NARRATIVE

Program Management

Sustainable painting operations are required to maintain combat fleet readiness. Paint systems provide corrosion protection, and more importantly, enhance system and soldier survivability through reduced signatures and chemical agent resistance. Many painting operations occur within a controlled environment, preventing the emission of hazardous air pollutants and volatile organic compounds, although some painting operations occur in locations without emission control. Painting operations are subject to work interruption when not in compliance with statutory national emission standards. The Sustainable Painting Operations for the Total Army program successfully provided materials and process equipment for applications across the spectrum of locations and performance requirements. The program was bilaterally funded by the Army environmental, acquisition and logistics communities, executed through Army laboratories in cooperation with Program Executive Offices for Ground Combat Systems, Combat Service/Combat Service Support, Aviation, and Missiles and Space representing the majority of weapon systems in the U.S. Army.

Background and Requirement. The U.S. Environmental Protection Agency (USEPA) regulates sources of hazardous air pollutants (HAPs) under the Clean Air Act with the issuance of National Emission Standards for Hazardous Air Pollutants (NESHAPs). Army surface coating operations are subject to NESHAPs because they emit toluene, xylenes, methylene chloride and other HAPs into the atmosphere. Regulated operations include painting, stenciling, marking, bonding, sealing, pretreating, cleaning and depainting of weapon systems and military equipment. The USEPA issued several different regulations that would have applied to the surface coating of ground-based equipment at DoD installations, but the USEPA exempted these operations in response to comments developed by the Army and submitted jointly by DoD. As a result, the USEPA proposed a new NESHAP for the surface coating of Defense Land Systems and Miscellaneous Equipment (DLSME) on DoD installations sometime in 2011. The DLSME NESHAP and its emission limits will be based primarily on data submitted by the Army and other Service installations.

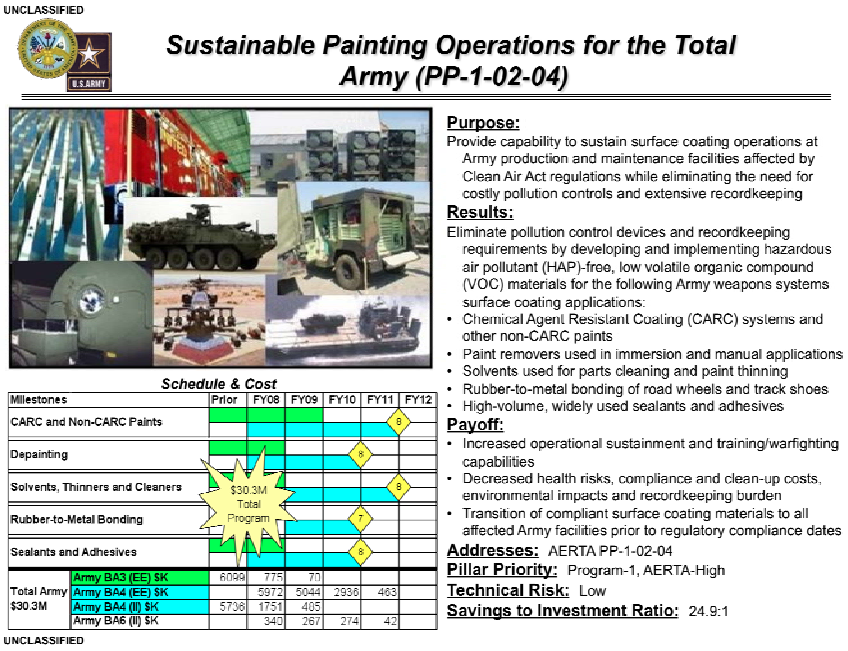
The Army conducted an analysis and projected that its installations would be unable to comply with the anticipated DLSME NESHAP limits by continuing to use the same coating materials, equipment and operational parameters. The only two options capable of bringing Army installations into compliance were: 1) to purchase, install, operate, maintain and keep records on air pollution control devices at each affected source, or 2) to develop, demonstrate and implement surface coating materials that are inherently compliant. The Army chose the second option, and it was implemented via the Sustainable Painting Operations for the Total Army (SPOTA) program.

Purpose and Approach. SPOTA was established to ensure that the Army mission, whether on a military installation or a commercial site, would be fulfilled under all applicable current, proposed and foreseeable surface coating regulations. Because

emission limits vary widely with different NESHAPs, the only path to truly sustainable painting operations was to make the targeted surface coating materials completely HAP-free and therefore compliant (by definition) with any possible HAP standard. This approach has provided the most flexibility for the Army and its industrial base.

The SPOTA program built on the successes of efforts from the late 1990s and early 2000s, overseen by the Strategic Environmental Research and Development Program (SERDP), the Environmental Security Technology Certification Program (ESTCP) and the Army Acquisition Pollution Prevention Support Office (now the Environmental Support Office). These included the development and demonstration of organic HAP-free, water-dispersible Chemical Agent Resistant Coatings (CARC) under MIL-DTL-64159, which has been recognized by other award programs in previous years.

Organization. SPOTA is a $30M program centrally managed by the U.S. Army Research, Development and Engineering Command (RDECOM) Environmental Acquisition and Logistics Sustainment Program (EALSP) and executed by the RDECOM Centers and Laboratories in coordination with their customer Life Cycle Management Commands (LCMCs), Program Executive Officers (PEOs) and Program Managers (PMs). The EALSP Director conducts regular in-process reviews that address cost, schedule and performance issues with all funded efforts. SPOTA has been formally endorsed by the PEO Combat Support and Combat Service Support, PEO Ground Combat Systems, PEO Aviation, PEO Missiles and Space, PM Maneuver Ammunition Systems and PM Conventional Ammunition Systems. Other key stakeholders include the General Services Administration (GSA), Defense Logistics Agency (DLA), and other Services. Details associated with the SPOTA program are shown in the adjacent graphic.



Technical Merit

Thrust Areas. SPOTA comprises five thrust areas. The technical approach within each thrust area is to identify, develop, evaluate, demonstrate, validate, qualify and implement alternative surface coating materials. Several key efforts were completed in FY09 and FY10 after years of work, and the majority of other efforts will be wrapping up in FY11. SPOTA focuses primarily on eliminating organic HAPs, with metallic HAPs and other pollutants as secondary concerns. The five SPOTA thrust areas are as follows.

- Paints: thermoset coatings that are applied to a substrate for appearance, identification, camouflage or protection. This thrust area includes but is not limited to the CARC family of products.
- Solvents, Thinners and Cleaners: liquid materials that are used for hand-wipe, immersion or flush cleaning, or for reducing the viscosity of a coating and that evaporate before or during the cure of the coating.
- Depainting: a process by which dried, hardened or cured coatings are removed or softened. This thrust area focused primarily on chemical removers.
- Rubber-to-Metal Bonding: materials that contain heat-activated polymer systems in either solvent or water that, when applied to metal substrates, dry to a non-tacky surface and react chemically with the rubber and metal during a vulcanization process.
- Sealants and Adhesives: materials with adhesive properties that are used to bond two surfaces together or to fill, seal, waterproof, or weatherproof gaps or joints between two surfaces and form a barrier against the intrusion of elements.

To expedite implementation, SPOTA adopted an evolutionary acquisition approach by which alternative materials were spun out to the field as soon as they were approved for use. As evidence of this approach, some material specifications were revised numerous times over the course of the SPOTA program to implement incremental improvements rather than waiting until the end of the program and implementing all improvements at once. For instance, MIL-DTL-53039 (single component CARC topcoat), revised pre-SPOTA in 2005 to implement organic HAP-free Type II, was revised again in 2009 to implement additional improvements including reduced volatile organic content, increased durability and portable touch-up kits. A third revision is scheduled in 2011 to cancel organic HAP-containing types and eliminate Cobalt use, among other improvements.

Mission Orientation

Army Need. Continuing to emit baseline levels of HAPs from surface coating operations would have severely jeopardized the Army's ability to equip its forces and operate its installations. Surface coating operations may be delayed or even shut down at facilities that do not comply with regulatory requirements. This affects a broad variety of Army weapon systems, including but not limited to ground combat and tactical vehicles, aircraft, armaments, munitions, and deployable combat support, aviation ground support, engineer, communication, personnel and medical equipment.

Sustainability. The program achievements in FY09 and FY10 supported the objectives set forth in the Army Strategy for the Environment. The SPOTA program:

- Fostered a sustainability ethic within the Army, going beyond compliance and anticipated future challenges by spinning out technologies with low or no hazardous emissions into Army surface coating operations.
- Minimized total ownership costs of Army materiel and facilities, not only by reducing emissions and the notices of violation associated with non-compliance, but also by eliminating maintenance, recordkeeping and reporting costs associated with pollution control devices while simplifying the compliance burden on installations.
- Strengthened Army operational capabilities by reducing the environmental footprint associated with hazardous waste from existing coatings and pollution control filters.

Risk Management

Technical Risk: SPOTA avoided much of the risk inherent in a basic and applied research program by proceeding directly to advanced technology development. The program focused on identifying promising commercial candidates and then adapting them to Army weapon systems. Materials were reformulated only when viable alternatives did not exist.

Transition Risk: By giving preference to alternatives that were similar to the existing materials—or that had the potential to streamline existing coating processes—products qualified under SPOTA generally did not increase labor, equipment, training, infrastructure or other costs. For example, a high-HAP, two-component topcoat (MIL-C-46168) was replaced with a HAP-free, one-component topcoat (MIL-DTL-53039) that used similar spray guns, feed lines and painting techniques.

Risk Mitigation: The EALSP Director conducted four formal in-process reviews during FY09 and FY10. Technical and funding challenges were identified at the reviews and addressed expediently. Cost risks were mitigated by first focusing on low-hanging fruit, i.e., low-risk, high-reward replacements. Compliance risks associated with future surface coating regulations were held low by establishing a strong, open working relationship with the USEPA. Instead of simply complying with existing and anticipated HAP limits, the program continually reduced HAP emissions from Army surface coating operations and served to eliminate any residual risk.

The following examples are representative of the programmatic decisions made by the EALSP Director in FY09 and FY10 to minimize risk and maximize the likelihood of the SPOTA program meeting its performance milestones and funding goals.

- Terminated funding for an effort investigating HAP-free adhesives conforming to Military Standard A-A-1936 because alternatives failed to meet performance requirements when evaluated in a laboratory environment.
- Reduced the scope of an effort investigating HAP-free chemical paint removers for manual applications by eliminating aviation applications from the test matrix

after it became evident that aviation authorization requirements were expanding far beyond the boundaries established in the project plan.
- Delayed funding for an effort investigating HAP-free sealants for use in tank ammunition in order to align more closely with the overall product improvement schedule of PM Maneuver Ammunition Systems.
- Accelerated funding for an effort investigating HAP-free paint thinners in response to increased demand from the ground vehicle user community.

Transferability

Leveraging: SPOTA has heavily leveraged projects funded through SERDP, ESTCP, the National Defense Center for Energy and Environment and the DoD Office of Corrosion Policy and Oversight. Regular testing performed as part of the weapon system lifecycle has also been leveraged throughout the SPOTA program. One example is the on-vehicle testing to qualify track shoes and road wheels. SPOTA has coordinated its rubber-to-metal bonding test program with regularly scheduled road tests conducted by PM Heavy Brigade Combat Team. This coordination has the potential to save more than $2M.

Interagency Coordination: The SPOTA program has established strong connections to other Service and Agency programs, maximizing joint involvement and opportunities. Many Army coatings are used extensively on platforms managed by other services and agencies, and vice versa. GSA and DLA are responsible for procuring and supplying thousands of different surface coating materials via National Stock Numbers (NSNs), making them critical partners in implementation. Forums such as the Clean Air Act Services Steering Committee, Joint Services Solvent Substitution Working Group and Joint Group on Pollution Prevention were utilized to minimize duplication of effort and maximize horizontal technology integration.

SPOTA is particularly well coordinated with the Navy. Significantly, the Army is leveraging several technologies that were developed and validated by the Navy, such as non-chromate primers and trivalent chromium pretreatments for Aluminum substrates. These technologies, already implemented in limited applications, were supported by SPOTA for more widespread demonstration, approval and use. Further, in FY10, the Navy transferred its role as Preparing Activity to the Army for MIL-PRF-22750 topcoats and MMM-A-121 adhesives in order to ensure the seamless transition of alternatives demonstrated under the SPOTA program. The Navy is retaining a third specification of interest to the Army, MIL-T-81772 paint thinners, but has agreed to implement any HAP-free products successfully demonstrated under SPOTA. Army and Navy representatives have also coordinated their sealant and adhesive environmental priority lists in order to maximize the benefit of the limited funding available to both Services.

Stakeholder Interaction: Soldier, Army civilian and contractor participation has been especially important for effective implementation, because all technologies are applied to weapon systems used in training and deployed to the field. HAP-free materials have

been demonstrated at more than a dozen different Army production and maintenance facilities by the same personnel that will utilize them during normal operations. All demonstrations have been coordinated with appropriate LCMC, PEO and PM personnel.

Accomplishments

The SPOTA program targeted dozens of material specifications, encompassing hundreds of qualified products and NSNs, called out in thousands of equipment publications and technical data packages. The total volume of surface coating materials that has been affected by the SPOTA program is estimated at roughly six million gallons per year, or nearly enough to fill the Lincoln Memorial Reflecting Pool. The following are three examples of accomplishments that were achieved during FY09 and FY10, representing a significant percentage of the overall SPOTA program goal.

Example #1: CARC System: Improvements made during FY09 and FY10 were:

- Demonstrated and implemented HAP-free primers (Type III) and HAP-free primers with enhanced corrosion performance (Type IV) under MIL-DTL-53022.
- Demonstrated and implemented HAP-free, water-based primers with enhanced corrosion performance (Type II) under MIL-DTL-53030.
- Implemented organic HAP-free touch-up kits containing products conforming to MIL-DTL-53039 (Type VIII) CARC topcoats and MIL-DTL-53022 (Type V) and MIL-DTL-53030 (Type III) primers.
- Implemented requirement for MIL-DTL-64159 CARC topcoats to be free of all metal HAPs other than Cobalt and trivalent chromium compounds, which are required for infrared camouflage protection.
- Developed and demonstrated Cobalt-free pigments with enhanced weathering properties for use in MIL-DTL-64159 and MIL-DTL-53039 CARC topcoats. This technology, entitled Development and Application of Low Solar Absorbing CARC, is scheduled to be implemented in FY11 and was recognized with a 2009 Army Research and Development Achievement Award.

The baseline (HAP-containing) versions of these four CARC topcoat and primer specifications are scheduled to be canceled during FY11 and FY12, leaving all available products organic HAP-free and free of metal HAPs with the exception of trivalent chromium compounds. This transition has already advanced to a substantial degree, as the majority of Army installations and original equipment manufacturers are ordering and applying organic HAP-free CARC topcoats. The Army Research Laboratory (ARL) is working with PMs to make the final stages of the transition as seamless as possible by continuing to qualify, on a case-by-case basis, baseline HAP-containing products that are required in binding contract documents.

The transition will affect well over two million gallons of topcoats and primers each year, according to monthly qualification data collected by ARL. CARC topcoats and primers contained an average of more than 1.0 pound/gallon organic HAP before the SPOTA program began in FY03, according to data collected to support development of the

DLSME NESHAP. Therefore, the impact to the Army is more than 1,000 tons/year reduction in organic HAP emissions.

Example #2: Depainting: SPOTA is enabling the Army to transition to organic HAP-free paint removers to replace methylene chloride-based products in numerous applications. The most promising alternatives for large immersion tank applications were demonstrated beginning in FY08 and were implemented partially during FY09 and FY10. Pending final demonstration results, one HAP-free product is anticipated to be implemented fully in FY11 at Anniston Army Depot—the largest user of methylene chloride remaining in the Army. This effort is a key component of Anniston's movement towards environmental sustainability.

Hand held lasers were demonstrated successfully in FY10 to replace methylene chloride-based products and hand sanding for spot depainting of primary metallic structures and non-critical composite parts on Army helicopters. This represents the culmination of several multi-year efforts investigating hand held lasers, dating back to ESTCP projects in the early 2000s. Hand held lasers are anticipated to be implemented in FY11 at Fort Rucker and potentially other installations that maintain Army aircraft. As a replacement for methylene chloride-based products, hand held lasers minimize air emissions and hazardous waste disposal issues. As a replacement for hand sanding, hand held lasers offer reduced occupational exposures resulting from airborne hexavalent chromium dust.

The Army's use of methylene chloride for depainting has varied in recent years from a low of roughly 220,000 pounds (2009) to a high of roughly 370,000 pounds (2008), according to the USEPA Toxics Release Inventory. Even at the low point, the impact to the Army is more than 100 tons/year reduction in organic HAP emissions.

Example #3: Torque Seal: SPOTA implemented a HAP-free version of the inspection lacquer known as Torque Seal in FY09 and FY10. In prior years, ARL developed a new formulation that eliminated methanol (an organic HAP), worked with the manufacturer to produce a prototype batch, and worked with the U.S. Army Aviation and Missile Command (AMCOM) to demonstrate the alternative at Fort Rucker. In FY09, the General Services Administration assigned new NSNs to enable widespread procurement and in FY10 added the alternatives to its Depot Stock Program, making all colors available by NSN in orders as small as one tube.

Overall Impact. A business case analysis conducted in FY06 concluded that the SPOTA program would result in roughly $1B cost avoidance over 15 years when compared to the alternative option of installing and operating pollution control devices at all Army installations anticipated to be out of compliance with the DLSME NESHAP. This included production plants, arsenals, depots and training installations. All told, the SPOTA program is anticipated to eliminate more than 4,000 tons of organic HAP and other pollutant emissions from Army surface coating operations.