

THE OZONE HOLE AND THE MONTREAL PROTOCOL

Discovery of the Ozone Hole

In 1974 scientists published the first scientific hypotheses that chemicals we produced could harm the stratospheric ozone layer. The ozone layer protects the earth against excessive ultraviolet radiation, which can cause genetic damage to human, plant, and animal cells. Scientists found that heavy chlorofluorocarbon gases (CFCs), which were widely used and viewed as posing no harm, could migrate to the stratosphere, remain intact for decades to centuries, and by releasing chlorine break down the ozone layer.

Montreal Protocol

In 1977 the United Nations Environment Programme (UNEP) concluded a World Plan of Action on the Ozone Layer, which called for intensive international research and monitoring. In 1981, the UN Governing Council authorized UNEP to draft a global framework on stratospheric ozone protection. The Vienna Convention, concluded in 1985, is an accord in which 28 signatory countries agreed to cooperate in research and scientific assessments of the ozone layer, to exchange information, and to adopt “appropriate measures” to prevent activities that harm life. The obligations, however, were general and contained no restrictions on ozone-depleting substances (ODS).

After the Vienna Convention, a UNEP Working Group began negotiations on a Protocol. The Montreal Protocol was concluded in September of 1987, only nine months after the diplomatic negotiations opened, and went into effect on January 1, 1989. 46 countries ratified the original Protocol, including the United States. There are now 197 signatories.

This treaty initially required that the use (defined as production and import) of CFCs, halons, carbon tetrachloride (Carbon Tet), and methyl chloroform (TCA) - all identified as Class I ODS - to be frozen by the year 2000. The London Amendment of 1990, however, called for a ban of the use of Class I ODS by 2000, and the Copenhagen Amendment of 1992 accelerated the phase-out of halons to January 1, 1994 and all other Class I ODS by January 1, 1996. Subsequent Amendments identified Class II ODS (hydrochlorofluorocarbons or HCFCs) and their phase-out dates.

Clean Air Act of 1990

Title VI of the Clean Air Act of 1990 codified these bans in the U.S. It also introduced various requirements and restrictions on the servicing of equipment using ODS, in fire suppression (Section 602) and stationary (Section 608) and mobile (Section 609) air conditioning and refrigeration (AC&R) systems. It also introduced the Significant New Alternatives Policy (SNAP) program (Section 612), through which the Environmental Protection Agency (EPA) controls - approves, limits or disapproves - the use of ODS alternatives by chemical composition in all the industrial sectors where ODS are used.

ESTABLISHMENT OF THE DOD ODS RESERVE

Army Requirements for ODS

The 1989 Department of defense (DoD) Directive 6050.9, "Chlorofluorocarbons and Halons," required the Services to ensure that "the required amounts and types of CFCs and halons are available for mission-critical applications when substitutes are not yet available." Department of the Army Letter 200-90-1, "Eliminating or Minimizing Atmospheric Emissions of Ozone-Depleting Substances," further defined mission-critical applications to include cooling operational assets and charging fire and explosion suppression systems in tactical vehicle crew compartments.

On August 11, 1992, the Under Secretary of Defense tasked the Military Departments to estimate and fund their ODS requirements. In December 1992, the Defense Logistics Agency (DLA) requested that the Services provide estimates of how much Class I ODS they would need to support their weapon systems until they were either modified or retired. They were also asked to provide estimates of how much of this requirement could be satisfied through the turn-in of excess ODS, and how much additional Class I ODS would then need to be procured to satisfy the remainder of their requirements.

The DOD ODS Reserve

The National Defense Authorization Act (NDAA) for Fiscal Year (FY) 1993 tasked DLA to support the ODS requirements for the DoD. Specifically, DLA was directed to 1) evaluate the use of ODS by the Military Services, 2) develop plans to reclaim, recycle, and reuse ODS, 3) create and maintain a stockpile or "Reserve" of Class I ODS, and 4) to report their progress on these actions to Congress. In light of the Services ongoing bottom-up review of future personnel, mission, and resource requirements, in July 1993 the DLA requested that they revalidate their ODS mission-critical requirements.

The DoD ODS Reserve was set up at the Defense Depot Richmond Virginia (now DLA Distribution Richmond Virginia) (DDRV), with administrative offices in the Headquarters building of the Defense Supply Center Richmond (DSCR) (now DLA-Aviation). The ODS Reserve went on line on January 1, 1994. DLA operates the ODS Reserve, and requisitions for Class I ODS are processed through the normal DoD supply system, but issues are controlled (approved) by the individual Services and each Service owns the product in their "account." In this way, each Service manages their own ODS Reserve.

Army ODS Reserve

The Environmental Support Office of the Assistant Secretary for Acquisition, Logistics and Technology (ASA(ALT)) (SAAL-ESO) manages the Army ODS Reserve. The ESO monitors Army ODS requirements, approves every individual requisition for Class I ODS issued to an Army unit, performs oversight of Army ODS replacement efforts at development and research activities and coordinates with the DoD ODS Reserve.

ARMY ODS REQUIREMENTS

Mission Critical Uses

The Office of the Secretary of Defense (OSD) defined an ODS mission-critical requirement as either a situation where an ODS use has a direct impact on combat mission capability, including uses that are integral to combat mission assets, or an ODS use that affects the operation of those assets. OSD permitted the Services to designate their ODS mission critical requirements, and the Army identified specific combat mission assets and designated specific mission-critical applications for ODS.

The Army initially included just two Class I ODS, CFC-12 (Freon) refrigerant and Halon 1301 fire suppression agent, as being mission-critical. Freon was used for AC&R in food service, mobile hospitals, tactical shelters, watercraft and ambulances. Halon was used for fire suppression in ground vehicle and watercraft engine compartments and aviation engine nacelles, for explosion protection in ground vehicle crew compartments and in support of numerous types of vehicles, shelters and equipment through hand-held fire extinguishers (HHFEs). Both Freon and halon were used heavily in facilities applications as well, but OSD identified these uses as mirroring commercial, civilian applications and therefore not of a “mission critical” nature. So the uses of halon for computer center fire suppression and Freon for comfort cooling of office spaces were not considered mission critical and so are not supported by the Army ODS Reserve.

Army Halon Requirements

In September 1993, in response to a DLA request, the Army re-evaluated its estimates for mission-critical requirements, for CFC-12 for 1994 through 1999 and Halon 1301 for 1994 through 2020. The Army further refined these estimates in 1994 and 1995.

INITIAL ARMY HALON RESERVE REQUIREMENTS

Date	Buy (lbs)	Reuse (lbs)	Total (lbs)
9/17/93	900,000	950,000	1,850,000
5/31/94	836,600	834,552	1,671,152
5/22/95	1,319,930	466,222	1,786,152

The Abrams main battle tank has historically used up to 70% of the Army’s annual halon issues. In 1997, PM Abrams reported that they would not retrofit the halon from their engine compartment fire suppression system. In response, the ESO negotiated with DLA to provide an additional 211,000 lbs turned in from non-DoD federal sources.

In the fall of 1998, PM Abrams announced that the service life of the M1 tank was being extended from 2020 to 2030, which resulted in a shortfall in the Army Halon Reserve of 400,000 lbs. Over 1999 and 2000, ESO negotiated with the Program Executive Office for Ground Combat Systems (PEO GCS) and they agreed to reprogram their engine compartment retrofit, which again balanced the Halon Reserve.

Army Audit of Halon Reserve

In 2000, the office of the Assistant Chief of Staff for Installation management (OACSIM) requested that the Army Audit Agency (AAA) conduct an audit of the Army Halon Reserve. The AAA audit concluded in January of 2002 and recommended in their Final Report (A-2002-0500-IME) that the Army turn in 300,000 lbs of Halon 1301 to DLA. In April of 2002, the ASALT Deputy for Systems Management and the Army Materiel Command (AMC) Chief of Staff non-concurred. In February of 2003, facing a determination by the Vice Chief of Staff of the Army, the AAA agreed that no halon had to be removed from the Army ODS Reserve. The AAA did a follow-up audit in 2004 and presented no findings in their Final Report (A-2005-0280-FFE).

Army Freon Requirements

The Army ODS Reserve also initially included the Class I ODS refrigerant R-12 or Freon. Freon was used heavily in a variety of systems, but they were expected to be converted to other refrigerants before the start-up of the ODS Reserve. It was also used for cooling in tactical ambulances, however, which did not have a qualified alternative, so a requirement for 66,000 lbs of R-12 was established. In 2005, a Maintenance Work Order was released to convert the ambulances to a cooling system that used R-134a, and the change-over was completed by 2007.

Army Halon HHFE Requirements

The 2.75 lbs Halon 1301 portable extinguisher is also managed by the ESO as an asset of the Army ODS Reserve, although it was not originally identified as such. Originally designed for the crew compartment of the M-60 tank, by the 1980s this HHFE was used throughout Army ground, aviation, and support systems. By 1995, most of the uses were converted to carbon dioxide (CO₂) extinguishers, but safety issues prevented CO₂ HHFE use in the crew compartment of the Abrams tank and in Army rotary winged aircraft. This extinguisher is managed by DLA-Aviation, the home organization of the DoD ODS Reserve, so it was a relatively easy to have their oversight fall under the DoD ODS Reserve office and the ESO via the management of the Army ODS Reserve.

Efforts to qualify extinguishers with different agents were challenging, but finally came to fruition in 2009 for the Abrams with an HHFE using a water-potassium acetate (WKA) mix, and for Army helicopters with an HFC-227ea plus dry powder HHFE in 2016. Production issues have hampered both “replace through attrition” processes, however, and both programs are still carrying back-up requirements for the halon HHFE.

Army R-22 Requirements

R-22 is a Class II ODS which was brought into the Army ODS Reserve in 2007 by a Deputy Assistant Secretary for Policy and Procurement memo to DLA. The requirement was for 120,000 lbs, through 2024, to support Environmental Control Units (ECUs), of which there are about 12,000 world-wide. Because of turn-ins by the Army and by other non-DoD federal activities, the ODS Reserve did not have to procure new material to satisfy this requirement.

The PEO for Combat Support and Combat Systems Support (CS/CSS) and the Communications and Electronics Command (CECOM) have been working on an Improved ECU (IECU) since 1997, that does not use an ODS, but there have been technical challenges and funding has been slow. Due to evolving requirements and additional turn-ins from Army installations, the ESO now projects that the Army ODS Reserve can support ECU operations, if need be, through 2030 (see Appendix 2).

Current Halon Status

Halon 1301 is used in the engine nacelles of the AH-64 Apache, UH-60 Blackhawk and CH-47 Chinook. A joint service program on halon alternatives, with the New Mexico Engineering Research Institute (NMERI) and the National Institute of Standards and Technology (NIST), concluded unsuccessfully in the late 1990s. In the late 2000s a joint flight test program failed to qualify an HFC-227ea system for the UH-60M Blackhawk (Army) and SH-60R/S Seahawk (Navy).

The ESO continues to sporadically hold Army Aviation Halon Summits (AAHSs) with PEO Aviation, Aviation and Missile Command (AMCOM) and PM personnel to discuss national and international halon replacement initiatives for new aircraft designs, but no alternative is currently available to modify legacy Army helicopters that satisfies weight, volume and performance requirements.

There is a qualified and fielded alternative for Halon 1301 in ground vehicle crew explosion protection systems: HFC-227ea plus sodium bicarbonate (baking soda). It has been successfully incorporated into the Stryker, up-armor modifications to tactical vehicles enacted in response to the use of Improvised Explosive Devices (IEDs), and will be used for future ground vehicle designs. However, at this time, the cost of retrofitting all the Abrams, Bradleys and Field Artillery Ammunition Support Vehicles (FAASVs) is prohibitive. Additionally, Service life extension programs for these vehicles (and legacy helicopters) have now extended the Army requirement for Halon 1301 from 2020 to 2050.