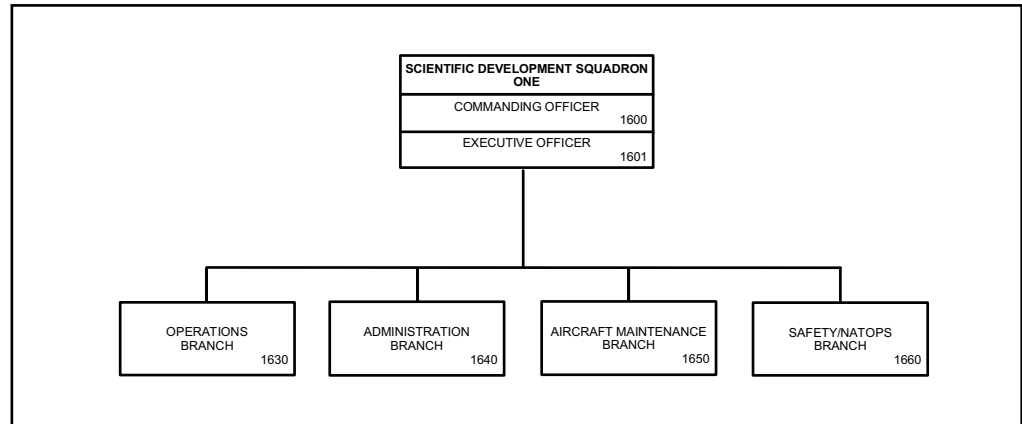
P-3 airborne research platform



Scientific Development Squadron One hangar



CDR J. PLAISANCE, USN



## Basic Responsibilities

The Scientific Development Squadron ONE (VXS-1) located at NAS Patuxent River, Maryland, operates and maintains three uniquely configured P-3 Orion aircraft and one C-12 aircraft. The men and women of the squadron provide the Naval Research Laboratory with airborne research platforms, conducting flights worldwide in support of a broad spectrum of projects and experiments. These include magnetic variation mapping, electro-optic infrared research, hydroacoustic research, bathymetry, electronic countermeasures, gravity mapping, data link, and radar research. The squadron annually logs approximately 1000 flight hours, and in its 51 years, Scientific Development Squadron ONE (VXS-1) has amassed 72,000 hours of mishap-free flying.

**Personnel:** 1 full-time civilian; 63 military; 7 full-time contractors

## Key Personnel

Title	Code
Commanding Officer, VXS-1	1600
Executive Officer	1601
Senior Enlisted Leader	1600.2
Executive Secretary	1600.4
Projects Director	1630
Operations Officer	1630.1
Safety/Quality Insurance Officer	1630.2/1650.3
NATOPS/Training Officer	1630.2
Administrative Officer/Public Affairs Officer	1640
Maintenance Officer	1650
Assistant Maintenance Officer	1650.1
Maintenance/Material Control Officer	1650.2
Projects Liaison Officer	1660

**Point of contact:** Code 1640, (301) 995-4122



# Laboratory for Autonomous Systems Research

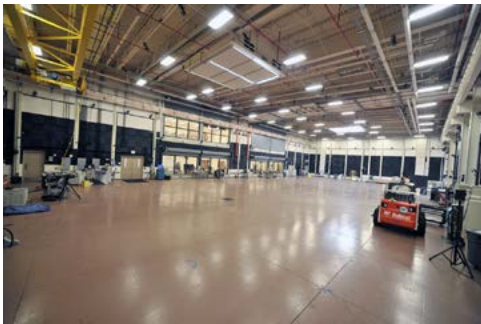
## Code 1700 Staff Activity Areas

Multidisciplinary research, development, and integration in autonomous systems, including:

- Software for intelligent autonomy
- Novel human-systems interaction technology
- Mobility and platforms
- Sensor systems
- Power and energy systems
- Networking and communications
- Trust and assurance



The Laboratory for Autonomous Systems Research integrates S&T components into research prototype systems.



The Prototyping High Bay can be used for small autonomous air vehicles, autonomous ground vehicles, and of course the people who interact with them.



The Tropical High Bay provides a simulated jungle terrain and rain forest including a flowing water feature in an enclosed greenhouse. Rain up to 6" per hour can be generated.



The Desert High Bay contains a 40 ft by 14 ft area of sand 2 feet deep, and contains 18-foot-high rock walls that allow testing of robots and sensors in a desert-like environment. We can introduce blowing sand, and can control the lighting in that environment.

The Littoral High Bay features a 45 ft by 25 ft by 5.5 ft deep pool. This pool has a 16-channel wave generator, allowing us to create directional waves. The Littoral High Bay has a variety of sediment tanks for testing sensors and energy-harvesting devices.





MR. A.C. SCHULTZ<sup>+</sup>

## Code 1700

### Basic Responsibilities

The Laboratory for Autonomous Systems Research provides specialized facilities to support highly innovative, interdisciplinary research in autonomous systems, including software for intelligent autonomy, sensor systems, power and energy systems, human-systems interaction, networking and communications, and platforms and mobility. The Laboratory capitalizes on the broad multidisciplinary character of NRL, bringing together scientists and engineers with disparate training and backgrounds to advance the state of the art in autonomous systems at the intersection of their respective fields. The Laboratory provides unique facilities and simulated environments (littoral, desert, tropical) and instrumented reconfigurable high bay spaces to support integration of science and technology components into research prototype systems. The objective of the laboratory is to enable Naval and DoD scientific leadership in this complex, emerging area and to identify opportunities for advances in future defense technology.

The facility includes a Reconfigurable Prototyping High Bay that allows real-time, accurate tracking of many entities (vehicles and humans) for experimental ground truth. Small UAVs and ground vehicles can simultaneously operate within the large high bay, which is viewable from four adjacent Human-System Interaction labs. The Tropical High Bay emulates a rainforest with appropriate terrain and plants, and includes flowing water features. An outdoor Highland Forest provides an additional forest environment, and also includes interesting water and terrain features. The Desert High Bay provides a simulated desert environment featuring a sand pit, natural rock walls, and appropriate lighting and wind. The Littoral High Bay provides a simulated coastal environment featuring sediment tanks, large pool with a sloping floor, and small flow tanks. In addition to the environmental high bays, the facility also has a Power and Energy Laboratory, a Sensor Laboratory, and a mechanical and electrical shop.

The facility is open to use by all NRL scientists contributing to the science and technology of autonomous systems and will host many NRL scientists as needed.

**Personnel:** 3.5 full-time civilian

### Key Personnel

Title	Code
Director, Laboratory for Autonomous Systems Research	1700
Facilities Manager	1700
Secretary	1700

**Point of contact:** Code 1700, (202) 767-0792

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<sup>+</sup>Additional Duty



# Human Resources Office

## Code 1800 Staff Activity Areas

- Personnel Operations (Staffing and Classification)
- Employee Relations
- Employee Development
- Equal Employment Opportunity and Manpower
- Compensation, Reports, and Demonstration Project
- Information Technology and Reports



Personnel Operations Branch



Diversity and Employee Recognition Branch



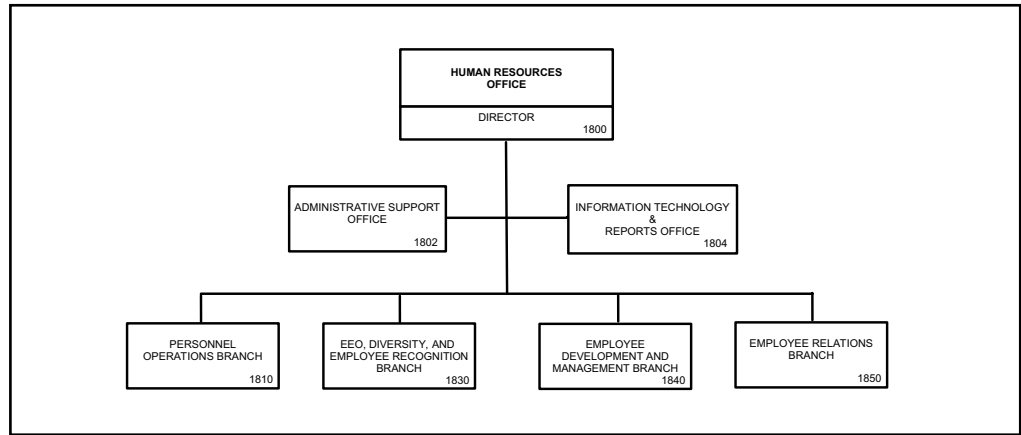
Employee Development and Management Branch



Employee Relations Branch



Ms. C.L. DOWNING\*



## Basic Responsibilities

The Human Resources Office (HRO) provides civilian personnel, manpower, and Equal Employment Opportunity (EEO) services to the Naval Research Laboratory. The Human Resources Program provides the full range of operating civilian personnel management in the staffing and placement, position classification, employee relations, labor relations, employee development, EEO functional areas, manpower management, and morale, welfare, and recreation programs.

The HRO at NRL's main site in Washington, DC, services approximately 2,500 employees and provides a centralized capability to perform managerial, service, and advisory functions in support of field office operations. These include issuing policy and procedural directives; developing, designing, and maintaining automated systems; and monitoring and evaluating product effectiveness to develop and maintain efficient, cost-effective, service-oriented methods.

**Personnel:** 30 full-time civilian

## Key Personnel

Title	Code
Director, Human Resources Office	1800
Administrative Officer	1802
Head, Information Technology and Reports Office	1804
Head, Personnel Operations Branch	1810
Head, EEO, Diversity, and Employee Recognition Branch	1830
Head, Employee Development and Management Branch	1840
Head, Employee Relations Branch	1850

**Point of contact:** Code 1802, (202) 404-2797

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\*Acting

# Ruth H. Hooker Research Library

**Code 5596**



Ms. S.M. RYDER

## Basic Responsibilities

NRL's Ruth H. Hooker Research Library supports NRL and ONR scientists in conducting their research by making a comprehensive collection of the most relevant scholarly information available and useable; by providing direct reference and research support; by capturing and organizing the NRL research portfolio; and by creating, customizing, and deploying a state-of-the-art digital library. Traditional library resources include extensive technical report, book, and journal collections dating back to the 1800s housed within a centrally located research facility that is staffed by subject specialists and information professionals. The collections include 44,000 books; 80,000 digital books; 80,000 bound historical journal volumes; more than 3,500 current journal subscriptions; and approximately 2 million technical reports in paper, microfiche, or digital format (classified and unclassified). Research Library staff members provide advanced information consulting; literature searches against all major online databases including classified databases; circulation of materials from the collection including classified literature up to the Secret level; and retrieval of articles, reports, proceedings, or documents through our interlibrary loan and document delivery network. The digital library provides desktop access to thousands of journals, books, proceedings, reports, databases, and reference sources.

**Personnel:** 21 full-time civilian

## Key Personnel

Title	Code
Chief Librarian	5596
Head, Research Reports and Bibliography	5596.3
Library IT Director	5596.2

**Point of contact:** Code 5596, (202) 767-2357



# **BUSINESS OPERATIONS DIRECTORATE**

## **BUSINESS OPERATIONS DIRECTORATE**

**Code 3000**

The Business Operations Directorate provides executive management, policy development, and program administration for business programs needed to support the activities of the scientific directorates. This support is in the areas of financial management, supply management, technical information services, contracting, research and development services, and management information systems support.



## Associate Director of Research for Business Operations



**Mr. D.K. Therning** was born in Modesto, California. He graduated from Washington State University with a bachelor's degree in finance in 1983 and earned a master's degree in business administration from George Mason University in 1993. Mr. Therning has accumulated extensive experience in the financial business management of research, development, test, and evaluation (RDT&E) activities within the Department of the Navy (DON) beginning at the Naval Weapons Center, China Lake, California, where he served as a budget analyst in the Public Works Department and then in the Weapons Department. In 1984, he became the Financial Management Advisor to the Ordnance Systems Department. In 1985, under the auspices of

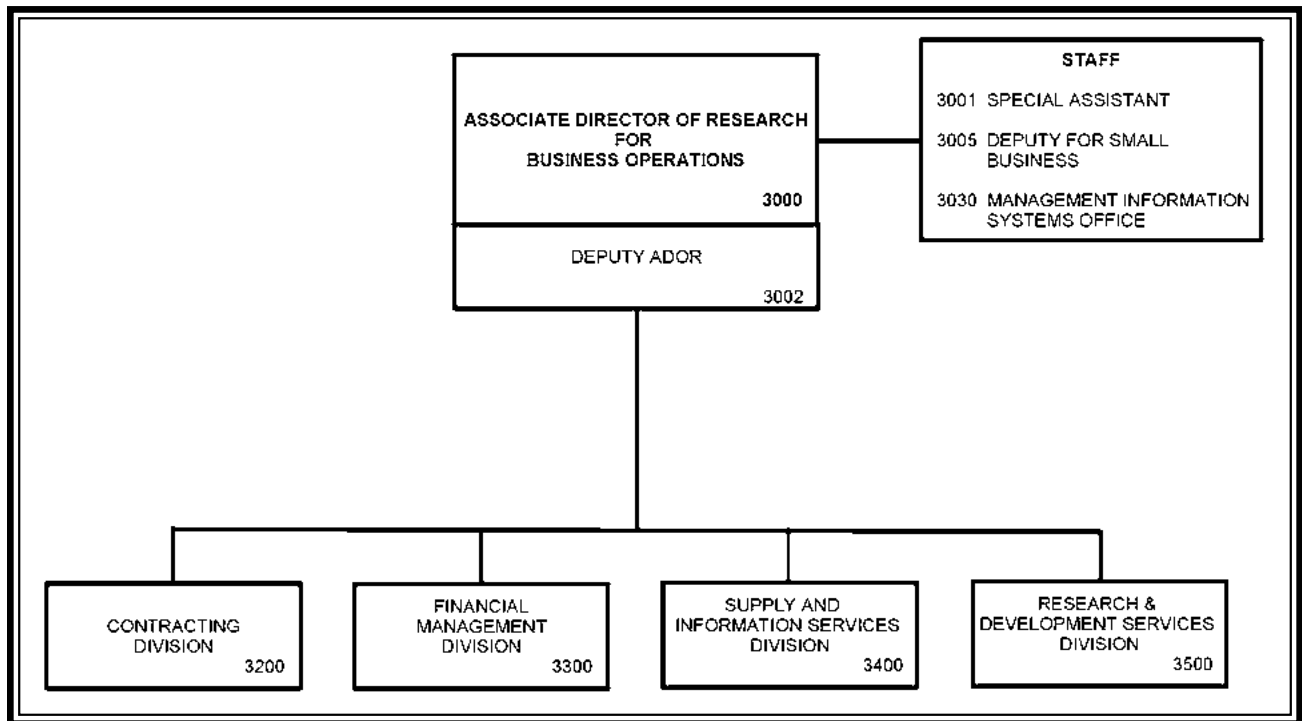
the Naval Scientist Training and Exchange Program, he was selected for a one-year assignment in the Office of the Director of Naval Laboratories (DNL), Washington, DC. He remained on the DNL staff as a budget analyst until 1987, when he was appointed Budget Officer of the DNL's seven Navy Industrial Fund R&D laboratories.

As the DON reorganized the R&D laboratories and T&E activities, Mr. Therning oversaw the financial reorganization of the DNL labs with other activities into the Naval warfare centers. Upon the disestablishment of DNL, Mr. Therning remained in the Space and Naval Warfare Systems Command as the Director of the Defense Business Operations Fund (DBOF) Resources Management Division, with collateral duty as the Financial Manager of the Naval Command, Control, and Ocean Surveillance Center (NCCOSC). During this time, he managed the conversion of nine appropriated fund engineering activities to DBOF and the financial consolidation of these activities with NCCOSC.

In 1995, Mr. Therning served as Head of the Revolving Funds Branch of the Office of the Assistant Secretary of the Navy (Financial Management and Controller), where he was responsible for the budget formulation and execution processes of all DON DBOF activities, which includes the RDT&E activities, shipyards, aviation depots, ordnance centers, and supply centers.

Mr. Therning was appointed Head, Financial Management Division/Comptroller of NRL in July 1996. In October 1996, in addition to leading the Financial Management Division, he assumed responsibilities for the Management Information Systems office. In January 1999, as an additional duty to his role as Comptroller, Mr. Therning was appointed to the newly established position of Deputy Associate Director of Research for Business Operations to assist in the management and administration of the Business Operations Directorate.

Mr. Therning was Acting Associate Director of Research for Business Operations from April 1999 until March 2000, when he was appointed the Associate Director of Research for Business Operations.



### Key Personnel

Title	Code
Associate Director of Research for Business Operations	3000
Special Assistant	3001
Deputy Associate Director of Research for Business Operations	3002
Deputy for Small Business	3005
Head, Management Information Systems Office	3030
Head, Contracting Division	3200
Head, Financial Management Division	3300
Head, Supply and Information Services Division	3400
Director, Research and Development Services Division	3500

**Point of contact:** Code 3000A, (202) 404-7461

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\* Acting



# Contracting Division

## Code 3200 Staff Activity Areas

- Advance Acquisition Planning
- Acquisition Strategies
- Acquisition Training
- Contract Negotiations
- Contractual Execution
- Contract Administration
- Acquisition Policy Interpretation and Implementation



Customers are greeted at the receptionist station.



Contracting personnel attend training session.



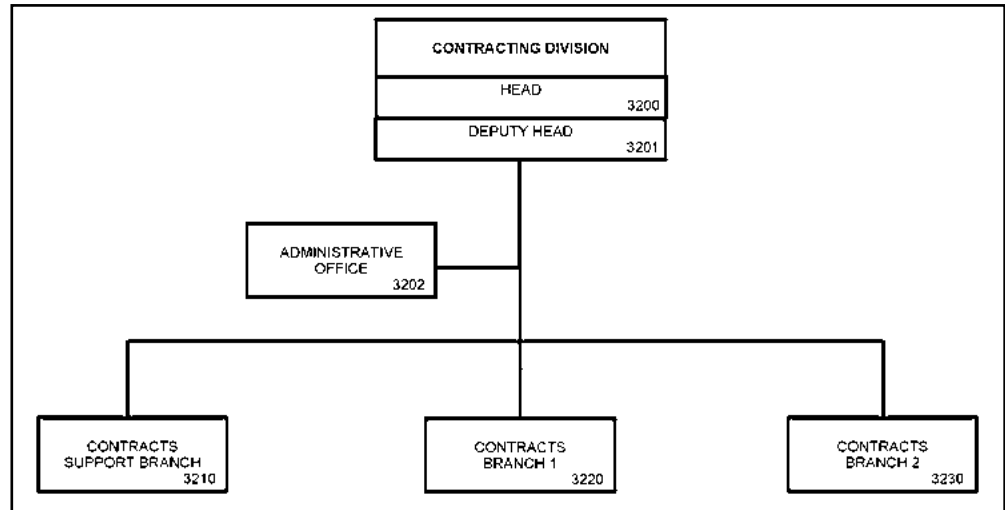
Procurement Technician reviews contract file.



Specialist and Division Head discuss small business programs.



Ms. C.A. HARTMAN\*



### Basic Responsibilities

The Contracting Division is responsible for the acquisition of major research and development materials, services, and facilities where the value is in excess of \$150,000. It also maintains liaison with the ONR Procurement Directorate on procurement matters involving NRL. Specific functions include: providing consultant and advisory services to NRL division personnel on acquisition strategy, contractual adequacy of specifications, and potential sources; reviewing procurement requests for accuracy and completeness; initiating and processing solicitations for procurement; awarding contracts; performing contract administration and post-award monitoring of contract terms and conditions, delivery, contract changes, patents, etc., and taking corrective actions as required; providing acquisition-related training to division personnel; and interpreting and implementing acquisition-related Federal, Department of Defense, and Navy regulations.

**Personnel:** 40 full-time civilian

### Key Personnel

Title	Code
Head, Contracting Division	3200
Deputy Head	3201
Administrative Officer	3202
Contracts Support Branch	3210
Head, Contracts Branch 1	3220
Head, Contracts Branch 2	3230
Team Lead, Contracts Section, SSC	3235

**Point of contact:** Code 3202, (202) 767-3749

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\*Acting

# Financial Management Division

## Code 3300 Staff Activity Areas

- Budget
- Reports and Statistics
- Accounting
- Travel Services
- Payroll Liaison
- Audit Readiness



The Financial Improvement and Audit Readiness team ensures that NRL is ready for a independent financial audit in accordance with Secretary of Defense and congressional mandates. They perform independent audit readiness testing, develop corrective action recommendations, and serve as NRL's liaison with the Navy's Financial Management Operations office.



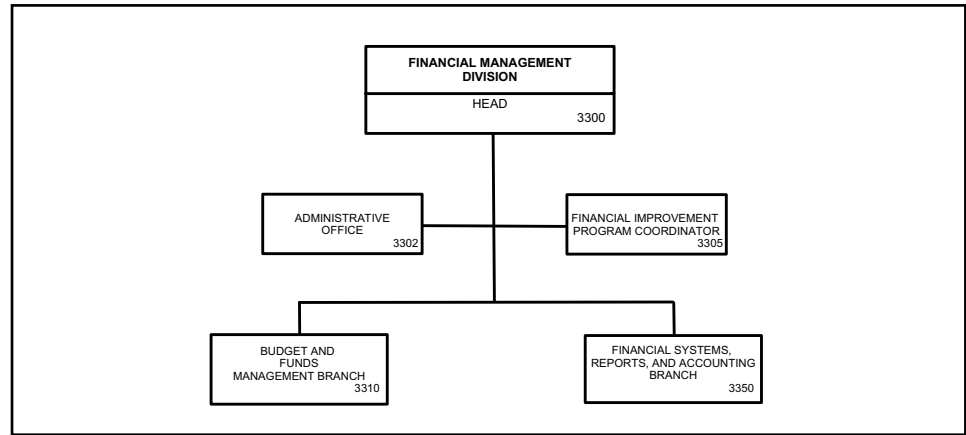
The Budget Branch prepares various financial analyses, reports, and studies in response to external data calls and/or management requests.



The Financial Systems, Reports, and Accounting Branch ensures that NRL's financial system satisfies user requirements and is in compliance with applicable rules and regulations, maintains official accounting records, and coordinates efforts with DFAS to complete payment transactions related to NRL business.



Ms. H.L. FINCH



## Basic Responsibilities

The Financial Management Division (FMD) develops, coordinates, and maintains an integrated system of financial management that provides the Comptroller, Commanding Officer, Director of Research, and other officials of NRL the information and support needed to fulfill the financial and resource management aspects of their responsibilities. FMD translates the NRL program requirements into the financial plan, formulates the NRL budget, monitors and evaluates performance with the budget plan, and provides recommendations and advice to NRL management for corrective actions or strategic program adjustments. FMD maintains the accounting records of NRL's financial and related resources transactions and prepares reports, financial statements, and other documents in support of NRL management needs and /or to comply with external reporting requirements. FMD provides financial management guidance, policies, advice, and documented procedures to ensure that NRL operates in compliance with Navy and DoD regulations and with economy and efficiency. FMD coordinates efforts with the Defense Finance and Accounting Service (DFAS) to complete payment transactions related to NRL business (e.g., the payment of NRL personnel for payroll and travel expenses and the payment to NRL's contractors and vendors for goods and services purchased by NRL). FMD coordinates Financial Improvement and Audit Readiness efforts to ensure NRL is ready for an independent financial audit. Additionally, FMD develops, operates, and maintains automated business and management information systems supporting the lab-wide administrative and business processes, including financial management, procurement and contracting, stores and inventory, asset management, human resources, facilities, and security.

**Personnel:** 68 full-time civilian

## Key Personnel

Title	Code
Head, Financial Management Division	3300
Administrative Officer	3302
Financial Improvement and Audit Readiness Coordinator	3305
Head, Budget and Funds Management Branch	3310
Head, Funding Section	3311
Head, Internal Budget Section	3312
Head, Corporate Budget Section	3313
Head, Financial Systems, Reports, and Accounting Branch	3350
Head, Cost Accounting Section	3351
Cost and Analysis Unit	3351.1
Head, Vendor Pay Unit	3351.2
Head, Financial Services Section	3352
Head, Payroll Services Unit	3352.1
Head, Travel Services Unit	3352.2
Head, Accounting Systems and Reports Section	3353
Head, Asset Management and Accounting Section	3354

**Point of contact:** Code 3302, (202) 767-2950



# Supply and Information Services Division

## Code 3400 Staff Activity Areas

- Purchasing
- Technical Information Services
- Customer Support and Program Management
- Material Control
- Administrative Services
- Automated Inventory Management System
- Disposal and Storage



Woodworkers prepare boxes for shipping.



Employees of the Administrative Services Branch discuss NRL electronic forms.



Customers and employee at the Supply store.



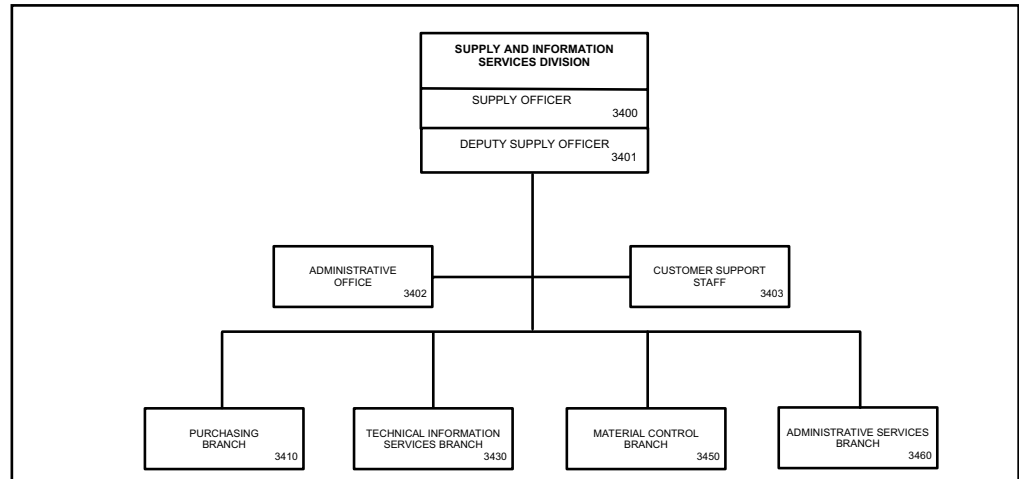
Disposal and storage in Building 49.



Photographer and videographer capture footage for a technical presentation.



Ms. C.A. HARTMAN



### Basic Responsibilities

The Supply and Information Services Division provides the Laboratory and its field activities with contracting, supply management, logistics, administrative, and technical information services. Specific functions include: procuring required equipment, material, and services; receiving, inspecting, storing, and delivering material and equipment; packing, shipping, and traffic management; surveying and disposing of excess and unusable property; operating various supply issue stores and performing stock inventories; providing technical and counseling services for the research directorates in the development of specifications for a complete procurement package; and obtaining and providing guidance in the performance stages of contractual services. Services also include publications, visual information, exhibits, photography, editing, and mailroom services and correspondence management.

**Personnel:** 81 full-time civilian; 1 part-time civilian

### Key Personnel

Title	Code
Supply Officer	3400
Deputy Supply Officer	3401
Administrative Officer	3402
Head, Customer Support Staff	3403
Head, Purchasing Branch	3410
Head, Technical Information Services Branch	3430
Head, Material Control Branch	3450
Head, Administrative Services Branch	3460

**Point of contact:** Code 3402, (202) 404-1701



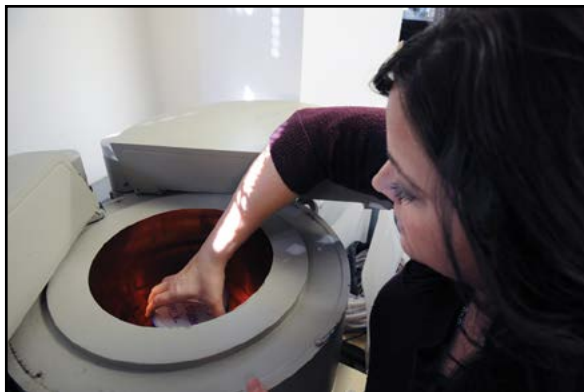
# Research and Development Services Division

## Code 3500 Staff Activity Areas

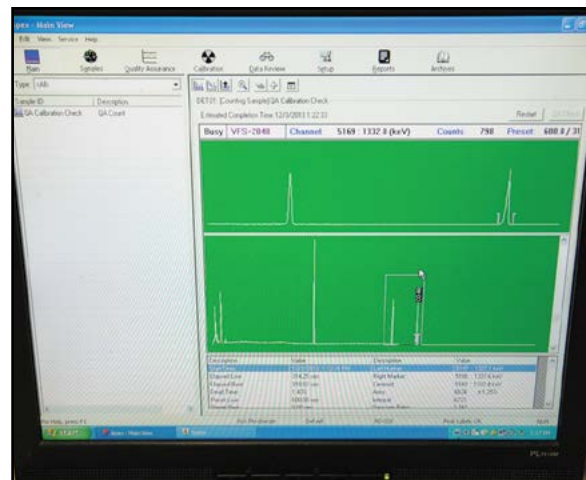
- Engineering
- Production Control and Transportation
- Shop Services
- Chesapeake Bay Facilities Management
- Customer Liaison
- Safety and Occupational Health/Industrial Hygiene
- Explosives Safety
- Health Physics
- Environmental
- Utilities
- Telephones
- Facilities Planning and Operations



Safety and Occupational Health — respirator fit testing for research support personnel.

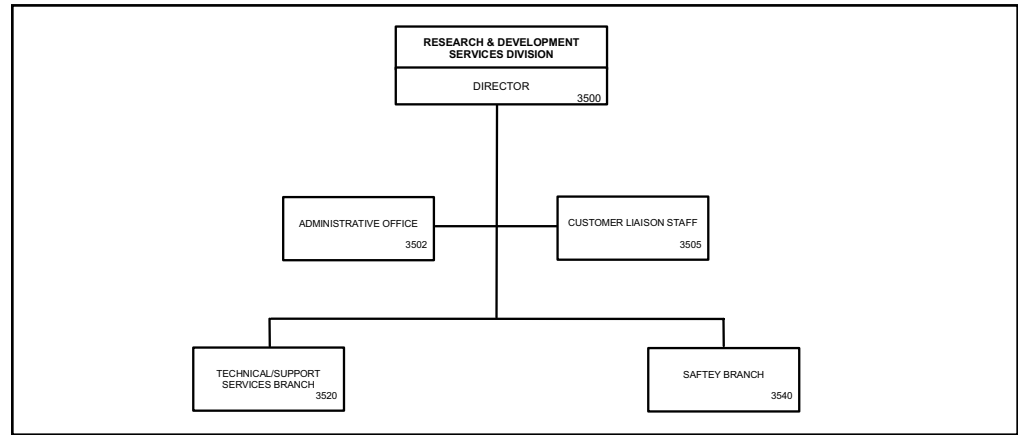


Health physics — analyzing samples for radioactive material.





Mr. T.K. HULL, JR.



## Basic Responsibilities

The Research and Development Services Division is responsible for the physical plant of the Naval Research Laboratory and subordinate field sites. The responsibilities include military construction, engineering, and coordination of construction; facility support services, planning, maintenance/repair/operation of all infrastructure systems; transportation; and occupational safety, health and industrial hygiene, and environmental safety.

The Division provides engineering and technical assistance to research divisions in the installation and operation of critical equipment in support of the research mission.

**Personnel:** 154 full-time civilian

## Key Personnel

Title	Code
Director, Research and Development Services Division	3500
Administrative Officer	3502
Customer Liaison	3505
Head, Technical/Support Services Branch	3520
Head, Engineering Section	3521
Head, Chesapeake Bay Section	3522
Head, Shop Services Section	3523
Head, Production Control Section	3524
Head, Facilities, Planning and Operations Section	3525
Head, Safety Branch	3540
Occupational Safety and Health/Industrial Hygiene Section	3541
Explosives Safety	3542
Health Physics Section	3544
Environmental Section	3546
Environmental Response Unit	3546.1

**Point of contact:** Code 3502, (202) 404-4312

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\* Acting

# **SYSTEMS DIRECTORATE**



# SYSTEMS DIRECTORATE

## Code 5000

The Systems Directorate applies the tools of basic research, concept exploration, and engineering development to expand operational capabilities and to provide materiel support to Fleet and Marine Corps missions. Emphasis is on technology, devices, systems, and know-how to acquire and move warfighting information and to deny these capabilities to the enemy. Current activities include:

- New and improved radar systems to detect and identify ever smaller targets in the cluttered littoral environment;
- Optical sensors and related materials to extract elusive objects in complex scenes when both processing time and communications bandwidth are limited;
- Unique optics-based sensors for detection of biochemical warfare agents and pollutants, for monitoring structures, and for alternative sensors;
- Advanced electronic support measures techniques for signal detection and identification;
- Electronic warfare systems, techniques, and devices including quick-reaction capabilities;
- Innovative concepts and designs for reduced observables;
- Techniques and devices to disable and/or confuse enemy sensors and information systems;

- Small “intelligent”/autonomous land, sea, or air vehicles to carry sensors, communications relays, or jammers; and

- High performance/high assurance computers with right-the-first-time software and known security characteristics despite commercial off-the-shelf components and connections to public communications media.

Many of these efforts extend from investigations at the frontiers of science to the support of deployed systems in the field, which themselves provide direct feedback and inspiration for applied research and product improvement and/or for quests for new knowledge to expand the available alternatives.

In addition to its wide-ranging multidisciplinary research program, the Directorate provides support to the corporate laboratory in shared resources for high performance computing and networking, technical information collection and distribution, and in coordination of Laboratory-wide efforts in signature technology, counter-signature technology, Theater Missile Defense, and the Naval Science Assistance Program.

## Associate Director of Research for Systems

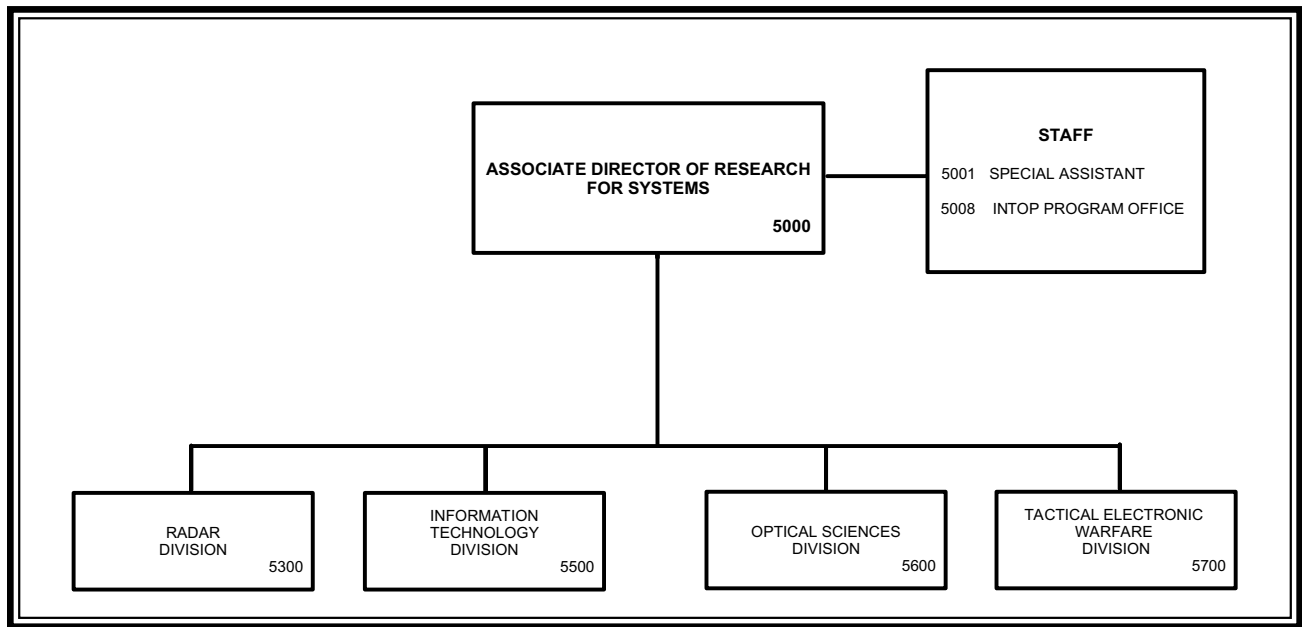


**D**r. G.M. Borsuk is the Associate Director of Research for Systems at the Naval Research Laboratory (NRL) in Washington, DC. In this position he provides executive direction and leadership to four major NRL research divisions that conduct a broad multidisciplinary program of scientific research and advanced technological development in the areas of optics, electromagnetics, information technology, and radar. He is responsible for the conduct and effectiveness of research programs conducted within these divisions and for the overall administration of activities throughout the Systems Directorate. He is also the Focus Area Coordinator

for all NRL base programs in electronics science and technology. Prior to this appointment, Dr. Borsuk served for 23 years as the Superintendent of the Electronics Science and Technology Division at NRL where he was responsible for the in-house execution of a multidisciplinary program of basic and applied research in electronic materials and structures, solid state devices, vacuum electronics, and circuits. Dr. Borsuk also serves as the Technical Chair of the DDR&E's Electronic Warfare Technology Task Force (EWTTF). He was the Navy Deputy Program Manager and Technical Director for the now completed DARPA/Tri-Service MIMIC and MAFET Programs. He was the Department of Defense (DoD) technical representative for Electronics to the Wassenaar Arrangement dealing with export control. He has also served as the DoD representative to the President's National Science and Technology Council's Electronic Materials Working Group.

Dr. Borsuk joined the ITT Electro-Physics Laboratory in Columbia, Maryland, as a staff physicist in 1973, where he worked on the application of charge-coupled devices (CCDs) for imaging and signal processing. In 1976 he joined the Westinghouse Advanced Technology Laboratory in Baltimore, Maryland, developing advanced silicon VLSI integrated circuits and performing device physics research. He performed original work in the design and fabrication of CCDs for signal processing and photodetectors for use with acousto-optic signal processors. He headed the Westinghouse VHSIC effort in advanced sub-micron VLSI device technology. Dr. Borsuk was department manager of Solid State Sciences at the Advanced Technology Laboratory when he left Westinghouse in 1983 to join the Naval Research Laboratory as the Superintendent of the Electronics Science and Technology Division.

Dr. Borsuk received a Ph.D. in physics from Georgetown University in Washington, DC, in 1973. He is a Fellow of the IEEE, a member of the American Physical Society, a member of the AVS, and is a member of Sigma Xi. He has 37 technical publications, four patents, and eleven invention disclosures. He is the recipient of four Presidential Rank Senior Executive Awards, the Distinguished, the most recent awarded in 2010. He is also the recipient of the IEEE Frederik Philips Award, the IEEE Harry Diamond Memorial Award, the IEEE Millennium Medal, and an IR-100 Award for his work on high-speed CCDs. Dr. Borsuk also served on the editorial board of the IEEE Proceedings.



### Key Personnel

Title	Code
Associate Director of Research for Systems	5000
Special Assistant	5001
Special Consultant	5007
Head, InTop Program Office	5008
Superintendent, Radar Division	5300
Superintendent, Information Technology Division	5500
Superintendent, Optical Sciences Division	5600
Superintendent, Tactical Electronic Warfare Division	5700

**Point of contact:** Code 5000A, (202) 767-3324

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\* Acting



# Radar Division

## Code 5300 Staff Activity Areas

Shipboard radar systems  
Small target detection  
Maritime Domain Awareness  
Networked Radar Concepts (FlexDAR)  
High-power millimeter-wave radar

### Radar Analysis

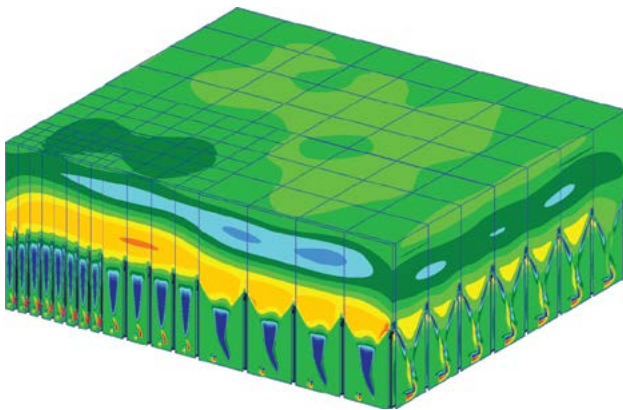
Target signature prediction  
Electromagnetics and antennas  
Airborne early-warning radar (AEW)  
Inverse synthetic aperture radar (ISAR)  
Sea clutter modeling  
Periscope detection  
Wideband array simulation and fabrication

### Advanced Radar Systems

High-frequency over-the-horizon radar systems  
HF Radar Technology  
Signal analysis  
Real-time signal processing and equipment  
Computer-aided engineering (CAE)  
Optimization techniques  
FPGA-based digital processing

### Surveillance Technology

Shipboard surveillance radar  
Ship self-defense  
Electronic counter-countermeasures and electronic protection (EP)  
Target signature and information extraction  
T/R module technologies  
Asymmetric and expeditionary warfare spectrum management  
Ultrawideband technology  
Dynamic waveform diversity  
Multistatic radar network information  
Ballistic missile defense  
Mine detection



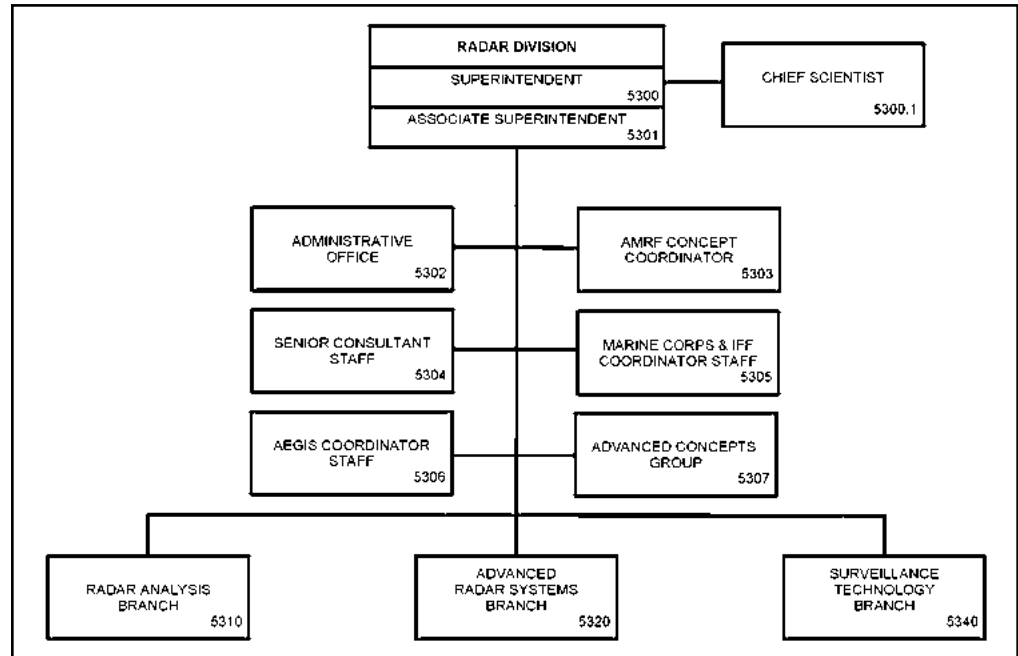
Wavelength scaled array: an ultrawideband array concept providing constant beamwidth across 8:1 bandwidth; designed using NRL-developed Domain Decomposition Algorithm.



The Advanced Multifunction RF Concept (AMRFC) test bed is a proof-of-principle demonstration system capable of simultaneously transmitting and receiving multiple beams from common transmit and receive array antennas for radar, electronic warfare, and communications. This testbed will be expanded to support the FlexDAR program.



DR. B.G. DANLY



## Basic Responsibilities

The Radar Division conducts research on basic physical phenomena of importance to radar and related sensors, investigates new engineering techniques applicable to radar, demonstrates the feasibility of new radar concepts and systems, performs related systems analyses and evaluation of radar, and provides special consultative services. The emphasis is on new and advanced concepts and technology in radar and related sensors that are applicable to enhancing the Navy's ability to fulfill its mission.

**Personnel:** 80 full-time civilian

## Key Personnel

Title	Code
Superintendent, Radar Division	5300
Chief Scientist	5300.1
Associate Superintendent	5301
Administrative Officer	5302
AEGIS Coordinator	5306
Head, Advanced Concepts Group	5307
Head, Radar Analysis Branch	5310
Head, Advanced Radar Systems Branch	5320
Head, Surveillance Technology Branch	5340

**Point of contact:** Code 5300, (202) 404-2700

# Information Technology Division

## Code 5500 Research Activity Areas

### **Freespace Photonics Communications Office**

- Extended spectrum communications
- Atmospheric channel effects on photonic transfer
- Studies in marine miraging
- Analog modulation techniques on freespace optical carriers
- Modulating retroreflector based communications
- Signature studies for ISR
- Adaptive optics for freespace optical communications

### **Adversarial Modeling and Exploitation Office**

- Behavioral indicators of hostile intent
- Suspicious behavior detection research
- Behavioral modeling, analysis, and metrics
- Deception detection research
- Geospatial modeling and simulation
- Spatially integrated social science
- Automated video analysis and retrieval

### **Navy Center for Applied Research in Artificial Intelligence**

- Intelligent decision aids
- Natural language and multimodal interfaces
- Intelligent software agents
- Machine learning and adaptive systems
- Robotics software and computer vision
- Neural networks
- Novel devices/techniques for HCI
- Spatial audio
- Immersive simulation
- Autonomous and intelligent systems
- Case-based reasoning and problem-solving methods
- Machine translation technology evaluation
- Cognitive architectures
- Human-robot interaction

### **Transmission Technology**

- Communication system architecture
- Communication antenna/propagation technology
- Communications intercept systems
- Virtual engineering
- Secure voice technology
- Satellite and tactical networking
- Satellite communications research
- Satellite architecture analysis
- RF systems analysis

### **Center for High Assurance Computer Systems**

- Secure Enterprise Architectures (SEA)
- Formal specification/verification of system security
- COMSEC application technology
- Technology and solutions to secure networks and databases
- Software engineering for secure systems
- Key management and distribution solutions
- Information systems security (INFOSEC) engineering
- Formal methods for requirements specification and verification
- Security product development
- Secure wireless network and wireless sensor technology
- Network security protocol modeling, simulation, and verification
- Cross-domain solution technology development
- Computer Network Defense (CND) technology
- Hardware/software co-design

- Malicious code analysis
- Information hiding (watermarking, covert channel analysis, etc.)
- Anonymizing systems
- Quantum information science
- Logical foundations of security

### **Networks and Communication Systems**

- Communication system engineering
- Mobile, wireless networking technology
- Bandwidth management (quality of service)
- Joint service tactical networking
- Integration of communication and C2 applications
- Automated testing of highly mobile tactical networks
- Reliable multicast protocols and applications
- Communication network simulation
- Networking protocols for directional antennas
- Policy-based network management
- Tactical voice-over IP
- Sensor networks
- Advanced tactical data links
- Cognitive radio technology

### **Information Management and Decision Architectures**

- Virtual reality/mobile augmented reality
- Visual analytics
- Scientific visualization
- Computer graphics
- Human-computer interaction
- Service oriented architecture
- Service orchestration
- Data and information management
- Human-centered design
- Parallel and distributed computation
- Distributed modeling and simulation
- Natural environments for distributed simulation
- Intelligent decision support
- Information sharing
- Semantic web technology
- Data mining
- Software agents for data fusion

### **Center for Computational Science**

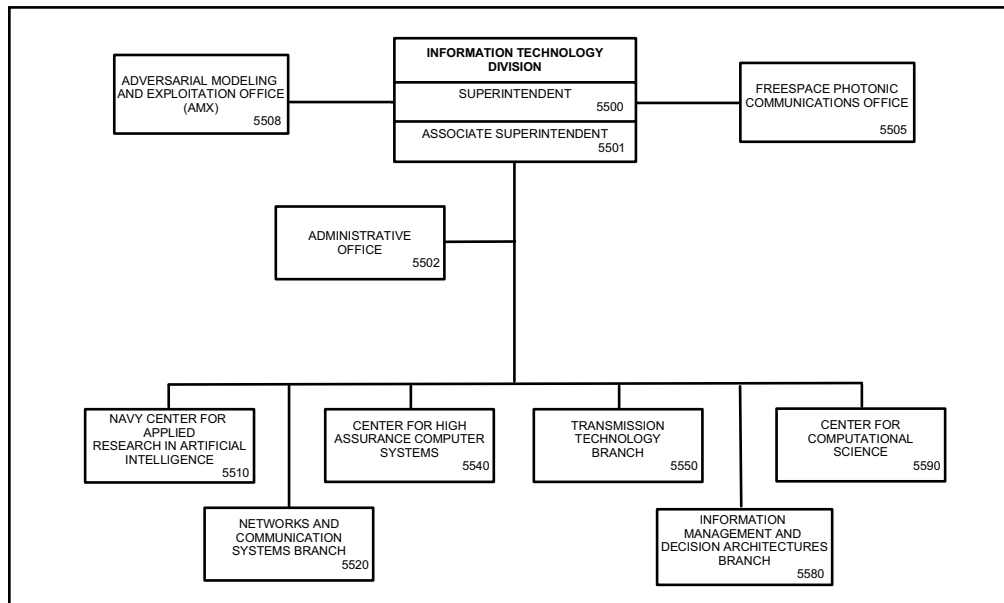
- Transparent optical network research and design
- Parallel computing
- Scalable high performance computing and networking for Navy and DoD
- Large data in distributed computing
- Scientific visualization
- High-performance file systems
- High-definition video technology
- NRL labwide computer network and related services
- Labwide support for web, email, and other information services
- ATDnet and leading-edge WAN research networks

### **Ruth H. Hooker Research Library**

- Desktop/workbench access to relevant scientific resources
- NRL scientific digital archive (TORPEDO)
- Authoritative database of NRL-produced publications (NRL Online Bibliography)
- Comprehensive literature/citation/classified searches
- Extensive collection of print and digital books, journals, and technical reports



Dr. J.D. McLEAN



## Basic Responsibilities

The Information Technology Division conducts basic research, exploratory development, and advanced technology demonstrations in the collection, transmission, processing, presentation, and distribution of information to provide information superiority and distributed networked force capabilities that improve Naval operations across all mission areas. The Division provides immediate solutions to current operational needs as required while developing those technologies necessary to implement the Navy after next.

**Personnel:** 204 full-time civilian

## Key Personnel

Title	Code
Superintendent/NRL Chief Information Officer <sup>+</sup>	5500
Associate Superintendent	5501
Administrative Officer	5502
Head, Freespace Photonic Communications Office	5505
Head, Adversarial Modeling and Exploitation Office	5508
Director, Navy Center for Applied Research in Artificial Intelligence	5510
Head, Networks and Communication Systems Branch	5520
Director, Center for High Assurance Computer Systems	5540
Head, Transmission Technology Branch	5550
Head, Information Management and Decision Architectures Branch	5580
Director, Center for Computational Science	5590
Chief Librarian, Ruth H. Hooker Research Library	5596

**Point of contact:** Code 5501, (202) 767-2954

<sup>+</sup>Additional Duty

# Optical Sciences Division

## Code 5600 Staff Activity Areas

Program analysis and development  
Special systems analysis  
Technical study groups

Technical contract monitoring  
Theoretical studies

## Research Activity Areas

### Optical Materials and Devices

Advanced infrared optical materials  
IR fiber-optic materials and devices  
IR fiber chemical and environmental sensors  
IR transmitting windows and domes  
Transparent ceramic armor materials  
Planar waveguide devices  
IR nonlinear materials and devices  
Ceramic laser gain materials  
Advanced solar cell materials  
Fiber lasers/sources and amplifiers  
Radiation effects

### Optical Physics

Laser materials diagnostics  
Nonlinear frequency conversion  
Optical instrumentation and probes  
Optical interactions in semiconductor superlattices and organic solids  
Laser-induced reactions  
Organic light-emitting devices  
Nanoscale electro-optical research  
Aerosol optics

### Applied Optics

UV, optical, and IR countermeasures  
Ultraviolet component development  
Missile warning sensor technology  
UV, visible, and IR imager development  
Multispectral/hyperspectral sensors  
Multispectral/hyperspectral/detection algorithms  
Framing reconnaissance sensors  
Novel optical components  
Sensor control and exploitation system development  
IR low observables  
EO/IR systems analysis  
Atmospheric IR measurements  
Airborne IR search and track technology

### Photonics Technology

Fiber and solid-state laser/sources  
High-speed (<100 fs) optical probing  
High-power fiber amplifiers  
High-speed fiber-optic communications  
Antenna remoting  
Free space communication  
Photonic control of phased arrays  
Micro-electro-optical-mechanical systems  
Optical clocks  
Microwave photonics

### Optical Techniques

Fiber-optic materials and fabrication  
Fiber Bragg grating sensors/systems  
Fiber-optic sensors/systems (acoustic, magnetic, gyroscopes)  
Integrated optics



The Advanced Optical Materials Fabrication Laboratory, a state-of-the-art high vacuum cluster system, consists of a series of interconnected chambers allowing vacuum deposition of complex, multilayer films to be deposited and patterned without breaking vacuum during processing.

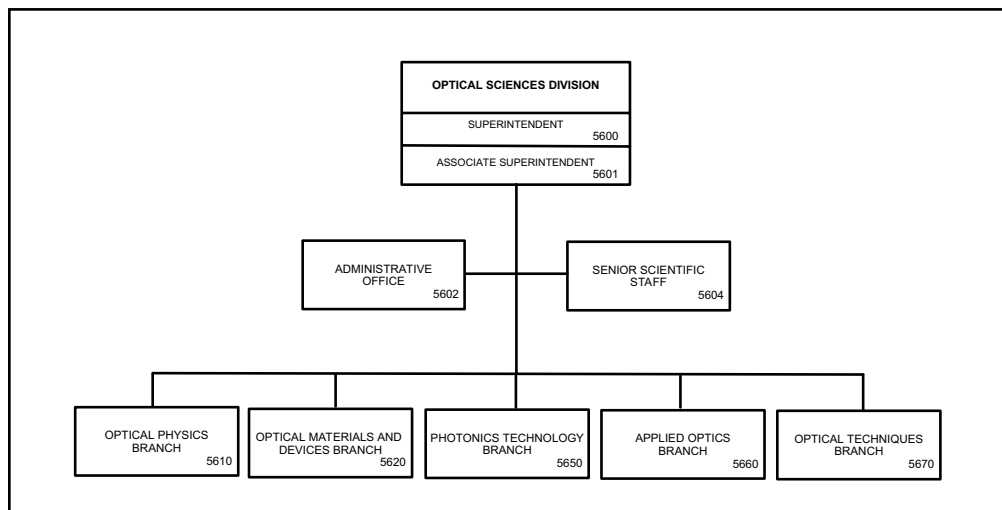


The Optical Fiber Preform Fabrication Facility includes computer control of the glass composition and standard fiber-optic dopants as well as rare earths, aluminum, and other components for specialty fibers.





DR. C.A. HOFFMAN\*



## Basic Responsibilities

The Optical Sciences Division carries out a variety of research, development, and application-oriented activities in the generation, propagation, detection, and use of radiation in the wavelength region between near-ultraviolet and far-infrared wavelengths. The research, both theoretical and experimental, is concerned with discovering and understanding the basic physical principles and mechanisms involved in optical devices, materials, and phenomena. The development effort is aimed at extending this understanding in the direction of device engineering and advanced operational techniques. The applications activities include systems analysis, prototype system development, and exploitation of R&D results for the solution of optically related military problems. In addition to its internal program activities, the Division serves the Laboratory specifically and the Navy generally as a consulting body of experts in optical sciences. The work in the Division includes studies in quantum optics, laser physics, optical waveguide technologies, laser-matter interactions, atmospheric propagation, holography, optical data processing, fiber-optic sensor systems, optical systems, optical materials, radiation damage studies, IR surveillance and missile seeker technologies, IR signature measurements, and optical diagnostic techniques. A portion of the effort is devoted to developing, analyzing, and using special optical materials.

**Personnel:** 132 full-time civilian

## Key Personnel

Title	Code
Superintendent, Optical Sciences Division	5600
Associate Superintendent	5601
Administrative Officer	5602
Head, Senior Scientific Staff	5604
Head, Optical Physics Branch	5610
Head, Optical Materials and Devices Branch	5620
Head, Photonics Technology Branch	5650
Head, Applied Optics Branch	5660
Head, Optical Techniques Branch	5670

**Point of contact:** Code 5602, (202) 767-9306

\*Acting



# Tactical Electronic Warfare Division

## Code 5700 Staff Activity Areas

EW Strategic Planning  
Signature Technology Office  
Effectiveness of Naval EW Systems (ENEWS)

## Research Activity Areas

### Offboard Countermeasures

Expendable technology and devices  
Unmanned air vehicles  
Offboard payloads  
Decoys

### Airborne Electronic Warfare Systems

Counter ISR  
Wireless network analysis  
Jamming technology and deception  
Communications CM

### Ships Electronic Warfare Systems

Ships systems development  
Jamming technology and deception  
EW antennas  
High power microwaves (HPM) research

### Electronic Warfare Support Measures

Intercept systems and direction finders  
RF signal simulators  
Systems integration  
Command and control interfaces  
Signal processing

### Advanced Techniques

Analysis and modeling simulation  
Experimental systems  
EW concepts  
Infrared technology

### Integrated EW Simulation

Hardware-in-the-loop simulation  
Data management technology  
Flyable ASM seeker simulators  
Foreign materiel exploitation (FME)

### EW Modeling and Simulation

High-fidelity threat models and simulations  
Advanced system visualization  
EW tactical decision aids  
RF environmental and propagation modeling

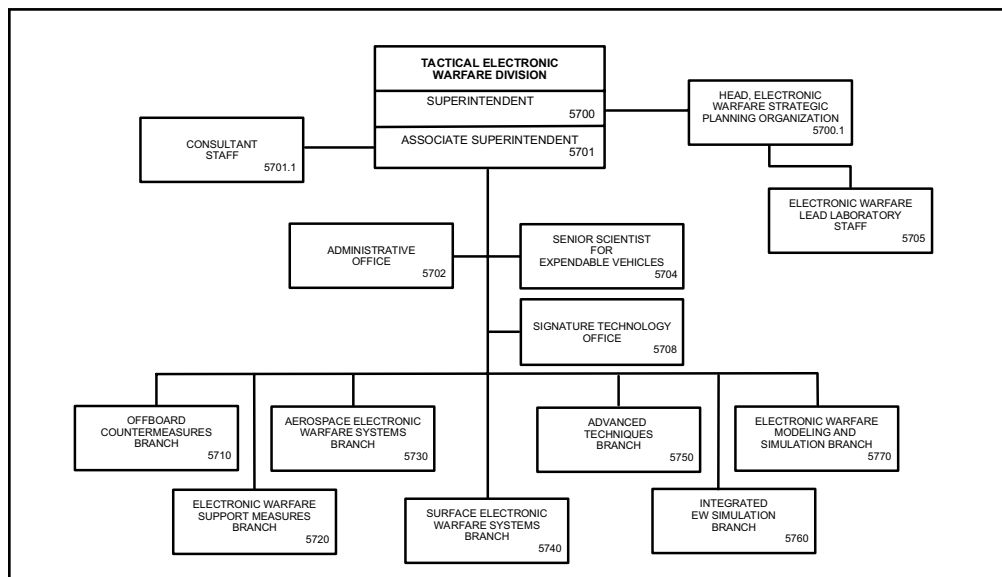


Using the latest composite, MMIC, and processing technologies, the Tactical Electronic Warfare Division has developed a small, lightweight, and inexpensive ESM receiving system for use on frigates, Coast Guard vessels, and various patrol aircraft.

The Central Target Simulator (CTS) Programmable Array is part of a large hardware-in-the-loop simulation facility whose purpose is to test and evaluate electronic warfare systems and techniques used to counter radar-guided missile threats to Navy forces.



DR. F.J. KLEMM



## Basic Responsibilities

The Tactical Electronic Warfare Division (TEWD) is responsible for research and development in support of the Navy's tactical electronic warfare requirements and missions. These include electronic warfare support measures, electronic countermeasures, and supporting counter-countermeasures, as well as studies, analyses, and simulations for determining and improving the effectiveness of these systems.

**Personnel:** 269 full-time civilian

## Key Personnel

Title	Code
Superintendent, Tactical Electronic Warfare Division	5700
Head, Electronic Warfare Strategic Planning Organization	5700.1
Associate Superintendent	5701
Administrative Officer	5702
Senior Scientist for Expendable Vehicles	5704
Head, Electronic Warfare Lead Laboratory Staff	5705
Head, Signature Technology Office	5708
Head, Offboard Countermeasures Branch	5710
Head, Electronic Warfare Support Measures Branch	5720
Head, Aerospace Electronic Warfare Systems Branch	5730
Head, Surface Electronic Warfare Systems Branch	5740
Head, Advanced Techniques Branch	5750
Head, Integrated Electronic Warfare Simulation Branch	5760
Head, Electronic Warfare Modeling and Simulation Branch	5770

**Point of contact:** Code 5701, (202) 767-5974

\*Acting



# **MATERIALS SCIENCE AND COMPONENT TECHNOLOGY DIRECTORATE**

# **MATERIALS SCIENCE AND COMPONENT TECHNOLOGY DIRECTORATE**

**Code 6000**

The Materials Science and Component Technology Directorate carries out a multidisciplinary research program whose objectives are the discovery, invention, and exploitation of new improved materials, the generation of new concepts associated with materials behavior, and the development of advanced components based on these new and improved materials and concepts. Theoretical and experimental research is carried out to determine the scientific origins of materials behavior and to develop procedures for modifying these materials to meet important naval needs for advanced platforms, electronics, sensors, and photonics.

The program includes investigations of a broad spectrum of materials including insulators, semiconductors, superconductors, metals and alloys, optical materials, polymers, plastics, artificially structured bio/molecular materials and composites, and energetic materials, which are used in important naval devices, components, and systems. New techniques are developed for producing, processing, and fabricating these

materials for crucial naval applications.

The synthesis, processing, properties, and limits of performance of these new and improved materials in natural or radiation environments, and under deleterious conditions such as those associated with the marine environment, neutron or directed energy beam irradiation, or extreme temperatures and pressures, are established. For new materials design, emphasis is placed on protection of the environment.

Additionally, major thrusts are directed in advanced sensing, detection, reactive flow physics, computational physics, and plasma sciences. Areas of particular emphasis include nanoscience and technology, fluid mechanics and hydrodynamics, nuclear weapon effects simulations, high energy density materials including fuels, propellants, explosives, and storage devices, interactions of various types of radiation with matter, survivability of materials and components, and directed energy devices.



## Associate Director of Research for Materials Science and Component Technology



**D**r. B.B. Rath was born in Banki, India. He received a B.S. degree in physics and mathematics from Utkal University, an M.S. in metallurgical engineering from Michigan Technological University, and a Ph.D. from the Illinois Institute of Technology.

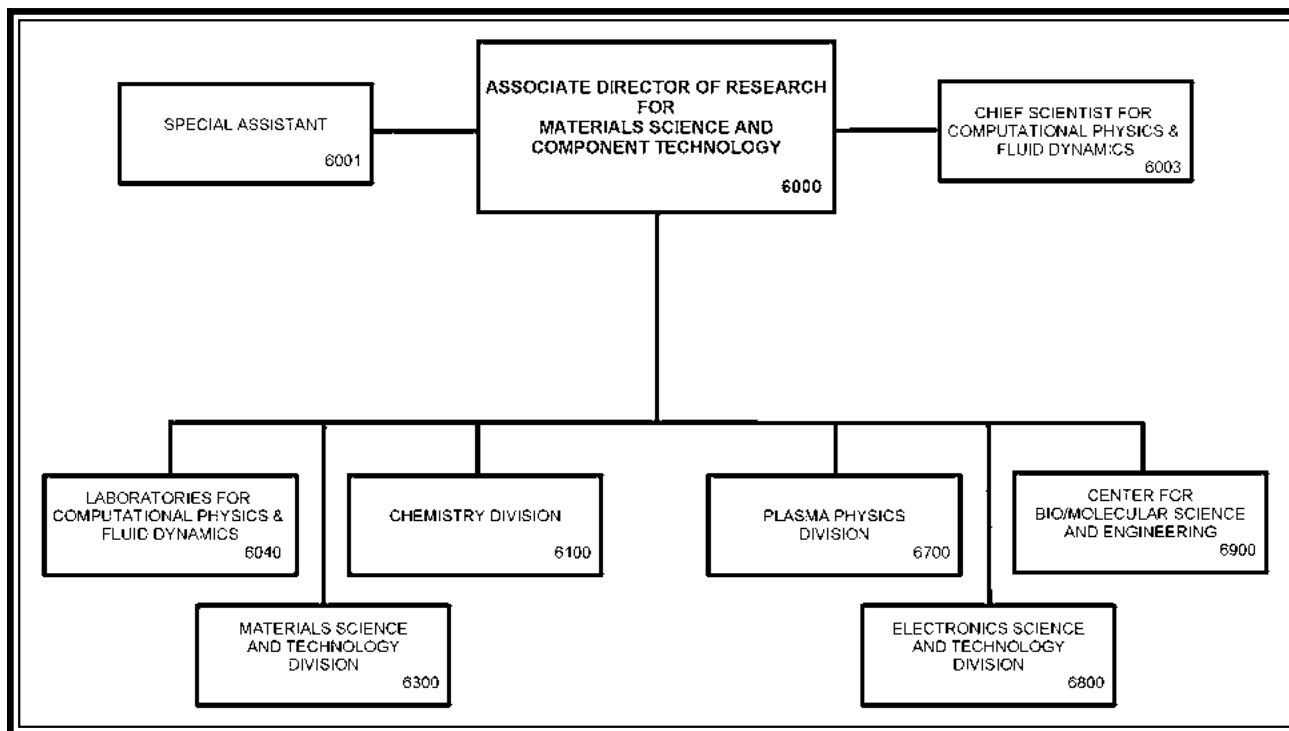
Dr. Rath was Assistant Professor of Metallurgy and Materials Science at Washington State University from 1961 to 1965. From 1965 to 1972, he was with the staff of the Edgar C. Bain Laboratory for fundamental research of the U.S. Steel Corporation. From 1972 to 1976, he headed the Metal Physics Research Group of the McDonnell Douglas Research Laboratories in St. Louis, Missouri, until he came to NRL as Head of the Physical Metallurgy Branch. During this period, he was adjunct professor at Carnegie-Mellon University, the University of Maryland, and the Colorado School of Mines. Dr. Rath served as Superintendent of the Materials Science and Technology Division from 1982 to 1986, when he was appointed to his present position.

Dr. Rath is recognized in the fields of solid-state transformations, grain boundary migrations, and structure-property relationships in metallic systems. He has published over 140 papers in these fields and edited several books and conference proceedings.

Dr. Rath serves on several planning, review, and advisory boards for both the Navy and the Department of Defense, as well as for the National Materials Advisory Board of the National Academy of Sciences, National Science Foundation, University of Virginia, Colorado School of Mines, and the University of Florida. He is currently the Navy representative to the DOE Deputy Assistant Secretary's advisory and planning committee on methane hydrates, and the Navy representative to the Indo-U.S. Joint Commission on Science and Technology. He previously served as the Navy representative to the panel of The Technical Cooperation Program (TTCP) countries.

Dr. Rath is a member of the National Academy of Engineering. He is a fellow of the Minerals, Metals and Materials Society (TMS), American Society for Materials-International (ASM), Washington Academy of Sciences, Materials Research Society of India, the Institute of Materials of the United Kingdom, and the American Association for the Advancement of Science (AAAS). In 2007, Dr. Rath received an honorary doctorate in engineering from the Michigan Technological University and was elected to deliver the commencement address to the 2007 graduating class. In 2008, he received the Illinois Institute of Technology Mechanical Materials & Aerospace Engineering Department 2008 Alumni Recognition Award. In 2010, he received an honorary doctorate from Ravenshaw University and Indian Institute of Technology.

Dr. Rath has received a number of honors and awards, most recently the Michigan Technological University Distinguished Alumni Award, the Padma Bhushan Award of Honors and Excellence bestowed by the President of India, and the Acta Materialia J. Herbert Hollomon Award. His other awards include the DoD Distinguished Civilian Service Award which is presented by the Secretary of Defense for distinguished accomplishments and sustained superior service, the 2005 Fred Saalfeld Award for Outstanding Lifetime Achievement in Science, the Presidential Rank Award for Distinguished Executive (2005), the NRL Lifetime Achievement Award (2004), National Materials Advancement Award from the Federation of Materials Societies (2001), the Presidential Rank of Meritorious Executive Award (1999 and 2004), the S. Chandrasekhar Award and Medal, and the Award of Merit for Group Achievement from the Chief of Naval Research. He received the 1991 George Kimball Burgess Memorial Award, the Charles S. Barrett Medal, and the prestigious TMS Leadership Award for his contributions to materials research. The American Society for Materials-International and The Metals, Minerals, and Materials Society have jointly recognized him with the TMS/ASM Joint Distinguished Lectureship in Materials & Society Award and the 2001 ASM Distinguished Life Membership Award. He has served as the 2004–2005 President of the American Society for Materials. He also has served as a member of the Boards of Directors/Trustees of TMS, ASM-International, and the Federation of Materials Society (FMS), as a member of the editorial boards of several international materials research journals, and as chairman of many committees of TMS, ASM, FMS, and American Association of Engineering Societies.



### Key Personnel

Title	Code
Associate Director of Research for Materials Science and Component Technology	6000
Special Assistant	6001
Chief Scientist for Computational Physics and Fluid Dynamics	6003
Director, Laboratories for Computational Physics and Fluid Dynamics	6040
Superintendent, Chemistry Division	6100
Superintendent, Materials Science and Technology Division	6300
Superintendent, Plasma Physics Division	6700
Superintendent, Electronics Science and Technology Division	6800
Director, Center for Bio/Molecular Science and Engineering	6900

**Point of contact:** Code 6000, (202) 767-2538



# Laboratories for Computational Physics and Fluid Dynamics

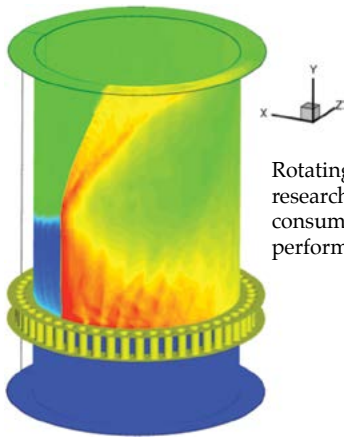
## Code 6040 Research Activity Areas

### Reactive Flows

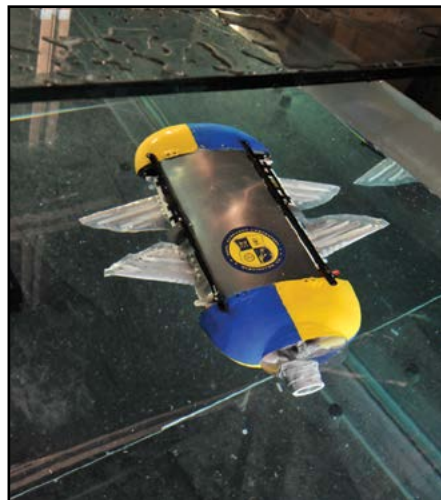
- Fluid dynamics in combustion
- Turbulence in compressible flows
- Multiphase flows
- Turbulent jets and wakes
- Jet noise S&T
- Detonation engines
- Propulsion systems analysis
- Contaminant transport modelling
- Fuel cells
- Fire and explosion mitigation

### Computational Physics Developments

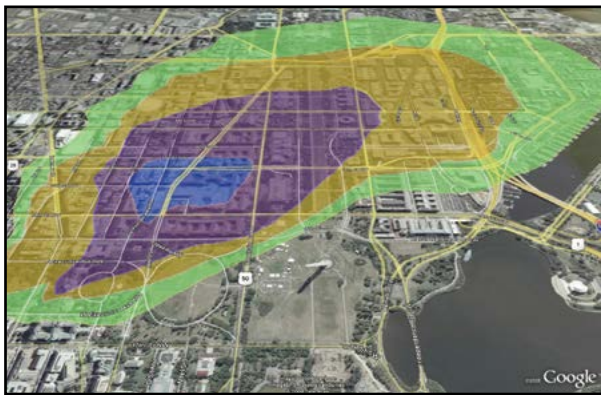
- Laser-plasma interactions
- Inertial confinement fusion
- Space debris elimination
- Solar physics modeling
- Dynamical gridding algorithms
- Advanced graphical and parallel processing systems
- Solar & Heliospheric Modeling
- Microfluidics
- Fluid structure interaction
- Shock and blast containment



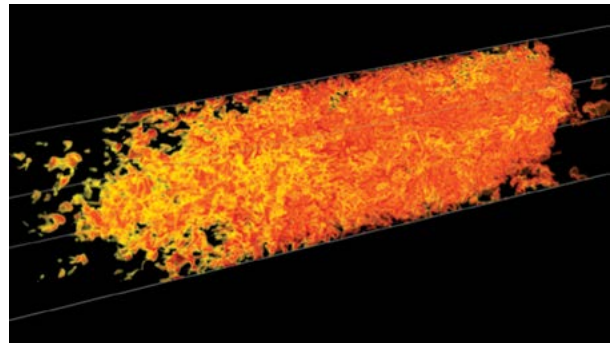
Rotating Detonation Engine research for reducing fuel consumption and improving performance.



Unstructured grid technology has been used to design and develop a flying unmanned underwater vehicle (UUV) for long range deployment.



CT-Analyst plumes displayed in Google Earth, showing the same colors and density information as in the CT-Analyst program.



Detailed simulations have led to new understanding of high-intensity, nonequilibrium, inhomogeneous, anisotropic reactive turbulent flows.



DR. K. KAILASANATH

## Basic Responsibilities

The Laboratories for Computational Physics and Fluid Dynamics (LCP&FD) are responsible for the research leading to and the application of advanced analytical and numerical capabilities that are relevant to NRL, Navy, DoD, and other Government agencies. This research is pursued in the fields of compressible and incompressible fluid dynamics, reactive flows, fluid / structure interactions including submarine and aerospace applications, atmospheric and solar geophysics, magnetoplasma dynamics, application of parallel processing to large-scale problems such as unsteady flows of contaminants in and around cities, advanced propulsion concepts, flame dynamics for shipboard fire safety, jet noise reduction, and other disciplines of continuum computational physics as required to further the overall mission of NRL. The specific objectives of the LCP&FD are to develop and maintain state-of-the-art analytical and computational capabilities in fluid dynamics and related fields of physics; to establish in-house expertise in parallel processing for large-scale scientific computing; to perform analyses and computational experiments on specific relevant problems using these capabilities; and to transfer this technology to new and ongoing projects through cooperative programs with the research Divisions at NRL and elsewhere.

**Personnel:** 22 full-time civilian

## Key Personnel

Title	Code
Director, Laboratories for Computational Physics and Fluid Dynamics	6040
Administrative Officer	6040.2
Chief Scientist for Computational Physics and Fluid Dynamics	6003
Head, Laboratory for Propulsion, Energetic, and Dynamic Systems	6041
Head, Laboratory for Advanced Computational Physics	6042
Head, Laboratory for Multiscale Reactive Flow Physics	6043

**Point of contact:** Code 6040, (202) 404-1064

# Chemistry Division

## Code 6100 Research Activity Areas

### Chemical Diagnostics

- Alternate energy sources
- Atmosphere analysis and control
- Environmental chemistry / microbiology
- Ion/molecule processes
- Kinetics of gas phase reactions
- Laboratory on a chip
- Methane hydrates
- Optical diagnostics of chemical reactions
- Trace analysis

### Materials Chemistry

- Bio-inspired materials
- Degradation and stabilization mechanisms
- Functional organic coatings
- High-temperature resins
- Magnetic resonance
- Novel nanotubes and nanofibers
- Polymer characterization
- Reactive nanometals
- Synthesis and evaluation of innovative polymers and composites

### Center for Corrosion Science and Engineering

- Aquatic invasive organism control
- Biofouling control
- Cathodic protection

- Corrosion control engineering
- Corrosion science
- Environmental fracture and fatigue
- Marine coatings
- Materials failure analysis

### Surface/Interface Chemistry

- Adhesion
- Bio/organic interfaces
- Chemical/biological sensors
- Diamond films
- Electrochemistry
- Plasmonics
- Energy storage materials
- Nanostructured materials and interfaces
- Surface/interface analysis
- Surface properties of materials
- Surface reaction dynamics
- Synchrotron radiation applications
- Tribology

### Safety and Survivability

- Chemometrics / data fusion
- Combustion dynamics
- Fire protection and suppression
- Mobility fuels
- Modeling and scaling of combustion systems
- Personnel protection
- System automation
- Trace analysis



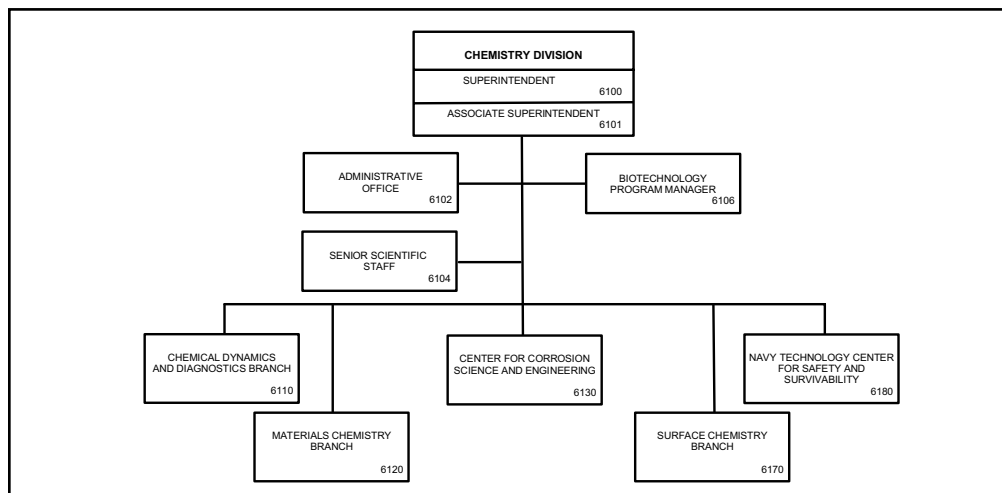
The ex-USS *Shadwell* (LSD 15), moored in Mobile Bay, Alabama, is NRL's full-scale, advanced research and full-scale demonstration vessel operated by the Chemistry Division.



The Key West site of the NRL Center for Corrosion Science and Engineering specializes in understanding and modeling the marine environment's impact on naval materials. A complete laboratory for the study of corrosion control technologies provides sponsors with prototypical seawater exposure of their systems.



Dr. B.J. SPARGO\*



## Basic Responsibilities

The Chemistry Division conducts basic research, applied research, and development studies in the broad fields of chemical / structural diagnostics, reaction rate control, materials chemistry, surface and interface chemistry, corrosion passivation, environmental chemistry, and ship safety / survivability. Specialized programs within these fields include coatings, functional polymers / elastomers, clusters, controlled release of energy, physical and chemical characterization of surfaces, electrochemistry, assembly and properties of nanometer structures, tribology, chemical vapor deposition / etching, atmosphere analysis and control, environmental protection / reclamation, prevention / control of fires, mobility fuels, modeling / simulation, and miniaturized sensors for chemical, biological, trace analysis and data fusion, and explosives.

To enhance protection of Navy personnel and platforms from damage and injury in peace and wartime, the Navy Technology Center for Safety and Survivability performs RDT&E on fire and personnel protection, fuels, chemical defense, submarine atmospheres, and damage control aspects of ship and aircraft survivability; supports Navy and Marine Corps requirements in these areas; and acts as a focus for technology transfer in safety and survivability.

To address problems in corrosion and marine fouling, a Marine Corrosion Facility is located in Key West, Florida. This laboratory resides in an unparalleled site for natural seawater exposure testing and marine related materials evaluation. The tropical climate is ideal for marine exposure testing. Along with the high quality seawater, the location provides small climatic variation and a stable biomass throughout the year.

**Personnel:** 113 full-time civilian; 1 military; 5 intermittent; 3 part-time

## Key Personnel

Title	Code
Superintendent, Chemistry Division	6100
Associate Superintendent	6101
Administrative Officer	6102
Senior Scientific Staff	6104
Senior Scientific Staff	6104
Biotechnology Program Manager	6106
Head, Chemical Dynamics and Diagnostics Branch	6110
Head, Materials Chemistry Branch	6120
Head, Center for Corrosion Science and Engineering	6130
Head, Surface Chemistry Branch	6170
Head, Navy Technology Center for Safety and Survivability	6180
Senior Scientist for Theoretical Chemistry	6189

**Point of contact:** Code 6102, (202) 767-2460

\*Acting

# Materials Science and Technology Division

## Code 6300 Research Activity Areas

### Materials and Sensors

- Laser direct write
- THz sources, devices, and sensors
- Spintronic materials and devices
- Magnetic materials
- Superconducting materials
- Optoelectronic materials
- Electroceramic materials
- Multiferroic materials
- Radar absorbing materials
- Analysis of extrasolar materials
- Chemical sensors
- Nonlinear dynamics and chaos theory
- Nanoplasmonic biosensors
- Thin film deposition for devices
- Ion implantation
- Glass fiber processing and characterization
- Polymer synthesis and characterization
- Personal protective equipment
- Remote explosives detection
- Automated learning

### Multifunctional Materials

- 3D Materials Science
  - Image-based microstructural modeling
  - Materials by design
  - Nano-, micro-, mesoscale material characterization
  - Grain boundary engineering
  - Atom probe tomography
- Physical metallurgy
  - Ferrous, nonferrous, and intermetallic alloys
  - Powder metallurgy
  - Microwave sintering
  - Rapid solidification
  - Rail gun materials

- Friction stir welding and joining technologies
- Heat treating and phase transformations
- Biomechanical surrogate development for warfighter protection
  - Biomechanical simulation
  - Personal protective equipment
- Composite material systems
  - Multifunctional structures
  - Armor
  - Porovascular structures
- Corrosion simulation and control
  - Modeling of electrochemical corrosion systems
  - Evaluation of cathodic protection performance
- Advanced ceramics
  - High energy density dielectrics
  - High temperature ceramics
  - Thermal barrier coatings

### Computational Materials Science

- Condensed matter theory
- Electronic structure of solids and clusters
- Molecular dynamics
- Quantum many-body theory
- Theory of magnetic materials
- Theory of alloys
- Materials for power and energy
- Semiconductor and surface physics
- Theoretical studies of phase transitions
- Atomic physics theory
- Protein modeling
- Continuum multiphysics modeling
- Reduced order modeling
- Multiphysics simulation of materials behavior
- Development of high-performance computational methods

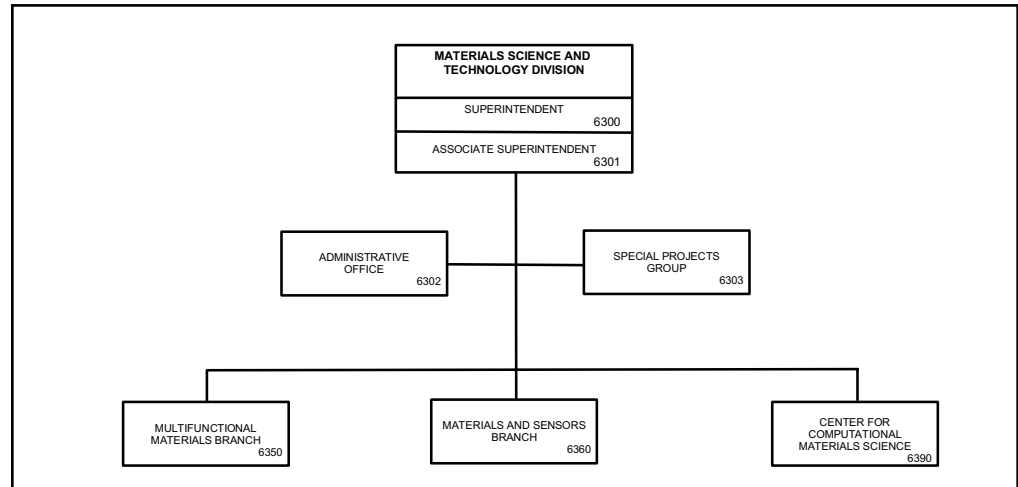


The Secondary Ion Mass Spectrometer/Single-Stage Accelerator Mass Spectrometer performs spatially resolved composition analysis using secondary ion mass spectrometer (SIMS) to sputter atoms, and single stage accelerator mass spectrometer (SSAMS) to reduce background interferences from commonly present molecular ions. Provides high-sensitivity and high-precision measurements.





DR. P. MATIC



## Basic Responsibilities

The Materials Science and Technology Division conducts basic and applied research and engages in exploratory and advanced development of materials having substantive value to the Navy. The Division is composed of multidisciplinary teams of materials scientists, metallurgists, ceramists, physicists, chemists, and engineers using the most advanced testing facilities and diagnostic techniques. R&D programs encompass the intrinsic behavior of metals, semiconductors, insulators, composites, and ceramics, including efforts in ferrous alloys, intermetallic compounds, superconducting, dielectric, and magnetic materials, films and coatings, and multifunctional materials systems. The programs encompass advanced synthesis and processing techniques, as well as postprocessing techniques to fabricate sensors, devices, structures, and components. A variety of state-of-the-art characterization tools are used to probe the atomic, grain, and defect structure (composition and microstructure) of the materials as well as to delineate the fundamental properties of the material or material system. Response of materials and material systems to a variety of external influences (mechanical, chemical, optical, electromagnetic radiation, high-power lasers, temperature, etc.) is integral to the Division's programs, as are performance and reliability projections for military service lifetime. The program includes strong theoretical, experimental, computational, and simulation efforts to predict, guide, and explain the behavior of materials and materials systems. Studies conducted in the Division provide guidance for the selection, design, certification, and life-cycle management of material in Naval vehicles and systems.

**Personnel:** 100 full-time civilian

## Key Personnel

Title	Code
Superintendent, Materials Science and Technology Division	6300
Associate Superintendent	6301
Administrative Officer	6302
Senior Scientist	6300.1
Head, Special Projects Group	6300.2
Head, Multifunctional Materials Branch	6350
Head, Materials and Sensors Branch	6360
Head, Center for Computational Materials Science	6390

**Point of contact:** Code 6302, (202) 767-2458

\*Acting



# Plasma Physics Division

## Code 6700 Research Activity Areas

### Radiation Hydrodynamics

- Radiation hydrodynamics of Z-pinches and laser-produced plasmas
- X-ray source development
- Cluster dynamics in intense laser fields
- Plasma kinetics for directed energy and fusion
- Plasma discharge physics
- Dense plasma atomic physics, equation of state
- Numerical simulation of high-density plasma
- Laser driven ion/neutron sources

### Laser Plasma

- Nuclear weapons stockpile stewardship
- Laser fusion, inertial confinement
- Megabar high-pressure physics
- Rep-rate KrF laser development
- High power electron beam applications
- Laser fusion technology
- Laser fusion energy
- Detection of chemical/biological/nuclear materials

### Charged Particle Physics

- Applications of modulated electron beams
- Rocket, satellite, and ISS natural and active experiments
- Laboratory simulation of space plasmas
- Large-area plasma processing sources

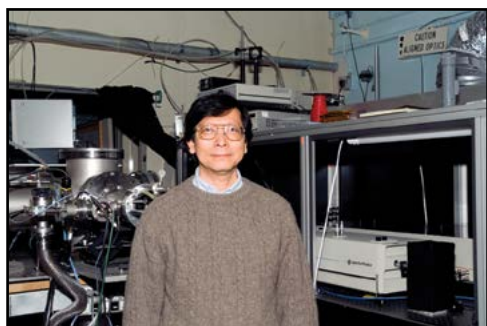
- Surface modification of energy sensitive materials
- Atmospheric and ionospheric GPS sensing
- Ionospheric effects on communications
- Electromagnetic launchers
- Radiation belt remediation

### Pulsed Power Physics

- Production, focusing, and propagation of intense electron and ion beams
- High-power, pulsed radiography
- Plasma and bremsstrahlung radiation sources
- Capacitive, inductive, and battery energy storage
- Nuclear weapons effects simulation
- Electromagnetic launchers
- Detection of Special Nuclear Materials
- Advanced energetics via stimulated nuclear decay

### Beam Physics

- Directed energy and laser propagation in the atmosphere
- Advanced accelerators and radiation sources
- Microwave, plasma, and laser processing of materials
- Microwave sources: magnicons and gyrotrons
- Nonlinear stochastic dynamical systems
- Ultrahigh-intensity laser-matter interactions
- Free electron lasers and laser synchrotrons
- Theory and simulation of space and solar plasmas
- Global ionospheric and space weather modeling
- Underwater laser interactions



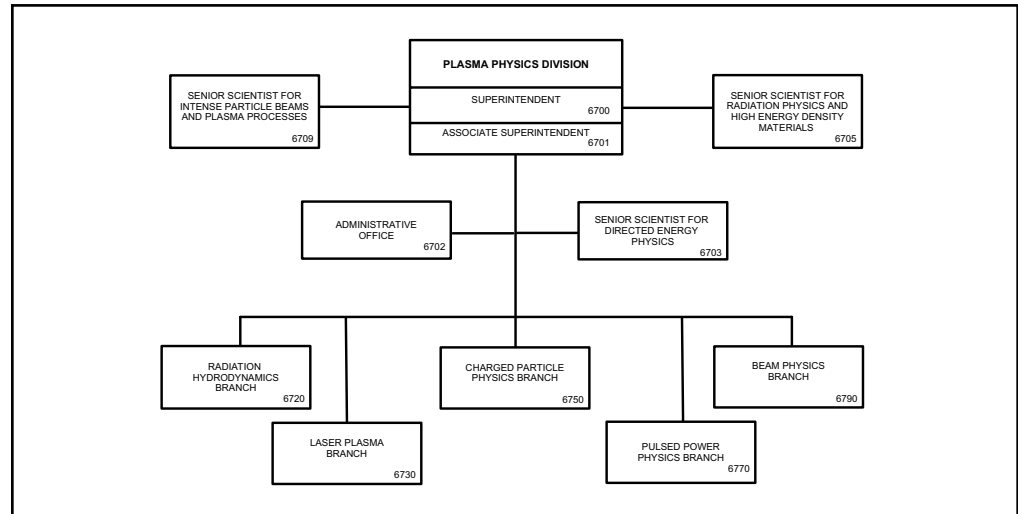
The NRL Ti:Sapphire Femtosecond Laser (TFL) currently operates at 40 fs, 15 TW and provides a facility to conduct research in intense laser-plasma interactions, ultrashort intense laser propagation in the atmosphere, remote sensing of chem/bio agents, and laser-induced electrical discharges.



Nike is the world's largest krypton fluoride (KrF) laser and is used to explore physics issues for laser fusion. Shown is the propagation bay where 56 short-duration (4–5 ns) beams are directed by mirrors first to the electron-beam-pumped amplifiers and then to the target facility. The Nike KrF system achieves extremely uniform high-intensity illumination of planar targets by overlapping numerous smoothed laser beams. Typical experiments include studies of the ablative acceleration of matter to high velocities (up to 1000 km/s) and studies of the reaction of materials to very high pressures (10 million atmospheres) produced by the laser light.



DR. T.A. MEHLHORN



## Basic Responsibilities

The Plasma Physics Division conducts a broad theoretical and experimental program of basic and applied research in plasma physics, laboratory discharge, and space plasmas, intense electron and ion beams and photon sources, atomic physics, pulsed power sources, laser physics, advanced spectral diagnostics, and nonlinear systems. The effort of the Division is concentrated on a few closely coordinated theoretical and experimental programs. Considerable emphasis is placed on large-scale numerical simulations related to plasma dynamics; ionospheric, magnetospheric, and atmospheric dynamics; nuclear weapons effects; inertial confinement fusion; atomic physics; plasma processing; nonlinear dynamics and chaos; free electron lasers and other advanced radiation sources; advanced accelerator concepts; and atmospheric laser propagation. Areas of experimental interest include laser-plasma, laser-electron beam, and laser-matter interactions, high-energy laser weapons, laser shock hydrodynamics, thermonuclear fusion, electromagnetic wave generation, the generation of intense electron and ion beams, large-area plasma processing sources, electromagnetic launchers, high-frequency microwave processing of ceramic and metallic materials, advanced accelerator development, inductive energy storage, laboratory simulation of space plasma phenomena, high-altitude chemical releases, and in situ and remote sensing space plasma measurements.

**Personnel:** 85 full-time civilian

## Key Personnel

Title	Code
Superintendent, Plasma Physics Division	6700
Associate Superintendent	6701
Administrative Officer	6702
Senior Scientist, Directed Energy Physics	6703
Senior Scientist, Radiation Physics and High Energy Density Materials	6705
Senior Scientist, Intense Particle Beams and Plasma Processes	6709
Head, Radiation Hydrodynamics Branch	6720
Head, Laser Plasma Branch	6730
Head, Charged Particle Physics Branch	6750
Head, Pulsed Power Physics Branch	6770
Head, Beam Physics Branch	6790

**Point of contact:** Code 6700, (202) 767-2723

# Electronics Science and Technology Division

## Code 6800 Research Activity Areas

### Nanoscience and Nanotechnology

- Nanoelectronics
- Plasmonics
- Energy harvesting
- Quantum information
- Sensing

### Surface and Interface Sciences

- Epitaxial growth of graphene
- Growth of hyper-abrupt junctions
- Atomic layer deposition of dielectrics

### Electronic Materials

- Advanced elemental and compound semiconductors, high- $\kappa$  dielectrics, and second-order materials
- Unique materials characterization
- Fabrication of electronic devices with high degree of complexity and precision

### Computational Modeling and Simulation

- Fast principles atomistic calculations
- Device modeling activities
- Modeling coherent interaction of electromagnetic fields with electron beams

### Power Electronics

- SiC and GaN epitaxial growth research
- Characterization of defects in SiC and GaN
- Development of advanced SiC and GaN power device processes
- Reliability of SiC and GaN power devices

### Microwave, Millimeter, and Sub-Millimeter Technology

- Millimeter-wave, sub-millimeter-wave and terahertz technology
- Vacuum electronics
- Solid-state electronics
- Filters and control components

### Optoelectronics

- Design and synthesis of new materials in the IR spectrum region

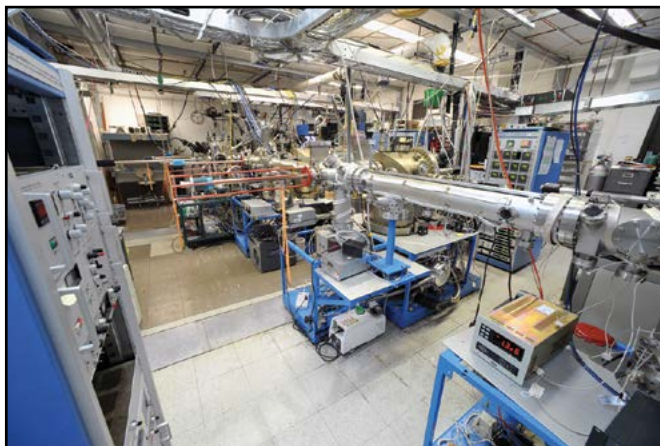
### Photovoltaics

- High-efficiency technologies for portable photovoltaic power systems

### Radiation Effects

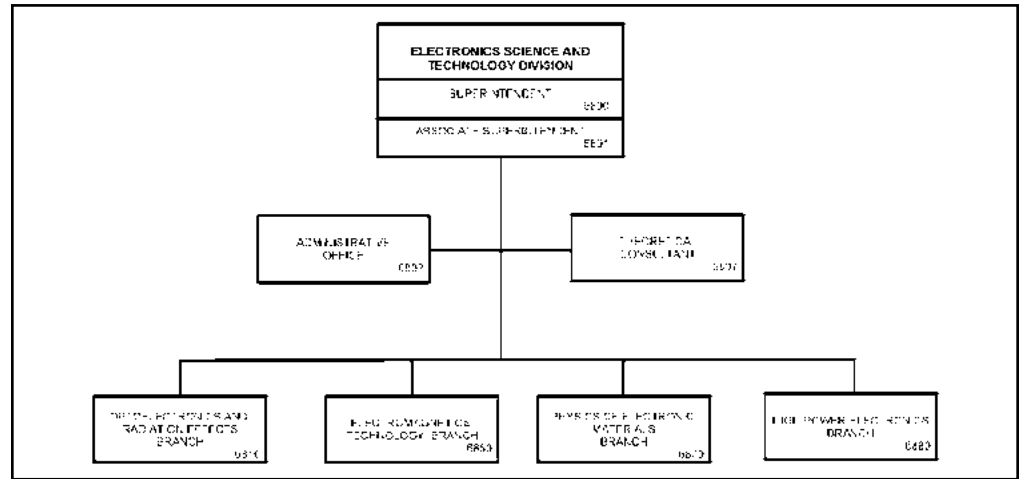
- Particle irradiation
- Photons irradiation
- Displacement damage dose effects in materials and devices

The EPICENTER specializes in molecular beam epitaxial growth of nanostructures created by alternating layers of narrow bandgap materials made available from four ultrahigh-vacuum chambers. These structures are expected to improve the performance of far-infrared detectors, midwave lasers, and superhigh frequency transistors and resonant tunneling diodes.





DR. B. LEVUSH



## Basic Responsibilities

The Electronics Science and Technology Division conducts programs of basic science and applied research and development in nanoscience and nanotechnology, surface and interface sciences, electronic materials, computational modeling and simulation, power electronics, microwave, millimeter, and sub-millimeter technology, optoelectronics, photovoltaic and radiation effects. The activities of the Division integrate device research with basic materials investigations and with systems research and development needs.

**Personnel:** 107 full-time civilian

## Key Personnel

Title	Code
Superintendent, Electronics Science and Technology Division	6800
Associate Superintendent	6801
Administrative Officer	6802
Senior Scientist for Nanoelectronics	6877
Head, Optoelectronics and Radiation Effects Branch	6810
Head, Electromagnetics Technology Branch	6850
Head, Physics of Electronic Materials Branch	6870
Head, High Power Electronics Branch	6880

**Point of contact:** Code 6802, (202) 767-3416

# Center for Bio/Molecular Science and Engineering

## Code 6900 Research Activity Areas

### Biologically Derived Microstructures

- Self-assembly, molecular machining
- Synthetic membranes
- Nanocomposites
- Tailored electronic materials
- Molecular engineering, biomimetic materials
- Molecular imprinting
- Viral scaffolds
- Multifunctional decontamination coatings

### Biosensors

- Binding polypeptides and proteins
- Cell-based biosensors
- DNA biosensors
- Fiber-optic biosensors
- Flow immunosensors
- Array-based sensors
- Optical biosensors
- Microfluidics and Microarrays

### Novel Materials

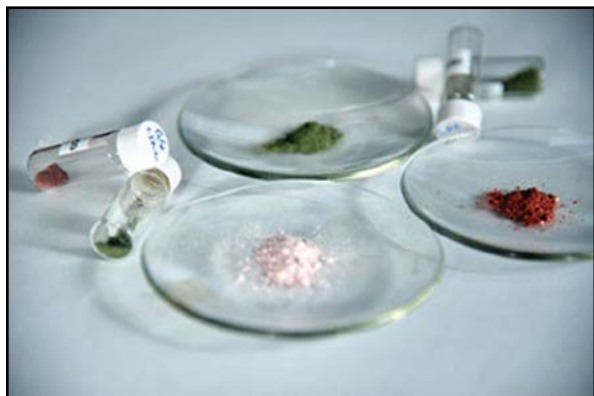
- Soil/groundwater explosives detection
- Single chain and single domain antibodies
- Nanoparticles and quantum dots
- Nano- and mesoporous materials
- Quantum dot and protein conjugates
- Biomimetic materials

### Molecular Biology

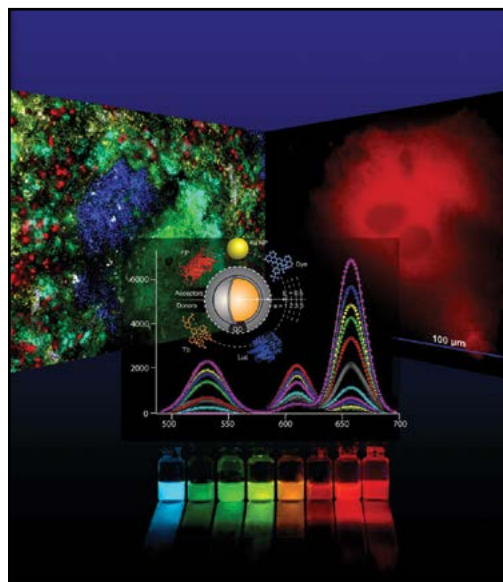
- Genomics and proteomics of marine bacteria
- Tissue engineering
- Gene arrays, biomarkers
- System and synthetic biology

### Energy Harvesting

- Biomaterials for charge storage
- Ocean floor biofuel cell
- Photo-induced electron transfer



Porphyrin-functionalized organosilicate sorbents provide capture and neutralization of vapor phase TIC/TIM targets. These materials offer the potential for new approaches to air filtration applicable to personal and facility protection.

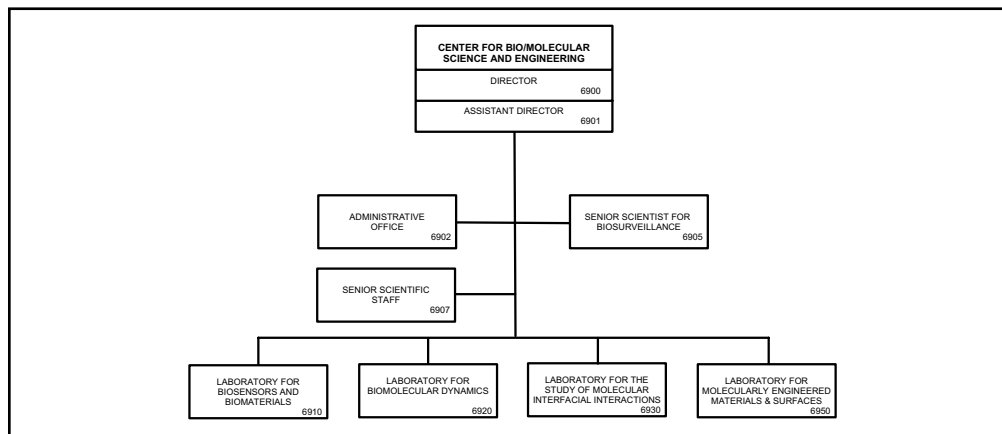


5-color quantum dot immunohistochemical labeling of mouse splenic tissue and an image of live HEK cells microinjected with quantum dots. Center: 3-color quantum dot immunoassay results along with a schematic showing quantum dot potential to function as both a donor or as an acceptor in different types of energy transfer biosensing configurations. Bottom: Quantum dot solutions highlighting their size-tunable photoluminescence.





Dr. B.R. RATNA



## Basic Responsibilities

The Center for Bio/Molecular Science and Engineering is using the tools of modern biology, physics, chemistry, and engineering to develop advanced materials and sensors. The long-term research goal is first to gain a fundamental understanding of the relationship between molecular architecture and the function of materials, then apply this knowledge to solve problems for the Navy and DoD community. The key theme is the study of complex bio/molecular systems with the aim of understanding how “nature” has approached the solution of difficult structural and sensing problems. Technological areas currently being studied include molecular and microstructure design, molecular biology, imaging of cells using nanoparticles, sensor design and prototype development for biosurveillance or underwater chemical detection, and energy harvesting. Much of the research deals with the engineering of peptides, proteins, and nanoparticles into complex microstructures for use in advanced material applications, and the harnessing of the recognition functions of proteins and cells for the development of advanced sensors. A highly multidisciplinary staff is required to pursue these research and development programs. The Center provides a stimulating environment for cross-disciplinary programs in the areas of immunology, biochemistry, systems biology, electrochemistry, synthetic chemistry, microbiology, microlithography, photochemistry, biophysics, spectroscopy, advanced diagnostics, organic synthesis, and electro-optical engineering.

**Personnel:** 57 full-time civilian

## Key Personnel

Title	Code
Director, Center for Bio/Molecular Science and Engineering	6900
Assistant Director	6901
Administrative Officer	6902
Senior Scientist for Biosurveillance	6905
Head, Laboratory for Biosensors and Biomaterials	6910
Head, Laboratory for Biomolecular Dynamics	6920
Head, Laboratory for the Study of Molecular Interfacial Interactions	6930

**Point of contact:** Code 6902, (202) 404-6012

\*Acting

# **OCEAN AND ATMOSPHERIC SCIENCE AND TECHNOLOGY DIRECTORATE**



## **OCEAN AND ATMOSPHERIC SCIENCE AND TECHNOLOGY DIRECTORATE**

### **Code 7000**

The Ocean and Atmospheric Science and Technology Directorate performs research and development in the fields of acoustics, remote sensing, oceanography, marine geosciences, marine meteorology, and space science. Areas of emphasis in acoustics include advanced acoustic concepts and computation, acoustic signal processing, physical acoustics, acoustic systems, ocean acoustics, and acoustic simulation and tactics. Areas of emphasis in remote sensing include radio, infrared, and optical sensors, remote sensing physics and hydrodynamics, remote sensing simulation, and imaging systems. Areas of emphasis in oceanography include coastal and open ocean dynamics, ocean modeling and prediction, coastal and open ocean processes, remote sensing applications to oceanography, and marine biocorrosion processes. Areas of emphasis in marine geosciences include

marine physics, seafloor sciences, geospatial information science and technology, and mapping, charting, and geodesy. Areas of emphasis in marine meteorology include atmospheric dynamics for theater-wide, tactical-scale prediction systems and forecast support, and meteorological applications development. Areas of emphasis in space science include middle and upper atmosphere physics, solar terrestrial relationships, solar physics, and higher energy astronomy. Senior naval officers are assigned as military advisors to help maintain the directorate focus on operational Navy and other DoD requirements in these areas of emphasis. The directorate is responsible for administrative and technical support to major activities in Washington, DC; Stennis Space Center, Mississippi; and Monterey, California.

## Associate Director of Research for Ocean and Atmospheric Science and Technology



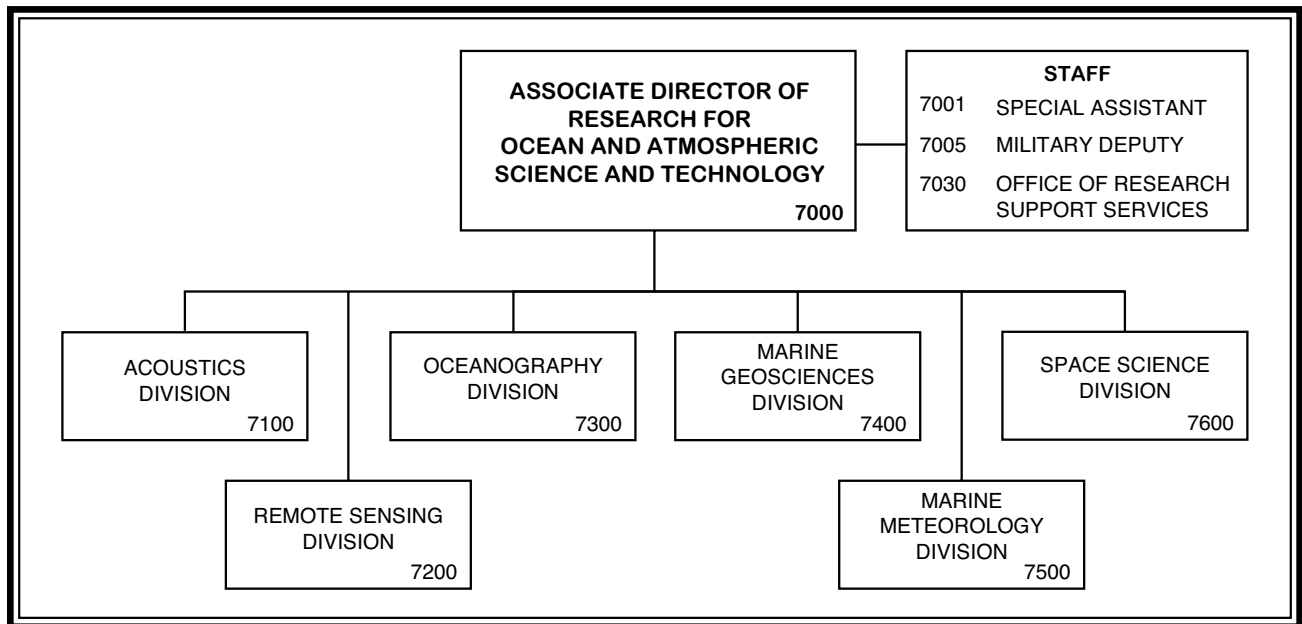
**D**r. E.R. Franchi was born in Huntington, New York. He graduated from Clarkson University in 1968 with a bachelor of science degree in mathematics. He received his master of science (1970) and Ph.D. (1973) degrees, both in applied mathematics, from Rensselaer Polytechnic Institute. After completing his graduate studies, Dr. Franchi accepted a research position with Bolt, Beranek, and Newman where he performed validation studies of underwater acoustic propagation and noise models.

Dr. Franchi joined the Naval Research Laboratory in 1975 as a research mathematician in the Acoustics Division. In this position, he conducted and directed research in low frequency acoustic reverberation and scattering, including design and conduct of field experiments, development of signal processing techniques, data analysis and interpretation, computer prediction models, and active sonar performance studies. In 1986, he was named Head of the Acoustic Systems Branch where he was responsible for programs that emphasized theoretical, experimental, and computational research to understand the physical mechanisms of acoustic propagation, scattering, and ambient noise that control the design and performance of large-aperture passive sonar

systems, low frequency active sonar systems, and shallow water sonar systems.

In July 1988, Dr. Franchi was appointed to the Senior Executive Service and selected as the Associate Technical Director of the Naval Ocean Research and Development Activity (NORDA) and its Director of Ocean Acoustics and Technology. The Directorate conducted basic, exploratory, and advanced research and development and program management in the areas of acoustic model development and simulation, ocean acoustics measurements, and ocean engineering in support of all undersea warfare missions. In October 1992, the Directorate became the Center for Environmental Acoustics in the Acoustics Division of the Naval Research Laboratory, with Dr. Franchi as Director. Dr. Franchi was selected to the position of Superintendent of the Acoustics Division in October 1993. The Acoustics Division conducts basic, exploratory, and applied research and development in areas of acoustic modeling and simulation, ocean acoustics measurements, acoustic systems development, acoustic signal processing, and physical acoustics. He was responsible for the technical/scientific management, direction, and administration of programs with a total budget in excess of \$25M, and for efficient management of division resources including the activities of approximately 110 civilian personnel. He served as Acting Associate Director of Research for the Ocean and Atmospheric Science and Technology Directorate from October 2001 to May 2002 and from June 2007 to April 2008. In April 2008, he was selected as the Associate Director of Research.

Dr. Franchi received the Presidential Rank Award of Meritorious Executive in 2003. He has over 35 years experience in underwater acoustics research and is the author/co-author of over 35 publications. He is recognized as an authority on underwater acoustic scattering and reverberation and has played major roles in Navy low frequency active sonar programs as both performer and advisor/consultant. He served as the U.S. National Leader of The Technical Cooperation Program's multinational Panel on ASW Systems and Technology from 1996 to 2002, and served as its Panel Chairman from 2002 to 2009. In 2011, Dr. Franchi received the TTCP Personal Achievement Award in recognition of his significant contributions and strategic vision in leading the ASW Panel. He represents the United States to the NATO Maritime Science and Technology Experts Committee and served as its Committee Chairman from 2010 to the present. In 2011, he was appointed to the NATO Science and Technology Reform Implementation Team. He was elected to Pi Mu Epsilon, the Honorary National Mathematics Society, while an undergraduate at Clarkson University. Dr. Franchi is a member of the Acoustical Society of America and past member of the Mathematical Association of America. From 2004 to 2013, he volunteered his time to serve on the Board of Directors of the NRL Federal Credit Union.



### Key Personnel

Title	Code
Associate Director of Research for Ocean and Atmospheric Science and Technology	7000
Special Assistant	7001
Military Deputy	7005
Head, Office of Research Support Services	7030
Superintendent, Acoustics Division	7100
Superintendent, Remote Sensing Division	7200
Superintendent, Oceanography Division	7300
Superintendent, Marine Geosciences Division	7400
Superintendent, Marine Meteorology Division	7500
Superintendent, Space Science Division	7600

**Point of contact:** Code 7000A, (202) 404-8174



# Office of Research Support Services (NRL-SSC)

## Code 7030 Staff Activity Areas

### **Office of Research Support**

Conference coordination, video teleconferencing  
Directives, reports, forms

### **Facilities Office**

Facilities planning and maintenance  
Vehicles

### **HPC Management Office**

Supercomputing interface management

### **Safety/Environmental Office**

Industrial/laboratory safety  
Specialized safety training  
Hazard abatement  
Mishap prevention  
Hazardous materials program  
Hazardous waste disposal

### **Public Affairs Office**

Community relations  
News releases  
Exhibits  
Information  
Freedom of Information Act

### **NRL-SSC Network Management Office**

Data communications  
Data networking  
Computer network maintenance



DR. H.C. EPPERT, JR.

### Basic Responsibilities

The Office of Research Support Services is responsible for the operational and management support necessary for the day-to-day operations at NRL Stennis Space Center, Mississippi (NRL-SSC). The Head of NRL-SSC acts for the Commanding Officer in dealing with local Navy, Federal, and civil activities and personnel on matters relating to NRL-SSC support activities and facilities, community and multicommand issues, and safety and disaster control measures.

Support functions include public affairs, network support, safety, high performance computer management, and support services to include management, administration, and facilities.

**Personnel:** 8 full-time civilian

### Key Personnel

Title	Code
Head, Office of Research Support Services	7030
Administrative Officer	7030.2
Head, Facilities Office	7030.3
Public Affairs Officer	7030.4
Safety/Environmental Officer	7030.5
HPC Management Office	7030.6
NRL-SSC Network Management Office	7030.8

**Point of contact:** Code 7030, (228) 688-4010; DSN 828-4010

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\*Acting

# Acoustics Division

## Code 7100 Research Activity Areas

### Physical Acoustics

- Structural acoustics
- Quantum effects in phononic crystals
- Nanomechanical devices
- Fiber-optic acoustic sensors
- Acoustic transduction
- Inverse scattering
- Target strength/radiation modeling
- Flow-induced noise and vibration
- Active sonar classification
- Underwater distributed, networked sensing
- AUV-based sensing



NRL's "Reliant" unmanned undersea vehicle with towed acoustic array being deployed during a long range active acoustics experiment.



Structural acoustic studies are conducted in the one-million-gallon Acoustic Holographic Pool Facility.

### Acoustic Signal Processing and Systems

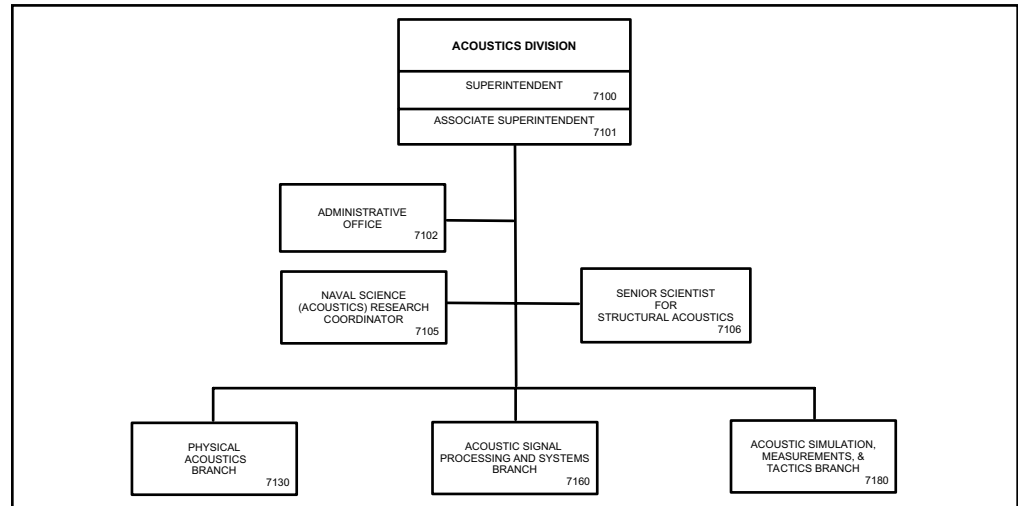
- Underwater acoustic communications and networking
- Limits of array performance
- Waveguide invariant processing
- Acoustic field uncertainty
- Acoustic interactions with transonic/supersonic flows
- Acoustic noise forecasting
- Long-range underwater communications
- Underwater distributed sensing networks
- Ocean boundary scattering
- Acoustic propagation
- Acoustic inversion
- Characterization of reverberation
- Acoustic metamaterials
- Acoustics of microfluidic bubbly emulsions
- Active sonar performance modeling
- Compressive sensing
- Acoustic classification
- Nonlinear propagation
- Underwater acoustic network warfare

### Acoustic Simulation, Measurements, and Tactics

- Ocean acoustic propagation and scattering models
- Fleet application acoustic models
- High-frequency seafloor and ocean acoustic measurements
- Riverine acoustics
- Distributed sensing networks
- Incorporating uncertainty in predictive models
- Tactical acoustic simulations and databases
- Warfare effectiveness studies and optimization
- Environmental assessment and planning tools



DR. D.G. TODOROFF



## Basic Responsibilities

The Acoustics Division conducts basic and applied research addressing the physics of acoustic signal generation, propagation, scatter, and detection with the objective of improving the strategic and tactical capabilities of the Navy and Marine Corps in the ocean and land operational environment. The Division's scientists and engineers perform collaborative research with scientists affiliated with national and international academic, private, and governmental research organizations. The Division's research spans classical and quantum physics, signal processing, the impact of fluid dynamics on the oceans sound speed field, the propagation and scatter of acoustic signals in the ocean and land environments, structural and physical acoustics including the development of MEMS and nanotechnology based sensors, and the application of networked unmanned underwater vehicles and associated sensors to the Navy's ASW, MCM, and ISR missions.

**Personnel:** 61 full-time civilian

## Key Personnel

Title	Code
Superintendent, Acoustics Division	7100
Associate Superintendent	7101
Administrative Officer	7102
Naval Science (Acoustics) Research Coordinator	7105
Senior Scientist for Structural Acoustics	7106
Head, Physical Acoustics Branch	7130
Head, Acoustic Signal Processing and Systems Branch	7160
Head, Acoustic Simulation, Measurements, and Tactics Branch	7180

**Point of contact:** Code 7100, (202) 767-3482

# Remote Sensing Division

## Code 7200 Research Activity Areas

### Remote Sensing

#### Sensors

- SAR
- Imaging radar
- Passive microwave imagers
- CCDs and focal plane arrays
- Thermal IR cameras
- Fabry-Perot spectrometers
- Imaging spectrometers
- Radio interferometers
- Optical interferometers
- Adaptive optics
- Lidar
- Spaceborne and airborne systems

#### Research Areas

- Radiative transfer modeling
- Coastal oceans
- Marine ocean boundary layer
- Polar ice
- Middle atmosphere
- Global ocean phenomenology
- Environmental change
- Ocean surface wind vector
- Soil moisture
- Ionosphere
- Data assimilation

### Astrophysics

- Optical interferometry
- Radio interferometry
- Fundamental astrometry and reference frames
- Fundamental astrophysics
- Star formation
- Stellar atmospheres and envelopes
- Interstellar medium, interstellar scattering pulsars
- Low-frequency astronomy

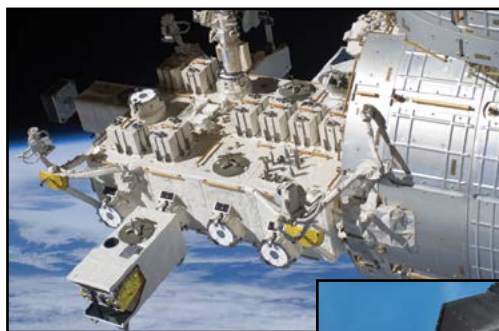
### Physics of Atmospheric/Ocean Interaction

- Mesoscale, fine-structure, and microstructure
- Aerosol and cloud physics
- Mixed layer and thermocline applications
- Sea-truth towed instrumentation techniques
- Turbulent jets and wakes
- Nonlinear and breaking ocean waves
- Stratified and rotating flows
- Turbulence modeling
- Boundary layer hydrodynamics
- Marine hydrodynamics
- Computational hydrodynamics

### Imaging Research/Systems

- Remotely sensed signatures analysis/simulation
- Real-time signal and image processing algorithm/systems
- Image data compression methodology
- Image fusion
- Automatic target recognition
- Scene/sensor noise characterization
- Image enhancement/noise reduction
- Scene classification techniques
- Radar and laser imaging systems studies
- Coherent/incoherent imaging sensor exploitation
- Numerical modeling simulation
- Environmental imagery analysis

The WindSat polarimetric radiometer prior to spacecraft integration.



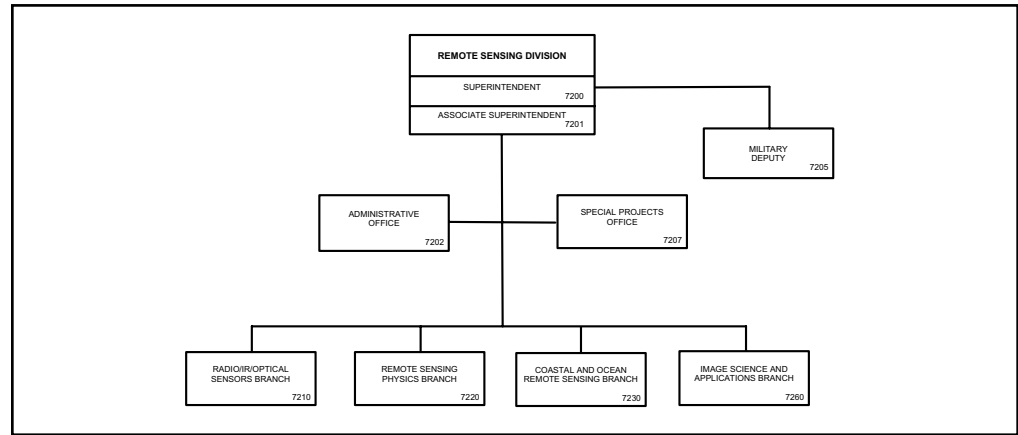
The Hyperspectral Imager for the Coastal Ocean, or HICO, is optimized to image the coastal ocean and adjacent land in 128 contiguous color bands. This spectral data is used to develop maps of water depth, water optical properties, land vegetation, and soil bearing strength. HICO was deployed to the International Space Station in September 2009, providing scientific imagery of varied coastal types worldwide.







Dr. R.M. BEVILACQUA



## Basic Responsibilities

The Remote Sensing Division is the Navy's center of excellence for remote sensing research and development, conducting a program of basic research, science, and applications aimed at the development of new concepts for sensors and imaging systems for objects and targets on the Earth, in the near-Earth environment, and in deep space. The research, both theoretical and experimental, deals with discovering and understanding the basic physical principles and mechanisms that give rise to target and background emission and to absorption and emission by the intervening medium. The accomplishment of this research requires the development of sensor systems technology. This development effort includes active and passive sensor systems to be used for the study and analysis of the physical characteristics of phenomena that give rise to naturally occurring background radiation, such as that caused by the Earth's atmosphere and oceans, as well as man-made or induced phenomena, such as ship/submarine hydrodynamic effects. The research also includes theory, laboratory, and field experiments leading to ground-based, airborne, and space-based systems for use in such areas as environmental remote sensing (including improved meteorological support systems for the operational Navy), astrometry, astrophysics, surveillance, and nonacoustic ASW. Special emphasis is given to developing space-based platforms and exploiting existing space systems.

**Personnel:** 97 full-time civilian

## Key Personnel

Title	Code
Superintendent, Remote Sensing Division	7200
Associate Superintendent	7201
Administrative Officer	7202
Military Deputy	7205
Head, Radio/Infrared/Optical Sensors Branch	7210
Head, Remote Sensing Physics Branch	7220
Head, Coastal and Ocean Remote Sensing Branch	7230
Head, Image Science and Applications Branch	7260

**Point of contact:** Code 7200, (202) 767-3391

# Oceanography Division

## Code 7300 Research Activity Areas

### Ocean Dynamics and Prediction

#### Circulation

- Global resolution of circulation and meso-scale fields

- Littoral circulation at the coast, bays, and estuaries

- Satellite observation processing and assimilation

- UUV adaptive sampling

- Observation system simulation experiments

- Ice volume and ice drift

- Tidal currents and heights

#### Surface effects

- Surface wave effects globally and into bays

- Wave breaking

- Mixed layer dynamics

- Swell propagation and dynamics

- Phase averaged wave evolution

- Phase resolved wave dynamics

#### Nearshore

- Wave breaking at the shore

- Rip currents at the shore

- Tidal currents and heights into rivers

- Nonlinear wave interaction

- Sensor deployment optimization

#### Acoustic effects

- Sound speed variation for acoustic propagation

- Internal waves, solitons, and bores for beam focusing

- Wave bubble entrainment and noise generation

### Ocean Sciences

#### Dynamical processes

- Optical turbulence

- Biological sensing and modeling

- Optical thin layers

- Coastal current systems

- Waves and bubbles

#### Coupled systems

- Air/ocean/acoustic coupling

- Coupled bio/optical/physical processes

- Coupled physical/sediment processes

#### Remote sensing applications

- 3D optical profiling

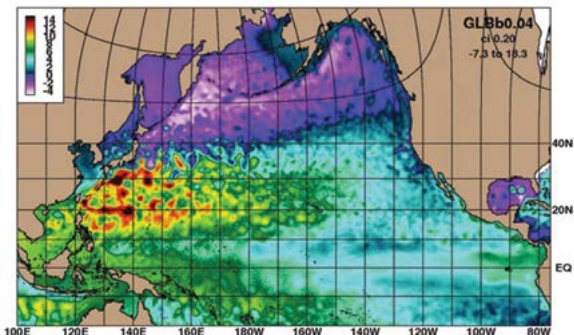
- Color/hyperspectral signatures

- Ocean optics

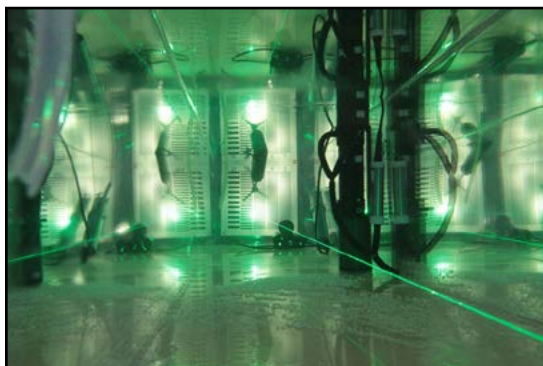
- Sea surface salinity

#### Microbiologically influenced corrosion

- Metal-microbe interaction



Sea surface height from the 1/25° Global Hybrid Coordinate Ocean Model (HYCOM) for the Northern Pacific Ocean.



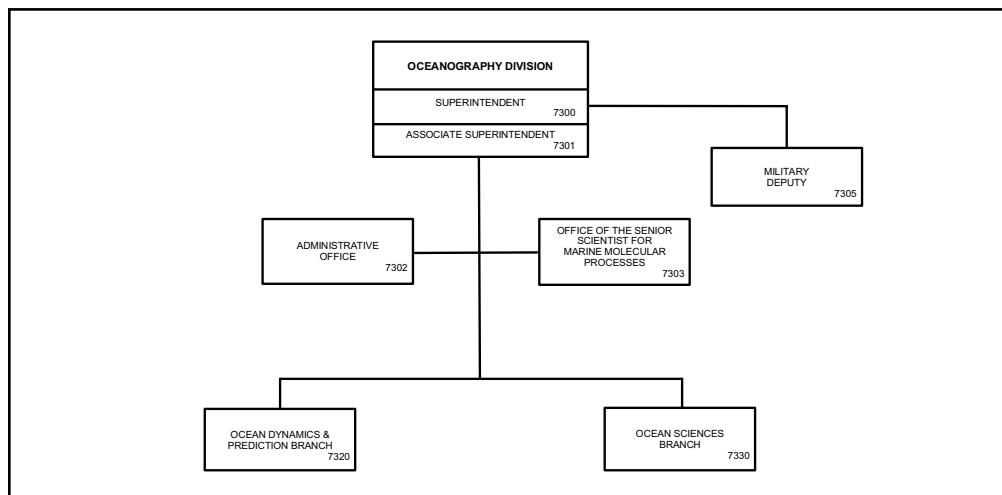
Rayleigh Bernard Convective Tank provides a controlled environment capable of generating turbulent microstructures at various repeatable intensities.



Environmental scanning electron microscope with focused ion beam (ESEM/FIB) coupled with an energy dispersive X-ray detector.



DR. R.H. PRELLER



## Basic Responsibilities

The Oceanography Division conducts basic and applied research in description and modeling of biological, physical, and dynamical processes in open ocean, regional, and littoral areas; in exploitation of satellite, airborne, and in situ sensors for environmental characterization; and in investigation and application of microbial processes to Navy problems. The oceanographic research is both theoretical and experimental in nature and is focused on understanding and modeling ocean, coastal, and littoral area hydro/thermodynamics, circulation, waves, ice dynamics, air-sea exchange, optics, and small and microscale processes. Analytical methods and algorithms are developed to provide quantitative retrieval of geophysical parameters of Navy interest from state-of-the-art sensor systems. The Division work includes analysis of biological processes that mediate and control optical properties of the oceans, coastal, and littoral regions, and microbially induced corrosion/metal-microbe interaction. The Division programs are designed to be responsive to and to anticipate Naval needs. Transition of Division products to the DoD, Navy systems developers, operational Navy, and civilian (dual use) programs is a primary goal. The Division's programs are coordinated and interactive with other NRL programs and activities, ONR's research programs, and other government agencies involved in oceanographic activities. The Division also collaborates and cooperates with scientists from the academic community and other U.S. and foreign laboratories.

**Personnel:** 78 full-time civilian; 1 military

## Key Personnel

Title	Code
Superintendent, Oceanography Division	7300
Associate Superintendent	7301
Administrative Officer	7302
Office of the Senior Scientist for Marine Molecular Processes	7303
Military Deputy	7305
Head, Ocean Dynamics and Prediction Branch	7320
Head, Ocean Sciences Branch	7330

**Point of contact:** Code 7301, (228) 688-4704; DSN 828-4704

# Marine Geosciences Division

## Code 7400 Research Activity Areas

### Marine Geology

- Sedimentary processes
- Sediment microstructure
- Pore fluid flow
- Diapirism, volcanism, faulting, mass movement
- Biogenic and thermogenic methane
- Hydrate distribution, formation, and dissociation
- Small-scale granular/fluid dynamics

### Marine Geophysics

- Seismic wave propagation
- Physics of low-frequency acoustic propagation
- Acoustic energy interaction with topography and inhomogeneities
- Gravimetry and geodesy
- Geomagnetic modeling

### Marine Geotechnique

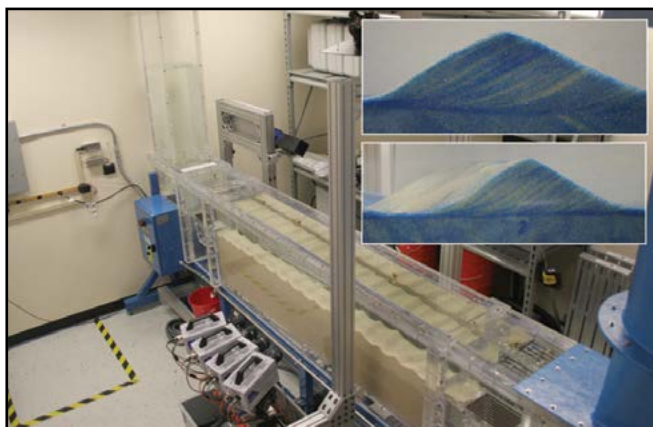
- Acoustic seafloor characterization
- Geoacoustic modeling
- Geotechnical properties and behavior of sediments
- Measurement and modeling of high-frequency acoustic propagation and scattering
- Mine burial processes
- Marine biogeochemistry
  - Animal-microbe-sediment interactions
  - Early sediment diagenesis
- Biomineralization of palladium species
- Physics-based and numerical modeling of sediment strength

### Geospatial Sciences and Technology

- Digital database design
- Digital product analysis and standardization
- Data compression techniques and exploitation
- Hydrographic survey techniques
- Bathymetry extraction techniques from remote and acoustic imagery
- Modeling of nearshore morphodynamics
- Geospatial portal design with 2D and 3D interfaces
- Characterization of the littoral from airborne platforms

### In Situ and Laboratory Sensors

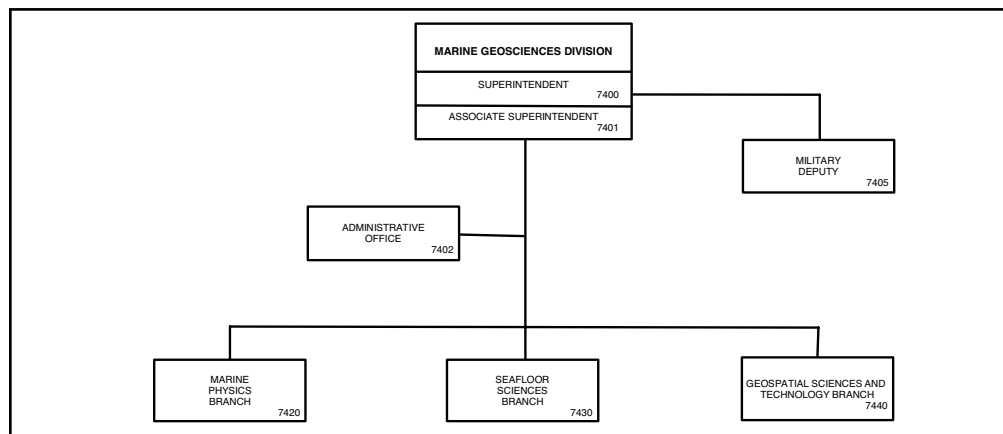
- High-resolution subseafloor 2D and 3D seismic imaging
- Laser/hyperspectral bathymetry/topography
- Swath acoustic backscatter imaging
- Sediment pore water pressure, permeability, and undrained shear strength
- Compressional and shear wave velocity and attenuation
- Airborne geophysics, gravity, and magnetics
- Seafloor magnetic fluctuation
- Sediment microfabric change with pore fluid and/or gas change
- Instrumented mine shapes
- Bottom currents and pressure fluctuations



In the Marine Geosciences Division, scientists perform laboratory experiments with a small oscillatory flow tunnel (S-OFT) to study the formation and migration of sand ripples. Rippled sand beds are ubiquitous on the seafloor in shallow water. Understanding the complex response of the seafloor to forcing from surface waves and currents is important for Naval operations from amphibious landings to mine warfare. Shown in the image is the S-OFT including a mounted laser and four high-speed video cameras to perform tomographic particle image velocimetry (Tomo-PIV) measurements, which estimate the three-dimensional fluid velocity in a volume up to 10 cm<sup>3</sup>. The upper inset is a picture of a sand ripple formed using a bimodal distribution of sand where the smaller sand particles are darker and the larger sand particles are lighter in color. The lower inset is a profile image of a sand ripple from the same experiment where the sorting processes between large and small grains have formed visible strata. Ripple migration is from right to left in both inset images.



DR. H.C. EPPERT, JR.



## Basic Responsibilities

The Marine Geosciences Division conducts a broadly based, multidisciplinary program of scientific research, advanced technology development, and applied research in marine geosciences, geodesy, geospatial information, and related technologies. This includes investigations of basic processes within ocean basins, littoral regions and adjacent land areas, and arctic regions; development of models, sensors, and techniques; and the exploitation of this knowledge and technology to enhance Navy and Marine Corps systems, plans, and operations, and to meet national needs.

As the Navy's subject matter expert in the areas of Geospatial Information and Services (GI&S), the Division provides vital technical support to the Oceanographer/Navigator of the Navy, CNO, N2/N6E, the National Geospatial-Intelligence Agency (NGA) and the Tri-Service Community. NRL also contributes to the development of leading-edge geospatial technology by reviewing emerging GI&S standards and products.

Close coordination and interactions with the Commander, Naval Meteorology and Oceanography Command, Naval Oceanographic Office, CNO, Office of Naval Research (ONR), Systems Commands, Warfare Centers, NGA, and the other DoD and national organizations are essential to the success of Division programs, with transition of Division technology to systems developers and to the operational Navy a primary goal. The Division program is coordinated and interactive with other NRL programs and activities, ONR's Research Program Department, NOAA, USGS, NSF, and other government agencies involved in seafloor activities. The Division collaborates and cooperates with scientists from the academic community, other U.S. and foreign laboratories, and industry.

**Personnel:** 62 full-time civilian; 2 military

## Key Personnel

Title	Code
Superintendent, Marine Geosciences Division	7400
Associate Superintendent	7401
Administrative Officer	7402
Head, Office of Geospatial Science and Technology Innovation	7403
Military Deputy	7405
Head, Marine Physics Branch	7420
Head, Seafloor Sciences Branch	7430
Head, Geospatial Sciences and Technology Branch	7440

**Point of contact:** Code 7402, (228) 688-4660; DSN 828-4660

\*Acting



# Marine Meteorology Division

## Code 7500 Research Activity Areas

### Atmospheric Dynamics and Prediction

- Global to tactical scale
- Deterministic and probabilistic forecasting
- Large eddy simulation
- Boundary layer processes
- Land surface processes and modeling
- Cloud microphysics and radiative processes
- Coastal processes and modeling
- Arctic processes and modeling
- Urban effects
- Coupled ocean/atmosphere phenomena
- Madden Julian oscillation
- Atmospheric waves and scale interactions
- Coupled littoral prediction
- Hydrology and hydrological cycle
- Tropical cyclones
- Aerosol particles
- Gravity waves
- Predictability
- Ensembles design
- Advanced numerical methods
- GPU-based computing

### Data Assimilation

- Hybrid ensemble-variational techniques
- 3D and 4D variational analysis
- Ensemble Kalman Filter (EnKF)
- Quality control and bias correction
- Tropical cyclone initialization
- Remotely sensed data assimilation
- Adjoint technique and applications
- Radar data assimilation
- Targeted observing strategies
- Data selection techniques
- Aerosol and trace gas assimilation
- UAV/UAS data assimilation
- Observing system assimilation experiment

### Tactical Environmental Support

- Rapid environmental assessment
- Through-the-sensor measurements
- Atmospheric impact on
  - weapons systems
- Data fusion
- Nowcasting
- Visualization
- Verification and Validation
- Information Assurance

- Expert systems
- Aviation risk assessment

### Atmospheric Physics

- Air-sea interaction
- Cloud and aerosol microphysics
- Radiative transfer
- Cloud and aerosol radiative properties
- Aerosol characterization
- Tropical cyclone structure
- Gravity wave drag

### Measurement Capabilities Atmospheric Physics

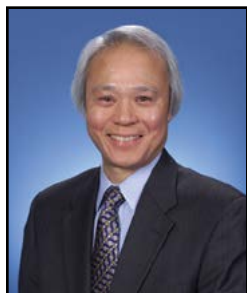
- Mobile Atmospheric Aerosol and Radiation Laboratory
- Platform Coastal Facility for Atmospheric Research
- Aircraft Aerosol and Radiation Instrumentation
  - Packages
- Aerosol and Radiation Instrumentation Calibration
  - Facilities

### Satellite Data/Imagery

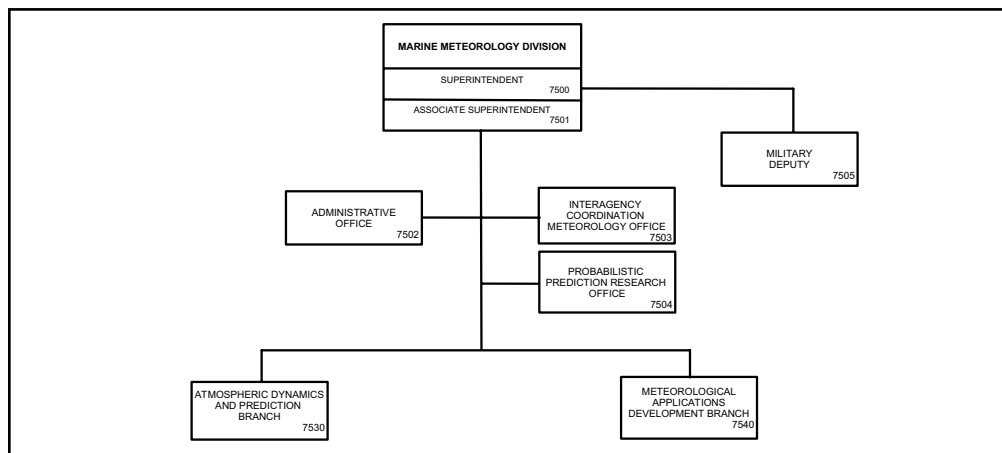
- Automated cloud properties
- Sensor calibration/validation
- Nighttime environmental analysis
- Multisensor data fusion
- Tropical cyclone characterization
- Dust/aerosols monitoring
- Satellite imagery analysis and enhancement
- Rain rate and snow cover
- Precipitation and cloud climatology
- Future satellite/constellation assessment
- Tactical meteorology
- Training and public outreach

### Decision Aids

- Probabilistic Decision aids
- Refractivity/ducting
- Ceiling/visibility
- Fog/turbulence/icing
- Atmospheric acoustics
- EM/EO propagation
- Tropical cyclones/consensus forecasts
- Port studies
- Typhoon havens
- Forecaster handbooks
- Quantification of uncertainty
- Counter-piracy guidance
- Tropical cyclone sortie guidance
- Forecast difficulty guidance
- Ship wind and wave limits
- Optimal ship routing – fuel savings



Dr. S.W. CHANG



## Basic Responsibilities

The Marine Meteorology Division conducts a basic and applied research and development program designed to improve scientific understanding of atmospheric processes that impact Fleet operations and to develop automated systems that analyze, simulate, predict, and interpret the structure and behavior of these processes and their effect on naval weapons systems. Basic and applied research includes work in air-sea interaction, aerosol and cloud physics, atmospheric turbulence, orographically forced flow, atmospheric predictability, scale interactions observation impact, advanced data assimilation, ensemble prediction, tropical dynamics, and numerical methods. Research and development ranges from development of atmospheric analysis/forecast systems and satellite data products to the development of tactical decision aids for operations support. Interdisciplinary research supports the development of coupled analysis/forecast systems, including components for ocean, wave, land surface, aerosol, chemistry, and middle atmosphere prediction. NRL-Monterey (NRL-MRY) is co-located with the Fleet Numerical Meteorology and Oceanography Center (FNMOC) and has developed and transitioned to FNMOC and other operational centers the data assimilation, global, and mesoscale weather forecast models, aerosol prediction systems, and satellite applications products that form the backbone of the Navy's worldwide environmental forecasting capability. Specialties of the Division include numerical weather prediction, data assimilation, tropical cyclones, marine boundary layer processes, aerosols, rapid environmental assessment, environmental decision aids, and satellite data analysis, interpretation, and application.

**Personnel:** 74 full-time civilian; 1 military

## Key Personnel

Title	Code
Superintendent, Marine Meteorology Division	7500
Associate Superintendent	7501
Administrative Officer	7502
Lead Scientist, Probabilistic Prediction Research Office	7504
Military Deputy	7505
Head, Atmospheric Dynamics and Prediction Branch	7530
Head, Meteorological Applications Development Branch	7540

**Point of contact:** Code 7500, (831) 656-4721; DSN 878-4721

# Space Science Division

## Code 7600 Research Activity Areas



### Geospace Science and Technology

Conduct research to observe, understand, model, and forecast the Earth's geospace environment and its connections to its lower and upper boundaries, to facilitate and create functional capabilities.



NRL's MIGHTI will launch in 2017 aboard NASA's Ionospheric Connection Explorer to measure the winds in the thermosphere/ionosphere, needed for accurate research and reliable operational forecasts.



With SuperMISTI (Mobile Imaging & Spectroscopic Threat Identification) in two 20-ft ISO shipping containers, SSD demonstrates detection and identification of radiological/nuclear materials at relevant operational standoff distances.

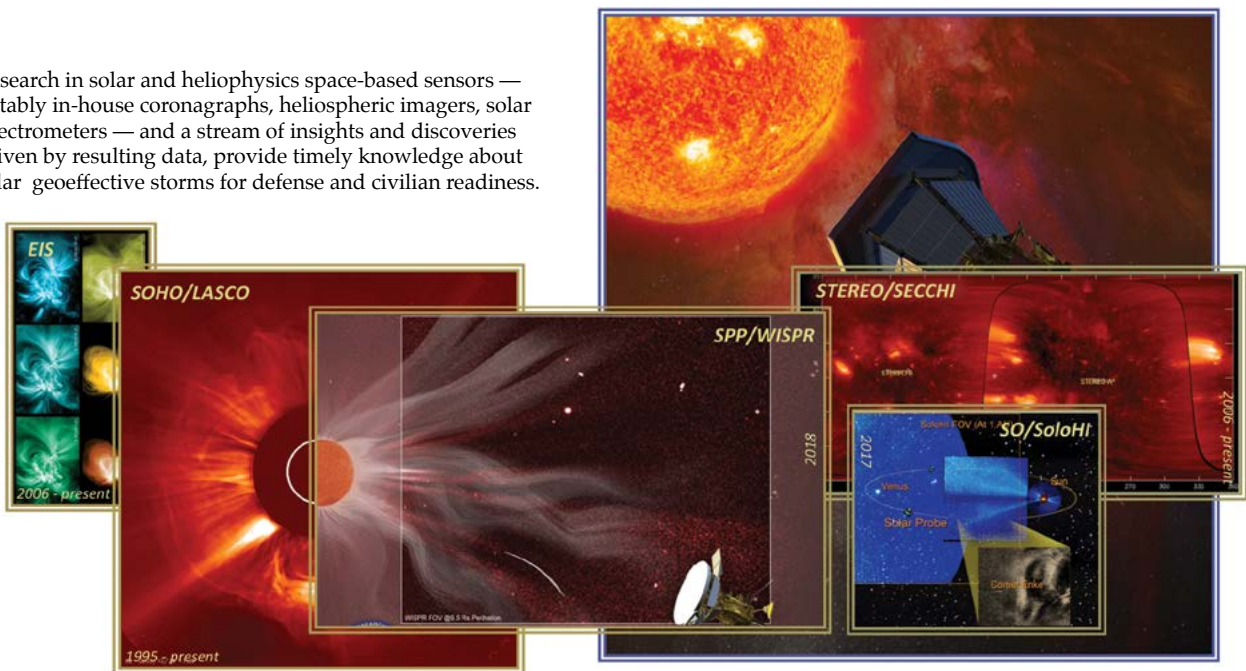
### High-Energy Space Environment

Advance the understanding of the high-energy environment through development and deployment of advanced detectors, simulation of the environments and operations concepts, and interpretation and theoretical modeling of the observed phenomena, to address priority S&T goals.

### Solar and Heliospheric Physics

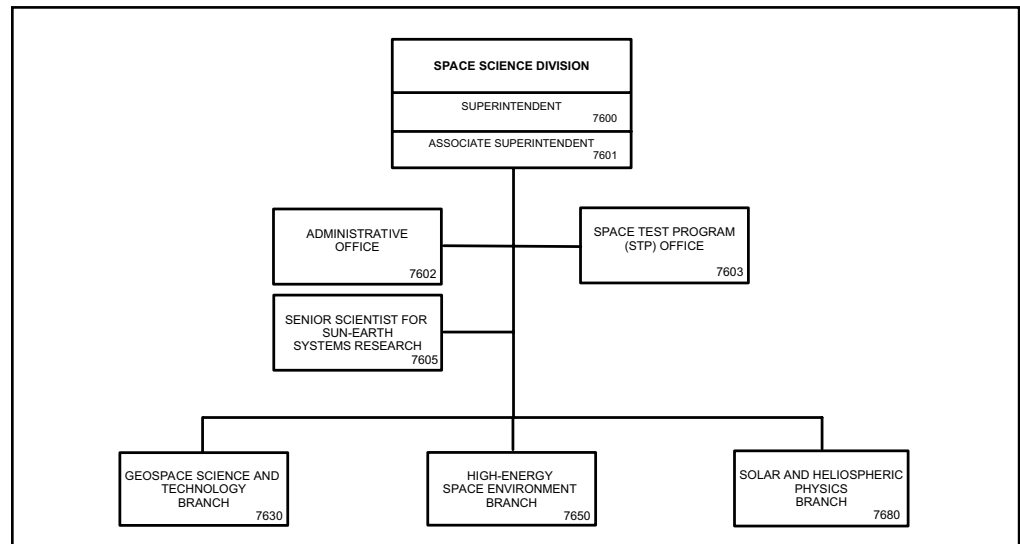
Develop improved heliospace environment understanding, awareness, sensors, forecast capabilities, and monitoring tools that predict operational impacts and enable real-time threat warning, and transition these developments as needed.

Research in solar and heliophysics space-based sensors — notably in-house coronagraphs, heliospheric imagers, solar spectrometers — and a stream of insights and discoveries driven by resulting data, provide timely knowledge about solar geoeffective storms for defense and civilian readiness.





DR. J.P. DAHLBURG



### Basic Responsibilities

The Space Science Division conducts a broad-spectrum RDT&E program in solar-terrestrial physics, astrophysics, upper / middle atmospheric science, and astronomy. Instruments to be flown on satellites, sounding rockets and balloons, and ground-based facilities and mathematical models are conceived and developed. Researchers apply these and other capabilities to the study of the atmospheres of the Sun and Earth, including solar activity and its effects on the Earth's ionosphere, upper atmosphere, and middle atmosphere; laboratory astrophysics; and the unique physics and properties of celestial sources. The science is important to orbital tracking, radio communications, and navigation that affect the operation of ships and aircraft, utilization of the near-space and space environment of the Earth, and the fundamental understanding of natural radiation and geophysical phenomena.

**Personnel:** 77 full-time civilian; 1 military

### Key Personnel

Title	Code
Superintendent, Space Science Division	7600
Associate Superintendent	7601
Administrative Officer	7602
Space Test Program Officer, Kirtland AFB, NM	7603
Senior Scientist for Sun-Earth Systems Research	7605
Head, Geospace Science and Technology Branch	7630
Head, High-Energy Space Environment Branch	7650
Head, Solar and Heliospheric Physics Branch	7680

**Point of contact:** Code 7602, (202) 767-3248





# **NAVAL CENTER FOR SPACE TECHNOLOGY**



# NAVAL CENTER FOR SPACE TECHNOLOGY

## Code 8000

In its role to preserve and enhance a strong space technology base and provide expert assistance in the development and acquisition of space systems that support naval missions, the Naval Center for Space Technology performs basic and applied research through advanced development in all areas of interest to the Navy space program. The Center develops spacecraft, systems using these spacecraft, and ground command and control stations. Principal functions of the Center include understanding and clarifying requirements, recognizing and prosecuting promising research and development, analyzing and testing systems to quantify their capabilities, developing operational concepts that exploit new technical capabilities, per-

forming system engineering to allocate design requirements to subsystems, and performing engineering development and initial operation to test and evaluate selected spacecraft subsystems and systems. The Center is a focal point and integrator for those divisions at NRL whose technologies are used in space systems. The Center also provides systems engineering and technical direction assistance to system acquisition managers of major space systems. In this role, technology transfer is a major goal and motivates a continuous search for new technologies and capabilities and the development of prototypes that demonstrate the integration of such technologies.

## Director, Naval Center for Space Technology

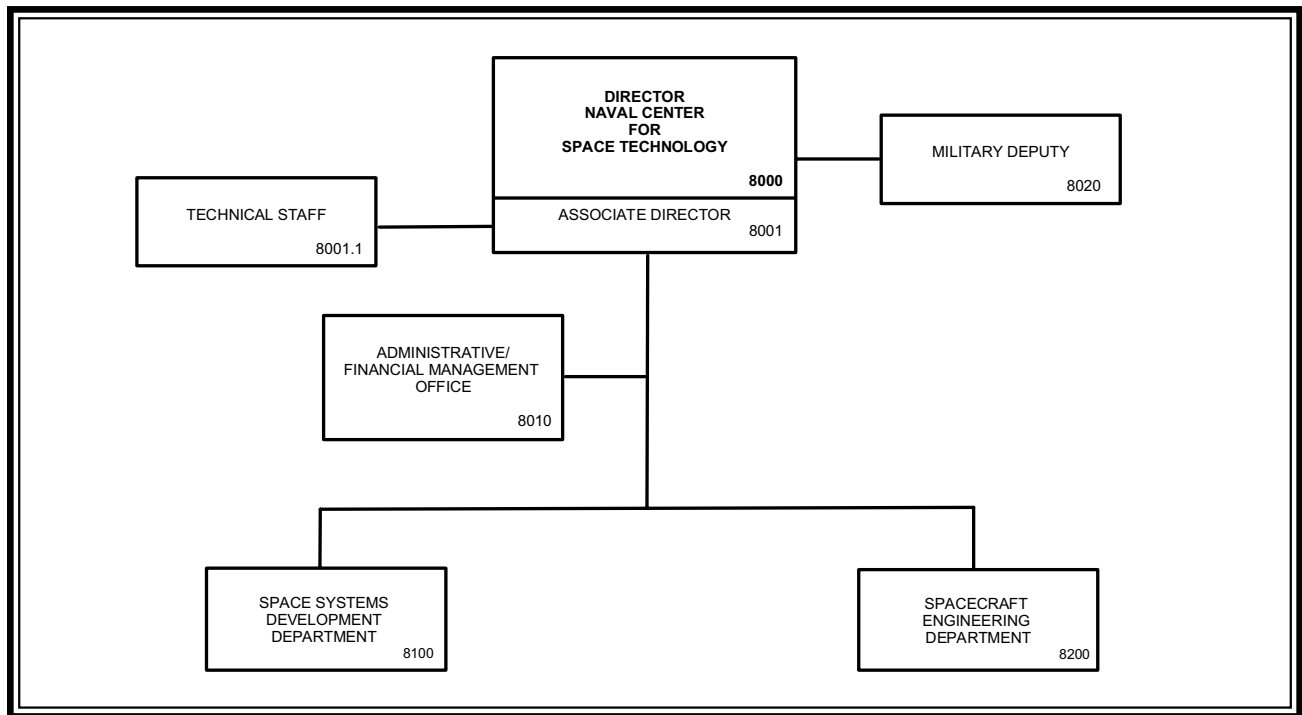


**Mr. P.G. Wilhelm** was born in New York City. He attended Purdue University, where he received a B.S.E.E. degree in 1957. By 1961, he had completed all the course work for an M.S.E. degree from George Washington University.

From 1957 to 1959, Mr. Wilhelm served as an electrical engineer with Stewart Warner Electronics where he was assigned to a project to redesign the UPM-70, a Navy radar test set. In March 1959, he joined the Naval Research Laboratory as an electrical scientist in the Electronics Division. In December 1959, he joined the Satellite Techniques Branch. In 1961, he became Head of the Satellite Instrument Section; in 1965, he became Head of the Satellite Techniques Branch; and in 1974, Head of

the Spacecraft Technology Center. In these positions, he performed satellite system design, equipment development, environmental testing, launch operations, and orbital data handling. In 1981, he was named Superintendent of the Space Systems and Technology Division, the Navy's principal organization, or lead laboratory, for space. He is credited with contributions in the design, development, and operation of more than 100 scientific and Fleet-support satellites. He has been awarded five patents. In October 1986, he was appointed Director of the newly established Naval Center for Space Technology. The Center's mission is to "preserve and enhance a strong space technology base and provide expert assistance in the development and acquisition of space systems which support naval missions."

Mr. Wilhelm has been recognized with numerous awards including the Navy's Meritorious Civilian Service Award, the DoD Distinguished Civilian Service Award, the Presidential Meritorious Executive Award, the Presidential Distinguished Rank Award, the Institute of Electrical and Electronics Engineers Aerospace and Electronic Systems Group Man of the Year Award, the NRL E.O. Hulburt Annual Science and Engineering Award, the Dexter Conrad Award, the Rotary National Stellar Award, the NRL Lifetime Achievement Award, and in May 1999, Mr. Wilhelm received the American Institute of Aeronautics and Astronautics (AIAA) Goddard Astronautics Award. He also has been elected a Fellow of the Washington Academy of Sciences and a Fellow of the American Institute of Aeronautics and Astronautics, and was elected to the National Academy of Engineering. Mr. Wilhelm is also the first recipient of the R.L. Easton Award for excellence in engineering.



### Key Personnel

Title	Code
Director, Naval Center for Space Technology	8000
Associate Director	8001
Technical Staff	8001.1
Head, Administrative/Financial Management Office	8010
Military Deputy	8020
Superintendent, Space Systems Development Department	8100
Superintendent, Spacecraft Engineering Department	8200

**Point of contact:** Code 8010, (202) 767-6551

# Space Systems Development Department

## Code 8100 Research Activity Areas

### Advanced Space/Airborne/Ground Systems Technologies

- Space systems architectures and requirements
- Advanced payloads and optical communications
- Controllers, processors, signal processing, and VLSI data management systems and equipment
- Embedded algorithms and software
- Satellite laser ranging

### Astrodynamics

- Precision orbit estimation
- Onboard autonomous navigation
- Onboard orbit propagation
- GPS space navigation
- Satellite coverage and mission analysis
- Geolocation systems
- Orbit dynamics
- Interplanetary navigation

### Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance

- Communications theory and systems
- Satellite ground station engineering and implementation
- Transportable and fixed ground antenna systems
- High-speed fixed and mobile ground data collection, processing, and dissemination systems
- Tactical communication systems

The Space Systems Development Department, operates extensive laser communication test bed facilities at Quantico, Virginia; Tilghman Island, Maryland; and NRL's Chesapeake Bay Detachment (CBD). Optical communications equipment at CBD and Tilghman Island are separated by 16 km across the Chesapeake Bay, creating a fully instrumented laboratory in a maritime environment. Measurements made at this facility may be applied directly to ship-to-ship laser communications applications. The optical test facility at Quantico, Virginia, hosts a 1-m telescope and satellite laser ranging equipment that is used for both precise orbit determination and space-to-ground laser communications research. Together, these facilities provide researchers the full spectrum of operating environments relevant to naval communications needs.



### Space and Airborne Payload Development

- Space and airborne system payload concept definition, design, and implementation including hardware and software
- Detailed electrical/electronic design of electronic and electromechanical payload and systems and components
- Design and verification of real-time embedded multiprocessor software
- Payload antenna systems
- Space and airborne payload fabrication, test, and integration
- Launch and on-orbit payload support

### Laser Communications Research

- Ship-to-ship laser communications
- Space-to-ground laser communications
- Satellite laser ranging for precise orbit determination

### Space and Airborne Mission Development

- Mission development and requirements definition
- Systems engineering and analysis
- Concepts of operations and mission simulations
- Mission evaluation and performance assessments

### Precision Navigation and Time

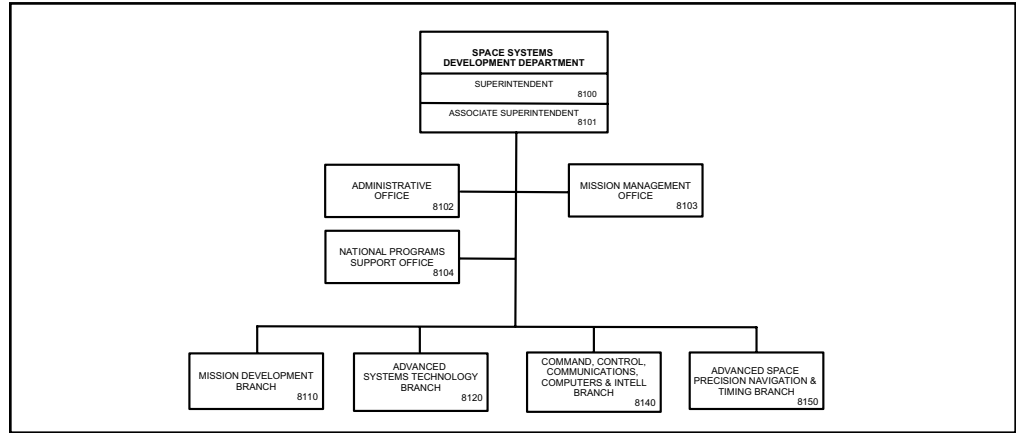
- Advanced navigation satellite technology
- Precise Time and Time Interval (PTTI) technology
- Atomic time/frequency standards/instrumentation
- Passive and active ranging techniques
- Precision tracking of orbiting objects from space/ground
- National and International standards for time keeping/Universal Coordinated Time/UTC (NRL)



One-meter SLR and Optical Test Facility in Quantico, Virginia.



Mr. C. DWYER



## Basic Responsibilities

The Space Systems Development Department (SSDD) is the space and ground support systems research and development organization of the Naval Center for Space Technology. The primary objective of the SSDD is to develop command, control, communications, computers, and intelligence, surveillance, and reconnaissance (C4ISR) hardware and software solutions to space, airborne, and ground applications to respond to Navy, DoD, and national mission requirements with improved performance, capacity, reliability, efficiency, and/or life cycle cost. The Department must derive system requirements from the mission, develop architectures in response to these requirements, and design and develop systems, subsystems, equipment, and implementation technologies to achieve the optimized, integrated operational space, airborne, and ground system. These development responsibilities extend across the entire space/airborne/ground spectrum of hardware, software, and advanced technologies, including digital processing and control, analog systems, power, communications, payload command and telemetry, radio frequency, optical, payload, and electromechanical systems, as well as systems engineering.

**Personnel:** 126 full-time civilian; 1 part-time civilian; 23 student civilian; 1 intermittent civilian

## Key Personnel

Title	Code
Superintendent, Space Systems Development Department	8100
Associate Superintendent	8101
Administrative Officer	8102
Head, Mission Management Office	8103
Head, National Programs Support Office	8104
Head, Mission Development Branch	8110
Head, Advanced Systems Technology Branch	8120
Head, Command, Control, Communications, Computers, and Intelligence Branch	8140
Head, Advanced Space Precision Navigation and Timing Branch	8150

**Point of contact:** Code 8102, (202) 767-0432



# Spacecraft Engineering Department

## Code 8200

### Research Activity Areas

#### Design, Test, and Processing

- Preliminary and detailed design of spacecraft mechanical components, structures, and mechanisms
- Fabrication, assembly, integration, and testing of spacecraft and payloads
- Vibration, shock, acoustic, and thermal vacuum testing of components, systems, payloads, and spacecraft
- Integration of spacecraft onto launch vehicles
- Systems engineering for new spacecraft proposals

#### Space Mechanical Systems Development

- Development, integration, and transition of prototype spacecraft systems and experimental payloads
- Structural design and analysis
- Large space structures
- Thermal design, analysis, fabrication, integration, test, and flight operation
- Pumped and advanced multiphase heat transfer devices
- Computational Fluid Dynamics (CFD) technique for space systems
- Integrated structural/thermal/optical or RF design and analysis
- Mission integration and development
- Mission assurance, configuration control, and safety
- Systems engineering and management

#### Control Systems

- Attitude determination and control systems
- Precision pointing
- Optical line-of-sight stabilization
- Propulsion systems
- Precision cleaning and component testing
- Propellant and pressurization systems
- Hydraulic and pneumatics control
- Test systems and services
- Analytical design and mission planning
- Navigation, tracking, and orbit dynamics
- Expert systems
- Flight operations support
- Computer simulation and animation
- Computer animation
- Robotics systems engineering
- Proximity operations
- Autonomous servicing and inspection
- Autonomous inspection
- End effector design

- Compliance control
- Trajectory planning
- Machine vision
- Fault detection, isolation, and recovery
- Electro-dynamic tethers
- Robotic control algorithms and software
- Robotic actuation and sensing

#### Space Electronic Systems Development

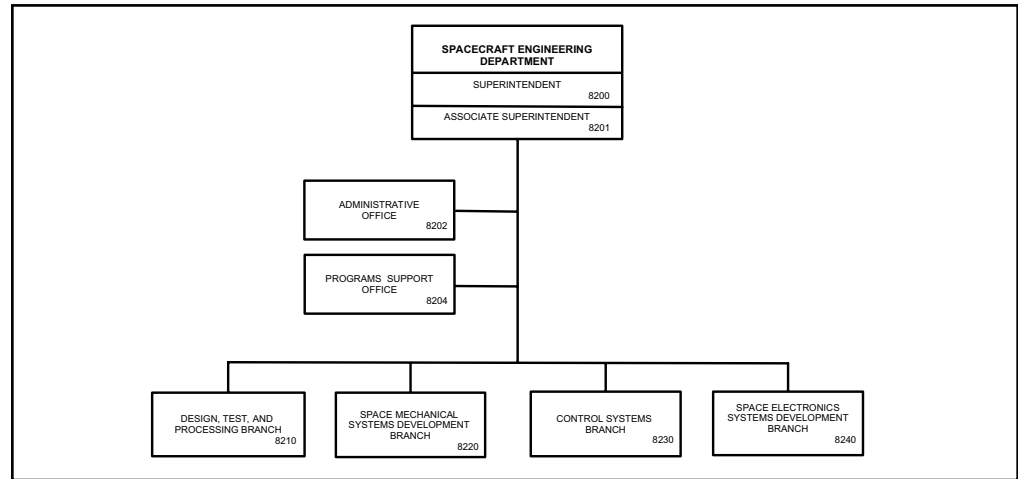
- Space system concept definition, design, and implementation including hardware and software
- Detailed electrical design of electronic and electromechanical systems and components
- Implementation of real-time flight software and embedded command, control, and telemetry software
- Implementation of Spacecraft Ground system software, including integration and test as well as operations (Neptune/CGA)
- Mission Tasking Software (VMOC)
- Spacecraft antenna systems, receivers, transmitters, and radiometers
- Space hardware design, fabrication, test, and integration
- Launch and on-orbit support
- Space test systems and electronic launch support equipment
- Spacecraft power systems— collection, storage, conversion, and distribution
- Spacecraft TT&C and control systems
- Space communications



Against the backdrop of a glowing morning sky, the TacSat-4 tactical satellite, carrying an experimental communications payload developed by NRL, successfully launched September 27, 2011, aboard an Orbital Sciences Minotaur-IV+ launch vehicle from the Alaska Aerospace Corporation's Kodiak Launch Complex, Kodiak Island, Alaska.



Mr. J.P. SCHaub



## Basic Responsibilities

The Spacecraft Engineering Department (SED) is the focal point for the Navy's capability to design and build spacecraft. Activities range from concept and feasibility planning to on-orbit IOC for NRL's space systems.

The SED provides spacecraft bus expertise for the Navy and maintains an active in-house capability to develop satellites; manages Navy space programs through engineering support and technical direction; in concert with the Space Systems Development Department, designs, assembles, and tests spacecraft and space experiments, including all aspects of space, launch, and ground support; analyzes and designs structures, mechanisms, and a variety of control systems, including attitude, propulsion, reaction, and thermal; integrates satellite designs, launch vehicles, and satellite-to-boost stages; functions as a prototype laboratory to ensure that designs can be transferred to industry and incorporated into subsequent satellite hardware builds; and consults with the Navy Program Office on technical issues involving spacecraft architecture, acquisition, and operation.

**Personnel:** 128 full-time civilian; 2 part-time civilian; 26 student civilian

## Key Personnel

Title	Code
Superintendent, Spacecraft Engineering Department	8200
Associate Superintendent	8201
Administrative Officer	8202
Head, Programs Support Office	8204
Head, Design, Test, and Processing Branch	8210
Head, Space Mechanical Systems Development Branch	8220
Head, Control Systems Branch	8230
Head, Space Electronics Systems Development Branch	8240

**Point of contact:** Code 8202, (202) 767-6412

\*Acting



# **TECHNICAL OUTPUT, FISCAL, AND PERSONNEL INFORMATION**

# Technical Output

## Publications, Presentations, and Patents

The Navy continues to be a pioneer in science and engineering developments and a leader in applying these advancements to military requirements. The primary means of informing the scientific and engineering community of the advances made at NRL is through the Laboratory's technical output—reports, articles in scientific journals, contributions to books, papers presented to scientific societies and topical conferences, patents, and inventions.

The figures for calendar years 2012 and 2013 presented below represent the output of NRL facilities in Washington, DC; Bay St. Louis, Mississippi; and Monterey, California.

In 1986, Congress enacted the Federal Technology Transfer Act in an effort to encourage the commercial use of technology developed in Federal laboratories. The Act allows Government inventors and the laboratories where they work to share the royalties generated by commercial licensing of their inventions. Also, the Act encourages the establishment of Cooperative Research and Development Agreements (CRADAs) between laboratories such as NRL and non-Federal entities such as state and local governments, universities, and business corporations. Such cooperative R&D agreements can include the allocation in advance of patent rights on any inventions made under the joint research effort.

The 1986 Act has given additional impetus to the Laboratory's efforts to patent important inventions arising out of its various research programs.

### Calendar Year 2012

Type of Contribution	Unclassified	Classified	Total
Articles in periodicals, chapters in books, and papers in published proceedings	1473*	0	1473*
Oral Presentations	1159	0	1159
NRL Formal Reports	7	4	11
NRL Memorandum Reports	61	1	62
Books	1	0	1
Patents granted	87	0	87
Trademarks registered	3	0	3

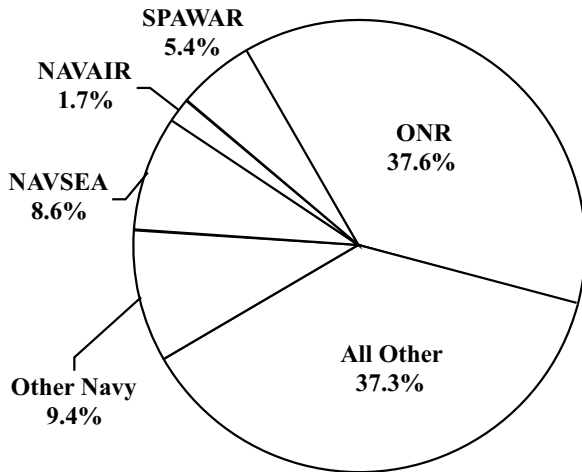
### Calendar Year 2013

Type of Contribution	Unclassified	Classified	Total
Articles in periodicals, chapters in books, and papers in published proceedings	1260*	0	1260*
Oral Presentations	1016	0	1016
NRL Formal Reports	9	7	16
NRL Memorandum Reports	33	5	38
Books	6	0	6
Patents granted	114	2	116
Trademarks registered	1	0	1

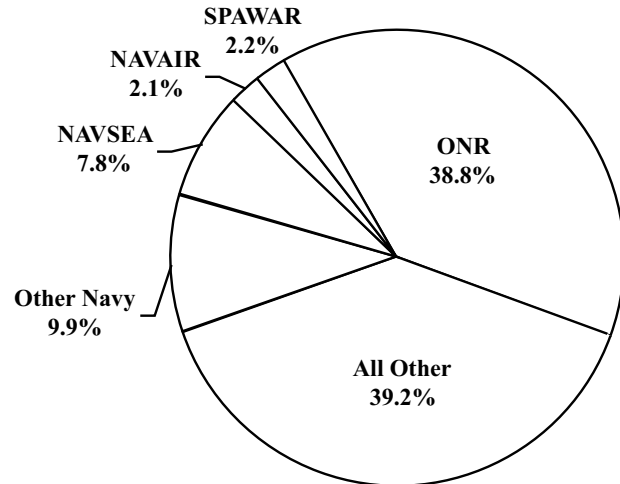
\*This is a provisional total based on information available to the Ruth H. Hooker Research Library on January 28, 2014. Total includes refereed and non-refereed publications.

## FY 2012/2013 Sources of New Funds (Actual)

**FY 2012**



**FY 2013**



**FY 2012  
Source of Funds**

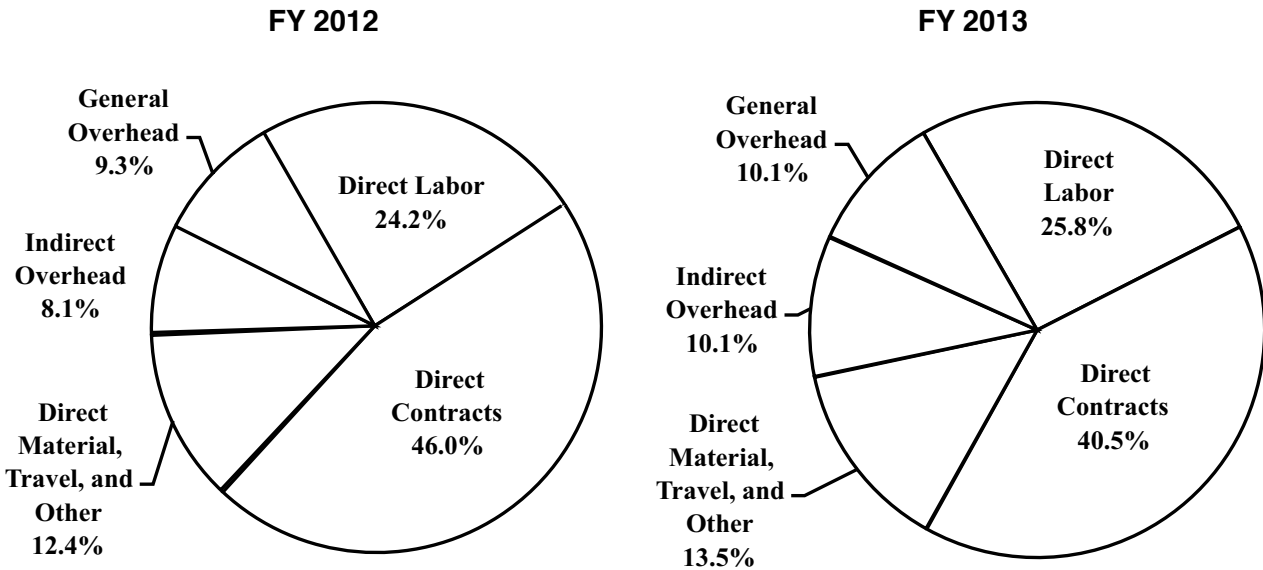
	\$M		
	Reimbursable	Direct Cite	Total
<b>FY 2012</b>			
Office of Naval Research (ONR)	347.6	56.8	404.4
Naval Sea Systems Command (NAVSEA)	48.1	44.3	92.4
Space and Naval Warfare Systems Command (SPAWAR)	29.5	28.9	58.4
Naval Air Systems Command (NAVAIR)	11.2	6.6	17.8
Other Navy	73.2	28.1	101.3
All Other	<u>286.9</u>	<u>113.6</u>	<u>400.5</u>
Total Funds	796.5	278.4	1074.8

**FY 2013  
Source of Funds**

	\$M		
	Reimbursable	Direct Cite	Total
<b>FY 2013</b>			
Office of Naval Research (ONR)	316.4	38.4	354.8
Naval Sea Systems Command (NAVSEA)	46.2	25.0	71.2
Space and Naval Warfare Systems Command (SPAWAR)	18.4	1.6	20.0
Naval Air Systems Command (NAVAIR)	8.9	10.7	19.5
Other Navy	68.2	22.0	90.2
All Other	<u>275.0</u>	<u>83.3</u>	<u>358.3</u>
Total Funds	733.1	181.0	914.0



## FY 2012/2013 Uses of Funds



**FY 2012  
Distribution of Funds**

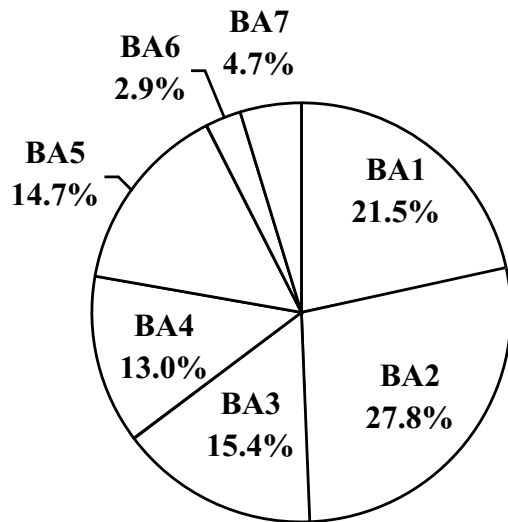
	<b>\$M</b>
Direct Labor	247.9
General Overhead	95.1
Indirect Overhead	82.8
Direct Material, Travel, and Other	127.0
Direct Contracts	<u>472.4</u>
Total Costs*	1025.2

**FY 2013  
Distribution of Funds**

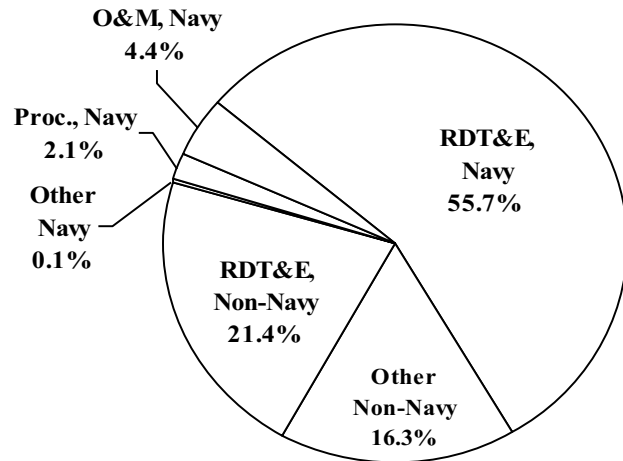
	<b>\$M</b>
Direct Labor	240.1
General Overhead	93.7
Indirect Overhead	93.6
Direct Material, Travel, and Other	125.7
Direct Contracts	<u>377.3</u>
Total Costs*	930.4

\*Costs based on CFO statements; direct contracts include costs for reimbursable-funded contracts and obligations for direct cite-funded contracts.

## FY 2012 Total New Funds by Category



**Distribution of RDT&E, Navy (%)**  
(\$598.2)

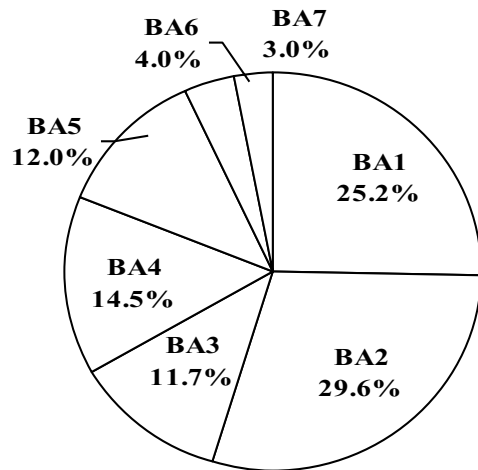


**Distribution of Total (%)**  
(\$1074.8)

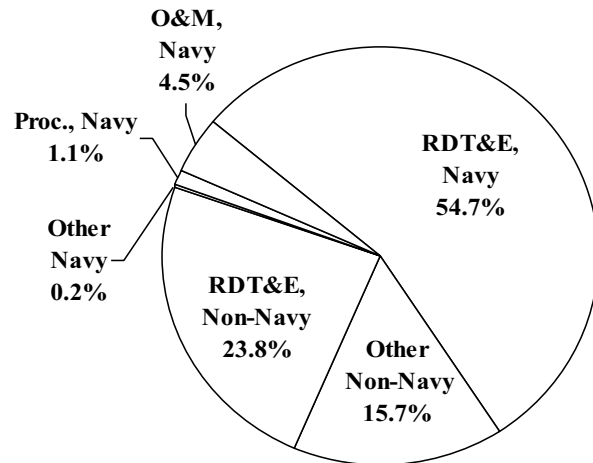
### FY 2012

Category	\$M		
	Navy	Non-Navy	Total
BA1 Basic Research	128.8	5.3	134.1
BA2 Applied Research	166.3	37.4	203.7
BA3 Advanced Technology Development	92.3	106.1	198.5
BA4 Advanced Component Development Prototypes	77.9	31.1	109.1
BA5 System Development and Demonstration	87.8	22.3	110.1
BA6 RDT&E Management Support	17.2	14.5	31.7
BA7 Operational System Development	<u>27.9</u>	<u>13.3</u>	<u>41.2</u>
Subtotal RDT&E	598.2	230.0	828.4
Operations and Maintenance	47.4	54.2	101.5
Procurement	22.7	31.5	54.2
Other	<u>1.0</u>	<u>89.8</u>	<u>90.8</u>
Total New Funds	669.3	405.5	1074.9

## FY 2013 Total New Funds by Category



**Distribution of RDT&E, Navy (%)**  
(\$499.8)



**Distribution of Total (%)**  
(\$914.2)

### FY 2013

Category	\$M		Total
	Navy	Non-Navy	
BA1 Basic Research	125.8	3.5	129.2
BA2 Applied Research	148.2	30.6	178.9
BA3 Advanced Technology Development	58.7	128.4	187.1
BA4 Advanced Component Development Prototypes	72.3	17.4	89.7
BA5 System Development and Demonstration	60.1	(1.6)	58.5
BA6 RDT&E Management Support	19.8	7.8	27.6
BA7 Operational System Development	<u>15.0</u>	<u>31.8</u>	<u>46.8</u>
Subtotal RDT&E	499.9	217.9	717.8
Operations and Maintenance	41.2	33.6	74.8
Procurement	10.1	28.0	38.0
Other	<u>1.7</u>	<u>81.9</u>	<u>83.6</u>
Total New Funds	552.9	361.4	914.2

## Personnel Information\*

### Civilian On-Board

Full-Time, Permanent (FTP)	
Graded	2,298
Ungraded	<u>88</u>
Total	2,386
Temporary, Part-Time, Intermittent (TPTI)	
TPTI	<u>168</u>
Total Civilian	2,554

#### FTP Breakdown

Scientific/Engineering Professional	1,561
Scientific/Engineering Technical	83
Administrative Specialist/Professional	386
Administrative Support	232
Senior Executive Service	22
Scientific or Professional	14
General Schedule	<u>0</u>
Total	2,298

### Military On-Board

Officers	31
Enlisted	<u>52</u>
Total Military On-Board	83
(Military Allowance)	106

### Annual Civilian Turnover Rate (%) (permanent employees only)

	2004	2005	2006	2007	2008	2009	2010	2011	2012
Research divisions	6.8	7.2	9.5	8.5	6.9	4.7	5	5.3	6.0
Nonresearch areas	8.2	8.5	11.0	13.7	13.3	7.4	11	13.5	11.1
Entire Laboratory	6.5	7.4	9.7	9.6	8.2	5.3	6.2	6.9	7.0

### Highest Academic Degrees Held by Civilian Permanent Employees

Bachelors	557
Masters	389
Doctorates	868

\*All data is as of 31 December 2013 unless otherwise noted.

# **PROFESSIONAL DEVELOPMENT**





# Professional Development

## Programs for NRL Employees

The Human Resources Office supports and provides traditional and alternative methods of training for employees. NRL employees are encouraged to develop their skills and enhance their job performance so they can meet the future needs of NRL and achieve their own goals for growth.

One common study procedure is for employees to work full time at the Laboratory while taking job-related courses at universities and schools local to their job site. The training ranges from a single course to undergraduate, graduate, and postgraduate course work. Tuition for training is paid by NRL. The formal programs offered by NRL are described here.

## Graduate Programs

The **Advanced Graduate Research Program** (formerly the Sabbatical Study Program, which began in 1964) enables selected professional employees to devote full time to research or pursue work in their own or a related field for up to one year at an institution or research facility of their choice without the loss of regular salary, leave, or fringe benefits. NRL pays all travel and moving expenses for the employee. Criteria for eligibility include professional stature consistent with the applicant's opportunities and experience, a satisfactory program of study, and acceptance by the facility selected by the applicant. The program is open to employees who have completed six years of Federal service, four of which have been at NRL.

The **Edison Memorial Graduate Training Program** enables employees to pursue graduate studies in their fields at local universities. Participants in this program work 24 hours each workweek and pursue their studies during the other 16 hours. The criteria for eligibility include a minimum of one year of service at NRL, a bachelor's or master's degree in an appropriate field, and professional standing in keeping with the candidate's opportunities and experience.

To be eligible for the **Select Graduate Training Program**, employees must have a bachelor's degree in an appropriate field and must have demonstrated ability and aptitude for advanced training. Students accepted into this program receive one-half of their salary and benefits and NRL pays for tuition and travel expenses.

The **Naval Postgraduate School (NPS)**, located in Monterey, California, provides graduate programs to

enhance the technical preparation of Naval officers and civilian employees who serve the Navy in the fields of science, engineering, operations analysis, and management. NRL employees desiring to pursue graduate studies at NPS may apply; thesis work is accomplished at NRL. Participants continue to receive full pay and benefits during the period of study. NRL also pays for tuition and travel expenses.

In addition to NRL and university offerings, application may be made to a number of noteworthy programs and fellowships. Examples of such opportunities are the **Capitol Hill Workshops**, the **Legislative Fellowship (LEGIS) program**, the **Federal Executive Institute (FEI)**, and the **Executive Leadership Program for Mid-Level Employees**. These and other programs are announced from time to time, as schedules are published.

## Continuing Education

**Undergraduate and graduate courses** offered at local colleges and universities may be subsidized by NRL for employees interested in improving their skills and keeping abreast of current developments in their fields.

NRL offers **short courses** to all employees in a number of fields of interest including administrative subjects, and supervisory and management techniques. Laboratory employees may also attend these courses at nongovernment facilities. HRO advertises training opportunities on the online *Billboard*, HRO website, and in the email newsletter, *HRO Highlights*.

For further information on any of the above Graduate and Continuing Education programs, contact the Employee Development and Management Branch (Code 1840) at (202) 767-8306 or via email at Training@hro.nrl.navy.mil.

The **Scientist-to-Sea Program (STSP)** provides opportunities for Navy R&D laboratory/center personnel to go to sea to gain first-hand insight into operational factors affecting system design, performance, and operations on a variety of ships. NRL is a participant of this Office of Naval Research (ONR) program. Contact (202) 404-2701.

## Professional Development

NRL has several programs, professional society chapters, and informal clubs that enhance the professional growth of employees. Some of these are listed below.

The **Department of the Navy Civilian Employee Assistance Program (DONCEAP)** provides confiden-

tial assessment, referral, and short-term counseling for employees (or their eligible family members) regarding personal concerns to help avoid adversely affecting job performance. Types of personal concerns may include challenging relationships (at work or at home); dealing with stress, anxiety, or depression; grief and loss; or substance abuse. The DONCEAP also provides work/life referral services such as live or on-demand webinars; discussion groups; and advice on parenting, wellness, financial and legal issues, education, and much more. Contact (844)-366-2327 or visit <http://donceap.foh.hhs.gov/>.

The NRL chapter of **Women In Science and Engineering (WISE)** was established to address current issues concerning the scientific community of women at the NRL such as networking, funding, work-life satisfaction, and effective use of our resources. We address these issues by empowering members through the establishment of a supportive and constructive network that serves as a sounding board to develop solutions that address said issues, and then serve as a platform in which members work together to implement these solutions. The NRL chapter of WISE has started several new initiatives for the 2013-2014 year, including a seminar series entitled “Working Smarter Not Harder at NRL — Effective Use of Our Resources” and a Science as Art competition, which is open to all NRL sites. Membership is open to all employees. For more information, contact (202) 404-3355.

**Sigma Xi**, The Scientific Research Society, encourages and acknowledges original investigation in pure and applied science. It is an honor society for research scientists. Individuals who have demonstrated the ability to perform original research are elected to membership in local chapters. The NRL Edison Chapter, comprising approximately 200 members, recognizes original research by presenting annual awards in pure and applied science to two outstanding NRL staff members per year. In addition, an award seeking to reward rising stars at NRL is presented annually through the Young Investigator Award. The chapter also sponsors several lectures per year at NRL on a wide range of topics of general interest to the scientific and DoD community. These lectures are delivered by scientists from all over the world. The highlight of the Sigma Xi Lecture Series is the Edison Memorial Lecture, which traditionally is given by an internationally distinguished scientist. Contact (202) 767-5528.

The **NRL Mentor Program** was established to provide an innovative approach to professional and career training and an environment for personal and professional growth. It is open to permanent NRL employees in all job series and at all sites. Mentees are matched with successful, experienced colleagues having more technical and/or managerial experience who can provide them with the knowledge and skills needed to maximize their contribution to the success of their immediate organization, to NRL, to the Navy, and to their chosen career fields. The ultimate goal of the program is to increase job productivity, creativity, and

satisfaction through better communication, understanding, and training. NRL Instruction 12400.1B provides policy and procedures for the program. For more information, please contact [mentor@hro.nrl.navy.mil](mailto:mentor@hro.nrl.navy.mil) or (202) 767-6736.

Employees interested in developing effective self-expression, listening, thinking, and leadership potential are invited to join the NRL Forum Toastmasters Club, a chapter of **Toastmasters International**. Members of this club possess diverse career backgrounds and talents and learn to communicate not by rules but by practice in an atmosphere of understanding and helpful fellowship. NRL's Commanding Officer and Director of Research endorse Toastmasters. Contact (202) 404-4670.

## Equal Employment Opportunity (EEO) Programs

Equal employment opportunity (EEO) is a fundamental NRL policy for all employees regardless of race, color, national origin, sex, religion, age, sexual orientation, or disability. The NRL EEO Office is a service organization whose major functions include counseling employees in an effort to resolve employee/management conflicts, processing formal discrimination complaints, and requests for reasonable accommodation, providing EEO training, and managing NRL's MD-715 and affirmative employment recruitment programs. The NRL EEO Office is also responsible for sponsoring special-emphasis programs to promote awareness and increase sensitivity and appreciation of the issues or the history relating to females, individuals with disabilities, and minorities. Contact the NRL Deputy EEO Officer at (202) 767-2486 for additional information on any of their programs or services.

## Other Activities

The award-winning **Community Outreach Program** directed by the NRL Public Affairs Office fosters programs that benefit students and other community citizens. Volunteer employees assist with and judge science fairs, give lectures, provide science demonstrations and student tours of NRL, and serve as tutors, mentors, coaches, and classroom resource teachers. The program sponsors student tours of NRL and an annual holiday party for neighborhood children in December. Through the program, NRL has active partnerships with three District of Columbia public schools. Contact (202) 767-2541.

Other programs that enhance the development of NRL employees include sports groups and the **Amateur Radio Club**. The **NRL Fitness Center** at NRL-DC, managed by Naval Support Activity Washington Morale, Welfare and Recreation (NSAW-MWR), houses a fitness room with treadmills, bikes, ellipticals, step mills, and a full strength circuit; a gymnasium for basketball, volleyball, and other activities; and full locker rooms. The Fitness Center is free to NRL employees and contractors. Various exercise classes

are offered for a nominal fee. NRL employees are also eligible to participate in all NSAW-MWR activities held on Joint Base Anacostia–Bolling and Washington Navy Yard, less than five miles away.

## Programs for Non-NRL Employees

Several programs have been established for non-NRL professionals. These programs encourage and support the participation of visiting scientists and engineers in research of interest to the Laboratory. Some of the programs may serve as stepping-stones to Federal careers in science and technology. Their objective is to enhance the quality of the Laboratory's research activities through working associations and interchanges with highly capable scientists and engineers and to provide opportunities for outside scientists and engineers to work in the Navy laboratory environment. Along with enhancing the Laboratory's research, these programs acquaint participants with Navy capabilities and concerns and may provide a path to full-time employment.

## Postdoctoral Research Associateships

Every year, NRL hosts several postdoctoral research associates through the National Research Council (NRC) and American Society for Engineering Education (ASEE) postdoctoral associateship and fellowship programs. These competitive positions provide postdoctoral scientists and engineers the opportunity to pursue research at NRL in collaboration with NRL scientists and engineers. Research associates are guest investigators, not employees of NRL.

**NRL/NRC Cooperative Research Associateship Program:** The National Research Council conducts a national competition to recommend and make awards to outstanding scientists and engineers at recent postdoctoral levels for tenure as guest researchers at participating laboratories. The objectives of the NRC program are (1) to provide postdoctoral scientists and engineers of unusual promise and ability opportunities for research on problems, largely of their own choice, that are compatible with the interests of the sponsoring laboratories and (2) to contribute thereby to the overall efforts of the Federal laboratories. The program provides an opportunity for concentrated research in association with selected members of the permanent professional laboratory staff, often as a climax to formal career preparation.

NRL/NRC Postdoctoral Associateships are awarded to persons who have held a doctorate less than five years at the time of application and are made initially for one year, renewable for a second and possible third year. Information and applications may be found at <http://www.national-academies.org/rap>. To contact NRL's program coordinator, call (202) 404-7450 or email [nrc@hro.nrl.navy.mil](mailto:nrc@hro.nrl.navy.mil).

**NRL/ASEE Postdoctoral Fellowship Program:** The ASEE program is designed to significantly increase the involvement of creative and highly trained scientists and engineers from academia and industry in scientific and technical areas of interest and relevance to the Navy. Fellowship awards are based upon the technical quality and relevance of the proposed research, recommendations by the Navy laboratory, academic qualifications, reference reports, and availability of funds.

NRL/ASEE Fellowship awards are made to persons who have held a doctorate for less than seven years at the time of application and are made for one year, renewable for a second and possible third year. Information and applications may be found at <http://www.asee.org/nrl/>. To contact NRL's program coordinator, call (202) 404-7450 or email [asee@hro.nrl.navy.mil](mailto:asee@hro.nrl.navy.mil).

## Faculty Member Programs

**The Office of Naval Research Summer Faculty Research and Sabbatical Leave Program** provides for university faculty members to work for ten weeks (or longer, for those eligible for sabbatical leave) with professional peers in participating Navy laboratories on research of mutual interest. Applicants must hold a teaching or research position at a U.S. college or university. Contact NRL's program coordinator at [sfrp@hro.nrl.navy.mil](mailto:sfrp@hro.nrl.navy.mil).

**The NRL/United States Naval Academy Cooperative Program for Scientific Interchange** allows faculty members of the U.S. Naval Academy to participate in NRL research. This collaboration benefits the Academy by providing the opportunity for USNA faculty members to work on research of a more practical or applied nature. In turn, NRL's research program is strengthened by the available scientific and engineering expertise of the USNA faculty. Contact NRL's program coordinator at [usna@hro.nrl.navy.mil](mailto:usna@hro.nrl.navy.mil).

## Professional Appointments

**Faculty Member Appointments** use the special skills and abilities of faculty members for short periods to fill positions of a scientific, engineering, professional, or analytical nature at NRL.

**Consultants and experts** are employed because they are outstanding in their fields of specialization or because they possess ability of a rare nature and could not normally be employed as regular civil servants.

**Intergovernmental Personnel Act Appointments** temporarily assign personnel from state or local governments or educational institutions to the Federal Government (or vice versa) to improve public services rendered by all levels of government.

## Student Programs

The student programs are tailored to high school, undergraduate, and graduate students to provide employment opportunities and work experience in naval research.

The **Naval Research Enterprise Intern Program (NREIP)** is a ten-week summer research opportunity for undergraduate sophomores, juniors, and seniors, and graduate students. The Office of Naval Research (ONR) offers summer appointments at Navy laboratories to current college sophomores, juniors, seniors, and graduate students from participating schools. Application is online at [www.asee.org/nreip](http://www.asee.org/nreip) through the American Society for Engineering Education. Electronic applications are sent for evaluation to the point of contact at the Navy laboratory identified by the applicant. Contact NRL's program coordinator at [nreip@nrl.navy.mil](mailto:nreip@nrl.navy.mil).

The **National Defense Science and Engineering Graduate Fellowship Program** helps U.S. citizens obtain advanced training in disciplines of science and engineering critical to the U.S. Navy. The three-year program awards fellowships to recent outstanding graduates to support their study and research leading to doctoral degrees in specified disciplines such as electrical engineering, computer sciences, material sciences, applied physics, and ocean engineering. Award recipients are encouraged to continue their study and research in a Navy laboratory during the summer. Contact NRL's program coordinator at (202) 404-7450 or [ndseg@hro.nrl.navy.mil](mailto:ndseg@hro.nrl.navy.mil).

The **Pathways Intern Program** (formerly STEP and SCEP) provides students enrolled in a wide variety of educational institutions, from high school to graduate level, with opportunities to work at NRL and explore Federal careers while still in school and while getting paid for the work performed. Students can work full-time or part-time on a temporary or non-temporary appointment. Students must be continuously enrolled on at least a half-time basis at a qualifying educational institution and be at least 16 years of age. The primary focus of our **Non-temporary** intern appointment is to attract students enrolled in undergraduate and graduate programs in engineering, computer science, or the physical sciences. Students on non-temporary appointments are eligible to remain on their appointment until graduation and may be noncompetitively converted to a permanent appointment within 120 days after completion of degree requirements. Conversion is not guaranteed. Conversion is dependent on work performance, completion of at least 640 hours of work under the intern appointment before completion of degree requirements, and meeting the qualifications for the position. The **Temporary** intern appointment is initially a one year appointment. This program enables students to earn a salary while continuing their studies and offers them valuable work experience. NRL's Pathways Intern Program opportunities are announced on USAJOBS four times per

year. Visit USAJOBS at <https://www.usajobs.gov/> to create an account, search for jobs, set up an e-mail notification alert of when positions of interest are posted (see "Saved Searches") and apply for our intern opportunities when posted. For additional information on NRL's Intern Program, contact (202) 767-8313.

The **Department of Defense Science and Engineering Apprenticeship Program (SEAP)** provides an opportunity for high school students who have completed at least Grade 9, and are at least 15 years of age, to serve as junior research associates. Under the direction of a mentor, for eight weeks in the summer, students gain a better understanding of research, its challenges, and its opportunities through participation in scientific, engineering, and mathematics programs. Criteria for eligibility are based on science and mathematics courses completed and grades achieved; scientific motivation, curiosity, the capacity for sustained hard work; a desire for a technical career; teacher recommendations; and exceptional test scores. The NRL program is the largest in the Department of Defense. For detailed information visit <http://seap.asee.org/>, or call (202) 767-8324, or email [seap@hro.nrl.navy.mil](mailto:seap@hro.nrl.navy.mil).

## Volunteer Opportunities

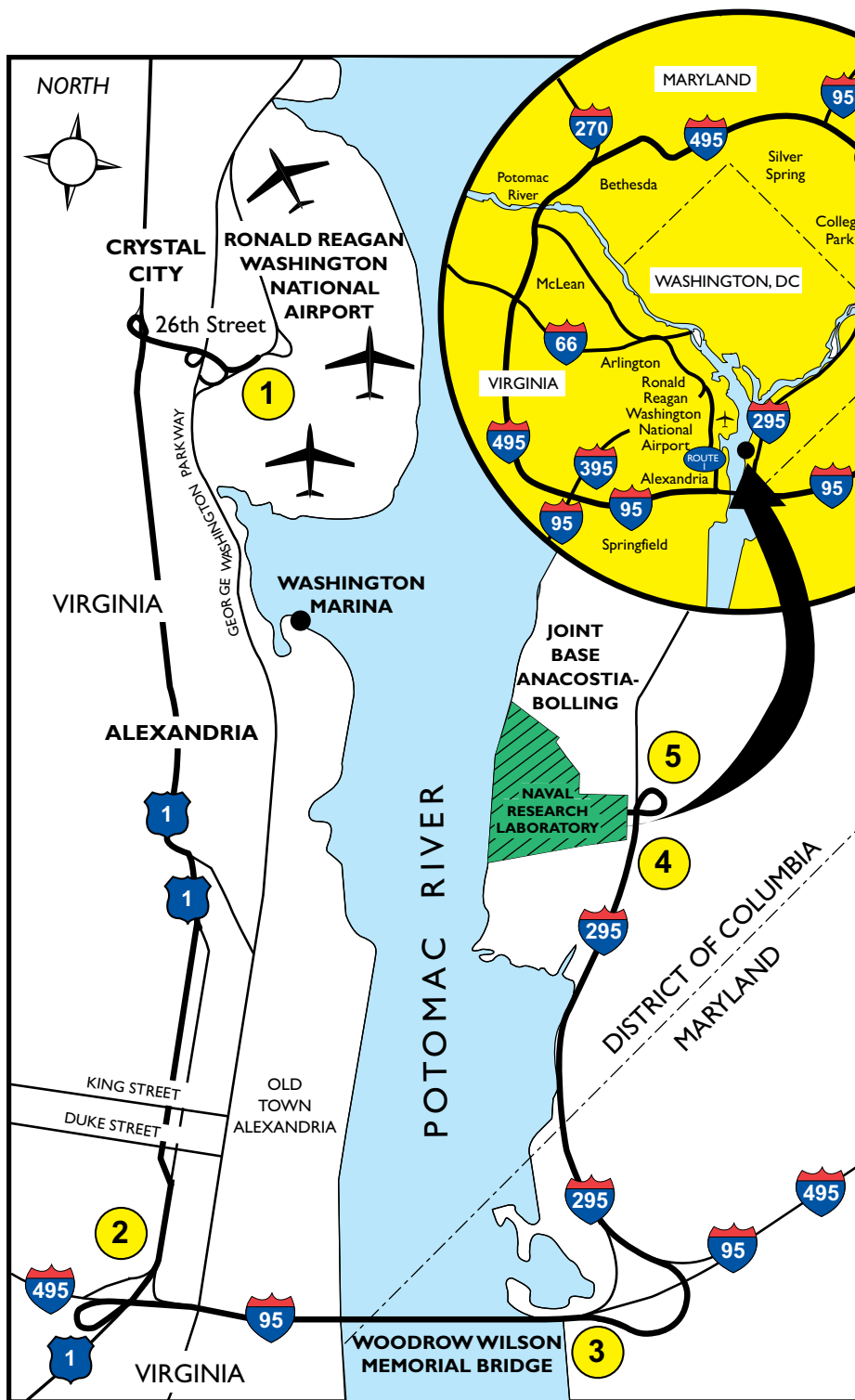
The **Student Volunteer Program** helps students gain valuable experience by allowing them to voluntarily perform educationally related work at NRL. It provides exposure to the work environment and also provides an opportunity for students to make realistic decisions regarding their future careers. Applications are accepted year-round. For additional information, contact (202) 767-8313.

The **Voluntary Emeritus Program (VEP)** uses the services of highly skilled and uniquely qualified individuals who are retired from the Federal Service. Participants will work under the program without compensation.



# **GENERAL INFORMATION**





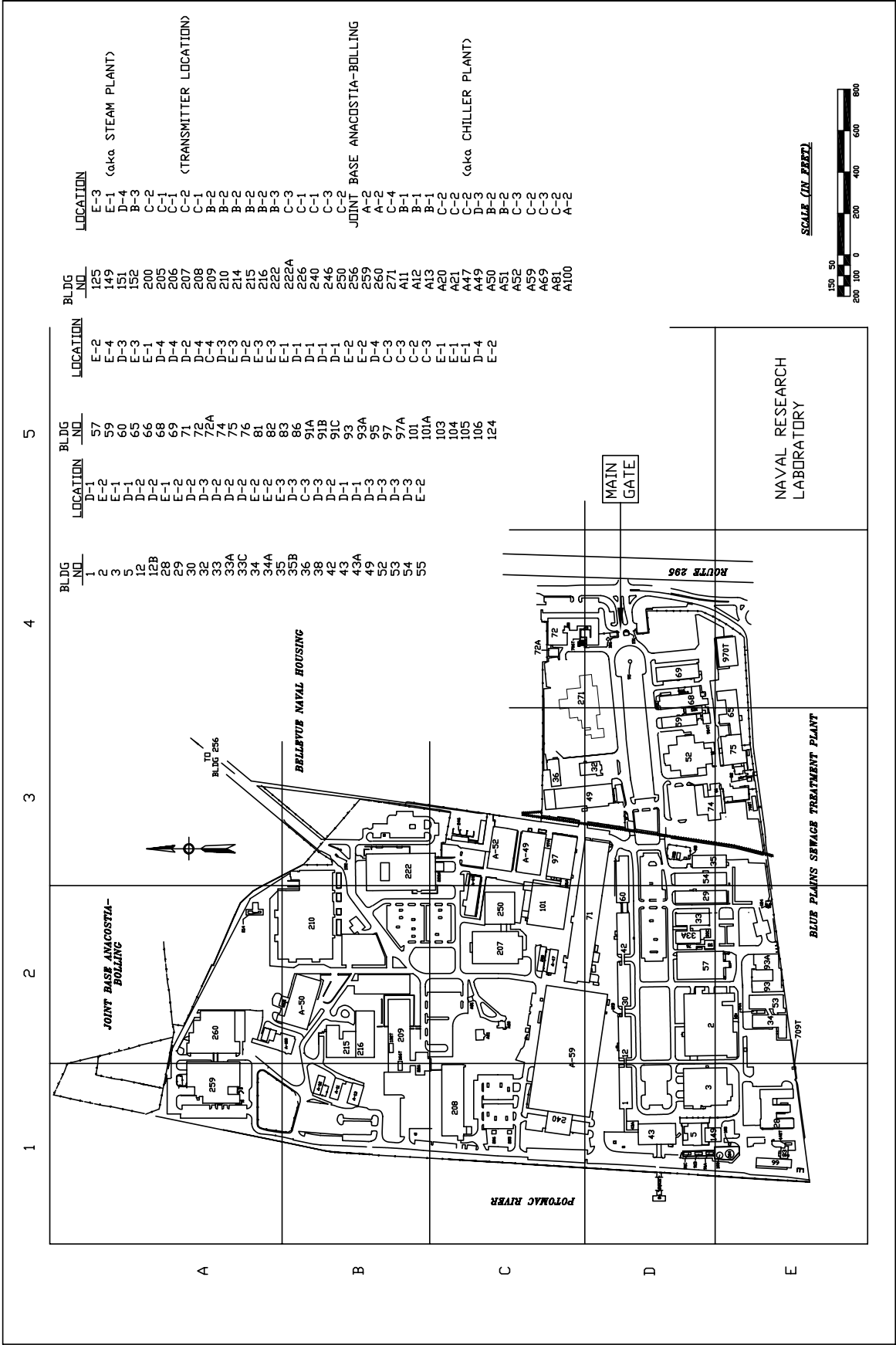
## Naval Research Laboratory (Washington, DC)

### Directions from Ronald Reagan Washington National Airport

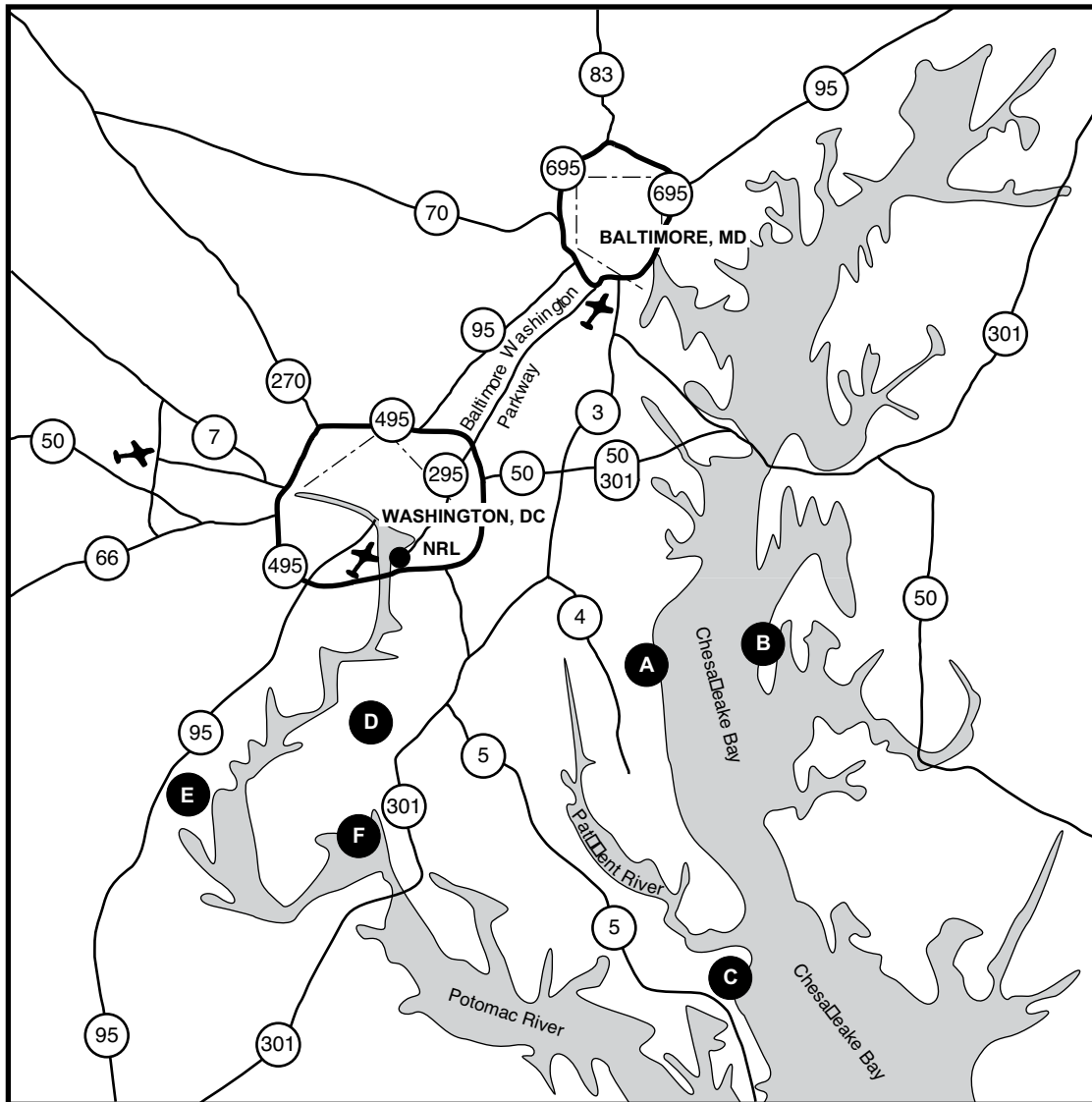
- 1 Follow Route 1 South for approximately 3 miles to the Beltway I-95/I-495.
- 2 Exit right to the Beltway. This exit curves to the right and then divides. Take the left fork to I-95 (Baltimore). Stay in local lanes.
- 3 Stay in the right lane on the Woodrow Wilson Bridge. After crossing the Woodrow Wilson Bridge, take the first exit (I-295). This exit divides. Take the left fork to I-295 North.
- 4 NRL is the first exit off of I-295 (approximately 2 miles) after crossing the Woodrow Wilson Bridge.
- 5 Make a right at the traffic light in front of the main gate (Overlook Avenue). Then make an immediate left into the parking lot. The Visitor Control Center (Building 72) is located on the corner in the brick building next to the main gate.

Naval Research Laboratory  
4555 Overlook Avenue, SW  
Washington, DC 20375-5320  
(202) 767-3200 – DSN 297-3200

Location of Buildings at NRL Washington

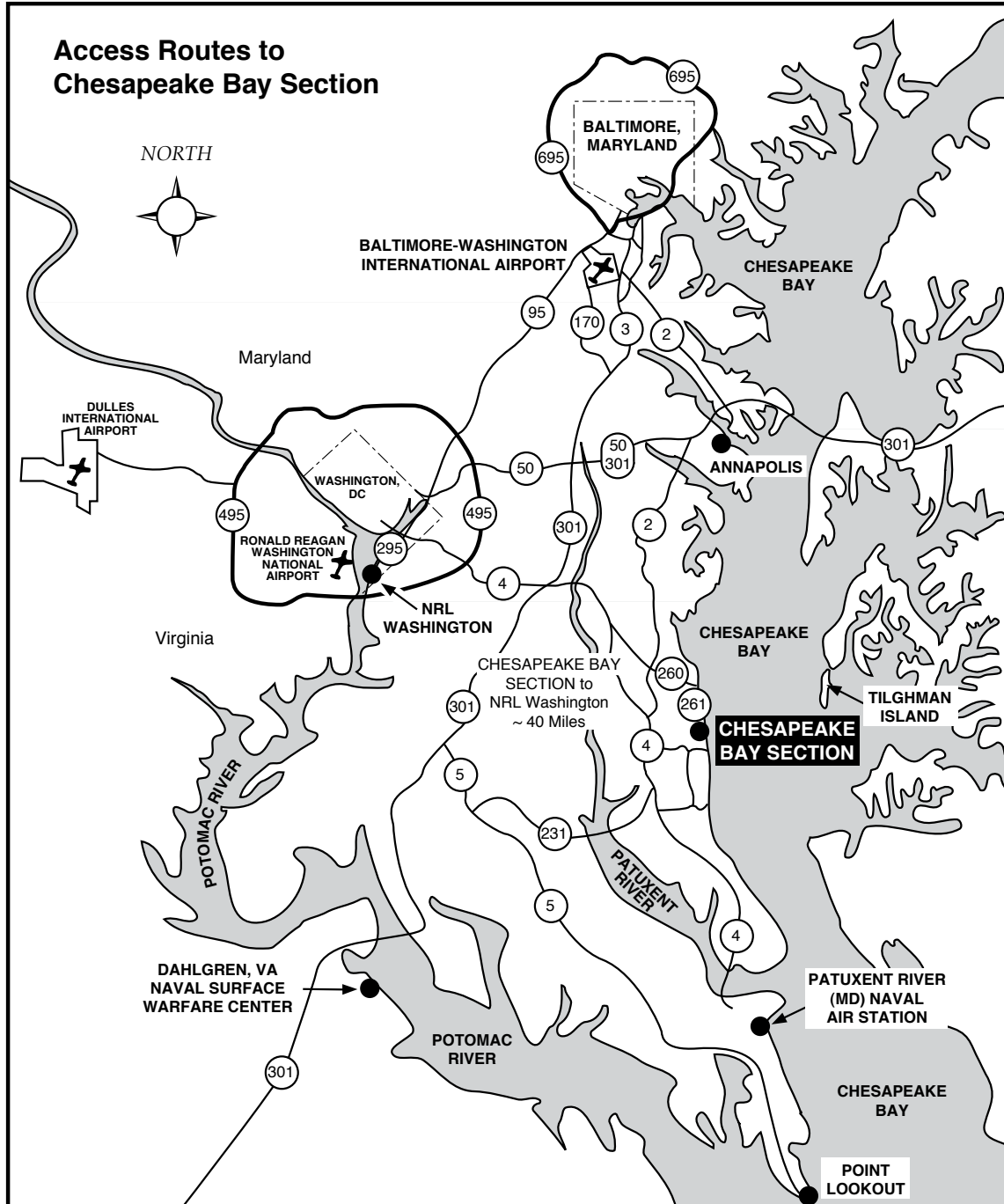


## Location of Field Sites in the NRL Washington Area



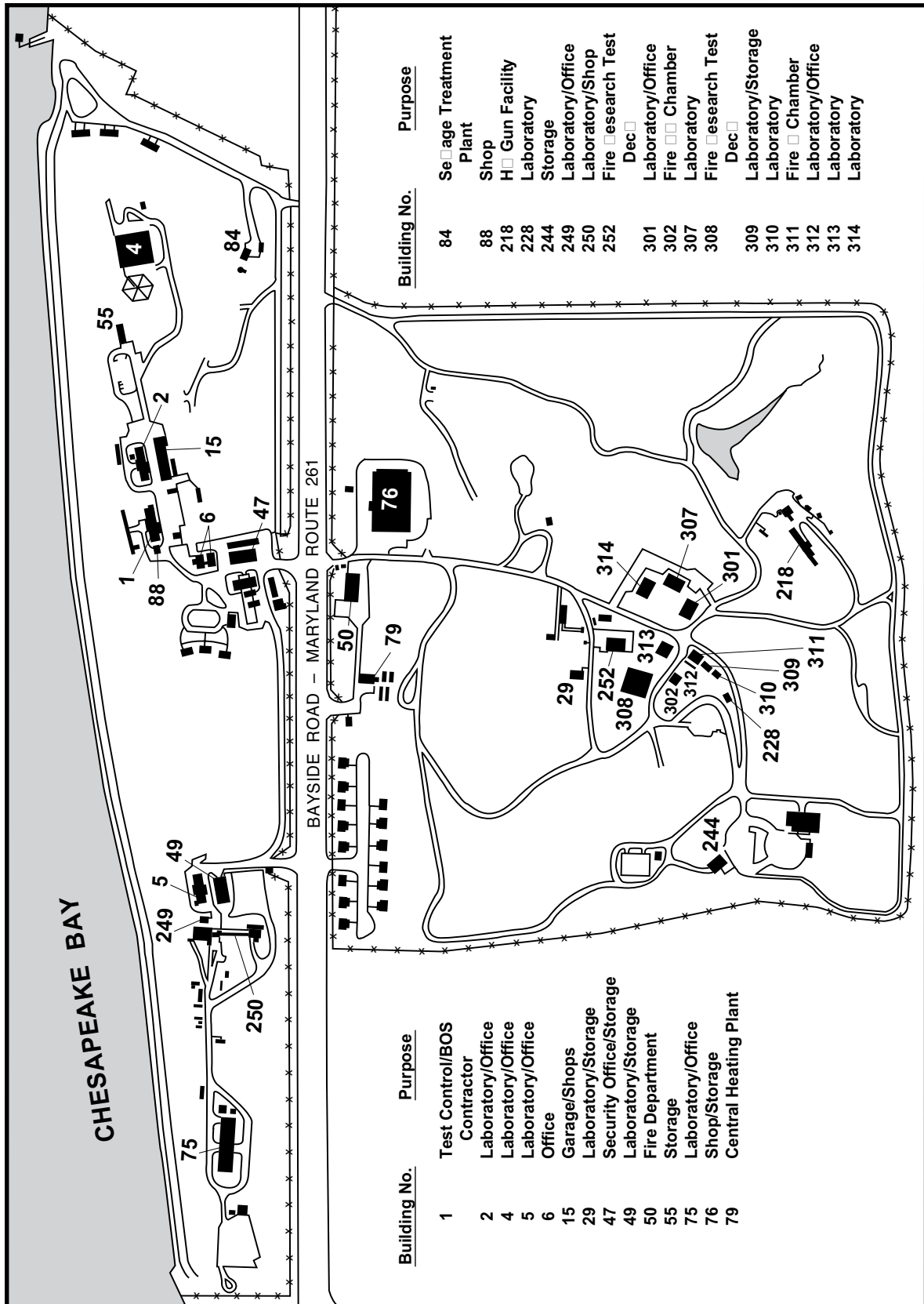
<u>Location</u>		<u>Approximate Mileage from NRL Washington</u>	<u>Cognizant Code</u>
A -	Chesapeake Bay Section, Chesapeake Beach, MD	40	3522
B -	Tilghman Island, MD	110	3522
C -	Patuxent River (MD) Naval Air Station	64	1600
D -	Pomonkey, MD	20	8124
E -	Midway Research Center, Quantico, VA	38	8140
F -	Blossom Point, MD	40	8140

## Chesapeake Bay Section (Chesapeake Beach, Maryland)



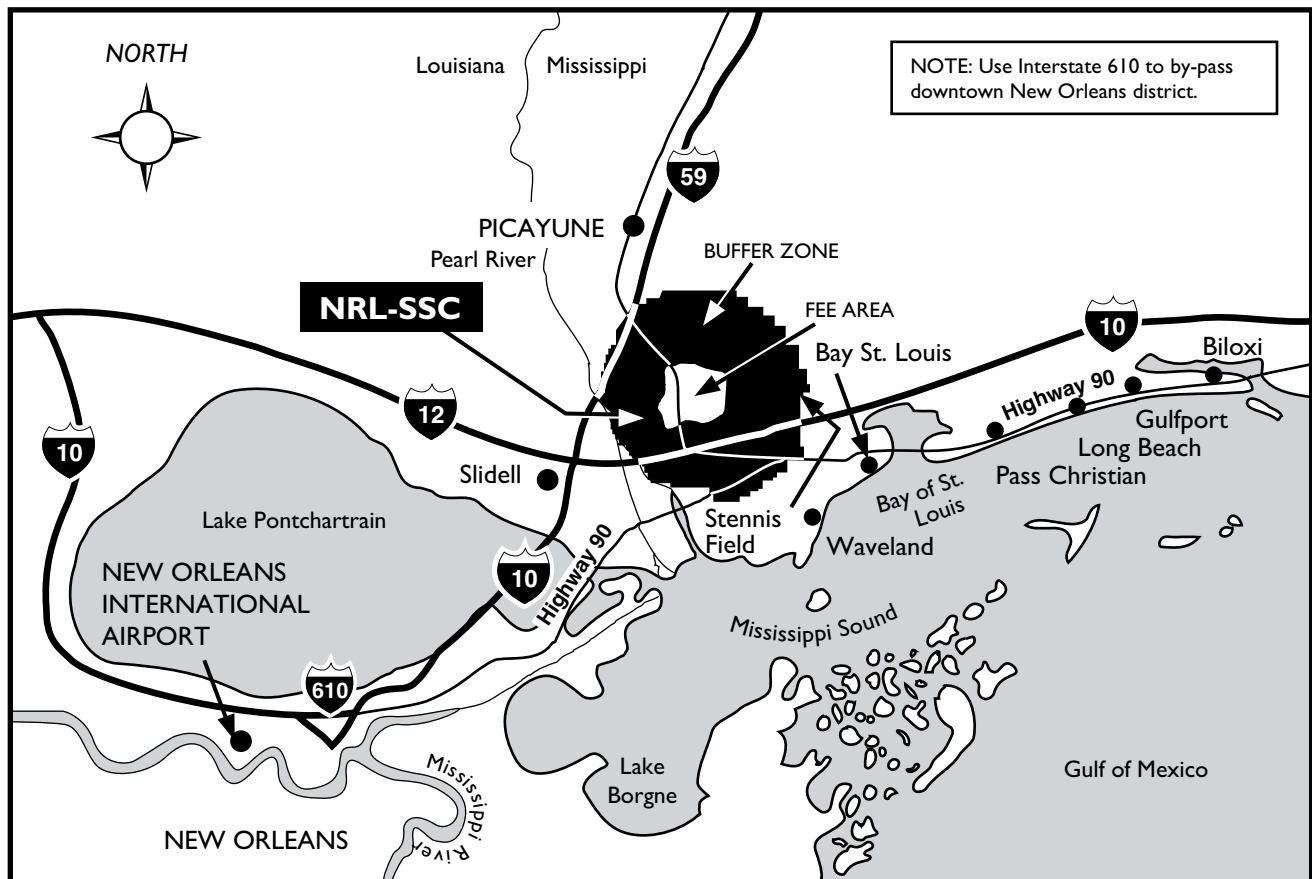
Naval Research Laboratory  
Chesapeake Bay Section  
5813 Bayside Road  
Chesapeake Beach, MD 20732  
(301) 257-4002

## Location of Buildings at the Chesapeake Bay Section



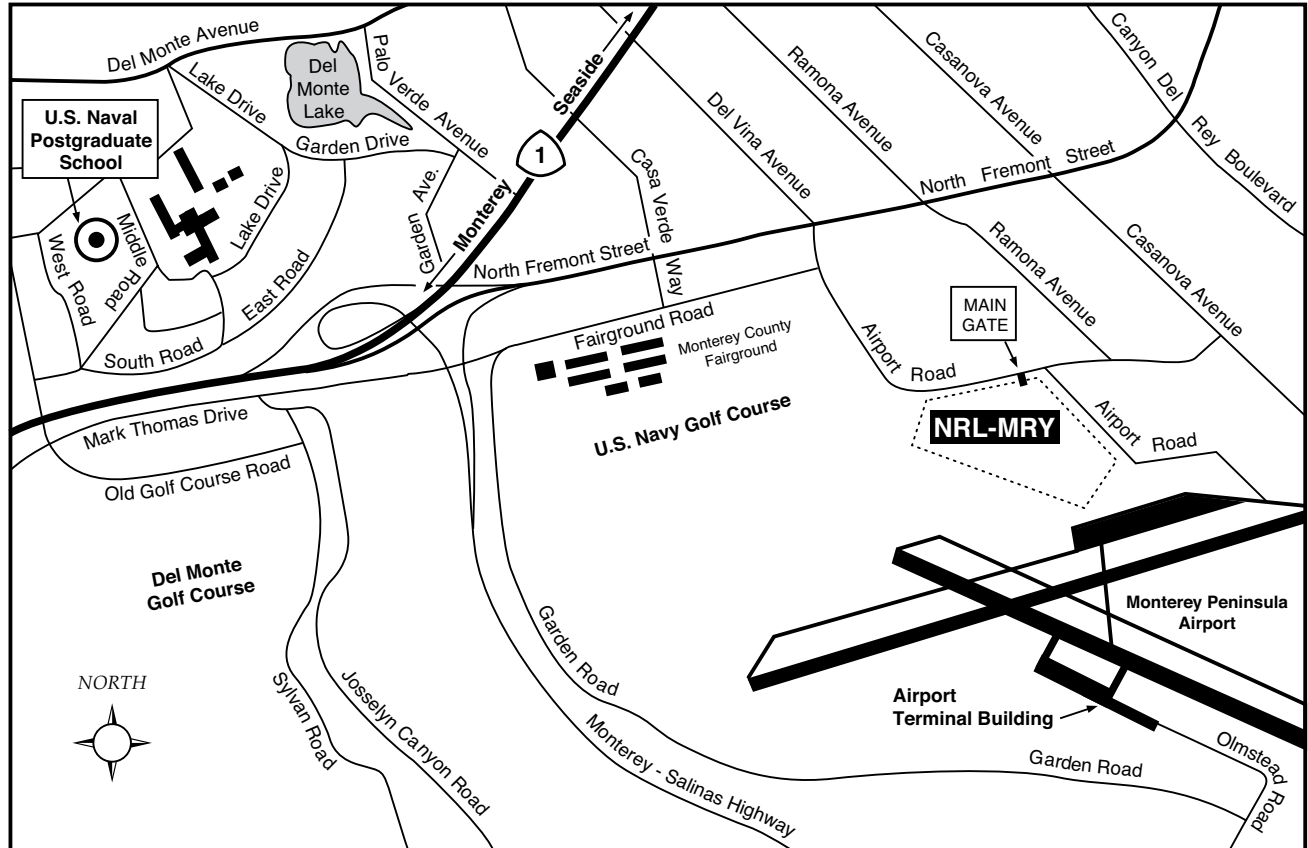


## John C. Stennis Space Center (Stennis Space Center, Mississippi)



Naval Research Laboratory  
John C. Stennis Space Center  
Stennis Space Center, MS 39529-5004  
(228) 688-3390

# Naval Research Laboratory Monterey (Monterey, California)



Naval Research Laboratory  
Marine Meteorology Division  
7 Grace Hopper Avenue  
Monterey, CA 93943-5502  
(831) 656-4721

# Key Personnel

**DSN: NRL Washington 297- or 754-; NRL/SSC 828-; NRL/Monterey 878-;  
NRL VXS-1/Patuxent River 342-**

Code		Telephone
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## EXECUTIVE DIRECTORATE

1000	Commanding Officer	(202) 767-3403
1000.1	Inspector General	(202) 767-3621
1001	Director of Research	(202) 767-3301
1001.1	Executive Assistant to the Director of Research	(202) 767-2445
1001.2	Head, Strategic Workforce Planning	(202) 767-3421
1001.3	Executive Assistant for Technology Deployment	(202) 767-0851
1002	Chief Staff Officer	(202) 767-3621
1004	Head, Office of Technology Transfer	(202) 767-3083
1006	Head, Office of Program Administration and Policy Development	(202) 767-1312
1008	Head, Office of Counsel	(202) 767-2244
1030	Head, Public Affairs Office	(202) 767-2541
1100	Director, Institute for Nanoscience	(202) 767-1803
1200	Head, Command Support Division	(202) 767-3091
1400	Head, Military Support Division	(202) 767-2273
1600	Commanding Officer, Scientific Development Squadron One (PAX River NAS)	(301) 342-3751
1700	Director, Laboratory for Autonomous Systems Research	(202) 767-0792
1800	Director, Human Resources Office	(202) 767-8322
1830	Deputy Equal Employment Opportunity Officer	(202) 767-8390
3005	Deputy for Small Business	(202) 767-0666
3540	Head, Safety Branch	(202) 767-2232

## BUSINESS OPERATIONS DIRECTORATE

3000	Associate Director of Research for Business Operations	(202) 767-2371
3005	Deputy for Small Business	(202) 767-0666
3030	Head, Management Information Systems Office	(202) 404-3659
3200	Head, Contracting Division	(202) 767-5227
3300	Head, Financial Management Division	(202) 767-3405
3400	Head, Supply and Information Services Division	(202) 767-3446
3500	Director, Research and Development Services Division	(202) 404-4054

## SYSTEMS DIRECTORATE

5000	Associate Director of Research for Systems	(202) 767-3525
5300	Superintendent, Radar Division	(202) 404-2700
5500	Superintendent, Information Technology Division/NRL Chief Information Officer*	(202) 767-2903
5600	Superintendent, Optical Sciences Division	(202) 767-3171
5700	Superintendent, Tactical Electronic Warfare Division	(202) 767-6278

## MATERIALS SCIENCE AND COMPONENT TECHNOLOGY DIRECTORATE

6000	Associate Director of Research for Materials Science and Component Technology	(202) 767-3566
6040	Director, Laboratories for Computational Physics and Fluid Dynamics	(202) 767-3055
6100	Superintendent, Chemistry Division	(202) 767-3026
6300	Superintendent, Materials Science and Technology Division	(202) 767-2926
6700	Superintendent, Plasma Physics Division	(202) 767-2723
6800	Superintendent, Electronics Science and Technology Division	(202) 767-3693
6900	Director, Center for Bio/Molecular Science and Engineering	(202) 404-6000

\*Additional duty

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**OCEAN AND ATMOSPHERIC SCIENCE AND TECHNOLOGY DIRECTORATE**

7000	Associate Director of Research for Ocean and Atmospheric Science and Technology	(202) 404-8690
7030	Head, Office of Research Support Services	(228) 688-4010
7100	Superintendent, Acoustics Division	(202) 767-3482
7200	Superintendent, Remote Sensing Division	(202) 767-3391
7300	Superintendent, Oceanography Division	(228) 688-4670
7400	Superintendent, Marine Geosciences Division	(228) 688-4650
7500	Superintendent, Marine Meteorology Division	(831) 656-4721
7600	Superintendent, Space Science Division	(202) 767-6343

**NAVAL CENTER FOR SPACE TECHNOLOGY**

8000	Director, Naval Center for Space Technology	(202) 767-6547
8100	Superintendent, Space Systems Development Department	(202) 767-4593
8200	Superintendent, Spacecraft Engineering Department	(202) 404-3727

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Anthony J. Ferrari, Captain, USN  
Commanding Officer





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