

INDUSTRIAL POLLUTION PREVENTION TECHNOLOGY

March 2002



U.S. ARMY TANK-AUTOMOTIVE AND ARMAMENTS COMMAND
INDUSTRIAL ECOLOGY CENTER
PICATINNY ARSENAL, NJ 07806-5000

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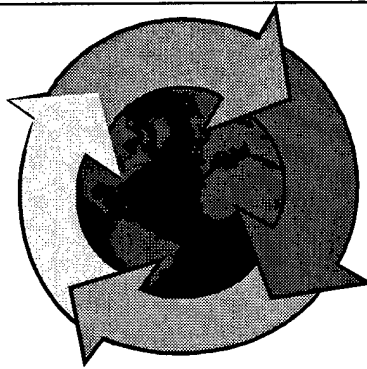
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1. Industrial Ecology Center Mission: The Industrial Ecology Center (IEC), located at Picatinny Arsenal, New Jersey is a principal manager in the Army's Environmental Quality Pollution Prevention Technology Program. The IEC's involvement includes the Army Environmental Quality Basic Research & Development Program (EQBRD), the Sustainable Green Manufacturing (SGM) Program, and the Army Corrosion Protection Program. In addition, a member of the IEC staff participates as the Army representative on the Strategic Environmental Research & Development Program (SERDP) Pollution Prevention (P2) Technology Thrust Area Working Group (TTAWG) to serves on the Pollution Prevention panel of the Environmental Security Technology Certification Program (ESTCP). The IEC is the Technical Oversight office for the DOD National Defense Center for Environmental Excellence (NDCEE) in support of the Executive Agent staff's management duties, is currently the program management office for the Casting Emission Reduction Program (CERP), and provides life cycle environmental support to the Army's armament mission.

WEB SITE: <http://www.pica.army.mil/iec/>

a. Science and Technology Programs:

This program is a technology base development program. It accomplishes basic research and development for the tri-services. It include the EQBRD program, SERD program, SGM program and AMC Corrosion Prevention and Control Program as defined in the following paragraphs:

(1.) Environmental Quality Basic Research and Development (EQBRD) Program

The EQBRD program funds basic research and represents the fundamental science and technology knowledge that will support the more mature advanced development efforts. This \$3.5 M/yr Army program is focused primarily on evaluating feasibility of early technology concepts for pollution prevention in the Army's industrial base. The objectives are to advance the state-of-the-art with respect to pollution prevention and the life-cycle management of hazardous materials and wastes. Our goal is to develop innovative key technologies that will contribute to maintaining readiness by reducing the costs and risks of meeting the Army's long range environmental challenges.

Our investment strategy centers on identifying the waste streams associated with the manufacture, maintenance and disposal of Army unique products and developing basic research projects that will provide the maximum economic return. Given that 85% of the AMC wastes generated are in energetic processing, metal finishing, cleaning/degreasing, and painting, our program targets these critical areas. *The POC for the EQBRD Program is Mr. Tom Sachar (973-724-2364)*

(2.) Strategic Environmental Research and Development Program (SERDP)

The SERDP typically represents technology at the exploratory research level. A small portion of SERDP also addresses basic research via Strategic SERDP Exploratory Development (SEED) Projects. The SERDP was established in November 1990 as a multi-agency program whose participants include the Department of Defense, Department of Energy, and the Environmental Protection Agency. There is also participation by the National Aeronautical & Space Administration, the Department of Interior, and the National Institute for Standards and Testing. The program is currently being funded at approximately \$52 million per year with the Pollution Prevention Pillar receiving approximately 30% of the budget. In FY01 the Army was the lead for \$3.091 million for pollution prevention efforts and is slated for \$2.652 million for FY02. This book will not address efforts under the other three pillars: Compliance, Remediation and Conservation. It also will not address SEED efforts.

The Pollution Prevention R&D program, under SERDP, is structured to address a wide variety of user environmental problems associated with surface protection, energetics, advanced materials, and elimination of ozone depleting chemicals, and life cycle environmental tools to assist weapon systems designers.

The POC for SERDP Program and Environmental Technology Team Leader is Mr. Tom Sachar (973-724-2364).

(3.) Sustainable Green Manufacturing (SGM) Program

The SGM program is an alliance including Armaments Research, Development, and Engineering Center (ARDEC), Concurrent Technologies Corporation (CTC), The New Jersey Institute of Technology and the Physical Science Laboratory at the New Mexico State University are subcontractors under this effort. The program focuses on research in pollution prevention and life cycle environmental issues that impact military systems.

The primary objective of the program is to develop life cycle-based, environmental improvements by conducting research and engineering in:

- Modeling and Simulation
- Environmental Engineering
- Coatings
- Corrosion Prevention
- Demilitarization Technologies
- Effectiveness of Environmental Management Systems

The POC for SGM Program is Mr. Don Skelton (973-724-4071)

(4.) AMC Corrosion Prevention and Control (CPC) Program

The IEC serves as a co-chair of AMC CPC programs with responsibility to develop a Corrosion Prevention and Control (CPC) Program to address the serious concerns for Army weapon systems corrosion. Although corrosion will never be completely stopped, its cost can be significantly reduced. The program objective is to reduce weapon system corrosion maintenance costs. The program has four major aspects: Management Structure, Policy, Communications, and Science and Technology. This objective is to be achieved through a management structure based on the concept of Integrated Product Teams (IPTs) - Corrosion Integrated Product Teams (CIPTs) at all AMC Subcommands - whose efforts are coordinated by the AMC Corrosion Manager (ACM). The CIPTs will be expected to seek participation from relevant program management, industrial, and academic experts familiar with their respective commodities. The science and technology issues, will be addressed by a two pronged attack which will identify, test and implement the latest CPC state-of-the-art practices available in industry and develop, verify, and implement new technologies to reduce corrosion in new and fielded systems.

Effectiveness of the CPC Program will be tracked quarterly, using the following performance indicators: Technology transfers, cost savings, extension of maintenance cycles, funds obligated, funds expended, equipment design modifications, pounds of hazardous materials eliminated, and number of meetings, papers, and training events.

The POC's for the CPC Program are Dr. Joseph Argento, IEC, ARDEC (973) 724-2428 and Mr. John Theis, IEC, ARDEC (973) 724-5795

(5.) Nanocoatings Program:

Use nanotechnology to develop the next generation of "smart" coatings for Army materiel through the use of nanomachines to address the serious concern over weapon system corrosion thereby resulting in longer service life and lower failure rates of current and future weapon systems. This program will Investigate the use of nanomachines for smart coatings development; develop coatings with corrosion-inhibiting and self-healing properties; perform field testing on Army materiel.

b. Demonstration/Validation Programs

Once the feasibility and utility of a key environmental technology concept has been proven and completed, the next step in the R&D process is Dem/Val. This step ensures validation prior to transition to field use. The Environmental Security Technology Certification Program (ESTCP) and the National Defense Center for Environmental Excellence (NDCEE) are two separate programs, established to accomplish this objective:

(1.) Environmental Security Technology Certification Program (ESTCP)

ESTCP's goal is to demonstrate and validate the most promising innovative technologies that target the Department of Defense's (DOD's) most urgent environmental needs and that are projected to pay back the investment through cost savings and improved efficiency. The current cost of remediation and compliance in the Department is significant. Innovative technology offers the opportunity to reduce both costs and environmental risks.

ESTCP's strategy is to select lab-proven technologies with broad DOD market application and aggressively move them to the field for rigorous trials documenting their cost, performance and market potential. Successful demonstration leads to acceptance of innovative technologies by DOD end-users and the regulatory community. To ensure that the demonstrated technologies have real impact, ESTCP incorporates these players in the development and execution of the program. In Pollution Prevention, technology demonstrations led by the Army include a phosphoric acid and sodium hydroxide waste stream recycling effort at Watervliet arsenal, nitrocellulose fines recycling at Radford Army Ammunition plant and target material which could be recycled at small arms firing ranges.

The POC for ESTCP Support is Mr. Tom Sachar (973-724-2364)

(2.) National Defense Center for Environmental Excellence (NDCEE)

was established in 1990 to "serve as a national leadership organization to address high priority environmental problems for the Department of Defense (DoD), other government organizations and the industrial community." The Assistant Secretary of the Army (Installations and Environment) (ASA (I&E)) was assigned to be the Executive Agent in FY 00.

The NDCEE is a source of expert scientific, engineering, laboratory and mini-factory services supporting the environmental technology requirements of DoD activities tasked with facilitating the transition of environmentally acceptable materials, engineering design tools and manufacturing processes to defense industrial activities and training to support their use. The Center features a demonstration factory in which the technologies can be fully demonstrated (excluding energetic materials).

The NDCEE is actively involved in DoD-wide environmental technology and acquisition reform initiatives and is transitioning environmentally acceptable technology to the defense and commercial industrial base. Efforts include alternative coatings, engineering design tools, cleaning, assembly, manufacturing and demanufacturing methods. Significant emphasis is also placed on environmental cost analysis, health risk assessment and technology transfer. WEB SITE: <http://www.ndcee.ctc.com>

The POC at the Industrial Ecology Center for the NDCEE Program is Mr. Mike Wrazen (973-724-3730).

(3.) Casting Emission Reduction Program (CERP)

The CERP is a Federal Government/Department of Defense (DOD) program established to conduct research and development on metal casting technologies, to investigate air emissions, and to investigate foundry product and process improvements in a real-world environment.

CERP's associated work with the American Industry/Government Emission Research project and other domestic and international stakeholder organizations expands the research into emission measurement technologies for both stationary and mobile sources. The Industrial Ecology Center is the Federal Program Manager for CERP.

CERP's mission provides for the evaluation, testing and qualifying possible replacement materials and/or manufacturing processes, as well as the validation testing of both materials and instrumentation for the reduction of hazardous emissions from both stationary and mobile sources. CERP initiatives include research involving lightweight casting materials and processes, such as titanium and thin-wall iron, for application to defense programs important to the Army's Transformation efforts.

CERP accomplishes this mission by conducting metal casting research and development to evaluate the ability of alternate products and processes to reduce emissions generated during the production of castings. CERP also develops emission measurement technology improvements for stationary and mobile sources, foundry safety and pollution process improvements, and accomplishes technology transfer and outreach to the DOD, its contractors, and the casting user community.

CERP is a key DOD program to sustain and enhance our nation's technical capabilities and to provide leadership in technology innovations in the Casting and Foundry industry. For additional information, please visit the CERP website at www.cerp-aiger.org/.

The POCs at the Industrial Ecology Center for the CERP Program are Mr. Garry Kosteck or Mr. Lawrence Pasterick (973-724-6755/7540).

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2. Industrial Ecology Center Staff Directory (Previous Page)

3. FY02 New Starts

TITLE: Development of Membrane Technology for Food and Water Monitoring

PROJECT Nos.: 3.5.c

PROGRAM FUNDING SOURCE:
EQBRD

PERFORMING LAB: Natick Soldier Center, Natick, MA

OBJECTIVE: To develop both biosensor detection platforms and membrane concentrators to improve sensitivity and real-time detection of chemical pollutants, bacterial pathogens and toxins.

APPROACH: Generate high surface area membranes with covalently attached Molecular Recognition Elements. This will increase the probability of finding and detecting analytes of interest present at low concentrations. Select polymer for use in high surface area membrane. ID specific MRE's for membrane association. Using Green Chemistries, fabricate high surface area membrane. Characterize and select MRE's and polymer membranes for sensor applications.

PROPONENT: Army

POC: Dr. Andrej W. Miziolek

PHONE: (410) 306-0884

STATUS: Initiated

FAX: (410) 306-1909

TITLE: Computational Model Development for Improved Solid Waste Reduction

PROJECT Nos.: 3.D-057CL

PROGRAM FUNDING SOURCE:
Army 6.1 EQT

PERFORMING LAB: US Army Research Laboratory, Aberdeen Proving Ground, MD

OBJECTIVE: Conduct a two-year study of the laser plasma phenomenon to provide fundamental understanding of the processes that are responsible for the generation of the analyte signal from various contaminants that the LIBS sensor detects.

APPROACH: Develop a CFD model of the LIBS plume, which is physically faithful to the laser-generated plasma event. The CFD code is based on a solution of the unsteady, Navier-Stokes equations including species diffusion, thermal conduction, viscosity, and nonequilibrium chemical kinetics.

PROPONENT: Army

POC: Dr. Andrej W. Miziolek

PHONE: (410) 306-0884

STATUS: Initiated

FAX: (410) 306-1909

TITLE: Nanomachines in Smart Coatings

PROJECT No.: AH28

PROGRAM FUNDING SOURCE: Army 6.2 RDT&E

PERFORMING LABS: U.S. Army Industrial Ecology Center and the New Jersey Institute of Technology

OBJECTIVE: Develop the next generation of "smart" coatings for Army materiel through the use of nanomachines to address the serious concern over weapon system corrosion thereby resulting in longer service life and lower failure rates of current and future weapon systems.

APPROACH: Investigate the use of nanomachines for smart coatings development; develop coatings with corrosion-inhibiting and self-healing properties; perform field testing on Army materiel.

PROPONENT: Army

POC: Ms. Laura Battista

PHONE: (973) 726-5650

STATUS: Initiated

FAX: (973) 724-6759

4. Green Programs

TITLE: Materials and Processes Partnership for Pollution Prevention (MP4) Program
PROJECT Nos.: 3.M-027 -N227) **PROGRAM FUNDING SOURCE:** Army
6.2 EQT

PERFORMING LAB: NDCEE

OBJECTIVES: Develop, demonstrate and validate pollution prevention cost saving technologies for the DoD acquisition, sustainment and industrial base, thereby reducing hazardous material usage, reducing regulatory pressure, and lowering the cost of weapon systems throughout their life cycle.

APPROACH: Identify pollution prevention technologies and management solutions to address DoD needs. Establish goals and technical requirements necessary to satisfy need. Develop, test, and demonstrate technology and management solutions including cost and health risk impacts. Transition new technologies and processes to the Army industrial base and other DoD and commercial sites.

PROPONENT: Congress

POC: Mr. Robert Moreira, /Mr. Robert Zanowicz IEC

PHONE: (973) 724-2617/5744

STATUS: Ongoing

FAX: (973) 724-6759

TITLE: Demanufacturing of Electronic Equipment for Reuse and Recycling (DEER2) Program

PROJECT Nos.: 3.D-050 (N.072) **PROGRAM FUNDING SOURCE:** Army 6.2
EQT

PERFORMING LAB: NDCEE

OBJECTIVE: Develop, demonstrate and validate new technologies and processes for the reuse, recycle, or disposal of manufactured electronic equipment used by the DoD and its suppliers. The Electronic Equipment Demanufacturing Program will be implemented in Largo, Florida. This site will allow access to source of raw materials to aid in the demonstration and validation of the developing technologies.

APPROACH: Identify and analyze DoD needs to establish goals and requirements for the DEER2 Program. Establish an Electronics Demanufacturing Technology and Demonstration Program in which technologies can be fully demonstrated and validated including training to DoD personnel. Use and Integrated Product Team (DLA, DoD Working Group, TACOM-ARDEC, IEC, CECOM/TYAD, CTC) approach to ensure satisfaction of DoD technology needs and program goal accomplishment.

PROPONENT: Congress

POC: Mr. Robert Moreira, IEC

PHONE: (973) 724-2617

STATUS: Ongoing

FAX: (973) 724-6759

TITLE: Sustainable Green Manufacturing Program

PROJECT Nos.: 3.D-051

PROGRAM FUNDING SOURCE: Army 6.2
EQT

PERFORMING LAB: Industrial Ecology Center, NDCEE, NJIT & NMSU

OBJECTIVE: Develop life cycle-based, environmental improvements by conducting research and engineering in: modeling and simulation, environmental engineering, coatings, corrosion prevention, demilitarization technologies, and the effectiveness of environmental management systems.

APPROACH: The program is divided into three program management tasks and six research tasks. Specific tasks have been identified for execution through teaming of Industrial Ecology Center, National Defense Center for Environmental Excellence, New Jersey Institute of Technology & New Mexico State University. The team will sponsor seminars and workshops, and generate handbooks, that describe the technology. Conduct environmental engineering studies for coatings, corrosion prevention, environmental management systems, life-cycle cost and health effects, and demilitarization technologies required for environmental improvements. The program will provide direct support to various green programs, Corrosion Protection and Control, Predictive and Life Cycle Environmental Modeling, develop environmentally friendly Non-destructive Inspection Technologies, and Smart Sensor and Packaging Technologies.

PROPONENT: Congress

POC: Mr. Don Skelton, IEC

PHONE: (973) 724-4071

STATUS: Ongoing

FAX: (973) 724-6759

TITLE: Green Gun Barrel Program (Roll up)

TITLE: Elimination of Aqueous Electrodeposition of Chromium for Gun Barrel Bore Protection

PROJECT Nos: 3.A.2-027 (SERDP PP1074-98)

PROGRAM FUNDING SOURCE:
Multiple

PERFORMING LAB: TACOM/ARDEC

OBJECTIVE: Provide an alternative, less polluting process and/or materials to chromium electroplating for bore protection in gun barrels.

APPROACH: Develop a process using chromium, tantalum, et al. based on Cylindrical Magnetron Sputtering (CMS) techniques. The CMS process has virtually no hazardous waste products and eliminates the need for any mitigation equipment. The work package includes the development of a medium caliber gun barrel magnetron sputtering laboratory facility, coating of tubes with various refractory materials and testing of the coatings. The work will be leveraged with efforts funded under the Future Tank Main Armament Program and will allow for scale-up to large caliber gun tubes. This effort also builds upon work funded under the ARMY 6.1 EQT 6.1 work package titled Target Technology Development for Coatings.

POC: Michalel Audino , ARDEC/Benet Labs
PHONE: (518) 266-5740

STATUS: In Progress
FAX: (518) 266-4661

TITLE: Green Bullet Program (Roll-up)

PROJECT Nos.: 3.D-052 (SERDP PP1074-98)

PROGRAM FUNDING SOURCE:
Multiple

PERFORMING LAB: TACOM/ARDEC

OBJECTIVES: Applied Research, Development, Demonstration/Validation and EO12856 funded efforts addressing pollution prevention and life cycle environmental issues that impact tri-service small caliber ammunition.

APPROACH: The list of pollutants and the sources have been identified and projects identified according to maturity of technology needs for achievement of pollution reduction goals and expected benefits. Total program extends from inception of initial needs with FY93 funding provided under SERDP and extends out to FY03. Being addressed are substitutes for: lead/antimony in bullet projectile core, barium nitrate, antimony sulfide and lead styphnate in primer, heavy metals in tracer and incendiary formulations, ODC's and VOC's in the manufacturing processes and materials.

POC: Mr. John Middleton TACOM/ARDEC
PHONE: (973) 724-7976

STATUS: Transitioning to production
FAX: (973) 724-6759

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5. Project Summaries

5. a. Cleaning and Degreasing Projects

TITLE: Aqueous Based Degreasing Technology

PROJECT NUMBER: 3.A.1-003

PROGRAM FUNDING SOURCE:

Army 6.1 EQT

PERFORMING LAB: U.S. Army Natick Research, Development & Eng. Center, Natick, MA

OBJECTIVE: Develop nonpolluting, nontoxic water-based degreasers for cleaning metal/glass/plastic surfaces using biopolymer, emulsifying materials.

APPROACH: Develop microbially produced natural surfactants (emulsions) through fermentation processes and optimize chemical structure of the new materials for specific oil/grease removal needs. Solve production issues for fermentation and purification of new bioemulsifiers. Relate detergency to chemical structure. Tailor chemical structure of bioemulsifiers for specific degreasing applications. Extramural: modify bioemulsifiers by fermentation feeding strategies. Chemically characterize new emulsifiers. Modify other similar biopolymers with fermentation technique. Optimize bioremediation methods for emulsified oil/grease solutions.

PROPONENT: TACOM/AMCOM/OSC

POC: Dr. Kevin McGrath, Natick

PHONE: (508) 233-4266

STATUS: Completed

FAX: (508) 233-5104

TITLE: Microbial Cleaning

PROJECT NUMBER: 3.A.1-018 (R2-12)

PROGRAM FUNDING SOURCE:

Army 6.2 EQT/SGM

PERFORMING LAB: NDCEE

OBJECTIVE: Develop a microbial cleaning process that will eliminate the use of hazardous materials in the AGT 1500 turbine engine.

APPROACH: Anniston Army Depot (ANAD) currently performs maintenance activities associated with the M1 Combat Tanks. Specifically, the maintenance activities include the cleaning of bearing housings and spacers in the rear module of the Engine. These components contain holes that are small and become plugged with carbonized synthetic oil residue, which could result in catastrophic failure. The current cleaning process is a multi-step method utilizing hazardous materials. Microbial cleaning can replace the cleaning material with a non-hazardous biological microbial media, which will significantly reduce the generation and management of hazardous waste. Also, the implementation of a microbial washer has the potential to greatly increase the cleaning efficiency of the parts by enabling the microbes to be exposed to the carbonized materials reducing the probability of engine failure due to air or fluid flow blockage.

PROPONENT: Army, Navy, Air Force

POC: Mr. Don Skelton IEC

PHONE: (973) 724-4071

STATUS: In Progress

FAX: (973) 724-6759

5. b. Plating and Finishing Projects

TITLE: Removal of Cyanide-Bearing Processes

PROJECT NUMBER: 3.A.1-019 (N.227 Sub Task 012)

PROGRAM FUNDING

SOURCE: Army 6.2EQT/SGM

PERFORMING LAB: NDCEE

OBJECTIVE: Reduce or eliminate the use of cyanide from the metal stripping and finishing facilities at Corpus Christi Army Depot (CCAD) and transfer knowledge gained to other DoD facilities.

APPROACH: Identify, demonstrate, validate, justify and implement removal of cyanide-bearing processes at CCAD. Perform preliminary testing required to qualify alternative chemistries for implementation at CCAD. A five-step approach will be used: perform a requirements analysis, identify alternatives, conduct technology demonstration, provide technology justification, and technology implementation.

PROPONENT: Army

POC: Mr. Robert Zanowicz IEC

PHONE: (973) 724-5744

STATUS: In Progress

FAX: (973) 724-6759

TITLE: Physical Vapor Deposition (PVD) Coatings And Ion Beam Processing

PROJECT NUMBER: 3.A.2-001 (A065) (SERDP PP632-94)

PROGRAM FUNDING

SOURCE: SERDP

PERFORMING LAB: Army Research Lab, Johns Hopkins University

OBJECTIVE: Demonstrate PVD coating techniques and ion beam processing as effective environmentally acceptable alternatives to chromium and cadmium electroplating.

APPROACH: Applied R&D was conducted to demonstrate that metal or ceramic coatings deposited by PVD and/or ion-beam-modified surfaces are equivalent in performance and a cost effective alternative to electroplated coatings.

PROPONENT: AMCOM, OSC, Navy

POC: Dr. John Beatty, ARL

PHONE: (410) 516-4748

STATUS: Completed FY 96

FAX: (410)516-5293

TITLE: Improving Aluminum Ion Vapor Deposition

PROJECT NUMBER: 3.B.3-016 (N.227 Sub Task 003)

PROGRAM FUNDING

SOURCE: Army 6.2 EQT

PERFORMING LAB: NDCEE

OBJECTIVE: The elimination of glass bead peening and the reduction or elimination of hexavalent chromium conversion coatings on IVD aluminum.

APPROACH: Demonstrate a pulsed high voltage IVD system, and justify it as a cost effective, environmentally benign process that can eliminate glass bead peening and chromate conversion coatings on IVD aluminum. A four-step approach will be used: perform a requirements analysis, identify alternatives, conduct technology demonstration, and provide technology justification.

PROPONENT: Army

POC: Mr. Robert Moreira/R. Zanowicz, IEC

PHONE: (973) 724-2617/5744

STATUS: Ongoing

FAX: (973) 724-6759

TITLE: Environmental Metal Plating Alternatives (EMPA)

PROJECT NUMBER: 3.A.2-004

PROGRAM FUNDING SOURCE:

Air Force

PERFORMING LAB: NDCEE

OBJECTIVE: To demonstrate environmentally acceptable alternatives to electroplating for surface protection processes.

APPROACH: State of the art new technologies that are considered more environmentally acceptable as replacements for older technologies supporting plating for surface protection were implemented at four Air Force sites.

PROPONENT: Multi-service

POC: Mr. Andrew Goetz IEC

PHONE: (973) 724-6324

STATUS: Completed FY97

FAX: (973) 724-6759

TITLE: Non-Line-of-Sight Hard Chromium Alternatives

PROJECT NUMBER: 3.A.2-036 (NDCEE Task N.229)

PROGRAM FUNDING SOURCE: Air Force

PERFORMING LAB: NDCEE, Air Force Materials Lab

OBJECTIVE: Replace Electroplated Chrome for DoD use with alternatives applied by tank processes using existing equipment and infrastructure as much as possible or with minimal modification.

APPROACH: The first year of funds looked at Air Force depots and picked candidate processes. The second year of funds was being used for performing screening tests to select the best candidates.

PROPONENT: Air Force Materials Lab

POC: Mr. Andrew Goetz IEC

PHONE: (973) 724-6324

STATUS: Ongoing

FAX: (973) 724-6759

TITLE: Target Technology Development for CMS Deposition

PROJECT NUMBER: 3.A.2-012

PROGRAM FUNDING SOURCE: Army
6.1 EQT

PERFORMING LAB: Benet Labs, Watervliet, NY

OBJECTIVE: To develop basic target design parameters for use in Cylindrical Magnetron Sputtering (CMS) Process Development.

APPROACH: Define process parameters and perform experimental studies to refine tantalum target design parameters to establish suitable limits to achieve proper adhesion to the interior bore surface of cannon barrels.

PROPONENT: Army

POC: Dr. John Vasilakis, ARDEC/Benet

PHONE: (518) 266-5615

STATUS: Transitioning

FAX: (518) 266-4661

TITLE: Elimination of Aqueous Electrodeposition of Chromium For Bore Protection of Gun Barrels (Part of Green Gun Barrel)

PROJECT NUMBER: 3.A.2-006 (F101) (SERDP PP1074-98) **PROGRAM FUNDING SOURCE:** SERDP

PERFORMING LAB: Benet Labs, Watervliet, NY

OBJECTIVE: To eliminate environmental considerations associated with the electrodeposition of chromium onto gun barrel surfaces.

APPROACH: Design and construction of medium/large caliber gun barrel magnetron sputtering facility, coating of tubes with various refractory materials (chrome, tantalum) and test firing the coatings.

PROPONENT: Army

POC: Michael Audino, ARDEC/Benet

PHONE: (518) 266-5615

STATUS: Ongoing

FAX: (518) 266-4661

TITLE: Sodium Hydroxide Recycling System

PROJECT NUMBER: 3.A.2-009

PROGRAM FUNDING SOURCE:
ESTCP/EO12856

PERFORMING LAB: Watervliet Arsenal, NY

OBJECTIVE: To design build and demonstrate a state-of-art production prototype sodium hydroxide (NaOH) recycling system.

APPROACH: Build an improved system based on the prototype NaOH Recycling System installed at Tinker Air Force Base, Oklahoma. The new system will be built with improvement in operability, reliability, and maintainability.

PROPONENT: Watervliet Arsenal, NY

POC: Mr. Phillip Darcy, Watervliet

PHONE: (518) 266-4534

STATUS: Nearing Completion

FAX: (518) 266-4555

TITLE: Ion Beam Processing for Improved Corrosion Protection

PROJECT NUMBER: 3.A.2-021(R4-1) **PROGRAM FUNDING SOURCE:** Army 6.2
EQT/SGM

PERFORMING LAB: NDCEE

OBJECTIVE: Develop in-house capability to provide coatings using the Ion Plater and the Ion Beam Processing System. Characterize those coatings, and compare similar coatings applied by the different methods.

APPROACH: DoD and industry alternatives or enhancements to chromium electrodeposits and other finishes will be investigated. Coatings will be applied using the Ion Plater and the ion beam processing system. The resistive evaporation, cathodic arc, and sputtering sources of the Ion Plater and the electron beam evaporators and low energy ion sources of the ion beam system will be used to deposit such coatings. The high-energy source of the ion beam system will be used to modify the surface of chromium electrodeposits.

Several vacuum processes will be identified with potential for cadmium replacement. The most promising will be implemented and evaluated as fastener coatings. A follow-on program will then be developed to assist in implementing the most successful alternative in Army repair depots.

PROPONENT: ARDEC

POC: Mr. Andrew Goetz IEC
PHONE: (973) 724-6324

STATUS: Ongoing
FAX: (973) 724-6759

TITLE: Membrane Separation Process

PROJECT NUMBER: 3.A.2-023 (R3-3) **PROGRAM FUNDING SOURCE:** Army 6.2
EQT/SGM

PERFORMING LAB: NJIT

OBJECTIVE: Identify various gaseous and liquid discharges from a variety of coating and painting operations. Determine quantitatively the composition of these discharges. Apply commercially available or advanced membrane separation processes to these discharges in order to control pollution. Conduct a demonstration of one of the membrane separation processes identified.

APPROACH: The approach to meet the objectives of this subtask is to verify operation, alarm, and condition sequencing with each unit. Liquid solutions will be processed through each unit and operational data captured.

PROPONENT: ARDEC

POC: Dr. Dan Watts, NJIT
PHONE: (973) 596-3465

STATUS: Ongoing
FAX: (973) 642-7170

TITLE: Waste Acid Detoxification & Reclamation

PROJECT NUMBER: 3.A.2-024 **PROGRAM FUNDING SOURCE:** ESTCP

PERFORMING LAB: Watervliet Arsenal, NY

OBJECTIVE: To design build and demonstrate a state-of-art production prototype waste acid recycling system for hard chrome plating facilities.

APPROACH: Build an improved system based on rapidly expanding new technology available to the industry.

PROPONENT: Watervliet Arsenal, NY

POC: Mr. Phillip Darcy, Watervliet

PHONE: (518) 266-4534

STATUS: Completed

FAX: (518) 266-4555

TITLE: Investigating Surface Finishing Techniques

PROJECT NUMBER: 3.A.2-029 (R4-3) **PROGRAM FUNDING SOURCE:** Army
6.2 EQT/SGM

PERFORMING LAB: NDCEE

OBJECTIVE: Investigate different inorganic finishing methods for improved corrosion resistance and engineering properties, and /or to improve the environmental impact of surface finishing methods.

APPROACH: This effort will evaluate metal ion implantation, closed loop chromium systems, and other alternatives to nickel electroplating. Primary site selected will be Corpus Christi Army Depot (CCAD). This effort is a follow-on to the effort initiated in FY99.

PROPONENT: Army

POC: Mr. Don Skelton, IEC

PHONE: (973) 724-4071

STATUS: Ongoing

FAX: (973) 724-6759

TITLE: Pollution Prevention Investigation of Chromium Demister at Anniston Army Depot

PROJECT NUMBER: 3.A.2-038 (N.261)

PROGRAM FUNDING SOURCE:
Army 6.2 EQT

PERFORMING LAB: NDCEE

OBJECTIVE: Choose, install, and train employees on an optimum system to provide Anniston Army Depot's deionized water needs.

APPROACH: Survey available units, make selection in accordance with budget, purchase and install the unit, and train the employees as needed.

PROPONENT: Anniston Army Depot

POC: Mr. Andrew Goetz IEC

PHONE: (973) 724-6324

STATUS: Complete

FAX: (973) 724-6759

TITLE: Ion Beam and Plasma-Based Alternatives to Chrome Plating of Gas Turbine Engines

PROJECT NUMBER: 3.A.2-031 (N.227 Sub Task 004)

PROGRAM FUNDING SOURCE: Army 6.2 EQT

PERFORMING LAB: NDCEE

OBJECTIVE: Reduce or eliminate electrolytic hard chrome (EHC) plating in gas turbine engine components.

APPROACH: Demonstrate ion beam and plasma-based deposition or surface modification techniques, and justify them as cost effective, environmentally benign processes that can reduce or eliminate EHC operations. A four-step approach will be used: perform a requirements analysis, identify alternatives, conduct technology demonstration, and provide technology justification.

PROPONENT: Army

POC: Mr. Robert Zanowicz, IEC

PHONE: (973) 724-5744

STATUS: Ongoing

FAX: (973) 724-6759

TITLE: Spent Acid Recovery

PROJECT NUMBER: 3.A.2-032 (N.227 Sub Task 007)

PROGRAM FUNDING

SOURCE: Army 6.2 EQT

PERFORMING LAB: NDCEE

OBJECTIVE: Investigate various technologies for increasing the longevity/quality of surface protection acid baths.

APPROACH: Technologies available to recover and reuse spent acid and caustics, such as vacuum evaporation, acid sorption, and diffusion dialysis, will be compared to conventional treatment technologies with regard to system performance, product quality, safety, environmental considerations, and costs (capital, operating, and maintenance). A four-step approach will be used: perform a requirements analysis, identify alternatives, conduct technology demonstration, and provide technology justification.

PROPONENT: Army

POC: Mr. Robert Zanowicz, IEC

PHONE: (973) 724-5744

STATUS: Ongoing

FAX: (973) 724-6759

TITLE: Electroplating/Cleaning Bath Life Extension

PROJECT NUMBER: 3.A.2-033 (N.227 Sub Task 013)

PROGRAM FUNDING

SOURCE: Army 6.2 EQT

PERFORMING LAB: NDCEE

OBJECTIVE: Validate and implement new technologies to extend the useful working life of electroplating/cleaning bath operations.

APPROACH: Identify, evaluate, and implement cost-effective, low-risk technologies to increase electroplating/cleaning bath life and thereby reduce the resultant waste streams caused by more frequent bath dumps. A five-step approach will be used: perform a requirements analysis, identify alternative, conduct technology demonstration, provide technology justification, and technology implementation.

PROPONENT: Army

POC: / Mr. Robert. Zanowicz, IEC

PHONE: (973) 724-5744

STATUS: Ongoing

FAX: (973) 724-6759

TITLE: Laser Induced Surface Improvement for Elimination of VOCs and Hazardous Materials in Plating Operations

PROJECT NUMBER: 3.A.2-034 (N.227 Sub Task 016)

PROGRAM FUNDING SOURCE: Army 6.2 EQT

PERFORMING LAB: NDCEE

OBJECTIVE: Demonstrate that laser-induced surface improvement (LISI) technology can create environmentally acceptable surfaces on materials used in weapon-critical applications without producing detrimental effects in the substrate.

APPROACH: Design/select surface compositions and associated process parameters using the LISI process. Information obtained in the execution of this task is directly transferable to other Navy and Air Force depots, as well as other DoD facilities and organizations. A three-step approach will be used: perform a requirements analysis, conduct technology demonstration, and provide technology justification.

PROPONENT: Army

POC: Robert. Zanowicz, IEC
PHONE: (973) 724-5744

STATUS: Ongoing
FAX: (973) 724-6759

TITLE: Electro-spark Deposited Coatings for Replacement of Chrome Electroplate (on non-line-of-sight surfaces)

PROJECT NUMBER: 3.A.2-028 (SERDP PP-1147)

PROGRAM FUNDING SOURCE: SERDP

PERFORMING LAB: TACOM/ARDEC/Pacific Northwest National Labs

OBJECTIVE: To develop an environmentally friendly replacement technology for current wet hard chrome electroplating for defense technology for non-line-of-sight (NLOS) applications where current High Velocity Oxy-Fuel technology cannot be used.

APPROACH: Develop the Electro-spark deposition process for non-line-of-sight surfaces based on proven technology developed for exterior surfaces assisted by sensor technology for automated or semi-automated application to NLOS surfaces.

PROPONENT: Army

POC: Mr. Andrew Goetz, IEC
PHONE: (973) 724-6324

STATUS: In Progress
FAX: (973) 724-6759

TITLE: Surface Treatments for Enhanced Wear Resistance

PROJECT NUMBER: 3.A.2-035 (NDCEE N.245)

**PROGRAM FUNDING
SOURCE:** PM-TAWS

PERFORMING LAB: NDCEE

OBJECTIVE: Search for improved surface finishes or coatings that provide an environmentally and economically acceptable coating to increase the service life of selected components.

APPROACH: Select various surface finishing processes which provide a wear resistant coating to be applied to various problem parts in the Army inventory as selected by Holland Hitch, an Army supplier. Holland Hitch will then test the parts.

PROPONENT: Army

POC: Mr. Andrew Goetz, IEC
PHONE: (973) 724-6324

STATUS: Completed
FAX: (973) 724-6759

TITLE: Facility-Wide Solid Waste Minimization Assessment at Anniston Army Depot
PROJECT NUMBER: 3.A.2-037 (N.260) **PROGRAM FUNDING SOURCE:** Army
6.2 EQT

PERFORMING LAB: NDCEE

OBJECTIVES: 1. Conduct an assessment of ANAD operations and activities to identify, characterize solid waste categories, and quantify waste generation and disposal rates, and quantify recycling rates and recycled content purchases.

2. Develop a proposal of alternatives for each waste category identified in the waste assessment above. The proposal should explain how each alternative does or does not meet these criteria.

3. Develop cost comparisons for those alternatives determined to be in the proposal above to current operations and activities.

4. Prepare prioritized recommendation of the evaluated alternatives by using the criteria ranking table provided by ANAD.

APPROACH: Perform a real time assessment of actual disposals, summarize the data gained, and make recommendations.

PROPONENT: Anniston Army Depot

POC: Mr. Andrew Goetz, IEC
PHONE: (973) 724-6324

STATUS: Complete
FAX: (973) 724-6759

TITLE: In-Situ Study of Phase Evolution in Sputtering

PROJECT Nos.: 3.A.2-039 **PROGRAM FUNDING SOURCE:** Army 6.1 EQT
PERFORMING LAB: ARDEC - Benet Laboratory

OBJECTIVE: Develop a new and novel, non-destructive technique for measurement & analysis of coating thickness in real time.

APPROACH: Develop innovative real time x-ray technique, such as digital films and two-dimensional detector for real time growth study of coatings phase evolution.

PROPONENT: Army

POC: Dr. S. L. Lee, ARDEC/Benet

PHONE: (518) 266-5503

STATUS: In process

FAX: (518) 266-4661

TITLE: Non-Chromate Sealers for Aluminum Anodizing

PROJECT NUMBER: 3.B.3-002 (ESTCP 199701) **PROGRAM FUNDING SOURCE:**
ESTCP

PERFORMING LAB: ARDEC

OBJECTIVE: The demonstration and validation of non-chromate sealing for aluminum anodizing processes at DOD anodizing facilities.

APPROACH: Evaluate by testing at NADEP Jax candidate non-chromate sealers for Aluminum alloys for comparison with the currently used chromate sealers. Several sources of supply for the non-chrome anodize sealer will be identified and evaluated in the laboratory and field tested with respect to Salt Spray, SO₂ corrosion resistance, acid dissolution, stain resistance, and outdoor exposure, abrasion resistance, adhesion to be equal or better than Sodium Dichromate.

PROPONENT: Tri Services/NDCEE

POC: Jules Senske, ARDEC

PHONE: (973-724-4225)

STATUS: Ongoing

FAX: (973-724-7378)

TITLE: Evaluation of Non-Chromate Conversion Coating / Pretreat of Aluminum
PROJECT NUMBER: 3.B.3-003 (N.008) **PROGRAM FUNDING SOURCE:** Army 6.2
EQT

PERFORMING LAB: NDCEE

OBJECTIVE: Eliminate discharge of toxic heavy metal wastes associated with chromate-based conversion coatings.

APPROACH: Design, fabricate, assemble, demonstrate, and validate a prototype system to apply non-chromate conversion coatings on aluminum alloys. Validate the effectiveness of non-chromate conversion coating for DOD applications Provide capabilities to evaluate opportunities for further waste minimization, such as rejuvenation and recycling of processing solutions. Installation at the NDCEE completed.

PROPONENT: Navy, Army

POC: Mr. Dave Brader, CTC/Mr. A. Goetz, IEC **STATUS:** Completed

PHONE: (814) 269-2857/(973) 724-6324 **FAX:** (814) 269-6847/(973) 724-6759

TITLE: Non-Chromate Pretreatment of Non-ferrous Metals

PROJECT NUMBER: 3.A.2-034 (N.227mod 1 Subtask 026) **PROGRAM FUNDING SOURCE:** Army 6.2 EQT

PERFORMING LAB: NDCEE

OBJECTIVE: Demonstrate and test the toxicological effects of candidate non-chromate pretreatments regarding dermal, inhalation and oral exposure methods

APPROACH: Leverage from previous JG-PP effort for candidate non-chromate pretreatments that have satisfied the performance requirements of the joint test protocol (JTP). The results will be evaluated against the OSHA/EPA standards as well as baseline chromate pretreatment data.

PROPONENT: Army

POC: Robert. Zanowicz, IEC

PHONE: (973) 724-5744

STATUS: Ongoing

FAX: (973) 724-6759

TITLE: Environmentally Acceptable Non-Line (NLOS) of Slight Alternatives to Chrome Plating

PROJECT NUMBER: 3.A.2-034 (N.227mod 1 Subtask 030) **PROGRAM FUNDING SOURCE:** Army 6.2 EQT

PERFORMING LAB: NDCEE

OBJECTIVE: Identify and test NLOS alternatives to chrome plating for applications in which HVOF is not a suitable candidate with the goal being to reduce the environmental impact and risk associated with the use of hexavalent chrome.

APPROACH: Leverage efforts from ongoing Air Force task for NLOS and investigate applications for the Army and the other services. In particular are engine components such as housings, shafts, cylinders and carriers. Alternatives the Army and Navy task include iron plating and trivalent chromium.

PROPONENT: Army

POC: Robert. Zanowicz, IEC
PHONE: (973) 724-/5744

STATUS: Ongoing
FAX: (973) 724-6759

TITLE: Organosilane-Based Pretreatment

PROJECT NUMBER: 3.B.3-004 **PROGRAM FUNDING SOURCE:** Army 6.2 EQT

PERFORMING LAB: NDCEE

OBJECTIVE: Investigate the application and performance of a proprietary organosilane formulation as a substitution for chromate sealing of aluminum alloys.

APPROACH: The task is divided into four tasks: process bath maintenance and treatment evaluation, 2014-T6 aluminum alloy coating performance evaluation, spray application evaluation and spray/immersion application of pretreatment on full-scale components.

PROPONENT: Navy, Army
POC: Ms. Heidi Nicely, CTC
PHONE: (814) 269-6461

STATUS: Ongoing
FAX: (814) 269-6847

TITLE: Advanced Polyelectrolyte Modified Zinc Phosphate Conversion System

PROJECT NUMBER: 3.B.3-005

PROGRAM FUNDING SOURCE:
Army 6.2 EQT

PERFORMING LAB: NDCEE

OBJECTIVE: Evaluate process parameters for the scale up of an environmentally responsible, non-hazardous zinc phosphate conversion coating developed by TACOM. A secondary objective of this task is to assist in the transfer of the technology to a full-scale manufacturing plant.

APPROACH: This task is divided into four tasks: scale-up components testing of the advanced zinc phosphate conversion coating at the 15, 100, 500 gallons scale in the Demonstration Factory, analyze statistically all data compiled to determine optimum operating conditions, risk assessment & life cycle cost analyses of implementing the new technology, and technology transfer to military industrial manufacturing facilities.

PROPONENT: Navy, Army

POC: Mr. Mike Docherty, CTC

PHONE: (814) 269-6462

STATUS: Ongoing

FAX: (814) 269-6847

TITLE: Innovative Coating Applications for Miscellaneous Metal Parts

PROJECT NUMBER: 3.B.3-009 (N.047)

PROGRAM FUNDING SOURCE:
EPA

PERFORMING LAB: NDCEE

OBJECTIVE: Environmental regulations significantly restrict the emissions of volatile organic compounds (VOCs) and hazardous air pollutants (HAPs) that are contained in many coatings. Focus is to assist small businesses that coat parts.

APPROACH: Assemble Coatings Research Forum that focuses on the automotive industry. Identify, select, and prioritize projects. Conduct pilot-scale testing.

PROPONENT: Environmental Protection Agency

POC: Mike Kosuko (EPA) / William Sharpe (TACOM-ARDEC) **STATUS:** Completed

PHONE: (919) 541-2734/(973) 724-6506

TITLE: Advanced Zinc Phosphate Metal Pre-treatment

PROJECT NUMBER: 3.B.3-010 (SERDP PP659-94)

**PROGRAM FUNDING
SOURCE:** SERDP

PERFORMING LAB: Tank Automotive Research Development and Engineering Center

OBJECTIVE: Eliminate hexavalent chromium rinses on zinc phosphate and to enhance corrosion protection and adhesion of paint films on ferrous and non-ferrous metal surfaces prior to painting or adhesive assembly.

APPROACH: Finish the laboratory studies at Brookhaven National Labs (BNL). Transfer this technology to the shop floor at TRW. Validate the concept under actual production on real parts as encountered by industry. Reformulate and adjust process as dictated by the scale up studies.

PROPONENT: TACOM.

POC: Mr. I. Carl Handsy, TACOM

PHONE: (810) 574-7738

STATUS: Completed FY 97

FAX: (810) 574-5413

TITLE: Self-Assembled Monolayers (SAMs) as Primers for Corrosion Protection for Metallic Substrates & Spectroscopic Studies of Primer Alternatives.

PROJECT NUMBER: 3.B.3-012

PROGRAM FUNDING SOURCE:
Army 6.1 EQT

PERFORMING LAB: Army Research Laboratory, APG, MD

OBJECTIVE: To prepare and characterize SAM coatings on steel and aluminum surfaces; to study the corrosive and oxidative resistance of the SAM coatings, and to identify the optimal coating characteristics with respect to metal protection, durability, ruggedness, ease of application, and longevity.

APPROACH: This project will be a collaborative effort between Aerodyne Research, Inc. (ARI) and the Army Research Laboratory (ARL). ARI will perform the synthesis of appropriate long-chain hydrocarbons for use as SAM coatings on steel and aluminum; the preparation, characterization, and testing of the SAM coatings; and the synthesis of terminal air-interface groups and chain modified materials for cross-linking and multi-layer SAM coatings. ARL will perform the FTIR and Raman characterization of chemical and morphological changes in SAM films due to exposure to common solvents, acidic and alkali solutions, and corrosive gases. In addition, ARL will conduct photochemical cross-linking studies of SAM coatings as well as characterize the structure and chemical resistance of multi-layer coatings.

PROPONENT: OSC

POC: Dr. R. Fifer, ARL

PHONE: (ARL) (410) 306-0929

STATUS: Final Report in Progress

FAX: (ARL) (410) 306-0640

5.c. Painting and Coating Process Projects

TITLE: Reduce or Eliminate VOCs in CARC Paint Formulation, Application, and Removal

PROJECT NUMBER: 3.B.1-010 (SERDP #1056) **PROGRAM FUNDING SOURCE:**
SERDP/ESTCP

OBJECTIVE: Develop a no/low VOC CARC system that satisfies the requirements of all military services and meets present and anticipated future regulatory requirements.

APPROACH: The technical approach for the formulation and application work will focus on high performance, water reducible, water dispersible polyurethane binder system and has the potential for chemical agent resistance and meets the performance requirements of the Army, Air Force and Marines. The approach to the stripping requirement will be to focus on evaluation of currently used methods of removal to optimize the processes for de-painting and disposal of the CARC being developed.

POC: Mr. Jae Shim, TACOM/ARDEC

STATUS: Nearing Completion

PHONE: (973) 724-6518

FAX: (973) 724-6503

TITLE: Powder Coating Technology for Small Arms Bullet Tip Identification

PROJECT NUMBER: 3.B.1-005 **PROGRAM FUNDING SOURCE:**
ESTCP/EO12856

PERFORMING LAB: TACOM/ARDEC

OBJECTIVE: Eliminate VOC's associated with painting bullet tips.

APPROACH: Demonstrate use of powder coating technologies for use in bullet tip identification.

PROPONENT: Multi-service

POC: Mr. Paul Riggs, TACOM/ARDEC

STATUS: Transitioning

PHONE: (973) 724-6938

FAX: (973) 724-7095

TITLE: Zippable Potential CARC Paints

PROJECT NUMBER: 3.B.1-007 (NAT01)

PROGRAM FUNDING SOURCE:
Army 6.1 EQT

PERFORMING LAB: U.S. Army Natick Research, Development & Engineering Center, Natick, MA

OBJECTIVE: Design and produce new protein based coatings for specific substrates (metals) and clean removal strategy based on new aqueous based systems.

APPROACH: Select suitable protein sequences for substrate and paint functional groups. Design coatings with specific recognition ends for the substrates to be coated and for the final coat chemistry. Optimize structures of proteins for optimal enzymatic stability or thermal susceptibility. Utilize genetic techniques to produce libraries of target protein sequences for screening and characterization. Demonstrate that proteins can be tightly bound to surfaces and then successfully removed using heat or enzymes in water environments. New approach is to incorporate bleaching agents into the primer and evaluate electrochemical methods of stripping.

PROPONENT: Army

POC: Mr. John Walker, Natick
PHONE: (508) 233-4562

STATUS: Revised Approach
FAX: (508) 233-5104

TITLE: Powder Coat Material Investigation for CCAD, NADEP-JAX, RRAD, and other

PROJECT NUMBER: 3.B.1-015 (R4-1)

PROGRAM FUNDING SOURCE: Army
6.2 EQT/SGM

PERFORMING LAB: NDCEE

OBJECTIVE: Evaluate and qualify lower temperature curing materials.

APPROACH: Since 1996 significant advances have been made by the powder coating industry in the development of lower-temperature curing materials. These new materials have the potential to provide the same level of performance while reducing the requirement to expose high-strength alloys to temperatures above 300 degrees Fahrenheit. This effort will qualify these lower-temperature curing materials and help facilitate the transfer of this technology, thereby reducing costs and emissions.

PROPONENT: Army

POC: Mr. Don Skelton, IEC
PHONE: (973) 724-4071

STATUS: Ongoing
FAX: (973) 724-6759

TITLE: Corrosion Protective Coatings for DU Penetrators

PROJECT Nos.: 3.B.1-016

PROGRAM FUNDING SOURCE: Army 6.1 EQT

PERFORMING LAB: ARL

OBJECTIVE: Design a surface treatment and/or coating system to reduce the generation of hazardous corrosion products on DU during exposure to the environment.

APPROACH: Design a completely new corrosion protection scheme based on the latest surface analytical techniques to inhibit uranium dissolution.

PROPONENT: Army

POC: Dr. J. Derek Demaree, ARL

PHONE: (410) 306-0840

STATUS: Ongoing

FAX: (410) 306-0829

TITLE: Unitized Coating Application Facility: E-Coat & Powder Coat

PROJECT NUMBER: 3.B.2-002 (N.002)

PROGRAM FUNDING SOURCE:

Army 6.2 EQT

PERFORMING LAB: NDCEE, Johnstown, PA

OBJECTIVE: To investigate paint application technologies which reduce VOC emissions and improve coating quality.

APPROACH: Identify present processes, define requirements through baselines and bench marking, and establish a demonstration/training capability to perform engineering and tests focusing on feasibility, process optimization and verification. Transition the technology to the field through the use of economic analysis, assisting sites with process design, and installation & startup. In addition, an assessment of Environmental Health and Safety risks will be conducted.

PROPONENT: OSC, Navy

POC: Carl Handsy, TACOM

PHONE: (810) 574-7738

STATUS: Completed

FAX: (810) 574-5413

TITLE: Paint Handling & Spraying Equipment Testing, Evaluation and Training

PROJECT NUMBER: 3.B.2-006 (N.023)

PROGRAM FUNDING SOURCE: Army

6.2 EQT

PERFORMING LAB: NDCEE

OBJECTIVE: Evaluate and test advanced paint handling and spray equipment for use in military industrial facilities that will reduce environmental discharges associated with painting operations, comply with EPA regulations, and improving productivity. The NDCEE will act as a non-biased third party to evaluate the various technologies against the DOD requirements using latest industry innovations.

APPROACH: First, a requirements analysis was undertaken. This will involve DOD specification owners, DoD end users, paint handling and spray equipment vendors, paint manufacturers and commercial users. These groups were assembled into committees, which will then be used for the information survey. Technologies that have the biggest benefit were identified and demonstrated first. Certification test programs were developed and carried out to ensure that the technologies meet all DoD and EPA requirements and specifications. A paint handling and spray technology information database was established and made accessible to the DOD and commercial industry. The NDCEE has established a training center that will allow for economical training of personnel.

PROPONENT: All services

POC: Mr. Nelson Colon, IEC

PHONE: (973) 724-2482

STATUS: Completed

FAX: (973) 724-6759

TITLE: Organic Coating Processes

PROJECT NUMBER: 3.B.2-008 (R4-1)

PROGRAM FUNDING SOURCE: Army
6.2 EQT/SGM

PERFORMING LAB: NJIT/NDCEE

OBJECTIVE: To work with military industrial facilities to evaluate and implement pollution prevention technologies in corrosion control efforts by applying environmentally compliant organic coatings.

APPROACH: Commercial technologies are available that can potentially protect military aircraft, vehicles, and weapons systems against corrosion. Testing, validation, training, system specification, and implementation support to military industrial facilities in their efforts to eliminate pollution will be provided. Military facilities will be assisted to develop a user-friendly, object-oriented database that will allow the tracking of vehicles to collect cost data related to corrosion, the performance of corrosion control measures, and other pertinent data about the systems.

PROPONENT: ARMY

POC: Mr. John Theis, IEC

PHONE: (973) 724-4092

STATUS: Ongoing

FAX: (973) 724-6759

TITLE: Supercritical CO₂ Painting Demonstration

PROJECT NUMBER: 3.B.2-003 (R3-1)

PROGRAM FUNDING SOURCE: Army
6.2 EQT/SGM

PERFORMING LAB: NDCEE

OBJECTIVE: The objective is to establish the capability to spray paint with the UNICARB CO₂ system. As a result of this effort, the NDCEE will have established a demonstrative platform for DOD users to investigate this paint spraying method in reducing the volatile organic compound (VOC) emissions from painting operations.

APPROACH: Procure a license agreement with Union Carbide for the right to conduct research and developmental activities with the UNICARB CO₂ painting technology for DOD. Procure a production size painting system that uses the UNICARB technology. The painting system will be large enough for job shop activities, yet small enough to conduct developmental activities. Train CTC personnel on the technology, operation, and maintenance of the painting system. Conduct a spray demonstration.

PROPONENT: TACOM

POC: Mr. James Tardoni (CTC)

PHONE: (814) 269-2540

STATUS: Ongoing
FAX: (814) 269-2798

TITLE: X - Ray Sorbing/Scattering Structural Characterization

PROJECT NUMBER: 3.B.2-001 (R4-2)

PROGRAM FUNDING SOURCE: Army

6.2 EQT/SGM

PERFORMING LAB: NJIT

OBJECTIVE: Determine the nature of the interactions between steel substrates and both metal and non-metallic coatings. A further goal is to develop rapid procedures to recognize early states of corrosion in order to facilitate development of field-able techniques leading to repair and maintenance on an as needed basis.

APPROACH: The proposed work will utilize X-ray techniques to determine the nature of the interactions between steel substrates and both metal and non-metallic coatings. Predictive issues to be considered are bonding strengths, permeability, and interfacial characteristics. The goal is to predict and assess the ability of alternative protective coatings to perform as well as present coatings such as chromium. A primary initial focus will be on use of tantalum coatings in gun barrels and the corrosion protection ability of such coatings.

PROPONENT: ARMY

POC: Dr. Dan Watts, NJIT

PHONE: (973) 596-34655

STATUS: Completed

FAX: (973) 642-7170

TITLE: Powder Coat Applications

PROJECT NUMBER: 3.B.2-010 (N.046)

PROGRAM FUNDING SOURCE:

EPA

PERFORMING LAB: NDCEE

OBJECTIVE: Environmental regulations significantly restrict the emissions of volatile organic compounds (VOCs) and hazardous air pollutants (HAPs) that are contained in many coatings. Powder coating is growing in use by metal finishers to eliminate VOCs and other Coating

Emissions.

APPROACH: Identify small business candidates for demonstration. Demonstrate application of powder coatings. Test coatings for product performance acceptability. Work with project team to transition use. Identify opportunities for improved acceptance and barriers to its use.

PROPONENT: Environmental Protection Agency

POC: C. Masser (EPA)/ William Sharpe (TACOM-ARDEC)

PHONE: (919) 541-2509/(973) 724-7144

STATUS: Completed

FAX: (973) 642-6503

TITLE: Evaluation, Qualification, and Implementation of Powder Coating for Tobyhanna Army Depot (TYAD)

PROJECT NUMBER: 3.B.2-012 (R4-2)

PROGRAM FUNDING SOURCE: Army
6.2 EQT/SGM

PERFORMING LAB: NDCEE

OBJECTIVE: Implement Powder Coat Technology at Tobyhanna Army Depot (TYAD)

APPROACH: As a DOD Industrial Painting Facility, TYAD has been tasked to reduce/eliminate VOC and HAP emissions associated with current coating processes. Powder coating is an industry-proven technology that offers the potential to eliminate VOC and HAP emissions. In 1993, TYAD expressed interest related to implementing a powder coating process but was restricted by funding issues. This effort will identify candidate parts and performance requirements to lead to the implementation of a powder coating process by providing equipment purchasing, installation, training, and start up support.

PROPONENT: Army

POC: Mr. Don Skelton, IEC

PHONE: (973) 724-4071

STATUS: Ongoing

FAX: (973) 724-6759

5.d. Paint Stripping Projects

TITLE: Waterjet Paint Stripping

PROJECT NO: 3.B.4-004 (93 SERDP) **PROGRAM FUNDING SOURCE:** SERDP

PERFORMING LAB: TACOM, Warren MI

OBJECTIVE: To eliminate or significantly lower the generation of hazardous and toxic materials during metal surface pretreatment. Ultimately this will reduce the cost of painting in manufacturing and in Depot repair.

APPROACH: Combine state of art robotics with Waterjet paint stripping and simultaneously apply an aqueous based non-hazardous material that will produce a continuous barrier between the metal oxide and primer paint. The effect will be to use all of the above new technologies into a single operation that is environmentally acceptable.

PROPONENT: TACOM

POC: Mr. Carl Handsy, TACOM

PHONE: (810) 574-7738

STATUS: Completed

FAX: (810) 574-6501

TITLE: Plasma Based Removal Of Organic Coatings

PROJECT No: 3.B.4-010 (F060)

PROGRAM FUNDING SOURCE:

Army 6.1 EQT

PERFORMING LAB: ARL, Aberdeen Proving Ground, MD

OBJECTIVE: Develop a non-abrasive, environmentally friendly method for char-free, solvent free removal of organic coatings.

APPROACH: Develop atomic plasma reactor. Demonstrate plasma gas technology as an approach for a dry non-polluting method for degreasing and paint stripping with minimal impact on substrates. Use chemical characterization to study the mechanisms of coating removal.

PROPONENT: ARMY

POC: Dr. Pam Kaste, ARL

PHONE: (410) 306-0749

STATUS: Complete

FAX: (410) 306-0640

TITLE: Tri-service Dem/Val FLASHJET Process for Military Application

PROJECT No: 3.B.4-006 (N.126)

PROGRAM FUNDING SOURCE:
ESTCP

PERFORMING LAB: AEC.

OBJECTIVE: To demonstrate and validate xexon flash lamp technology to remove organic coatings from airframes, landing gear and ground vehicles.

APPROACH: Xexon flashlamp technology or Flashjet, developed by McDonnell Douglas now part of Boeing, is a state of the art paint removal system. The system removes paint rapidly and produces no additional hazardous waste stream while having no effect on the substrate. This is important due to thin aluminum and composite skins, which comprise airframes. Boeing's test facility in Mesa, AZ has successfully demonstrated this technology on the Army's Apache Helicopters. The thrust of this particular effort is expanding the testing to Navy and Air Force Rotary Aircraft and Army ground combat vehicles.

PROPONENT: DOD

POC: Mr. Robert Zanowicz, IEC

PHONE: (973) 724-5744

STATUS: Completed

FAX: (973) 724-6759

TITLE: Paint Stripping Using CO2 Pellets

PROJECT No: 3.B.4-002 (N.045)

PROGRAM FUNDING SOURCE: Army 6.2
EQT

PERFORMING LAB: NDCEE, Naval Aviation Depot, Jacksonville.

OBJECTIVE: Demonstrate and validate the mobile manipulation of an advanced CO2 Turbine wheel, for paint stripping using CO2 pellets and then integrate it into production in an actual depot

APPROACH: System uses solid CO2 pellets as abrasive mediums to strip paints and surface coatings off metal parts. This has the advantage of having no waste medium (such as sand) to add to the hazardous waste stream. The pellets are cylindrical and are fed through a turbine wheel where they are accelerated to a high rate of speed. When striking the surface they shatter the paint and the pellets evaporate. An advanced pelletizer was obtained in November 1997 and is 90% efficient compared to a 50% efficiency of the first generation model. The newest phase of the project is to integrate this technology into a production work cell by stripping paint off of engine containers.

PROPONENT: DOD

POC: (Army) Mr. Robert Zanowicz (Navy) Mr. Steve Hartle

PHONE: (Army) (973) 724-5744 (Navy) (301) 342-8006

STATUS: Completed

FAX: (973) 724-6759

TITLE: Laser Decoating for Missiles

PROJECT NUMBER: 3.B.4-013 (N.227 Sub Task 014)

**PROGRAM FUNDING
SOURCE:** Army 6.2 EQT

PERFORMING LAB: NDCEE

OBJECTIVE: Reduce or eliminate the use of hazardous chemicals and blast media during decoating of missile components.

APPROACH: Evaluate the removal of coatings from missile airframes, such as the Standard, AMRAAM, ASRAAM, Maverick, and TOW missiles. Laser technologies to be examined will include and be limited to: TEA-CO₂ and Diode lasers incorporated into robotic workcells. A four-step approach will be used: perform a requirements analysis, identify alternatives, conduct technology demonstration, and provide technology justification.

PROPONENT: Army

POC: Mr. Robert Moreira/Mr. Robert Zanowicz, IEC
PHONE: (973) 724-2617/5744

STATUS: Ongoing
FAX: (973) 724-6759

TITLE: Zero VOC/HAP Chemical Stripper for Large Aircraft Depainting Operations

PROJECT NUMBER: 3.A.1-019 (N.227 Sub Task 002)

**PROGRAM FUNDING
SOURCE:** Army 6.2EQT

PERFORMING LAB: NDCEE

OBJECTIVE: Develop a chemical Depainting process for radomes that safely removes coatings from the exterior of large aircraft and other weapon system components without admitting HAPs or VOCs to the environment

APPROACH: Identify baseline requirements of existing radomes stripping processes and demonstrate, validate, justify and implementation this unique photochemical process. Demonstration will not only involve sample coupons but actual aircraft components. Project will not only measure performance of stripping process but just as important, effects on mechanical properties of substrates,

PROPONENT: Navy - Navair

POC: Mr. Robert Zanowicz IEC/Dr. Vinod Agarwala NAWCAD
PHONE: (973) 724-5744/(301) 342-8002

STATUS: In Progress
FAX: (973) 724-6759

TITLE: Evaluation of Coatings Removal Technologies with/without Vacuum Recovery on Delicate Substrates

PROJECT NUMBER: 3.A.1-019 (N.227 Mod 1, SubTask 022) **PROGRAM FUNDING SOURCE:** Army
6.2EQT/SGM

PERFORMING LAB: NDCEE

OBJECTIVE: Identify and evaluate less labor intensive, more efficient and cost beneficial coatings removal technologies on soft substrate materials such as submarines, surface ships, aircraft components and ground vehicles.

APPROACH: Identify, demonstrate, validate, justify and implement coating removal processes that are environmentally compatible and safe for soft substrates such as those found on submarine and surface vessels. Perform preliminary testing required to qualify alternative processes such as Xenon lamp, laser and various blast media on sample components. A five-step approach will be used: perform a requirements analysis, identify alternatives, conduct technology demonstration, provide technology justification, and technology implementation.

PROPONENT: Navy

POC: Mr. Robert Zanowicz IEC

PHONE: (973) 724-5744

STATUS: In Progress

FAX: (973) 724-6759

5. e. Ordnance-Reuse/Recycling Projects

TITLE: Catalytic Hydrotreatment of Military Compounds

PROJECT No: 3.C.1-022

PROGRAM FUNDING SOURCE:

Army 6.1 EQT

PERFORMING LAB: ARO

OBJECTIVE: To develop practical catalysts for the hydrotreatment of military compounds, particularly chemical agents into non-lethal compounds.

APPROACH: Use hydrotreatment, a process to remove atoms in a compound that are undesirable, by reacting the compound with hydrogen in order to form a benign compound that is more easily disposed of or has commercial value for other purposes. Determine feasibility for non-destructive removal of explosives from complex metal surfaces using low temp plasmas.

PROPONENT: Research Triangle Institute

POC: Dr. R. Shaw, ARO

PHONE: (919) 549-4293

STATUS: Completed

FAX: (919) 549-4310

TITLE: Extraction and Recycling of Nitramines With Supercritical Fluids

PROJECT No: 3.C.1-005 (SERDP PP695-94)

PROGRAM FUNDING

SOURCE: SERDP

PERFORMING LAB: Army Research Lab, APG, MD

OBJECTIVE: Initial objective was to identify suitable supercritical fluid solvents for use in extracting and recycling the ingredients of obsolete solid Low Vulnerability Ammunition (LOVA) gun propellants and nitramine explosives. This was subsequently revised to extraction of RDX from Comp B, explosive.

APPROACH: Experimental investigations of the effectiveness of polar "modifiers" in increasing the solubility of energetic materials in supercritical CO₂.

PROPONENT: OSC

POC: Dr. Jeffrey B. Morris, ARL

PHONE: (410) 306-0929

STATUS: Completed

FAX: (410) 306-0640

TITLE: Recycling Propellants in Non-Polluting Supercritical Fluids

PROJECT No: 3.C.1-006

PROGRAM FUNDING SOURCE:

SERDP

PERFORMING LAB: Army Research Laboratory, APG MD

OBJECTIVE: To determine the optimal physical conditions and chemical makeup of an effective SCF_{CO2}/modifier solvent using well established computational chemistry techniques to recover nitramines from obsolete energetic materials.

APPROACH: Use computer modeling theoretical chemistry to predict solubility of RDX in supercritical CO₂ and validate project 3.C.1-005.

PROPONENT: OSC

POC: Dr. Betsy Rice, ARL

PHONE: (410) 306-0929

STATUS: Completed

FAX: (410) 306-0640

TITLE: Adams Process Evaluation

PROJECT No: 3.C.3-001C (N.042)

PROGRAM FUNDING SOURCE:

Army 6.2 EQT

PERFORMING LAB: NDCEE

OBJECTIVE: Development of a technology based on a patented process using high temperature reaction involving liquid and gaseous sulfur (Adams Process) as an alternative to open burning of hazardous wastes.

APPROACH: A patented chemical process that uses molten/vaporized sulfur at ambient pressure and high temperature (150 C - 500 C) for destroying oxygenated and halogenated compounds. Project evaluated the following wastes: Nitrocellulose, nitrolycerin propellant M30, Fuse containing lead azide, Composition B - an explosive containing RDX and TNT, malathion a surrogate for chemical agent GB and polychlorinated biphenyls (PCB).

Computer modeling and bench scale testing showed that the target waste streams are essentially destroyed to greater than 99.9999%. A pilot plant to destroy 1 kg/hr of chemical agent surrogate would cost a little less than \$1M. A large amount of sulfur containing by-products would be produced. There is a need for additional experimental follow-on work for a soundly based pilot plant design.

PROPONENT: Army

POC: Mr. R. Goldberg, TACOM/ARDEC

PHONE: (973) 724-4078

STATUS: Completed

FAX: (973) 724-4096

TITLE: Molten Metal Catalytic Extraction Process for Military Specific Hazardous Waste and Munitions

PROJECT No: 3.C.3-002C

PROGRAM FUNDING SOURCE:
SERDP

PERFORMING LAB: TACOM/ARDEC, Picatinny Arsenal, NJ

OBJECTIVE: To investigate Molten Metal Extraction Process as recycling alternative to open burning open/detonation (OB/OD).

APPROACH: Demonstrate technology patented by Molten Metal Technology for breaking down hazardous wastes, organic and inorganic, and munitions components into their elemental constituents.

PROPONENT: OSC

POC: Mr. Stu Levy, TACOM/ARDEC

PHONE: (973) 724-4122

STATUS: Completed

FAX: (973) 724-3162

TITLE: Recycling of Nitrocellulose Fines

PROJECT No: 3.C.1-014

PROGRAM FUNDING SOURCE:
ESTCP

PERFORMING LAB: TACOM/ARDEC, Picatinny Arsenal, NJ

OBJECTIVE: Demonstrate recycling alternatives to open burning open detonation (OB/OD) for nitrocellulose (NC) in wastewater system at Radford Army Ammunition Plant.

APPROACH: Validate the USACERL developed pollution prevention ideas to recycle NC in full scale manufacturing processes at RAAP and Indian Head Division. Several microfiltration techniques are under study and show promise.

PROPONENT: TACOM/ARDEC

POC: Mr. Richard Ames, TACOM/ARDEC

PHONE: (973) 724-5572

STATUS: Nearing Completion

FAX: (973) 724-3162

TITLE: Extraction/Recycling of Triple Base Propellants with Supercritical Fluids

PROJECT No: 3.C.1-016

PROGRAM FUNDING SOURCE:

Army 6.1 EQT

PERFORMING LAB: ARL, Aberdeen Proving Ground, MD

OBJECTIVE: To investigate solubility and reactivity of triple-base propellant nitro guanidine (NQ) and nitroglycerin (NG) in supercritical fluids (SCFs).

APPROACH: It is believed that amines like NQ will be incompatible with SC CO₂, due to carbonate formation. Since CO₂ is the usual SCF of choice, it is necessary to confirm this reaction and the conditions under which it occurs. Assuming that CO₂ cannot be used with NQ, a concerted theoretical and experimental investigation will be made of the solubility (phase diagrams) of NQ and NG in alternative SCFs (e.g., ethane, ethylene, fluoroform). SCF extraction will also be compared to "gas anti-solvent re-crystallization" techniques for NQ.

PROPONENT: OSC

POC: Dr. Jeffery B. Morris, ARL

STATUS: Final Report in Progress

PHONE: (410) 306-0929

FAX: (410) 306-0640

TITLE: Full Scale Simulation for Production Process of Energetic Material Using a Twin Screw Extruder

PROJECT No: 3.C.1-037 (R2-8)

PROGRAM FUNDING SOURCE: Army
6.2 EQT/SGM

PERFORMING LAB: NDCEE

OBJECTIVE: Evaluate the performance of the granular activated carbon (GAC) process at Milan AAP and Iowa AAP to improve process parameters.

APPROACH: Currently, there are three government owned, government operated and eleven government owned contractor operated Army depots, arsenals, and or plants (AAPs) in the United States. Most of these sites generate pink water during load, assembly, and packing and demilitarization operations. Pink water contains hazardous contaminants that are toxic and photochemically active. Previously, the process was evaluated at NDCEE and put in use at Milan AAP. However, due to low production levels, the process appears inefficient generating waste at a quicker rate, increasing disposal costs. It is planned to add the use of microbes that are grown under thermophilic conditions and then added to the pink water treatment system. The process is currently being demonstrated at Iowa AAP.

PROPONENT: TACOM/ARDEC

POC: Mr. Don Skelton, IEC

PHONE: (973) 724-4071

STATUS: Ongoing

FAX: (973) 724-6759

TITLE: Fiber Optic Sensors for Manufacturing Facilities

PROJECT NO. 3.C.1-037 (00R2-13)

PROGRAM FUNDING SOURCE: Army 6.2
EQT/SGM

PERFORMING LAB: NDCEE

OBJECTIVE: Evaluate the use of fiber optic sensors for in situ monitoring of the concentration of pink water as a methodology of extending column life in the treatment process.

APPROACH: Through the use of real-time in situ measurements, the life of the GAC in a packed column may be extended. This program will identify several fiber optic sensors capable of rapidly measuring concentrations of TNT, and RDX/HMX in process wastewater. Potential candidates will be demonstrated at either Iowa AAP or Milan AAP.

PROPONENT: TACOM/ARDEC

POC: Mr. Don Skelton, IEC

PHONE: (973) 724-4071

STATUS: Ongoing

FAX: (973) 724-6759

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5. f. Ordnance-Eliminate Toxic Materials Projects

TITLE: Clean Burning Solid Propellants

PROJECT No: 3.C.2-001

PROGRAM FUNDING SOURCE:

Army 6.1 EQT

PERFORMING LAB: Army Research Laboratory

OBJECTIVE: To eliminate toxic gases, CO, NO, and HCN due to incomplete combustion of solid gun propellants.

APPROACH: Investigate use of "DENOX" agents for elimination of NOx. If successful the plan is to make use of reducing agents as catalysts vs. oxidizing agents as the approach to reduce all the toxic gases.

PROPONENT: OSC

POC: Dr. Rose Pesce Rodriguez, ARL

PHONE: (410) 278-6183

STATUS: Completed

FAX: (410) 278-6150

TITLE: Design/Use Catalysts to Avoid Redwater in TNT Production

PROJECT No: 3.C.2-002 (B048)

PROGRAM FUNDING SOURCE:

Army 6.1 EQT

PERFORMING LAB: TACOM/ARDEC, Picatinny Arsenal, NJ

OBJECTIVE: Prevention of Red Water and other waste products in TNT manufacturing

APPROACH: Regioselectively nitrate toluene to generate orthonitro toluene (ONT) and further to TNT using small amounts of catalyst in systematic way. Various clay and zeolite based catalysts of appropriate pore size will be designed using modeling studies. These catalysts will be employed in nitration studies of toluene and other aromatic and non aromatic nitration processes. Zeolites with appropriate pore size will lead to selective nitration thus avoid unwanted byproducts in the nitration process.

PROPONENT: OSC

POC: Dr. Reddy Damavarapu, TACOM/ARDEC

PHONE: (973) 724-5810

STATUS: Nearing Completion

FAX: (973) 724-5713

TITLE: Develop Non-Polluting Primary Explosives

PROJECT No: 3.C.2-003 (B069)

PROGRAM FUNDING SOURCE:

SERDP/EO12856/Army 6.1 EQT

PERFORMING LAB: TACOM/ARDEC, Picatinny Arsenal, NJ

OBJECTIVE: Eliminate heavy metals (lead and mercury) in the formulation of primary explosives by evaluating poly-nitro-alkyl-ammonium nitrate substitute compounds.

APPROACH: New promising primary explosive compounds, e.g. different polynitro alkyl ammonium nitrate compounds, will be researched, synthesized and down selected. New compounds, which satisfy the requirements, will be further tested in end-items.

PROPONENT: OSC

POC: Dr. S. Iyer, TACOM/ARDEC

PHONE: (973) 724-3135

STATUS: Unsuccessful

FAX: (973) 724-5713

TITLE: Laser Ignition to Replace Chemical Ordnance Igniters for Propulsion

PROJECT No: 3.C.2-004

PROGRAM FUNDING SOURCE:

SERDP

PERFORMING LAB: Army Research Lab, APG MD

OBJECTIVE: To reduce production of waste and unnecessary energetic material in manufacturing for guns and rockets. To eliminate the use of energetic ignition systems

APPROACH: To set up laboratory scale experiments for propellant ignition using a state of the art laser laboratory with full electro-optics diagnostics capability. Full-scale components were fabricated and demonstration firings performed for Crusader and 30mm AAH. Based on the results achieved in actual firings, Cooperative Research Agreements have been signed to scale concept down to small arms applications.

PROPONENT: TACOM

POC: Dr. Brad E. Forch, ARL

PHONE: (410) 306-0929

STATUS: Completed

FAX: (410) 306-0640

TITLE: Eliminate Toxic and VOC Constituents from Small Caliber Ammunition (Green Bullet)

PROJECT No: 3.C.2-015 (SERDP #1057)

PROGRAM FUNDING SOURCE:
SERDP

PERFORMING LAB: TACOM/ARDEC, Picatinny Arsenal, NJ

OBJECTIVE: Develop nontoxic small caliber ammunition that meets US and NATO performance standards for all calibers. Emphasis of this program is on the bullet core and the primer.

APPROACH: Develop a sintered tungsten based material as a substitute for lead in the bullet core. Evaluate candidate commercial primers and or develop a new non-toxic primer that will meet military needs for environmental extremes.

PROPONENT: Multi-service

POC: Mr. John Middleton, TACOM/ARDEC

PHONE: (973) 724-7976

STATUS: Ongoing

FAX: (973) 724-7095

TITLE: Improved CL-20 Manufacturing Process

PROJECT No: 3.C.2-019

PROGRAM FUNDING SOURCE: Army
6.2 EQT

PERFORMING LAB: TACOM/ARDEC, Picatinny Arsenal, NJ

OBJECTIVE: Develop environmentally friendly, cost effective, safe process for the manufacture of CL-20 (4th Generation) high explosive for high performance applications..

APPROACH: Eliminate several process steps by applying together such chemicals as Urea or Oxamide to control chemical geometry during condensation. Recycle excess acetylating or formulating agent. Optimize operating parameters for scale-up.

POC: Dr. R. Damavarapu, TACOM/ARDEC

PHONE: (973) 724-5810

STATUS: In Progress

FAX: (973) 724-5713

TITLE: Pink Water Treatment Technology

PROJECT No: 3.C.2-021 (N.015)

PROGRAM FUNDING SOURCE:
Army 6.2 EQT

PERFORMING LAB: NDCEE

OBJECTIVE: Development of a technology to reduce nitrobody content in munitions manufacturing complexes (e.g. pink water, DNT) from 1% to a few ppm that can be treated and discharged from typical waste processing plants.

APPROACH: Conduct a literature survey to identify the available technologies that comply with mandated limits on waste streams. Select the five leading candidates and bench-scale test the best candidate. Design, build and install a pilot plant and operate this plant for at least six (6) months and evaluate it. The technology selected is Thermophilic (Biological) Process (TBP) which utilizes Granular Activated Carbon (GAC) to adsorb the explosives, followed by thermophilic regeneration of the GAC.

PROPONENT: US Army Environmental Center, APG, MD

POC: Mr. L Kanaras, AEC

PHONE: (410) 436-6854

STATUS: Technically Complete

FAX: (410) 671-6836

TITLE: Green Ammo - MIC/Primer Scaleup

PROJECT Nos.: 3.C.2-031 (R2-3)

PROGRAM FUNDING SOURCE: Army
6.2 EQT/SGM

PERFORMING LAB: NJIT

OBJECTIVE: Address issues related to the scale-up of the process for production of MIC (metastable interstitial composites).

APPROACH: The original process has been developed at Los Alamos National Laboratory. The objective of this work is to facilitate the scale-up of production of MIC by concentrating on the requirements of the mixing phase. Included in the effort is the need to identify and develop methods to characterize physically the degree of mixing.

PROPONENT: ARMY

POC: Dr. Dan Watts, NJIT

PHONE: (973) 596-34655

STATUS: Ongoing

FAX: (973) 642-7170

TITLE: Green Ammo - TNAZ

PROJECT Nos.: 3.C.2-032 (R2-4) **PROGRAM FUNDING SOURCE:** Army 6.2
EQT/SGM

PERFORMING LAB: NJIT

OBJECTIVE: The objective of the activity is to identify alternative synthetic routes that can be used for new energetic materials resulting in reduced levels of environmental implications.

APPROACH: The current methods of production of energetic compounds produce contaminated water containing nitric and acetic acid. Air emissions containing NOX are also a problem. In addition, use of solvents and other hazardous materials is common. The ARMY 6.2/SGM Team has coordinated with Army and other DOD personnel to catalog current production chemistry and identify reagents that can be substituted to prevent the formation and emission of several types of pollutants. A synthetic process design protocol for bench chemists, leading to incorporation of pollution prevention concepts, has been prepared. The activities of this task will focus on verification of the protocol in some laboratory situations.

PROPONENT: ARMY

POC: Dr. Dan Watts, NJIT

PHONE: (973) 596-34655

STATUS: Ongoing

FAX: (973) 642-7170

TITLE: Environmentally Friendly Process for The Preparation of Diaminodinitroethylene (DADE, FOX-7).

PROJECT Nos.: 3.C.2-035 **PROGRAM FUNDING SOURCE:** Army 6.1 EQT

PERFORMING LAB: ARDEC - WECAC

OBJECTIVE: Develop an optimized synthesis process for DADE that would use less solvents and preferably less hazardous reagents.

APPROACH: Concentrate on the first steps in production, reduce the amount of solvent, and investigate alternative reagents and bases. Investigate the nitration reaction using concentrated nitric acid alone in lieu of mixed acid as the process reagent.

PROPONENT: Army

POC: Dr. Reddy Damavarapu, ARDEC

PHONE: (973) 724-5810

STATUS: Ongoing

FAX: (973) 724-5713

PROJECT TITLE: Laser Ignition for Medium Caliber Armaments

PROJECT Nos.: 3.C.2-036

PROGRAM FUNDING SOURCE: Army
6.1 EQT

PERFORMING LAB: ARL

OBJECTIVE: Investigate the chemistry and ignition kinetics for direct ignition of nitrocellulose based main propelling charge with laser radiation and the existing qualified energetic materials in 30 mm ammunition.

APPROACH: Address chemical composition of the decomposition/combustion products of ignited propellant using computer models, simple, idealized experiments, and verification in gun fixture.

PROPONENT: Army

POC: Dr. Brad E. Forch, ARL

PHONE: (410) 306-0929

STATUS: Ongoing

FAX: (410) 278-6150

5. g. VOC Elimination Projects (In Ordnance Manufacturing)

TITLE: Primerless RTV Sealants/Adhesives

PROJECT No: 3.C.4-001 (SERDP PP1135-99)

PROGRAM FUNDING SOURCE:
SERDP

PERFORMING LAB: Industry and TACOM/ARDEC, Picatinny Arsenal, NJ

OBJECTIVE: Development, evaluation and transition of a primerless self-bonding low temperature curable addition cured silicone which eliminates the use of high VOC primers with out compromising durability, compatibility, thermal resistance and long term stability.

APPROACH: A four phased approach will be taken. The first three phases will focus on a methodical development of adhesion promoting technology using a risk reduction strategy and spectrographic analysis of failure modes. Phase IV will focus on evaluating and validating developed technology on a fielded system.

PROPONENT: OSC

POC: Mr. Dean Martinelli, TACOM/ARDEC

PHONE: (973) 724-5333

STATUS: In Progress

FAX: (973) 724-7095

TITLE: Solventless Manufacturing of Propellants using TPE Binder

PROJECT No: 3.C.4-002 (B045)

PROGRAM FUNDING SOURCE:
SERDP

PERFORMING LAB: Naval Air Warfare Center, China Lake and TACOM/ARDEC, Picatinny Arsenal, NJ

OBJECTIVE: To provide a demonstration of solventless processing of a Thermoplastic Elastomer (TPE) polymeric system for artillery propellant. To develop new energetic materials and processes necessary to eliminate or greatly reduce both VOC production and ancillary waste through enhanced DEMIL and recyclability.

APPROACH: To utilize technology initially developed, in conjunction with ARL, for a LOVA tank propellant and currently being investigated under a follow-on technology-base program to develop a high performance, i.e. TNAZ, RDX or CL20 TPE tank propellant. To provide maximum VOC elimination, artillery propellants will be formulated for Unicharge based on TPE elastomeric binders. These propellants must have characteristics similar to M30 for Unicharge to function properly. Production of the candidate propellants initially will be by batch extrusion. Both molecular modeling and advanced chemical diagnostics will be used to optimize the propellant. The propellant will be tested in Unicharge gun firings to optimize performance. Continuous twin-screw extruder processing will be developed for the most promising candidates.

PROPONENT: OSC

POC: Dr. Lee Harris, TACOM/ARDEC

PHONE: (973) 724-4535

STATUS: Completed

FAX: (973) 724-2443

TITLE: Clean Agile Manufacturing of TNAZ

PROJECT No: 3.C.4-013 (E285)

PROGRAM FUNDING SOURCE: SERDP

PERFORMING LAB: TACOM/ARDEC, Picatinny Arsenal, NJ

OBJECTIVE: Develop an environmentally friendlier and economical process for the manufacture of TNAZ for energetics applications.

APPROACH: Conduct exploratory research to meet objectives based on the Fluorchem Process.

PROPONENT: TACOM/ARDEC

POC: Dr. Rao Surapaneni, TACOM/ARDEC

PHONE: (973) 724-4903

STATUS: Completed

FAX: (973) 724-4308

TITLE: Supercritical Fluid Processing of Pyrotechnic Binders.

PROJECT No: 3.C.4-014

PROGRAM FUNDING SOURCE: Army
6.1 EQT

PERFORMING LAB: TACOM/ARDEC, Picatinny Arsenal NJ

OBJECTIVE: Demonstrate novel process using supercritical fluids as solvents to produce countermeasure flare mixes.

APPROACH: Currently in basic research, the effort is focused on identification of supercritical fluids that solubilize various candidate organic polymer binders. Investigate parametrics for coating magnesium powders with polymer binder dissolved in supercritical fluid.

POC: Mr. Russell Broad, TACOM/ARDEC

PHONE: (973) 724-5797

STATUS: Completed

FAX: (973) 724-2291

5.h. Other Projects**TITLE:** Engineering and Technical Services for JG-PP Projects**PROJECT Nos.:** 3.D-046 (N.272)**PROGRAM FUNDING SOURCE:** Tri-Service
Customer Funded**PERFORMING LAB:** NDCEE**OBJECTIVE:** Provide engineering, technical, management, and business support to the Joint Acquisition Sustainment Pollution Prevention Activity (JASPPA), which is chartered by the Joint Group on Pollution Prevention (JG-PP) to reduce or eliminate hazardous materials (HAZMATS) by fostering joint service and NASA cooperation to avoid duplication of effort. The focus is on design, manufacturing, re-manufacturing, and depot maintenance process locations that affect DoD and NASA systems.**APPROACH:** Engineering and technical services are provided in support of the JG-PP pollution prevention efforts, which concentrate on defense contractors with multiple defense contracts, for multiple services, and multiple program managers. A methodology developed by the JASPPA is used for identifying, evaluating, selecting, and implementing candidate JG-PP projects, and support is provided in managing, coordinating, and facilitating project execution. A comprehensive performance specification (Joint Test Protocol), reflecting minimum engineering/performance requirements and pass/fail criteria for qualification of alternative processes/materials, is developed in coordination with affected stakeholders for each JG-PP project. Affected stakeholders monitor and /or participate in joint testing and contribute an adjudicated share of project costs. The block change mechanism under the Single Process Initiative (SPI) is used to implement the approved, validated change(s) simultaneously on multiple affected contracts. Depot sustainment maintenance activities will utilize their respective service/agency mechanism for implementation.**PROPONENT:** Joint Group on Pollution Prevention (JG-PP)**POC:** Mr. L. M. Pasterick, IEC**PHONE:** (973) 724-7540**STATUS:** Ongoing**FAX:** (973) 724-6759**TITLE:** Development, Testing and Evaluation of Functional Fluids from Agricultural Materials**PROJECT NUMBER:** 3.A.1-019 (N.227mod1 SubTask 020) **PROGRAM FUNDING SOURCE:** Army 6.2EQT/SGM**PERFORMING LAB:** NDCEE**OBJECTIVE:** Develop demonstrate and validate a biobased hydraulic fluid which can be a candidate for the qualified products list and a National Stock Number (NSN).**APPROACH:** Generate specifications for petroleum based hydraulic fluids and distribute to potential suppliers. Bio based samples will then be solicited and bench tested under laboratory conditions. The best candidates will be field tested on a variety of vehicles. Will leverage efforts from NDCEE task N224**PROPONENT:** Defense Logistics Agency**POC:** Mr. Robert Zanowicz IEC**PHONE:** (973) 724-5744**STATUS:** In Progress**FAX:** (973) 724-6759**TITLE:** Ecotoxicity Tests for CW Compounds

PROJECT Nos.: 3.D-049CL

PROGRAM FUNDING SOURCE:

Army 6.1 EQT

PERFORMING LAB: US Army Edgewood Chemical & Biological Center

OBJECTIVE: Develop new adaptable methods at the ecosystem level for identifying and measuring significant changes in ecological systems due to the impacts of chemical agents and military unique compounds.

APPROACH: Focus on the areas of probable negative environmental impact due to DoD activities including habitat alteration, loss of biodiversity, and alternation of ecosystem structure and function. The USEPA (Science Advisory Board, 1990) has identified three critical areas for ecological hazards assessment: Soil Fauna Microcosm, Ecosystem Structure and Function. Scaling Ecological Studies.

PROPONENT: Army

POC: Dr. Ronald T. Checkai, CBC

PHONE: (410) 671-4700

STATUS: Initiated

FAX: (410) 671-2081

TITLE: Environmental Fate and Toxicity of CW Related Material

PROJECT Nos.: 3.D-054CL

PROGRAM FUNDING SOURCE:

Army 6.1 EQT

PERFORMING LAB: US Army Edgewood Chemical & Biological Center

OBJECTIVE: Determine the major chemical and Physical mechanisms controlling the environmental fate of selected chemical agents and munition compounds in soil.

APPROACH: The determination and characterization of the factors affecting the environmental fate and bioavailability/toxicity of chemical agents and munition compounds in soils will be undertaken by four tasks: Soil Factors affecting environmental fate in intact soil, Soil Constituents, Soil Characteristics Affecting Plant Uptake and Soil Characteristics Affecting the Toxicity.

PROPONENT: Army

POC: Dr. Ronald T. Checkai, CBC

PHONE: (410) 671-4700

STATUS: Initiated

FAX: (410) 671-2081

TITLE: Natural Products Decontamination of BW Agents

PROJECT Nos.: 3.D-057

PROGRAM FUNDING SOURCE:

Army 6.1 EQT

PERFORMING LAB: US Army Edgewood Chemical & Biological Center

OBJECTIVE: Develop natural products as effective biological warfare agent decontaminants with desirable permeation characteristics on porous surfaces, a low degree of corrodibility, minimum subsequent hazardous waste disposal and safer handling characteristics.

APPROACH: Formulate BW agent decontaminants from microbial and plant products. Such products are utilized in nature by these organisms as defensive systems.

Bacteriocins are anti-microbial peptides produced by bacteria to eliminate neighboring microbes sharing the same niche and thereby reduce nutrient competition. Likewise, it is speculated that plant essential oils were evolved as a defense against plant pathogens or to discourage grazing animals.

PROPOSER: Army

POC: Mr. Abe L. Turetsky, CBC

PHONE: (410) 436-2404

STATUS: In progress

FAX: (410) 436-2081

TITLE: Investigation of Melt Processed Polymer/Clay Nanocomposites: Biodegradable and Recyclable Packaging Items for Solid Waste Reduction

PROJECT Nos.: 3.D-055

PROGRAM FUNDING SOURCE: Army

6.1 EQT

PERFORMING LAB: US Army NATICK Soldier Center

OBJECTIVE: Research addresses replacement of the MRE pouch and other packaging items of interest to the Army.

APPROACH: Incorporation of clay nanoparticles into biodegradable polymers and recyclable thermoplastic polymers to decrease the solid waste and to improve physical properties of the materials including: heat deflection temperatures, mechanical and barrier properties.

PROPOSER: Army

POC: Dr. Jo Ann Ratto, Natick

PHONE: (508) 233-5315

STATUS: Ongoing

FAX: (508) 233-5363

TITLE: Spinning of Fibers from Aqueous Solutions

PROJECT Nos.: 3.D-056

PROGRAM FUNDING SOURCE:

Army 6.1 EQT

PERFORMING LAB: US Army Natick Soldier Center

OBJECTIVE: Develop high strength fibers based on biodegradable materials and optimize the method.

APPROACH: Milligram quantities of three different recombinant proteins based on spider silk have been successfully spun on a small scale and patent application submitted. Fermentation, tissue culture, or transgenic systems have been used to produce silk proteins from renewable resources.

PROPONENT: Army

POC: Mr. Steve Arcidiacono, Natick

PHONE: (508) 233-4893

STATUS: Ongoing

FAX: (508) 233-5521

TITLE: Munitions Monitoring using Fiber-Bragg Grating System

PROJECT Nos.: 3.D-053 (00R2-14)

PROGRAM FUNDING SOURCE: Army

6.2 EQT/SGM

PERFORMING LAB: PSL

OBJECTIVE: Develop a prototype Optical Fiber Munitions System (OFMMS) to optimize the inspection of munitions in storage, develop an innovative, non-destructive monitoring system that facilitates self monitoring of munitions, and help the Army implement total asset visibility, improve mobility and pre-positioning and a seamless logistics systems to reduce the cost of weapons system ownership.

APPROACH: Develop a prototype OFMMS consisting of a network of optical fiber grating sensors measuring dynamics strain, static strain, temperature, and humidity at several locations on inert munitions.

PROPONENT: ARMY

POC: Mr. Don Skelton, IEC

PHONE: (973) 724-4071

STATUS: Ongoing

FAX: (973) 724-6759

5.h. Other Projects (Continued)

TITLE: Fluid Sensors

PROJECT Nos.: 3.D-054 (R2-7)

PROGRAM FUNDING SOURCE: Army 6.2
EQT/SGM

PERFORMING LAB: NDCEE

OBJECTIVE: The objective is to develop sensors to be used in monitoring fuels, lubricants, coolants, cleaners, hydraulic agents and charge media.

APPROACH: Fluids play an extremely important role in today's automotive and weapons systems. They serve as fuels, lubricants, coolants, cleaners, hydraulic agents, and charge media. When a fluid depletes, whether it is through contamination with foreign matter, critical vehicle systems can cease to operate and suffer damage. It is imperative that fluids be maintained. However, few vehicles or systems have diagnostic sensors to assist in assessing fluid status. Fluid replacement, which has an environmental cost is typically indicated by calendar or odometer readings.

PROPONENT: ARMY

POC: Mr. Don Skelton, IEC

PHONE: (973) 724-4071

STATUS: Ongoing

FAX: (973) 724-6759

TITLE: Casting Emission Reduction Program

PROJECT Nos.: 3K-006

PROGRAM FUNDING SOURCE: MANTECH

PERFORMING LAB: US Army ARDEC, Industrial Ecology Center, Picatinny Arsenal
NJ

OBJECTIVE: To improve and /or develop materials and processes used in foundry operations, and conduct evaluations in a demonstration foundry with the goals of reducing air emissions and facilitating compliance with Federal Clean Air Standards. Further, to advance emission measurement technologies needed to support environmental improvements.

APPROACH: Conduct metal casting research and development to evaluate the ability of alternative products and processes to reduce emissions generated during the production of castings, develop emission measurement technology improvements for stationary and mobile sources, develop foundry safety and pollution prevention process improvements, research lightweight casting materials and processes, and accomplish technology transfer and outreach to the DOD and metal casting industry to share the results of the research efforts.

PROPONENT: Army

POC: Mr. G. Kosteck/L. Pasterick, IEC

PHONE: (973) 724-6755/7540

STATUS: Ongoing

FAX: (973) 724-6759

5. i. Elimination of Ozone Depleting Solvents Projects

TITLE: Continuous Aqueous Cleaning to Eliminate ODC

PROJECT No: 3.E-001

PROGRAM FUNDING SOURCE:

SERDP

PERFORMING LAB: OSC, Rock Island Arsenal, IL

OBJECTIVE: To develop non-ODC metal parts cleaning process for use prior to painting.

APPROACH: Validate an aqueous based cleaning system for degreasing metal parts at Rock Island Arsenal prior to the application of a chemical agent resistant coating (CARC). A three-step approach will be followed. First the aqueous based cleaner will be selected to replace 1,1,1-trichloroethane, which is an ODC. Secondly equipment specifications and purchase descriptions including wastewater treatment requirements will be developed. Lastly the most feasible alternative will be installed.

PROPONENT: OSC

POC: Tara Hill, OSC

PHONE: (309) 782-7860

STATUS: Completed

FAX: (309) 782-7122

TITLE: Chemistry of Halon Substitutes

PROJECT No: 3.E-004 (D070)

PROGRAM FUNDING SOURCE:

SERDP

PERFORMING LAB: Army Research Lab, APG, MD

OBJECTIVE: Identify potential halon replacement agents which are efficient in extinguishing fuel fires without producing excessive amounts of toxic by-products.

APPROACH: Agents will be ranked according to their ability to extinguish JP-8 fires and their production of toxic gases.

PROPONENT: ATCOM

POC: Dr. Androj Mizeolek, ARL

PHONE: (410) 306-0929

STATUS: Completed

FAX: (410) 306-0640

TITLE: Atmospheric Fate of Halon Alternative Compounds

PROJECT No: 3.E-007 (E217)

PROGRAM FUNDING SOURCE:

Army 6.1 EQT

PERFORMING LAB: Army Research Lab, APG, MD

OBJECTIVE: To determine the environmental acceptability of current and future candidates replacement compounds.

APPROACH: This research project consists of multiple tasks which involves primarily a chemical kinetic research of both atmospheric gas phase and surface (heterogeneous) reactions (joint ARL/NIST collaborative effort), (b) spectroscopy and photochemistry (including surface photochemistry) of halocarbon replacement compounds or their reaction products (joint ARL/NIST collaborative effort), and (c) determination of GWP and ODP for the halocarbon replacement compounds or for their reaction products. The actual ODP and GWP calculations will be done at the University of Illinois.

PROPOSER: TACOM

POC: Dr. Andrzej W. Miziolek, ARL

PHONE: (410) 306-0929

STATUS: Completed

FAX: (410) 306-0640

TITLE: Chemical and Physical Processes Responsible for Flame Inhibition Using Halon Agents and Their Alternatives.

PROJECT No: 3.E-008 (E219)

PROGRAM FUNDING SOURCE:

SERDP

PERFORMING LAB: Army Research Lab, APG, MD

OBJECTIVE: The goal of this research project is to develop a detailed flame chemistry computer model which will not only predict the relative flame extinguishment properties of new Halon alternative compounds, but also will identify the possible formation of toxic flame products resulting from the use of the agents(s).

APPROACH: The basic approach involves a tightly coordinated research program of flame model development coupled with experimental verification. The flame experiments involve the use of a low pressure burner apparatus which contains a premixed laminar flow flame. We use the Tunable Diode Laser (TDL) absorption technique for flame profile studies. The detailed chemical flame mechanisms are tested on the basis of agreement with the experimental results. The detailed kinetic models are based on accurate knowledge of thermodynamic and kinetic properties of the relevant species and reactions.

PROPOSER: TACOM, ATCOM, Wright Paterson AFB.

POC: Dr. Andrzej W. Miziolek, ARL

PHONE: (410) 306-0929

STATUS: Completed

FAX: (410) 306-0640

TITLE: Hazardous Material (HAZMAT) Alternatives for Turbine Engines

PROJECT Nos.: 3.E-032 (N.240)

PROGRAM FUNDING

SOURCE: USAF

PERFORMING LAB: NDCEE

OBJECTIVE: Eliminate all Class I Ozone Depleting Chemicals (ODCs), reduce the use of EPA-17 chemicals and comply with NESHAP requirements to limit the emissions of Hazardous Air Pollutants (HAPs) and Volatile Organic Compounds (VOCs) cited in turbine engine technical orders (T.O.s) used to specify the operation and maintenance of weapon systems. The current task addresses T.O.s for engines used on Cruise Missiles, as well as Air Force Aircraft F-4, C-141, KC/EC-135, B-52, E-3, B-2, U-2S, F-15, F-16 and B-1B. Previously completed tasks addressed engines used on C-5A/B, A-10, and B-2 Air Force aircraft, as well as numerous Army aircraft.

APPROACH: Turbine engine technical orders and first-tier military/OEM specifications are screened to identify all references to the use of targeted HAZMATS. A Chemical Process List is created to include each reference to the targeted HAZMATS and the page and paragraph number of the T.O. where each reference occurs. The application-specific requirements are identified and analyzed to establish the minimum acceptable conditions or requirements that will satisfy operation/performance objectives.

Alternatives to the use of HAZMATS are identified, evaluated and qualified. Results are published for use by the government in implementing T.O. revisions. If required, complete T.O. revision documentation can be provided to facilitate the updating of T.O.s for publishing and distribution.

PROPONENT: Air Force

POC: Mr. L. M. Pasterick, IEC

PHONE: (973) 724-7540

STATUS: Ongoing

FAX: (973) 724-6759

TITLE: Non-Ozone Depleting Sealants for Ammunition Applications

PROJECT No: 3.E-033 (SERDP PP674/456)

PROGRAM FUNDING SOURCE:

SERDP

PERFORMING LAB: TACOM/ARDEC, Picatinny Arsenal, NJ

OBJECTIVE: Replace high ODC sealant in case mouth interface for small caliber ammo.

APPROACH: A non-hazardous aqueous base sealant compatible with existing high rate production equipment was downselected by fast track testing to minimize facilities impact and was transitioned to production.

PROPONENT: TACOM/ARDEC

POC: Mr. D. Martinelli, ARDEC

PHONE: (973) 724-5333

STATUS: Completed

FAX: (973) 724-4482

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5. j. Reduce Greenhouse Gas Emissions Projects

TITLE: Climate Change Fuel Cell Program

PROJECT No: 3.K-001 (N.037)

PROGRAM FUNDING SOURCE:

USDS-ES 6.5

PERFORMING LAB: NDCEE, ARDEC

OBJECTIVE: To demonstrate fuel cell technology as a means to generate electricity with minimal environmental emissions.

APPROACH: The U.S. Army, Armament Research Development & Engineering Center, (ARDEC) was selected to manage the combined FY96-97 Climate Change Fuel Cell Program. A solicitation was advertised providing Grants to be awarded of up to \$1,000 per kilowatt or approximately \$200,000 per Grant.

PROPONENT: DUSD-ES

POC: Mr. Garry Kosteck, IEC

PHONE: (973) 724-6755

STATUS: Ongoing

FAX: (724) 724-6759

TITLE: Casting Emission Reduction Program

PROJECT Nos.: 3K-006

PROGRAM FUNDING SOURCE: MANTECH

PERFORMING LAB: US Army ARDEC, Industrial Ecology Center, Picatinny Arsenal NJ

OBJECTIVE: To improve and /or develop materials and processes used in foundry operations, and conduct evaluations in a demonstration foundry with the goals of reducing air emissions and facilitating compliance with Federal Clean Air Standards. Further, to advance emission measurement technologies needed to support environmental improvements.

APPROACH: Conduct metal casting research and development to evaluate the ability of alternative products and processes to reduce emissions generated during the production of castings, develop emission measurement technology improvements for stationary and mobile sources, develop foundry safety and pollution prevention process improvements, and accomplish technology transfer and outreach to the DOD and metal casting industry to share the results of the research efforts.

PROPONENT: Army

POC: Mr. G. Kosteck/L. Pasterick, IEC

PHONE: (973) 724-6755/7540

STATUS: Ongoing

FAX: (973) 724-6759

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TITLE: Environmental/Health Effects Evaluation of Alternatives for DU Penetrators.

PROJECT No: 3.L-003 (BAA94-019)

PROGRAM FUNDING SOURCE:

Army 6.1 EQT

PERFORMING LAB: Oak Ridge (DOE)/TACOM/ARDEC, Picatinny Arsenal, NJ

OBJECTIVE: Investigate alternative alloys to depleted uranium for kinetic energy penetrators that do not have the low-level radiation and health effects issues of depleted uranium

APPROACH: Investigate tungsten based alloys having improved binder materials to currently available iron-nickel. The alternate binders have initially been identified as hafnium, zirconium, titanium, intermetallic compounds, and precipitation and spinodally-hardened copper alloys.

PROPONENT: TACOM

POC: Mr. Ken Willison, ARDEC

PHONE: (973) 724-2596

STATUS: 6.1 Completed

FAX: (973) 724-7378

TITLE: Light Weight Protective Ceramics

PROJECT No: 3.L-004 (C010)

PROGRAM FUNDING SOURCE:

Army 6.1 EQT

PERFORMING LAB: NRDEC, Natick, MA

OBJECTIVE: Develop new processing systems to reduce environmental burdens (organic solvents) and energy requirements of ceramic manufacturing through new processing approaches in the formation of ceramic powders and composites by mimicking biological methods to control inorganic-organic interfaces.

APPROACH: Identify the proteins involved in natural mineralization. Determine protein function as matrix material for biomineralization. Synthesize modified matrix biopolymers for specific structures. Select and evaluate ceramic and composite systems of military importance for study. Conduct modeling studies to predict structure-function relationships relative to crystal growth studies. Determine conditions necessary for aqueous ambient growth of technologically important ceramic materials.

PROPONENT: NRDEC

POC: Dr. Peter Stenhouse, Natick

PHONE: (508) 233-4114

STATUS: In Progress

FAX: (508) 233-5521

TITLE: Aqueous Processing of Fibers and Composites

PROJECT No: 3.L-005 (E196)

PROGRAM FUNDING SOURCE:

Army 6.1 EQT

PERFORMING LAB: NRDEC, Natick, MA

OBJECTIVE: Demonstrate environmentally compatible, viable technology for aqueous processing of high performance polymers into functional materials. This will be done using aqueous based synthesis and processing and use of materials derived from renewable resources.

APPROACH: Design and optimize biopolymer materials that exhibit key structural properties for specific applications and that can be processed from aqueous systems. Structurally functional protein polymers will be genetically designed. Key polymers will be produced from biological cultures, isolated, purified characterized and scaled up for processing studies. Functional properties of new materials will be evaluated in fiber film, membrane and composite form. Extramural solubilization problems will be solved for biopolymers in aqueous systems. Processing will be optimized to produce high orientation and controlled structure in fibers/films/composites. New biopolymers for high performance, multifunctional applications will be synthesized by recombinant DNA techniques and expressed in bacteria/plant cells and characterized or use in membrane, film and composite applications.

PROPONENT: AMC

POC: Dr. Peter Stenhouse, Natick

PHONE: (508) 233-4114

STATUS: In Progress

FAX: (508) 233-5521

TITLE: Non-Polluting Composite Repair & Remanufacture for Military Application

PROJECT No: 3.L-012 9 (SERDP PP1109-98)

PROGRAM FUNDING SOURCE:

SERDP

PERFORMING LAB: ARL, Aberdeen Proving Ground, MD

OBJECTIVE: To develop environmentally friendly composite repair procedures

APPROACH: A variety of novel composite processing and cure methods, including vacuum-assisted resin transfer molding, Army developed multi-resin co-injection process, Army developed electromagnetic PMC curing technology, and novel portable radiation (UV and electron beam) cure techniques to solve generic but specific application unique repairs.

PROPONENT: ARL

POC: Dr. James Sands, ARL

PHONE: (410) 386-0878

STATUS: In Progress

FAX: (410) 306-0640

TITLE: Composite and Ceramic Materials Recycling

PROJECT No: 3.L-018 (R2-4)

PROGRAM FUNDING SOURCE: Army 6.2
EQT/SGM

PERFORMING LAB: TACOM/ARDEC, Picatinny Arsenal, NJ

OBJECTIVE: To reduce the environmental impact of advanced composite materials by identifying and assessing technologies for the recycling of carbon fiber composites and to establish an infrastructure for that activity.

APPROACH: Improve composite recycling infrastructure by increasing industry awareness of reduction, reuse, and recycling technologies. Acquire, analyze, summarize, and publicize green composite information for this purpose.

Information to be obtained and disseminated includes:

- DOD waste and end-of-life composites source streams
- Strategies for reducing consumption of composite precursors
- Strategies and support for reuse of composites and precursors
- Potential composites shredding and matrix digestion processes
- Integrated recycling material flow requirements
- High value reuse opportunities for reinforcing fibers.

PROPONENT: TACOM/ARDEC

POC: Mr. Joseph Brescia, ARDEC

PHONE: (973) 724-2326

STATUS: Completed

FAX: (973) 724-7378

TITLE: CMS Target Production/Protection - Electro Cleaning

PROJECT No: 3.L-019

PROGRAM FUNDING SOURCE: Army 6.2
EQT/SGM

PERFORMING LAB: Benet Labs/NJIT/NDCEE/ARL

OBJECTIVE: Support the development of technology to assist in the R&D for a new tantalum coating process at Benet Laboratories.

APPROACH: The effort will focus on three distinct but interrelated areas: fabrication of sputtering target, substrate pretreatment, and the sputtering process.

PROPONENT: Army

POC: Dr. John D. Vasilakis, ARDEC/Benet
Completed

PHONE: (518) 326-5615

STATUS:

FAX: (518) 266-4661

5. I.(five point ell) Design Tools Projects

TITLE: Identification Of Health Effects And Costs Assoc. With Toxic Substances In DOD Workplace

PROJECT NUMBER: 3.M-002 (N.016)

PROGRAM FUNDING SOURCE:

Army 6.2 EQT

PERFORMING LAB: NDCEE, Johnstown, PA

OBJECTIVE: To investigate the hazards associated in working in the DOD industrial workplace and to establish risks.

APPROACH: Apply state-of-the-art risk assessment methods to existing DOD industrial processes and environmental technologies. Compare results to replacement technologies and incorporate optimal processes.

PROPONENT: OSC, TACOM, Air Force, NAVY, CHPPM

POC: Mr. R. Moreira, IEC

STATUS: Completed

PHONE: (973) 724-2617

FAX: (973) 724-6759

TITLE: Facility Environmental Management and Monitoring System (FEMMS)

PROJECT NUMBER: 3.M-003 (N.041)

PROGRAM FUNDING SOURCE: Army

6.2 EQT

PERFORMING LAB: NDCEE, Johnstown, PA

OBJECTIVE: To install a Facility Management and Monitoring System (FEMMS) Test Bed at Tobyhanna Army Depot. This test bed will focus on toxics reduction evaluation, air emissions inventory, real-time monitoring of water usage/flows, monitoring of pollutants and air emissions monitoring.

APPROACH: The environmental management requirements at Tobyhanna AD will be evaluated to determine needed capabilities. The FEMMS testbed will be established which will employ the use of the latest computer, communications, and pollution prevention technologies as well as environmental sensors, meters, monitors, and alarms integrated into a single real-time system capable of supporting the environmental requirements of any Army facility.

PROPONENT: Army, Navy, Air Force

POC: Mr. Joseph Maciejewski, Tobyhanna Army Depot, PA

STATUS: Ongoing

PHONE: (717) 894-7090

FAX: (717) 894-

7005

TITLE: Environmental Cost Analysis Methodology (ECAM)

PROJECT NUMBER: 3.M-004 (N.098)

PROGRAM FUNDING SOURCE:
ESTCP

PERFORMING LAB: NDCEE, Johnstown, PA

OBJECTIVE: Provide a consistent means of identifying, quantifying and evaluating environmental costs and benefits for all DoD programs and projects.

APPROACH: Integrate process flow, material energy balance, activity-based-costing (ABC) concepts and techniques to collect, analyze, and evaluate innovative technologies that target urgent environmental needs, as identified by U.S. Department of Defense (DoD) into a compressive usable model. Document results in to a manual.

PROPONENT: Army, Navy, Air Force

POC: Ms. J. Shum, IEC

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STATUS: Completed

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TITLE: Surface Properties and Interactions of Coating Materials

PROJECT NUMBER: 3.M-013 (R1-5)

PROGRAM FUNDING SOURCE: Army
6.2 EQT/SGM

PERFORMING LAB: NJIT

OBJECTIVE: Develop an atomic level model to predict deleterious interactions with atmospheric and environmental agents.

APPROACH: This is in response to the continuing Army need for longer lasting organic coatings with increased resistance to environmental challenges and increased adhesion to substrates. The quality of a paint spray coating is intricately related to atomization conditions occurring during paint spray. Atomization depends on gun design, paint characteristics and paint spray process conditions. A quantitative understanding of the effects of gun design (orifice size), paint characteristics and parameter settings on atomization will allow optimization of spraying conditions to achieve desirable atomization and coating quality. The model will construct coating surfaces based on atomistic electronic properties using density functional and/or ab initio level calculations. The model will be designed to predict the results of interactions with active species, such as ozone, hydroxyl radicals, acidic liquids, SO_x, and NO_x. The predictions from the model are expected to provide opportunities for structural modifications of coating materials leading to longer lifetimes.

PROPONENT: Army, Navy, Air Force

POC: Dr. Dan Watts, NJIT

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STATUS: Ongoing

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TITLE: Green Ammo - MIC/Primer Risk Assessment

PROJECT NUMBER: 3.M-016 (R2-1)

PROGRAM FUNDING SOURCE: Army
6.2 EQT/SGM

PERFORMING LAB: NJIT

OBJECTIVE: Assess the human and environmental risks of implementing metastable interstitial composites (MIC) into green ammunitions development.

APPROACH: Conduct a qualitative hazard and exposure toxicity risk assessment to characterize human and ecological risks associated with the use of MIC/primer. Risks from alternative constituents of the MIC/primer process will be compared to risks from constituents used under the baseline (current) process. The analysis will evaluate and determine the worker health threats from each process and comparatively present which process will adequately protect worker and environmental health.

PROPONENT: Army, Navy, Air Force

POC: Dr. Dan Watts, NJIT

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STATUS: Completed

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TITLE: Green Gun Barrel - Tantalum Risk Assessment

PROJECT NUMBER: 3.M-017 (R2-2)

PROGRAM FUNDING SOURCE: Army 6.2
EQT/SGM

PERFORMING LAB: NJIT

OBJECTIVE: Qualitatively assess the human health and environmental risks of implementing the use of tantalum and tantalum sputtering in support of green gun barrel manufacturing. The focus is to qualitatively assess hazard, exposure, human health risk, and ecological risk to support risk-based decision-making and assure that risks are reduced for workers.

APPROACH: Conduct a qualitative risk assessment to characterize human and ecological risks associated with the use of tantalum and tantalum sputtering as a green gun hexavalent chromium electroplating) to the use of the tantalum sputtering alternative will be completed to document potential health threats and determine which process will adequately protect worker health.

PROPONENT: Army, Navy, Air Force

POC: Dr. Dan Watts, NJIT

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STATUS: Completed

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TITLE: Green Processes Simulation - Environmental Lifecycle Model

PROJECT NUMBER: 3.M-020 (R1-1)

PROGRAM FUNDING SOURCE: Army
6.2 EQT/SGM

PERFORMING LAB: NJIT

OBJECTIVE: Develop modeling and numerical simulation capability for materials processing applications.

APPROACH: Adaptation of a process engineering methodology, integration of existing hardware and software systems, and implementation of an initial set of priority process examples for the purpose of establishing a computer-based framework to model and simulate green process engineering and management. Goal is to develop an integrated approach for design, manufacturing, use and disposal of environmentally sound products. Pollution prevention, treatment of pollutants, and the potential for reuse will be accounted for while maintaining the specifications and standards necessary for the highest quality of the product. Useful approaches for risk modeling and comparison for human health implications exist and are used in determining potential impacts of various environmental scenarios including economic implications. A key initial activity is the examination of one manufacturing operation at the Iowa Army Ammunition Plant with the initial objective of developing a protocol for prioritizing chemicals for use reduction based on environmental costs. The longer-term goal will be to use the data as a key part of the simulation development process for the total lifecycle of the ammunition product.

PROPONENT: Army, Navy, Air Force

POC: Dr. Dan Watts, NJIT

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STATUS: Ongoing

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TITLE: Modeling of Fate and Transport of Chemicals

PROJECT NUMBER: 3.M-021 (R1-4)

PROGRAM FUNDING SOURCE: Army 6.2
EQT/SGM

PERFORMING LAB: NJIT

OBJECTIVE: Develop risk modeling that will give a good capability for comparing ecological risks.

APPROACH: The goal of this project is to develop a general Ecological Risk Model (ERA) which can be applied to a broad range of problems. The ultimate goal is to provide a tool that can be used by the Army to facilitate informed decision making about product and process design to optimize lifecycle environmental costs for weapon systems. Additionally, the tool should be useful for environmental decision making for emission management and remediation activities.

PROPONENT: Army, Navy, Air Force

POC: Dr. Dan Watts, NJIT

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STATUS: Ongoing

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TITLE: Demil Disassembly

PROJECT NUMBER: 3.M-022 (R5-1)

PROGRAM FUNDING SOURCE: Army 6.2
EQT/SGM

PERFORMING LAB: NJIT

OBJECTIVE: Conduct research leading to the identification and development of new process or methods applicable to the relatively new area of final disposition. The proposed effort will be focused on the area of development of tools applicable to design for de-manufacturing.

APPROACH: Activities leading to decision support tools specific to design of military products from the perspective of decommissioning and demilitarization will be carried out. Issues to be considered are efficient and effective metrics and guidelines, assembly and disassembly process simulation, and enhanced production data management for disassembly planning. It is planned to conduct this activity in the context of design of a new "green bullet" component.

PROPONENT: Army, Navy, Air Force

POC: Dr. Dan Watts, NJIT

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STATUS: Ongoing

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TITLE: General Tasks in Support of Education

PROJECT NUMBER: 3.M-023

PROGRAM FUNDING SOURCE: Army
6.2 EQT/SGM

PERFORMING LAB: NDCEE

OBJECTIVE: Conduct continuing research related to environmental awareness training.

APPROACH: A team of environmental/economic educators and an expert in the area of computerized data collection, analysis, and presentation will work with the investigators of each of the technical research areas, in the Sustainable Green Manufacturing Program, to monitor the research results for incorporation into training packages. The team will consider, through interviews and appropriate participation in CTC and government training activities, optimum opportunities to incorporate the findings and perspectives into modified training activities. While the team will be involved in each of the individual research elements, they will be expected to gain an overview perspective of the entire program and to incorporate that broad view into the training instruments developed. The activities of the team will be described in each of the monthly reports and they will assist the investigators of each technical research element in preparing the required reports and technology transfer/transition applications.

PROPONENT: Army, Navy, Air Force

POC: Mr. Don Skelton, IEC

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STATUS: Ongoing

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TITLE: Modeling the Cylindrical Magnetron Sputtering System

PROJECT NUMBER: 3.M-024

PROGRAM FUNDING SOURCE:
Army 6.1 EQT

PERFORMING LAB: Benet Labs

OBJECTIVE: Develop capability to model the best target-annulus-substrate configuration for cylindrical magnetron sputtering (CMS) system.

APPROACH: Required are plasma models, collision models, cellular automata and statistical thermodynamics. Utilization of CMS required to eliminate high costs resulting from the mitigation of environmental impacts of chromium plating..

PROPONENT: Army, Navy, Air Force

POC: Dr. John Vasilakas, ARDEC/Benet

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STATUS: In Progress

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TITLE: Radford Environmental Development and Management Program (REDMAP)

PROJECT NUMBER: 3.M-025 (N.125/225) **PROGRAM FUNDING SOURCE:** Army
6.2 EQT

PERFORMING LAB: NDCEE, Johnstown, PA

OBJECTIVE: To install a real time Environmental Management and Monitoring System at Radford Army Depot. Identify high priority P2 and environmental monitoring /control needs based on cost and compliance. Implement pollution prevention technologies and ISO 14000.

APPROACH: Build on the knowledge of the environmental management and monitoring system at Tobyhanna AD. Utilize an integrated product team to ensure customer satisfaction. Make maximum use of off-the-shelf hardware and software to reduce costs and technical schedule/quality risks. Promote technical data exchange and demonstrate to other interested parties.

PROPONENT: Army

POC: Mr. Nelson Colon, IEC

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STATUS: Ongoing

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TITLE: Erosive Element Interaction with Gun Tube Alloy and Coatings

PROJECT Nos.: 3.M-028

PROGRAM FUNDING SOURCE: Army
6.1 EQT

PERFORMING LAB: ARL

OBJECTIVE: Measure (H,C,N,) interactions with gun tube material surfaces under simulated firing conditions and correlate with existing erosion models.

APPROACH: Employ high sensitivity ion beam techniques for quantifying behavior (diffusion) of select elements.

PROPONENT: Army

POC: Dr. Jim Hirvonen, ARL

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STATUS: Completed

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TITLE: Sensor/Modeling Research and Development

PROJECT NUMBER: 3.M-029 (R1-1)

PROGRAM FUNDING SOURCE: Army
6.2EQT/SGM

PERFORMING LAB: NDCEE

OBJECTIVE: Develop a smart structure system that will increase the life-span of helicopter blades, lessening the environmental impact of manufacturing (resins and composite materials).

APPROACH: The concept under development is to develop the Fiber-Bragg Grating (FBG) sensors to measure strain, deformation, force, and vibration in the AH-64 (Apache) Helicopter. Optical fiber sensors bring a number of unique advantages for smart structures that cannot be achieved by conventional strain gauge systems. Specifically, the sensors can be multiplexed along a single fiber to give indiscreet, distributed measurements throughout an entire structure. Conventional data collection methods have proven unreliable resulting in low data quality.

PROPONENT: Army, Navy, Air Force

POC: Mr. Don Skelton, IEC

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STATUS: Ongoing

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TITLE: Environmental Management Research and Engineering

PROJECT NUMBER: 3.M-030 (R6-1)

PROGRAM FUNDING SOURCE: Army
6.2 EQT/SGM

PERFORMING LAB: NDCEE

OBJECTIVE: Facilitate the deployment of an ISO 14001/CEMP compliant complete Environmental Management System (EMS) at DID sites as well as other Federal agencies.

APPROACH: The DOD recently concluded a two-year pilot program that evaluated the use of the International Organization for Standardization's (ISO) EMS standard, Environmental Management Systems Specification with Guidance for Use (ISO 14001). The results of the DOD Pilot Program baseline and pilot studies suggest that while the DOD has many of the requirements of a conforming EMS, critical elements of a complete EMS are missing and implementation of existing elements within installations is uneven. Federal Agencies, including DOD, have until the year 2005 to implement a complete EMS.

PROPONENT: Army

POC: Mr. Don Skelton, IEC

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STATUS: Ongoing

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TITLE: Army and DOD Requirements Lists

PROJECT NUMBER: 3.M-031 (R6-2)

PROGRAM FUNDING SOURCE: Army
6.2 EQT/SGM

PERFORMING LAB: NDCEE

OBJECTIVES: Establish cooperative endeavors among both defense and commercial industrial entities focusing on Army needs and NAFTA's environmental requirements in conjunction with ARMY 6.2/SGM partners and other DOD representatives. Demonstrate the use of commercial practices to produce military acceptable products, specifically evaluating cost efficiencies realized through single process utilization. Identify raw material use, manufacturing processes, intermediate processes, waste generation/disposal issues, and regulatory enforcement issues related to industries along the border. Identify processes and products that are in common with the US-Mexico private sector manufacturing and the DOD for which IEC/CTC/NJIT could develop environmentally friendly alternatives.

APPROACH: This is a continuation of a current effort to develop an Army and DOD requirements list applicable to ARMY 6.2/SGM efforts and make comparisons of DOD requirements with those of private sector manufacturers along the US-Mexico border.

PROPONENT: Army, Navy, Air Force

POC: Mr. Don Skelton, IEC

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STATUS: Ongoing

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TITLE: Mechanisms of Military Coatings Degradation

PROJECT No: 3.B. (SERDP PP1133-99)

PROGRAM FUNDING SOURCE:
SERDP

PERFORMING LAB: ARL, Aberdeen Proving Ground, MD

OBJECTIVE: Pollution prevention via extended coating durability. Identify modes and primary factors to understand military coatings degradation. Establish priority of significant factors. Establish confidence in degradation modes and test protocols. Provide formulation recommendations for improved performance of topcoats, primers and substrate protection by tech transfer to suppliers.

APPROACH: Validate models, develop independent models and sub-models, modes and mechanisms to end up with a usable predictive model, quantify degradation mechanisms UV oxidation and corrosion to yield a kinetic model and toolbox to track changes.

PROPONENT: ARL

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STATUS: In Progress

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