2012 Secretary of Defense Environmental Award Submission: Environmental Excellence in Weapon System Acquisition, Large Program

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Introduction

In Fiscal Years 2010 and 2011, the Project Management Office for the Stryker Brigade Combat Team (PMO SBCT) continued to aggressively implement pollution prevention, waste minimization, and environmental compliance strategies into the Stryker Family of Vehicles (FoV) Program. In addition, the PMO SBCT designed, validated, manufactured and will be fielding 450 of the Double V-Hull (DVH) Strykers in Afghanistan. The DVH Strykers significantly increase crew and vehicle protection against IEDs. Throughout the DVH program, PMO SBCT continued to utilize the SBCT Environmental Management Team (SBCT EMT), which is comprised of representatives from several Government agencies and contractors. The SBCT EMT assisted PMO BCT in identifying and resolving current or potential environmental issues as well as identifying potential pollution prevention and HazMat reduction opportunities. The use of the SBCT EMT allowed PMO SBCT to concurrently incorporate perspectives and input from the vehicle system manufacturer, Soldiers, and maintainers. The SBCT EMT conducted the trade-off studies of less or non-hazardous materials and manufacturing processes; reviewed system requirements for environmental issues and pollution prevention opportunities for exploitation, and ensured that the program remained in compliance with federal, state, local environmental laws as well as DoD and DA regulations and requirements.

Background

In October 1999, the Army announced its vision for what became the Stryker Brigade Combat Team, which has the Stryker Family of Vehicles (FoV) as its centerpiece. The Stryker FoV consists of ten vehicle variants including the Mobile Gun System (MGS) and the Infantry Carrier Vehicle (ICV). The MGS serves as the direct fire platform, which will provide maneuver fire support for the Stryker Brigade Combat Team (SBCT). The ICV serves as the infantry or mission vehicle platform. The remaining eight variants are based upon the ICV configuration and include: the Commander's Vehicle, Fire Support Vehicle, Engineer Squad Vehicle, Nuclear, Biological, Chemical Reconnaissance Vehicle, Medical Evacuation Vehicle, Reconnaissance Vehicle, Mortar Carrier Vehicle, and the Anti-Tank Guided Missile Vehicle. The use of the common platform reduced vehicle development and test and evaluation timelines, increased commonality and decreased the logistics footprint.

In FYs 2010 and 2011, PMO SBCT continued to implement environmental stewardship into the decision making process. PMO SBCT enlisted support from its Technical Management, Acquisition Support, Integrated Logistics Support, and Business Management Divisions. This active participation by all of the PM SBCT Divisions ensured that environmental initiatives were balanced with system cost, performance, and schedule. PMO SBCT resides within the Program Executive Office – Ground Combat Systems (PEO-GCS). PEO-GCS is a tenant of the Tank-automotive and Armaments Command (TACOM) in Warren, Michigan.

The SBCT EMT contained representatives that reflected the vehicle systems' life cycles from materiel development to operations and support. The use of this expertise and knowledge base enabled PMO SBCT to resolve environmental issues and identify early pollution prevention opportunities. The SBCT EMT consisted of representatives from the following organizations and companies:

- ⇨ PMO SBCT Technical Management, Acquisition Support, and Integrated Logistics Support Divisions
- ⇨ Program Executive Office – Ground Combat Systems (PEO-GCS)
- ⇨ Tank and Automotive Research and Development Engineering Center Materials/Environmental Team (TARDEC ME Team)
- ⇨ Tank-automotive and Armaments Command (TACOM) Safety Office
- ⇨ Tank-automotive and Armaments Command (TACOM) General Law Division
- ⇨ US Army Acquisition Pollution Prevention Support Office (AAPPSO)/Environmental Support Office (ESO)
- ⇨ US Army Research Laboratory (ARL)
- ⇨ US Army Environmental Command (AEC)
- ⇨ General Dynamics Land Systems (GDLS)
- ⇨ Anniston Army Depot (ANAD)
- ⇨ Joint Base Lewis-McChord (JBLM)
- ⇨ U.S Army Forces Command (FORSCOM)

Program Summary

During FY2010 and FY2011, PMO SBCT's duties and responsibilities included proactively addressing environmental concerns and incorporating pollution prevention opportunities when feasible and applicable while managing program cost, performance and schedule. PMO SBCT followed DoD 5000.2 guidance on program environmental requirements in order to accomplish its environmental duties and responsibilities. This included designing vehicle survivability kits and the Double V-Hull with an awareness of potential environmental impacts during manufacture, testing, operations and support, and disposal.

PMO SBCT used all available resources to proactively eliminate hazardous materials within the Stryker FoVs. For example, the preparation of environmental documentation aided PMO SBCT in monitoring environmental compliance issues while developing a proactive pollution prevention program. Through the elimination of hazardous materials usage and reduction of hazardous waste generation, PMO SBCT efforts assisted facilities and installations associated with the Stryker Program in remaining in compliance with environmental laws and regulations. A corresponding benefit was, and continues to be, decreased safety and occupational health risks associated with the Stryker FoVs.

Accomplishments

During FY2010 and FY2011, the SBCT EMT coordinated the environmental efforts for the entire Stryker Program including the DVH Strykers. These efforts included reviewing requirements for hazardous materials and trade-off studies of alternative materials, elevating alternative material use impacts to vehicle maintenance, and potential finical consequences. PMO personnel ensured that the reduction of the environmental issues and implementation of pollution prevention methodologies occurred at the earliest possible time in the Stryker FoV's life cycle and did not result in a decrease in the Stryker FoVs' military readiness. Personnel followed established procedures and a systems engineering approach for evaluating these areas of responsibility. As an element of PMO SBCT, the various SBCT EMT members directly contributed their expertise in resolving real and potential environmental issues and reducing the amount HazMat usage within the Stryker FoVs.

I. Incorporating Environmental Analysis into the Acquisition Decision Making Process

During FY 2010 and 2011, the PMO SBCT continued in its dynamic and comprehensive approach of integrating environmental analysis into the decision making process. While developing efforts to reduce or eliminate environmental issues and hazardous materials, PMO SBCT personnel considered all known factors including technical, environmental, safety, occupational health, and business issues. The information in this section highlights how PMO SBCT utilized several resources for integrating environmental analysis into its decision making process.

The SBCT EMT continued to use a system engineering methodology to ensure a comprehensive approach in establishing its membership, resolving environmental impacts, and implementing pollution prevention opportunities. The use of SBCT EMT allowed a two-way exchange whereby PMO SBCT received direct input from areas not typically included within a vehicle system program and quickly share lessons learned across the Army and DOD. PMO SBCT relied upon SBCT EMT members' expertise to provide additional information on ways to resolve environmental impacts during the phases.

The PMO SBCT personnel and SBCT EMT members assisted and/or coordinated in the development of several Environmental documents. The use of these documents helped PMO SBCT identify and resolve potential environmental issues and implement reductions in hazardous material usage. The information presented in the PESHE helped PMO SBCT gage its progress in eliminating and mitigating ESOH issues as well as provided direction where resources should be directed in resolving any outstanding issues.

II. Material Substitution

In order to eliminate the use of hazardous materials on the Stryker FoV at the earliest possible time, PMO SBCT developed contract language that restricted the use of hazardous materials on the Stryker vehicles. Specifically, the contract states that "The contractor shall not deliver any Stryker common and unique parts containing cadmium, hexavalent chromium, beryllium, mercury, asbestos, radioactive materials or other highly toxic or carcinogenic materials as defined in 29 CFR 1910.1200 without Government approval." The contract further states… "The contractor shall also request Government approval prior to delivering parts with lead and lead solder."…" No Class I or Class II ozone depleting chemicals (ODC) as defined in Section 602 of the Clean Air Act (42 USC 767(a) shall be used."
These contract requirements were based upon the areas of concern listed in user requirements for use of metal pretreatment, painting, and fire suppression agents. Since the Stryker FOVs are based on a performance specification, revision of existing technical data packages (TDPs) and technical manuals (TMs) did not immediately occur; rather, alternative materials were initially substituted for commonly used hazardous materials during the initial preparation of the TDPs and TMs. Through active contract management and aggressive enforcement of pollution prevention measures, PMO SBCT required the prime contractor to rectify any breached environmental contract requirements while meeting overall vehicle production schedules. The eradication of hazardous materials not only benefited the environment during the previous two fiscal years, but it will also continue to benefit the environment through the Stryker vehicles' estimated 30-year service life and later.

Rather than trying to "reinvent the wheel" and develop new alternatives for commonly used hazardous materials, SBCT EMT members used existing government and commercial information sources in identify existing alternatives. These sources included pollution prevention databases, Joint Service organizations, product/equipment manufacturers and recently updated metal finishing specifications. The alternative

material evaluation criteria required the alternative materials be commercially available, have reduced environmental and health impacts as well as equal or superior performance, provide cost savings/avoidance, and be previously validated in other trade-off studies. The use of previously tested and validated alternative materials assisted in reducing the amount of time to implement the alternatives into the Stryker Program.

Actions to successfully implement alternative materials into the Stryker Program TDPs and TMs during the 2010/2011 time frame included:

- Replaced Cr^{+6} containing aluminum pretreatments on non-electrical and electrical aluminum vehicle components with alternative aluminum pretreatments that do not contain Cr^{+6}.
- Replaced Cr^{+6} containing sealers utilized in aluminum anodizing with alternative sealers not containing Cr6+
- Replaced Cr^{+6} post rinse treatments on zinc plated mechanical fasteners with trivalent chromium post treatments.
- The aforementioned changes will result in the elimination of over 50% of the remaining HazMat on SFoV Flat bottom and DVH variants by part number.
- The real percentage of total HazMat elimination on SFoVs will be much greater in the reduction of parts utilized per vehicle since mechanical fasteners represent the most plentiful type of part on most vehicle assemblies. Estimates point to a 75% to 80% reduction in the total number of parts per vehicle utilizing HazMat.

III. Improved Program Management

In a model based on the principles of MIL-STD-882D, PMO SBCT implemented an environmental management system (EMS) within its program structure. The EMS has assisted PMO SBCT in tracking environmental issues and gauging its progress in resolving those issues. The SBCT EMT has implemented the fundamentals of PMO SBCT's Environmental Policy within its core efforts.

As part of improved program management efforts, PMO SBCT developed the Environmental Impact Management Program (EIMP). The EIMP assisted the SBCT EMT and PMO SBCT in managing, tracking, and resolving potential and real environmental impacts that the Stryker FoV may have on the environment. Continued use of the EIMP model throughout the last two years has provided accurate tracking of any additional environmental concerns.

IV. Research, Development, and Technology Demonstration/Validation

Strykers were recently utilized in a Technology Demonstration/Validation project coauthored by TARDEC Materials & Environmental Team and SBCT Engineering. Four Stryker vehicles were outfitted with Thin Dense Plated Aluminum (TDPA) with trivalent chromium conversion coating on their wheel lugs. These were positioned side by side with new installs of the OEM supplied wheel lugs with legacy surface finish (zinc aluminum composite coating). The outfitted Strykers were stationed in Hawaii for over one year and the coatings were compared at ~6 month intervals. The two year mark has

been achieved with little to no degradation of the TDPA coating. By contrast, the zinc aluminum composite coated bolts showed corrosion degradation in first initial months. This project collaboration is in support of the TAREDEC M&E effort to utilize TDPA as the cadmium replacement for mechanical fasteners and electrical connectors.

V. Process Modification and Improvement

As has been exhibited in previous sections, PMO SBCT has proactively eliminated uses of hazardous materials. During the same time, PMO SBCT and GDLS have incorporated several process modifications and improvements into the Stryker FoV designs. These modifications and improvements assisted in eliminating sources of potential pollution generating activities.

Previously reconciled in the Stryker Flat Bottom variants, fielded ground vehicle systems often contain several locations where vehicle fluids – such as engine oil and coolant - could leak from vehicle components and contaminate the soils and/or bodies of water. In order to eliminate or reduce vehicle fluid leaks to the environment, the Stryker vehicles were designed to have seamless lower hulls. This design feature eliminated uncontrolled lower hull fluid leaks and allowed for the containment of any interior vehicle fluid and fuel spills inside the vehicle hull. In addition, personnel utilized drainage holes for controlled draining of loss water, vehicle fluids, and fuel from vehicles' lower hull. PMO SBCT inserted in the TM instructions on the proper method for draining the vehicle hull and disposal of the drained fluids. The design of the Stryker vehicle lower hull did not have a cost impact on PMO BCT, and additionally, the design assisted in eliminating soil and water contamination at Stryker test and fielding installations. The seamless hull design can be transferred to designs for new ground vehicle systems. The design enhancements described above were also utilized in the Stryker DVH variants now in production.

VI. Education and Outreach

The SBCT EMT routinely shares its lesson learned in pollution-prevention and health risk mitigation methods throughout the Army and DOD. This includes internal communications among the SBCT EMT representatives' organizations and presentations at conferences. The PMO SBCT has also assisted other U.S. Army PMOs in resolving related environmental concerns. These efforts have included metal pretreatments, coatings, and coating application technologies.

Since the EMT members come from various locations throughout the U.S., efforts to coordinate and share information with state and local agencies, organizations, academic institutions, and other civic organizations are ongoing. Overall, the team members have developed a strong and comprehensive relationship with the previously identified organizations. Examples of these collaborations include:

- "Stryker HazMat Elimination Strategy" brief presented at the DoD Vehicle Workshop - Sur/Fin Conference hosted by the National Association of Surface Finishers and ASETSDefense in Grand Rapids, MI on 15 June 2010.

- "Stryker Program HazMat Elimination Update" brief presented at the Light Armored Vehicle User Nation Group (LAVUNG) in London, ONT on 26 Oct 2011.
- Collaboration with the NASA Corrosion Technology Laboratory in the discussion of advanced corrosion technology ("Smart Coating for Corrosion Control") and HazMat reduction methodologies. (Previous location for BCT/HBCTEMT Meeting)
- All Stryker EMT Meetings are held in collaboration with Heavy Brigade Combat Team (HBCT). These meetings serve as a collaborative forum for environmental and corrosion experts from numerous organizations from the military, academia, commercial industry. They serve as mechanisms for educating and updating these organizations of interested stakeholders.

VII. Accomplishments

The update to non HazMat containing alternatives of both the mechanical fastener population, along with the update aluminum parts set , comprising both pretreatment on aluminum (per MIL-DTL-5541) and anodizing of aluminum (per MIL-A-8625) is currently being executed using the System Engineering Services project platform.

Mechanical fasteners, by far the most plentiful by number of the HazMat containing parts on the Stryker FoV, were affected by the 2007 update to ASTM B633 (Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel) and by the 2007 update to ASTM F1941 (Standard Specification for Electrodeposited Coatings on Threaded Fasteners). Both of these specifications now allow for a trivalent chromium post treatment as one of the specification callouts to be administered over the zinc plating. This circumstance supplied the potential to reconcile most of the mechanical fastener part set on the SFoV to non-HazMat containing substances. The current portion of the SES task involving the reconciliation of mechanical fasteners to non hexavalent chromium post treatment on all flat bottom and DVH Stryker variants is over 95% complete.

The remaining aluminum parts population is currently being updated to a non-Cr6+ surface treatment using specification approved alternatives found in the update of MIL-C-5541 to MIL-DTL-5541 Rev F (11 July 2006). There are currently nine approved non-Cr6+ chemistries in the associated QPL List associated with MIL-DTL-5541's parent specification MIL-DTL-81706 (QPL-81706).

In summary, the aforementioned changes will result in the elimination of over 50% of the remaining HazMat on SFoV Flat bottom and DVH variants by part number. The real percentage of total HazMat elimination on SFoVs will be much greater in the reduction of parts utilized per vehicle since mechanical fasteners represent the most plentiful type of part present on most vehicle assemblies. Estimates point to a 75% to 80% reduction in the total number of parts per vehicle utilizing HazMat and in particular, Cr6. Although not totally free of the Cr6+, overall the progress to date on the Stryker vehicles represents a substantial step in the goal of complete HazMat elimination on the SFoVs.