



# NRL Overview and Project Update

Jimmy Tagert

Center for Corrosion Science and Engineering, Code 6130

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# Establishment of NRL



**THOMAS A. EDISON**

“GOVERNMENT SHOULD MAINTAIN A GREAT RESEARCH LABORATORY TO DEVELOP GUNS, NEW EXPLOSIVES AND ALL THE TECHNIQUE OF MILITARY AND NAVAL PROGRESSION WITHOUT ANY VAST EXPENSE.”

THOMAS A. EDISON,  
THE NEW YORK TIMES MAGAZINE  
SUNDAY, MAY 30, 1915

## A WORLD-CLASS LABORATORY

- Idea followed the sinking of the Lusitania in 1915
- Secretary Josephus Daniels Established Naval Consulting Board with Edison Chair, meeting October 7, 1915
- August 29, 1916 Congress appropriates funds to establish the Lab
- Delayed by WW-I, Assistant Secretary of the Navy, Theodore Roosevelt, Jr., Commissions the Lab at Bellevue (DC) site on July 2, 1923

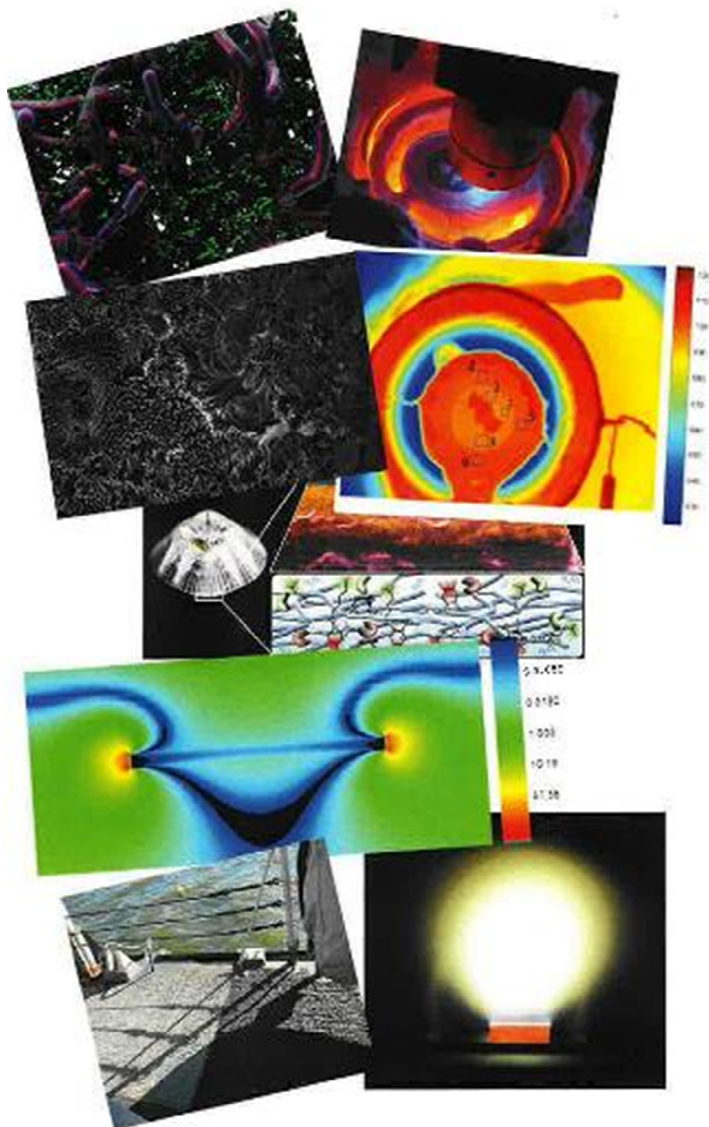
*Navy and Marine Corps Corporate Laboratory*

# Naval Research Laboratory Mission

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- To conduct a broadly based **multidisciplinary program of scientific research and advanced technological development** directed toward maritime applications of new and improved materials, techniques, equipment, systems and ocean, atmospheric, and space sciences and related technologies.
- **Primary in-house research** for the physical, engineering, space, and environmental sciences
- Broadly based applied research and advanced technology development program in response to identified and anticipated **Navy and Marine Corps needs**
- **Broad multidisciplinary support to the Naval Warfare Centers**
- **Space & space systems** technology development & support
- Designated as the **Navy's corporate laboratory** by SECNAV 1991





90

years of

Chemical Dynamics and Diagnostics  
Materials Chemistry  
Center for Corrosion Science and Engineering  
Navy Technology Center for Safety & Survivability  
Surface/Interface Chemistry

1930s

Submarine storage batteries;  
Superoxide rebreathers;  
Acoustically transparent paints

CW agent detector kit;  
Synthetic lubricants; Chlorate  
oxygen candles; Fire fighting  
research; Purple K powder;  
Non-flammable hydraulic fluids

1950s

Diester hydrocarbon lubes;  
Polyester oils; Teflon dry  
lubricants; HEPA filters;  
Surface monolayers; Non-  
contamination submarine  
paints

1960s

EDTA boiler water treatment;  
Contact angle goniometer  
apparatus; Aqueous film  
forming foam (AFFF);  
Fluorinated polyurethane resins

1970s

Submarine Central Atmosphere  
Monitor System (CAMS); Boiler corrosion  
inhibition; 1st mass spec. w/  $m/c > 18,000$

1980s

Functional coatings; Combustion chemistry;  
High-temperature polymers; Navy infrared  
thermal imager; SAW sensors; NMR imaging;  
Empirical carbon potential for MD simulations;  
1985 Nobel Prize in Chemistry

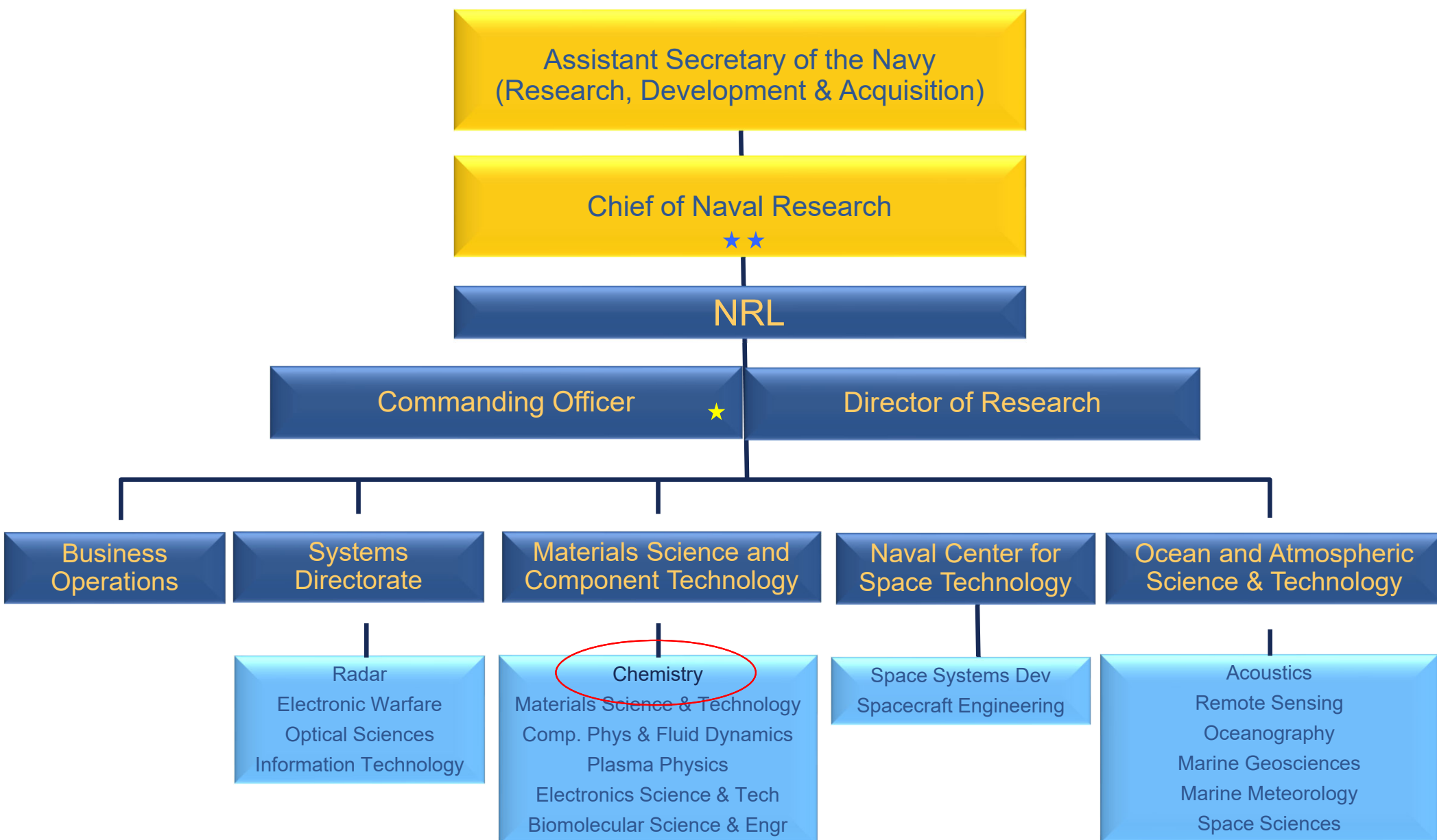
1980s

Hydrazine dosimeter; Diamond CVD; MD shock  
simulations; Nanomechanics and forces; Water  
mist and smoke ejection systems; MTADS  
ordnance detection; NQR explosive detection;  
1995 National Medal of Science.

2000s

Nanoscale biosensors; Nanolithography; High expansion  
foams; Volume Fire sensor; Aerogels/xerogels; Polymer  
dynamics; Hydrogen, solid oxide, and microbial fuel cells;  
Rapid cure single coat & polysiloxane nonskid paints;  
Rechargeable Zn batteries

# NRL Organizational Relationships





# Code 6130 Overview

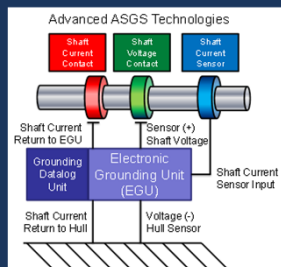
Center for Corrosion Science and Engineering

Branch Head – Ted Lemieux

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### Corrosion Science & Environmental Effects

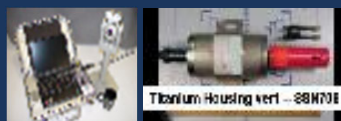
Electrochemistry  
U/W Electrochemical Signals  
Surface Treatments  
Tribo-corrosion  
Corrosion Fatigue  
Stress Corrosion Cracking  
Interstitial Hardening for Cavitation Resistance  
Advanced Active Shaft Grounding



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### Corrosion & Marine Engineering

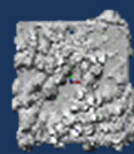
Cathodic Protection Design  
Marine Material Design & Selection  
Atmospheric Corrosion  
Condition Based Maintenance  
Corrosion Sensors & Detection  
Multi-Scale Lifecycle Performance Analysis  
Physical Scale Modeling  
Environmental Corrosion  
Cathodic Tech Warrant Authority



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### Marine Biosciences and Engineering

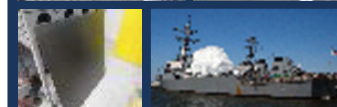
Biofouling Control for Seawater Systems  
Fouling Diagnostics & Prediction  
Ballast Water Management System  
Aquatic Nuisance Species control  
Effects of Biofilms on Marine Materials  
Chlorination / De-chlorination of piping system  
Shipboard Sampling



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### Marine Coatings Technology & Systems

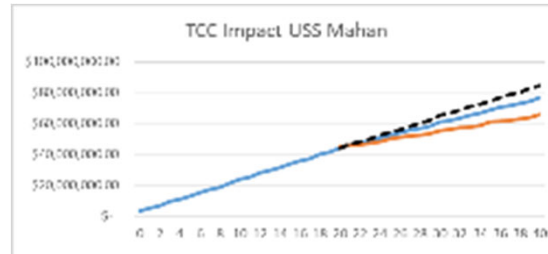
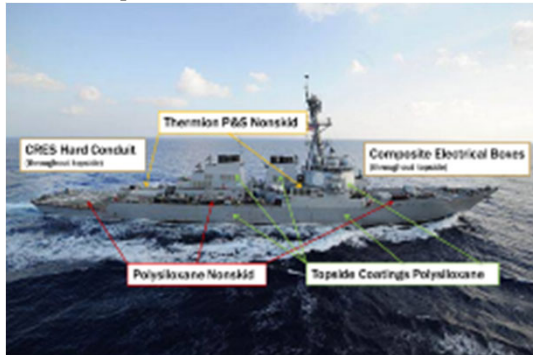
Coating Application Processes  
Thermal Spray Coatings  
Non-Destructive Evaluation for Coatings  
Robotic Application Systems  
Novel, Non-Mechanical Surface Preparation  
Multi-functional Coatings  
Polymer Synthesis  
Anti-fouling Coatings  
Damping Coatings  
Coating Tech Warrant Authority





# Coatings Highlights

## DDG Topside Corrosion Control Effort shows 31X decrease in sailor workload

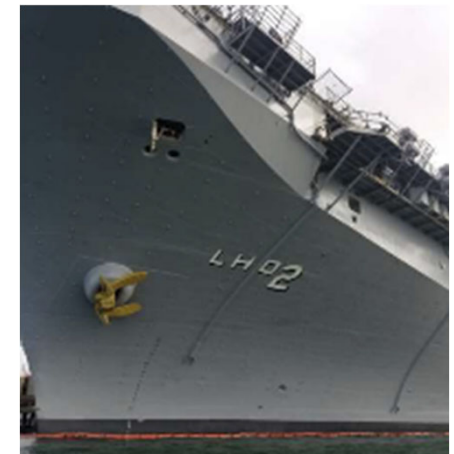


Projected \$8 Million in Cost Reduction, Full Budget Impact \$19M

## Thermal Spray Nonskid on LHD and LHA Class Ships



## NRL's Single Component Siloxane Used by Sailors for Freeboard Preservation







# **Current Relevant Corrosion Efforts at NRL-Key West**



- History of accurate, relevant, and significant testing
  - NAVAIR, AFRL, F-5, F-18, F-22, F-35
- Operationally-relevant test environment
  - High UV, marine, access to freshwater & clean seawater
  - Ongoing correlation to bases around the world
- Mechanical loading for true combined effects testing (C-CoAST)
- On-site, permanent staff
  - Corrosion & coatings scientists & engineers + facilities & fabrication support
  - Certified coatings inspectors
  - Hurricane preparedness
- One of the most well-characterized test sites
- DoD facility
  - Work with program security officers to modify posture to meet program needs
  - All staff have a minimum of Secret clearance
- Environmental modification
  - Freshwater, seawater, covering, vibration, handwashing ...





# F-15 Ambient Beachside Exposure





# F-15 Pier Spray Systems

- Adjustable racks, adjustable spray interval sourced directly from the ocean
- Fabricated and maintained by in-house personnel



Ground Support Equipment



# F-1 Outdoor Site





# F-1 Atmospheric Exposure Racks



Seawater/Freshwater Spray



Covered/Freshwater Spray



Freshwater Spray

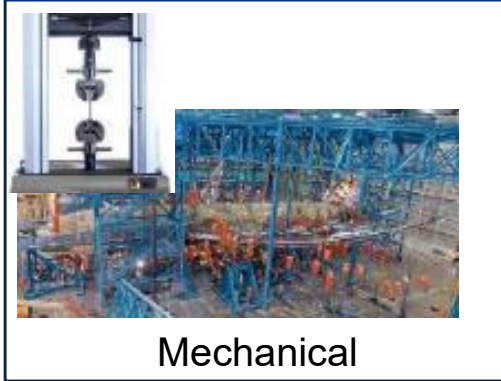


# Why do systems still fail, when we spend so much money on materials development and qualification?

## How materials are qualified:



"Environmental"



Mechanical

## How typical materials fail:



Mechanical failure of coating followed by corrosion

Lap splice corrosion followed by mechanical failure

## Emerging Naval Material Challenges:



New alloys and composites

New treatments and coatings

**Materials often fail at interfaces and under multi-modal stressors.**

**We need to develop the appropriate tools to accurately assess complex material interactions to avoid costly system failures.**

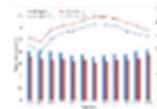


# C-CoAST – Expandable System Design

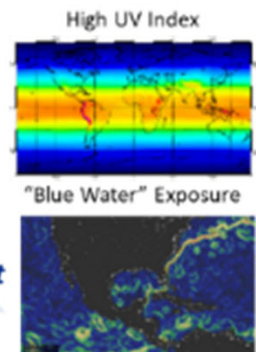
## Center for Corrosion and Atmospheric Structural Testing (C-CoAST)



Dynamic mechanical load testing in outdoor, high UV, and high corrosivity environment



Real time characterization of atmospheric conditions during test



High UV + high corrosivity =  
*Operationally Relevant Environment*

- Adaptable steel I-beam structure
- 10 to 50 Kip, servo-hydraulic actuators
- Uni- or Multi-axial loading
- Static, dynamic, or spectrum loading

**C-CoAST offers combined marine environment exposure and realistic static and dynamic loading with concurrent atmospheric monitoring.**

# Recent Programs

Covers Evaluation



Durable Ground  
Support Equipment



Vibration/Saltwater Spray Study



Combined Effects



F5 Wash Evaluation



Simulated Railgun Exposure

