Substitution & Elimination of CFCs at the Pantex Plant

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Introduction

Chlorofluorocarbons (CFCs) are categorized as Class I Ozone Depleting Solvents (ODSs). Due to the detrimental effects which these have on the ozone layer of the stratosphere, current federal legislation mandates their eliminated production. As part of this mandate, President Bush ordered the production of CFCs to cease by 1995. Facilities are, therefore, striving to eliminate the use of CFCs by this time.

In the past, large quantities of CFCs were used at the Pantex Plant as fire suppressants, as solvents, and as refrigerants. The solvents were primarily used for cleaning weapon components, as well as various other applications.

The Mason & Hanger has been very successful in its efforts to reduce the discharge of CFCs to the environment. This has been accomplished by initiating elimination, substitution, and recycling practices, as well as by instituting new technologies, such as waterjet machining.

Halon Fire Suppression Systems

The fixed Halon fire suppression systems installed at Pantex use Halon 1301 as the fire suppression agent. Halon 1301 is a Class I, Group II ODS. Current planning for phaseout involves replacing these systems with wet pipe automatic sprinkler systems.

The estimated cost to provide five buildings with an underground lead-in, install a building sprinkler system, and remove the Halon system is $391,000. The total cost to install automatic sprinklers from a connection to the existing building sprinkler system, and to remove the Halon system for three buildings is $22,000. The replacement activities are planned to begin in FY 1994.

The Halon fire extinguishers use Halon 1211, which is a Class I, Group II ODS. The Pantex Fire Department is replacing the 5-lb, 9-lb, and 13-lb extinguishers with conventional 10-lb Type ABC Dry Chemical extinguishers. To date, 140 of these units have been replaced. The Fire Department is awaiting the shipment of more ABC extinguishers to replace 214 more units. All 142 of the 1.25-lb and 1.5-lb Halon fire extinguishers have been removed from the flammable liquid cabinets. A fire hazard is not presented because these cabinets are located in close proximity to the 10-lb ABC Dry Chemical extinguishers. The cost of replacing the Halon extinguishers with ABC Dry Chemical units is estimated to be approximately $7000. The existing Halon extinguishers that were removed are being stored until orders for further disposition are received.

Solvent Operations

Solvents at the Pantex Plant have largely been used for removing component parts from weapon systems. All solvent substitution projects are approached with the goal of minimizing worker exposure to solvents. Operations, particularly ones using CFCs and perfluorocarbons, are performed in hoods or with some other draft device, such as an "elephant trunk". Protective clothing are also worn. CFCs are recycled, where practical, to eliminate the release of these solvents to the atmosphere.

A database is being gathered to identify worker exposure to each CFC or CFC substitutes. This information will be used to monitor workers in the event certain solvents are later identified as having a health risk.

A database of the plant's CFC and CFC substitute chemicals was completed in May '92. It lists all the

plant's chemicals, their building location, and the quantities on-hand. With this database building managers can be contacted for help in replacing and/or eliminating undesirable materials. The database is currently being updated to quantify the amount of improvement Mason & Hanger has made in different areas.

Most of the CFCs used for general cleaning purposes have been substituted with acetone, ethyl alcohol, or isopropyl alcohol. Several potential substitutes for CFCs have been identified. Each substitute is tested for compatibility with particular applications. Mason & Hanger has identified several good substitutes.

Freon TF (CFC-113) has been used to remove Kel-F in some of our operations. This is a Class I, Group I ODS. The substitute material for future disassembly activities will be a 3M's Fluoroinert Brand Electronic Liquid FC-43. FC-43 is composed mostly of perfluorinated octanes. It is inert, non-reactive, non-ozone depleting, and has virtually non-existent health risks. A filter and recycle system has been installed for reuse of FC-43. With the installation of the recycle system, the discharge of FC-43 will be 30-40 gallons per month.

The use of FC-84, which has a lower viscosity, lower boiling point, and higher vapor pressure than FC-43 at "dry ice" temperatures, is being evaluated as a replacement for Freon 113 for freezing Sylgard two-component packages.

The Explosive Engineering Section used Freon-MF as a solvent in its formulations. This is a Class I, Group II ODS. They are replacing this Freon with FC-43. This solvent will be used in a well ventilated facility to limit personnel exposure. A work space air sampling will be taken for the formulation of the next lot.

The Firing Site operations use Micro Duster spray cans, which contain CFC-12, a Class I, Group I ODS. The supply of these chemicals are being replaced with Micro Duster II OS (Ozone Safe).

The Electronics Department has substituted Tech Spray 1638, which contains Freon 113, with Envi-ro-tech 1677. Envi-ro-tech 1677 contains Freon 141 and other "ozone safe" components.

CFC-113 is used in Formulation Operations. The development and evaluation of a substitute is expected to require 0.5 man-years, at an estimated cost of $35,000. The work is scheduled to start in April 1993. Three solvents have been identified as possible candidates. These solvents are FC-72, Perfluorocarbon 5050, and Perfluorocarbon 5090. The research team is initiating the paperwork needed for approval of the substitution. This new process will eliminate 50 pounds of CFC-113 per formulation. Final evaluation and replacement is expected to be completed in January 1995.

The Gas Lab, which previously used Freons for cleaning diffusion pumps, has found two satisfactory replacements. A water-based system with Joy detergent followed by rinsing with ethanol proved to be satisfactory. Baked deposits in the pumps are able to be removed using Varley Porcelain Cleaner. This is also a water-based material containing substantial amounts of glycolic and phosphoric acid, which are not objectionable.

Genesolve 2000 has been approved as a ozone-safe substitute for Freon 113. The Pantex Plant has 14 pounds of the substitute on hand. However, until the health studies are completed, we are promoting the use of FC-43.

Mason & Hanger eliminated the use of solvents containing HCFC-123 upon receipt of its lowered exposure limits.

Alternative Technologies

As a viable alternative to solvent dissolution processes, the Pantex Plant uses a coherent high pressured waterjet instrument to mechanically machine the explosive PBX-9404, a HMX-based explosive, from metal parts. The waterjet sweeps a focused water stream across the assembly at pressures sufficiently high to cut the explosives off the part. Very little slurry or small pieces of HE are generated by this process.

The waterjet instrument is manufactured by Ingersol Rand and has a maximum rating of one gallon per minute and 55 kpsi water pressure. For the Pantex Plant's applications, the waterjet typically cuts at pressures of 20 - 40 kpsi, with a nozzle size of 0.010 - 0.014 inches. The waterjet operates at ambient temperatures with a typical flow rate of .5 gallons per minute. The water is recycled through the system by filtering the water through three filters, with the final filter being a 10 micron sock. Before machining actual parts, a factorial test is performed with

mockups to determine the feed rates, sweep pattern, and pressures to optimize the process.
In a typical two hour operation to remove PBX 9404, 20-25 gallons of waste water is generated. Most of this water originates from cleanup and wash down activities.

Research is being done to quantify the efficiency of the system, as well as adapting it to a broad range of explosives. Furthermore, markets are being investigated to sell the reclaimed HMX.

Plasma energy is used at the Pantex Plant to modify the surface and increase the wettability of explosives. This is not a cleaning activity and, therefore, is not a replacement for CFCs. However, the knowledge and experience that Mason & Hanger is gaining in this field can be used to remove topical contaminants in other applications. The CFC's associated with these applications could then be eliminated.

Refrigeration Systems

The Pantex Plant's refrigeration system chillers use two Class I ODSs: CFC-11 and CFC-12. The Maintenance Planning Section completed an engineering study that evaluated options for replacing or retrofitting chillers to accommodate substitute refrigerants that are less destructive to the environment. Five systems will be retrofitted. Two systems, each containing 525 pounds of CFC-11 will be converted using the refrigerant HCFC-123. Three systems, containing 675 lbs, 700 lbs, and 790 lbs of CFC-12 will be converted using the refrigerant HCFC-22. The estimated cost to retrofit each chiller is $65,000. The work is expected to begin by the end of CY 93.

The Pantex Plant's automotive department uses CFC-12 in its cooling systems. Mason & Hanger uses a recycle and reuse system that is able to recover approximately 95% of the refrigerant.