PEO AVIATION

Cargo Helicopter System Safety Environmental Working Group

ENVIRONMENTAL EXCELLENCE IN WEAPON SYSTEM ACQUISITION

INTRODUCTION

This nomination is for the Program Executive Officer (PEO) for Aviation, Cargo Helicopter (CH) Program Management Office (PMO), CH-47F Block II Acquisition Category (ACAT) IC program, and the CH System Safety Environmental Working Group (SSEWG).

The Project Manager for Cargo Helicopters (PMCH) chartered and staffed the CH SSEWG to analyze and track environment, safety and occupational health (ESOH) issues across the program life-cycle. The SSEWG was chaired by the CH Project Safety Manager and consisted of the following voting members:

- Project Manager, Cargo Helicopters
- Product Manager, CH-47F
- Chief, Technical Division, Cargo Helicopters
- Safety Manager, Cargo Helicopters
- Fleet Manager, Cargo Helicopters
- Logistics Division, Cargo Helicopters
- Product Manager, Modernization/Block II, Cargo Helicopters
- Safety Representative, Program Executive Officer (PEO) for Aviation
- Safety Office Representative, Aviation and Missile Command (AMCOM)
- Representative, U.S. Army RDECOM/AMRDEC Aviation Engineering Directorate (AED)
- Representative, U.S. Army RDECOM/AMRDEC Software Engineering Directorate (SEO)
- Representative, U.S. Army Aviation Logistics Center (ALC)
- Representative, U.S. Army Aviation Center of Excellence (Combat Developer)
- Representative, Boeing Helicopters
- Representative, Honeywell Aerospace
- Representative, Rockwell Collins Inc.

BACKGROUND

PMCH integrates ESOH issues within the systems engineering process, to establish responsibilities, track progress and resolve open issues. The SSEWG is the key element of this strategy, and is tasked with system safety management, hazardous material (hazmat) management and environmental compliance for the design, operation and disposal of CH aircraft and its equipment and kits. Over the last 2 fiscal years, the CH SSEWG achieved these goals by:

- Maintaining a centralized hazard log of all Cargo Helicopters safety hazards that provided appropriate risk assessments of hazards and track resolution actions.
- Recommending actions to close hazards to PMCH for decision authority signature.
- Managing the CH Hazardous Materials Management Program (HMMP).
- Overseeing contractor pollution prevention (P2) programs to eliminate or reduce use of hazmat and disposal of hazardous wastes for processes such as production, repair and overhaul.
- Tracking projects that eliminated hazmat in the aircraft design and components.
- Recommending actions on environmental compliance and system safety matters.
- Providing recommendations for establishing or revising system safety requirements.

The SSEWG also reviewed and provided recommendations on all Safety-of-Flight, Aviation Safety Action Messages, Category I Quality Deficiency Reports, Environmental Impact Reports, Abbreviated Aviation Action Reports, Engineering Change Proposals, Maintenance Work Orders, Manpower and Personnel Integration, field reports and lessons learned.

PROGRAM DESCRIPTION

The CH-47 Chinook is a twin-engine, tandem rotor, heavy lift helicopter. Its primary roles are 1) air assault of troops and weapon systems, 2) air movement of cargo and personnel, and 3) casualty evacuation. The first CH-47 aircraft was designed and

CH-47F Block II Upgrade.

produced in the early 1960s. The Chinook Helicopter is the Army's only heavy-lift cargo helicopter and is expected to remain in service until Future Vertical Lift (FVL) heavy is fielded.

The Block II program buys back performance lost due to weight added in upgrading the CH-47 to F-model in 2007. It includes a more efficient drivetrain and new swept-tip rotor blades, designed to lift an additional 1,500 pounds. The standard configuration of six fuel tanks (three on each side) is reduced to two, allowing for the Block II to carry more fuel while losing weight. The fuselage structure is also strengthened in critical areas to allow helicopter to carry an increased payload. The program successfully transitioned into Engineering Manufacturing and Development (EMD) in the 3rd quarter FY17 and will begin flight testing in 2019.

STAKEHOLDER INTERACTION

As can be seen by the list of voting members, the SSEWG included technical and managerial representation across the functional areas. It also gave voice to the equipment manufacturers, identifying them as voting members, and to activities outside the aviation acquisition community, such as the Army Aviation Logistics Center and RDECOM. Equally important, it also recognized the need to include the user, represented by the Combat Developer in the Army Aviation Center for Excellence.

The SSEWG meets semiannually, with additional discussions as needed to address environmental risks and their potential impacts, new or changing environmental regulations and policies, or the

importance of coordination of potential compliance issues with facility personnel.

In large part, the CH SSEWG was able to successfully communicate, implement and execute ESOH requirements because of a high level of team communication. Lessons learned were regularly discussed and applied across all supporting disciplines.

HAZARDOUS MATERIALS MANAGEMENT PROGRAM

The CH HMMP used both Department of Defense (DoD) guidance and industry standards, including National Aerospace Standard (NAS) 411, to ensure hazmat were identified and efforts were initiated to either eliminate, reduce or mitigate their use throughout the life cycle of the CH-47F system. The HMMP succeeded by focusing the attention of system managers and engineers on hazmats early in system design and material selection. The primary goal was replacement; reduction or mitigation was considered only when the hazmat could not be eliminated.

A key element of the HMMP was the Boeing-U.S. Army CH-47 HMMP Plan, based on the NAS 411-1 list of prohibited, restricted and tracked materials. The Plan directed the preparation of periodic HMMP Reports which identified and characterized all the hazmat required for production, operation, repair, maintenance, storage, transportation or disposal of the weapon system.

To identify and manage hazmat used during operations and maintenance, the AMCOM Environmental Technology Team conducted a thorough review of all Technical Manuals (TMs) and Depot Maintenance Work Requirements (DMWRs). As a result of their efforts, all hazmat called out in Army maintenance and repair manuals, including Class I and Class II ozone-depleting substances (ODS), have been identified and indexed to their locations in these technical documents.

POLLUTION PREVENTION

Boeing provides a good example of a very active contractor P2 program, integral to the manufacturing process and a major thrust at the production facility. P2 program activities documented and tracked hazmats identified in aerospace products, establishing baselines and influencing design by proposing alternatives made available through company-wide chemical reduction and P2 efforts. Because of this, there are no new hazmat materials, processes or disposal activities with the CH-47F that were introduced by the Block II Program.

Program Area or Material	Status
Asbestos	Use of asbestos in manufactured parts such as blades was mitigated prior to the D Mod Program. Up until the early to mid-70's Asbestos was present in small amounts as a fortified mastic for inner layers of the built up blade and not in sufficient quantity that the blade itself would be categorized as ACM (Asbestos Containing Material, greater than 1% Asbestos). It has not been used since the middle 1970's.
Chemical agent resistant coating paint.	During the upgrade, aircraft will be stripped and repainted with Chemical agent resistant coating paint. Boeing Helicopters uses a dry plastic media blasting process to remove paint in lieu of hazardous chemical paint strippers. The plastic media is reclaimed and recycled. This process separates paint particles, heavy contaminants, debris, etc. removed from the aircraft. The process is faster and cheaper than chemical removal and allows media recovery. This process is compliant with Federal and State of Pennsylvania Health, Safety, and Environmental requirements.
Chrome Plating	Boeing deactivated the chrome plating line on August 2, 1996. The large Chromic Acid Anodizing line was replaced with Boric-Sulfuric Acid Anodizing in 1997. The small Chromic Acid Anodizing line meets environmental regulations using wetting agents that reduce chromium emissions. Qualifications testing is underway to approve Boric-Sulfuric Acid Anodizing for fatigue critical parts in an effort to completely eliminate Chromic Acid Anodizing from use at this facility.
Methyl ethyl ketone	Used to remove caked propellant and carbon buildup on weapons. Methyl ethyl ketone has been replaced at Boeing. Replacements vary depending on the process and uses.
Magnesium	The PMO has implemented design changes to eliminate magnesium used in shafting, control tubes, and bell cranks and to replace the magnesium with steel. This was done to protect the integrity of these components from in-flight fires. The residual benefit was elimination of hazards associated with dust particles from machinery magnesium components.

Examples of Pollution Prevention Initiatives

TECHNICAL ACCOMPLISHMENTS

Drive System Magnesium Castings

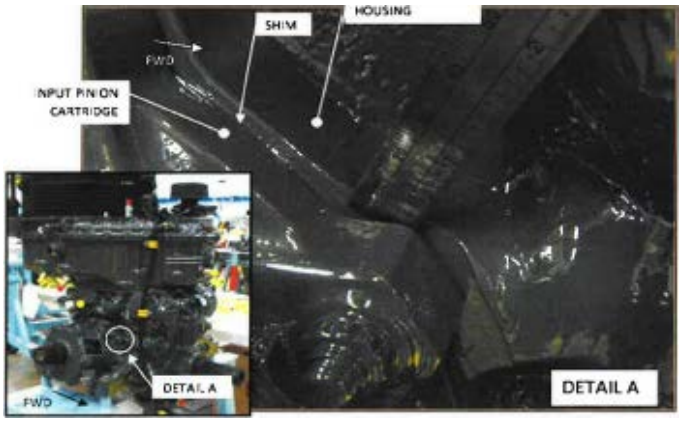
Elimination of the use of hexavalent chromium was identified as a primary hazmat goal. The use of the Tagnite© advanced coating system for magnesium surfaces of the Chinook Drive System was the result of a very successful project to identify appropriate replacements for hexavalent chromium.

The baseline coating system for cast and machined magnesium surfaces of the CH-47F Drive System consists of four different surface treatments and coatings. All of them, however, use a chromium-based surface treatment before application. The adhesion and abrasion-resistance requirements for that surface treatment, Type I HAE, were used as the performance requirements for the tests to qualify the Tagnite© coating.

After the laboratory tests were completed and data analyzed, the Tagnite© surface treatment met or

exceeded all physical and performance requirements necessary to replace the chromate surface treatments for cast, magnesium surfaces on a case-by-case determination. Boeing therefore created and approved a Process Specification for the manufacture and acceptance of the application on new production Drive System components.

The PMCH then adopted an advanced Tagnite© coating system to replace the chromate-based corrosion control treatment for the Block II aircraft.



Drive System Magnesium Surfaces

The Tagnite© coating system not only reduces the amount of chromium used on the CH-47 aircraft, but also will reduce parts rejection and the amount of re-work required.

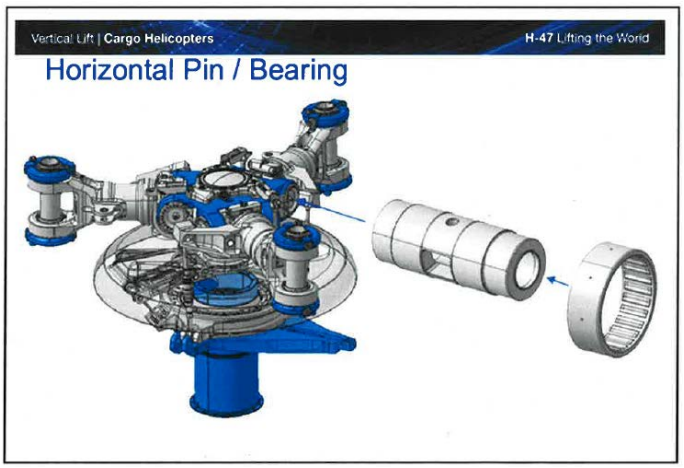
In addition, Rockhard© resin coating has been qualified as a replacement for the previous drive system resin coating based on methyl ethyl ketone and butanol. Rockhard© is sprayed over a base treatment on exterior surfaces and then cured with multiple heating and cooling cycles.

Improved Rotor System

The CH-47F Block II program includes an Improved Rotor System (IRS) that involves new swept-tip, anhedral advanced composite rotor blades. These blades provide 1,500 pounds of greater lift capacity. The increased loads required that the critical horizontal hinge pin had to be redesigned and the material was changed from AISI 9310 steel to PH 13-8Mo stainless steel. Also, the sleeves (bearing inner races) were strengthened by increasing their thickness and using M-50-Nil, a low-carbon, carburizing steel.

To eliminate the use of chromium plating for metal hardening and corrosion protection, a project was initiated to qualify a tungsten carbide (WC) High Velocity Oxy-Fuel (HVOF) thermal spray coating. Three coating suppliers were evaluated and two tungsten carbide coating chemistries were defined for full-scale fatigue testing.

Along with eliminating approximately 0.6 pounds of chromium per aircraft, the WC HVOF coating reduces wear and is more consistently applied. In addition, the pin and bearing are compatible with all the F and G models of the CH-47 aircraft. This will eliminate approximately 300 pounds of hexavalent chromium, based on current fleet size, and well over 300 pounds when spares and additional parts are considered.



CH-47F Block II IRS Horizontal Pin.

Ozone-Depleting Substances

PMCH has taken a leading role in the pursuit of a replacement for halon in the engine compartment fire suppression systems. Halon 1301 is a Class I ozone-depleting substance (ODS), which was banned from production in 1994. Over the last 25 years, the CH SSEWG has pursued multiple halon replacement efforts.

Over the last 3 decades, the PMO has participated in multi-agency initiatives to identify an effective alternative for Halon 1301. These initiatives include work with the other Services, Federal Aviation Administration, National Institute of Standards and Technology, Environmental Protection Agency and others in both private and public sectors.

Last year, DLA initiated a contract to produce a new

hand-held fire extinguisher that uses sodium bicarbonate (SBC) and the hydrofluorocarbon HFC-227 in lieu of Halon 1301. The new extinguisher was developed and qualified under a PEO Aviation and AMCOM project, in which the PMO was an active participant. The SBC extinguisher may be fielded on the CH-47F Block II with successful completion of testing. The CH SSEWG is monitoring the progress of the new extinguisher contract and the first article testing to ensure its producibility and availability.

With the exception of halon used for fire suppression, no Class I or Class II ODS are used or required during the production, operation or maintenance of the Block II aircraft.

Conclusion – Summary of Accomplishments

The CH PMO embraces integration of ESOH requirements throughout acquisition process. The CH-47F Block II program has successfully integrated ESOH principles into their Systems Engineering process, establishing a strong presence in the program which will carry through the remaining program phases. The CH SSEWG has put forth great effort to ensure safe and environmentally acceptable design, production, fielding and operation of Block II aircraft with minimal effect on mission effectiveness and program cost. Notable accomplishments over this Army Environmental Award period include:

- Successful integration of ESOH into the Systems Engineering process through the establishment of a cross-agency, interdisciplinary SSEWG.
- Established thorough HMMP identification process, based on NAS 411, to ensure hazmat were identified and efforts were initiated to either eliminate, reduce or mitigate their use throughout life cycle of the CH-47F system.
- Involved the Aviation Center of Excellence in the SSEWG to ensure ESOH hazards were coordinated with the user community throughout the program rather than when risk acceptance is required.
- Included ESOH related requirements in the Block II contract and included contractor involvement in the SSEWG.
- Integrated contractor P2 initiatives into the program baseline, along with safety and health requirements including hazardous material minimization.