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Demilitarization and Disposal: An ESH Perspective

Ever wonder what happens to military aircraft when they are no longer needed, have been severely damaged, or have reached the end of their life cycle? Generally, they are sent to the Air Force Material Command's Aerospace Maintenance and Regeneration Center (AMARC) facility, located at Davis-Monthan AFB (DM/AFB) near Tucson, Arizona.

B52s awaiting demolition in compliance with START.

This facility includes more than 5,000 aircraft from the Air Force, Army, Coast Guard, Marine Corps, and Navy. This fleet provides a unique savings account from which the military units throughout the world may withdraw parts and aircraft.

The chief reasons for selecting DM/AFB as the site for a storage center were Tucson's meager rainfall, low humidity, and alkaline soil. These conditions make it possible to store aircraft indefinitely with a minimum of deterioration and corrosion. In addition, the soil (called caliche) is hard, making it possible to park aircraft in the desert without concrete or steel parking ramps.

Aircraft arriving at AMARC are placed in a flyable or temporary hold status, prepared for foreign military sales, salvaged for parts, or placed into long-term storage awaiting either eventual disposal or reuse determination. Once the military services have determined that no further need exists for the aircraft, they are released for disposal.

These aircraft and related parts are subjected to demilitarization processes to prevent further military use. Part of the process involves removing all remaining hazardous materials from the aircraft. Aircraft that will be stored are inspected and an inventory of subcomponents is made. The fluids are drained and systems preserved. The outside of the aircraft is then protected with various masking materials depending on the planned length of storage. Once protected, the vehicles are parked in rows in the dry Arizona desert. Many of the aircraft at DM/AFB may be used again, and can be restored to flight condition after a storage period ranging from weeks to many years.

For aircraft that will not be used again, a different process occurs. Demilitarization includes removing weapons and other designated items from the aircraft and then taking the aircraft off-line. Other demilitarization actions include removing equipment that still has, directly or indirectly, a significant military utility or capacity, such as sensitive radar equipment. The aircraft structure is then damaged in such a way that a scrap buyer (or anyone else!) cannot restore the structure. Any useful systems, equipment or parts are put into the parts supply system for that vehicle.

Hazardous materials, such as batteries, pyrotechnics and coolants, must be removed and, if necessary, disposed of when the aircraft are taken out of service. Some hazardous materials can be recycled and reused multiple times, but the materials will eventually have to be disposed of appropriately. For new weapons systems, including aircraft, the disposal costs, including demilitarization costs, are to be developed as part of the life-cycle cost analysis required by the DoD Regulation 5000.2R. Once the salvage work is completed, the aircraft carcasses are grouped together and sold to recyclers. They then grind, cut, saw, shred and/or smelt, and segregate, by material type (aluminum, steel, etc.).

Guillotine blade used to sever B-52s at predetermined points.

AMARC has recently (within the last three and one half years) planned, managed and supervised the elimination of 352 B-52 bombers in compliance with the conditions of the Strategic Arms Reduction Treaty (START). This was accomplished by using a 13,000 pound guillotine blade and Linkbelt crane with slip clutch that allows the guillotine blade to freefall, thereby severing the fuselage and wings into manageable sections for recyclers. Russian representatives have visited AMARC to confirm the elimination process.

This effort re-emphasized that design and material choices (often made 20-40 years prior to demilitarization) can and do affect the value of the aircraft to be recycled. More specifically, these environmental safety and health (ESH) decisions made years ago can have a major cost impact during disposal. This realization prompted the Air Force to recently hold a meeting in Tucson to discuss ESH issues associated with aircraft disposal. Discussions between Air Force, Army, Navy, and contractor personnel raised their awareness of current ESH aircraft disposal concerns. The following paragraphs share some of their thoughts.

Cadmium is one of the leading hazardous materials that generates costs in scrapping or storing an aircraft. A special water-capture/treatment unit had to be built to capture cadmium in the rinse water from washing aircraft prior to desert storage. Cadmium is also a problem for the scrap dealers that smelt the shredded metal. Expensive air capture equipment has to be used to control the cadmium fumes. Also, the slag that forms during smelting operations is extremely expensive to dispose of due to cadmium content.

Chromated paints on non-metallic composites present another problem. The composites themselves can be land filled, but painted composites may not be land filled due to leaching of hexavalent chromium from the paint. Incineration is another option for composite disposal, but if the composite is carbon fiber, then it can not be incinerated due to the potential release of small electrically conductive fibers. So if they can not be land filled or incinerated, a better disposal method needs to be found.

Some of the new alloy materials, such as aluminum lithium, may also be a problem for recyclers if the parts/structure cannot be distinguished from regular aluminum alloys. Radioactive materials also cause a major problem. When equipment boxes are shredded and mixed with other aluminum alloys, the material goes through a Geiger counter to find radioactive materials. A tiny amount of radioactive material accidentally mixed with a larger batch of material may prevent the whole lot from being reused. These problems can perhaps be mitigated somewhat by color-coding the hazardous material or by some other means of identification.

Guillotine at work on B-52 wing.

The bottom line is that demilitarization and disposal (D&D) is another ESH consideration. The DoD customer has advocated its inclusion in the acquisition process. As a result, the Program Office becomes responsible for its integration by utilizing risk management, cost analysis, and trade off techniques. Integration is most effective if: D&D concerns are addressed early in system development; lessons learned from earlier programs are utilized; and participation with systems engineering is obtained from the customer, ESH and D&D representatives. Ultimately, these decisions require input from subcontractors as well as the prime.

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BOEING INSTALLS A CHROMIUM-FREE LAUNCH VEHICLE PROCESSING LINE

The Boeing Expendable Launch System in Huntington Beach has been awarded a United States Air Force contract to develop prototype launch vehicles evolved from the long-successful Delta series. The Air Force defines this new product as the Evolved Expendable Launch Vehicle (EELV).

Boeing has developed a manufacturing plan which will evolve the Delta vehicle into a new family of launch vehicles, a highly marketable commercial product line. The Delta IV Medium will eventually replace the newly developed Delta III, while the Delta IV Heavy will accomplish heavy lift functions currently and historically performed by the Titan series.

In order to manufacture the evolved Delta IV, Boeing is utilizing the Focused Factory concept, an idea endorsed by the U.S. Air Force as part of the EELV development contract. To manufacture EELV and the commercial line, a major new facility has been master planned, designed, and constructed.

Fig. 1 Aerial view of factory under construction

The Focused Factory under construction covers 60 acres on a 400 acre site. The building will have 1.4 million square feet of floor space. This new factory at Decatur, Alabama (Fig. 1) is dedicated solely to the production of the Delta IV. Ground breaking took place in November 1997. The factory consists of four product centers: (1) skins and rings are machined, inspected, and anodized in the Skin, Ring, and Dome Center; (2) friction stir welding, variable polarity plasma arc welding, inspection, pressure testing, and application of thermal protection occur in the Tank Center ; (3) metallic and composite structures are assembled in the Major Structure Center; and (4) final assembly and production acceptance tests take place in the Stage Center.

Fig. 2 Mezzanine view of chemical processing line.

One of the primary goals in the design process was to make the factory as environmentally friendly as possible and to minimize costs related to the handling and disposal of hazardous materials. The chemical processing line was identified as one of the greatest potential sources for the generation of hazardous waste.

Fig. 3 First floor view of piping system for tanks

The line's processing tanks are 47 feet long, 9 feet wide, and 22 feet deep (Figs. 2, 3, and 4). All parts processed are fabricated from 0.875 to 1.5 inch 2219 aluminum alloy plate. The Delta vehicle liquid oxygen (LOX) and fuel tank skins have historically been protected from

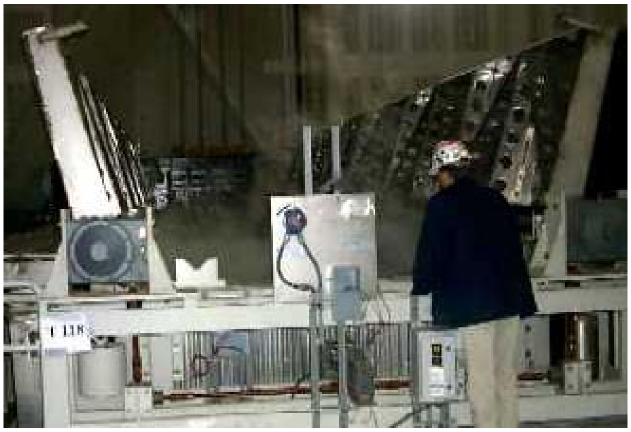

Fig. 4 Mezzanine view of typical tank lids

corrosion by chromic acid anodizing per MIL-A-8625. This process has used large amounts of hexavalent chromium compounds both in the deoxidizing and anodizing processes. This led to an expensive and complex waste water treatment plant and costly disposal of chromium-bearing sludge and solutions when the depleted tank solutions had to be changed.

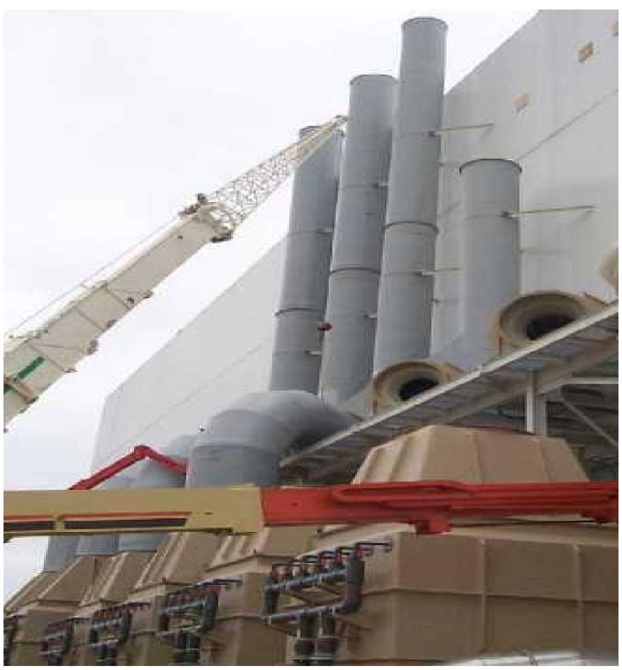

Fig. 5 Vent stacks for processing line scrubbers

In addition to hexavalent chromium compounds, hydrofluoric acid was used in the deoxidizing step. The material required special storage and handling facilities, as well as the preparation of an EPA required risk management prevention plan.

Boeing chose to completely change the process to eliminate the need for both hexavalent chromium compounds and hydrofluoric acid. An alkaline deoxidizing solution followed by an acid desmut bath will be used. The anodizing process will then be performed in sulfuric acid. The benefits of this selection are that the wastewater treatment process will consist only of neutralization prior to discharge and that there will be no cost for the handling and disposal of hexavalent chromium compounds. To capture the remaining regulated air emissions, fume scrubbers (Fig 5) will be used.

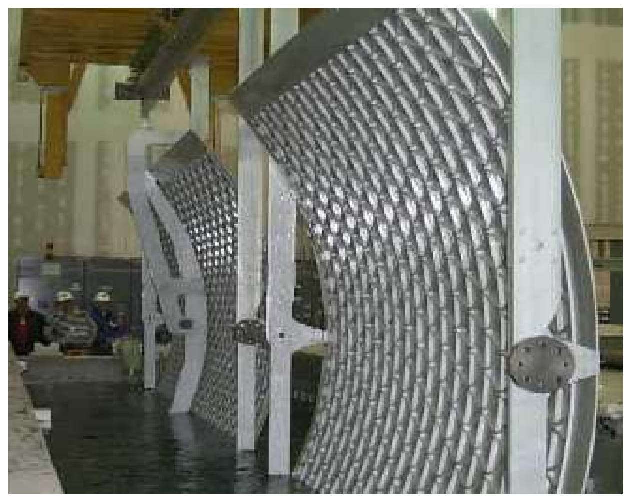

Fig. 6 Two skins mounted in tooling and ready for processing

The first production parts, liquid oxygen tank skins, (Fig. 6) were successfully anodized in March of this year.

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