



GE Corporate Research and Development

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January 22, 1997

TO: Thomas Moran
Harold Guard
DCMC Hartford
Director, Naval Research Laboratory
Defense Technical Information Center

Enclosed is the DARPA R&D Status Report for October through December, 1996, Contract No. N00014-96-C-0145.

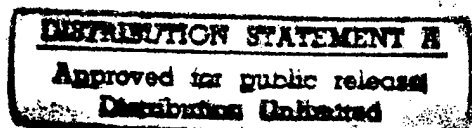
If you have any questions, please call me.

Sincerely,

J. A. Cella, Manager
Silicone Technology Program

cc: B.J. Malloy
L.T. Comly

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Short Title of Work: Non-toxic, Self-cleaning Silicone FR Coatings
Reporting Period: October through December, 1996
Contract No: N00014-96-C-0145

Executive Summary
October-December 1996

Panels for waterline immersion were prepared and shipped by GE-CRD and installed at Miami Marine and SUNY Buffalo for analysis of (a) the effect of oils (1) in two topcoats and (2) in the tiecoat on fouling release properties; (b) the effect of fillers on oil retention and fouling release; and (c) the effect of microencapsulated oils on oil release rates.

Synthetic methods for preparation of radiolabeled silicone fluids for environmental fate studies have been developed.

Four predator exclusion cages have been designed by FIT and are under construction for the placement of test samples for biofouling evaluation at the FIT static immersion site. The skin friction foil is being subjected to further wind tunnel calibration.

Two utility sites for panel immersion in New England coastal waters have been identified by Bridger Scientific and access negotiated. Both sites have historical and recent inspection records on operational, maintenance, and fouling problems. A supplemental location that may test the self-cleaning properties has been identified.

The availability of bilge keel panel positions was determined by NSWC. Plans were finalized for copper antifouling control panels for exposure sites and materials were procured. Commitment was received from submarine sponsor for a combatant platform when needed.

DARPA R&D Status Report

DARPA Order No.:

Program Code No.:

Contractor: General Electric / Corporate Research and Development

Contract Amount: \$2,582,405

Contract No: N00014-96-C-0145

Effective Date of Contract: June 26, 1996

Expiration Date of Contract: June 30, 2000

Principal Investigator: James A. Cella

Telephone No.: (518) 387-6173 / (518) 387-7342

Short Title of Work: Non-toxic, Self-cleaning Silicone Foul Releasing Coatings

Reporting Period: October through December, 1996

Description of Progress:

Task 1: Design, synthesis and testing of foul-release paints with improved properties (CRD)

Panels (206) have been prepared and pseudobarnacle measurements were made prior to shipment to Miami Marine, SUNY Buffalo and FIT for immersion. Analyses will be made on (a) the effect of oils (1) in two topcoats and (2) in the tiecoat on fouling release properties; (b) the effect of fillers on oil retention and fouling release; and (c) the effect of microencapsulated oils on oil release rates. SUNY will conduct surface analysis and Miami Marine and FIT will evaluate anti-fouling and fouling release properties. Initial panels were immersed face down to accelerate fouling; these panels will now be hung vertically. All tests are being conducted with either RTV11 or 1225-04-036 topcoat formulations.

To understand the potential mechanism for fouling release, barnacle basal plates removed from US Coast Guard hulls were analyzed for silicone content. Barnacle basal plates removed from a hull coated with RTV11 + 20% SF1154 showed negligible amounts of silicone and complete adhesive failure whereas a small amount of silicone was present on basal plates removed from EXSIL and RTV11 coated hulls.

Task 1.1.1: Quantitative foul-release performance of new materials (FIT)

Four predator exclusion cages have been designed and are under construction for the placement of test samples for biofouling evaluation at the FIT static immersion site. These cages are required to allow the rapid development of fouling communities on the foul release surfaces. The skin friction foil is being subjected to further wind tunnel calibration. Contact is being maintained with Carlos Perez at Miami Marine concerning test panels that were placed in December 1996. When fouling does occur, barnacle adhesion measurements will be taken.

Task 1.1.2: Field Exposure Testing (Bridger Scientific)

Following discussions with members of the project team, it was agreed that the primary criterion for site selection is a location where conditions are consistent with rapid settlement/attachment of fouling organisms. Additional considerations include (1) availability of historical fouling data (species diversity, seasonality), (2) water quality data, (3) immersion location (velocity, light, depth), (4) accessibility, (5) security and (6) interest. Based on these requirements, two utility sites were identified; both have agreed to provide plant access, space for test assemblies, and minimal plant support where required. The intake structures and condenser waterboxes at both plants were inspected at the end of the 1996 fouling season, and operational, maintenance and performance problems related to macrofouling have been documented. Fouling occurs from April to October and consists primarily of hydroids, blue mussels, barnacles, and mollusks.

A supplemental location is also included in the northeastern site test matrix. Due to differences in tidal range and the timing of the mean high tide between the two bodies of water, this site experiences significantly higher, and more variable, current velocities (5 - 8 ft/sec). It is anticipated that this test location may provide an

excellent opportunity to evaluate the "self-cleaning" properties of selected formulations during the course of this project.

Task 1.2: Validation Testing (NSWC)

Because this agency receives separate funding, the report is attached separately.

Task 3: Toxicological Studies (CRD)

Synthetic methods for preparation of radiolabeled silicone fluids for environmental fate studies have been developed. The fluids will be incorporated into fouling release compositions and analyzed in salt-water tanks for degradation and speciation.

Change in Key Personnel:

Judith Serth-Guzzo, Chemist, has joined the CRD Fouling Release Coatings Team. Judith joined GE-CRD in 1989 and completed her MS in Inorganic Chemistry at the University of Notre Dame in 1994. Her research has focused on the development of high temperature polymers, the fate of silicones in the environment, thermoplastic liquid composites, and the synthesis and properties evaluation of new high temperature crystalline polymers.

Summary of Substantive Information Derived from Special Events:

Visits to over ten utility, industrial and other northeastern locations (as potential candidates for panel testing) by Bridger Scientific indicates (1) macrofouling continues to contribute to significant operational problems for industrial users of bulk water and (2) regulatory restrictions are promoting interest in non-toxic approaches.

Judy Stein presented an overview of this program at the DARPA Coatings Conference in San Diego, November 1996.

Problems Encountered and/or Anticipated:

None

Action Required by the Government:

None

Fiscal Status:

(1) Project Cost:	\$ 490,646
(2) Cost Share:	<u>(110,395)</u>
(3) Net to ONR/DARPA:	\$ 380,251

DARPA R&D Status Report

DARPA Order No.: ONR FY96PR NUMBER 96PRO4639-01

Program Code No.:

Contractor: NAVAL SURFACE WARFARE CENTER, CARDEROCK DIVISION

Contract Amount: PLANNED FY97 FUNDS - \$128,174.50

Contract No: FY97 WORK REQUEST NOT YET RECEIVED

Effective Date of Contract: ANTICIPATED FY 97 WORK REQUEST START DATE - 1/97

Expiration Date of Contract: ANTICIPATED FY 97 WORK REQUEST COMPLETION DATE - 9/97

Principal Investigator: KAREN M. POOLE

Telephone No.: (301)227-4783

Short Title of Work: NON-TOXIC, SELF-CLEANING SILICONE FR COATINGS

Reporting Period: 1Q FY97 (10/97-12/97)

Description of Progress: Under FY96 carryover funds, availability of bilge keel panel positions was determined. Plans were finalized for copper antifouling control panels for exposure sites and materials were procured. Commitment received from submarine sponsor for combatant platform when needed.

Change in Key Personnel: None

Summary of Substantive Information Derived from Special Events: None

Problems Encountered and/or Anticipated: None

Action Required by the Government: None

Fiscal Status:

- (1) Amount currently provided on contract: FY97 FUNDS NOT YET RECEIVED
- (2) Expenditures and commitments to date: FY96 470,484.48
- (3) Funds required to complete the work: \$446,180.80