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REPORT DOCUMENTATION PAGE

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6. AUTHOR(S): Dr. Robert P. Wei

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES): Lehigh University, 327 Sinclair Laboratory, 7 Asa Drive, Bethlehem, PA 18015 8. PERFORMING ORGANIZATION REPORT NUMBER:

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13. ABSTRACT (Maximum 200 words): Modernization of the research facility for environment assisted fracture has been completed under this DURIP/AFOSR grant. The modernization included the replacement of controllers for two automated electrohydraulic testing machines, modernization of the AC potential drop system for crack length measurement, and the addition of a high-speed, digital storage oscilloscope for measuring transient events. Coupled with prior acquisitions and the facilities for chemical and microstructure analyses, these additions have brought the environment assisted fracture facility back up to the state-of-the-art to support cutting-edge research and education. This line of research is key to the development of advanced methodology for life-cycle design and management of engineered systems for use in defense and civilian applications.

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FINAL PERFORMANCE REPORT

(DURIP00)

“Modernization of Research Facility for Environment Assisted Fracture”
AFOSR Grant No. F49620-00-1-0193

TO: Dr. Walter F. Jones, Program Manager
AFOSR/NA
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Arlington, VA 22203-1977

FROM: Dr. Robert P. Wei
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SUBJECT: Final Performance Report (DURIP00)
“Modernization of Research Facility for Environment Assisted Fracture”
AFOSR Grant No. F49620-00-1-0193

DATE: 19 July 2001

This report summarizes the modernization of the research facility at Lehigh University for performing cutting edge research and for training future engineers and scientists in the area of environment assisted fracture in engineering materials. The topical area is of primary importance in ensuring the durability and reliability of engineered systems, and for developing science-based methodology of the life-cycle design and management of these systems.

Specific equipment acquired and placed into operation under this grant, and the acquisition costs, are given below.

Item	Description	Budget (\$)	Cost (\$)
1	MTS TestStar IIs Control System	31975.00	31975.00
2	MTS TestStar IIs Control System	31975.00	31975.00
3	EG&G Instruments Model 7265 DSP Lock-in Amplifier	4275.00	4235.06
4	Kepeco Model BOP 50-2M Power Supply / Amplifier	1589.00	1524.31
5	Kepeco Model BOP 50-2M Power Supply / Amplifier	1589.00	1524.31
6	Nicolet Integra 20 Digital Storage Oscilloscope	11990.00	12005.40
7	Installation; Software (C++ Compiler) for Items 1 and 2	0.00	153.92
	TOTAL	83393.00	83393.00

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Items 1 and 2 provide modernization of the computer controlled controllers for the 10 KIP and 100 KIP (KIP = 1000 lbs.) axial testing systems manufactured by the MTS Systems Corporation. Items 3 and 4 provide upgrade for the AC (alternate current) potential drop measurement system for monitoring crack growth that is shared by the two MTS test systems. Item 5 is used to upgrade the AC potential drop system that is used with a MTS axial-torsion testing system. This system is currently dedicated to studies of oxygen enhanced crack growth in nickel-based superalloys at temperatures up to 973 K; the controller for the MTS testing system had been modernized in 1999 with internal funds from Lehigh University. Item 6 provides a new capability for studying transient phenomena, such as the electrochemical reactions with bare metal surfaces that are essential for understanding corrosion fatigue crack growth in aluminum, ferrous and titanium alloys. Item 7 represents costs of C++ compiler for writing application programs for use with the MTS controllers (Items 1 and 2) and incidental costs associated with installation of the controllers..

All of the equipment has been installed and is performing within the manufacturers' specifications. They are used in support of research and the training of graduate students. Active research enhanced by the modernized facility includes a program supported by the Air Force Office of Scientific Research on "Corrosion and Corrosion Fatigue of Aluminum Alloys: Chemistry, Micromechanics and Reliability" (Grant F49620-98-1-0198), and one by the Division of Materials Research of NSF on "Oxygen Enhanced Crack Growth in Nickel-Based Superalloys" (Grant DMR-9632994).

The modernized facility also made it possible for Lehigh University to continue its tradition of contributing to DoD's research in the development of design tools for environment enhanced crack growth, whose importance in the development of reliable and cost effective (affordable) engineered systems is being increasingly recognized. One proposal to AFOSR, in response to BAA2001-04, on "Modeling of oxygen Enhanced Damage Evolution in Nickel-Based Superalloys" is currently under review. Based on competitive preproposals submitted in response to ONR BAA2001-014, Lehigh University has just been invited to submit a full proposal for "Corrosion-Assisted Fatigue Modeling for Life Assessment."

Support by the DURIP program and by AFOSR for the modernization of Lehigh's facility for conducting cutting-edge research on environment assisted fracture is very much appreciated.

cc: R. Tallman, ORSP
Dr. Thomas Hahn, AFOSR/NA