POLLUTION PREVENTION FACT SHEET

Pollution Prevention Program - Federal Programs Division

Fact Sheet #4: A Halocarbon Management Strategy for Federal Facilities

This Pollution Prevention Fact Sheet is one in a continuing series prepared under the Pollution Prevention Program of the Federal Programs Division of Environment Canada, Ontario Region. This Program is intended to help federal organizations in Ontario become model environmental citizens by managing beyond compliance. This Fact Sheet describes:

- Reasons why halocarbon management is critical;
- Major uses of halocarbons at federal facilities in Ontario;
- An ISO 14004 approach to managing halocarbons; and
- Further sources of information.

Why Manage Halocarbons?

Halocarbons, such as chlorofluorocarbons (CFCs) and bromofluorocarbons (halons), are carbon-based compounds that may contain hydrogen, fluorine, chlorine and/or bromine. Federal facilities may use halocarbons in refrigeration and air conditioning, fire suppression, solvent cleaning, laboratory applications (e.g. solvent extraction, analytical standards and synthesizing agents), sterilants (e.g. propellants found in inhalers for asthmatics) and pesticide applications. These substances contribute to ozone depletion and/or climate change when released into the atmosphere. It is estimated that about 10% of the halocarbons in use within Canada can be attributed to federally regulated operations.

Ninety per cent of all ozone is concentrated in the stratosphere which is located between 15 and 35 km above the earth's surface. This "ozone layer" forms an invisible filter which protects all forms of life from over-exposure to the sun's harmful ultraviolet (UV) rays. Excessive exposure to UV radiation can disrupt important biological processes, cause adverse health effects in humans and animals, and damage a number of materials such as plastics, rubber and wood. Depletion of stratospheric ozone starts when the molecular bonds of a halocarbon molecule are severed by UV radiation. This reaction frees highly reactive atoms of chlorine or bromine which destroy ozone molecules. For example, a single atom of chlorine can

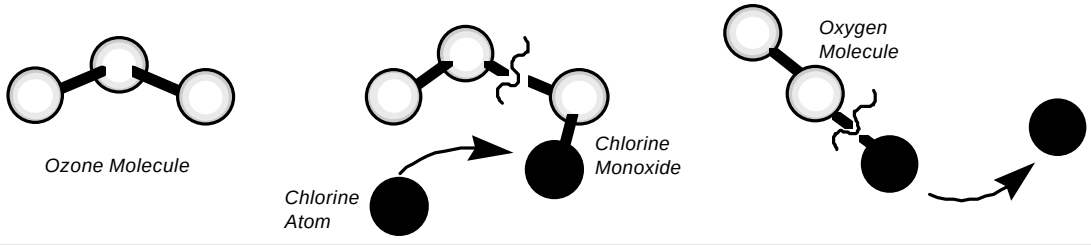
How CFCs destroy stratospheric ozone

Ozone is a molecule made of three oxygen atoms.

Chlorine atoms from CFCs attack the ozone, taking one oxygen atom away to form chlorine monoxide and oxygen.

The chlorine monoxide then combines with another oxygen atom, to form a new oxygen molecule and a chlorine atom.

This same chlorine atom can continue to break apart thousands of ozone molecules.



destroy 100,000 or more molecules of ozone before being washed out of the atmosphere.

Global warming, also known as the greenhouse effect, is the gradual rise in temperature of the Earth's atmosphere which is caused by the presence of certain atmospheric gases (e.g. water vapour, carbon dioxide, halocarbons) that absorb energy that is radiated by the Earth, thereby preventing its loss to space. Over long periods of time, these human-made global warming gases can cause climate to change. For example, an analysis of temperature records shows that the Earth has warmed an average of 0.5°C over the past 100 years. Global warming and climate changing gases are already causing the polar ice caps to melt, sea levels to rise and chaotic weather to become more frequent.

Different types of halocarbons have varying degrees of environmental risk (see table below). Two indicators of environmental risk are Ozone Depletion Potential (ODP) and Global Warming Potential GWP). Substances that contain chlorine and bromine in their structure cause large amounts of ozone depletion. ODP is the ratio of the ozone depletion caused by a substance relative to the ozone depletion caused by a similar mass of CFC-11 which is assigned a base value of 1.00. ODP is calculated over the entire atmospheric lifetime of the ozone-depleting substance. For example, Halon-1301 which has an ODP of 10.0 is ten times more destructive to stratospheric ozone than CFC-11.

Some halocarbons that have zero ODP (e.g. HFC-134a) are still of great concern because they contribute to global warming. Global Warming Potential (GWP) is the ratio of the global warming caused by a substance relative to the global warming caused by a similar mass of carbon dioxide which is assigned a base value of 1.00. GWP is calculated to a time horizon of 100 years. For example, Halon-1301 can cause 9,400 times as much global warming as an equivalent amount of carbon dioxide. Obviously, there is significantly more carbon dioxide being released to the atmosphere, but halocarbons are still a significant international concern with respect to climate change.

Associated Environmental Risks & Use-types of Common Halocarbons

Formula	Name	Environmental Risk		Use-type			
		ODP	GWP	Cooling	Fire Ext.	Cleaning	Lab
CCl_4	Carbon tetrachloride (tetrachloromethane)	1.11	1300		✓	✓	✓
CFC-11 (R-11)	Trichlorofluoromethane	1.00	4000	✓			✓
CFC-12 (R-12)	Dichlorodifluoromethane	1.00	8500	✓			✓
CFC-13 (R-13)	Chlorotrifluoromethane	1.00	11700			✓	✓
CFC-113 (R-113)	1,1,2-trichloro-1,2,2-trifluoroethane	0.80	5000				✓
CFC-114 (R-114)	1,2 dichlorotetrafluoro-ethane	1.00	9200				✓
CFC-115 (R-115)	Chloropentafluoroethane	0.60	9300	✓			✓
CH_3Br	Methyl bromide	0.7	-				✓
CH_3CCl_3	Methyl chloroform (1,1,1-trichloroethane)	0.1	100			✓	✓
Halon-1211	Bromochloro-difluoromethane	3.00	-		✓		✓
Halon-1301	Bromotrifluoromethane	10.00	5600		✓		✓
Halon-2402	Dibromotetrafluoroethane	6.00	-		✓		✓
HCFC-22	Chlorodifluoromethane	0.055	1700	✓	✓		✓
HCFC-123	$CHCl_2CF_3$	0.02	93	✓	✓		✓
HCFC-124	$CHFClCF_3$	0.030	480		✓		
HCFC-141b	Dichlorofluoroethane	0.11	630			✓	✓
HFC-134a	CH_2FCF_3	0.00	1300	✓		✓	✓
Isceon 69	Blend: R-22:R-218:propane	0.04	-	✓			
MP-39	Blend: R-22:R-124:R-152a=53:34:13	0.036	1120	✓			
R-404a (HP-62)	Blend: R-125:R-143a:R-134a=44:52:4	0.00	3850	✓			
R-407c	Blend: R-32:R-125:R-134a=23:25:52	0.00	1370	✓			
R-410a	Blend: R-32:R-125=50:50	0.00	1370	✓			
R-410b	Blend: R-32:R-125=45:55	0.00	1490	✓			
R-500	Blend: R-12:R-152a=73.8:26.2	0.545	5210	✓			
R-502	Blend: R-22:R-115=48.8:51.2	0.18	4510	✓			

Note:
- = not available

Types of Halocarbons

Chlorofluorocarbons (CFCs):

CFCs are ozone depleting and global warming gases. Federal operations may use CFCs in refrigeration, air conditioning and other applications which include solvent cleaning[1], laboratory chemicals[1] and sterilants[1]. North America discontinued production of CFCs in 1996.

Halons:

Halons, or bromofluorocarbons, can deplete up to ten times as much stratospheric ozone as CFCs. They also contribute to climate change and global warming. Federal operations may use Halons in portable and fixed fire suppression systems, and laboratory[1] and sterilant applications[1]. North America discontinued production of halons in 1994.

Hydrochlorofluorocarbons (HCFCs):

Most HCFCs are used as interim replacements for CFCs because they have low ODP. For example, HCFC-22 (R-22) is often used to replace CFC-12 (R-12) in domestic air conditioning and heat pump units, and HCFC-123 (R-123) can be used to replace R-11 in large chillers. Some HCFCs are also used as fire extinguishing agents.

Hydrofluorocarbons (HFCs) & Perfluorocarbons (PFCs)

HFCs and PFCs do not deplete stratospheric ozone but do contribute to global warming. These chemicals are available as replacements for both CFCs and HCFCs in cooling applications. For example, HFC-134a is often used to replace CFC-12 in mobile and domestic air conditioning units. They may also be used as solvents.

Other Halocarbons:

Other halocarbons include carbon tetrachloride (CCl_4), methyl chloroform (1,1,1-trichloroethane) and methyl bromide (CH_3Br). These substances deplete stratospheric ozone and contribute to climate change. Federal operations may use carbon tetrachloride and methyl chloroform in solvent cleaning[1] and laboratory applications[1]. Methyl bromide is an effective pesticide and used to fumigate soil and many agricultural products. North America discontinued the production of carbon tetrachloride and 1,1,1-trichloroethane in 1995 and 1996 respectively.

[1] Most solvent uses of halocarbons not in completely closed systems are illegal in Ontario. Certain essential laboratory and sterilant uses can still continue. The *Federal Halocarbons Regulations* restricts halocarbon use in solvent systems.

Where are Halocarbons Used at Federal Facilities?

Cooling Equipment

Cooling systems account for the majority of CFC and HCFC use at federal facilities. Consult Fact Sheet # 10 for information regarding the management of controlled refrigerants.

Small Cooling Equipment	*Mid/Large Cooling Equipment*
• Domestic refrigerators • Domestic air conditioners • Vehicle air conditioners • Domestic freezers • Drinking water fountains • Vending machines • Dehumidifiers • Heat pumps • Lab cryostat shakers • Lab water baths • Lab solvent traps	• Compressors • Walk-in refrigerators • Commercial air conditioners • Condensers • Air dryers • Air humidifier units • Roof-top chillers • Main building chillers

Fire Protection Systems and Extinguishers

Halons are used in total flooding fire extinguishing systems in computer rooms, airport facilities, military applications, museums, archival storage facilities and aircraft. Halons are also found in some hand-held (portable) fire extinguishers. In some cases, it is no longer necessary to employ halons for fire suppression. Consult Fact Sheet # 14 for further information regarding Halon fire suppression systems and their alternatives.

Lab Method Applications

Ozone-depleting substances such as methyl chloroform, carbon tetrachloride, methyl bromide, CFCs, halons and HCFCs are often used in laboratories for solvent extraction, analytical standards and synthesizing agents. Many laboratories have discontinued the use of ozone depleting substances for solvent extractions by adopting new technologies or alternative solvents.

Solvents and Degreasers

CFC-11, CFC-113, HCFC-22 and methyl chloroform were used as solvents or degreasing agents to preserve documents, clean coins and degrease electronic/mechanical parts. Consult Fact Sheet #12 for further information regarding the management of Ozone-depleting solvents and degreasers.

The Halocarbon Management Strategy

The Halocarbon Management Strategy (HMS) is a five-step approach to achieve organized and systematic control of halocarbons used in facility operation in order to protect human health and the environment. This Strategy adopts many of the framework requirements suggested by ISO 14004, an international guidance document for developing Environmental Management Systems. As a result, it can be aligned with existing departmental Environmental Management Systems which support sustainable development initiatives.

The HMS is also an important tool to help ensure compliance with federal and provincial legislation, and corporate environmental policies. The Strategy provides a mechanism in which specific legal responsibilities and personal liabilities are identified, communicated and documented. These and subsequent corrective actions will help to ensure that the concept of reasonable care prevails in federal operations.

The use of Halocarbon Management Strategies exists to varying degrees from one federal department to the next: some have implemented organized and systematic plans, others must still conduct basic inventory studies and develop strategic plans. The Strategy presented here is already in place at a number of Environment Canada operations, including Ontario Region, the Environmental Technology Centre and the Canadian Centre for Inland Waters. Its continued use has proven to generate savings in terms of both time and money from improved management and equipment maintenance programs.

Step 1. Commit

(i) Get buy-in from management: Getting buy-in from senior management is perhaps the single most important component of an HMS. Senior management must be prepared to contribute sufficient human, physical and financial resources to proceed with the Strategy's design and implementation.

To help accomplish this, a champion must first be identified to oversee and coordinate the Strategy throughout each of its five steps. This champion could be you, a facility manager or anyone that deals with environmental issues. This individual must be prepared to make a long-term commitment and willing to develop an acquired knowledge regarding halocarbon-related issues facing a Department, facility or operation.

Secondly, depending on the scope of operations, this champion may find it necessary to create a team to assist in the collection of data, assessment of information, and planning for and monitoring of implementation activities of the HMS. Ideally, this team should consist of players of diverse expertise and duties, including individuals with financial authority and/or influence with senior management.

Thirdly, senior management must be convinced that an HMS is needed. This can be accomplished by writing a detailed memo or delivering a presentation to senior management which introduces the issue and explains the environmental, operational and legal risks that may result from the mismanagement of halocarbons. Although senior management may authorize limited resources to start the HMS, they should be advised that, depending on the results of the initial assessment in the planning process, some significant resources may be required in the future for Strategy implementation (e.g. converting or replacing equipment).

(ii) Review Environmental Policy: Demonstrating how government and corporate environmental policies support the adoption of an HMS may also help to secure buy-in. The 1995 Cabinet Policy on *Greening Government Operations* and the Treasury Board Real Property 1995 *Code of Environmental Stewardship* both encourage the incorporation of environmental management, regulatory compliance and pollution prevention principles in government operations. In addition, some corporate environmental policies may contain specific objectives and targets to help provide direction and measure the success of the Strategy over time.

A corporate environmental policy can be taken one step further by drafting a policy with specific objectives and targets for halocarbons. Such a policy may commit an organization to reducing and eventually eliminating the use and release of halocarbons, adhering to all federal regulatory requirements and demonstrating compatibility with the technical requirements of all provincial regulations related to halocarbons. It may also declare target dates for phasing out specific halocarbon groups and uses.

(iii) Inventory Halocarbons: The halocarbon inventory will form the baseline information needed to identify the location and quantities of halocarbons in use and storage. Although inventory collection is time consuming, it is necessary to properly identify the environmental risks, legal compliance issues, and management needs within a chosen scope of operations.

First, a database or spreadsheet listing all the parameters that need to be inventoried for equipment and applications containing halocarbons must be assembled. Some parameters that one would expect to inventory are listed below. Detailed inventory forms and spreadsheets are available on request from Environment Canada, Federal Programs Division, Ontario Region (613-952-8675) or email (FPD@ec.gc.ca).

PARAMETERS FOR THE HALOCARBON INVENTORY

- Equipment/processes
- Use-type (cooling, lab, fire)
- Owner / Responsibility Centre
- Location
- Type of halocarbon
- Quantity of halocarbon
- Ozone Depletion Potential (ODP)
- Global Warming Potential (GWP)
- Equipment age
- Inspection frequency
- Maintenance history
- Release history

Secondly, it will be necessary to identify all equipment and applications using or containing halocarbons. This may include stationary or mobile refrigeration and air conditioning equipment, fixed and portable fire extinguishing systems, and other applications (laboratory, solvent cleaning, sterilants, pesticides). Label each piece of equipment or application as soon as it is identified and recorded to avoid double accounting and help identify missed items later.

It may be of benefit to develop the HMS in stages if large, complex inventories are anticipated. In this case, inventory and plan for larger equipment (e.g. building chillers, fixed fire suppression systems) first. Once addressed, smaller, less risky applications (e.g. domestic refrigeration and air conditioning) can be reviewed. Environment Canada's experience has shown that larger systems, and sometimes laboratory uses, represent the most significant applications in terms of environmental risk, despite the small number of individual units or applications.

This approach is also consistent with the *Federal Halocarbons Regulations* which place more stringent requirements on medium and large refrigeration and A/C systems (i.e. over 19 kW refrigeration capacity)

and larger fixed and portable fire extinguishing systems (over 25 kg) compared with their smaller counterparts.

Converting refrigeration capacity:

19 kW = 5.4 tons = 64,828 Btu/h = 25.5 Hp

Step 2. Plan

(i) Assess Operations: Having identified a champion and team, achieved senior management buy-in, and compiled a halocarbon inventory, it is time to take a close look at existing operations. This will involve assessing the relative risk of the halocarbon inventory and determining the suitability of existing halocarbon management practices within the chosen scope of operations.

To fully understand the significance of a potential release into the environment, it will be necessary to calculate the ODP and GWP for each piece of equipment or application inventoried. This can be achieved by using the following equations:

How to Calculate Environmental Risk

total ODP = halocarbon ODP x total quantity

total GWP = halocarbon GWP x total quantity

Risk of 100 kg of Halon 1301:

total ODP = 10.00 x 100
= 1000

total GWP = 5,600 x 100
= 56,000

Other factors will also need to be considered in the assessment of environmental risk, such as:

- ***How likely is a release into the atmosphere?*** Refrigerators and a lot of other small, medium and even large cooling and air conditioning equipment operate in closed systems that are less likely to leak. Other equipment (e.g. low pressure chillers) are engineered to purge air mixed with refrigerant on a regular basis. In addition, corrosion, loose fittings and worn seals can lead to leaks in older or poorly maintained units. Many solvent cleaning systems release halocarbons as vapour because they are not closed systems; such open systems have been illegal in Ontario since 1996 and many facilities have converted to aqueous systems.
- ***Under what conditions is the equipment expected to operate?*** Unprotected roof-top chillers are directly exposed to daily and seasonal fluctuations of heat, cold and moisture. Similarly, mobile A/C units experience vibration, shock and temperature fluctuations, causing fittings and seals to loosen or rupture with time.
- ***Have compliance needs changed over time?*** Some halocarbon applications are no longer required, including Halon fire suppression under the National Fire Code for areas such as computer rooms.

This initial assessment will provide the necessary information to make recommendations for the continued use, conversion, replacement or disposal of halocarbon equipment and applications.

In some cases, it may be appropriate to minimize risk by replacing a high risk halocarbon and with a low risk halocarbon. This is typically the case in the conversion of cooling equipment and solvent applications. If a unit has reached the end of its useful life, consider whether it requires replacement and/or disposal. Should you decide to replace a unit, opt for a unit that employs halocarbons with little or no environmental risk, or better yet a unit that does not employ halocarbons at all. For example, the associated risk of fire suppression equipment and laboratory methods can be eliminated altogether by using non-halocarbon replacements.

To determine the suitability of existing halocarbon management practices, several questions pertaining to maintenance programs, purchasing practices and record keeping will need to be answered:

- ***Are contractors or building maintenance staff who service equipment certified as required by law?*** An ODP Card is issued by the Ontario Ministry of Environment to service personnel as proof of certification.
- ***Does a routine inspection program exist to prevent major halocarbon releases?*** Dedicated building systems staff usually implement routine inspection programs at most larger facilities. However there is a

need for these programs at smaller facilities as well.

- ***Are there rules for purchasing halocarbon equipment or considering alternatives before acquiring new equipment?***
- ***Are halocarbons handled and stored properly in laboratory settings?***
- ***Are records of service, maintenance, shipment, purchase, training and halocarbon releases maintained?***
- ***Are records organized and accessible from a central location?***
- ***Have appropriate halocarbon training programs been offered to staff?***
- ***Are staff aware of existing and upcoming compliance needs?***

(ii) Ensure Compliance: Part of planning involves a review of federal and provincial halocarbon legislation that affect the chosen scope of operations. The *Federal Halocarbons Regulations*, to be published in 1999, will control halocarbon end-uses such as refrigeration, air conditioning, fire extinguishing and solvent applications on federal lands, including First Nations, and at federal works and undertakings. These regulations contain prohibitions on halocarbon releases and requirements for the use of licensed technicians, maintenance and leak testing, release reporting, and record keeping. The federal *Ozone Depleting Substances Regulations, 1998* combine and replace the 1995 *Ozone-depleting Substances Regulations* and *Ozone-depleting Substances Products Regulations* to control the direct import, manufacture, use, sale and export of ozone-depleting substances and products. Review this regulation if your operations involve the import of halocarbons or use of halocarbons in solvent applications.

In many cases, compliance must go beyond federal legislation to include provincial regulations, guidelines, codes of practice, and international standards, particularly where federal requirements are lacking. Compatibility with the technical requirements of supporting environmental legislation is also a requirement of the 1995 *Greening of Operations Cabinet Policy*. Ontario regulations place restrictions on certain halocarbon end-uses and control the management of halocarbons as waste. The inclusion of these requirements in federal facility operations is good environmental practice and one of several ways to demonstrate reasonable care. Consult COMPROs #10, #11 and #13 for Ontario regulatory information regarding refrigerants, Halon fire suppression systems, and solvents.

Phase-outs and end-use regulations have implications for all real property custodians, property managers, facility operators, environmental managers and maintenance staff. Due to production, import and export bans, the market prices for many halocarbons have already escalated substantially and are expected to increase further as they become more scarce. Eventually they will become a liability and may have to be stored awaiting destruction. Replacements such as HFCs can have a high global warming potential and are subject to the same regulatory requirements as ozone depleting substances.

ODS LEGISLATION OF INTEREST TO FEDERAL FACILITIES
FEDERAL REGULATIONS
1. Federal Halocarbons Regulations
2. Ozone-depleting Substances Regulations, 1998
ONTARIO REGULATIONS
1. Refrigerants Regulations
2. Solvents Regulation
3. Halon Fire Extinguishing Equipment Regulation
4. Sterilants Regulations
5. General Waste Regulations

(iii) Design Action Plan: Next, an Action Plan will need to be assembled. The assessment of operations and legal review will help to formulate specific recommendations for the HMS. Such recommendations may involve actions to eliminate or minimize the relative risk of various applications and revise management practices to include training programs, record keeping, purchasing procedures, and regular inspection and maintenance programs.

After the action items are identified, they will need to be prioritized. Consider each recommendation carefully and rank the urgency/importance of each. A consideration of cost is also necessary to establish practical timelines for large capital projects, such as replacing a building chiller which can run several hundred thousand dollars. For early successes, explore some inexpensive, quick and easy activities such as converting CFC refrigerants in mobile A/C or changing the refrigerant in medium sized equipment.

When assigning an appropriate target date to each recommendation, it is often helpful to group action items into ongoing (or immediate), near term (within six months to a year) and two year horizons. Leave items that require longer periods of time to future reviews of your HMS, but make note of them in your report. These action items and target dates will help to identify where resources will be required in the near future and over the long term. Lastly, clearly identify and document the responsibility centres, individuals or

groups that have a role in carrying out each undertaking.

(iv) Approve Action Plan: Once the Action Plan is ready, it must receive approval from senior management. Present the Plan in person to justify why each action item was chosen and ranked accordingly. Although there may be several environmental issues to deal with, senior management may opt to address compliance issues first because these are the ones where they'll be liable (especially once you have brought these issues to their attention). Ultimately the best indicator of senior management commitment will be their approval to proceed with the implementation phases of the HMS and the amount of resources that they are prepared to allocate for Strategy implementation.

Step 3. Implement

(i) Carry out Projects: Once the Action Plan is approved, implementation can begin. Again, each action item will be addressed on the basis of its priority. Recruit the input of the team and other responsibility centres to assist in the initial planning stages for each action item, including the more detailed budgeting and design for large scale projects.

It is also essential that the team maintain communications with all responsibility centres, individuals or groups that have a role to play in completing each action item.. Strive to complete objectives and targets on schedule to maintain the credibility and momentum of the HMS. For those actions that fall short of set target dates, communicate the reasons of delay to senior management and other staff involved. This will demonstrate ongoing commitment and interest in the success of each activity.

(ii) Communicate Strategy: Promote the Strategy and make it (or the Action Plan) accessible to all staff concerned. While communicating the Strategy, try to make it personal to staff by explaining how this Strategy will ultimately benefit them. Ask for feedback from those involved in the Strategy's implementation. Ensure that someone is available to initiate contact or respond to comments. All these efforts will help to ensure buy-in from staff.

(iii) Assign Responsibilities: As each action item is addressed, it may be necessary to assign new responsibilities to management, building & maintenance, laboratory, procurement and other staff. Communicate these new responsibilities to all concerned. They must be made aware of their legal responsibilities for such things as record keeping, labeling and release reporting. They'll also need to be aware of their responsibilities under the organization's environmental policy. Lastly, they will need to know which items of the Action Plan involve their area of responsibility, so that they can take ownership for success.

(iv) Adopt New Procedures: Some new procedures to ensure compliance with laws and policies will be needed. For example, the *Federal Halocarbons Regulations* make it mandatory to report halocarbon releases. How will federal facilities ensure that this activity takes place and appropriate records are maintained? Also, who will be responsible for reporting halocarbon releases to Environment Canada? Similarly, corporate policy may require environmental considerations when purchasing new equipment. This is the case with Environment Canada's Operational Environmental Policy for its Environmental Management System.

New procedures may also be needed for alternative processes which do not use halocarbons. For example, laboratory methods are now prescribed which do not use halocarbons for solvent extractions. Several years ago, the Royal Canadian Mint in Ottawa changed its CFC-based solvent cleaning processes in the production of coins to an aqueous system that does not employ the use of halocarbons. This replacement required the communication of new operational procedures to ensure that cleaning effectiveness was not compromised.

(v) Provide Training: Training is an excellent opportunity to communicate new knowledge or working skills to staff. Depending on the complexity of the HMS, it may be necessary to:

- ***make staff aware of the Strategy and how it will affect their jobs;***
- ***demonstrate how staff can exercise their new responsibilities; and***
- ***give them the skills necessary to apply new procedures.***

Once training needs are identified and training sessions are developed, an appropriate level of training can be delivered to each target audience. For example, senior management will require briefings on halocarbon-related issues including regulatory requirements to assist them in decision making. Building, purchasing and laboratory staff may also require training on new methods and procedures for state-of-the-art equipment and green procurement policies. These and other staff

will also require regulatory training on *the Federal Halocarbons Regulations* and *Ozone Depleting Substances Regulations, 1998* (the latter if you directly import ODS or use HCFC solvents).

Step 4. Measure & Evaluate

(i) Monitor Halocarbons: Once the Strategy is implemented, measure and evaluate its success. This will involve choosing appropriate indicators to gauge the performance of the Strategy. These indicators should be quantifiable and simple to measure, such as:

- ***tracking inventory changes of halocarbon quantities***
- ***tracking inventory changes of environmental risk (i.e. total ODP and GWP)***
- ***tracking the amount of equipment replaced, converted and disposed***
- ***tracking the number of reportable halocarbon releases under the Federal Halocarbons Regulations***
- ***tracking the number of staff trained for specific halocarbon-related issues***

Another way of monitoring halocarbons is to implement regular inspection and maintenance programs for equipment to prevent halocarbon releases in the first place, rather than reacting to them after they have occurred. For example, the *Federal Halocarbons Regulations* will require that leak tests be conducted for refrigeration, air conditioning and fire suppression equipment at least once each year.

Maintain Records: Maintaining records is important for several reasons. First, it is a regulatory requirement. The *Federal Halocarbons Regulations* make it mandatory to maintain release reports, service records and notices of leak test results for five years. These records will prove to be very useful as the Strategy is audited and each step is revisited.

Furthermore, as each action item is completed, keep a record of what was done and how effective it was. This will enable federal facilities to document and share successes, thereby identifying new opportunities for other locations or applications. It is important that records remain accessible for review by the HMS team, senior management, auditors and regulatory inspectors. Each organization or facility is unique and ultimately facility managers will need to decide where and how records are stored. This is also a regulatory issue. The *Federal Halocarbons Regulations* require that copies of appropriate records always be kept at the facility where the equipment or halocarbon system is located to ensure ease of access (exceptions for remote and mobile equipment).

Evaluate Findings: It is important to regularly reevaluate your equipment and halocarbon needs. For example, with organizations downsizing some managers are now finding that an excess chiller capacity exists. In many cases, managers are opting for replacements which are smaller, more energy efficient and use alternative refrigerants which have a low environmental risk. In addition, new laboratory methods and equipment may no longer require large stockpiles of halocarbons. As the Action Plan is implemented, record any reductions in the total environmental risk (i.e. ODP and GWP). Such evaluations will bring to light new opportunities, problems and priorities.

Remedy Problems: It is important to be proactive in all approaches to halocarbon management. Identify and deal with any roadblocks, problems or shortcomings of the action plan or implementation stages as soon as possible. Ensure that preventative activities are ongoing and not just a one-time event. Track regular inspection and maintenance programs to ensure that they are actually being implemented. Ensure that staff receive an appropriate level of training with respect to halocarbon issues. Use training records to track when refresher courses will be required if so needed.

Remedying problems also includes responding to the reality that even the best management plan cannot always prevent accidents from occurring. Such response measures may involve the installation of detection sensors which need to be tested and calibrated on a regular basis, and ensuring that halocarbon releases are reported to the appropriate manager and Environment Canada as soon as they are discovered. Since halocarbon releases are prohibited, such events must quickly be brought under control by isolating, evacuating and repairing the leaking system. The *Federal Halocarbons Regulations* place time restrictions on the period between the discovery of a leak and the repair of the equipment. The Regulations also require that leaks and releases over 10 kg be reported to Environment Canada within prescribed time periods. For example, halocarbon releases over 100 kg must be brought to the attention of the department within 24 hours.

Step 5. Review & Improvement

Review Plan: Depending on the chosen scope of operations, it will likely take one to two years to get to

the stage where the Strategy is ready to be audited for success. Take a critical look at the Strategy in place:

- ***Does it work?***
- ***Is it helping to ensure regulatory compliance?***
- ***Were responsibilities assigned to the right people?***
- ***Is it time to address certain equipment and applications that were consciously ignored the first time?***

Review your Action Plan:

- ***Was it fully implemented?***
- ***Will some projects take longer than expected to complete?***

Revisit the ultimate goal of the HMS (e.g. to eliminate certain classes of chemicals by a certain date):

- ***Is this still feasible?***
- ***Is there still a strong commitment for the Strategy?***
- ***Has the support of senior management and staff decreased?***

Ongoing Improvement: Improvement of the HMS includes a search for new and innovative technologies that do not employ halocarbons. For example, the Cool Tech water cooler replaces a typical office water cooler with a process that does not use chemical refrigerants. Direct groundwater heating and cooling systems can be installed to replace halocarbon cooling applications. New refrigerants are available to replace CFCs and even HCFCs in conventional equipment at minimal cost. New fire suppressants are available to replace Halons. Of course, it will always be necessary to examine the cost effectiveness of installing these alternative technologies. Ongoing improvement may also involve updating action items and setting new objectives and targets. Legislation and corporate policy may change over time changing the relative importance of certain halocarbon applications.

Finally, revisit each step of your Strategy. Do not allow the Strategy to go dormant. Keep it active, share its successes, and congratulate staff for a job well done. What should come out of this review is a new edition of the HMS, which revisits each step in the cycle and continues until all of the objectives in the Action Plan are accomplished. That is why the five steps of the HMS are shown in a continuous circle.

The HMS at Work:

Let's take a look at how Environment Canada's Environmental Technology Centre (ETC) applied many elements of its HMS to help manage its halocarbon risk.

Commitment: In 1995, ETC saw halocarbon management as a priority. New Ontario provincial halocarbons regulations were promulgated and the Department was gearing up for the development of environmental management systems and new federal halocarbons regulations. These events helped convince ETC management that an HMS was needed. The Assistant Director of ETC volunteered to oversee and coordinate this undertaking with assistance from the Federal Programs Division. Due to the size and complexity of the facility, it was determined that a team with more focused knowledge and an understanding of building, maintenance and laboratory operations would be needed. A presentation of the environmental risks, legal risks, environmental policies and proposed strategy made to the facility's Director and senior management led to the required buy-in and commitment. Sufficient resources were made available and a halocarbon team was assembled consisting of representatives from management, facility operations and capital projects, laboratories and environmental stewardship. The team compiled an inventory spreadsheet of all halocarbon equipment and applications. In total, 1,395 kg of halocarbons (or 205 kg of ODP) were inventoried. A breakdown of the inventory results can be seen in Figures 1 to 4.

Plan: An assessment of the halocarbon inventory and existing management practices was conducted to develop a list of recommendations which were used to develop the Action Plan. A more thorough review of halocarbon legislation and environmental risk helped to prioritize the following Plan:

Ongoing basis:

- copy Plan and discuss with staff
- review progress annually
- review lab methods and adopt alternatives
- maintain HCFC large cooling equipment
- use certified service staff

Near term (within 6 months):

- ban CFC use in lab extraction
- dispose of CFC-113 reserves used in lab extraction
- dispose of CFC-11, CFC-114 and HCFC-22 in lab stockpiles
- develop ODS procurement policy
- develop purchasing, storage and inventory protocols for labs
- label small cooling equipment
- regularly inspect and maintain small cooling equipment

Within 2-years:

- develop and update central ODS database
- install direct groundwater heating and cooling
- convert CFC-12 and R-502 mid-sized cooling equipment
- remove surplus mid-sized cooling equipment
- replace chiller unit for the X-ray spectrometer
- ban use of carbon tetrachloride and methyl chloroform for lab extraction

Fig.1 : Amount of ODS in End Use Applications at ETC (%)

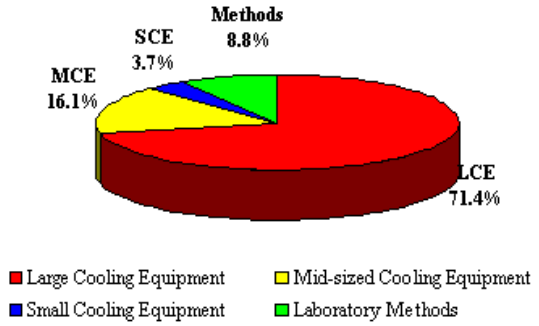


Fig. 3 : ODP by Responsibility Centre at ETC (%)

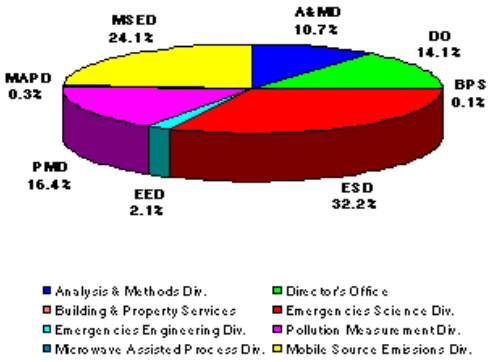


Fig.2 : ODP by End Use Applications at ETC (%)

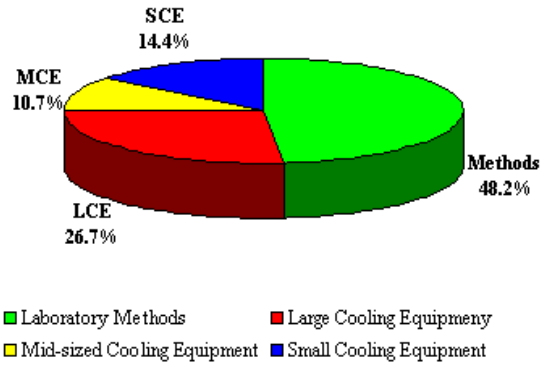
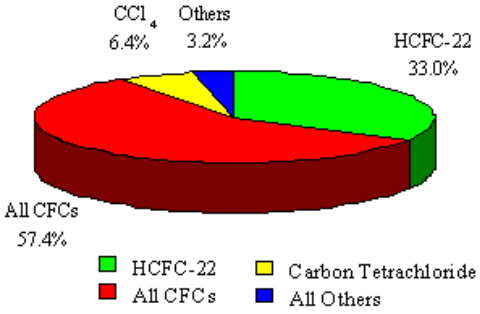


Fig.4 : ODP by Type of ODS Used at ETC (%)



Implement: To gain the support of staff in carrying out or participating in many of these areas it was essential to communicate the Strategy. The Action Plan was customized for each of the Divisions at ETC and was discussed at divisional staff meetings. The Director of the facility instructed each Division manager to implement the sections of the Action Plan for which their Division had some responsibility. Implementation was very successful, although the large capital expenditure for direct groundwater heating and cooling required an extra year for implementation.

Measure & Evaluate: To help gauge the success of the program, ETC turned to its halocarbon inventory which could be used to track changes of halocarbon quantity and environmental risk (i.e. ODP, GWP). Training records, service logs, and release reports were also used as performance indicators. Good record-keeping was also important to help ensure legal compliance and the ability to communicate successes and opportunities to other facilities.

Review & Improve: ETC strives for continuous improvement in all areas of halocarbon management. Year end reviews of its HMS have demonstrated the success of its improved risk management system for halocarbons. All of the projects in its 2-year Action Plan are complete or ongoing. ETC has also identified new initiatives to further manage its risk potential. Some of these initiatives involve adopting new technologies and preparing for the *Federal Halocarbons Regulations*.

Contact FPD

The Federal Programs Division offers its services free of charge or on a limited cost recovery basis to federal facilities in Ontario. You can reach us at (613) 952-8675 or email (FPD@ec.gc.ca) for further information, assistance and training on Halocarbon Management Strategies and regulatory requirements.

Further Sources of Information

Canadian Environmental Protection Act (CEPA), Ozone-Depleting Substances Regulations, 1998, Canada Gazette, Part II, December 1998.
Web site: *http://www.ec.gc.ca/ozone/tocregs.htm*

CEPA, Draft Federal Halocarbons Regulations, Canada Gazette, Part I, August 1998
Web site: *http://www.ec.gc.ca/ozone/tocregs.htm*

Canada's Ozone Layer Protection Program - A Summary Report; Environment Canada; 1994; # EN40-442/1994.
Tel: (819) 997- 2800. Fax: (819) 953-2225.

Code of Practice for the Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems. Environment Canada, March 1996 # EPS 1/RA/2.
Tel: (819) 997- 2800. Fax: (819) 953-2225.

Code of Practice on Halons, Report EPS 1/RA/3E, Environment Canada, July 1996. Contact Environment Canada Library.
Tel: (819) 997- 2800. Fax: (819) 953-2225.

Handbook for the International Treaties for the Protection of the Ozone Layer; Ozone Secretariat, United Nations Environment Programme; Fourth Edition (1996).

Ontario Environmental Protection Act, Regulation 189/94-Refrigerants. Tel.: 1-800-668-9938
Web site: *http://www.gov.on.ca*

Ontario Environmental Protection Act, Regulation 413/94-Halon Fire Extinguishing Equipment. Tel: 1-800-668-9938. Web site: *http://www.gov.on.ca*

Ontario Environmental Protection Act, Regulation 718/94-Sterilants. Tel: 1-800-668-9938. Web site: *http://www.gov.on.ca*

Ontario Environmental Protection Act, Regulation 717/94-Solvents. Tel.: 1-800-668-9938
Web site: *http://www.gov.on.ca*

Environment Canada Stratospheric Ozone Website
Information and links about the ozone layer and ODS.
Web site: *http://www.ec.gc.ca/ozone*

The Ozone Depleting Substances Alternatives and Supplier List, Ozone Protection Programs, Commercial Chemical Branch, Environment Canada, December, 1994.
Tel: (819) 997-2800 Fax: (819) 953-2225.

For further information about the Pollution Prevention Program for federal facilities in Ontario, please contact:

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All Fact Sheets and COMPROS can be found on the Internet at:

www.on.ec.gc.ca/epb/fpd
(Aussi disponible en Francais)