U.S. MILITARY HALON BANK MANAGEMENT STUDY

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OBJECTIVES

The objectives of this project were to research halon phaseout restrictions, identify halon uses, requirements, and inventories in the US military services and recommend amounts and strategies for maintaining a bank for the halon reserves to meet mission-critical needs (Reference 1). This included identification of emerging halon replacement chemicals and alternative fire protection methods to be used in place of halon systems, and their effect on the halon reserve needs for the bank.

BACKGROUND

Halons, along with chlorofluorocarbons (CFCs), are part of a family of chemicals that have been implicated in depleting the earth's protective stratospheric ozone. Certain ozone depleting-chemicals (ODCs), including Halons 1211 and 1301, are now being phased out of production through international and domestic regulations. The current phaseout date for production of halons is 1 January 1994, except for limited amounts for uses determined to be essential. Halons are used extensively in the military services, with many applications classified as mission-critical uses. A complete analysis of halon replacement technologies, alternative fire suppression methods, and availability of recovered and recycled or reclaimed halons from nonmission-critical uses is required to ensure that plans are made to meet the mission-critical needs of the services.

THE COPENHAGEN AMENDMENTS TO THE MONTREAL PROTOCOL

The Fourth Meeting of the Parties to the Montreal Protocol was held in Copenhagen, Denmark on **23-25** November **1992.** At that meeting, the Parties agreed to accelerate the phaseout schedule for certain controlled substances, including halons (Reference 1). The Parties also agreed to allow for an exemption of essential uses of controlled substances from the consumption phaseout schedule. It was further agreed "that production and consumption, if any, of a controlled substance for essential uses should be permitted only if all economically feasible steps have been taken to minimize the essential use and any associated emission of the controlled substance; and the controlled substance is not available in sufficient quantity and quality from the existing stocks of banked or recycled controlled substances".

SUBSTITUTES FOR HALONS

There are two different approaches to decreasing the reliance on halons: (1) use of replacement chemicals and **(2)** use of alternative fire extinguishing agents or methods. A replacement chemical is an extinguishant that is chemically similar to the present halons and CFCs, e.g., a halogenated hydrocarbon. An alternative is the use of either an extinguishing agent that does not resemble halon in its chemistry or a different method of achieving the required fire protection.

1. Status of Possible Replacements for Halons

Halon replacement chemicals generally require four characteristics: low-ozone depletion potential, acceptable toxicity, cleanliness and volatility, and effectiveness. Though it is very easy to find candidate replacement chemicals that meet any three of these criteria, it is difficult to find agents that meet all four. Some believe that a low atmospheric lifetime should be included in this list owing to increased concerns about global warming (i.e., the Global Warming Potential of a chemical) and that long-lived chemicals may lead to unanticipated environmental problems. Although a much longer list of agents now under serious investigation could be given, Table 1 contains a list of candidate replacement agents that are now planned for commercialization. In Table 1, the SVEq values are derived from laboratory data or are estimated and may not be applicable to **real** scenarios, particularly for streaming applications.

Three conclusions can be drawn. First, all announced candidates have significant tradeoffs in environmental acceptability (ODP, atmospheric lifetime), toxicity, and/or effectiveness. Second, advanced (second-generation) replacements with fewer or no tradeoffs will require time to be developed. Until the applicability of candidate replacement chemicals is better defined, halon minimization and conservation and alternative methods of fire protection should be used.

2. Alternatives to Halons for Fire Protection

At least five different classes of alternative extinguishing agents exist—water, dry chemicals, carbon dioxide, foams/loaded stream, and inert gases; they have differing applications depending on the fire type. None of the agents discussed, whether alternatives or replacements, is satisfactory for Class D (combustible metal) fires.

For Class **A** (ordinary combustibles) fires, water is much more effective than halons. However, water does have some disadvantages: (1) it can cause secondary damage (damage to facilities and contents due to the agent); **(2)** clean-up is required; (3) it is not well suited for Class C (energized electrical equipment) fires; and **(4)** in most cases, it is relatively poor for Class B (flammable liquid) fires. In many cases, the disadvantages of water can be overcome.

TABLE 1. CANDIDATE REPLACEMENT AGENTS FOR COMMERCIALIZATION.

Manufacturer and Designation	Chemical	Chemical Formula	Primary Application	SVEq[a]	ODP
Great Lakes *FM100*	HBFC-22B1[b]	CHF_2Br	Streaming	1.3	~1.4
DuPont FE 232	HCFC-123[c]	CF_3CHCl_2	Streaming	2.3	0.02
DuPont FE 241	HCFC-124[c]	CF_3HClF	Total-flood	2.9	0.022
3M PFC310	FC-3-1-10[d]	$CF_3CF_2CF_2CF_3$	Total-flood	3.0	0.0
3M *PFC514*	FC-5-1-14[d]	$CF_3CF_2CF_2CF_2CF_2CF_3$	Streaming	3.1	0.0
DuPont FE 13	HFC-23[e]	CHF_3	Total-flood	4.6	0.0
DuPont FE 25	HFC-125[e]	CF_3CHF_2	Total-flood	3.2	0.0
Great Lakes FM200	HFC-227ea[e]	$CF_3CHFCF23$	Total-flood	2.5	0.0
North American	NAF S-III	Blend (primarily HCFC)	Total-flood	~2.3	0.05
Fire Guardian	NAF P	Blend (primarily CFCs)	Streaming		1.0
American Pacific	*Halotron I*	Blend (primarily HCFC)	Streaming		0.02

[a]SVEq means storage volume equivalent relative to that of the quantity of halons required to obtain the same fire protection; e.g., an SVEq of 2 means that twice as much storage volume for the agent is required.
[b]HBFC means hydrobromofluorocarbon.
[c]HCFC means hydrochlorofluorocarbon.
[d]FC means perfluorocarbon.
[e]HFC means hydrofluorocarbon.

Another type of water-based fire suppression system that may be a viable alternative is water misting. There is a lot of interest in water misting technology, also called water fog or fine water mist; some research and development work is in progress. The obvious desirability of water mist systems lies in both the smaller quantities of water used and the reduced potential for secondary damage from excess water and the resultant cleanup.

Dry chemicals, generally used in portable extinguishers, provide rapid knockdown of fires and are often more effective than halons. These chemicals, however, can cause severe secondary damage to electronic and mechanical equipment and usually require major cleanup. Dry chemicals are suitable for Class **A,** B, and, in some cases, C fires depending on the agent. They are often good halon substitutes in situations where a range of different fire classes is possible.

Carbon dioxide has none of the secondary damage or cleanup problems of water and dry chemicals; however, it has a low effectiveness and cannot be used for total-flood applications in occupied areas since its lethal concentration is lower than its extinguishing concentration. **As** with carbon dioxide, in only a few selected applications can inert gases be used owing to the danger of asphyxiation. However, at least one proprietary mixture that **is** claimed to be breathable **is** being marketed.

One other alternative to a halon fire suppression system exists, i.e., no active fire suppression system at all. Water sprinkler systems should be the objective for a baseline fire protection system for most facilities to protect the facility itself, if not the contents, from fire spread and catastrophic loss. But other considerations may make the fire risk so low that an active fire suppression system may not be warranted. Such factors as the construction of the facility, the fire load of the contents, the fire threat of adjacent or adjoining structures, the response time of firefighters, and the percentage of time the facility is staffed are all considerations in making that decision. If response time by an emergency response team is short or the facility is continuously staffed, a properly supervised ultrasensitive detection system or other system capable of detecting the early products of combustion may be sufficient. Early warning, optical air sampling systems can detect overheating of combustible materials well before ignition and alert response personnel who can take necessary steps to prevent the start of a fire (Reference 2).

RECOVERY, RECYCLING, AND RECLAMATION OF HALONS

Since recovery, recycling, and reclamation (RRR) of halons are critical to their removal and reuse, the status of RRR technology is discussed. The terms recovery, recycling, and reclamation (RRR) could have a variety of meanings depending on personal interpretation. The Air-conditioning and Refrigeration Institute (ARI) initially defined these terms to standardize their use for CFCs. The following definitions have been tailored to cover ODCs and were adopted at the Fourth Meeting of the Parties to the Montreal Protocol (Reference 3):

Recovery: The collection and storage of controlled substances from machinery, equipment, containment vessels, etc., during servicing or prior to disposal.

Recycling: The reuse of a recovered controlled substance following a basic cleaning process such as filtering and drying. For refrigerants, recycling normally involves recharge back into equipment. It often occurs "on-site."

Reclamation: The reprocessing and upgrading of a recovered controlled substance through such mechanisms as filtering, drying, distillation, and chemical treatment in order to restore the substance to a specified standard of performance. It often involves processing "off-site" at a central facility.

Recovery and recycling are appropriate any time halon has to be removed from an extinguisher or storage container. Halon 1211 extinguishers have traditionally been filled or emptied using pressure transfer of the liquid halon. Losses occur when disconnecting the transfer hoses and allowing the residual halon vapor to escape. Recovery and recycling units eliminate most of these losses by the use of liquid pumps to transfer the liquid halon and then a compressor to remove all of the vapors and recondense them to a liquid in the storage tank. In addition, recycling units remove contaminants such as acids, moisture, oils, and particulates by passing the halon through replaceable filter-driers. Noncondensable gases can be removed by a purge system, with some small loss of halon vapors.

A Halon 1211 recovery and recycling unit was developed (Reference 4) and is being produced under contract to the US Navy; it is available for purchase by DoD agencies through the Navy contract. This unit meets the 99 percent recovery efficiency requirement of UL 2006. Further information can be obtained about availability of this unit by contacting Pam Jubic, Naval Air Warfare Center, Aircraft Division Lakehurst, Code SR-41, Lakehurst, New Jersey (908-323-1397).

Efficient recovery and recycling of Halon 1301 is more difficult than for Halon 1211 because of the low boiling point (-72 "F) and high vapor pressure (207 lb/in.^{2} at 68 "F) of Halon 1301. In addition, Halon 1301 is usually superpressurized with nitrogen to 360 lb/in.^{2} or 600 lb/in.^{2} in extinguishing systems depending on the application, which means that recovery and recycling equipment must be able to handle these higher pressures. Very little work has been done on the effects of the nitrogen pressurizing gas in the possible contamination of Halon 1301. Other possible contaminates are oil residues, particulates, acids, and moisture.

Several devices have been developed to recover and recycle Halon 1301, and four are available for purchase. They have been developed for specific applications, primarily that of recovery, recycling, and recharging relatively small Halon 1301 bottles (a few kilograms halon capacity) such as those from tracked combat vehicles and aircraft engine nacelle systems. These units are designed to remove contaminants from the halon including the nitrogen used for superpressurization. The systems are automated for ease of operation and accuracy. The cost of these machines is generally in the $100-200,000 range. A Halon 1301 recoverylrecycling system designed specifically for the large tanks or cylinders used for room-size, total-flood systems is not yet commercially available. The four commercialized machines will perform that function; however, their throughput rate may be too low for practical recovery/recycling of larger quantities of Halon 1301. The names of the companies that make the commercialized machines are given below:

1. HAL'' by, Team Aer Lingus and Marotta Scientific Controls, Inc., Montville, NJ (201) 334-7800

2. REACH", Walter Kidde Aerospace, Inc., Wilson, NC, (919) 237-7004

3. A Halon 1301 Recycling System, Pacific Scientific, Duarte, CA, (818) 359-9317

4. A Halon 1301 Recovery System, AES-NTRON INC., Exton, PA, (215) 524-8800

HALON USES AND INVENTORY IN THE US MILITARY

1. Army Halon Uses

The major use for halon fire suppression systems in Army fixed facilities, both in the amount of halon used and the dollar value of equipment protected, is Halon 1301 total-flood protection of computer systems. These systems have been protected with halons for a variety of reasons including design convenience, dollar value of equipment, and importance of equipment and data with respect to site operations and Rational security. Another large use of halon systems in Army facilities is for the protection of communications equipment, which is normally considered to be of importance to national security. Other facilities protected by Halon 1301 total-flood systems are electronic laboratories, chemistry laboratories, museum artifact storage, and hospital diagnostic equipment.

Halons are used to protect Army weapons systems resources in both fire and explosion suppression applica :ons. Halon 1211 is used in wheeled and handheld extinguishers on flightlines to protect fixed and rotary wing aircraft. Halon 1301 is used for fire suppression in aircraft engine nacelles, watercraft spaces, and tracked combat vehicle engine compartments. It is also used in total-flood explosion suppression systems for crew compartments of combat tracked vehicles.

2. Army Halon Inventory

In the first phase of this study, an inventory of the halons contained in US Army fixed facilities was conducted. About 65 percent of the installations conducted inventory surveys and provided the information for this study. An algorithm was developed and estimates of the halon inventories at the remaining installations were calculated. The details of the Army study are contained in a separate report (Reference 5). Table 2 shows the summary halon inventory data from the Army study.

The accuracy of the Army Halon 1301 inventory total is considered to be about plus or minus 13 percent. Results of the inventory of Army halon uses in nonfacility (weapons systems) applications were not available for this study. The Army Materiel Command is collecting the data for the weapons systems halon inventory estimates and the halon requirements for mission-critical uses.

3. Navy Halon Uses

Halon uses in the US Navy can be divided into three broad categories: shipboard, shore facilities, and aircraft. Halon 1211 primary uses are for aircraft fire protection with portable fire extinguishers on shore flightlines and shipboard flight decks, in crash/fire/rescue vehicles and twin agent units, and for limited Marine *Corps* firefighter training. Halon 1301 primary uses are for fire suppression of shipboard spaces by total-flooding, aircraft engine nacelles, shore facility total-flooding, aircraft fuel tank inerting, and handheld portables for aircraft passenger/cargo spaces.

TABLE 2. ARMY FIXED FACILITY HALON INVENTORY.

	Halon 1301 (lbs)	Halon 1211[a] (lbs)
Actual	612,622	244,026
Projected	332,350	[b]
TOTAL	944,972	244,026

[a]The information on Halon 1211 was requested but not emphasized and is included here from those installations that did provide the information.
[b]Not projected.

4. Navy Halon Inventory

The Navy halon inventory data available for this study are based on information compiled at the end of 1992. These data are subdivided into halons installed in operational systems, held in storage as reserves, and available in supply ready for issue. The summary inventory data for the Navy are shown in Table 3. An estimate of the accuracy of the Navy inventory data was not provided.

TABLE 3. NAVY HALON INVENTORY.

	Halon 1301 (lbs)	Halon 1211 (lbs)
Installed in Systems	1,978,096	1,976,000
Held in Storage	101,057	336,000
In supply for Issue	3,000	------
TOTAL	2,082,153	2,312,000

5. Air Force Halon Uses

Halon uses in the Air Force are primarily on aircraft, on flightlines, and in fixed facilities. Aircraft uses are Halon 1301 fire suppressions systems in engine nacelles, auxillary power systems, and gun compartments, explosion suppression systems in fuel tanks, and handheld portables for cargo and passenger compartments. Uses on the flightline are Halon 1211 wheeled, portable extinguishers and installed systems on crash/rescue vehicles. The Air Force recently issued guidance to disable the Halon 1211 systems on crash/rescue vehicles and implement a phased program to replace the systems with nonhalon firefighting agents.

6. Air Force Halon Inventory

The Air Force halon inventory data presented here are based on a request to all commands to provide halon inventory, procurement, and use information for the period 1 Jan-30 Jun 1992. A summary of the reports for that period are shown in Table 4. It is not known how much of the data are from actual physical inventories or from estimates. Therefore, the accuracy of the data is unknown, and no estimates were attempted.

TABLE 4. AIR FORCE HALON INVENTORY.

	Halon 1301 (lbs)	Halon 1211 (lbs)
TOTAL	2,067,744	6,620,510

D. THE DEPARTMENT OF DEFENSE

Taking the available Halon 1211 and 1301 inventory data from the Army, Navy, and Air Force and adding them gives the total Halon 1211 and 1301 resources available (with the limitations on data availability and accuracv previously specified) in the DoD. Table 5 shows the inventories from each of the services and the DoD totals.

TABLE 5. DoD HALON INVENTORY.[a]

	Halon 1301 (lbs)	Halon 1211 (lbs)
ARMY	944,972	244,026
NAVY	2,082,153	2,312,000
AIR FORCE	2,067,744	6,620,510
TOTALS	5,094,869	9,176,536

[a]It must be emphasized that the Army Halon 1211 data are only a partial inventory, that the Army Halon 1301 data are only for fixed facil' , and that the accuracy and completeness of the other data are not known or were not provided.

HALON REQUIREMENTS

The size of the halon bank or reserve required is dependent on the projected use rate of halons in particular applications and the projected lifetime of the resource being protected. This is a worst-case scenario since it is assumed that an acceptable replacement will not be found within the useful lifetime of the resource being protected. The military services are working to determine the size of halon reserve or bank required to meet their mission-critical needs. The mission-critical halon use rate will determine the minimum rate by which halons must be removed from nonmission-critical uses, reclaimed, and placed in the bank. The mission-critical halon use rates of the services, and therefore the banking requirements, are still being refined by the services and thus not available for this study. Some preliminary requirements provided by the Navy were for a total of 1,000,000 lbs of Halon 1211 and 2,777,000 lbs of Halon 1301 to be banked to meet Navy mission-critical needs throughout their service life. Those requirements now must be re-evaluated because of the recent announcement of further base closings and force and weapon systems reductions. Preliminary estimates from the Army and Air Force were not provided.

Halons are an important DoD resource that must be conserved, removed from use for nonmission-critical applications, and placed in a managed reserve (bank) for use in mission-critical applications. The amounts banked as an asset now could become a liability later if excessive amounts are left when they are no longer needed and have to be destroyed. Consequently, realistic estimates of bank requirements need to be prepared and reassessed periodically.

MILITARY BANKING STRATEGIES

There are many possible ways that the military halon reserve from nonmission-critical uses could be allocated *to* or placed in a bank to be drawn from in the future to meet mission-critical needs. In all cases, for halons installed in systems, there will be some processing of the halons required to recover them from their containers and recycle *or* reclaim them to acceptable quality for reuse. Three banking strategies are presented here with consideration given to their advantages and disadvantages: decentralized, centralized, and a combination of centralized recovery, reclamation, and banking with some decentralized recovery.

1. Decentralized Banking

In this banking strategy, each installation that has a significant amount of nonmission-critical halons would establish the capability to process them on site as they were removed from service. This strategy would require the allocation and training of manpower, facilities in which to store and process halons, and the purchase of recovery and recycling or reclamation equipment and bulk halon storage/shipping containers. A capability to test or have the reclaimed halon tested to verify the purity would also be required. The reclaimed halons could then be shipped to organizations within their own military service as mission-critical requirements were identified. As their own requirements were met, excess reclaimed halons could be provided to the other military services as priorities dictated.

The advantages to this banking strategy are as follows: (1) it establishes the control of the halons at the lowest organizational level where the most is known about the halons and their availability for recovery, and (2) it precludes the requirement for a potentially large organization and facilities that may have to be constructed to handle large quantities of halons. The disadvantages are the following: (1) it could cost more since economy of scale would not be realized in the recovery and reclaiming of the halons, and (2) local priorities on allocation of reclaimed halons may not be in agreement with those of the individual service or DoD.

2. Centralized Banking

In this strategy, one or more centralized centers could be established to receive nonmission-critical halons in their original containers, be responsible for the recovery and reclamation of the halons, the testing and certification of punty, short-term and long-term storage in proper storage/shipping containers, and distribution for mission-critical uses according to established priorities. The center(s) could be set up within each military service (Army, Navy, Air Force) or by the DoD. The center(s) could procure and operate the equipment to recover and reclaim the halons, or contract the responsibility to commercial firms.

The following are the advantages of this banking strategy; (1) it will probably cost less because economy of scale can be realized due to the recovery and reclamation of large quantities of halons, and (2) the reallocation of reclaimed halons to the highest priorities can be better controlled by an independent organization whether the center is within each service or in the DoD. The disadvantages of this strategy are (1) it could cost more unless care is exercised to ensure that an excessively large organization and capability is not put in place, and **(2)** a centralized organization will usually have little knowledge about the potential availability and history of the halons at the installation level.

3. Combination Strategy

In this strategy, there could be a combination of centralized recovery, reclamation, and banking with some decentralized halon recovery and storage. This is the strategy that is recommended by this study. The majority of the nonmission-critical halons would be shipped directly to the centralized center(s) in their original containers. Where there are high concentration of halon systems in a geographic area, it will probably be more cost effective to purchase recovery/recycle equipment for that area to recover the halons from the smaller cylinders and consolidate the halons into larger bulk Department of Transportation (DOT) approved storage/shipping containers (typically 1500 lbs for Halon 1211 and 2000 lbs for Halon 1301). The recovered halons could then be stored locally until needed at the reclamation center or shipped as soon as the container was filled. This approach could be particularly better suited for transporting halons from OCONUS installations to CONUS centers.

DEFENSE LOGISTICS AGENCY BANK

After this study was begun, the Defense Logistics Agency (DLA) was designated by the DoD as the agency to establish and manage the DoD halon reserve (bank) to meet mission-critical needs for the life of the DoD systems being protected. Although their plans are preliminary, the DLA has indicated that they will establish two centers to receive halons for recovery and placing into the DoD halon bank: one in Richmond, VA, and one in Ogden, UT. DLA has also indicated that they will **track** the source of the halons as they are received and credit the accounts of each particular service (Army, Navy, Air Force). It is incumbent upon the services to protect and preserve halon resources, both to abide by the novent laws and to maintain halon resources for DoD mission-critical needs. The points of contact at DLA for establishing the bank program are Lt. Col. Randy Turner, DSN 667-7883 (703-617-7883) or Mr. Jan Reitman, DSN 284-6124 (703-274-6124).

CONCLUSIONS AND RECOMMENDATIONS

1. CONCLUSIONS

Halons are used in a variety of applications in the DoD, but only the major uses were outlined here. Halon 1211 is used extensively for aircraft fire protection on flightlines and flight decks using wheeled portable extinguishers and crash/fire/rescue vehicles. Use of handheld Halon 1211 extinguishers was widespread, but most of those uses are being phased out, except for the few mission-critical applications. Halon 1301 is used extensively in total-flood systems to protect computers, communications equipment, and other electrical/ electronic resources in land and shipboard facilities. It is used in total-flood systems to protect aircraft engine nacelles and auxillary power systems, aircraft gun compartments, and the engine compartments and crew spaces of tracked combat vehicles. It is also used for explosion suppression of crew spaces of tracked combat vehicles, aircraft dry bays, and inerting of aircraft fuel tanks. Finally, Halon 1301 handheld extinguishers are used to protect the crew, passenger, and cargo spaces of aircraft.

Although several halon replacement chemicals have been announced by various manufacturers, all of them have some deficiencies, and some have serious deficiences, when compared to Halons 1211 and 1301. Most require significantly greater quantities for suppression when compared to the halons. A true "drop-in" replacement for Halon 1301 is not available and will not likely be available in the near future; therefore, alternative fire protection methods will need to be used to protect nonmission-critical resources. These alternative methods will need to be installed as Halon 1301 systems are removed from service.

A bank or reserve of halons, recovered from nonmission-critical uses, will need to be established in order to meet the mission-critical requirements of the DoD. Halons removed from nonmission-critical uses must be recycled or reclaimed to meet acceptable purity standards for reuse.

The halon inventory data from the services are not complete; the use rate and total mission-critical requirements have not been finalized. These data will have to be complete before it can be determined whether there are sufficient halons in nonmission-critical uses, which can be removed and placed in the bank, to meet the mission-critical needs of the DoD.

2. RECOMMENDATIONS

Every effort should be made to minimize emissions of halons as required by current regulations and directives. Conservation of these resources reduces the effect of ODCs on stratospheric ozone and also conserves them for use in DoD mission-critical applications.

Priority needs to be given by the individual military services to perform complete physical inventories of all halons and their uses if they have not done so and to project their mission-critical requirements. Accurate data are essential before the plans for banking can be finalized.

Planning should begin immediately to program the resources required to replace halon fire protection systems. Replacement chemicals will not be available in the short term to replace the halons with in-kind type protection. Alternative fire protection methods must be used in all applications except those designated as mission-critical. The early installation of alternatives to halons for fire protection will ensure that adequate quantities of recovered halon are deposited in the DLA bank to meet the mission-critical needs of the services and the DoD. Funds originally programmed to buy new (virgin) Halon 1301 for mission-critical requirements could be used to install alternative fire protection systems where nonmission-critical halons are now used. The early installation of these alternative fire protection methods would ensure halons are freed to be reclaimed and placed in the DoD bank.

Revision of military standards, specifications, and maintenance documents to allow the use of properly recovered and recycled or reclaimed Halon 1301 must be given priority, or the end user will not be able to use the Halon 1301 removed from nonmission-critical systems. The revisions can be based on the new **ASTM** standard for recovered and recycled or reclaimed Halon 1301, which is due to be released soon.

In order to provide halons for the mission-critical needs of the services, there needs to be a bank of reserve halons established to conserve the halons removed from nonmission-critical resources. To realize the economies of scale, it is recommended that one or more regional centers be established in the **CONUS** to receive the halons in their original containers and recover, recycle or reclaim the halons. The center(s) could be established within each military service or within the DoD. Reclamation could probably be accomplished more cost effectively by contracting with established firms to bank halons in large batches rather than building **an** in-house capability. Procurement of recovery and recycle machines at some locations to consolidate halons from system cylinders to bulk shipping/storage containers may be more cost effective, particularly for OCONUS regions.

As halon systems are removed from service, the cylinders containing the halon should be kept in suitable storage until the final procedures are available and distributed on how to transfer them to the DoD halon bank managed and **operated** by the **DLA.** The purchase of a recovery/recycle devices to recover the halons from system cylinders into bulk storagelshipping tanks may be appropriate for some installations or regions.

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